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HEINZMANN®

Digital Electronic Speed Governors

Digital Basic Systems

ARCHIMEDES – ORION
PRIAMOS – HELENOS
PANDAROS – XIOS

Control devices for conventional injection with actuators

DANGER

The appropriate manuals must be thoroughly studied before installation, initial start-up and maintenance.

All instructions pertaining to the system and safety must be followed in full. Non-observance of the instructions may lead to injury to persons and/or material damage.

HEINZMANN shall not be held liable for any damage caused through non-observance of instructions.

Independent tests and inspections are of particular importance for all applications in which a malfunction could result in injury to persons or material damage.

All examples and data, as well as all other information in this manual are there solely for the purpose of instruction and they may not be used for special application without the operator running independent tests and inspections beforehand.

HEINZMANN does not guarantee, neither expressly nor tacitly, that the examples, data or other information in this manual is free from error, complies with industrial standards or fulfils the requirements of any special application.

WARNING

To avoid any injury to persons and damage to systems, the following monitoring and protective systems must be provided:

– Overspeed protection independent of the rpm controller

HEINZMANN shall not be held liable for any damage caused through missing or insufficiently rated overspeed protection.

– thermal overload protection

The following must also be provided for alternator systems:

– Overcurrent protection
– Protection against faulty synchronisation for excessively-large frequency, voltage or phase difference
– Directional contactor

The reasons for overspeeding may be:

– Failure of positioning device, control unit or its auxiliary devices
– Linkage sluggishness and jamming

WARNING

The following must be observed before an installation:

– Always disconnect the electrical mains supply before any interventions to the system.
– Only use cable screening and mains supply connections that correspond with the *European Union EMC Directive*
– Check the function of all installed protection and monitoring systems

	**Please observe the following for electronically controlled injection (MVC):** – For **common rail** systems each injector line must be equipped with a separate mechanical flow-rate limiter – For **unit pump** (PLD) and **pump-injector unit** (PDE) systems, the fuel enable is first made possible by the solenoid valve's control plunger motion. This means that in the event of the control plunger sticking, the fuel supply to the injection valve is stopped.
	As soon as the positioning device receives power, it can actuate the controller output shaft automatically at any given time. The range of the controller shaft or control linkage must therefore be secured against unauthorised access.
	HEINZMANN expressly rejects any implied guarantee pertaining to any marketability or suitability for a special purpose, including in the event that **HEINZMANN** was notified of such a special purpose or the manual contains a reference to such a special purpose.
	HEINZMANN shall not be held liable for any indirect and direct damage nor for any incidental and consequential damage that results from application of any of the examples, data or miscellaneous information as given in this manual.
	HEINZMANN shall not provide any guarantee for the design and planning of the overall technical system. This is a matter of the operator its planners and its specialist engineers. They are also responsible for checking whether the performances of our devices match the intended purpose. The operator is also responsible for a correct initial start-up of the overall system.

Contents

1 Safety instructions and related symbols

This publication offers wherever necessary practical safety instructions to indicate inevitable residual risks when operating the engine. These residual risks imply dangers to

- Personnel
- Product and machine
- The environment

The primary aim of the safety instructions is to prevent personal injury!

The signal words used in this publication are specifically designed to direct your attention to possible damage extent!

DANGER *DANGER indicates a hazardous situation the consequence of which could be fatal or severe injuries if it is not prevented.*

WARNING *WARNING indicates a hazardous situation which could lead to fatal injury or severe injuries if it is not prevented.*

CAUTION *CAUTION indicates a hazardous situation which could lead to minor injuries if it is not prevented.*

NOTICE *NOTICE indicates possible material damage.*

Safety instructions are not only denoted by a signal word but also by hazard warning triangles. Hazard warning triangles can contain different symbols to illustrate the danger. However, the symbol used is no substitute for the actual text of the safety instructions. The text must therefore always be read in full!

This symbol does not refer to any safety instructions but offers important notes for better understanding the functions that are being discussed. They should by all means be observed and practiced.

1.1 Basic Safety Measures for Normal Operation

- The installation may be operated only by authorized persons who have been duly trained and who are fully acquainted with the operating instructions so that they are capable of working in accordance with them.
- Before turning the installation on please verify and make sure that

  - only authorized persons are present within the working range of the engine;

  - nobody will be in danger of suffering injuries by starting the engine.
- Before starting the engine always check the installation for visible damages and make sure it is not put into operation unless it is in perfect condition. On detecting any faults please inform your superior immediately!
- Before starting the engine remove any unnecessary material and/or objects from the working range of the installation/engine.
- Before starting the engine check and make sure that all safety devices are working properly!

1.2 Basic Safety Measures for Servicing and Maintenance

- Before performing any maintenance or repair work make sure the working area of the engine has been closed to unauthorized persons. Put on a sign warning that maintenance or repair work is being done.
- Before performing any maintenance or repair work switch off the master switch of the power supply and secure it by a padlock! The key must be kept by the person performing the maintenance and repair works.
- Before performing any maintenance and repair work make sure that all parts of engine to be touched have cooled down to ambient temperature and are dead!
- Refasten loose connections!
- Replace at once any damaged lines and/or cables!
- Keep the cabinet always closed. Access should be permitted only to authorized persons having a key or tools.
- Never use a water hose to clean cabinets or other casings of electric equipment!

1.3 Before Putting an Installation into Service after Maintenance and Repair

- Check on all slackened screw connections to have been tightened again!
- Make sure the control linkage has been reattached and all cables have been reconnected.
- Make sure all safety devices of the installation are in perfect order and are working properly!

2 General

2.1 General system description

HEINZMANN control units are universally applicable control units for diesel engines, gas engines and other prime movers. In addition to their basic purpose of controlling speed, these governors are capable of performing a multitude of other tasks and functions.

At the core of the control unit is a very fast and powerful microprocessor (CPU). The controller programme itself, the so-called firmware, on which the microprocessor operates is permanently stored in a so-called Flash-ROM. Application dependent configuration data are saved in an E^2PROM.

In addition to the main processor, the HEINZMANN control units of the PRIAMOS/PRIAMOS III series are equipped with an auxiliary processor (CPU2) that performs two monitoring functions. On the one hand, the auxiliary processor will monitor engine speed for overspeeding and signals to the actuator independently of the main processor, on the other hand, it will supervise the operability of the main processor itself. Whenever the auxiliary processor registers an error, it triggers an emergency engine shutdown.

Actual engine speed is measured by a magnetic pickup on the starter gear.

At any system a redundant speed pickup can be installed additionally thus, there will be no interruption of operation if the first pickup should happen to fail. In vehicle applications, the control can use the alternator signal from terminal *W* as a default speed signal.

Engine speed is set by one or more setpoint adjusters. These adjusters can be designed to be analogue or digital ones. Additional digital inputs permit to switch functions on and off or to change over to other functions.

Various sensors are provided to transmit to the control the data it needs to adjust the engine's operating state. As an example, it is possible to have several temperature and pressure signals transmitted from the engine.

The actuator regulating fuel supply to the engine is driven by a PWM signal. By this, both 2-quadrant actuators (electrically working one way) and four-quadrant actuators (electrically working both ways) can be driven.

The control generates analogue and digital output signals which are used to indicate the engine's operating conditions or serve other purposes and functions. Communication with other units is established via a serial interface and, optionally, a CAN bus.

2.2 Firmware

The control unit’s software is conceived both for universal applicability and a wide range of functions. This means that the firmware contains many more functions than those actually used for a specific application. Both the configuration of the input/output channels of the control unit and the activation and parameter setting of functions may be carried out by the customer.

Each control unit contains a boot loader (↑*27.5 Bootloader*) for loading the firmware into the unit. HEINZMANN usually delivers the devices with a so-called HEINZMANN basic software that contains the standard delivery functions.

Starting from this basic software many diverse custom firmware variants are prepared.

The software version number xx.y.zz or xxxx.yy.zz in parameter 3842 *SoftwareVersion* consists of the following elements:

Customer number	xx or xxxx
Variant	y or yy
Modification index	zz.

2.2.1 HEINZMANN basic software

In each device, the HEINZMANN basic software carries the customer number x = 0.

It is delivered in different basic variants y = 0..99.

The modification index z = 0..99 is a serial index increased by a unit with each software modification for each variant. Each higher index completely includes the preceding lower one and replaces it. At each moment in time there is only one valid version of a basic software variant, the one with the currently highest modification index.

At the moment, the following variants of HEINZMANN basic software are delivered. The variants in the first table are described in this manual, along with their functionality. The variants listed in the second table are explained in separate documents.

Software version	Variant	Control unit	Meaning
00.0.zz	0	HELENOS PRIAMOS	General variant, includes variants 1 to 4
		ARCHIMEDES ORION PANDAROS	General variant, includes variants 1, 3 and 4
00.1.zz	1	ARCHIMEDES HELENOS PRIAMOS	Vehicle application
		PANDAROS	Standard Generator
00.2.zz	2	HELENOS PRIAMOS	Locomotive application
		PANDAROS	Standard general
00.3.zz	3	ARCHIMEDES HELENOS PRIAMOS	Generator application
		PANDAROS	Extended Generator 1

00.4.zz	4	ARCHIMEDES HELENOS PRIAMOS	Marine application
		PANDAROS	Extended Generator 2
00.5.zz	5	HELENOS PRIAMOS	Marine application for multiple-engine systems via HZM-CAN with coupled pre-defined setpoint and direction
		PANDAROS	Extended general
00.6.zz	6	HELENOS PRIAMOS	Marine application for twin-engine systems via HZM-CAN with master/slave operation on a single shaft
		PANDAROS	Extended Generator 3 with connection to THESEUS via HZM-CAN
00.9.zz	9	HELENOS PRIAMOS	Generator application with connection to THESEUS via HZM-CAN

Table 1 Basic firmware variants

Software version	**Variant**	**Control unit**	**Meaning**
00.7.zz	7	HELENOS	Hydro turbine application
		PANDAROS	Vehicle dual-fuel application with connection of periphery module via HZM-CAN
00.8.zz	8	HELENOS	Steam turbine application
		PANDAROS	Generator duel-fuel application with connection of periphery module and THESEUS via HZM-CAN
00.10.zz	10	HELENOS	Gas engine generator application within system KRONOS 30 with connection of THESEUS and ELEKTRA via HZM-CAN

00.11.zz	11	HELENOS PRIAMOS	Vehicle duel-fuel application with connection of periphery module via HZM-CAN
00.12.zz	12	HELENOS PRIAMOS	Locomotive duel-fuel application with connection of periphery module via HZM-CAN
00.13.zz	13	HELENOS PRIAMOS	Generator dual-fuel application with connection of periphery module and THESEUS via HZM-CAN
00.14.zz	14	HELENOS	Gas addition in CR engine with measurement of injection time

Table 2 Special firmware variants

2.2.2 Custom firmware

Custom firmware always has a definite customer number x > 0. Once assigned, the customer number remains assigned to the customer and is used for every custom software he orders, independently from the control device used.

Different software variants y = 0..99 are programmed on the customer's request, e.g., for different engine types or different applications with one and the same control device.

The modification index z = 0..99 is a serial index increased by a unit with each software modification for each variant. Each higher index completely includes the preceding lower one and replaces it. At each moment in time there is only one valid version of a custom software variant, the one with the currently highest modification index.

HEINZMANN communication modules such as the PC programme ↑*3.3 DcDesk 2000* or the handheld programmer HP03 allow the customer to access the general HEINZMANN basic software 00.y.zz and their own custom software. This means that many customers have access to the so-called 0-software but only one customer (and, eventually, others he may have authorized) has access to his own custom software. If an application, therefore, is to be protected against access by other HEINZMANN customers, a custom firmware must be ordered from HEINZMANN.

2.3 Further information

This manual contains a brief presentation of the different adjustment parameters and characteristics. Error handling will be discussed in detail.

The functionality of speed governing in general, the specifications and connections of the control electronics, sensors, setpoint adjusters and actuators are described in detail in the manuals:

HELENOS

Title	Order number
Digital Basic System HELENOS I	DG 95 102-e
Digital Basic System HELENOS II	DG 95 100-e
Digital Basic System HELENOS III	DG 96 005-e
Digital Basic System HELENOS IV	DG 96 003-e
Digital Basic System HELENOS V	DG 97 014-e

Table 3 HELENOS basic Systems

ORION

Title	Order number
ORION low-cost speed governor KG-LC-D/DC 9	DG 06 005-e

Table 4 ORION basic systems

PANDAROS

Title	Order number
PANDAROS for generator applications	DG 02 007-e
Digital Basic System PANDAROS I	DG 00 006-e
Digital Basic System PANDAROS II	DG 01 002-e
Digital Basic System PANDAROS IV	DG 01 003-e
Digital Basic System PANDAROS V	DG 01 004-e
Digital Basic System PANDAROS VI	DG 03 006-e

Table 5 PANDAROS basic systems

PRIAMOS

Title	Order number
Digital Basic System PRIAMOS I	DG 93 101-e
Digital Basic System PRIAMOS II	DG 94 111-e
Digital Basic System PRIAMOS III	DG 95 111-e
Digital Basic System PRIAMOS IV	DG 96 004-e
Digital Basic System PRIAMOS V	DG 97 013-e
Digital Basic System PRIAMOS VI	DG 06 009-e

Table 6 PRIAMOS basic systems

Dual-fuel systems

Title	Order number
ARTEMIS II digital control units for small to medium dual-fuel engines	DG 03 005-e
ARTEMIS III dual-fuel system with mechanical diesel governor and digital gas governor	DG 04 001-e
ARTEMIS VI dual-fuel addition module for vehicles with electronic diesel injection system	DG 06 008-e

Table 7 Dual-fuel basic systems

HEINZMANN control units are shipped tailored to custom requirements and have been configured as far as possible at the factory. To properly execute an order therefore it is absolutely necessary that the customer completes and returns to **HEINZMANN** the following form.

Title	Order number
Ordering Information for Digital Controls	DG 96 012-e

Table 8 Ordering information for digital controls

The sensors available from **HEINZMANN** are described in the manual

Title	Order number
Product Overview Sensors	E 99 001-e

Table 9 Product overview sensors

The functionality of the communication programme DcDesk 2000 both as on-site and as remote control communication variant is described in the following manuals and in the online help of the programme.

Title	Order number
Operating Instructions Communication Programme DcDesk 2000	DG 00 003-e
Basic Information Remote Communication Programme DcDesk 2000/Saturn	DG 05 008-e
Basic Information Remote Communication Programme SATURN	DG 05 006-e

Table 10 Communication programmes

2.4 Functional block diagram

The functional block diagram provides a simplified view of the control structure of HEINZMANN control units, showing their basic functions as well as the signal flow of various important functions.

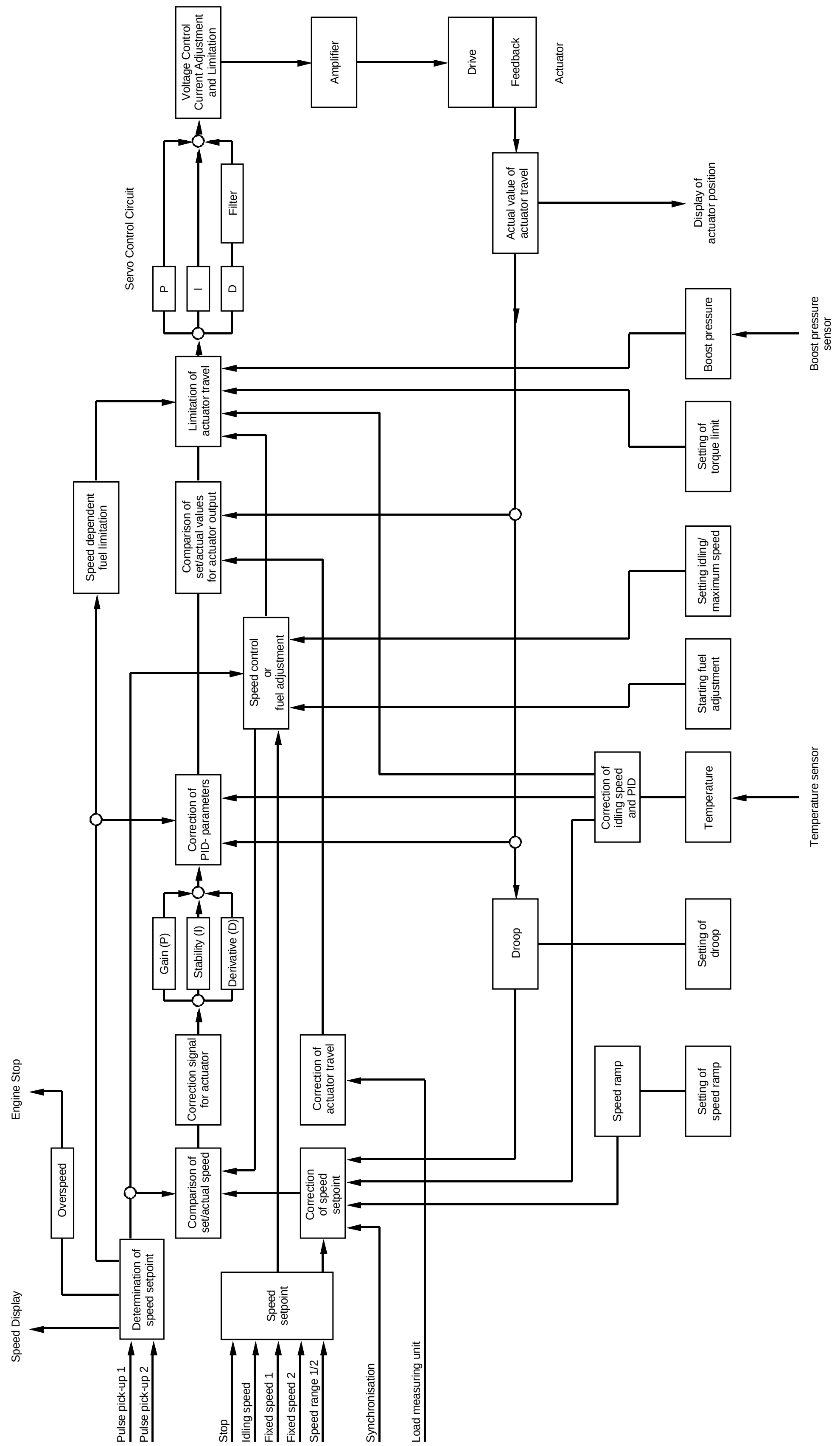


Fig. 1 Functional block diagram

2.5 Conventions

Throughout this manual the following typographic conventions have been adopted:

100 *Gain*	Parameter names (identifiers) are always italicized. No difference is made between the four ↑*2.6 Parameter lists*.
↑100 *Gain*	An arrow preceding a parameter name is to signal that this parameter is explained in detail in some other section. For a brief description see chapter ↑*28 Parameter description*. In this chapter you will also find references to the pages containing a detailed discussion of the respective parameter.
<100>	In diagrams, numbers enclosed by pointed brackets are used to indicate that the position thus specified corresponds to a parameter number.
[500..501]	There are certain parameters for which the limits of their respective value ranges cannot be specified explicitly in chapter ↑ *28 Parameter description* but have to be communicated to the control as values of specific parameters. For any such parameters with variable value ranges, the parameter numbers defining their specific range limits are enclosed in square brackets.
↑	An arrow followed by italicized text refers to a chapter where the respective function is described in more detail.

2.6 Parameter lists

For each function of the firmware a certain number of parameters must be adjusted. A system was needed to conveniently organize the great number of parameters that would inevitably result from the numerous functions to be implemented. For the sake of clarity and easy access, the parameters have therefore been grouped into four lists.

1. Parameter — Parameters used for adjusting the control and the engine (parameter numbers 1..1999, 10000..11999, 20000..21999)

2. Measurements — Parameters for indicating the actual states of the control and the engine (parameter numbers 2000..3999, 12000..13999, 22000..23999)

3. Functions — Parameters used for activating and switching over functions (parameter numbers 4000..5999, 14000..15999, 24000..25999)

4. Curves — Parameters used for parameterization of characteristic curves and maps (parameter numbers 6000..9999, 16000..19999, 26000..29999)

Each parameter has been assigned a number and an abbreviation (identifier). The parameter number also indicates which list the parameter belongs to. Within these lists, the parameters are arranged by groups to facilitate identification and reference for more detailed information.

No.	Parameter	No.	Measurements	No.	Functions	No.	Curves
1	No. of teeth, speed	2000	Speed pickup, speed	4000	Speed pickup, speed	6000	Misfire recognition
50	Misfire recognition	2050	Misfire recognition	4050	Misfire recognition		
100	Stability, droop	2100	Stability, droop	4100	Stability, droop	6100	Stability map,speed governor (speed values)
						6150	Stability map, speed governor (fuel values)
200	Ramp	2200		4200	Ramp	6200	Stability map, speed governor (correction values)
250	Start	2250		4250		6250	
300	Actuator travel	2300	Actuator travel	4300		6300	Stability curve, power governor
						6350	Stability map, speed governor (power values)
400	HZM-CAN	2400	HZM-CAN	4400	HZM-CAN	6400	Boost pressure dependent fuel and load limitation
500	Oil pressure, boost pressure, temperatures	2500		4500	Oil pressure, boost pressure, temperatures	6500	Oil pressure and coolant pressure monitoring
600	Excitation control	2600	Excitation control	4600	Excitation control	6600	Excitation control
700	Limitations	2700	Limitations	4700	Limitations	6700	Speed-dependent fuel limitation 1
800	Digital switch functions	2800	Digital switch functions	4800	Configuration of digital input/output channels	6800	Speed-dependent fuel limitation 2
850	Digital outputs (simple assignment)	2850	Digital outputs	4850	Digital outputs (multiple assignment)	6850	
900	Setpoint adjuster and sensors	2900	Setpoint adjuster and sensors	4900	Setpoint adjuster and sensors	6900	Notches, speed dependent load limitation
1000	Error handling	3000	Current errors part I	5000	Setpoint adjusters and sensors	7000	
1100		3100	Error memory part I	5100	Error handling	7100	
1200	Generator	3200	Generator	5200	Generator	7200	Zero fuel characteristic or pump map
1250	Marine	3250	Marine	5250	Marine		
1300		3300	KRONOS 30 M	5300		7300	Actuators map
1350	Locomotive	3350	Locomotive	5350	Locomotive		
1500	Analogue inputs	3500	PWM inputs analogue inputs	5500	Configuration analogue input/output channels	7500	
1600	PWM outputs analogue outputs	3600	Internal measurement values, feedback digital outputs	5600	Analogue outputs	7600	
1700	Positioner	3700		5700	Positioner	7700	
1800	Status	3800	Status	5800		7800	Temperature sensors

No.	Parameter	No.	Measurements	No.	Functions	No.	Curves
1900	Servo loop	3900	Servo loop	5900	Servo loop	7900	Temperature sensors
1950	Feedback	3950	Feedback	5950	Feedback	7980	Feedback
						8100	Speed map
						8800	Digital outputs (multiple assignment)
						9000	HZM-CAN
						9900	Stability map 2 (correction values)
10000	Dual fuel	12000	Dual fuel	14000	Dual fuel	16000	Dual fuel
		13000	Current errors part II				
		13100	Error memory part II				
20800	Communications switching functions			24800	Communications switching functions		
		23000	Current errors part III				
		23100	Error memory part III				
		23700	Bit collections				
21750	CANopen	23750	CANopen	25750	CANopen		
21800	Modbus	23800	Modbus	25800	Modbus		
21850	DeviceNet	23850	DeviceNet	25850	DeviceNet		
21900	SAE J1939	23900	SAE J1939	25900	SAE J1939		
21950	HZM-CAN customer module			25950	HZM-CAN customer module		
						29000	CANopen
						29200	Modbus
						29400	DeviceNet
						29600	SAE J1939
						29800	HZM-CAN customer module
						29900	Bit collections

The present manual contains explanations of all functions performable by the basic systems ARCHIMEDES, HELENOS, ORION, PANDAROS, PRIAMOS and PRIAMOS III. For specific applications, however, part of these functions will be of no relevance and may be ignored. In such cases, the parameters associated with these functions will also be omitted. The varying hardware requirements of specific devices mean that some functions could not be integrated due to the number or required inputs and outputs. Some of the described functions are implemented in the firmware only on request. All such exceptions are indicated in the text.

Furthermore, customer specific applications may contain new or extended functions which will be documented in separate brochures.

2.7 Level

As it is the control unit's primary function to control the operational behaviour of the engine with regard to speed, power, etc., parameterization should remain entrusted exclusively to the engine manufacturer. However, to let the end customer participate in the advantages of the digital control, the parameters of the **HEINZMANN** digital control have been classified according to seven levels.

- **Level 1: Level for the end customer**
  On this level, it is possible to have the basic operational values (e.g., set values and current values of speed and injection quantity) and errors displayed. This level does not allow any manipulations of the control data or the engine data.
- **Level 2: Level for the device manufacturer**
  The device manufacturer can set speeds within the permissible ranges. Besides, the control's dynamic parameters and the dynamics map may be modified and power output reduced.
- **Level 3: Level for servicing**
  Except for the most significant engine specific parameters, such as engine output and boundaries of various characteristic diagrams, all types of modifications are permitted on this level.
- **Level 4: Level for the engine manufacturer**
  On this level, all parameters are accessible that are needed to adjust the engine's operational performance.
- **Level 5: Level for manufacturers of engines with specific software**
  This level includes parameters that are required for customer specific software modifications or expansions.
- **Level 6: Level for the control unit manufacturer**
  On this level, the control functions may be manipulated directly. Therefore, access remains reserved to HEINZMANN.
- **Level 7: Level for development department**
  This level remains reserved to the HEINZMANN development department.

As can be seen from this survey any superior level is a proper superset of the previous level. For each individual parameter the respective level is listed in the section ↑ *28 Parameter description*. The maximum level is determined by the diagnostics device used (PC or handheld programmer) and cannot be changed. However, the option of reducing the currently valid level by means of a special menu item of the PC-programme or via parameter ↑ 1800 *Level* is provided, thus allowing to reduce the number of visible parameters and functions at any given time.

3 Parameterization of HEINZMANN control units

The following chapters describe the functions of the **HEINZMANN** control units and their adjustment. Certain functions will work only in combination with others or can be affected by other functions (e.g. ↑*5.2 Variable starting fuel limitation* with ↑*5.4 Starting sequence with starting speed ramp).* When parameterizing or optimizing any such function, it will frequently be advisable to disable other functions so that the effect of the specific function can be examined in isolated state. How these functions are to be adjusted will be described in the respective chapters.

3.1 Possibilities of parameterization

There are various ways to set the parameters for **HEINZMANN** control units. For testing and initial commissioning HEINZMANN recommend to use the PC software ↑ *3.3 DcDesk 2000* as a tool for diagnostics and parameterization. DcDesk 2000 can also be used for servicing purposes where, in addition, the handheld programmers PG 02 and HP 03 are available. The remote connection option DcDesk 2000/Saturn is another important aid for servicing.

The following list gives an overview of all available options of parameterization:

- **Parameterization by HEINZMANN**
  During final inspection at the factory, the functionality of the control is checked by means of a test programme. If customer specific operational data is available, the test programme is executed using those data. When mounted on the engine, only the dynamic values and, if necessary, the fuel quantity limitations and the sensors remain to be calibrated.

- **Parameterization with a handheld programmer.**
  Depending on the level, parameterization can be completely conducted using the handheld programmers PG 02 or HP 03. These handy devices are particularly suited for maintenance and servicing.

- **Parameterization with display panel ARGOS.**
  The display and control panel ARGOS allows to carry out the complete setting of parameters for the accessible levels.

- **Parameterization using DcDesk 2000 or DcDesk 2000/Saturn, respectively**
  Using the PC programme DcDesk 2000, it is possible to have several parameters continuously displayed and accessible to modification. Besides, the PC-programme is capable of displaying limitation curves, characteristics, etc. in graph form, and of adjusting them easily and quickly. The control data can be stored by the PC or downloaded from the PC to the control. A further advantage of the PC programme is its ability to visualize in high-resolution measured values (such as speed, injection quantity) as functions of time or as functions of each other (e.g., fuel versus speed).

- **Parameterization with user mask**
  Parameterization can always be conducted by means of user masks that are provided

by **HEINZMANN** or can easily be created by the user himself. A user mask will display only the parameters that are really needed for the specific application.

- **Downloading data sets**
  Once parameterization has been completed for a specific engine type and its application, the data set can be stored within the handheld programmer or on a disk. For future applications of the same type, any such data sets can be downloaded to the new controls.

- **End-of-line parameterization**
  This type of parameterization is performed by the engine manufacturer during the final bench tests of the engine. During these tests, the control unit is adjusted to the requirements of the engine’s applicative context. With a command line call from DcDesk 2000 both the control unit’s firmware and a delivery data record may be programmed without operator intervention during check-out.

3.2 Saving data

On principle, the above mentioned communication programmes and -devices will modify parameters only in the volatile memory of the control unit. Although the control unit will immediately operate using the new values these modifications will get lost as soon as the voltage supply is switched off. In order to permanently save the parameter adjustments in the control unit a storing command must be given. To execute this command, DcDesk 2000 uses the function key F6, whereas the handheld programmers use the key or menu item "Save Parameters", and it is this operation that is meant whenever it is required in this manual that the parameters be saved.

3.3 DcDesk 2000

The **HEINZMANN** PC programme DcDesk 2000 serves for adjustment and transmission of operating data for all digital **HEINZMANN** systems, and, in particular, for the systems described in this manual.

The connection between PC and control unit can be established using a serial interface or the CAN bus with the HEINZMANN-CAN protocol. The remote communication variant allows access via internet, intranet or a direct modem connection.

Designed as a Windows® programme, it offers all numerical and graphical features required for testing, initial commissioning and servicing, and helps with preparing the respective documentations.

DcDesk 2000 also allows to produce hardcopy printouts of its screens and of its data records. The data are recorded in a standard text format for further processing and for incorporation into reports, etc.

The data set of any connected control unit can be processed, and, at the same time, the responses to parameter changes can be observed. Even without a control unit connected, it will be possible to process a parameter set and evaluate the recorded data. Any parameter set generated that way can later on be downloaded to the control unit.

Any adjustment can be made by directly accessing the respective parameter numbers. Special windows simplify the adjustment of specific functions, in particular the configuration of the system and the parameter setting of characteristics and maps.

Actual measurement data is displayed numerically and/or graphically. In a separate window, up to ten freely selectable measuring values can be displayed simultaneously as functions of time. There is a further window that permits to have nine measurements represented in dependence of a tenth. All of these records can be logged to be evaluated later on and eventually printed out.

Any of the characteristics and maps available within the control unit can be displayed two- or three-dimensionally in separate windows. By this, the profile and shape of any specific characteristic or map can immediately be viewed. The actual point within the characteristic or map at which the system is currently operating will be displayed online. To make an adjustment it is not necessary to know the precise interrelation between the parameter numbers and the points of the characteristic or map since a special input section has been provided offering assistance with regard to the peculiarities of parameterizing characteristics and maps. This feature will prove very helpful to avoid erroneous inputs.

DcDesk 2000 is being continuously updated and enhanced by additional functions.

HEINZMANN recommend the use of DcDesk 2000 for testing and initial commissioning. Similarly, when servicing the system, DcDesk 2000 will prove a decisive advantage for diagnosis and troubleshooting.

3.4 ARGOS

The display and control panel ARGOS features a menu command structure and can be used either for continuous display of measuring values or for parameter setting.

The measuring values shown on the display are entered stably in the control unit and cannot be changed.

In addition, the device is equipped with light emitting diodes that can be assigned configuring the control unit with ARGOS itself or with DcDesk 2000.

The positioning of the LED’s is as follows. LED 1 is orange, LED 5 is red, all other LED’s are green.

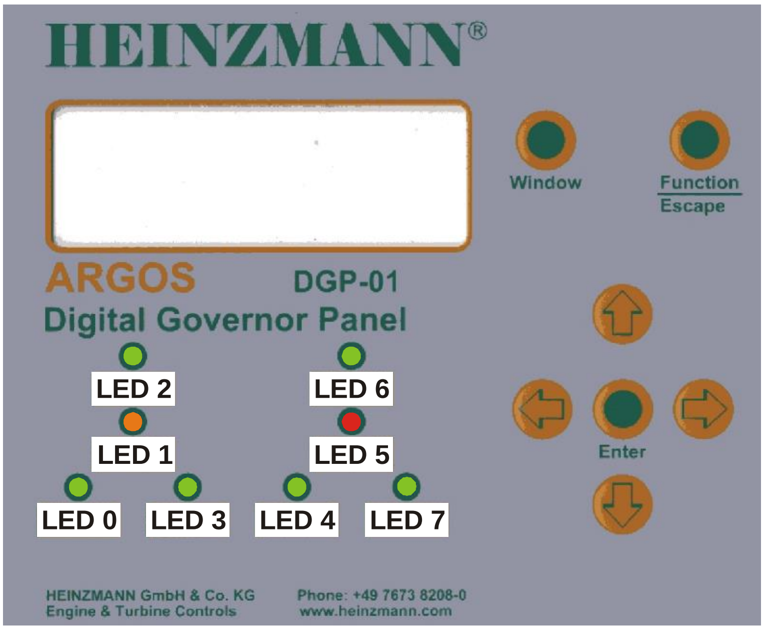


Fig. 2: ARGOS front cover

The field index of parameters starting from 29950 *ArgosLEDParamSet(0)* corresponds to the LED number. In these eight parameters the parameter of any measurement value with range 0/1 can be entered, resulting in the according value to be displayed.

The LED's can be marked by inserting small strips of paper under the transparent covering.

3.5 Parameter value ranges

Each parameter is assigned a specific range of values. Since there is a multitude of parameters and functions, there also exists a great number of value ranges. In chapter ↑*28 Parameter description* the value ranges are listed for each individual parameter. Besides, the parameter value ranges can be viewed by means of the PC or the handheld programmer (↑*3.1 Possibilities of parameterization).*

For speed parameters a common value range is provided. As a standard, it covers the range from 0 to 4,000 rpm and allows to run engines up to maximum speeds of approx. 3,500-3,600 rpm (There must be some reserve for ↑***6.4 Overspeed monitoring***).

Throughout this manual the standard value ranges are 0..4000 rpm for speed parameter and 0..100 % fuel for actuator position. Note that selection of any other value range will imply changes of the range limits. These changes are explained in the chapter ↑*28.3 List 3: Functions* and should be carefully taken account of.

For certain parameters the value ranges cannot be explicitly specified in advance, but must be communicated to the control by the user. This applies to all parameters indicating physical measurements such as readings from pressure or temperature sensors.

Some parameters have a value range that is capable of two states only, viz. 0 or 1. This type of parameter is used to activate or switch over particular functions or to indicate error conditions or states of external switches, etc. Parameters with this value range are confined to the lists 2 and 3.

With these parameters, state "1" signifies that the respective function is active or that the respective error has occurred, whereas state "0" signals the function to be inactive resp. that there is no error.

The identifiers of change-over switches or of parameters selecting between two functions always include an “Or” (e.g.: 2812 *SwitchDroop2****Or****1*). The function preceding “Or” will be active when the parameter value is = 1 whilst the function after “Or” will be active when the parameter value is = 0.

3.6 Activation of functions

As regards activation of functions, the following alternatives are provided:

- **permanently active**
  These functions cannot be turned off (e.g., ↑ **6.4 Overspeed monitoring**).
- **Parameter**
  Parameters contained in list 3 (↑*28.3 List 3: Functions*) enable functions that will remain permanently active when selected by the user (e.g., ↑***9.1 Speed dependent fuel limitation***).
- **Switch functions**
  By means of external switches (↑***18 Configuration of*** switching functions) the control can be instructed to adopt certain requested operational states that are subject to frequent changes during operation (e.g., switch-over ↑***7.8 Droop***). The states of the switching functions can be read from the parameters numbering from 2810 on upward.

Note

The control units are equipped with several inputs that can be configured at the user's option. The number of functions that can be activated by external switches is, however, considerably larger than the number of inputs. Therefore, depending on the device version and on customer demands, the digital inputs can be assigned to different functions. In the following chapters, it is presumed that with regard to any function that is to be activated or switched over by external switches, the respective switch has been accordingly implemented and/or activated via a communication module.

3.7 Parameterization of characteristics

Parameterization of characteristic curves follows a specific procedure that remains the same for all characteristics. The number of pairs of variates, however, will be different for each function. A pair of variates consists of one x-value and one y-value both with the same index. Intermediary values between adjacent pairs of variates will be interpolated by the control.

When parameterizing a characteristic, the following instructions must be observed:

- The characteristics must always begin with the pair of values indexed 0.
- The x-values must be sorted in ascending order.
- Each x-value may occur only once.
- For unused pairs at the end of the characteristic, the x-variate must be set to the smallest possible value.

Parameterization of any characteristic does not require all pairs of variates to be assigned a value. It will suffice to assign values only to as many parameters (beginning with index 0) as will be needed. Similarly, it will not be necessary that the distances between the base points be the same.

When the current x-value of any characteristic is below the first supporting point, the value of the characteristic will be set to the y-value of the first supporting point (base point), and when it is beyond the last supporting point, the y-value of this supporting point will be used. In other words, the first and last of the y-values will be retained in case the current x-value is outside the characteristic's domain. DcDesk 2000’s graphic display shows this.

3.8 Parameterization of maps

Parameterization of maps will always follow the same procedure. The number of base points, however, will be different for different functions. A supporting point consists of one x-value and one y-value and the associated z-value. Intermediary values between adjacent pairs of variates will be interpolated by the control.

When parameterizing a map, the following instructions must be observed:

- The x- and y-values must always begin with index 0.
- The x- and y-values must be arranged by ascending order.
- Each x- and y-value may occur only once.
- For unused base points at the end of the map, the x- and y-variates must each be assigned their respective smallest possible values.

Parameterization of any map does not require all pairs of variates to be assigned a value. It will suffice to assign values only to as many parameters (beginning with index 0 for the x- and y-values) as will be needed. Similarly, it will not be necessary that the distances between the base points be the same.

As an illustration of how parameter indexes are assigned to a map, the following example shows a map table with a domain of 5 times 5 base points:

y-values	x-values x index 0	x index 1	x index 2	x index 3	x index 4
y index 0	z index 0	z index 1	z index 2	z index 3	z index 4
y index 1	z index 5	z index 6	z index 7	z index 8	z index 9
y index 2	z index 10	z index 11	z index 12	z index 13	z index 14
y index 3	z index 15	z index 16	z index 17	z index 18	z index 19
y index 4	z index 20	z index 21	z index 22	z index 23	z index 24

Table 11: Map structure

If the current values in direction of the x- and/or y-axes are outside the domain of the map as defined by the base points, the respective border value of the map will be used instead. DcDesk 2000’s graphic display shows this.

If it should prove necessary to restrict dependence to only one direction this can be achieved by setting the base points for the other direction to their minimum value. In other words, if there is functional dependence only in direction of the y-axis, all x index values are to be set to minimum value. The base points for z will then be those of the series with x-index 0.

HEINZMANN recommend to use ↗ *3.3 DcDesk 2000* for parameterizing maps and characteristics as this programme will take care of all particulars to be paid attention to and will simplify parameterization considerably. Thus, the above table is included in DcDesk 2000 in identical form and offers easy access to any of the base points. Furthermore, the characteristics and maps can be represented graphically by this tool.

3.9 Examples of parameterization

For the majority of functions, an example has been provided of how parameterization is to be conducted. These examples will include all the parameters needed for the function being discussed. The values, however, will be different ones for different engines and applications and must be understood to be adduced merely as examples. When adjusting any function, it will, therefore, be necessary to use reasonable values suiting the engine and the application.

3.10 Reset of control unit

A reset is tantamount to powering down the control and restarting it. This can be achieved by shortly turning off the power supply or else by a specific command from DcDesk 2000 or from the handheld programmer HP 03. Control units of the types PRIAMOS and HELENOS are equipped with an additional reset button located close to the rotary switch or the 48-pin connector on the printed circuit board, respectively.

Note

A reset will clear any data that has not been saved in the control's permanent memory. It is, therefore, imperative that before executing a reset all data be transferred to the control's permanent memory if this data is to be preserved.

Certain functions of the control unit require a reset for activation. These are mostly functions that serve the purpose to put the control into some other operating state, or parameters that cannot be modified during operation for safety reasons. The parameters and functions belonging to this category will be explained in detail in the respective chapters.

Warning

Since during each reset the control is de-energized for a short time, a reset may be executed only when the engine is not running!

4 Starting the engine

On first commissioning the control on the engine, the following instructions should be strictly followed. This is the only way to ensure that the engine can be started without any problems.

These instructions, however, can give only some brief information on how to commission the control. For more detailed information, please refer to the respective chapters or manuals.

The instructions cover all parameters that must be adjusted to start the engine. It should be noted, however, that the parameter values used in these instructions are adduced only by way of example. For actual operation they must be replaced by appropriate values suiting the engine and the specific application.

- **Adjust distance of speed pickup**

  The distance between the pickup and the top of the teeth should be approx. 0.5 to 0.8 mm. For more detailed information see the manuals for the basic systems (↑ *2.3 Further information*).

- **Check linkage.**

  The linkage must operate smoothly and easily, and it must be capable of moving to the stop and maximum fuel positions.

- **Check cabling**

  On actuating any switch, the respective indication parameter should reflect the change. If several switches are provided this check must be conducted for all of them.

  ↑***18 Configuration of*** switching functions.

  On first commissioning the engine, it is only the setpoint adjusters that are needed since the functions operating by signals from the analogue inputs (such as boost pressure dependent fuel limitation, speed dependent oil pressure monitoring, etc.) must not yet be activated. Nevertheless, all analogue inputs should be checked.

  ↑***17 Configuration*** of sensors and ↑***20.2 Analogue inputs***

  Example:

  Let us assume the setpoint adjuster 1 is connected to analogue input 1. When altering the set value, the parameter 3511 *AnalogIn1_Value* is expected to change accordingly. If there is no change, the cabling of the setpoint adjuster must be at fault. Together with 3511 *AnalogIn1_Value*, the parameter 3510 *AnalogIn1* and the specific setpoint adjuster parameter 2900 *Setpoint1Extern* are also bound to change from 0 to 100 % when the setpoint adjuster is turned from minimum into maximum position. If this is not the case, the input needs to be normalized (↑***20.2.1 Calibration of current/voltage inputs***).

- **Adjust and check the actuator**

Calibration of the actuator can be performed with the aid of the PC program or the handheld programmer. For control units of the type PANDAROS or ORION auto adjustment can also be started by pressing a push-button on the printed circuit board, for control units of the type PRIAMOS by putting the rotary switch in position 1 before the restart of the control unit.

Automatic calibration of the actuator is to be carried out with the linkage removed from the governor and the injection pump or the gas mixer, respectively, to make sure that the actuator is capable of travelling to its minimum and maximum positions.

Checking the actuator can be enabled by setting the parameter 5700 *PositionerOn* = 1. By this procedure, the actuator position can be preset directly by 1700 *PositionerSetpoint* and then checked by having the actual actuator position indicated by parameter 2300 *ActPos*. Again, the actuator should be able to move across its total displacement range from 0 % to 100 %. To perform this check, the actuator is activated by setting 5910 *ActuatorOn* = 1. This check cannot be performed if a speed signal is coming in, i.e. positioning is not possible unless the engine is at a standstill.

Number	Parameter	Value	Unit
1700	*PositionerSetpoint*	*50*	*%*

Activation:

5910	*ActuatorOn*	*1*	
5700	*PositionerOn*	*1*	

Indication:

2300	*ActPos*	*50*	*%*

- **Parameterizing the most significant parameters.**

Begin by parameterizing number of teeth, minimum and maximum speeds, and overspeed (↑***7 Speed setpoint determination***):

Number	Parameter	Value	Unit
1	*TeethPickup1*	*160*	
10	*SpeedMin1*	*700*	*rpm*
12	*SpeedMax1*	*2100*	*rpm*
21	*SpeedOver*	*2500*	*rpm*

Preset the PID values (↑***8.1 Adjustment of PID parameters***):

Number	Parameter	Value	Unit
100	*Gain*	*15*	*%*
101	*Stability*	*10*	*%*
102	*Derivative*	*0*	*%*

Parameterize the absolute limits of actuator travel

Number	Parameter	Value	Unit
310	*ActPosSecureMin*	*3*	*%*
312	*ActPosSecureMax*	*97*	*%*

Adjust starting fuel (type 1 ↑*5.1 Fixed starting fuel limitation*):

Number	Parameter	Value	Unit
250	*StartType*	*1*	
251	*LimitsDelay*	*3*	*s*
255	*StartSpeed1*	*10*	*rpm*
256	*StartSpeed2*	*400*	*rpm*
260	*StartFuel1*	*60*	*%*

Save the values to the control device ↑*3.2 Saving data* and restart with a ↑*3.10 Reset of control unit*.

- **Check speed pickup and determine starter speed**

Operate the engine stop switch so that the engine cannot be started.

Indication:

Number	Parameter	Value	Unit
2810	*SwitchEngineStop*	*1*	

NOTICE	Before starting the engine ensure separate overspeed protection independent of the rpm controller!

Operate starter and check the measured speed as indicated by 2000 *Speed*. At this point, the parameter should indicate cranking speed.

Check starter speed, i.e. the minimum speed at which the governor recognizes that the engine has started (256 *StartSpeed2*). This speed must be above cranking speed.

- **Start the engine and adjust control circuit stability**

Disable engine stop switch.

Indication:

Number	Parameter	Value	Unit
2810	*SwitchEngineStop*	*0*	

Start the engine and run it up to rated speed using the setpoint adjuster.

Optimize the PID-values (↑***8.1 Adjustment of PID parameters***).

- Increase gain (P-factor) 100 *Gain* until the engine becomes unstable, then reduce it until stability is restored.
- Increase stability (I-factor) 101 *Stability* until the engine becomes unstable, then reduce it until stability is restored.
- Increase derivative (D-factor) 102 *Derivative* until the engine becomes unstable, then reduce it until stability is restored.

With this adjustment, disturb engine speed shortly and observe the transient response.

- **Perform this checking procedure across the entire speed range.**

  If for minimum and maximum speeds this checking procedure results in values differing from the programmed ones, the setpoint adjuster needs to be calibrated (↑ ***20.2.1 Calibration of current/voltage inputs***). The parameter 2031 *SpeedSetp* will indicate whether the value has been set correctly.

- **Correction of PID parameters**

  Adjustment of speed and/or fuel dependent correction of PID parameters over the whole speed range (↑***8 Optimizing control circuit stability***).

- **Adjusting the remaining functions**

  Adjustment of functions such as ↑ ***7.7 Speed ramp*** and ↑ ***9.1 Speed dependent fuel limitation*** etc.

- **Save the data thus determined by storing them in the control**

  ↑*3.2 Saving data*, ↑*3.10 Reset of control unit*

5 Starting fuel limitation

To start properly, naturally aspirated diesel engines and engines with low pressure charging need to be fed an excess quantity of fuel; in other words, for start-up a larger amount of fuel must be injected than for full load.

Diesel engines fitted with more powerful turbochargers will operate during start-up by a reduced starting injection quantity to prevent smoke bursts.

The **HEINZMANN** control units comply with these stipulations by de-activating the control's limiting functions during start-up. This allows to freely programme the adjustment of starting fuel quantity. For this purpose, three options are available that can be selected by the parameter 250 *StartType* as follows:

250 *StartType* = 1:	fixed starting fuel
250 *StartType* = 2:	variable starting fuel
250 *StartType* = 3:	temperature dependent starting fuel limitation (not for ORION)

The single phases of engine start and of the speed governor are indicated in parameter 3830 *Phase* and, in the PRIAMOS system, also in the seven-segment display (↑ *27.3.3 Seven-segment display of the DC 1 series*.

0: Waiting for engine start
1: Starting phase 1
2: Starting phase 2
3: Starting phase 3
4: Speed control enabled, limiting functions disabled
5: Speed control enabled, limiting functions enabled
6: Speed control enabled, lower limit enabled
7: Speed control enabled, upper limit enabled
8: Autoadjustment
9: Positioner

In the control units of the type ARCHIMEDES, PANDAROS and ORION each engine start is counted in 2250 *EngineStartCounter*. Operating hours of the running engine are recorded in 3871 *OperatingHourMeter* and 3872 *OperatingSecondMeter*. By request, the control unit HELENOS can be equipped with an external memory for operative data and errors, too.

The current engine states are indicated by the following parameters:

3802 *EngineStopRequest*	A request for stopping the engine is being applied, the running engine stops, engine start is not possible
3803 *EngineStopped*	Engine stopped
3804 *EngineStarting*	Engine is being started
3805 *EngineRunning*	Engine is running
3806 *EngineReleased*	Injection enabled

Injection is released only if there is no engine stop request and no fatal error.

5.1 Fixed starting fuel limitation

On reaching the speed set by 255 *StartSpeed1* the control recognizes that the engine is being cranked, and releases the starting quantity as set in 260 *StartFuel1*. At this point, the speed setpoint is set from 0 rpm to minimum speed 10 *SpeedMin1*.

On reaching speed as set by 256 *StartSpeed2*, the control recognizes that the engine is running. At this point, there is a change-over to the externally applied speed setpoint 2031 *SpeedSetp*. Starting fuel limitation 260 *StartFuel1*, however, is sustained for the duration set by 251 *LimitsDelay*. After that, the control passes over to using the governor's normal limiting functions.

The successive stages of the speed setpoint during start-up can be viewed in the parameter 2031 *SpeedSetp* (↑ *Fig. 3: Fixed starting fuel limitation*). Below starting speed 1, the setpoint is set to 0. During cranking (with the speed ranging between starting speeds 1 and 2), control is to idle speed. It is only after the engine is running (i.e., at speeds higher then starting speed 2) that the actually preset setpoint will be active.

<u>Parameterizing Example:</u>

The engine is supposed to start using a pre-defined maximum fixed starting fuel amount of 50%. Furthermore, on reaching a speed of 10 rpm the engine is to be recognized as being cranked, and at 400 rpm as being running. Once the engine has started off, starting quantity limitation is supposed to be active for 5 more seconds.

Number	Parameter	Value	Unit
250	*StartType*	*1*	
251	*LimitsDelay*	*5*	*s*
255	*StartSpeed1*	*10*	*rpm*
256	*StartSpeed2*	*400*	*rpm*
260	*StartFuel1*	*50*	*%*

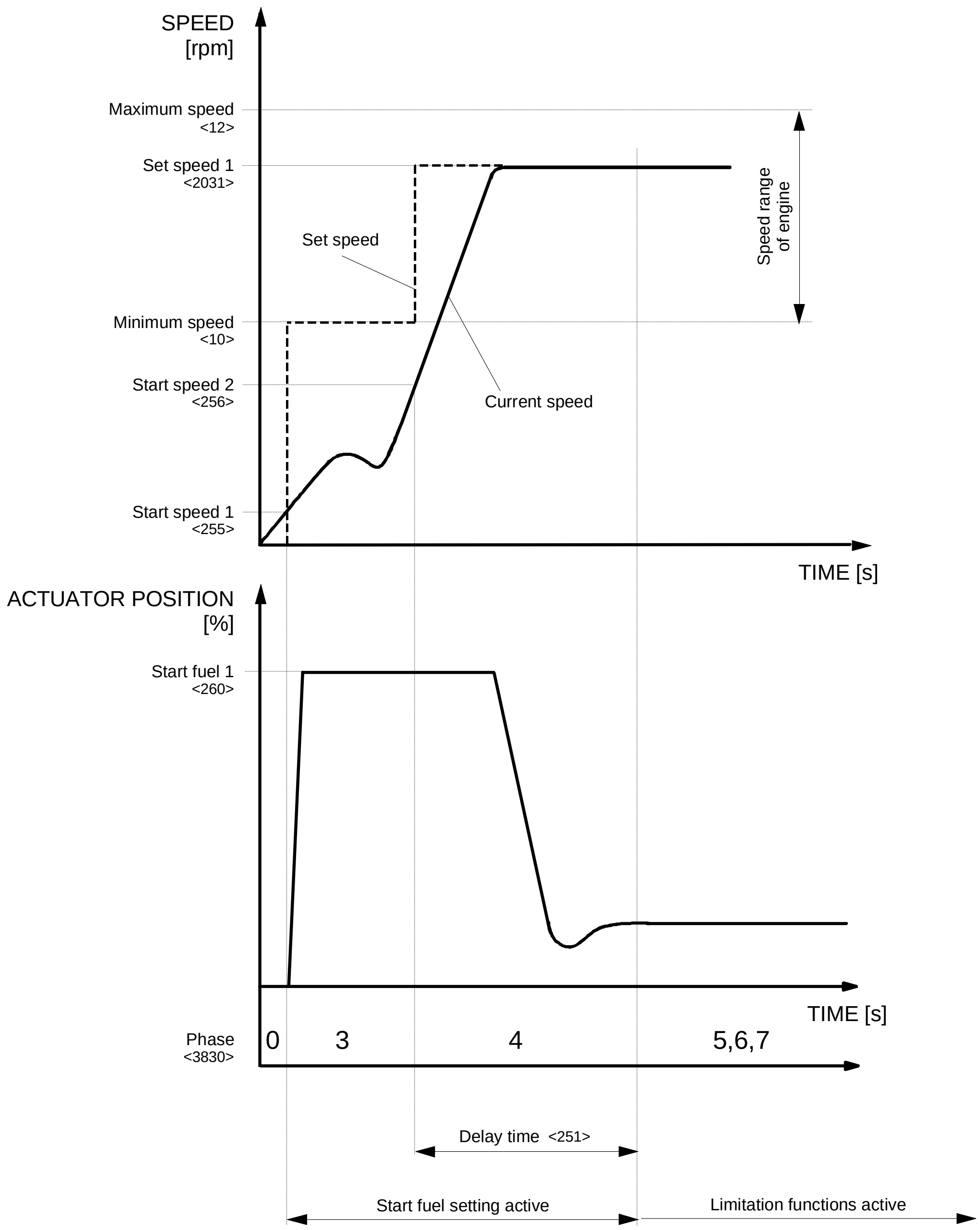


Fig. 3: Fixed starting fuel limitation

5.2 Variable starting fuel limitation

Variable starting fuel adjustment is mainly used for diesel engines with little or medium output. In these cases, two starting fuel amounts are provided. The first start quantity 260 *StartFuel1* is set to the value by which the warm engine will start properly, whilst the start quantity 261 *StartFuel2* is set to the value by which the cold engine is sure to start even at extremely low temperatures (↑ *Fig. 4: Variable starting fuel limitation*).

Note

In case a temperature sensor is provided, it is recommended to use ↑ 5.3 Temperature dependent starting fuel limitation.

If within the time defined by 265 *StartDuration1* the engine should not start off with starting fuel set to 260 *StartFuel1*, the control will increase the fuel quantity to 261 *StartFuel2* for the time defined in 266 *StartDuration2*. This fuel quantity is sustained until the engine starts off or cranking is aborted.

On reaching speed as set by 256 *StartSpeed2*, the control recognizes that the engine is running. At this point, there is a change-over to the externally applied speed setpoint 2031 *SpeedSetp*. The starting quantity, however, with which the engine had started off is sustained as a fuel limitation for the duration set by 251 *LimitsDelay*. After that, the control passes over to using the governor's normal limiting functions.

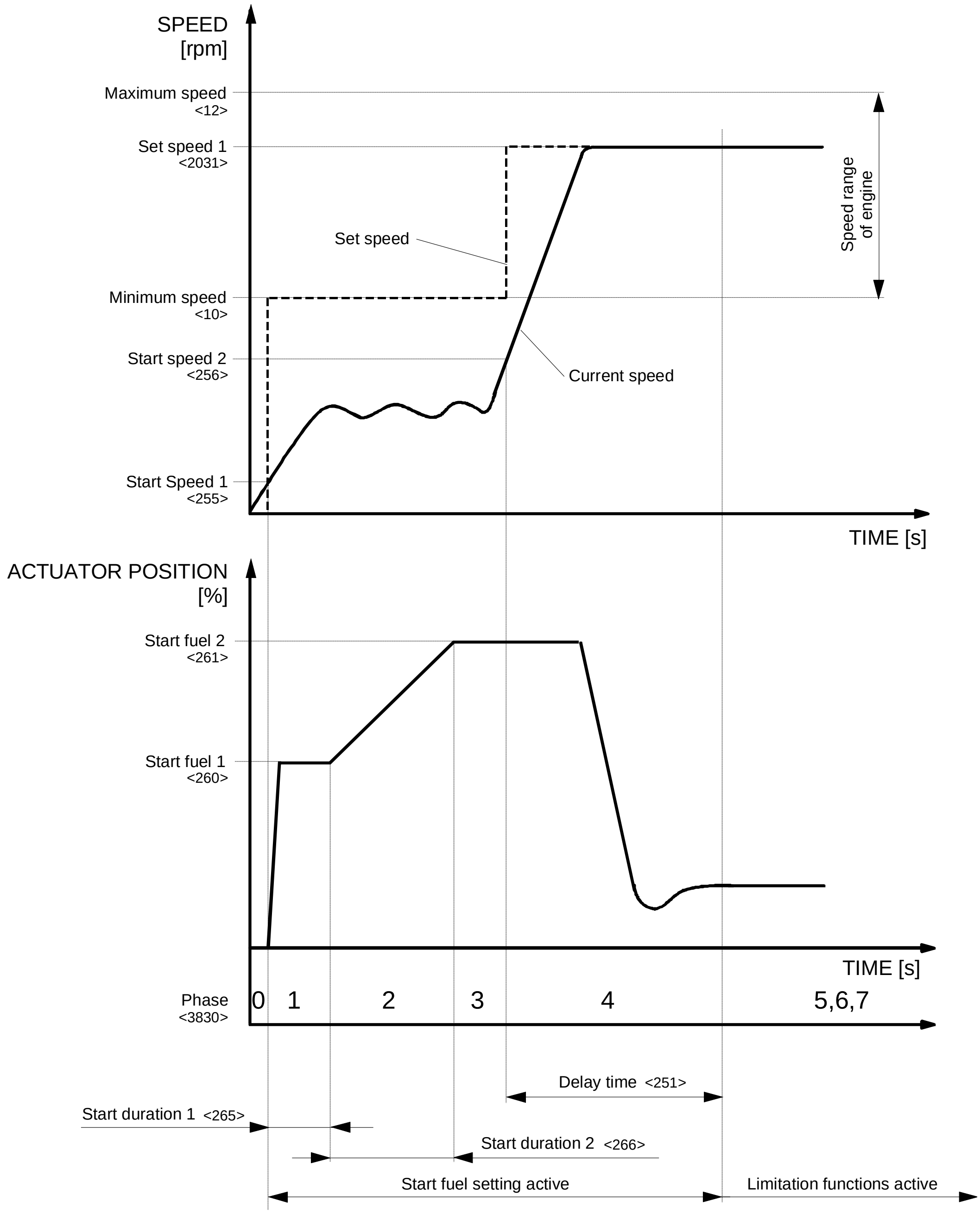


Fig. 4: Variable starting fuel limitation

Parameterizing Example:

The engine is supposed to start using the initially pre-defined maximum starting fuel quantity of 60%. At speeds of 10 rpm and higher the engine is to be recognized as being cranked, and at a speed of 400 rpm as being running. If the engine is not running after 3 seconds, the initially pre-defined maximum starting fuel quantity is raised until it reaches a maximum starting fuel quantity of 90% after further 7 seconds. The starting fuel quantity limitation stays on this level if the engine has not started to run yet. Once the engine has started off, starting quantity limitation is supposed to be active for 5 more seconds.

Number	Parameter	Value	Unit
250	*StartType*	*2*	
251	*LimitsDelay*	*5*	*s*
255	*StartSpeed1*	*10*	*rpm*
256	*StartSpeed2*	*400*	*rpm*
260	*StartFuel1*	*60*	*%*
261	*StartFuel2*	*90*	*%*
265	*StartDuration1*	*3*	*s*
266	*StartDuration2*	*7*	*s*

5.3 Temperature dependent starting fuel limitation

With this mode of starting fuel adjustment, starting fuel is adjusted in dependence on temperature. By means of a temperature sensor the engine temperature 2907 *CoolantTemp* is determined and used by the control to determine the most adequate starting quantity for this temperature. For the rest, the cranking procedure works the same way as with fixed starting fuel adjustment; the only difference is that the fixed starting quantity is derived from the current engine temperature.

i
Note

This function is not available in control units of the ORION type.

As long as the cold engine's temperature is below 271 *StartTempCold* the starting fuel quantity 261 *StartFuel2* is released. As engine temperature increases, starting fuel is decreased, until at the temperature set in 270 *StartTempWarm* the starting fuel defined in 260 *StartFuel1* is reached (↑ *Fig. 5: Temperature dependent starting fuel*).

On attaining 255 *StartSpeed1* the control will, as before, recognize that the engine is being cranked, and on reaching 256 *StartSpeed2* that the engine is running. At this point, there is a change-over to the externally applied speed setpoint 2031 *SpeedSetp* (↑ *Fig. 6: Temperature dependent starting fuel limitation*). The starting quantity, however, with which the engine had started off is sustained as a fuel limitation for the duration set by 251 *LimitsDelay*. After that, the control passes over to using the control unit’s normal limiting functions.

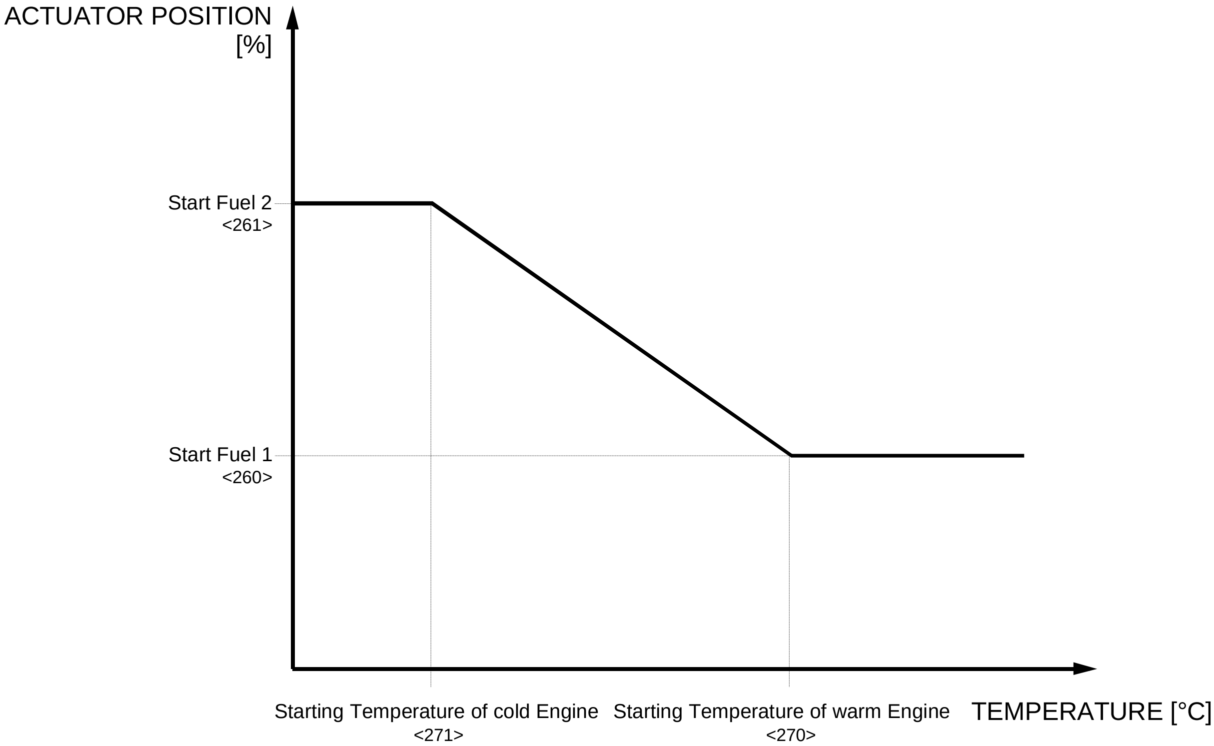


Fig. 5: Temperature dependent starting fuel

Parameterizing Example:

The engine is supposed to start at an engine temperature of -10°C with temperature dependent maximum starting injection quantity of 70%. If the engine temperature is higher during start-up, the starting injection quantity is to be reduced accordingly. If, however, engine temperature has already risen above 40°C, starting fuel quantity is no longer to be reduced, but to be held at 50%. Furthermore, on reaching a speed of 10 rpm the engine is to be recognized as being cranked, and at 400 rpm as being running. Once the engine has started off, starting quantity limitation is supposed to be active for 5 more seconds.

Number	Parameter	Value	Unit
250	*StartType*	*3*	
251	*LimitsDelay*	*5*	*s*
255	*StartSpeed1*	*10*	*rpm*
256	*StartSpeed2*	*400*	*rpm*
260	*StartFuel1*	*50*	*%*
261	*StartFuel2*	*70*	*%*
270	*StartTempWarm*	*40*	*°C*
271	*StartTempCold*	*-10*	*°C*

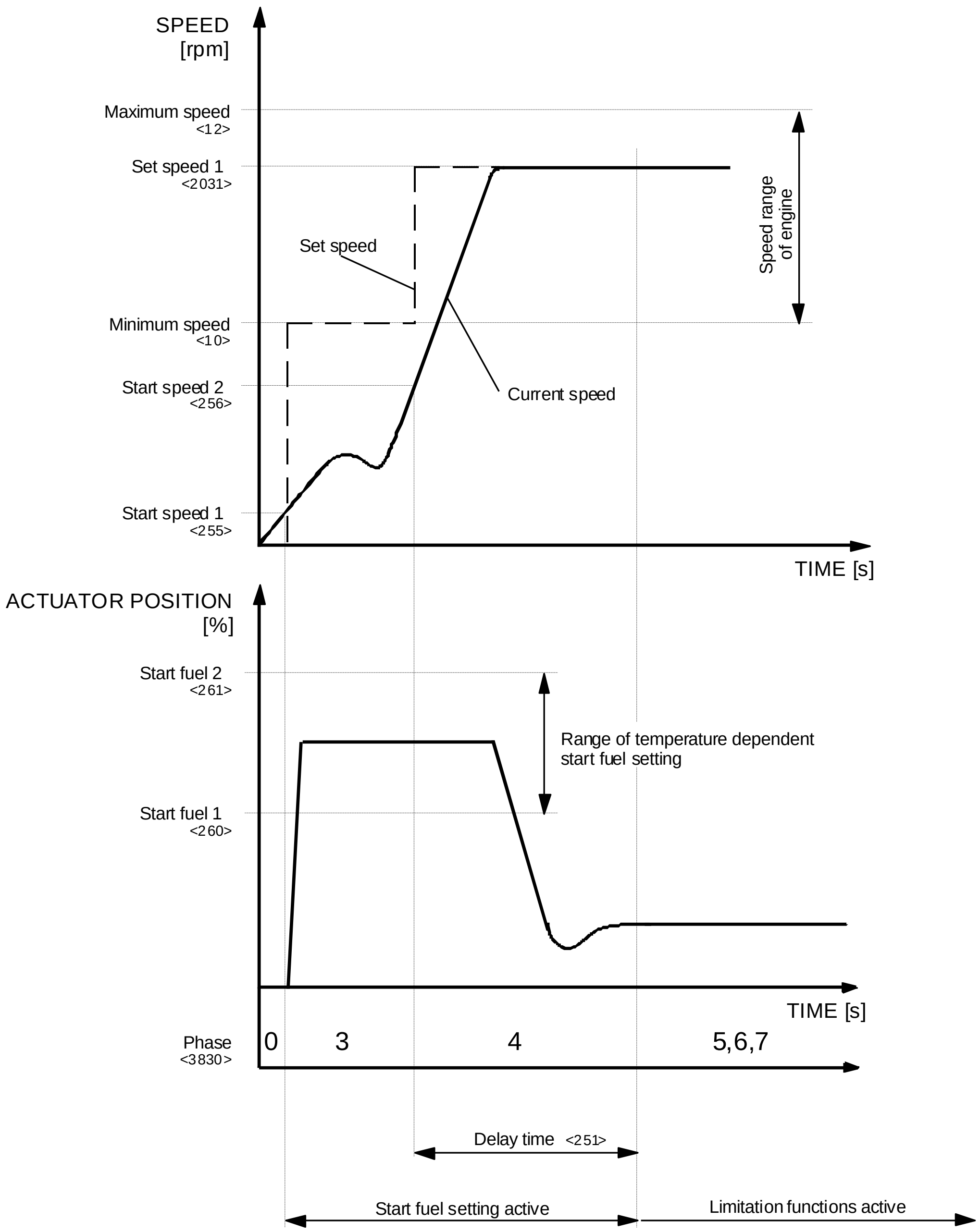


Fig. 6: Temperature dependent starting fuel limitation

5.4 Starting sequence with starting speed ramp

Once the engine has started, it may be desirable to have it ramp slowly to its ultimate speed value. This helps to protect the engine from premature wear and to avoid overshooting. This function is activated by the parameter 4240 *StartSpeedRampOn*.

When starting the engine now and on attaining speed 255 *StartSpeed1*, the control recognizes that the engine is being cranked, and the speed setpoint is raised from 0 rpm to speed 257 *StartSpeed3* (↑*Fig. 7: Starting behaviour when starting speed ramp is enabled*). The parameterized speed must lay between the speed at which the control recognizes that the engine is being cranked 256 *StartSpeed2* and the minimum speed 10 *SpeedMin1*. If engine start-off is detected the speed setpoint is increased by the ramping rate as pre-defined by 240 *StartSpeedRampUp* until the externally applied speed setpoint is attained. Actual speed will follow these changes of set speed.

The starting is independent of the normal ↑ ***7.7 Speed ramp***. It is only used to start the engine, and its priority is superior to that of the normal speed ramp. If both the starting speed and the normal speed ramps are enabled, the set normal speed ramp will remain inactive until after engine start the desired speed has been reached via the starting speed ramp.

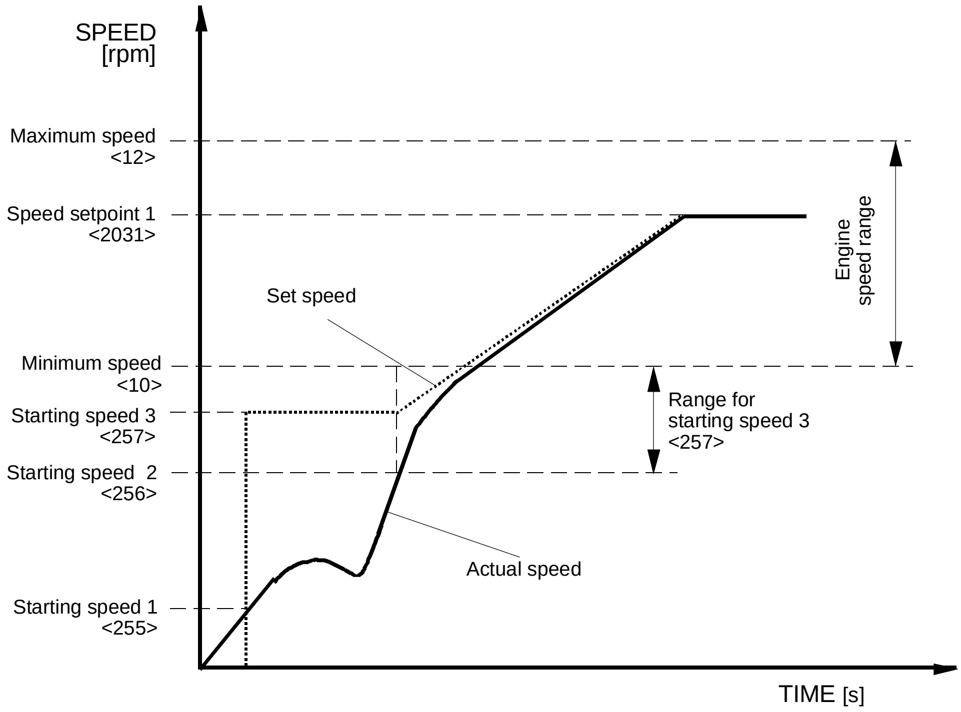


Fig. 7: Starting behaviour when starting speed ramp is enabled

<u>Parameterizing Example:</u>

In addition to the settings in the preceding examples, the speed setpoint is to ramp after start-off from 600 rpm to the externally applied setpoint by a ramping rate of 100 rpmps (rpm per second). To achieve this, the following parameters must be additionally programmed:

Number	Parameter	Value	Unit
240	*StartSpeedRampUp*	*100*	*rpmps*
257	*StartSpeed3*	*600*	*rpm*
4240	*StartSpeedRampOn*	*1*	

5.5 Forced actuator opening

In certain applications, it may be required that with the engine stopped the actuator delivers starting fuel without having detected speed. By using the switch function 2833 *SwitchForcedStart* the control enables this function.

2833 *SwitchForcedStart* = 1 Forced start required

2833 *SwitchForcedStart* = 0 Forced start not required

Note

If the switch function 2833 SwitchForcedStart is enabled automatic calibration cannot be activated or will immediately be de-activated.

On activating forced start the control will always go to starting fuel 1 (260 *StartFuel1*). After that, engine start should occur, i.e. speed signals must be detected, within the time period set by 252 *ForcedStartSupvTime*. If this is not the case, a pickup error is generated and engine start is aborted. Otherwise, the starting procedure will continue in accordance with the preset start type.

NOTICE	**For reasons of safety, this function should be used only if a backup speed pickup has been installed.** For if the engine is started and there is no speed detected due to some pickup fault (e.g., poor contact of the pickup cable), starting fuel will be maintained even if the engine exceeds preset speed. In such cases, there is the risk that overspeeding will not be recognized by the HEINZMANN control due to the pickup fault. Therefore, the check time 252 ForcedStartSupvTime has to be set as short as possible

6 Speed sensing

6.1 Speed parameters

For speed parameters a common value range is provided. As a standard, it covers the range from 0 to 4000 rpm and allows to run engines up to maximum speeds of approx. 3,500-3,600 rpm (There must be some reserve for ↑ *6.4 Overspeed monitoring*). Other speed ranges are possible on request, limited by the maximum admissible frequency on the pickup input ↑*6.2 Speed measurement*.

Current speed is indicated by the following parameters, whereby for control devices of the types PANDAROS and ORION the second pickup input must be activated separately (↑ *19.4.2 Pickup 2 input* and ↑*19.5.2 Pickup 2 input*) :

2000 *Speed*	Current engine speed.
2001 *SpeedPickUp1*	Speed as read by speed pickup 1
2002 *SpeedPickUp2*	Speed as read by speed pickup 2
2003 *SpeedPickUp1Value*	Speed as read by speed pickup 1 unfiltered.
2004 *SpeedPickUp2Value*	Speed as read by speed pickup 2 unfiltered.
2005 *PickUp2Or1Active*	Indication of currently active speed pickup

Depending on which speed pickup is active, actual speed 2000 *Speed* will coincide with either 2001 *SpeedPickUp1* or 2002 *SpeedPickUp2*. This speed value is used by other functions like speed control, fuel limitations, etc. The unfiltered speed value is needed only for ↑*6.3.2* Gradient monitoring, otherwise it is for information only.

Note

The measured speeds are filtered with a special process to eliminate engine speed variations due to the coefficient of cyclic variation.

6.2 Speed measurement

Whenever possible, the pickup should be mounted to the starter gear.

For safe operation, an independent second speed pickup can be connected to take over sensing engine speed in case the first pickup should fail. Speed pickup 1 is always the one to be used under normal operation whereas the second serves as a backup speed probe only.

The alternator signal (terminal W) can also serve as a redundant speed sensing signal in place of a second pickup. For further information on how to connect the pickups please refer to the manuals of the basis systems.

When parametrizing, in parameter 1 *TeethPickUp1* and 2 *TeethPickUp2*, the number of teeth the respective pickup sees during one complete revolution of the engine is to be entered. If the second redundant pickup is connected to terminal W, the frequency is to be entered for the signal from terminal W, and the control must be instructed via the parameter 4003 *PickUp2AtAlternator* that terminal W is being used.

Note

The decimal places of the number of teeth for speed pickup 2 will be used only when connected to terminal W of the alternator (4003 PickUp2AtAlternator = 1).

Filtering of the speed signal is normally done using the measurement data of one crankshaft revolution. This allows a very quick reaction to speed changes. For engines with an odd number of cylinders or irregular advance angles it may be convenient to filter over two crankshaft revolutions to eliminate speed irregularities.

4001 *PickUpFilter2Or1Rev* = 0 filtering over one revolution

4001 *PickUpFilter2Or1Rev* = 1 filtering over two revolutions

Note

Filtering of speed signals is on principle always done over two crankshaft rotations when misfire monitoring is implemented in the firmware. (↑10.8 Misfire monitoring in generator operation)

The measurement frequency resulting from teeth number and maximum speed/overspeed may not exceed the following values:

Control unit	Maximum frequency
ARCHIMEDES	9,000 Hz
HELENOS	12,000 Hz
ORION	9,000 Hz
PANDAROS	9,000 Hz
PRIAMOS	9,000 Hz

Table 12 Maximum frequency

The control device monitors this and sends out a configuration error message (↑ *27.6* Configuration errors) in case of error. In addition, 3004 *ErrOverSpeed* is activated in order to prevent engine starting.

Parameterizing Example:

Number	Parameter	Value	Unit
1	*TeethPickUp1*	*160*	
2	*TeethPickUp2*	*60.0*	

Activation:

4002	*PickUp2On*	*1*	
4003	*PickUp2AtAlternator*	*0*	

Note

The second speed pickup must be activated separately. All these parameters will be active only after ↑3.2 Saving data in the control unit followed by a↑ 3.10 Reset of control unit.

6.3 Speed pickup monitoring

For either speed pickup, identical monitoring functions have been separately implemented. It should be noted, however, that on starting the engine other conditions will have to be observed than in normal operation. Failure of a speed pickup is indicated by these parameters:

3001 *ErrPickUp1*	Speed pickup 1 at fault
3002 *ErrPickUp2*	Speed pickup 2 at fault

6.3.1 Failure monitoring

If on starting the engine one of the speed pickups is sensing some speed above the starting speed 255 *StartSpeed1* the other pickup must detect some speed not equal to zero within 0.5 seconds. Otherwise, this pickup will be assumed to be at fault. When commissioning the engine, care should be taken to preset 255 *StartSpeed1* in such a way that both speed pickups will be able supply a reliable signal for this speed. This monitoring mode requires implementation of two speed pickups

With the engine running, speed monitoring will commence as soon as the upper starting speed 256 *StartSpeed2* is exceeded. Both speed pickups are continuously monitored for failures. Failure of a speed pickup is reported if for a certain time period depending on the number of teeth and on the current speed there is no measuring pulse received from the pickup.

If only one speed pickup is connected (or only one pickup can be connected), an emergency engine shutdown will immediately be executed in case of its failure. With two pickups connected, speed sensing will continue by means of the healthy pickup. The following parameter provides information on the active pickup by which the control is currently operating:

2005 *PickUp2Or1Active* = 0	Pickup 1 is relevant
2005 *PickUp2Or1Active* = 1	Pickup 2 is relevant

If the second speed pickup fails too, the engine will be immediately shut down.

If pickup errors turn up after engine stop, the reason may be the backward rotation of the engine. In this case it is recommended to prolong the duration of engine stop request.

Should both speed pickups be faulty before the engine is started, the control unit will not be able to detect any fault. Neither will it be possible to start the engine since no speed is being measured. In order to make it possible for the service staff to recognize this problem, on the PRIAMOS and HELENOS type control units the speed pickup inputs are monitored by means of LEDs. The respective LEDs light up when the engine is still and go off when speed is recognized (↑*27.3.4 Error indication by LEDs)*

Note

A pickup error can be cleared only when the engine is still. If speed pickup 1 is at fault and the engine is operating by speed pickup 2, any attempt at clearing the error would result in a switch-back to pickup 1. Before it is again recognized to be at fault, it will take a short time during which speed cannot be controlled and may lead to undesirable speed and load variations.

6.3.2 Gradient monitoring

The speed signals can generally be monitored with regard to an admissible change rate (gradient). This will require information on free engine acceleration as depending on engine size, torque, etc. The parameters of the gradient monitoring should be very carefully adjusted to the engine used.

The currently valid change rate can be read from the parameter 2025 *SpeedGradient*. This value is determined by means of the currently active speed pickup, but only after the engine is running, i.e., above starting speed 256 *StartSpeed2*. To determine this value, unfiltered speeds are used (2003 *SpeedPickUp1Value* and 2004 *SpeedPickUp2Value* respectively).

Gradient monitoring is motivated as a possibility of detecting additional wrong pulses during speed sensing. This is why only increase of speed (acceleration) is being checked. There is no need for monitoring decrease of speed as this will be done by ↑ *6.3.1 Failure monitoring*.

It may happen, however, that the engine's gradient is by itself so large and unstable that no appropriate monitoring will be possible. So, before activating this function the gradient should be carefully observed and the admissible change rate set to a value in sufficient distance from the actual maximum change rate.

For gradient monitoring the following parameters are provided:

25 *SpeedGradientMax*	Admissible change rate
26 *SpeedGradientTime*	Time window for the number of admissible excesses
27 *SpeedGradientMaxCnt*	Number of admissible excesses
2025 *SpeedGradient*	Current change rate
4025 *SpeedGradientOn*	Activation of gradient monitoring

An error message will be generated only if within the time as set by 26 *SpeedGradientTime* more than 27 *SpeedGradientMaxCnt* excesses of 25 *SpeedGradientMax* have occurred. If there is an excess it is not the value measured together with the excess that is used for speed but the last valid measurement plus the speed resulting from the admissible gradient 25 *SpeedGradientMax*.

For error messages, the same parameters are used as for ↑*6.3.1 Failure monitoring*.

Number	Parameter	Value	Unit
3001	*ErrPickUp1*	*1*	
and/or:			
3002	*ErrPickUp2*	*1*	

6.3.3 Difference monitoring

When two speed pickups are connected, the difference between the speeds measured by the two devices may be monitored.

To do so, the variation of measured values from a maximum admissible value 14 *PickUpSpeedDiffMax* is monitored. It may be exceeded for no longer than the time indicated in 15 *PickUpSpeedDMaxTime*. After this time is exceeded, error 3001 *ErrPickUp1* or error 3002 *ErrPickUp2*, respectively, are output for the pickup showing the lower value, while operation is continued with the pickup showing the higher value.

Current speed difference is shown in 2014 *PickUpSpeedDiff*, this function is activated with 4014 *CheckPickUpDiffOn*.

Monitoring is carried out only if both pickups have exceeded start speed 256 *StartSpeed2* and no engine stop request is active.

6.4 Overspeed monitoring

Overspeed is set with parameter 21 *SpeedOver*. This value will be valid for speed pickup 1 as well as for speed pickup 2 even though their speed signals are monitored independently of each other.

Regardless of which speed pickup is currently active, exceeding overspeed will always prove a fatal error and cause an emergency engine shutdown. If this occurs the parameter 3004 *ErrOverSpeed* is set to 1. To restart the engine, it will be necessary to clear the error and to execute a ↑*3.10 Reset of control unit* or turn the supply voltage off.

Overspeed monitoring cannot be disabled. Control devices of the PRIAMOS type have a second independent overspeed monitoring system (↑*27.9 Watchdog processor CPU2 in PRIAMOS series*).

6.5 Speed switching points

All **HEINZMANN** control units except the ORION system offer the possibility of signalling via digital outputs that certain speeds have been attained.

For this purpose three (in PANDAROS only two) speed switching points are provided which can be parameterized:

90	*SpeedSwitch*	Speed switching point 1
91	*SpeedSwitch2*	Speed switching point 2
92	*SpeedSwitch3*	Speed switching point 3

If the respective speed is exceeded a signal is triggered.

2090	*SpeedSwitchActive*	1 = Switching point speed 1 is reached
2091	*SpeedSwitch2Active*	1 = Switching point speed 2 is reached
2092	*SpeedSwitch3Active*	1 = Switching point speed 3 is reached

The signal is deactivated if speed is lower than 90% of switching point speed.

These signals can be assigned to digital outputs (↑*20.8 Digital outputs*) and evaluated by an external control, e.g., the starter may be de-activated when cranking speed is reached or synchronization activated when generator frequency is reached. The digital control itself does not require these signals.

7 Speed setpoint determination

HEINZMANN control units may be configured for a wide variety of different applications. Any such configuration will make specific functions available for the respective application of the engine, but will also require that determination of the speed setpoints be conducted in a suitable manner. Presently, the following applications are provided:

Application	Mode	ARCHIMEDES PANDAROS	HELENOS PRIAMOS	ORION	Chapter
General	0	●	●	●	↑*7.1 General application*
Vehicle	1	●	●	●	↑*7.2 Vehicle operation*
Locomotive	2		●		↑*7.3 Locomotive operation*
Generator	3	●	●	●	↑*7.4 Generator operation*
Marine	4	●	●		↑*7.5 Marine operation*

Table 13: Applications

The application mode must to be entered in parameter 1810 *OperationMode*. If this parameter is not provided, the parameter 3810 *OperationMode* will display the permanently preset application mode of the firmware version actually used.

Once the application specific speed setpoint has been determined, it may additionally be delayed by a speed ramp (↑*7.7 Speed ramp*) and modified by droop (↑*7.8 Droop*). The following chapters will begin by explaining application-specific determination of speed setpoints and then deal with application-independent speed setpoint functions such as speed ramps, droop and temperature dependent raising of idle speed.

The PANDAROS system is available in a freely configurable variant and with fixed configurations for specific applications. The variants DC 6-01, DC 6-03, DC 6-04, DC 6-08, DC 6-11 and DC 6-14 are generator applications. The setpoint is determined according to ↑*7.4 Generator operation* (also ↑*14.5 PANDAROS variants*). The variants 6-02 and 6-05 are general applications, here the setpoint is determined as described in ↑*7.1 General application*. Variant 6-10 is for ↑*7.2 Vehicle operation*.

Note

Before reading the chapter dealing with setpoint determination for the particular application, it is recommended to work through the chapter on general application as this chapter describes the influences that can affect setpoint determination and may therefore be of importance for the various applications.

7.1 General application

For general application, the parameter 1810 *OperationMode* must be set to "0" resp. the parameter 3810 *OperationMode* must display "0".

Setpoints may be pre-defined by means of setpoint adjusters (potentiometers, foot throttle, current signal, etc., see ↑*17 Configuration* of sensors or ↑*18 Configuration of* switching functions for fixed speed values. Switching functions that have not been assigned an external switch will always enter into determination of speed setpoints with value "0" or "no" respectively.

The following switching functions are provided for general determination of speed setpoints:

Indication parameter	**Meaning**
2810 *SwitchEngineStop*	1 = Engine stop
2811 *SwitchIdleSpeed*	1 = Idle speed active
2812 *SwitchDroop2Or1* ORION: 2812 *SwitchDroopOn*	0 = Droop 1 active 1 = Droop 2 active 0: Droop inactive, 1 = droop active
2815 *SwitchSpeedFix1*	1 = Fixed speed 1 active
2827 *SwitchSetpoint2Or1* (not in PANDAROS)	0 = Setpoint 1 active (in PANDAROS always active) 1 = Setpoint 2 active

Table 14: Speed setpoint switching functions 1

The following switching functions and respective parameters are not provided in the systems PANDAROS and ORION, for which speed range 1 applies always.

Indication parameter	**Meaning**
2816 *SwitchSpeedFix2*	1 = Fixed speed 2 active
2814 *SwitchSpeedRange2Or1*	0 = Speed range 1 active 1 = Speed range 2 active

Table 15: Speed setpoint switching functions 2

Note

To facilitate commissioning, it is possible to directly pre-define a setpoint by means of a PC or handheld programmer without having to modify the inputs that have already been parameterized. This function is activated by the parameter 4020 SpeedSetpPCOn, and the setpoint is adjusted by means of the parameter 20 SpeedSetpPC. This function is non-latching, i.e., it will not store *that value. Following a ↑3.10 Reset of control unit, the original value will be active again.*

As the control may see several signals coming in at the same time, the signal sources have been assigned different priorities with respect to the determination of setpoints. For applications in general, the determination of the speed setpoint 2031 *SpeedSetp* is illustrated by the diagram below.

Strictly speaking, the function "Engine stop" (zero speed) does not represent a setpoint adjustment; it is, however, assigned higher priority than any of the other functions. The parameter 4810 *StopImpulseOrSwitch* permits to decide by way of configuration whether the stop command is to be in effect for the period the command is being applied via the switch or whether a pulse will suffice to activate the command until the engine comes to a standstill.

4810 *StopImpulseOrSwitch* = 0	engine stop is active only as long as the stop command is coming in
4810 *StopImpulseOrSwitch* = 1	engine stop is activated by a single switching pulse until the engine stops

The parameter 3802 *EngineStopRequest* serves to indicate that the engine is being stopped by some internal or external stop command. External engine stop is executed by means of the switch 2810 *EngineStop* while for an internal engine stop the shutdown command is issued by the control itself (e.g., in case of ↑*6.4 Overspeed monitoring*). The parameter 3803 *EngineStopped* is provided to indicate that the engine has stopped.

Setpoint adjustment by analogue adjusters (2900 *Setpoint1Extern* and 2901 *Setpoint2-Extern*) is possible only if there is no setpoint coming in from the PC and if none of the switches for fixed speed values has been actuated. Otherwise, the control will operate according to the speed setpoint selected from among 20 *SpeedSetpPC*, 10 *SpeedMin1/2*, 17 *SpeedFix1* or 18 *SpeedFix2* (in this order of priority – exception ↑*7.5.1 Setpoint adjuster with directional information*).

In other words, though setpoint adjustment by the PC has topmost priority but it is used only during commissioning. Therefore, it is the switching function for idle speed that has highest priority in normal operation. It is followed by the switching function for fixed speed 1 which, in its turn, is ranking before fixed speed 2 and the setpoint adjusters.

Note

In the systems PANDAROS and ORION the request for fixed speed 2 is always answered by a "No" and in PANDAROS the speed setpoint is always selected by "Speed setpoint 1" in the following diagram.

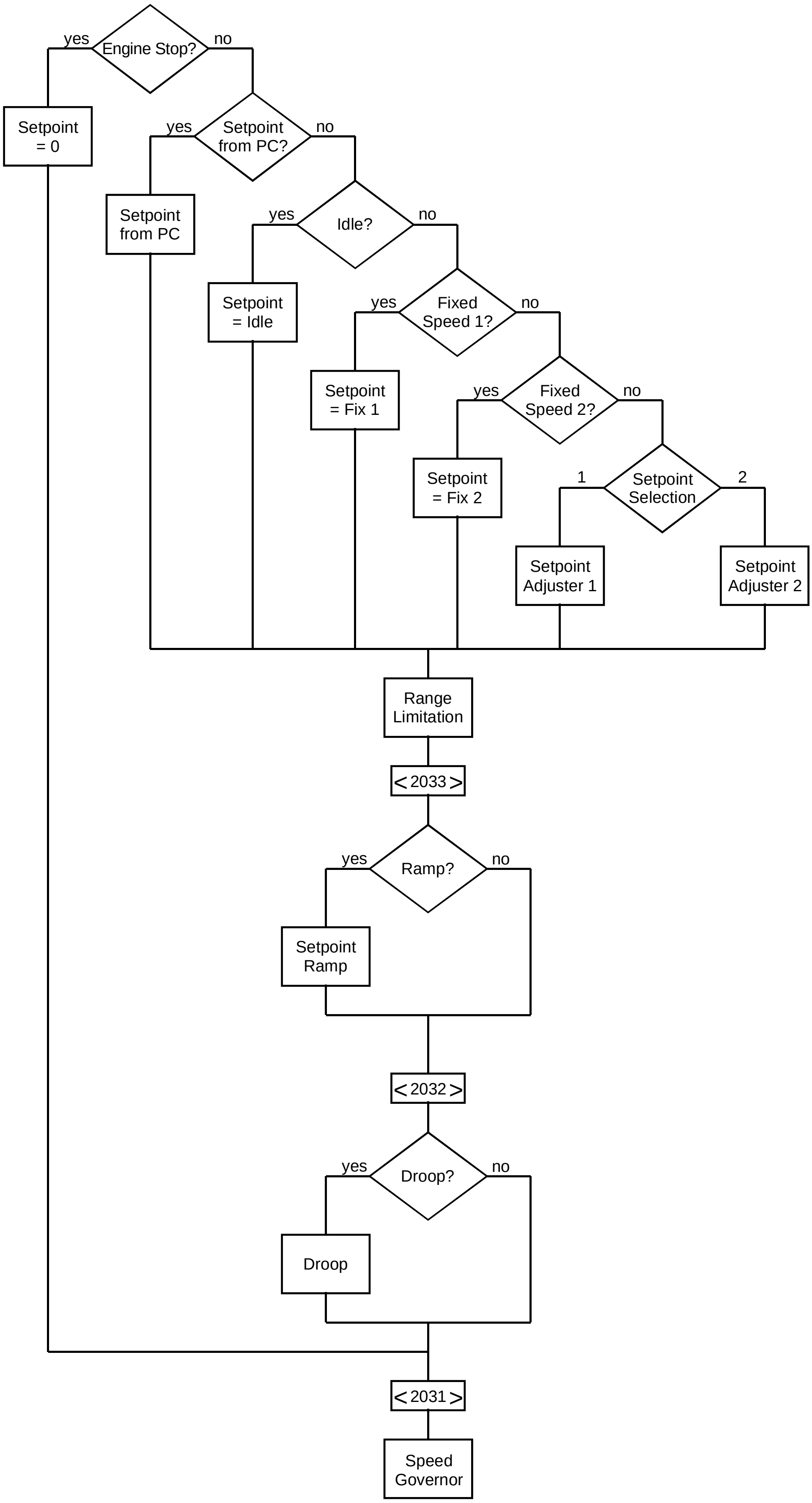


Fig. 8: Speed setpoint determination for general purposes

The setpoint 2033 *SpeedSetpSelect* thus determined can be delayed by activated ramp functions (↑*7.7 Speed ramp*) before droop is applied. The intermediary value attained after ramping can be read from the parameter 2032 *SpeedSetpRamp*. The final setpoint used by the speed governor after addition of droop is indicated in parameter 2031 *SpeedSetp*.

Note

Parameter 2031 SpeedSetp is equal to zero when the engine is at a standstill or is to be shut down. On starting the engine, control is first by idle speed. The actual setpoint will be active only when the engine has started off and is running (↑5 Starting fuel limitation).

As an adaptation to the engine's operating modes, two different speed ranges can be provided, e.g., one for driving and one for stationary operation – except for PANDAROS and ORION. For driving operation the speed range is normally defined with regard to the requirements of the prime mover, and for stationary operation with regard to those of the working machine.

These speed ranges are parameterized by means of the following parameters. These limit values apply to all speed setpoint adjustments except for droop.

10	*SpeedMin1*	Minimum Speed for range 1
12	*SpeedMax1*	Maximum Speed for range 1
11	*SpeedMin2*	minimum speed for range 2
13	*SpeedMax2*	maximum speed for range 2

Parameterizing Example:

Speed range is assumed to be from 700 rpm to 2,100 rpm for driving operation, and from 1,000 rpm to 1,800 rpm for stationary operation. Besides, there are fixed speeds to be provided for stationary operation at 1,200 rpm and at 1,500 rpm.

Number	Parameter	Value	Unit
10	*SpeedMin1*	*700*	*rpm*
11	*SpeedMin2*	*1000*	*rpm*
12	*SpeedMax1*	*2100*	*rpm*
13	*SpeedMax2*	*1800*	*rpm*
17	*SpeedFix1*	*1200*	*rpm*
18	*SpeedFix2*	*1500*	*rpm*

The speed range switch as defined by the selector switch function 2814 *SwitchSpeedRange2Or1* serves to select the speed range by which the control is supposed to operate.

2814 *SwitchSpeedRange2Or1* = 0	Control is operating by speed range 1
2814 *SwitchSpeedRange2Or1* = 1	Control is operating by speed range 2

If no selector switch is provided (PANDAROS and ORION or 814 *FunctSpeedRange2Or1* = 0 and 20814 *CommSpeedRange2Or1* = 0 or both parameters not available) the control will always operate using speed range 1.

When the speed range is changed while the engine is running it may happen that the old set value – and the current speed along with it – lies out of range of the new speed range. In such a case, the engine runs up to the new setpoint inside the new speed range using the speed ramp (↑*7.7 Speed ramp*), if the latter is active.

Note

Minimum and maximum speeds can be increased by ↑7.8 Droop.

For variable operating conditions, it is in general possible to make use of two different setpoint adjusters. The selector switch defined by the switching function 2827 *SwitchSetpoint2Or1* is provided to select by which setpoint adjuster the control is going to operate.

2827 *SwitchSetpoint2Or1* = 0	Control is operating by setpoint adjuster 1
2827 *SwitchSetpoint2Or1* = 1	Control is operating by setpoint adjuster 2

If no selector switch is provided (PANDAROS or 827 *FunctSetpoint2Or1* = 0 and 20827 *CommSetpoint2Or1* = 0 or both parameters not available) the control will always operate using setpoint adjuster 1.

The setpoint values of the setpoint adjusters are indicated by the parameters

2900 *Setpoint1Extern*	Setpoint adjuster 1
2901 *Setpoint2Extern*	Setpoint adjuster 2

7.1.1 Speed setpoint limitation

The speed setpoint may be limited via communication modules. The limit set can be viewed in 2035 *SpeedSetpLimit*. Whether the limit is currently active is indicated in 2730 *SetpLimitExtActive*.

7.2 Vehicle operation

For vehicle operation the value of the parameter 1810 *OperationMode* must have been set to "1" resp. the parameter 3810 *OperationMode* must display "1".

Vehicle operation provides the additional option of having the control unit configured as an ↑*12.1 Idle/maximum speed control*. In this operating mode, the determination of speed setpoints will define only idle and maximum speeds and possibly required intermediary speeds.

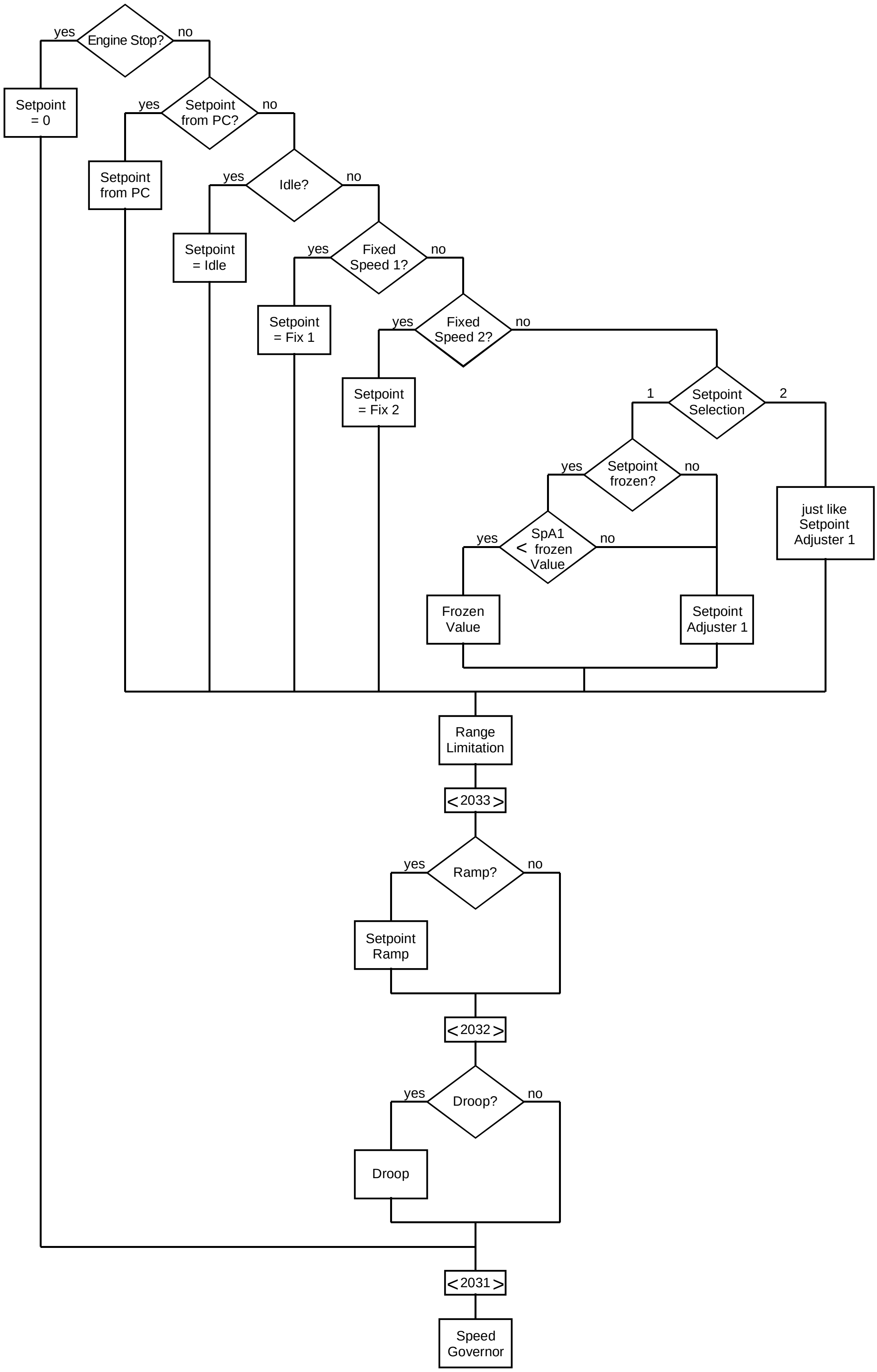


Fig. 9: Determination of speed setpoints for vehicle operation

7.2.1 Freezing the speed setpoint

For particular vehicle applications, it may be desirable to freeze the current speed setpoint via a switch and to continue operation using this setpoint (variable fixed speed – not featured in PANDAROS and ORION). To this purpose, the two switching functions

2829 *SwitchFreezeSetp1* = 1	Value of setpoint 1 has been frozen
2830 *SwitchFreezeSetp2* = 1	Value of setpoint 2 has been frozen

are used. The setpoint coming in when the function is activated will be frozen. As long as the function is active, the current setpoint will be compared with the stored setpoint. If the set value coming from the setpoint adjuster exceeds the frozen value, operation will continue using the current value of the setpoint adjuster; otherwise the frozen value is used. The frozen setpoint, however, will be abandoned only when the switch is opened.

The speed setpoint resulting from this method of speed setpoint determination can be read from the parameter 2033 *SpeedSetpSelect*.

7.2.2 Work machine application with up/down steps

In cranes and other industrial vehicles the same engine frequently changes over from driving to stationary working operation and back. While in driving operation the setpoint determination is achieved by means of the foot throttle, for working operation it might be required non to pre-determine the setpoint in analogue form but to change it with keys (speed higher/speed lower). This digital potentiometer always has additive effect, limited to setpoint adjuster 2 2901 *Setpoint2Extern*.

The use of the digital potentiometer makes sense only in the operational mode variable speed control. Using idle/maximum speed control for driving operation (speed adjuster 1) therefore at the same time operation is switched over to stationary work operation (speed adjuster 2) it must be switched to variable speed control: 2827 *SwitchSetpoint2Or1*= 1 and 2831 *SwitchIMOrAllSpeed* = 0. To this purpose, the same digital input with inverted sign may be used.

The states of the two switching functions of the digital potentiometer can be viewed by the parameters

2825 *SwitchSpeedInc* = 0	no increase of the speed setpoint
2825 *SwitchSpeedInc* = 1	increase of the speed setpoint
2826 *SwitchSpeedDec* = 0	no decrease of the speed setpoint
2826 *SwitchSpeedDec* = 1	decrease of the speed setpoint

There will be changes of the setpoint only if the two parameters read different values, i.e., if only one of the two functions is active. The ramping rate for the digital potentiometer is set by means of the parameter 1210 *DigitalPotSpeedRamp*. If the signals for changing the setpoint consist of pulses, these pulses must have a duration of at least 20 ms in order to be detected by the control circuit. The control electronics will respond to pulses for changing the setpoint only when the engine is running.

Setpoint changes will be possible until either maximum or minimum speed is attained. Furthermore, speed will be increased only if fuel quantity has not yet attained maximum limitation, and likewise decreased only, when fuel quantity has not yet attained minimum limitation. On switching back to setpoint adjuster 1 the value of the digital potentiometer is deleted. The offset from the digital potentiometer that is added to the current value of the setpoint adjuster 2 is indicated in 2041 *DigitalPotOffset*.

If it is desired to let the digital potentiometer start always with idle speed, the speed adjuster 2 does not have to be connected (901 *AssignIn_Setp2Ext* = 0). Wanting to start from another fixed speed, a fixed speed has to be defined with 17 *SpeedFix1* or 18 *SpeedFix2* respectively, that is activated together with the commutation to setpoint adjuster 2: 2827 *SwitchSetpoint2Or1* = 1 and 2815 *SwitchSpeedFix1* = 1 (resp.: 2816 *SwitchSpeedFix2* = 1). To this purpose, the same digital input may be used.

7.3 Locomotive operation

For locomotive operation the value of the parameter 1810 *OperationMode* must have been set to "2" resp. the parameter 3810 *OperationMode* must display "2".

Note

The control units ARCHIMEDES, PANDAROS and ORION are not suited for locomotive operation.

In locomotive operation, setpoint 1 can be determined either via digital speed notch switches, via setpoint adjuster 1 or via up/down keys serving as a digital potentiometer. Selection of setpoint adjuster 1 is made by software using the parameter

5350 *LocoSetpoint1Mode* = 0	Digital speed notch switches
5350 *LocoSetpoint1Mode* = 1	Setpoint adjuster
5350 *LocoSetpoint1Mode* = 2	Digital potentiometer.

It is also possible to switch over to setpoint 2 using the switch 2827 *SwitchSetp2Or1*. Setpoint 2, however, will always be an analogue setpoint adjuster.

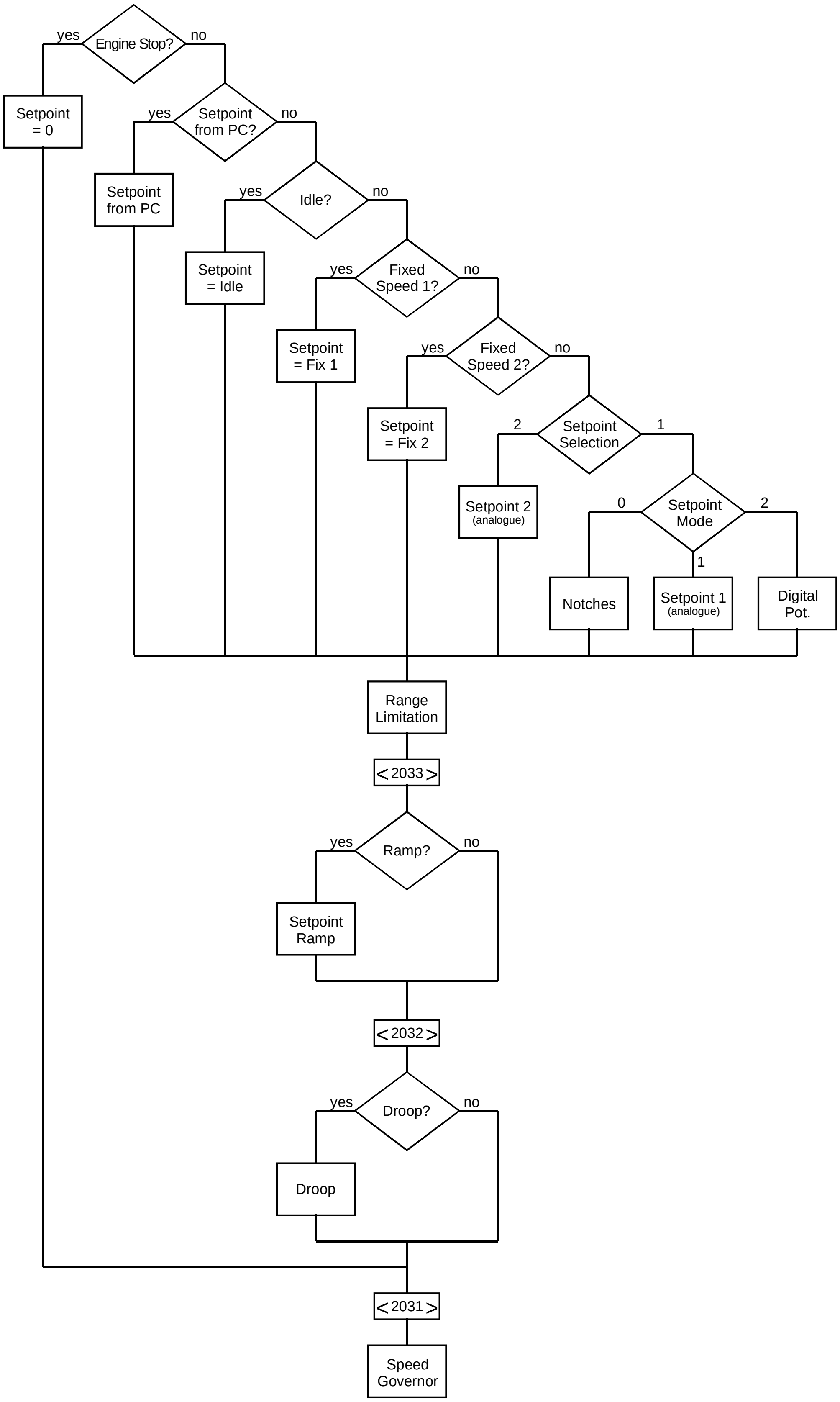


Fig. 10: Determination of speed setpoints for locomotive operation

7.3.1 Digital notch switches

For operation by speed notch switches the parameter 5350 *LocoSetpoint1Mode* must be set to 0. The chapter ↑ *13.1 Speed notch switches* contains a description of how to determine the actual speed notch 3350 *Notch* by means of the speed notch switches.

For each speed notch 0..15 the respective speed must be entered in the field parameters 6900 to 6915 *LocoSpeedLevel*(x). The speed notch corresponds to the field index.

<u>Parameterizing Example:</u>

Using setpoint 1, the speeds for a locomotive are to be set from 500 rpm to 1200 rpm by means of 8 notch switches.

Number	Parameter	Value	Unit
5350	*LocoSetpoint1Mode*	*0*	
6900	*LocoSpeedLevel(0)*	*500*	*rpm*
6901	*LocoSpeedLevel(1)*	*600*	*rpm*
6902	*LocoSpeedLevel(2)*	*700*	*rpm*
6903	*LocoSpeedLevel(3)*	*800*	*rpm*
6904	*LocoSpeedLevel(4)*	*900*	*rpm*
6905	*LocoSpeedLevel(5)*	*1000*	*rpm*
6906	*LocoSpeedLevel(6)*	*1100*	*rpm*
6907	*LocoSpeedLevel(7)*	*1200*	*rpm*

7.3.2 Digital potentiometer

Setpoint 1 can also be implemented as a digital potentiometer so that setpoint adjustment can be made by push-buttons (Speed Up/Speed Down). To do so, parameter 5350 *LocoSetpoint1Mode* must be set to the value "2". In contrast to generator operation, the digital potentiometer will not be additive in locomotive operation as it is in generator operation, i.e., it will be the only operative setpoint adjuster.

The states of the switching functions of the digital potentiometer can be viewed by the parameters

2825 *SwitchSpeedInc* = 0	no increase of the speed setpoint
2825 *SwitchSpeedInc* = 1	increase of the speed setpoint
2826 *SwitchSpeedDec* = 0	no decrease of the speed setpoint
2826 *SwitchSpeedDec* = 1	decrease of the speed setpoint

There will be changes of the setpoint only if the two parameters read different values, i.e., if only one of the two functions is active. The ramping rate for the digital potentiometer is set by means of the parameter 1210 *DigitalPotSpeedRamp*. If the signals for changing the setpoint consist of pulses, these pulses must have a duration of at least 20 ms in order to be detected by the control circuit. The control electronics will respond to pulses for changing the setpoint only when the engine is running.

Setpoint changes will be possible until either maximum or minimum speed is attained. Furthermore, speed will be increased only if fuel quantity has not yet attained maximum limitation, and likewise decreased only, when fuel quantity has not yet attained minimum limitation. With the engine standing, the accumulated offset will be cleared.

When there is a change-over to the digital potentiometer (de-activation of fixed speed or change-over from setpoint 2 to setpoint 1) the currently set speed is used as an initial value for adjustment by the digital potentiometer. This avoids unwanted setpoint skips.

Parameterizing Example:

Speed is to be adjusted using the digital potentiometer. Speed change is supposed to be 25 rpmps throughout.

Number	Parameter	Value	Unit
1210	*DigitalPotSpeedRamp*	*25*	*rpmps*
5350	*LocoSetpoint1Mode*	*2*	

7.4 Generator operation

For generator operation the value of the parameter 1810 *OperationMode* must have been set to "3" resp. the parameter 3810 *OperationMode* must display "3".

For parallel generator operation, various devices are required to perform synchronization and real load sharing in isolated parallel operation or real load control when paralleled to the mains (↑*14 Generator operation*). All of these devices will affect the speed setpoint. It is for this reason that a setpoint value for synchronization and a setpoint value for load control are added to the delayed setpoint value as determined from the pre-defined setpoint. This offset is indicated by 2042 *GenSetOffset*.

In most cases, generator operation will not require variable speed setting as the engine is run at rated speed only. Starting from this condition, synchronization and load control can then be conducted.

For configuring speed setting it is therefore recommended to assign rated speed to fixed speed 1 and to preset this switching function inverted with respect to engine stop.

Number	Parameter	Value	Unit
10	*SpeedMin1*	*700*	*rpm*
17	*SpeedFix1*	*1500*	*rpm*
810	*FunctEngineStop*	*1*	
815	*FunctSpeedFix1*	*-1*	

Due to the priorities of setpoint determination fixed speed 1 will always be active when there is no engine stop (↑*7.1 General application*).

During cranking the engine, however, speed will automatically set to minimum speed (↑*5 Starting fuel limitation*). If after engine start rated speed is to be run up to via a ↑*7.7 Speed ramp* it will suffice to parameterize and activate this ramp.

Number	Parameter	Value	Unit
230	*SpeedRampUp*	*50*	*rpmps*
231	*SpeedRampDown*	*50*	*rpmps*
4230	*SpeedRampOn*	*1*	

When the engine is supposed to run at idle speed for a certain time to warm up after start-up or to cool down before being stopped it will be necessary to use a specific switching function for changing over between idle speed and fixed speed besides the switching function for engine stop. The following example illustrates this change-over, but it is equally possible to use two separate inputs for the two switching functions. In this case, idle speed will have priority when both are simultaneously active.

Number	Parameter	Value	Unit
10	*SpeedMin1*	*700*	*rpm*
17	*SpeedFix1*	*1500*	*rpm*
810	*FunctEngineStop*	*1*	
811	*FunctIdleSpeed*	*-2*	
815	*FunctSpeedFix1*	*2*	

Even when the engine is running at rated speed only, the minimum and maximum speeds must have been set to reasonable values since by synchronization and load control a speed offset will be generated and added to rated speed.

As an orientation, minimum and maximum speeds should differ from rated speed by at least 5 % as in the following example:

Number	Parameter	Value	Unit
10	*SpeedMin1*	*1425*	*rpm*
12	*SpeedMax1*	*1575*	*rpm*
17	*SpeedFix1*	*1500*	*rpm*

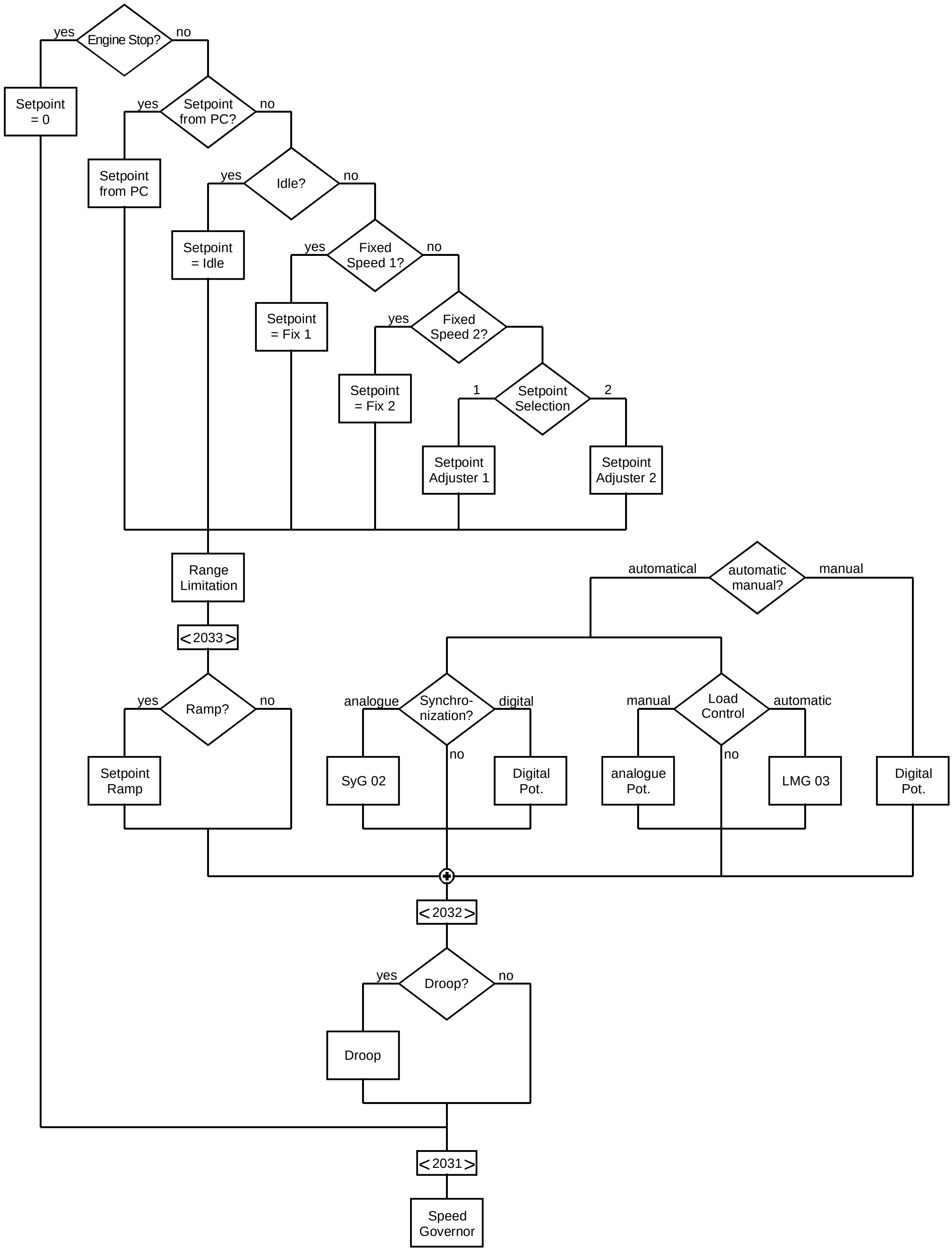


Fig. 11: Determination of speed setpoints for generator sets

7.5 Marine operation

For marine operation the value of the parameter 1810 *OperationMode* must have been set to "4" resp. the parameter 3810 OperationMode must display "4".

Note *The control device ORION is not suited for marine operation.*

The speed setpoint from the bridge (remote operation) is pre-determined with a 4..20 mA current signal. This signal is sent to an analogue input and assigned to setpoint 1 by parameter 900 *AssignIn_Setp1Ext*.

Two different variants are possible for setpoint adjuster 1. Either the 4...20 mA signal determines only the speed setpoint or, in addition, the signal transmits also a directional information.

In the first case, 4 mA correspond to 0% of the setpoint (idle speed) and 20 mA to 100% of the setpoint (maximum speed). In the second case, 4 to approx. 10 mA correspond to 100…0% in reverse direction and approx. 14 to 20 mA correspond to 0…100% of the setpoint in forward direction. The selection is carried out with

5253 *ShipSetp1LeverOrPot* = 0 setpoint without directional information

5253 *ShipSetp1LeverOrPot* = 1 setpoint with directional information

If the parameter does not exist the setpoint is to be understood always without directional information. Determination of the value of adjuster 1 with directional information is described in ↑*7.5.1 Setpoint adjuster with directional information*.

Adjustment by setpoint 2 is provided for manual or emergency operation to be conducted from the engine room (local operation).

The setpoint selector switch is defined by the switching function:

2827 *SwitchSetpoint2Or1* = 0 Setpoint 1 active

2827 *SwitchSetpoint2Or1* = 1 Setpoint 2 active

Setpoint 1 is always analogue and is indicated by the parameter 2900 *Setpoint1Extern*. Setpoint 2 can alternatively be configured as an analogue setpoint adjuster (indicated by parameter 2901 *Setpoint2Extern*) or as a digital potentiometer . The type of setpoint adjuster 2 is selected by means of the parameter

5250 *ShipSetp2DigiOrAna* = 0 Setpoint 2 = setpoint adjuster

5250 *ShipSetp2DigiOrAna* = 1 Setpoint 2 = digital potentiometer.

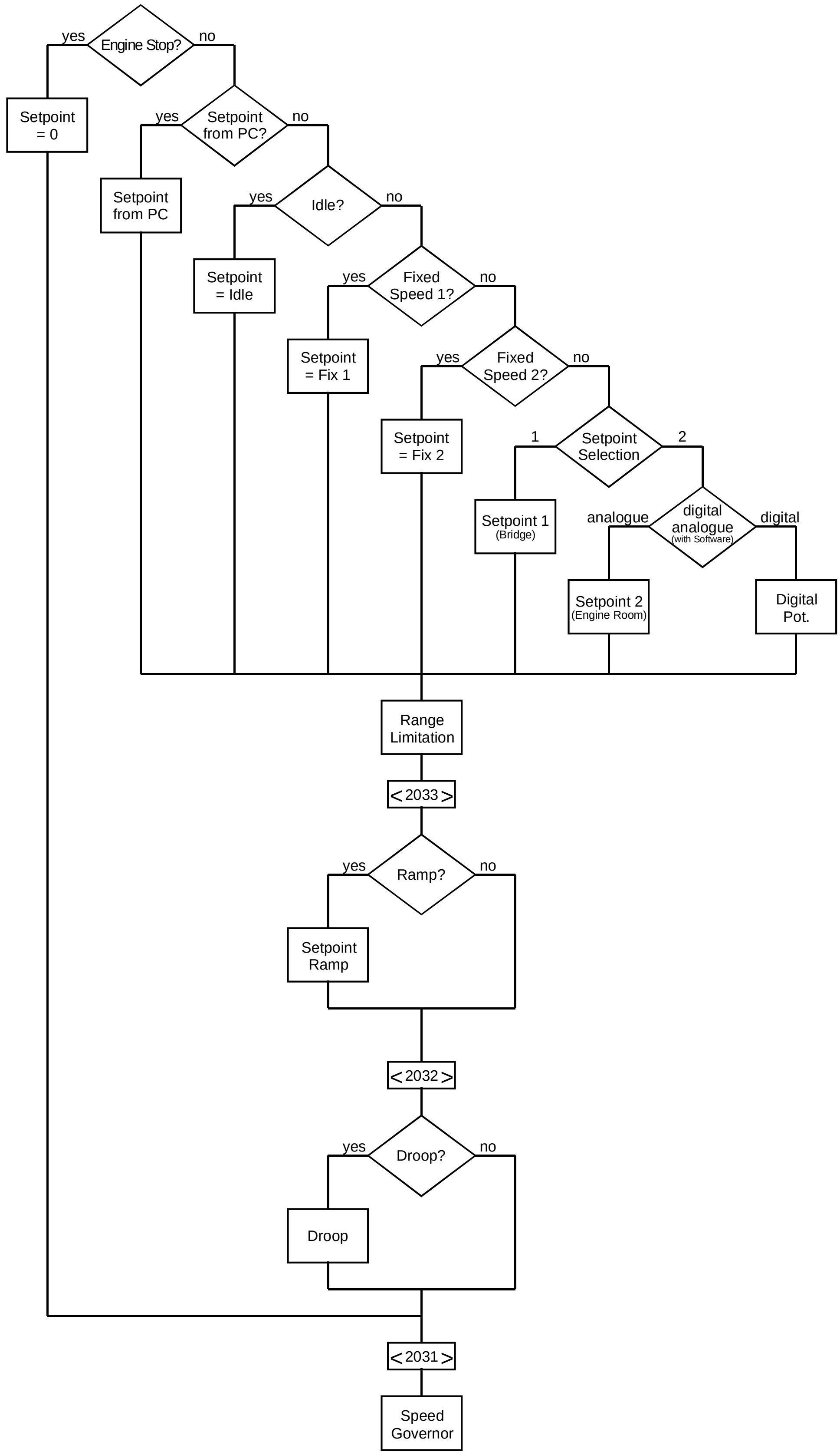


Fig. 12: Determination of setpoints for marine operation

If in marine operation there is a failure of speed adjustment by setpoint 1, normally the digital potentiometer is automatically activated to ensure that speed changes will still be possible for emergency operation.

This automatic switching does not happen when parameter 5252 *NoDigPotAtSetp1Err* is set. In this case, operation continues with the pre-defined setpoint without directional information (5253 *ShipSetp1LeverOrPot* does not exist or = 0) with the configured sensor error value (substitution or last valid value). In case of setpoint determination with directional information (5253 *ShipSetp1LeverOrPot* = 1), setpoint adjuster 1 is on principle substituted with 0%, i.e. idle speed. But it is also possible to continue operation with the last valid value. Direction and gear setting remain the same.

7.5.1 Setpoint adjuster with directional information

When 5253 *ShipSetp1LeverOrPot* = 1, setpoint adjuster 1 (remote setpoint) is controlled by a throttle lever with three lock-in positions. In the middle position 0 the engine is off shaft. Position I (forward from the middle position) inserts the forward gear. Position III (back from the middle position) inserts the reverse gear (↑ *Fig. 13: Setpoint determination with directional information*).

The range between positions I and III corresponds to 0% setpoint, i.e. idle speed. The end positions of the lever in both directions correspond to 100% of the setpoint (maximum speed). Returning from outside to inside to positions I or III respectively, the engine is disengaged.

7.5.1.1 Calibration of lever positions

As a first step, the two end positions of the lever must be entered in the reference parameters for the assigned analogue inputs 15x0 *AnalogInx_RefLow* and 15x1 *AnalogInx_RefHigh* (↑ *20.2.1 Calibration of current/voltage inputs*). Parameter 2900 *Setpoint1Extern* then indicates 0..100%, accordingly to the 4..20 mA input.

Next, the three lock-in positions must be adjusted by reading out 2900 *Setpoint1Extern* at the respective position and entering the values in the following parameters.

1250 *PositionIUpperRef*	forward position of the lever in lock-in position I (forward direction)
1251 *Position0UpperRef*	forward position of the lever in lock-in position 0 (forward direction)
1252 *PositionIIILowerRef*	back position of the lever in lock-in position III (reverse direction)

Since the mechanical position of the lever throttle in the lock-in position is not exactly replicable, in

1253 *PositionIRange*	range of the lever in lock-in position I

1254 *Position0Range* range of the lever in lock-in position 0

1255 *PositionIIIRange* range of the lever in lock-in position III

the range must be entered that the lever covers within a lock-in position. For positions 0 and I the range towards the back (reverse direction) must be indicated and for position III the range forward (forward direction) – seen from the reference position.

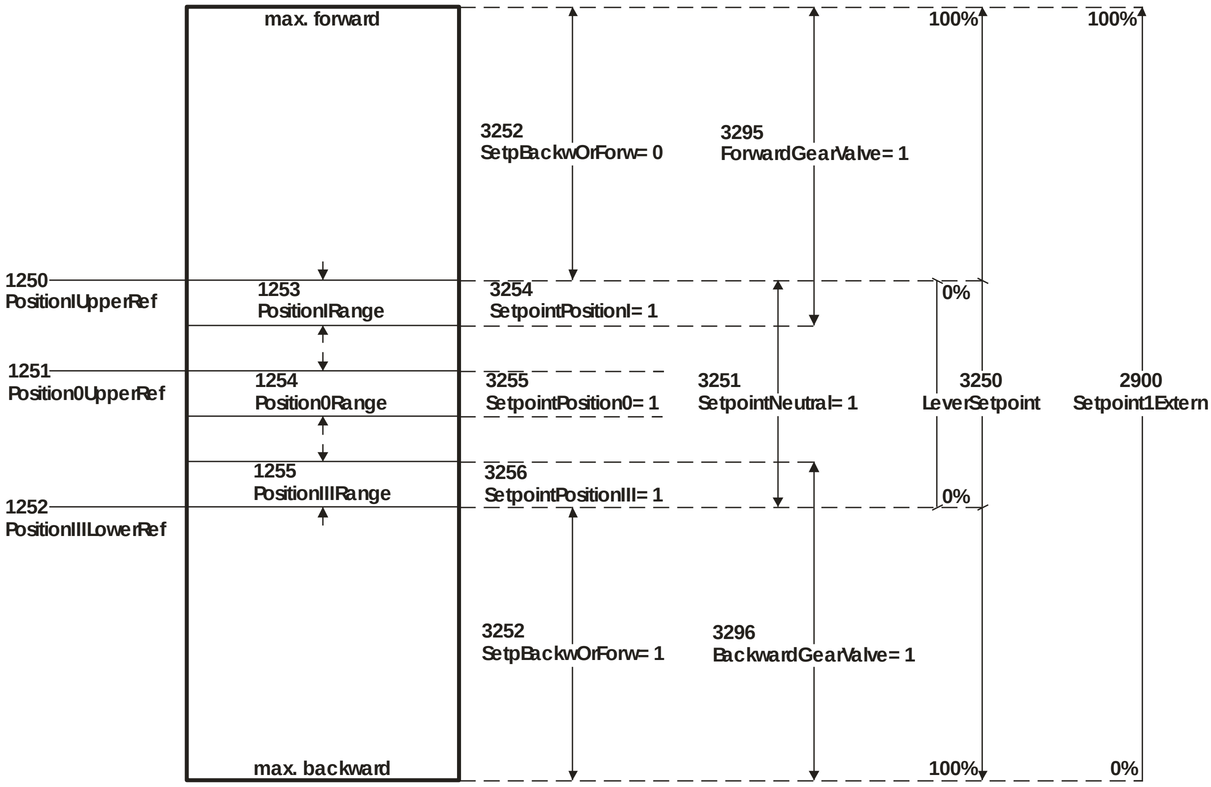


Fig. 13: Setpoint determination with directional information

The settings must be checked by repeatedly driving through all positions of the lever throttle. Parameters 3254 *SetpointPositionI*, 3255 *SetpointPosition0* and 3256 *SetpointPositionIII* indicate with “1” that the control unit has recognized the respective lock-in position.

The effective setpoint after extraction of the directional information from 2900 *Setpoint1Extern* is indicated in 3250 *LeverSetpoint*. This value then determines the speed setpoint 2033 *SpeedSetpSelect*.

7.5.1.2 Clutch

Parameter 3251 *SetpointNeutralPos* indicates the neutral position with "1", that is the lever position between the locking positions I and III. When the lever is outside this range, 3251 *SetpointNeutralPos* = 0 and 3252 *SetpBackwOrForw* indicates the current direction of movement:

3252 *SetpBackwOrForw* = 0 forward

3252 *SetpBackwOrForw* = 1 reverse

Parameters 3295 *ForwardGearValve* and 3296 *BackwardGearValve* are enabled when the lever is shifted from the neutral position to positions I or III (except with ↑ *7.5.1.3 Clutch disabling*). These two values are connected via digital outputs with the respective valve for clutch functionality (↑ *20.8 Digital outputs*).

When the lever is shifted from neutral position, setpoint transmission can be delayed by setting 1258 *PositionIDelay* or 1259 *PositionIIIDelay* resp. to a value greater than 0 s. When this function is used, it is recommended to enable the speed ramp, in order for the set speed to gently follow the movement of the lever after the end of the delayed interval.

The mechanical insertion of a gear can take long enough to break off speed. Parameters 1256 *PositionISpeedInc* and 1257 *PositionIIISpeedInc* are conceived expressly for the purpose of raising idle speed as soon as the gear is inserted. When the lever is brought back into neutral position, the increase is disabled and idle speed 10 *SpeedMin* as set in the parameter applies again.

Note

In multiple engine operation (↑ 15.2 Multiple engine set with directional information) the common setpoint adjuster also supplies the signal for engaging the clutch to the other engines. 3295 ForwardGearValve and 3296 BackwardGearValve are therefore not determined by the lever throttle if the lever is not the active setpoint adjuster .

7.5.1.3 Clutch disabling

To let the engine run to operating temperature at standstill the automatic clutch must be disabled. To this purpose, the switching function 2811 *SwitchIdleSpeed* is put into neutral position, i.e. the lever is between positions I and III or, put differently, 3251 *SetpointNeutralPos* = 1.

The lever throttle now can be moved in one of the two 100% directions without activating the clutch. The function “Clutch disabled” is terminated by switching off 2811 *SwitchIdleSpeed*.

Note

When setpoint is determined with directional information, the setpoint priority "10 SpeedMin1 before 17 SpeedFix1 before 18 SpeedFix2 before external setpoint adjuster" is suspended. Only the setpoint transmitter via PC and the engine stop switch have a higher priority than the setpoint adjuster with directional information. The indicated switching functions are therefore not handled as usual in this case.

Switching to setpoint adjuster 2 (remote operation → local operation) the clutch always disengages automatically. Switching from setpoint adjuster 2 to 1 (local operation → remote operation) the clutch remains disengaged until the lever throttle is shifted away from the neutral position, possibly requiring to shift it into that position first.

Note

In multiple engine operation (↑15.2 Multiple engine set with directional information) the common setpoint adjuster also supplies the signal for disengaging the clutch to the other engines.

When the engine stands still or in case of an incoming engine stop request – for whatever reason, i.e., also in case of fatal error – the clutch is equally disengaged automatically.

Note

In case of multiple engine operation (↑15.2 Multiple engine set with directional information), the engine receiving the engine stop command is taken out of the common setpoint determination. If this refers to the currently active setpoint adjuster, the common setpoint determination is automatically suspended and each of the two or four setpoint adjusters becomes active separately again.

3253 *GearShiftingOff* = 1 indicates every situation in which the clutch is disabled. This parameter can be connected to a visual indicator.

7.5.2 Digital potentiometer

If setpoint 2 has been configured as a digital potentiometer setpoint adjustment is made by push-buttons (Speed Up/Speed Down). In contrast to generator operation, the digital potentiometer will not be additive in marine operation, i.e., it will operate as the sole setpoint adjuster. If, e.g., the switch for fixed speed 1 is set, this speed will be directly run up to without any offset, and the digital potentiometer will be inactive.

The digital potentiometer is defined by the two switching functions 2825 *SwitchSpeedInc* and 2826 *SwitchSpeedDec*:

2825 *SwitchSpeedInc* = 0	no increase of speed setpoint
2825 *SwitchSpeedInc* = 1	increase of speed setpoint

2826 *SwitchSpeedDec* = 0	no decrease of the speed setpoint
2826 *SwitchSpeedDec* = 1	decrease of the speed setpoint

There will be changes of the setpoint only if the two parameters read different values, i.e., if only one of the two functions is active. The ramping rate for the digital potentiometer is set by means of the parameter 1210 *DigitalPotSpeedRamp*. If the signals for changing the setpoint consist of pulses, these pulses must have a duration of at least 20 ms in order to be detected by the control circuit. The control electronics will respond to pulses for changing the setpoint only when the engine is running.

Setpoint changes will be possible until either maximum or minimum speed is attained. Furthermore, speed will be increased only if fuel quantity has not yet attained maximum limitation, and likewise decreased only, when fuel quantity has not yet attained minimum limitation. The current offset value of the digital pot can be viewed by the parameter 2041 *DigitalPotOffset*. With the engine standing, the accumulated offset will be cleared.

When there is a change-over to the digital potentiometer (de-activation of fixed speed or change-over from setpoint 1 to setpoint 2) the currently set speed is used as an initial value for the adjustment by the digital potentiometer.

7.6 Temperature dependent idle speed

When the engine is cold idle speed can be increased in dependence of temperature. Engine temperature ↑2907 *CoolantTemp* is sensed by a temperature sensor. If engine temperature falls below 62 *SpeedMinTempHigh*, idle speed is increased linearly until, with the engine at temperature 61 *SpeedMinTempLow*, it reaches the value 60 *SpeedMinAtTempLow*.

Note

This function is not available in control units of the ORION type.

Temperature dependent raising of idle speed will also be in effect during engine start as long as idle speed is pre-defined as speed setpoint. This does not depend on the selected start type.

Temperature dependent idle speed is activated by the parameter 4060 *SpeedMinTempOn* = 1.

Parameterizing Example:

Number	Parameter	Value	Unit
10	*SpeedMin1*	*700*	*rpm*
60	*SpeedMinAtTempLow*	*950*	*rpm*
61	*SpeedMinTempLow*	*-20*	*°C*
62	*SpeedMinTempHigh*	*10*	*°C*

Activation:

4060	*SpeedMinTempOn*	*1*

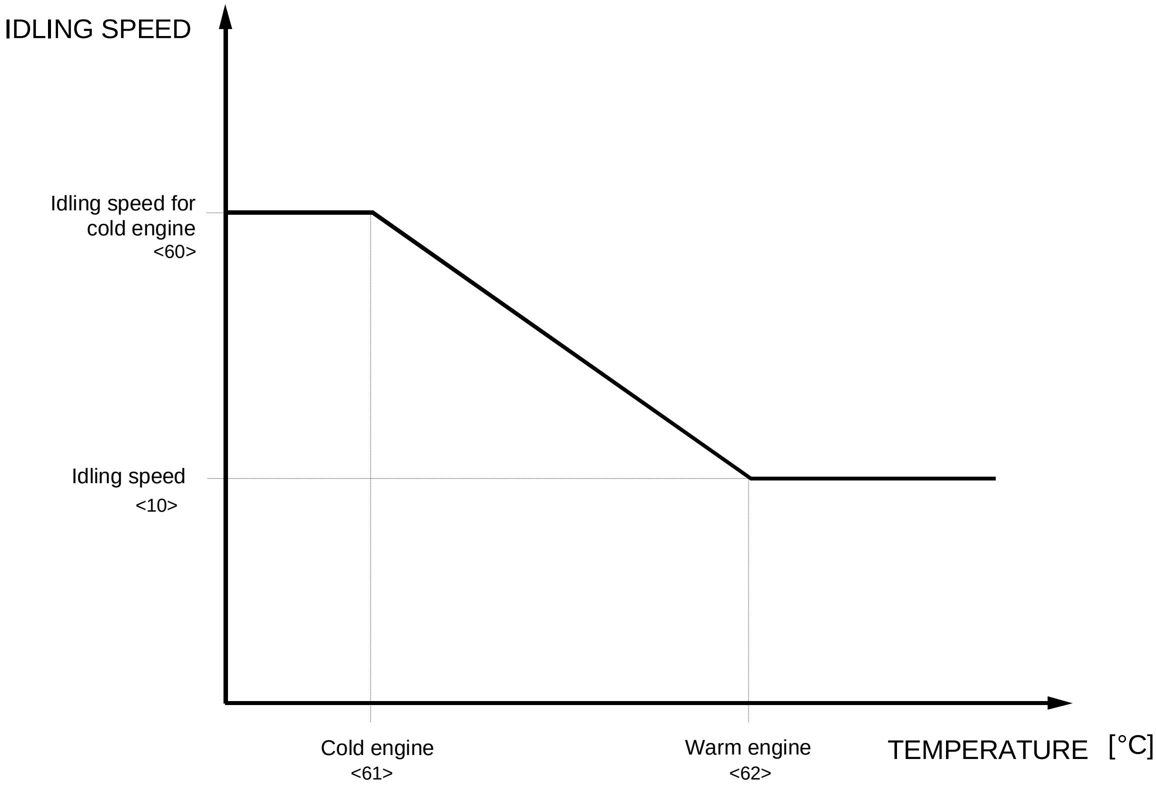


Fig. 14: Temperature dependent idle speed

7.7 Speed ramp

For prime movers of ships, locomotives and certain types of vehicles, it will be frequently desirable to have the speed not change abruptly when the set value is altered, but to make it attain the new setpoint smoothly.

To achieve this, the control provides ramps to retard acceleration. The delay rate of increasing or decreasing the set value can be adjusted separately in either direction. Furthermore, it is possible to decide on the type of speed ramp by means of the parameter

4232 *SectionalOrFixedRamp* = 0	fixed speed ramp
4232 *SectionalOrFixedRamp* = 1	sectional speed ramp.

The ramp functions are activated by the parameter 4230 *SpeedRampOn*.

7.7.1 Fixed speed ramp

With the fixed speed ramp, the rate by which the setpoint is delayed will be the same for the entire speed range. The ramp rates for ramping upward and downward can be separately set by means of the parameters

230 *SpeedRampUp*	ramping rate for upward ramp
231 *SpeedRampDown*	ramping rate for downward ramp.

The unit of these parameters is again given by speed increase or speed decrease per second. Both ramps are enabled through the parameter 4230 *SpeedRampOn*. For the fixed speed ramp, the parameter 4232 SectionalOrFixedRamp must in addition have been set to "0". If ramping is desired in one direction only, the maximum value (4000 rpmps) is to be entered for the other direction.

The speed setpoint as delayed by the ramp can be viewed by the parameter 2032 *SpeedSetpRamp*. The parameter 2033 *SpeedSetpSelect* represents the speed setpoint that the ramp is supposed to ramp to.

Parameterizing Example:

It is wished to have a speed increase from 1000 rpm to 1,500 rpm within 20 seconds. This is equivalent to increasing speed by 500 rpm within 20 seconds or by 25 rpm per second. Deceleration is to work without a ramp.

Number	Parameter	Value	Unit
230	*SpeedRampUp*	*25*	*rpmps*
231	*SpeedRampDown*	*4000*	*rpmps*

Activation:

4230	*SpeedRampOn*	*1*
4232	*SectionalOrFixedRamp*	*0*

7.7.2 Sectional speed ramp

For certain applications, such as asynchronous generators or ship manoeuvring operation, it is desirable that the ramping rate be not the same over the entire speed range. To achieve this, the control offers the option to split the full speed range up into 3 sections and to set different ramping rates for each respective section. This also implies that the ramping rate will depend on the current setpoint value 2031 *SpeedSetp*.

The switch points where the ramping rate is to change are determined by these parameters

236 *SpeedSwitchToRamp2*	rate change from section 1 to section 2
237 *SpeedSwitchToRamp3*	rate change from section 2 to section 3

The various ramping rates by which the setpoint is to be delayed within the respective sections are set by means of the following parameters:

230 *SpeedRampUp*	ramp rate for ramping up in section 1
231 *SpeedRampDown*	ramp rate for ramping down in section 1
232 *SpeedRampUp2*	ramp rate for ramping up in section 2
233 *SpeedRampDown2*	ramp rate for ramping down in section 2
234 *SpeedRampUp3*	ramp rate for ramping up in section 3
235 *SpeedRampDown3*	ramp rate for ramping down in section 3

The unit of these parameters is again given by speed increase or -speed decrease per second. The ramps are enabled via the parameter 4230 *SpeedRampOn*, selection of the sectional speed ramp is made by setting 4232 *SectionalOrFixedRamp* = 1.

When only two ramp sections are to be used then the switching point 2, i.e. parameter 237 *SpeedSwitchToRamp3* must be set to maximum speed value.

The speed setpoint as delayed by the ramp can be viewed by the parameter 2032 *SpeedSetpRamp*. The parameter 2033 *SpeedSetpSelect* represents the speed setpoint that the ramp is supposed to ramp to.

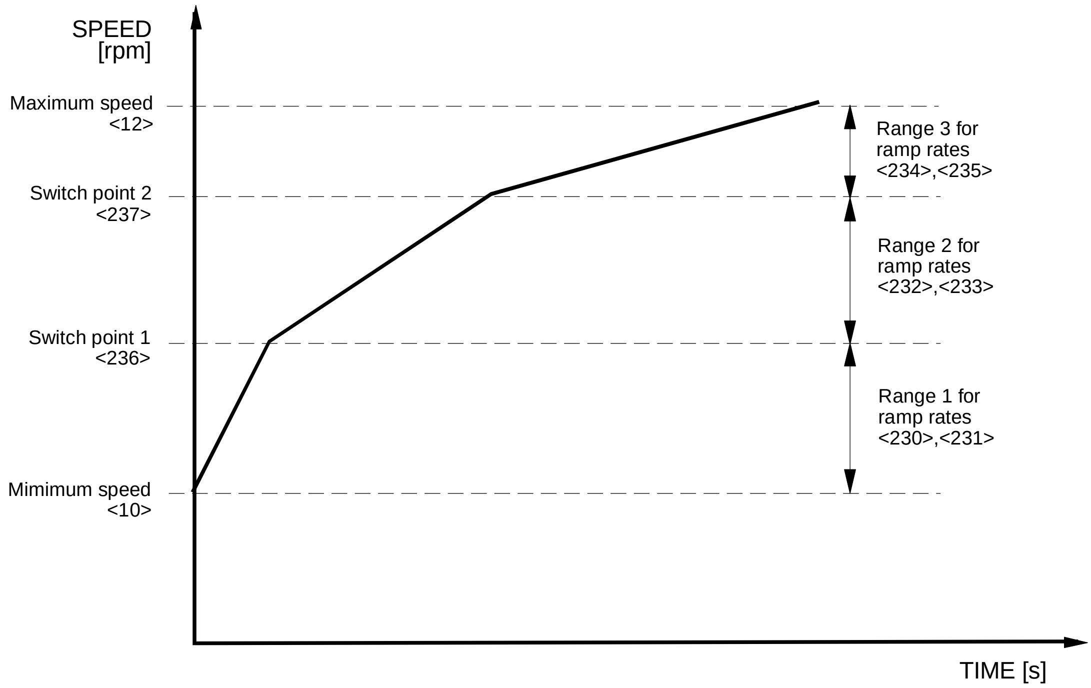


Fig. 15: Speed profile of sectional speed ramp

Parameterizing Example:

The upward ramping rate between minimum speed and 800 rpm is supposed to be 100 rpmps, and speed reduction to be performed as fast as possible. The upward ramping rate between 800 rpm and 1200 rpm is to be 50 rpmps, the downward ramping rate 40 rpmps. Between 1200 rpm and maximum speed both the upward and downward rates shall be 20 rpmps.

Number	Parameter	Value	Unit
230	*SpeedRampUp*	*100*	*rpmps*
231	*SpeedRampDown*	*4000*	*rpmps*
232	*SpeedRampUp2*	*50*	*rpmps*
233	*SpeedRampDown2*	*40*	*rpmps*
234	*SpeedRampUp3*	*20*	*rpmps*
235	*SpeedRampDown3*	*20*	*rpmps*
236	*SpeedSwitchToRamp2*	*800*	*rpm*
237	*SpeedSwitchToRamp3*	*1200*	*rpm*

Activation:

4230	*SpeedRampOn*	*1*
4232	*SectionalOrFixedRamp*	*1*

7.8 Droop

Droop (also called proportional band) of an engine is defined as the permanent speed drop when the engine takes on load. It is desirable that droop and, hence, speed drop be equal to zero (isochronous operation). For certain applications, however, droop will be required, e.g. for

- Vehicle operation
- Isolated and mains parallel operation of generator sets, when no accessory units by **HEINZMANN** are being used
- special load sharing modes, e.g., parallel operation with mechanical governors.

The settings explained in the following section refer to variable speed operation. For vehicle operation by ↑ *12.1 Idle/maximum speed control*, droop can independently be adjusted for idle and maximum speed control.

In isochronous operation without droop, any fuel quantity may be set with a pre-defined fixed speed setpoint. When using droop, however, there is a close interrelation between speed and fuel quantity. In this case, the pre-defined speed setpoint corresponds to that for full load. Depending on current load, droop is used to calculate an offset which after being added to the given speed setpoint will yield the actual speed setpoint for the control unit.

Activation of droop is achieved by setting the parameter 4120 *DroopOn* = 1.

Note

Droop is automatically disabled in generator operation when load control by an external device is enabled with 5230 LoadControlOrPot = 1 and 2835 SwitchLoadEnable is either not wired or = 1.

To accommodate droop to the current operating state of the controlled engine, the possibility of choosing between two droops has been provided. A switching function 2812 *SwitchDroop2Or1* is provided to select the droop by which the control is supposed to operate. The respective selection is indicated by:

2812 *SwitchDroop2Or1* = 0	Control is operating by droop 1 (120 *Droop1*)
2812 *SwitchDroop2Or1* = 1	Control is operating by droop 2 (125 *Droop2*)

If measured power is available in 2918 *MeasuredPower* and 4121 *DroopLoadOrFuel* is active, droop is calculated on load-basis. 1232 *RatedPower* shows the value for 100 % load in the range of 2918 *MeasuredPower*.

If measured power is not available or the sensor is down, droop is calculated on the basis of the actuator reference values for zero load and full load – these should therefore always be parameterized even if they are not used during normal operation.

The reference point for the droop is determined by parameter 4122 *Droop@ZeroOrFullLoad*. The full load point if used whenever the parameter is 0 but the zero load point becomes active when the parameter is 1.

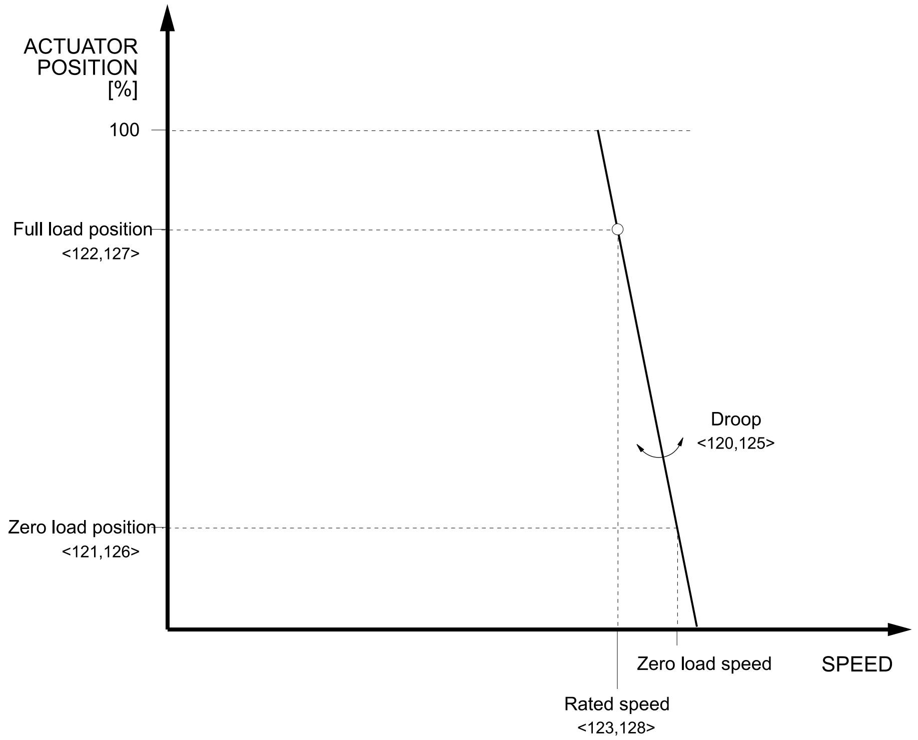


Fig. 16: Droop with full load reference

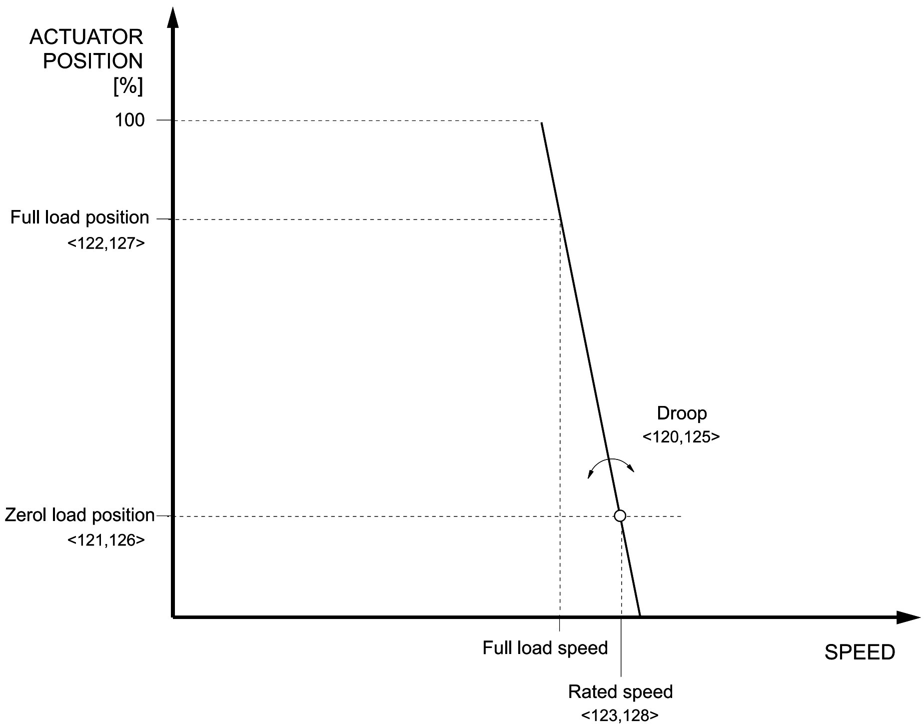


Fig. 17: Droop with zero load reference

The following section only explains the adjustment of droop 1, since the adjustment of droop 2 is identical. Frequently only one switch position of 2812 *SwitchDroop2Or1* is used with droop, and the other is assigned a value of 0%.

The following relation holds:

$$X_P = \frac{n_0 - n_V}{n_V} \cdot 100\,\%$$

Example:

Full-load speed: 1500 rpm

Zero-load speed: 1560 rpm

$$P - Bereich = \frac{1560 - 1500}{1500} * 100\% = 4\%$$

Any adjustment of droop refers to the reference speed as set by 123 *Droop1SpeedRef* (or 128 *Droop2SpeedRef* for droop 2). Thus, e.g., for a reference speed of 123 *Droop1SpeedRef* = 1500 rpm, a droop of 120 *Droop1* = 4 % will yield a speed change of 60 rpm.

This speed change, however, will apply only to the working range between full-load and zero-load. As reference values the measurements of 2918 *MeasuredPower* with 1232 *RatedPower* for full-load and 0 % (resp. 0 kW) for zero-load are used. If no load measurement data are available, the reference points of fuel quantities 122 *Droop1RefHigh* and 121 *Droop1RefLow* are used. For correct adjustment therefore the full-load fuel quantity 122 *Droop1RefHigh* and the zero-load fuel quantity 121 *Droop1RefLow* (resp. 127 *Droop2RefHigh* and 126 *Droop2RefLow* for droop 2) at reference speed must be known.

The droop offset will be the same over the entire speed range. Using the values of the above example, the offset for idle speed 700 rpm will also be 60 rpm between zero load and full load. The relative droop, however, as relating to the current speed setpoint will change within the speed range. In the example, it will be 8.6 % at 700 rpm, 4 % at reference speed 1500 rpm and, accordingly, 2.9% at maximum speed 2100 rpm, each time calculated from the fixed offset of 60 rpm.

The current relative droop as relating to the current speed setpoint is indicated by the parameter 2120 *DroopPresent*. The speed offset as calculated from droop can be viewed by the parameter 2040 *DroopOffset*. This offset is added to the speed setpoint value after the ramp 2032 *SpeedSetpRamp* thus yielding the speed setpoint 2031 *SpeedSetp* for the control unit.

Parameterizing Example:

Number	Parameter	Value	Unit
10	*SpeedMin1*	*700*	*rpm*
12	*SpeedMax1*	*2100*	*rpm*

120	*Droop1*	4	%
121	*Droop1RefLow*	20	%
122	*Droop1RefHigh*	80	%
123	*Droop1SpeedRef*	1500	rpm

Indication at minimum speed and zero-load quantity:

2031	*SpeedSetp*	760	rpm	
2032	*SpeedSetpRamp*	700	rpm	(independent of quantity)
2033	*SpeedSetpSelect*	700	rpm	(independent of quantity)
2040	*DroopOffset*	60	rpm	
2120	*DroopPresent*	2.9	%	
2812	*SwitchDroop2Or1*	0		

Activation:

4120	*DroopOn*	1

Parameterizing Example 2:

Number	Parameter	Value	Unit
10	*SpeedMin1*	700	rpm
12	*SpeedMax1*	2100	rpm
120	*Droop1*	4	%
121	*Droop1RefLow*	20	%
122	*Droop1RefHigh*	80	%
123	*Droop1SpeedRef*	1500	rpm
4122	*Droop@ZeroOrFullLoad*	1	

Indication at minimum speed and zero-load quantity:

2031	*SpeedSetp*	700	rpm	
2032	*SpeedSetpRamp*	700	rpm	(independent of quantity)
2033	*SpeedSetpSelect*	700	rpm	(independent of quantity)
2040	*DroopOffset*	0	rpm	
2120	*DroopPresent*	0.0	%	
2812	*SwitchDroop2Or1*	0		

Activation:

4120	*DroopOn*	1

Note

Since droop offset is added to speed setpoint value, when droop is used the value range of minimum and maximum speed relates only to the full-load reference points. Below this quantity, or below 100% load respectively, droop increases minimum and maximum speed.

8 Optimizing control circuit stability

Once the engine is running, the first step should always be to optimize control circuit stability. With diesel engines operating permanently at constant speeds (e.g., generator operation), a basic adjustment of the PID parameters will do. For other applications, it may prove necessary to correct the PID parameters in dependence of speed or injection quantity. This may particularly be required for engines with large ranges of speed variation. The following chapters cover the adjustment of the PID parameters as well as the speed and fuel dependent correction of the PID values.

8.1 Adjustment of PID parameters

Adjustment of the PID parameters will always be the first step to be taken. The values defined at this stage will serve as a basis for all subsequent corrections. During adjustment, any other functions affecting control circuit stability must be de-activated.

When optimizing the PID parameters, the initial values are to be set as follows:

Number	Parameter	Value	Unit
100	*Gain*	*15*	*%*
101	*Stability*	*10*	*%*
102	*Derivative*	*0*	*%*

NOTICE	**Before starting the engine ensure separate overspeed protection independent of the rpm controller!**

With these values set, the engine is started and run up to the working point for which the adjustment is to be made. As a rule, this working point will be at rated speed and off-load. For optimization of the PID parameters, proceed by the following steps:

- Increase the P-factor 100 Gain until the engine tends to become unstable. Then, decrease the P-factor again until the speed oscillations disappear or are reduced to a moderate level.
- Increase the I-factor 101 Stability until the engine passes over to long-waved speed oscillations.
- Increase the D-factor 102 Derivative until the speed oscillations disappear. If the oscillations cannot be eliminated by the D-factor, the I-factor will have to be reduced.

With these values set, disturb engine speed for a short moment (e.g., by shortly operating the engine stop switch) and observe the transient response. Continue to modify the PID parameters until the transient response is satisfactory.

The fuel setpoint value as determined by the control circuit is indicated by the parameter 2110 *FuelSetpSpeedGov*. This value is limited by ↑ *9 Limiting Functions* and will then yield the fuel setpoint 2350 *FuelQuantity*.

8.2 PID map

As speed goes up, the engine's kinetic energy is equally bound to increase. With regard to the governor, this implies that its characteristic dynamics values (PID) may also have to be increased. When the engine takes on load, the remaining free engine acceleration is reduced which in turn may admit of another increase of the dynamic parameters.

Normally, the PID parameters are set at rated speed and off-load. As a consequence, it may be desirable to reduce the PID values for minimum speed and to increase the PID values for load. The PID parameters as set for rated speed and off-load (↑*8.1 Adjustment of PID parameters*) will serve as a basis for correction. Setting the correction value to 100 % will leave the PID parameters unaltered. Starting from this value, correction can be made in upward direction (maximum 400 %, which will be equivalent to increasing the PID parameters four times) as well as in downward direction (though 0 % is the minimum possible value, values below 10 % should never be entered).

Note

Although it is called PID map the correction will change only gain and stability (P and I) parameters.

The values for the stability map are stored under the following parameter numbers:

6100 to 6109 *PIDMap:n*(x) :	Speed values for stability map
6150 to 6159 *PIDMap:f*(y) :	Fuel quantity values for stability map
6200 to 6299 *PIDMap:Corr*(z) :	Correction values for stability map.

Note

If the control unit in generator sets contains an integrated power governor in addition to the speed governor, the map parameters for the speed control circuit will be called PIDMapSpGov instead of PIDMap. The parameter numbers remain the same.

Because of the pressure governor, in gas engines it is not advisable to relate the PID map to fuel quantities. In generator applications, if a measured power value can be made available in 2918 *MeasuredPower* it is advisable to use the speed- and load-dependent PID map

6100 through 6109 *PIDMap:n*(x) :	Speed values for stability map
6350 through 6359 *PIDMap:P*(y) :	Load values for stability map
6200 through 6299 *PIDMap:Corr*(x) :	Correction values for stability map.

In case of general activation of the map with 4100 *PIDMapOn* = 1, the map type is selected by

4101 *PIDMapPowOrFuel* = 0	dependent on speed and fuel quantity
4101 *PIDMapPowOrFuel* = 1	dependent on speed and load.

10 base points each are available for correction implying a maximum number of 100 correction values. A base point consists of a speed value and a fuel quantity/load value and

of the respective correction value. For adjacent correction values the intermediary values are interpolated by the control. If PID correction is performed in dependence of either speed or fuel quantity/load alone, any unused values must be set to zero (↑ *3.8 Parameterization of maps*).

If the current working point of the engine lies outside the map as specified by the mapping parameters, the control will calculate the value which is located on the border of the map and take this as the associated correction value.

The actual correction value which is being used to correct the PID parameters with regard to the current working point can be viewed by the parameter 2100 *PID_CorrFactor*. With this correction value the parameters 100 *Gain* for the P-factor and 101 *Stability* for I-factor can be changed in per cent values and fed to the control circuit. The stability map is activated by means of the parameter 4100 *PIDMapOn*.

In the examples below, correction of PID parameters will be explained using two correction values for each case and correspondingly four values for the characteristic map

Note

The ***HEINZMANN*** *PC programme ↑3.3 DcDesk 2000 provides an easy and comfortable way of adjusting the map as it allows to have the map displayed three-dimensionally and to view the adjustment values listed in tables.*

8.2.1 Speed dependent correction of PID parameters

The PID values are entered for maximum speed, and on setting the engine into operation off-load they are adjusted accordingly. For minimum speed, a downward correction is entered and suitably adjusted on the engine.

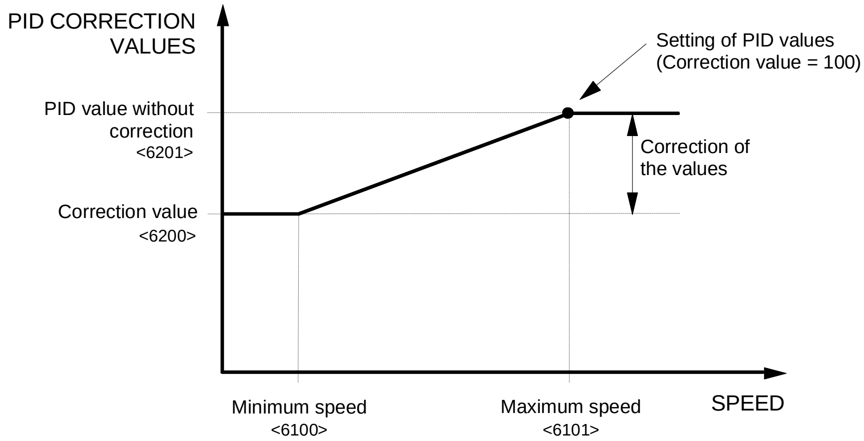


Fig. 18: Speed dependent correction

Parameterizing Example:

Number	Parameter	Value	Unit
6100	*PIDMap:n(0)*	*700*	*rpm*
6101	*PIDMap:n(1)*	*2100*	*rpm*
6102	*PIDMap:n(2)*	*0*	*rpm*
:	*:*	*:*	
6109	*PIDMap:n(9)*	*0*	*rpm*
6150	*PIDMap:f(0)*	*0*	*%*
:	*:*	*:*	
6159	*PIDMap:f(9)*	*0*	*%*
6200	*PIDMap:Corr(0)*	*60*	*%*
6201	*PIDMap:Corr(1)*	*100*	*%*

Activation:

4100	*PIDMapOn*	*1*	

8.2.2 Load dependent correction of PID parameters

8.2.2.1 Diesel engine

Input of the values and adjustment with the engine running is done off-load. For full-load, an upward correction is provided. Normally, setting the actuator position values to 20 % for off-load and to 80 % for full-load will prove sufficiently accurate.

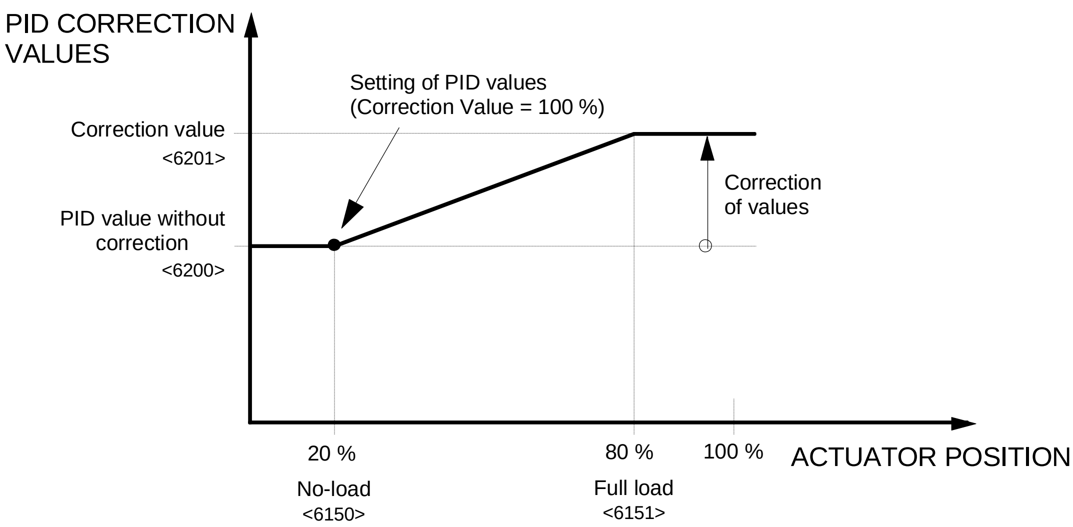


Fig. 19: Load dependent correction in diesel engines

Parameterizing Example:

Number	Parameter	Value	Unit
6100	*PIDMap:n(0)*	*0*	*rpm*
:	*:*	*:*	
6109	*PIDMap:n(9)*	*0*	*rpm*

6150	*PIDMap:f(0)*	*20*	*%*
6151	*PIDMap:f(1)*	*80*	*%*
6152	*PIDMap:f(2)*	*0*	*%*
:	*:*	*:*	
6159	*PIDMap:f(9)*	*0*	*%*
6200	*PIDMap:Corr(0)*	*100*	*%*
6210	*PIDMap:Corr(10)*	*150*	*%*

Activation:

4100	*PIDMapOn*	*1*

8.2.2.2 Gas engine

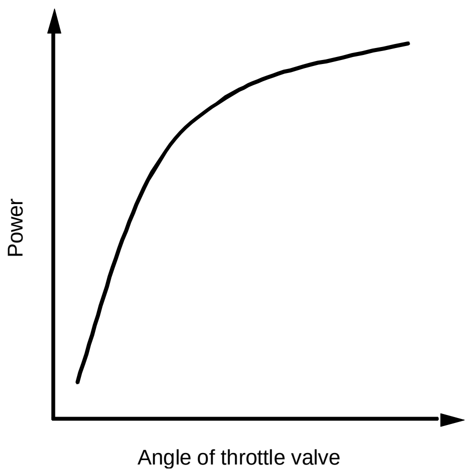


Fig. 20: Performance graph of gas engine in dependence of throttle valve position

With gas engines, it is of particular importance that PID correction be carried out in dependence of load. The foregoing diagram ↑*Fig. 20: Performance graph of gas engine in dependence of throttle valve position* depicts the performance curve versus throttle valve position. The lower domain is characterized by a fast increase of power output, while in the upper domain there is only a modest rise. For optimum control, these facts must particularly be taken into account.

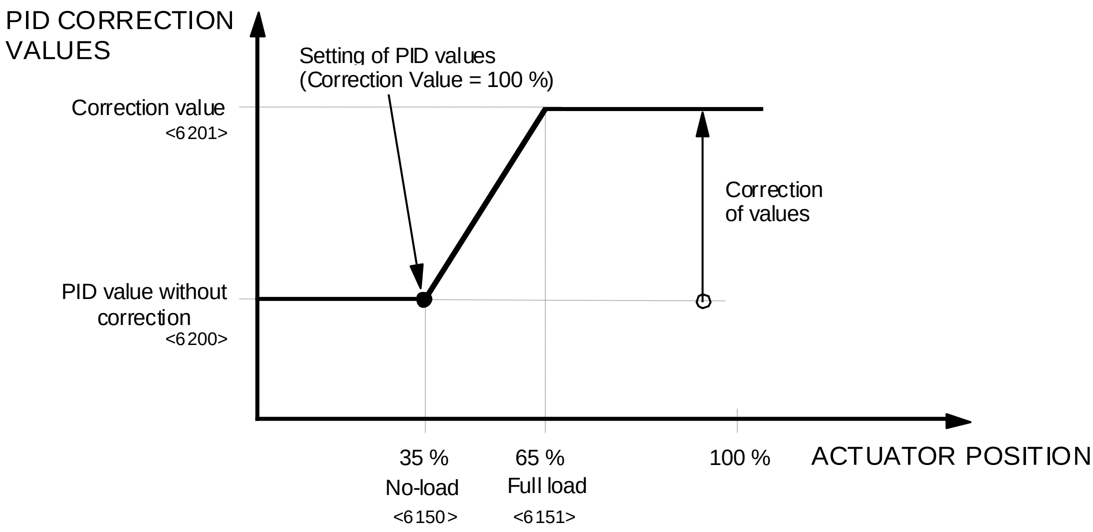


Fig. 21: Load dependent correction in gas engines

As explained in the previous section, adjustment of PID values is done for no-load and correction for full-load. For a majority of applications, the inflexion points for actuator travel can be set to 35 % and 60 %. It may, however, prove necessary to readjust these values with regard to specific requirements.

Parameterizing Example:

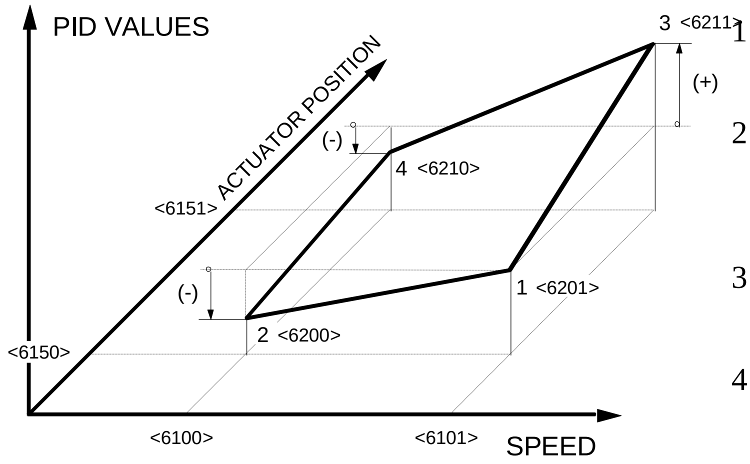
Number	Parameter	Value	Unit
6100	*PIDMap:n(0)*	*0*	*rpm*
:	*:*	*:*	
6109	*PIDMap:n(9)*	*0*	*rpm*
6150	*PIDMap:f(0)*	*35*	*%*
6151	*PIDMap:f(1)*	*60*	*%*
6152	*PIDMap:f(2)*	*0*	*%*
:	*:*	*:*	
6159	*PIDMap:f(9)*	*0*	*%*
6200	*PIDMap:f(0)*	*100*	*%*
6210	*PIDMap:f(10)*	*200*	*%*

Activation:

4100	*PIDMapOn*	*1*	

8.2.3 Stability map

When setting the PID parameters for the map, the parameters are to be modified depending on both speed and load. This may be required, e.g., for engines with large ranges of speed variation.



1 Setting the PID values at maximum speed and off- load

2 (-) Correction value at minimum speed and off-load

3 (+) Correction at maximum speed and full-load

4 (-) Correction at minimum speed and full-load

Fig. 22: Stability map

The basic setting is done at rated speed and off-load (point 1). Then the first correction (point 2) is made at minimum speed and off-load. The next correction (point 3) is carried out at rated speed and full load, and finally the last correction (point 4) is made at minimum speed and with the respective load.

Parameterizing Example:

Number	Parameter	Value	Unit	
6100	*PIDMap:n(0)*	*700*	*rpm*	
6101	*PIDMap:n(1)*	*2100*	*rpm*	
6102	*PIDMap:n(2)*	*0*	*rpm*	
:	*:*	*:*		
6109	*PIDMap:n(9)*	*0*	*rpm*	
6150	*PIDMap:f(0)*	*20*	*%*	
6151	*PIDMap:f(1)*	*80*	*%*	
6152	*PIDMap:f(2)*	*0*	*%*	
:	*:*	*:*		
6159	*PIDMap:f(9)*	*0*	*%*	
6200	*PIDMap:Corr(0)*	*60*	*%*	*(point 2)*
6201	*PIDMap:Corr(1)*	*100*	*%*	*(point 1)*
6210	*PIDMap:Corr(10)*	*90*	*%*	*(point 4)*
6211	*PIDMap:Corr(11)*	*150*	*%*	*(point 3)*

Activation:

4100	*PIDMapOn*	*1*

8.3 Second PID parameter set

For certain generator applications it might be necessary to switch between two PID settings, for instance in case of emergency power sets with very large flywheel mass. This function is available on request.

The parameters of the second set are located in

105 *Gain2*	P-factor 2
106 *Stability2*	I-factor 2
107 *Derivative2*	D-factor 2
6100 to 6109 *PIDMap:n*(x)	speed values for stability maps 1 and 2
6150 to 6159 *PIDMap:f*(y)	fuel values for stability maps 1 and 2
resp.	
6350 to 6359 *PIDMap:P*(y)	power values for stability maps 1 and 2
9900 to 9999 *PIDMap2:Corr(z)*	correction values for stability map 2

For the second PID map the same supporting points as for the first map are used, whereby 4101 *PIDMapPowOrFuel* is also taken into account. Setting and optimization are performed in the same way as described in ↑*8.1 Adjustment of PID parameters* and ↑*8.2 PID map*.

The switching between the two parameter sets occurs online with the switching function 2841 *SwitchPID2Or1*:

2841 *SwitchPID2Or1* = 0	the first PID set is used
2841 *SwitchPID2Or1* = 1	the second PID set is used.

8.4 Temperature dependent correction of stability

While the engine is still cold, it may show a tendency for speed oscillations regardless of the stability map. In this event, the stability map can be corrected in dependence of temperature.

Note

This function is not available in ORION.

Depending on the engine, the map is corrected in upward or downward direction.

Engine temperature ↑2907 *CoolantTemp* is sensed by a temperature sensor. If engine temperature falls below the high value for the cold engine 162 *PID_CorrTempHigh* the entire characteristic map is corrected by the value calculated by the control in accordance with the following figure. If engine temperature falls below the low value for the cold engine 161 *PID_CorrTempLow* the characteristic map is corrected by the value given by 160 *PID_ColdCorr*.

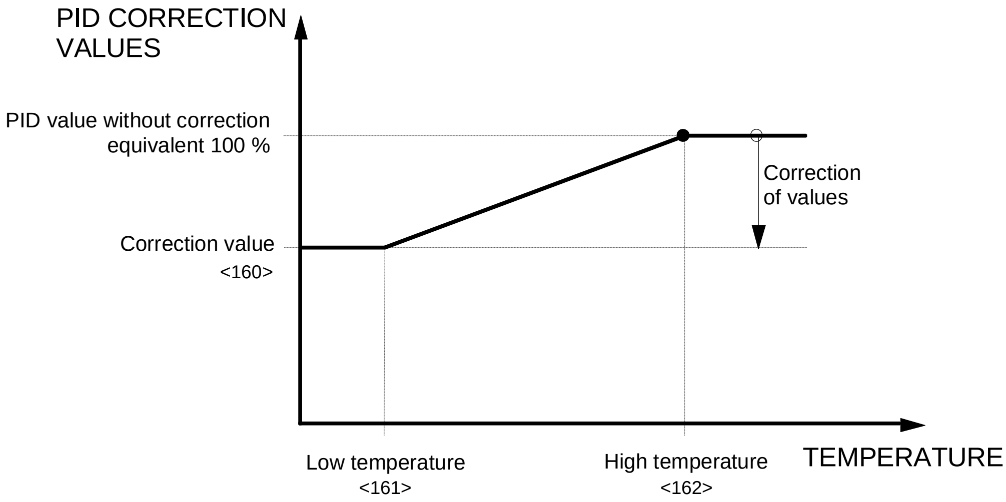


Fig. 23: Temperature dependent correction of stability

This function is enabled by setting the parameter 4160 *PIDTempOn* = 1.

Parameterizing Example:

Number	Parameter	Value	Unit
160	*PID_ColdCorr*	*60*	*%*
161	*PID_CorrTempLow*	*-20*	*°C*
162	*PID_CorrTempHigh*	*10*	*°C*

Activation:

4160	*PIDTempOn*	*1*	

8.5 Correction of PID parameters for static operation

When running engines with small load flywheel effects, load changes may result in considerable speed drops or speed rises. This is caused mainly by the fact that the control's P-factor (gain) required for the engine to run smoothly in steady-state operation is rather small. As a countermeasure, the **HEINZMANN** control units offer the option to adjust the PID values for dynamic operation and to reduce them for static (steady-state) operation. By this, it can be ensured that the engine runs properly after having attained steady-state operation and that the governor still remains capable of reacting quickly to load changes.

If speed deviation remains within the range of 111 *StaticCorrRange* the P and D parameters will be corrected by the value given by 110 *StaticCorrFactor*. Outside twice this range, the normal parameters will be valid. If speed deviation is somewhere in between, there will be interpolation to ensure smooth transition. This function is enabled by the parameter 4110 *StaticCorrOn* = 1.

The value of 110 *StaticCorrFactor* should be set to 40-70 %.

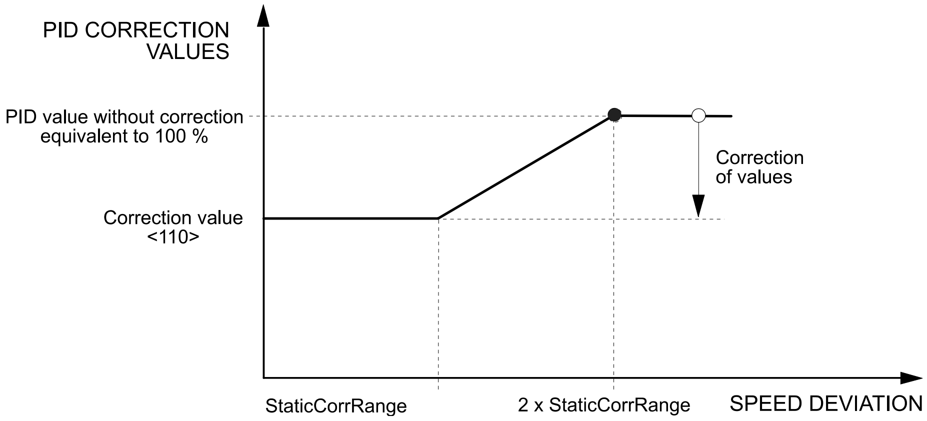


Fig. 24: Correction for static operation

Parameterizing Example:

Number	Parameter	Value	Unit
110	*StaticCorrFactor*	*50*	*%*
111	*StaticCorrRange*	*20*	*rpm*

Activation:

4110	*StaticCorrOn*	*1*

8.6 Load jump regulation in generator systems (DT1 factor)

In addition to the factors P, I and D it is possible to pre-set a DT1 factor for the speed control circuit which allows to correct load jumps faster and better. To this purpose either a load jump detector or a speed jump detector is required.

For load jump detection, information on current load must be available in 2918 *MeasuredPower*. If current load is not measured, a load jump can alternatively be identified by a speed jump. Added load causes speed undershooting and dropped load causes speed overshooting. The function to use (load jump detection or speed jump detection) can be selected separately.

The reaction to load jumps must be observed at the engine, in order to derive the threshold values and the DT1 factor. The aim is a reduction of speed overshooting and undershooting and a shortening of transient time. The control circuit takes the DT1-factor into account only if the respective function is active.

It doesn't make sense to activate both functions at the same time, for this can result in an undesired amplification of speed deviation in the opposite direction. But it may be useful to test both variants in order to be identify the variant that is better suited. Depending on the load measurement unit used, it is possible that load jump recognition from load change takes longer than from speed change – and this is a matter where quick reaction is of crucial importance. The DT1-factor can be activated in addition to rapid power cut-off (↑ *8.7 Load shedding in generator systems*).

Load and speed jump monitoring by principle becomes active only above the speed threshold 28 *DT1SpeedThreshold*, which should be set far enough below rated speed to enable the registering of speed undershooting. Both the speed setpoint 2031 *SpeedSetp* and actual speed 2000 *Speed* must be above this threshold.

To prevent a false interpretation of speed setpoint jumps, an additional maximum admissible speed setpoint difference should be set in 29 *DT1SpeedSpDiffThresh*. This condition becomes active only if load jump recognition by speed jump is active. Only if the speed setpoint changes by less than 29 *DT1SpeedSpDiffThresh* the speed jump is reacted on in the sense of a load jump. It does not make sense to enter the value 0 since especially in generator systems the speed setpoint is changed continually for adjustment to the load.

Load gradient (load change rate) 2029 *LoadGradientDT1* is determined on the basis of 2918 MeasuredPower through the filter 35 *PowerGradDT1Filter* and speed gradient (speed change rate) 2028 *SpeedGradientDT1* is calculated from 2000 *Speed* through the filter 33 *SpeedGradDT1Filter*.

A load jump is recognized and indicated in 2122 *LoadJumpActive* if the value of the load gradient 2029 *LoadGradientDT1* is higher than 34 *LoadGradDT1Thresh*. A speed jump is recognized and indicated in 2121 *SpeedJumpActive* if the value of the speed gradient 2028 *SpeedGradientDT1* exceeds 32 *SpeedGradDT1Thresh*.

To the load gradient the amplification factor 104 *LoadDT1* is multiplied and transmitted as additive factor to the PID control circuit if the function has been activated with 4029 *LoadGradientDT1On* = 1. To the speed gradient the DT1-factor 103 *SpeedDT1* is multiplied and transmitted to the PID control circuit as new additional part, if the function has been activated with 4028 *SpeedGradientDT1On* = 1.

The load jump or the resulting speed jump are regarded as compensated when speed 2000 *Speed* stays within the range +/- 30 *DT1SpeedDiffMax* around the current speed setpoint for the duration of 31 *DT1SpeedDiffTime*.

Parameterizing Example:

Number	Parameter	Value	Unit
28	*DT1SpeedThreshold*	*1350*	*rpm*
29	*DT1SpeedSpDiffThresh*	*25*	*rpm*
30	*DT1SpeedDiffMax*	*10*	*rpm*
31	*DT1SpeedDiffTime*	*3*	*s*
32	*SpeedGradDT1Thresh*	*20*	*rpmps*
33	*SpeedGradDT1Filter*	*8*	
34	*LoadGradDT1Thresh*	*10*	*%/s*
35	*LoadGradDT1Filter*	*8*	
103	*SpeedDT1*	*30*	*%*
104	*LoadDT1*	*25*	*%*
2028	*SpeedGradientDT1*	*300*	*rpmps*
2029	*LoadGradientDT1*	*150*	*%/s*
2121	*SpeedJumpActive*	*0/1*	
2122	*LoadJumpActive*	*0/1*	

Activation:

4028	*SpeedGradientDT1On*	*1*
4029	*LoadGradientDT1On*	*1*

8.7 Load shedding in generator systems

Opening the generator contactor under load (e.g. during power failure) may lead to great speed overshoots. In order to react quickly in such cases and to minimize the overshoot, the opening of the contactor can be used to bring the speed control immediately to reduce to zero-load fuel quantity. To do so, the generator contactor must be connected to the switch function 2846 *SwitchGenBreaker*. Zero-load fuel quantity is set in 352 *FuelAtZeroLoad*. In addition, the control unit continually determines the effective value of minimal fuel quantity, which can be lower than the value of the parameter.

The function “Quick power cut-off” is an additional aid when it comes to reducing a considerable positive speed deviation very quickly. This function is used mainly to minimize speed overshoot during load shedding. Rapid power cut-off can be activated in addition to the speed-regulating DT1-factor (*↑ 8.6 Load jump regulation in generator systems (DT1 factor)*.

The quick power cut-off is most effective with actuators that respond to the 2Q output stage of the control unit, i.e. when 5911 *Amplifier2QOr4Q* is active. For actuators addressed by a 4Q output stage it is recommended to test the effect first and to activate the function only if the effect is positive. The function quick power cut-off is effective only if 1810/3810 *OperationMode* is set to 3 for generator systems.

Note

This function may not be activated when using the Bosch EDC pump or the HEINZMANN linear actuator type LStG 25 – in general, whenever an actuator with linear magnets is used.

When both the speed setpoint 2031 *SpeedSetp* and the current speed 2000 *Speed* have exceeded the threshold 28 *DT1SpeedThreshold* and the current speed gradient 2025 *SpeedGradient* exceeds the threshold 320 *CurrShutOffGradient*, fuel feeding is stopped immediately by energizing the output stage addressing the actuator in direction 0%. 28 *DT1SpeedThreshold* must be set far enough under rated speed to allow for the identification of speed undershoot.

Note

The DT1-factor of the speed control becomes active when the filtered speed gradient 2028 SpeedGradientDT1 exceeds a pre-set threshold. Quick power cut-off can react quicker since it monitors the unfiltered speed gradient 25 SpeedGradient. On the other hand, this also means that the gradient threshold 320 CurrShutOffGradient must be determined with greater accuracy since the unfiltered value can be very unstable.

Attention must be paid to the fact that when the function quick power cut-off is active no control by output of a defined actuator position is possible and the time quick power cut-off lasts therefore should be not long enough to allow strong undershoot. Therefore the power cut-off is terminated automatically as soon as speed ceases to increase, at the latest after decurrence of the interval pre-set in 321 *CurrentShutOffTime*. After each quick power cut-off the function is interdicted for 500 ms. Within this time span the speed jump is compensated.

The current used for energizing the actuator in direction 0 % must be pre-set in 322 *CurrentShutOff*. Due to the relatively short duration of the quick power cut-off function this current may be higher than the maximum current 1917 *ServoCurrentMax*.

The function quick power cut-off is activated with parameter 4320 *CurrentShutOff* = 1.

Parameterizing Example:

Number	Parameter	Value	Unit
28	*DT1SpeedThreshold*	*1350*	*rpm*
320	*CurrShutOffGradient*	*300*	*rpmps*
321	*CurrentShutOffTime*	*50*	*ms*
322	*CurrentShutOff*	*70*	*%*
2025	*SpeedGradient*	*55*	*rpmps*

Activation:

4320	*CurrentShutOffOn*

9 Limiting Functions

For optimum engine performance, it is necessary that the control provide various limitations of fuel injection quantity The following figure gives an overview of the most significant limiting functions.

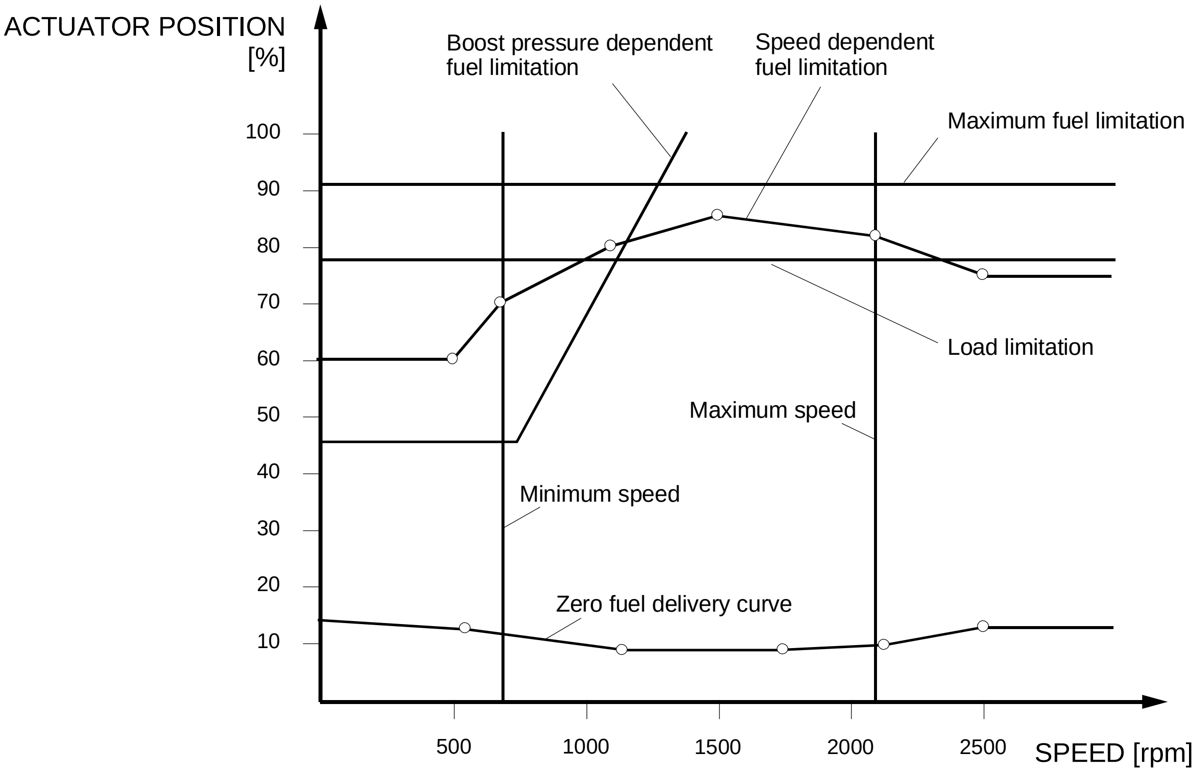


Fig. 25: Important limiting functions

If different limiting functions are operable, the one yielding the smallest fuel quantity value will override all others. The presently valid fuel quantity is indicated by the parameter 2350 *FuelQuantity*. In addition, unlimited fuel quantity is transmitted by parameter 2114 *FuelSetpointUnlimited*.

The parameter 711 *FuelLimitMaxAbsolute* can be used to define a fixed maximum injection limit. This limit value will always be active.

Note

During start-up, the speed and boost pressure dependent fuel limitations are disabled (↑5 Starting fuel limitation).

Parameters 2700 through 2721 are provided to indicate the maximum fuel quantity admissible under the current operating conditions (speed, boost pressure) and to display which limiting function is presently enabled. These parameters are listed and described in ↑ *Table 16: Limiting functions*.

Indication Parameter	**Meaning**
2701 *FuelLimitMax*	Currently admissible maximum fuel
2702 *FuelLimitStart*	Currently admissible maximum starting fuel
2703 *FuelLimitSpeed*	Currently valid speed dependent fuel limit
2704 *FuelLimitBoost*	Currently valid boost dependent fuel limit
2705 *FuelLimitForced*	Currently valid fuel limit as resulting from forced limitation
2722 *FuelLimitAsymLoad*	Currently valid fuel limit as resulting from externally set asymmetrical load
2923 *FuelLimitExtern*	externally forced limitation
2710 *FuelLimitMinActive*	1 = for lower limit
2711 *FuelLimitMaxActive*	1 = for upper limit
2712 *StartLimitActive*	1 = for starting fuel limitation
2713 *SpeedLimitActive*	1 = for speed dependent limitation
2714 *BoostLimitActive*	1 = for boost pressure dependent limitation
2715 *ForcedLimitActive*	1 = for external forced limitation
2720 *FuelLimitExtActive*	1 = for externally set limitation
2721 *AsymLoadLimitActive*	1 = for externally set asymmetrical load limitation

Table 16: Limiting functions

When 4724 *CheckFuelLimitOn* is set, 2724 *NearFuelLimitActive* indicates when current fuel quantity is closer than 724 *FuelLimitDistance* from the current limit 2701 *FuelLimitMax*. If 2724 *NearFuelLimitActive* is fed into a digital output, it is possible to warn the operator when he is running the engine close to its load limit (↑*20.8* Digital outputs).

9.1 Speed dependent fuel limitation

The speed dependent full-load limiting characteristic determines the maximum admissible amount of fuel (actuator travel, and resulting torque) the engine may be supplied for at a certain speed.

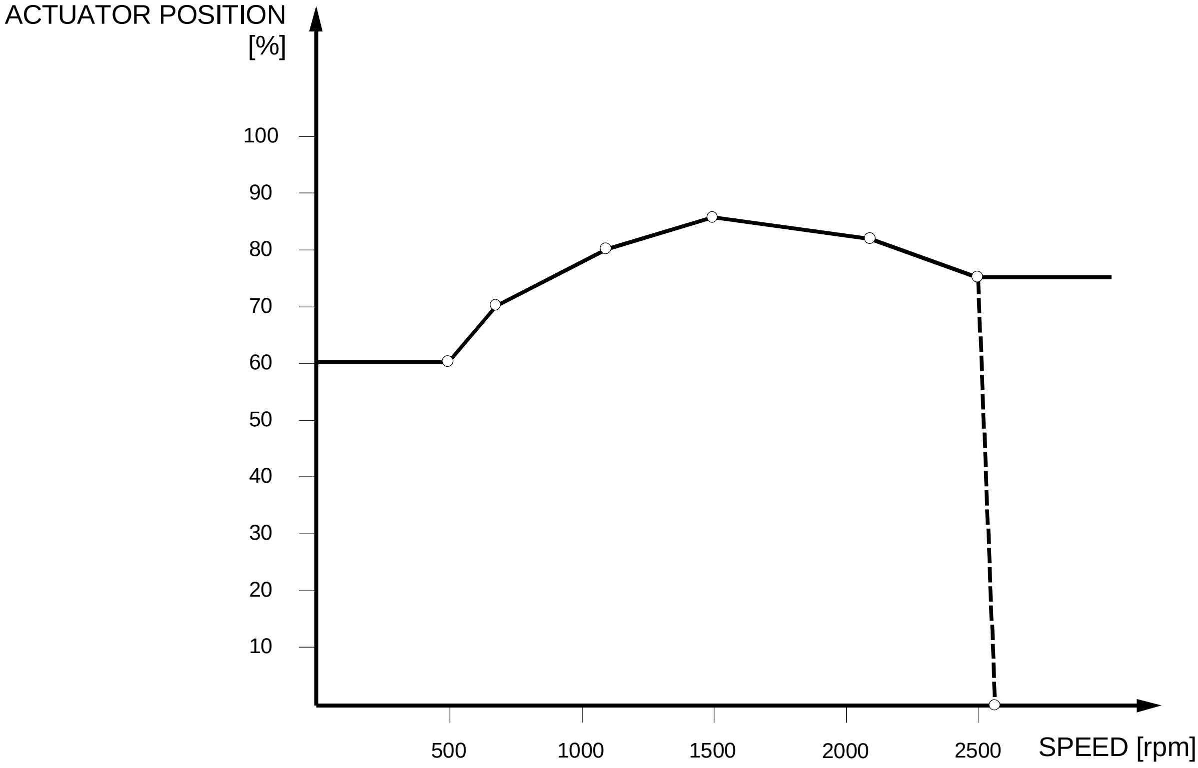


Fig. 26: Speed dependent fuel limitation

For adaptation to engine operating conditions, two different speed dependent limiting functions can be provided as alternatives, e.g., one for driving operation and one for stationary operation – albeit not for the systems PANDAROS and ORION that feature only one full load characteristic. For driving operation limitation is normally defined with regard to the requirements of the prime mover, for stationary operation, however, with regard to the working machine.

A switching function 2817 *SwitchSpeedLimit2Or1* serving as a selector switch between the two speed dependent limiting functions is provided to select the limiting function by which the control is supposed to operate. The currently active function is indicated by:

2817 *SwitchSpeedLimit2Or1* = 0   Limiting function 1 is active.

2817 *SwitchSpeedLimit2Or1* = 1   Limiting function 2 is active.

The values defining the full-load characteristics are stored at the following parameter positions:

6700 through 6729 *SpeedLimit1:n(x)* Speed values for full-load curve 1

6750 through 6779 *SpeedLimit1:f(x)* Fuel quantity for full-load curve 1

6800 through 6829 *SpeedLimit2:n(x)* Speed values for full-load curve 2

6850 through 6879 *SpeedLimit2:f(x)* Fuel quantity for full-load curve 2

Parameterization is to be conducted according to ↑ ***3.7 Parameterization of characteristics***. There are up to 30 pairs of programmable values available. The characteristics are enabled by setting the parameter 4700 *SpeedLimitOn* = 1.

Parameterization Example:

Parameterization is to be made for a full-load characteristic consisting of 6 pairs:

Number	Parameter	Value	Unit	Number	Parameter	Value	Unit
6700	*SpeedLimit1:n(0)*	*500*	*rpm*	*6750*	*SpeedLimit1:f(0)*	*60*	*%*
6701	*SpeedLimit1:n(1)*	*700*	*rpm*	*6751*	*SpeedLimit1:f(1)*	*70*	*%*
6702	*SpeedLimit1:n(2)*	*1100*	*rpm*	*6752*	*SpeedLimit1:f(2)*	*80*	*%*
6703	*SpeedLimit1:n(3)*	*1500*	*rpm*	*6753*	*SpeedLimit1:f(3)*	*86*	*%*
6704	*SpeedLimit1:n(4)*	*2100*	*rpm*	*6754*	*SpeedLimit1:f(4)*	*82*	*%*
6705	*SpeedLimit1:n(5)*	*2500*	*rpm*	*6755*	*SpeedLimit1:f(5)*	*75*	*%*
6706	*SpeedLimit1:n(6)*	*0*	*rpm*	*6756*	*SpeedLimit1:f(6)*	*0*	*%*
:	:	:		:	:	:	
6729	*SpeedLimit1:n(29)*	*0*	*rpm*	*6779*	*SpeedLimit1:f(29)*	*0*	*%*

Activation:

4700 SpeedLimitOn 1

For speeds below the first of the parameterized speed values, the control will limit actuator travel to the first of the parameterized fuel values. Thus in the above example, actuator travel is limited to 60 % for the range from 0 to 500 rpm. Likewise, for speeds beyond the last of the parameterized speed values (in the above example 2,500 rpm) actuator travel will remain limited to the last parameterized fuel value (in the above example 75 %).

If this is not desirable, an additional pair of values should be programmed with the fuel value set to 0 %. This will be a counterpart of the absolute limit line as known from other controls (dashed line in ↑*Fig. 26: Speed dependent fuel limitation*).

Number	Parameter	Value	Unit	Number	Parameter	Value	Unit
6706	*SpeedLimit1:n(6)*	*2510*	*rpm*	*6756*	*SpeedLimit1:f(6)*	*0*	*%*

The parameter

2713 *SpeedLimitActive* = 0	Fuel limitation currently not enabled
2713 *SpeedLimitActive* = 1	Limitation currently enabled

permits to check upon whether or not this limitation is currently in effect. The actual limiting value is indicated by the parameter 2703 *FuelLimitSpeed*.

9.1.1 Temperature dependent reduction of full-load characteristic

To protect the engine against possible damages from high temperatures the full-load characteristic (↑*9.1 Speed dependent fuel limitation*) can be lowered in dependence of temperature.

Note

This function is not available in ORION systems.

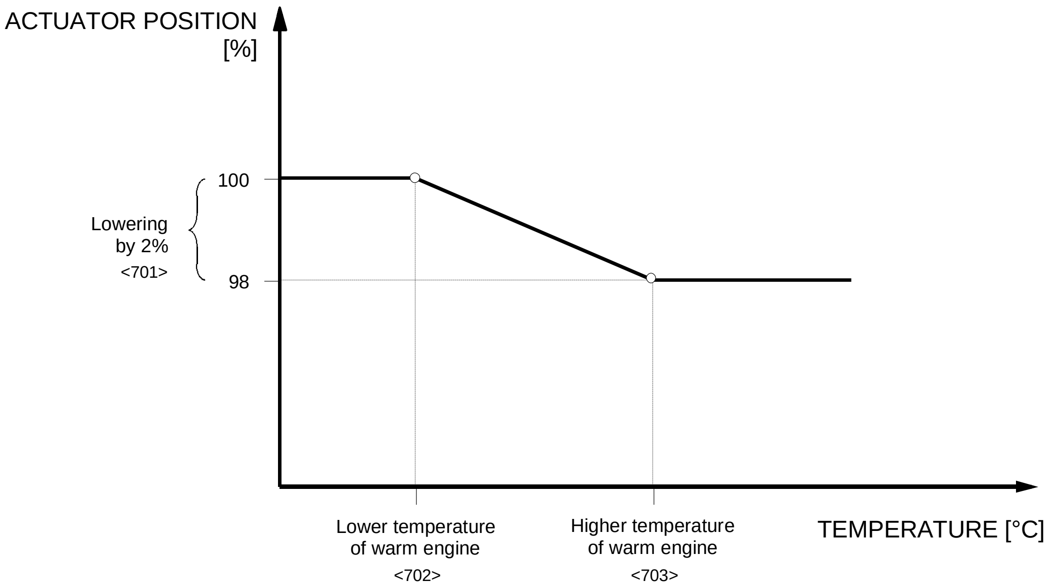


Fig. 27: Temperature dependent reduction of full-load characteristic

Engine temperature (↑ 2907 *CoolantTemp*) is sensed by a temperature sensor. If engine temperature rises above the value 702 *SpeedLimitTempLow* the complete full-load characteristic is lowered in dependence on temperature. If engine temperature exceeds the value given by 703 *SpeedLimitTempHigh* there will be a constant decrease by the value 701 *SpeedLimitTempDec* (absolute fuel).

This function is activated by parameter 4701 *SpeedLimitTempOn*.

Parameterization Example:

Number	Parameter	Value	Unit
701	*SpeedLimitTempDec*	*2*	*%*
702	*SpeedLimitTempLow*	*90*	*°C*
703	*SpeedLimitTempHigh*	*110*	*°C*

Activation:

4701	*SpeedLimitTempOn*	*1*

In case further temperature-dependent reductions of full-load characteristic are implemented, the parameter names change from a temperature-dependent reduction to a coolant temperature-dependent reduction. *SpeedLimitTemp* becomes *SpeedLimCoolTemp*. This does not imply, however, any changes with respect to their meaning.

9.1.2 Other temperature dependent reductions of full-load characteristic

Whenever there are more temperatures to take into account, the firmware can on request be complemented with additional temperature dependent reductions of full-load characteristic. This refers to charge air temperature, exhaust temperature and oil temperature.

Note

This function is not available in ORION systems.

Their functioning is identical to coolant temperature dependent reduction. The following parameters must be referred to:

<u>Charge air temperature dependent reduction</u>

690 *SpeedLimChAirTempDec*

691 *SpeedLimChAirTempLow*

692 *SpeedLimChAirTmpHigh*

2908 *ChargeAirTemp*

4690 *SpeedLimitChAirTmpOn*

<u>Exhaust gas temperature dependent reduction</u>

695 *SpeedLimExhTempDec*

696 *SpeedLimExhTempLow*

697 *SpeedLimExhTempHigh*

2911 *ExhaustTemp*

4695 *SpeedLimitExhTempOn*

<u>Oil temperature dependent reduction</u>

705 *SpeedLimOilTempDec*

706 *SpeedLimOilTempLow*

707 *SpeedLimOilTempHigh*

2909 *OilTemp*

4705 *SpeedLimitOilTempOn*

9.2 Boost pressure dependent fuel limitation

The boost pressure dependent limit characteristic (boost curve) defines the maximum admissible amount of fuel (actuator travel, i.e. torque) the engine may be supplied when a certain boost pressure has been attained. Current boost pressure (↑2904 *BoostPressure*) is determined by a boost pressure sensor and the respective maximum admissible fuel value calculated by means of the characteristic.

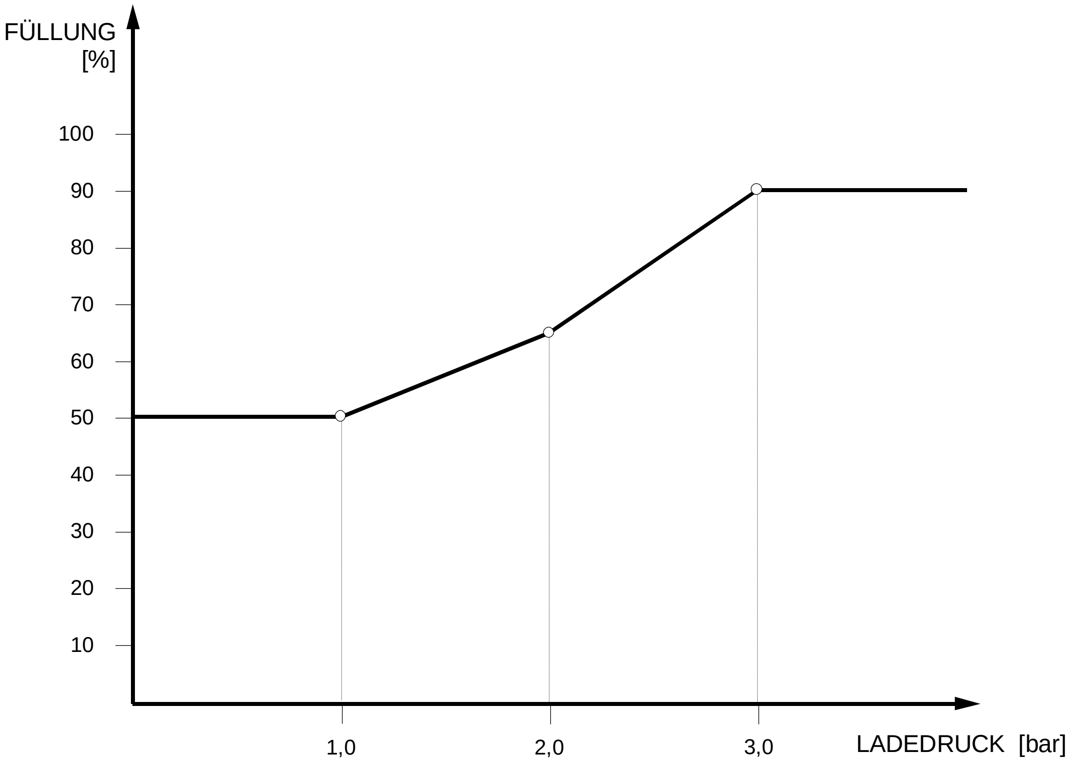


Fig. 28: Boost pressure dependent fuel limitation

The values of the characteristics are stored at the following parameter positions:

6400 to 6409 *BoostLimit:p(x)*	Boost pressure values for boost curve
6420 to 6429 *BoostLimit:f(x)*	Fuel values for boost curve.

To parameterize the boost pressure dependent limit characteristic, there are up to 10 pairs of values available. Each pair of values consists of one boost pressure value and one fuel value, both with the same index. Intermediary values between adjacent pairs of variates will be interpolated by the control (↑***3.7 Parameterization of characteristics***).

The characteristic is activated by setting the parameter 4710 *BoostLimitOn* = 1.

Parameterizing Example:

A boost pressure dependent limit characteristic supported by 3 pairs of values is to be parameterized.

Number	Parameter	Value	Unit	Number	Parameter	Value	Unit
6400	*BoostLimit:p(0)*	*1.0*	*bar*	*6420*	*BoostLimit:f(0)*	*50*	*%*
6401	*BoostLimit:p(1)*	*2.0*	*bar*	*6421*	*BoostLimit:f(1)*	*65*	*%*
6402	*BoostLimit:p(2)*	*3.0*	*bar*	*6422*	*BoostLimit:f(2)*	*90*	*%*

Activation:

4710	*BoostLimitOn*	*1*

For boost pressures below the first of the parameterized values, the control will limit the actuator travel to the first of the parameterized actuator positions. Thus in the above example, actuator position is limited to 50 % for the range from 0 to 1 bar boost pressure. Likewise, for boost pressure values higher than the last parameterized one (in the above example 3.0 bar) actuator travel will remain limited to the last parameterized value (in the above example 90 %).

The parameter

2714 *BoostLimitActive* = 0	Fuel limitation currently not enabled
2714 *BoostLimitActive* = 1	Limitation currently enabled

permits to check upon whether or not this limitation is currently in effect. The current limiting value is indicated by the parameter 2704 *FuelLimitBoost*.

9.3 Forced limitation

Regardless of speed and boost pressure dependent limitation, fuel can be restricted to a externally pre-set value. Two possibilities are provided to this purpose. Either a fixed value is set for use as a limiting value in specific conditions, or a variable limiting value is used.

9.3.1 Fixed limit

In parameter 715 *FuelLimitForced* a constant maximum injection quantity is defined. This function is enabled by activating the switching function 2813 *SwitchForcedLimit*.

Again, the rule holds that the least limitation value enabled will override any other limitation. The parameter

2715 *ForcedLimitActive* = 0	external limitation currently not enabled
2715 *ForcedLimitActive* = 1	external limitation currently enabled

therefore shows whether the fixed value indicated in 2705 *FuelLimitForced* is currently responsible for the resulting fuel limitation.

Parameterizing Example:

On closing the switch at digital input 4 actuator travel is to be limited to 78 % maximum.

Number	Parameter	Value	Unit
715	*FuelLimitForced*	*78*	*%*
813	*FunctForcedLimit*	*4*	

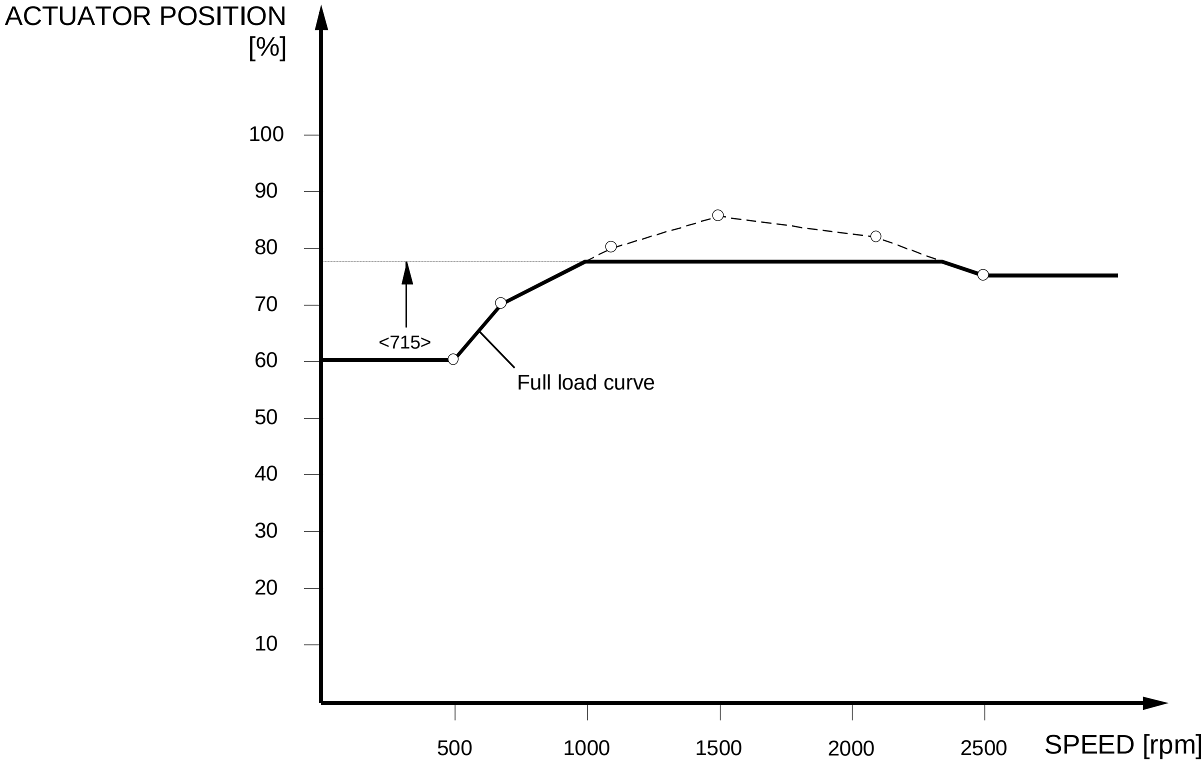


Fig. 29: Externally activated power limitation

9.3.2 Variable limit

The variable limitation pre-set is derived from sensor 2923 *FuelLimitExtern*. This value may be connected directly to an analogue or PWM input, as usually the case for sensors, or received via communication modules. For example, the telegram TSC1 of SAE J1939 CAN communication may be used to transmit this limit.

The value 2720 *FuelLimitExtActive* = 1 indicates that the externally pre-set limit is currently responsible for the actual fuel limitation.

Note

Especially in case of connection to an analogue input, it must be ensured that 2923 FuelLimitExtern reaches maximum value when this limit is not active.

9.4 Zero fuel delivery characteristic

The injection pump of a diesel engine will start delivering only from a certain speed dependent position onward. Knowledge of this zero fuel delivery characteristic can have a positive effect on speed setpoint adjustments in direction of lower speeds whenever some actuator setpoint position below the characteristic is being calculated.

The precise zero fuel delivery characteristic can be determined only on a pump test stand. As a simple equivalent the zero load delivery characteristic can be determined, i.e. the characteristic corresponding to the fuel quantity of the engine running off-load.

This zero load delivery characteristic can be determined without difficulty by running across the entire speed range using a very slow speed ramp with the engine off-load. To obtain the zero fuel delivery characteristic a safety distance is deducted from the zero load delivery characteristic as determined and entered together with the speed supporting points in the characteristic 7200 *ZeroLoadFuel:n* or 7250 *ZeroLoadFuel:Pos* respectively.

If inappropriate values have been entered for this characteristic, only the proportional part of the speed governor will be working which is bound to result in a permanent speed deviation. Therefore, great care should be taken in determining the characteristic.

On activating the characteristic by 4720 *ZeroFuelCurveOn* the speed governor will take zero delivery into account and be capable of reacting faster when speed increases again. This will also have the effect that undershooting is reduced during downward speed jumps. The current actuator value as resulting from the zero fuel delivery characteristic is indicated by 2340 *ActPosAtZeroFuel*.

Using DcDesk 2000 the zero fuel delivery characteristic can be determined as described below:

1. 4720 *ZeroFuelCurveOn = 0, i.e., de-activation of the zero fuel delivery characteristic.*
Activate speed ramp for 2 rpmps.
230 *SpeedRampUp* = 2
233 *SpeedRampDown* = 2
4230 *SpeedRampOn* = 1
4232 *SectionalOrFixedRamp* = 0
Set speed setpoint to idle speed by 20 *SpeedSetpPC* = value as set by 10 *SpeedMin*.

Set speed adjustment by 4020 *SpeedSetpPCOn* = 1 to definition by PC.

2. Start and run engine up to idle speed off-load. If possible turn off any users (loads).

3. Open DcDesk 2000 "Curve over X".
Assign speed 2000 *Speed* to x-axis.
Assign actuator position 2300 *ActPos* to y-axis.
Set speed range to 10 *SpeedMin,* 12 *SpeedMax*.

4. Ramp up speed by setting the speed setpoint 20 *SpeedSetpPC* to maximum speed.
Record actuator position against speed using a ramp of 2 rpmps.
Stop the graph as soon as maximum speed is attained.

5. Subtract 5 % from the recorded values at the selected supporting points and enter them as values for the zero fuel delivery characteristic from 7200 *ZeroFuelCurve:n* and 7250 *ZeroFuelCurve:Po*s. respectively onward (↑ ***3.7 Parameterization of characteristics***).
If it was not possible to turn all users off, 10 % should be deducted instead.

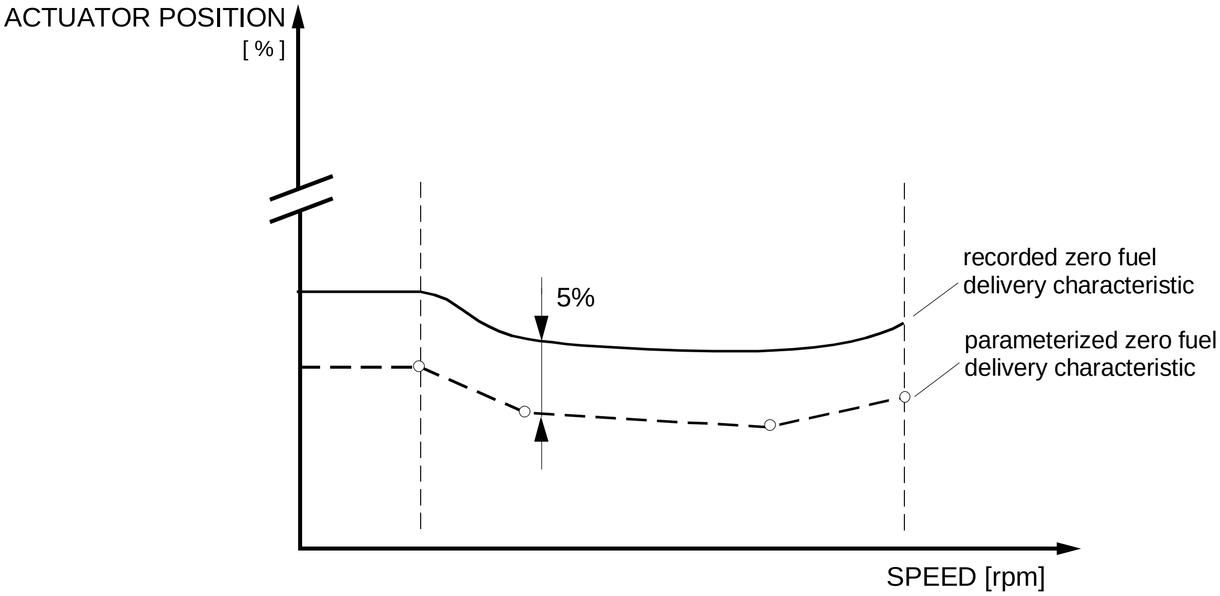


Fig. 30: Zero fuel delivery characteristic

9.5 Reduction of the full-load characteristic with XIOS

The reduction of the full-load characteristic *(↑ 9.1* Speed dependent fuel limitation) can take place depending on the coolant temperature, the charge air temperature, the fuel temperature, the exhaust temperature and/or the ambient pressure. Each of these power reductions can be activated separately or combinations are used.

Of the temperature-dependent power reductions, only the largest power reduction is used, i.e. the one that results in the smallest limiting value. The ambient pressure dependent power reduction acts as an additional reduction independently of these temperature-dependent functions.

Parameter numbers 2716 to 2726 show whether and which power reduction is active. A value of 0 means that the relevant reduction is not active.

2716 *CoolantTempRedActive* = 1	active due to fuel temperature
2717 *ChAirTempRedActive* = 1	active due to charge air temperature
2718 *FuelTempRedActive* = 1	active due to fuel temperature
2719 *AmbPressTempRedActive* = 1	active due to ambient pressure
2726 *ExhaustTempRedActive* = 1	active due to exhaust temperature

All temperature-dependent functions act in the same way:

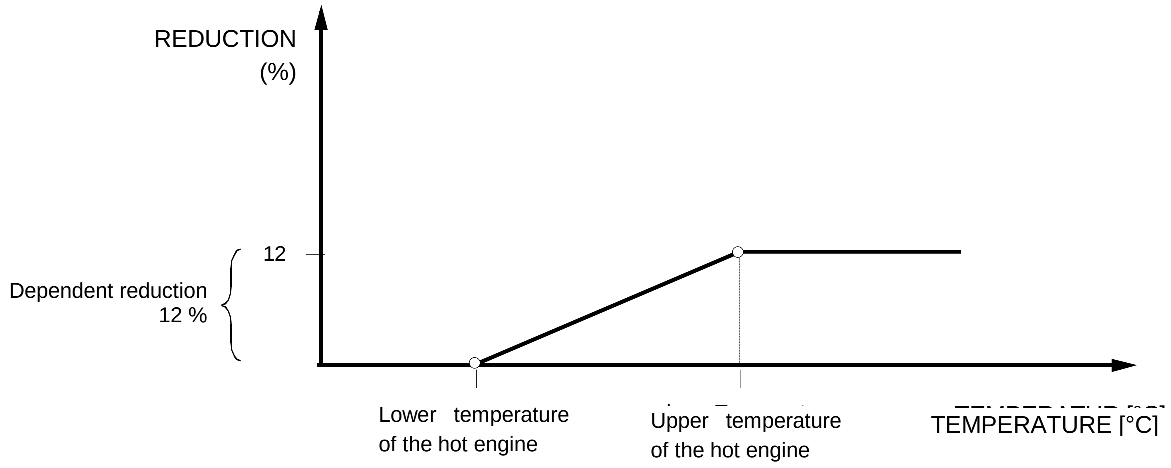


Fig. 31: Temperature dependent reduction of the full-load characteristic (XIOS)

9.5.1.1 Coolant temperature dependent reduction

The coolant temperature (↑ 2907 *CoolantTemp*) is determined via a temperature sensor. If the temperature is too high, the full-load characteristic can be reduced. A characteristic with 8 data points is available for this.

The values of the characteristic are stored at the following parameter positions:

7100 *CoolTempReduce:T(x)*	Coolant temperature values of the reduction
7110 *CoolTempReduce:F(x)*	Percentage reduction

With this curve, a factor by which the value of the speed-dependent limitation is reduced is determined based on the coolant temperature. The value resulting from the limitation and reduction is shown in parameter 2706 *FuelRedCoolantTemp*. If the fuel limitation is carried out with this value, this is signalled by parameter 2716 *CoolantTempRedActive*.

This function is activated by parameter 4706 *FuelRedCoolTempOn*.

Parametrization example:

Number	Parameter	Value	Unit
7100	*CoolTempReduce:T(0)*	*90.0*	*°C*
7101	*CoolTempReduce:T(1)*	*110.0*	*°C*
7110	*CoolTempReduce:F(0)*	*0.0*	*%*
7111	*CoolTempReduce:F(1)*	*12.0*	*%*

Activation:

4706	*FuelRedCoolTempOn*	*1*

9.5.1.2 Charge air temperature dependent reduction

The charge air temperature is determined via a temperature sensor (↑ 2908 *ChargeAirTemp*). If the temperature is too high, the full-load characteristic can be reduced. A characteristic with 8 data points is available for this.

The values of the characteristic are stored at the following parameter positions:

7120 *ChAirTempReduce:T(x)*	Charge air temperature of the reduction
7130 *ChAirTempReduce:F(x)*	Percentage reduction

With this curve, a factor by which the value of the speed-dependent limitation is reduced is determined based on the charge air temperature. The value resulting from the limitation and reduction is shown in parameter 2707 *FuelRedChargeAirTemp*. If the fuel limitation is carried out with this value, this is signalled by parameter 2717 *ChAirTempRedActive*.

This function is activated by parameter 4707 *FuelRedChAirTempOn*.

9.5.1.3 Fuel temperature dependent reduction

The fuel temperature is determined via a temperature sensor (↑2910 *FuelTemp*). If the temperature is too high, the full-load characteristic can be reduced. A characteristic with 8 data points is available for this.

The values of the characteristic are stored at the following parameter positions:

7140 *FuelTempReduce:T(x)*	Fuel temperature values of the reduction
7150 *FuelTempReduce:F(x)*	Percentage reduction

With this curve, a factor by which the value of the speed-dependent limitation is reduced is determined based on the fuel temperature. The value resulting from the limitation and reduction is shown in parameter 2708 *FuelRedFuelTemp*. If the fuel limitation is carried out with this value, this is signalled by parameter 2718 *FuelTempRedActive*.

This function is activated by parameter 4708 *FuelRedFuelTempOn*.

9.5.1.4 Exhaust-dependent reduction

If the exhaust temperature is too high, the full-load curve can be reduced. A characteristic with 8 data points is available for this. Depending on whether just one or multiple exhaust temperature sensors are installed, the value of 2911 *ExhaustTemp* or the highest value of all sensors 12573 *ExhaustTempMax* is used for the following function.

The values of the characteristic are stored at the following parameter positions:

7160 *ExhTempReduce:T(x)*	Fuel temperature values of the reduction

7170 *ExhTempReduce:F(x)*   Percentage reduction

With this curve, a factor by which the value of the speed-dependent limitation is reduced is determined based on the exhaust temperature. The value resulting from the limitation and reduction is shown in parameter 2725 *FuelRedExhaustTemp*. If the fuel limitation is carried out with this value, this is signalled by parameter 2726 *ExhaustTempRedActive*.

This function is activated by parameter 4705 *FuelRedExhaustTempOn*.

9.5.1.5 Ambient pressure dependent reduction

The ambient pressure (↑ 2906 *AmbientPressure*) is determined via an ambient pressure sensor. If the ambient pressure is too low, the full-load curve can be reduced dependent on the speed and ambient pressure. A map with 8x8 data points is available for this.

The values for the map are stored on the following parameter numbers:

7000 *AmbPressRedMap:n(x)*   Speed values for the reduction

7010 *AmbPressRedMap:p(y)*   Ambient pressure values of the reduction

7020 *AmbPressRedMap:F(z)*   Percentage reduction

With this map, a factor by which the value of the speed-dependent limitation is reduced is determined based on the speed and ambient pressure. The value resulting from the limitation and reduction is shown in parameter 2709 *FuelRedAmbientPress*. If the fuel limitation is carried out with this value, this is signalled by parameter 2719 *AmbPressRedActive*.

This function is activated by parameter 4709 *FuelRedAmbPressOn*.

10 Warning and emergency shutdown functions

On exceeding a pre-defined coolant, boost air or oil temperature limit, a warning message can be issued via a digital output.

Note

Control units of the ORION type feature no temperature input. The functions relating to or depending on temperature therefore are not available.

Likewise, if oil pressure falls below a programmable speed dependent oil pressure characteristic, a warning can be output, and if oil pressure continues to fall below a second programmable oil pressure characteristic, the control can trigger an emergency shutdown.

Note

The variable assignment of digital outputs is dealt with in chapter ↑ 20.8 Digital outputs.

10.1 Coolant temperature warning

For coolant temperature monitoring a temperature threshold for warning is set with parameter 510 *CoolantTempLimit*. If current coolant temperature exceeds this threshold, a warning message is output by setting the parameter 3032 *ErrCoolantTempWarn* = 1 . If coolant temperature falls below the warning threshold by more than 5°C the parameter is set to 0 again, and the error is cleared.

The actual temperature is indicated by the parameter 2907 *CoolantTemp*. The function itself is activated by means of the parameter 4510 *CoolantTempWarnOn*.

<u>Parameterizing Example:</u>

Number	Parameter	Value	Unit
510	*CoolantTempLimit*	*90*	*°C*

<u>Indication:</u>

2907	*CoolantTemp*	*90*	*°C*
3032	*ErrCoolantTempLimit*	*0/1*	

<u>Activation:</u>

4510	*CoolantTempWarnOn*	*1*

10.2 Charge air temperature warning

For charge air temperature monitoring a temperature threshold for warning is set with parameter 515 *ChargeAirTempLimit*. If current charge air temperature exceeds this threshold, a warning message is output by the parameter 3033 *ErrChargeAirTempWarn* being set to 1. When the charge air temperature is again below the warning threshold by more than 10°C the parameter is set to 0, and the error is cleared.

The actual temperature is indicated by the parameter 2908 *ChargeAirTemp*. The function itself is activated by means of the parameter 4515 *ChargeAirTempWarnOn*.

Parameterizing Example:

Number	Parameter	Value	Unit
515	*ChargeAirTempLimit*	120	°C

Indication:

2908	*ChargeAirTemp*	90	°C
3033	*ErrChargeAirTempLimit*	0/1	

Activation:

4515	*ChargeAirTempWarnOn*	1	

10.3 Oil temperature warning

For oil temperature monitoring a temperature threshold for warning is set with parameter 520 *OilTempLimit*. If current oil temperature exceeds this threshold, a warning message is issued by setting the parameter 3034 *ErrOilTempWarn* to 1. When oil temperature drops below the warning threshold by more than 5°C the parameter is set to 0 again, and the error is cleared.

The actual temperature is indicated in parameter 2909 *OilTemp*. The function itself is activated by means of parameter 4520 *OilTempWarnOn*.

Parameterizing Example:

Number	Parameter	Value	Unit
520	*OilTempLimit*	90	°C

Indication:

2909	*OilTemp*	90	°C
3034	*ErrOilTempWarn*	0/1	

Activation:

4520	*OilTempWarnOn*	1	

10.4 Exhaust gas temperature warning

For exhaust gas temperature monitoring a temperature threshold for warning is set with parameter 525 *ExhaustTempLimit*. If current exhaust gas temperature exceeds this threshold, a warning message is output by setting the parameter 3041 *ErrExhaustTempWarn* = 1. When exhaust gas temperature drops below the warning threshold by more than 10°C the parameter is set to 0 again, and the error is cleared.

The actual temperature is indicated by the parameter 2911 *ExhaustTemp*. The function itself is activated by means of the parameter 4525 *ExhaustTempWarnOn*.

Parameterizing Example:

Number	Parameter	Value	Unit
525	*ExhaustTempLimit*	700	°C

Indication:

2911	*ExhaustTemp*	*650*	*°C*
3041	*ErrExhaustTempWarn*	*0/1*	

Activation:

4525	*ExhaustTempWarnOn*	*1*

10.5 Forced idle speed in locomotive applications

On exceeding the limit temperature 510 *CoolantTempLimit*, in addition to the error message 3032 *ErrCoolantTempWarn* (↑*10.1 Coolant temperature warning*) it is possible to force the engine to run at idle speed. This function is enabled by means of the parameter 4511 *CoolantTmpWarnIdleOn*. The delay time between exceeding the temperature limit and changing over to idle speed is set via the parameter 511 *CoolantTempIdleDelay*. As soon as the error 3032 *ErrCoolantTempWarn* is cleared forced idle speed is de-activated, too.

On exceeding the limit temperature 520 *OilTempLimit*, in addition to the error message 3034 *ErrOilTempWarn* (↑*10.3 Oil temperature warning*) it is possible to force the engine to run at idle speed. This function is enabled by means of the parameter 4521 *OilTempWarnIdleOn*. The delay time between exceeding the temperature limit and changing over to idle speed is set via the parameter 521 *OilTempIdleDelay*. As soon as the error 3034 *ErrOilTempWarn*is cleared, forced idle speed is de-activated too.

Note

The control units ARCHIMEDES, PANDAROS and ORION are not suited for locomotive operation.

10.6 Speed dependent oil pressure monitoring

With rising speed the engine will need higher oil pressure. For monitoring oil pressure, two characteristics are provided. Actual oil pressure (↑2905 *OilPressure*) is checked by a pressure sensor.

After starting the engine, a certain time will have elapsed before oil pressure builds up. This can be taken account of by delaying the beginning of oil pressure monitoring after engine start by means of the parameter 500 *OilPressStartDelay*.

If oil pressure remains below the oil pressure warning characteristic for a period longer than defined by 501 *OilPressWarnDelay*, a warning message will be output by the parameter 3030 *ErrOilPressWarn* = 1. This oil pressure warning is automatically cleared as soon as oil pressure returns to a value above the oil pressure warning characteristic.

If oil pressure remains below the emergency stop characteristic for a period longer than preset by 502 *OilPressEcyDelay* an engine emergency shutdown will be executed and indicated by the parameter 3031 *ErrOilPress-Ecy* = 1.

Once the engine has stopped, the errors are cleared with a time delay of approximately one second to enable the engine to be restarted. If after restarting the engine oil pressure should again be outside its normal working range, another warning is output if necessary or another emergency shutdown is executed.

The messages issued by the control are displayed by the following parameters:

3030 *ErrOilPressWarn*	0 = oil pressure above warning characteristic 1 = oil pressure below warning characteristic
3031 *ErrOilPressEcy*	0 = oil pressure above emergency stop characteristic 1 = oil pressure below emergency stop characteristic, engine shutdown has been executed.

The values for the oil pressure characteristics are stored at these parameter positions

6500 to 6509 *OilPressWarn:n(x)*:	speed values for oil pressure warning curve
6520 to 6529 *OilPressWarn:p(x)*:	oil pressure values for oil pressure warning curve
6550 to 6559 *OilPressEcy:n(x)*:	speed values for oil pressure emergency stop curve
6570 to 6579 *OilPressEcy:p(x)*:	oil pressure values for oil pressure emergency stop curve.

Parameterization is to be conducted according to ↑*3.7 Parameterization of characteristics*. 10 pairs of values are available for each curve.

The characteristics are activated by setting the following parameters:

4500 *OilPressWarnCurveOn* = 1	for the oil pressure warning characteristic
4501 *OilPressEcyCurveOn* = 1	for the oil pressure emergency stop characteristic.

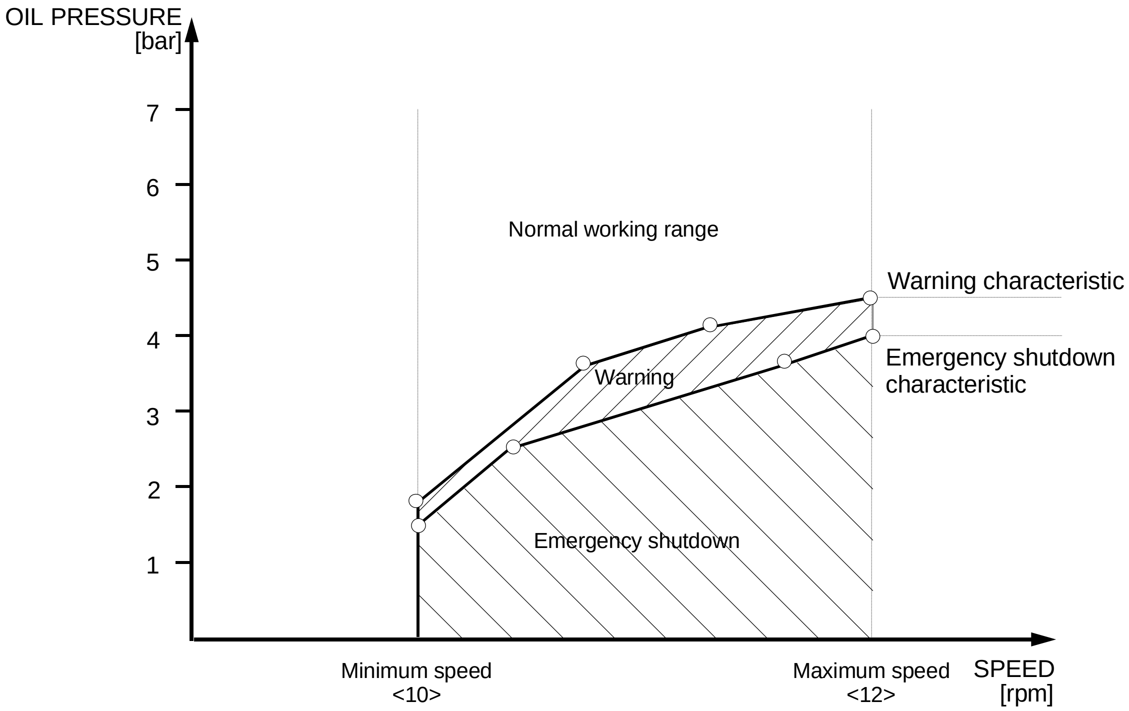


Fig. 32: Oil pressure characteristics

Parameterizing Example:

The oil pressure warning characteristic and the oil pressure emergency stop characteristic are to be parameterized using 3 pairs of values for each. No monitoring is provided below minimum speed of 700 rpm. This is achieved by setting the first values of both characteristics to 0 bar. For values beyond the last parameterized speed value (in this example index 3) the oil pressure value associated with this last value shall be retained. Oil pressure monitoring is supposed to become active after a time delay of 45 seconds. When pressure has been below the oil warning characteristic for more than 3 seconds a warning is to be issued. If pressure remains below the oil pressure emergency stop characteristic for more than 1 second, an emergency shutdown is to be executed.

Number	Parameter	Value	Unit
500	*OilPressStartDelay*	*45.0*	*s*
501	*OilPressWarnDelay*	*3.0*	*s*
502	*OilPressEcyDelay*	*1.0*	*s*

Number	Parameter	Value	Unit	Number	Parameter	Value	Unit
6500	*OilPressWarn:n(0)*	*699*	*rpm*	*6520*	*OilPressWarn:p(0)*	*0*	*bar*
6501	*OilPressWarn:n(1)*	*700*	*rpm*	*6521*	*OilPressWarn:p(1)*	*1.8*	*bar*
6502	*OilPressWarn:n(2)*	*1200*	*rpm*	*6522*	*OilPressWarn:p(2)*	*3.3*	*bar*
6503	*OilPressWarn:n(3)*	*2100*	*rpm*	*6523*	*OilPressWarn:p(3)*	*4.5*	*bar*
6504	*OilPressWarn:n(4)*	*0*	*rpm*	*6524*	*OilPressWarn:p(4)*	*0*	*bar*
6550	*OilPressEcy:n(0)*	*699*	*rpm*	*6570*	*OilPressEcy:p(0)*	*0*	*bar*
6551	*OilPressEcy:n(1)*	*700*	*rpm*	*6571*	*OilPressEcy:p(1)*	*1.5*	*bar*
6552	*OilPressEcy:n(2)*	*1000*	*rpm*	*6572*	*OilPressEcy:p(2)*	*2.5*	*bar*
6553	*OilPressEcy:n(3)*	*2100*	*rpm*	*6573*	*OilPressEcy:p(3)*	*4.0*	*bar*

6554	*OilPressEcy:n(4)*	*0*	*rpm*	*6574*	*OilPressEcy:p(4)*	*0*	*bar*

Activation:

4500	*OilPressWarnCurveOn*	*1*
4501	*OilPressEcyCurveOn*	*1*

10.7 Speed dependent coolant pressure monitoring

With rising speed the water-cooled engine will need higher coolant pressure. For monitoring coolant pressure, two characteristics are provided. Actual coolant pressure (↑2916 *CoolantPressure*) is checked by a pressure sensor.

After starting the engine, a certain time will have to elapse for coolant pressure to build up. This can be taken account of by delaying the beginning of coolant pressure monitoring after engine start by means of the parameter 505 *CoolPressStartDelay*.

If coolant pressure remains below the warning characteristic for a period longer than defined by 506 *CoolPressWarnDelay* a warning message is output via the parameter 3044 *ErrCoolPressWarn* = 1. This pressure warning is automatically cleared as soon as the coolant pressure returns to a value above the pressure warning characteristic.

On falling below a second characteristic for a period longer than preset by 507 *CoolPressIdleDelay* forced idle speed can be initiated. This function is enabled by setting the parameter 3045 *ErrCoolPressIdle* = 1. When after enabling forced idle speed the characteristic is exceeded again by 10 % the parameter 3045 *ErrCoolPressIdle* is cleared and forced idle speed abandoned. This function is chiefly used in locomotive operation.

The messages issued by the control are displayed by the following parameters:

3044 *ErrCoolPressWarn*	0 = coolant pressure above warning characteristic 1 = coolant pressure below warning characteristic
3045 *ErrCoolPressIdle*	0 = coolant pressure above forced idle speed characteristic 1 = coolant pressure below forced idle speed characteristic

The values for the coolant pressure characteristics are stored at these parameter positions:

6530 to 6539 *CoolPressWarn:n(x)*:	speed values for coolant warning characteristic
6540 to 6549 *CoolPressWarn:p(x)*:	pressure values for coolant warning characteristic
6580 to 6589 *CoolPressIdle:n(x)*:	speed values for coolant pressure forced idle speed
6590 to 6599 *CoolPressIdle:p(x)*:	pressure values for coolant pressure forced idle speed

Parameterization is to be conducted according to ↑*3.7 Parameterization of characteristics*. To parameterize the characteristics, 10 pairs of values are available for each.

The characteristics are activated by setting the following parameters:

4505 *CoolPressWarnCurveOn* = 1 coolant pressure warning curve

4506 *CoolPressIdleCurveOn* = 1 coolant pressure monitoring, forced idle speed

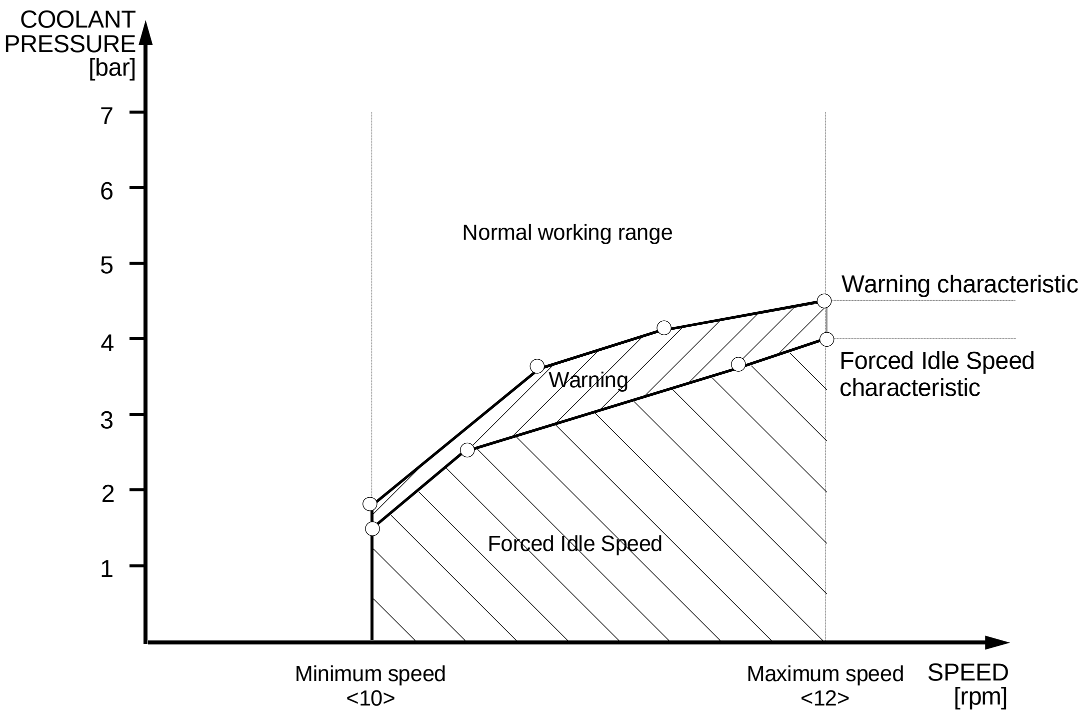


Fig. 33: Coolant pressure characteristics

10.8 Misfire monitoring in generator operation

Misfire monitoring can be implemented in the firmware on request. It is based on the observation of the speed variation caused by each ignition.

Although misfire monitoring is conceived primarily for gas engines, it can be used with diesel engines too, for example when conditions require the use of very bad quality fuel.

When 4050 *SpeedVarDetectOn* is active, the control unit calculates a unit for speed variance on the basis of 2000 *Speed* and the sampling value 50 *SpeedVarSampleSize* while the engine is running and indicates it as 2050 *SpeedVariance*. The value changes if single cylinders misfire. Since speed change is load-dependent even if the engine ignites correctly, for the error message both a warning and a shutdown characteristic are defined, both of which are load-dependent.

Note

Should the speed pickup 1 fail and the redundant speed pickup 2 take over its task, misfire monitoring can continue only if pickup 2 is mounted on the same toothed gear as pickup 1.

To determine the parameter for misfire monitoring, on the engine test stand single cylinders must be switched off and the sampling value 50 *SpeedVarSampleSize* must be determined in relation to 2050 *SpeedVariance*.

1. Let the engine run at rated speed and rated load under normal conditions. All cylinders must ignite correctly. The function 4050 *SpeedVarDetectOn* must be active and the functions 4055 *MisfireWarnCurveOn* and 4056 *MisfireEcyCurveOn* must be disabled.
2. Raise parameter 50 *SpeedVarSampleSize* step by step from 3 to max. 20. Good results were recorded for the values 9 and 12. Record the value of 2050 *SpeedVariance* for each step.
3. Switch off one cylinder, maintaining the load as far as possible.
4. Repeat step 2 for this load and this switched-off cylinder. In doing so, optimize the filter constant 51 *SpeedVarFilterConst* used for determining 2050 *SpeedVariance*. The value of 2050 *SpeedVariance* must increase in comparison to normal conditions.
5. Record the value of 50 *SpeedVarSampleSize* for which the relative increase of 2050 *SpeedVariance* is highest. The best sensibility is found when the <u>relation</u> between 2050 *SpeedVariance* on misfiring and normal ignition is highest.
6. Now determine parameter 50 *SpeedVarSampleSize* for the other switched-off cylinders and, if required, for different loads by repeating steps 2 to 5.
7. Choose the value of parameter 50 *SpeedVarSampleSize* which yields the clearest relative variation in 2050 *SpeedVariance* under all conditions and represents the best compromise for the measurements taken under different loads and with different inactive cylinders.

Note

Filtering of speed signals for is on principle always done over two crankshaft rotations when misfire monitoring is implemented in the firmware (↑6.2 Speed measurement).

To determine the thresholds for monitoring and error messages proceed as follows:

1. Using the identified value for 50 *SpeedVarSampleSize*, run the engine to several load points both under normal conditions and with selected cylinders switched-off. Two different load-dependent curves for 2050 *SpeedVariance* result, one representing the "good" and the other the "bad" operating conditions. Pay attention that the curves differ noticeably from each other at all chosen load points.
2. Record the load value in 6000 *MisfireWarn:P(x)* and 6020 *MisfireEcy:P(x)* respectively. Draw the warning characteristic and shutoff characteristic between the two limit characteristics and record the respective values in 6010 *MisfireWarn:nVar(x)* and 6030 *MisfireEcy:nVar(x)*. Enable the functions 4055 *MisfireWarnCurveOn* and/or 4056 *MisfireEcyCurveOn*.

3. Determine the delay times for 55 *MisfireWarnDelay* and 56 *MisfireEcyDelay*. Only when the current value of 2050 *SpeedVariance* has exceeded the warning and/or the shutoff characteristic for at least the respective time indicated the errors 3046 *ErrMisfireWarn* / 3047 *ErrMisfireEcy* are triggered.
   When the value of 2050 *SpeedVariance* falls below the load-dependent trigger level by relative 15 % the error 3046 *EErrMisfireWarns* cleared. The emergency shutoff signal 3047 *ErrMisfireEcy* on the other hand can be cleared only by a ↑*3.10 Reset of control unit*, or by an error clearing through a communication module or switch function.

10.8.1 Single cylinder recognition

Misfire monitoring may optionally be expanded to indicate the cylinder responsible for misfiring. This is possible on condition that misfire monitoring in general is active and a signal from the camshaft is available (with one impulse each crankshaft rotation), on the basis of which the control unit may identify the sequence of cylinders.

In the systems ARCHIMEDES, PRIAMOS and HELENOS the camshaft signal is connected to the input of the second speed pickup. The second speed pickup must be de-activated for redundant speed measuring by setting 4002 *PickUp2On* = 0. The input is configured as camshaft signal reader instead by setting 4005 *CamIndexOn* = 1.

In the system PANDAROS the camshaft signal must be connected to PWM-input 3 (4805 *PUp2_PWMIn3OrDigIn5* = 1). This input too is configured as camshaft signal reader by setting 4005 *CamIndexOn* = 1.

In the system ORION the camshaft signal must be connected to PWM-input 3 (4805 *Pup2_PWMInOrDigIn3* = 1). This input too is configured as camshaft signal reader by setting 4005 *CamIndexOn* = 1.

i *Since these inputs are not prepared for inductive pickups, in the systems PANDAROS and ORION only a Hall impulse sensor can be used for reading the camshaft signal.*

The speed measured at the camshaft is indicated in parameter 2009 *SpeedCamIndex*. Cylinder identification is active only when the camshaft signal is forthcoming and parameter 3003 *ErrCamIndex* registers no error.

The position of the camshaft signal must be communicated to the control unit by entering it in parameter 52 *CamIndexOffset* in degrees crankshaft. In this parameter the distance of the camshaft signal to the top dead center (TDC) of cylinder 1 must be entered.

In order to identify the misfiring cylinder the control unit must know the number of cylinders and their ignition sequence. Starting from parameter 6050 *AngleCylinder1* the TDC angles of the single cylinders must therefore be entered. Unused elements must be assigned a 0. The control unit automatically recognizes the number of cylinders on basis of the assigned elements. When the parameters for the angles are set, the first data to enter must always be the TDC of cylinder 1 with a crankshaft angle of 0°. The values for the other cylinders are to be entered correspondingly in degrees of crankshaft angle.

Note

These parameters will become active only following a reset.

Example:

A 6 cylinder engine has an ignition sequence of 1-5-3-6-2-4 with an ignition setoff of 120°crank. According to the abovementioned definition, since cylinder 1 has a TDC of 0° the other TDC's will accordingly be equal to:

Cylinder	**1**	**5**	**3**	**6**	**2**	**4**
TDC	0°	120°	240°	360°	480°	600°

These values must now be entered in the cylinder sequence.

Number	Parameter	Value	Unit
6050	*AngleCylinder1*	*0.0*	*°crank*
6051	*AngleCylinder2*	*480.0*	*°crank*
6052	*AngleCylinder3*	*240.0*	*°crank*
6053	*AngleCylinder4*	*600.0*	*°crank*
6054	*AngleCylinder5*	*120.0*	*°crank*
6055	*AngleCylinder6*	*360.0*	*°crank*
6056	*AngleCylinder7*	*0.0*	*°crank*
:	:	:	:
6069	*AngleCylinder20*	*0.0*	*°crank*

For the unused positions of 6056 *AngleCylinder7* to 6069 *AngleCylinder20*, the value of 0° crank must be entered in each case.

The number of cylinder recognized by the control unit is then indicated in parameter 2083 *NumberOfCylinders*.

If a misfiring is now registered by 3046 *ErrMisfireWarn* or 3047 *ErrMisfireEcy* while the engine is running, parameter 2081 *MisfireCylinderNo* will now indicate the cylinder responsible for misfiring. In addition, parameter 2080 *VarianceMaxAngle* will indicate the calculated TDC angle and parameter 2082 *MisfireCylinderAngle* the assigned TDC angle of the cylinder in question.

Note

The precision of recognition depends on the number of teeth on the crankshaft, the quality of the speed signal and also on the number of cylinders. A 12 or 16 cylinder engine with a misfiring cylinder will run much smoother than a 6 or 8 cylinder engine in the same condition. With such bigger engines it is therefore possible that the indicated cylinder will *not correspond to the misfiring one but is the preceding or following one in the ignition sequence.*

During commissioning, cylinder misfire identification should be checked carefully, ideally by disabling each single cylinder in turn. Subsequently it must be verified if the indicated cylinder and the calculated TDC angle are correct. If a general displacement between indicated and effective TDC angle of the cylinder is noticed, this may be corrected in parameter 52 *CamIndexOffset*.

Note

The parameter 52 CamIndexOffset may be determined in a simple way by disabling a specific cylinder and then changing the value of parameter 52 CamIndexOffset until 2088 MisfireCylinderAngle corresponds to the TDC angle of the disabled cylinder. The value obtained in this way must at all costs be checked against those obtained for other disabled cylinders.

24 single values of cyclic speed variance are determined in order to analyze the misfiring cylinder. When the engine is running, the control unit indicates these values in the parameters ranging from 2051 *VarianceElement1* to 2074 *VarianceElement24*. The 24 elements are filtered through the same filtering constant 51 *SpeedVarFilterConst* as the general cyclic speed variance 2050 *SpeedVariance*. When the engine does not misfire, all indicated values are close to 0. As soon as a cylinder fails, the values shift. The misfiring cylinders is where the values are lowest.

10.9 Alternator charge monitoring

In control units of the ARCHIMEDES type the battery may be monitored in order to see whether the alternator is charging the battery. To this purpose, alternator voltage is to be measured at terminal D+ with 2905 *Alternator* by connecting it to analogue input 6.

If alternator charge monitoring has been activated with 5300 *AlternVoltSupviseOn* = 1, the warning 3040 *ErrAlternatorWarn* is issued when the value falls below 1301 *AlternatorLowValue*. As soon as 1302 *AlternatorHighValue* is exceeded, the warning is automatically cleared.

Monitoring starts after *1300 AlternatorDelayTime* after each engine start.

10.10 Electronics monitoring

In order to safeguard operational safety, electronic devices carry out autotests. The following table informs about what is monitored and what errors are set in each case. There is a description of the tests carried out only when the control unit is booted. ↑ *27.7* Emergency shutdown errors indicates, which errors lead to an emergency stop or inhibit the engine start, respectively. In ↑ *27.8* Error parameter list each single error is described in detail.

Errors	Reason

Errors	**Reason**
3075 *ErrClearFlash*	Error erasing the flash memory (indicated in bootloader)
3076 *ErrParamStore*	Error saving parameters
3077 *ErrProgramTest*	Error during permanent check of programme memory
3078 *ErrRAMTest*	Error during permanent check of RAM memory
3081 *Err5V_Ref*	Error in voltage reference values
3085 *ErrVoltage*	Operating voltage too high or too low
3089 *ErrWatchdog*	Undefined programme flow, internal programming error (indication in bootloader)
3090 *ErrData*	No parameters available or checksum over parameters wrong (after programme download always active in ARCHIMEDES, ORION and PANDAROS)
3091 *ErrLogical*	Error in parameter structure (HELENOS and PRIAMOS)
3093 *ErrStack*	Stack overflow, internal programming error
3094 *ErrIntern*	Exception, internal programming error

10.10.1 Voltage references

Some control units use voltage reference values for ratiometric measurement of analogue inputs. The values must lie within fixed limits determined by the software and hardware, otherwise an error is output and the respective analogue inputs cannot be corrected.

ARCHIMEDES:	3603 *5VRefAnalog/TempIn1*	3081 *Err5VRefAna/TempIn1*
	3604 *5VRefAnalog/TempIn2*	3082 *Err5VRefAna/TempIn2*
	3605 *5VRefAnalog/TempIn3*	3083 *Err5VRefAna/TempIn3*
	3606 *5VRefAnalog/TempIn4*	3084 *Err5VRefAna/TempIn4*
ORION, PANDAROS:	3603 *5V_Ref*	3081 *Err5V_Ref*

10.10.2 RAM test

When the application is running, the whole utilized RAM is tested. The address of the currently tested cell is indicated in 3895 *RAMTestAddr*. The current test value is indicated in 3896 *RAMTestPattern*. Whenever a faulty cell is recognized, both these indications stop, error 3078 *ErrRAMTest* is output and the engine is stopped.

10.10.3 Application memory test

When the application is running, application memory is tested. The checksum for the whole application memory is calculated progressively and then compared with the saved checksum. If they don’t match, error 3077 *ErrProgramTest* is output and the engine is stopped.

10.10.4 Stack depth test

To execute subprogrammes and interrupt service routines a stack is required. The utilization of this memory is constantly monitored and error 3093 *ErrStack* is output when it runs too low. At the same time, an emergency stop is carried out when the engine is running, since ordinary programme sequence is not guaranteed.

10.10.5 Programme sequence test

While the application is running, it is tested whether the software runs through valid memory ranges. If this is not the case, exception error 3094 *ErrIntern* is output and the engine is stopped. From the values indicated starting from 3095 *ExceptionNumber*, HEINZMANN is able to derive information on the type of error that has occurred.

The value indicated in 3865 *CalculationTime* allows to determine how much computer time the current application requires. The value 3870 *Timer* is a millisecond indicator running end-to-end, used internally for time-dependent functions and influencing the graphical representation of DcDesk 2000.

10.10.6 Monitoring of power supply

Operating voltage 3600 *PowerSupply* is monitored by every control unit. While in ARCHIMEDES, HELENOS and PRIAMOS each crossing of the voltage limits in excess or in defect by the unfiltered operating voltage 3602 *PowerSupplyRaw* is registered immediately in 3085 *ErrVoltage*, ORION and PANDAROS are able tolerate a drop of battery voltage for a certain time before the error is output.

Normally these two control units carry out a reset when voltage is lower than 9 V. If the function 5600 *LowPowerEnable* is active and the hardware allows it, a low voltage of 8.5 V is tolerated for 20 s and, according to the 12 V battery norm, a voltage below 7 V is tolerated for 1 s. Thereafter the voltage must stay above 9 V for at least three times the duration it had been low before a new occurrence of undervoltage can be tolerated.

If voltage drops for longer than allowed, error 3085 *ErrVoltage* is output.

The function 5600 *LowPowerEnable* can be enabled/disabled at any time but it becomes valid only after a reset of the control unit. 3601 *LowPowerEnabled* shows whether the used control unit hardware is suited for the function.

11 Additional functions

11.1 Engine operating hours counter

Operating hours of the running engine are recorded in 3871 *OperatingHourMeter* and 3872 *OperatingSecondMeter*. An engine is considered running when parameter 3805 *EngineRunning* is set.

The engine operating hours counter is used for ↑*27.4 Error memory*, in order to save each error with the time of its first and last occurrence. The engine operating hours counter can be reset only by means of the special function "Delete operating data" in ↑*3.3 DcDesk 2000* or with the handheld programmer HP 03.

Note

The operating hours counter is available in controls of ARCHIMEDES, ORION and PANDAROS type. It may provided in the system HELENOS on request.

11.2 Jet Assist

The control unit can assist the turbocharger by injecting additional air at specific operating points. This is useful, for instance, in case of load additions. To this purpose, a booster is addressed via a digital output whenever current boost air pressure lies below a curve parameterized in dependence of fuel (↑*20.8 Digital outputs*). This allows to boost pressure for a (compressor-dependent) presettable maximum duration.

1247 *JetAstMaxBoostDiff*	max. admissible distance to curve (hysteresis)
1248 *JetAstMaxBoostDTime*	max. duration for boost signal
3247 *JetAstActive*	boost signal
3248 *JetAstCurrBoostDiff*	current distance to curve
5247 *JetAssistOn*	function enabled
6480 *JetAstBoostDiff:f*	fuel base points
6490 *JetAstBoostDiff:p*	boost air pressure values

If current boost air pressure 2904 *BoostPressure* for current fuel is lower than the curve value minus 1247 *JetAstMaxBoostDiff*, 3247 *JetAstActive* is activated until boost air pressure returns above the curve, but at longest for the duration 1248 *JetAstMaxBoostDTime*. Current pressure difference between the curve value and 2904 *BoostPressure* is indicated in 3248 *JetAstCurrBoostDiff*, whenever boost air pressure is below the curve.

11.3 Starting request

Control units of the type ARCHIMEDES are able to start the engine on their own. To this purpose a start request must be transmitted to the control with the switching function 2849 *SwitchStartEngine* while the engine is standing. If this occurs, parameter 3808 *EngineStarter* is set. This parameter must be connected to the starter via one of the digital outputs 5, 6 which are able to drive 12 V (↑*20.8 Digital outputs* and ↑*19.2.7 Digital outputs*). With 4849 *StartImpulseOrSwitch* it can be decided whether the starter shall be disabled as soon as the function 2849 *SwitchStartEngine* is disabled or if a single impulse to this switching function is sufficient to activate the starter until it is switched off by other conditions.

4849 *StartImpulseOrSwitch* = 0	engine start command continues only as long as 2849 *SwitchStartEngine* remains active
4849 *StartImpulseOrSwitch* = 1	a single switching pulse activates engine start

On reaching speed as set in 256 *StartSpeed2*, the control recognizes that the engine is running. This is also indicated by parameter 3805 *EngineRunning* (also see ↑*5 Starting fuel limitation*). At this moment, parameter 3808 *EngineStarter* is set back and the starter correspondingly de-activated.

In any case, the starter is addressed at most for the duration of 280 *StarterCrankTimeMax*. If the engine does not start within this time, the starter is de-activated. After the waiting time of 281 *StarterInterlockTime* a further starting attempt is undertaken. The maximum number of cranking attempts is set in 282 *StarterCrankAttempts*. Should the engine not have started after the max. number of cranking attempts, error message 3039 *ErrStarter* is output and the starting request is terminated. A repetition of cranking attempts is possible by setting the starting request again with 2849 *SwitchStartEngine*.

12 Vehicle operation

HEINZMANN control units may be used as idle/maximum speed controls in the operative mode vehicle application (↑*7.2 Vehicle operation*), i.e., it is possible to switch between the operation modes of variable speed control and idle/maximum speed control (e.g., for applications with stationary and driving operation).

12.1 Idle/maximum speed control

The control unit may be operated by standard as an idle/maximum speed control. This mode is selected by the parameters:

Number	Parameter	Value	Unit
1810/3810	*OperationMode*	*1*	
Activation:			
4130	*IMGovernorOn*	*1*	

This parameter 4130 *IMGovernorOn* (IM = **I**dle/**M**aximum) applies when only idle/maximum speed control is required or when idle/maximum speed operation at fixed intermediary speeds via external switches (fixed speeds or idle speed) is envisaged.

If, however, change-over between operation as an idle/maximum speed control and variable speed control with variable speed setting (e.g., by foot throttle) is desired the switching function 2831 *SwitchIMOrAllSpeed* is to be used:

2831 *SwitchIMOrAllSpeed* = 0 variable speed control

2831 *SwitchIMOrAllSpeed* = 1 idle/maximum speed control.

The control unit will operate in idle/maximum speed control mode only if there is no need for intermediary speeds. The parameter 2141 *IMOrAllSpeedGov* is therefore provided to check on which mode the control is currently operating by:

2141 *IMOrAllSpeedGov* = 0 variable speed control

2141 *IMOrAllSpeedGov* = 1 idle/maximum speed control.

At idle and at maximum speeds the control unit's performance is the same as that of the variable speed control. Between idle speed and absolute maximum speed (maximum speed limit line), the fuel setpoint is determined by the active setpoint adjuster 2900 *Setpoint1Extern* or 2901 *Setpoint2Extern* respectively.

12.1.1 Fuel Setpoint

The fuel setpoint is determined by 2900 *Setpoint1Extern* or 2901 *Setpoint2Extern* respectively, depending on the position of 2827 *SwitchSetpoint2Or1* (PANDAROS and ORION have only one setpoint adjuster).

In addition, there is the option to freeze the fuel setpoint via a switch and to continue operation using the frozen setpoint (not for ORION). This is indicated by the parameter

2829 *SwitchFreezeSetp1* = 1	value of setpoint 1 has been frozen
2830 *SwitchFreezeSetp2* = 1	value of setpoint 2 has been frozen.

The setpoint coming in when the function is activated will be frozen. As long as the function is active, the current setpoint will be compared with the stored setpoint. If the set value coming from the setpoint adjuster exceeds the frozen value, operation will continue using the current value of the setpoint adjuster; otherwise the frozen value is used. The frozen setpoint, however, will be abandoned only when the switch is opened.

The chosen fuel setpoint is indicated by 2133 *IMFuelSetpExtern*. This value may be used directly as fuel setpoint or else the fuel setpoint is derived from a fuel setpoint and speed dependent map – the ↑*12.1.2* Drive map. In any case, the resulting fuel setpoint for the idle/maximum governor is indicated by parameter 2131 *IMFuelSetp*.

12.1.2 Drive map

The drive map allows to interpret the accelerator pedal position at different speeds so as to achieve optimal injection quantity for the required torque. This function is purely for the comfort of the driver.

The value coming from the setpoint adjuster used for the speed map is indicated by 2133 *IMFuelSetpExtern*. The resulting fuel setpoint is indicated by parameter 2131 *IMFuelSetp*. The drive map is activated by parameter 4132 *IMDriveMapOn*.

The values for the map are stored at the following parameter positions:

8100 to 8108 *IMDriveMap:n(x)*	speed values for speed map
8109 to 8117 *IMDriveMap:Setp(x)*	setpoints for drive map
8118 to 8198 *IMDriveMap:f(x)*	fuel values for speed map

The drive map can be adjusted with up to 9 speed values and setpoints. Intermediary values between adjacent pairs of variates will be interpolated by the control ↑*3.8 Parameterization of maps*.

Parameterizing Example:

Number	Parameter	Value	Unit
8100	*IMDriveMap:n(0)*	*800*	*rpm*
8101	*IMDriveMap:n(1)*	*1000*	*rpm*
8102	*IMDriveMap:n(2)*	*1200*	*rpm*
8103	*IMDriveMap:n(3)*	*1600*	*rpm*
8104	*IMDriveMap:n(4)*	*2000*	*rpm*
8109	*IMDriveMap:Setp(0)*	*10*	*% (foot throttle)*
8110	*IMDriveMap:Setp(1)*	*30*	*%*
8111	*IMDriveMap:Setp(2)*	*50*	*%*
8112	*IMDriveMap:Setp(3)*	*70*	*%*
8113	*IMDriveMap:Setp(4)*	*100*	*%*

8118	*IMDriveMap:f(0)*	*8*	*% (fuel)*
8119	*IMDriveMap:f(1)*	*10*	*%*
8120	*IMDriveMap:f(2)*	*10*	*%*
8121	*IMDriveMap:f(3)*	*8*	*%*
8122	*IMDriveMap:f(4)*	*7*	*%*
8127	*IMDriveMap:f(9)*	*25*	*%*
8128	*IMDriveMap:f(10)*	*28*	*%*
8129	*IMDriveMap:f(11)*	*30*	*%*
8130	*IMDriveMap:f(12)*	*30*	*%*
8131	*IMDriveMap:f(13)*	*28*	*%*
8136	*IMDriveMap:f(18)*	*40*	*%*
8137	*IMDriveMap:f(19)*	*40*	*%*
8138	*IMDriveMap:f(20)*	*40*	*%*
8139	*IMDriveMap:f(21)*	*40*	*%*
8140	*IMDriveMap:f(22)*	*40*	*%*
8145	*IMDriveMap:f(27)*	*60*	*%*
8146	*IMDriveMap:f(28)*	*70*	*%*
8147	*IMDriveMap:f(29)*	*70*	*%*
8148	*IMDriveMap:f(30)*	*70*	*%*
8149	*IMDriveMap:f(31)*	*80*	*%*
8154	*IMDriveMap:f(36)*	*80*	*%*
8155	*IMDriveMap:f(37)*	*90*	*%*
8156	*IMDriveMap:f(38)*	*90*	*%*
8157	*IMDriveMap:f(39)*	*90*	*%*
8158	*IMDriveMap:f(40)*	*90*	*%*

<u>Activation:</u>

4132	*IMDriveMapOn*	*0/1*

12.1.3 Controlling idle and maximum speeds

For the idle/maximum speed control, idle speed is determined by the parameters 10 *SpeedMin1* and 11 *SpeedMin2*, respectively *(↑ 7.1 General application*). With low temperatures, this value can be raised by *↑ 7.6 Temperature dependent idle speed* (not available in ORION). Likewise, maximum speed is given by the respective parameters 12 *SpeedMax1* and 13 *SpeedMax2*. (PANDAROS and ORION offer only one speed range [10 *SpeedMin*, 12 *SpeedMax*].)

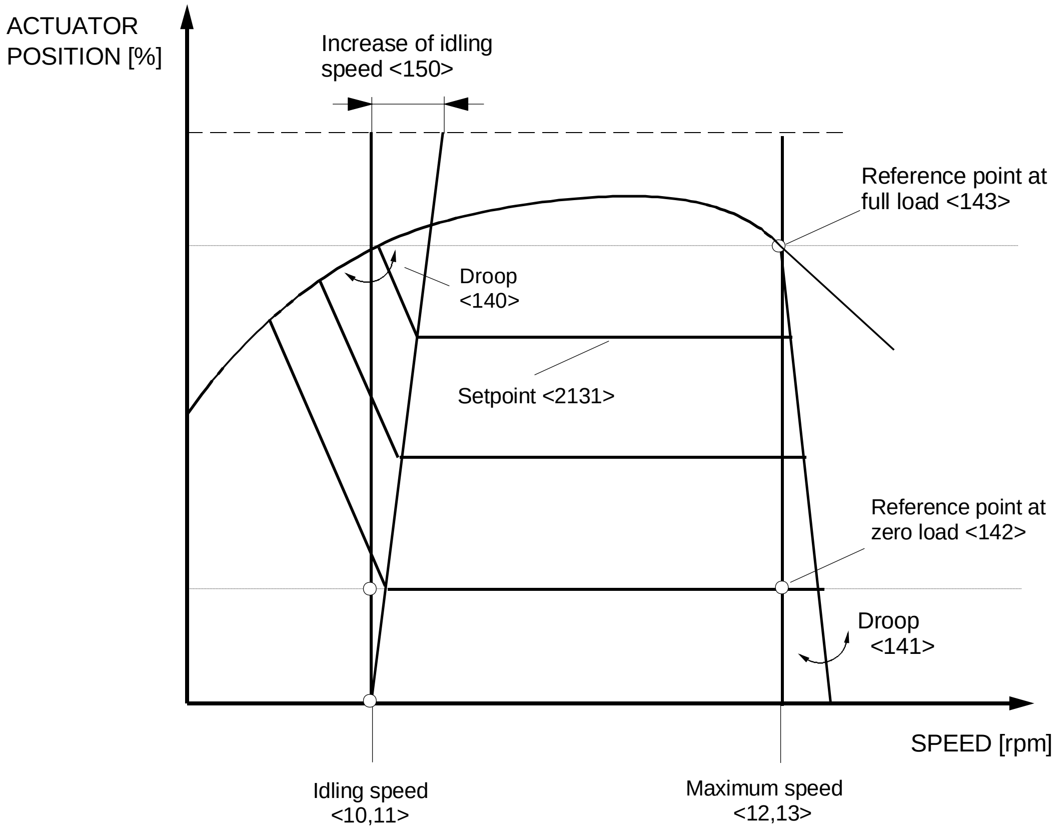


Fig. 34: Idle/maximum speed control

When in idle/maximum speed control mode, the speed control will be on-line all the time using either idle speed or maximum speed as a target speed. Which speed the control unit is operating at can be read from the parameter 2140 *GoverningAtMaxOrIdle.*

2140 *GovernorAtMaxOrIdle* = 0	idle speed control
2140 *GovernorAtMaxOrIdle* = 1	maximum speed control.

Independently of ↑ *7.8 Droop* for the variable speed control, a separate droop is available for idle/maximum speed control. Droop for idle speed control is defined by 140 *IMIdleDroop* and for maximum speed limitation by 141 *IMMaximumDroop*. The reference point for zero-load is to be entered via the parameter 142 *IMDroopRefLow* and that for full-load via 143 *IMDroopRefHigh*.

The speed reference point is in each case given by the minimum and maximum speed respectively:

140 *IMIdleDroop*	Droop for idle speed control
141 *IMMaximumDroop*	Droop for maximum speed limit
142 *IMDroopRefLow*	Reference point for zero-load
143 *IMDroopRefHigh*	Reference point for full-load.

12.1.4 On-load idle speed

When the control is operating in idle/maximum speed control mode, it will in the majority of cases not be desirable to keep idle speed constant. Instead, idle speed will be increased with higher fuel setpoints. This can be achieved through the parameter 150 *IMSpeedIncrease*, which indicates the relative increase of idle speed for 100 % fuel quantity.

Parameterizing Example:

Number	Parameter	Value	Unit
150	*IMSpeedIncrease*	*100*	*rpm*

12.1.5 Fuel ramp

When operating in idle/maximum speed control mode, it may be necessary to delay increase injection quantity, e.g., in order to reduce free acceleration. This can be achieved by activating a fuel ramp.

The rate of the delay can be adjusted for setpoint increase and setpoint decrease independently of one another.

130 *IMRampUp* for upward ramps

131 *IMRampDown* for downward ramps.

The unit for these parameters is increase or decrease speed per second, respectively. Both ramps are enabled by the parameter 4131 *IMFuelRampOn*. If ramping is to be selected for one direction only, the maximum value must be entered for the other direction.

The fuel quantity setpoint as delayed by the ramp can be read from the parameter 2131 *IMFuelSetp*. The parameter 2132 *IMFuelSetpSelect* represents the fuel quantity setpoint the ramp is to arrive at.

Parameterizing Example:

Number	Parameter	Value	Unit
130	*IMRampUp*	*400.0*	*%/s*
131	*IMRampDown*	*700.0*	*%/s*

Activation:

4131	*IMFuelRampOn*	*1*

Note

This fuel ramp may be used only when the control is operating in idle/maximum speed control mode. For variable speed control mode, a ↑7.7 Speed ramp is provided to achieve smooth speed changes for this mode of operation, too.

13 Locomotive operation

Applications for locomotive operation are possible only with the control units HELENOS and PRIAMOS. For diesel-electric applications the system PEGASOS with integrated HELENOS control unit is particularly suited.

There are many special applications for locomotive operation. Part of them relate to determination of speed setpoints (↑ *7.3 Locomotive operation*), others to manipulation of generator excitation with diesel-electric applications. Furthermore, forced idle speed as is normally used in locomotive applications on exceeding or dropping below certain sensor values (↑ *10.5 Forced idle speed in locomotive applications*) can be implemented as well as slide protection functions. Interesting for fuel saving is the reduction of lower idle speed when the machine is standing (↑ *13.3 Low idle speed*).

If any of the special locomotive functions are to be used the operation mode Locomotive operation must be set to 1810 /3810 *OperationMode* = 2.

13.1 Speed notch switches

Up to four switching functions, from 2819 *SwitchNotch3* to 2822 *SwitchNotch0*, are available to configure the speed notch switches. With these four switches 16 running notches can be determined. For 8 speed notches the switching functions from 2820 *SwitchNotch2* to 2822 *SwitchNotch0* are used.

The states of the speed notch switches can be read from these parameters:

2819 *SwitchNotch3*	Speed notch switch 3
2820 *SwitchNotch2*	Speed notch switch 2
2821 *SwitchNotch1*	Speed notch switch 1
2822 *SwitchNotch0*	Speed notch switch 0

The four available speed notch switches allow to set exactly the 16 binary values of 0…15. From the three speed notch switches 2820 *SwitchNotch2*..2822 *SwitchNotch0* result the binary values 0..7 (first eight lines of the table). The following table shows how these binary values can be determined.

Binary value	2819 *SwitchNotch3*	2820 *SwitchNotch2*	2821 *SwitchNotch1*	2822 *SwitchNotch0*
= ∑ bit values	Bit value 8	Bit value 4	Bit value 2	Bit value 1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Table 17: Speed notches from speed notch switches

In locomotive application, the speed notches may either be directly the same as the binary value resulting from the switching functions (see first column of ↑ *Table 17: Speed notches from speed notch switches*), or it may be necessary to determine the speed notch indirectly from another table via the binary value.

Whether or not direct assignment can be made, will depend on whether it is possible to realize the above binary table with the speed notch switches that are available. Possibly, some of the signals must be inverted before assigning them to the respective speed notch switch (↑*18 Configuration of* switching functions). If this is not feasible - particularly with retrofit applications - there exists an further possibility of determining the speed notches by means of a second table (↑*Table 18: Extended notch table*).

The assignment array consists of 16 components 6880 *LocoNotchAssign(0)* to 6895 *LocoNotchAssign(15)* whose indices are equal to the binary values. In each component the associated speed notch must be entered.

If a specific binary value is intended to lead to an engine stop, instead of the speed notch the value 255 should be entered. This engine stop is equivalent to any other engine stop request for what reason whatsoever (↑ 2810 *SwitchEngineStop* or ↑ *27.7* Emergency shutdown errors). If there is no speed notch associated with a specific binary value 0 will have to be entered. Should one of these combinations occur during operation, then the last value determined will be retained as speed notch value.

Note

The speed notches are always numbered from 0 to 15. But since in the table 6880 LocoNotchAssign() the value 0 means that no speed notch can be assigned, in this specific table (and only here) the speed notches must be entered in the range from 1 to 16.

The selection of whether the speed notches are to correspond directly to the binary value as derived from the switching functions or whether they are to be determined via another table must be communicated to the control by 5353 *NotchAssignOrBinary*.

5353 *NotchAssignOrBinary* = 0 Speed notch = binary value

5353 *NotchAssignOrBinary* = 1 Speed notch = LocoNotchAssign(binary value)

In either case the result is indicated by 3350 *Notch*.

<u>Parameterizing Example:</u>

The speed notches 0..7 result from four switching functions, according to the table below. The combination of 0-0-0-1 (binary value 1) should trigger an engine stop. The other seven binary combinations (3, 4, 5, 9, 11, 12, 13) do not occur or will not change the speed notch.

Notch	**2819 *SwitchNotch3***	**2820 *SwitchNotch2***	**2821 *SwitchNotch1***	**2822 *SwitchNotch0***	**Binary value**
	Bit value 8	Bit value 4	Bit value 2	Bit value 1	= ∑ bit values
Engine stop	0	0	0	1	1
0	0	0	0	0	0
1	1	0	0	0	8
2	0	0	1	0	2
3	1	0	1	0	10
4	0	1	1	1	7
5	1	1	1	1	15
6	0	1	1	0	6
7	1	1	1	0	14

Table 18: Extended notch table

Binary value and speed notch derived from the above table now are sorted in order of ascending binary values. Not used binary combinations receive the speed notch value 0. For real speed notches a value increased by 1 is entered, as it is expected for 6880 *LocoNotchAssign()*. For the engine stop request the value 255 must be used.

Binary value	Notch
0	1
1	255
2	3
3	0
4	0
5	0
6	7
7	5

Binary value	Notch
8	2
9	0
10	4
11	0
12	0
13	0
14	8
15	6

The index x of 6880 *LocoNotchAssign(x)* corresponds to the binary value from the first column. The notch value from the second column is entered in the parameters belonging to the binary value.

Number	Parameter	Value	Unit
5350	*LocoSetpoint1Mode*	*0*	
5352	*NotchAssignOrBinary*	*1*	
6880	*LocoNotchAssign(0)*	*1*	
6881	*LocoNotchAssign(1)*	*255*	
6882	*LocoNotchAssign(2)*	*3*	
6883	*LocoNotchAssign(3)*	*0*	
6884	*LocoNotchAssign(4)*	*0*	
6885	*LocoNotchAssign(5)*	*0*	
6886	*LocoNotchAssign(6)*	*7*	
6887	*LocoNotchAssign(7)*	*5*	
6888	*LocoNotchAssign(8)*	*2*	
6889	*LocoNotchAssign(9)*	*0*	
6890	*LocoNotchAssign(10)*	*4*	
6891	*LocoNotchAssign(11)*	*0*	
6892	*LocoNotchAssign(12)*	*0*	
6893	*LocoNotchAssign(13)*	*0*	
6894	*LocoNotchAssign(14)*	*8*	
6895	*LocoNotchAssign(15)*	*6*	

13.2 Generator excitation

In diesel-electric locomotive operation the digital control can influence generator excitation in dependence of current speed and fuel quantity. To this purpose, an excitation signal (correction value) is determined and output via an analogue port.

The excitation signal can be determined either by means of two characteristics and a correction factor or by a closed loop fuel quantity circuit. The first method is called excitation control, the latter excitation governing.

Generally, determination of the excitation signal is enabled with 4600 *Excitation-ControlOn* = 1. Selection of excitation control or excitation governing is made by

4601 *ExcitGovOrControl* = 0	Excitation control
4601 *ExcitGovOrControl* = 1	Excitation governing.

Selection is made during the phase of parameterization. Hence it cannot be modified while the engine is running. This will also explain why certain parameters that are required for both methods have been assigned identical addresses (parameter numbers).

Calculation of an excitation signal can be conducted only when the engine is neither at a standstill nor being stopped – in these cases the value “0” is output. In addition, the switching function 2840 *SwitchExcitationOn* has been provided. It allows to enable or disable the excitation signal by external intervention.

2840 *SwitchExcitationOn* = 1	Excitation signal enabled
2840 *SwitchExcitationOn* = 0	Excitation signal not enabled

If no external switch has been assigned to the associated parameter 840 *FunctExcitationOn* (↑*18 Configuration of* switching functions), the excitation signal will always be enabled when the engine is running and cannot be affected by external intervention.

Note

In the course of time, parameter names for generator excitation in locomotive operation have been modified to read "Excitation..." instead of "Power...". This does not imply, however, any changes with respect to their meaning.

13.2.1 Excitation control

The excitation signal 2600 *ExcitationSetpoint* is a function of current speed 2000 *Speed*, of current fuel quantity 2350 *FuelQuantity* and of the amplification factor 600 *ExcitCntrlFactor*. This means that for each speed at a specific fuel quantity there is a specific excitation signal value. If there is any difference between actual and programmed fuel quantity, there will be a reaction by varying the excitation signal via a proportional controller.

One triplet of values consists of a speed value, a fuel value and an excitation value, all with the same index. Intermediary values between two adjacent triplets of values will be computed by the control. The characteristics are evaluated based on current speed 2000 *Speed* (↑*3.7 Parameterization of characteristics*).

For parameterizing the characteristic, there are up to 16 triplets of values available for each. This implies that on using speed notches each speed notch can be assigned its own value. This is not obligatory, though.

The values of the characteristics are stored at the following parameter positions:

6600 to 6615 *ExcitControl:n(x)* :	speed values for fuel setpoint characteristic and excitation signal characteristic
6620 to 6635 *ExcitControl:f(x)* :	fuel setpoint characteristic
6640 to 6655 *ExcitControlSetp(x)*:	excitation signal characteristic.

The control will calculate the correction value with the following formula:

$$\text{Korrekturwert} = (\text{aktuelle Füllung} - \text{Füllungswert (Drehzahl)}) \bullet \frac{\text{Bewertungsfaktor}}{100\,\%} + \text{Erregungssignalwert (Drehzahl)}$$

This means that the speed dependent fuel quantity derived from characteristic 6620 *ExcitControl:f(x)* is subtracted from the current fuel quantity 2350 *FuelQuantity* and the difference is multiplied by the weighting factor 600 *ExcitCntrlFactor*. Adding the speed dependent excitation signal value 6640 *ExcitControlSetp(x)* will yield the excitation control correction value 2600 *ExcitationSetpoint*.

Hence when current fuel quantity coincides with the fuel quantity characteristic it is exclusively the excitation signal characteristic that will have an effect.

When current fuel quantity, however, does not coincide with the characteristic it is possible to choose whether the excitation signal is to be increased or decreased by modifying the weighting factor. With a negative weighting factor, a value smaller than the excitation signal value will be output whenever the current injection quantity is above the injection quantity characteristic value (generator excitation), whereas with a positive weighting factor a value larger than the excitation signal value will be output in the same case (generator de-excitation).

13.2.1.1 Fuel quantity offset

The value derived from the fuel quantity characteristic can be modified by 636 *ExcitFuelOffset*. This allows parallel shifting of the fuel quantity characteristic as might be necessary when calibration of one engine is to be transferred to another engine in case the profile of the characteristic is basically identical for both. If no such shifting is required the offset parameter must be set to 0.

13.2.1.2 Excitation ramp

Running up to the calculated excitation signal can be delayed by ramps. The ramp is to be adjusted and activated by means of the following parameters:

610 *ExcitCntrlRampUp*	upward ramp rate
611 *ExcitCntrlRampDown*	downward ramp rate
4610 *ExcitControlRampOn*	activation of the ramps.

13.2.1.3 Determination of excitation characteristics

For capturing the two characteristics, 600 *ExcitCntrlFactor* must be set to 0%. This means that it is exclusively the signal characteristic that will be relevant. Furthermore, it must be ensured that no fuel quantity limitation whatsoever is active, i.e., that all of the fuel quantity limitation functions are disabled (↑ *9 Limiting Functions*).

Then, the speed points for which certain power outputs have been defined should be run up to. At each speed supporting point the excitation signal is to be adjusted manually until the desired power output is obtained. The resulting fuel quantity can then be read from 2350 *FuelQuantity*.

Note

Measuring and indicating current power output will require using an external device.

The most convenient way of defining the speed setpoints as well as of adjusting the excitation signal is by using the PC. To do so, the parameters 4020 *SpeedSetpPCOn* and 4635 *ExcitationSetpPCOn* have to be set to 1. Speed setting is made using the parameter 20 *SpeedSetpPC*, input of the excitation signal is achieved using the parameter 635 *ExcitationSetpPC*.

Speed base points must be entered as x-values in the curve 6600..6615 *ExcitControl:n(x)* einzutragen (↑ *3.7 Parameterization of characteristics*). The determined excitation signal value is entered above the speed supporting point in the characteristic 6640..6655 *ExcitControlSetp(x)*. The fuel quantity 2350 *FuelQuantity* thus established is then to be entered in 6620..6635 *ExcitControl:f(x)* under the same index as the speed value.

Once the characteristics have been evaluated, power control via fuel quantity can be enabled by setting the factor 600 *ExcitCntrlFactor*. The greater this factor is chosen the greater an amplification of the control circuit will result. The values are determined by running up to all speeds on-load; at each point control should be as fast as possible without becoming unstable.

20 *SpeedSetpPC*	Speed setpoint adjustment via PC
600 *ExcitCntrlFactor*	Weighting factor
635 *ExcitationSetpPC*	Adjustment of excitation signal by PC
4020 *SpeedSetpPCOn*	Activate speed setpoint adjustment via PC
4635 *ExcitationSetpPCOn*	Activate adjustment of excitation signal via PC
6600..6615 *ExcitControl:n(x)*	Speed values for the characteristics
6620..6635 *ExcitControl:f(x)*	Fuel quantity values for the fuel setpoint characteristic
6640..6655 *ExcitControlSetp(x)*	Excitation signal values for the excitation characteristic

Parameterizing Example:

With diesel-electric locomotive operation, generator excitation is supposed to be controlled in such a way that in steady state operation the diesel engine follows a characteristic within the range of optimum consumption.

If the driving system is operating in accordance with the fuel quantity setpoint characteristic it is the value of the excitation characteristic that will be output. If above the fuel quantity setpoint characteristic, the signal is reduced to a lower value which implies that generator excitation is also reduced until the system is working in accordance with the characteristic again.

Let us suppose, e.g., that with a speed of 1,900 rpm actual actuator travel amounts to 70 %, and that for this speed the value of the fuel quantity setpoint characteristic is 60 %. Now, instead of the excitation characteristic value of 50 % an excitation signal of 37.5 % is to be output in order to reduce actuator travel to 60 %.

Since the weighting factor 600 *ExcitCntrlFactor* has been set to 0%, this characteristic will not take account of load. By entering in the above formula the desired influence of load upon the excitation signal, the weighting factor can be derived from it:

$$37.5\,\% = 10\,\% \bullet \frac{\text{Factor}}{100\,\%} + 50\,\%$$

This yields a weighting factor of –125% by which the entire excitation characteristic will be shifted in parallel.

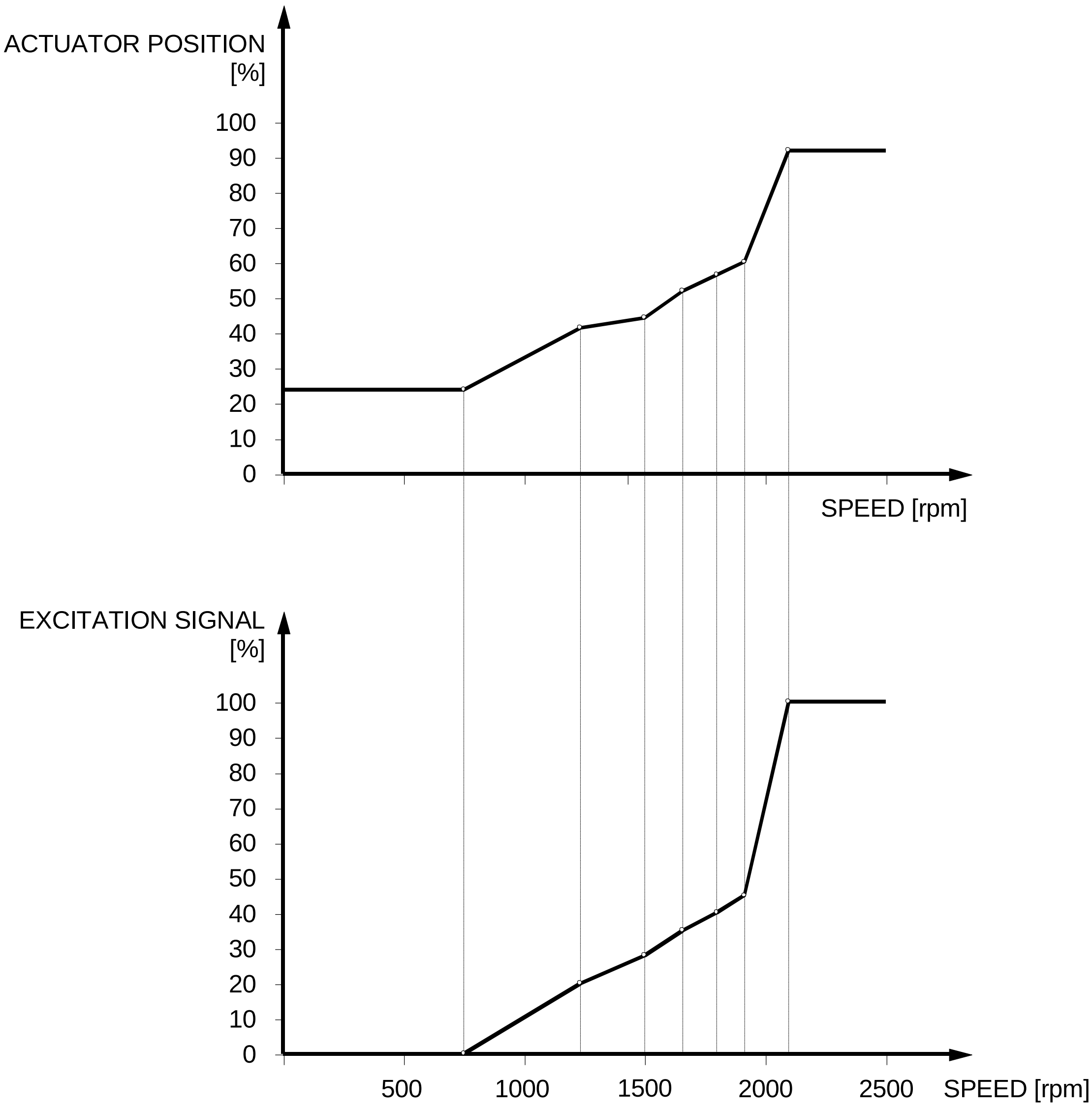


Fig. 35: Excitation control

Number	Parameter	Value	Unit
600	*ExcitCntrlFactor*	*-125*	*%*

Activation:

4600	*ExcitationControlOn*	*1*
4601	*ExcitGovOrControl*	*0*

13.2.2 Excitation governing

With excitation governing, 2600 *ExcitationSetpoint* constitutes the output signal of a fuel control circuit into which a desired fuel quantity value (reference value) and an actual fuel quantity value will enter. In contrast to excitation control, there exists no adjustable interrelation between speed and excitation signal basing on some characteristic.

The reference value for the excitation control circuit is derived from a single excitation characteristic (↑*3.7 Parameterization of characteristics*) where in dependence on speed the fuel quantities are stored that corresponds to the required generator output.

6600..6615 *ExcitControl:n(x)* :	speed values for the excitation characteristic
6620..6635 *ExcitControl:f(x)* :	fuel values for the excitation characteristic

Starting from current speed 2000 *Speed* the characteristic is evaluated, and the fuel quantity setpoint thus determined is indicated by 2602 *ExcitFuelSetpoint*, after it has been acted upon by any offsets, ramps or limitations.

The actual values of the excitation control circuit corresponds to the current, possibly limited fuel quantity setpoint 2350 *FuelQuantity* as derived from the speed control circuit.

The output value of the excitation control circuit is 2600 *ExcitationSetpoint*. This value can in addition be filtered by setting 633 *ExcitationSetpFilter* to a value greater than 1.

13.2.2.1 Fuel quantity offset

The fuel quantity setpoint value derived from the excitation characteristic can be modified by 636 *ExcitFuelOffset*. This will allow parallel shifting of the fuel quantity characteristic as might be necessary when calibration of one engine is to be transferred to another engine in case the profile of the characteristic is basically identical for both. If no such shifting is required the offset parameter must be set to 0.

13.2.2.2 Ramps for fuel quantity setpoint

The fuel quantity setpoint value (↑ *13.2.3 Power limitation*) as derived from the characteristic and possibly limited can be delayed by ramps. The ramp is to be adjusted and activated by means of the following parameters:

640 *ExcitGovFuelRampUp*	Upward ramp for fuel quantity setpoint
641 *ExcitGovFuelRampDown*	Downward ramp for fuel quantity setpoint
4640 *ExcitGovFuelRampOn*	Activation of both ramps

13.2.2.3 Adjustment of PID Parameters

The setpoint value of the fuel quantity 2602 *ExcitFuelSetpoint* and the actual value 2350 *FuelQuantity*enter go into a control circuit whose PID parameters are to be entered in

630 *ExcitGovGain*

631 *ExcitGovStability*

632 *ExcitGovDerivative*

The result is 2600 *ExcitationSetpoint*. While determining the control circuit parameters, all limiting functions should be de-activated.

To accommodate the control circuit to different operating conditions the values of 630 *ExcitGovGain* and 631 *ExcitGovStability* can be corrected in dependence on injection quantity. For unstable working points (e.g., due to non-linear interrelations between actuator travel and injection quantity or between excitation signal and generator output, or, with two cycle diesel engines, when operating within the turbocharger's range of transition from mechanical to exhaust gas drive) some decrease may be necessary whereas full load may under certain circumstances require an increase. The correction factor is to be entered in the following characteristics (↑*3.7 Parameterization of characteristics*):

6660 to 6675 *ExcitGovPI:f(x)*	injection values for PI correction
6680 to 6695 *ExcitGovPI:Corr(x)*	Correction values for P and I

Correction of the PI values is activated by setting 4630 *ExcitGovPICurveOn* = 1. The currently determined correction value is indicated by 2630 *ExcitPI_CorrFactor*.

13.2.2.4 Determination of excitation characteristic

Furthermore, it must be ensured that no fuel quantity limitation whatsoever is active, i.e., that all of the fuel quantity limitation functions are disabled (↑ *9 Limiting Functions* and ↑*13.2.3 Power limitation*).

Then, the speed points for which certain power outputs have been defined should be run up to one after another. At each speed supporting point the excitation signal is to be adjusted manually until the desired power output is obtained. The resulting fuel quantity can then be read from 2350 *FuelQuantity*.

Note

Measuring and indicating current power output will require using an external device.

The most convenient way of defining the speed setpoints as well as of adjusting the excitation signal is by using the PC. To do so, the parameters 4020 *SpeedSetpPCOn* and 4635 *ExcitationSetpPCOn* have to be set to 1. Speed setting is made using the parameter 20 *SpeedSetpPC*, input of the excitation signal is achieved using the parameter 635 *ExcitationSetpPC*.

Speed base points must be entered as x-values in the curve 6600..6615 *ExcitControl:n(x)* einzutragen. The fuel quantity thus established is then to be entered in 6620..6635 *ExcitControl:f(x)* under the same index as the speed value.

20 *SpeedSetpPC*	Speed setpoint adjustment via PC
635 *ExcitationSetpPC*	Adjustment of excitation signal by PC
4020 *SpeedSetpPCOn*	Activate speed setpoint adjustment via PC
4635 *ExcitationlSetpPCOn*	Activate adjustment of excitation signal via PC
6600..6615 *ExcitControl:n(x)*	Speed values for the excitation characteristic
6620..6635 *ExcitControl:f(x)*	Fuel quantity values for excitation characteristic.

13.2.3 Power limitation

The excitation signal 2600 *ExcitationSetpoint* that is either determined by excitation control or excitation governing can be limited by various factors.

In the case of excitation control, it is the excitation signal 2600 *ExcitationSetpoint* itself that will be subject to limitation. The currently applied limit is indicated by 2601 *ExcitControlLimit*.

With excitation governing, the excitation signal is indirectly limited by limiting the fuel quantity setpoint for the control circuit.

The parameter 2640 *ExcitLimitMaxActive* is used to indicate whether any limitation is active. The values of 2641 *ExcitFuelLimActive* through 2647 *ExcitSpeedLimActive* offer more detailed information about the causes of limitation. The different causes are described below.

Indication parameter	Used for	Reason	Reference
2640 *ExcitLimitMaxActive*	One of the following power limitations is active:		
2641 *ExcitFuelLimActive*	Excitation control and governing	Speed or boost pressure dependent fuel quantity limitation	↑*9.1 Speed dependent fuel limitation*, ↑*9.2 Boost pressure dependent fuel limitation*
2642 *ExcitForceLim1Active*, 2643 *ExcitForceLim2Active*	Excitation control and governing	Power limitation selected by switching function	↑*13.2.3.1 Externally activated power limitation*
2644 *ExcitSlideLimActive*	Excitation control and governing	Power limitation by active slide protection	↑*13.4 Slide protection*
2645 *ExcitTempLimActive*	Excitation governing	Temperature dependent power reduction	↑*13.2.3.2 Temperature dependent power reduction*
2646 *ExcitBoostLimActive*	Excitation governing	Boost pressure dependent power limitation	↑*13.2.3.3 Boost pressure dependent power limitation*
2647 *ExcitSpeedLimActive*	Excitation governing	Speed-dependent power limitation	↑*13.2.3.4 Speed dependent power limitation*

Table 19: Excitation signal limitation

13.2.3.1 Externally activated power limitation

Activation of the switch functions 2823 *SwitchExcitLimit1* or 2824 *SwitchExcitLimit2*, respectively, offers the possibility of limiting the excitation signal to two previously defined maximum values.

When using excitation control, the excitation signal 2600 *ExcitationSetpoint* itself will be limited to 605 *ExcitLimitForced1*or 606 *ExcitLimitForced2*, respectively.

When using excitation governing, however, the fuel quantity setpoint is limited to 637 *ExcitFuelLimForced1* or 638 *ExcitFuelLimForced2* respectively, and the excitation signal is affected via the control circuit.

The parameters 2642 *ExcitForceLim1Active* and 2643 *ExcitForceLim2Active* respectively indicate whether limitation is due to externally activated power limitation.

13.2.3.2 Temperature dependent power reduction

In the event that engine temperature 2907 *CoolantTemp* exceeds the value of 651 *ExcitLimitTempLow* the entire excitation characteristic is lowered in dependence of temperature. The lowering value is linearly interpolated between reduction by 0 % at 651 *ExcitLimitTempLow* and reduction by 650 *ExcitLimitTempDec* at 652 *ExcitLimitTempHigh*. If current temperature exceeds the value of 652 *ExcitLimitTempHigh*, there will be continuous reduction by the value of 650 *ExcitLimitTempDec*.

This function is operative only with excitation governing and is to be activated by the parameter 4650 *ExcitTempLimitOn*. The actual maximum value of the fuel quantity setpoint thus obtained is indicated by 2650 *ExcitFuelLimitTemp*. Whether this value has caused limitation can be seen from 2645 *ExcitTempLimActive*.

On exceeding a coolant temperature limit independent of this function, it is also possible to activate forced idle speed (↑ *10.5 Forced idle speed in locomotive applications*).

13.2.3.3 Boost pressure dependent power limitation

This function is provided to take into account that atmospheric pressure is reduced when operating in high altitudes. By lowering the excitation signal, generator output is reduced and automatically also diesel injection quantity. In diesel-electric operation this function should be preferred to boost pressure dependent fuel quantity limitation (↑ *9.2 Boost pressure dependent fuel limitation*) where injection quantity is reduced without reduction of load. This may lead to speed drops and engine overload.

By means of a boost pressure sensor the current boost pressure 2904 *BoostPressure* is measured and then a characteristic is used to determine the associated maximum fuel quantity. The values of the characteristics are stored at the following parameter positions:

6440 to 6449 *ExcitBoostLimit:p(x)* Boost pressure values for limitation curve

6460 to 6469 *ExcitBoostLimit:f(x)* Fuel quantity values for limitation curve.

For parameterizing the boost pressure dependent limit characteristic, up to 10 pairs of values are available. Each pair of values consists of one boost pressure value and one fuel quantity value, both with the same index. Intermediary values between adjacent pairs of variates will be interpolated by the control (↑ *3.7 Parameterization of characteristics*).

This function is operative only with excitation governing and is to be activated by the parameter 4655 *ExcitBoostLimitOn*. The actual maximum value of the fuel quantity setpoint thus obtained is indicated by 2655 *ExcitFuelLimitBoost*. The parameter 2646 *ExcitBoostLimActive* will indicate whether there is limitation caused by this value.

13.2.3.4 Speed dependent power limitation

Based on current speed the related maximum excitation signal is determined via a characteristic.

The values of the characteristics are stored at the following parameter positions:

6966 to 6981 *ExcitSpeedLim:n(x)*	Speed values for limitation curve
6982 to 6997 *ExcitSpeedLim:E(x)*	Excitation values for limitation curve

For parameterizing the speed dependent limit characteristic, there are up to 16 pairs of values available. Each pair of values consists of one speed value and one excitation value, both with the same index. Intermediary values between adjacent pairs of variates will be interpolated by the control (↑ *3.7 Parameterization of characteristics*).

This function is operative only with excitation governing and is to be activated by the parameter 4656 *ExcitSpeedLimitOn*. The resulting actual maximum value for excitation is indicated by 2656 *ExcitationLimitSpeed*. The parameter 2647 *ExcitSpeedLimActive* will indicate whether there exists limitation caused by this value.

13.3 Low idle speed

The function "Low Idle Speed" is offered to save fuel. It allows to set idle speed to a specific level if no excitation signal has been requested for a pre-set minimum time.

The lowest possible idle speed is indicated in 24 *SpeedMinAbsolute*. If after activation of signal 2841 *SwitchLowIdleOn* no excitation signal is triggered for the duration of 242 *SpeedMinAbsDelay* (2600 *ExcitationSetpoint* = 0), the speed setpoint is progressively lowered with ramp value 241 *SpeedMinAbsRampDown* towards 24 *SpeedMinAbsolute*. As soon as the switching function is disabled or the excitation signal is triggered again, the engine returns to the previous operating mode using the normal ramp (↑*7.7 Speed ramp*).

If pre-set temperatures are exceeded, it is possible to protect the engine by letting it run at forced idle speed (↑*10.5 Forced idle speed in locomotive applications*). If conditions for low idle speed are given, in this case too the lowest possible idle speed will be used.

13.4 Slide protection

When it detects skidding wheels, the control will continuously reduce the excitation signal until the wheels have a firm grip again. A separate electronic device is required to detect sliding of the wheels and to transmit a specific signal to the control. If modification of the excitation signal is insufficient or impossible the speed setpoint can be modified instead.

13.4.1 Reduction of excitation by digital slide signal

The switch function 2818 *SwitchSlide* is used to inform the control about the currently valid status of slide protection:

2818 *SwitchSlide* = 0	no slide signal coming in
2818 *SwitchSlide* = 1	slide signal received.

The same switch can also initiate influencing the speed setpoint (↑ *13.4.3 Speed reduction by digital slide signal*). When the control recognizes the slide signal for the first time, the current excitation signal 2600 *ExcitationSetpoint* is frozen and reduced by 620 *ExcitSlideDec*. This new excitation signal is held for the time defined by 621 *ExcitSlideDuration*. If there is still a slide signal coming in after that, the excitation signal will be reduced once again. Reduction will be repeated until the slide signals cease to come in, i.e., until the wheels are gripping again.

After that the currently calculated excitation signal is activated again and run up to via the power ramp in case this ramp has been activated.

This digital slide protection function is to be activated by the parameter 4620 *DigSlideExcitCntrlOn*. The parameter 2644 *ExcitSlideLimActive* will indicate whether power limitation is active due to slide protection.

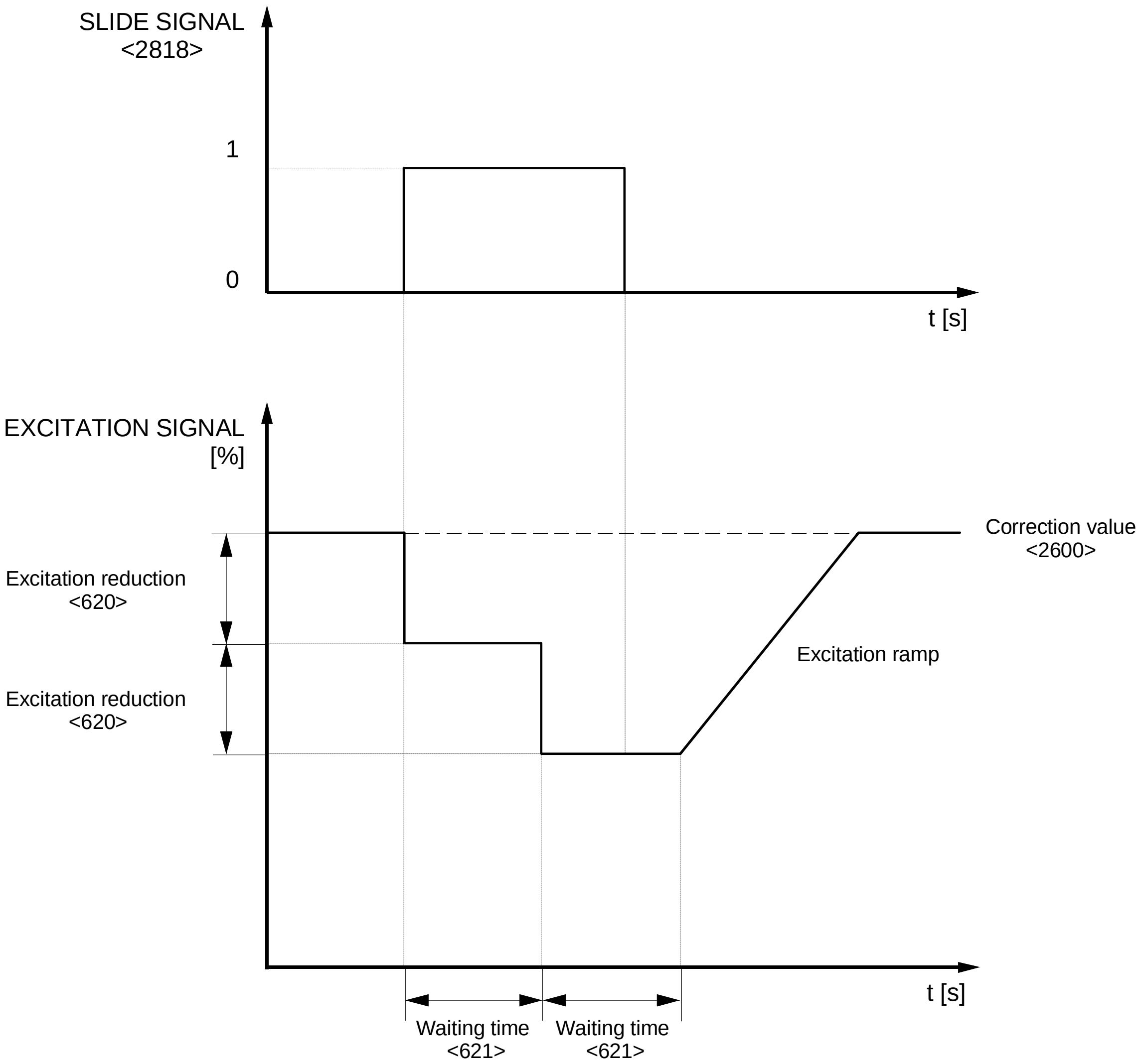


Fig. 36: Slide protection

13.4.2 Reduction of excitation by analogue slide signal

Instead of a digital slide protection signal and a fixed reduction of the excitation value during a predefined period of time (↑*13.4.1 Reduction of excitation by digital slide signal*) there exists also the possibility of having the reduction value defined by the evaluating electronics directly via a sensor input, viz. 2914 *SlideExcitReduction* (↑*17 Configuration* of sensors).

Whenever 2914 *SlideExcitReduction* yields a value not equal to zero for the first time, the current excitation signal 2600 *ExcitationSetpoint* will be frozen. Up to the time when 2914 *SlideExcitReduction* returns to zero, its actual value is subtracted from the frozen value. The new excitation signal 2600 *ExcitationSetpoint* will result from the smaller value obtained by the reduction as just described and from the excitation signal value depending on current speed and fuel quantity. This means that the calculations via excitation control/excitation governing will continue but will only be applied if they define an excitation signal value even smaller than the one determined by the reduced value.

This slide protection function can be activated by 4621 *AnaSlideExcitCntrlOn*. Again 2644 *ExcitSlideLimActive* will indicate whether power limitation is active due to slide protection.

Note

Special care should be taken when determining the reference values at the analogue input for 2914 SlideExcitReduction so that a value greater than zero will be measured only if any slide protection measure is supposed to take effect.

13.4.3 Speed reduction by digital slide signal

The same switch function 2818 *SwitchSlide* that initiates affection of the excitation signal (↑ *13.4.1 Reduction of excitation by digital slide signal*) serves to inform the control about the state of slide protection that is currently active.

2818 *SwitchSlide* = 0	no slide signal coming in
2818 *SwitchSlide* = 1	slide signal received.

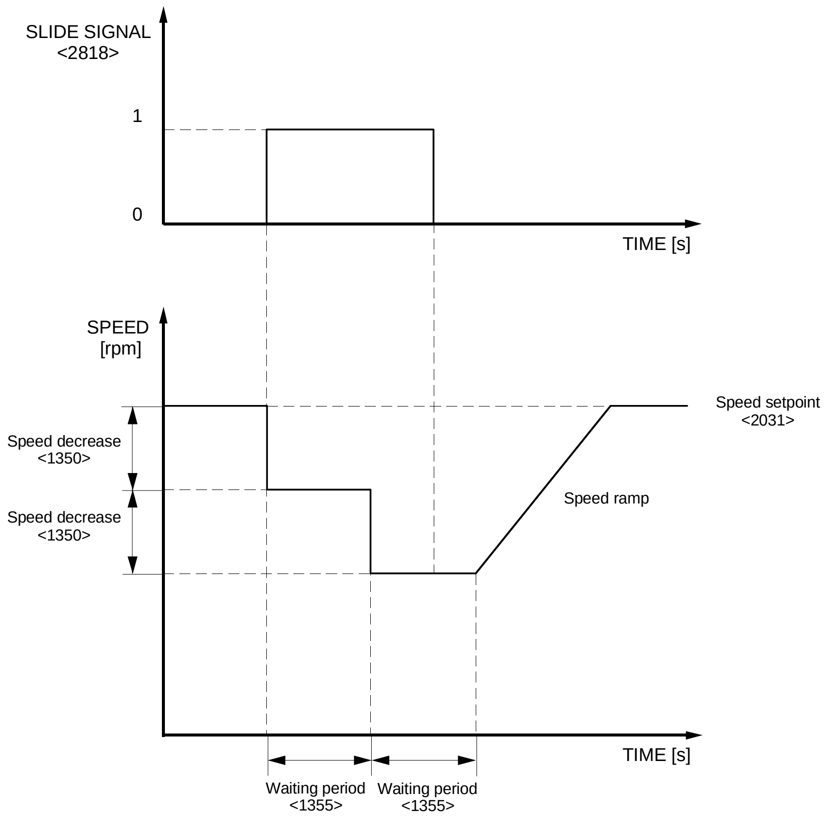


Fig. 37: Slide protection

Whenever the control recognizes the slide signal, set speed will be reduced by 1350 *DigSlideSpeedDec*. This new speed setpoint is held for the time defined by 1355 *DigSlideDuration*. If after that there is still a slide signal coming in, the set value will be reduced once again. Reduction will be repeated until the slide signals cease to come in, i.e., until the wheels are gripping again. After that, the previous setpoint is restored and is slowly run up to via the ↑*7.7 Speed ramp* if a speed ramp is being used.

This slide protection function is activated with parameter 5351 *DigSlideSpeedSetpOn*.

13.4.4 Speed reduction by analogue slide signal

Instead of a digital slide protection signal and a fixed reduction of the excitation value for a predefined period of time (↑*13.4.3 Speed reduction by digital slide signal*) there exists also the possibility of having the reduction value defined by the evaluating electronics directly via a sensor input, viz. 2915 *SlideSpeedReduction* (↑ *17 Configuration* of sensors).

Whenever 2915 *SlideSpeedReduction* yields a value not equal zero for the first time, the current speed setpoint will be frozen. Up to the time when 2915 *SlideSpeedReduction* returns to zero again, its value is subtracted from the frozen value and care is taken that the resulting speed setpoint will never drop below 1356 *AnaSlideSpeedMin*.

This slide protection function can be activated by 5352 *AnaSlideSpedSetpOn*.

Special care should be taken when determining the reference values at the analogue input for 2915 SlideSpeedReduction so that a value greater than zero will be measured only if any slide protection measure is supposed to take effect.

14 Generator operation

For parallel generator operation, various devices are required to perform synchronization and real load sharing in isolated parallel operation or real load control when paralleled to the mains. All of these devices will affect the speed setpoint. It is for this reason that a setpoint offset for synchronization and a setpoint offset for load control are added to the setpoint value as determined from the pre-defined setpoint (↑*7.4 Generator operation*).

If no additional load control device is provided then droop (proportional band) can be used instead though with certain restrictions in case of isolated parallel operation. In mains parallel operation droop can be employed for setting the desired load. In isolated parallel operation droop is made use of to obtain homogeneous load sharing.

To use the specific generator functions the parameter 1810 / 3810 *OperationMode* has to be set to 3.

Note

The following descriptions of synchronizing and power control are valid for automatic operation only. For manual operation and for the conditions of switching over between automatic and manual operation refer to ↑ 14.4 Automatic or manual operation.

14.1 Synchronization

Synchronization can be performed analogously using the **HEINZMANN** synchronization unit or digitally by presetting synchronization values. Selection is made by the parameter

5210 *SyncAnalogOrDigital* = 0	digital synchronization
5210 *SyncAnalogOrDigital* = 1	synchronization using the synchronization unit

The following switch function serves to inform the control unit that synchronization is enabled:

2834 *SwitchSyncEnable* = 0	synchronization not enabled
2834 *SwitchSyncEnable* = 1	synchronization enabled

Note

If no external switch is assigned to the switching function, the function synchronization will always be active. When assigning digital inputs to the switching functions for enabling synchronization and load control the same input can be assigned inverted which will allow to easily change over between the two operating modes.

The setpoint change resulting from synchronization and load control is indicated by the parameter 2042 *GenSetOffset*.

14.1.1 Digital synchronization

With digital synchronization two switching functions are provided for determining whether the setpoint is to be increased or decreased. The states of the switching functions can be read from the parameters

2825 *SwitchSpeedInc* = 0	no increase of speed setpoint
2825 *SwitchSpeedInc* = 1	increase of speed setpoint
2826 *SwitchSpeedDec* = 0	no decrease of the speed setpoint
2826 *SwitchSpeedDec* = 1	decrease of the speed setpoint.

There will be no changes of the setpoint unless the two parameters read different values, i.e., if only one of the two functions is active. The scope of the change can be defined by means of the parameter 1210 *DigitalPotSpeedRamp* with speed change per second as a unit. Setpoint changes can be conducted until either maximum or minimum speed is attained. If the signals for changing the setpoint consist of pulses, these pulses must have a duration of at least 20 ms in order to be detected by the control circuit. The control electronics will respond to pulses for changing the setpoint only when the engine is running.

The setpoint change by the digital potentiometer is added as an offset to the value of 2033 *SpeedSetpSelect* as resulting from the preceding setpoint determination after the ramp. This modification of the speed setpoint is executed with the given step size and direction until either maximum (or minimum) speed is attained or the states of both functions are identical (0 or 1). The offset remains in effect even if there is a change-over to some other setpoint value or if an adjustment of the analogue potentiometer occurs. The minimum or maximum speeds, however, can never be exceeded (except for droop). The offset can be read from the parameter 2041 *DigitalPotOffset*. With the engine standing, the accumulated offset will be cleared.

If an offset is applied to the analogue setpoint, minimum or maximum speed will be attained before the potentiometer reaches its end position. When the potentiometer is further turned into its stop position, the offset will be decreased again. In other words, if there has been a digital modification of the setpoint and the potentiometer is then turned on full-scale, the resulting offset will have disappeared.

Parameterizing Example:

Number	Parameter	Value	Unit
1210	*DigitalPotSpeedRamp*	*5*	*rpmps*
1810/3810	*OperationMode*	*3*	
5210	*SyncAnalogOrDigital*	*0*	

Indication:

2825	*SwitchSpeedInc*	*0/1*
2826	*SwitchSpeedDec*	*0/1*

Note

If fuel quantity arrives at the high fuel quantity limit(2711 FuelLimitMaxActive = 1) there will be no further increase of speed. This will prevent increasing the set speed when the engine is operating in overload blocking mode (i.e., when the engine is operating at its power range limit and if there is an additional speed drop due to load). Similarly, the speed setpoint cannot be reduced if fuel quantity is at the low fuel quantity limit (2710 FuelLimitMinActive = 1).

14.1.2 Synchronization using the HEINZMANN Synchronizing Unit

With analogue synchronization, the control unit will receive the actual output value of the **HEINZMANN** synchronization unit SyG 02 as sensor value 2903 *SyncInput* via an analogue input. This is provided by setting the parameter 5210 *SyncAnalogOrDigital* to "1".

Note

When the HEINZMANN synchronizing unit is connected to a control of PANDAROS type, analogue input 2 is to use and 5211 SyncInputOrHZM_SyG must be set to 0.

In order to use the switching function 2834 *SwitchSyncEnable* this function must be active. Likewise, when used, the switching function 2836 *SwitchAutoOrManual* must have been set to automatic operation (*↑14.4 Automatic or manual operation*).

Note

Prior to adjusting the synchronizing unit, the voltages of the generators should be set to equal values. Besides, reactive load distribution has to be ensured, e.g., by paralleling the generator brushes. If necessary, the generator manufacturers will provide information on this subject.

To adapt the setpoint input to the synchronization unit the following steps must be taken:

NOTICE	Before switching on for the first time, it must be checked whether the voltage across the mains breaker is approximately 0 Volts at all three phases. This is to ensure that there is no phase rotation at the mains breaker. **Caution: High voltage!**

- With bridges between the terminals 14 and 15 and the terminals 17 and 18 of the synchronization unit the generator set is to be started and voltage to be applied to the synchronization unit. Parameter 1220 *SynchronFactor* is to be set to 10 %, and then the engine to synchronous speed,. e.g., 50 Hz.
- Since the control value from the synchronization unit can completely cover the analogue input range of 0..5 V the reference and error thresholds for the respective

analogue input should be set to the minimum and maximum values (↑*20.2.4 Error detection for analogue inputs*).

- The signal coming in from the synchronization unit is read out via the parameter 2903 *SyncInput* and then entered in the parameter 1221 *SynchronReference* as a reference value. Reference should be about 50%.
- As soon as frequencies, phase positions and voltages of both generators are equal the relay of the synchronization unit will operate after a delay time that can be adjusted from 0.5 to 5 seconds. When terminals 17 and 18 are bridged the relay for addressing the generator contactor will not switch. This bridge will therefore have to remain connected while adjustments are being made.
- Synchronization is then activated by removing the bridge between terminals 14 and 15. To optimize the dynamic behaviour of synchronization the amplification of the synchronization signal may be modified by means of the parameter 1220 *SynchronFactor* starting with 2%.
- The value range of the amplification factor is defined as follows: Given a signal difference of 10% between 2903 *SyncInput* and 1221 *SynchronReference* and an amplification factor 1220 *SynchronFactor* of 10%, a speed change of +10 rpm will be achieved.
- When synchronization is operating satisfactorily, the bridge between terminals 17 and 18 is to be removed to enable closing of the generator contactor.

Note

For further information on the synchronization unit, please refer to the manual Synchronization Unit SyG 02 no. E 82 002-e.

14.2 Load control

Load control can be performed analogously using the **HEINZMANN** Load Measuring Unit or an external setpoint potentiometer or – on request – with an integrated power governor. Selection is made by the parameters

5233 *PowerGovernorOrLMG* = 1	integrated power governor is used
5233 *PowerGovernorOrLMG* = 0	integrated power governor is not used
5230 *LoadControlOrPot* = 1	HEINZMANN Load Measuring Unit
5230 *LoadControlOrPot* = 0	external potentiometer

Note

Parameter 5233 PowerGovernorOrLMG is available only if the integrated load governor is implemented in the firmware. Otherwise only parameter 5230 LoadControlOrPot is valid for the selection.

The following switch functions normally connected to generator contactor or mains breaker, serve to inform the control unit that load control is enabled:

2835 *SwitchLoadEnable* = 0 load control not enabled

2835 *SwitchLoadEnable* = 1 load control enabled.

Note

If no external switch is assigned to the switching function, the load control function will always be active. When assigning digital inputs to the switching functions for enabling synchronization and load control the same input can be assigned inverted which will allow to easily change over between the two operating modes.

The setpoint change resulting from synchronization and load control is indicated by the parameter 2042 *GenSetOffset*.

14.2.1 Load control using the HEINZMANN Load Measuring Unit

Load control by means of the **HEINZMANN** Load Measuring Unit LMG 10 is based on evaluation of the output signal that is coming from the Load Measuring Unit and has been connected to one of the control unit's analogue inputs. This signal can be generated also by the generator management system THESEUS (or another load control device). In this case the following statements apply similarly, except that THESEUS has operates in the direction opposite to that of the Load Measuring Unit, therefore the amplification factor must be entered in positive.

To connect the Load Measuring Unit 5233 *PowerGovernorOrLMG* must be set to 0 and 5230 *LoadControlOrPot* must be set to 1.

Note

When the HEINZMANN Load Measuring Unit LMG 10 is connected to a control of PANDAROS type, analogue input 1 is to use and 5231 LoadControlOrHZM_LMG must be set to 0. This parameter must be set to 1 when using the THESEUS or another load control device.

Besides, when using the switching function 2835 *SwitchLoadEnable* this function must have been activated. Likewise, when used, the switching function 2836 *SwitchAutoOrManual* must have been set to automatic operation (↑*14.4 Automatic or manual operation*).

Note

Droop is deactivated automatically if this operating mode is active and 1230 LoadControlFactor is not equal to zero, for droop must not be used in this case.

To adapt the setpoint input to the Load Measuring Unit the following procedure must be followed:

- The Load Measuring Unit must have been completely connected, the engine must be running, and operating voltage must be applied.

- The generator breaker must be open so that there is no power output from the generator.
- Since the control value from the load measuring unit can completely cover the analogue input range of 0..5 V, the reference and error thresholds for the respective analogue input must be set to the minimum and maximum values (↑*20.2.4* Error detection for analogue inputs).
- The parameter 1230 *LoadControlFactor* is to be set to 0.
- The signal from the Load Control Unit is read out via the parameter 2902 *LoadControlInput* and entered in the parameter 1231 *LoadControlReference* as a reference value. Reference should be about 30%.
- With the generator on load the setting is conducted at full load. To optimize the dynamic behaviour of the power control, the amplification of the power setpoint signal sent to the governor may be modified by means of the parameter 1230 *LoadControlFactor* starting with -2%.
- The value range of the amplification factor is defined as follows: A signal difference of -10% between 2902 *LoadControlInput* and 1231 *LoadControlReference* and an amplification factor 1230 *LoadControlFactor* of 10% will yield a speed change of +10 rpm.

Note

The working direction of the HEINZMANN Load Control Unit LMG 10 is inverted, i.e., decreasing the control value will increase speed and vice versa. Therefore, the values to be entered for 1230 LoadControlFactor must be negative ones when using the LMG 10.

For more detailed information on the Load Control Unit, please refer to the manual Load Control Unit LMG 10-1 no. E 02 001-e.

In automatic mode or if 5230 LoadControlOrPot = 1 and 2835 SwitchLoadEnable aktiated (or not used), ↑7.8 Droop will be automatically de-activated by the control unit as these operating modes do not permit of using droop.

14.2.2 Load control by a preset value

The power output to be produced by the engine in generator operation may also be directly set by a setpoint within the range of 0..100%. This mode requires the parameter 5230 *LoadControlOrPot* to be set to "0". In this case, there is actually no power control but fuel quantity is set according to the given power setpoint assuming output to be linearly depending on fuel quantity.

In pure mains parallel operation, there will be no problem in using droop. Since in this case actual speed must not change when the generator set is coupled to the mains alteration of the setpoint can be used to change fuel quantity and by this engine load.

Droop is required to set a stable load point for the engine, for without droop the engine would slowly tend either to minimum fuel quantity or maximum fuel quantity as resulting from the ↑*9 Limiting Functions*, because without droop there exists no well-defined relation between speed and fuel quantity. Hence is would be impossible to obtain a stable point.

This is why for this application case a droop of normally 4 % is preset which allows to obtain stable adjustment of load. With droop below 4 %, there exists a certain risk of load variations since no stable load point can be found.

In island parallel operation, droop can be used to achieve that all installations that have been coupled together across the bus bar take over the same percentage of load. This mode of operation, however, has the disadvantage that due to droop load sharing will result in speed changes, i.e., depending on load different speeds will be attained.

If this is not desirable and load distribution at identical speeds is required (so-called isochronous operation), load sharing has to be performed by means of an additional control device , e.g., by employing ↑*14.2.1 Load control using the HEINZMANN Load Measuring Unit* or by using the ↑*14.3 Digital generator management THESEUS*.

In isolated parallel operation with droop all sets have been coupled across a bus bar. This means that all sets are working at identical actual speeds. Since a well-defined relation between speed and load is given by droop all sets will produce the same percentage of power output provided droop has been correctly set.

For correct adjustment of droop, the reference speeds 123 *Droop1SpeedRef* and 128 *Droop2SpeedRef* respectively as well as the droops 120 *Droop1* and 125 *Droop2* respectively must be identical for all sets.

The fuel reference value for zero load 121 *Droop1RefLow* and full load 122 *Droop1RefHigh* (126 *Droop2RefLow* and 127 *Droop2RefHigh* respectively) must be determined and parameterized separately for each engine – even if droop refers to an actual power signal (↑*7.8 Droop*).

14.2.2.1 Analogue setpoint adjustment

To activate this function, the parameter 5230 *LoadControlOrPot* is to be set to "0". Furthermore, droop must have been activated as it is absolutely necessary for correct operation (↑*7.8 Droop*).

Presetting power output is achieved by means of the input for the load setpoint 2902 *LoadControlInput*. Using preset power output the current load is adjusted via the fuel quantity reference values for droop 121 *Droop1RefLow* and 122 *Droop1RefHigh* or respectively 126 *Droop2RefLow* and 127 *Droop2RefHigh* for droop 2. In other words, with 2902 LoadCtrlInput set to 0 %, fuel quantity will correspond to 121 *Droop1RefLow*, and similarly with 2902 LoadCtrlInput = 100 %, fuel quantity will correspond to 122 *Droop1RefHigh*. Intermediary values will be accordingly interpolated.

Parameterizing Example:

Number	Parameter	Value	Unit
120	*Droop1*	*4*	*%*
121	*Droop1RefLow*	*20*	*%*
122	*Droop1RefHigh*	*80*	*%*
123	*Droop1SpeedRef*	*1500*	*rpm*
2040	*DroopOffset*	*0..60*	*rpm*
2042	*GenSetOffset*	*-60..0*	*rpm*
2902	*LoadControlInput*	*0..100*	*%*
4120	*DroopOn*	*1*	
5230	*LoadControlOrPot*	*0*	

In this example, the engine is running at rated speed 1500 rpm and 4% droop. The fuel quantity reference value for zero load is 20 % (the control unit reads 20 % fuel quantity for 0 % power output) and the reference value for full load is 80 % (the control unit reads 80 % fuel quantity for 100 % power output). Now, the desired output can be adjusted within the range from 0% to 100% by means of the load setpoint.

Due to droop, there is a speed setpoint offset of 60 rpm at zero load (4% of 1500 rpm) and of 0 rpm at full load, as indicated by the parameter 2040 *DroopOffset*.

The load setpoint generates an opposite offset in order to return in combination with droop to the total setpoint value of 1500 rpm. This means, the 0 % load setpoint will correspond to an offset of –60 rpm and 100% load setpoint to an offset of 0 rpm.

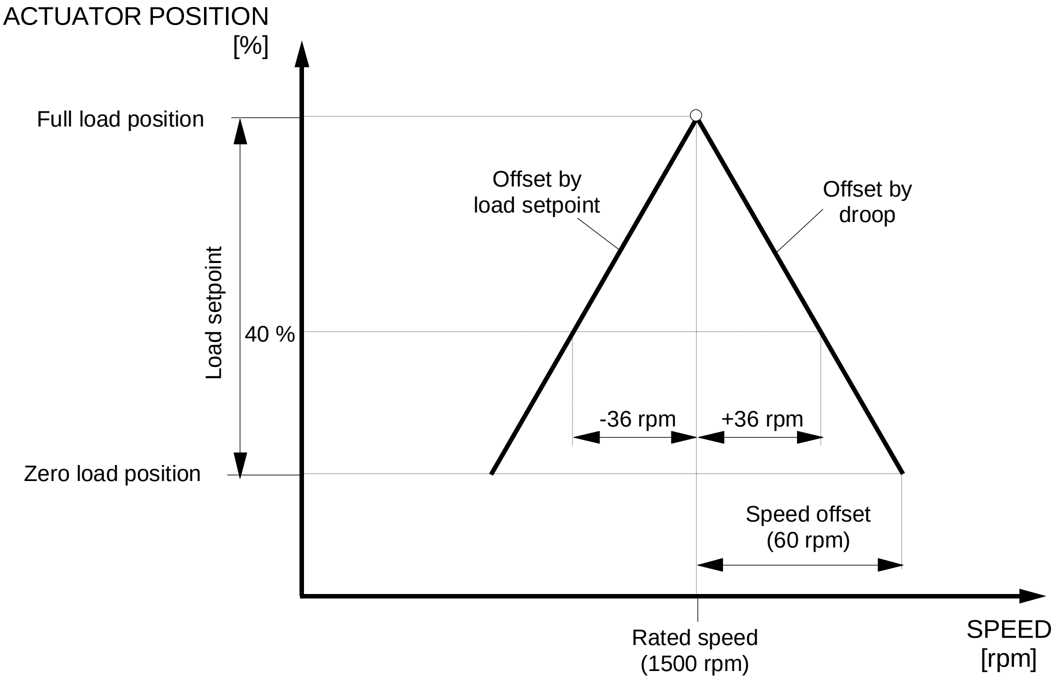


Fig. 38: Load control by Setpoint Adjustment

Given a load setpoint of 2902 *LoadControlInput* = 40%, this will result in calculating a speed offset of –36 rpm. Fuel quantity will now continue to be altered via droop until droop arrives at the fuel quantity of 40 % and with this calculates an offset of +36 rpm which yields a speed setpoint of 1500 rpm - 36 rpm + 36 rpm = 1500 rpm.

So, by load adjustment a speed setpoint offset is formed which corresponds to the droop offset as mirrored with respect to rated speed thus yielding eventually a total offset of 0 rpm.

14.2.2.2 Digital setpoint adjustment

If synchronization and load control are performed exclusively via digital potentiometers it is recommended to configure load control for power adjustment by setpoint definition with 5230 *LoadControlOrPot* = 0 but to leave the load setpoint 2902 *LoadControlInput* unassigned by setting 902 *AssignIn_LoadCtrlInp* = 0 (↑*17 Configuration* of sensors). Due to this, the load setpoint will always yield 2902 *LoadControlInput* = 0 % which will result in an exactly opposite droop offset at zero load. This will cause the engine to run exactly at rated speed after start-up. Afterwards, synchronization can be performed via the digital potentiometer and load accordingly controlled.

This will, however, presuppose droop to have been accurately parameterized. Since in this case neither the switch 2836 *SwitchAutoOrManual* will be needed nor activation by 2834 *SwitchSyncEnable* and 2835 *SwitchLoadEnable* required, they must not have been configured.

14.2.3 Integrated power governor

If both a setpoint and an actual power signal are available, the control unit can take over load control if the integrated power governor has been implemented in the firmware by request. In this case the internal, higher-ranking power governor calculates a speed setpoint offset for the speed governor or, for mains operation, even the fuel setpoint for the engine, bypassing the speed control circuit.

To activate the integrated power governor 5233 *PowerGovernorOrLMG* must be set to 1. Parameter 5230 *LoadControlOrPot* has no meaning.

The power setpoint is transmitted in 2919 *PowerSetpoint*. For testing and commissioning, instead of this value a pre-set PC value 1243 *PowerSetpointPC* may be used if 5243 *PowerSetpPCOn* is set to 1. This function cannot be saved, i.e. after a reset of the control device the external value 2919 *PowerSetpoint* will be active again.

If required, the setpoint can be approached by ramp, with 1241 *PowerSetpRampUp* denoting increasing adjustment speed and 1242 *PowerSetpRampDown* decreasing adjustment speed. Both ramp directions are activated together with 5241 *PowerSetpRampOn*. If ramping is to be in one direction only, the other parameter must be set to its maximum value.

The resulting effective power setpoint is indicated in 3233 *PowerSetpEffective*. In addition, measured power 2918 *MeasuredPower* is indicated in relation to rated power 1232 *RatedPower* in 3232 *RelativePower*.

Power control is effective only when the engine is running (3830 *Phase* > 4), when the values for measured power and power setpoint are available without errors (3023 *ErrMeasuredPower* = 0 and 3024 *ErrPowerSetpoint* = 0), when there is no engine stop request (3802 *EngineStopRequest* = 0) and the breaker is closed (2835 *SwitchLoadEnable* = 1).

3234 *GovernorPowerOrSpeed* = 1 indicates whether the power governor is active or not. Otherwise only speed is controlled. The error situation arising when power control fails while the contactor is closed, because measured power or power setpoint register a sensor error should be provided for by always parameterizing the droop mode ↑ *7.8 Droop*.

Settings for the power control circuit are made in:

1233 *PowerGovGain*	proportional factor of power governor
1234 *PowerGovStability*	integral factor of power governor
1235 *PowerGovDerivative*	derivative factor of power governor

The P-factor and I-factor can be subjected to power-dependent variation by activating a characteristic with 5235 *PIDCurvePowerOn* = 1.

6300 *PIDCrvPowGov:P*	power supporting points
6310 *PIDCrvPowGov:Corr*	correction factors
3235 *PowerPIDCorrFactor*	current correction factor for P and I

5234 *FuelOrSpeedOffsMode* allows to decide if power governor output acts as modification of the speed setpoint or directly on fuel quantity. Fuel offset is used in mains operation and speed setpoint offset in island operation. If a system is to work in both operational modes the modification of the speed setpoint must be parameterized.

5234 *FuelOrSpeedOffsMode* = 0	speed setpoint offset
5234 *FuelOrSpeedOffsMode* = 1	fuel offset
2042 *GenSetOffset*	current speed setpoint offset
2111 *FuelGenSetOffset*	current fuel offset

If fuel offset is enabled, 2835 *SwitchLoadEnable* should be connected with the mains breaker, if speed setpoint offset is used it should be connected with the generator contactor. When the integrated power governor works with fuel offset in mains operation, this is indicated by 3200 *GenCtrlMainsOrIsland* = 1.

The results of power control can be monitored for deviations if in 1239 *MaxPowerDifference* a maximum admissible deviation for the duration of 1240 *MaxPowerDiffMaxTime* is set and the function has been enabled with 5239

SupvisePowerDiffOn. Deviations from the set values are indicated in 3048 *ErrPowerDifference*.

14.2.3.1 Reduced power caused by knocking

The switch function 2818 *SwitchKnock* is used to inform the control about the presence of knocking.

2818 *SwitchKnock* = 0	no knocking
2818 *SwitchKnock* = 1	engine is knocking

When the power governor recognizes the knock signal for the first time, the current power setpoint 3233 *PowerSetpEffective* is frozen and reduced by 1245 *KnockPowerReduction*. This new power setpoint is maintained for the duration of 1246 *KnockDuration*. If after that there is still a knock signal coming in, the power setpoint will be reduced further. The reduction continues until the knock signal ends.

After that the currently pre-set power setpoint is activated again and run up to via the power ramp if this ramp has been activated.

This engine protection function – which is implemented in the firmware only on request – is enabled by means of the parameter 5245 *KnockControlOn*. 3245 *KnockPowerRedActive* shows whether a power reduction is active.

14.3 Digital generator management THESEUS

THESEUS Digital Generator Management is an accessory device for generator operation that is capable of executing all synchronization and power control functions. This **HEINZMANN** device has been designed for optimum cooperation with **HEINZMANN** control units. The preferred type of connection is via the CAN bus. ↑ *23 Bus Protocols* offers a description of how to configure the CAN bus system for this purpose. But it is also possible to connect the THESEUS output to the control unit using an analogue input. This value is used in the same way as for the Load Control Unit and is described in ↑*14.2.1 Load control using the HEINZMANN Load Measuring Unit*.

For operation with THESEUS, droop will be de-activated automatically, yet for the eventuality of a change-over to manual operation (↑*14.4 Automatic or manual operation*) droop should always be parameterized. Any further adjustment for synchronization and load control will performed on the part of THESEUS.

Operation using THESEUS offers the possibility of disabling synchronization and load control in case of failure or of changing over to manual operation by means of a digital potentiometer. For this purpose, the switching function

2836 *SwitchAutoOrManual* = 0	manual operation by digital potentiometer
2836 *SwitchAutoOrManual* = 1	automatic operation

is available. If this switching function is not parameterized, no external change-over to manual operation will be possible. When THESEUS has been switched over to manual operation, the control unit will be switched over to manual operation as well. There will also be manual operation in case CAN communication with THESEUS is no longer available. Operation mode can be checked by the parameter 3201 *GenCtrlAutoOrManual*.

In manual operation, the control signals received from THESEUS unit will not be evaluated, and it is only the switch inputs for the digital potentiometer that will be active. The inputs and parameters used in this case are the same as for ↑ *14.1.1 Digital synchronization*. In case manual operation is also to be used for load control, this will in addition require to activate droop. On switching over to manual operation, the current offset values will be taken over for the digital potentiometer to avoid speed and load jumps. When switching back to automatic operation this will not always be possible since the offset values of the digital potentiometer are cleared and the signals from THESEUS have to be used (see also ↑*14.4 Automatic or manual operation*).

Note

For further information about the adjustment and operation of THESEUS, please refer to the manual Basic Information THESEUS, ord. no. DG 01 015-e.

14.4 Automatic or manual operation

Generator operation offers the additional option to disable synchronization and load control in case of failure and to switch over to manual operation using a digital potentiometer. For this purpose, the switching function

2836 *SwitchAutoOrManual* = 0	manual operation by digital potentiometer
2836 *SwitchAutoOrManual* = 1	automatic operation

is available. If the switching function has not been parameterized (↑*18 Configuration of* switching functions) the system always runs in automatic mode.

In manual operation, the control signals received via the analogue inputs or from the THESEUS unit (↑*14.3 Digital generator management THESEUS*) will not be taken into account, and it is only the switch inputs for the digital potentiometer that will be active. The inputs and parameters used in this case are the same as for ↑ *14.1.1 Digital synchronization*. The switch functions 2834 *SwitchSyncEnable* and 2835 *SwitchLoadEnable* for enabling synchronization and power control, however, will be ignored.

In case manual operation is also to be used for load control, this will in addition require to activate droop. This is achieved by assigning the same digital input which is used to change over to manual operation to the switch 812 *FunctDroop2Or1* (↑*18 Configuration of* switching functions) for changing over between droop 1 and droop 2.

On switching over to manual operation, the current offset values will be taken over for the digital potentiometer to avoid speed and load jumps. When switching back to automatic operation this will not always be possible since when using, e.g., the synchronization and load measuring devices the offset values of the digital potentiometer will be cleared and the input signals used.

Whether the control unit is operating in automatic or manual mode can be read from the parameter 3201 *GenCtrlAutoOrManual*.

Note

If the engine is started by manual operation it will run by set speed plus droop. On switching over to automatic operation droop will be deactivated thus clearing also the offset resulting from droop. The engine will then be running at pre-set speed. When returning to manual operation droop will be activated, but in such a way as to retain the currently set speed, and on switching back again to automatic operation the set speed will no longer undergo alteration. This is motivated by the wish to avoid load jumps when switching over under load after attaining a stabilized state. In automatic operation, the set will be running in isochronous mode, i.e., there will be no speed change across load. Therefore, this speed must be sustained on switching over to manual operation, as in manual operation the actual set speed can be altered by droop and by this possibly cause a speed or load jump when switching back to automatic operation. By using the *↑7.7 Speed ramp* *any such speed jump and hence load jump can be retarded by a ramp.*

Parameterizing Example:

Synchronization is to be enabled with switch input 4 opened and load is to be enabled with switch input 4 closed. Switch input 5 serves for changing between automatic and manual operation. In addition, droop of 4 % is to be provided for manual operation..

Number	Parameter	Value	Unit
120	*Droop1*	*4*	*%*
125	*Droop2*	*0*	*%*
812	*FunctDroop2Or1*	*5*	
834	*FunctSyncEnable*	*-4*	
835	*FunctLoadEnable*	*4*	
836	*FunctAutoOrManual*	*5*	
4120	*DroopOn*	*1*	

Indication when synchronizing in manual mode:

2812	*SwitchDroop2Or1*	*0*
2834	*SwitchSyncEnable*	*1*
2835	*SwitchLoadEnable*	*0*
2836	*SwitchAutoOrManual*	*0*
3201	*GenCtrlAutoOrManual*	*0*

Indication when load controlling in automatic mode:

2812	*SwitchDroop2Or1*	*1*
2834	*SwitchSyncEnable*	*0*
2835	*SwitchLoadEnable*	*1*
2836	*SwitchAutoOrManual*	*1*
3201	*GenCtrlAutoOrManual*	*1*

14.5 PANDAROS variants

The control unit PANDAROS is available both with freely configurable firmware and in variants with fixed functionality. This section describes the generator variants and how they relate to the abovementioned functionality for generators. The integrated power governor is not implemented in these variants with fixed functionality.

14.5.1 DC 6-01: Standard Generator

The standard generator variant is a simple solution fitted for example for island single or mains parallel operation.

Digital input	*Pin*	*Designation*	*Configuration*
3	7	SpA	fixed 2825 *SwitchSpeedInc*
4	9	SpD	fixed 2826 *SwitchSpeedDec*
5	11	Stp	1: fixed 2810 *SwitchEngineStop* 0: fixed 2815 *SwitchSpeedFix*

Digital output	*Pin*	*Designation*	*Configuration*
Error output	10	Err	fixed 3801 *CommonAlarm*

The assignment of digital inputs to switching functions is fixed and cannot be configured separately. The polarity of the engine shutdown input on the other hand may be set with 4811 *StopOpenOrClose*. After having changed the polarity the parameters must be saved and the control unit must be restarted (↑*3.10 Reset of control unit*). The changed polarity will be valid for 2815 *SwitchSpeedFix* too.

5230 *LoadControlOrPot* is fixedly set to “0” (↑*14.2 Load control*).

When the engine stop input is disabled, speed setpoint is automatically set to fixed speed 17 *SpeedFix*. This can be changed additively with the aid of the buttons 2825 *SwitchSpeedInc* and 2826 *SwitchSpeedDec* (↑*14.2.2.2 Digital setpoint adjustment*).

For mains parallel operation droop 120 *Droop* must be adjusted and enabled with 4120 *DroopOn* = 1. In island single operation it is possible to use droop or isochronous mode.

14.5.2 DC 6-03: Extended Generator 1

With the variant Extended Generator 1 it is possible to signal to the device after synchronization with the buttons 2825 *SwitchSpeedInc* and 2826 *SwitchSpeedDec* (↑ *14.1.1 Digital synchronization)* via 2835 *SwitchLoadEnable* that the generator contactor is closed. This enables input 2902 *LoadControlInput*, which is used for load sharing in island parallel operation with the aid of the HEINZMANN load control unit LMG 10 (or another control device) (↑ *14.2.1 Load control using the HEINZMANN Load Measuring Unit*).

Analogue input	***Pin***	***Designation***	***Configuration***
1	2	P1	fixed 2902 *LoadControlInput*, 0..5 V

Digital input	***Pin***	***Designation***	***Configuration***
2	1	P2	fixed 2835 *SwitchLoadEnable*
3	7	SpA	fixed 2825 *SwitchSpeedInc*
4	9	SpD	fixed 2826 *SwitchSpeedDec*
5	11	Stp	fixed 2810 *SwitchEngineStop*

Digital output	***Pin***	***Designation***	***Configuration***
Error output	10	Err	fixed 3801 *CommonAlarm*

The assignation of inputs and outputs is fixed and cannot be configured separately.

5210 *SyncAnalogOrDigital* is stably set to 0 (↑*14.1.1 Digital synchronization*).

5230 *LoadControlOrPot* is stably set to 1 (↑ *14.2.1 Load control using the HEINZMANN Load Measuring Unit*).

When the HEINZMANN load control unit LMG 10 is connected, 5231 *LoadControlOrHZM_LMG* must be set to 0, otherwise to 1.

After changing this value or the polarity of the engine stop input with 4811 *StopOpenOrClose* the parameters must be saved and the control unit must be restarted (↑*3.10 Reset of control unit*).

14.5.3 DC 6-04: Extended Generator 2

The variant Extended Generator 2 allows to modify the speed setpoint with 2900 *SetpointExtern* over the engine's whole speed range. For synchronizing and load control 2815 *SwitchSpeedFix* is used to switch to fixed speed 17 *SpeedFix*. At the same time, 2834 *SwitchSyncEnable* and 2835 *SwitchLoadEnable* are enabled.

For operation with variable speed setpoint, droop 120 *Droop* may be adjusted and enabled (4120 *DroopOn* = 1). During load control in fixed speed operating mode, droop will be automatically disabled (isochronous operating mode).

For synchronization the HEINZMANN synchronizing unit SyG 02 (or a similar device) is used, connected to 2903 *SyncInput*.

For load sharing the HEINZMANN load control unit LMG 10 (or a similar device) is used, connected to 2902 *LoadControlInput*.

5210 *SyncAnalogOrDigital* and 5230 *LoadControlOrPot* are both set stably to 1 (↑ *14.1.2 Synchronization using the HEINZMANN Synchronizing Unit* and ↑ *14.2.1 Load control using the HEINZMANN Load Measuring Unit*).

Analogue input	***Pin***	***Designation***	***Configuration***
1	2	P1	fixed 2902 *LoadControlInput*, 0..5 V
2	1	P2	fixed 2903 *SyncInput*, 0..5V
3	7	SpA	fixed 2900 *SetpointExtern*

Digital input	***Pin***	***Designation***	***Configuration***
4	9	SpD	fixed 2815 *SwitchSpeedFix* fixed 2834 *SwitchSyncEnable* fixed 2835 *SwitchLoadEnable*
5	11	Stp	fixed 2810 *SwitchEngineStop*

Digital output	***Pin***	***Designation***	***Configuration***
Error output	10	Err	fixed 3801 *CommonAlarm*

The assignation of inputs and outputs is fixed and cannot be configured separately.

When thr HEINZMANN synchronizing unit SyG 02 is connected, 5211 *SyncInputOrHZM_SyG* must be set to 0, otherwise to 1.

When the HEINZMANN load control unit LMG 10 is connected, 5231 *LoadControlOrHZM_LMG* must be set to 0, otherwise to 1.

After having changed these values or the polarity of the engine stop input with 4811 *StopOpenOrClose*, the parameters must be saved and the control unit must be restarted (↑ *3.10 Reset of control unit*).

14.5.4 DC 6-14: Extended Generator 3

The variant Extended Generator 3 has been developed specifically for operation in conjunction with generator management THESEUS (↑ *14.3 Digital generator management THESEUS*). Both devices are connected via the HEINZMANN-CAN bus.

This variant allows to change between automatic and manual operation (↑ *14.4 Automatic or manual operation*).

In automatic operation synchronization and load sharing are carried out by THESEUS. In doing so, the engine runs at fixed speed 17 *SpeedFix*.

In manual operation, speed is set by the potentiometer 2900 *SetpointExtern*. Synchronizing and load sharing are carried out using the Up/Down keys.

Analogue input	***Pin***	***Designation***	***Configuration***
3	7	SpA	fixed 2900 *SetpointExtern*

Digital input	***Pin***	***Designation***	***Configuration***
1	2	P1	fixed 2825 *SwitchSpeedInc*
2	1	P2	fixed 2826 *SwitchSpeedDec*
4	9	SpD	1: fixed 2815 *SwitchSpeedFix* 1: fixed 2836 *SwitchAutoOrManual* 0: fixed 2836 *SwitchAutoOrManual*
5	11	Stp	fixed 2810 *SwitchEngineStop*

Digital output	***Pin***	***Designation***	***Configuration***
Error output	10	Err	fixed 3801 *CommonAlarm*

For mains parallel operation droop 120 *Droop* must always be adjusted and enabled with 4120 *DroopOn* = 1. It will be taken into account only in manual operation.

After having changed the polarity of the engine stop input with 4811 *StopOpenOrClose* the parameters must be saved and the control unit must be restarted (↑ *3.10 Reset of control unit*)

15 Marine operation

15.1 Master/slave operation

For ships equipped with two engines on one shaft the function twin-engine operation, respectively, master/slave or father/son operation is available.

The switch function 2841 *SwitchMasterOrSlave* tells both control devices which engine is master and which is slave. It is convenient to use a single switch and connect it to both control devices. In one device the digital input is assigned the respective value in positive, in the other with negative sign (↑*18 Configuration of* switching functions). In this way, both get the same information, but in inverted form.

The switch functions 2843 *SwitchClutch*, 2842 *SwitchLoadTransfer* and, if required, 2844 *SwitchAsymLoadEnable* must be connected to both control devices, for the selection master/slave is dynamic. The effective elaboration in the control device depends on the assigned engine type.

The two control units are connected with the HZM-CAN bus. The bus transmits the fuel setpoint for the slave. Besides, the two control units continually exchange information about the operative state of the engines. This allow a quick reaction when errors require both engines to go in droop ↑*7.8 Droop*.

Parameter 3250 *TwinEnginePhase* shows the different phases of engaging, load pick-up and disengaging.

0: engine runs by itself, not engaged, has not reached engagement speed yet

1: engagement speed reached, engine waits for engagement

master stays in this phase

slave proceeds to phase 2 after engagement

2: engaged slave, ramp running after clutch is closed

3: engaged slave, load pick-up active

4: engaged slave, load pick-up deactivated, ramp to minimum load

5: engaged slave, disengagement load reached, engine waits for disengagement

As soon as engagement speed range between 1255 *LowerSpeedClutchIn* and 1256 *UpperSpeedClutchIn* is reached, the value of 3251 *CloseClutchPossible* switches from 0 to 1 and engaging becomes possible.

If the value changes from 1 to 0, disengaging is possible because the slave engine has reached the disengagement load 1252 *SlaveLoadForDeClutch*.

If parameter number 3251 is assigned to a digital output and therefore to a lamp, the lamp is off when the engine starts and lights up when engagement speed is reached; it stays on as long as load pick-up is required and goes out when load pick-up is over and disengaging load has been reached (↑*20.8 Digital outputs*).

The engagement request by switch function 2843 *SwitchClutch* = 1 is accepted by the control unit only if 3251 *CloseClutchPossible* has been enabled from 0 to 1 – or differently put, when 3250 *TwinEnginePhase* = 1.

After engaging, the slave runs up to load 1252 *SlaveLoadForDeClutch*, until load pick-up is requested by 2842 *SwitchLoadTransfer* = 1. From then on, the slave runs along the ramps 1253 *SlaveLoadRampUp* or 1254 *SlaveLoadRampDown* to the position pre-set by the master.

2842 *SwitchLoadTransfer* = 0 ends the load pick-up. The slave goes automatically to disengagement load 1252 *SlaveLoadForDeClutch* and signals it with 3251 *CloseClutchPossible* = 0.

The disengagement request operated by switch function 2843 *SwitchClutch* = 0 is accepted by the slave engine only if the disengagement load has been reached and 3251 *CloseClutchPossible* has been disabled from 1 to 0 – or differently put, when 3250 *TwinEnginePhase* = 5.

3252 *PositionerOrGovernor* indicates whether the respective control unit is the active speed governor or the slave in positioning mode.

3252 *PositionerOrGovernor* = 0	Speed governor
3252 *PositionerOrGovernor* = 1	Slave in positioning mode

The transmission of the setpoint from master to slave is in form of load value. To this purpose it is necessary to define the respective actuator positioning values for zero-load and full-load on both control units.

1250 *FuelAtZeroLoad*	Actuator position at zero-load
1251 *FuelAtFullLoad*	Actuator position at full-load

The resulting own load setpoint is indicated in 3253 *MyLoadSetpoint*, the load setpoint of the other engine in 3254 *OtherLoadSetpoint*. The slave derives its own fuel setpoint from the received load setpoint and the two own actuator positions and indicates it in 3255 *SlaveFuelSetpoint*.

The fuel setpoint can be limited both in master and slave. This is indicated by the following parameters:

2711 *FuelLimitMaxActive*	fuel for this engine is limited
2721 *AsymmLoadLimitActive*	slave limit for asymmetric load is active
3256 *Slave&MasterLimited*	fuel for both engines is being limited

While fuel limitation in the master, i.e. in the speed governor, may be either speed-dependent or boost pressure dependent, in the slave it is determined exclusively by the asymmetric load value received as sensor value 2917 *AsymmetricLoad*. If the asymmetric load value is connected by cable, 2722 *FuelLimitAsymmLoad* is set to 2917 *AsymmetricLoad*, otherwise this value is equal to 100%, i.e. no limitation is active. In this case the limitation in the master applies to the slave too, for both are working with the same load setpoint.

When the asymmetric load value is connected, the switching function 2844 *SwitchAsymLoadEnable* allows to determine whether 2917 *AsymmetricLoad* is to be observed or not.

For the CAN connection between the two control units set following parameters.

400 *CanStartTimeOutDelay*	delay after switching on the control until messages are expected from the other engine
401 *CanMyNodeNumber*	node number of this engine
402 *CanDCNodeNumber*	node number of the other engine
4400 *CanCommDCOn*	enabling of CAN communication

The node numbers of the two control devices must be parameterized crosswise.

2405 *CanOnline* indicates whether the CAN connection is established. If one of the CAN errors 3070 *ErrCanBus* or 3071 *ErrCanComm* is indicated, meaning that the connection is disturbed, 3048 *ErrTwinEngine* is output and both engines go into single operation with droop (↑*7.8 Droop*).

The droop parameters for this error situation are:

129 *TwinEcyDroop*	droop
130 *TwinEcyDroopRefLow*	actuator values for zero-load
131 *TwinEcyDroopRefHigh*	actuator values for full-load
132 *TwinEcyDroopSpeedRef*	rated speed

These droop parameters are used whenever errors occur in twin-engine systems. They do not depend on droop being generally enabled and on how the droop values are set in parameters 120 ff and 125 ff. The parameters 129 *TwinEcyDroop* and 132 *TwinEcyDroopSpeedRef* must be identical in both control units.

The function twin-engine system is enabled by setting 5251 *TwinEngineEnable* = 1.

15.2 Multiple engine set with directional information

The throttle lever with directional setting (↑ *7.5.1 Setpoint adjuster with directional information*) can be adjusted in order to operate two engines. The lever itself is then present twice on the unit, in order to allow separate addressing of each engine.

Note

In the following section "Throttle lever" will refer to the whole device and "Lever" to the setpoint adjuster only.

A COMMAND button on the throttle lever (or separate from it) allows to request that both engines receive setpoint and directional information from the same lever. For an engine set composed of three or four engines, a second throttle lever has to be used accordingly. By enabling the SYNCHRO button on one of the two throttle levers (or separate from them), all engines can be driven from a single one of the four levers.

15.2.1 CAN communication

The coupling of the engines is achieved by a CAN bus connection between the **HEINZMANN** control units. For this purpose the same parameters have to be set in all control units.

400 *CanStartTimeOutDelay*	delay after switching on the control until messages are expected from the other engines
401 *CanMyNodeNumber*	node number of this engine
397 *PartnerDCNodeNumber*	node number of the other engine on same throttle lever
398 *ThirdDCNodeNumber*	node number of the third engine
399 *FourthDCNodeNumber*	node number of the fourth engine
4400 *CanCommDCOn*	enabling of CAN communication

Engine node numbers must be determined first and then be entered crosswise in the four parameters for each control unit, e.g., in the following way:

Throttle lever	**1**		**2**	
Parameter	**Engine 1**	**Engine 2**	**Engine 3**	**Engine 4**
401 *CanMyNodeNumber*	1	2	3	4
397 *PartnerDCNodeNumber*	2	1	4	3
398 *ThirdDCNodeNumber*	3	3	1	1
399 *FourthDCNodeNumber*	4	4	2	2

Table 20: HZM-CAN: Node numbers in multiple engine set

If only two or three engines are used, zeros must be entered in 398 *ThirdDCNodeNumber* and/or 399 *FourthDCNodeNumber*.

The current states of the other engines are indicated by the following parameters:

3260 *CanSetp2Setpoint* through 3266 *CanSetp2PositionIII*

3270 *CanSetp3Setpoint* through 3276 *CanSetp3PositionIII*

3280 *CanSetp4Setpoint* through 3286 *CanSetp4PositionIII.*

These values have the same meaning as the parameters

3250 *LeverSetpoint* through 3256 *SetpointPositionIII*, that indicate the values of the primary engine (↑*7.5.1 Setpoint adjuster with directional information*). CanSetp2 is always the value of node 397 *PartnerDCNodeNumber*, CanSetp3 the value of node 398 *ThirdDCNodeNumber* and CanSetp4 of node 399 *FourthDCNodeNumber*.

15.2.2 Common setpoint adjustment

Each engine is equipped with its own **HEINZMANN** control unit. The commutation Local ↔ Remote must be connected to all control units. In every control unit the respective lever with directional information must be calibrated as described in chapter ↑ *7.5.1.1 Calibration of lever positions*. The engagement is achieved as described in ↑ *7.5.1.2 Clutch* or ↑*7.5.1.3 Clutch disabling*.

COMMAND and SYNCHRO buttons of a throttle lever (or an external device) can be connected in parallel to both engine controlling units as 2842 *SwitchCommand* or 2843 *SwitchSynchro*. For the SYNCHRO button this is recommended especially when the four engines do no run together all the time.

However, for the function discussed here it is sufficient if the switches are connected to the one control unit that is entrusted with the common setpoint adjustment and transmission. Both are push-buttons, i.e., non-locking switches.

Note

Enabling and disabling of a common setpoint adjustment can be done only when all levers are in neutral position.

The command 2842 *SwitchCommand* enables common setpoint adjustment with the partner engine from the same throttle lever. This is indicated by 3257 *SetpointCommandActiv* = 1 and 3267 *CanSetp2CommandActiv* = 1. When 2842 *SwitchCommand* is enabled at the other throttle lever, this is indicated by 3277 *CanSetp3CommandActiv* = 1 and 3287 *CanSetp4CommandActiv* = 1.

In the same way, this applies to 2843 *SwitchSynchro*, which allows to take over setpoint adjustment for all engines from one of the two throttle levers. The enabled state of the function is indicated by a "1" in 3258 *SetpointSynchroActiv* and 3268 *CanSetp2SynchroActiv* or by a "1" in 3278 *CanSetp3SynchroActiv* and 3288 *CanSetp4SynchroActiv*.

After the respectively applying function is enabled, setpoint adjustment can be taken over by one of the two levers on the same throttle lever on which the button has been pressed. This is always the first lever shifted away from the neutral position. From which node the common setpoint adjustment is being effected at any given time is indicated with a "1" in 3259 *SetpointActive*, 3269 *CanSetp2Active*, 3279 *CanSetp3Active* or 3289 *CanSetp4Active*. In case of separated setpoint adjustment all four values are equal to "0". The resulting setpoint for two or all engines is taken from 3290 *CommonLeverSetpoint*.

Common setpoint adjustment for two engines is disabled by pressing again the same COMMAND button that had been used to enable the function, on condition both levers are in neutral position.

Common setpoint adjustment for all engines is disabled by pressing again the same SYNCHRO button that had been used to enable the function, on condition all levers are in neutral position.

Note

If the currently active setpoint adjuster receives an engine stop request, the common setpoint determination is automatically suspended and each of the two or four setpoint adjusters becomes active separately again.

15.2.3 LED indicators

On the throttle lever, or separate from it, two lamps can be addressed. The respective output parameters are stored in 3291 *CommandLED* and 3292 *SynchroLED*.

3291 *CommandLED* is active when the COMMAND button on its own throttle lever has been pressed, thereby enabling setpoint adjustment in common with the partner engine.

3292 *SynchroLED* is active when one of the SYNCHRO buttons on the two throttle levers has been pressed, thereby enabling common setpoint adjustment for all engines.

16 Speed control for dual fuel engines (ARTEMIS)

The basic systems DC 1, DC 2, DC 6 and XIOS are conceived not only for control of diesel and gas engines but also for use in dual fuel engines.

The DC 1-04 and XIOS control units can each directly operate up to three actuators – the diesel actuator and one or two gas throttle valves. The DC 1-03, DC 2 and DC 6 systems control only the diesel actuator with their own hardware and transmit the gas setpoint either through an analogue output to an external gas adjuster or are connected to a periphery module via the HEINZMANN CAN bus (↑ *23.1 CAN protocol* HZM-CAN) that receives the gas setpoint and controls the throttle valve or MEGASOL valves. In addition, the periphery module provides additional inputs and outputs for sensors, switching functions and indicators.

ARTEMIS is the overall system consisting of the control unit, periphery module and actuators/throttle valves or valves.

The control unit is responsible for all tasks necessary to ensure dual fuel operation and for clean switching from diesel to gas and back. Various conditions that have to be met for dual fuel operation can be enabled, for example that the load must be in a certain range, that the exhaust temperature must not be too high, or that there must be a minimum gas pressure.

For dual fuel operation, either a separate speed control loop is enabled to determine the gas setpoint or the gas quantity to be supplied is determined from a diesel reduction control loop.

One of the most important requirements for safe dual fuel operation and protection of the engine against overload is the presence of a power or power-equivalent signal. In contrast to a diesel engine, where the power and (diesel) injection quantity are normally in proportion to each other, this is no longer the case in dual fuel operation. A diesel engine governor can therefore work with the diesel fuel quantity of diesel as a power-equivalent signal, but a dual fuel control unit cannot (at least not in dual fuel operation).

Therefore, in generator applications the power measured by the HEINZMANN LMG power measuring unit (or other external units) 2918 *MeasuredPower* or the relative power supplied by the HEINZMANN THESEUS generator management system 3232 *RelativePower* is required.

In diesel / electric locomotive applications, the traction power calculated from the traction current and voltage 3231 *TractionPower* is used for functions relating to power.

In control units for marine drives, the pure diesel power is determined on the test bench and used in speed and fuel quantity dependent characteristic maps, while the gas power is calculated online by the HEINZMANN ELEKTRA gas metering unit (FlowControl).

16.1 Gas speed control

Integrated diesel and gas speed governors can be used in dual fuel applications with fixed speed. This variation can only be used in generator applications – and primarily in mains parallel systems. The safety functions are based on power.

Once the conditions for dual fuel operation are met, the switch to gas is performed. To do this, the gas is positioned increasingly high using a ramp until the diesel speed governor, which responds to the gas power supplied by reducing the diesel quantity, only calculates the minimum permitted diesel fuel quantity, known as the ignition oil quantity, previously specified. At that point, the speed control is switched from diesel to gas, which means that the output value of the speed governor is a gas fuel quantity value from now on. Meanwhile, the diesel is positioned at the ignition oil quantity.

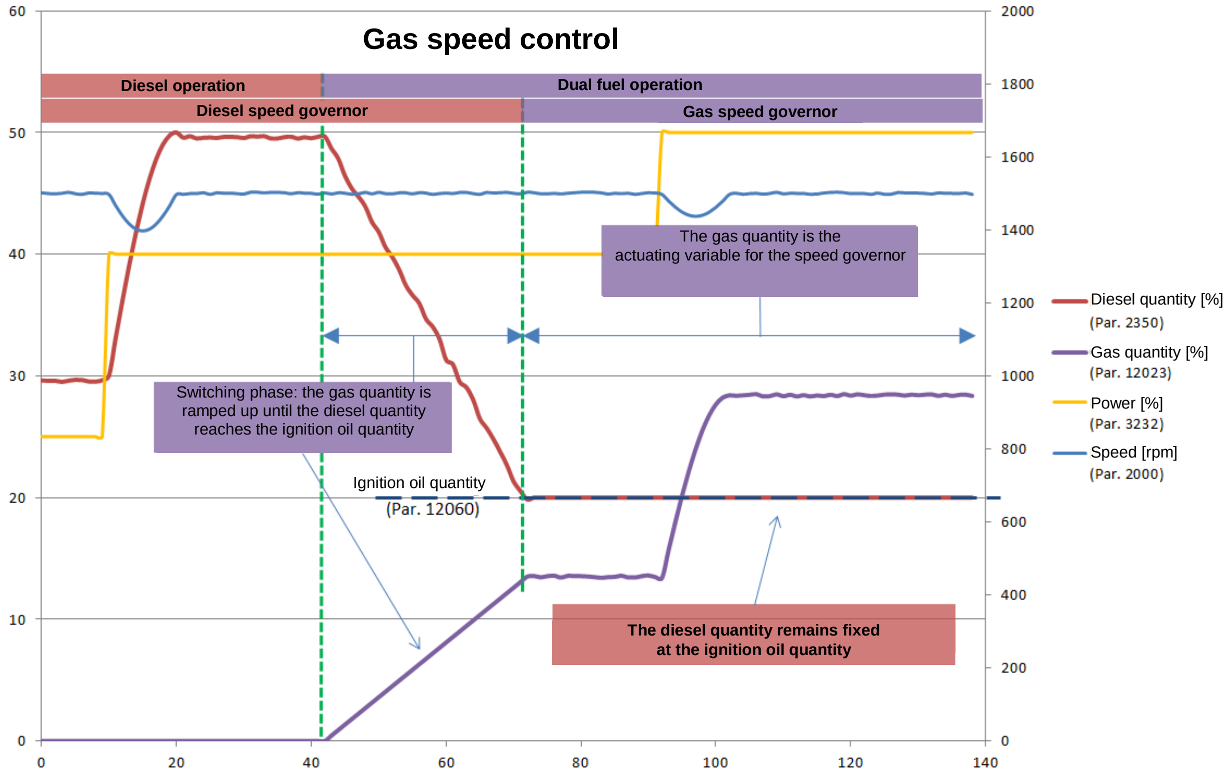


Fig. 39: Gas speed control

If the conditions for dual fuel operation are no longer met, the diesel speed governor is enabled again and the gas is returned to 0% either immediately or via a ramp.

16.2 Diesel reduction control

The diesel reduction control function is always used when dual fuel engines are to be used in applications with a variable speed or in generator sets if a very fast response to changes of load is important. To date, locomotive, generator and marine drive applications have been realised.

In this dual fuel variation, the diesel quantity always remains the actuating variable for the speed governor. The gas quantity is calculated by a second, subordinate control loop, known as the diesel reduction governor. The same algorithm is also used in separate dual fuel gas positioners that are connected to an external diesel speed governor.

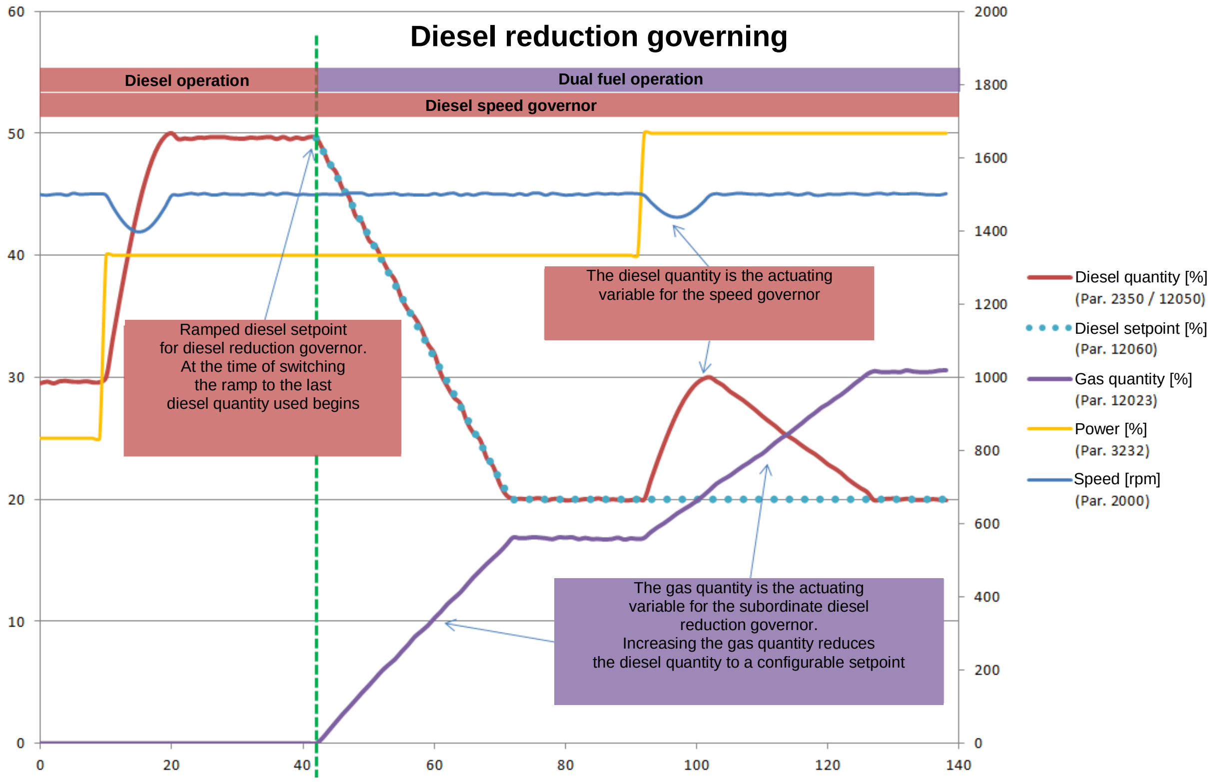


Fig. 40: Diesel reduction control

There are two variations of diesel reduction control. Either the setpoint and actual diesel fuel quantity or the setpoint and actual diesel power are fed into the control loop. In the first case, we refer to diesel fuel quantity control and in the second case to diesel power control. However, this explicitly does not involve engine power control; in both cases it involves reduction of the diesel proportion of the total power.

Diesel fuel quantity control can always be used if the diesel fuel quantity is proportional to the diesel power at a particular speed. For example, if this is not the case for engines with PT pump, diesel power control is to be used. This relates exclusively to the setpoint and actual value for the control loop, otherwise both functions are absolutely identical.

16.2.1 Diesel reduction by diesel fuel quantity control

The diesel fuel quantity setpoint 12060 *DieselRedGovSetp* is taken from a speed or load dependent characteristic and corresponds to the permitted minimum diesel quantity, so it is never less than the ignition oil quantity. The output value from the higher level speed governor is used as the actual diesel fuel quantity for the diesel reduction governor, i.e. the diesel fuel quantity setpoint 2350 *FuelQuantity*. The actuating variable for the control loop is the gas quantity that is required to achieve the specified diesel fuel quantity.

To avoid interfering with the higher level speed governor, the diesel fuel quantity setpoint is supplied to the diesel reduction governor with a delay using a ramp function.

Every change of speed or load is compensated by the higher priority and faster speed governor and the diesel reduction governor is then subordinate with the gas addition.

16.2.1.1 Applications for locomotive operation

In diesel/electric locomotive operation, the diesel fuel quantity setpoint is determined depending on the traction power. The calculated traction power is also the most important value for protecting the engine against overload in dual fuel operation.

The traction power is determined from the traction current and the traction voltage, which must be available as measured values.

On the test bench, the diesel fuel quantity is determined relative to the electrical diesel power over the entire speed range and is saved as a characteristic. During operation, it can be used to determine the current diesel power at any time and to calculate the maximum possible proportion of the gas power.

In this case, both actuators on throttle valves and HEINZMANN solenoid valves (MEGASOL) can be used for the gas positioning.

16.2.1.2 Generator applications

In generator operation, the electrical proportion of the engine power is measured. This is the most important value for protecting the engine against overload in dual fuel operation.

On the test bench, the diesel fuel quantity is determined relative to the electrical diesel power at the nominal speed and is saved as a characteristic. During operation, it can be used to determine the current diesel power at any time and to calculate the maximum possible proportion of the gas power.

In this case, both actuators on throttle valves and HEINZMANN solenoid valves (MEGASOL) can be used for the gas positioning.

16.2.1.3 Maritime applications

In Marine operation, the gas positioning is performed by the HEINZMANN ELEKTRA unit (publication “ELEKTRA FLOW Control”, order no. DF 14 001-d).

ELEKTRA calculates the gas power from the gas flow. Together with the speed-dependent and fuel quantity dependent diesel power calculated on the test bench, the target gas quantity for the specified gas power can be calculated and the engine can thus be protected against overloading. The application is performed on the test bench with the engine manufacturer.

16.2.2 Diesel reduction by diesel power control

In engines with a PT pump, as the diesel power does not have a linear correlation with the actuating variable, the reduction governor cannot operate based on the set and actual diesel fuel quantity. Instead, the set and actual diesel power are fed into the control loop.

The diesel power setpoint 12060 *DieselRedGovSetp* is taken from a load dependent characteristic and corresponds to the permitted minimum diesel quantity, so it is never less than the ignition oil quantity. The associated diesel quantity must be sufficient to ignite the gas. The actual diesel power 12050 *DieselPower* is taken from a speed and fuel pressure dependent map. The actuating variable for the control loop is the gas quantity that is required to achieve the specified diesel power.

To avoid interfering with the higher level speed governor, the diesel power setpoint is supplied to the diesel reduction governor with a delay using a ramp function.

Every change of speed or load is compensated by the higher priority and faster speed governor and the diesel reduction governor is then subordinate.

16.3 Determining the ignition oil quantity

To ensure safe dual fuel operation, it is essential that the current diesel quantity is sufficient to burn the gas. The ignition oil quantity must therefore be defined.

Notice

The term "ignition oil quantity" implies that it always relates to diesel fuel quantity. This is the case, but with one exception. For diesel reduction by diesel power control, it is a diesel power value, ↑16.2.2 Diesel reduction by diesel power control, but this must of course correspond to a minimum permitted diesel quantity.

The ignition oil quantity that must always be met is specified as a fixed value for the entire speed and power range in 10055 *PilotDslAbsMinimum*. This value applies without exception as the absolute minimum; an ignition oil quantity calculated in another way is always (!) limited with this value as the lower threshold.

The minimum ignition oil quantity can also be stipulated depending on speed in the 16780 *PilotDslAbsMin:n(x)* and 16790 *PilotDslAbsMin:Dsl(x)* curve. This curve is enabled with 14055 *PilotAbsMinCurveOn* = 1, otherwise the parameter 10055 *PilotDslAbsMinimum* is used. These curve values are also limited internally with 10055 *PilotDslAbsMinimum* in the event of incorrect configuration.

These parameters for the absolute minimum ignition oil quantity are stipulated in Level 6 and are normally specified by the engine manufacturer. For safety reasons, they should not be enabled for changes by end customers.

Parameters

10055 *PilotDslAbsMinimum*	Absolute minimum ignition oil quantity
12055 *PilotDslAbsMinimum*	Current minimum ignition oil quantity
14055 *PilotAbsMinCurveOn*	Enable / disable speed-dependent absolute minimum ignition oil quantity
16780 *PilotDslAbsMin:n(x)*	Speed grid points for absolute minimum ignition oil quantity
16790 *PilotDslAbsMin:Dsl(x)*	Values for the absolute minimum ignition oil quantity

The ignition oil quantity should normally be set higher than the absolute minimum. To do this, either the parameter 10060 *PilotDieselSetpoint* or the result of the power-dependent characteristic for 16300 *PilotDiesel:P(x)* and 16310 *PilotDiesel:Dsl(x)* is used. This curve is enabled with 14060 *PilotDslPowerCurvOn*.

These parameters are available at Level 4 and can therefore be influenced by end customers. The ignition oil quantity valid at a specific time is indicated in 12060 *PilotDieselPresent*. It is never less than 10055 *PilotDslAbsMinimum*.

In applications with a gas speed governor, the parameter 14062 *PilotDslCurrLessOn* is a special case. It must be set if a mechanical stop on the engine specifies the minimum position for the ignition oil quantity. Without this parameter, the diesel actuator would continuously press against the stop and be permanently overloaded or overheat when the diesel is positioned to the ignition oil quantity in gas control mode. With the parameter enabled, the diesel actuator is disconnected and the gas speed governor is enabled. This is the case when switching from diesel to gas if the diesel fuel quantity has reached the ignition oil quantity. The value of 10055 *PilotDslAbsMinimum* must be adapted to the mechanical stop.

Parameters

10055 *PilotDslAbsMinimum*	Absolute minimum ignition oil quantity
10060 *PilotDieselSetpoint*	Ignition oil quantity parameter if 14060 *PilotFuelPowerCurvOn = 0*
12060 *PilotDieselPresent*	Current ignition oil quantity, never less than 10055 *PilotDslAbsMinimum*
14060 *PilotDslPowerCurvOn*	Enable / disable power-dependent ignition oil quantity
14062 *PilotDslCurrLessOn*	Enable / disable deactivation of the actuator power supply when the gas speed governor is enabled

16300 *PilotDiesel:P(x)*	Power grid points for ignition oil quantity
16310 *PilotDiesel:Dsl(x)*	Ignition oil quantity setpoints

16.4 Determining the power proportions

Monitoring the total engine power from the diesel and gas proportions is one of the most important tools for avoiding engine overloads in dual fuel operation. Power or power-equivalent measurement and calculation values are therefore needed in all dual fuel variants, for use for limitation.

In a pure diesel engine, the injection quantity and the power are normally equivalent at a speed. It is therefore often sufficient here to use the speed-dependent fuel quantity limitation instead of real power limitation. This is different in a dual fuel engine as, the gas quantity is no longer equivalent to the power output due to various external influences such as gas pressure, gas temperature and changing gas quality.

16.4.1 Applications for locomotive operation

In diesel / electric locomotives, the measured values for traction current 2919 *TractionCurrent* and traction voltage 2918 *TractionVoltage* can be used to calculate the traction power 3231 *TractionPower*.

3231 *TractionPower* [kW] =
2918 *TractionVoltage* [V] x 2919 *TractionCurrent* [A] / 1000

Multiplying the maximum current and voltage sensor values gives a maximum power value, which is well above the actual range of the generator. For this reason,

1232 *TractionPowerHigh*

should contain the actual maximum power value. This maximum value applies to all traction power parameters. The relative power 3232 *RelativTractionPower* is specified as a percentage of this value.

The locomotive manufacturer specifies the required traction power for each speed notch and thus for fixed values, and these also have to be observed with a dual fuel engine. These values are entered in the 16050 *MaxPower:n* and 16060 *MaxPower:P* characteristic, enabling the maximum total electric power required 12048 *PowerMax* to be determined at any time.

During commissioning, the pure diesel traction power is entered in a speed and fuel quantity dependent map or, for engines with a PT pump, in a speed and diesel pressure dependent map, 16800 *DieselPower:n(x)*, 16810 *DieselPower:f* (y) / *DieselPower:p(y)* and 16835 *DieselPower:P(z)*. In dual fuel operation, the diesel proportion taken from the map 12050 *DieselPower* is subtracted from the current traction power, thus giving the current gas proportion 12051 *GasPower*.

Parameters

1232 *TractionPowerHigh*	Definition of the actual maximum traction power of the locomotive
2918 *TractionVoltage*	Current traction voltage
2919 *TractionCurrent*	Current traction current
3231 *TractionPower*	Current traction power
3232 *RelativTractionPower*	Traction power relative to 1232 *TractionPowerHigh*
12048 *PowerMax*	Current maximum traction power
12049 *DieselPowerMap*	Diesel power from speed and fuel quantity dependent map
12050 *DieselPower*	Current diesel power
12051 *GasPower*	Current gas power
12053 Relative*DieselPower*	Current diesel power relative to 1232 *TractionPowerHigh*
14050 *DieselPowerCurveOn*	Enable / disable diesel power map
16050 *MaxPower:n(x)*	Speed grid points for max. traction power
16060 *MaxPower:P(x)*	Maximum traction power values
16800 *DieselPower:n(x)*	Speed grip points for diesel power
16810 *DieselPower:f(y)*	Diesel fuel quantity grid points for diesel power
16810 *DieselPower:p(y)*	Diesel pressure grid points for diesel power (engines with PT pump)
16835 *DieselPower:P(z)*	Diesel power

16.4.2 Generator applications

In generator sets, the actual power 2918 *MeasuredPower* must be transmitted to the control unit. The relationship between actual power and diesel fuel quantity is determined on the test bench in pure diesel operation and the relevant power is entered in a fuel quantity dependent characteristic for 16050 *DieselPower:f* and 16065 *DieselPower:P*. This curve is enabled with 14050 *DieselPowerCurveOn*.

In dual fuel operation, the diesel power taken from the characteristic, 12050 *DieselPower*, is subtracted from the total power 2918 *MeasuredPower* and the rest is the gas power, 12051 *GasPower*.

Parameters

1232 *RatedPower*	Nominal power
2918 *MeasuredPower*	Current power
3232 *RelativePower*	Power relative to nominal power
12050 *DieselPower*	Current diesel power
12051 *GasPower*	Current gas power
14050 *DieselPowerCurveOn*	Enable / disable diesel power characteristic
16050 *DieselPower:f(x)*	Diesel fuel quantity grid points for diesel power
16065 *DieselPower:P(x)*	Diesel power

16.4.3 Maritime applications

In ships, there are ship generators, which are included in this brochure in the generator application section, and drive motors.

For dual fuel operation in drive motors, the lack of power measurement means that it is necessary to calculate the engine power online. The required maps for the maximum permitted engine power and the diesel proportion of the power are prepared using a test bench with integrated power measurement. This is mostly only possible in conjunction with the engine manufacturer. Dual fuel operation on marine drive motors is not possible without these values. There is therefore no separate on/off switch for these maps. In other words, they are essential and are therefore always active.

The speed-dependent maximum engine power resulting from the propeller curve must be saved in 16130 *DFSpeedLimit:P(x)*. The speed grid points correspond to those for speed-dependent diesel fuel quantity limitation 6700 *SpeedLimit:n(x)*. In other words, in pure diesel operation the maximum engine power is determined using the envelope curve and in dual fuel operation using the power values specified here. During operation, the current maximum engine power is indicated in *12052 DF:EnginePowerLimit*.

The speed and fuel quantity dependent diesel power is then determined on the test bench by running up to the speed / power levels of the propeller curve. The speed grid points are entered in 16800 *DieselPower:n(x)*. The diesel fuel quantity is taken from 2350 *DieselFuelQuantity* and saved in 16810 *DieselPower:f(y)* while the associated diesel power values have to be entered in 16835 *DieselPower:P(z)*. The resulting current diesel power value appears in 12050 *DieselPower*.

Notice

Due to the different fuel quantity values at the speed and power levels, a conversion using an Excel sheet may be necessary to enter the power values at the same fuel quantity grid points.

Parameters

3231 *EnginePower*	Current engine power
12050 *DieselPower*	Current diesel power
12051 *GasPower*	Current gas power
12052 *DF:EnginePowerLimit*	Maximum permitted total engine power
16800 *DieselPower:n(x)*	Speed grid points for diesel power map
16810 *DieselPower:f(y)*	Diesel fuel quantity grid points for diesel power map
16835 *DieselPower:P(z)*	Diesel power values

16.4.3.1 Diesel power for power take-offs

The minimum ignition oil quantity 12055 *PilotDslAbsMinimum* may be below the electrical zero power limit if power take-offs are consuming part of the total mechanical engine power. In dual fuel operation it is possible that this diesel power proportion will also be substituted with gas, thus increasing the conversion rate.

The mechanical diesel power proportion under the electrical zero-fuel limit is saved in the characteristic for 16490 *DieselNegPow:f(x)* and 16500 *DieselNegPow:P(x)* depending on the fuel quantity. Of course, the diesel fuel quantity 2350 *DieselFuelQuantity* is below the values of 16810 *DieselPower:f(y)*, which determine the electrical diesel power. The current mechanical diesel power value is indicated in 12049 *NegDieselPower*.

NOTICE	For safety reasons, this characteristic may only be created by the engine manufacturer, who can also specify a low ignition oil quantity such that gas combustion is guaranteed at all times. Otherwise, the ignition oil quantity must be above the electrical zero-fuel limit and 0 should be entered as the power values for this characteristic.**Fehler! Textmarke nicht definiert.**

Parameters

12049 *NegDieselPower*	Mechanical diesel power under the electrical zero-fuel limit
12055 *PilotDslAbsMinimum*	Current minimum ignition oil quantity
16490 *DieselNegPow:f(x)*	Fuel quantity grid points
16500 *DieselNegPow:P(x)*	Power values

16.5 Configuring the gas output

Depending on the application, the calculated gas setpoint value can either be output at an actuator to thus control a throttle valve, or at a solenoid valve control unit, which uses it to determine the actuation period for MEGASOL valves.

When using the DC 1-04 or XIOS as a dual fuel control unit, the gas actuator can be connected to its own hardware, otherwise the HZM-CAN bus is used to connect a periphery module whose actuator or valves are used for the gas output.

In marine drives, the ELEKTRA Flow-Control is used, which transmits the gas power setpoint. The ELEKTRA is an HZM-CAN add-on module.

The customer-specific firmware specifies the general application and only the relevant variation from those listed below is provided.

16.5.1 Own actuator (DC 1-04)

One or two throttle valves are required depending on the mechanical mounting of the gas section (e.g. on the V-type engine). The DC 1-04 control unit can control up to three actuators, one for the diesel and one or two for the gas. However, if the StG 180 is required for the diesel fuel quantity, only one free amplifier is available for the gas. In any case, the firmware always specifies the maximum possible number of gas actuators.

The gas setpoint 12023 *GasFuelQuantity* is either transmitted directly to 12021 *GasActSetpoint* or it can be routed through the fuel quantity dependent actuator characteristic 16210 *GasFToActSetp:f(x)* / 16225 *GasFToActSet:Pos(x)*. The curve is enabled with 14021 *GasFuelToActPosCrvOn*.

If 14090 *GasActuatorOn* is enabled, 12021 *GasActSetpoint* is always output to amplifier 2. If 14091 *GasDoubleActuatorOn* is also enabled, the same value is also transmitted to amplifier 3.

The values of 14090 *GasActuatorOn* and 14091 *GasDoubleActuatorOn* are only considered during initialisation after a control unit reset. 12092 *ActuatGasPositioner* and 12093 *ActuatGasPositioner2* indicate whether one or two (or no) assignment to actuators was detected for the gas output.

For configuration of the actuators themselves, see ↑*24 Actuator trigger with position feedback.*

Parameters

12021 *GasActSetpoint*	Gas actuator setpoint
12023 *GasFuelQuantity*	Gas setpoint
12092 *ActuatGasPositioner*	Amplifier 2 is used
12093 *ActuatGasPositioner2*	Amplifier 3 is used

14021 *GasFuelToActPosCrvOn*	Enable / disable fuel quantity dependent actuator characteristic
14090 *GasActuatorOn*	Enable / disable output to amplifier 2
14091 *GasDoubleActuatorOn*	Enable / disable output to amplifier 3
16210 *GasFToActSetp:f(x)*	Fuel quantity grid points for the actuator characteristic
16225 *GasFToActSet:Pos(x)*	Positions of the actuator characteristic

16.5.2 Own actuator (XIOS)

One or two throttle valves are required depending on the mechanical mounting of the gas section (e.g. on the V-type engine). The XIOS control unit can control up to three actuators – one for the diesel and one or two for the gas, or two for the diesel and one for the gas. Additional periphery modules may have to be used for other combinations. In any case, the firmware always specifies the maximum possible number of gas actuators.

The diesel and gas setpoints are assigned to actuators by the assignment to actuator outputs. These values are only taken into account after a control unit reset. 12092 *ActuatGasPositioner* and 12093 *ActuatGasPositioner2* indicate whether one or two (or even no) assignment to actuators was detected for the gas output.

If only one gas actuator is controlled, it must be assigned the parameter 12023 *GasFuelQuantity*. If two gas actuators are used, they must be assigned 12026 *GasFuelQuantityBank1* and 12027 *GasFuelQuantityBank2* even if the two values are identical. 12021 *GasActSetpoint(0)* or 12022 *GasActSetpoint(1)* must not be assigned as these values are only generated by the above assignment.

For configuration of the actuators themselves, see ↑*24 Actuator trigger with position feedback.*

<u>Parameters</u>

12021 *GasActSetpoint*	Gas actuator setpoint (1 throttle valve)
12021 *GasActSetpoint(0)* 12022 *GasActSetpoint(1)*	Gas actuator setpoints (2 throttle valves)
12023 *GasFuelQuantity*	Gas setpoint for one throttle valve
12026 *GasFuelQuantityBank1* 12027 *GasFuelQuantityBank2*	Gas setpoints for two throttle valves
12092 *ActuatGasPositioner*	First throttle valve is used
12093 *ActuatGasPositioner2*	Second throttle valve is used

16.5.3 HZM-CAN periphery module: Actuator or solenoid valves

If the gas value is to be transferred to an HZM-CAN periphery module, the assignment is carried out as described in ↑*20 Configuring the control's inputs and outputs*.

The configuration values are only taken into account after a control unit reset. 12094 *CanGasPositioner* and 12096 *CanGasPositioner2* indicate whether one or two (or no) periphery modules are used for the gas output. For assignment to periphery modules with electronic fuel injection, 12095 *EFIGasPositioner* and 12097 *EFIGasPositioner2* are also set to 1. For assignment to periphery modules with actuators, these parameters either do not exist at all or they indicate a value of 0.

For configuration of the periphery module communication, see ↑*23.1 CAN protocol* HZM-CAN.

<u>Parameters</u>

12094 *CanGasPositioner*	HZM-CAN periphery module for gas value output
12095 *EFIGasPositioner*	HZM-CAN periphery module for gas value output to: 0: Throttle valve 1: MEGASOL solenoid valves
12096 *CanGasPositioner2*	Second HZM-CAN periphery module for gas value output
12097 *EFIGasPositioner2*	Second HZM-CAN periphery module for gas value output to: 0: Throttle valve 1: MEGASOL solenoid valves

During operation, when using an MVC periphery module, 2200 (previously 2305) *PEGasQuantity* indicates which fuel quantity value the module is currently using. The value is 0 if the MVC is not synchronised. When using a periphery module with an actuator, 2200 (previously 2305) *PEActPos* shows the current back measurement of the actuator position (corresponds to 2300 *ActPos* in the periphery module) and 2210 (previously 2320) *PEActuatorOn* indicates whether the actuator is enabled (corresponds to 5910 *ActuatorOn* in the periphery module).

16.5.4 HZM-CAN add-on module: ELEKTRA Flow-Control

In maritime applications, the HEINZMANN ELEKTRA unit is connected to the dual fuel control unit via the HZM-CAN bus to determine the gas quantity necessary at the required gas power and for output to an actuator. In terms of the HZM-CAN bus system, ELEKTRA is known as an add-on module (AC). ELEKTRA Flow-Control has the AC module type 1.

Up to five add-on modules can normally be connected to a control unit. Their node numbers are saved in the parameters starting from 430 *CanACNodeNumber* and their type in the parameters starting from 435 *CanACNodeType*. Therefore, during initialisation after a control unit reset, these two fields are searched for the first add-on module with a node number not equal to 0 and AC module type 1. If a matching element is found, this indicated by 12091 *CanGasFlowControl*.

To transfer the setpoint 12023 *GasPowerSetpoint* to the ELEKTRA Flow-Control, the enable parameter associated with the AC module 4375 *AC1SetpointOn*…4395 *AC5SetpointOn* must also be set, where the number AC1...AC5 must correspond to the Index+1 of 430 *CanACNodeNumber*.

For configuration of the add-on module communication, see ↑ *23.1* CAN protocol HZM-CAN. The functioning of the ELEKTRA is described in the “ELEKTRA Flow Control” manual, order no. DF 14 001-e.

Parameters

430 *CanACNodeNumber*	Node numbers of up to 5 AC modules
435 *CanACNodeType*	Node type of up to 5 AC modules
4375 *ACxSetpointOn*	Enable / disable setpoint transmission
12023 *GasPowerSetpoint*	Gas power setpoint
12091 *CanGasFlowControl*	ELEKTRA Flow-Control is enabled

16.5.5 Analogue or PWM output of gas setpoint

If a gas actuator is not available on its own hardware and the HZM-CAN bus cannot be used, it is also possible to output the gas setpoint using an analogue or PWM output on the dual fuel control unit.

For assignment of the gas setpoint 12021 *GasActSetpoint* or 12023 *GasFuelQuantity* to this kind of output, see ↑ *20 Configuring the control’s inputs and outputs* . Evaluation is only carried out in the initialisation phase after a control unit reset and the result of this check is indicated in 12091 *ADPWMGasPositioner*.

Parameters

12021 *GasActSetpoint*	Gas actuator setpoint
12023 *GasFuelQuantity*	Gas fuel quantity setpoint
12091 *ADPWMGasPositioner*	The gas setpoint is output using an analogue or PWM output

16.6 Enabling and disabling dual fuel operation

For the engine to run in dual fuel operation, this must generally be enabled first with 14000 *DualFuelOn* = 1.

The engine generally starts in diesel mode and only switches to dual fuel operation when all of the required conditions are met. An important and essential condition is enabling or disabling using the switching function 2837 *SwitchGasOrDiesel*. The switch back to diesel operation is normally performed by disabling this switch. The switching function 2838 *SwitchFastToDiesel* enables dual fuel operation to be terminated more quickly – but still in a controlled way – while 2849 *SwitchEmergencyStop* (XIOS: 2873 *SwitchEmergencyStop*) shuts it down immediately with no conditions.

In generator operation with a gas speed governor, diesel control mode is indicated by 12030 *DieselGovernorActive* = 1 and gas control mode by 12031 *GasGovernorActive* = 1.

On control units with diesel reduction control, the diesel speed governor is always enabled and therefore does not need to be signalled separately. However, 12031 *GasActive* = 1 indicates whether gas is currently enabled.

12034 *GasConsumptionActive* indicates whether gas is actually being consumed in dual fuel operating mode. This is always the case if a gas quantity <> 0 is calculated; i.e. the throttle valve or MEGASOL valves are open.

16.6.1 Conditions for enabling dual fuel operating mode

A wide range of different conditions for dual fuel operation can be checked – depending on the engine type, the available sensors and the required safety measures. The control unit is only able to switch to this operating mode if all the active checks return positive results. Accordingly, dual fuel mode is terminated immediately if at least one of the conditions ceases to be met.

In generator operation with gas speed control, an external device can also be used to check whether dual fuel operation is permitted. In this case, only a few safety-related tests are performed in the speed governor and otherwise the decision is made exclusively using the switching function 2837 *SwitchGasOrDiesel*, which is controlled by the external device. This type of check is known as monitoring mode and is enabled using 14098 *GasSupviseOrCntlMode* = 1. However, if the dual fuel control unit is intended to carry out all control itself, 14098 *GasSupviseOrCntlMode* = 0 should be set.

The diesel reduction governor is always enabled if the conditions for dual fuel operation are met and it is disabled again as soon as this is not the case. Thus, the operating mode is changed continuously depending on the condition – but always in such a way that as much gas as possible is supplied. Separate enabling of this function is not necessary.

The following table lists all the check types and notes the application for which the relevant test is relevant.

In gas speed governor mode “(Control)” indicates which tests play a role exclusively in the control mode, i.e. when 14098 *GasSupviseOrCntlMode* = 0. All other tests are also performed in monitoring mode.

Test	Gas speed governor	Diesel reduction governor		
Reference	**Gen**	**Gen**	**Loc**	**Marine**
Gas request active	X	X	X	X
	2837 *SwitchGasOrDiesel* = 1			
No fast switch back request	X	X	X	X
	2838 *SwitchFastToDiesel* = 0			
No external gas alarm	X	X	X	X
↑*16.7.15 External gas alarm*	2847/2871 *SwitchExternGasAlarm* = 0			
No fatal error	X	X	X	X
↑*27.7 Emergency shutdown errors*	3800 *EmergencyAlarm* = 0			
Engine running	X	X	X	X
↑*5 Starting fuel limitation*	3830 *Phase* between 4 and 7 3805 *EngineRunning* = 1			
No gas termination error	X	X	X	X
↑*16.6.2 Conditions for terminating dual fuel operating* mode	12032 *PromptReturnToDiesel* = 0			
No gas output device error	X	X	X	X
↑*16.7.16 Monitoring the gas* output device	13001 *ErrGasPositioner* = 0 13032 *ErrDualFuelStatus.0* = 0 (XIOS)			
No error in ARIADNE knock monitoring device	X	X	X	X
↑*16.7.14 Engine*	13009 *ErrKnockControlOff* = 0 13032 *ErrDualFuelStatus.1* = 0 (XIOS)			
MEGASOL control unit is synchronised	X	X	X	X
↑*16.7.16.4 MEGASOL valves on HZM-CAN* periphery module	13022 *ErrEFIGasPosDiff* = 0 13031 *ErrGasConditions.12* = 0 (XIOS)			
No misfires	X	X	-	-
↑*10.8 Misfire monitoring in generator operation*	3046 *ErrMisfireWarn* = 0 3047 *ErrMisfireEcy* = 0 3047 *ErrMisfireDetection* = 0 (XIOS)			

Test	Gas speed governor	Diesel reduction governor		
Reference	**Gen**	**Gen**	**Loc**	**Marine**
Gas section monitoring OK	(Control)	X	X	X
↑*16.7.1* Gas section test	12082 *GasTrainReady* = 1			
Power in permissible range	(Control)	X	X	X
↑*16.7.2 Monitoring the power*	13013 *ErrPowerRangeForGas* = 0 13031 *ErrGasConditions.2* = 0 (XIOS)	12013 *PowerInRangeForGas* = 1		
Exhaust temperature not too high	(Control)	X	X	X
↑*16.7.3 Monitoring the exhaust* temperature	13019 *ErrExhTRangeForGas* = 0 13031 *ErrGasConditions.8* = 0 (XIOS)	12017 *ExhTInRangeForGas* = 1		
Exhaust temperature difference (max-min) not too high	(Control)	X	X	X
↑*16.7.3 Monitoring the exhaust* temperature	13020 *ErrExhTDRangeForGas* = 0 13031 *ErrGasConditions.8* = 0 (XIOS)	12018 *ExhTDInRangeForGas* = 1		
Coolant temperature OK	(Control)	X	X	X
↑*16.7.4 Coolant temperature monitoring*	13018 *ErrCoolTRangeForGas* = 0 13031 *ErrGasConditions.6* = 0 (XIOS)	12019 *CoolTInRangeForGas* = 1		
Charge air temperature OK	(Control)	X	X	X
↑*16.7.5 Charge air temperature* monitoring	13021 *ErrChAirTRangeForGas* = 0 13031 *ErrGasConditions.7* = 0 (XIOS)	12002 *ChAirTInRangeForGas* = 1		
Oil pressure OK	(Control)	X	X	X
↑*16.7.7 Oil pressure monitoring*	13016 *ErrOilPRangeForGas* = 0 13031 *ErrGasConditions.5* = 0 (XIOS)	12015 *OilPrInRangeForGas* = 1		

Test	**Gas speed governor**	**Diesel reduction governor**		
Reference	**Gen**	**Gen**	**Loc**	**Marine**
Boost pressure OK	(Control)	X	X	X
↑*16.7.8 Boost pressure monitoring*	13015 *ErrBoostRangeForGas* = 0 13031 *ErrGasConditions.4* = 0 (XIOS)	12016 *BoostInRangeForGas* = 1		
Gas pressure OK	(Control)	X	X	X
↑*16.7.9 Gas rail pressure* monitoring	13017 *ErrGasPrRangeForGas* = 0 13030 *ErrGasRailStatus.7* = 0 (XIOS)	12005 *GasPrInRangeForGas* = 1		
Gas pressure switch active (if assigned)	(Control)	X	X	X
↑*16.7.10 External gas pressure monitoring*	2845/2870 *SwitchGasPressReady* = 1			
Speed OK	(Control)	X	X	X
↑*16.7.11 Speed monitoring*	13012 *ErrSpeedRangeForGas* = 0 13031 *ErrGasConditions.1* = 0 (XIOS)	12010 *SpeedInRangeForGas* = 1		
Diesel fuel quantity OK	(Control)	X	X	X
↑*16.7.12 Ignition oil quantity* monitoring	13014 *ErrFuelRangeForGas* = 0 13031 *ErrGasConditions.13* = 0 (XIOS)	12012 *DieselInRangeForGas* = 1		
Excitation governor on traction power	-	-	X	-
↑*13.2.1 Excitation control*		2605 *ExcitGovTrPowOrFuel* = 1		
ELEKTRA is enabled	-	-	-	X
↑*16.7.16.5 ELEKTRA FlowControl (HZM-CAN add-on* module*)*		12006 *GasPosNotActive* = 0		

Tab. 21: Conditions for enabling dual fuel operating mode

16.6.2 Conditions for terminating dual fuel operating mode

If at least one of the following conditions is met in dual fuel operating mode, this operating state is terminated. Depending on the specified safety level, the return is either performed using a ramp or dual fuel mode has to be terminated immediately.

The following table lists the situations that lead to termination of dual fuel mode. In gas speed governor mode “(Control)” indicates which tests play a role exclusively in the control mode, i.e. when 14098 *GasSupviseOrCntlMode* = 0. All other tests are also performed in monitoring mode. (↑ *16.6.1* Conditions for enabling dual fuel operating mode).

In the gas speed governor, “Norm” indicates normal termination using the gas ramp, “Fast” indicates use of a separate, faster ramp and “Prompt” indicates immediate, non-ramped termination (↑*16.8.3 Switching ramp from gas to* diesel operation).

In the diesel reduction governor, “Fast” or “Prompt” indicates whether dual fuel mode has to be terminated using a fast ramp or immediately. By contrast, “Norm” means termination using the normal diesel ramp (↑*16.9.3 Diesel* setpoint ramp).

In case of error, the fast shutdown is signalled using 12032 *PromptReturnToDiesel* = 1. The gas is immediately switched to 0 % and the diesel takes over abruptly. In this case, the cause of the error is indicated by an error marker. It is not possible to enable dual fuel operation again until the cause has been remedied and an edge change from 0 → 1 is detected in the switching function 2837 *SwitchGasOrDiesel*.

Test	**Gas speed governor**	**Diesel reduction governor**		
Reference	**Gen**	**Gen**	**Loc**	**Marine**
Gas request ends	Norm	Norm	Norm	Norm
	2837 *SwitchGasOrDiesel* = 0			
Fast switch back to diesel requested	Fast	Fast	Fast	Fast
	2838 *SwitchFastToDiesel* = 1			
Fatal error	Prompt	Prompt	Prompt	Prompt
↑*27.7 Emergency shutdown errors*	3800 *EmergencyAlarm* = 1 2849 *SwitchEmergencyStop* = 1			
External gas alarm	Fast	Prompt	Prompt	Prompt
↑*16.7.15 External gas alarm*	2847/2871 *SwitchExternGasAlarm* = 1 13024 *ErrExternGasAlarm* = 1 13030 *ErrGasRailStatus.6*=1 (XIOS)			
Breaker opens	Prompt	Fast	-	-
↑*9.4 Zero fuel delivery characteristic*	2846 *SwitchGenBreaker* 1 → 0			

Test	**Gas speed governor**	**Diesel reduction governor**		
Reference	**Gen**	**Gen**	**Loc**	**Marine**
Gas pressure switch inactive	Prompt (Control)	Fast	Fast	Fast
↑*16.7.10 External gas pressure monitoring*	2845/2870 *SwitchGasPressReady* = 0			
Gas pressure too high	Prompt	Fast	Fast	Fast
↑*16.7.9 Gas rail pressure* monitoring	13017 *ErrGasPrRangeForGas* = 1 13030 *ErrGasRailStatus.7* = 1 (XIOS)	12005 *GasPrInRangeForGas* = 0 2925/2942 *GasDiffPressure* > 10006 *GasModeGasRPressMax*		
Gas pressure switch “not ready”	Prompt	-	-	-
↑*16.7.1 Gas* section test	2848/2872 *SwitchExternGasReady* = 0			
Diesel fuel quantity < ignition oil quantity	Prompt	Fast	Fast	Fast
↑*16.7.12 Ignition oil quantity* monitoring	13023 *ErrBelowPilotFuel* = 1 13031 *ErrGasConditions.13* = 1 (XIOS)	12011 *DieselBelowPilotFuel* = 1		
Heavy knocking	Prompt	Prompt	Prompt	Prompt
↑*16.7.14 Engine*	13007 *ErrHeavyKnocking*=1 13031 *ErrGasConditions.11*=1 (XIOS)			
Error in ARIADNE knock monitoring device	Prompt	Prompt	Prompt	Prompt
↑*16.7.14 Engine*	13009 *ErrKnockControlOff* = 1 13032 *ErrDualFuelStatus.1* = 1 (XIOS)			
Gas actuator error	Prompt	Fast	Fast	Fast
↑*16.7.16 Monitoring the gas* output device	13001 *ErrGasPositioner* = 1 (13032 *ErrDualFuelStatus.0*=1 (XIOS) 13025 *ErrGasPosFatal* = 0 13032 *ErrDualFuelStatus.15*=0 (XIOS)			
MEGASOL control unit is not synchronised (setpoint <> 0, actual value = 0)	Prompt	Prompt	Prompt	Prompt
↑*16.7.16.4 MEGASOL valves on HZM-CAN* periphery module	13022 *ErrEFIGasPosDiff* = 1 13031 *ErrGasConditions.12* = 1 (XIOS)			

Test	Gas speed governor	Diesel reduction governor		
Reference	**Gen**	**Gen**	**Loc**	**Marine**
Misfire	Prompt	Fast	-	-
↑*27.8.1.4* Misfire monitoring (generator)	3047 *ErrMisfireEcy* = 1 3047 *ErrMisfireDetection.6* = 1 (XIOS)			
Engine stop request in dual fuel mode	Fast	Fast	Fast	Fast
↑*16.12 Residual* gas combustion	12068 *EngStopRequWithGas* = 1			
Gas governor at lower limit for a maximum time	Norm	-	-	-
↑*16.7.13 Gas quantity monitoring*	Diesel at ignition oil quantity cannot be reduced, risk of passing the limit			
Power not in permissible range	-	Fast	Fast	Fast
↑*16.7.2* Monitoring *the power*		12013 *PowerInRangeForGas* = 0		
Power too high	Prompt	-	-	-
↑*16.7.2 Monitoring the power*	13013 *ErrPowerRangeForGas* = 1 13031 *ErrGasConditions.2* = 1 (XIOS)			
Power too low	Norm (Control)	-	-	-
↑*16.7.2 Monitoring the power*	13013 *ErrPowerRangeForGas* = 1 13031 *ErrGasConditions.2* = 1 (XIOS)			
Max. exhaust temperature too high	Norm (Control)	Fast	Fast	Fast
↑ 16.7.3 *Monitoring the exhaust* temperature	13019 *ErrExhTRangeForGas* = 1 13031 *ErrGasConditions.8* = 1 (XIOS)	12017 *ExhTInRangeForGas* = 0		
Exhaust temperature difference	Norm (Control)	Fast	Fast	Fast

Test	Gas speed governor	Diesel reduction governor		
Reference	**Gen**	**Gen**	**Loc**	**Marine**
(max-min) too high				
↑*16.7.3.2* One exhaust temperature sensor per cylinder or per throttle valve	13020 *ErrExhTDRangeForGas* = 1 13031 *ErrGasConditions.9* = 1 (XIOS)	12018 *ExhTDInRangeForGas* = 0		
Coolant temperature not OK	Norm (Control)	Fast	Fast	Fast
↑*16.7.4 Coolant temperature monitoring*	13018 *ErrCoolTRangeForGas* = 1 13031 *ErrGasConditions.6* = 1 (XIOS)	12019 *CoolTInRangeForGas* = 0		
Charge air temperature not OK	Norm (Control)	Fast	Fast	Fast
↑*16.7.5 Charge air temperature* monitoring	13021 *ErrChAirTRangeForGas* = 1 13031 *ErrGasConditions.7* = 1 (XIOS)	12002 *ChAirTInRangeForGas* = 0		
Oil pressure not OK	Norm (Control)	Fast	Fast	Fast
↑*16.7.7 Oil pressure monitoring*	13016 *ErrOilPrRangeForGas* = 1 13031 *ErrGasConditions.5* = 1 (XIOS)	12015 *OilPrInRangeForGas* = 0		
Boost pressure not OK	Norm (Control)	Fast	Fast	Fast
↑*16.7.8 Boost pressure monitoring*	13015 *ErrBoostRangeForGas* = 1 13031 *ErrGasConditions.4* = 1 (XIOS)	12016 *BoostInRangeForGas* = 0		
Speed not OK	Norm (Control)	Fast	Fast	Fast
↑*16.7.11 Speed monitoring*	13012 *ErrSpeedRangeForGas* = 1 13031 *ErrGasConditions.1* = 1	12010 *SpeedInRangeForGas* = 0		

Test	Gas speed governor	Diesel reduction governor		
Reference	**Gen**	**Gen**	**Loc**	**Marine**
	(XIOS)			
Light knocking and max. offset reached	Norm (Control)	Fast	Fast	Fast
↑*16.7.14 Engine*	13011 *ErrLight*Knocking = 1 13031 *ErrGasConditions.10* = 1 (XIOS)	12014 *LightKnocking* = 1		
Gas above a minimum value but diesel setpoint/actual variation still too high over time	-	Prompt	Prompt	Prompt
↑*16.7.12.2 Diesel* reduction governor		Diesel speed governor not responding to addition of gas, main gas valve closed? 13027 *ErrGasNoPower* = 1 13031 *ErrGasRailStatus.9* = 1 (XIOS)		
Excitation governor on diesel fuel quantity	-	-	Prompt	-
↑*13.2.2 Excitation governing*		2605 *ExcitGovTrPowOrFuel* = 0		
ELEKTRA is not active	-	-	-	Fast
↑*16.7.16.5* ELEKTRA FlowControl (HZM-CAN add-on module)		12006 *GasPosNotActive* = 1		

Tab. 22: Conditions for terminating dual fuel operating mode

16.6.2.1 Gas speed control

In generator operation with gas speed control, once enabled dual fuel operation must be terminated if at least one of the conditions is not met. Depending on the cause, there is normally a ramped return to diesel, or dual fuel mode has to be terminated immediately.

However, whether there is an automatic switch back to dual fuel operation if the conditions are met again after normal termination of dual fuel operation is determined by the parameter 14001 *GasAutomaticModeOn*. If it is set to 1, there is always an automatic switch to dual fuel mode if the conditions are met again. If it is set to 0, the switch has to be requested manually, in this case always by an edge change from 0 → 1 in 2837 *SwitchGasOrDiesel*.

In case of error, the fast shutdown is signalled using 12032 *PromptReturnToDiesel* = 1. The gas is immediately set to 0 % and the diesel takes over abruptly. The cause of the error is indicated by an error marker. Regardless of the parameter 14001 *GasAutomaticModeOn* a return to gas is only possible after remedying the cause and an edge change from 0 → 1 in 2837 *SwitchGasOrDiesel*.

16.6.2.2 Diesel reduction control

In the diesel reduction governor, the gas supply is interrupted if either slightly changing conditions are no longer met or if such a serious error has occurred that its cause can only be remedied by a service callout.

In the first case 12033 *FastReturnToDiesel* = 1 is set. The gas is reduced to 0 % and the diesel takes over gradually. When the conditions are met again, there is a switch back to gas.

The second case is indicated by 12032 *PromptReturnToDiesel* = 1. The gas is immediately switched to 0 % and the diesel takes over abruptly. In this case, the cause of the error is indicated by an error marker. It is not possible to enable dual fuel operation again until the cause has been remedied and an edge change from 0 → 1 is detected in the switching function 2837 *SwitchGasOrDiesel*.

16.7 Monitoring functions

This section sets out all the monitoring functions, which either have to be observed to switch to dual fuel mode or which have a negative output that leads to dual fuel mode having to be terminated. The response to the monitoring is listed in detail in a table in ↑ *16.6 Enabling and disabling* dual fuel operation.

16.7.1 Gas section test

The gas section is normally monitored by the manufacturer's electronics. In this case, the HEINZMANN control unit only outputs the signal that monitoring should start and expects the response that everything is OK within a certain time.

Based on explicit customer requests, however, gas section monitoring can also be performed internally in the HEINZMANN control unit. As this is not certified, the customer accepts complete responsibility for the gas section.

The monitoring does not start until dual fuel operation is requested using the switching function 2837 *SwitchGasOrDiesel* and all other conditions are met. As one of the potentially enabled conditions, the gas pressure can of course only be checked once the gas section test has been successfully completed.

In applications with a gas speed governor, the monitoring always starts when there is to be a switch from pure diesel operation to dual fuel operation.

However, in applications with a diesel reduction governor this is only necessary when switching to gas for the first time after starting the engine or after dual fuel operation has had to be aborted due to an error and is to restart. Under normal circumstances, the gas proportion changes constantly and can also fall to 0. For safety reasons, the valves are closed in this situation. However, repeat monitoring is not necessary; it would take too much time and would be detrimental to the overall gas/diesel ratio.

Monitoring is enabled with 14080 *CheckGasValveReady*.

Notice

The parameter 14080 CheckGasValveReady must always be set in delivered applications; it is only permitted to dispense with it for tests on test benches.

At the start of gas section monitoring 12081 *GasValveCheckActive* = 1 is set. This parameter must be assigned to a binary output, which is connected to the associated input to the external electronics.

Within 10080 *GasValveCheckDelay* seconds, it is expected that the switching function 2848 *SwitchExternGasReady* (XIOS: 2872 *SwitchExternGasReady*) will be enabled, which in turn is actuated by the gas section electronics.

Successful completion of the gas section test is indicated by 12082 *GasTrainReady* and the gas valves are opened, 12035 *GasValvesOpen* = 1. To do this, 12035 must be assigned to a binary output that is connected to the valves.

In the event of a failed gas section test, 13010 *ErrGasTrain* = 1 or 13030 *ErrGasRailStatus.0* = 1 on the XIOS is set and dual fuel operation is not possible.

If the duration of the test in the external electronics is not known, for setting purposes 10080 *GasValveCheckDelay* can be set to a high value and the actual time required can be observed with 12080 *GasValveCheckDelay* and 12082 *GasTrainReady*. Meaningful adjustment of the parameter is then possible.

<u>Parameters</u>

2848 *SwitchExternGasReady* 2872 *SwitchExternGasReady* (XIOS)	Response from external electronics
10080 *GasValveCheckDelay*	Time in which 2848/2972 *SwitchExternGas-Ready* has to be enabled
12035 *GasValvesOpen*	1: Gas valves open
12080 *GasValveCheckDelay*	Currently elapsing time
12081 *GasValveCheckActive*	Start signal for external electronics
12082 *GasTrainReady*	1: Gas section OK
13010 *ErrGasTrain* 13030 *ErrGasRailStatus.0* (XIOS)	1: Gas section not OK

16.7.2 Monitoring the power

For dual fuel operation, the total power must be between 10013 *GasModePowerMin* and 10014 *GasModePowerMax* if this function has been enabled with 14013 *CheckPowerInRange*.

Parameters

10013 *GasModePowerMin*	Minimum power for dual fuel operation
10014 *GasModePowerMax*	Maximum power for dual fuel operation
10015 *GasModePowerHyst*	Hysteresis
14013 *CheckPowerInRange*	Enable / disable monitoring

16.7.2.1 Gas speed governor

If gas is requested in diesel operation when the function is enabled or if the engine is already running in dual fuel operation and the power is not (or is no longer) in the permissible range, the error 13013 *ErrPowerRangeForGas* (or 13031 *ErrGasConditions.2* for XIOS) is reported.

Parameters

3232 *RelativePower*	Current power in generator operation
13013 *ErrPowerRangeForGas* 13031 *ErrGasConditions.2 (XIOS)*	Power not in permissible range

16.7.2.2 Diesel reduction governor

Different power values are monitored depending on the application. If the power is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

If the power is in the range or if the monitoring function is not enabled at all, this is signalled with 12013 *PowerInRangeForGas* = 1. This indication is cancelled if monitoring is enabled and the power is 10015 *GasModePowerHyst* below 10013 *GasModePowerMin* or above 10014 *GasModePowerMax* or if the power signal has failed.

Notice

If both 14013 CheckPowerInRange and 14110 MaxGasPosGovernorOn are actuated in generator or locomotive operation, then 10014 GasModePowerMax must be greater than 10062 GasPowerLimitMaxAbs. Up to 10062 GasPowerLimitMaxAbs the gas falling is reduced but at 10014 GasModePowerMax the gas is switched off.

Parameters

12013 *PowerInRangeForGas* Power in permissible range

16.7.2.2.1 Applications for locomotive operation

In diesel/electric locomotive operation, the traction power is used to determine the required and permissible gas quantity and to protect the engine against overload. The traction power is determined from the traction current and the traction voltage, which must be available as measured values.

Parameters

3231 *TractionPower* Power in locomotive operation

16.7.2.2.2 Generator applications

The engine power is available in generator operation. The fuel quantity dependent diesel power is determined on the test bench and saved in a characteristic. During operation at nominal speed,the current diesel power can thus be determined at any time and the maximum possible gas power can be calculated.

Parameters

3232 *RelativePower* Power in generator operation

16.7.2.2.3 Maritime applications

In Marine operation, gas positioning is performed by the HEINZMANN ELEKTRA device. ELEKTRA calculates the gas power from the gas flow. Together with the speed-dependent and fuel quantity dependent diesel power established on the test bench, the target gas quantity for the specified gas power can be calculated and the engine can thus be protected against overloading.

Parameters

3231 *EnginePower* Engine power in marine operation

16.7.3 Monitoring the exhaust temperature

When monitoring the exhaust temperature, we differentiate whether a single measured value is available for the entire engine or whether an exhaust temperature sensor is attached to each cylinder.

16.7.3.1 One exhaust temperature for the entire engine

For dual fuel operation, the exhaust temperature 2911 *ExhaustTemp* must be below 10017 *GasModeExhTempMax* if this function has been enabled with 14017 *CheckExhTempInRange*.

Parameters

2911 *ExhaustTemp* Current exhaust temperature

10017 *GasModeExhTempMax*	Maximum temperature for dual fuel operation
10018 *GasModeExhTempHyst*	Hysteresis
14017 *CheckExhTempInRange*	Enable / disable monitoring

16.7.3.1.1 Gas speed governor

If gas is requested in diesel operation when the function is enabled or if the engine is already running in dual fuel operation and the exhaust temperature is not (or is no longer) below the maximum value, the error 13019 *ErrExhTRangeForGas* (or 13031 *ErrGasConditions.8* on XIOS) is signalled.

<u>Parameters</u>

13019 *ErrExhTRangeForGas* 13031 *ErrGasConditions.8* (XIOS)	1 = Exhaust temperature not in permissible range

16.7.3.1.2 Diesel reduction governor

If the exhaust temperature is below the limit or if the monitoring function is not enabled at all, this is signalled with 12017 *ExhTInRangeForGas* = 1. This indication is cancelled if the exhaust temperature is 10018 *GasModeExhTempHyst* above 10017 *GasModeExhTempMax* when the function is enabled.

If the exhaust temperature is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

<u>Parameters</u>

12017 *ExhTInRangeForGas*	1 = Exhaust temperature in permissible range

16.7.3.2 One exhaust temperature sensor per cylinder or per throttle valve

The minimum, maximum and average values are determined from all exhaust temperatures on an ongoing basis: 2911 *ExhaustTempMin*, 2913 *ExhaustTempMax* and 2912 *ExhaustTempAverage (*or 12572 *ExhaustTempMin*, 12573 *ExhaustTempMax* and 12570 *ExhaustTempAverage* on XIOS).

To switch to dual fuel operation, the maximum exhaust temperature must be below 10017 *GasModeExhTempMax* and the difference between the minimum and maximum exhaust temperature must be less than 10019 *GasModeExhTempDiff* in diesel operation and less than 10027 *GasModeGasExhTmpDiff* in dual fuel operation if monitoring has been enabled with 14017 *CheckExhTempInRange*.

Every time there is a switch between diesel and dual fuel operation and vice versa, there is a monitoring delay 10028 *GasModeExhTempDelay* before the permissible difference – which then changes – is taken into account.

Parameters

2911/12572 *ExhaustTempMin*	Current minimum exhaust temperature
2912/12570 *ExhaustTempAverage*	Current average value of all exhaust temperatures
2913/12573 *ExhaustTempMax*	Current maximum exhaust temperature
10017 *GasModeExhTempMax*	Maximum temperature for dual fuel operation
10018 *GasModeExhTempHyst*	Hysteresis
10019 *GasModeExhTempDiff*	Maximum permissible difference between 2911 *ExhaustTempMin* and 2913 *ExhaustTempMax* in diesel operation
10027 *GasModeGasExhTmpDiff*	Maximum permissible difference between 2911 *ExhaustTempMin* and 2913 *ExhaustTempMax* in dual fuel operation
10028 *GasModeExhTempDelay*	Monitoring delay after switching to gas or diesel operation
14017 *CheckExhTempInRange*	Enable / disable monitoring

16.7.3.2.1 Gas speed governor

If the exhaust temperature is 10018 *GasModeExhTempHyst* above 10017 *GasModeExhTempMax* when the function is enabled or if the difference is greater than 10019 *GasModeExhTempDiff* in diesel operation or greater than 10027 *GasModeGasExhTmpDiff* in dual fuel operation, the error 13019 *ErrExhTRangeForGas* (or 13031 *ErrGasConditions.8* for XIOS) or 13020 *ErrExhTDRangeForGas* (or 13031 *ErrGasConditions.9* for XIOS) is signalled.

Parameters

13019 *ErrExhTRangeForGas* 13031 *ErrGasConditions.8* (XIOS)	1 = Exhaust temperature too high
13020 *ErrExhTDRangeForGas* 13031 *ErrGasConditions.9* (XIOS)	1 = Exhaust temperature difference too high

16.7.3.2.2 Diesel reduction governor

If both the maximum exhaust temperature and the difference are below the relevant limit or if monitoring is not enabled at all, this is signalled with 12017 *ExhTInRangeForGas* = 1 and 12018 *ExhTDInRangeForGas* = 1. This indication is cancelled if the exhaust temperature is 10018 *GasModeExhTempHyst* above 10017 *GasModeExhTempMax* or the difference is greater than 10019 *GasModeExhTempDiff* or 10027 *GasModeGasExhTmpDiff* when the function is enabled.

If the exhaust temperatures are not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

<u>Parameters</u>

12017 *ExhTInRangeForGas*	1 = Exhaust temperature in permissible range
12018 *ExhTDInRangeForGas*	1 = Exhaust temperature difference in permissible range

16.7.4 Coolant temperature monitoring

For dual fuel operation the coolant temperature 2907 *CoolantTemp* must be between 10020 *GasModeCoolTempMin* and 10021 *GasModeCoolTempMax* if this function has been enabled with 14020 *CheckCoolTempInRange*.

<u>Parameters</u>

2907 *CoolantTemp*	Current coolant temperature
10020 *GasModeCoolTempMin*	Minimum temperature for dual fuel operation
10021 *GasModeCoolTempMax*	Maximum temperature for dual fuel operation
10022 *GasModeCoolTempHyst*	Hysteresis
14020 *CheckCoolTempInRange*	Enable / disable monitoring

16.7.4.1 Gas speed governor

If gas is requested in diesel operation when the function is enabled or if the engine is already running in dual fuel operation and the coolant temperature is not (or is no longer) in the permissible range, the error 13018 *ErrCoolTRangeForGas* (or 13031 *ErrGasConditions.6* for XIOS) is reported.

<u>Parameters</u>

13018 *ErrCoolTRangeForGas* 13031 *ErrGasConditions.6* (XIOS)	Coolant temperature not in permissible range

16.7.4.2 Diesel reduction governor

If the coolant temperature is in the range or if the monitoring function is not enabled at all, this is signalled with 12019 *CoolTInRangeForGas* = 1. This indication is cancelled if the coolant temperature is 10022 *GasModeCoolTempHyst* below 10020 *GasModeCoolTempMin* or above 10021 *GasModeCoolTempMax* when monitoring is enabled.

If the coolant temperature is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

<u>Parameters</u>

12019 *CoolTInRangeForGas*	Coolant temperature in permissible range

16.7.5 Charge air temperature monitoring

For dual fuel operation the charge air temperature 2908 *ChargeAirTemp* must be between 10002 *GasModeChAirTempMin* and 10003 *GasModeChAirTempMax* if this function has been enabled with 14002 *CheckChAirTmpInRange*.

<u>Parameters</u>

2908 *ChargeAirTemp*	Current charge air temperature
10002 *GasModeChAirTempMin*	Minimum temperature for dual fuel operation
10003 *GasModeChAirTempMax*	Maximum temperature for dual fuel operation
10004 *GasModeChAirTempHyst*	Hysteresis
14002 *CheckChAirTmpInRange*	Enable / disable monitoring

16.7.5.1 Gas speed governor

If gas is requested in diesel operation when the function is enabled or if the engine is already running in dual fuel operation and the charge air temperature is not (or is no longer) in the permissible range, the error 13021 *ErrChAirTRangeForGas* (or 13031 *ErrGasConditions.7* for XIOS) is reported.

<u>Parameters</u>

13021 *ErrChAirTRangeForGas* 13031 *ErrGasConditions.7* (XIOS)	Charge air temperature not in permissible range

16.7.5.2 Diesel reduction governor

If the charge air temperature is in the range or if the monitoring function is not enabled at all, this is signalled with 12002 *ChAirTInRangeForGas* = 1. This indication is cancelled if the charge air temperature is 10004 *GasModeChAirTempHyst* below 10002 *GasModeChAirTempMin* or above 10003 *GasModeChAirTempMax* when monitoring is enabled.

If the charge air temperature is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

<u>Parameters</u>

12002 *ChAirTInRangeForGas*	Charge air temperature in permissible range

16.7.6 Gas temperature monitoring

For dual fuel operation the gas temperature 2910 *GasTemp* (XIOS: 2926 *GasTemp*) must be between 10023 *GasModeGasTempMin* and 10024 *GasModeGasTempMax* if this function has been enabled with 14022 *CheckGasTempInRange*.

<u>Parameters</u>

2910 *GasTemp* (Others) 2926 *GasTemp* (XIOS)	Current gas temperature
10023 *GasModeGasTempMin*	Minimum temperature for dual fuel operation
10024 *GasModeGasTempMax*	Maximum temperature for dual fuel operation
10025 *GasModeGasTempHyst*	Hysteresis
14022 *CheckGasTempInRange*	Enable / disable monitoring

16.7.6.1 Gas speed governor

If gas is requested in diesel operation when the function is enabled or if the engine is already running in dual fuel operation and the gas temperature is not (or is no longer) in the permissible range, the error 1301826 *ErGasTRangeForGas* (or 13030 *ErrGasRailStatus.8* for XIOS) is reported.

<u>Parameters</u>

13026 *ErrGasTRangeForGas* 13030 *ErrGasRailStatus.8* (XIOS)	Gas temperature not in permissible range

16.7.6.2 Diesel reduction governor

If the gas temperature is in the range or if the monitoring function is not enabled at all, this is signalled with 12004 *GasTInRangeForGas* = 1. This indication is cancelled if the gas temperature is 10025 *GasModeGasTempHyst* below 10023 *GasModeGasTempMin* or above 10024 *GasModeGasTempMax* when monitoring is enabled.

If the gas temperature is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

<u>Parameters</u>

12004 *GasTInRangeForGas*	Gas temperature in permissible range

16.7.7 Oil pressure monitoring

For dual fuel operation the oil pressure 2905 *OilPressure* must be above the warning curve if this function has been enabled with 14015 *CheckOilPressInRange* (↑ *10.6 Speed dependent oil pressure monitoring*).

Of course, the oil pressure must be sufficient for diesel operation, but this is to be monitored separately.

<u>Parameters</u>

2905 *OilPressure*	Current oil pressure
3030 *ErrOilPressWarn* 3010 *ErrOilPressure.bExceedLimit1*(XIOS)	Oil pressure is below warning curve
14015 *CheckOilPressInRange*	Enable / disable monitoring

16.7.7.1 Gas speed governor

If gas is requested in diesel operation when the function is enabled or if the engine is already running in dual fuel operation and the oil pressure is not (or is no longer) in the permissible range, the error 13016 *ErrOilPrRangeForGas* (or 13031 *ErrGasConditions.5* for XIOS) is reported.

<u>Parameters</u>

13016 *ErrOilPrRangeForGas* 13031 *ErrGasConditions.5* (XIOS)	Oil pressure not in permissible range

16.7.7.2 Diesel reduction governor

If the oil pressure is above the warning curve or if the monitoring function is not enabled at all, this is signalled with 12015 *OilPrInRangeForGas* = 1. This indication is cancelled if the oil pressure falls below the warning curve 3030 *ErrOilPressWarn* (or 3010 *ErrOilPressure.bExceedLimit1* for XIOS) when monitoring is enabled.

If the oil pressure is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

Parameters

12015 *OilPrInRangeForGas*	Oil pressure in permissible range

16.7.8 Boost pressure monitoring

For dual fuel operation the boost pressure 2904 *BoostPressure* must be above the power-dependent characteristic if this function has been enabled with 14016 *CheckBoostPrInRange*.

In generator and Marine operation, the characteristic is created based on the relative power 3232 *RelativePower* and in locomotive applications based on the traction power 3231 *TractionPower*.

Parameters

2904 *BoostPressure*	Current boost pressure
16100 *GasModeBoostPr:P(x)*	Power values from characteristic
16115 *GasModeBoostPr:p(x)*	Boost pressure values from characteristic
10016 *GasModeBoostHyst*	Hysteresis
14016 *CheckBoostPrInRange*	Enable / disable monitoring

16.7.8.1 Gas speed governor

If gas is requested in diesel operation when the function is enabled or if the engine is already running in dual fuel operation and the boost pressure is not (or is no longer) in the permissible range, the error 13015 *ErrBoostRangeForGas* (or 13031 *ErrGasConditions.4* for XIOS) is reported.

Parameters

13015 *ErrBoostRangeForGas* 13031 *ErrGasConditions.4* (XIOS)	Boost pressure not in permissible range

16.7.8.2 Diesel reduction governor

If the boost pressure is in the range or if the monitoring function is not enabled at all, this is signalled with 12016 *BoostInRangeForGas* = 1. This indication is cancelled if the boost pressure is 10016 *GasModeBoostHyst* below the power-dependent characteristic or if the power signal has failed when monitoring is enabled.

If the boost pressure is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

Parameters

12016 *BoostInRangeForGas*	Boost pressure in permissible range

16.7.9 Gas rail pressure monitoring

The gas rail pressure 2921 *GasRailPressure* (XIOS: 2928 *GasRailPressure*) is monitored for dual fuel operation. It is calculated relative to the boost pressure on the charged engine and the result is provided in 2925 *GasDiffPressure* (XIOS: 2942 *GasDiffPressure*). On a non-charged engine 2925 *GasDiffPressure* and 2921 *GasRailPressure* are identical (XIOS: 2942 *GasDiffPressure* and 2928 *GasRailPressure*).

For dual fuel operation 2925 *GasDiffPressure* (XIOS: 2942 *GasDiffPressure*) must be between 10005 *GasModeGasRPressMin* and 10006 *GasModeGasRPressMax* if this function has been enabled with 14005 *CheckGasRPrInRange*.

Parameters

2921 *GasRailPressure* 2928 *GasRailPressure* (XIOS)	Gas pressure
2925 *GasDiffPressure* 2942 *GasDiffPressure* (XIOS)	Relative gas pressure (gas rail pressure minus boost pressure)
10005 *GasModeGasRPressMin*	Minimum relative gas pressure for dual fuel operation
10006 *GasModeGasRPressMax*	Maximum relative gas pressure for dual fuel operation
10007 *GasModeGasRPressHyst*	Hysteresis
10008 *GasModeGasAtLimitMax* pressure	Max. time for which the relative gas can be outside the error limits
14005 *CheckGasRPrInRange*	Enable / disable monitoring

16.7.9.1 Gas speed governor

The error 13017 *ErrGasPrRangeForGas* (or 13030 *ErrGasRailStatus*.7 for XIOS) is reported if the relative gas pressure is more than 10007 *GasModeGasRPressHyst* below 10005 *GasModeGasRPressMin* or above 10006 *GasModeGasRPressMax* for the time period 10008 *GasModeGasAtLimitMax* when monitoring is enabled.

Parameters

13017 *ErrGasPrRangeForGas* 13030 *ErrGasRailStatus.7* (XIOS)	Relative gas pressure not in permissible range

16.7.9.2 Diesel reduction governor

If the relative gas pressure is in the range or if the monitoring function is not enabled at all, this is signalled with 12005 *GasPrInRangeForGas* = 1. This indication is cancelled if the relative gas pressure is more than 10007 *GasModeGasRPressHyst* below 10005 *GasModeGasRPressMin* or above 10006 *GasModeGasRPressMax* for the duration 10008 *GasModeGasAtLimitMax* when monitoring is enabled.

If the relative gas pressure is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

Parameters

12005 *GasPrInRangeForGas*	1: Relative gas pressure in permissible range

16.7.10 External gas pressure monitoring

If an external monitoring device checks the gas pressure, the result must be transferred to the control unit with the switching function 2845 *SwitchGasPressReady* (XIOS: 2870 *SwitchGasPressReady*). If this function becomes inactive 13008 *ErrGasPressTooLow* or 13030 *ErrGasRailStatus.5* (XIOS) is triggered and there is no switch to gas operation or dual fuel mode is terminated.

Parameters

2845 *SwitchGasPressReady* 2870 *SwitchGasPressReady* (XIOS)	Gas pressure switch state
13008 *ErrGasPressTooLow* 13030 *ErrGasRailStatus.5* (XIOS)	Gas pressure switch is inactive when dual fuel operation is requested

16.7.11 Speed monitoring

For dual fuel operation the speed 2000 *Speed* must be between 10010 *GasModeSpeedMin* and 10011 *GasModeSpeedMax* if this function has been enabled with 14010 *CheckSpeedInRange*.

Parameters

2000 *Speed*	Current speed
10010 *GasModeSpeedMin*	Minimum speed for dual fuel operation
10011 *GasModeSpeedMax*	Maximum speed for dual fuel operation

10012 *GasModeSpeedHyst*	Hysteresis
14010 *CheckSpeedInRange*	Enable / disable monitoring

16.7.11.1 Gas speed governor

If gas is requested in diesel operation when the function is enabled or if the engine is already running in dual fuel operation and the speed is not (or is no longer) in the permissible range, the error 13012 *ErrSpeedRangeForGas* (or 13031 *ErrGasConditions.1* for XIOS) is reported.

Parameters

13012 *ErrSpeedRangeForGas* 13031 *ErrGasConditions.1* (XIOS)	Speed not in permissible range

16.7.11.2 Diesel reduction governor

If the speed is in the range or if the function is not enabled at all, this is signalled with 12010 *SpeedInRangeForGas* = 1. This indication is cancelled if the speed is 10012 *GasModeSpeedHyst* below 10010 *GasModeSpeedMin* or above 10011 *GasModeSpeedMax* when the function is enabled.

If the speed is not in the permissible range, either there is no switch to dual fuel mode or the mode is terminated. However, in each case this is viewed as a normal operating condition and no error is reported.

Parameters

12010 *SpeedInRangeForGas*	Speed in permissible range

16.7.12 Ignition oil quantity monitoring

To ensure safe dual fuel operation, it is essential that the current diesel quantity is sufficient to combust the gas. The ignition oil quantity must therefore be monitored on an ongoing basis.

16.7.12.1 Gas speed governor

In pure diesel operation, a check is made for whether the current diesel quantity 2350 *DieselFuelQuantity* is above the ignition oil quantity 12060 *PilotFuelPresent* + 10061 *PilotFuelHysteresis*. If this is the case, or if the associated monitoring function 14012 *CheckDieslAbovePilot* is not enabled at all, this condition – as one of several – is met. Otherwise, there is no switch to dual fuel operation and the error message 13014 *ErrFuelRangeForGas* or 13031 *ErrGasConditions.3* (XIOS) is indicated despite the request.

The enabled dual fuel operation must be terminated if 2350 *DieselFuelQuantity* falls below 12060 *PilotFuelPresent* – 10061 *PilotFuelHysteresis*. Monitoring in dual fuel operation is always carried out, regardless of whether 14012 *CheckDieslAbovePilot* is enabled or not. In case of error 13023 *ErrBelowPilotFuel* or 13031 *ErrGasConditions.13* (XIOS) is indicated.

Parameters

10061 *PilotFuelHysteresis*	Hysteresis
12060 *PilotFuelPresent*	Current ignition oil quantity, never less than 10055 *PilotDslAbsMinimum*
12061 *DieselAtPilotFuel*	Diesel fuel quantity has reached ignition oil quantity
13014 *ErrFuelRangeForGas* 13031 *ErrGasConditions.3 (XIOS)*	Diesel fuel quantity in diesel operation not in permissible range for gas
13023 *ErrBelowPilotFuel* 13031 *ErrGasConditions.13 (XIOS)*	Diesel fuel quantity in dual fuel operation below ignition oil quantity
14012 *CheckDieslAbovePilot*	Enable / disable check in diesel operation

16.7.12.2 Diesel reduction governor

In applications with diesel reduction governor, dual fuel operation is terminated without errors if the diesel fuel quantity 2350 *DieselFuelQuantity* falls 10061 *DieselHysteresis* below the current setpoint 12060 *DieselRedGovSetp* and it is re-enabled when the conditions are met again. The diesel fuel quantity must be 10061 *DieselHysteresis* above 12060 *DieselRedGovSetp*.

If the current diesel fuel quantity in dual fuel operation actually falls below the ignition oil quantity 12055 *PilotDslAbsMinimum* – 10061 *DieselHysteresis*, this is indicated by the message 12011 *DieselBelowPilotFuel*. This message is only cancelled if the current diesel fuel quantity is above 12055 *PilotDslAbsMinimum* + 10061 *DieselHysteresis*.

To stop the diesel, which is currently being ramped up, from being reduced again immediately, connection of the gas is delayed by 10094 *GasStartDelay* after the diesel has reached the setpoint 12060 *DieselRedGovSetp*.

If dual fuel operation is active, a check is made of whether the actual diesel value is actually falling towards the setpoint when gas is added. This is an indirect test of whether the main gas valve is open. The check is of whether, with addition of gas greater than 10040 *DieselDiffGasMin*, the difference between the diesel actual value and setpoint remains greater than 10041 *DieselDiffMax* over the time period 10042 *DieselDiffDelay*. In this case dual fuel operation is immediately terminated with the error 13027 *ErrGasNoPower* or 13031 *ErrGasRailStatus.9* (XIOS).

Parameters

10040 *DieselDiffGasMin*	Minimum gas value for valve test
10041 *DieselDiffMax*	Difference between diesel actual value and setpoint for valve test
10042 *DieselDiffDelay*	Valve testing time
10061 *DieselHysteresis*	Hysteresis
10094 *GasStartDelay*	Delay time for gas addition after diesel ignition oil quantity is reached again
12011 *DieselBelowPilotFuel*	Diesel is below current ignition oil quantity
12012 *DieselInRangeForGas*	In diesel operation, diesel is in permissible range for dual fuel operation
12060 *DieselRedGovSetp*	Current diesel setpoint
13027 *ErrGasNoPower*	Gas does not produce any power
proportion, diesel	
13031 *ErrGasRailStatus.9* (XIOS)	not responding, main gas valve open?

16.7.13 Gas quantity monitoring

16.7.13.1 Gas speed governor

If no power is requested from the engine in standard gas operation, it must be ensured that the total of the current gas and diesel power proportions does not lead to the engine overspeeding. This is particularly necessary because the ignition oil quantity generates a certain power proportion. Therefore if the calculated gas fuel quantity over the time period *10069 GasMinToDieselDelay* is less than *10065 GasDecrAtDieselStart* the gas must be switched off with a return to diesel.

Note that *10065 GasDecrAtDieselStart* is also used in ↑*16.8.3 Switching ramp from gas to* diesel operation and ↑*16.8.4.1Gas at the power* limit.

Parameters

10065 GasDecrAtDieselStart	Lower limit for dual fuel operation at zero fuel
10069 GasMinToDieselDelay	Maximum permissible time at the lower limit

16.7.14 Engine knocking monitoring

For knock monitoring, the HEINZMANN ARIADNE device is connected to the dual fuel control unit via the HZM-CAN bus. In terms of the HZM-CAN bus system, ARIADNE is known as an add-on module (AC).

Up to five add-on modules can normally be connected to a control unit. Their node numbers are saved in the parameters starting from 430 *CanACNodeNumber* and their type in the parameters starting from 435 *CanACNodeType*. ARIADNE has type 0 (not specified).

It is essential to use 10056 *KnockModulACIndex* to notify the dual fuel control unit which index (0...4) is assigned to the ARIADNE starting at 430 *CanACNodeNumber/*435 *CanACNodeType*. This parameter is only evaluated after a reset. For the messages about light or heavy knocking to be evaluated, the control unit must evaluate the ARIADNE error messages. To do this 4430 *ReceiveACErrorOn* must be enabled. Whether the control unit has accepted the configuration is indicated with 12090 *AriadneKnockControl* = 1.

In order to evaluate the knocking 14014 *CheckKnocking* must be enabled.

In the dual fuel control unit, light knocking is indicated in 13011 *ErrLightKnocking* (gas speed governor and diesel reduction governor) or 12014 *LightKnocking* (diesel reduction governor) and heavy knocking in 13007 *ErrHeavyKnocking*. If the CAN connection to the ARIADNE is lost, this is noted in 13009 *ErrKnockControlOff*.

The reaction to light knocking is described in the two following subchapters. In the event of heavy knocking or failure of the monitoring by ARIADNE, the gas is shut down immediately.

The ARIADNE also reports fatal errors in its own control unit, e.g. pickup or overspeed errors or if the synchronisation is lost. In these cases, knocking cannot be monitored and therefore the dual fuel control unit should also shut down the gas immediately here. This function is enabled with 14057 *GasOff@AriadneFatal*.

Parameters

430 *CanACNodeNumber*	Node numbers of up to 5 AC modules
435 *CanACNodeType*	Node type of up to 5 AC modules
10056 *KnockModulACIndex*	Index for ARIADNE in 430 *CanACNode-number/* 435 *CanACNodeType*

12090 *AriadneKnockControl*	ARIADNE configuration accepted
13007 *ErrHeavyKnocking*	Heavy knocking
13009 *ErrKnockControlOff*	Connection to ARIADNE has failed
14014 *CheckKnocking*	Enable / disable knock monitoring
14057 *GasOff@AriadneFatal*	Switch off gas if ARIADNE reports a fatal error

16.7.14.1 Gas speed governor

With light knocking, in the gas speed governor the current ignition oil quantity and thus the diesel proportion is gradually increased by 10057 *KnockPilotDslOffset*. This automatically results in calculation of a smaller gas quantity. If the light knocking persists, the next increase is carried out 10059 *KnockPilotDOffsDelay* seconds later. The increases indicated as a total in 12059 *DieselKnockOffset* continue up to a maximum of 10058 *KnockPilotDslOffsMax* after which the gas is switched off with the error message 13011 *ErrLightKnocking* or 13031 *ErrGasConditions.13* (XIOS).

If the knocking is remedied by increasing the ignition oil quantity, this new ignition oil value is retained until an external or internal request leads to a return to diesel operation. The next dual fuel operation starts again with the originally configured ignition oil quantity.

<u>Parameters</u>

10057 *KnockPilotDslOffset*	Offset for the ignition oil quantity
10058 *KnockPilotDslOffsMax*	Max. permissible offset total
10059 *KnockPilotDOffsDelay*	Waiting time between two increases
12059 *DieselKnockOffset*	Current offset total
13011 *ErrLightKnocking* 13031 *ErrGasConditions.13* (XIOS)	Max. offset for light knocking reached

16.7.14.2 Diesel reduction governor

With light knocking 12014 *LightKnocking* in the diesel reduction governor the current diesel setpoint is gradually increased by 10057 *KnockDslSetpOffset*. This automatically results in calculation of a smaller gas quantity. If the light knocking persists, the next increase is carried out 10059 *KnockDslSetOffsDelay* seconds later. The increases indicated as a total in 12059 *DieselKnockOffset* continue up to a maximum of 10058 *KnockDslSetpOffsMax* after which the gas is switched off.

As this operating mode involves continuous switching between pure diesel and dual fuel operation, the offset for the diesel setpoint is increased with light knocking and lowered again when there is no knocking. The increase is made at intervals of 10059

KnockDslSetOffsDelay, for as long as knocking persists. Lowering of the offset is half as fast at intervals of 2 x 10059 *KnockDslSetOffsDelay*, as long as no knocking is detected. This automatically results in the necessary offset to prevent knocking.

Parameters

10057 *KnockDslSetpOffset*	Offset on diesel setpoint
10058 *KnockDslSetpOffsMax*	Max. permissible offset total
10059 *KnockDslSetOffsDelay*	Waiting time between two increases, double between two reductions
12014 *LightKnocking*	Light knocking
12059 *DieselKnockOffset*	Current offset total
13011 *ErrLightKnocking* 13031 *ErrGasConditions.13* (XIOS)	Max. offset for light knocking reached

16.7.15 External gas alarm monitoring

If an external monitoring device triggers a gas alarm, this must be transferred to the control unit using the switching function 2847 *SwitchExternGasAlarm* (2871 *SwitchExternGasAlarm* on XIOS). When this function is enabled, 13024 *ErrExternGasAlarm* or 13030 *ErrGasRailStatus.6* on the XIOS is triggered and the gas is immediately switched off.

Parameters

2847 *SwitchExternGasAlarm* 2871 *SwitchExternGasAlarm* (XIOS)	Gas alarm switch state
13024 *ErrExternGasAlarm* 13030 *ErrGasRailStatus.6* (XIOS)	Gas alarm switch active

16.7.16 Monitoring the gas output device

Ongoing checks must be made for whether the gas output on the actuator or valves is operational. Otherwise, there is no switch to dual fuel mode or the mode is terminated immediately. If one of the following errors occurs, dual fuel operation is not possible.

16.7.16.1 Own actuator (DC 1-04)

Parameters

3051 *ErrFeedback2*	Only if 12092 *ActuatGasPositioner = 1*
3052 *ErrFeedback3*	Only if 12093 *ActuatGasPositioner2 = 1*

16.7.16.2 Own actuator (XIOS)

A check is made for whether the actuators to which the gas value 12023 *GasFuelQuantity* or, with two throttle valves, 12022 *GasFuelQuantity*(0) or 12023 *GasFuelQuantity*(1) has been assigned have an error.

<u>Parameters</u>

3050 *ErrActuator1*	Error on actuator 1
3051 *ErrActuator2*	Error on actuator 2
3051 *ErrActuator3*	Error on actuator 3

16.7.16.3 Actuator on HZM-CAN periphery module

A check is made whether the CAN connection to the periphery module has been established and that the periphery module is not reporting any actuator or other fatal errors.

<u>Parameters</u>

3070 *ErrCanBus*	CAN bus error
3071 *ErrCanComm*	CAN communication error (timeout)
12020 *GasActPos*	Actuator position in periphery module
13001 *ErrGasPositioner*	Gas positioner error
13025 *ErrGasPosFatal*	Fatal error on gas positioner
13032 *ErrDualFuelStatus.0* (XIOS)	

16.7.16.4 MEGASOL valves on HZM-CAN periphery modules

A check is made whether the CAN connection to the periphery module has been established and that the periphery module is not reporting any fatal errors. Whether the periphery module is actually outputting the gas value to the MEGASOL valves is also monitored. 13022 *ErrEFIGasPosDiff* is set if this is not possible due to a lack of synchronisation. In this case, instead of the received setpoint the periphery module always returns the value 0 %. This received value is compared with the send value in the master and the error is output after 1 s.

<u>Parameters</u>

3070 *ErrCanBus*	CAN bus error
3071 *ErrCanComm*	CAN communication error (timeout)
12020 *GasFuelActual*	Return value from periphery module, = 0 % if not synchronised
13022 *ErrEFIGasPosDiff*	Error if 12020 *GasFuelActual* over 1 s = 0%, although 12023 *GasFuelQuantity* > 0

16.7.16.5 ELEKTRA FlowControl (HZM-CAN add-on module)

Parameters

3070 *ErrCanBus*	CAN bus error
3071 *ErrCanComm*	CAN communication error (timeout)
12006 *GasPosNotActive*	Gas positioner is not active

16.7.16.6 Gas output via analogue output

When the gas value is output to an analogue or PWM output to actuate an external device (↑*20 Configuring the control's inputs and outputs*) this device is expected to return the current throttle valve position. This value can be received using an analogue or PWM input and is indicated in the sensor value 2916 *GasPosition* (XIOS: 2927 *GasPosition*) (↑*17* Configuration of sensors). If the setpoint and actual gas position differ from one another by more than 5 % over a second, 13001 *ErrGasPositioner* is set.

Furthermore, it is expected that 2839 *SwitchGasPosState* will be active for as long as the external positioner is not reporting an error. If 2839 *SwitchGasPosState* = 0, 13001 *ErrGasPositioner* is also set.

Both monitoring functions are only taken into account if the relevant input is configured.

Parameters

2839 *SwitchGasPosState*	Switching function that is assigned the status of the gas positioner
2916 *GasPosition* 2927 *GasPosition* (XIOS)	Current gas position via analogue input
13001 *ErrGasPositioner*	Gas positioner error

16.7.17 Compressed status indication

Parameters

12084 *GasConditionStatHigh*

Bit	Meaning
8000	Switching function of ext. gas alarm is active
4000	Ariadne reporting heavy knocking
2000	Ariadne reporting light knocking
1000	Gas section OK
0800	Relative gas pressure can be calculated
0400	Load in range for dual fuel operation
0200	Diesel below true ignition oil quantity in the case of gas usage
0100	Diesel in range for gas
0080	Speed in range for dual fuel operation
0040	Oil pressure in range for dual fuel operation
0020	Gas pressure in range for dual fuel operation
0010	Boost pressure in range for dual fuel operation
0008	Charge air temperature in range for dual fuel operation
0004	Coolant temperature in range for dual fuel operation
0002	Exhaust temperature difference in range for dual fuel operation
0001	Exhaust temperature in range for dual fuel operation

12085 *GasConditionStateLow*

Bit	Meaning
8000	Elektra reports error to switch off gas but recovers
4000	Gas positioner: Setpoint specified by PC
2000	-
1000	Gas temperature in range for dual fuel operation
0800	Gas does not produce any power; main valve closed?

12086 *DualFuelState1High*

Bit	Meaning
8000	Continue ramp after interruption
4000	Gas is held (at limit or load jump)
2000	Gas at lower limit
1000	Error conditions for immediate reset
0800	Error conditions for reset using fast ramp

0400	Diesel rises while gas is held
0200	Gas lowered after it has been fixed (because diesel is lagging below)
0100	Reaction to downwards load jump in dual fuel operation
0080	Reaction to upwards load jump in dual fuel operation
0040	Gas is involved – as governor or positioner
0020	Initialise filter buffer due to diesel<-->gas switch
0010	Residual gas combustion after return to diesel running
0008	Switch to gas is active (mixed operation)
0004	Switch to diesel is active (mixed operation)
0002	Switch to gas requested
0001	Switch to diesel requested

12087 *DualFuelState1Low*

Bit	**Meaning**
8000	Gas at limit active
4000	Diesel controller active
2000	Gas governor active
1000	Gas is being consumed (throttle valve open), only for display
0800	Diesel at the ignition oil quantity
0400	Engine stop request in dual fuel operation
0200	Monitoring of the gas section has been triggered
0100	Open (1) or close (0) gas valve 1 – upstream pressure → pressure chamber
0080	Open (1) or close (0) gas valve 2 – pressure chamber → rail
0040	
0020	Temperature compensation is possible
0010	Everything in green range apart from gas pressure, switch to gas can start
0008	Error conditions for immediate reset but work can continue
0004	Upwards setpoint ramp enabled/disabled
0002	Downwards setpoint ramp enabled/disabled
0001	Check gas setpoint at 0 % to close valves

13030 *ErrGasRailStatus* (XIOS)

Bit	Meaning
0200	Gas does not produce any power
0100	Gas temperature is not in the range for dual fuel operation
0080	Gas pressure is not in the range for dual fuel operation
0040	The gas alarm external switch is active
0001	Gas section not OK

13031 *ErrGasConditions* (XIOS)

Bit	Meaning
2000	Diesel fuel quantity is below ignition oil quantity
1000	MEGASOL gas positioner not synchronised
0800	Ariadne reporting heavy knocking
0400	Ariadne reporting light knocking
0200	Exhaust temperature difference is not in the range for dual fuel operation
0100	Exhaust temperature is not in the range for dual fuel operation
0080	Charge air temperature is not in the range for dual fuel operation
0040	Coolant temperature is not in the range for dual fuel operation
0020	Oil pressure is not in the range for dual fuel operation
0010	Boost pressure is not in the range for dual fuel operation
0008	Diesel fuel quantity is not in the range for dual fuel operation
0004	Power is not in the range for dual fuel operation
0002	Speed is not in the range for dual fuel operation
0001	Conditions for gas incorrect

13032 *ErrDualFuelStatus* (XIOS)

Bit	Meaning
0004	Emergency stop command via external input
0002	Ariadne is not responsive
0001	Gas positioner is not responsive

16.8 Gas speed control loop

If the conditions for dual fuel operation are met in diesel mode (↑*16.6.1 Conditions for enabling dual fuel operating* mode) and the request for dual fuel operation is enabled (↑*16.6* Enabling and disabling dual fuel operation), the switch starts.

The switch from diesel to dual fuel operation and vice versa is always performed with an active diesel speed governor and gas positioning. The gas value is gradually changed using ramps and the diesel speed governor reacts to this by recalculating the diesel proportion. The I-ratio of the diesel speed control loop is assigned the offset 10033 *ConversionStability* during the change (↗*8.1 Adjustment of PID parameters*).

Ramping from diesel to dual-fuel mode is ended when the diesel proportion has reached the ignition oil quantity. At the same moment, the speed governor is switched to dual fuel operation, i.e. the diesel is positioned to the ignition oil quantity and the actuating variable is then the gas proportion.

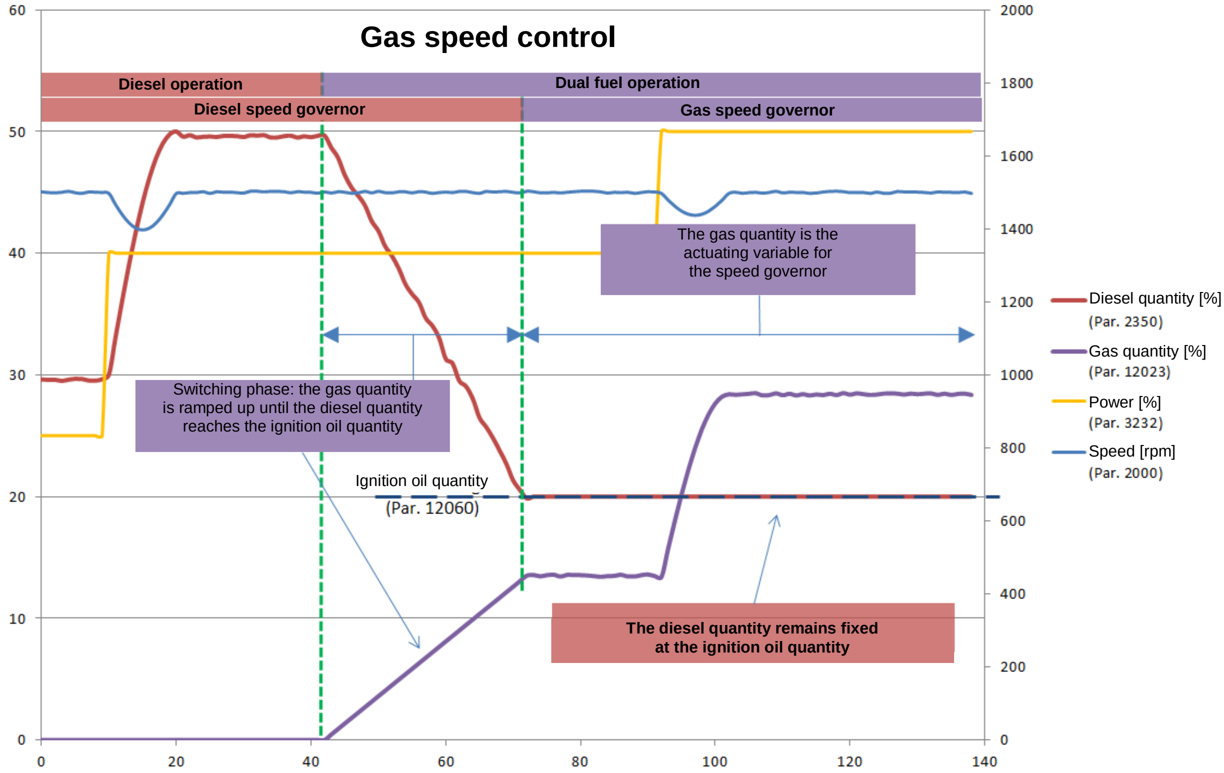


Fig. 41: Gas speed control

If the conditions for dual fuel operation are no longer met in dual fuel mode (↗*16.6.2* Conditions for terminating dual fuel operating mode), it is normally terminated using a ramp. In exceptional situations, a faster ramp can be used instead or immediate termination of dual fuel mode can be enabled. In any case, the diesel speed governor is enabled immediately and the gas is then only positioned. Mixed operation is ended when the gas proportion has fallen to 0%.

Active diesel control operation is indicated with 12030 *DieselGovernorActive* = 1 (including while the gas is ramped) and active gas control operation is indicated with 12031 *GasGovernorActive* = 1. 12034 *GasConsumptionActive* indicates whether gas is actually being consumed in dual fuel operating mode. This is always the case if a gas quantity <> 0 is calculated; i.e. the throttle valve or MEGASOL valves are open.

16.8.1 Setting the PID parameters

Different PID settings naturally apply in dual fuel operation than in diesel operation. Otherwise the gas speed governor functions in exactly the same way as the diesel speed governor, see (↑*8.1 Adjustment of PID parameters*). As in the diesel speed governor, PID corrections are possible for static and/or dynamic operation.

For static operation see ↑*8.5 Correction of PID parameters for static operation*, for the PID curves see ↑*8.2 PID map*.

As only one of the PID curves specified below should be enabled, the parameters for the correction values 16030 *GasPIDCurve:Corr(x)* only appear once. If multiple values are enabled, 14030 *GasPIDCurvePowerOn* therefore applies before 14031 *GasPIDCurveSpeedOn* before 14032 *GasPIDCurveGasFuelOn*, otherwise the PID values are not corrected.

The gas value resulting from the control loop is indicated in 12025 *GasFuelSetpUnlimited*. It may then be limited with 12062 *GasFuelLimitMax*, the resulting value appears in 12024 *GasFuelQuantUncorr* (↑*16.10.1* Gas speed governor) and finally it can be corrected with the gas pressure and/or gas temperature (↑*16.11* Gas fuel quantity correction). The actual result to be output is provided in 12023 *GasFuelQuantity*.

Notice

If the firmware does not contain any sensors for gas pressure and gas temperature, there is no parameter 12024 GasFuelQuantUncorr and the result of the limitation appears immediately in 12023 GasFuelQuantity.

Parameters

10030 *GasGain*	P-ratio of gas PID control loop
10031 *GasStability*	I-ratio of the gas PID control loop
10032 *GasDerivative*	D-ratio of the gas PID control loop
10033 *ConversionStability*	Additional I-ratio for the diesel PID control loop during switch from diesel to gas or from gas to diesel
10034 *GasSpeedDT1*	Speed DT1 proportion, gas PID control loop
10035 *GasPowerDT1*	Power DT1 proportion, gas PID control loop
10036 *GasStaticCorrFactor*	Static correction factor
10037 *GasStaticCorrRange*	Static correction range

14035 *GasStaticCorrOn*	Enable / disable static correction
12023 *GasFuelQuantity*	Resulting effective gas value after correction with gas pressure/temperature
12024 *GasFuelQuantUncorr*	Current gas value after limitation with 12062 GasFuelLimitMax
12025 *GasFuelSetpUnlimited*	Current gas value calculated by gas speed governor or ramped during switch
12030 *DieselGovernorActive*	Diesel speed governor is active
12031 *GasGovernorActive*	Gas speed governor is active
12034 *GasConsumptionActive*	Indicates that the throttle valve or MEGASOL valves are open
14030 *GasPIDCurvePowerOn*	Enable / disable power-dependent correction of P and I-ratio
16020 *GasPIDCurve:P(x)*	Power grid points, PI correction
14031 *GasPIDCurveSpeedOn*	Enable / disable speed-dependent correction of P and I-ratio
16000 *GasPIDCurve:n(x)*	Speed grid points, PI correction
14032 *GasPIDCurveGasFuelOn*	Enable / disable gas fuel quantity dependent correction of P and I-ratio
16010 *GasPIDCurve:Gasf(x)*	Gas fuel quantity grid points, PI correction
16030 *GasPIDCurve:Corr(x)*	PI correction values

16.8.2 Switching ramps from diesel to dual fuel operation

Switching from diesel, to dual fuel operation is always carried out using a ramp. The ramp speeds must therefore be set but they do not have to be separately enabled. The gas value is gradually increased and the diesel speed governor, which is still active, reacts to this by reducing the diesel proportion. Ramping is ended when the diesel proportion has reached the ignition oil quantity (↑ *16.7.12 Ignition oil quantity* monitoring). At the same moment, the speed governor is switched to dual fuel operation, i.e. the actuating variable is now the gas proportion and the diesel, is positioned at the ignition oil quantity.

The ramp can begin quickly and stop slowly like an e-curve if 10051 *DieselToGasRampHigh* is greater than 10050 *DieselToGasRampLow*. Otherwise, the ramp function is carried out with the lower, i.e. slower, of the two values.

Parameters

10033 *ConversionStability*	Additional I-ratio for the diesel PID control loop during switch from diesel to gas or from gas to diesel
10050 *DieselToGasRampLow*	Slow gas ramp for a gentle phase-in to gas control operation
10051 *DieselToGasRampHigh*	Faster gas ramp for start of switching

16.8.3 Switching ramp from gas to diesel operation

Switching from gas to diesel operation is normally carried out using a ramp, unless it has to be switched off immediately for safety reasons (↑ *16.6.2 Conditions for terminating dual fuel operating* mode).

The diesel speed governor is enabled and the gas value is simultaneously reduced by 10065 *GasDecrAtDieselStart*. Due to the resulting abrupt reduction in the gas power proportion, the diesel speed governor takes over control immediately.

The gas value is then gradually reduced from the current value. The diesel speed governor reacts to this by increasing the diesel proportion. Ramping is ended when the gas proportion has reached 0%.

The ramp can begin quickly and stop slowly like an e-curve if 10053 *GasToDieselRampHigh* is greater than 10052 *GasToDieselRampLow*. Otherwise, the ramp function is carried out with the lower, i.e. slower, of the two values.

If a fast ramp is requested using the switching function 2838 *SwitchFastToDiesel* or an external engine stop request is enabled during dual fuel operation with 3802 *EngineStopRequest* = 1 or the external gas alarm 2847 *SwitchExternGasAlarm* (XIOS: 2871 *SwitchExternGasAlarm*) is active the fast ramp 10054 *FastGasToDieselRamp* is used instead.

Parameters

10033 *ConversionStability*	Additional I-ratio for the diesel PID control loop during switch from diesel to gas or from gas to diesel
10052 *GasToDieselRampLow*	Slow gas ramp for gentle phase-out of the gas supply
10053 *GasToDieselRampHigh*	Faster gas ramp for start of switching

10054 *FastGasToDieselRamp*	General fast gas ramp
10065 *GasDecrAtDieselStart*	Gas reduction value at start of ramp

16.8.4 Diesel support in gas control operation

When the gas speed governor is active – 12031 *GasGovernorActive* = 1 – and either the gas reaches the power limit or a fast response to load additions or load shedding is needed, diesel can intervene to provide support.

16.8.4.1 Gas at the power limit

The gas is at the power limit if the value determined from the speed governor 12025 *GasFuelSetpUnlimited* exceeds the maximum permissible value 12062 *GasFuelLimitMax* and has to be limited. This is indicated by 2711 *FuelLimitMaxActive* = 1 (↑ *16.10.1* Gas speed governor). The resulting gas value actually used is provided in 12023 *GasFuelQuantity*.

If the calculated gas value has to be limited for over 10067 *GasFuelLimitMaxTime* seconds, 12063 *GasAtUpperLimit* is set. If 14076 *GasLimitReactionOn* is then enabled, support from diesel begins.

The current gas value is reduced to double the value of 10065 *GasDecrAtDieselStart* and held at this position. At the same time, the gas speed governor is disabled and the diesel speed governor is enabled.

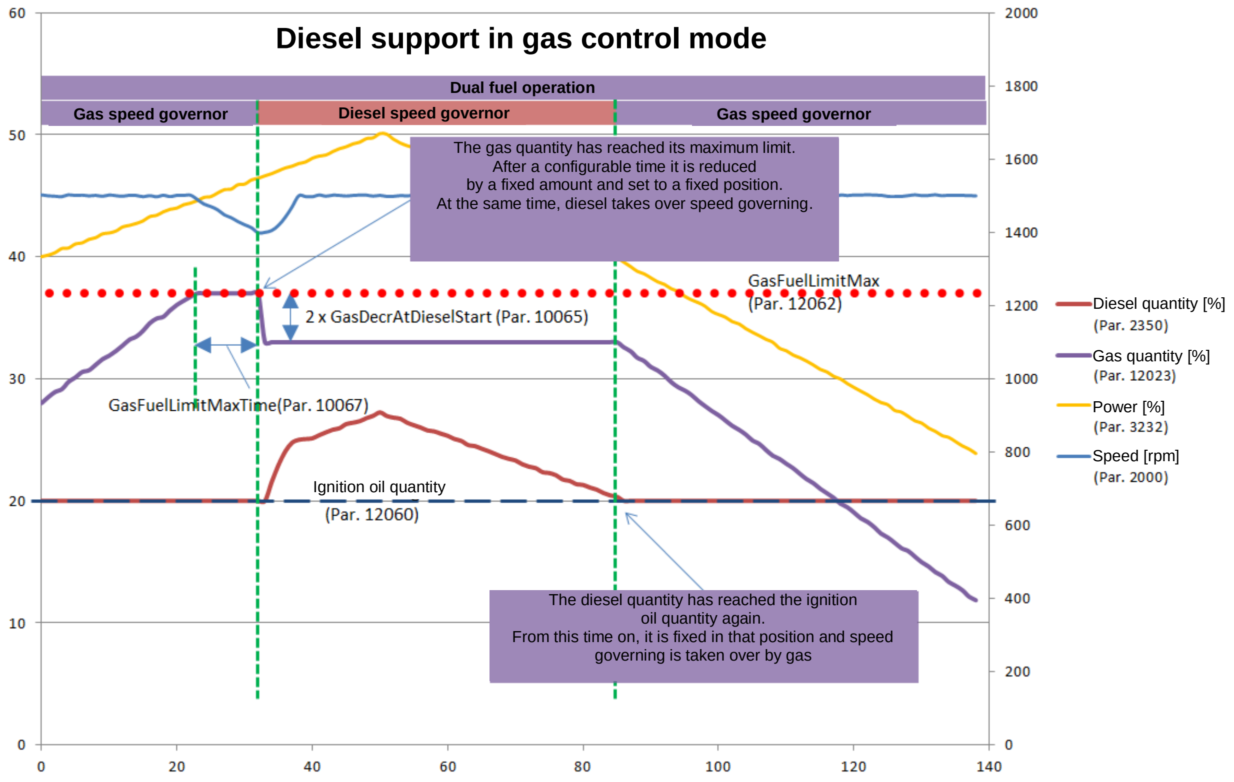


Fig. 42: Diesel support in gas control operation

The gas power proportion is therefore slightly reduced and the diesel can cover the rest of the high load request. When the load request ends, the diesel speed governor will automatically lower the diesel proportion. When it reaches the ignition oil quantity again, there is a switch back to gas control operation. Of course, the prerequisite is that the conditions for dual fuel operation are met.

This enables the conversion rate to be kept high while still achieving the full engine power.

Parameters

2711 *FuelLimitMaxActive*	Indicator that the gas value is being limited
10065 *GasDecrAtDieselStart*	Reduction value at start of diesel support (subtracted 2x)
10067 *GasFuelLimitMaxTime*	Maximum time for gas at the power limit before diesel support is enabled
12023 *GasFuelQuantity*	Resulting gas value
12024 *GasFuelQuantUncorr*	Current gas value after limitation with 12062 *GasFuelLimitMax*
12025 *GasFuelSetpUnlimited*	Current gas value calculated by the gas speed governor
12030 *DieselGovernorActive*	Diesel speed governor is active
12031 *GasGovernorActive*	Gas speed governor is active
12062 *GasFuelLimitMax*	Maximum permissible gas quantity
12063 *GasAtUpperLimit*	Indication that gas was at the power limit for a specified time
12064 *DieselSupportActive*	Indication that diesel is supporting operation
14076 *GasLimitReactionOn*	Enable / disable diesel support

16.8.4.2 Load addition

On a dual fuel engine, when compensating for load additions in generator operation (↑*8.6 Load jump regulation in generator systems (DT1 factor)*) it is essential to take into account whether the gas speed governor is currently active. It is possible to configure that the diesel speed governor intervenes to provide support for major load additions.

A major load jump in dual fuel operation is detected when 2029 *LoadGradientDT1* is greater than 10075 *GasPowGradThreshold*. If the load measuring unit only detects a load jump with a delay, it is possible to react to a significant speed undershoot instead if 2028 *SpeedGradientDT1* < – 10076 *GasLoadingSpeedGrThr*. The decision is made in pure diesel operation and either 4029 *LoadGradientDT1On* or 4028 *SpeedGradientDT1On* is selected accordingly. Regardless of how the load addition is detected, 12075 *GasLoadingActive* = 1 is set as an indicator.

If diesel support is now requested with 14077 *GasLoadingReactOn* = 1, the gas speed governor is disabled, the gas is held at the current position and the diesel speed governor is enabled and compensates for the load jump. This situation is indicated by 12076 *GasLoadingReactionOn* = 1.

When the load addition has been compensated (↑ *8.6 Load jump regulation in generator systems* (DT1 factor)), a check is made of whether it is possible to switch immediately back to dual fuel operation. If the conditions are met, it is executed. If the conditions are not met at this time, the engine remains in the diesel speed governor. At this point it is crucial whether automatic mode was enabled with 14001 *GasAutomaticModeOn* = 1 (↑ *16.6.2.1* Gas speed control). In this case, the return to gas occurs at the latest when the conditions are met again. Otherwise, an edge change 0→1 on the gas switch 2837 *SwitchGasOrDiesel* is necessary.

<u>Parameters</u>

12075 *GasLoadingActive*	Indicator of major load addition in gas control operation
12076 *GasLoadingReactionOn*	Indication that diesel is supporting
14077 *GasLoadingReactOn*	Enable / disable diesel support

16.8.4.3 Load shedding

On a dual fuel engine, when compensating for load shedding in generator operation (↑ *8.6 Load jump regulation in generator systems (DT1 factor)*) it is essential to take into account whether the gas speed governor is currently active. It is possible to configure that if there is major load shedding the diesel speed governor can control freely in order to go below the ignition oil quantity, which is otherwise held.

Major load shedding in dual fuel operation is detected when 2029 *LoadGradientDT1* is less than 10075 *GasPowGradThreshold*. If the load measuring unit only detects a load jump with a delay, it is possible to react to a significant speed overshoot instead if 2028 *SpeedGradientDT1* > – 10078 *GasLoadingSpeedGrThr*. The decision is made in pure diesel operation and either 4029 *LoadGradientDT1On* or 4028 *SpeedGradientDT1On* is enabled. Regardless of how the load shedding is detected, 12077 *GasLoadRejectActive* = 1 is set as an indicator.

If diesel support is now requested with 14078 *GasLoadRejectReactOn* = 1, the gas speed governor is disabled, the gas is immediately set to 0% and the diesel speed governor is enabled. It compensates for the load shedding, in particular ensuring that the diesel proportion can quickly fall below the ignition oil quantity. This situation is indicated by 12078 *GasLoadRejReactionOn* = 1.

When the load shedding has been compensated (↑ *8.6 Load jump regulation in generator systems* (DT1 factor), a check is made of whether it is possible to switch immediately back to dual fuel operation. If the conditions are met, it is executed. If the conditions are not met at this time, the engine remains in the diesel speed governor. At this point it is crucial whether automatic mode was enabled with 14001 *GasAutomaticModeOn* = 1 (↑ *16.6.2.1 Gas* speed control). In this case, the return to gas occurs at the latest when the conditions for this are met again. Otherwise, an edge change 0→1 on the gas switch 2837 *SwitchGasOrDiesel* is necessary.

Parameters

12077 *GasLoadRejectActive*	Indication of major load shedding in gas control operation
12078 *GasLoadRejReactionOn*	Indication that diesel is supporting
14078 *GasLoadRejectReactOn*	Enable / disable diesel support

16.8.5 Integrated power governor

If the integrated power governor is used ↑ *16.1 Gas speed control*, it should be expected that different PID parameters are required in dual fuel operation than in diesel operation.

Parameters

10070 *GasPowGovGain*	P-ratio of integrated power governor in dual fuel operation
10071 *GasPowGovStability*	I-ratio of integrated power governor in dual fuel operation
10072 *GasPowGovDerivative*	D-ratio of integrated power governor in dual fuel operation

Power-dependent correction is also possible for these parameters. The associated characteristic is enabled with 14070 *GasPowGovPIDCurveOn*.

Parameters

6300 *PIDCrvPowGov:P(x)*	Power grid points for PI correction of the integrated power governor in diesel and dual fuel operation
16040 *GasPICrvPGov:Corr(x)*	Correction values for PI correction of the integrated power governor in dual fuel operation

16.9 Diesel reduction control loop

The diesel reduction governor is always active if the conditions for gas are met. One of the most important conditions is that the diesel quantity calculated by the speed governor 2350 *DieselFuelQuantity* or, for engines with PT pump, the calculated diesel power 12050 *DieselPower* is above the ignition oil quantity necessary for ignition of the gas.

A required diesel setpoint 12060 *DieselRedGovSetp* and the current diesel fuel quantity 2350 *DieselFuelQuantity* or, for engines with PT pump, the calculated diesel power 12050 *DieselPower* are fed into the control loop. The result of the control loop is a gas fuel quantity 12023 *GasFuelQuantity*. Adding the gas automatically increases the speed and the speed governor responds to this by reducing the diesel quantity. As a result of the interrelationships between the two control loops, gas is added until the diesel value reaches the desired low setpoint. In static operation, this diesel value is held and thus ensures the maximum possible conversion rate.

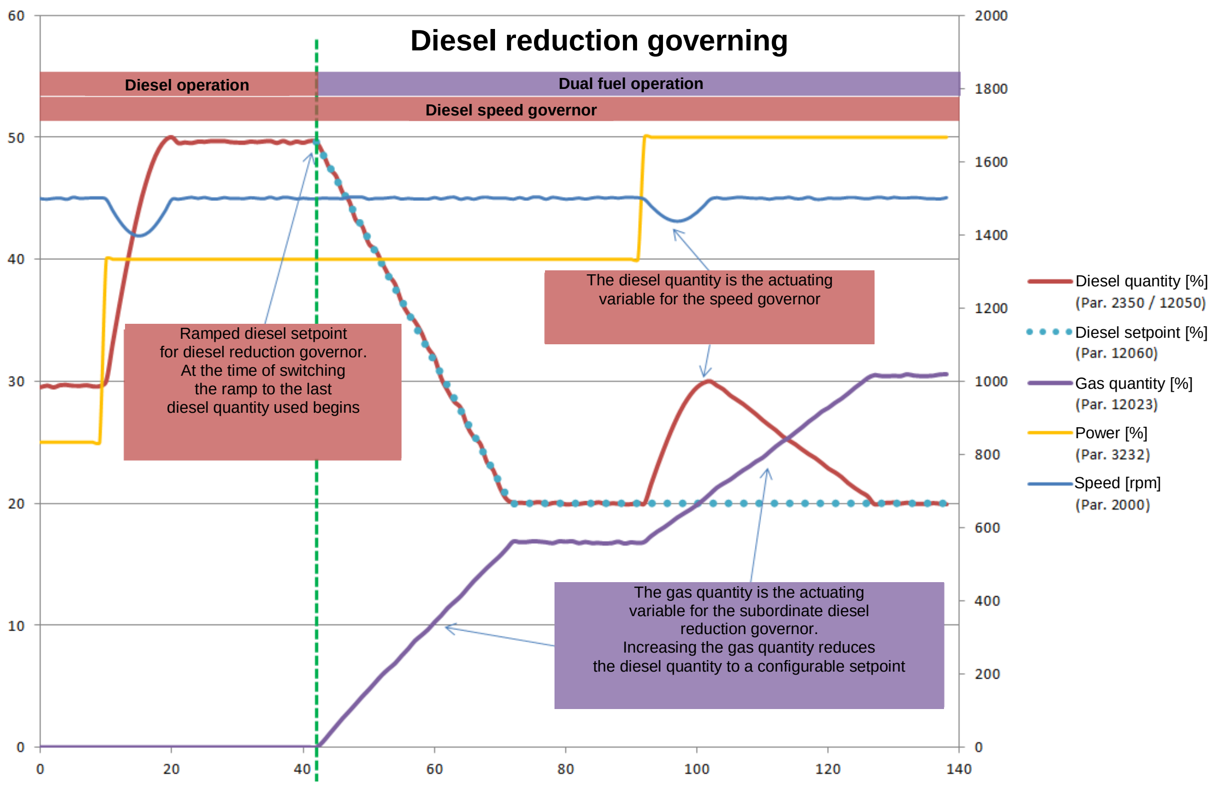


Fig. 43: Diesel reduction control

Because the diesel speed governor can control freely, it reacts quickly to every change in speed or load with no influence from the gas. The diesel reduction governor follows more slowly – but always taking into account the safety conditions that determine whether gas can actually be added. Thus, if the calculated diesel quantity after load shedding is below the current setpoint or even below the ignition oil quantity, the gas is immediately switched off.

However, due to the dynamics of the diesel speed governor it is possible that the diesel reduction governor setpoint 12060 *DieselRedGovSetp* is not reached for a long time and the actual diesel value 2350 *DieselFuelQuantity* or, for engines with PT pump, the actual diesel power 12050 *DieselPower* remains higher than the setpoint. The diesel reduction governor would respond to this by continuously increasing the gas value 12023 *GasFuelQuantity* in order to reduce the diesel proportion. This can lead to overloading of the engine. Therefore, it is hugely important that the gas quantity calculated in the diesel reduction governor is limited in such a way that this kind of overload is prevented or at least its duration is limited.

NOTICE	HEINZMANN does not accept any responsibility for damage due to engine overload, as suitable software functions are available to prevent this. The actual use of these functions is the responsibility of the operator. Particular attention should therefore be paid to chapters: ↑*16.4Determining the power proportions* and ↑*16.10Gas limitation*!

16.9.1 Determining the diesel setpoint

The value to which the diesel quantity is to be adjusted in dual fuel operation is determined on the test bench. It is possible to gradually specify the gas directly by bypassing the diesel reduction governor using 10029 *GasSetpointPC*. To do this 14030 *GasSetpointPCOn* must be enabled. This function cannot be saved and thus is always inactive after a control unit reset. Gas is added until the diesel either reaches the ignition oil quantity limit or engine disturbances or even knocking is detected before this. In the two cases mentioned, the gas value must be reduced again until the engine is running smoothly. The resulting diesel value is the minimum possible target value.

During commissioning on the test bench,this target value can be determined for each load stage and then either a load-independent fixed value can be assigned to the parameter 10060 *DieselSetpoint* or a characteristic can be drawn up.

The power-dependent characteristic exists in generator sets for this purpose, and in locomotive applications there is an equivalent traction power dependent curve 16300 *DieselSetpGas:P(x)* and 16310 *DieselSetpGas:Dsl(x)*.

In marine drives, the characteristic is speed-dependent to match the propeller curve, 16300 *DieselSetpGas:n(x)* and 16310 *DieselSetpGas:Dsl(x)*.

This curve is used when 14060 *DieselSetpGasCurveOn* is enabled, otherwise the fixed parameter 10060 *DieselSetpoint* is applicable. The currently valid setpoint is indicated in 12060 *DieselRedGovSetp*.

<u>Parameters</u>

10029 *GasSetpointPC*	Gas specified by PC
10060 *DieselSetpoint*	Fixed diesel setpoint

12060 *DieselRedGovSetp*	Current diesel setpoint
14030 *GasSetpointPCOn*	Enable / disable gas specification by PC (cannot be saved)
14060 *DieselSetpGasCurveOn*	Enable / disable power or speed-dependent setpoint characteristic
16300 *DieselSetpGas:P(x)* 16300 *DieselSetpGas:n(x)*	Power grid points (generator, locomotive) Speed grid points (marine drive)
16310 *DieselSetpGas:Dsl(x)*	Diesel setpoints

Notice

Between 12060 DieselRedGovSetp and 10055 PilotDslAbsMinimum a fixed hysteresis of 2 % is included. Therefore, the setpoint can never be lower than 10055 PilotDslAbsMinimum + 2 %.This is intended to prevent dual fuel operation from being constantly switched on and off when the actual diesel value moves too close to the absolute minimum.

16.9.2 Setting the PID parameters

Determination of the diesel setpoint is followed by tests involving load changes in order to derive the PID control parameters. As in the speed governor, the PID values can be adapted to dynamic processes and can undergo a reduction in static operation using the StaticCorrection function (↑*8.5* Correction of PID parameters for static operation).

The diesel reduction governor is designed to supply as much gas as possible as quickly as possible, but without interfering with the diesel speed governor to such an extent that it rises rapidly. For this reason, the PID parameters selected for the diesel reduction governor should be lower than those for the speed governor so that it reacts more slowly and the speed control loop retains the higher priority.

The output value of the control loop can never be greater than the limiting value 12062 *GasFuelLimitMax* determined separately. The result of the limitation is indicated in 12024 *GasFuelQuantUncorr* if a gas temperature and/or gas pressure correction of the value can still be carried out. In any case, the resulting effective gas value is available in 12023 *GasFuelQuantity*. This is output to either an actuator with throttle valve or to electronic fuel injection with MEGASOL valves (↑*16.5 Configuring the gas* output).

<u>Parameters</u>

10030 *DieselRedGain*	PID governor P-ratio
10031 *DieselRedStability*	PID governor I-ratio
10032 *DieselRedDerivative*	PID governor D-ratio
10035 *DslRedStatCorrFactor*	Correction value for the PID parameters

10036 *DslRedStatCorrRange*	Static range around the setpoint
14035 *DieselRedStatCorrOn*	Enable / disable static correction
2350 *DieselFuelQuantity* or	Current actual diesel fuel quantity value (speed control loop output)
12050 *DieselPower*	Current actual diesel power value in engines with PT pump
12060 *DieselRedGovSetp*	Current diesel setpoint
12083 *GasReleased*	Indication that dual fuel mode is active
12062 *GasFuelLimitMax*	Current limiting value
12023 *GasFuelQuantity*	Resulting effective gas value
12024 *GasFuelQuantUncorr*	Current gas value before gas temperature/gas pressure correction

16.9.3 Diesel setpoint ramp

To avoid unnecessarily interfering with the speed governor, changes in the diesel setpoint are not made abruptly but with a ramp so that the resulting gas quantity builds up slowly. This is especially important as dual fuel operation depends on many conditions and can be continuously switched on or off. Therefore it changes constantly – regardless of whether the fixed or power-dependent setpoint is used for 12060 *DieselRedGovSetp*.

When activating dual fuel mode, the setpoint should always move away from the current actual value with a ramp. For this reason the diesel setpoint 12060 *DieselPosGovSetp* corresponds to the actual value 2350 *DieselFuelQuantity* or, on engines with PT pump, 12050 *DieselPower*, as long as dual fuel mode is switched off and it corresponds to the (ramped) target value when dual fuel mode is enabled.

The setpoint can be changed upwards and downwards at different speeds, with an increasing diesel setpoint meaning that less gas is to be added, i.e. a faster reaction is required, than when more gas is to be calculated for a falling diesel setpoint. The upwards ramp 10051 *DieselSetpRampUp* should therefore be faster than the downwards ramp 10052 *DieselSetpRampDown*.

The conditions for terminating dual fuel operation are specified in ↑ *16.6.2 Conditions for terminating dual fuel operating* mode. There are normal termination (Norm) and fast termination (Fast) using a ramp, and unramped immediate termination (Prompt).

To terminate dual fuel operation with a ramp, the diesel setpoint is always changed upwards, i.e. it moves towards a higher actual diesel value. For normal termination, 10051 *DieselSetpRampUp* is applicable. For fast termination the ramp 10050

FastDieselSetpRampUp is used instead. As a result, there is a faster reduction of the gas proportion but not an immediate shutdown. Each ramped termination of dual fuel mode is indicated by 12039 *RampToDieselActive*.

For immediate termination the gas supply must be stopped immediately. The diesel speed governor will experience a slight interruption depending on how high the gas proportion was at this time. However, this is unavoidable on safety grounds.

All ramps are enabled collectively with 14051 *DieselSetpRampOn*.

The upwards diesel setpoint ramp is internally disabled when the resulting gas value has reached 0 %. 12060 *DieselRedGovSetp* is then set to the actual value 2350 *DieselFuelQuantity* or, on engines with PT pump, 12050 *DieselPower*.

In parallel, the downwards diesel setpoint ramp is internally disabled when the gas reaches the permissible maximum value (↑*16.10.2* Diesel reduction governor).

<u>Parameters</u>

10050 *FastDieselSetpRampUp*	Fast upwards diesel setpoint ramp to terminate dual fuel operation
10051 *DieselSetpRampUp*	Normal upwards diesel setpoint ramp
10052 *DieselSetpRampUp*	Normal downwards diesel setpoint ramp
14051 *DieselSetpRampOn*	Enable / disable diesel setpoint ramp

16.10 Gas limitation

Limitation of the current gas proportion is one of the most important functions in dual fuel operation to protect the engine against overloading. There are several options available for this, which can also be enabled all together. The smallest value is then selected from all the limiting values.

16.10.1 Gas speed governor

There is a maximum permissible value for gas fuel quantity limitation, 10063 *GasFuelLimitMaxAbs*, but the value may be lower than this for different speed and/or power dependent functions or with an external setpoint. The resulting limiting value is provided in 12062 *GasFuelLimitMax*. If the gas speed governor is active, 12031 *GasGovernorActive* = 1, and the gas fuel quantity value calculated in it is limited, this is indicated with 2711 *FuelLimitMaxActive* = 1.

The gas value calculated by the gas speed governor 12025 *GasFuelSetpUnlimited* can therefore be limited with 12062 *GasFuelLimitMax*. The result is provided in 12024 *GasFuelQuantUncorr*. After any correction with gas pressure and/or gas temperature, the actual gas value used is provided in 12023 *GasFuelQuantity*.

<u>Parameters</u>

10063 *GasFuelLimitMaxAbs*	Absolute maximum gas fuel quantity value
2711 *FuelLimitMaxActive*	Gas fuel quantity is currently being limited
12023 *GasFuelQuantity*	Resulting effective gas value after correction with gas pressure/temperature
12024 *GasFuelQuantUncorr*	Current gas value after limitation with 12062 *GasFuelLimitMax*
12025 *GasFuelSetpUnlimited*	Current gas value calculated by gas speed governor or ramped during switch
12031 *GasGovernorActive*	1 = Gas speed governor is active
12062 *GasFuelLimitMax*	Current maximum permissible gas fuel quantity value

Notice

If the firmware does not contain any sensors for gas pressure and gas temperature, there is no parameter 12024 GasFuelQuantUncorr and the result of the limitation appears immediately in 12023 GasFuelQuantity.

16.10.1.1 Speed-dependent gas fuel quantity limitation

Speed-dependent gas fuel quantity limitation is only effective if the gas speed governor is active, 12031 *GasGovernorActive* = 1. It uses a characteristic to determine the maximum gas fuel quantity value associated with the current speed 2000 *Speed*. This can still be reduced depending on various temperatures.

As the diesel speed governor and gas speed governor are only active in alternation, the same parameters are used for the limitation indication. The speed grid points for the limitation characteristic are also identical; only the limiting values themselves are different in diesel mode than they are in gas mode.

Speed-dependent gas fuel quantity limitation must be enabled with 14023 *GasFuelLimitSpeedOn* = 1.

For the temperature dependent reductions, see ↑ *16.10.4* Temperature dependent reduction. The overall result is provided in 2703 *FuelLimitSpeed*.

If the current gas fuel quantity limitation actually results from this speed-dependent function, 2713 *SpeedLimitActive* is set.

<u>Parameters</u>

2000 *Speed*	Current speed
2703 *FuelLimitSpeed*	Speed-dependent gas fuel quantity limitation

2713 *SpeedLimitActive*	Indicates that the current gas fuel quantity limitation is speed-dependent
12031 *GasGovernorActive*	1 = Gas speed governor is active
14023 *GasFuelLimitSpeedOn*	1 = Enable / disable speed-dependent gas fuel quantity limitation
6700 *SpeedLimit:n(x)*	Speed grid points
16140 *GasSpeedLimit:f(x)*	Gas fuel quantity values

16.10.1.2 Power-dependent gas fuel quantity limitation

Power-dependent gas fuel quantity limitation uses a characteristic to determine the maximum gas fuel quantity value associated with the current power 2918 *MeasuredPower*. To do this, the function must have been enabled with 14027 *GasFuelLimitPowerOn* = 1. It is only effective if the gas speed governor is active, 12031 *GasGovernorActive* = 1.

The value determined can be reduced further depending on various temperature values, see ↑ *16.10.4* Temperature dependent reduction. The overall result is provided in 12064 *GasFuelLimitPower.*

If the current gas fuel quantity limitation actually results from this function, 2716 *PowerLimitActive* (XIOS: 2728 *PowerLimitActive*) is set.

Parameters

2716 *PowerLimitActive* XIOS: 2728 *PowerLimitActive*	Indication that the current gas fuel quantity limitation is power-dependent
2918 *MeasuredPower*	Current power
12031 *GasGovernorActive*	1 = Gas speed governor is active
12064 *GasFuelLimitPower* limitation	Power-dependent gas fuel quantity
14027 *GasFuelLimitPowerOn*	1 = Enable / disable power-dependent gas fuel quantity limitation
16150 *GasPowerLimit:P(x)*	Power grid points
16180 *GasPowerLimit:f(x)*	Gas fuel quantity values

16.10.1.3 Externally enabled gas fuel quantity limitation

This gas fuel quantity limitation is enabled using the switching function 2813 *SwitchForcedLimit*. It is only effective if the gas speed governor is active, 12031 *GasGovernorActive* = 1. The resulting maximum gas fuel quantity value is a fixed setting in 10066 *GasFuelLimitForced*. If the current gas fuel quantity limitation actually results from this function, 2715 *ForcedLimitActive* is set.

Parameters

10066 *GasFuelLimitForced*	Gas fuel quantity limitation
2715 *ForcedLimitActive*	Indication that the current gas fuel quantity limitation is externally specified
2813 *SwitchForcedLimit*	1 = Enable / disable external limitation
12031 *GasGovernorActive*	1 = Gas speed governor is active

16.10.2 Diesel reduction governor (maritime application)

For gas power limitation there is a maximum permissible value 10062 *GasPowerLimitMaxAbs*, but the value can be below this depending on the speed. The lowest limiting value is used and is indicated in 12062 *GasPowerLimitMax*.

The maximum permissible gas power at a particular speed is determined by the current value of the propeller curve 12052 *DF:EnginePowerLimit* minus the current diesel power proportion 12050 *DieselPower* (↑ *16.4.3* Maritime applications). This value is indicated in 12063 *GasPowerLimitSpeed*. If it is actually being used for limitation, this is indicated by 12065 *GasSpeedLimitActive* = 1.

If the diesel fuel quantity during operation is below the electrical zero load limit, i.e. if 12050 *DieselPower* = 0 kW, then 12063 *GasPowerLimitSpeed* is set to the value of 12049 *NegDieselPower*, which corresponds to the remaining mechanical engine power necessary to supply power take-offs.

NOTICE	For safety reasons, the characteristic for determination of *12049 Neg Diesel Power* may only be created by the engine manufacturer, who can also specify a low ignition oil quantity such that gas combustion is guaranteed at all times. Otherwise, the ignition oil quantity must be above the electrical zero-fuel limit and 0 should be entered as the power values for this characteristic.

The gas value calculated by the diesel reduction governor is constantly limited with 12062 *GasPowerLimitMax*. The result is provided in 12024 *GasPowerUncorr*. After any correction with gas pressure and/or gas temperature the actual gas value used is provided in 12023 *GasPowerSetpoint.* This value is sent to the HEINZMANN ELEKTRA Flow Control gas control unit as the setpoint power for the gas.

Parameters

10062 *GasPowerLimitMaxAbs*	Absolute maximum gas power value
12023 *GasPowerSetpoint*	Resulting effective gas power after correction with gas pressure/temperature
12024 *GasPowerUncorr*	Current gas value after limitation with 12062 *GasFuelLimitMax*
12062 *GasPowerLimitMax*	Current maximum permissible gas power value
12063 *GasPowerLimitSpeed*	Speed-dependent gas power limitation
12065 *GasSpeedLimitActive*	1 = Current limitation using speed
6700 *SpeedLimit:n(x)*	Speed grid points
16130 *DFSpeedLimit:P(x)*	Gas power limits

Notice

If the firmware does not contain any sensors for gas pressure and gas temperature, there is no parameter 12024 GasPowerUncorr and the result of the limitation appears immediately in 12023 GasPowerSetpoint.

16.10.3 Diesel reduction governor (generator and locomotive application)

As the power must be available in these applications, in each case power-dependent limitation ↑*16.10.3.2 Power-dependent gas* fuel quantity limitation should be selected. Additional speed-dependent fuel quantity limitation still makes at least some sense in locomotives ↑*16.10.3.1 Speed-dependent gas* fuel quantity limitation.

For gas fuel quantity limitation, there is a maximum permissible value 10063 *GasFuelLimitMaxAbs*. However, different functions can specify lower values. The lowest limiting value is used and is indicated in 12062 *GasFuelLimitMax*. It is used continuously for gas fuel quantity limitation.

The gas value calculated by the diesel reduction governor is constantly limited with 12062 *GasFuelLimitMax*. The result is provided in 12024 *GasFuelQuantUncorr*. After any correction with gas pressure and/or gas temperature the actual gas value used is provided in 12023 *GasFuelQuantity*.

Parameters

10063 *GasFuelLimitMaxAbs*	Absolute maximum gas fuel quantity value
12023 *GasFuelQuantity*	Resulting effective gas value after correction with gas pressure/temperature
12024 *GasFuelQuantUncorr*	Current gas value after limitation with 12062 *GasFuelLimitMax*

12062 *GasFuelLimitMax*	Current maximum permissible gas fuel quantity value

Notice

If the firmware does not contain any sensors for gas pressure and gas temperature, there is no parameter 12024 GasFuelQuantUncorr and the result of the limitation appears immediately in 12023 GasFuelQuantity.

16.10.3.1 Speed-dependent gas fuel quantity limitation

Speed-dependent gas fuel quantity limitation uses a characteristic to determine the maximum gas fuel quantity value associated with the current speed 2000 *Speed*. This can still be reduced depending on various temperatures.

For the temperature dependent reductions, see ↑ *16.10.4* Temperature dependent reduction. The overall result is provided in 12063 *GasFuelLimitSpeed*.

Speed-dependent gas fuel quantity limitation must be enabled with 14023 *GasFuelLimitSpeedOn* = 1.

If 12063 *GasFuelLimitSpeed* is actually being used for limitation, 12065 *GasSpeedLimitActive* is set.

<u>Parameters</u>

2000 *Speed*	Current speed
12063 *GasFuelLimitSpeed*	Speed-dependent gas fuel quantity limitation
12065 *GasSpeedLimitActive*	1 = Indication of current gas fuel quantity limitation using speed
14023 *GasFuelLimitSpeedOn*	Enable / disable speed-dependent gas fuel quantity limitation
16130 *GasSpeedLimit:n(x)*	Speed grid points
16140 *GasSpeedLimit:f(x)*	Gas fuel quantity values

16.10.3.2 Power-dependent gas fuel quantity limitation

For power-dependent limitation, either a limiting governor or a power-dependent gas fuel quantity value can be used. The first choice is to enable the limiting governor. This determines the maximum permissible gas fuel quantity in a control loop from the distance between the current power and the nominal power (or between the current and maximum traction power in locomotives). The governing and the exclusive reference to the total power means that the relationship between gas fuel quantity and gas power no longer plays a role, while the gas fuel quantity values in a limitation characteristic actually only apply under the same ambient conditions as at the time of configuration (gas quality, gas pressure, gas temperature etc.).

In generator sets, power-dependent limitation is based on 2918 *MeasuredPower*, and in locomotive applications is carried out using 3231 *TractionPower*.

If neither of the two limitation functions listed below is active, the value of 10063 *GasFuelLimitMaxAbs* is returned.

The result of the power-dependent limitation can then be reduced further depending on different temperature values, ↑ *16.10.4 Temperature dependent* reduction. The overall result appears in 12064 *GasFuelLimitPower*.

16.10.3.2.1 Power limiting governor

If the engine power is below the nominal power 1232 *RatedPower* or the speed-dependent maximum traction power 12048 *PowerMax* (↑ *16.4.1 Applications* for locomotive operation) and it was not previously above it, there is currently no power-dependent gas limitation.

However, if the engine power rises above the nominal or maximum traction power, the gas is gradually reduced starting from the current value 12023 *GasFuelQuantity*; thus the limiting value for gas 12064 *GasFuelLimitPower* is not fixed in the configuration, it is determined from the current power and gas values. At the same time, the diesel fuel quantity is limited with the value that was recorded when the engine or traction power exceeded the limit. This value is indicated in 2706 (*Diesel)FuelLimPower* (XIOS: 2727 *FuelLimPower*). Both limiting values remain active until the measured power falls below the limit minus hysteresis 10015 *GasModePowerHyst*.

The gas limiting value is determined with governing. The actual and nominal power in generator operation or the actual and maximum traction power in locomotive operation are fed into the control loop.

If power measurement fails, the limitation function passes over to the characteristic, provided it is enabled, ↑ *16.10.3.2.2 Power-dependent limitation* characteristic. Otherwise the fixed limiting value 10063 *GasFuelLimitMaxAbs* is used.

Notice

If monitoring of the power range for dual fuel operation is enabled ↑16.7.2 Monitoring *the power, failure of the power sensor switches off the gas. This function has a higher priority than the limiting governor and limitation characteristic.*

Parameters

1232 *RatedPower*	Maximum power in generator operation
12048 *PowerMax*	Maximum power in locomotive operation

2918 *MeasuredPower* 3231 *TractionPower*	Current power in generator operation Current power in locomotive operation
10015 *GasModePowerHyst*	Hysteresis on the power limit
10063 *GasFuelLimitMaxAbs*	Absolute maximum permissible gas fuel quantity in dual fuel operation
2706 (*Diesel)FuelLimPower* XIOS: 2727 *FuelLimPower*	Current power-dependent diesel limitation
2716 *PowerLimitActive* XIOS: 2728 *PowerLimitActive*	1 = Current diesel limitation using Power
12064 *GasFuelLimitPower*	Gas limiting value (after reduction)
12066 *GasPowerLimitActive*	1 = Current gas limitation using power
10110 *MaxGasPosGain*	PID gas limiting governor P-ratio
10111 *MaxGasPosStability*	PID gas limiting governor I-ratio
10112 *MaxGasPosDerivative*	PID gas limiting governor D-ratio
14110 *MaxGasPosGovernorOn*	Enable / disable gas limiting governor

Notice

If both 14013 CheckPowerInRange and 14110 MaxGasPosGovernorOn are enabled (↑16.7.2 Monitoring the power), then 10014 GasModePowerMax must specify a higher value than 1232 *RatedPower*/12048 *PowerMax. Above these power values, the gas fuel quantity is reduced, but above 10014 GasModePowerMax the gas is switched off immediately.*

16.10.3.2.2 Power-dependent limitation characteristic

If the limiting governor 14110 *MaxGasPosGovernorOn* is not enabled or the actual power signal has failed, the limiting value must be taken from the power-dependent gas limitation curve 16150 *GasPowerLimit:P(x)* and 16180 *GasPowerLimit:f(x)* if this is enabled with 14027 *GasFuelLimitPowerOn* = 1.

The current maximum permissible gas power value is provided in 12052 *GasPowerMax*. If is determined from the difference between the maximum permissible engine or traction power (1232 *RatedPower* or 12048 *PowerMax*) and the current diesel proportion 12050 *DieselPower*. 12052 *GasPowerMax* is used to derive the associated maximum gas fuel quantity value from the characteristic. It can then also be reduced depending on the temperature. The result is provided in 12064 *GasFuelLimitPower*. Whether it is actually being used to limit the gas fuel quantity can be seen from the indication 12066 *GasPowerLimitActive* .

If 14027 *GasFuelLimitPowerOn* is not enabled, 12064 *GasFuelLimitPower* is assigned the value of 10063 *GasFuelLimitMaxAbs*.

Notice

If monitoring of the power range for dual fuel operation is enabled ↑16.7.2 Monitoring *the power, failure of the power sensor switches off the gas. This function has a higher priority than the limiting governor and limitation characteristic.*

Parameters

1232 *RatedPower* 12048 *PowerMax*	Maximum power in generator operation Maximum power in locomotive operation
2918 *MeasuredPower* 3231 *TractionPower*	Current power in generator operation Current power in locomotive operation
10063 *GasFuelLimitMaxAbs*	Absolute maximum permissible fuel quantity in dual fuel operation
12050 *DieselPower*	Current diesel power
12052 *GasPowerMax*	Current maximum permissible gas power
12064 *GasFuelLimitPower*	Gas fuel quantity limiting value (after reduction)
12066 *GasPowerLimitActive*	1 = Current limitation using power
14027 *GasFuelLimitPowerOn*	1 = Enable / disable gas limitation curve
16150 *GasPowerLimit:P(x)*	Power grid points
16180 *GasPowerLimit:f(x)*	Fuel quantity limiting values

16.10.3.3 Externally enabled gas fuel quantity limitation

Parameters

2813 *SwitchForcedLimit*	Switching function to enable / disable 10066 *GasFuelLimitForced*
10066 *GasFuelLimitForced*	Fixed limiting value
12067 *GasForcedLimitActive*	1 = Current externally requested limitation

16.10.4 Temperature dependent reduction

Speed and power-dependent gas fuel quantity limitation in generator and locomotive operation can be reduced both in the gas speed governor and in the diesel reduction governor depending on the charge air, exhaust and/or coolant temperature.

Each reduction function has its own on/off switch. The temperature dependent reductions take effect exactly as described in *↑ 9.5 Reduction of the full-load* *characteristic with XIOS*, except that in dual fuel operation different parameters are used.

Notice

Note that the reduction parameters including enabling / disabling the function can be used for both speed-dependent and power-dependent gas fuel quantity limitation.

16.10.4.1 Charge air temperature dependent reduction

The speed-dependent and power-dependent gas fuel quantity limitation can be reduced simultaneously depending on the current charge air temperature 2908 *ChargeAirTemp*.

In all control units except for XIOS, a reduction of 10100 *GasReductChAirTmpDec* is made if 2908 *ChargeAirTemp* is above 692 *SpPowLimChAirTmpHigh*.

At temperatures between 691 *SpPowLimChAirTempLow* and 692 *SpPowLimChAirTmpHigh* the reduction value is determined by linear interpolation between 0 % and 10100 *GasReductChAirTmpDec*. At charge air temperatures below 691 *SpPowLimChAirTempLow* there is no reduction.

On the XIOS, charge air temperature grid points starting at 7120 *ChAirTempReduce:T(x)* are available for calculating the reduction value, and these apply for both diesel and dual fuel operation (↑ *9.5.1.2* Charge air temperature dependent reduction). However, the corresponding factors for the percentage reduction are stored separately for dual fuel operation starting from 16680 *GasLChAirTmpRed:F(x)*.

The reduction function must be enabled with 14100 *GasReductChAirTmpOn*.

<u>Parameters</u>

2908 *ChargeAirTemp*	Current charge air temperature
14100 *GasReductChAirTmpOn*	1 = Enable / disable reduction
Not XIOS:	
691 *SpPowLimChAirTempLow*	Lower temperature without reduction
692 *SpPowLimChAirTmpHigh*	Upper temperature with max. reduction
10100 *GasReductChAirTmpDec*	Maximum reduction in dual fuel operation
XIOS:	
7120 *ChAirTempReduce:T(x)*	Charge air temperature values for reduction
16680 *GasLChAirTmpRed:F(x)*	Percentage reduction in dual fuel operation

Notice

*On V engines with one charge air temperature sensor per bank (*2908 *ChargeAirTempLB and* 2920 *ChargeAirTempRB) the higher value from the two sensors is used for reduction.*

16.10.4.2 Exhaust temperature dependent reduction

The speed-dependent and power-dependent gas fuel quantity limitation can be reduced simultaneously depending on the current exhaust temperature. If only one exhaust temperature sensor is fitted on the engine, this is done using the value 2911 *ExhaustTemp*. With multiple exhaust temperature sensors, the current highest temperature 2913 *ExhaustTempMax* is used for reduction instead.

In all control units except XIOS, a reduction of 10103 *GasReductExhTempDec* is made if the exhaust temperature is above 697 *SpPowLimExhTempHigh*.

At temperatures between 696 *SpPowLimExhTempLow* and 697 *SpPowLimExhTempHigh* the reduction value is determined by linear interpolation between 0 % and 10103 *GasReductExhTempDec*. At exhaust temperatures below 696 *SpPowLimExhTempLow* there is no reduction.

On the XIOS, exhaust temperature grid points starting at 7160 *ExhTempReduce:T(x)* are available for calculating the reduction value, and these apply for both diesel and dual fuel operation (↑ *9.5.1.4* Exhaust-dependent reduction). However, the corresponding factors for the percentage reduction for dual fuel operation are stored in 16700 *GasLimExhTmpRed:F(x)*.

The reduction function must be enabled with 14103 *GasReductExhTempOn*.

<u>Parameters</u>

2911 *ExhaustTemp*	Current exhaust temperature (one sensor)
2913 *ExhaustTempMax* 12573 *ExhaustTempMax* (XIOS)	Maximum exhaust temperature (multiple sensors)
14103 *GasReductExhTempOn*	1 = Enable / disable reduction
Not XIOS:	
696 *SpPowLimExhTempLow*	Lower temperature without reduction
697 *SpPowLimExhTempHigh*	Upper temperature with max. reduction
10103 *GasReductExhTempDec*	Maximum reduction in dual fuel operation
XIOS:	
7160 *ExhTempReduce:T(x)*	Exhaust temperature values for reduction
16700 *GasLimExhTmpRed:F(x)*	Percentage reduction in dual fuel operation

16.10.4.3 Coolant temperature dependent reduction

The speed-dependent and power-dependent gas fuel quantity limitation can be reduced simultaneously depending on the current coolant temperature 2907 *CoolantTemp*.

In all control units except for XIOS, a reduction of 10106 *GasReductCoolTempDec* is made if 2907 *CoolantTemp* is above 703 *SpPowLimCoolTempHigh*.

At temperatures between 702 *SpPowLimCoolTempLow* and 703 *SpPowLimCoolTempHigh* the reduction value is determined by linear interpolation between 0 % and 10106 *GasReductCoolTempDec*. At coolant temperatures below 702 *SpPowLimCoolTempLow* there is no reduction.

On the XIOS, coolant temperature grid points starting at 7100 *CoolTempReduce:T(x)* are available for calculating the reduction value, and these apply for both diesel and dual fuel operation (↑*9.5.1.1* Coolant temperature dependent reduction). However, the corresponding factors for the percentage reduction are stored separately for dual fuel operation starting from 16670 *GasLimColTmpRed:F(x)*.

The reduction must be enabled with 14106 *GasReductCoolTempOn*.

Parameters

2907 *CoolantTemp*	Current coolant temperature
14106 *GasReductCoolTempOn*	1 = Enable / disable reduction
Not XIOS:	
702 *SpPowLimCoolTempLow*	Lower temperature without reduction
703 *SpPowLimCoolTempHigh*	Upper temperature with max. reduction
10106 *GasReductCoolTempDec*	Maximum reduction in dual fuel operation
XIOS:	
7100 *CoolTempReduce:T(x)*	Coolant temperature values for reduction
16670 *GasLimColTmpRed:F(x)*	Percentage reduction in dual fuel operation

16.11 Gas fuel quantity correction

If the gas pressure 2921 *GasRailPressure* (XIOS: 2928 *GasRailPressure*) and/or the gas temperature 2910 *GasTemp* (XIOS: 2926 *GasTemp*) are measured on the engine, these values can be used to correct the gas quantity. There are two curves for doing this, in which factors are stored depending on gas temperature or relative gas pressure to correct the calculated and, where applicable, limited gas value 12024 *GasFuelQuantUncorr* before it is output as 12023 *GasFuelQuantity*.

On the charged engine, the gas pressure is calculated relative to the boost pressure and the result is provided in 2925 *GasDiffPressure* (XIOS: 2942 *GasDiffPressure*). On a non-charged engine 2925 *GasDiffPressure* and 2921 *GasRailPressure* (XIOS: 2942 and 2928) are identical. In any case, the function uses 2925/2942 *GasDiffPressure*.

Parameters

12023 *GasFuelQuantity*	Resulting effective gas value after correction with gas pressure/temperature
12024 *GasFuelQuantUncorr*	Current gas value after limitation with 12062 *GasFuelLimitMax*
12025 *GasFuelSetpUnlimited*	Current gas value calculated by gas speed governor or ramped during switch
2910 *GasTemp* (Others) 2926 *GasTemp* (XIOS)	Current gas temperature
14028 *GasTempFactorOn*	Enable / disable gas temperature dependent correction
16450 *GasTempFactor:T(x)*	Gas temperature grid points
16460 *GasTempFactor:F(x)*	Correction factors
2904 *BoostPressure*	Boost pressure
2921 *GasRailPressure* 2928 *GasRailPressure* (XIOS)	Gas pressure
2925 *GasDiffPressure* 2942 *GasDiffPressure* (XIOS)	Gas differential pressure
14029 *GasPressFactorOn*	Enable / disable gas pressure dependent correction
16470 *GasPressFactor:p(x)*	Gas pressure grid points
16480 *GasPressFactor:F(x)*	Correction factors

Notice

If the firmware does not contain any sensors for gas pressure and gas temperature, there is no parameter 12024 GasFuelQuantUncorr and the result of the limitation with 12062 GasFuelLimitMax appears immediately in 12023 GasFuelQuantity.

16.12 Residual gas combustion

After switching off dual fuel operation and closing the gas values, for safety reasons it is essential to ensure that any residual gas remaining in the pipe is combusted.

In the gas speed governor every gas switch-off is “final”, i.e. the electrically operated valves are closed and the gas section is monitored again before any further gas request. Residual gas combustion should therefore take place each time dual fuel operation is terminated – whether this is because the gas request was cancelled, because the conditions for dual fuel operation are no longer met, or because an engine stop was requested during dual fuel operation.

By contrast, in the diesel reduction governor there is continuous switching between diesel and dual fuel operation. The electrically operated values 12035 *GasValvesOpen* must be closed if a gas value of 0% is calculated, because the throttle valve is not impermeable, but a repeated time-consuming gas section test would have an extremely negative impact on the conversion rate. Therefore, in contrast to the gas speed governor in this case residual gas combustion is performed exclusively after an engine stop request and when the gas request is disabled using the switching functions 2837 *SwitchGasOrDiesel* = 0 and 2838 *SwitchFastToDiesel* = 1, but not if the gas is temporarily switched off due to other conditions.

In any case, the prerequisite for residual gas combustion is that the current diesel fuel quantity at least corresponds to the ignition oil quantity.

16.12.1 Engine stop request

If there is a fatal error 3800 *EmergencyAlarm*, the engine is always stopped immediately (↑*27.7 Emergency shutdown errors*. The gas is abruptly positioned to 0 % and the gas valves are closed, 12035 *GasValvesOpen* = 0. However, residual gas remains in the supply pipe and in this case has to be removed in another way, for example using a valve into the open air, which is switched using 3800 *EmergencyAlarm*.

For a normal engine stop request 2810 *SwitchEngineStop* when dual fuel operation is active, on the other hand, this operating mode is terminated first, i.e. there is a switch back to diesel. This is always done using the fast ramp *(*↑*16.8.3 Switching ramp from gas to* diesel operation and ↑*16.9.3 Diesel* setpoint ramp). This situation is indicated with 12068 *EngStopRequWithGas*.

When the gas is switched off and the valves are closed – 12035 *GasValvesOpen* = 0 – combustion of the residual gas in the pipe begins.

Therefore, the stop request is delayed until the gas has reached 0 %, the valves have been closed and then the residual gas combustion has also been completed. This takes different times depending on the current gas value.

16.12.2 Gas speed governor

For residual gas combustion, it is important that the diesel is running at least at the ignition oil quantity 12061 *DieselAtPilotFuel* = 0, otherwise the residual gas combustion has to be terminated.

After closing the gas supply valves. 12035 *GasValvesOpen* = 0, the gas value is ramped to 10091 *DslModeGasFuelBurn* to open the actuator or the MEGASOL valves. Residual gas combustion is normally terminated either when the rail pressure 2921 *GasRailPressure* falls below 10090 *DslModeGasRPressMax* or, at the latest, when the time 10092 *GasBurnTimeMax* has elapsed. 12069 *RemainGasBurning* indicates that residual gas combustion is in progress.

Parameters

10090 *DslModeGasRPressMax*	Max. permissible remaining relative gas pressure in rail
10091 *DslModeGasFuelBurn*	Forced gas opening
10092 *GasBurnTimeMax*	Max. time for residual gas combustion
12068 *EngStopRequWithGas*	Engine stop request in dual fuel operation
12069 *RemainGasBurning*	Residual gas combustion in progress

16.12.3 Diesel reduction governor

The gas is reduced to 0 % if it is not already there. The gas supply valves are closed, 12035 *GasValvesOpen* = 0, and the time 10092 *GasBurnTimeMax* begins to elapse. During this time, the throttle valve or the MEGASOL valves are opened to the value 10091 *DslModeGasFuelBurn* so that the residual gas in the pipe can be combusted. The prerequisite is that the diesel fuel quantity 2350 *DieselFuelQuantity* or – on engines with PT pump – the actual diesel power 12050 *DieselPower* is still above the ignition oil quantity 12055 *PilotDslAbsMinimum*. After 10092 *GasBurnTimeMax* has elapsed, the engine stop – if requested – is performed, i.e. both the gas and the diesel fuel quantity are reduced to 0 %. 12069 *RemainGasBurning* indicates that residual gas combustion is in progress.

Parameters

10091 *DslModeGasFuelBurn*	Forced gas opening
10092 *GasBurnTimeMax*	Max. time for residual gas combustion
12068 *EngStopRequWithGas*	Engine stop request in dual fuel operation
12069 *RemainGasBurning*	Residual gas combustion in progress

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17 Configuration of sensors

In the HEINZMANN control units, a strict distinction is made between hardware and communication inputs on one side and sensors on the other. This means that the engine or application control is determined by the current values read by sensors, but where those sensors take their values from is configured separately.

Normally, they will be influenced by analogue or PWM inputs but in specific applications they can also be assigned their values via Modbus or CAN protocols.

For this reason, it must first be defined which type should be assigned to variable ports (*↑19.1.1 Variable Ports*), then the inputs must be configured. Only then – if no configuration error is reported – can the sensors be configured and the source from which they receive their current status be specified. If communication modules are used for transmitting sensor values, they must also be configured beforehand.

Once the entire configuration is complete and a reset has been carried out, there must be no configuration error reported, otherwise the configuration must be checked again.

17.1 Overview of all sensors

Sensors are needed to measure set values, pressures, temperatures, etc., and to execute functions depending on these quantities. The following table gives an overview of implemented sensors, although not all of them are usually found in every application or firmware:

Parameter	**Meaning**	**Usage**
2900 *Setpoint1Extern*	Setpoint adjuster 1	Setpoint for speed governor
2901 *Setpoint2Extern*	Setpoint adjuster 2	2. Setpoint for speed governor
2902 *LoadControlInput*	Input value from load control unit	Generator operation: Power control
2903 *SyncInput*	Input value from synchronization unit	Generator operation: Synchronization
2904 *BoostPressure*	Boost pressure	Boost-pressure dependent fill limit dual fuel: Boost pressure monitoring
2905 *OilPressure*	Oil pressure	Oil pressure monitoring
2906 *AmbientPressure*	Ambient pressure	Calculation of relative boost pressure, reduction of speed-dependent filling limitation
2907 *CoolantTemp*	Coolant temperature	Coolant temperature warning, temperature-dependent idle speed and start filling, PID correction, reduction of the speed-dependent or power-dependent fill limit, locomotive operation: forced idle speed

Parameter	Meaning	Usage
2908 *ChargeAirTemp*	Charge air temperature	Charge air temperature warning, reduction of the speed-dependent or power-dependent fill limit
2909 *OilTemp*	Oil temperature	Oil temperature warning, locomotive operation: forced idle speed
2910 *FuelTemp*	Fuel temperature	Reduction of the speed-dependent filling limitation
2910 *GasTemp* (XIOS see 2926)	Gas temperature	Dual fuel: Gas filling correction, gas temperature monitoring
2911 *ExhaustTemp* see 12900 *ExhaustTempCylx*, if exhaust temperature measurement per cylinder	Exhaust temperature	Exhaust temperature warning, reduction of the speed-dependent or power-dependent fill limit, gas limit on the dual-fuel engine
2914 *SlideExcitReduction*	Reduction value of excitation signal	Locomotive operation: Slide protection
2915 *SlideSpeedReduction*	Reduction value for the setpoint speed	Locomotive operation: Slide protection
2915 *AlternatorVoltage* (XIOS see 2936)	Alternator voltage	Vehicle operation: Alternator monitoring
2916 *CoolantPressure*	Coolant pressure	Locomotive operation: Coolant pressure monitoring, forced idle speed
2916 *GasPosition* (XIOS see 2927)	Position of external gas throttle valve	Monitoring actuator difference
2917 *AsymmetricLoad*	Asymmetric load	Nautical applications: Offset on slave filling setpoint in twin-engine systems (master/slave)
2918 *MeasuredPower*	Actual power If the breaker on the control unit is wired, 2918 *MeasuredPower* = 0 if 2846 *SwitchGenBreaker* is inactive.	Generator operation: Misfire monitoring, speed governor DT1 factor load-dependent P-level, actual value for integrated power governor
2918 *TractionVoltage*	Traction voltage	Locomotive operation: Calculation of the traction power
2919 *PowerSetpoint*	Power setpoint	Generator operation: Setpoint for integrated power governors
2919 *TractionCurrent*	Traction current	
2920 *TurboOilTemp*	Turbocharger oil	Turbocharger oil temperature monitoring

Parameter	Meaning	Usage
	temperature	
2921 *FuelPressure*	Fuel pressure	Fuel pressure monitoring
2921 *GasRailPressure* (XIOS see 2928)	Gas rail pressure	Dual fuel: Gas rail pressure monitoring
2922 *OilLevel*	Oil level	Oil level monitoring
2923 *FuelLimitExtern*	Filling limitation from external source	Filling limitation
2924 *TransmissionOilPress*	Transmission oil pressure	Transmission oil pressure monitoring
2925 *AirMass*	Air mass sensor	
2926 *GasTemp* (not XIOS, see 2910)	Gas temperature	Dual fuel: Gas filling correction, gas temperature monitoring
2927 *GasPosition* (not XIOS see 2916)	Position of external gas throttle valve	Dual fuel: Actuator difference monitoring of external gas positioners
2928 *GasRailPressure* (not XIOS see 2921)	Gas rail pressure	Dual fuel: Gas rail pressure monitoring
2931 *BoostPressure2*	2. Boost pressure sensor	Boost-pressure dependent fill limit dual fuel: Boost pressure monitoring
2932 *Lambda1*	Lambda 1	Exhaust recycling
2933 *Lambda2*	Lambda 2	Exhaust recycling
2934 *NOx*	Nitrogens	Exhaust recycling
2935 *O2*	Oxygen	Exhaust recycling
2936 *AlternatorVoltage* (DC5 see 2915)	Alternator voltage	Vehicle operation: Alternator monitoring
12900 *ExhaustTempCylx*	Exhaust temperature per cylinder	Exhaust temperature warning, reduction of the speed-dependent fill limit, gas limit on the dual-fuel engine

Table 23: Sensors

Note

The 2918 MeasuredPower value is set to 0 % / 0 kW automatically by the control unit if the switching function 2846 SwichGenBreaker is assigned and has the current value "0". In this case, it is assumed that the breaker is open and the power can therefore not be measured.

The following sensor values can be derived from the received values outlined below:

Parameter	Meaning	Usage
2925 *GasDiffPressure* (XIOS see 2942)	Relative gas pressure, if a boost pressure sensor is present	Dual-fuel engines
2940 *BoostPressRelative*	Relative boost pressure, if a boost pressure and ambient pressure sensor are present	Boost pressure dependent fill limitation
2941 *AbsoluteAltitude*	Height above sea level if an ambient pressure sensor is present	Display
2942 *GasDiffPressure* (not XIOS see 2925)	Relative gas pressure, if a boost pressure sensor is present	Dual-fuel engines
2943 *LambdaCalculated*	Lambda if, instead of a lambda sensor, the Smart NO_x and O_2sensor are connected via SAE J1939 CAN protocol	Exhaust recycling
3231 *TractionPower*	Traction power, if 2918 *TractionVoltage* and 2919 *TractionCurrent* are present, 1232 *TractionPowerHigh* should also be considered as an applicable limit value for the traction power	Locomotive operation
12570 *ExhaustTempAverage* 12572 *ExhaustTempMin* 12573 *ExhaustTempMax*	average minimum maximum exhaust temperature of all cylinders	Exhaust temperature warning, reduction of the speed-dependent fill limit, gas limit on the dual-fuel engine (all with 12573 *ExhaustTempMax)*

Table 24: Derived sensors

17.2 Configuration of sensors

Sensors and setpoint adjusters deliver either an analogue signal (current or voltage) or a PWM or frequency signal. This signal may also be measured at a different point and sent to the control unit via communication modules, ↑*22 Bus-Protokolle*. The firmware decides which options are available, as CAN protocols are usually only implemented on request.
The sensors available from HEINZMANN are described in detail in the manuals of the basic systems as well as in the brochure "Product overview sensors no. E 99 001-e".

The selection of the sensor as an analogue, PWM, frequency or "communication" sensor takes place via the parameters from 4900 *ChanTyp…* or 14900 *ChanTyp…* One of the following values must be entered there depending on the application:

ChanTyp	Sensor source
0	Analogue signal (current or voltage) on own hardware
1	PWM signal on own hardware
2	HZM-CAN periphery module
3	Customer-defined CAN protocol
4	CANopen protocol (speed governor control unit is CANopen slave)
5	DeviceNet CAN protocol (speed governor control unit is slave)
6	Modbus protocol
7	SAE J1939 CAN protocol
8	HZM-CAN customer module
9	HZM-CAN second control unit of same type (double system)
10	WAGO module protocol (speed governor control unit is CANopen master)
13	ICENI module protocol (speed governor control unit is CANopen master)
14	HZM-CAN ALL
15	Frequency signal on own hardware (only XIOS)
16	HZM-CAN add-on module

Table 25: Sensor sources

When assigning a HZM-CAN periphery module, it is important to note whether just one or multiple periphery modules can be connected to the control unit. With multiple periphery modules, the module in question must also be entered in the parameters for the sensor. For this, the index of the module is assigned in the field 404 *CanPENodeNumber()* to the sensor from 4950 *PEIx…* or 14950 *PEIx…*.

Note

When configuring the system with DcDesk 2000, only the options implemented in the relevant firmware are available for selection in the sensor window.

Parametrization example:

The signal for setpoint adjuster 1 is received from an analogue potentiometer, and setpoint adjuster 2 works with a PWM signal. The boost pressure is received from a periphery module via the HZM-CAN bus: It is connected to the second of three periphery modules.

Number	Parameter	Value	Unit
404	*CanPENodeNumber(0)*	*1*	
405	*CanPENodeNumber(1)*	*2*	
406	*CanPENodeNumber(2)*	*3*	
4900	*ChanTypSetp1Ext*	*0*	
4901	*ChanTypSetp2Ext*	*1*	
4904	*ChanTypBoostPress*	*2*	
4954	*PEIxBoostPress*	*1*	

17.3 Assigning the inputs to the sensors and setpoint adjusters

The assignment of inputs to sensors and setpoint adjusters is made by entering the corresponding channel numbers of the analogue, PWM or frequency input channels or the channel number of the communication module in the assignment parameters from 900 *AssignIn…* or 10900 *AssignIn…* . The channel numbers run from 1 to the maximum number for the control unit or communication module. The port number is entered on the XIOS.

Note

It should be noted that only a few fixed defined sensors can be received via equally fixed defined telegrams via the CAN protocols SAE J1939 and HZM-CAN ALL (↑23.2 Configuration of sensors*). In this case, the assignment to the sensor in* 4900 *ChanTyp… is only possible with the value 1 (= yes), not with a counter variable. The relevant receipt telegram must also be activated for this.*

For the assignment of hardware inputs, it must first be defined which type should be assigned to variable ports (↑*19.1.1 Variable Ports*), then the inputs must be configured. Only then can the sensors be configured and the source from which they receive their current value be specified. If communication modules are used for receiving sensors, they must also be configured beforehand.

Note

If the HEINZMANN load measuring unit LMG 10 is connected to 2902 LoadCtrlInput or the HEINZMANN synchronising unit SyG 02 is connected to 2903, the hardware of the 0…5 V analogue input in control units type DC 1 and DC 2 must first be adapted in the HEINZMANN production line.

Control units of type DC 6 and DC 11 enable the adjustment to be carried out via the configuration parameters 5231 LoadControlOrHZM_LMG or 5211 SyncInputOrHZM_SyG, with analogue input 1 used for the load control unit and analogue input 2 for the synchronising unit.

Entering the number 0 in the assignment parameter signifies that the respective sensor has neither been connected nor activated. Consequently, the input will not be subject to monitoring. Therefore, the assignment parameters of any sensors not needed should be set to zero. The sensor value during operation will then constantly be equal to the minimum value.

Double assignments will not be intercepted. But the HEINZMANN communication program DcDesk 2000 reports such multiple configurations in its sensor window.

Parametrization example XIOS:

Setpoint adjuster 1 should be connected to port 1 (voltage input), setpoint adjuster 2 to port 89 (PWM input) and the boost pressure sensor to the HZM-CAN periphery module input 3. For the other sensors remaining unused, the value zero must be entered.

Number	Parameter	Value	Unit
900	*AssignIn_Setp1Ext*	*1*	
901	*AssignIn_Setp2Ext*	*89*	
904	*AssignIn_BoostPress*	*3*	
4900	*ChanTypSetp1Ext*	*0*	
4901	*ChanTypSetp2Ext*	*1*	
4904	*ChanTypBoostPress*	*2*	

Parametrization example other control unit:

Setpoint adjuster 1 should be connected to analogue input 1, setpoint adjuster 2 to PWM input 1 and the boost pressure sensor to the HZM-CAN periphery module input 3. For the other sensors remaining unused, the value zero must be entered.

Number	Parameter	Value	Unit
900	*AssignIn_Setp1Ext*	*1*	
901	*AssignIn_Setp2Ext*	*1*	
904	*AssignIn_BoostPress*	*3*	
4900	*ChanTypSetp1Ext*	*0*	
4901	*ChanTypSetp2Ext*	*1*	
4904	*ChanTypBoostPress*	*2*	

17.4 Measuring ranges of sensors

In HEINZMANN control units, all sensor parameters and all relating values are provided with the maximum possible value range. Thus, temperature sensors can be utilized for a range from –100 to +1,000 °C. Boost pressure and coolant pressure sensors cover a maximum range from 0 to 5 bar, and oil pressure sensors work with a maximum range from 0 to 10 (resp. 20) bar. Indication for sensors without physical measurement ranges (setpoint adjuster) is by per cent.

Since there are pressure sensors with different measurement ranges, the control unit must be informed of the particular value ranges which may differ from the maximum possible physical value range. These ranges are defined as the physical values corresponding to minimum and maximum input values such as 0.5 to 4.5 Volts or 4 to 20 mA for analogue inputs or 10 % to 90 % for PWM inputs.

Sensor	Minimum measured value	Maximum measured value
Air mass sensor	966 *AirMassSensorLow*	967 *AirMassSensorHigh*
Nitrogens	968 *NOxSensorLow*	969 *NOxSensorHigh*
Oxygen	970 *O2SensorLow*	971 *O2SensorHigh*
Lambda sensor 1	972 *Lambda1SensorLow*	973 *Lambda1SensorHigh*
Lambda sensor 2	974 *Lambda2SensorLow*	975 *Lambda21SensorHigh*
Boost pressure sensor 2	976 *BoostPress2SensLow*	977 *BoostPress2SensHigh*
Coolant pressure	978 *CoolPressSensorLow*	979 *CoolPressSensorHigh*
Oil pressure	980 *OilPressSensorLow*	981 *OilPressSensorHigh*
Boost pressure	982 *BoostPressSensorLow*	983 *BoostPressSensorHigh*
Ambient pressure	984 *AmbPressSensorLow*	985 *AmbPressSensorHigh*
Coolant temperature	986 *CoolTempSensorLow*	987 *CoolTempSensorHigh*
Charge air temperature	988 *ChAirTempSensorLow*	989 *ChAirTempSensorHigh*
Gas temperature (dual fuel)	990 *GasTempSensorLow*	991 *GasTempSensorHigh*
Reduction value setpoint speed (locomotives)	fixed, 0	991 *SpeedRedSensorHigh*
Traction voltage (locomotives)	fixed, 0	992 *TractVoltSensorHigh*
Traction current (locomotives)	fixed, 0	993 *TractCurrSensorHigh*
Traction power calculated from the traction current and traction voltage (locomotives)	fixed, 0	1232 *TractionPowerHigh*
Actual power (generator) ↑*23.5 Configuration of power* sensors	992 *MeasPowerSensorLow*	993 *MeasPowerSensorHigh*
Power setpoint ↑*23.5 Configuration of power* sensors	994 *PowerSetpSensorLow*	995 *PowerSetpSensorHigh*
Nominal output reference value for 3232 *RelativePower*	-	1232 *RatedPower*
Fuel pressure	996 *FuelPressSensorLow*	997 *FuelPressSensorHigh*
Gas rail pressure (dual fuel)	996 *GasRailPrSensorLow*	997 *GasRailPrSensorHigh*
Transmission oil pressure	998 *TrOilPressSensorLow*	999 *TrOilPressSensorHigh*

Table 26: Sensor measurement ranges

Note

The reference values of the corresponding analogue inputs may not be used to determine the physical value range. They are only responsible for the definition of 4 and 20 mA or 0 and 5 V (or 0.5 and 4.5 V). The physical value range is defined exclusively via the sensor reference values.

Temperature sensors usually have a non-linear behaviour, which is why linearisation curves are specified for different temperature sensors at the factory. There is no need to specify the physical measurement range for these sensors. It is different if the linearisation takes place in the sensor. In this case, reference values must also be specified for temperature sensors.

Parametrization example:

A boost pressure sensor has a measurement range from 0.5 to 3.5 bar.

Number	Parameter	Value	Unit
982	*BoostPressSensorLow*	*0.5*	*bar*
983	*BoostPressSensorHigh*	*3.5*	*bar*

17.5 Configuration of power sensors

Some additional information is required for the correct parametrisation of power sensors and derived values.

17.5.1 Load measurement

If the generator breaker or mains breaker is wired to the control unit, 2918 *MeasuredPower* = 0 if 2846 *SwitchGenBreaker* is inactive, or, in other words, if the breaker is open.

17.5.2 Value ranges

All measured power values have the value range [0, x] kW or [0, 100] %, which is fixed in the firmware. Kilowatt values are only possible in customer firmware, where the engine/generator power range is known. In the HEINZMANN basic software 00.x.xx, the values are shown in percent to be independent from a specific power range.

The following parameters therefore all have the same value range [0, x] kW or [0, 100] %, within which operation can take place:

2918 *MeasuredPower*	Power actual value
2919 *PowerSetpoint*	Power setpoint
1232 *RatedPower*	Rated power
992 *MeasPowerSensorLow*	Minimum value of the rated power sensor
993 *MeasPowerSensorHigh*	Maximum value of the rated power sensor

994 *PowerSetpSensorLow*	Minimum value of the setpoint power sensor
995 *PowerSetpSensorHigh*	Maximum value of the setpoint power sensor

Note

The reference values of the corresponding analogue inputs may not be used to define the power range. They are only responsible for the definition of 4 and 20 mA or 0 and 5 V (or 0.5 and 4.5 V). The corresponding power range is defined exclusively via the sensor reference values.

The measured actual power value (and the power setpoint) are also displayed relative to the rated power.

Note

The integrated power governor currently does not permit any overload (the setpoint is limited to RatedPower). If necessary, the firmware can be adapted on request. In this case, 995 PowerSetpSensorHigh must be selected larger as required, but never larger than the value range of the measured value sensor.

Power-related parameters and curves always refer to the relative power. All these parameters have the value range [0, 200] %. Examples include:

3232 *RelativePower*	Relative actual power value
3231 *RelativePowerSetp*	Relative power setpoint
6000 *MisfireWarn:P(x)*	Power-dependent misfire monitoring
6350 *PIDMap:P(x)*	Speed-dependent and power-dependent PID map

The internal calculation of the power-dependent P-level (4121 *DroopPowerOrFuel* = 1) also takes place with the relative power.

17.5.3 Configuration example with kilowatt entry

The value range specified by the firmware for power values is [0, 4000] kW. The engine/generator used works in the power range up to 2000 kW, the setpoint potentiometer (a voltage sensor here) should therefore be able to give values between 0 and 2000 kW. The connected power sensor (a current sensor here) can measure up to 3000 kW.

Value range firmware:	[0, 4000] kW
Engine/generator:	[0, 2000] kW → 1232 *RatedPower* = 2000 kW
Measured value sensor:	[4, 20] mA = [0, 3000] kW

→ 992 *MeasPowerSensorLow* = 0 kW
→ 993 *MeasPowerSensorHigh* = 3000 kW

Setpoint potentiometer: [0, 5] V = [0, 2000] kW

→ 994 *PowerSetpSensorLow* = 0 kW
→ 995 *PowerSetpSensorHigh* = 2000 kW

→ full adjustment range of the potentiometer up to the rated power

17.5.4 Configuration example with percent entry

If the power is shown in percent rather than kW in the software, then, in contrast to the configuration described above, the measurement range of the power sensor is used and defined as [0, 100] %. 1232 *RatedPower* and 2919 *PowerSetpoint* are adapted accordingly.

The engine used works in the power range up to 2000 kW, the setpoint potentiometer (a voltage sensor here) should therefore be able to give values between 0 and 2000 kW. The power sensor used (a current sensor here) can measure up to 2500 kW.

Value range firmware: [0, 100] %

Measured value sensor: [4, 20] mA = [0, 2500] kW = [0, 100] %

→ 992 *MeasPowerSensorLow* = 0 %
→ 993 *MeasPowerSensorHigh* = 100 %

Engine/generator: [0, 2000] kW

→ 1232 *RatedPower* = 2000 kW * 100 % / 2500 kW

= 80 %

Setpoint potentiometer: [0, 5] V = [0, 2000] kW = [0, 80] %

→ 994 *PowerSetpSensorLow* = 0 %
→ 995 *PowerSetpSensorHigh* = 80 %

→ full adjustment range of the potentiometer up to the rated power

17.6 Influence on reaction to sensor errors

Setpoint adjusters and sensors on analogue or PWM inputs are monitored for compliance with the valid measurement range. If the values stray outside of this range in either direction, a sensor error is detected. If a sensor is received via a communication module, it is faulty if the bus fails completely, or if only the corresponding transmission telegram fails, or the opposite side is not transmitting the sign of life as agreed.

For any detected error, the respective response to this error can be modified by appropriate configuration which will allow to adjust the control's behaviour to the specific application and mode of operation in case of failure.

For setpoint adjusters and sensors, the parameters from 1000 *Subst…* can be used to define substitute values with which the control unit can continue working in the event of a failure in the relevant sensor. However, there is also the possibility of reverting to the last valid value before the setpoint adjuster or sensor failure occurred rather than maintaining operation by resorting to a substitute value. The parameters from 5000 *SubstOrLast…* are used to decide by which value the control unit is to continue operation in the event of a failure in the setpoint adjuster or the sensor. If the relevant parameter is set to "1", the defined substitute value is used; if it is set to "0", the last valid value is used. This troubleshooting measure helps to maintain more reliable emergency operation for the system.

The table below lists both the parameters where the substitute values are stored and the associated parameters for selecting operation by substitute value or by the last valid value.

Substitute value	**Selection of substitute value**	**Substitute value for**
1000 *SubstSetp1Ext*	5000 *Setp1ExtSubstOrLast*	Target value 1
1001 *SubstSetp2Ext*	5001 *Setp2ExtSubstOrLast*	Target value 2
1002 *SubstLoadCtrlInput*	5002 *LoadCtrInSubstOrLast*	Value from load control unit
1003 *SubstSyncInput*	5003 *SyncInputSubstOrLast*	Synchronisation
1004 *SubstBoostPressure*	5004 *BoostPresSubstOrLast*	Boost pressure
1005 *SubstOilPressure*	5005 *OilPressSubstOrLast*	Oil pressure
1006 *SubstAmbientPressure*	5006 *AmbPressSubstOrLast*	Ambient pressure
1007 *SubstCoolantTemp*	5007 *CoolTempSubstOrLast*	Coolant temperature
1008 *SubstChargeAirTemp*	5008 *ChAirTempSubstOrLast*	Charge air temperature
1009 *SubstOilTemp*	5009 *OilTempSubstOrLast*	Oil temperature
1010 *SubstFuelTemp*	5010 *FuelTempSubstOrLast*	Fuel temperature
1011 *SubstExhaustTemp*	5011 *ExhstTempSubstOrLast*	Exhaust temperature
fixed 0 %	5014 *ExcitRedSubstOrLast*	Slide protection signal
fixed 0 rpm	5015 *SpeedRedSubstOrLast*	Slide protection signal
1015 *SubstAlternator*	5015 *AlternatrSubstOrLast*	Alternator
1016 *SubstCoolPressure*	5016 *CoolPressSubstOrLast*	Coolant pressure
1017 *SubstAsymmetricLoad*	5017 A*symmLoadSubstOrLast*	Asymmetric load
1018 *SubstMeasuredPower*	5018 *MeasPowerSubstOrLast*	Measured power
1018 *SubstTractionVoltage*	5018 *TractVoltSubstOrLast*	Traction voltage
1019 *SubstPowerSetpoint*	5019 *PowerSetpSubstOrLast*	Power setpoint
1019 *SubstTractionCurrent*	5019 *TractCurrSubstOrLast*	Traction current
1020 *SubstTurboOilTemp*	5020 *TuOilTempSubstOrLast*	Turbocharger oil

Substitute value	Selection of substitute value	Substitute value for
		temperature
1021 *SubstFuelPressure*	5021 *FuelPressSubstOrLast*	Fuel pressure
1022 *SubstOilLevel*	5022 *OilLevelSubstOrLast*	Oil level
1023 *SubstFuelLimitExtern*	5023 *FuelLimExSubstOrLast*	External filling limitation
1024 *SubstTransmOilPress*	5024 *TransOilPSubstOrLast*	Transmission oil pressure
1025 *SubstAirMass*	5025 *AirMassSubstOrLast*	Air mass
1026 *SubstGasTemp*	5026 *GasTempSubstOrLast*	Gas temperature
1027 *SubstGasPosition*	5027 *GasPosSubstOrLast*	External gas actuator position
1028 *SubstGasRailPressure*	5028 *GasRailPrSubstOrLast*	Gas rail pressure
1029 *SubstGasVCheckPress*	5029 *GasVChPrSubstOrLast*	Gas valve check pressure
1031 *SubstBoostPressure2*	5031 *BoostPr2SubstOrLast*	Boost pressure 2
1032 *SubstLambda1*	5032 *Lambda1SubstOrLast*	Lambda 1
1033 *SubstLambda2*	5033 *Lambda2SubstOrLast*	Lambda 2
1034 *SubstNOx*	5034 *NoxSubstOrLast*	Nitrogens
1035 *SubstO2*	5035 *O2SubstOrLast*	Oxygen
1036 *SubstAlternatorVolt*	5036 *AlterVoltSubstOrLast*	Alternator voltage
11000 *SubstExhaustTempCylx*	15000 *ExTmpCyl1SubstOrLast*	Exhaust temperature per cylinder

Table 27: Sensor substitution in case of error

Note

If the speed adjustment by setpoint 1 (normally bridge, 4-20 mA) fails during nautical applications, the digital potentiometer is activated automatically to enable adjustment of the speed in emergency operation. In this case, it is always the last valid speed setpoint that is used as an initial value for the digital potentiometer.

If the parameter 5252 NoDigPotAtSetp1Err exists, this automatic function can be deactivated with 5252 NoDigPotAtSetp1Err = 1. In this case, operation continues with either the last valid value or the substitute value of setpoint 1 1000 SubstSetp1Ext.

For the setpoint and sensor inputs, the parameters from 5040 *HoldOrReset…* can also be used to decide how the control unit should react if the error disappears by itself (e.g. loose wiring contact or a missing CAN telegram returns). If the corresponding parameter is set to "1" the error will be treated as having resolved itself. In this case, the control unit does not react when the measured sensor value returns to the valid range. If the parameter is set to "0", the error is reset and the system continues working with the signal coming from the sensor (or telegram).

Parameter	**Reaction to error at**
5040 *Setp1ExtHoldOrReset*	Target value 1
5041 *Setp2ExtHoldOrReset*	Target value 2
5042 *LoadCtrInHoldOrReset*	Value from load control unit
5043 *SyncInputHoldOrReset*	Synchronisation
5044 *BoostPressHoldOrReset*	Boost pressure
5045 *OilPressHoldOrReset*	Oil pressure
5046 *AmbPressHoldOrReset*	Ambient pressure
5047 *CoolTempHoldOrReset*	Coolant temperature
5048 *ChAirTempHoldOrReset*	Charge air temperature
5049 *OilTempHoldOrReset*	Oil temperature
5050 *FuelTempHoldOrReset*	Fuel temperature
5051 *ExhstTempHoldOrReset*	Exhaust temperature
5054 *ExcitRedHoldOrReset*	Slide protection signal
5055 *SpeedRedHoldOrReset*	Slide protection signal
5055 *AlternatrHoldOrReset*	Alternator
5056 *CoolPressHoldOrReset*	Coolant pressure
5057 *AsymmLoadHoldOrReset*	Asymmetric load
5058 *MeasPowerHoldOrReset*	Measured power
5059 *PowerSetpHoldOrReset*	Power setpoint
5060 *TuOilTempHoldOrReset*	Turbocharger oil temperature
5061 *FuelPressHoldOrReset*	Fuel pressure
5062 *OilLevelHoldOrReset*	Oil level
5063 *FuelLimExHoldOrReset*	External filling limitation
5064 *TransOilPHoldOrReset*	Transmission oil pressure
5065 *AirMassHoldOrReset*	Air mass
5066 *GasTempHoldOrReset*	Gas temperature
5067 *GasPosHoldOrReset*	External gas actuator position
5068 *GasRailPrHoldOrReset*	Gas rail pressure
5069 *GasVChPrHoldOrReset*	Gas valve check pressure
5071 *BoostPr2HoldOrReset*	Boost pressure 2
5072 *Lambda1HoldOrReset*	Lambda 1
5073 *Lambda2HoldOrReset*	Lambda 2
5074 *NoxHoldOrReset*	Nitrogens
5075 *O2HoldOrReset*	Oxygen
5076 *AlterVoltHoldOrReset*	Alternator voltage
15040 *ExTmpCyl1HoldOrReset*	Exhaust temperature per cylinder

Table 28: Sensor error with latching

18 Configuration of switching functions

In HEINZMANN control units, a strict distinction is made between external switches and internal switching functions. This means that engine or application control is determined by the current values read by switching functions but where those switching functions take their values from is configured separately.

Normally, they will be influenced by binary inputs but in specific applications they can also be assigned their values via analogue inputs, Modbus or CAN protocols.

For this reason, it must first be defined which type should be assigned to variable ports (↑*Variable Ports*), then the inputs must be configured. Only then can the switching functions be configured and the source from which they receive their current status be specified. If communication modules are used for receiving switch values, they must also be configured beforehand (↑*22 Bus-Protokolle*).

Once the entire configuration is complete and a reset has been carried out, there must be no configuration error reported, otherwise the configuration must be checked.

For each switching function there are up to five parameters defining the external source and the current value. The last three digits of the parameter numbers are always identical for a specific switching function and, of course, the parameter name also matches the function.

Parameter	Meaning
810 *Funct…*	Assignment of a binary input on the own hardware or assignment of an analogue input on the own hardware or assignment of a binary input on a HZM-CAN periphery module (latter only in old control units or older firmware)
2810 *Switch…*	Display of the current value of the switching function that the firmware is working with
20810 *Comm…*	Assignment of the input number of a communication module (in XIOS and in newer control units or newer firmware, this also includes the HZM-CAN periphery modules)
24810 *ChanTyp…*	Assignment of the communication module type
24910 *PEIx…*	Assignment of the HZM-CAN periphery module if several PE modules are released

Table 29: Switching function parameters

18.1 Complete overview of all switching functions

Switching functions may be defined as on-off switches or as selector switches. The name of a switching function will indicate the meaning. The names of selector switches always include the operator *Or*, where the expression preceding "*Or*" will be valid when the value of the switching function is "1" and where the expression following "*Or*" will be valid when the switching function has the value "0". In the case of on/off switches, the name is equivalent to the condition *On*. State "1" will always define *On* and the state "0" *Off*.

For each of the switching functions there exists a parameter to indicate whether the function is active.

The following table gives an overview of the existing switch functions. Explanations of the individual functions and switch priorities will be found in the corresponding chapters of the function descriptions.

Note

The firmware of the control units is prepared on an application-specific basis. Depending on the application therefore only a part of the listed switching functions is required and indicated.

Switch function	Meaning	Application
2810 *SwitchEngineStop*	1 = Engine stop	
2811 *SwitchIdleSpeed*	1 = Idle speed active	
2812 *SwitchDroop2Or1*	0 = P droop 1 active 1 = P droop 2 active	
2813 *SwitchForcedLimit*	1 = Fixed fuel limitation active	
2814 *SwitchSpeedRange2Or1*	0 = Speed range 1 active 1 = Speed range 2 active	
2815 *SwitchSpeedFix1*	1 = Fixed speed 1 active	
2816 *SwitchSpeedFix2*	1 = Fixed speed 2 active	
2817 *SwitchSpeedLimit2Or1*	0 = Speed-depend. Fill limit 1 active 1 = Speed-depend. Fill limit 2 active	
2818 *SwitchSlide*	1 = Slide signal coming in	Locomotive
2818 *SwitchKnock*	1 = Knock signal coming in	Generator
2819 *SwitchNotch3*	1 = Speed notch switch 3	Locomotive
2820 *SwitchNotch2*	1 = Speed notch switch 2	Locomotive
2821 *SwitchNotch1*	1 = Speed notch switch 1	Locomotive
2821 *SwitchBackwards*	1 = Backwards	Marine
2822 *SwitchNotch0*	1 = Speed notch switch 0	Locomotive
2822 *SwitchForwards*	1 = Forwards	Marine
2823 *SwitchExcitLimit1*	1 = Excitation signal limit 1 active	Locomotive
2824 *SwitchExcitLimit2*	1 = Excitation signal limit 2 active	Locomotive
2825 *SwitchSpeedInc*	1 = Speed increase	
2826 *SwitchSpeedDec*	1 = Speed decrease	
2827 *SwitchSetpoint2Or1*	0 = Setpoint adjuster 1 active 1 = Setpoint adjuster 2 active	

Switch function	Meaning	Application
2828 *SwitchErrorReset*	0→1 = Clear current error (only with edge change)	
2829 *SwitchFreezeSetp1*	1 = Freeze setpoint 1	Vehicle
2830 *SwitchFreezeSetp2*	1 = Freeze setpoint 2	Vehicle
2831 *SwitchIMOrAllSpeed*	0 = Variable speed control 1 = Idle/Maximum speed control	Vehicle and locomotive
2833 *SwitchForcedStart*	1 = Forced opening of actuator	
2834 *SwitchSyncEnable*	1 = Synchronizing enabled	Generator
2835 *SwitchLoadEnable*	1 = Load control enabled	Generator
2836 *SwitchAutoOrManual*	0 = Manual mode 1 = Automatic mode	Generator
2837 *SwitchGasOrDiesel*	0 = Diesel request 1 = Gas request	Dual fuel
2838 *SwitchFastToDiesel*	1 = Fast reset to diesel	Dual fuel
2839 *SwitchGasPositioner*	1 = External gas positioner OK	Dual fuel
2840 *SwitchExcitationOn*	1 = Excitation signal enabled	Locomotive
2840 *SwitchPitchOn*	1 = Pitch control on	Marine
2841 *SwitchLowIdleOn*	1 = Low idle speed requested	Locomotive
2841 *SwitchMasterOrSlave*	0 = Slave 1 = Master in twin-engine applications	Marine
2842 *SwitchPID2Or1*	0 = PID set 1 1 = PID set 2	Generator
2842 *SwitchLoadTransfer*	1 = Load pick-up requested in twin-engine applications	Marine
2842 *SwitchCommand*	1 = Command button enabled in multiple engine applications	Marine
2843 *SwitchClutch*	1 = Clutch closed in twin-engine applications	Marine
2843 *SwitchSynchro*	1 = Synchro button enabled in multiple engine applications	Marine
2844 *SwitchAsymLoadEnable*	1 = Asymmetric load input enabled in twin-engine setups	Marine
2844 *SwitchEngineRelease*	1 = Engine release	
2845 *SwitchAutoAdjust*	0→1 = Automatic actuator adjustment (once at edge change)	
2845 *SwitchGasPressReady*	1 = Gas pressure switch (not XIOS)	Dual fuel
2846 *SwitchGenBreaker*	1 = Breaker closed	Generator
2847 *SwitchAlternator*	1 = Alternator signal	Vehicle
2847 *SwitchExternGasAlarm*	1 = External gas alarm (not XIOS)	Dual fuel

Switch function	Meaning	Application
2848 *SwitchExternGasReady*	1 = External gas section ready (not XIOS)	Dual fuel
2849 *SwitchStartEngine*	1 = Starter switch enabled	Vehicle
2849 *SwitchEmergencyStop*	1 = Emergency stop request (not XIOS)	Dual fuel
2870 *SwitchGasPressReady*	1 = Gas pressure switch (XIOS)	Dual fuel
2871 *SwitchExternGasAlarm*	1 = External gas alarm (XIOS)	Dual fuel
2872 *SwitchExternGasReady*	1 = External gas section ready (XIOS)	Dual fuel
2873 *SwitchEmergencyStop*	1 = Emergency stop request (XIOS)	Dual fuel

Table 30: Switch functions

18.1.1 Engine start request

For the engine start switch 2849 *SwitchStartEngine* parameter 4849 *StartImpulseOrSwitch* can be used to specify whether the engine start shall remain active as long as the switch itself remains active or whether a single switching pulse shall be sufficient to activate the engine start.

4849 *StartImpulseOrSwitch* = 0	engine start command continues only as long as 2849 *SwitchStartEngine* remains active
4849 *StartImpulseOrSwitch* = 1	the engine start is activated via a single switching pulse

In the second case, the command is terminated only when starting speed 256 *StartSpeed2* is exceeded or another condition interrupts the starting procedure.

18.1.2 Engine stop request

There are different ways of requesting an engine stop externally depending on the unit and application. All of these sources are equal, although the emergency stop request also results in the unconditional immediate stop of a dual-fuel engine, while the other stop requests end the dual fuel operation correctly first before the diesel operation is stopped. For details of other emergency stop situations see referring chapter.

2810 *SwitchEngineStop*	directly wired or received via a communication module
2844 *SwitchEngineRelease* = 0	no start release
2849 *SwitchEmergencyStop* (not XIOS) 2873 *SwitchEmergencyStop* (XIOS)	emergency stop request (wired directly!)
3790 *IgnitionOn* = 0	terminal 15 inactive (XIOS from revision 7)
5353 *NotchAssignOrBinary* = 1 and 6880 *LocoNotchAssign*(x) = 255	stop request via speed levels in locomotive applications

For all engine stop requests, 4810 *StopImpulseOrSwitch* can be used to specify whether they shall remain active as long as the input itself remains active or whether a single switching pulse shall be sufficient to activate the engine stop. In this second case, the engine stop request will end only when the engine has completely stopped, i.e. when speed 0 is recognized.

4810 *StopImpulseOrSwitch* = 0	engine stop is active only as long as the stop command is coming in
4810 *StopImpulseOrSwitch* = 1	one-off impulse keeps the engine stop request active until the engine stops

In specific situations it might be necessary to uphold the engine stop request even longer, for example when the engine turns backwards after a very quick stop. In such a case, the electronic control recognizes new impulses from the pick-up and erroneously interprets them as engine start. In extreme cases this can lead to a pick-up error. In order to avoid this situation, the engine stop request can be prolonged by the duration of 809 *EngineStopExtraTime* after speed 0 is recognized.

The parameter 3802 *EngineStopRequest* serves to indicate that the engine is being stopped by an internal or external engine stop request. The external engine stop requests are described above. For an internal engine stop, the stop command is determined by the control unit itself (e.g. in the event of overspeed). The parameter 3803 *EngineStopped* is provided to indicate that the engine has stopped.

For safety reasons, HEINZMANN recommends direct connection of the engine stop switch 2810 SwitchEngineStop and/or 2849 SwitchEmergencyStop (XIOS: 2873 SwitchEmergencyStop), regardless of whether it is also received via a communication module.

18.2 Assignment of hardware inputs

18.2.1 Assignment of binary inputs

A binary input can be assigned to a switching function by entering the number of the input in the corresponding assignment parameter of the function from 810 *Funct*….

These assignment parameters are parallel to the indication parameters for switching functions that start from 2810 *Switch*….

The numbers of binary inputs always run from 1 to the maximum number maxDI of the particular control unit. If the number of assignable inputs from parameter 810 *Funct*... exceeds the maximum possible number of binary inputs on the control unit, the first maxDI inputs are the binary inputs. An explanation for the surplus inputs can be found in ↑*24.2.2 Assignment of other inputs*.

For XIOS, it is important to remember that there is no automatic assignment of ports to binary or other input types. Each of the 117 ports can be assigned here, providing they are only configured as binary inputs.

An assignment of 0 means that the switching function is not being used by a binary input. Such a switching function will always have the value 0, except when it is received via a communication module *(↑24.3 Assignment of communication* modules).

The switching functions via binary inputs can be configured as high-active, i.e., active with the switch closed, or low-active, i.e. active with the switch open. High-active switching functions are assigned positive binary input numbers, low-active ones with negative binary input numbers.

One single binary input may simultaneously activate or change several functions. In this case, the functions involved will have to be assigned the same input number, possibly with the activity inverted (negative sign).

If a switching function is required that is permanently active (e.g. when the engine is running exclusively with active fixed speed 2815 *SpeedFix1*), in generator operation, any unused (not connected) binary input may be utilized to activate this function by assigning the negative number of this input to the switching function. For a selector switch, the meaning to the left of "Or" can be set with negative assignment and the meaning to the right of "Or" with positive assignment of an unused binary input.

Note

A switch impulse must be at least 20 ms long to be detected by the control electronics. Any switching function will remain active only for the time the switch input is active (with the exception of ↑24.1.1 Engine start and ↑24.1.2 Engine stop).

Parametrization example:

Closing the switch of input no. 1 should stop the engine. When the switch is open on input 2, you want the engine to run at fixed speed 1. By closing the switch on input 2 you want to disable fixed speed 1 and at the same time enable the fixed fuel limitation.

Number	Parameter	Value	Unit
810	*FunctEngineStop*	*1*	
813	*FuncForcedLimit*	*2*	
815	*FunctSpeedFix1*	*-2*	

Indication:		Switch open	Switch closed
2810	*SwitchEngineStop*	*0*	*1*
2813	*SwitchForcedLimit*	*0*	*1*
2815	*SwitchSpeedFix1*	*1*	*0*

18.2.2 Assignment of other inputs

If the number of assignable inputs from parameter 810 *Funct...* exceeds the maximum possible number of binary inputs maxDI on the control unit, the possible sources for switching functions were expanded for this firmware. The binary inputs on the own hardware are always the first 1…maxDI assignment options (↑*24.2.1 Assignment of binary* inputs).

Due to the development history, there are two different versions for the assignment of other inputs via this route:

- <u>Assignment of binary inputs on the HEINZMANN-CAN periphery modules</u>

  If the firmware generally allows HZM-CAN periphery module connection (parameter 4402 *CanCommPEOn* is available), this can be the binary inputs on these modules. For this variant, it is important that there is no switching function parameter from 20810 *Comm…* or, if there is, that it only has a positive value range. Further information is available under ↑*24.2.2.1 Assignment of binary inputs of the* HZM-CAN periphery modules.

- <u>Assignment of analogue inputs on the own hardware</u>

  If the firmware does not support the connection of HZM-CAN periphery modules (parameter 4402 *CanCommPEOn* does not exist) or there are no switching function parameters from 20810 *Comm…*, or if there are, the value range has a sign, the surplus inputs from parameter 810 *Funct...* are the analogue inputs on the own hardware ↑*24.2.2.2 Assignment of analogue* inputs. The binary inputs of any connected HZM-CAN periphery modules are treated like other communication modules in this case, ↑ *24.3 Assignment of communication* modules.

If the number of assignable inputs from parameter 810 *Funct...* corresponds exactly to the maximum possible number of binary inputs of the control unit and HZM-CAN periphery modules can be connected (parameter 4402 *CanCommPEOn* exists), their binary inputs are treated like those of other communication modules, ↑*24.3 Assignment of communication* modules.

All variants for the assignment of inputs to switching functions are detected automatically in a special window of DcDesk 2000 and can be configured easily there without having the take into account the criteria outlined above.

18.2.2.1 Assignment of binary inputs of the HZM-CAN periphery modules

With their binary inputs, the periphery modules connected via the HZM-CAN protocol (↑*Basic information HEINZMANN-CAN, publication no. DG 13 002-d*) are classed as an extension of the binary inputs on the own hardware. They are therefore added together in older systems or firmware variants.

To make the configuration in newer systems easier, the periphery modules are treated like other communication modules here (↑ *24.3 Assignment of communication* modules). This means that the binary inputs of the periphery modules are now no longer an extension of the hardware binary inputs, but are treated separately – as has always been the case for sensors connected to periphery modules. In addition to the clearer configuration, it is therefore also possible to receive a switching function via the main module, as well as via a periphery module, which can sometimes be necessary for safety reasons (e.g. the engine stop request).

The parameters from 20810 *Comm…* indicate whether a system uses the old or new configuration method. If there is no parameter there or, if one does exist, it only has a positive value range, then it is an older system, where the binary inputs of the periphery modules are added to those of the main module (↑*24.2.2.1.1* Assignment in older systems).

If parameters from 20810 *Comm*… exist and have a signed value range, then it is a new system (↑*24.3 Assignment of communication* modules).

As newer systems, the control units DC 8, DC 11, DC 12 and XIOS only offer the new variant. On all older systems, downwards compatibility means that it is not possible to change the HEINZMANN basic software or existing customer software variants. New customer-specific firmware solutions may use the new variant, however.

18.2.2.1.1 Assignment in older systems

If the system includes at least one periphery module, the total number of binary inputs in the control unit increases by the number of binary inputs on all periphery modules, whereby the sequence of the periphery module types from 407 *CanPENodeType* determines the number of the input. The total number of binary inputs is limited to 32, however.

If, for example, with

407 *CanPENodeType(0)* = 1 type 1 (PE 6-07 with max. 5 binary inputs)

408 *CanPENodeType(1)* = 0 type 0 (PE 2 with max. 8 binary inputs)

two periphery modules are connected to a control unit of the type DC 2, the resulting number of available binary inputs is 21 with numbers from 1 to 8 on the own hardware, numbers 9 to 13 on the PE 6-07 periphery module and numbers 14 to 21 on the PE 2 periphery module. Here, it does not matter whether all possible ports have actually been configured as binary inputs, the maximum number is always used.

18.2.2.2 Assignment of analogue inputs

It is always advisable to use analogue inputs for switching functions if either the number of binary inputs is not sufficient, but free analogue inputs are available, or the input has to be monitored. This is the case in maritime applications, for example.

In this case, the value range of the assignment parameters to switching functions from parameter 810 *Funct…* is larger than the equivalent for the number of maxDI binary inputs of the control unit. The switches 1 .. maxDI are the binary inputs, the switches maxDI+1 to maxDI+maxAI are the current/voltage inputs of the control unit.

The XIOS is an exception here, as no automatic assignment of ports to binary or analogue inputs takes place. Each of the 117 ports can be assigned here, providing they are only configured as current or voltage inputs.

During the assignment to switching functions, the two reference values of the analogue inputs are used to determine the switching thresholds for the binary value 0 or 1 (with hysteresis).

Assuming that analogue input 1 is assigned to a switching function. If the current value of the switching function is 0, the switch to 1 takes place if the unfiltered analogue value 3511 *AnalogIn1_Value* exceeds the limit 1511 *AnalogIn1_RefHigh*. If the value of the switching function is 1, the return to 0 takes place if the unfiltered value 3511 *AnalogIn1_Value* falls below the limit 1510 *AnalogIn1_RefLow*.

For the XIOS, the same applies with the values 32021 *P001_(1.1)_AI_Value*, 30020 *P001_(1.1)_IO_RefLow* and 30021 *P001_(1.1)_IO_RefHigh* (if port 1 is configured as an analogue input and has been assigned a switching function).

18.2.2.2.1 Monitoring for cable breakage

On request, the firmware provides parameters for selected switching functions, which can be used to activate the monitoring for cable breaks and display errors. It should be noted that this monitoring requires a pull-up resistor on the analogue input.

For example, it may be necessary to monitor the engine stop input 2810 *SwitchEngineStop*. In this case, the parameters 4809 *SwitchEngStopBWDOn* (BWD = Broken Wire Detection) and 23810 *ErrSwEngineStop* would be made available. The exact parameters can be found in the relevant firmware description.

The monitoring of the analogue inputs takes place as described in ↑ *20.2.1.5 Fehlererkennung bei den analogen Eingängen*.

18.3 Assignment of communication modules

A switching function can also receive its current value via communication modules, e.g. from a CAN protocol like CANopen *(↑22.4 CAN-Protokoll CANopen*) or a serial protocol like Modbus *(↑ 22.8 Seriell-Protokoll Modbus).* In newer control units or firmware versions, the HZM-CAN periphery module is also integrated in this way.

The communication module type is specified per switching function in 24810 *ChanTyp*…. These assignment parameters are parallel to the assignment parameters of binary inputs from 810 *Funct*… and the display parameters of the switching functions from 2810 *Switch*….

ChanTyp	Switching function source
0	No receipt via a communication module
2	HZM-CAN periphery module
3	Customer-defined CAN protocol
4	CANopen protocol (speed governor control unit is CANopen slave)
5	DeviceNet CAN protocol (speed governor control unit is slave)
6	Modbus protocol
7	SAE J1939 CAN protocol
8	HZM-CAN customer module
9	HZM-CAN second control unit of same type (double system)
10	WAGO module protocol (speed governor control unit is CANopen master)
13	ICENI module protocol (speed governor control unit is CANopen master)
15	HZM-CAN add-on module

Table 31: Communication modules as switching function sources (channel type)

For the receipt from HZM-CAN periphery modules, the number of the binary input on this module must be entered in the assignment parameters from 20810 *Comm*…. All values are always transferred, i.e. according to the maximum number of binary inputs, even if a specific port has a different configuration. In this case, the transferred value is always 0.

Which switching function is received by which bit of other communication modules is determined by the manufacturer of the sending module and must be agreed with him. The switching functions received from the communication module are then simply numbered from 1 onwards:

Telegram byte 0, bit 0 to bit 7 → switching function 1..8

Telegram byte 1, bit 0 to bit 7 → switching function 9..16

Telegram byte 2, bit 0 to bit 7 → switching function 17..23 etc.

The relevant number is entered in the assignment parameters from 20810 *Comm…*. These assignment parameters are parallel to the assignment parameters of binary inputs from 810 *Funct…* and the display parameters of the switching functions from 2810 *Switch…*.

Note

It should be noted that only a few fixed defined switching functions can be received via equally fixed defined telegrams via the CAN protocol SAE J1939. In this case, the assignment to the switching function in 20810 *Comm… is only possible with the value 1 (= yes), not with a counter variable.*

If the parameters from 20810 *Comm…* are signed, the switching functions via communication modules can also be high-active, i.e. active when 1 is received, or low-active, i.e. active when a 0 is received. High-active switching functions are assigned positive communication input numbers, low-active ones with negative communication input numbers.

Assignment of 0 to 20810 *Comm…* means that the respective switching function is not received via a communication module (but possibly via another input ↑*24.2 Assignment of hardware* inputs). For communication purposes, such a switching function will always have the value 0.

Note

In old systems, if the connection to the communication module is interrupted, all "binary inputs" of the relevant receipt telegram are set to 0 (positive assignment parameters only). In newer systems (assignment parameters signed), the most recent state is retained.

18.4 Value of a switch function

In the case of on/off switches, the name is equivalent to the condition *On*. Status "1" of the switching function always defines *On* while status 0 denotes *Off*. In the case of selector switches, the names of which always contain the text "Or", the part to the left of "Or" is active when the switching function has the value "1", while the part to the right of the "Or" is active when it has the value "0".

If no communication module is integrated in the current firmware, the value of the switch function is dictated solely by the hardware input (binary or analogue). The parameters from 20810 *Comm…*, 24810 *ChanTyp…* and 24910 *PEIx…* do not exist.

However, if a communication module is to be taken into account, every switching function can be received either via the hardware input, the communication module or both.

1. Receipt via digital input only
   The parameter 20810 *Comm…* must be set to 0.
   If 810 *Funct…* = 0, then the switching function always has the value 0, otherwise it has the current value of the hardware input (with inverted activity if the input number is negative).

2. Receipt via communication module only
The parameter 810 *Funct…* must be set to 0 and 24810 *ChanTyp…* >= 2.
If 20810 *Comm…* = 0, the switching function always has the value 0, or otherwise the current value from the receipt telegram.
In older systems, only high-active receipt is possible via a communication module, i.e. the assignment parameters on 20810 *Comm…* can only be entered in positive state. If the connection to the communication module is interrupted on systems like this, the values of the receipt telegram are set to 0 automatically.
In newer systems, these parameters can be entered signed as for the parameters from 810 *Funct…* and can therefore also be low-active. If the connection to the communication module is interrupted in these systems, the switching functions retain their most recent value.

3. Receipt via hardware input and communication module
The parameter 810 *Funct…* is not equal to 0, 20810 *Comm…* is not equal to 0 and 24810 *ChanTyp…* >= 2.
The current value of the hardware input (poss. inverted) and that of the communication module (poss. inverted) are linked via OR. Therefore, the switch function is only 0 when both sources specify the value 0, and is only 1 when at least one source specifies the value 1.

Note

For safety reasons, it is advisable to always connect the engine stop request 2810 SwitchEngineStop directly, regardless of a possible additional transmission via a communication module (20810 CommEngineStop). HEINZMANN also advises never to connect selector switches that switch between two functions (with "Or" in their parameter name) with two signal paths.

19 Inputs and outputs

The following sections describe the inputs and outputs of the various types of control unit.

Note

HEINZMANN control units may be connected to HEINZMANN I/O modules via a CAN bus to increase the number of inputs and outputs.

All adjustments for inputs and outputs can be carried out comfortably using ↑3.3 DcDesk 2000, where there are specific windows for all the important aspects, considerably simplifying the process of parameter setting.

19.1 General

19.1.1 Selectable inputs and outputs

In all basic control systems the direction and/or signification of certain connections are freely configurable. This affects the number of available analogue, PWM and digital inputs and outputs. The parameter setting required to define these properties are described in the respective sections *Selectable inputs and outputs*.

The effectively available number of inputs and outputs must be taken into account during the configuration of sensors (↑*17 Configuration* of sensors), the configuration of switching functions (↑*18 Configuration of* switching functions) and the configuration of analogue, PWM and digital outputs (↑*20 Configuring the control's inputs and outputs*).

The maximum possible number of ports for a specific connection type is numbered serially. Even when the number of available inputs and outputs varies due to a change of configuration, the serial number assigned to a connection stays the same, regardless of possible gaps in the numbering.

Note

The assignments of the channels cannot be altered during operation. It will therefore be necessary to save the data (↑3.2 Saving data) and restart the control unit with a ↑3.10 Reset of control unit after configuration. The value ranges of analogue inputs and outputs then must be adapted again to the newly chosen electric unit.

19.1.2 Pickup inputs

While the input for pickup1 has fixed and unchangeable functionality in all control units, for the input of pickup2 the same holds true only in control devices ARCHIMEDES, HELENOS, PRIAMOS and PRIAMOS III. In ORION and PANDAROS the input for pickup2 must be configured specifically for this function since the port-pin may also be used as digital or PWM input.

19.1.3 Analogue inputs

The different types of control unit are equipped with different numbers and types of analogue inputs. The possible variants are described in the following sections. Sensors receive values from analogue inputs ↑*17 Configuration* of sensors.

On request it is also possible to implement switching functions via analogue inputs. In this case, a lower switching threshold, below which the switching function has the value “0”, must be entered in parameter 976 *SensorSwitchLow*.

When the upper switching threshold 977 *SensorSwitchHigh* is exceeded, the switching function assumes the value “1”.

19.1.4 PWM inputs

The various control units have a certain number of inputs that can be configured as PWM inputs. Sensors receive PWM input values, the configuration of sensors is described in ↑*17 Configuration* of sensors.

19.1.5 Digital inputs

The digital inputs are used as on/off or toggle switches for switching functions ↑*18 Configuration of* switching functions. The switching functions can be configured to be high-active, i.e., active with the switch closed, or low-active, i.e., active with the switch opened.

For each of the switching functions, there exists a parameter to indicate whether the function is active. Regardless of whether the respective switching function is high-active or low-active, the state "1" will always signify that the function is active, and "0" that it is inactive. regardless of the hardware design of the respective switch (high side/low side).

Note

Since the input signals are being debounced by the control circuit it is necessary that they be applied for at least 20 ms to be detected. In general, any switching function will be active only for the time the switch input is active.

19.1.6 Analogue outputs

The control units have several analogue outputs that may be utilized for indicating speed or injection quantity or as setpoint outputs to other units ↑*20.5 Analogue outputs*.

19.1.7 PWM outputs

HEINZMANN control units are equipped with ports that can be used as PWM outputs to control power end stages or for signal transmission ↑*20.6 PWM outputs*.

19.1.8 Digital outputs

The control units are equipped with several digital outputs that may be used to address optical or acoustic signalling devices, according to their capacity range, or to transmit signals to other devices ↑*20.8 Digital outputs*.

19.2 ARCHIMEDES (DC 5)

19.2.1 Selectable inputs/outputs

The basic system ARCHIMEDES is equipped with six configurable ports: a PWM or digital input, two frequency or digital outputs, a PWM or digital output, a current or voltage input and a current or voltage output.

The speed measured at both pickup inputs can be configured to be transmitted to the two frequency outputs, where it is ready for use by other users.

“F” means the vehicle plug, “M” the engine plug.

Connection name	Plug pin	Configuration parameters	Configuration
ID1	F11	4800 *PWMIn1OrDigitalIn1*	0 = digital input 1 1 = PWM input 1
IA5	F2	5550 *AnalogIn5_Type*	1 = 0..5 V input 2 = 4.. 20 mA input
OD8	F26	4801 *FreqOut1OrDigOut8*	0 = digital output 8 1 = frequency output 1
OD9	M26	4802 *FreqOut2OrDigital*	0 = output 1 = frequency output 2
		4803 *PWMOut2OrDigOut9*	if output: 0 = digital output 9 1 = PWM output 2
OD10	F13	4804 *PWMOut1OrDigOut10*	0 = digital output 10 1 = PWM output 1
OA1	F3	5640 *AnalogOut_Type*	3 = 0..5 V output 4 = 4..20 mA output

Table 32: ARCHIMEDES: Variable connections

19.2.2 Analogue inputs

HEINZMANN control units of the ARCHIMEDES series are equipped with ten analogue inputs.

Input 5 may be configured on site for current or voltage ↑ *19.2.1 Selectable inputs/outputs*. Input 6 in conceived primarily for monitoring of battery voltage. The analogue inputs 7 to 10 are used as temperature inputs.

“F” means the vehicle plug, “M” the engine plug.

Input	Designation	Plug pin	Range
Analogue input 1	IA1	M3	fixed 0..5 V
Analogue input 2	IA2	M31	fixed 0..5 V
Analogue input 3	IA3	M37	fixed 0..5 V
Analogue input 4	IA4	F4	fixed 0..5 V
Analogue input 5	IA5	F2	0..5 V or 4..20 mA
Analogue input 6	IA6	M20	fixed 0..37.2 V
Analogue input 7 Temperature input 1*	IT1	M9	PT 2000
Analogue input 8 Temperature input 2*	IT2	M15	PT 2000
Analogue input 9 Temperature input 3*	IT3	M25	PT 2000
Analogue input 10 Temperature input 4*	IT4	F9	PT 2000

* Microcontroller resolution is 1/1024, with a precision of ± 3 digits.
One digit corresponds to approx. 22Ω.
PT100: 3.8 Ω deviation for 10°C → excluded
PT1000: 38Ω deviation 10°C → may be used, but not precise
NI 1000: approx. 50Ω deviation for 10°C → may be used, but not precise

Table 33: ARCHIMEDES: Analogue inputs

19.2.3 PWM input

The ARCHIMEDES series features an input on the vehicle plug that can be used as PWM input ↑*19.2.1 Selectable inputs/outputs*.

Input	Designation	Plug pin	Maximum frequency
PWM input*	ID1	F11	500 Hz

* digital input also possible

Table 34: ARCHIMEDES: PWM input

19.2.4 Digital inputs

The series ARCHIMEDES features eight digital inputs, one of which may be configured as PWM input ↑*19.2.1 Selectable inputs/outputs*.

"F" means the vehicle plug, "M" the engine plug.

Input	Designation	Plug pin
Digital input 1*	ID1	F11
Digital input 2	ID2	F18
Digital input 3	ID3	F22
Digital input 4	ID4	F21
Digital input 5	ID5	F17
Digital input 6	ID6	F10
Digital input 7	ID7	F16
Digital input 8	ID8	M16

* configurable as PWM input

Table 35: ARCHIMEDES: Digital inputs

19.2.5 Analogue output

HEINZMANN control units of the ARCHIMEDES series are equipped with one current output on the vehicle plug.

Output	Designation	Plug pin	Type	Range
Analogue output	OA1	F3	current	4..20 mA

Table 36: ARCHIMEDES: Analogue output

19.2.6 PWM outputs

The series ARCHIMEDES features two PWM outputs that may be also be configured as digital outputs, ↑*19.2.1* Selectable inputs/outputs.

"F" means the vehicle plug, "M" the engine plug.

Input	Designation	Plug pin	Frequency range	Type	Power (max.)
PWM output 1*	OD10	F13	50..500 Hz	low side	1.3 A
PWM output 2*	OD9	M26	50..500 Hz	low side	0.43 A at 85 °C

* also configurable as digital output

Table 37: ARCHIMEDES: PWM outputs

19.2.7 Digital outputs

HEINZMANN control units of the ARCHIMEDES series are equipped with ten freely configurable digital outputs and one error output, ↑*19.2.1 Selectable inputs/outputs*.
“F” means the vehicle plug, “M” the engine plug.

Input	Designation	Plug pin	Type	Power (max.)
Digital output 1	OD1	M12	high side	I_{nom} = 2.5 A
Digital output 2	OD2	F23	high side	I_{nom} = 2.5 A
Digital output 3	OD3	M17	high side	I_{nom} = 2.5 A
Digital output 4	OD4	F19	high side	I_{nom} = 2.5 A
Digital output 5	OD5	M28	high side	I_{nom} = 12 A
Digital output 6	OD6	M34	high side	I_{nom} = 12 A
Digital output 7	OD7	F20	low side	I_{nom} = 0.43 A @ 85 °C I_{max} = 1.2 A
Digital output 8*	OD8	F26	low side	I_{nom} = 0.43 A @ 85 °C
Digital output 9+	OD9	M26	low side	I_{nom} = 0.43 A @ 85 °C
Digital output 10#	OD10	F13	low side	I_{nom} = 1.3 A
Error output	ODE	F7	low side	I_{nom} = 0.43 A @ 85 °C I_{max} = 1.2 A

* also configurable as frequency output pickup 1
* also configurable as frequency output pickup 2 or PWM output 2
\# also configurable as PWM output 1

Table 38: ARCHIMEDES: Digital outputs

The parameters starting from 3611 *DigitalOut1:Feedback* indicate the output signal fed back for each digital output. The parameters starting from 3631 *DigitalOut1:ErrType* give detailed information in case of error:

Bit	Meaning
0	short against Ubatt
1	short against GND
2	OpenLoad or short against Ubatt
3	OpenLoad or short against GND

19.3 HELENOS (DC 2-01)

19.3.1 Selectable inputs/outputs

The HELENOS digital control is equipped with 4 channels that can be individually configured as PWM or digital inputs or outputs and an additional channel that can be used as a PWM output or digital output. The following parameters determine the direction and type of the ports:

Connection name	Plug pin terminal	Configuration parameters	Configuration
IO 0	K3 / 30	4800 *DigChannel1OutOrIn*	0 = input 1 = output
		4801 *DigChannel1PWMOrDIO*	if input: 0 = digital input 5 1 = PWM input 1
			if output: 0 = digital output 1 1 = PWM output 1
IO 1	J3 / 31	4802 *DigChannel2OutOrIn*	0 = input 1 = output
		4803 *DigChannel2PWMOrDIO*	if input: 0 = digital input 6 1 = PWM input 2
			if output: 0 = digital output 2 1 = PWM output 2
IO 2	T3 / 32	4804 *DigChannel3OutOrIn*	0 = input 1 = output
		4805 *DigChannel3PWMOrDIO*	if input: 0 = digital input 7 1 = PWM input 3
			if output: 0 = digital output 3 1 = PWM output 3
IO 3	H3 / 33	4806 *DigChannel4OutOrIn*	0 = input 1 = output
		4807 *DigChannel4PWMOrDIO*	if input: 0 = digital input 8 1 = PWM input 4
			if output: 0 = digital output 4 1 = PWM output 4
AN OUT 0	V3 / 25	4809 *DigChannel5PWMOrDO*	0 = digital output 5

Connection name	Plug pin terminal	Configuration parameters	Configuration
			1 = PWM output 5

Table 39: HELENOS: Variable connections

Parameterizing Example:

The first channel is to be used as a switch input and the second as a switch output. The third digital input shall be configured as a PWM input and the fourth as a PWM output.

Number	Parameter	Value	Unit
4800	*DigChannel1OutOrIn*	*0*	
4801	*DigChannel1PWMOrDIO*	*0*	
4802	*DigChannel2OutOrIn*	*1*	
4803	*DigChannel2PWMOrDIO*	*0*	
4804	*DigChannel3OutOrIn*	*0*	
4805	*DigChannel3PWMOrDIO*	*1*	
4806	*DigChannel4OutOrIn*	*1*	
4807	*DigChannel4PWMOrDIO*	*1*	

19.3.2 Analogue inputs

The **HEINZMANN** control units of the HELENOS series are equipped with 6 analogue inputs whose hardware must be adapted to the desired requirements.

Four inputs may be factory-configured individually as current inputs with 4..20 mA or as voltage inputs with 0..5 V for universal use as setpoint and pressure inputs.

The analogue inputs 5 to 6 are used as temperature inputs. They too must be prepared in the factory for the respective temperature sensor type.

In the table below the standard configurations are in bold print.

Input	Designation	Plug pin / terminal	Range
Analogue input 1	ANIN 0	R2 / 16	fixed **0..5 V** or 0..22.7 mA
Analogue input 2	ANIN 1	S2 / 17	fixed **0..5 V** or 0..22.7 mA
Analogue input 3	ANIN 2	P1 / 4	fixed 0..5 V or **4..20 mA**
Analogue input 4	ANIN 3	L1 / 6	fixed 0..5 V or **4..20 mA**
Analogue input 5 Temperature input 1	THIN 0	S1 / 13	fixed **PT 1000** or PT 200 or NTC
Analogue input 6 Temperature input 2	THIN 1	U1 / 14	fixed **NTC** or PT 1000 or PT 200

Table 40: HELENOS: Analogue inputs

19.3.3 PWM inputs

The **HEINZMANN** control units of the HELENOS series are equipped with four inputs configurable as PWM inputs, ↑*19.3.1 Selectable inputs/outputs*.

Input	Designation	Plug pin / terminal	Maximum frequency
PWM input 1*	IO 0	K3 / 30	1000 Hz
PWM input 2*	IO 1	J3 / 31	1000 Hz
PWM input 3*	IO 2	T3 / 32	1000 Hz
PWM input 4*	IO 3	H3 / 33	1000 Hz

* configurable as PWM output, digital input, digital output

Table 41: HELENOS: PWM inputs

19.3.4 Digital inputs

The **HEINZMANN** control units of the HELENOS series feature four digital inputs. Four further ports may be configured individually as digital inputs, ↑*19.3.1 Selectable inputs/outputs*.

Input	Designation	Plug pin / terminal
Digital input 1	DIGI IN 0	B3 / 26
Digital input 2	DIGI IN 1	C3 / 27
Digital input 3	DIGI IN 2	P3 / 28
Digital input 4	DIGI IN 3	D3 / 29
Digital input 5*	IO 0	K3 / 30
Digital input 6*	IO 1	J3 / 31
Digital input 7*	IO 2	T3 / 32
Digital input 8*	IO 3	H3 / 33

* configurable as digital output, PWM input, PWM output

Table 42: HELENOS: Digital inputs

19.3.5 Analogue outputs

The **HEINZMANN** control units of the HELENOS series feature four analogue outputs, two of which are implemented as current outputs and two as voltage outputs.

Output	Designation	Plug pin / terminal	Type	Range
Analogue output 1	CURR0	K2 / 21	current	4..20 mA
Analogue output 2	CURR1	J2 / 22	current	4..20 mA
Analogue output 3	VOLT0	B2 / 19	voltage	0..5 V/0..10 V
Analogue output 4	VOLT1	C2 / 20	voltage	0..5 V/0..10 V

Table 43: HELENOS: Analogue outputs

The selection of the voltage range for analogue outputs 3 and 4 is made with 5651 *VoltOut1Range10VOr5V* and 5656 *VoltOut2Range10VOr5V*. Value “1” selects 10V, value “0” selects 5V.

19.3.6 PWM outputs

The **HEINZMANN** control units of the HELENOS series are equipped with five ports that can be configured individually as PWM outputs, ↑ *19.3.1 Selectable inputs/outputs*.

Input	Designation	Plug pin / terminal	Frequency range	Type	Power (max.)
PWM output 1*	IO 0	K3 / 30	128…4000 Hz	low side	(bus driver)
PWM output 2*	IO 1	J3 / 31	128…4000 Hz	low side	(bus driver)
PWM output 3*	IO 2	T3 / 32	128…4000 Hz	low side	(bus driver)
PWM output 4*	IO 3	H3 / 33	128…4000 Hz	low side	(bus driver)
PWM output 5+	AN OUT 0	V3 / 25	128…4000 Hz	low side	3 A

* configurable as PWM input, digital input, digital output
* also configurable as digital output

Table 44: HELENOS: PWM outputs

For the outputs 1..4 **HEINZMANN** offers the relay interface RIF 01, which on the HELENOS side ensures that the strict specification of the bus drivers is observed and on the output side admits a maximum current of 3 A at 24 V. Ordering Number: 620-00-041-00.

19.3.7 Digital outputs

The **HEINZMANN** control units of the HELENOS series feature a maximum of five freely configurable digital outputs, ↑*19.3.1 Selectable inputs/outputs*.

Input	Designation	Plug pin / terminal	Type	Power (max.)
Digital output 1*	IO 0	K3 / 30	low side	(bus driver)
Digital output 2*	IO 1	J3 / 31	low side	(bus driver)
Digital output 3*	IO 2	T3 / 32	low side	(bus driver)
Digital output 4*	IO 3	H3 / 33	low side	(bus driver)
Digital input 5+	ANOUT 0	V3 / 25	low side	3 A

* configurable as digital input, PWM input, PWM output
\+ also configurable as PWM output

Table 45: HELENOS: Digital outputs

For the outputs 1..4 **HEINZMANN** offers the relay interface RIF 01, which on the HELENOS side ensures that the strict specification of the bus drivers is observed and on the output side admits a maximum current of 3 A at 24 V. Ordering Number: 620-00-041-00.

19.3.8 Fixed alarm outputs

The control units of the HELENOS series provide dedicated outputs that have been pre-configured for error-indication and overspeed.

The overspeed output is provided as a relay output to enable a separate overspeed protection to be activated by this output. For a description of how to adjust overspeed, chapter ↑*6.4 Overspeed monitoring* offers a description of adjustment of overspeed and of the control unit’s response to overspeeding. It should be noted that the output is triggered for each error intended to lead to an engine stop (↑*27.7* Emergency shutdown errors), not just when overspeed is detected. The engine stop is achieved – independently from the existence of a separate overspeed protection device – by the control unit itself, that forcefully pulls the actuator in “0” position. A separate overspeed protection is important for all situations in which the actuator can no longer be moved and is therefore indispensable.

As to its meaning, the output “Control unit operative” is identical with the overspeed output and serves to indicate that no fatal error such as overspeed has occurred and that the governor is able to control engine speed.

The common alarm output is activated when the control has detected at least one error or sent out a warning. The output may be used for a visual or audible signal. The common alarm output 3825 *LED_CommonAlarm* is described in detail in the chapter ↑ *27 Error Handling* which will also deal with the possible error causes.

The common alarm as well as the overspeed output may be more heavily loaded than the other governor outputs. The following table shows the pin assignments of the alarm outputs.

Output	Plug pin / terminal	Type	Power (max.)
Overspeed	X1 / 10	high side	3 A
Control ready	A2 / 23	high side	3 A
Common alarm	L2 / 24	high side	3 A

Table 46: HELENOS: Fixed alarm outputs

19.4 ORION (DC 9)

19.4.1 Selectable inputs

The basic system ORION is equipped with two configurable inputs, that may function as digital input, current or voltage input. A further input may be used as digital, PWM or frequency input.

Connection name	Terminal	Configuration parameters	Configuration
Tmp	4	4806 *AnalogIn2OrDigIn4*	0 = digital input 4 1 = analogue input 2 always 0..5 V
SpA	5	4804 *AnalogInOrDigitalIn1*	0 = digital input 1 1 = analogue input 1
		5510 *AnalogIn1_Type*	if analogue input: 1 = 0..5 V 2 = 4..20 mA
Stp	11	4805 *PUp2_PWMInOrDigIn3*	0 = digital input 3 1 = pickup2/PWM
		4002 *PickUp2On*	if pickup2/PWM: 0 = PWM input 1 1 = pickup2 input

Table 47: ORION: Variable connections

Parameterizing Example:

The variable input on pin 5 is to be configured for a 4..20 mA sensor.

Number	Parameter	Value	Unit
4804	*AnalogInOrDigitalIn1*	*1*	
5510	*AnalogIn1_Type*	*2*	

19.4.2 Pickup 2 input

HEINZMANN control devices of the ORION series feature an input that may be configured as input for pickup2, ↑*19.4.1* Selectable input.

Input	Designation	Terminal
Pickup 2*	Stp	11

* configurable as digital input or PWM input

Table 48: ORION:I nput for pickup 2

While the input for pickup 1 may be used with a Hall or inductive sensor, for pickup 2 only Hall sensor or terminal W are allowed.

19.4.3 Analogue inputs

The digital control of the ORION series are equipped with 2 analogue inputs. One of them can be configured for current or voltage by setting the adequate parameters, ↑ *19.4.1 Selectable input*.

Input	Designation	Terminal	Range
Analogue input 1*	SpA	7	0..5 V or 4..20 mA
Analogue input 2	Tmp	4	fixed 0...5 V

* configurable as digital input or PWM input

Table 49: ORION: Analogue inputs

19.4.4 PWM input

ORION systems feature a configurable PWM input ↑*19.4.1 Selectable input*.

Input	Designation	Terminal	Max. frequency
PWM input*	Stp	11	500 Hz

* configurable as digital input or input for pickup 2

Table 50: ORION:PWM input

19.4.5 Digital inputs

The **HEINZMANN** control units of the ORION series are equipped with four digital inputs, one of which can be configured as analogue input, ↑*19.4.1 Selectable input*.

Input	Designation	Terminal
Digital input 1*	SpA	7
Digital input 2	SpD	9
Digital input 3*	Stp	11
Digital input 4+	Tmp	4

* configurable as input for pickup 2 or PWM input 1
\+ configurable as analogue input

Table 51: ORION: Digital inputs

19.4.6 Digital outputs

The **HEINZMANN** control units of the ORION series feature one freely configurable digital output that is normally assigned to error-indication.

Input	Designation	Terminal	Type	Power (max.)
Digital output / error output	Err	10	low side	0.3 A

Table 52: ORION: Digital outputs

It should be noted that the error output is commuted by the bootloader during the control unit's start-up (↑*27.5 Bootloader*).

Note

The ORION series has neither analogue nor PWM outputs.

19.5 PANDAROS (DC 6)

19.5.1 Selectable inputs/outputs

The basic system PANDAROS is equipped with four selectable ports. Two of these so-called multifunctional ports can function as input or output, digital, PWM or analogue. A further port can be used as digital or analogue input and the last as digital, PWM or pickup 2 input.

Connection name	Terminal	Configuration parameters	Configuration
P1	2	4800 *Port1Type*	0 = analogue 1 1 = PWM 1 2 = digital 1
		4801 *Port1OutOrIn*	0 = input 1 1 = output 1 if analogue output: 4..20 mA
		5510 *AnalogIn1_Type*	if analogue input: 1 = 0..5 V 2 = 4..20 mA 3 = 0..10 V
P2	1	4802 *Port2Type*	0 = analogue 2 1 = PWM 2 2 = digital 2
		4803 *Port2OutOrIn*	0 = input 2 1 = output 1 if analogue output: 4..20 mA
		5520 *AnalogIn2_Type*	if analogue input: 1 = 0..5 V 2 = 4..20 mA 3 = 0..10 V
SpA	7	4804 *AnaIn3OrDigIn3*	0 = digital input 3 1 = analogue input 3
		5530 *AnalogIn3_Type*	if analogue input: 1 = 0..5 V 2 = 4..20 mA
Stp	11	4805 *PUp2_PWMIn3OrDigIn5*	0 = digital input 5 1 = pickup 2 or PWM input
		4002 *PickUp2On*	if pickup2/PWM input: 0 = PWM input 3 1 = pickup 2 input

Table 53: PANDAROS: Variable connections

Parameterizing Example:

Multifunctional port 1 is used as current input 1 and multifunctional port 2 as digital output 2. The third channel is to be used as digital input 3.

Number	Parameter	Value	Unit
4800	*Port1Type*	*0*	
4801	*Port1OutOrIn*	*0*	
5510	*AnalogIn1_Type*	*2*	
4802	*Port2Type*	*2*	
4803	*Port2OutOrIn*	*1*	
4804	*AnaIn3OrDigIn3*	*0*	

19.5.2 Pickup 2 input

HEINZMANN control devices of the PANDAROS series feature an input that may be configured as input for pickup2, ↑*19.5.1 Selectable inputs/outputs*.

Input	Designation	Terminal
Pickup 2*	Stp	11

* configurable as digital input or PWM input

Table 54: PANDAROS: Input for pickup2

While the input for pickup 1 may be used with a Hall or inductive sensor, for pickup 2 only Hall sensor or terminal W are allowed.

19.5.3 Analogue inputs

The series PANDAROS is equipped with a maximum of four analogue inputs. Three inputs be configured for current or voltage by setting the respective parameters, ↑*19.5.1 Selectable inputs/outputs*. Analogue input 4 is an universal temperature input.

Input	Designation	Terminal	Range
Analogue input 1*	P1	2	0..5 V or 4..20 mA or 0..10 V
Analogue input 2*	P2	1	0..5 V or 4..20 mA or 0..10 V
Analogue input 3+	SpA	7	0..5 V or 4..20 mA
Analogue input 4 Temperature input	Tmp	4	both as PT 1000 and NTC

* configurable as analogue output, digital input/output, PWM input/output
+configurable as digital input

Table 55: PANDAROS: Analogue inputs

19.5.4 PWM inputs

The **HEINZMANN** control units of the series PANDAROS are equipped with three inputs that may be configured as PWM inputs, ↑*19.5.1 Selectable inputs/outputs*.

Input	Designation	Terminal	Maximum frequency
PWM input 1*	P1	2	500 Hz
PWM input 2*	P2	1	500 Hz
PWM input 3+	Stp	11	500 Hz

* configurable as digital output, PWM input/output, analogue input/output
+ configurable as digital input or input for pickup 2

Table 56: PANDAROS: PWM inputs

19.5.5 Digital inputs

The **HEINZMANN** control units of the PANDAROS series feature a maximum of five digital inputs, ↑*19.5.1 Selectable inputs/outputs*.

Input	Designation	Terminal
Digital input 1*	P1	2
Digital input 2*	P2	1
Digital input 3+	SpA	7
Digital input 4	SpD	9
Digital input 5#	Stp	11

* configurable as digital output, PWM input/output, analogue input/output
+ configurable as analogue input
# configurable as PWM input or input for pickup 2

Table 57: PANDAROS: Digital inputs

19.5.6 Analogue outputs

The **HEINZMANN** control units of the series PANDAROS are equipped with two ports that may be configured individually as current outputs, ↑ *19.5.1 Selectable inputs/outputs*.

Output	Designation	Terminal	Type	Range
Analogue output 1*	P1	2	current	4..20 mA
Analogue output 2*	P2	1	current	4..20 mA

* configurable as digital output, PWM input/output, analogue input/output

Table 58: PANDAROS: Analogue outputs

19.5.7 PWM outputs

The **HEINZMANN** control units of the series PANDAROS are equipped with two ports that may be configured as PWM outputs, ↑*19.5.1 Selectable inputs/outputs*.

Input	Designation	Terminal	Frequency range	Type	Power (max.)
PWM output 1*	P1	2	50…500 Hz	low side	0.3 A
PWM output 2*	P2	1	50…500 Hz	low side	0.3 A

* configurable as PWM input, digital input/output, analogue input/output

Table 59: PANDAROS: PWM outputs

19.5.8 Digital outputs

The **HEINZMANN** control units of the PANDAROS series feature a maximum of two freely configurable digital outputs. The required parameter settings for the assignment are described in chapter ↑*19.5.1 Selectable inputs/outputs*.

Input	Designation	Terminal	Type	Power (max.)
Digital output 1*	P1	2	low side	0.3 A
Digital output 2*	P2	1	low side	0.3 A
Error output	Err	10	low side	0.3 A

* configurable as digital input, PWM input/output, analogue input/output

Table 60: PANDAROS: Digital outputs

19.6 PRIAMOS (DC 1-03)

19.6.1 Selectable inputs/outputs

The basic system PRIAMOS is equipped with two channels that can be utilized as PWM inputs or digital inputs and three channels that can be utilized as PWM outputs or digital outputs. The following parameters serve to define the signal type of the channels.

Plug pin	Configuration Parameter	Configuration
E3	4801 *PWMIn1OrDigitalIn11*	0 = digital input 11 1 = PWM input 1
G4	4802 *PWMIn2OrDigitalIn12*	0 = digital input 12 1 = PWM input 2
S1	4803 *PWMOut1OrDigitalOut1*	0 = digital output 1 1 = PWM output 1
X1	4804 *PWMOut2OrDigitalOut2*	0 = digital output 2 1 = PWM output 2
A4	4805 *PWMOut3OrDigitalOut3*	0 = digital output 3 1 = PWM output 3

Table 61: PRIAMOS: Variable connections

Parameterizing Example:

The first channel is to be used as a PWM input and the second as a digital output 12. The third and fourth channels shall both be configured as digital outputs.

Number	Parameter	Value	Unit
4801	*PWMInOrDigitalIn11*	*1*	
4802	*PWMIn2OrDigitalIn12*	*0*	
4803	*PWMOut1OrDigitalOut1*	*0*	
4805	*PWMOut2OrDigitalOut2*	*0*	

19.6.2 Analogue inputs

The **HEINZMANN** control units of the PRIAMOS series are equipped with seven analogue inputs whose hardware must be adapted to the desired requirements. Five inputs may be factory-configured individually as current inputs with 4..20 mA or as voltage inputs with 0..5 V for universal use as setpoint and pressure inputs. The analogue inputs 6 to 7 are used as temperature inputs.

In the table below the standard configurations are in bold print.

Input	Designation	Plug pin	Range
Analogue input 1	ADC1	A3	fixed 0..5 V or **4..20 mA**
Analogue input 2	ADC2	L3	fixed 0..5 V or **4..20 mA**
Analogue input 3	ADC3	C3	fixed 0..5 V or **4..20 mA**
Analogue input 4	ADC4	T1	fixed 0..5 V or **4..20 mA**
Analogue input 5	ADC5	R1	fixed 0..5 V or **4..20 mA**
Analogue input 5 Temperature input 1	ADC6 / TEMP1	J1	fixed NTC
Analogue input 6 Temperature input 2	ADC7 / TEMP2	L1	fixed Ni 1000

Table 62: PRIAMOS: Analogue inputs

19.6.3 PWM inputs

The series PRIAMOS features two inputs, that may be configured as PWM inputs, ↑ *19.6.1 Selectable inputs/outputs*.

Input	Plug pin	Maximum frequency
PWM input 1*	E3	1000 Hz
PWM input 2*	G4	1000 Hz

* digital input also possible

Table 63: PRIAMOS: PWM inputs

19.6.4 Digital inputs

The **HEINZMANN** controls of the PRIAMOS series are equipped with a maximum of twelve digital inputs, ↑*19.6.1 Selectable inputs/outputs*.

Input	Plug pin
Digital input 1	T2
Digital input 2	V2
Digital input 3	P2
Digital input 4	H2
Digital input 5	S2
Digital input 6	R2
Digital input 7	D2
Digital input 8	G2
Digital input 9	F2
Digital input 10	E2
Digital input 11*	E3
Digital input 12*	G4

* configurable as PWM input

Table 64: PRIAMOS: Digital inputs

19.6.5 Analogue outputs

The **HEINZMANN** control units of the PRIAMOS series feature two outputs, which can be implemented either as current or as voltage output.

Output	Plug pin	Type	Range
Analogue output 1	J3 K3	Current Voltage	4..20 mA 0..5 V
Analogue output 2	G3 S3	Current Voltage	4..20 mA 0..5 V

Table 65: PRIAMOS: Analogue outputs

19.6.6 PWM outputs

The **HEINZMANN** control units of the PRIAMOS series are equipped with three configurable outputs that can be utilized as PWM outputs, ↑ *19.6.1 Selectable inputs/outputs*.

Input	Plug pin	Frequency range	Type	Power (max.)
PWM output 1*	S1	128…4000 Hz	low side	1 A
PWM output 2*	X1	128…4000 Hz	low side	1 A
PWM output 3*	A4	128…4000 Hz	low side	1 A

* digital input also possible

Table 66: PRIAMOS: PWM outputs

19.6.7 Digital outputs

The **HEINZMANN** controls of the PRIAMOS series are equipped with a maximum of three digital outputs. The required parameter settings for the assignment are described in chapter ↑*19.6.1 Selectable inputs/outputs*.

Output	Plug pin	Type	Power (max.)
Digital output 1*	S1	low side	1 A
Digital output 2*	X1	low side	1 A
Digital output 3*	A4	low side	1 A

* also configurable as PWM output

Table 67: PRIAMOS: Digital outputs

19.6.8 Fixed alarm outputs

The control units of the PRIAMOS series provide three dedicated outputs that have been pre-configured for error-indication and overspeed.

The overspeed output is provided as a relay output to enable a separate overspeed protection to be activated by this output. For a description of how to adjust overspeed, chapter ↑*6.4 Overspeed monitoring* offers a description of adjustment of overspeed and of the control unit's response to overspeeding. It should be noted that the output is triggered for each error intended to lead to an engine stop (↑*27.7* Emergency shutdown errors), not just when overspeed is detected. The engine stop is achieved – independently from the existence of a separate overspeed protection device – by the control unit itself, that forcefully pulls the actuator in "0" position. A separate overspeed protection is important for all situations in which the actuator can no longer be moved and is therefore indispensable.

As to its meaning, the output “Control unit operative” is identical with the overspeed output and serves to indicate that no fatal error such as overspeed has occurred and that the governor is able to control engine speed.

The common alarm output is activated when the control has detected at least one error or sent out a warning. The output may be used for a visual or audible signal. The common alarm output 3826 *LED_CommonAlarm* is described in detail in the chapter ↑ *27 Error Handling* which will also deal with the possible error causes.

The common alarm as well as the overspeed output may be more heavily loaded than the other governor outputs. The following table shows the pin assignments of the alarm outputs.

E1 and C2 are the same output physical. They can supply the nominal current only once (combinded power).

Output	Plug pin	Type	Power (max.)
Overspeed	E1	high side	3 A
Control ready	C2	high side	3 A
Common alarm	B2	low side	1 A

Table 68: PRIAMOS: Fixed alarm outputs

Note

When initializing the digital contro DC 1l, the common alarm output is activated for about 500 ms.

19.7 PRIAMOS III (DC 1-04)

19.7.1 Selectable inputs/outputs

The basic system PRIAMOS III is equipped with one port that can be utilized as a PWM input or digital input and three channels that can be utilized as PWM outputs or digital outputs. The following parameters serve to define the signal type of the channels.

Plug pin	Configuration parameters	Configuration
E3	4801 *PWMIn1OrDigitalIn11*	0 = digital input 11 1 = PWM input 1
S1	4803 *PWMOut1OrDigitalOut1*	0 = digital output 1 1 = PWM output 1
X1	4804 *PWMOut2OrDigitalOut2*	0 = digital output 2 1 = PWM output 2
A4	4805 *PWMOut3OrDigitalOut3*	0 = digital output 3 1 = PWM output 3

Table 69: PRIAMOS III: Variable connections

Parameterizing Example:

The first channel is to be used as a digital input 11 and the second as a digital output 1.

Number	Parameter	Value	Unit
4801	*PWMIn1OrDigitalIn11*	*0*	
4803	*PWMOut1OrDigitalOut1*	*0*	

19.7.2 Analogue inputs

The HEINZMANN control units of the PRIAMOS III series are equipped with ten analogue inputs whose hardware must be adapted to the desired requirements.

The inputs 1..8 may be factory-configured individually as current inputs with 4..20 mA or as voltage inputs with 0..5 V for universal use as setpoint and pressure inputs.

The analogue inputs 9 to 10 are used as temperature inputs.

In the table below the standard configurations are in bold print.

Input	Designation	Plug pin	Range
Analogue input 1	ADC1	A3	fixed 0..5 V or **4..20 mA**
Analogue input 2	ADC2	L3	fixed 0..5 V or **4..20 mA**
Analogue input 3	ADC3	C3	fixed 0..5 V or **4..20 mA**
Analogue input 4	ADC4	T1	fixed 0..5 V or **4..20 mA**
Analogue input 5	ADC5	R1	fixed 0..5 V or **4..20 mA**
Analogue input 6	ADC6	T5	fixed 0..5 V or **4..20 mA**
Analogue input 7	ADC7	X5	fixed 0..5 V or **4..20 mA**
Analogue input 8	ADC8	Y5	fixed 0..5 V or **4..20 mA**
Analogue input 9 Temperature input 1	ADC9 / TEMP1	J1	fixed NTC
Analogue input 10 Temperature input 2	ADC10 / TEMP2	L1	fixed Ni 1000

Table 70: PRIAMOS III : Analogue inputs

19.7.3 PWM input

PRIAMOS III has one input that can be configured as PWM input, ↑*19.7.1 Selectable inputs/outputs*.

Input	Plug pin	Maximum frequency
PWM input*	E3	1000 Hz

* digital input also possible

Table 71: PRIAMOS III: PWM input

19.7.4 Digital inputs

HEINZMANN control units of the PRIAMOS III series feature 10 digital inputs. Another port may be configured as a further digital input if required, ↑*19.7.1 Selectable inputs/outputs*.

Input	Plug pin
Digital input 1	T2
Digital input 2	V2
Digital input 3	P2
Digital input 4	H2
Digital input 5	S2
Digital input 6	R2
Digital input 7	D2
Digital input 8	G2
Digital input 9	F2
Digital input 10	E2
Digital input 11*	E3

* configurable as PWM input

Table 72: PRIAMOS III : Digital inputs

19.7.5 Analogue outputs

The **HEINZMANN** control units of the PRIAMOS III series feature two outputs, which can be implemented either as current or as voltage output.

Output	Plug pin	Type	Range
Analogue output 1	J3 K3	Current Voltage	4..20 mA 0..5 V
Analogue output 2	G3 S3	Current Voltage	4..20 mA 0..5 V

Table 73: PRIAMOS III : Analogue outputs

19.7.6 PWM outputs

The **HEINZMANN** control units of the PRIAMOS III series are equipped with three configurable outputs that can be utilized as PWM outputs, ↑ *19.7.1 Selectable inputs/outputs*.

Input	Plug pin	Frequency range	Type	Power (max.)
PWM output 1*	S1	128…4000 Hz	low side	1 A
PWM output 2*	X1	128…4000 Hz	low side	1 A
PWM output 3*	A4	128…4000 Hz	low side	1 A

* digital output also possible

Table 74: PRIAMOS III: PWM outputs

19.7.7 Digital outputs

The **HEINZMANN** controls of the PRIAMOS series are equipped with a maximum of three digital outputs. The required parameter settings for the assignment are described in chapter ↑*19.7.1 Selectable inputs/outputs*.

Output	Plug pin	Type	Power (max.)
Digital output 1*	S1	low side	1 A
Digital output 2*	X1	low side	1 A
Digital output 3*	A4	low side	1 A

* also configurable as PWM output

Table 75: PRIAMOS III: Digital outputs

19.7.8 Fixed alarm outputs

The control units of the PRIAMOS III series provide dedicated outputs pre-configured for error-indication and overspeed.

The overspeed output is provided as a relay output to enable a separate overspeed protection to be activated by this output. For a description of how to adjust overspeed, chapter ↑*6.4 Overspeed monitoring* offers a description of adjustment of overspeed and of the control unit's response to overspeeding. It should be noted that the output is triggered for each error intended to lead to an engine stop (↑*27.7* Emergency shutdown errors), not just when overspeed is detected. The engine stop is achieved – independently from the existence of a separate overspeed protection device – by the control unit itself, that forcefully pulls the actuator in “0” position. A separate overspeed protection is important for all situations in which the actuator can no longer be moved and is therefore indispensable.

As to its meaning, the output “Control unit operative” is identical with the overspeed output and serves to indicate that no fatal error such as overspeed has occurred and that the governor is able to control engine speed.

The common alarm output is activated when the control has detected at least one error or sent out a warning. The output may be used for a visual or audible signal. The common alarm output 3826 *LED_CommonAlarm* is described in detail in the chapter ↑ *27 Error Handling* which will also deal with the possible error causes.

The common alarm as well as the overspeed output may be more heavily loaded than the other governor outputs. The following table shows the pin assignments of the alarm outputs.

Output	Plug pin	Type	Power (max.)
Overspeed	E1	high side	3 A
Control ready	C2	high side	3 A
Common alarm	B2	low side	1 A

Table 76: PRIAMOS III: Fixed alarm outputs

Note

When initializing the digital control, the common alarm output is activated for about 500 ms

19.8 XIOS

All ports on the universally configurable control unit, type XIOS, must be configured with regard to their meaning and direction.

The XIOS consists of a main board, known as the C module, an extender board, known as the D module, and eleven slots for so-called A modules. Five of these slots are located on the main board (C module) and six are on the extender board (D module). Both the C and D module have the option of using inputs and outputs directly. The A modules are available for I/O extension.

The inputs/outputs of the A modules are referred to as "channel" if they are looked at in isolation, but inputs/outputs with reference to the slots or connector pins are referred to as "port". The XIOS can operate 117 ports in the maximum expansion stage.

Due to the wide range of options offered by the XIOS with the plug-on modules, it is not advisable to divide the ports according to analogue, PWM and binary inputs or outputs from the outset as is the case in other control units. Instead, every port must be configured, specifying whether something is connected to it and, if yes, what.

The ports are numbered according to the following table and each A module slot is always assigned eight ports (of which max. 6 are used by the A7 module, however).

Note

The configuration of the XIOS system described below can be achieved very easily and conveniently using a special window in DcDesk 2000.

19.8.1 Module types

Module type	Ports	Usage options
A Expander module	01 – 08, slot C1	Analogue input Temperature input Binary input Actuator feedback (only SL1, SL2 and SL5)
	09 – 16, slot C2	
	17 – 24, slot C3	
	25 – 32, slot C4	
	33 – 40, slot C5	
	41 – 48, slot D1	Analogue output Binary output PWM output Actuator control (only SL1, SL2 and SL5)
	49 – 56, slot D2	
	57 – 64, slot D3	
	65 – 72, slot D4	
	73 – 80, slot D5	
	81 – 88, slot D6	
C Main board	*01 – 40*	*5 slots for A modules, C1 – C5, s.a.*
	89	Binary input, pull down Speed input (Hall sensor) Frequency input (Hall sensor) PWM input
	90	Binary input, pull down Speed input (Hall sensor) Frequency input (Hall sensor)
	91 – 92	Binary output, low side, 4 A
	93 – 103	Analogue input, 0…5 V Binary input, pull down
D Expander board	*41 – 88*	*6 slots for A modules, D1 – D6, s.a.*
	104	Binary input, pull down Speed input (inductive sensor) Frequency input (inductive sensor)
	105	Binary input, pull down Speed input (inductive sensor) Frequency input (inductive sensor)
	106 – 107	Binary input, pull down
	108 – 109	Binary output, low side, 4 A
	110 – 117	Analogue input, 0…10 V Binary input, pull down

Table 77: XIOS – module types

19.8.2 A module versions

In the following three tables, the different A modules are listed sorted according to input and output modules.

<table>
<tr><th>Module</th><th>Meaning</th><th>Type</th><th>Config.</th><th>Channels</th></tr>
<tr><td rowspan="8">A1</td><td rowspan="7">Thermocouple
-10..+75 mV</td><td>K</td><td>5</td><td rowspan="7">2</td></tr>
<tr><td>J</td><td>6</td></tr>
<tr><td>N</td><td>7</td></tr>
<tr><td>R</td><td>8</td></tr>
<tr><td>T</td><td>9</td></tr>
<tr><td>B</td><td>10</td></tr>
<tr><td>E</td><td>11</td></tr>
<tr><td colspan="4">Both channels are galvanically isolated.
A non-galvanically isolated terminal for the thermal compensation of the two channels via sensor PT1000 is present on the same slot (this means that the C module analogue input on the connector is no longer available).</td></tr>
<tr><td rowspan="8">A3</td><td rowspan="4">Voltage</td><td>0…5 V</td><td>1</td><td rowspan="7">4</td></tr>
<tr><td>0…5 V, pull-up</td><td>38</td></tr>
<tr><td>0…10 V</td><td>2</td></tr>
<tr><td>0…36 V</td><td>3</td></tr>
<tr><td>Current</td><td>0…31.24 mA</td><td>4</td></tr>
<tr><td>Temperature</td><td>0.05…60 kΩ</td><td>12…21</td></tr>
<tr><td>Binary</td><td>Pull-up</td><td>23</td></tr>
<tr><td colspan="4">All four channels are applied to one signal ground and connected internally with "-BAT".
Sensor supply, standard equipment 5 V, 40 mA
<u>Equipment versions</u>
1. Sensor supply 12 V or +VBAT_p
2. Second sensor supply (the C module analogue input on the connector is no longer present)</td></tr>
<tr><td rowspan="8">A4</td><td rowspan="3">Voltage</td><td>0…5 V</td><td>1</td><td rowspan="7">2</td></tr>
<tr><td>0…10 V</td><td>2</td></tr>
<tr><td>0…36 V</td><td>3</td></tr>
<tr><td>Current</td><td>0…31,24 mA</td><td>4</td></tr>
<tr><td>Temperature</td><td>0.05…60 kΩ</td><td>12…21</td></tr>
<tr><td rowspan="2">Binary</td><td>Pull down</td><td>22</td></tr>
<tr><td>Pull-up</td><td>23</td></tr>
<tr><td colspan="4">Both channels are galvanically isolated</td></tr>
</table>

Module	Meaning	Type	Config.	Channels
	Sensor supply 5 V, 40 mA equipment version: Second sensor supply 5 V, 40 mA (the C module analogue input on the connector is no longer present)			
A7	Binary	Pull down	22	6
	All 6 channels are applied to one signal ground and connected internally with "-BAT". The C module analogue input is no longer present.			

Table 78: XIOS - input A modules

Module	Meaning	Type	Config.	Channels
A2	Voltage	0…5 V	29	4
	Current	0…24 mA	30	
	Binary, 1.2 A	high-side	31	
		low-side	32	
	PWM, 100 mA	high-side	33	
		low-side	34	
		half bridge	35	
	All 4 channels are applied to one signal ground and connected internally with "-BAT".			
A5	Voltage only channel 1 and 3	0…5 V	29	2
	Current only channel 1 and 3	0…22.2 mA	30	
	Binary, 400 mA only channel 2 and 4	low side	32	2
	Galvanically isolated islands Isolated island A with channel 1 and 2 Isolated island B with channel 3 and 4			
A6	Voltage	0…5 V	29	2
	Current	0…24 mA	30	
	Both channels are galvanically isolated. Output current and output voltage are measured.			
A8	Binary, 4 A	high-side	31	2
		low-side	32	
	PWM, 3 A,	high-side	33	

Module	Meaning	Type	Config.	Channels
	126…300 Hz	low-side	34	
	Both channels are connected internally with "-BAT" and "+BAT" and have safety functions, measurement of the output current for diagnosis. A8 can only be connected on the slots SL1, SL2 and SL5.			

Table 79: XIOS - output A modules

Module	Meaning	Type	Config.	Channels
A9	Actuator, 2 kHz (4 A static, 11 A brief)	H-bridge	36	1
	Current-controlled proportional valve 0.1…2 A, +/-1%, T=10 ms	H-bridge	39	
	Feedback	Elysion	37	1
		Analogue, 0…5 V, pull-up	38	
	The control channel is connected internally with "-BAT" and "+BAT", has safety functions and measurement of the output current for diagnostic purposes and current control in the proportional valve. When the analogue feedback is used, the C module analogue input on the connector is no longer available. A9 can only be connected on the slots SL1, SL2 and SL5.			

Table 80: XIOS – actuator module A9

19.8.3 Maximum number of inputs and outputs

Because each of the 117 ports on the XIOS has different uses, there are an endless number of combination options for input and output types. The two tables below provide a brief overview of the theoretical maximum values if the device were to be equipped with just one single type.

Input type		A	C	D	C+D	Maximum
Voltage	0...5 V	44	11	-	11	55
	0…10 V	44	-	8	8	54
	0…36 V	44	-	-	-	44

Current	0…31.24 mA	44	-	-	-	44
Temperature	Thermocouple	22	-	-	-	22
	Resistance	44	-	-	-	44
PWM		-	1	-	1	1
Binary		66	13	12	25	91
Pickup	Hall sensor	-	2	-	4	4
	Inductive sensor	-	-	2		

Table 81: XIOS – maximum number of inputs

Output type		**A**	**C**	**D**	**C+D**	**Maximum**
Analogue		44	-	-	-	44
PWM		44	-	-	-	44
Binary		44	2	2	4	48

Table 82: XIOS – maximum number of outputs

Actuator		**A9**	**C**	**D**	**C+D**	**Maximum**
Amplifier Actuator HEINZMANN	4Q	3	-	-	-	3
Feedback Actuator HEINZMANN	Analogue	3	-	-	-	
	Elysion	3	-	-	-	
Current-controlled proportional valve		3				

Table 83: XIOS – maximum number of actuators

The table also shows what can be achieved with the C module or the C plus D module alone, without considering the options afforded by the A modules.

The possible alternatives available for each port must be taken into account for a real application.

19.8.4 Minimum configuration for speed governors and positioners

The main board (C module) alone has two Hall sensor speed inputs, up to eleven voltage inputs and thirteen binary inputs and up to two binary outputs, but no temperature measurement and no actuator control or feedback. This means that, if no external actuator or electronic fuel injection with connection via the CAN bus are to be used, at least one A9 module is required.

The main board with an A9 module on slot C1 is therefore the minimum configuration for a speed governor with Hall sensor pickup and an actuator with analogue or Elysion feedback.

The same configuration level is also the minimum configuration for a positioner with external setpoint selection for an actuator.

This means that, for a positioner with three actuators, three analogue inputs on the mainboard are required for the external setpoint selection and three A9 modules for the control and feedback of the actuators.

19.8.5 Pin assignment

The following table lists the pin assignment on the eleven slots of the C module depending on which A module is connected. Input modules are shown in blue, output modules are shown in green. A9 is a bi-directional actuator module.

Pin	**no A module**	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**A8**	**A9**
									only on SL1, SL, SL5	
		2x TC in.	4x AO	4x AI	2x is. AI	2x is. AO+DO	2x is. AO	6x DI	2x Power-DO	1x StG-IO
	on GND	2x isol. island	on GND	on GND	2x isol. island	2x isol. island	2x isol. island	on GND	on GND	on GND
1	AIx	- (PT1000)	AIx	AIx or suppl. 2 (n.b.)	Ch2 suppl. (+5 V)	Ch2 suppl. (+5 V)	Ch2 suppl. (+5 V)	Ch6	AIx	FB Analogu e
2	-	GND	GND	GND	Ch2 GND	Ch2 GND	Ch2 GND	GND	Ch2	-out
3	-	Ch2 signal -	Ch4 signal	Ch4 signal	-	Ch2 signal DO	-	Ch5	-	Elysion FB_L
4	-	Ch2 signal +	Ch3 signal	Ch3 signal	Ch2 signal	Ch2 signal AO	Ch2 signal	Ch4	-	Elysion FB_H
5	-	Ch1 signal +	Ch2 signal	Ch2 signal	-	Ch1 signal DO	-	Ch3	-	-
6	-	Ch1 signal -	Ch1 signal	Ch1 signal	Ch1 signal	Ch1 signal AO	Ch1 signal	Ch2	-	GND
7	-	GND	GND	GND	Ch1 GND	Ch1 GND	Ch1 GND	GND	Ch1	+out
8	-	-	-	Suppl.1 (+5 V)	Ch1 suppl. (+5 V)	Ch1 suppl. (+5 V)	Ch1 suppl. (+5 V)	Ch1	-	Suppl. (+8 V)

Table 84: XIOS - pin assignment A modules on slots

19.8.6 Port configuration

All 117 ports on the XIOS must be configured with regard to meaning and direction ↑*19.12.1 Module* types. Depending on the add-on board used on a slot, it is possible that not all ports that are assigned to this slot are used (or can be used). The port numbering always remains the same, however. An A module uses the slot ports from the first specified through to the total number of channels of the module (exception: A5).

The meanings of the configuration values for each individual port are listed separately for inputs and outputs in the following two tables. The corresponding configuration parameters are available from 24000 *P001_(C1.1)_Config*.

Unused ports and ports that are not present – including on unused slots – must be given the configuration value 0.

Config.	Channel type	Module	Section
0	Port is not used	-	
1	Analogue input, 0…5 V	A3, A4 C	
2	Analogue input, 0…10 V	A3, A4 D	
3	Analogue input, 0…36 V	A3, A4	
4	Analogue input, 0…31.24 mA	A3, A4	
5	Thermocouple input, type K	A1	
6	Thermocouple input, type J		
7	Thermocouple input, type N		
8	Thermocouple input, type R		
9	Thermocouple input, type B		
10	Thermocouple input, type T		
11	Thermocouple input, type E		
12	Temperature input, PT100	A3, A4	
13	Temperature input, PT200		
14	Temperature input, PT1000		
15	Temperature input, Ni1000		
16	Temperature input, NTC 0…60 kΩ		
17	Temperature input, 0…5 kΩ		
18	Temperature input, 0…5 kΩ		
19	Temperature input, 0…5 kΩ		
20	Temperature input, 0…60 kΩ		
21	Temperature input, 0…60 kΩ		

Config.	Channel type	Module	Section
22	Binary input	A4, C, D	
23	Binary input with internal pull-up	A3, A4	
24	PWM input	C	
25	Speed input, reaction to falling edge	C, D	
26	Speed input, reaction to rising edge	C, D	
27	Frequency input, reaction to falling edge	C, D	
28	Frequency input, reaction to rising edge	C, D	
37	Elysion actuator feedback	A9	↑*19.12.6.9.2* Feedback
38	Analogue actuator feedback, with internal pull-up		

Table 85: XIOS - input channel types

Config.	Channel type	Module	Section
29	Analogue output, 0…5 V	A2, A6	
	Analogue output, 0…5 V only channel 1 and 3 can be used	A5	
30	Analogue output, 0…22.2 mA only channel 1 and 3 can be used	A5	
	Analogue output, 0…24 mA	A2, A6	
31	Binary output, high side	A2, A8	
32	Binary output, low side A5 only channel 2 and 4 can be used	A2, A5, A8	
33	PWM output, high side	A2, A8	
34	PWM output, low side	A2, A8	
35	PWM output, half bridge	A2	
36	Actuator control	A9	

Table 86: XIOS - output channel types

Once the port configuration has been defined, the parameters must be saved and a reset carried out so that the corresponding parameters and measured *values are shown in the correct physical unit (↑3.2 Saving data*

and ↑*3.10* Reset of control unit).

The configuration is checked during the control unit initialization during booting or after each reset. The parameters from 22000 *P001_(1.1)_Function* show which function is correctly assigned to the relevant port.

The configuration is only successful if all 117 parameters from 22000 *P001_(1.1)_Function*are identical with those from 24000 *P001_(1.1)_Config*. Incorrectly parametrised ports receive the value 0 in the *Function* and a configuration error is shown in 3000 *ConfigurationError*. The relevant channel is not operated.

Warning

HEINZMANN recommends carrying out the configuration while the drive is not yet wired. This is to prevent sensors which are already (or still) connected from being damaged by any reconfiguration of inputs to outputs or vice versa.

19.8.6.1 Analogue inputs

The modules C, D, A3 and A4 are available for analogue inputs. The A modules can be connected to any slot. This means that all ports 1 to 84, 93 to 103 and 110 to 117 can be used. The parameter for port 1 is shown as an example:

Parameter	**Meaning**
24000 *P001_(C1.1)_Config*	Selection of the sensor type 1: 0…5 V 2: 0…10 V 3: 0...36 V 4: 0...31,24 mA

Table 87: XIOS – port configuration analogue inputs

Module A4 has a maximum of two galvanically isolated analogue inputs. Therefore, only the first two ports of the respective slot can be used here – the other six ports must be configured with 0.

Note

The analogue input of the C module (port 93…103) is no longer available on the slot when a number of A modules are used ↑19.12.2 A module versions.

Parametrization example:

Module A4 is used with a voltage and a current input on slot C2. The two inputs of the module are therefore on ports 9 and 10. The remaining ports of the slot must be set with 0.

Number	Parameter	Value	Unit
24008	*P009_(C2.1)_Config*	*1*	
24009	*P010_(C2.2)_Config*	*4*	
24010	*P011_(C2.3)_Config*	*0*	
24011	*P012_(C2.4)_Config*	*0*	
24012	*P013_(C2.5)_Config*	*0*	
24013	*P014_(C2.6)_Config*	*0*	
24014	*P015_(C2.7)_Config*	*0*	
24015	*P016_(C2.8)_Config*	*0*	

19.8.6.2 Temperature inputs

Thermocouples and resistance sensors up to a measurement range of 60 kΩ can be connected on the XIOS.

A1 modules must be used for thermocouples, A3 or A4 modules are used for other temperatures sensors. The A modules can be connected to any position, which means that, in principle, all ports 1 to 84 can be used. The parameter for port 1 is shown as an example:

Parameter	**Meaning**
24000 *P001_(C1.1)_Config*	5..21: Selection of the temperature sensor type

Table 88: XIOS – port configuration temperature inputs

A maximum of 2 temperature sensors can be connected to A1 and A4 modules. Therefore, only the first two ports of the respective slot can be assigned in this case – the following six ports must be configured with 0.

The corresponding analogue input of the C module is no longer available on a slot when the A1 module is used. For the temperature compensation of the thermocouple, a PT1000 resistor must be attached on pin 1 instead.

For each temperature sensor, a characteristic is required, which provides the temperature from the relevant resistance or voltage values. The characteristics for the twelve most common temperature sensor types (including the thermocouple) are saved in the control unit and can be selected with the configuration type.

The characteristic for NTC sensors and five further freely selectable characteristics for resistance sensors can be assigned themselves as required, as with NTC sensors in particular, there are a large number with different characteristics. It is important to remember that the free types 17..19 have a value range up to 5 kΩ, while the types 16, 20 and 21 go up to 60 kΩ.

Configuration	Channel type	Characteristic
5	Thermocouple, type K	fixed
6	Thermocouple, type J	fixed
7	Thermocouple, type N	fixed
8	Thermocouple, type R	fixed
9	Thermocouple, type B	fixed
10	Thermocouple, type T	fixed
11	Thermocouple, type E	fixed
12	PT100	fixed
13	PT200	fixed
14	PT1000	fixed
15	Ni1000	fixed
16	NTC 0 – 60000 Ω	7700 *TempLinNTC:Ohm* 7720 *TempLinNTC:T*
17	freely definable temperature sensor, 0 – 5000 Ω	7740 *TempLinUser1:Ohm* 7760 *TempLinUser1:T*
18	freely definable temperature sensor, 0 – 5000 Ω	7780 *TempLinUser2:Ohm* 7800 *TempLinUser2:T*
19	freely definable temperature sensor, 0 – 5000 Ω	7820 *TempLinUser3:Ohm* 7840 *TempLinUser3:T*
20	freely definable temperature sensor, 0 – 60000 Ω	7860 *TempLinUser4:Ohm* 7880 *TempLinUser4:T*
21	freely definable temperature sensor, 0 – 60000 Ω	7900 *TempLinUser5:Ohm* 7920 *TempLinUser5:T*

Table 89: XIOS – port configuration temperature sensors

19.8.6.3 PWM input

Of all ports, only port 89 can be used as the PWM input on the C module. All relevant parameters are listed below.

Note

Port 89 is not available as a PWM input, if it is used for a speed or frequency input (↑19.12.6.5 Speed and frequency inputs*).*

Parameter	Meaning
24088 *P089_(MC.DI1)_Config*	24: Selection as PWM input

Table 90: XIOS – port configuration PWM input

19.8.6.4 Binary inputs

The modules C, D, A3, A4 and A7 are available for binary inputs. The A modules can be connected to any slot. This means that ports 1 to 90, 93 to 107 and 110 to 117 can be used.

The table shows the parameter for port 1 as an example.

Parameter	Meaning
24000 *P001_(C1.1)_Config*	Selection as binary input 22: Binary input 23: Binary input with internal pull-up

Table 91: XIOS – port configuration binary inputs

Module A4 has max. two galvanically isolated binary inputs, which means that, here too, only the first two ports of the relevant slot can be used. The remaining six ports must be configured with 0.

Module A7 is the only module with 6 inputs, i.e. all ports and all eight pins of the connector strip on the relevant slot are used. This means that the analogue input, GND and sensor supply are no longer available on this slot of the C or D module.

19.8.6.5 Speed and frequency inputs

The ports 89 and 90 on the C module and 104 and 105 on the D module can be used as speed or frequency inputs. The ports 89 and 90 on module C are only approved for Hall sensors and ports 104 and 105 on module D are only approved for inductive sensors.

Hall sensors must be supplied and 5 V or 12 V are available as POW SIC. A second sensor supply POW SID is available on the expansion module D, which can also be configured on 5 V or 12 V:

4032 *SensorSupplyMC5VOr12V* 1 = 5 V, 0 = 12 V

4033 *SensorSupplyMD5VOr12V* 1 = 5 V, 0 = 12 V

The input frequency of the ports must not exceed 15 kHz.

Note

Port 89 is not available as a speed or frequency input if it is used for a PWM input (↑19.12.6.3 PWM input).

19.8.6.5.1 Speed measurement

The table shows the parameter for port 90 as an example.

Parameter	**Meaning**
24089 *P090_(MC.DI2)_Config*	Selection as speed input 25: Reaction to falling edge 26: Reaction to rising edge

Table 92: XIOS – port configuration speed inputs

After one or two ports have been configured as speed inputs, the assignment to Pickup1 and possibly Pickup2 still has to be carried out.

Parameter	**Meaning**
4030 *PickUp1PortNo*	Definition of the channel that Pickup1 is connected to only 89, 90, 104 or 105 possible Use only if 4000 *PickUp1On* = 1
4031 *PickUp2PortNo*	Definition of the channel that Pickup2 is connected to only 89, 90, 104 or 105 possible Use only if 4002 *PickUp2On* = 1

Table 93: XIOS – port assignment to pickup sensors

19.8.6.5.2 Frequency measurement

The table shows the parameter for port 90 as an example.

Parameter	Meaning
24089 *P090_(MC.DI2)_Config*	Selection as frequency input 27: Reaction to falling edge 28: Reaction to rising edge

Table 94: XIOS – port configuration frequency inputs

19.8.6.6 Analogue outputs

The modules A2, A5 and A6 are available for analogue outputs. They can be connected anywhere, meaning that ports 1 to 84 can be used. The example shows parametrisation as performed on port 1.

Parameter	**Meaning**
24000 *P001_(C1.1)_Config*	Selection of the analogue output type 29: 0…5 V 30: 0…24 mA

Table 95: XIOS – port configuration analogue outputs

A maximum of 2 galvanically isolated analogue outputs can be connected to modules A5 and A6. Therefore, only the first 2 ports of the slot that is in use can be configured in this case – the other 6 ports must receive 0 as the configuration value. Module A2 can operate four analogue outputs - here too, the remaining four ports must be configured with 0.

19.8.6.7 PWM outputs

The modules A2 and A8 are available for PWM outputs. They can be connected anywhere, meaning that ports 1 to 84 can be used. The example shows parametrisation as performed on port 1.

Parameter	**Meaning**
24000 *P001_(C1.1)_Config*	Selection of the PWM output type 33: high side 34: low side 35: half bridge

Table 96: XIOS – port configuration PWM outputs

A maximum of 2 PWM outputs can be connected to module A8. Therefore, only the first 2 ports of the respective slot can be used in this case – the other 6 ports must receive 0 as the configuration value. Module A2 can operate four PWM outputs, the remaining four ports must therefore be configured with 0.

19.8.6.8 Binary outputs

The modules C, D, A2, A5 and A8 are available for binary outputs. The A modules A2 and A5 can be connected anywhere, meaning that ports 1 to 88, 91, 92, 108 and 109 can be used. The example shows parametrisation as performed on port 1.

Parameter	Meaning
24000 *P001_(C1.1)_Config*	Selection of the binary output type 31: high side 32: low side

Table 97: XIOS – port configuration binary outputs

A maximum of 2 binary outputs can be connected to modules A5 and A8. Therefore, only the first two ports of the slot that is in use can be configured in this case – the other 6 ports must be given 0 as the configuration value. Module A2 can operate four binary outputs, the remaining four ports must be configured with 0.

19.8.6.9 Actuator configuration

Module A9 is used for actuator control and feedback. Actuator 1 is assigned to slot C1, actuator 2 is operated via slot C2 and actuator 3 via slot C5, other slots are not approved for the A9 module.

It is essential that both the control and the feedback channel are configured for the required actuators (up to three). It is also essential that the actuator 1 on slot C1 is used for speed governors (diesel or gas engine). On dual-fuel engines, the diesel actuator is on slot 1 and one or two gas actuators are on slot 2 and 3 if the gas is not supplied via an external device.

19.8.6.9.1 Control

The first channel of the A9 module is available for the control, which means that channels 1, 9 and 33 can be used for this.

Actuator	Parameter	Meaning
1	24000 *P001_(C1.1)_Config*	36: Selection as actuator control (amplifier)
2	24008 *P009_(C2.1)_Config*	
3	24032 *P033_(C5.1)_Config*	

Table 98: XIOS – port configuration actuator control

19.8.6.9.2 Feedback

HEINZMANN actuators use either an analogue signal with a voltage range of approx. 1.6 V to 2.8 V for the feedback, or a high-precision digital, so-called Elysion feedback. The 0…5 V input of the C module on the relevant slot is used for the analogue feedback. This is therefore no longer available separately. In this case, it is wired internally with a pull-up resistor. This is a safety requirement if the feedback fails.

The second port of the A9 module must be used for the feedback parametrisation, which means that the channels 2, 10 and 34 are available.

<table>
<tr><th>Actuator</th><th>Parameter</th><th>Meaning</th></tr>
<tr><td>1</td><td>24001 P002_(C1.2)_Config</td><td rowspan="3">Selection of the feedback type
37: Elysion feedback
38: Analogue feedback</td></tr>
<tr><td>2</td><td>24009 P010_(C2.2)_Config</td></tr>
<tr><td>3</td><td>24033 P034_(C5.2)_Config</td></tr>
</table>

Table 99: XIOS – port configuration actuator feedback

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20 Configuring the control's inputs and outputs

20.1 Digital inputs

Configuring of digital inputs is described in detail in chapter ↑ *18 Configuration of* switching functions.

20.2 Analogue inputs

20.2.1 Calibration of current/voltage inputs

Sensors convert physical quantities (e.g., pressure) to electric quantities (voltage, current). The control unit measures voltage/current and indicates them directly (ARCHIMEDES, ORION, PANDAROS) or in digits/percent (HELENOS, PRIAMOS) of the sensor range. To enable the control to operate with the physical value transmitted by the sensor, it is necessary that the control be provided with two reference values informing it about the relation between the electrically measured values and the actual physical quantities. The two reference values are the sensor output values associated with the minimum and maximum measuring. With this information, the control is capable of normalizing the measured values and of displaying them specified in per cent of the sensor range or directly in terms of their physical values.

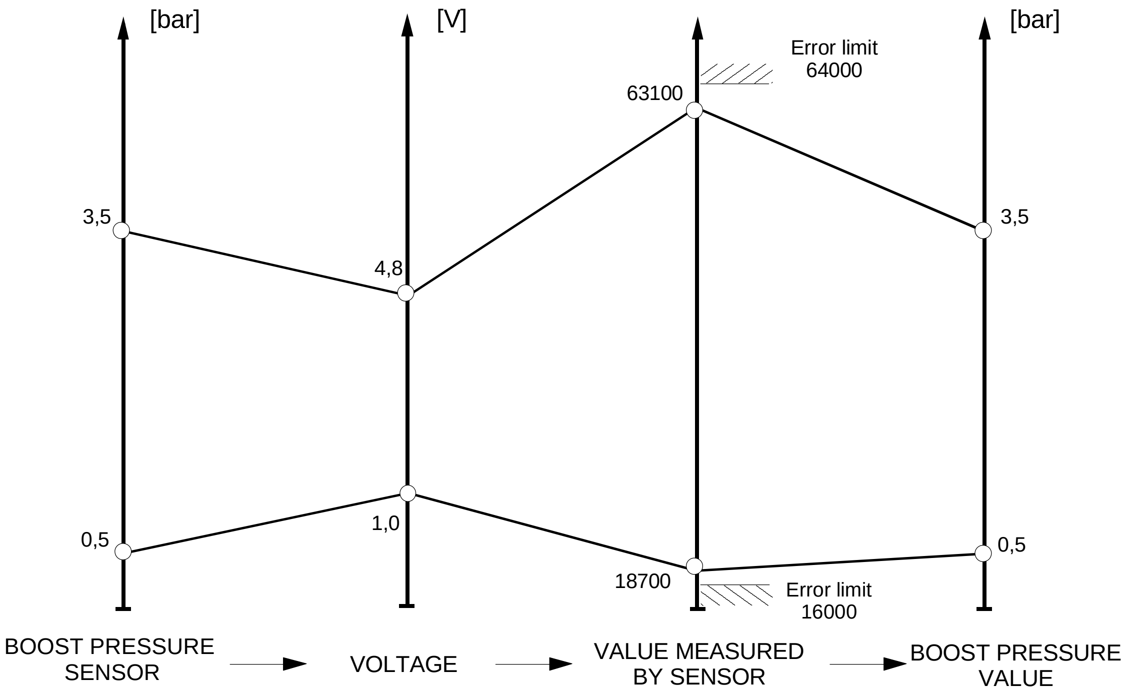

Fig. 44: Calibration procedure

Each of the voltage/current inputs is associated with a low reference value (parameters 15xx *AnalogInx_RefLow*) and a high reference value (parameters 15xx *AnalogInx_RefHigh*). If the sensor signal is inverted the low reference value absolutely may be higher than the high reference value.

Parameterizing example for HELENOS/PRIAMOS:

A boost pressure sensor has been connected to input 3. Its measuring range is supposed to be from 0.5 bar to 3.5 bar and is to be converted into voltages ranging from 1.0 V to 4.8 V. At minimum voltage the parameter 3531 *AnalogIn3_Value* will indicate a value of 9,000 and at maximum voltage a value of 35,000. The parameter 3530 *AnalogIn3* will display the actual measurement as related to the reference values in per cent, and the parameter 2904 *BoostPressure* will read the converted measuring value in bar.

Number	Parameter	Value	Unit
904	*AssignIn_BoostPress*	*3*	
982	*BoostPressSensorLow*	*0.5*	*bar*
983	*BoostPressSensorHigh*	*3.5*	*bar*
1530	*AnalogIn3_RefLow*	*9000*	*digit*
1531	*AnalogIn3_RefHigh*	*35000*	*digit*
4904	*ChanType_BoostPress*	*0*	

Parameterizing example for ARCHIMEDES, ORION, PANDAROS:

A boost pressure sensor has been connected to input 2. Its measuring range is supposed to be from 0.5 bar to 3.5 bar and is to be converted into voltages ranging from 1.0 V to 4.8 V. Parameter 3520 *AnalogIn2* will display the actual measurement in V and parameter 2904 *BoostPressure* will read the converted measuring value in bar.

Number	Parameter	Value	Unit
904	*AssignIn_BoostPress*	*2*	
982	*BoostPressSensorLow*	*0.5*	*bar*
983	*BoostPressSensorHigh*	*3.5*	*bar*
1530	*AnalogIn3_RefLow*	*1.0*	*V*
1531	*AnalogIn3_RefHigh*	*4.8*	*V*
4904	*ChanType_BoostPress*	*0*	

20.2.1.1 Using current/voltage inputs for temperature sensors

If the number of available temperature inputs is not sufficient for the required sensors, the temperature sensors may also be connected to the first four current or voltage inputs via a transducer. This function is available on request. To make the temperatures known to the control device a linearization characteristic must be enabled starting from parameter 7800 as for the temperature inputs.

78xx *SensorLinx:digit* and 78xx *SensorLinx:T*

Assignment of one of these characteristics to an analogue input starting from 5512 is done with

55xx *AnalogInx_TempLin* characteristic selection for analogue input x.

To select the first of the characteristics, enter the value from 1, 2 for the second, and so on. If a 0 is assigned, the related current/voltage input will not be used for a temperature.

When a temperature characteristic is used, the parameters 15xx *AnalogInx_RefLow* and 15xx *AnalogInx_RefHigh* are no longer necessary.

20.2.2 Calibration of temperature inputs

Due to the non-linear behaviour of temperature sensor signals, two reference values will not suffice to precisely determine temperature. For this reason, linearization characteristics must be introduced. In most control units the number of defined characteristics is equal to the number of temperature inputs although this is not necessary for so many different sensor types are rarely used.

By means of the parameters *TempInx_SensorType* it is decided for each single temperature channel by which characteristic the respective sensor is to be scaled. The parameters relating to sensor type are to be found starting from the following numbers:

ARCHIMEDES:	5570 *TempIn1_SensorType*
HELENOS:	5550 *TempIn1_SensorType*
ORION:	no temperature input
PANDAROS:	5540 *TempIn_SensorType*
PRIAMOS:	5590 *TempIn1_SensorType*

The value “0” selects the first linearization characteristic, the value “1” the second etc.

The values defining temperature linearization are stored at the parameter positions following 7900 *TempLin1:digit(0)* and 7920 *TempLin1:T(0)*. To parameterize the characteristics up to 10 pairs of values are available for each.

In most control units the possible temperature sensor types are pre-defined in the factory. If other types of sensor are used, the characteristics may be adapted accordingly. This applies in particular to NTC sensors, since their characteristic is not standardized, but may change according to the sensor used. It must be noted that in all cases the control unit hardware pre-determines the possible sensor type (e.g., PT 1000 or PT 200).

20.2.3 Filtering of analogue inputs

The measured value of an analogue input can be filtered through a digital filter. The respective parameters are stored at the numbers 15x4 *AnalogInx_Filter*.

Each of these parameters is to hold a filter value ranging from 1 to 255. The value 1 signifies that there will be no filtering. The filtering time constant for the control units HELENOS and PRIAMOS can be derived from the filter values by the following equation:

$$\tau = \frac{filtering\ \ value}{64}\ [s].$$

For control units of the types ARCHIMEDES, ORION and PANDAROS the equation is the following

$$\tau = \frac{filtering\ \ value}{62.5}\ [s].$$

For normally fast sensor changes filter value 8 will be best suited. For measuring quantities that change more slowly, such as temperatures, a filter value of about 50 can be used. The filtering time constant should correspond approximately to the sensor's time constant.

Parameterizing Example:

Number	Parameter	Value	Unit
1524	*AnalogIn2_Filter*	*8*	

Time constant for HELENOS, PRIAMOS:

$$\tau = \frac{8}{64}\ [s] = 0.125\ s$$

Time constant for ARCHIMEDES, ORION, PANDAROS:

$$\tau = \frac{8}{62.5}\ [s] = 0.128\ s$$

20.2.4 Error detection for analogue inputs

If a sensor fails (e.g., by short circuit or cable break), the control will read voltages or currents lying outside the normal measuring range. These irregular measuring values can be used to define inadmissible operating ranges by which the control can recognize that the sensor is at fault.

The error limits are entered in electric units for the control units ARCHIMEDES, ORION and PANDAROS and in digits for the control units HELENOS and PRIAMOS.

The parameters 15x2 *AnalogInx_ErrorLow* and *TempInx_ErrorLow* define the lower error limits. The parameters 15x3 *AnalogInx_ErrorHigh* and *TempInx_ErrorHigh* determine the upper error limits.

Parameterizing Example:

The boost pressure sensor connected to analogue input 3 normally supplies measuring values ranging between 9,000 and 35,000. In case of a short circuit or a cable break the measurements will be below or above these values, respectively. The ranges below 7,000 and above 38,000 are defined as inadmissible by the following parameters:

Number	Parameter	Value	Unit

904	*AssignIn_BoostPress*	*3*
1530	*AnalogIn3_RefLow*	*9000.0*
1531	*AnalogIn3_RefHigh*	*35000.0*
1532	*AnalogIn3_ErrorLow*	*7000.0*
1533	*AnalogIn3_ErrorHigh*	*38000.0*
4904	*ChanType_BoostPress*	*0*

These error limits should not be chosen too close to the minimum and maximum values in order to prevent natural fluctuations of the values measured by the sensors from being mistaken as errors. On the other hand, it must be ensured that short circuits or cable breaks are unambiguously recognized as such.

Once an error is detected, the sensor error parameter (error flag) associated with the analogue input is set. For the actions to be taken in the event that any such error occurs, please refer to chapter ↑*27.8 Error parameter list*. If an analogue input is not used due to not being assigned to a sensor it will not be monitored for errors.

20.2.5 Overview of the parameters associated with analogue inputs

For inputs relating to setpoints and pressure the following parameters are provided:

Parameter	**Meaning**
15x0 *AnalogInx_RefLow*	lower reference value
15x1 *AnalogInx_RefHigh*	upper reference value
15x2 *AnalogInx_ErrLow*	lower error limit
15x3 *AnalogInx_ErrHigh*	upper error limit
15x4 *AnalogInx_Filter*	filtering constant
35x0 *AnalogInx*	current measuring value in %
35x1 *AnalogInx_Value*	current measuring value in digits (HELENOS, PRIAMOS) or electrical unit (others) ARCHIMEDES: referenced by 3603 *5VRefAnalog/TempIn1* to 3606 *5VRefAnalog/TempIn4* PANDAROS/ORION: referenced by 3603 *5V_Ref*
55xx *AnalogInx_TempLin*	selection of linearization characteristic if the input is used for a temperature sensor (on request)

Table 100: Parameters for analogue inputs

For temperature inputs the following parameters are provided:

Parameter	**Meaning**
15x2/7 *TempIny_ErrorLow*	lower error limit
15x3/8 *TempIny_ErrorHigh*	upper error limit
15x4/9 *TempIny_Filter*	filtering constant
35x0/5 *TempIny*	current measuring value in °C
35x1/6 *TempIny_Value*	current measuring value in digits ARCHIMEDES: referenced by 3603 *5VRefAnalog/TempIn1* to 3606 *5VRefAnalog/TempIn4* PANDAROS/ORION: referenced by 3603 *5V_Ref*
55x0 *TempIny_SensorType*	selection of linearization characteristic for temperature sensor

Table 101: Parameters for temperature inputs

Any inputs that have not been assigned a sensor (↑*17 Configuration* of sensors) will not be monitored for errors, and indicate only the measuring value 35xx *AnalogInx_Value* resp. *TempIny_Value.*

20.3 PWM inputs

Transmission of the PWM signal typically uses a range from 5 % to 95 % PWM. To standardize the measuring range, the lower reference values must be entered in parameters 1500 *PWMInx_RefLow* and the upper reference values in parameters 1501 *PWMInx_RefHigh*. If the sensor signal is inverted the low reference value absolutely may be higher than the high reference value.

The measuring parameters starting from 3500 *PWMInx* will indicate the PWM ratio, and the measuring parameters starting from 3501 *FrequencyInx* the PWM frequency.

Selection as a PWM sensor is to be made as described in chapter ↑*17 Configuration of sensors*. Assignment to the sensors is to be conducted as explained in chapter↑*17.3 Assigning the inputs to the sensors and setpoint adjusters*.

<u>Parameterizing Example:</u>

The setpoint adjuster 2 is to set speed by means of a PWM ratio of between 5% and 95%.

Number	Parameter	Value	Unit
901	*AssignIn_Setp2Ext*	*1*	
1500	*PWMIn1_RefLow*	*5*	*%*
1501	*PWMIn1_RefHigh*	*95*	*%*
4901	*ChanTyp_Setp2Ext*	*1*	

20.3.1 Error detection at PWM inputs

The following failure causes will be detected at the PWM input and indicated as errors of the assigned sensor:

- PWM signal is missing
- Frequency exceeds the maximum admissible frequency by 25% (ARCHIMEDES and PANDAROS: 500 Hz, HELENOS and PRIAMOS: 1000 Hz). In this case, the PWM input is switched off in order to minimize interrupt stress for the control.
- The PWM ratio lies outside the error limits, that are equivalent to half the lower reference parameter (starting from 1500 *PWMIn1_RefLow)* and the average between the higher reference parameter (starting from 1501 *PWMIn1_RefHigh)* and 100%.

20.4 XIOS

20.4.1 Current/voltage inputs

The following parameters are available for all analogue inputs, port 1 is shown as an example:

Parameter	Meaning
30020 *P001_(C1.1)_IO_RefLow*	lower reference value or threshold, below which the binary value 0 is generated (during assignment to the switching function)
30021 *P001_(C1.1)_IO_RefHigh*	upper reference value or threshold, above which the binary value 1 is generated (during assignment to the switching function)
30022 *P001_(C1.1)_AI_ErrLow*	lower error limit
30023 *P001_(C1.1)_AI_ErrHigh*	upper error limit
30024 *P001_(C1.1)_AI_Filter*	filtering constant
32020 *P001_(C1.1)_AI*	current measured value in %
32021 *P001_(C1.1)_AI_Value*	current measured value in electric unit

Table 102: XIOS – parameters analogue inputs

The meaning of the reference values and of the error limits is explained in ↑*19.8 XIOS*. A filter value of 0.12 s must be used for normally fast sensor changes. For measuring quantities that change more slowly, such as temperatures, a filter value of about 0.8 can be used. The filtering time constant should correspond approximately to the sensor's time constant.

While binary inputs are usually assigned to the switching functions, it is also possible to assign analogue inputs to enable the switching function to be monitored for cable breaks. In this case, 30020 *P001_(C1.1)_IO_RefLow* is not the low reference, but the threshold below which the binary value 0 is generated and 30021 *P001_(C1.1)_IO_RefHigh* is the threshold above which the binary value 1 is applied. The other parameters retain their meaning.

20.4.2 Temperature inputs

The following parameters are available for temperature inputs, port 1 is shown as an example:

Parameter	Meaning
30022 *P001_(C1.1)_AI_ErrLow*	lower error limit
30023 *P001_(C1.1)_AI_ErrHigh*	upper error limit
30024 *P001_(C1.1)_AI_Filter*	filtering constant
32020 *P001_(C1.1)_AI*	current measured value in °C
32021 *P001_(C1.1)_AI_Value*	current measured value in Ω or mV

Table 103: XIOS – parameter temperature inputs

20.4.3 PWM input

Of all ports, only port 89 can be used as the PWM input on the C module. All relevant parameters are listed below.

Parameter	Meaning
30012 *P089_(MC.DI1)_IO_RefLow*	Lower duty cycle
30013 *P089_(MC.DI1)_IO_RefHigh*	Upper duty cycle
30014 *P089_(MC.DI1)_PI_Filter*	Filter value
32012 *P089_(MC.DI1)_PI_PWMIn*	current PWM measured value
32013 *P089_(MC.DI1)_PI_PWMFreq*	current PWM frequency

Table 104: XIOS – parameter PWM input

The duty cycle can be [0, 100]%, but [10, 90]% of the PWM ratio is normally used in order to enable monitoring.

If RefLow is smaller than RefHigh, [10, 90] % duty cycle results in a sensor value of [0,100] %. However, if the low duty cycle is entered in RefHigh and the high duty cycle is entered in RefLow, the sensor signal is read in inverted, meaning that [10, 90] % results in a sensor value of [100, 0] %.

A filter value of 0.12 s must be used for normally fast sensor changes. The filtering time constant should correspond approximately to the connected sensor's time constant.

The following error causes are detected on the PWM input and displayed as an error on the assigned sensor:

- PWM signal is missing
- The frequency is 25 % higher than the maximum permitted frequency of 1000 Hz. In this case, the PWM input is switched off in order to minimize interrupt stress for the control unit.
- The PWM ratio is not within the error limits, which correspond respectively to half of the low duty cycle and the mid-point between the high duty cycle and 100 %.

20.4.4 Binary inputs

The assignment of a binary input to switching functions is described in ↑*20.4.4 Binary inputs*.

20.4.5 Frequency inputs

Two frequency inputs are on the C module and two on the D module. The table shows the parameters for port 90 on the C module as an example.

Parameter	**Meaning**
30003 *P090_(MC.DI2)_FI_TOutFact*	timeout factor
30004 *P090_(MC.DI2)_FI_ErrLimit*	error limit
30005 *P090_(MC.DI2)_FI_Filter*	filtering constant
32003 *P090_(MC.DI2)_FI_FreqIn*	measured frequency

Table 105: XIOS – parameters frequency inputs

The timeout factor can be used to specify when a missing signal should result in an error. The period after which the missing signal is detected depends on the last measured valid frequency with the relevant factor applied.

The error limit (max. 15 kHz) is used to monitor the frequency, which must not exceed this value, in order to minimize the interrupt stress on the system.

The assignment of a frequency input to sensors, e.g. a speed sensor, is described in ↑*18 Configuration of switching functions*.

20.5 Analogue outputs

20.5.1 Assignment of output parameters to analogue outputs

Every parameter of the control unit can be read out via analogue outputs. This is achieved by assigning to the desired output x starting from 1640 *AnalogOutx_Assign* the parameter number of the measuring value that is to be read out.

Note

Output parameters are named AnalogOut if the output signal can be configured as current or voltage. Otherwise they are named according to signal type CurrentOut or VoltOut .

Parameterizing Example:

We want to read out speed (indication parameter 2000) from analogue output 1 and fuel quantity (indication parameter 2350) from analogue output 2.

Number	Parameter	Value	Unit
1640	*AnalogOut1_Assign*	*2000*	
1645	*AnalogOut2_Assign*	*2350*	

Note

Signal output can be inverted (e.g., low current for high speeds) by entering the parameter numbers negative in sign.

20.5.2 Value range of output parameters

When values are read out, sometimes it is convenient not to read out the entire range but only a part of it, for instance one might not wish to see the whole control unit’s speed range of 0..4000 rpm on an instrument but only the actually used range of 700..2100 rpm.

It is therefore possible to limit the output range with parameters 16x3 *AnalogOutx_ValueMin* and 16x4 *AnalogOutx_ValueMax*.

As there are a great many different value ranges, these parameters are to be set to the required low and high output values specified in per cent of the value range of the respective output parameter. If the entire value range is required, the minimum value is to be set to 0 % and the maximum value to 100 %.

Note

The PC programme DcDesk 2000 allows to display output ranges in the parameter's specific measurement unit.

Parameterizing Example:

Current speed 2000 *Speed* is to be read out via a current output of 4..20 mA. The output range shall be restricted to 500 rpm through 1500 rpm. i.e., 500 rpm correspond to 4 mA and 1500 rpm to 20 mA. Since the values of this parameter have a range from 0 to 4000 rpm, output will have to be adjusted accordingly:

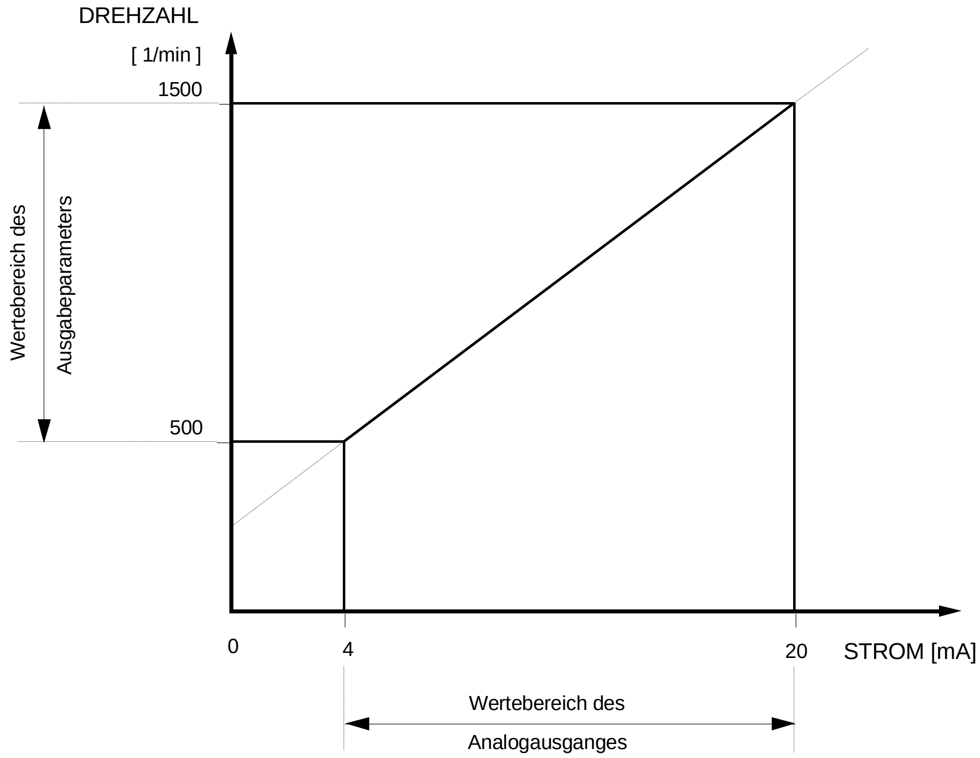

Fig. 45: Reading out a parameter via an analogue output

$$1643\ \text{AnalogOut1\_ValueMin} = \frac{500}{4000} * 100\% = 12{,}5\%$$

$$1644\ \text{AnalogOut1\_ValueMax} = \frac{1500}{4000} * 100\% = 37{,}5\%$$

Number	Parameter	Value	Unit
1640	*AnalogOut1_Assign*	*2000*	
1643	*AnalogOut1_ValueMin*	*12.5*	*%*
1644	*AnalogOut1_ValueMax*	*37.5*	*%*

20.5.3 Value range of analogue outputs

Analogue outputs can be defined as current outputs or as voltage outputs.

In the majority of cases, particularly with current outputs, not the maximum output range of approx. 0..22 mA is required but the standard output range of 4..20 mA.

Parameters 16x1 *AnalogOutx_RefLow* and 16x2 *AnalogOutx_RefHigh* are provided to adapt the output range. The value to be entered relates to the maximum output value and must be specified in per cent for HELENOS and PRIAMOS type control units. For all other control units the output range may be specified directly in electric units.

i Note

The determination of the connection type (current or voltage) cannot be altered during operation. It will therefore be necessary to save the data (↑3.2 Saving data) and restart the control unit with a ↑ 3.10 Reset of control unit after configuration. The value ranges of analogue outputs then must be adapted again to the newly chosen electric unit.

<u>Parameterizing Example:</u>

Current speed 2000 *Speed* is to be output out via a current output of 4..20 mA, but with the range restricted to 500 rpm to 1500 rpm, Only the range from 500 rpm to 1500 rpm is to be output, i.e., 500 rpm correspond to 4 mA and 1500 rpm correspond to 20 mA.

<u>Parametrizing example for ARCHIMEDES/PANDAROS:</u>

Number	Parameter	Value	Unit
1640	*CurrentOut1_Assign*	*2000*	
1641	*CurrentOut1_RefLow*	*4.00*	*mA*
1642	*CurrentOut1_RefHigh*	*20.00*	*mA*
1643	*CurrentOut1_ValueMin*	*12.5*	*%*
1644	*CurrentOut1_ValueMax*	*37.5*	*%*

<u>Parameterizing example for HELENOS/PRIAMOS:</u>

$$1641\ \text{CurrentOut1\_RefLow} = \frac{4}{22} * 100\% = 18{,}2\%$$

$$1642\ \text{CurrentOut1\_RefHigh} = \frac{20}{22} * 100\% = 90{,}9\%$$

Number	Parameter	Value	Unit
1640	*CurrentOut1_Assign*	*2000*	
1641	*CurrentOut1_RefLow*	*18.2*	*%*
1642	*CurrentOut1_RefHigh*	*90.9*	*%*
1643	*CurrentOut1_ValueMin*	*12.5*	*%*
1644	*CurrentOut1_ValueMax*	*37.5*	*%*

Note

Due to component tolerances of the series HELENOS and PRIAMOS the output range for the same parameter values may differ from one control unit to the next. To ensure accuracy of output, the output ranges should be measured and the parameters accordingly adjusted. When parameters are copied from one control unit to another this set of configuration values should be excluded.

20.6 PWM outputs

20.6.1 Assignment of PWM outputs

Every parameter of the control unit can be read out via PWM outputs. To this purpose, all you have to do is to assign its parameter number to the desired output to 1600 *PWMOut1_Assign*. This makes sense only for measurement or indication values with a value range greater than [0,1], but in the control itself no limitations are implemented.

Signal output can be inverted (e.g., small PWM ratio for high speeds) by entering the parameter numbers negative in sign. The effect of the parameter number being entered with a negative sign will be that there is a long high-phase for small output values and a short high-phase for large ones.

Parameterizing Example:

PWM output 1 is to be used to read out speed (indication parameter 2000 *Speed*), and output 2 to read out injection quantity (indication parameter 2350 *FuelQuantity*).

Number	Parameter	Value	Unit
1600	*PWMOut1_Assign*	*2000*	
1605	*PWMOut2_Assign*	*2350*	

20.6.2 Value range of output parameters

When values are to be read out, it will sometimes not be the entire range that is of interest but only a restricted one. Therefore, output via the first PWM output can be adapted to the desired range by means of parameters 1603 *PWMOut1_ValueMin* and 1604 *PWMOut1_ValueMax*. As there are a great many different value ranges, these parameters are to be set to the required low and high output values specified in per cent of the value range of the respective output parameter.

If the entire value range is required, the minimum value is to be set to 0 % and the maximum value to 100 %.

Parameterizing Example:

Actual speed 2000 *Speed* is to be read out via a PWM output, restricted to the range from 500 rpm to 1500 rpm. i.e., 500 rpm correspond to 5 % and 1500 rpm correspond to 95 %. As the values of this parameter have a range from 0 to 4000 rpm, output will have to be adapted:

$$PWMOut1\_ValueMin = \frac{500}{4000} * 100\% = 12,5\%$$

$$PWMOut1\_ValueMax = \frac{1500}{4000} * 100\% = 37,5\%$$

Number	Parameter	Value	Unit
1600	*PWMOut1_Assign*	*2000*	
1603	*PWMOut1_ValueMin*	*12.5*	*%*
1604	*PWMOut1_ValueMax*	*37.5*	*%*

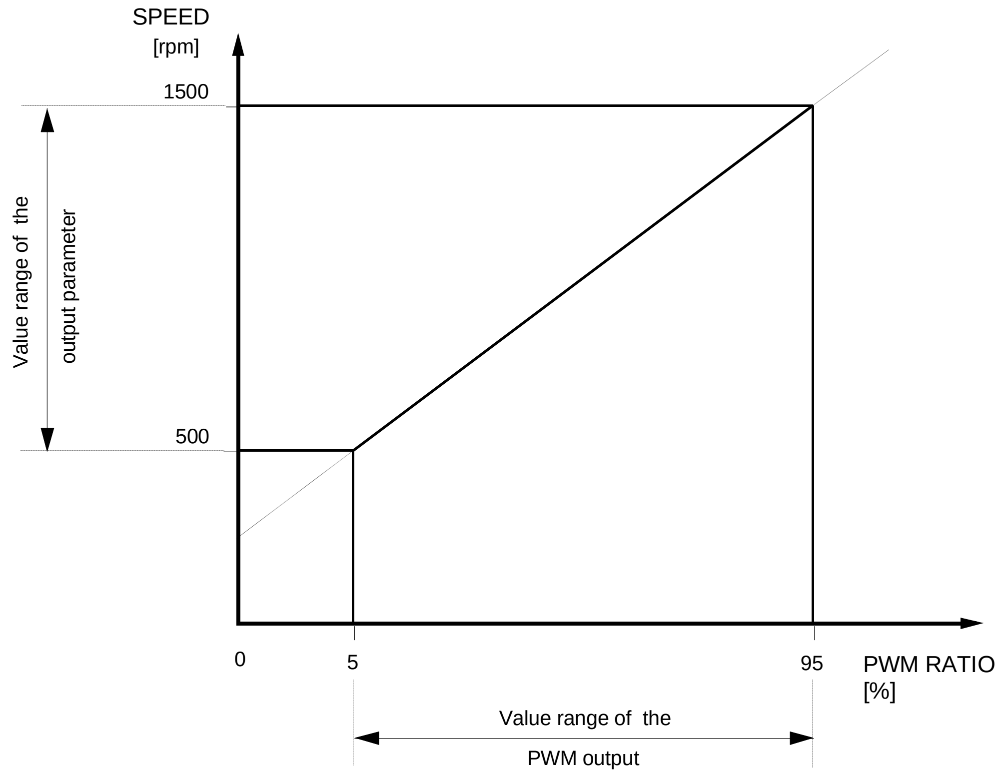

Fig. 46: Reading out a parameter via a PWM output

20.6.3 Value range of PWM outputs

Normally, only a PWM ratio between 5 % and 95 % will be required.

To adapt the output range of the first PWM output the parameters 1601 *PWMOut1_RefLow* and 1602 *PWMOut1_RefHigh* are to be used. The limit values may be specified directly in per cent PWM ratio.

The frequency of the PWM signals can be jointly adjusted for all outputs by means of the parameter 1625 *PWMOutFrequency*. For the power output (PWM output 5) of the control unit HELENOS (↑ *Table 44: HELENOS: PWM outputs*) the frequency is determined separately with parameter 1626 *PowerOutFrequency*.

<u>Parameterizing Example:</u>

Actual speed 2000 *Speed* is to be read out via PWM output 1 using a pulse-pause-ratio of 5..95 %. Only the range from 500 rpm to 1500 rpm is to be output, i.e. 500 rpm will correspond to 5 % and 1500 rpm to 95 % PWM ratio. Frequency is to be set to 500 Hz.

Number	Parameter	Value	Unit
1600	*PWMOut1_Assign*	*2000*	
1601	*PWMOut1_RefLow*	*5*	*%*
1602	*PWMOut1_RefHigh*	*95*	*%*
1603	*PWMOut1_ValueMin*	*12.5*	*%*
1604	*PWMOut1_ValueMax*	*37.5*	*%*
1625	*PWMOutFrequency*	*500*	*Hz*

20.7 Dedicated alarm outputs

The control units of the PRIAMOS and HELENOS series provide dedicated outputs that have been pre-configured for indication of errors and overspeed.

With both series, the overspeed output is provided as a relay output to enable a separate overspeed protection to be activated by this output. For a description of how to adjust overspeed, chapter ↑ *6.4 Overspeed monitoring* offers a description of adjustment of overspeed and of the control unit's response to overspeeding.

As to its meaning, the output "Control unit operative" is identical with the overspeed output and serves to indicate that no fatal error such as overspeed has occurred and that the governor is able to control engine speed.

The common alarm output is activated when the control has detected at least one error. The output may be used for a visual or audible signal. The common alarm output is described in detail in the chapter ↑ *27.3.1 Common alarm output*, which will also deal with the possible error causes.

Note

When initializing the PRIAMOS system, the common alarm output is activated for about 500 ms.

20.8 Digital outputs

A digital output may be assigned to each measurement or indication value with value range [0,1] in parameter list 2. Two variants are possible, only one of which is implemented in the firmware of the control unit. Either each digital output is assigned exactly one output value (so called simple allocation) or several values may be assigned to each digital output (so called multiple allocation – only on request).

The values currently output are displayed by parameter 2851 *DigitalOut1* and subsequent parameters.

Note

The parameter settings described in the following sections – in particular multiple allocation – can be achieved in an easy and comfortable way using a dedicated window of DcDesk 2000. In addition, this window allows to conduct a test of the digital output's connections.

20.8.1 Simple allocation

Assignment is made by means of the parameters starting from 851 *DigitalOut1_Assign*. The parameter numbers of the desired measuring values must be entered there. If inverted output of the measurement is desired, the number of the measuring parameter is to be entered negative in sign.

Parameterizing Example:

Output 1 is to indicate "Fuel quantity limited by boost pressure" (↑ 2714 *BoostLimitActive*) and output 2 to indicate "Oil pressure warning" (↑ 3030 *ErrOilPressWarn*). You wish output 3 to be active as long as engine start has not been enabled (i.e., as long as ↑3806 *EngineRelease* has not been activated).

Number	Parameter	Value	Unit
851	*DigitalOut1_Assign*	*2714*	
852	*DigitalOut2_Assign*	*3030*	
853	*DigitalOut3_Assign*	*-3806*	

20.8.2 Multiple allocation

Using multiple allocation, up to 8 output values may be assigned to each digital output. The maximum amount is defined in the firmware and cannot be augmented. But it is possible to use less values than the maximum.

This type of allocation makes sense whenever it is necessary to visualize a number of error parameters greater than the number of available digital outputs. The related parameter numbers must be entered in the parameter fields starting from 8800 *DigitalOut1:Param(0)..(7)*. If you wish to negate an allocation parameter, its parameter number must be entered with negative sign.

The current values of these single output parameter now may either be linked by logic operator for output on the digital output or configured to produce different blinking codes. The preferred alternative may be chosen separately for each digital output.

To do this, indicate the logical link you wish to use or the value 80 Hex if your prefer a blinking code in the parameters starting from 4851 *DigitalOut1:Logic.*

If only one parameter is to be assigned to an output (as in simple allocation) a "0" must be entered in the respective parameter starting from 4851 *DigitalOut1:Logic*.

20.8.3 Logical operators

The value for the logical operation in 4851 *DigitalOut1:Logic* consists of single bits. Bit value 0 corresponds to the logic operator AND and bit value 1 to the logic operator OR. The lowest bit represents the operator between the allocation parameters 1 and 2, the following bit between assignment parameters 2 and 3 and so forth. With a maximum of eight allocation parameters this allows a maximum of seven operators, equivalent to a value between 0 and 7F Hex. The processing sequence is from the lowest to the highest allocation parameter. Bracketing is not possible.

20.8.3.1 Blinking signals

If, instead of a logical operation the value 80 Hex was entered in 4851 *DigitalOut1:Logic*, the digital output visualizes blinking signals. If the first allocation parameter is active, the output emits the following blinking signal:

2 short,* ***1* long,*** *2* short*

for the second allocation parameter

2 short,* ***2* long,*** *2* short*

for the third

2 short,* ***3* long,*** *2* short*

and so on. In between signals there is a pause to better distinguish the single errors. If, for instance, both the first and the third allocation parameters are active, the resulting blinking signal is as follows:

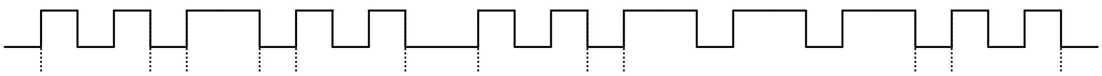

Fig. 47: Blinking signal

By counting along with the long blinks it is possible to determine which parameter is active. The operator of the system must be informed which type of blinking signal is assigned to which error.

20.8.3.2 Blinking and continuous light

Operators frequently wish to visualize error messages in form of blinking signals, and to allocate a continuous light to one or more specific errors of particular importance (values with high priority). The parameters starting from 4880 *DigitalOut1:Prior* can be used for this purpose.

Each set bit means that the active state of the related parameter in 8800 *DigitalOut1:Param(0)..(7)* is to generate a continuous light on the digital output. All other values with a 0 in the priority bit continue to generate blinking signals – please note that these are visible only if no value of higher priority is active.

It is recommended to start the allocation of parameter numbers to the digital output from the blinking signals and to put the ones with high priority at the end of the field.

<u>Parameterizing Example:</u>

The control unit allows to indicate up to four parameters for each digital output.

- output 1 is to
  blink once if oil pressure is too low (3030 *ErrOilPressWarn*),
  blink twice if coolant temperature is too high (3032 *ErrCoolantTempWarn*),

blink thrice if exhaust gas temperature is too high (3041 *ErrExhaustTempWarn*),
be lit continuously if oil pressure is so low that engine has to be stopped (3031 *ErrOilPressEcy*)

- we want output 2
  to indicate pick-up errors (3001 *ErrPickUp1* or 3002 *ErrPickUp2*)
- output 3 is to be
  active as long as engine start has not been enabled (i.e., as long as 3806 *EngineRelease* has not been activated).

Number	Parameter	Value	Unit
4851	*DigitalOut1:Logic*	*80*	*Hex (blinking)*
4852	*DigitalOut2:Logic*	*01*	*Hex (logical OR)*
4853	*DigitalOut3:Logic*	*00*	*Hex (single parameter)*
4880	*DigitalOut1:Prior*	*08*	*Hex (continuously lit 4th parameter)*
4881	*DigitalOut2:Prior*	*00*	*Hex (not used)*
4882	*DigitalOut3:Prior*	*00*	*Hex (not used)*
8800	*DigitalOut1:Param(0)*	*3030*	
8801	*DigitalOut1:Param(1)*	*3032*	
8802	*DigitalOut1:Param(2)*	*3041*	
8803	*DigitalOut1:Param(3)*	*3031*	
8810	*DigitalOut2:Param(0)*	*3001*	
8811	*DigitalOut2:Param(1)*	*3002*	
8812	*DigitalOut2:Param(2)*	*0*	
8813	*DigitalOut2:Param(3)*	*0*	
8820	*DigitalOut3:Param(0)*	*-3806*	
8821	*DigitalOut3:Param(1)*	*0*	
8822	*DigitalOut3:Param(2)*	*0*	
8823	*DigitalOut3:Param(3)*	*0*	

20.8.4 XIOS

20.8.4.1 Analogue outputs

The example shows parametrisation as performed on port 1.

Parameter	Meaning
30020 *P001_(1.1)_IO_RefLow*	Lower reference value, e.g. 0.5 V or 4 mA
30021 *P001_(1.1)_IO_RefHigh*	Upper reference value, e.g. 4.5 V or 20 mA

Table 106: XIOS – analogue outputs

20.8.4.2 PWM outputs

The example shows parametrisation as performed on port 1.

Parameter	Meaning

Parameter	Meaning
30020 *P001_(1.1)_IO_RefLow*	low duty cycle, e.g. 10 %
30021 *P001_(1.1)_IO_RefHigh*	high duty cycle, e.g. 90 %
30025 *P001_(1.1)_PO_Freq*	Output frequency

Table 107: XIOS – PWM outputs

20.8.5 Other control units

20.8.5.1 Analogue outputs

The analogue outputs can be designed as current outputs or voltage outputs. However, for the voltage outputs in particular, it is usually not the maximum output range of approx. 0…22 mA that is desired but the standard output range of 4…20 mA.

The parameters

1641 *AnalogOutx_RefLow*

1642 *AnalogOutx_RefHigh*

are available for adjusting the output range. The value to be entered relates to the maximum output value and must be specified in per cent for DC 1 and DC 2 type control units. In all other control units, the output range can be parametrised in the electrical unit itself.

Note

The definition of the connection type (current or voltage) cannot be altered during operation. It will therefore be necessary to save the parameters (↑3.2 Saving data) and reset the control unit (↑3.10 Reset of control unit) after configuration. The value ranges of analogue outputs must then be adapted to the newly selected electric unit.

Parametrization example:

A value is to be output over a current output with 4..20 mA.

Parametrization example DC 1/DC 2:

$$1641\ \text{CurrentOut1\_RefLow} = \frac{4}{22} * 100\% = 18{,}2\%$$

$$1642\ \text{CurrentOut1\_RefHigh} = \frac{20}{22} * 100\% = 90{,}9\%$$

Number	Parameter	Value	Unit
1641	*CurrentOut1_RefLow*	*18.2*	*%*
1642	*CurrentOut1_RefHigh*	*90.9*	*%*

Due to component tolerances of the series DC 1 and DC 2 the output range for the same parameter values may differ from one control unit to the next. To ensure accuracy of output, the output ranges should be measured and the parameters adjusted accordingly. When copying parameters from one control unit to another, these configuration values must therefore be excluded or at least noted down separately and transferred back.

Parametrization example otherwise:

Number	Parameter	Value	Unit
1641	*CurrentOut1_RefLow*	*4,00*	*mA*
1642	*CurrentOut1_RefHigh*	*20,00*	*mA*

20.8.5.2 PWM outputs

A PWM ratio of between 10 and 90 % is normally desired. The parameters 1601 *PWMOut1_RefLow* and 1602 *PWMOut1_RefHigh* should be used to adjust the output range. The limits are entered directly as a percentage of the PWM ratio.

On the DC 7, there are two separate frequency parameters 1625 *PWMOut1_Frequency* and 1626 *PWMOut2_Frequency* for the two PWM outputs.

For the power output (PWM output 5) of the control unit DC 2, the frequency is determined separately with parameter 1626 *PowerOutFrequency*.

Otherwise, the frequency of the PWM signals can be set for all PWM outputs together with the parameter 1625 *PWMOutFrequency*.

Parametrization example:

PWM output 1 should be operated with 5..95 % pulse-pause ratio. A frequency of 500 Hz must be set.

Number	Parameter	Value	Unit
1601	*PWMOut1_RefLow*	*5*	*%*
1602	*PWMOut1_RefHigh*	*95*	*%*
1625	*PWMOutFrequency*	*500*	*Hz*

21 Technical data

21.1 ARCHIMEDES

The system ARCHIMEDES is based on DC 5 type control units. To these control units the following technical data apply.

21.1.1 General

Rated voltage	12 V DC or 24 V DC,
Min. voltage	8 V DC (for a short time during engine start)
Reverse polarity protection	yes
Max. voltage	32 V DC
Current consumption	max. 7 A, max. 11 A for max. 60 seconds
Fuse protection of control unit	35 A
Storage temperature	-40°C to +85°C
Operating temperature range	-40°C to +80°C
EMI	Directives RL95/54/EC, EN13309, ISO13766, EN55011 K1.A, EN50081-2 CE: EN 61000-6-2, Road vehicles, resistance to electric disturbances: ISO 11452-2, -5 Road vehicles, impulses: ISO 7637-2, ISO 7637-3

21.1.2 Inputs and outputs

2 measured speed inputs	for inductive sensors, with f_i = 25 to 9000 Hz, U_i = 0.5 to 30 V AC R_{pu} = 10 kΩ
Analogue inputs 1..4	U = 0..5 V, R_e = 220 kΩ, f_g = 15 Hz
Analogue input 5	U = 0..5 V, R_e = 100 kΩ, f_g = 15 Hz or I = 4 .. 20 mA, V_{source} > 7 V, R_e = 200 Ω, f_g = 15 Hz
Analogue input 6	U = 0..37 V, R_e = 34.8 kΩ, f_g = 15 Hz
Temperature inputs 1..4	for PT1000, NI1000 or NTC
4 reference voltages for	U_{ref} = 5 V ±125mV, I_{ref} < 30 mA analogue inputs 1..4 and temperature inputs 1..4
Digital inputs 1..6	U_0 < 1 V, U_1 > 6 V, R_{pd} = 64 kΩ
Digital inputs 1..6	together optionally $R_{pu/pd}$ = 4.75 kΩ, on request
Digital input 7	U_0 < 1 V, U_1 > 6 V, R_{pd} = 64 kΩ, optional $R_{pu/pd}$ = 4.75 kΩ, on request
Digital input 8	U_0 < 1 V, U_1 > 6 V, R_{pd} = 64 kΩ, optional $R_{pu/pd}$ = 4.75 kΩ, on request
PWM output 1..2	I_{sink} < 0.43 A, low-side switching
PWM output 3	I_{sink} < 1.3 A, low-side switching

Digital outputs 1..4	I_{source} < 2.5 A, high-side
Digital outputs 5..6	I_{source} < 12 A, high-side
Digital output 7	I_{sink} < 0.43 A, low-side switching
Switching output error lamp	I_{sink} < 0.43 A, low-side switching
Operating magnet output	I < 7 A, I < 11 A for T < 60 s, PWM
Actuator travel monitoring	inside actuator, with reference feedback
Serial communication	HZM interface, up to 57600 baud
CAN communication	ISO/DIS 11898, standard/extended identifier, baud rate up to 1 MBit/s
Modbus communication	RS 232

21.2 HELENOS

The system HELENOS is based on DC 2-01 type control units. It is suited for connection of HEINZMANN actuators and the Bosch EDC pump. To these control units the following technical data apply.

21.2.1 General

Rated voltage	24 VDC (12 VDC special variant on request)	
Min. voltage	9 V DC (for a short time during engine start)	
Max. voltage	35 V DC	
Residual ripple at max. current	max. 10% at 100Hz	
Fuse protection of control unit	16 A	
Max. current consumption	200 mA + actuator current	
Storage temperature	-55°C to +85°C	
Operating temperature range	-40°C to +70°C	
Air humidity	up to 98% % at 55°C, condensing	
Shock	50 g, 11 ms- half sine	
Isolation resistance	> 1 MOhm at 48 V DC	
Protection grade	DC ...2 - 01 - 00	IP 00
	DC ...2 - 01 - 55	IP 55
Weight	DC ...2 - 01 - 00	approx. 1.2 kg
	DC ...2 - 01 - 55	approx. 3 kg
EMI	EN 50081-1, EN50082-2	

21.2.2 Inputs and outputs

2 speed inputs	for inductive sensors, f_i = 25..9000Hz, U_i = 0.5..30VAC for hall sensor on request
Actuator output	PWM with 2000Hz, I_{eff} < 6.4A
Reference voltage for setpoint adjuster	U_{ref} = 5VDC I_{max} = 20mA (10mA 12V variant)

Actuator travel monitoring	inside actuator with reference feedback $U_{Reg.weg}$ = 1.4..3.0V, U_{ref} = 8 VDC, I_{ref} < 20mA
1 temperature input	for PT 1000 (PT 200, NTC on request PT 200: measuring range 100°C..850°C)
1 temperature input	for NTC (PT1000, PT200 on request PT 200: measuring range 100°C..850°C)
2 analogue voltage inputs	U = 0..5V, f_g = 16 Hz for use with LMG 10 and SyG 02 on request current input on request
2 analogue current inputs	I = 4..20mA, f_g = 16 Hz voltage inputs on request
4 digital inputs	R_{pd} = 2.2kΩ, f_g = 160 Hz
4 digital/PWM inputs/outputs	R_{pu} = 2.2kΩ, I_{sink} < 0.1A, f_g = 160Hz - as inputs, low-side switching with internal pull-up - for outputs the relay interface RIF 01 is available, that respects the strict bus driver specification on the HELENOS side and on the output side allows a maximum current of 3 A at 24 V. Ordering Number: 620-00-041-00.
2 analogue current outputs	I_{out} = 0..22.5mA, R_{max} = 470Ω (125Ω 12 V variant)
2 analogue voltage outputs	U_{out} = 0..5V or 0..10 V (configurable), R_{min} = 250Ω (500Ω 12 V variant)
1 PWM output	I_{sink} < 3 A low-side switching
2 switching outputs error lamp	I_{sink} < 3 A high-side switching
Serial interface	HZM interface, up to 57600 baud
CAN communication	on request, ISO/DIS 11898, standard/extended identifier, baud rate up to 1 MBit/s
Modbus communication	on request, RS 232 and RS 485

21.3 PANDAROS

The system PANDAROS is based on DC 6 type control units. To these control units the following technical data apply.

21.3.1 General

Rated voltage	12 V DC or 24 V DC,
Min. voltage	9 V DC (for a short time during engine start)
Max. voltage	32 V DC
Current consumption	max. 7 A max. 11 A for max. 60 secs
Fuse protection of control unit	12 A

Storage temperature	-40°C to +85°C
Operating temperature range	-40°C to +80°C
Operating temperature LCD	0°C to +50°C optionally -20°C to +70°C
Air humidity	up to 98% % at 55°C, condensing
Vibration	max. ±1.75 mm maximum at 10 to 21 Hz, max. 0.24 m/s maximum at 21 to 45 Hz max. 7 g at 45 to 400 Hz
Shock	30 g, 11 ms- half sine
Protection grade	IP 00
Insulation resistance	> 1 MOhm at 48 V DC
Weight	approx. 0.5 kg
EMI	EMI directives: 89/336/EEC, 95/54/EEC CE: EN 61000-6-2, EN 61000-6-4 Road vehicle: resistance to electric disturbances ISO 11452-2, -5 Road vehicle, impulses: ISO 7637-2, ISO 7637-3

21.3.2 Inputs and outputs

All inputs and outputs are reverse polarity protected and short-circuit-proof against battery plus and minus.

2 Speed inputs	- for inductive sensor - for Hall sensor or terminal W with f_i = 25 to 9000 Hz, U_i = 0.5 to 30 V AC
Temperature input	PT1000/NTC U_i = 0..5V, R_i = 1.2 kΩ
Reference voltage setpoint adjuster	U_{ref} = 5 V ±125mV, I_{ref} < 30 mA
Setpoint adjustment analogue	U = 0..5 V, R_e = 100 kΩ, f_g = 15 Hz or I = 4 .. 20 mA, R_e = 200 Ω, f_g = 15 Hz
Setpoint adjustment digital 1	U_0 < 1 V, U_1 > 6 V, R_{pd} = 100 kΩ
Setpoint adjustment digital 2	U_0 < 1 V, U_1 > 6 V, R_{pd} = 100 kΩ, optionally $R_{pu/pd}$ = 4.75 kΩ
Digital input engine stop	U_0 < 1 V, U_1 > 6 V, R_{pd} = 100 kΩ, optionally $R_{pu/pd}$ = 4.75 kΩ
Actuator travel monitoring	inside actuator, with reference feedback
Operating magnet output	I < 7 A, I < 11 A for T < 60 s, PWM
Digital output error lamp	I_{sink} < 0.3 A, low-side switching
2 multifunctional ports:	
Voltage input	U_e = 0..10 V, R_e = 20 kΩ, f_g = 15 Hz
or voltage input	U_e = 0..5 V, R_e = 100 kΩ, f_g = 15 Hz
or current input	I_e = 4 .. 20 mA, R_e = 200 Ω, f_g = 15 Hz
or digital input	U_0 < 1 V, U_1 > 6 V, R_{pd} = 100 kΩ, optionally $R_{pu/pd}$ = 4.75 kΩ

or current output	I_a = 4 .. 20 mA
or digital output	I_{sink} < 0.3 A, low-side switching
	optionally $R_{pu/pd}$ = 4.75 kΩ
Serial communication	HZM interface, up to 57600 baud
CAN communication	ISO/DIS 11898, standard/extended identifier, baud rate up to 1 MBit/s

21.4 ORION

The digital system ORION is based on DC 9 type control units. To these control units the following technical data apply.

21.4.1 General

Operating voltage	12 V DC or 24 V DC,
Max. voltage	32 V DC
Min. voltage	9 V DC (for a short time during engine start)
Fuse protection of control unit	12 A
Current consumption total	max. 5 A
	in stable state 1.7 A
Storage temperature	-40°C to +85°C
Ambient temperature during operation	-40°C to +80°C
Air humidity	up to 98% % at 55°C, condensing
Vibration	max. ±1.75 mm at 10 to 21 Hz,
	max. 0.24 m/s at 21 to 45 Hz
	max. 7 g at 45 to 400 Hz
Shock	30 g, 11 ms- half sine
Protection grade	IP 00
Insulation resistance	> 1 MOhm at 48 V DC
Weight	approx. 0.5 kg
EMI	EMI directives: 89/336/EEC
	CE: EN 61000-6-2, EN 61000-6-4

21.4.2 Inputs and outputs

All inputs and outputs are reverse polarity protected and short-circuit-proof against battery plus and minus.

2 Speed inputs	- for inductive sensor
	- for Hall sensor or terminal W
	with f_i = 25 to 9000 Hz, U_i = 0.5 to 30 V AC
Actuator travel monitoring	inside actuator, with reference feedback
Operating magnet output	I_{max} = 6.4 A, I_{dauer} = 3.5 A
Digital output error lamp	I_{sink} < 0.3 A, low-side switching
Reference voltage setpoint adjuster	U_{ref} = 5 V ±125mV, I_{ref} < 30 mA

Input terminal 7	analogue 0..5 V or 4..20 mA or digital $U_0 < 1$ V, $U_1 > 6$ V, $R_{pd} = 100$ kΩ
Analogue input terminal 4	0..5 V
Digital input terminal 9	$U_0 < 1$ V, $U_1 > 6$ V, $R_{pd} = 100$ kΩ
Digital input terminal 11	$U_0 < 1$ V, $U_1 > 6$ V, $R_{pd} = 100$ kΩ
Serial communication	HZM interface, up to 57600 baud

21.5 PRIAMOS

The system PRIAMOS is based on DC 1-03 type control units. It is suited for connection of HEINZMANN actuators and the Bosch EDC pump. For these control units the following technical data apply.

21.5.1 General

Rated op. voltage 1 (electronics)	24 V DC
Min. voltage	8 V DC (5 V DC for t <10s) If supply voltage can fall below 8V for a prolonged period of time, an undervoltage protection is required; a stable 5V supply to external sensors is not guaranteed in this case.
Max. voltage	33 V DC
Current consumption	typically 250mA @ 24V (w/o CAN module) typically 0.68A @ 8V
Rated op. voltage 2 (end stage)	36 V DC STG90 requires a voltage limiter SBG01 to limit return voltage
Min. voltage	18V DC (36V DC for STG90)
Max. voltage	40 V DC
max. current consumption	12A peak for t<0.1s
Residual ripple at max. actuator current	max. 10% @ 100Hz
Admissible voltage drop at max. power consumption	max. 10 % at control unit
Fuse protection of control unit	electronics 3A end stage 16A
Storage temperature	-55°C to +85°C
Operating temperature range	-40°C to +70°C
Air humidity	up to 98% % at 55°C, condensing
Vibration	≤ 1g , ≤ 100Hz
Shock	50 g, 11 ms- half sine
Protection grade	IP 55
Insulation resistance	> 1 MOhm at 100 V DC

Weight	approx. 3 kg
EMI	EN 55011:1991-03 prEN50082-2:1994-08 GL Type-Approval-1:1993 DIN 40839 and VDE0879

21.5.2 Inputs and outputs

Speed inputs	2 * for inductive sensor (hall sensor on request) f_i = 30..10kHz, U_i = 0.5..30VAC , f_g = 4.2kHz operating frequency range 200..6000Hz
Actuators output	1 * max. 9A / 12A peak
Actuator travel monitoring	inside actuator with reference feedback $U_{Reg.weg}$ = 1.6..2.8V, U_{ref} = 7.5VDC, I_{ref} < 10mA or PWM f. EDC pump
Reference voltage for setpoint adjuster	
	2 * 5V DC ≤30mA @24V (15mA @12V DC) rated operating voltage
Power supply for handheld programmer	
	8.2V / 100mA
Reference voltage for setpoint potentiometers	
	U_{ref} = 5 V DC, I_{max} = 20 mA (10 mA)
Temperature inputs	1 * Ni1000 -50...+150°C 1 * NTC -40...110°C
Digital inputs	10 * 24VDC electroplated sep. with common ground R_E = 5.7kΩ, f_g = 300Hz, “0” ≤ 2V DC, “1” ≥5.5V DC
PWM inputs	1x 5V..24V R_E = 10kΩ, f_g = 3kHz 1x 5V..10V R_E = 2kΩ, f_g = 10kHz
Analogue inputs	5 * 4..20mA (or 0..5V)
Analogue outputs	2 * 0..5V (and 4..20mA)
Digital outputs	1 * low-side switch 3A with current measurement 3 * low-side switches 2.5A (PWM) with recovery diode 1x high-side output 2A
Serial communication	HZM interface, up to 57600 baud
CAN communication	ISO/DIS 11898, standard/extended identifier, baud rate up to 1 MBit/s

21.6 PRIAMOS III

The system PRIAMOS III is based on DC 1-04 type control units. It is suited for connection of HEINZMANN actuators and the Bosch EDC pump. To these control units the following technical data apply.

21.6.1 General

Rated operating voltage 1 (electronics)	24 V DC
Min. voltage	8 V DC (5 V DC for t <10s) If supply voltage can fall below 8V for a prolonged period of time, an undervoltage protection is required; a stable 5V supply to external sensors is not guaranteed in this case.
Max. voltage	33 V DC
Current consumption	typically 320mA @ 24V (w/o CAN module) typically 1A @ 8V DC
Rated operating voltage 2 (end stage)	36 V DC STG90 and STG180 require a voltage limiter SBG01 to limit return voltage
Min. voltage	18V DC (36V DC for STG90, STG180)
Max. voltage	40 V DC
Max. current consumption	24A peak for t<0.1s
Residual ripple at max. actuator current	max. 10% @ 100Hz
Admissible voltage drop at max. power consumption	max. 10 % at control unit
Fuse protection of control unit	electronics 3A end stage 16A
Storage temperature	-55°C to +85°C
Operating temperature range	-40°C to +70°C
Air humidity	up to 98% % at 55°C, condensing
Vibration	≤ 1g , ≤ 100Hz
Shock	50 g, 11 ms- half sine
Protection type	IP 55
Insulation resistance	> 1 MOhm at 100 V DC
Weight	approx. 5 kg
EMI	EN 55011:1991-03 prEN50082-2:1994-08

21.6.2 Inputs and outputs

Speed inputs	2 * for inductive sensor (hall sensor on request) f_i = 30..10kHz, U_i = 0.5..30VAC , f_g = 4.2kHz operating frequency range 200..6000Hz
Actuator outputs	3 * max. 9A / 12A peak
Actuator travel monitoring	inside actuator with reference feedback 1 * $U_{Reg.weg}$ = 1.6..2.8V, U_{ref} = 7.5VDC, I_{ref} < 10mA or PWM f. EDC pump 2 * $U_{Reg.weg}$ = 1.6..2.8V, U_{ref} = 7.5VDC, I_{ref} < 30mA
Reference voltage for setpoint adjuster	2 * 5V DC ≤30mA @24V (15mA @12V DC) rated operating voltage
Power supply for handheld programmer	8.2V / 100mA
Reference voltage for setpoint potentiometers	U_{ref} = 5 V DC, I_{max} = 20 mA (10 mA)
Temperature inputs	1 * Ni1000 -50...+150°C 1 * NTC -40...110°C
Digital inputs	10 * 24VDC electroplated sep. with common ground R_E = 5.7kΩ, f_g = 300Hz, "0" ≤ 2V DC, "1" ≥5.5V DC
PWM inputs	1x 5V..24V R_E = 10kΩ, f_g = 3kHz 1x 5V..10V R_E = 2kΩ, f_g = 10kHz
Analogue inputs	8 * 4..20mA (or 0..5V)
Analogue outputs	2 * 0..5V (and 4..20mA)
Digital outputs	1 * low-side switch 3A with current measurement 3 * low-side switches 2.5A (PWM) with recovery diode 1x high-side output 2A 2x low-side switches 500mA with recovery diode
Serial communication	HZM interface, up to 57600 baud
CAN communications	ISO/DIS 11898, standard/extended identifier, baud rate up to 1 MBit/s

21.7 XIOS

The technical data of this highly complex control unit is described in detail in ↑ *XIOS universal control unit and extended I/O-modules, publication no. UC 14 001-d.*

21.7.1 Terminal 15

The XIOS control units from revision 7 are equipped with a so-called "terminal 15" function (in automotive electrics, the terminal designation is an ID number to make connecting cables easier. In Germany, the terminal designations are standardized in the DIN 72552.)

"Terminal 15" is a switched plus which is used to switch on the control unit. Even if the supply to the power section and the electronics is ensured, the control unit cannot be switched on without this contact.

If terminal 15 is removed, the control unit is not deactivated automatically, but enters a so-called follower control, where the engine is stopped immediately first of all and other tasks, such as saving the operating hours counter, are completed. Only then does the control unit switch off automatically.

The status of terminal 15 can be seen on parameter 3790 *IgnitionOn*. If this value is zero and the control unit is not yet deactivated, it is in follower control.

We strongly recommend shutting down the control unit via the terminal 15. A direct switch-off of the supply to the power section and the electronics prevents follower control from being carried out and may therefore only be carried out in absolute emergencies.

21.7.2 Terminal RC

The control units XIOS from revision 7 are equipped with a so-called "terminal RC" – "Ripcord" function. With the "Ripcord" function, the amplifiers are switched off in the hardware if a voltage over +8 V is measured on the terminal RC. If the voltage is below +3 V, the amplifiers work in normal operation. This means that there is the option of triggering an immediate shut down of the amplifiers externally. HEINZMANN recommends that the quick-closing valve should also be activated if the diesel supply is specified via one or several amplifiers.

On dual-fuel engines, the gas supply must be interrupted first before the diesel actuator is switched off for safety reasons!

22 Integrated control elements

22.1 Push buttons in PANDAROS and ORION series

On the left edge of the control unit's circuit board – above the 9-pin communication plug – there is a push button that can be used to request automatic actuator adjustment.

22.2 Rotary switches in PRIAMOS series

On the pc board of the control unit - immediately beside the seven-segment display and the LED display - a rotary switch is located which can be used to implement application specific functions. The current value of the rotary switch is displayed in parameter 2800 *RotarySwitch*. It can be read out only on turning the control on.

If the rotary switch is in position "1" (2800 *RotarySwitch* = 1) during the control unit's start-up or reset, an automatic actuator calibration will be carried out once.

23 Bus Protocols

In many cases, data may have to be transferred from the control unit to an external device via a communication bus or it may be necessary to receive sensor values and/or switching functions from the external device. To this end, almost all HEINZMANN control units have at least one CAN bus interface, and sometimes also Modbus interfaces.

The control units DC 1 and DC 2 may be equipped with an add-on board featuring a CAN controller and corresponding CAN protocol. The add-on board of the DC 2 control unit also features an interface switchable from RS232 to RS485 and back, making it possible to have either a Modbus point-to-point connection or integration in a Modbus system in addition to the CAN protocol.

The DC 5 control unit features two integrated CAN controllers and an additional RS232 interface, allowing two CAN protocols and a Modbus point-to-point connection at the same time.

The DC 9 control unit is a stand-alone system that cannot be connected to a bus system, neither a CAN bus nor a Modbus system.

All other control units are equipped with an integrated CAN controller, but have no Modbus interface except for the XIOS.

	CAN controller	**Modbus interface**
DC 1	1 (on request)	-
DC 2	1 (on request)	RS232/RS485 (on request)
DC 5	2	RS232 (on request)
DC 6, DC 7	1	-
DC 8	1 (+1 on request)	-
DC 9	-	-
DC 10, DC 11, DC 12	1	-
XIOS	2	RS485

Table 108: Bus interfaces

The hardware interface is just one side of the coin. The most important thing is which protocol is running on the bus. ↑ *Tab. 2: Bus protocols* lists which firmware variants are implemented or can be integrated on request.

A CAN controller is normally able to run only one of the listed CAN protocols. If the HZM-CAN protocol is used, however, it will nevertheless be possible to use one of the two 11-bit protocols (CANopen or DeviceNet) on the same bus – if busload is high, a gateway may be required.

Bus system	Protocol	Note
CAN 29 bit identifier	HZM-CAN	between all digital HEINZMANN devices
	SAE J1939	standard for automotive applications
CAN 11 bit identifier	CANopen	CANopen slave, 12 additional TPDOs
	DeviceNet	slave in predefined master / slave connection set
	WAGO®	CANopen master
	ICENI®	CANopen master
Serial RS232	Modbus	Point-to-point connection
Serial RS485		Bus system

Table 109: Bus protocols

On request, customer-specific protocols can be integrated at any time if the hardware requirements are met.

The firmware variants of the HEINZMANN basic software can also be delivered with one of the above protocols as standard. A relevant protocol ID is added to the version number yy of the software number 00.yy.zz:

Protocol	ID
HZM-CAN customer module	50
Modbus	60
DeviceNet	70
SAE J1939	80
CANopen	90

Table 110: Firmware variants with bus protocols

The generator application 00.3.zz therefore becomes e.g. 00.63.zz if Modbus is implemented, or the vehicle application 00.1.zz becomes 00.81.zz if SAE J1939 is integrated. Otherwise, the function remains the same.

23.1 CAN protocol HZM-CAN

The HZM CAN protocol is a proprietary protocol for HEINZMANN control units and customer modules, i.e. customer units, which have been included in this protocol. It is based on the CAN specification 2.0B with a 29-bit identifier.

Each individual unit in the HZM-CAN bus is clearly identified by the defined unit type and the node number to be assigned via parametrisation.

The following unit types are defined:

ID	Meaning	Control unit
DC	Digital control	Speed governors
GC	GENERATOR CONTROL	GENERATOR CONTROL UNITS
PE	Peripheral extension	Extension modules
AC	Accessory control	Additional units
CM	Customer modules	Customer units (third-party units)
PC	Personal computer	Communication modules
ALL	All types except PE and PC	Used for transfers to all

Table 111: Node types

All parameters relating to the relevant unit type contain the specified letter ID in the parameter name e.g. 403 *Can**CM**NodeNumber* for the node number of a customer module or 404 *Can**PE**NodeNumber* and 407 *Can**PE**NodeType* for the node numbers and the node types of periphery modules to be connected.

The value 2 must be entered as a channel type for sensors and switching functions if they are received by a HZM-CAN periphery module. The value 14 must be entered if they come via a HZM-CAN multipoint connection. The communication between the HEINZMANN control units and the necessary parametrisation is described in detail in ↑ *Basic information HEINZMANN-CAN, publication no. DG 13 002-d*.

23.2 CAN protocol HZM-CAN customer module

Implementing the HZM-CAN protocol in external devices enables external access to measured and calculated values of the HEINZMANN control unit and also enables sensors and switching functions to be transferred to HEINZMANN control units.

The HEINZMANN control unit allows all receive and send values to be parametrized. The values of the customer modules in the CAN bus can be assigned to the relevant sensors or switching functions in the control unit. The value 8 must be entered as the channel type.

The implementation of the HZM-CAN customer module protocol in external devices is addressed in detail in *HZM-CAN customer module, publication no. DG 05 007-d*.

23.3 CAN protocol SAE J1939

The SAE J1939 protocol is a standard protocol used primarily in automotive applications. It describes both the way data is transmitted as the content of the data. In general, it is the firmware of the control device that decides which data can be received and sent. The single telegrams may be enabled and disabled with parameter settings. Each telegram source and transmission rate may be parametrized separately.

The HEINZMANN control unit allows all receive and send values to be parametrized. The values of the SAE J1939 modules in the CAN bus can be assigned to the relevant sensors or switching functions in the control unit. The value 7 must be entered as the channel type.

The SAE J1939 connection in the HEINZMANN control units is explained in *SAE J1939 Telegrams 2012-03-20* .

23.4 CAN protocol CANopen

The CANopen protocol is an open protocol with general validity for the most varied applications. It defines the way data is transmitted but not the contents of the resulting communication. Data transmission therefore must be agreed between the users on both sides. The HEINZMANN devices are designed as slaves in the predefined master/slave connection set. In addition to the standard four TPDOs, an additional 12 TPDOs are available on request.

The HEINZMANN control unit allows all receive and send values to be parametrized. The values of the CANopen master can be assigned to the relevant sensors or switching functions in the control unit. The value 4 must be entered as the channel type.

The parametrisation of the CANopen integration in the HEINZMANN control units is described in detail in *CANopen Implementation, publication no. DG 06 002-d* .

23.5 CAN protocol DeviceNet

The DeviceNet protocol is an open protocol with general validity for the most varied applications. It defines the way data is transmitted but not the contents of the resulting communication. The HEINZMANN control unit allows all receive and send values to be parametrized.

The HEINZMANN devices only support part of the complete protocol, the so called Predefined Master/Slave Connection Set. This establishes a master/slave connection, where all HEINZMANN devices act as slaves. The respective messages are exclusively Group 2 Messages, i.e. the HEINZMANN devices support only Group 2 Only Messages.

The HEINZMANN control unit allows all receive and send values to be parametrized. The values of the DeviceNet master can be assigned to the relevant sensors or switching functions in the control unit. The value 5 must be entered as the channel type.

The parametrisation of the DeviceNet integration in the HEINZMANN control units is described in *DeviceNet, publication no. DG 06 003-d*.

23.6 CAN protocol WAGO® (CANopen) and AXIOMATIC® (CANopen)

Under the parameter ID "Wago", the HEINZMANN control units act as a simple CANopen master, which is responsible for the communication with modules from the companies WAGO® and AXIOMATIC®.

At the current time, communication with the following WAGO modules from the 750 series is implemented, for which the field bus coupler CANopen 750-337 is required.

Type	Meaning	Order no.
0	Thermoelement (0.1°C per digit)	750-469
1	0-20 mA	750-452
	4-20 mA	750-454
3	PT100 / PT1000 (0.1°C per digit)	750-460-003

Table 112: WAGO® analogue input modules

Communication with the AXIOMATIC module AX030100/AX030101 (CANopen) is also possible:

Type	Meaning
2	0-5 V
4	4-20 mA
5	0-20 mA

Table 113: AXIOMATIC® analogue input modules

Additional modules can be added to these tables on request. In the HEINZMANN control unit, a maximum of 64 binary inputs and 76 sensor values can be received from these modules, although the actual maximum number is defined by the control unit firmware.

The parametrisation of the baud rate and the node numbers (identifiers) of the CANopen slaves in the master must be carried out for the CAN communication (HEINZMANN control unit).

21700 *Wago:Baudrate*

Permissible values for the baud rate are 125, 250, 500 and 1000 kBaud. All other values are set to 250 kBaud internally.

One or multiple node numbers are required depending on how many receipt telegrams RPDO are required to cover the connected modules. A node number (identifier) is always responsible for a group of four RPDO. Up to 64 binary inputs and three analogue inputs can be received via the first RPDO, the following RPDO transfer four analogue inputs each.

The node numbers (identifiers) start at the parameter value of

	21701 *Wago:SlaveID*	for max. 64 binary inputs and 3 analogue inputs
or	21701 *Wago:SlaveID+0_1*	for max. 64 binary inputs and 7 analogue inputs
	…	

or 21701 *Wago:SlvID+0_1_2_3_4* for 64 binary inputs and 19 analogue inputs.

This means that the number of identifiers specified in the parameter name is firmly agreed based on the parameter. These RPDOs are required to cover the fixed maximum number of inputs specified in the HEINZMANN control unit. It is important to note that these identifiers may not be used for other control units in the bus, even if fewer analogue inputs are read by the WAGO or AXIOMATIC module.

The transmission rate at which the WAGO or AXIOMATIC module should transmit the measured values to the master must be specified for each of the max. 20 RPDO (four per identifier). If only one group with 4 RPDOs is planned or required, the send rate is entered in

21702 *Wago:ModulSendRate*

otherwise, it is entered separately for each module:

21702 *Wago:SendRateDI01-64*

21703 *Wago:SendRateAI01-04*

21704 *Wago:SendRateAI05-08* etc.

The type from ↑ *Tab. 5: WAGO® analogue* input modules or ↑ *Tab. 6: AXIOMATIC® analogue* input modules is entered for each used input in the parameter from 25710 *Wago:ClampTypeAI1*. The channel numbering must be observed. For more than four RPDOs with 12 analogue inputs in total, the additional parameters are located from 25630 *Wago:ClampTypeAI13.*

The value range must also be parametrised for each input:

21710 *Wago:AI1_RefLow* lower reference value of the input

21711 *Wago:AI1_RefHigh* upper reference value of the input.

The receipt values of WAGO or AXIOMATIC modules can be assigned to the relevant sensors (or switching functions) in the control unit. The value 10 must be entered as the channel type.

23.7 CAN protocol ICENI® (CANopen)

Under the parameter ID ICENI, the HEINZMANN control units act as a simple CANopen master, which is responsible for the communication with modules from the company RE REGULATEURS EUROPA®. Documents on the ICENI system or its individual modules can be downloaded from the

http://www.regulateurseuropa.com/download-etm/cat_view/415-datasheets/408-iceni-distributed-system

website.

A maximum of 16 analogue or digital modules can be connected to each ICENI master module MA-02. Each module has up to 8 channels depending on the type.

The implementation in the HEINZMANN system has been achieved as follows:

The communication currently takes place with the "ICENI AI-03 T/C Inputs Module". There are a maximum of four modules.

"ICENI AI-03 T/C Inputs Module" has 4 temperature input channels and an internal reference temperature per module. Each input signal measures the sensor signal and calculates the temperature. This calculation includes a cold junction compensation.

The following sensor types are supported

E type: -50 °C to +1000 °C (-58 °F to 1832 °F)

J type: -50 °C to +1200 °C (-58 °F to 2192 °F)

K type: -50 °C to +1372 °C (-58 °F to 2501 °F)

N type: -50 °C to +1300 °C (-58 °F to 2372 °F)

and the following types with reduced accuracy

E type: -270 °C to -50 °C (-454 °F to -58 °F)

J type: -210 °C to -50 °C (-346 °F to -58 °F)

K type: -270 °C to -50 °C (-454 °F to -58 °F)

N type: -270 °C to -50 °C (-454 °F to -58 °F)

Expansions are possible on request.

A maximum of 20 sensor values (16 temperature values and 4 reference values) can be received, although the actual maximum number is defined by the control unit firmware.

The parametrisation of the baud rate and the node numbers (identifiers) of the CANopen slaves in the master must be carried out for the CAN communication (HEINZMANN control unit).

21550 *Iceni:Baudrate*

Permissible values for the baud rate are 126, 250, 500 and 1000 kBaud. All other values are set to 250 kBaud internally.

The node numbers (identifiers) are entered in

21551 *Iceni:SlaveID*

and the send rates in

21552 *Iceni:ModulSendRate*.

The value range must also be parametrised for each input:

21560 *Iceni:AI1_RefLow*   lower reference value of the input

21561 *Iceni:AI1_RefHigh* upper reference value of the input

The receipt values of ICENI modules can be assigned to the relevant sensors (or switching functions) in the control unit. The value 13 must be entered as the channel type.

23.8 Serial protocol Modbus

The Modbus protocol is an open protocol with general validity for the most varied applications. It defines the way data is transmitted but not the contents of the resulting communication. The HEINZMANN control unit allows all receive and send values to be parametrized.

The HEINZMANN control unit allows all receive and send values to be parametrized. The values of the Modbus remote station(s) can be assigned to the relevant sensors or switching functions in the control unit. The value 6 must be entered as the channel type.

The Modbus connection to HEINZMANN control devices is described in detail in *Modbus, publication no. DG 05 002-d*.

23.9 Summary of bit values

Only words can be sent via the communication protocols ↑*22.2* CAN protocol HZM-CAN customer module, ↑*22.4* CAN protocol CANopen, ↑*22.5* CAN protocol DeviceNet and ↑*22.8* Serial protocol Modbus (16 bit). This also applies if the parameter numbers of a bit value are specified in the assignment fields, i.e. one with the value range [0, 1].

23.9.1 BitCollection

To enable these bit values to be transferred in compressed format, fields with 16 elements each are provided from 29900 *BitCollParamSet* , which can be used to collect bit values into words. The parameter numbers of the bit parameters are entered in these field elements.

If individual bit values are to be sent inverted, the parameter numbers must be entered in negative format in the elements from 29900 *BitCollParamSet* for all control units except XIOS. For XIOS, the field 29932 *BitCollParamInverted* is available instead, where the inverting should be carried out in hexadecimal form for an entire block of 16

The current values of the assignments also appear collected in hexadecimal form under 23720 *BitCollection*. The parameter numbers from 23720 must finally be entered in the assignment fields of the individual communication protocols.

23.9.2 Error status

For the compressed transmission of error states via the protocols ↑*22.5 CAN protocol* DeviceNet and ↑*22.8 Serial protocol* Modbus, parameters are also available in the control unit, with numbers that can be entered in the assignment fields of the protocol.

23.9.2.1 XIOS

The display values from 23680 *ErrorState* contain one bit each for an error number, which shows the current status of this error (↑ *28.8.1* XIOS). The bit number corresponds to the error number from 3000 to 3099, whereby the value 3000 must be deducted. This is followed by the errors from 13000, which are located on bits 200 to 199 accordingly. These are followed by the errors from 23000 on bits 200 to 299. After these errors come those on 33000…33099, 43000…43099 and 53000…53011. These 512 errors therefore result in a maximum of 32 words to be transferred, although how many error numbers are actually required depends on the firmware.

Each error number corresponds to an entire group of up to 14 error states. The transferred bit 1 means that at least one error is active in the group, while 0 indicates that the entire group is free from errors.

23.9.2.2 Other control units

The display values from 23700 *ErrorState* contain one bit each for an error number, which shows the current status of this error. The bit numbers in the first six words correspond to the error numbers between 3000 and 3094 (-3000), followed by six words for the errors 13000 to 13094 (-13000) and the final six words contain the errors between 23000 and 23094 (-23000). This means that 6, 12 or 18 words are transferred depending on the control unit and firmware. A 0 in a bit means that the corresponding error is not active. A value of 1 means that the error is active.

23.10 CAN or Modbus networks

If a control unit is to communicate via one of the above mentioned bus systems, the following aspects must be observed to avoid problems.

– Special cabling should be used for each communication network in order to satisfy the respective requirements of CAN and Modbus. Recommended cable types are listed in the table below.

– All communication cables should be shielded and the shielding should be grounded in one place in each network.

– Connections between CAN repeaters and control units count as separate networks.

– Each network must be terminated on both ends with a 120 ohm terminator.

– When planning network structures, stubs should be limited to a max. length of 2.0 meters.

– Avoid kinks and sharp bends of the cables.

Note

Some HEINZMANN control units feature an integrated terminating resistor or can be factory-terminated. Consultation is required before designing the *network. Detailed documentation is available in "Basic information HEINZMANN-CAN, publication no. DG 13 002-d".*

Supplier	**CAN**		**Modbus**	
	2 wires	**4 wires**	**2 wires**	**4 wires**
HELU (Art. numbers)	81286 81911	81284 81912		
BELDEN (Trade numbers)	9841	9842	9841+ (1 pair) 3105A (1 pair) 3106A (1.5 pairs)	3107A (2 pairs) 3108A (3 pairs)

Table 114: Cable types for CAN and Modbus systems

24 Actuator trigger with position feedback

The HEINZMANN control units with conventional injection can work with actuators with different methods of operation and feedback. Up to three actuators can be triggered directly by the DC 1-04 and XIOS, while all other control units can drive precisely one actuator directly.

For the DC 6, there is a hardware version with 200 mA amplifier and for the DC 8, there is a hardware version with 1 A amplifier. Here, a setpoint for an external actuator is output via the amplifier without carrying out a back measurement of the position. For the XIOS, it is important to remember that the ports for actuator control and feedback must be configured before the actuators can be accessed. If HZM-CAN periphery modules are connected, additional actuators can be operated in this way. Although the configuration of the actuators takes place on the periphery module side in this case, the process is identical to the information in this section.

It is also possible to connect external positioners, which receive their setpoints via the CAN protocol SAE J1919. These positioners are suitable for exhaust flaps, waste gate or bypass controls, but HEINZMANN strongly recommends that only direct control actuators are used for the speed control. The time delay via the CAN bus is not determined, which means that the positioning of external actuators can result in the system swinging up here.

24.1 Actuator control

Actuators with two-quadrant operation (2Q, electrically energized on one side, with a strong spring return) or with four-quadrant operation (4Q, electrically energized on both sides) can be used depending on the control unit type.

Control unit	**Actuator control**			
	Two quadrant		Four quadrant	
	Linear actuator	Rotary magnet	Rotary magnet	Servo motor
DC 1-03, DC 2 DC 11, XIOS	-	X	X	X
DC 1-04	-	only amplifier 1	X	X
DC 6, DC 8, DC 9, DC 12	X	X	X	X
DC5, DC 7, DC 10	X	X	-	-

Tab. 201: Actuator control

The five tables below show which actuator can be (usefully) connected to which control unit.

The first two tables show actuators with two-quadrant control, divided according to linear actuators and actuators with a rotary magnet.

The third and forth tables show actuators with four-quadrant control, divided according to operation with a rotary magnet or a servo motor. It should be noted that some actuators can be used for both two-quadrant and four-quadrant operation, e.g. the StG 3010. Here, the desired control type must be specified explicitly in the order.

The last table contains electrically commutated actuators.

Although, in principle, more control units can operate two-quadrant actuators than are listed below, some are nevertheless oversized for the small engines that these actuators are reasonably used on. That is why they are not listed here.

It should also be noted that not all actuators operate all feedback variants, which could result in further restrictions depending on the control unit type. It is advisable to select actuators with the required adjustment force and then to compare the feedback type of the actuator and control unit to find the suitable combination.

Actuator	Adjustment force max. [N]	Adjustment range	Feedback type	DC						
				5	6	7	8	9	10	12
LA 25	25	19.5 mm	Digital	X	X	X	X	X	X	X
LA 30	30	15.5 mm	Digital	X	X	X	X	X	X	X
LA 35	35	12.5 mm	Digital	X	X	X	X	X	X	X

Tab. 202: Linear actuator with 2Q control

Actuator	Torque max. [Nm]	Adjustment range	Feedback type	DC						
				5	6	7	8	9	10	12
StG 3005	0.3	53°	Digital	X	X	X	X	X	X	X
StG 3010	0.6	50°	Digital	X	X	X	X	X	X	X
StG 2005	0.8	32°	Digital	X	X	X	X	X	X	X
StG 2040DP	5.6	36°	Digital	X	X	X	X	X	X	X

Tab. 203: Actuators with rotary magnet and 2Q control

Actuator	Torque max. [Nm]	Adjustment range	Feedback type	DC						XIOS
				2	6	8	9	11	12	
StG 3005	0.3	53°	Digital		X		X		X	

Actuator	Torque max. [Nm]	Adjustment range	Feedback type	DC 2	DC 6	DC 8	DC 9	DC 11	DC 12	XIOS
StG 3010	0.6	50°	Digital		X		X		X	
StG 2005	0.8	32°	Digital		X		X		X	
StG 2005DP	0.8	32°	Digital		X		X		X	
StG 2010	1.4	68°	Analogue		X	X	X			X
StG 2010	2	36°	Analogue		X	X	X			X
StG 2040DP	5.6	36°	Digital		X		X		X	
StG 2040	5.6	68°	Analogue		X	X	X	X*		X
StG 2040	7.4	36°	Analogue		X	X	X	X*		X
StG 2080	8.4	68°	Analogue		X	X	X	X*		X
StG 2080	11	36°	Analogue		X	X	X	X*		X
StG 2120	13	68°	Analogue	X						

* Control unit integrated in the actuator

Tab. 204: Actuators with rotary magnet and 4Q control

Actuator	Torque max. [Nm]	Adjustment range	Feedback type	DC 1-03	DC 1-04	DC 2	DC 6#	DC 9#	XIOS#
StG 6-01	4	36°	Analogue		X*	X	X	X	X
StG 6-02V	6	36°	Analogue		X*	X	X	X	X
StG 10	10	36°	Analogue		X*	X	X	X	X
StG 16	15	42°	Analogue		X*	X	X	X	X
StG 30	31.5	42°	Analogue	X	X	X	X	X	X
StG 30.90	31.5	90°	Analogue	X	X	X	X	X	X
StG 40	44	42°	Analogue	X	X	X			X
StG 40.90	40	90°	Analogue	X	X	X			X
StG 64	64	42°	Analogue	X	X				
StG 90	90	42°	Analogue	X	X				
StG 180	180	42°	Analogue		X				

* only amplifier 2 and/or 3
# only with external coil unit

Tab. 205: Actuators with servo motor and 4Q control

The actuator StG 180 requires two amplifiers for the control. It can therefore only be used with the control device from the DC 1-04 series. In this case, a specific firmware is required. For StG 180, amplifiers 2 and 3 of the control unit are used for actuator 1, and amplifier 1 is free for use for a second actuator, e.g., for a gas actuator in dual fuel operation. The parameter names of Actuator/Actuator2, Fuel/Fuel2 and Servo/Servo2 will in this case refer to other amplifiers and feedbacks than when utilizing one to three smaller actuators.

Actuator	Torque max. [Nm]	Adjustment range	Feedback type	DC 8 integrated
StG-EC 40	> 40	90°	Elysion I^2C	X
StG-EC 250	> 250	90°	Elysion I^2C	X

Tab. 206: Electrically commutated actuators with Elysion feedback

24.2 Actuator feedback

The feedback of the current actuator position on the control unit is an important signal for checking whether the actuator is complying with the specification. If this is not the case, various different errors are generated, which, in the worst case scenario, must result in an engine shutdown.

Depending on the actuator type, an analogue or a digital signal is used to feed back the actuator position. With an analogue signal, the information about the actuator position is contained in the size of the DC voltage signal, whereas with a digital feedback the actuator position is computed from time intervals between pulses.

As well as the measurement signal for the actuator position, actuators with digital feedback have a reference signal. The reference signal is used to compensate for temperature variations in the feedback which might affect the measurement signal.

Actuators with an Elysion PWM measurement system send a specially prepared PWM signal, which enables extremely long transmission lines (i.e. connection to a normal PWM input is not possible). These actuators are used in applications requiring a highly accurate measurement signal.

The following table shows a list of which actuator feedbacks can be processed by the individual control units. However, these are always hardware versions, which must be specified explicitly when placing the order for the control unit.

Control unit	**Actuator feedback**			
	Analogue 1.6…2.8 V	Digital	Elysion	
			PWM	I^2C
DC 1	X	-	-	-
DC 2, DC 6, DC 9, DC 10	X	X	-	-
DC 5, DC 7, DC 12	-	X	-	-
DC 8 (separate)	X	-	-	-
DC 8 (integrated in actuator)	-	-	-	StG-EC 40 StG-EC 250

DC 11	X	-	on request	-
XIOS	X	-	X	-

Tab. 207: Actuator feedback

In the following, all three actuator parameters are always shown. If the control unit currently in use can only control one actuator, the first parameter always applies.

The relevant actuator is enabled with parameter

5910 *Actuator(1)On*
5930 *Actuator2On*
5940 *Actuator3On.*

The operation of the amplifiers is selected with the parameters

5911 *Amplifier(1)_2Qor4Q*
5931 *Amplifier2_2Qor4Q*
5941 *Amplifier3_2Qor4Q*,

where 0 refers to the 4-quadrant amplifier and 1 refers to the 2-quadrant amplifier (with return springs).

If the actuator transmits its feedback data via the high-precision Elysion-PWM feedback,

5953 *Feedback(1)ElysionOn*
5963 *Feedback2ElysionOn*
5973 *Feedback3ElysionOn*

must be activated with 1. If this parameter is not present or is set to 0,

5950 *FeedbDigitalOrAnalog* = 0 analogue feedback
5950 *FeedbDigitalOrAnalog* = 1 digital feedback

determines the feedback type. If present, this parameter only applies for the first actuator or several actuators. If this parameter is (also) not present, the only option defined in the hardware and software for the control unit to address an actuator applies automatically (analogue only or digital only).

For some actuators, the evaluation of the feedback must be inverted (small feedback signal with a large filling and vice versa). The following parameters are used to set separately for each individual actuator whether the feedback signal is rising or falling with increasing filling:

5951 *Feedb(1)SlopeFallOrRise*
5961 *Feedb2SlopeFallOrRise*
5971 *Feedb3SlopeFallOrRise*

The value 0 is used to indicate that the feedback signal of the actuator is rising with increasing filling, 1 indicates that it is falling with increasing filling.

The parameters 59x1 Amplifier(y_)2Qor4Q, 5950 FeedbDigitalOrAnalog and 59z1 FeedbySlopeFallOrRise only become active after saving data and reset of control unit (x = 1,3,4, y = 1,2,3, z = 5,6,7).

If the feedback signals are not linear with respect to the actuator positions, a separate linearisation curve with 10 value pairs can be provided for each actuator on request. The measured values are entered in the parameters from

7980 *Feedback(1):digit(0)*
8000 *Feedback2:digit(0)*
8020 *Feedback3:digit(0)*

and the respective actuator positions in the parameters from

7990 *Feedback(1):Pos(0)*
8010 *Feedback2:Pos(0)*
8030 *Feedback3:Pos(0).*

The linearization curves are enabled with parameter

5952 *Feedback(1)LinearOn*
5962 *Feedback2LinearOn*
5972 *Feedback3LinearOn*.

Following a restart, reset or if the engine was switched off either intentionally or due to an error, the actuator is energized for 5 seconds with simultaneous output of an actuator position setpoint 0 % for safety. The power is then switched off until an actuator setpoint is specified (again).

During the emergency engine shutdown due to a pickup error, the actuator is even taken to 0 % for 5 minutes before the power is switched off to ensure that the engine is really switched off (a check is not possible due to the absence of the speed signal).

Control of the actuator StG 180 requires two amplifiers, which means it can only be used in combination with the control device of the DC 1-04 series. In this case, a specific firmware is required. For StG 180, amplifiers 2 and 3 of the control device are used for actuator 1, and amplifier 1 is free for use for a second actuator, e.g., for a gas actuator in dual fuel operation or a wastegate. The parameter names of Actuator/Actuator2, Fuel/Fuel2 and Servo/Servo2 will in this case refer to other amplifiers and feedbacks than when utilizing one to three smaller actuators.

24.3 Calibrating the actuator

Before the control unit can compute the exact position of the control path, reference values must tell it the relationship between the control path measured value and the position of the actuator. These reference values correspond to the control unit's measured values at the minimum and maximum position of the actuators. In the case of actuators with digital feedback, the reference signal must also be measured.

Calibration can be carried out automatically or manually. The actuators must be capable of reaching the minimum and maximum positions in all cases. The actuator should therefore be calibrated without its linkage if possible.

Note

Actuator calibration must be carried out for every control unit with its associated actuator, otherwise component tolerances of both the actuator and the control unit will affect control quality and especially the compliance of the limiting functions. Actuators must be re-calibrated in particular if the actuator or the control unit have been replaced.

24.3.1 Manual calibration

Manual calibration is performed similarly to the calibration of analogue inputs. The actuator must be moved to the minimum and maximum position, with the control unit measured value

3950 *Feedback(1)*
3960 *Feedback2*
3970 *Feedback3*

being entered in the parameters

1950 *Feedback(1)Ref_0%*
1960 *Feedback2Ref_0%*
1970 *Feedback3Ref_0%*

for the minimum position and in the parameters

1951 *Feedback(1)Ref_100%*
1961 *Feedback2Ref_100%*
1971 *Feedback3Ref_100%*

for the maximum position (in older firmware versions, these parameters are called *FeedbackRefLow* and *FeedbackRefHigh*, but have the same meaning).

For actuators with digital feedback, the reference signal 3955 *FeedbackReference* must also be entered in parameter 1955 *FeedbackReference*. The reference signal does not change over the entire range of the actuator.

Note

With manual calibration, these parameters are only active after saving data and reset of control unit.

The control unit is then able to standardise the measured value of the feedback and display it exactly in 3951 *FeedbackCorrection* (note that, currently, all control units have a maximum of one digital feedback). The actuator position can be verified with the parameter

2300 *Act(1)Pos*
2302 *Act2Pos*
2303 *Act3Pos,*

that indicates the current actuator travel.

24.3.2 Automatic calibration

Automatic calibration can be started from the PC or hand programmer *(↑3.3 DcDesk 2000*) on request.

In the basic system DC 1, the calibration of actuator 1 is also possible by putting the rotary switch in position 1 (only after power-up) and in basic systems DC 6, 8 and 9 by pressing a push-button on the circuit board. For the first or only actuator, the activation can also take place via the switching function 2845 *SwitchAutoAdjust*.

Warning

For this, ↑24.3 Calibrating the actuator must be observed!

With automatic calibration, the control unit measures the reference values by itself. It does this by energizing the selected actuator for a certain time to ensure that the minimum or maximum position is positively reached, then measures the reference values.

Note

Automatic actuator calibration cannot be started if a fatal error is present.

The measured values are entered in the corresponding parameters

1950 *Feedback(1)Ref_0%*
1960 *Feedback2Ref_0%*
1970 *Feedback3Ref_0%*

for the minimum position and

1951 *Feedback(1)Ref_100%*
1961 *Feedback2Ref_100%*
1971 *Feedback3Ref_100%*

for the maximum position (in older firmware versions, these parameters are called *FeedbackRefLow* and *FeedbackRefHigh*, but have the same meaning) and

1955 *FeedbackReference*

for the reference of the digital feedback. In contrast to manual calibration, these values are available immediately.

The time during which the control unit energizes the actuator and waits for the minimum or maximum position to be positively reached is defined by the parameter

1900 *Feedback(1)AdjustTime*
1930 *Feedback2AdjustTime*
1940 *Feedback3AdjustTime*

The level of current for automatic calibration is determined by the parameter

1919 *Servo(1)CurrentAdjust*
1939 *Servo2CurrentAdjust*
1949 *Servo3CurrentAdjust*.

During automatic calibration, the errors

3059 *ErrFeedback(1)Adjust* or 3050 *ErrActuator(1).bFeedbackAdjust*

3060 *ErrFeedbackAdjust2* or 3051 *ErrActuator2.bFeedbackAdjust*
3061 *ErrFeedbackAdjust3* or 3052 *ErrActuator3.bFeedbackAdjust*

can occur (the right column applies to the XIOS, the left column applies to all other control units). These errors are fatal and therefore prevent the engine start.

24.3.3 Automatic zero-position calibration at each engine stop

If drifting in the feedback values is identified over time on actuators with analogue feedback, which is indicated by the engine not reaching the maximum power, then it is advisable to carry out the automatic calibration automatically with each engine stop. In this case, only the zero-position is calibrated and the expansion range between

1950 *Feedback(1)Ref_0%* and 1951 *FeedbackRef_100%*
1960 *Feedback2Ref_0%* and 1961 *Feedback2Ref_100%*
1970 *Feedback3Ref_0%* and 1971 *Feedback3Ref_100%*

remains the same. The newly obtained parameters are saved immediately in the control unit.

For this, ↑24.3 Calibrating the actuator must be observed!

This function is activated with

5900 *FeedbZeroPosAdjustOn*

or, on the XIOS, with

5900 *Act1ZeroPosAdjustOn*
5934 *Act2ZeroPosAdjustOn*
5944 *Act3ZeroPosAdjustOn*

In the XIOS, only one actuator may receive this calibration. If the function is activated for several actuators, it is not carried out. The calibration is only of use for the actuator that is assigned to the speed governor.

24.3.4 Saving the calibration data

When automatic calibration is initiated with DcDesk 2000 or the hand programmer, the device asks if you wish to save the results in the read-only memory. It is therefore the responsibility of the operator to decide whether to accept the settings as final.

If the calibration is initiated with the rotary switch, switching function or push-button, however or via the function zero setting the calibration values will be automatically saved following successful automatic calibration.

The time for the calibration itself is determined by

1900 *Feedback(1)AdjustTime*
1939 *Feedback2AdjustTime*
1949 *Feedback3AdjustTime*.

– once on the 0 % and once on the 100 % position. The control unit requires an additional approx. 60 s for saving the calculated values automatically. Only then can the control unit be switched off, i.e. never at the same time as the engine stop request. The automatic calibration function must also not be activated during an engine stop, if the engine was shut down by switching off the voltage supply instead of via a stop signal.


Warning

After calibration, wait for at least twice the calibration time + 60 s before the control unit is de-energised or a reset is otherwise triggered! If this cannot be ensured by personnel, a delay circuit must be built in.

24.3.5 Error detection during feedback

Similarly to sensors at analogue inputs, the feedback has error limits by which the control unit can detect when a measured value is prohibited. The error limits must be entered by hand with both manual and automatic calibration.

In this process, a measured value that is below the lower error limit

1952 *Feedback(1)ErrLow*
1962 *Feedback2ErrLow*
1972 *Feedback3ErrLow*

and above the upper error limit

1953 *Feedback(1)ErrHigh*
1963 *Feedback2ErrHigh*
1973 *Feedback3ErrHigh*

is defined as prohibited. The error limits are designated "Low/High" and refer to the minimum and maximum measured value respectively – not to the actuator position.

Similarly, the error limits 1956 *FeedbackRefErrLow* and 1957 *FeedbackRefErrHigh* apply for the reference value in the case of digital feedback.

These error limits should not be too close to the minimum and maximum value to prevent natural measured value fluctuations in the feedback causing error detection. A short circuit or open circuit in the supply or signal line must be positively detected however.

A detected error sets the corresponding error parameter of the feedback.

3050 *ErrFeedback(1)*	or 3050 *ErrActuator(1).bFeedback*
3051 *ErrFeedback2*	or 3051 *ErrActuator2.bFeedback*
3052 *ErrFeedback3*	or 3052 *ErrActuator3.bFeedback*

These errors are fatal and therefore result in the engine being shut down or prevent the engine start.

24.4 Limiting the actuator stroke

Absolute limiting of the actuator's control path is also provided to protect the actuator from mechanical and thermal overload. This limiting provides a safety distance ahead of the actuator's mechanical limit stops.

The minimum position of the control path is limited by parameter

310 *ActPos(1)SecureMin*
314 *ActPos2SecureMin*
316 *ActPos3SecureMin*

The parameter

312 *ActPos(1)SecureMax*
315 *ActPos2SecureMax*
317 *ActPos3SecureMax*

provides a limit for the maximum position of the control path and should therefore be above the filling limitations. The following values are usually used for these two parameters:

Number	Parameter	Value	Unit
310	*ActPosSecureMin*	*3.0*	*%*
312	*ActPosSecureMax*	*97.0*	*%*

When the actuator is used on throttle valves, clearance may be required for the full range [0, 100] %.

Note

The parameters described above may be used only as a protection for the actuator. A limitation of the injection quantity is set with the parameter 711 FuelLimitMaxAbsolute. For limitation in the minimum filling direction, the zero-fuel curve is used.

24.5 Servo loop

The speed governor control unit calculates a filling setpoint 2350 *FuelQuantity* from which a setpoint position for the actuator must be calculated. As 2350 *FuelQuantity* is provided in % of the injection quantity, with linear linkage – and in particular on the diesel engine – the actuator setpoint

2330 *Act(1)PosSetpoint*
2332 *Act2PosSetpoint*
2333 *Act3PosSetpoint*

can be taken directly from

2350 *FuelQuantity*

or, on the V-type engine, from

2351 *FuelQuantityBank1*
2352 *FuelQuantityBank2*

This also applies for other setpoints in XIOS applications, which can be assigned to an actuator.

In certain cases however it may be necessary to take the actuator setpoint from a filling-dependent curve. This is especially useful with nonlinear linkages or throttles, or if the actuator is mounted directly without any linkage.

When the pump map is known, it can also be useful to activate a pump map calculating the actuator position from the required filling depending on the speed.

24.5.1 Actuator curve

For the fuel quantity dependent actuator position, the curve in 7300 *FuelToActSp:f* and 7315 *FuelToActSp:Pos* is provided, which is activated with 4721 *FuelToActPosCurveOn*. 2330 *ActPosSetpoint* indicates the resulting actuator position.

7300 *FuelToAct(1)Sp:f(0)*	Fill values of the curve for actuator 1
7315 *FuelToAct(1)Sp:Pos(0)*	Position values of the curve for actuator 1
4721 *FuelToActPos(1)CurveOn*	Activation of the curve for actuator 1
2330 *Act(1)PosSetpoint*	Resulting setpoint for actuator 1
7330 *FuelToAct2Sp:f*(0)	Fill values of the curve for actuator 2
7345 *FuelToAct2Sp:Pos(0)*	Position values of the curve for actuator 2
4722 *FuelToActPos2CurveOn*	Activation of the curve for actuator 2
2332 *Act2PosSetpoint*	Resulting setpoint for actuator 2
7360 *FuelToAct3Sp:f(0)*	Fill values of the curve for actuator 3
7375 *FuelToAct3Sp:Pos(0)*	Position values of the curve for actuator 3
4723 *FuelToActPos3CurveOn*	Activation of the curve for actuator 3
2333 *Act3PosSetpoint*	Resulting setpoint for actuator 3

24.5.2 Pump map

If the relation between an actuator position and injection quantity is linear, the setpoint position for the actuator 2330 *ActPosSetpoint* is equivalent to the fuel setpoint. When the pump map is known, it might be useful to activate a pump map calculating the actuator position from the required speed-dependent fuel quantity. This function is available from engine manufacturers on request.

Note

The pump map only applies for the actuator, which is assigned to the speed governor. On the DC 1-04, this can also be the StG 180.

The pump map is determined on the pump testing stand and entered in parameters

7200 *InjectorMap:n(x)*	engine speed values for pump map
7250 *InjectorMap:f(y)*	fill values for pump map
7300 *InjectorMap:Pos(z)*	actuator position from pump map

The pump map is activated with 4300 *InjectorPumpMapOn*.

24.5.3 Servo control loop

The servo loop or position control loop serves the purpose of making the actuator travel to the setpoint position. The servo loop is an autonomous control loop which is subordinate to the speed governor. In the same way as for the speed governor, there are PID parameters provided for this control loop, separate parameters for each actuator. There is also an additional DD parameter for the servo loop to counteract the acceleration of the actuator. This parameter is used primarily with the particularly fast actuators in the 2000 series.

1911 *Servo(1)Gain*	P-ratio for servo loop of actuator 1
1912 *Servo(1)Stability*	I-ratio for servo loop of actuator 1
1913 *Servo(1)Derivative*	D-ratio for servo loop of actuator 1
1914 *Servo(1)Acceleration*	DD-ratio for servo loop of actuator 1
2300 *Act(1)Pos*	current value of actuator 1
2330 *Act(1)PosSetpoint*	setpoint position for actuator 1
1931 *Servo2Gain*	P-ratio for servo loop of actuator 2
1932 *Servo2Stability*	I-ratio for servo loop of actuator 2
1933 *Servo2Derivative*	D-ratio for servo loop of actuator 2
1934 *Servo2Acceleration*	DD-ratio for servo loop of actuator 2
2302 *Act2Pos*	current value of actuator 2
2332 *Act2PosSetpoint*	setpoint position for actuator 2
1941 *Servo3Gain*	P-ratio for servo loop of actuator 3
1942 *Servo3Stability*	I-ratio for servo loop of actuator 3
1943 *Servo3Derivative*	D-ratio for servo loop of actuator 3
1944 *Servo3Acceleration*	DD-ratio for servo loop of actuator 3

2303 *Act3Pos*	current value of actuator 3
2333 *Act3PosSetpoint*	setpoint position for actuator 3

The values for the servo loop vary depending on the actuator type and must be set accordingly. The initial settings are made at the factory by HEINZMANN when the control unit is shipped and do not normally need to be altered.

24.5.3.1 Monitoring of the actuator position

The setpoint position of the actuator

2330 *Act(1)PosSetpoint*
2332 *Act2PosSetpoint*
2333 *Act3PosSetpoint*

is constantly compared with the measured actual position

2300 *Act(1)Pos*
2302 *Act2Pos*
2303 *Act3Pos*

if the actuator is activated and energised. With a deviation of more than 10 % over a second, the error

3053 *ErrActuatorDiff(1)*	or 3050 *ErrActuator(1).0*
3054 *ErrActuatorDiff2*	or 3051 *ErrActuator2.0*
3055 *ErrActuatorDiff3*	or 3052 *ErrActuator3.0*

is reported (the right column applies to the XIOS, the left column applies to all other control units). This can happen when the fuel injection pump, the throttle valve, the linkage or the actuator sticks or is not connected.

If this type of error is so severe in an application that the engine has to be stopped, the error message can be classed as fatal. For this, the parameters

5153 *EcyActuatorDiff(1)On*	or 5150 *EcyActuatorDiff(1)On*
5154 *EcyActuatorDiff2On*	or 5151 *EcyActuatorDiff2On*
5155 *EcyActuatorDiff3On*	or 5152 *EcyActuatorDiff3On*

must be set. In this case, this type of error results in an engine shut-down or engine start prevention.

24.5.3.2 Correction of the servo PID parameters for static operation

In a similar way as for the speed control loop, a simple correction of the PID parameters of the servo loop is possible if the actuator is in static operation.

If the actuator position deviation between target and actual position is within the range 1906 *ServoCorrRange*, then the PID parameters are corrected with the value 1905 *ServoCorrFactor*.

The normal parameters are used outside the double range. Between these two values, interpolation is used to achieve a smooth transition. This function is always active. A value of 100% means no influence on the servo loop parameters. The current correction factor is displayed in the parameter 3905 *ServoPIDCorr*.

1906 *Servo(1)CorrRange*	1905 *Servo(1)CorrFactor*	3905 *Servo(1)PIDCorr*
1908 *Servo2CorrRange*	1907 *Servo2CorrFactor*	3935 *Servo2PIDCorr*
1910 *Servo3CorrRange*	1909 *Servo3CorrFactor*	3945 *Servo3PIDCorr*

24.5.4 Actuator current

The servo loop will calculate the current for the actuators based on the servo loop parameters.

3916 *Servo(1)CurrentSetp*	3936 *Servo2CurrentSetp*	3946 *Servo3CurrentSetp.*

To prevent the actuators from being overloaded, the maximum current can be limited with parameter 1917 *ServoCurrentMax*. The maximum current can be tolerated briefly for position changes, but over longer periods the current has to be reduced to prevent the actuator being thermally overloaded. This is why the servo controller reduces the current under static load by an exponential function with a time constant of approx. one minute to the value set with parameter 1918 *ServoCurrentRed.* The reduction only begins after the delay time 1916 *ServoCurrentRedDelay*. If this parameter does not exist, the reduction begins without a delay.

1917 *Servo(1)CurrentMax*	1918 *Servo(1)CurrentRed*	1916 *Servo(1)CurrRedDelay*
1937 *Servo2CurrentMax*	1938 *Servo2CurrentRed*	1936 *Servo2CurrRedDelay*
1947 *Servo3CurrentMax*	1948 *Servo3CurrentRed*	1946 *Servo3CurrRedDelay*

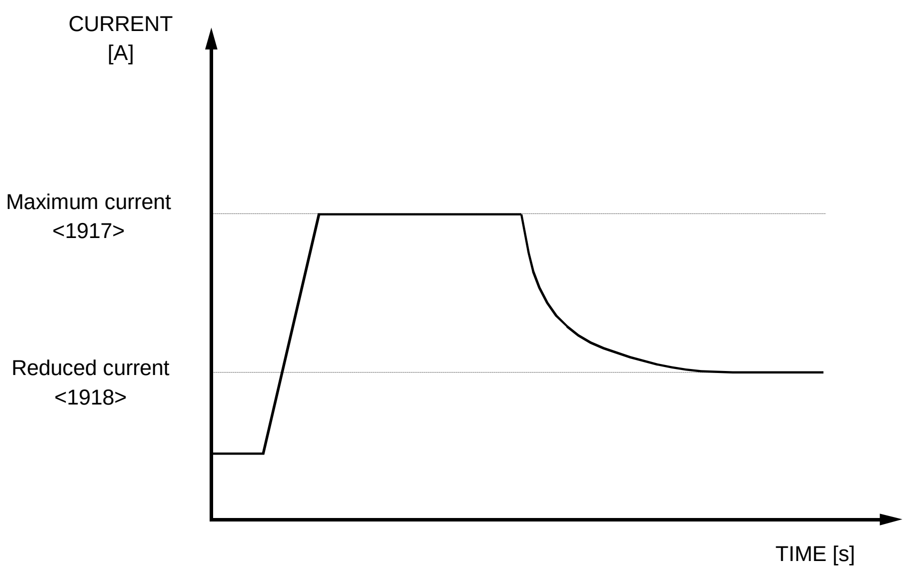

Fig. 48: Current reduction under static load

The maximum current is still available for dynamic position changes. When setting the current reduction, the current must be measured in the supply cable to the actuators, with the corresponding cable length. It must be remembered that the current cannot be measured until the actuators have warmed up (static operation) because the flowing current changes as temperature rises.

For test purposes, the current setpoint can be specified directly via the PC, this function cannot be saved, however, i.e. it is automatically switched off after a control unit reset. 1920 *ServoCurrentPC* is used for specifying the test values and 5920 *ServoCurrentPCOn* is used to activate the test mode.

24.5.4.1 DC 5, DC 6, DC 8, DC 9, DC 10, DC 11 and DC 12

These control units are equipped with a current controlled amplifier. The current setpoint 3916 *ServoCurrentSetpoint* is output directly on the amplifier here.

The current flowing through the amplifier is read back and displayed in the control units DC 8, DC 11 and DC 12 in

3920 *ServoCurrLowSidePos*
3921 *ServoCurrLowSideNeg*
3922 *ServoCurrHighSide*

The DC 10 shows the measured value in 3609 *ServoCurrentLowSide* .

24.5.4.2 DC 1, DC 2, DC 7 and XIOS

These control units output a PWM ratio to the actuator, from which the actual flowing current is derived. Due to cable lengths and the actuator types being used, however, there may be differences between the required current and the flowing current.

To enable the maximum current to be set exactly, 5920 *ServoCurrentPCOn* = 1 is used to activate the test mode. Now, a PWM ratio can be specified in 1920 *ServoCurrentPC* and the current in the engine cable can be measured with a suitable measuring device. The PWM ratio in 1920 *ServoCurrentPC* must be changed until the permissible maximum current is flowing.

It should be noted that the current specification is output on all activated actuators at the same time. If you do not want this, the actuators must be activated individually with

5910 *Actuator(1)On*
5930 *Actuator2On*
5940 *Actuator3On*

so that only one is energised.

The maximum value determined in this way is then entered in

1917 *Servo(1)CurrentMax*
1937 *Servo2CurrentMax*
1947 *Servo3CurrentMax*

When conducting this adjustment, it is important to note that a certain amount of time must elapse before the current that is actually flowing can be measured.

The current setpoint from the actuators can be read from the parameter

3916 *Servo(1)CurrentSetp*
3937 *Servo2CurrentSetp*
3947 *Servo3CurrentSetp*

The unit of the parameter is percent. The sign indicates the current direction.

Since the current actually flowing through the actuator will, however, depend on the amplifier voltage. The parameter

5915 *Servo(1)CurrentCorrOn*
5935 *Servo2CurrentCorrOn*
5945 *Servo3CurrentCorrOn*

can therefore be used to activate a current correction for the actuator.

With current correction activated, the current setpoint as calculated from the servo loop is correlated to a standard voltage of 24 V using the current measured supply voltage 3600 *PowerSupply*. The corrected value is displayed in the

3917 *Servo(1)CurrentCorr*
3937 *Servo2CurrentCorr*
3947 *Servo3CurrentCorr*

parameters.

With the DC 1 series, the actuators can be supplied with 40 V. The amplifier voltage is therefore displayed here in 3600 *PowerSupply* instead of the supply voltage and used for standardisation. The amplifier voltage of the additional board on the DC 1-04 is shown in 3601 *PowerSupplyExt* and is also used for current correction of the actuators on connector V.

In XIOS control units with up to three connectible actuators, the power to the control unit can be activated permanently on request

5916 *Servo(1)CurrentPermOn*
5936 *Servo2CurrentPermOn*
5946 *Servo3CurrentPermOn*.

In this case, the power is only switched off in the event of a pickup error, after the actuator has been supplied with power in the position 0 direction for five minutes to stop the fuel supply.

24.5.4.3 Monitoring of the actuator current

All control units apart from DC 1 and DC 2 monitor the amplifier current. A group error from hardware and software monitoring is reported in 3060 *ErrAmplifier* or, for XIOS, in 3050 *ErrActuator1.4*, 3052 *ErrActuator2.4* and 3053 *ErrActuator3.4*. In the DC 10 3084 *ErrLowSideCurrent* is also shown.

In the event of an overcurrent fault, the amplifier is always switched off to protect the actuator and control unit. Amplifier errors result in an emergency shutdown which means that the engine is switched off or is prevented from starting up.

On the XIOS with three actuators, the actuator where a fatal error may not result in an emergency shutdown, but merely trigger a suitable error reaction, can be defined in customer-specific firmware depending on the application. In a dual-fuel application, for example, it would make sense for a fatal error to only be triggered on the diesel actuator (because this means that the engine can no longer be operated), but not on the gas actuators (work could continue here with pure diesel).

24.6 Positioner mode

Speed control will not be satisfactory unless the actuator is positioning precisely. PID parameters to match the actuator are set at the factory. But when mounted on the engine, the actuator will be subject to influences both by the mechanical assembly with the linkage and by the dimensions of the control rods.

In order to optimize the servo loop parameters without being influenced by the control unit, the positioner mode has been provided. It is used exclusively for testing and adjustment purposes, i.e. this function cannot be saved, and it is switched off automatically following a control unit reset.

The positioner mode can only be started if the switching function 2833 *SwitchForcedStart* is inactive, the actuator selected for the positioner test has been switched on with

5910 *Actuator(1)On*
5930 *Actuator2On*
5940 *Actuator3On*

and if there is no speed and no fatal error active.

Note

On control units with older firmware, the positioner mode is only permitted if the function 2810 SwitchEngineStop is deactivated.

For safety reasons, the program will automatically exit the positioner mode when the speed pickups detect speed.

With the parameter 5700 *PositionerOn* = 1, the positioner mode is switched on for all activated actuators at the same time. If you do not want this, the actuators must be activated individually so that only one is tested at a time.

If an actuator setpoint is now selected with parameter 1700 *PositionerSetpoint*, the actuator's reaction can be observed and/or measured via the feedback. The current actuator position is displayed in

2300 *Act(1)Pos*
2302 *Act2Pos*
2303 *Act3Pos.*

By changing the setpoint, the step response of the relevant actuator can be monitored and optimised by adjusting the PID values.

To be able not only to check the static setting, but also to optimise the much more important dynamic response of the actuator, the change in setpoint selection can be automated via 5701 *PositionerMode*:

5701 *PositionerMode* = 0	1700 *PositionerSetpoint* is output unchanged
5701 *PositionerMode* = 1	1700*PositionerSetpoint* receives the value from 1701 *PositionerAmplitude* in positive and negative form alternately. The result is a square-wave function.
5701 *PositionerMode* = 2	1700 *PositionerSetpoint* and 1701 *PositionerAmplitude* form a triangle function
5701 *PositionerMode* = 3	1700 *PositionerSetpoint* and 1701 *PositionerAmplitude* form a sine function.

The frequency of the positioning change is pre-set in 1702 *PositionerFrequency*.

After completing the servo loop settings in positioner mode, these settings will have to be tested with the engine running and adjusted if necessary. Due to the engine's vibrations the friction torque may be considerably reduced and require other parameter settings than with the engine at standstill. In extreme cases, this can even result in the actuator positioning very badly when the engine is at standstill, whereas the governing results obtained with the engine running are most satisfactory.

24.7 Actuators on HZM-CAN periphery modules

In the control unit, the current back measurement of the actuator position appears from 2200 (previously 2305) *PEActPos* (corresponds to 2300 *ActPos* in the relevant periphery module) and whether or not the actuator is activated is visible from 2210 (previously 2320) *PEActuatorOn* (corresponds to 5910 *ActuatorOn* in the periphery module).

From 2380 *PEActuatorError* or from 23030 *ErrCanPEAct* on the XIOS, the condensed error state is shown per periphery module actuator. The individual bits have the following meaning:

Error bit	Error	Reference
0	Actuator difference error	↑ 3053 *ErrActuatorDiff*
1	Actuator calibration error	↑ 3059 *ErrFeedbackAdjust*
2	Feedback error	↑3050 *ErrFeedback*
3	Feedback error of the reference	↑3056 *ErrFedbackRef*
4	Overcurrent ID	↑3060 *ErrAmplifier*

Fig. 49: Actuator errors on a periphery module

It must be decided in the relevant application whether errors reported by the periphery module are important enough for the speed governor that the engine has to be shut down. A situation like this could arise, for example, if the speed governor control unit controls the actuator on one side of a V-type engine and the periphery module for a second actuator is used on the other side of the V-type engine. Errors in the actuator control of the periphery module, which mean that this side of the V-type engine is no longer operated correctly, are therefore fatal for the entire engine and should result in an engine stop.

The decision takes place in two steps per periphery module and per actuator on periphery modules, as a periphery module can have several actuators.

In the first step, an error mask 5380 *ErrMaskPEActuator(x)* or 25030 *ErrMaskPEActuator(x)* in the XIOS speed governor, must be defined for each actuator on periphery modules. The structure corresponds exactly to the table above. If a bit is set to 1, the relevant error is important for the master (i.e. the speed governor). If the bit is set to 0, the corresponding error is not so important for the master that the engine has to be stopped.

The second step is used to define whether an actuator error with this type of mask in a specific periphery module must result in an engine stop in the master.

In all control units except for XIOS, the parameter 5189 *EcyPEFatalErrorOn* must be activated first.

Finally, there are the mask parameters per periphery module from 5440 *ErrMaskPEModul* or, in the XIOS, from 25002 *EcyMaskPEModul*. If bit 4 is set here for actuator errors for a periphery module, one of the actuator errors selected above results in 3800 *EmergencyAlarm* = 1 in the master, which means that the engine is stopped immediately due to a fatal error.

Note

The HEINZMANN PC program ↑3.3 DcDesk 2000 makes setting the masks easy, as all errors are listed in an easily legible way and exact knowledge of bit positions is not required.

25 Current-controlled valves on hydraulic actuators

Some control units have the necessary hardware requirements for activating a current-controlled proportional valve for controlling a hydraulic actuator instead of a HEINZMANN actuator.

For the DC 6, there is a hardware version with 200 mA amplifier and for the DC 8, there is a hardware version with 1 A amplifier instead of the actuator output. On the XIOS, assignment parameters can be used to decide whether an actuator or a proportional valve is connected on each of the three actuator outputs.

For all other control units and all other hardware versions of the DC 6 and DC 8, HEINZMANN actuators must be connected.

25.1 DC 6 and DC 8

25.1.1 Current setpoint

The current setpoint 3916 *ServoCurrentSetpoint* on the DC 6 and DC 8 is determined directly from the fuel setpoint 2350 *FuelQuantity* and output on the amplifier.

The current flowing through the amplifier is read back and displayed in the control units DC 8 with 1 A-amplifier in

3920 *ReadBackAmpl1000*

while the DC 6 with 200 mA-amplifier displays the current divided into HighSide and LowSide in

3920 *ServoCurrHighSide*
3921 *ServoCurrLowSide*

25.1.2 Monitoring

The amplifier current is monitored, an error appears in 3064 *ErrAmplCurrent*. A group error from hardware and software monitoring is also reported in 3060 *ErrAmplifier*.

In the event of an overcurrent fault, the amplifier is always switched off to protect the control unit. Amplifier errors result in an emergency shutdown, which means that the engine is switched off or is prevented from starting up. *↑27.8 Error parameter list* describes possible causes for these errors and includes instructions on how to remedy them.

DC 6 shows more measured values and corresponding errors for a more detailed description:

3601 *AmplifierTemp*	3066 *ErrAmplTempWarn* 3067 *ErrAmplTemp*
3602 *AmplifierSupply*	3068 *ErrAmplSupply*
3604 *Int13V*	3069 *ErrInt13V*
3605 *AmplifierVoltage.*	

25.2 XIOS

The control and monitoring of the current outputs is activated with the

14400 *Amplifier1On*

14405 *Amplifier2On*

14410 *Amplifier3On*

functions.

If a HZM-CAN periphery module type XIOS is connected, additional current-controlled valves can be operated in this way. Although the configuration of the valves takes place on the periphery module side in this case, the process is identical to the information in this section.

25.2.1 Current setpoint

The setpoints which have been assigned to the individual outputs are used to calculate the following current setpoints

12400 *Amplifier1CurrentSetp*

12405 *Amplifier2CurrentSetp*

12410 *Amplifier3CurrentSetp*.

The current flowing through the amplifiers and the voltages are read back and displayed in

12401 *Amplifier1Current*	12402 *Amplifier1Voltage*
12406 *Amplifier2Current*	12407 *Amplifier2Voltage*
12411 *Amplifier3Current*	12412 *Amplifier3Voltage*

The current difference between the setpoint and actual current is shown in

12403 *Amplifier1CurrentDiff*

12408 *Amplifier2CurrentDiff*

12413 *Amplifier3CurrentDiff*.

25.2.2 Monitoring

A group error from hardware and software monitorings is reported in

13080 *ErrAmplifier1*

13081 *ErrAmplifier2*

13082 *ErrAmplifier3*

↑*27.8 Error parameter list* describes possible causes for these errors and includes instructions on how to remedy them.

Amplifier errors result in an emergency shutdown as standard, which means that the engine is switched off or is prevented from starting up if ↑*25.2.2.1 Deactivation of the emergency shutdown* does not apply.

There is an overcurrent detection function in the hardware and, in the software, the amplifier current can be monitored in two ways after a start delay of 10400 *AmplifierCurrCheckStartDelay*:

Undercurrent and overcurrent monitoring is active as soon as the amplifier of the current output is activated. The permissible lower and upper limit is set with the parameters

10401 *Amplifier1CurrentErrLow*	10402 *Amplifier1CurrentErrHigh*
10406 *Amplifier2CurrentErrLow*	10407 *Amplifier2CurrentErrHigh*
10411 *Amplifier3CurrentErrLow*	10412 *Amplifier3CurrentErrHigh*

The function switches

14403 *Amplifier1CurrDiffCheckOn*

14408 *Amplifier2CurrDiffCheckOn*

14413 *Amplifier3CurrDiffCheckOn*

can also be used to monitor for the tolerated deviation between the setpoint and actual value being exceeded. The tolerance range is defined with the parameters

10403 *Amplifier1CurrentDiff*

10408 *Amplifier2CurrentDiff*

10413 *Amplifier3CurrentDiff*

25.2.2.1 Deactivation of the emergency shutdown

Depending on the application, it is possible to define on which current output a fatal error should potentially not result in the standard emergency shutdown and should only trigger a suitable error response. In a dual-fuel application, for example, it would make sense for a fatal error to only be triggered on the valve that controls the diesel supply (because this means that the engine can no longer be operated), but not on the gas controls (work could continue here with pure diesel).

The software monitorings described above do not result in an emergency shutdown error if the relevant corresponding function

14404 *EcyAmplifier1ErrorOn*

14409 *EcyAmplifier2ErrorOn*

14414 *EcyAmplifier3ErrorOn*

is deactivated.

Attention

HEINZMANN recommends taking particular care when deactivating the emergency shutdown, because there is a risk of engine overspeed in the event of incorrect use!

26 Data management

The control provides various parameters for information on control device type, software version, hardware version, etc.

26.1 Serial number of control unit

Each individual control unit is unambiguously identified by a serial number. The first 4 digits identify the year of production and the month of delivery. The other digits represent the serial production number. The serial number is to be found on the **HEINZMANN** type plate or can be viewed by the following parameters:

3844 *SerialDate*	year and month of production
3845 *SerialNumber*	serial production number

26.2 Identification of control unit

The application-dependent functionality of a control is unambiguously defined by the firmware, which runs only on exactly one specific type of hardware.

3840 *HardwareVersion*	version number of control unit hardware
3841 *AddHardwareVersion*	version number of hardware modifications
3842 *SoftwareVersion*	version number of control unit firmware
3843 *BootSoftwareVersion*	version number of bootloader software

The software version identifier consists of a unique two to four digit customer number x defined by **HEINZMANN**, by a one to two digit variant number y and by a two digit revision index z. Either

xx.y.zz or xxxx.yy.zz

DcDesk2000 and the handheld programmer will allow the customer access only to control devices with a specific HEINZMANN basic software 00.yy.zz or to a custom firmware xxxx.yy.zz with the proprietary customer number x. The variants y serve to define different firmware implementations, e.g., for different engines of a manufacturer or for different applications of a certain type engine. Due to software extensions there may exist different revision stages z for the same variant with every higher ranking revision index encompassing the one below it and replacing it completely (↑*2.2* Firmware).

26.3 Identification number of PC-programme / handheld programmer

Each dongle for the **HEINZMANN** PC programme DcDesk 2000 and each **HEINZMANN** handheld programmer (↑*3.3 DcDesk 2000*), required for the setting of parameters has its own specific identification number that is passed on to the control. The current identification number of the PC programme or handheld programmer is displayed in parameter 3850 *Identifier*. The identification number of the dongle or handheld programmer which was utilized last for storing parameter changes in the control can be viewed by the parameter 3851 *LastIdentifier*. The user of this identifier is responsible for the setting of parameters.

CAN and Modbus communications modules also allow to change and save parameters in the control unit. In such cases a fixed identifier number is registered in 3851 *LastIdentifier*.

Communications module	**Identifier**
Modbus	94
CANopen	95
SAE J1939	96
DeviceNet	97
Custom protocol	98
Integrated control panel	99

27 Error Handling

27.1 General

HEINZMANN control units include an integrated error monitoring system by which errors caused by sensors, speed pickups, etc., may be detected and reported.

27.2 Error types

The following basic error types can be identified:

- Errors in configuring and parametrizing the control unit

  These errors as caused by incorrect inputs made by the user and which the PC or hand programmer cannot intercept. They do not occur with a series-produced control unit.

- Errors during ongoing operation

  These errors are the most important errors in a control unit in serial operation. Errors such as failures of speed pickups, setpoint adjusters, pressure and temperature sensors, or logical errors such as excessive temperatures or low boost pressure are typical of this category.

- Internal computing errors of the control unit

  These errors can be due to faulty components or other unacceptable operating conditions. They do not occur in normal circumstances.

The various errors may be taken from the parameters 3000...3099, 13000...13095 and 23000...23095. When an error is currently present the value is set to 1, otherwise it is 0.

When rectifying an error, you should first eliminate the cause and then clear the current errors (reset). Some errors also reset by themselves as soon as the cause has been removed.

Errors can be reset with a PC, a hand programmer or, given the appropriate configuration, with the switching function 2828 *SwitchErrorReset*. If the error is still present, you will need to continue looking for the cause.

The control unit always starts with the assumption that no error is present and then checks the error conditions. The control unit can therefore be put in an error-free condition by a ↑*3.10* Reset of control unit, currently present errors are immediately displayed again, however.

27.3 Alarm display

The errors are divided into two basic groups. There are errors where powered mode can be continued although functionality may be restricted (e.g. sensor errors). The other category consists of so-called fatal errors that will cause an emergency shutdown of the engine (e.g., overspeeding, failure of both speed pickups).

These two error groups are signalled by the following parameters:

3799 *CommonWarning* all errors are only warnings (XIOS)

3800 *EmergencyAlarm*

3801 *CommonAlarm*

The parameter 3801 *CommonAlarm* will be set on the occurrence of any error, 3799 *CommonWarning* if all errors are only warnings (XIOS only) and 3800 *EmergencyAlarm* for fatal errors only (↑ *28.7 Notabschaltfehler)*. This means that 3800 *EmergencyAlarm* cannot occur by itself.

For type DC 1 and DC 2 control units, both the common alarm and the emergency alarm are output via two fixed binary outputs (↑ *28.3.2 Error outputs of the control units DC 1* and DC 2) and can therefore be linked with a visual or acoustic signal. With these two unit types and control unit types DC 8 and DC 10, there is also the option of carrying out an initial diagnosis via the ↑ *28.3.4 Error indication by* LEDs and, with the DC 1, also via the ↑ *28.3.3 Seven-segment display of the DC 1* series.

27.3.1 Common alarm output

Control units of the types DC 5, 6, 7 and 11 are equipped with a dedicated binary error output for the transmission of the common alarm.

The DC 8 has an error LED fed to the outside and one on the circuit board, which are assigned to the common alarm. The circuit board LED is located to the left of the 9-pin communication connector (the bottom LED in the direction of the LEDs fed to the outside).

In the control units DC 9, 10 and 12, the only binary output can be freely parametrized. It is assigned the common alarm parameter 3801 *CommonAlarm* as standard.

Note

For the control unit types DC 5, 6 7, 9 and 11, it should be noted that the error output or the only binary output is commuted by the bootloader during the control unit start-up (↑ 28.5.1 Bootloader start tests). With the DC 8, it is only the error LED on the circuit board, while the error LED visible on the outside is not affected by this.

As to the common alarm, there is also the option of making the output flash at a frequency of 1 Hz for identifying warnings. For this purpose, the parameter 5101 *CommAlarmWarnFlashOn* = 1 must be set. As soon as at least one true error (no warning) is present, the common alarm output remains continuously active.

The common alarm output can also be configured so that it is reset for 0.5 s when a new additional error occurs. A PLC connected to this output can therefore detect the new error. For this, 5102 *CommonAlarmResetOn* = 1 must be set and the above flashing function disabled (5101 *CommAlarmWarnFlashOn* = 0). To also obtain an edge change when an error clears, 5103 *CommonAlarmResetBoth* must also be set to 1.

Note

The flashing or the edge change are also shown in the parameter 3801 CommonAlarm. If this parameter is assigned to a binary output on the DC 8, 9, 10, 12 or XIOS, the reaction is therefore the same as on control units with a fixed assignment to the error output.

27.3.2 Error outputs of the control units DC 1 and DC 2

Emergency alarm and common alarm are each assigned to a dedicated binary output (↑*19.3.9 Feste Alarmausgänge*) to indicate the error state. The emergency alarm is output inverted (low-active) and interpreted as the "*Control ready*"signal , which would also signal a fatal error in case of missing power supply.

With this assignment, the outputs are to be interpreted as follows:

State "Common alarm"	State "Control ready"	Meaning
not active	not active	no power supply
not active	active	no error
active	not active	emergency alarm
active	active	common alarm

Tab. 1: Error outputs of DC 1 and DC 2

The "*Control ready*" output, i.e., the inverted emergency alarm signal, is usually used to activate the overspeed protection device.

27.3.3 Seven-segment display of the DC 1 series

With the DC 1 system, the operating state of the control unit or the engine can be viewed on a seven-segment display and an initial error diagnosis can be carried out in the event of severe errors if the cover is removed.

The operating states are indicated by a number. These numbers correspond to the values of parameter ↑*3830 Phase*:

0: Waiting for engine start
1: Starting phase 1
2: Starting phase 2
3: Starting phase 3
4: Speed governor enabled, limiting functions disabled
5: Speed governor enabled, limiting functions enabled
6: Speed governor enabled, lower limit enabled
7: Speed governor enabled, upper limit enabled
8: Autoadjustment
9: Positioner

Severe errors are indicated by a letter:

d	Data record error:	The control unit cannot continue working, as there is no valid data record available. This error corresponds to the errors 3090 *ErrData* or 3091 *ErrLogical*.
E	Fatal error:	This error is indicated in case of particularly severe input and output errors (e.g. actuator cycle not completed, both speed pickups out of order etc.), causing the control unit to stop working. This indication is equivalent to the errors causing an emergency shutdown.
E.	Exception error:	Internal computing error. This error is equivalent to the error 3094 *ErrIntern*.

27.3.4 Error indication by LEDs

The circuit boards of DC 1 control units have ten LEDs, DC 2 circuit boards have five LEDs, DC 8 circuit boards have six LEDs and DC 10 circuit boards have three LEDS, all providing further information on the operating and error state of the control unit. The majority of these LEDs are represented by parameters so that their states may also be examined with the housing closed.

27.3.4.1 LED error indication in the DC 1 series

LED no.	Colour	Parameter	Meaning
1	Red	-	The watchdog processor (CPU2) has detected an error.
2	Green	3821 *LED_CPU*	The main processor is working.
3	Red	3822 *LED_SpeedPickUp1Off*	There are no pulses on speed pickup 1.
4	Red	3823 *LED_SpeedPickUp2Off*	There are no pulses on speed pickup 2.
5	Red	3824 *LED_Actuator*	An actuator error has occurred. This LED will come on if one of the following errors occurs 3050 *ErrorFeedback*, 3053 *ErrActuatorDiff*, 3059 *ErrFeedbackAdjust*.
6	Red	3825 *LED_PowerSupply*	An error in the supply voltage has occurred and 3085 *ErrPowerSupply* or 3086 *ErrPowerSupplyExt* has occurred on DC 1-04.
7	Red	3826 *LED_CommonAlarm*	At least one error has occurred. This LED is the equivalent of the common alarm output 3801 *CommonAlarm*.
8	Red	3827 *LED_FuelLimitBoost*	The filling is being limited by 2714 *BoostLimitActive* is set to 1.

9	Red	3828 *LED_FuelLimitMax*	The filling is being limited by 2711 *FuelLimitMaxActive* is set to 1.
10	Red	3829 *LED_FuelLimitMin*	The filling setpoint is 0 % and 2710 *FuelLimitMinActive* is set to 1.

Tab. 2: LED error indication DC 1

27.3.4.2 LED error indication in the DC 2 series

LED	Colour	Parameter	Meaning
1	Green	3821 *LED_CPU*	The main processor is working.
2	Red	3822 *LED_SpeedPickUp1Off*	There are no pulses on speed pickup 1.
3	Red	3823 *LED_SpeedPickUp2Off*	There are no pulses on speed pickup 2.
4	Red	3824 *LED_Actuator*	An actuator error has occurred. This LED will come on if one of the following errors occurs 3050 *ErrorFeedback*, 3053 *ErrActuatorDiff*, 3059 *ErrFeedbackAdjust*.
5	Red	3825 *LED_CommonAlarm*	At least one error has occurred. This LED is the equivalent of the common alarm output 3801 *CommonAlarm*.

Tab. 3: LED error indication DC 2

27.3.4.3 LED error indication in the DC 8 series

LED	Colour	Parameter	Meaning	
			flashing (2 Hz)	permanently active
1	Green	2858 *LED_PowerSupply*	An error has occurred on the supply voltage, 3085 *ErrPowerSupply1* = 1 or 3086 *ErrPowerSupply2* = 1.	The supply voltage is OK.
2	Green	2859 *LED_SpeedPickUp1*	An error has occurred on speed pickup 1. This flashing is the equivalent of 3001 *ErrPickUp1* =1.	There are pulses on speed pickup 1. This indication is the equivalent of 2006 *PickUp1Active* = 1.
3	Green	2860 *LED_SpeedPickUp2*	An error has occurred	There are pulses on

			on speed pickup 2. This flashing is the equivalent of 3002 *ErrPickUp2* =1.	speed pickup 2. This indication is the equivalent of 2007 *PickUp2Active* = 1.
4	Orang e	2861 *LED_OverTemp*	The circuit board temperature is too high. This flashing is the equivalent of the error 3075 *ErrOverTemp*.	-
5	Red	2862 *LED_Feedback*	An actuator error has occurred. This flashing is the equivalent of the error 3053 *ErrActuatorDiff*.	An actuator error has occurred. This indication is activated if 3050 *ErrorFeedback* or 3059 *ErrFeedbackAdjust* have occurred.
6	Red	2863 *LED_Alarm*	At least one non-fatal error has occurred. This flashing is the equivalent of 3801 *CommonAlarm* = 1, 3800 *Emergency Alarm* = 0.	A fatal error occurred and the engine had to be switched off. This indication is the equivalent of 3800 *EmergencyAlarm* = 1.

Tab. 4: LED error indication DC 8

27.3.4.4 LED indicator in the DC 10 series

The HEINZMANN control units from the DC 10 series can be equipped with three indicator LEDs (hardware version). The green LED shows whether the power supply to the control unit is on. The red LED is connected to the binary output (terminal 13), which is freely parametrizable, but is usually parametrized with the error indication 3801 *CommonAlarm*. The yellow status LED is freely parametrizable.

LED	Colour	Assignment parameter / meaning
1	Green	Power supply to the control unit is on
2	Yellow	852 *StatusLED_Assign*
3	Red	*851 DigitalOut_Assign*

Tab. 5: LED error indication DC 10

27.4 Error memory

When the control unit is powered off, it loses all its information about the current errors. However, the unit has an integral permanent error memory that provides an overview of errors that have occurred. Every error that has occurred at least once since the last time the error memory was cleared is entered here.

All control units except for DC 1 and DC 2 contain an extended error memory as standard (↑ 28.4.1 Operating data memory and extended error memory), which logs the number of occurrences and the times when the error occurred. On request, the DC 2 system may also be equipped with an extended error memory.

All firmware variants of the DC 1 system and the basic software of the DC 2 system only show that an error has occurred, however, and do not indicate the order or the time of their occurrence (simple error memory).

For the firmware, the values in the error memory are just display values and are not otherwise relevant. It only responds to the occurrence of errors during ongoing operation.

The permanent error memory can be inspected via the parameters 3100, 13100 or 23100 upwards respectively. In simple error memories, only 0 or 1 is indicated here, in the extended memory, an error counter is included. The numbers of these historic errors are incremented by 100 compared to their associated current error.

Once a system has been commissioned, the error memory must always be cleared to ensure that errors which occurred, e.g. due to sensors that are not yet connected, are not subsequently evaluated as errors during engine operation.

Note

When parameter 5100 NoStoreSErrOn = 1 is set and the error memory is then cleared, no errors will be stored in the error memory until the next ↑3.10 Reset des Steuergerätes. This means that a control unit with a customised data record can be shipped in error-free condition without the inputs having to be stimulated with the correct values. Parameter 5100 itself cannot be stored.

The permanent error memory can only be reset with the PC or hand programmer. The control unit then starts to accumulate new errors in the empty error memory. The error memory must therefore be cleared after each successful service.

27.4.1 Operating data memory and extended error memory

All control units except for DC 1 and DC 2 contain an operating data memory and an extended error memory as standard.

On request, the DC 2 system can be provided with an operating data memory and an extended error memory on the CAN or Modbus additional module respectively. This is true irrespective of whether CAN or Modbus protocols are used.

The logged operating data consists of the number of engine starts in 2250 *EngineStartCounter* and the operating hours, i.e. the number of hours the engine is running, in 3871 *OperatingHourMeter* and 3872 *OperatingSecondMeter*.

For each error that has occurred since the last error memory reset, there is an error counter and the time of the first and last occurrence. These times are shown in operating hours. Up to 12 environmental data can also be logged with each error, to match the time of the last occurrence. The maximum number of environmental data is set by the firmware that is used, and cannot be changed. However, the choice of environmental data can be freely configured by the user in the error memory window of DcDesk 2000. This should take place when the system is commissioned and the values should not be changed at a later stage unless absolutely necessary.

In all systems except for XIOS, the error counters are displayed in the error memory parameters starting from 3101 *SErr…*. The times of the first and last occurrence and the environmental data can be viewed in the error memory window of DcDesk 2000 or ARGOS or on the hand programmer HP 03.

27.5 Bootloader

The HEINZMANN control units contain a so-called bootloader. This part of the program is located in a certain section of the ROM and is programmed at the factory. The bootloader cannot be erased.

When the control unit is started by switching on the supply voltage or a reset, the bootloader program is always run first. It executes important tests which tell it whether the actual control unit program can function or not. The bootloader then decides whether the rest of the program sequence can be sent to the control unit program or whether it should stay in bootloader mode for the safety of personnel and the machine. As long as the program is in bootloader mode, the engine cannot be started.

All tests on the bootloader and the subsequent initialization of the main program take approx. 500 ms in DC 1 and DC 2, in the other control units, the process takes approx. 200…300 ms.

27.5.1 Bootloader start tests

In the following, you will find a description of the tests performed by the bootloaders of all control units and the resulting actions. Communication with the unit is not possible while the tests are in progress, especially when the program sticks in an endless loop because of a fatal error. This is why different types of display on the control units are used to indicate the current test mode. Unfortunately, DC 12 and XIOS do not have an option for these displays, but, of course, also carry out these tests.

- Watchdog test

Control unit	Error indication type
DC 1	one bar of the seven-segment display
DC 2	LED 5 is lit
DC 8	Error LED on the circuit board is on
other (except for DC 12 and XIOS)	Error output on (on DC 9, the binary output)

Tab. 6: Bootloader: Watchdog test

The test checks whether the watchdog built into the processor is operational. The purpose of the test is to ensure that, in an undefined program sequence, the control unit enters a safe state after a defined time. If the watchdog test is negative, the bootloader program stays in an endless loop and the said display stays on.

- External RAM test

Control unit	Error indication type
DC 1	two bars of the seven-segment display
DC 2	LEDs 5 and 4 are lit
other	-

Tab. 7: Bootloader: RAM test

During this test, various binary patterns are written to the external RAM memory on the control circuit board and read out again. If at least one cell does not contain the expected code, the bootloader program enters an endless loop and the said display stays on.

- Internal RAM test

Control unit	Error indication type
DC 1	two bars of the seven-segment display
DC 2	LEDs 5 and 4 and 3 are lit
DC 8	Error LED on the circuit board is on
other (except for DC 12 and XIOS)	Error output on (on DC 9, the binary output)

Tab. 8: Bootloader: Internal RAM test

Different bit patterns are read to the internal processor RAM and read back again. If at least one cell does not contain the expected code, the bootloader program enters an endless loop and the said display stays on.

- <u>Bootloader program test</u>

Control unit	Error indication type
DC 1	three bars of the seven-segment display
DC 2	LEDs 5, 4, 3 and 2 are lit
DC 8	Error LED on the circuit board is on
other (except for DC 12 and XIOS)	Error output on (on DC 9, the binary output)

Tab. 9: Bootloader: Bootloader program test

A checksum is calculated over the memory area that contains the bootloader program and is compared with the checksum programmed at the factory. If they do not match, the bootloader program stays in an endless loop and the said display stays on.

- <u>Control unit program test</u>

Control unit	Error indication type
DC 1	three bars and dot in the seven-segment display
DC 2	all five LEDs are lit
DC 8	error LED on the circuit board flashing: three short flashes, long off, three short flashes, …
other (except for DC 12 and XIOS)	error output flashing (binary output on DC 9): three short flashes, long off, three short flashes, …

Tab. 10: Bootloader: Control unit program test

A checksum is calculated over the memory area that contains the control unit program and is compared with the programmed checksum. If they do not match, the bootloader enters a state in which the error 3087 *ErrMainCheckSum* is displayed via the serial communication (DcDesk 2000 PC program or hand programmer).

- <u>Watchdog trigger</u>

The bootloader enters a state in which the watchdog error 3089 *ErrWatchdog* is displayed via the serial communication (DcDesk 2000 PC program or hand programmer).

27.5.2 Bootloader communication

Communication between DcDesk 2000 or a hand programmer and the bootloader can commence when

DC 1:	"b" appears in the seven-segment display
DC 2:	the five LEDs are running completely
DC 5, 6, 7, 9, 11:	the error output on the control units is flashing (binary output on DC 9)
DC 8:	the error LED on the circuit board is flashing and all LEDs visible on the outside are deactivated
DC 12, XIOS:	

In this condition, errors are indicated and it is also the starting point for the download of a new control unit program (only with DcDesk 2000) which is performed by the bootloader.

Note

On the DC 1, the rotary switch should be in position 0 before communication with DcDesk 2000 is started (↑19.2.3 Drehschalter).

27.5.3 Bootloader error

The error indications of the bootloader can be found under ↑*28.8 Fehlerparameterliste*.

27.6 Configuration errors

If the configuration of the control device is faulty, this will be indicated in 3092 *ErrConfiguration*. A faulty configuration may result for instance if during parameter setting for inputs and outputs the channel type was not indicated.

In addition to 3092 *ErrConfiguration* an error code is output in 3000 *ConfigurationError*, which gives information about the type of error occurred. The message displayed in 3000 *ConfigurationError* changes every second and shows all currently present configuration errors.

Note

The communication programme DcDesk2000 displays the error message for configuration errors in the window "Current errors".

A configuration error can be deleted with the command “Clear error” but this does not correct the cause of the error. Most configuration errors are checked only when the control device starts. Therefore a reset will be necessary after the parameters have been changed and saved in the control device.

The following tables give an overview of the error codes and their meaning. It depends on the version of the control device software whether one of the mentioned communications protocols is supported or less. In other words, not all the errors mentioned here will occur in a specific control unit.

Variable Ports	
10	Port used as analogue input but not so configured

15	Port used as analogue output but not so configured
20	Port used as PWM input but not so configured
25	Port used as PWM output but not so configured
30	Port used as digital input but not so configured
35	Port used as digital output but not so configured
41	Channel type not applicable to this port

DC 6	
11	LMG on analogue input 1, but not configured to 0..5V or 5230 LoadControlOrPot <> 1
12	SyG on analogue input 2, but not configured to 0..5V

DC 5	
105	Port as frequency output 1 configured but as digital output 8 used
106	Port as frequency output 2 configured but as digital output 9 used
120	Port as PWM input 1 configured but as digital input 1 used
125	Port as PWM output 1 configured but as digital output 10 used
126	Port as PWM output 2 configured but as digital output 9 used
130	Port as digital input 1 configured but as PWM input 1 used
135	Port as frequency output 2 or as digital output 9 configured but as PWM output 2 used
136	Port as digital output 10 configured but as PWM output 1 used
140	The 37 V channel or one of the temperature channels is assigned to a current or voltage sensor
141	There is another channel assigned to the alternator than the 37 V channel
142	There is another channel assigned to a temperature sensor than a temperature channel

DC 10	
200	Port 3 als Analog- oder Binäreingang konfiguriert aber nicht verfügbar
201	Port 4 als Analog- oder Binäreingang konfiguriert aber nicht verfügbar

202	Port 6 ist als analoger oder digitaler Eingang benutzt, ist aber nicht verfügbar (altes Layout)
203	Kanal 7 ist verwendet (Temp Eingang), ist aber nicht verfügbar (altes Layout)
204	Einem Sensor ist dem Temperaturkanal (7) zugeordnet, Port 5 ist aber nicht als Temperatureingang konfiguriert
205	PU1 ist an , Port 6 ist aber nicht als Pickup-Eingang konfiguriert
206	PU2 ist an , Port 5 ist aber nicht als Pickup-Eingang konfiguriert
207	Port 5 Pull-up-Widerstand ist konfiguriert, ist aber nicht verfügbar (altes Layout)
208	CAN-Kommunikation ist konfiguriert, ist aber nicht verfügbar (Hardware-Variante ohne CAN)
209	Endstufe ist an (ActuatorOn), ist aber nicht verfügbar (Variante ohne Endstufe)
210	LED-Ausgang ist zugewiesen, ist aber nicht vorhanden
211	Port 7 ist als digitaler Eingang benutzt, ist aber nicht verfügbar (altes Layout)
212	PU1 nicht verfügbar (altes Layout)
213	Lambda-Sensor ist auf dem Kanal nicht zuweisbar
214	Lambda-Sensor ist auf Port 3 zugewiesen. Port 3 ist aber nicht als Lambda-Sensor-Eingang konfiguriert
215	Lambda-Sensor ist auf Port 6 zugewiesen. Port 6 ist aber nicht als Lambda-Sensor-Eingang konfiguriert

DC 8	
300	Analogeingang 2 kann nicht als Stromeingang konfiguriert werden

Ausgangs-Zuweisung	
700	unbekannter Ausgangs-Kanaltyp zugewiesen
701	Ausgangs-Kanaltyp wird nicht unterstützt
702	Kanaltyp Binärausgang wird nicht unterstützt
703	Kanaltyp Analogausgang wird nicht unterstützt
704	Kanaltyp PWM-Ausgang wird nicht unterstützt
705	Kanaltyp Stellgeräteausgang wird nicht unterstützt
706	Kanalnummer für Binärausgang zu groß
707	Kanalnummer für Analogausgang zu groß

708	Kanalnummer für PWM-Ausgang zu groß
709	Kanalnummer für Stellgeräteausgang zu groß oder nicht zuweisbar
710	zugewiesene Parameternummer existiert nicht
711	zugewiesener Parameter ist kein Bitwert

Configuration errors – switching functions allocation	
800	Channel type was assigned to a switching function not supported by the software
804	Channel number too high for customer protocol switching function
805	Channel number too high for CANopen switching function
806	Channel number too high for DeviceNet switching function
807	Channel number too high for Modbus switching function
808	Channel number too high for SAE J1939 sensor input.
809	Channel number too high for HZM-CAN customer module switching function
810	Channel number too high for HZM-CAN twin-module switching function
811	Channel number too high for WAGO module switching function
812	More than 32 switching functions set
854	Customer protocol inactive or not supportive of switching functions
855	CANOpen inactive or not supportive of switching functions
856	DeviceNet inactive or not supportive of switching functions
857	Modbus inactive or not supportive of switching functions
858	SAE J1939 protocol not active or without digital inputs
859	HZM-CAN customer module inactive or not supportive of switching functions
860	HZM-CAN twin-module inactive or not supportive of switching functions
861	WAGO inactive or not supportive of switching functions
863	HZM-CAN-PE-module switching input inactive or not supportive of digital inputs

Configuration errors - sensor allocation	
900	Channel type was assigned to sensor not supported by the software
901	Channel number too high for analogue sensor input
902	Channel number too high for PWM sensor input
903	Channel number too high for HZM-CAN-PE module sensor input
904	Channel number too high for customer protocol sensor input

Configuration errors - sensor allocation	
905	Channel number too high for CANopen sensor input
906	Channel number too high for DeviceNet sensor input
907	Channel number too high for Modbus sensor input
908	Channel number too high for SAE J1939 sensor input.
909	Channel number too high for HZM-CAN customer module sensor input
910	Channel number too high for HZM-CAN twin-module sensor input
911	Channel number too high for WAGO module switching function
912	A HZM-CAN PE module type was assigned that is not configured or is not equipped with sensors.
916	HZM-CAN-ALL sensor not supported
917	Knotennummer des Sensor-Senders über HZM_CAN_ALL nicht belegt
918	DC-Knoten zugewiesen, der nicht konfiguriert ist oder keine Sensoren besitzt
919	Kanalnummer für ICENI-Sensoreingang zu groß
920	Kanalnummer für Frequenz-Sensoreingang zu groß
921	Sensorkanal zugewiesen, der nicht als Analogeingang konfiguriert ist
922	Sensorkanal zugewiesen, der nicht als PWM-Eingang konfiguriert ist
923	Sensorkanal zugewiesen, der nicht als Frequenzeingang konfiguriert ist

Configuration error – Engine configuration	
1000	Frequency resulting from teeth number and maximum required speed is too high.
1012	No pickup available, one pickup must be activated at least
1015	With odd teeth number it is not possible to filter over only one crank shaft revolution

Configuration error – Dual fuel engine	
1100	Gas PE node number not defined or node type false
1101	Gas PE node number defined but actuator by own hardware activated
1102	Gas PE node number defined but actuator/fuel telegram not activated
1103	Gas setpoint has no destination
1104	Supervisor mode configured but nevertheless control functions activated
1105	zu viele Ausgänge für Drosselklappen konfiguriert

Fahrgeschwindigkeit	
1150	Velocity gefordert, aber Eingang nicht konfiguriert

Funktionale Fehler	
3000	Relative Leistung nicht parametriert

Stellgerät	
3950	Kanal zugewiesen, der nicht als Stellgeräterückführung möglich ist
3951	Kanal zugewiesen, der nicht als Stellgeräteendstufe möglich ist
3952	Die Hardware unterstützt keine Elysion-Rückführung
3953	Elysion-Rückführung darf nicht doppelt linearisiert werden
3954	Autoabgleich an Nullposition ist nur mit einem Stellgerät möglich
3955	Autoabgleich an Nullposition ist am V-Motor nicht möglich
3956	bei Ausgabe an Stellgerät ist der volle Wertebereich des Parameters gefordert
3957	Zuweisungsparameter für Ausgabe an Stellgerät nicht zugelassen
3958	Stellgerät aktiviert aber kein Zuweisungsparameter konfiguriert
3959	Stellgerät aktiviert aber kein Port konfiguriert

XIOS	
4000	unbekanntes Modul
4002	Modul existiert nicht
4003	Pickup-Konfiguration passt nicht zur Hardware (FPGA)
4009	IP6K9K Software passt nicht zur IP00-Hardware und umgekehrt (FPGA)

Communication protocol HZM-CAN PE	
11000	No master activated for periphery module
11001	PE module type is not supported by master
11002	Number of nodes for this PE module type exceeded
11003	PE module node number assigned twice
11004	PE-node not activated
11005	More than one master defined for periphery module
11006	No PE-module with actuator or valve output implemented

Communication protocol WAGO module	
21700	WAGO module not active, but values from it have been requested

Communication protocol CANopen	
21750	CANopen not active, but values from it have been requested

Communication protocol Modbus	
21800	Modbus not active, but values from it have been requested

Communication protocol DeviceNet	
21850	DeviceNet not active, but values from it have been requested
21851	A DeviceNet sensor that is not transmitted was allocated

Communication protocol SAE J1939	
21900	SAE J1939 not active, but values from it have been requested

Communication protocol HZM-CAN CM	
21950	HZM-CAN CM not active, but values from it have been requested

27.7 Emergency shutdown errors

The following list offers a summary of all errors that will cause an emergency shutdown during operation or inhibit engine start. When at least one so-called fatal error has occurred 3800 *EmergencyAlarm* is activated and in the control units HELENOS and PRIAMOS the signal "Control ready" is cancelled. These errors are described in detail in chapter ↑*27.8 Error parameter list*.

In custom firmware other errors may lead to an engine shutdown, e.g., when in a system with V-engines with two actuators and a connection via HZM-CAN the CAN connection fails or the second actuator reports an error.

Errors	**Reason**
3001 *ErrPickup1*	Error at pickup 1
3002 *ErrPickup2*	Error at pickup 2
3004 *ErrOverspeed*	Overspeed
3031 *ErrOilPressEcy*	Oil pressure below speed dependent shutdown threshold
3047 *ErrMisfireEcy*	Misfire signal over speed-dependent threshold
3050 *ErrFeedback*	Error at feedback of actuator 1
3051 *ErrFeedback2*	Error at feedback of actuator 2 (PRIAMOS III)
3052 *ErrFeedback3*	Error at feedback of actuator 3 (PRIAMOS III)
3056 *ErrFeedbackRef*	Error at feedback reference of actuator 1
3059 *ErrFeedbackAdjust*	Error during automatic actuator adjustment with actuator 1
3060 *ErrAmplifier*	Error end stage (ARCHIMEDES, ORION, PANDAROS)
3060 *ErrFeedbackAdjust2*	Error during actuator auto-adjust of actuator 2 (PRIAMOS III)
3061 *ErrFeedbackAdjust3*	Error during actuator auto-adjust of actuator 3 (PRIAMOS III)
3075 *ErrClearFlash*	Error at erasing the flash memory
3076 *ErrParamStore*	Error at saving of the parameters in flash memory (HELENOS and PRIAMOS) or E^2PROM memory (ARCHIMEDES; ORION, PANDAROS)
3077 *ErrProgramTest*	Error during permanent check of programme memory
3078 *ErrRAMTest*	Error during permanent check of RAM memory
3089 *ErrWatchdog*	Undefined programme flow, internal programming error (indication in bootloader)
3090 *ErrData*	No parameters or wrong check sum over parameters (always active after programme download in ARCHIMEDES, ORION or PANDAROS)
3091 *ErrLogical*	Error in parameter structure
3093 *ErrStack*	Stack overflow, internal programming error
3094 *ErrIntern*	Exception, internal programming error

Note

If a fatal error is reported, automatic calibration of actuators is not possible.

27.8 Error parameter list

The following error parameter list indicates the causes of each single error and the respective response of the control. Furthermore, it lists the appropriate actions to be taken to eliminate the respective error.

The errors are stored in the volatile error memory under the parameter numbers 3000/13000/23000 and higher and in the permanent error memory under the parameter numbers from 3100/13100/23100 onward.

The errors are sorted by ascending numbers with the parameter on the left indicating the actual error as stored in the volatile memory and with the parameter on the right indicating the one stored as a sentinel in the permanent error memory. As explained above, the control will only react to actual errors whereas the permanent error memory serves no other purpose than to accumulate information on the occurrences of errors.

3000 ConfigurationError

Cause: Configuration error.

Response: Error message.

Action: Check and correct control unit configuration, save parameters and reset control unit.

Reference: ↑*27.6 Configuration errors*

3001 ErrPickUp1 **3101 SErrPickUp1**

Cause:
- Speed pickup 1 is at fault.
- Distance between speed pickup 1 and gear rim is too large.
- Speed pickup 1 is supplying faulty redundant pulses.
- Interruption of cable from speed pickup 1.
- Speed pickup 1 wrongly mounted.

Response:
- Control continues operation with speed pickup 2 if available.
- Emergency shutdown if there is no pickup 2 or it is also at fault.

Action:
- Check distance between speed pickup 1 and gear rim.
- Check preferred direction of pickup.
- Check cable to speed pickup 1.
- Check speed pickup 1, replace if necessary.

Reference: ↑*6 Speed sensing*

3002 ErrPickUp2 **3102 SErrPickUp2**

Cause: - Speed pickup 2 is at fault.
- Distance between speed pickup 2 and gear rim is too large.
- Speed pickup 2 sends additional error pulses
- The cable from pickup 2 is interrupted
- Speed pickup 2 wrongly mounted.

Response: - Control unit continues working with pickup 1.
- Emergency shutdown if speed pickup 1 is also at fault.

Action: - Check distance between speed pickup 2 and gear rim.
- Check preferred direction of pickup.
- Check cable to speed pickup 2.
- Check speed pickup 2, replace if necessary.

Reference: ↑*6 Speed sensing*

3003 ErrCamIndex **3103 SErrCamIndex**

Cause: - Cam index is at fault.
- Distance between cam index and camshaft is too large.
- Cam index sends additional error pulses
- The cable from cam index is interrupted
- Cam index wrongly mounted.

Response: Single cylinder recognition no further available.

Action: - Check distance between cam index and camshaft.
- Check cable to cam index.
- Check cam index, replace if necessary.

Reference: ↑*10.8.1* Single cylinder recognition

3004 ErrOverSpeed **3104 SErrOverSpeed**

Cause: Engine speed was/is exceeding overspeed.

Response: Emergency shutdown.

Action: - Check overspeed parameter (21 *SpeedOver*).
- Check adjustment of set speed.
- Check PID adjustment.
- Check mechanical parts, linkage is possibly jamming.
- Check actuator.
- Check cable to actuator.
- Substitute actuator.
- Check pickup, possibly it sends wrong speed data.

- Check numbers of teeth (1 *TeethPickUp1* and 2 *TeethPickUp2*).
- With vehicle operation, check whether overspeed was due to thrust operation.

Reference: ↑*6.4 Overspeed monitoring*

3005 ErrSetpoint1Extern	**3105 SErrSetpoint1Extern**
3006 ErrSetpoint2Extern	**3106 SErrSetpoint2Extern**
3007 ErrLoadCtrlInput	**3107 SErrLoadCtrlInput**
3008 ErrSyncInput	**3108 SErrSyncInput**
3009 ErrBoostPressure	**3109 SErrBoostPressure**
3010 ErrOilPressure	**3110 SErrOilPressure**
3011 ErrAmbientPressure	**3111 SErrAmbientPressure**
3012 ErrCoolantTemp	**3112 SErrCoolantTemp**
3013 ErrChargeAirTemp	**3113 SErrChargeAirTemp**
3014 ErrOilTemp	**3114 SErrOilTemp**
3015 ErrFuelTemp	**3115 SErrFuelTemp**
3016 ErrExhaustTemp	**3116 SErrExhaustTemp**
3019 ErrExcitReduct	**3119 SErrExcitReduct**
3020 ErrSpeedReduct /	**3120 SErrSpeedReduct /**
3020 ErrAlternator	**3120 SErrAlternator**
3021 ErrCoolantPressure	**3121 SErrCoolantPressure**
3022 ErrAsymmetricLoad	**3122 SErrAsymmetricLoad**
3023 ErrMeasuredPower	**3123 SErrMeasuredPower**
3024 ErrPowerSetpoint	**3124 SErrPowerSetpoint**
3025 ErrTurboOilTemp	**3125 SErrTurboOilTemp**
3026 ErrFuelPress	**3126 SErrFuelPress**
3027 ErrOilLevel	**3127 SErrOilLevel**
3028 ErrFuelLimitExtern	**3128 SErrFuelLimitExtern**
3029 ErrTransOilPressure	**3129 SErrTransOilPressure**

Cause: Some error has been detected for the respective sensor input (e.g., short circuit or cable break).

Response: Error my disappear by itself if configuration is adequate, i.e., when control unit measuring values return inside admissible limits.

Action:
- Check sensor cable for short circuit or cable break.
- Check the respective sensor, replace if necessary.
- Check error limits for this sensor.

Reference:
- ↑*20.2.4 Error detection for analogue inputs*
- ↑*20.3.1 Error detection at PWM inputs*

3030 ErrOilPressWarn **3130 SErrOilPressWarn**

Cause: Oil pressure has dropped below the speed dependent oil pressure warning characteristic.

Response:
- Error message.
- Error is cleared automatically when oil pressure is back above the oil pressure warning characteristic.

Action:
- Check engine (oil level, oil pump, etc.).
- Check oil pressure sensor.
- Check cable of oil pressure sensor.
- Check oil pressure warning characteristic

Reference: ↑*10.6 Speed dependent oil pressure monitoring*

3031 ErrOilPressEcy **3131 SErrOilPressEcy**

Cause: Oil pressure has fallen below the speed dependent oil pressure emergency shutdown characteristic.

Response: Emergency shutdown.

Action:
- Check engine (oil level, oil pump, etc.).
- Check oil pressure sensor.
- Check cable of oil pressure sensor.
- Check oil pressure emergency stop characteristic.

Reference: ↑*10.6 Speed dependent oil pressure monitoring*

3032 ErrCoolantTempWarn **3132 SErrCoolantTempWarn**
3033 ErrChargeAirTempWarn **3133 SErrChargeAirTempWarn**
3034 ErrOilTempWarn **3134 SErrOilTempWarn**
3041 ErrExhaustTempWarn **3141 SErrExhaustTempWarn**

Cause: Temperature has exceeded the warning threshold.

Response:
- Error message.
- Error is cleared automatically when coolant temperature returns below the warning characteristic.

Action:
- Check temperature.
- Check temperature sensor.
- Check temperature sensor cable.
- Check warning threshold.

Reference: - ↑*10.1 Coolant temperature warning*
- ↑*10.2 Charge air temperature warning*
- ↑*10.3 Oil temperature warning*
- ↑*10.4 Exhaust gas temperature warning*

3039 ErrStarter **3139 SErrStarter**

Cause: Engine has not started after the max. number of cranking attempts.

Response: - Error message.
- The starting request is terminated. A repetition of cranking attempts is possible by setting the starting request again.

Action: - Check alternator
- Check starter

Reference: ↑*11.3* Starting request

Note: This parameter is implemented only in the ARCHIMEDES series.

3040 ErrAlternatorWarn **3144 SErrAlternatorWarn**

Cause: Alternator voltage has dropped below a minimum value and cannot load the battery.

Response: - Error message.
- Error is cleared automatically when alternator voltage returns above parameterized threshold

Action: - Check alternator
- Check thresholds

Reference: ↑*10.9 Alternator charge monitoring*

Note: This parameter is implemented only in the ARCHIMEDES series.

3044 ErrCoolantPressWarn **3144 SErrCoolantPressWarn**

Cause: Coolant pressure has dropped below the speed dependent coolant pressure warning characteristic.

Response: - Error message.
- Error is cleared automatically when coolant pressure is back above the coolant pressure warning characteristic.

Action: - Check engine (coolant level, coolant pump...)
- Check coolant pressure sensor
- Check cable of coolant pressure sensor
- Check coolant pressure warning characteristic

Reference: ↑*10.7 Speed dependent coolant pressure monitoring*

3045 ErrCoolantPressIdle **3145 SErrCoolantPressIdle**

Cause: Coolant pressure has dropped below the speed dependent coolant pressure forced idle speed characteristic.

Response: Forced idle speed

Action:
- Check engine (coolant level, coolant pump...)
- Check coolant pressure sensor
- Check cable of coolant pressure sensor
- Check coolant pressure forced idle speed characteristic

Reference: ↑*10.5 Forced idle speed in locomotive applications*

3046 ErrMisfireWarn **3146 SErrMisfireWarn**

Cause: The calculated misfire value is below the load dependent characteristic.

Response:
- Error message.
- Error is cleared automatically when the calculated misfire value returns above the characteristic.

Action: Check

Reference: ↑*10.8 Misfire monitoring in generator operation*

3047 ErrMisfireEcy **3147 SErrMisfireEcy**

Cause: The calculated misfire value is below the load-dependent emergency shutdown characteristic.

Response: Emergency shutdown

Action: Check

Reference: ↑*10.8 Misfire monitoring in generator operation*

3048 ErrPowerDifference **3148 SErrPowerDifference**

Cause: The integrated power control outputs a difference between power setpoint and measured power for a period longer than set in 1240 *MaxPowerDiffMaxTime* and greater than set in 1239 *MaxPowerDifference*.

Response:
- Error message.
- Error is cleared automatically when power difference returns to admissible range.

Action: Check.

Reference: ↑*14.2.3 Integrated power governor*

3048 ErrTwinEngine **3148 SErrTwinEngine**

Cause: Power setpoint transmission from master to slave is disturbed.

Response: Both controls go into droop mode.

Action: - Check CAN connection
- Check CAN modules

Reference: - ↑*15.1 Master/slave operation*

3049 ErrPECommonAlarm **3149 SErrPECommonAlarm**

Cause: At least one of the HZM-CAN PE modules reports an error.

Response: Depends on the application

Action: - Parameter 2440 *CanPEError* gives detailed information for each PE module:

Bit number	Meaning
0	fatal error in periphery module
1	common alarm in periphery module
2	pickup error
3	I/O error
4	actuator or feedback error
5	velocity measurement error
6	cylinder error

- Check PE module

3050 ErrFeedback **3150 SErrFeedback**
3051 ErrFeedback2 **3151 SErrFeedback2**
3052 ErrFeedback3 **3152 SErrFeedback3**

Cause: Error in feedback system of first, second or third actuator, actuator not connected.

Response: - Control unit cannot be put into operation
- Emergency shutdown.

Action: - Check feedback cable to actuator.
- Check actuator, replace actuator if necessary.
- Check error limits for feedback:
1952 *FeedbackErrLow* / 1953 *FeedbackErrHigh*

1962 *FeedbackErrLow2* / 1963 *FeedbackErrHigh2*
1972 *FeedbackErrorLow3* / 1973 *FeedbackErrorHigh3*

Reference: —

Note: *The parameters for a second and third actuator are implemented only in the PRIAMOS III series.*

3053 ErrActuatorDiff **3153 SerrActuatorDiff**
3054 ErrActuatorDiff2 **3154 SErrActuatorDiff2**
3055 ErrActuatorDiff3 **3155 SErrActuatorDiff3**

Cause: The difference between set actuator travel and actual actuator travel has exceeded 10 % of the total actuator travel for more than one second. This error will occur if the injection pump or the actuator are jamming or are not connected.

Response:
- Error message.
- Error will be cleared automatically, as soon as the difference falls below 10%.

Action:
- Check injection pump / throttle valve, replace if necessary.
- Check mechanical parts (linkage).
- Check cables to actuator.
- Check actuator, replace if necessary.

Reference: —

Note: *The parameters for a second and third actuator are implemented only in the PRIAMOS III series.*

3056 ErrFeedbackRef **3156 SerrFeedbackRef**

Cause: Error in feedback system of actuator, actuator not connected.

Response:
- Control unit cannot be put into operation
- Emergency shutdown.

Action:
- Check feedback cable to actuator.
- Check actuator, replace actuator if necessary.
- Check error limits for feedback reference:
  1956 *FeedbackRefErrLow* / 1957 *FeedbackRefErrHigh*

Reference: —

3059 ErrFeedbackAdjust **3159 SErrFeedbackAdjust**
3060 ErrFeedbackAdjust2 **3160 SErrFeedbackAdjust2**
3061 ErrFeedbackAdjust3 **3161 SErrFeedbackAdjust3**

Cause: Automatic calibration of the actuator could not be performed, wrong input of reference values for actuator.

Response: Control unit cannot be put into operation

Action:
- Check voltage supply and supply lines to actuator.
- Check feedback cable to actuator.
- Check actuator, replace actuator if necessary.
- For actuators with 2-quadrant operation the engine stop switch must be opened (indication parameter 2810 *SwitchEngineStop* = 0) to perform automatic calibration of actuator.
- Check reference values and error limits for feedback
- Error thresholds
  1952 *FeedbackErrorLow* = 0
  1953 *FeedbackErrorHigh* = 65535
  1956 *FeedbackRefErrLow* = 0
  1957 *FeedBackRefErrHigh* = 65535
  for feedback and store values,
  restart governor by reset and repeat automatic calibration.
- Set error limits again.

Reference: —

Note: The parameters for a second and third actuator are implemented only in the PRIAMOS III series.

3060 ErrAmplifier **3160 SErrAmplifier**

Cause: Overcurrent in actuator addressing

Response:
- Engine cannot be started
- Emergency shutdown.

Action: Check actuator, replace actuator if necessary.

Note: These parameters are implemented only in the ARCHIMEDES, ORION and PANDAROS series.

3061 ErrDigiIO1 **3161 SErrDigiIO1**
3062 ErrDigiIO2 **3162 SErrDigiIO2**
3063 ErrDigiIO3 **3163 SErrDigiIO3**
3064 ErrDigiIO4 **3164 SErrDigiIO4**

Cause: Hardware component has detected overload.

Response: Error message.

Action:
- Check digital IOs.
- Clear error.
- Insert relay interface module RIF 01

Reference: ↑*19.3.7 Digital outputs*

Note: *These parameters are implemented only in the HELENOS series.*

3065 ErrISOCommLine **3165 SErrISOCommLine**

Cause: Error at hardware component.

Response: Communication is not possible

Action: - Restart control with ↑*3.10 Reset of control unit*
- Notify **HEINZMANN**.

Note: *These parameters are implemented only in the HELENOS series.*

3070 ErrCanBus **3170 SErrCanBus**
3072 ErrCanBus2 **3172 SErrCanBus2**

Cause: The CAN controller reports errors such as BusStatus, ErrorStatus or DataOverrun. In spite of resetting the controller, it may sometimes not be possible to clear the errors permanently.

Response: Depends on the application

Action: - Check CAN module
- Check CAN connection

Reference: —

Note: *The parameters for the second CAN controller are available only in the ARCHIMEDES series.*

3071 ErrCanComm **3171 SErrCanComm**
3073 ErrCanComm2 **3173 SErrCanComm2**

Cause: There is an overrun in the destination buffer or a message cannot be fed into CAN bus.

Response: Depends on the application

Action: - Check CAN module
- Check CAN connection

Reference: —

Note: *The parameters for the second CAN controller are available only in the ARCHIMEDES series.*

3074 ErrModbusComm **3174 SErrModbusComm**

Cause: Error in Modbus communication

Response: Depends on the application

Action: - Check the Modbus module
- Check the Modbus connection

3075 ErrClearFlash **3175 SErrClearFlash**

Cause: Error on clearing the control's flash memory.

Response: - Engine cannot be started
- Emergency shutdown.

Action: - Restart control with ↑*3.10 Reset of control unit*.
- Notify **HEINZMANN**.

3076 ErrParamStore **3176 SErrParamStore**

Cause: Occurrence of an error on programming the control's parameter memory.

Response: - Engine cannot be started
- Emergency shutdown.

Action: - Restart control with ↑*3.10 Reset of control unit*.
- Notify **HEINZMANN**.

3077 ErrProgramTest **3177 SErrProgramTest**

Cause: Actual monitoring of the programme memory reports an error.

Response: - Engine cannot be started
- Emergency shutdown.

Action: - Restart control with ↑*3.10 Reset of control unit*.
- Notify **HEINZMANN**.

3078 ErrRAMTest **3178 SErrRAMTest**

Cause: Current RAM monitoring reports an error.

Response: - Engine cannot be started
- Emergency shutdown.

Action: - Write down values of parameters 3895 *RAMTestAddrHigh* and 3896 *RAMTestAddrLow*
- Restart control with a ↑*3.10 Reset of control unit.*
- Notify **HEINZMANN**.

3079 ErrInternTemp1 **3179 SErrInternTemp1**
3080 ErrInternTemp2 **3180 SErrInternTemp2**

Cause: Error at internal temperature starting from 3607 *InternTempIn1*.

Response: - Error message.
- Error is cleared automatically as soon as temperature is back within the normal range.

Note: These parameters are implemented only in the ARCHIMEDES series.

3080 ErrDisplay **3180 SErrDisplay**

Cause: Integrated display cannot be addressed.

Response: Error message.

Action: Check display

Note: These parameters are implemented only in the PANDAROS series.

3081 Err5V_Ref **3181 SErr5V_Ref**

Cause: The internal 5V supply for sensor reference 3603 *5V_Ref* is not within the permissible range between 4.5 and 5.5 V.

Response: - Error message.
- Error is cleared automatically as soon as the voltage is back within normal range.

Action: Check sensor supply

Note: These parameters are implemented only in the ORION and PANDAROS series.

3081 Err5VRefAna/TempIn1 **3181 SErr5VRefAna/TempIn1**
3082 Err5VRefAna/TempIn2 **3182 SErr5VRefAna/TempIn2**
3083 Err5VRefAna/TempIn3 **3183 SErr5VRefAna/TempIn3**
3084 Err5VRefAna/TempIn4 **3184 SErr5VRefAna/TempIn4**

Cause: The internal 5V supply for sensor reference 3603 *5VRefAnalog/TempIn1* is not within the permissible range between 4.5 and 5.5 V.

Response: - Error Message
- Error is cleared automatically as soon as the voltage is back within normal range.

Action: Check sensor supply

Note: These parameters are implemented only in the ARCHIMEDES series.

3085 ErrVoltage **3185 SErrVoltage**
3085 ErrPowerSupply **3185 SErrPowerSupply**

Cause: Power supply to the control unit is not within the permissible range between 9 and 32 V for ARCHIMEDES, ORION and PANDAROS, respectively between 8 to 33 V for HELENOS or 8 to 45 V for PRIAMOS.

Response: - Error message
- Error is cleared automatically as soon as the voltage is back within normal range.

Action: Check power supply.

3086 ErrVoltageExt **3186 SErrVoltageExt**

Cause: The supply voltage for the extension board is not within the permissible range from 8 to 45 V.

Response: - Error message
- Error is cleared automatically as soon as the voltage is back within normal range.

Action: Check power supply.

Note: These parameters are implemented only in the PRIAMOS III series.

3086 ErrPowerSupplyEDCFb **3186 SErrPowerSupplyEDCFb**

Cause: The supply voltage for EDC-actuator feedback 3602 *PowerSupplyEDCFeedb* is not within the permissible range from 4.5 to 5.5 V.

Response: - Error message
- Error is cleared automatically as soon as the voltage is back within normal range.

Action: Check power supply.

Note: These parameters are implemented only in the ARCHIMEDES series.

3087 ErrCPU2 **3187 SErrCPU2**

Cause: CPU 2 of control units of the PRIAMOS type has failed.

Response: Error message

Action: Notify **HEINZMANN**.

Reference: *↑27.9 Watchdog processor CPU2 in PRIAMOS series*

Note: These parameters are implemented only in the PRIAMOS III series.

3087 ErrSupply7.5V **3187 SErrSupply7.5V**

Cause: The internal 7.5V supply 3601 *Supply7.5V* is not within the permissible range between 7 and 8 V.

Response: - Error message
- Error is cleared automatically as soon as the voltage is back within normal range.

Action: Check power supply.

Note: These parameters are implemented only in the ARCHIMEDES series.

3087 ErrMainCheckSum

Cause: Check-sum of control programme is wrong.

Response: Control unit cannot be put into operation

Action: - Restart control with ↑*3.10 Reset of control unit*.
- Notify **HEINZMANN**.

Reference: ↑*27.5 Bootloader*

Note: This error will only be displayed by the bootloader.

3088 ErrDigitalOut **3188 SErrDigitalOut**

Cause: An error was recognized at one or more digital outputs.

Response: - Depends on the application.

Action: - The parameters starting from 3631 *DigitalOut1:ErrType* give detailed information in case of error:

Bit number	Meaning
0	short against Ubatt
1	short against GND
2	OpenLoad or short against Ubatt
3	OpenLoad or short against GND

- the parameters starting from 3611 *DigitalOut1:Feedback* show the feed back output signal

Reference: ↑*19.2.7* Digital outputs

Note: These parameters are implemented only in the ARCHIMEDES series.

3089 ErrPEFatal **3189 SErrPEFatal**

Cause: At least one of the HZM-CAN PE modules reports a fatal error.

Response: Depends on the application

Action: - Parameter 2440 *CanPEError* gives detailed information for each PE module:

Bit number	Meaning
0	fatal error in periphery module
1	common alarm in periphery module
2	pickup error
3	I/O error
4	actuator or feedback error
5	velocity measurement error
6	cylinder error

- Check PE module

Reference: —

3089 ErrWatchdog

Cause: Internal computing error, so-called "watchdog error" .

Response: - Control unit cannot be put into operation
- Emergency shutdown

Action: - Restart control with ↑*3.10 Reset of control unit*.
- Notify **HEINZMANN**.

Reference: ↑*27.5 Bootloader*

Note: *This error will only be displayed by the bootloader.*

3090 ErrData **3190 SErrData**

Control devices of the type HELENOS and PRIAMOS

Cause: No data found or check sum over data is wrong.

Response: - Engine cannot be started
- Control unit is operating with default parameters

Action: - Check data for correct setting,
- Save parameters ↑*3.2 Saving data* and restart control unit by a ↑*3.10 Reset of control unit.*

Note: *This error will occur only when adjusting and saving parameters.*

3090 ErrData **3190 SErrData**

Control devices of the type ARCHIMEDES, ORION and PANDAROS

Cause: Parameter 3099 *EEPROMErrorCode* gives detailed information on error type.

Bit	Meaning
0	Programme recognition in E^2PROM is not valid, programme remains in bootloader, engine start is not possible
1	Operational data memory 1 in E^2PROM is not valid, operational data are cancelled, engine start is possible
2	Operational data memory 2 in E^2PROM is not valid, operational data are cancelled, engine start is possible
3	Serial number memory in E^2PROM is not valid, engine start is possible (level of integrated display is set to „1“)
4	Error memory in E^2PROM is not valid, error memory is cancelled, engine start is possible
5	Parameter memory in E^2PROM is not valid, standard firmware parameters are used, engine start is not possible
6	Exceptions memory in E^2PROM is not valid, engine start is possible

Action: - Check data for correct setting,
- Restart governor with a ↗*3.10 Reset of control unit*
- Notify **HEINZMANN**

Note: The error appears only after a reset of the control unit. Bit 5 is reported after every programme download.

3091 ErrLogical **3191 SErrLogical**

Cause: Data structure error

Response: - Engine cannot be started
- Control unit is operating with default parameters

Action: - Check data for correct setting,
- Restart governor with a ↗*3.10 Reset of control unit*
- Notify **HEINZMANN**

3092 ErrConfiguration **3192 SErrConfiguration**

Cause: Configuration error

Response: - Engine cannot be started
- Control unit is operating with default parameters

Action: - Check data for correct setting,
- Restart governor with a ↑*3.10 Reset of control unit*
- Notify HEINZMANN

Reference: ↑*27.6 Configuration errors*

3093 ErrStack **3193 SErrStack**

Cause: Internal programming or computing error, "stack-overflow".

Response: - Engine cannot be started
- Emergency shutdown.

Action: - Note down the value of parameter 3897 *StackTestFreeBytes* (HELENOS, PRIAMOS)
or 3897 *CStackTestFreeBytes* and 3898 *IStackTestFreeBytes* (ARCHIMEDES, ORION, PANDAROS)
- Notify **HEINZMANN**.
- Restart control with ↑*3.10 Reset of control unit*.

3094 ErrIntern **3194 SErrIntern**
3095 ExceptionNumber **3195 SExceptionNumber**
3096 ExceptionAddr1High **3196 SExceptionAddr1High**
3097 ExceptionAddr1Low **3197 SExceptionAddr1Low**
3098 ExceptionAddr2High **3198 SExceptionAddr2High /**
3198 SExceptionFlag
3099 ExceptionAddr2Low **3199 SExceptionAddr2Low**

Cause: Iinternal programming or computing error, so-called "EXCEPTION" error.

Response: - Engine cannot be started
- Emergency shutdown.

Action: - Note down the values of the parameters 3195 to 3199
- Notify **HEINZMANN**
- Restart control with ↑*3.10 Reset of control unit*

Note: *In control units of the ARCHIMEDES, ORION and PANDAROS series only the parameters of the error memory are shown.*

27.8.1 XIOS

The following error parameter list of the XIOS describes the causes of the individual errors and the reaction of the control unit. It also indicates actions to rectify the errors.

The errors are sorted in ascending order by number 3001…3099, 13000...13099, 23000...23099. Each number corresponds to an error group of up to 14 individual error states and two pieces of additional information. The error states are shown coded by bit (↑ *Tab. 37*). If several errors in an error group occur at the same time, the relevant combination or error bits is shown in hexadecimal format. DcDesk 2000 has one special window for displaying the current errors and one for the saved errors, where the individual error states are shown along with a brief description.

At least one of the errors 0 to 13 (0x0001..0x2000) from each error group has a meaning, which is described in the following tables.

Error 14 (0x4000) is set if all other active errors from this error group are only warnings.

Error 15 (0x8000) indicates that at least one of the errors 0...13 in this error group has resulted in an emergency shutdown.

Unused errors between 0 and 13 are not described.

The following table provides an overview of the individual errors in an error group and the corresponding ID, along with a description of the two errors 14 and 15, which are present in every error group. The errors 14 and 15 are not referred to again in the subsequent description of the individual error groups.

Error	ID	Meaning
0	0x0001	
1	0x0002	
2	0x0004	
3	0x0008	
4	0x0010	
5	0x0020	
6	0x0040	
7	0x0080	
8	0x0100	
9	0x0200	
10	0x0400	
11	0x0800	

Error	ID	Meaning
12	0x1000	
13	0x2000	
14	0x4000	**Warning** At least one error in this group has triggered a warning. → indication only
15	0x8000	**Emergency shutdown** At least one error in this group has triggered an emergency shutdown. → Engine is shut down or can not be started.

Tab. 37: XIOS: General error status

27.8.1.1 Speed sensors

3001 ***ErrPickUp1*** **3002** ***ErrPickUp2***

Error	Meaning
0	**Speed pickup has failed or the cable of the speed pickup is broken or disconnected.** - No signal is measured over a specific period of time (monitoring only if 2000 *Speed* > 256 *StartSpeed2).* - The camshaft index encoder has measured one rotation and there is no signal from the speed pickup. - The fail-safe camshaft index encoder is synchronised and there is no signal from the speed pickup. → The speed pickup is deactivated, redundant speed pickup takes over (if possible) • Check the distance between the speed pickup and the toothed gear • Check the cable to the speed pickup • Check the speed pickup and replace if necessary
1	**Speed pickup does not start or is too far away from the toothed gear** - There is no signal from the speed pickup, even though the redundant speed pickup measures a speed. Only with redundant speed pickups 1 and 2. → The speed pickup is deactivated, redundant speed pickup takes over (if possible) • Check the distance between the speed pickup and the toothed gear • Check the cable to the speed pickup • Check the speed pickup and replace if necessary

Error	Meaning
3	**The frequency delivered by the speed pickup is too high** - The interrupt difference over several periods is below 500 µs, which means that the input frequency is too high. → The speed pickup is deactivated, redundant speed pickup takes over (if possible) • Check the speed pickup and replace if necessary

Tab. 38: XIOS: Possible errors speed sensors

27.8.1.2 Overspeed

3004 *ErrOverSpeed*

Error	Meaning
0	**Overspeed PickUp1** - The speed on PickUp1 was/is higher than the overspeed. - The combination of the number of teeth on PickUp1 and maximum speed/overspeed delivers a measurement frequency that is higher than the permitted value. → Emergency shutdown • Check the parameter for overspeed (21 *SpeedOver*). • Check the speed setting. • Check the PID setting. • Check whether the overspeed was caused by overrun mode.
1	**Overspeed pickup 2** - The speed on PickUp2 was/is higher than the overspeed. - The combination of the number of teeth on PickUp1 and maximum speed/ overspeed delivers a measurement frequency that is higher than the permitted value. → Emergency shutdown • Check the parameter for overspeed (21 *SpeedOver*). • Check the speed setting. • Check the PID setting. • Check whether the overspeed was caused by overrun mode.

Tab. 39: XIOS: Possible errors overspeed

27.8.1.3 Setpoint adjusters and sensors

3005 ***ErrSetpoint1Extern***
3006 ***ErrSetpoint2Extern***
3007 ***ErrLoadCtrlInput*** (generator)
3008 ***ErrSyncInput*** (generator)
3009 ***ErrBoostPressure/ErrBoostPressure1***
3010 ***ErrOilPressure***
3011 ***ErrAmbientPressure***
3012 ***ErrCoolantTemp***
3013 ***ErrChargeAirTemp***
3014 ***ErrOilTemp***
3015 ***ErrFuelTemp***
3016 ***ErrExhaustTemp***
3019 ***ErrExcitReduct*** (locomotives)
3020 ***ErrSpeedReduct*** (locomotives)
3021 ***ErrCoolantPressure***
3022 ***ErrAsymmetricLoad*** (ship)
3023 ***ErrTractionVoltage*** (locomotives)
3023 ***ErrMeasuredPower*** (generator)
3024 ***ErrTractionCurrent*** (locomotives)
3024 ***ErrPowerSetpoint*** (generator)
3025 ***ErrTurboOilTemp***
3026 ***ErrFuelPress***
3027 ***ErrOilLevel***
3028 ***ErrFuelLimitExtern***
3029 ***ErrTransOilPressure***

13040 ***ErrExhaustTempCyl1*** **– 13063** ***ErrExhaustTempCyl24***
13064 ***ErrAirMass***
13065 ***ErrAlternatorVoltage*** (XIOS, vehicle)
13066 ***ErrBoostPressure2***
13067 ***ErrLambda1***
13068 ***ErrLambda2***
13069 ***ErrNOx*** (↑*28.8.1.22 Smart NOx and O2* **sensor**)
13070 ***ErrO2*** (↑*28.8.1.22 Smart NOx and O2* **sensor**)
13071 ***ErrGasTemp*** **(**DualFuel**)**
13072 ***ErrGasPosition*** **(**DualFuel**)**
13073 ***ErrGasRailPressure*** **(**DualFuel**)**
13074 ***ErrGasValveCheckPr*** **(**DualFuel**)**
13075 ***ErrIgnitionOffset*** **(**DualFuel**)**

Monitoring only if the sensor is received via an analogue or PWM input or a communication module.

Error	Meaning
0	**Signal short circuit to ground** - The measured value of the corresponding input value is below the lower error threshold. → Reaction according to the configuration of the sensor error handling • Check the sensor cable. • Check the sensor. • Check the parameters for the error limits.
1	**Signal short circuit to supply voltage** - The measured value of the corresponding input value is above the upper error threshold. → Reaction according to the configuration of the sensor error handling • Check the sensor cable. • Check the sensor. • Check the parameters for the error limits.
2	**Sensor supply voltage cable break or short circuit to ground** - The measured value of the corresponding reference voltage is below 4.5 V - Monitoring only during temperature input or if sensor referencing is activated. → Reaction according to the configuration of the sensor error handling • Check the sensor cable. • Check the sensor.
3	**Sensor supply voltage short circuit to supply voltage** - The measured value of the corresponding reference voltage is higher than 5.5 V - Monitoring only during temperature input or if sensor referencing is activated. → Reaction according to the configuration of the sensor error handling • Check the sensor cable. • Check the sensor.
4	**Error via communication module** - The connection to the communication module has failed. - The communication module reports an incorrect sensor value. → Reaction according to the configuration of the sensor error handling • Check the connection to the communication module. • Check the sensor cable. • Check the sensor.

Error	Meaning
5	**Threshold 1 exceeded or not reached** - The sensor value has exceeded/not reached threshold 1 and the corresponding delay time has expired. Warning message or emergency shutdown depending on the monitoring configuration
6	**Threshold 2 exceeded or not reached** - The sensor value has exceeded/not reached threshold 2 and the corresponding delay time has expired. → Warning message or emergency shutdown depending on the monitoring configuration

Tab. 40: XIOS: Possible errors adjusters and sensors

27.8.1.4 Misfire monitoring (generator)

3047 *ErrMisfireDetection*

Error	Meaning
5	**Warning threshold exceeded** - 2050 *SpeedVariance* has exceeded the warning threshold - Monitoring only if 4055 *MisfireWarnCurveOn* is set → Warning message
6	**Switch-off threshold exceeded** - 2050 *SpeedVariance* has exceeded the switch-off threshold - Monitoring only if 4056 *MisfireEcyCurveOn* is set → Emergency shutdown

Tab. 41: XIOS: Possible errors misfire monitoring

27.8.1.5 Twin-engine applications (ship)

3048 *ErrTwinEngine*

Error	Meaning
0	**Error in the transfer via HZM-CAN** - The CAN controller reports an error 3070 *ErrCanBus1* - The transfer message is in timeout 3071 *ErrCanComm1* (opposite side is not transmitting). - Monitoring only if 5251 *TwinEngineEnable* and 4400 *CanCommDCOn* are set

Error	Meaning
	→ the CAN connection is switched off and both engines run in droop mode • Check the CAN cables. • Check the CAN terminating resistor. • Check the baud rate. • Configure the unit numbers 401 *CanMyNodeNumber* and 402 *CanOtherNodeNumber* correctly

Tab. 42: XIOS: Possible errors twin-engine applications (ship)

27.8.1.6 Integrated power governor

3048 *ErrPowerGovernor*

Error	Meaning
0	**Control deviation too large** - The difference between the actual power and the setpoint power is over 1240 *MaxPowerDiffMaxTime* seconds higher than the 1239 *MaxPowerDifference*. - Monitoring only if 5233 *PowerGovernorOrLMG* = 1. → Error message, error is self-cleaning

Tab. 43: XIOS: Possible errors integrated power governor

27.8.1.7 Actuator error

3050 *ErrActuator/ErrActuator1*

3051 *ErrActuator2*

3052 *ErrActuator3*

Error	Meaning
0	**Actuator difference** - The difference between the target control path and the actual control path exceeds 10% of the total control path for more than one second. This situation exists when the fuel injection pump, the throttle valve, the linkage or the actuator sticks or is not connected. → Error display. The error clears when the difference is below 10% again.

Error	Meaning
1	**Autoadjustment error** - Error during autoadjustment. → Engine start not possible.
2	**Feedback error** - Measured values outside the error limits → Engine start not possible, fatal error, amplifier switched off.
3	-
4	**Overcurrent error** - Overcurrent ID → Engine start not possible, fatal error, amplifier switched off.

27.8.1.8 CAN bus

3070 *ErrCanBus1* **3072 *ErrCanBus2***

Error	Meaning
0	**BusOff detected** - The CAN controller reports BusOff. → CAN telegrams can no longer be sent or received. • Check the CAN cables. • Check the CAN terminating resistor. • Check the baud rate.

Tab. 44: XIOS: Possible errors CAN bus

27.8.1.9 CAN communication

3071 *ErrCanComm1* **3072 *ErrCanComm2***

Error	Meaning
0	**Timeout for receipt** - The parameter 2403 *CanRxTimeout* shows which device type the timeout occurred in. → Reaction depends on the device type and application.
1	**Overflow of the receive buffer** - The receive buffer has overflowed. Some messages could not be received. The parameter 2402 *CanRxBufferState* shows which device type the receive buffer overflow occurred in.

Error	Meaning
	→ error message only
2	**Overflow of the send buffer** - The send buffer has overflowed. Some messages could not be sent. The parameter 2401 *CanTxBufferState* shows which device type the send buffer overflow occurred in. → error message only
3	**Incorrect unit configuration** - Two units with the same unit number and the same unit type are connected to the CAN network. The CAN communication is deactivated. → CAN telegrams are no longer sent or received. • Parametrize the unit numbers clearly.

Tab. 45: XIOS: Possible errors CAN communication

27.8.1.10 Internal temperature measurement

3079 *ErrInternTemperature*

Error	Meaning
5	**Internal temperature too high** - The internal temperature is higher than 100 °C for longer than 1 s. → Warning message
6	**Internal temperature extremely high** - The internal temperature is higher than 110 °C for longer than 1 s. → Warning message

Tab. 46: XIOS: Possible errors internal temperature measurement

27.8.1.11 Ethernet

3080 *ErrEthernet1* **3082 *ErrEthernet2***

Error	Meaning
0	**Hardware error during initialization** - The Ethernet component is not synchronized → Error message and communication is not possible via this connection
1	**Broadcast server could not be created** - Server for DcDesk unit search could not be started →Error message and the unit can not be found via DcDesk

Error	Meaning
2	**Main server could not be created** - Server for DcDesk communication could not be started →Error message and communication is not possible via this connection
3	**Ethernet test** - Error in the Ethernet test function (only available with special software) →error message only

Tab. 47: XIOS: Possible errors Ethernet

27.8.1.12 Voltage supply

3085 *ErrPowerSupply*

Error	Meaning
0	**Supply voltage too low** - The supply voltage 3606 *BoardVoltageVBAT* of the control unit is lower than 5 V or lower than 9 V for 0.5 s → Emergency shutdown • Check the supply voltage.
1	**Supply voltage too high** - The supply voltage 3606 *BoardVoltageVBAT* of the control unit is higher than 35 V for longer than 0.5 s → Emergency shutdown • Check the supply voltage.
7	**Current consumption too high** - More than 22 A is drawn, indication in 3607 *BoardCurrentSupply* → Emergency shutdown • Check cabling.

Tab. 49: XIOS: Possible errors voltage supply

27.8.1.13 Data storage

3087 *ErrEEPROM*

Error	Meaning
0	**Error during EEPROM access** - The data storage cannot be read or written on. → Error during reading: emergency shutdown, standard program parameters are used (this error can only be read during control unit start) → Error during saving: error message only, saving is not possible
1	**Parameter storage fault** - There is a fault in the data area for the parameter storage (this error can only be read during control unit start) → Emergency shutdown, standard program parameters are used
2	**Parameter storage invalid** - EEPROM can not be read (see error 0) (this error can only be read during control unit start) - First control unit start after program download → Emergency shutdown, standard program parameters are used
3	**ECU page fault** - There is a fault in the data area for the control unit identification. → error message only, data is still used
4	**NMI page fault** - There is a fault in the data area for the NMI data (e.g. operating seconds). → error message only, data is still used
5	**Workdata page fault** - There is a fault in the data area for the operating data. → the error memory is cleared, other data is still used
7	**Temperature page fault** - There is a fault in the data area for the calibration of resistance temperature sensors. → error message only, data is still used

Tab. 50: XIOS: Possible errors data storage

27.8.1.14 File system

3088 *ErrFilesys*

Error	Meaning
1	**Access not possible** - → Error message File system could not be connected • Hardware error
2	**Driver initialization fault** - → Error message **File system driver could not be initialized** Hardware error

Tab. 51: XIOS: Possible errors file system

27.8.1.15 USB host

3089 *ErrUSBHost*

Error	Meaning
0	- USB host functions could not be initialized → Error message • Disconnect the connected unit, carry out a reset and connect the unit again
1	- Read or write error → error message only • **Data could not be read or written**

Tab. 52: XIOS: Possible errors USB host

27.8.1.16 FPGA

3090 *ErrFPGA*

Error	Meaning
0	**No access** - No access to FPGA → FPGA is either faulty or not programmed • Check the following parameters for reasonable content 3831 *CompileTimeFPGAMC* 3832 *CompileDateFPGAMC* 3833 *CompileYearFPGAMC* 3852 *FpgaIdMC* • FPGA must be reprogrammed
1	**DPRAM fault** - RAM test during initialization failed → FPGA is either faulty or not programmed • Check the following parameters for reasonable content 3831 *CompileTimeFPGAMC* 3832 *CompileDateFPGAMC* 3833 *CompileYearFPGAMC* 3852 *FpgaIdMC* FPGA must be reprogrammed

Tab. 53: XIOS: Possible errors FPGA

27.8.1.17 Engine-specific error

3091 *ErrEngine*

Error	Meaning
0	**Charge control alternator** - The battery is not charged via the alternator. → error message only • Check the connection between the alternator and battery
1	**Starter** - The starter can not start the engine. → error message only

Tab. 54: XIOS: Possible errors engine-specific errors

27.8.1.18 Configuration

3092 *ErrConfiguration*

Error	Meaning
0	**Configuration errors** - There is a fault in at least one configuration of the control unit. → error message only • The configuration error is displayed in the parameter 3000 *ConfigurationError* • Check the control unit configuration and rectify, save parameters and perform a control unit reset

Tab. 55: XIOS: Possible errors configuration

27.8.1.19 Internal errors

3094 *ErrIntern*

Error	Meaning
0	**Stack overflow** - The storage area available for the stack is full. → Emergency shutdown • Note down parameters 3190 to 3198 • Note down parameter 3897 *StackTestFreeBytes* • Carry out a reset to restart the control unit and inform HEINZMANN
1	**Exception error** - The control unit reported an internal computing error. → Emergency shutdown • Note the parameters 3190 *ExceptionNumber* to 3198 *ExceptionInfo2Low* • Carry out a reset to restart the control unit and inform HEINZMANN
2	**Error in the cyclical program test** - The checksum calculated continuously via the program does not match the saved checksum. → Emergency shutdown • Note down parameters 3190 to 3198 • Carry out a reset to restart the control unit and inform HEINZMANN

Error	Meaning
3	**Error in the cyclical RAM test** - The running RAM test reports an error. → Emergency shutdown • Note down parameters 3190 to 3198 • Note 3895 *RAMTestAddrHigh* and 3896 *RAMTestAddrLow* • Carry out a reset to restart the control unit and inform HEINZMANN
4	**Overflow in the error memory** - The space available for the error memory is full. → error message only → new errors are no longer recorded in the error memory. • The error memory must be read out and cleared
5	**Error index too large** - An error is to be set, for which no parameter is available. → error message only • Carry out a reset to restart the control unit and inform HEINZMANN

Tab. 56: XIOS: Possible errors internal computing error

27.8.1.20 Dual fuel

13030 *ErrGasRailStatus*

Error	Meaning
0	**Gas section not OK** - External gas section monitoring was not completed successfully → The switch to dual fuel mode does not take place • Check the gas supply • Check the gas section
6	**The gas alarm external switch is active** - The external monitoring device has triggered a gas alarm → The switch to dual fuel mode does not take place Gas speed governor: The dual fuel mode is exited via the fast ramp Diesel reduction governor: The dual fuel mode is exited immediately without a ramp • Check the external monitoring device • Check 2847 *SwitchExternGasAlarm* (2871 *SwitchExternGasAlarm* with the XIOS)

Error	Meaning
7	**Gas pressure not in the range for gas operation** - Relative gas pressure is not in the range for dual-fuel mode → The switch to dual fuel mode does not take place. Gas speed governor: If the gas pressure is too high, the dual fuel mode is exited immediately without a ramp, otherwise via the normal ramp Diesel reduction governor: If the gas pressure is too high, the dual fuel mode is exited immediately without a ramp, otherwise via the fast ramp • Check the gas pressure • Check the boost pressure • Check the limit values
8	**Gas temperature is not in the range for dual fuel operation** - Gas temperature is not in the range for dual fuel mode → The switch to dual fuel mode does not take place. The dual fuel mode is exited with the normal ramp • Check the gas temperature • Check the temperature limits
9	**Gas does not bring any power** - Diesel speed governor does not react to the addition of gas in duel fuel mode, i.e. the diesel quantity does not fall → The dual fuel mode is exited immediately without a ramp • Check the gas valves • Check the actuator on the throttle valve or MEGASOL control unit

Tab. 57: XIOS: Possible errors gas section

13031 *ErrGasConditions*

Error	Meaning
0	**Conditions for gas incorrect** - Duel fuel operation is required 2837 *SwitchGasOrDiesel* = 1, but at least one of the conditions does not apply → The switch to dual fuel mode does not take place Dual fuel mode is exited • Check the conditions • Gas speed governor: evaluate the individual error messages
1	**Speed is not in the range for dual fuel operation** - Speed is not in the range for dual fuel mode → The switch to dual fuel mode does not take place The dual fuel mode is exited with the normal ramp

Error	Meaning
	• Check the speed • Check the limit values
2	**Power is not in the range for dual fuel operation** - Power is not in the range for dual fuel mode → The switch to dual fuel mode does not take place The dual fuel mode is exited with the normal ramp • Check the power • Check the limit values
3	**Diesel filling is not in the range for dual fuel operation** - Diesel filling is not in the range for dual fuel mode in diesel operation → The switch to dual fuel mode does not take place • Check the diesel filling • Check the limit values
4	**Boost pressure is not in the range for dual fuel operation** - Boost pressure is not in the range for dual fuel mode → The switch to dual fuel mode does not take place The dual fuel mode is exited with the normal ramp • Check the boost pressure • Check the limit values
5	**Oil pressure is not in the range for dual fuel operation** - Oil pressure is not in the range for dual fuel mode, i.e. the oil pressure warning is active → The switch to dual fuel mode does not take place The dual fuel mode is exited with the normal ramp • Check the oil pressure
6	**Coolant temperature is not in the range for dual fuel operation** - Coolant temperature is not in the range for dual-fuel mode → The switch to dual fuel mode does not take place The dual fuel mode is exited with the normal ramp • Check the coolant temperature • Check the temperature limits
7	**Charge air temperature is not in the range for dual fuel operation** - Charge air temperature is not in the range for dual fuel mode → The switch to dual fuel mode does not take place The dual fuel mode is exited with the normal ramp • Check the charge air temperature • Check the temperature limits

Error	Meaning
8	**Exhaust temperature is not in the range for dual fuel operation** - Exhaust temperature is not in the range for dual fuel mode → The switch to dual fuel mode does not take place The dual fuel mode is exited with the normal ramp • Check the exhaust temperature • Check the temperature limits
9	**Exhaust temperature difference is not in the range for dual fuel operation** - Exhaust temperature difference between the hottest and the coldest cylinder is not in the range for dual fuel operation → The switch to dual fuel mode does not take place The dual fuel mode is exited with the normal ramp • Check the cylinder temperatures • Check the temperature parity of the cylinders • Check the temperature limits
10	**Ariadne reports a light knocking** - Light knocking → Gas speed governor: Gradual increase of the ignition oil quantity. Dual fuel mode is exited with the normal ramp if the maximum permissible increase is reached and the engine is still knocking Diesel reduction governor: Gradual increase of the diesel position setpoint. Dual fuel mode is exited with the fast ramp if the maximum permissible increase is reached and the engine is still knocking. • Raise the absolute minimum ignition oil quantity 10055 *PilotDslAbsMinimum* • Gas speed governor: Raise the ignition oil quantity 10060 *PilotDieselSetpoint* (or curve) • Diesel reduction governor: Raise the diesel position setpoint 10060 *DieselSetpoint* (or curve)
11	**Ariadne reports heavy knocking** - Heavy knocking → The dual fuel mode is exited immediately without a ramp • Raise the absolute minimum ignition oil quantity 10055 *PilotDslAbsMinimum* • Gas speed governor: Raise the ignition oil quantity 10060 *PilotDieselSetpoint* (or curve) • Diesel reduction governor: Raise the diesel position setpoint 10060 *DieselSetpoint* (or curve)

Error	Meaning
12	**MEGASOL gas positioner not synchronised** - MEGASOL gas positioner is not synchronised, although the diesel speed governor is running and a gas setpoint is transferred → The dual fuel mode is exited immediately without a ramp • Check the MVC control unit • Check the speed sensors on MVC
13	**Diesel filling is below ignition oil quantity** - In dual fuel operation, diesel filling is below 12060 *PilotFuelPresent* → The dual fuel mode is exited immediately without a ramp • Check the diesel filling • Check ignition oil quantity • Check the limit values

Tab. 58: XIOS: Possible errors gas conditions

13032 *ErrDualFuelStatus*

Error	Meaning
0	**Gas positioner is not responsive** - The control unit that the gas actuator or the gas valves are connected to reports an error → The switch to dual fuel mode does not take place The dual fuel mode is exited immediately without a ramp • Check the gas actuator • Check the gas control unit
1	**Ariadne is not responsive** - ARIADNE knock detection module has failed or CAN connection is faulty, no knock detection monitoring → The switch to dual fuel mode does not take place The dual fuel mode is exited immediately without a ramp • Check the CAN connection • Check ARIADNE
2	**Emergency stop command via external input** - 2873 *SwitchEmergencyStop* is active → Emergency shutdown

Tab. 59: XIOS: Possible errors dual fuel status

27.8.1.21 Smart NOx and O2 sensor

13033 *ErrSNSNOx*, 13034 *ErrSNSO2*

Error	Meaning
0	**Sensor supply** - Voltage supply not in the permissible range. • Check the sensor supply voltage.
1	**Heating** - Short circuit. •
2	**Heating** - Interrupted power circuit. •
3	**Sensor** - Short circuit. •
4	**Sensor** - Interrupted power circuit. •
5	**SAE J1939 CAN transfer** - RX message not consistent. •
6	**SAE J1939 CAN transfer** - RX message in timeout. •

Tab. 60: XIOS: Possible errors Smart NO_x and O_2 sensor

Additional information:

27.8.1.22 Exhaust temperature

13039 *ErrExhaustTempMax*

Error	Meaning
4	**Error via HZM-CAN periphery module** - The connection to the periphery module has failed. • Check the connection to the periphery module.

Tab. 61: XIOS: Possible errors maximum exhaust temperature

27.8.1.23 Error at valves with current control loop

13080 *ErrAmplifier1*
13081 *ErrAmplifier2*
13082 *ErrAmplifier3*

Error	Meaning
0	**Error current deviation** - Difference between current set-point an actual value is larger than allowed deviation for more than 100 ms. This occures when the cabel is broken for example • Error indication
1	—
2	**Error of current value** - Measured value beyond limit • Engine start not possible, fatal error, end stage shut down
3	—
4	**Overcurrent error** - Overcurrent detection • Engine start not possible, fatal error, end stage shut down

Tab. 61: XIOS: Possible errors maximum exhaust temperature

27.9 Watchdog processor CPU2 in PRIAMOS series

The controls of the PRIAMOS/PRIAMOS III type are equipped with a second processing unit CPU2. CPU2 serves for monitoring the main processor itself and for additional monitoring of overspeed which is also being supervised by the main processor. In vehicle applications, CPU2 can also be used for monitoring the gas pedal thus offering a second way of engine shutdown in case of failure, independently of the main processor.

Between the main processor and the watchdog processor two signals are continuously exchanged representing a sign of life of the respective sender. If the main processor's signal to the CPU2 fails this will be interpreted to imply that the main processor's performance is disturbed and that it is no longer capable of reliably governing the engine. For this reason the CPU2 will inhibit energizing of the actuator and trigger a permanently active reset by the main processor. By this, the engine is stopped and the main processor turned off.

Should the signal from the watchdog processor to the main CPU fail then only the error message 3087 *ErrCPU2* will be output and a common alarm issued. The alarm alerts to the fact that the main processor is no longer monitored. In this event, the control unit should be exchanged as soon as possible for reasons of safety.

For additional monitoring of overspeed the parameter 22 *SpeedOverCPU2* has to be set. Overspeed as monitored by the CPU2 should be above overspeed 21 *SpeedOver* as monitored by the main processor in order to prevent this rather tough way of executing a shutdown from acting earlier than the controlled shutdown as executed by the programme of the main processor. This is of particular importance in case the main programme is to handle overrun conditions.

In vehicle operation, the CPU2 may be used to implement a second way of supervising the gas pedal and the actuator independently of the main processor.

To implement this monitoring function vehicle mode must have been selected. In addition, the gas pedal must have been connected to the analogue input 1 and an actuator with two-quadrant control such as the Bosch EDC pump must be used. Actuators of this type are energized only in direction of 100 % whereas a return spring is provided for acting in direction of 0 %. Besides, the signals of specific digital inputs must be set to certain values in order to activate monitoring: The digital input 2 must have been set to high, and the digital inputs 5 and 7 to low. This should be kept in mind when assigning these digital inputs to certain switching functions.

For this method of monitoring the following parameters must be set:

23 *SpeedSetpCPU2* = ...	Idle speed in CPU2
811 *FunctIdleSpeed* = 2	Idle speed switch
1200 *CPU2StartTimOutDelay* = ...	Delay time for shutdown test
1512 *AnalogIn1_ErrorLow* = ...	Low error threshold for gas pedal
1513 *AnalogIn1_ErrorHigh* = ...	High error threshold for gas pedal
1810 /3810 *OperationMode* = 1	Vehicle mode in main programme
1921 *ServoCurrentCPU2* = ...	Actuator current for shutdown test in CPU2
1922 *ServoCurrentStartTest* = ...	Actuator current for shutdown test in main processor
5200 *CPU2VehicleMode* = 1	Vehicle mode in CPU2
5911 *Amplifier2Qor4Q* = 1	Actuator with two-quadrant control

On powering up the control unit, a test is performed to ascertain whether the actuator can be controlled. This is done by being fully energized by the main processor. The CPU2 measures current that must be higher than 1921 *ServoCurrentCPU2*. Once the delay time 1200 *CPU2StartTimOutDelay* has elapsed, the CPU2 will turn energizing off and measure current once more. If it has remained above 1921 *ServoCurrentCPU2*, then the CPU2 will take this as a symptom that the actuator cannot be controlled properly. In either case the CPU2 will inhibit any engine start. This is achieved by turning the main processor off through a permanent reset.

For monitoring the gas pedal, the error thresholds of the analogue input will be checked and verified. Besides, a logical check of the gas pedal value is performed by means of the signal from the idle speed switch 2811 *SwitchIdleSpeed* and the currently sensed speed. If the gas pedal is in position of 0 %, the idle speed switch must be active and speed may not exceed 23 *SpeedSetpCPU2*. All other combinations point to an error and lead to a current shut-off for actuators and main processor.

Whenever the CPU2 executes an error shutdown, this state is indicated by two LEDs on the casing. The first LED of the control unit (located directly at the edge of the casing) will light up red. The second LED indicating normally by green that the main processor is operating will darken.

When the main processor is turned off by the CPU2, communication or diagnostics by handheld programmers or by the PC programme DcDesk 2000 will no longer be possible. This is why this information is output via the LEDs.

28 Parameter description

Table *Parameter groups* provides an overview of which number ranges which functions can be found in. The following four sections list each individual parameter with a brief description and make reference to the detailed explanation of the parameter in this document or other publications.

These four parameter lists explain all parameters that can be defined in the control units with conventional injection. Not all of these parameters will appear in special firmware, however, in particular due to the different hardware requirements and the application or customer-specific implementation of functions that must be achieved. For this reason, only the available parameters determine the potential functionality of a control unit. Claims relating to certain functions cannot be made on the basis of the list provided here.

The defined level is given for each parameter. An operating tool such as DcDesk 2000, ARGOS or a hand programmer can only be used to view parameters with a level that is no higher than the level of the tool.

Parameters that require saving and a control unit reset after a change are marked by (RESET) (↑*3.2* Saving data, ↑*3.10* Reset of control unit.

Functional parameters that only apply to specific base systems have a list of the associated control units in italics alongside the parameter name, while device-specific (hardware dependent) parameters are set out in separate subordinate lists (e.g. the XIOS configuration). The identification DC 1 includes DC 1-03 and DC 1-04 if this is not explicitly noted. Parameters that are described in detail elsewhere but are included here for the sake of completeness can also be found in separate lists (e.g. CANopen parameters).

Only the first field parameter is given for curves and maps; the parameter number is labelled "ff" (and following). Groups of parameters that follow on from each other with consecutive numbering and the same name, e.g. 1510 *AnalogIn1_RefLow*, 1520 *AnalogIn2_RefLow*, are also listed under the first number with the label "ff". The numbers in parameter names are replaced by "x" or "y".

Parameters that have the same meaning in the control units but have slightly different names, e.g. 703 *SpeedLimitTempHigh* and 703 *SpeedLimitCoolTempHigh*, are listed under the same number with both names. In a small number of cases, the same parameter number has different functions in different applications. These numbers then occur multiple times with an indication of the application (e.g. Marine operation or locomotive operation).

No.	Parameters	No.	Measured values	No.	Functions	No.	Curves
1	Number of teeth, speed	2000	Speed pickup, speed	4000	Speed pickup, speed	6000	Misfire detection
50	Misfire detection	2050	Misfire detection	4050	Misfire detection		
100	Stability, droop	2100	Stability, droop	4100	Stability, droop	6100	Stability map, speed governor (speed values)
						6150	Stability map, speed governor (fuel quantity values)
200	Ramp			4200	Ramp	6200	Stability map, speed governor (correction values)
		2200	PE module actuator travel				
250	Engine start	2250	Engine start counter				
300	Actuator travel	2300	Actuator travel			6300	Stability curve, power governor
330	HZM-CAN ALL			4330	HZM-CAN ALL		
350	Fuel quantity	2350	Fuel quantity	4350	HZM-CAN	6350	Stability map, speed governor (performance values)
400	HZM-CAN	2400	HZM-CAN	4400	HZM-CAN	6400	Boost-pressure dependent fuel quantity and power limitation
500	Monitoring of pressures, temperatures, filling level, alternator			4500	Monitoring of pressures, temperatures, filling level, alternator	6500	Monitoring of oil pressure and coolant pressure
600	Excitation control PitchControl	2600	Excitation control PitchControl	4600	Excitation control PitchControl	6600	Excitation control PitchControl
680	Exhaust recycling Intake air throttle valve Wastegate Bypass valve	2680	Exhaust recycling Intake air throttle valve Wastegate Bypass valve	4680	Exhaust recycling Intake air throttle valve Wastegate Bypass valve		
700	Fuel quantity limitation	2700	Fuel quantity limitation Fuel quantity reduction	4700	Fuel quantity limitation Fuel quantity reduction	6700	Speed-dependent fuel quantity limitation 1
800	Binary switching functions	2800	Switching functions	4800	Configuration of input/output channels	6800	Speed-dependent fuel quantity limitation 2
850	Binary outputs (single assignment)	2850	Binary outputs	4850	Binary outputs (multiple assignment)		
900	Setpoint adjusters and sensors	2900	Setpoint adjusters and sensors	4900	Setpoint adjusters and sensors	6900	Notches, speed-dependent power limitation
1000	Error handling for setpoint adjusters and sensors	3000	Current errors	5000	Error handling for setpoint adjusters and sensors	7000	Speed-dependent and ambient pressure-dependent power reduction
		3100	Error memory	5100	Error handling	7100	Temperature dependent power reduction
1200	Generator	3200	Generator	5200	Generator	7200	Zero-fuel curve or pump map
1250	Marine	3250	Marine	5250	Marine		
1300	Vehicle speed	3300	Velocity	5300	Vehicle speed	7300	Actuator characteristic
1350	Locomotive	3350	Locomotive	5350	Locomotive		
1500	Analogue inputs	3500	PWM inputs Analogue inputs	5500	Configuration of analogue input/output channels	7500	Fuel temperature dependent target quantity correction
1600	PWM outputs Analogue outputs	3600	Internal measured values, feedback, binary outputs	5600	Analogue outputs	7600	
1700	Positioner			5700	Positioner	7700	Temperature sensors

No.	Parameters	No.	Measured values	No.	Functions	No.	Curves
1800	State	3800	State			7800	Temperature sensors
1900	Servo loop	3900	Servo loop	5900	Servo loop	7900	Temperature sensors
1950	Feedback	3950	Feedback	5950	Feedback	7980	Feedback
						8100	Drive map
						8300	Exhaust recycling
						8400	Intake air throttle valve
						8500	Wastegate
						8600	Bypass valve
						8800	Binary outputs (multiple assignment)
						9000	HZM-CAN
						9900	Stability map 2 (correction values)
10000	Dual fuel	12000	Dual fuel	14000	Dual fuel	16000	Dual fuel
10900	Sensors	12900	Sensors	14900	Sensors		
11000	Error handling, sensors	13000	Current errors	15000	Error handling, sensors		
		13100	Error memory				
11400	CommonOutput	13400	CommonOutput	15400	CommonOutput		
20000	XIOS IP addresses	22000	XIOS port functions	24000	XIOS port configuration		
		22120	XIOS module types				
		22150	XIOS feedback, binary outputs				
20800	Communication switching functions			24800	Communication switching functions		
		23000	Current errors	25000	Error handling		
		23100	Error memory				
21550	ICENI			25550	ICENI		
21700	WAGO	23700	Bit collections	25700	WAGO		
21750	CANopen	23750	CANopen	25750	CANopen		
21800	Modbus	23800	Modbus	25800	Modbus		
21850	DeviceNet	23850	DeviceNet	25850	DeviceNet		
21890	XCP			25890	XCP		
21900	SAE J1939	23900	SAE J1939	25900	SAE J1939		
21950	HZM-CAN Customer module			25950	HZM-CAN Customer module		
						28500	DO-Collections
						29000	CANopen
						29200	Modbus
						29400	DeviceNet
						29600	SAE J1939
						29800	HZM-CAN Customer module
						29900	Bit collections
30000	XIOS frequency, PWM and analogue inputs and outputs	32000	XIOS frequency, PWM and analogue inputs				

Tab. 157: Parameter groups

28.1 List 1: Parameters

No.	Name	Meaning
1	**TeethPickup1**	
	Level: 4 Range: 0…400 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Number of teeth on the measuring wheel for speed pickup 1 (RESET)
2	**TeethPickup2**	
	Level: 4 Range: 0…400 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Number of teeth on the measuring wheel for speed pickup 2 (RESET)
10	**SpeedMin** **SpeedMin1**	
	Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Minimum speed for first or only speed range
11	**SpeedMin2**	
	Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Minimum speed for second speed range
12	**SpeedMax** **SpeedMax1**	

No.	Name		Meaning
	Level:	2	Maximum speed for first or only speed range
	Range:	0…4000 rpm	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
13	**SpeedMax2**		
	Level:	2	Maximum speed for second speed range
	Range:	0…4000 rpm	
	Page(s):**Fehler! Textmarke nicht definiert.**		
14	**PickUpSpeedDiffMax**		
	Level:	2	Maximum permitted variation between 2001 *SpeedPickUp1* and 2002 *SpeedPickUp2* for the duration 15 *PickUpSpeedDMaxTime*
	Range:	0…4000 rpm	
	Page(s):**Fehler! Textmarke nicht definiert.**		
15	**PickUpSpeedDMaxTime**		
	Level:	2	Maximum duration for a difference between 2001 *SpeedPickUp1* and 2002 *SpeedPickUp2*, that is greater than 14 *PickUpSpeedDiffMax*
	Range:	0…10 s	
	Page(s):**Fehler! Textmarke nicht definiert.**		
17	**SpeedFix** **SpeedFix1**		
	Level:	2	First or only fixed speed
	Range:	0…4000 rpm	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		

No.	Name	Meaning
18	**SpeedFix2** Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Second fixed speed
20	**SpeedSetpPC** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Speed setpoint set by PC
21	**SpeedOver** Level: 4 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 410, **Fehler! Textmarke nicht definiert.**	Speed for emergency shutdown due to overspeed
24	**SpeedMinAbsolute** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Minimum idle speed for reduction in zero load locomotive operation
25	**SpeedGradientMax** Level: 4 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Maximum permissible rate of change of speed gradient
26	**SpeedGradientTime** Level: 4 Range: 0…100 s Page(s):**Fehler! Textmarke nicht definiert.**	Time window for the number of permissible overruns of the speed gradient
27	**SpeedGradientMaxCnt** Level: 4 Range: 1…1000 Page(s):**Fehler! Textmarke nicht definiert.**	Number of permissible overruns of the speed gradient within the time window

No.	Name	Meaning
28	**DT1SpeedThreshold** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Speed threshold above which the rate of change is monitored
29	**DT1SpSetpDiffThresh** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Speed setpoint jump threshold, speed gradient is only monitored below this
30	**DT1SpeedDiffMax** Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Speed range around speed setpoint for detection of load or speed jump compensation
31	**DT1SpeedDiffTime** Level: 2 Range: 1…1000 Page(s):**Fehler! Textmarke nicht definiert.**	Time for detection of load or speed jump compensation
32	**SpeedGradDT1Thresh** Level: 2 Range: 0…2000 rpm/s Page(s):**Fehler! Textmarke nicht definiert.**	Threshold for speed gradient, outside this DT1-factor is calculated
33	**SpeedGradDT1Filter** Level: 2 Range: 1…255 Page(s):**Fehler! Textmarke nicht definiert.**	Filter for determination of speed gradient
34	**PowerGradDT1Thresh** Level: 2 Range: 0…50 %/s Page(s):**Fehler! Textmarke nicht definiert.**	Threshold for load gradient, outside this DT1-factor is calculated
35	**PowerGradDT1Filter** Level: 2 Range: 1…255 Page(s):**Fehler! Textmarke nicht definiert.**	Filter for determination of load gradient
50	**SpeedVarSampleSize**	*All except DC 5*

No.	Name	Meaning
	Level: 4 Range: 1…20 Page(s):**Fehler! Textmarke nicht definiert.**	Sample size for best detection of cylinder misfires
51	**SpeedVarFilterConst** Level: 4 Range: 0…100 s Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*All except DC 5* Filter constant for determination of speed variation 2050 *SpeedVariation*
52	**CamIndexOffset** Level: 1 Range: 0…720°crank Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*All except DC 5* Offset of camshaft index sensor compared to cylinder A1 TDC
55	**MisfireWarnDelay** Level: 4 Range: 0…100 s Page(s):**Fehler! Textmarke nicht definiert.**	Delay until new misfire warning is output
56	**MisfireEcyDelay** Level: 4 Range: 0…100 s Page(s):**Fehler! Textmarke nicht definiert.**	Delay before an emergency shutdown due to misfires
60	**SpeedMinAtTempLow** Level: 3 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Idle speed for cold engine
61	**SpeedMinTempLow** Level: 3 Range: -100…+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**	Lower temperature limit for temperature dependent idle speed

No.	Name	Meaning
62	**SpeedMinTempHigh** Level: 3 Range: -100…+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	Upper temperature limit for temperature dependent idle speed
90 ff	**SpeedSwitchx** Level: 3 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Switching speed x x = 1…3
100	**Gain** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Gain for speed governor
101	**Stability** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Stability for speed governor
102	**Derivative** Level: 2 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Derivative for speed governor
103	**SpeedDT1** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	DT1-factor for speed gradient for speed governor
104	**PowerDT1** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	DT1-factor on power gradient for speed governor
105	**Gain2**	

No.	Name	Meaning
	Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	Gain 2 for speed governor if 2842 *SwitchPID2Or1* = 1
106	**Stability2** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	Stability 2 for speed governor if 2842 *SwitchPID2Or1* = 1
107	**Derivative2** Level: 2 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**	Derivative 2 for speed governor if 2842 *SwitchPID2Or1* = 1
110	**StaticCorrFactor** Level: 2 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**	Correction factor of PID values in static operation
111	**StaticCorrRange** Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Speed range for correction factor
120 **125**	**Droopx** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Droop x x = 1…2
121 **126**	**DroopxRefLow** Level: 2 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Fuel quantity reference value at zero-fuel for droop x x = 1…2
122	**DroopxRefHigh**	

No.	Name	Meaning
127	Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Fuel quantity reference value at full load for droop x x = 1…2
123 128	**DroopxSpeedRef** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Speed reference point for droop x x = 1...2
129	**TwinEcyDroop** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Droop for emergency operation in master/slave systems
130	**IMRampUp** Level: 2 Range: 0…800 %/s Page(s): **Fehler! Textmarke nicht definiert.**	*Vehicle operation* Fuel quantity ramp upwards with idle / maximum speed governor
130	**TwinEcyDroopRefLow** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Fuel quantity reference point at zero-fuel for droop in emergency operation in master/slave systems
131	**IMRampDown** Level: 2 Range: 0…800 %/s Page(s): **Fehler! Textmarke nicht definiert.**	*Vehicle operation* Fuel quantity ramp downwards with idle / maximum speed governor
131	**TwinEcyDroopRefHigh** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Fuel quantity reference point at full load for droop in emergency operation in master/slave systems
132	**TwinEcyDroopSpeedRef** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Speed reference point for droop during emergency operation in master/slave systems
140	**IMIdleDroop** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Vehicle operation* Droop for idle governing for idle / maximum speed governor

No.	Name	Meaning
141	**IMMaximumDroop** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Vehicle operation* Droop for maximum governing for idle / maximum speed governor
142	**IMDroopRefLow** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Vehicle operation* Reference point at zero-fuel for droop for idle / maximum speed governor
143	**IMDroopRefHigh** Level: 2 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**	*Vehicle operation* Reference point at full load for droop for idle / maximum speed governor
150	**IMSpeedIncrease** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Vehicle operation* Speed increase for loaded idle speed
160	**PID_ColdCorr** Level: 3 Range: 0…400 % Page(s):**Fehler! Textmarke nicht definiert.**	PID correction factor for cold engine
161	**PID_CorrTempLow** Level: 3 Range: -100…+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**	Lower temperature limit for temperature dependent PID correction
162	**PID_CorrTempHigh** Level: 3 Range: -100…+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**	Upper temperature limit for temperature dependent PID correction
230	**SpeedRampUp** Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Factor for upward speed ramps (speed increase per second)
231	**SpeedRampDown**	

No.	Name	Meaning
	Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Factor for downward speed ramps (speed decrease per second)
232	**SpeedRampUp2**	
	Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Factor for second upward speed ramp (speed increase per second)

No.	Name	Meaning
233	**SpeedRampDown2** Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Factor for second downward speed ramp (speed decrease per second)
234	**SpeedRampUp3** Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Factor for third upward speed ramp (speed increase per second)
235	**SpeedRampDown3** Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Factor for third downward speed ramp (speed decrease per second)
236	**SpeedSwitchToRamp2** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Speed for switching to second speed ramp
237	**SpeedSwitchToRamp3** Level: 2 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Speed for switching to third speed ramp
240	**StartSpeedRampUp** Level: 3 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Factor for speed increase during start-up (speed increase per second)
241	**SpeedMinAbsRampDown** Level: 2 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Factor for speed decrease during idle speed reduction in locomotive operation (speed decrease per second)
242	**SpeedMinAbsDelay** Level: 2 Range: 0…x s Page(s):**Fehler! Textmarke nicht definiert.**	Delay before start of idle speed reduction in locomotive operation x = XIOS: 600 s, others: 1000 s
250	**StartType** Level: 3 Range: 1…3 Page(s): **Fehler! Textmarke nicht definiert.**	Type of starting fuel limitation: 1: Fixed starting fuel limitation 2: Variable starting fuel limitation 3: Temperature dependent starting fuel limitation

No.	Name		Meaning
251	**LimitsDelay**		
	Level:	3	Delay for enabling limitation functions. This time starts running when the control unit detects that the engine has started
	Range:	0…100 s	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		

No.	Name	Meaning
252	**ForcedStartSupvTime**	
	Level: 3 Range: 0…100 s Page(s):**Fehler! Textmarke nicht definiert.**	Delay during which a speed signal must be detected after a forced start
255	**StartSpeed1**	
	Level: 3 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Minimum speed above which starting of the engine is detected (beginning of starting phase 1)
256	**StartSpeed2**	
	Level: 3 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 251, 409	Minimum speed above which engine starting is detected
257	**StartSpeed3**	
	Level: 3 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	With starting speed ramp function enabled, the control unit starts the engine at the set speed *StartSpeed3* and then ramps up to the setpoint speed.
260	**StartFuel1**	
	Level: 3 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Starting fuel 1
261	**StartFuel2**	
	Level: 3 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Starting fuel 2 (only necessary for start types 2 and 3)

No.	Name		Meaning
265	**StartDuration1**		
	Level:	3	Stop time during which the engine works with starting fuel 1 (only required for start type 2)
	Range:	0…100 s	
	Page(s):**Fehler! Textmarke nicht definiert.**		
266	**StartDuration2**		
	Level:	3	Time during which the starting fuel is increased on a linear basis from 260 *StartFuel1* for 261 *StartFuel2* (only necessary for start type 2)
	Range:	0…100 s	
	Page(s):**Fehler! Textmarke nicht definiert.**		
270	**StartTempWarm**		
	Level:	3	Temperature of warm engine at which the engine is started with 260 *StartFuel1* (only necessary for start type 3)
	Range:	-100…+1000 °C	
	Page(s):**Fehler! Textmarke nicht definiert.**		
271	**StartTempCold**		
	Level:	3	Temperature of cold engine at which the engine is started with 261 *StartFuel2* (only necessary for start type 3).
	Range:	-100…+1000 °C	
	Page(s):**Fehler! Textmarke nicht definiert.**		

No.	Name		Meaning
280	**StarterCrankTimeMax**		*DC 5, XIOS*
	Level:	4	Maximum starter time
	Range:	0…x s	x =
	Page(s):**Fehler! Textmarke nicht definiert.**		DC 5: 1000 s XIOS: 600 s
281	**StarterInterlockTime**		*DC 5, XIOS*
	Level:	4	Waiting time between two starter cranking operations
	Range:	0…x	x = XIOS: 600 s, DC 5: 1000 s
	Page(s):**Fehler! Textmarke nicht definiert.**		
282	**StarterCrankAttempts**		*DC 5, XIOS*
	Level:	4	Maximum number of cranking attempts
	Range:	1…255	
	Page(s):**Fehler! Textmarke nicht definiert.**		
290	**AlternatorStartDelay**		*DC 5, XIOS*
	Level:	4	Delay time after starting the engine before the alternator
	Range:	0…x s	voltage (charging the battery) can be monitored
	Page(s):**Fehler! Textmarke nicht definiert.**		x = XIOS: 600 s, DC 5: 1000 s
291	**AlternatorLowValue**		*DC 5*
	Level:	4	Permitted minimum value for the alternator voltage in
	Range:	0…37.2 V	order to charge the battery
	Page(s):**Fehler! Textmarke nicht definiert.**		
292	**AlternatorHighValue**		DC 5
	Level:	4	Permitted maximum value for the alternator voltage in
	Range:	0…37.2 V	order to charge the battery
	Page(s): **Fehler! Textmarke nicht definiert.**		
310	**ActPosxSecureMin**		
314	Level:	6	Minimum actuator travel to protect actuator x against
316	Range:	0…100 %	mechanical and thermal overload (approx. 3 %)
	Page(s):	357	x = 1..3
312	**ActPosxSecureMax**		
315	Level:	6	Maximum actuator travel to protect actuator x against
317	Range:	0…100 %	mechanical and thermal overload (approx. 97 %)
	Page(s):	357	x = 1…3
320	**CurrxShutOffGradient**		
323	Level:	6	Threshold for speed gradient for activating current
326	Range:	0…4000 rpm	shutoff
	Page(s): **Fehler! Textmarke nicht definiert.**		x = 1…3, if actuator x is assigned to speed governor
321	**CurrentxShutOffTime**		

No.	Name	Meaning
324 **327**	Level: 6 Range: 0…200 ms Page(s): **Fehler! Textmarke nicht definiert.**	Maximum duration of current shutoff x = 1…3, if actuator x is assigned to speed governor

No.	Name		Meaning
322	**CurrentxShutOff**		
325	Level:	6	Pre-set current for current shutoff
328	Range:	0…100 %	*DC 1, DC 2, DC 7, DC 10, XIOS*
		or 0…8 A	*DC 8, DC 11, DC 12*
		or 0…12.5 A	*DC 5, DC 6, DC 9*
	Page(s): **Fehler! Textmarke nicht definiert.**		x = 1…3, if actuator x is assigned to speed governor
332	**CanPowerSrcNodeNo**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Node number of sender of relative power via HZM_CAN_ALL, used if 5232 *CanPowerPercentOn* = 1
	Range:	0…31	
333	**CanPowerSrcNodeType**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Node type of the sender of relative power via HZM_CAN_ALL
	Range:	0…31	
338	**CanBoostSrcNodeNo**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Node number of the sender of the boost pressure sensor via HZM_CAN_ALL
	Range:	0…31	
339	**CanBoostSrcNodeType**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Node type of the sender of the boost pressure sensor via HZM_CAN_ALL
	Range:	0…31	
342	**CanExhTempSrcNodeNo**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Node number of the sender of the exhaust temperature sensor via HZM_CAN_ALL Maximum of all exhaust temperatures if the sender measures multiple values, otherwise value of the only sensor
	Range:	0…31	
343	**CanExhTmpSrcNodeType**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Node type of the sender of the exhaust temperature sensor via HZM_CAN_ALL
	Range:	0…31	
352	**FuelAtZeroLoad**		
	Level:	3	Zero-fuel quantity for rapid reaction during load shedding
	Range:	0…100 %	
	Page(s): **Fehler! Textmarke nicht definiert.**		
397	**PartnerDCNodeNumber**		*Marine operation multi-engine system* *See basic information HZM-CAN DG 13 002-d*
	Level:	6	Node number of the other engine on the same throttle lever
	Range:	1…31	
	Page(s): **Fehler! Textmarke nicht definiert.**		
398	**ThirdDCNodeNumber**		*Marine operation multi-engine system* *See basic information HZM-CAN DG 13 002-d*

No.	Name	Meaning
	Level: 6 Range: 1…31 Page(s): **Fehler! Textmarke nicht definiert.**	Node number of the first engine on the other throttle lever

No.	Name	Meaning
399	**FourthDCNodeNumber** Level: 6 Range: 1…31 Page(s): **Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* *See basic information HZM-CAN DG 13 002-d* Node number of the second engine on the other throttle lever
400	**CanStartTimeOutDelay** Level: 6 Range: 0…100 s Page(s): **Fehler! Textmarke nicht definiert.**	*See basic information HZM-CAN DG 13 002-d* Delay in HZM-CAN-connection monitoring after reset
401	**CanMyNodeNumber** Level: 6 Range: 1…31 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 414	*See basic information HZM-CAN DG 13 002-d* Own node number in HZM-CAN network (RESET)
402	**CanOtherNodeNumber** **CanDCNodeNumber** Level: 6 Range: 1…31 Page(s): **Fehler! Textmarke nicht definiert.**, 414	*Marine operation twin-engine system* *See basic information HZM-CAN DG 13 002-d* Node number of the other speed governor control unit in the HZM-CAN network
403	**CanCMNodeNumber** Level: 6 Range: 1…31 Page(s): 339	*See basic information HZM-CAN DG 13 002-d* Node number of the customer module in the HZM-CAN network
404 ff	**CanPENodeNumber(x)** Level: 6 Range: 0…31 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 339, 238	*See basic information HZM-CAN DG 13 002-d* Node number of x-the periphery module in HZM-CAN bus, x = 0..2 Node number = 0: not assigned (RESET)
407 ff	**CanPENodeType(x)**	

No.	Name		Meaning	
	Level:	6	Type of x-th periphery module in HZM-CAN bus	
	Range:	0…18	x = 0…2	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 339, 255		0 = PE 2	12 PE MVC03
			1 = PE 6-07	13 PE 11
			3 = PE 1-03	14 PE 10
			4 = PE 1-04	15 PE 8
			6 = PE MVC01	16 PE MVC04
			8 = PE XIOS	18 PE 12
			Possible types and maximum possible number per type are specified by the firmware, see 2489 *PEModulesMax* and 2490 *PEModulesMaxType(x)*	
				(RESET)
410 ff	**CanxPrescaler**		*See basic information HZM-CAN DG 13 002-d*	
	Level:	6	Prescaler for HZM-CAN baud rate when 4416/4426 *CanxSegmentOrBaudrate* = 1	
	Range:	0…63	CAN controller x = 1...2	

No.	Name		Meaning
411 ff	**CanxSyncJumpWidth**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Synchronising jump width for HZM-CAN baud rate
	Range:	0...3	when 4416/4426 *CanxSegmentOrBaudrate* = 1
			CAN controller x = 1...2
412 ff	**CanxSamplingMode**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Sampling mode for HZM-CAN baud rate when
	Range:	0/1	4416/4426 *CanxSegmentOrBaudrate* = 1
			CAN controller x = 1...2
413 ff	**CanxPhaseSegment1**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Phase segment 1 for HZM-CAN baud rate when
	Range:	0…15	4416/4426 *CanxSegmentOrBaudrate* = 1
			CAN controller x = 1...2
414 ff	**CanxPhaseSegment2**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Phase segment 2 for HZM-CAN baud rate when
	Range:	0…7	4416/4426 *CanxSegmentOrBaudrate* = 1
			CAN controller x = 1...2
415 ff	**CanxPropSegment**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Propagation segment for HZM-CAN baud rate when
	Range:	0…7	4416/4426 *CanxSegmentOrBaudrate* = 1
			CAN controller x = 1...2
416 ff	**CanxBaudrate**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN baud rate when
	Range:	125,250,500,1000 kBaud	4416/4426 *CanxSegmentOrBaudrate* = 0 (Standard)
			CAN controller x = 1...2
430 ff	**CanACNodeNumber(x)**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Node number of x-th add-on module in HZM-CAN bus,
	Range:	0…31	x = 0...4
	Page(s):	173, 199	Node number = 0: not assigned (RESET)
435 ff	**CanACNodeType(x)**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Type of x-th add-on module in HZM-CAN bus
	Range:	0…1	x = 0...4
	Page(s):	173, 199	0: Type not specified
			1: Elektra FlowControl
			Possible types and maximum possible number per type are specified by the firmware, see 2549 *ACModulesMax* and 2550 *ACModulesMaxType(x)* (RESET)
440	**PEFuelSetpSendRate**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Transmission rate of fuel quantity setpoint to HZM-CAN periphery modules
	Range:	0...100 s	0 s means at each main loop cycle, if value is changed (recommended)

No.	Name		Meaning
441	**PEDigOutSendRate**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Transmission rate of binary output values to HZM-CAN periphery modules
	Range:	0…100 s	0 s means at each main loop cycle, if value is changed (recommended)
442	**PEAnalogOutSendRate**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Transmission rate of analogue output values to HZM-CAN periphery modules
	Range:	0...100 s	
443	**PEPWMOutSendRate**		*See basic information HZM-CAN DG 13 002-d*
	Level:	6	Transmission rate of PWM output values to HZM-CAN periphery modules
	Range:	0…100 s	
450 ff	**PEDigOutx_Assign**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	6	Direct assignment of a parameter to digital output x of HZM-CAN periphery modules
	Range:	-29999...+29999	x = 1...Total digital outputs of all periphery modules used
	Page(s):		
455 ff	**PEPWMOutx_Assign**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	4	Assignment of a parameter to PWM output x of HZM-CAN periphery modules
	Range:	-29999...+29999	x = 1... Total PWM outputs of all periphery modules used
458 ff	**PEPWMOutx_ValueMin**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	4	Minimum value in percent of value range of output parameter at PWM output x of HZM-CAN periphery module
	Range:	0…100 %	(x: See 455 *PEPWMOutx_Assign*)
459 ff	**PEPWMOutx_ValueMax**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	4	Maximum value in percent of value range of output parameter at PWM output x of HZM-CAN periphery module
	Range:	0...100 %	(x: See 455 *PEPWMOutx_Assign*)
480 ff	**PEAnaOutx_Assign**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	4	Assignment of a parameter to analogue output x of HZM-CAN periphery modules
	Range:	-29999...+29999	x = 1... Total analogue outputs of all periphery modules used

No.	Name		Meaning
483 ff	**PEAnaOutx_ValueMin**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level: Range:	4 0…100 %	Minimum value in percent of value range of output parameter at analogue output x of HZM-CAN periphery module (x: See 480 *PEAnaOutx_Assign*)
484 ff	**PEAnaOutx_ValueMax**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level: Range:	4 0...100 %	Maximum value in percent of value range of output parameter at analogue output x of HZM-CAN periphery module (x: See 480 *PEAnaOutx_Assign*)
500	**OilPressStartDelay**		
	Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	4 0...x s	Start delay for speed-dependent oil pressure monitoring x = XIOS: 600 s, others: 100 s
501	**OilPressWarnDelay**		
	Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	4 0...x s	Delay for oil pressure warning x = XIOS: 600 s, others: 100 s
502	**OilPressEcyDelay**		
	Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	4 0...x s	Delay for oil pressure emergency shutdown x = XIOS: 600 s, others: 100 s
503	**OilPressHysteresis**		*XIOS*
	Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	4 0...10 bar	Hysteresis for oil pressure monitoring
505	**CoolPressStartDelay**		
	Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	4 0...x s	Start delay for speed-dependent coolant pressure monitoring x = XIOS: 600 s, others: 100 s
506	**CoolPressWarnDelay**		*Not XIOS*
	Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	4 0...100 s	Delay for coolant pressure warning
506	**CoolPressDelay1**		*XIOS*

No.	Name		Meaning
	Level:	4	Delay for 1st monitoring threshold
	Range:	0...600 s	
	Page(s): **Fehler! Textmarke nicht definiert.**		
507	**CoolPressIdleDelay**		*Not XIOS*
	Level:	4	Delay for coolant pressure at forced idle speed
	Range:	0...100 s	
	Page(s): **Fehler! Textmarke nicht definiert.**		

No.	Name	Meaning
507	**CoolPressDelay2** Level: 4 Range: 0...600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay for 2nd monitoring threshold
508	**CoolPressHysteresis** Level: 4 Range: 0…10 bar Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Hysteresis for coolant pressure monitoring
510	**CoolantTempLimit** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Temperature limit for coolant temperature warning
511	**CoolantTempIdleDelay** Level: 4 Range: 0...1000 s Page(s):**Fehler! Textmarke nicht definiert.**	*Not XIOS* Delay for temperature dependent forced idle speed in locomotive operation
515	**ChargeAirTempLimit** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	*Not XIOS* Temperature limit for charge air temperature warning
520	**OilTempLimit** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Temperature limit for oil temperature warning
521	**OilTempIdleDelay** Level: 4 Range: 0…1000 s Page(s):**Fehler! Textmarke nicht definiert.**	*Not XIOS* Delay for temperature dependent forced idle speed in locomotive operation
525	**ExhaustTempLimit** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**	*Not XIOS* Temperature limit for oil temperature warning
545	**AlternatorHysteresis**	*XIOS*

No.	Name		Meaning
	Level:	4	Alternator voltage hysteresis
	Range:	0...36 V	
	Page(s): **Fehler! Textmarke nicht definiert.**		
546	**AlternatorLimit1**		*XIOS*
	Level:	4	Monitoring threshold 1 for alternator voltage monitoring
	Range:	0..36 V	
	Page(s): **Fehler! Textmarke nicht definiert.**		
547	**AlternatorDelay1**		*XIOS*
	Level:	4	Delay at monitoring threshold 1 for alternator voltage monitoring
	Range:	0..600 s	
	Page(s): **Fehler! Textmarke nicht definiert.**		

No.	Name	Meaning
548	**AlternatorLimit2** Level: 4 Range: 0...36 V Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 2 for alternator voltage monitoring
549	**AlternatorDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for alternator voltage monitoring
550	**CoolTempHysteresis** Level: 4 Range: 0…150 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Coolant temperature hysteresis
551	**CoolTempLimit1** Level: 4 Range: -100…+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 1 for coolant temperature monitoring
552	**CoolTempDelay1** Level: 4 Range: 0...600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 1 for coolant temperature monitoring
553	**CoolTempLimit2** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 2 for coolant temperature monitoring
554	**CoolTempDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for coolant temperature monitoring
555	**ChAirTempHysteresis** Level: 4 Range: 0...150 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Charge air temperature hysteresis
556	**ChAirTempLimit1**	*XIOS*

No.	Name	Meaning
	Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	Monitoring threshold 1 for charge air temperature monitoring
557	**ChAirTempDelay1**	*XIOS*
	Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	Delay at monitoring threshold 1 for charge air temperature monitoring
558	**ChAirTempLimit2**	*XIOS*
	Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	Monitoring threshold 2 for charge air temperature monitoring

No.	Name	Meaning
559	**ChAirTempDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for charge air temperature monitoring
560	**OilTempHysteresis** Level: 4 Range: 0...150 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Oil temperature hysteresis
561	**OilTempLimit1** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 1 for oil temperature monitoring
562	**OilTempDelay1** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 1 for oil temperature monitoring
563	**OilTempLimit2** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 2 for oil temperature monitoring
564	**OilTempDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for oil temperature monitoring
565	**FuelTempHysteresis** Level: 4 Range: 0…150 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Fuel temperature hysteresis
566	**FuelTempLimit1** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 1 for fuel temperature monitoring
567	**FuelTempDelay1**	*XIOS*

No.	Name	Meaning
	Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	Delay at monitoring threshold 1 for fuel temperature monitoring
568	**FuelTempLimit2**	*XIOS*
	Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	Monitoring threshold 2 for fuel temperature monitoring
569	**FuelTempDelay2**	*XIOS*
	Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	Delay at monitoring limit 2 for fuel temperature monitoring

No.	Name	Meaning
570	**ExhaustTempHysteres** Level: 4 Range: 0...150 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Exhaust temperature hysteresis
571	**ExhaustTempLimit1** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 1 for exhaust temperature monitoring
572	**ExhaustTempDelay1** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 1 for exhaust temperature monitoring
573	**ExhaustTempLimit2** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 2 for exhaust temperature monitoring
574	**ExhaustTempDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for exhaust temperature monitoring
575	**TurboOilTempHysteres** Level: 4 Range: 0…150 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Turbocharger oil temperature hysteresis
576	**TurboOilTempLimit1** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 1 for turbocharger oil temperature monitoring
577	**TurboOilTempDelay1** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 1 for turbocharger oil temperature monitoring
578	**TurboOilTempLimit2** Level: 4 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 2 for turbocharger oil temperature monitoring

No.	Name	Meaning
579	**TurboOilTempDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for turbocharger oil temperature monitoring
580	**FuelPressHysteresis** Level: 4 Range: 0…10 bar Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Fuel pressure hysteresis

No.	Name	Meaning
581	**FuelPressLimit1** Level: 4 Range: 0...10 bar Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 1 for fuel pressure monitoring
582	**FuelPressDelay1** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 1 for fuel pressure monitoring
583	**FuelPressLimit2** Level: 4 Range: 0...10 bar Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 2 for fuel pressure monitoring
584	**FuelPressDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for fuel pressure monitoring
585	**OilLevelHysteresis** Level: 4 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Oil level hysteresis
586	**OilLevelLimit1** Level: 4 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 1 for oil level monitoring
587	**OilLevelDelay1** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 1 for oil level monitoring
588	**OilLevelLimit2** Level: 4 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 2 for oil level monitoring
589	**OilLevelDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for oil level monitoring

No.	Name	Meaning
590	**TrOilPressHysteresis**	*XIOS*
	Level: 4	Transmission oil pressure hysteresis
	Range: 0..40 bar	
	Page(s): **Fehler! Textmarke nicht definiert.**	
591	**TrOilPressLimit1**	
	Level: 4	Monitoring threshold 1 for transmission oil pressure monitoring
	Range: 0...40 bar	
	Page(s): **Fehler! Textmarke nicht definiert.**	

No.	Name	Meaning
592	**TrOilPressDelay1** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 1 for transmission oil pressure monitoring
593	**TrOilPressLimit2** Level: 4 Range: 0...40 bar Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Monitoring threshold 2 for transmission oil pressure monitoring
594	**TrOilPressDelay2** Level: 4 Range: 0…600 s Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Delay at monitoring threshold 2 for transmission oil pressure monitoring
600	**ExcitCntrlFactor** Level: 2 Range: -400…+400 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Amplification factor for excitation control
605	**ExcitLimitForced1** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Limitation of the excitation signal when 2823 *SwitchExcitLimit1* = 1
606	**ExcitLimitForced2** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Limitation of the excitation signal when 2824 *SwitchExcitLimit2* = 1
610	**ExcitCntrlRampUp** Level: 2 Range: 0...800 %/s Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Factor for upward ramp for excitation control (percent per second)
611	**ExcitCntrlRampDown** Level: 2 Range: 0…800 %/s Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Factor for downward ramp for excitation control (percent per second)
620	**ExcitSlideDec**	*Locomotive operation*

No.	Name	Meaning
	Level: 2 Range: -50...+50 % Page(s):**Fehler! Textmarke nicht definiert.**	Reduction value for excitation reduction when wheel sliding is detected
621	**ExcitSlideDuration** Level: 2 Range: 0…100 s Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Waiting time after excitation setpoint signal has been reduced after detection of wheel sliding
630	**ExcitGovGain** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Gain for excitation governor

No.	Name	Meaning
630	**PitchGovGain** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Gain for adjustable propeller governor
631	**ExcitGovStability** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Stability for excitation governor
631	**PitchGovStability** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Stability for adjustable propeller governor
632	**ExcitGovDerivative** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Derivative for excitation governor
632	**PitchGovDerivative** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Derivative for adjustable propeller governor
633	**ExcitationSetpFilter** Level: 2 Range: 1...255 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Filter constant for excitation signal filtering
633	**PitchSetpFilter** Level: 2 Range: 1...255 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation* Filter constant for adjustable propeller signal filtering
635	**ExcitationSetpPC** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Excitation signal set by PC
635	**PitchSetpPC**	*Marine operation*

No.	Name	Meaning
	Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Adjustable propeller signal set by PC
636	**ExcitFuelOffset** Level: 2 Range: -50...50 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Offset for fuel quantity value from power characteristic
637	**ExcitFuelLimForced1** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Limitation of fuel quantity setpoint for power limitation when 2823 *SwitchExcitLimit1* = 1

No.	Name	Meaning
638	**ExcitFuelLimForced2** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* 2. Limitation of fuel quantity setpoint for power limitation when 2824 *SwitchExcitLimit2* = 1
640	**ExcitGovSetpRampUp** Level: 2 Range: 0…800 %/s Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Factor for upward ramp for setpoint (percent per second)
640	**PitchGovFuelRampUp** Level: 2 Range: 0...800 %/s Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Factor for upward ramp for fuel quantity (percent per second)
641	**ExcitGovSetpRampDown** Level: 2 Range: 0...800 %/s Page(s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Factor for downward ramp for setpoint (percent per second)
641	**PitchGovFuelRampDown** Level: 2 Range: 0...800 %/s Page(s): **Fehler! Textmarke nicht definiert.**	*Marine operation* Factor for downward ramp for fuel quantity (percent per second)
650	**ExcitLimitTempDec** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Fuel quantity reduction for temperature dependent lowering of the fuel quantity setpoint characteristic during excitation control with warm engine
651	**ExcitLimitTempLow** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Lower limit for temperature dependent lowering of the fuel quantity setpoint characteristic during excitation control
652	**ExcitLimitTempHigh** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Upper limit for charge air temperature dependent lowering of the fuel quantity setpoint characteristic during excitation control
657	**ExcitTrPowLimForced** Level: 4 Range: 0...x kW Page (s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Limitation of traction power setpoint when 2823 *SwitchExcitLimit1* = 1 x: Depending on application

No.	Name		Meaning
658	**ExcitTrPowLimForced2**		*Locomotive operation*
	Level:	4	2. Limitation of traction power setpoint when 2824
	Range:	0...x kW	*SwitchExcitLimit2* = 1
	Page (s): **Fehler! Textmarke nicht definiert.**		x: Depending on application

No.	Name	Meaning
670	**ExcitLimtTrPowTmpDec** Level: 4 Range: 0...x kW Page (s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Maximum reduction of traction power setpoint when the cooling water temperature exceeds 652 *ExcitLimitTempHigh* (no reduction if the cooling water temperature remains below 651 *ExcitLimitTempLow*, linear interpolation of reduction value between these two points) x: Depending on application
676	**TractionVoltageHyst** Level: 4 Range: 0...x V Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Hysteresis for traction voltage dependent limitation of the excitation signal x: Depending on application
677	**TractionCurrentHyst** Level: 4 Range: 0...x A Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Hysteresis for traction current dependent limitation of the excitation signal x: Depending on application
678	**TractPowLimGain** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Gain for the traction voltage and/or traction current dependent limiting governor for the excitation signal
679	**TractPowLimStability** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Stability for the traction voltage and/or traction current dependent limiting governor for the excitation signal
680	**TractPowLimDerivativ** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.Fehler! Textmarke nicht definiert.**	*Locomotive operation* Derivative for the traction voltage and/or traction current dependent limiting governor for the excitation signal
690	**SpeedLimChAirTempDec** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Fuel quantity reduction for charge air temperature dependent lowering of full load curve for warm engine
691	**SpeedLimChAirTempLow** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, 228	Lower limit for charge air temperature dependent lowering of full load characteristic
692	**SpeedLimChAirTmpHigh**	

No.	Name	Meaning
	Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, 228	Upper limit for charge air temperature dependent lowering of full load characteristic
695	**SpeedLimExhTempDec** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Fuel quantity reduction for exhaust temperature dependent lowering of full load curve for warm engine

No.	Name	Meaning
696	**SpeedLimExhTempLow** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, 229	 Lower limit for exhaust temperature dependent lowering of full load characteristic
697	**SpeedLimExhTempHigh** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, 229	 Upper limit for exhaust temperature dependent lowering of full load characteristic
701	**SpeedLimitTempDec** **SpeedLimCoolTempDec** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	 Fuel quantity reduction for (coolant) temperature dependent lowering of full load curve for warm engine
702	**SpeedLimitTempLow** **SpeedLimCoolTempLow** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, 230	 Lower limit for (coolant) temperature dependent lowering of full load characteristic
703	**SpeedLimitTempHigh** **SpeedLimCoolTempHigh** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, 230	 Upper limit for (coolant) temperature dependent lowering of full load characteristic
705	**SpeedLimOilTempDec** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	 Fuel quantity reduction for oil temperature dependent lowering of full load curve for warm engine
706	**SpeedLimOilTempLow** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**	 Lower limit for oil temperature dependent lowering of full load characteristic
707	**SpeedLimOilTempHigh** Level: 4 Range: -100...+1000 °C Page(s):**Fehler! Textmarke nicht definiert.**	 Upper limit for oil temperature dependent lowering of full load characteristic
711	**FuelLimitMaxAbsolute**	

No.	Name	Meaning
	Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, 357	Absolute fuel quantity limitation
715	**FuelLimitForced**	
	Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Fill limit with power limitation enabled using 2813 *SwitchForcedLimit*

No.	Name		Meaning			
724	**FuelLimitDistance**					
	Level:	4	Distance to current fuel quantity limitation, within which 2724 *NearFuelLimitActive* is enabled			
	Range:	0...100 %				
	Page(s):**Fehler! Textmarke nicht definiert.**					
809	**EngineStopExtraTime**					
	Level:	4	Extra time for engine stop request			
	Range:	0...100 s				
	Page(s):	252				
810 ff	**Funct...**					
	Level:	6	Configuration of a switching function via binary input x:			
	Range:	-x...x				
	Page(s):	248, 252, 254, 256, 258	DC 1-03:	12	DC 8:	8
			DC 1-04:	11	DC 9:	3
			DC 2:	8	DC 10:	6
			DC 5:	8	DC 11:	6
			DC 6:	5	DC 12:	2
			DC 7:	10	XIOS:	117 ports
			With HZM-CAN periphery modules: Up to 32			
			With analogue inputs: Up to 127			
			Assignment 0: Not used			
			Switching functions see 2810 *Switch*... ff			
851 ff	**DigitalOutx_Assign**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10*			
	Level:	6	Configuration of binary output x (direct simple assignment):			
	Range:	-29999...+29999				
	Page(s):**Fehler! Textmarke nicht definiert.**, 378		DC 1-03:	3	DC 6:	2
			DC 1-04:	5	DC 7:	7
			DC 2:	5	DC 9:	1
			DC 5:	11	DC 10:	1
			Assignment 0: Not used			
900 ff	**AssignIn_...**					
	Level:	6	Input configuration for a setpoint adjuster or sensor via channel x:			
	Range:	0...x				
	Page(s): **Fehler! Textmarke nicht definiert.**, 239		DC 1-03:	7	DC 8:	8
			DC 1-04:	10	DC 9:	2
			DC 2:	6	DC 10:	6
			DC 5:	10	DC 11:	6
			DC 6:	4	DC 12:	5
			DC 7:	7	XIOS:	117 ports
			Communication modules:		Depending on application	
			Assignment 0:		Not used	
			Sensors see 2900 ff, channel type see 4900 ff			

No.	Name		Meaning
966	**AirMassSensorLow**		
	Level:	4	Minimum air mass sensor value
	Range:	0...1000	
	Page(s):	241	
967	**AirMassSensorHigh**		
	Level:	4	Maximum air mass sensor value
	Range:	0...1000	
	Page(s):	241	
968	**NOxSensorLow**		
	Level:	4	Minimum nitrogen sensor value
	Range:	0...5000 ppm	
	Page(s):	241	
969	**NOxSensorHigh**		
	Level:	4	Maximum nitrogen sensor value
	Range:	0...5000 ppm	
	Page(s):	241	
970	**O2SensorLow**		
	Level:	4	Minimum oxygen sensor value
	Range:	-12..+21.02707 %	
	Page(s):	241	
971	**O2SensorHigh**		
	Level:	4	Maximum oxygen sensor value
	Range:	0...1000	
	Page(s):	241	
972	**Lambda1SensorLow**		
	Level:	4	Minimum value of first lambda sensor
	Range:	0...30	
	Page(s):	241	
973	**Lambda1SensorHigh**		
	Level:	4	Maximum value of first lambda sensor
	Range:	0...30	
	Page(s):	241	
974	**Lambda2SensorLow**		
	Level:	4	Minimum value of second lambda sensor
	Range:	0...30	
	Page(s):	241	
975	**Lambda2SensorHigh**		
	Level:	4	Maximum value of second lambda sensor
	Range:	0...30	
	Page(s):	241	
976	**BoostPress2SensLow**		
	Level:	4	Minimum value of second boost pressure sensor
	Range:	0...5 bar	
	Page(s):	241	

No.	Name		Meaning
977	**BoostPress2SensHigh**		
	Level:	4	Maximum value of second boost pressure sensor
	Range:	0...5 bar	
	Page(s):	241	
978	**CoolPressSensorLow**		
	Level:	4	Minimum coolant pressure sensor value
	Range:	0…10 bar	
	Page(s):	241	
979	**CoolPressSensorHigh**		
	Level:	4	Maximum coolant pressure sensor value
	Range:	0…10 bar	
	Page(s):	241	
980	**OilPressSensorLow**		
	Level:	4	Minimum oil pressure sensor value
	Range:	0...20 bar	
	Page(s):	241	
981	**OilPressSensorHigh**		
	Level:	4	Maximum oil pressure sensor value
	Range:	0…20 bar	
	Page(s):	241	
982	**BoostPressSensorLow**		
	BoostPress1SensLow		*If second boost pressure sensor exists*
	Level:	4	Minimum value of first or only boost pressure sensor
	Range:	0...5 bar	
	Page(s):	241	
983	**BoostPressSensorHigh**		
	BoostPress1SensHigh		*If second boost pressure sensor exists*
	Level:	4	Maximum value of first or only boost pressure sensor
	Range:	0...5 bar	
	Page(s):	241	
984	**AmbPressSensorLow**		
	Level:	4	Minimum ambient pressure sensor value
	Range:	0...2000 mbar	
	Page(s):	241	
985	**AmbPressSensorHigh**		
	Level:	4	Maximum ambient pressure sensor value
	Range:	0...2000 mbar	
	Page(s):	241	
986	**CoolTempSensorLow**		
	Level:	4	Minimum coolant temperature sensor value
	Range:	-100…1000 °C	if sensor is already linearised (otherwise ↑5540
	Page(s):	241	*TempIn_SensorType*)

No.	Name		Meaning
987	**CoolTempSensorHigh**		
	Level:	4	Maximum coolant temperature sensor value
	Range:	-100…1000 °C	if sensor is already linearised (otherwise ↑5540
	Page(s):	241	*TempIn_SensorType*)
988	**ChAirTempSensorLow**		
	Level:	4	Minimum charge air temperature sensor value
	Range:	-100…1000 °C	if sensor is already linearised (otherwise ↑5540
	Page(s):	241	*TempIn_SensorType*)
989	**ChAirTempSensorHigh**		
	Level:	4	Maximum charge air temperature sensor value
	Range:	-100…1000 °C	if sensor is already linearised (otherwise ↑5540
	Page(s):	241	*TempIn_SensorType*)
990	**GasTempSensorLow**		*Dual fuel*
	Level:	4	Minimum gas temperature sensor value
	Range:	-100…1000 °C	if sensor is already linearised (otherwise ↑5540
	Page(s):	241	*TempIn_SensorType*)
991	**GasTempSensorHigh**		*Dual fuel*
	Level:	4	Maximum gas temperature sensor value
	Range:	-100…1000 °C	if sensor is already linearised (otherwise ↑5540
	Page(s):	241	*TempIn_SensorType*)
991	**SpeedRedSensorHigh**		
	Level:	4	Maximum value of sensor for speed reduction for slide
	Range:	0...4000 rpm	protection in locomotive operation
	Page(s):	241	
992	**MeasPowerSensorLow**		*Generator operation*
	Level:	4	Minimum actual pressure sensor value
	Range:	0...100 %	
		or 0...x kW	x: Depending on application
	Page(s):	241, 244	
992	**TractVoltSensorHigh**		*Locomotive operation*
	Level:	4	Maximum traction voltage sensor value
	Range:	0..x V	x: Depending on application
	Page(s):	241	
993	**MeasPowerSensorHigh**		*Generator operation*
	Level:	4	Maximum actual pressure sensor value
	Range:	0...100 %	
		or 0..x kW	x: Depending on application
	Page(s):	241, 244	
993	**TractCurrSensorHigh**		*Locomotive operation*
	Level:	4	Maximum traction current sensor value
	Range:	0...x A	x: Depending on application
	Page(s):	241	

No.	Name		Meaning
994	**PowerSetpSensorLow**		*Generator operation*
	Level:	4	Minimum power setpoint sensor value
	Range:	0...100 %	
		or 0...x kW	x: Depending on application
	Page(s):	241, 244	
995	**PowerSetpSensorHigh**		*Generator operation*
	Level:	4	Maximum power setpoint sensor value
	Range:	0...100 %	
		or 0...x kW	x: Depending on application
	Page(s):	241, 244	
996	**FuelPressSensorLow**		
	Level:	4	Minimum fuel pressure sensor value
	Range:	0...10 bar	
	Page(s):	241	
996	**GasRailPrSensorLow**		*Dual fuel*
	Level:	4	Minimum gas pressure sensor value
	Range:	0...10 bar	
	Page(s):	241	
997	**FuelPressSensorHigh**		
	Level:	4	Maximum fuel pressure sensor value
	Range:	0…10 bar	
	Page(s):	241	
997	**GasRailPrSensorHigh**		*Dual fuel*
	Level:	4	Maximum gas pressure sensor value
	Range:	0...10 bar	
	Page(s):	241	
998	**TrOilPressSensorLow**		
	Level:	4	Minimum transmission oil pressure sensor value
	Range:	0...40 bar	
	Page(s):	241	
999	**TrOilPressSensorHigh**		
	Level:	4	Maximum value of transmission oil pressure sensor
	Range:	0...40 bar	
	Page(s):	241	
1000ff	**Subst...**		
	Level:	4	Substitute value for setpoint adjuster or sensor in case
	Range:	0...x	of error
	Page(s):	245	x: Depending on sensor
			For sensors see 2900 ff
1210	**DigitalPotSpeedRamp**		

No.	Name	Meaning
	Level: 2 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Rate of change of speed setpoint when using speed increase/decrease switches

No.	Name		Meaning
1220	**SynchronFactor**		
	Level:	2	Amplification factor for synchronisation signal for analogue setpoint adjustment
	Range:	-100...+100 %	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
1221	**SynchronReference**		
	Level:	2	Reference value for the synchronisation signal
	Range:	0…100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
1222	**SyncAnaErrLimitDelay**		
	Level:	2	Time delay before 2903 *SyncInput* is reported as an error when the error limits are exceeded
	Range:	0...x s	x = XIOS: 600 s, others 1000 s
	Page(s):**Fehler! Textmarke nicht definiert.**		particularly necessary for HZM SyG
1228	**LoadCtrlErrLimDelay**		
	Level:	2	Time delay before 2902 *LoadControlInput* is reported as an error when the error limits are exceeded x = XIOS: 600 s, others 1000 s
	Range:	0...x s	particularly necessary for HZM LMG
	Page(s):**Fehler! Textmarke nicht definiert.**		
1229	**LoadControlDiffMax**		
	Level:	2	Limitation of the difference between 2902 *LoadControlInput* and 1231 *LoadControlReference* has the same effect as a ramp
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
1230	**LoadControlFactor**		
	Level:	2	Amplification factor of power governing signal for analogue setpoint adjustment
	Range:	-100...+100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
1231	**LoadControlReference**		
	Level:	2	Reference value of power governing signal
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
1232	**RatedPower**		*Generator operation*

No.	Name		Meaning
	Level:	2	Nominal power
	Range:	0…100 %	
		or 0…x kW	x: Depending on application
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 225, 226, 241, 242		
1232	**TractionPowerHigh**		*Locomotive operation*
	Level:	2	Max. traction power
	Range:	0...x kW	x: Depending on application
	Page(s): **Fehler! Textmarke nicht definiert.**, 167, 237, 241		
1233	**PowerGovGain**		
	Level:	2	Gain for integrated power governor
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
1234	**PowerGovStability**		
	Level:	2	Stability for integrated power governor
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
1235	**PowerGovDerivative**		
	Level:	2	Derivative for integrated power governor
	Range:	0…100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
1239	**MaxPowerDifference**		
	Level:	2	Maximum permissible setpoint/actual power difference for integrated power governor
	Range:	0...100 %	
		or 0...x kW	x: Depending on application
	Page(s):**Fehler! Textmarke nicht definiert.**, 414, **Fehler! Textmarke nicht definiert.**		
1240	**MaxPowerDiffMaxTime**		
	Level:	2	Maximum permissible duration for the maximum permissible setpoint/actual power difference for integrated power governor
	Range:	0...x s	*x = XIOS: 600 s, others 1000 s*
	Page(s):**Fehler! Textmarke nicht definiert.**, 414, **Fehler! Textmarke nicht definiert.**		
1241	**PowerSetpRampUp**		

No.	Name		Meaning
	Level:	2	Factor for upward power ramp for integrated power governor (power increase per second)
	Range:	0...800 %/s or 0...x kW/s	x: Depending on application
	Page(s):**Fehler! Textmarke nicht definiert.**		
1242	**PowerSetpRampDown**		
	Level:	2	Factor for downward power ramp for integrated power governor (power decrease per second)
	Range:	0…800 %/s or 0...x kW/s	x: Depending on application
	Page(s):**Fehler! Textmarke nicht definiert.**		
1243	**PowerSetpointPC**		
	Level:	2	Power setpoint specified using PC for integrated power governor
	Range:	0...100 % or 0...x kW	x: Depending on application
	Page(s):**Fehler! Textmarke nicht definiert.**		
1245	**KnockPowerReduction**		
	Level:	2	Reduction value for power reduction after identification of engine knocking (integrated power governor)
	Range:	0...100 % or 0...x kW	x: Depending on application
	Page(s):**Fehler! Textmarke nicht definiert.**		
1246	**KnockDuration**		
	Level:	2	Waiting time until next reduction after one reduction in the power setpoint after detection of engine knocking (integrated power governor)
	Range:	0…100 s	
	Page(s):**Fehler! Textmarke nicht definiert.**		

No.	Name	Meaning
1247	**JetAstMaxBoostDiff** Level: 2 Range: 0...5 bar Page(s):**Fehler! Textmarke nicht definiert.**	Distance to fuel quantity dependent minimum boost pressure curve, below which 3247 *JetAstActive* is enabled
1248	**JetAstMaxBoostDTime** Level: 2 Range: 0…100 s Page(s):**Fehler! Textmarke nicht definiert.**	Maximum duration for boost signal 3247 *JetAstActive*
1250	**PositionIUpperRef** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Upper reference of throttle lever in position I (marine setpoint with direction information)
1250	**FuelAtZeroLoad** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Fuel quantity value for zero fuel in master / slave mode
1251	**Position0UpperRef** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Upper reference of throttle lever in position 0 (marine setpoint with direction information)
1251	**FuelAtFullLoad** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Fuel quantity value for full load in master / slave mode
1252	**PositionIIILowerRef** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Lower reference of throttle lever in position III (marine setpoint with direction information)
1252	**SlaveLoadForDeClutch** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Own load setpoint in master / slave mode
1253	**PositionIRange** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Range of throttle lever in position I (marine setpoint with direction information)

No.	Name	Meaning
1253	**SlaveLoadRampUp** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Load setpoint of other control unit in master / slave mode
1254	**Position0Range** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Range of throttle lever in position 0 (marine setpoint with direction information)

No.	Name	Meaning
1254	**SlaveLoadRampDown** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Fuel quantity setpoint for slave in master / slave mode
1255	**PositionIIIRange** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Range of throttle lever in position III (marine setpoint with direction information)
1255	**LowerSpeedClutchIn** Level: 4 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Minimum engagement speed
1256	**PositionISpeedInc** Level: 4 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Speed increase during engagement in position I (marine setpoint with direction information)
1256	**UpperSpeedClutchIn** Level: 4 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Maximum engagement speed
1257	**PositionIIISpeedInc** Level: 4 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Speed increase during engagement in position III (marine setpoint with direction information)
1258	**PositionIDelay** Level: 4 Range: 0...100 s Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Delay of setpoint selection during engagement in position I (marine setpoint with direction information)
1259	**PositionIIIDelay** Level: 4 Range: 0...100 s Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Delay of setpoint selection during engagement in position III (marine setpoint with direction information)
1260	**IdleSpeedRange** Level: 4 Range: 0...100 s Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation setpoint adjuster with direction* Range around the idle speed within which forward or reverse gear can be engaged (marine setpoint with direction information)

No.	Name	Meaning
1350	**DigSlideSpeedDec** Level: 2 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Speed reduction after detection of sliding wheels
1355	**DigSlideDuration** Level: 2 Range: 0…100 s Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Waiting time during slide protection after reduction of setpoint 1356 *AnaSlideSpeedMin*

No.	Name	Meaning
1356	**AnaSlideSpeedMin** Level: 2 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Absolute minimum speed during reduction with analogue slide protection
1500ff	**PWMInx_RefLow** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Not XIOS* Lower reference value of PWM input x: DC 1-03: 2 DC 8: 2 DC 1-04: 1 DC 9: 1 DC 2: 4 DC 10: 1 DC 5: 1 DC 11: 3 DC 6: 3 DC 12: 1 DC 7: 2
1501ff	**PWMInx_RefHigh** Level: 4 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Not XIOS* Upper reference value of PWM input x: see 1500 *PWMInx_RefLow*
1510ff	**AnalogInx _RefLow** Level: 4 Range: 0...65472 or 0...65520 or 0...5 V or 0...10 V or 0...37.2 V or 0..22 mA or 0...25 mA Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**,256, 431, 467	*Not XIOS* Lower reference value of analogue input x = 1: DC 1-03: 5 DC 8: 6 DC 1-04: 8 DC 9: 2 DC 2: 4 DC 10: 6 DC 5: 6 DC 11: 5 DC 6: 3 DC 12: 3 DC 7: 4
1511ff	**AnalogInx_RefHigh** Level: 4 Range: Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 256	*Not XIOS* Upper reference value of analogue input x: x and range: see 1510 *AnalogInx_RefLow*
1512ff	**AnalogInx_ErrorLow** **TempIny_ErrorLow**	*Not XIOS*

No.	Name		Meaning			
	Level:	4	Lower error limit of analogue input x x and range for analogue inputs: see 1510 *AnalogInx_RefLow*			
	Range:	0...65472	Temperature input y = 1..:			
		or 0...65520	DC 1:	2	DC 8:	2
		or 0...60000 Ω	DC 2:	2	DC 9:	-
		or 0...65000 Ω	DC 5:	4	DC 10:	1
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		DC 6:	1	DC 11:	1
			DC 7:	3	DC 12:	2

No.	Name	Meaning
1513ff	**AnalogInx_ErrorHigh** **TempIny_ErrorHigh** Level: 4 Range: Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Upper error limit of analogue input x or temperature input y x and range for analogue inputs: see 1510 *AnalogInx_RefLow*, y and range for temperature inputs: see 1512 *TempIny_ErrorLow*
1514ff	**AnalogInx_Filter** **TempIny_Filter** Level: 4 Range: 1…255 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Filter value of analogue input x or temperature input y (x: see 1510 *AnalogInx_RefLow*, y: see 1512 *TempIny_ErrorLow*)
1600ff	**PWMOutx_Assign** Level: 4 Range: -26999...+26999 Page(s):**Fehler! Textmarke nicht definiert.**	*DC 1, DC 2, DC 5, DC 6, DC 7* Parameter assignment to PWM output x: DC 1: 3 DC 6: 2 DC 2: 5 DC 7: 2 DC 5: 2
1601ff	**PWMOutx_RefLow** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*DC 1, DC 2, DC 5, DC 6, DC 7, DC 8, DC 11* Minimum value of PWM output x = 1: DC 1: 3 DC 7: 2 DC 2: 5 DC 8: 1 DC 5: 2 DC 11: 2 DC 6: 2
1602ff	**PWMOutx_RefHigh** Level: 4 Range: 0..100 % Page(s):**Fehler! Textmarke nicht definiert.**	*DC 1, DC 2, DC 5, DC 6, DC 7, DC 8, DC 11* Maximum value of PWM output x (x: see 1601 *PWMOutx_RefLow*)
1603ff	**PWMOutx_ValueMin** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*DC 1, DC 2, DC 5, DC 6, DC 7* Minimum value in percent of value range of output parameter at PWM output x (x: see 1600 *PWMOutx_Assign*)
1604ff	**PWMOutx_ValueMax** Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*DC 1, DC 2, DC 5, DC 6, DC 7* Maximum value in percent of value range of output parameter at PWM output x (x: see 1600 *PWMOutx_Assign*)
1625ff	**PWMOutxFrequency**	*Not XIOS*

No.	Name		Meaning
	Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**	4 50...500 Hz 128...4000 Hz	Frequency of PWM outputs (DC 7: x = 1..2) DC 5, DC 6, DC 7, DC 8, DC 11 DC 1, DC 2 (with DC 2 for PWM outputs 1 ... 4)
1626	**PowerOutFrequency**		*DC 2*
	Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**	4 128...4000 Hz	Frequency of power output (PWM output 5)
1640ff	**AnalogOutx_Assign** **CurrentOutx_Assign** **VoltOutx_Assign**		*DC 1, DC 5* *DC 2, DC 6* *DC 2, DC 10*
	Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	4 -26999...+26999 or -9999...+9999	Function assignment to analogue output x: DC 1: 2 DC 6: 2 DC 2: 2+2 DC 10: 1 DC 5: 1
1641ff	**AnalogOutx_RefLow** **CurrentOutx_RefLow** **VoltOutx_RefLow**		*DC 1, DC 5, DC 12* *DC 2, DC 6, DC 8, DC 11* DC 2, DC 10
	Level: Range: Page(s):	4 0…100 % or 0...22 mA or 0...5 V or 0...10 V 324	Minimum value of analogue output x DC 1: 2 DC 8: 1 DC 2: 2+2 DC 10: 1 DC 5: 1 DC 11: 2 DC 6: 2 DC 12: 1
1642ff	**AnalogOutx_RefHigh** **CurrentOutx_RefHigh** **VoltOutx_RefHigh**		*DC 1, DC 5, DC 12* *DC 2, DC 6, DC 8, DC 11* DC 2, DC 10
	Level: Page(s):	4 324	Maximum value of analogue output x x and range: see 1641 *AnalogOut_RefLow*
1643ff	**AnalogOutx_ValueMin** **CurrentOutx_ValueMin** **VoltOutx_ValueMin**		*DC 1, DC 5* *DC 2, DC 6* *DC 2, DC 10*
	Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**	4 0...100 %	Minimum value in percent of value range of output parameter at analogue output x x: see 1640 *AnalogOutx_Assign*
1644ff	**AnalogOutx_ValueMax** **CurrentOutx_ValueMax** **VoltOutx_ValueMax**		*DC 1, DC 5* *DC 2, DC 6* *DC 2, DC 10*

No.	Name		Meaning
	Level:	4	Maximum value in percent of value range of output parameter at analogue output x
	Range:	0...100 %	x: see 1640 *AnalogOutx_Assign*
	Page(s):**Fehler! Textmarke nicht definiert.**		
1700	**PositionerSetpoint**		
	Level:	2	Setpoint for actuator travel in positioner mode
	Range:	0…100 %	
	Page(s): **Fehler! Textmarke nicht definiert.**, 365		
1701	**PositionerAmplitude**		
	Level:	2	Amplitude of actuator travel jump generator in positioner mode
	Range:	0...20 % or 0...25 %	
	Page(s):	365	
1702	**PositionerFrequency**		
	Level:	2	Frequency setting for positioner
	Range:	0...16 Hz	
	Page(s):	365	
1800	**Level**		
	Level:	1	User level
	Range:	1...7	Maximum level of the dongle or hand programmer, can be reduced
	Page(s):**Fehler! Textmarke nicht definiert.**		
1810	**OperationMode**		
	Level:	6	Operation mode for setpoint selection
	Range:	0...4	0 = Standard 1 = Vehicle 2 = Locomotive 3 = Generator system 4 = Marine (RESET)
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
1876	**ValueStep**		*Only required for hand programmer*
	Level:	2	Increment for value changes
	Range:	0...65535	
1900 1930 1940	**FeedbackxAdjustTime**		
	Level:	6	Hold time at 0 and 100 % position for automatic calibration of actuator x
	Range:	0...100 s	x = 1...3
	Page(s):	355	

No.	Name		Meaning
1905	**ServoxCorrFactor**		
1907	Level:	6	Correction factor of PID values for servo loop x
1909	Range:	0...400 %	x = 1...3
	Page(s):	360	
1906	**ServoxCorrRange**		
1908	Level:	6	Position range for correction factor for servo loop x
1910	Range:	0…50 %	x = 1...3
	Page(s):	360	
1911	**ServoxGain**		
1931	Level:	6	Gain for servo loop x
1941	Range:	0...100 %	x = 1...3
	Page(s):	359	
1912	**ServoxStability**		
1932	Level:	6	Stability for servo loop x
1942	Range:	0...100 %	x = 1...3
	Page(s):	359	
1913	**ServoxDerivative**		
1933	Level:	6	Derivative for servo loop x
1943	Range:	0...100 %	x = 1...3
	Page(s):	359	
1914	**ServoxAcceleration**		
1944	Level:	6	DD factor for servo loop x
1954	Range:	0...100 %	x = 1...3
	Page(s):	359	
1916	**ServoxCurrentRedDelay**		
1936	Level:	6	Delay time for the start of current reduction in servo
1946	Range:	0...100 s	loop x
	Page(s):	361	x = 1...3

No.	Name		Meaning
1917	**ServoxCurrentMax**		
1937	Level:	6	Maximum current for actuator x (in motion)
1947	Range:	0...100 %	*DC 1, DC 2, DC 7, DC 10, XIOS*
		or 0...8 A	*DC 8, DC 11, DC 12*
		or 0...12.5 A	*DC 5, DC 6, DC 9*
	Page(s): **Fehler! Textmarke nicht definiert.**, 361, 363		x = 1...3
1918	**ServoxCurrentRed**		
1938	Level:	6	Reduced current for static state of actuator x
1948			*DC 1, DC 2, DC 7, DC 10, XIOS*
	Range:	0...100 %	*DC 8, DC 11, DC 12*
		or 0...8 A	*DC 5, DC 6, DC 9*
		or 0...12.5 A	x = 1...3
	Page(s):	361	
1919	**ServoxCurrentAdjust**		
1939	Level:	6	Current for automatic calibration of actuator x
1949	Range:	0...100 %	*DC 1, DC 2, DC 7, DC 10, XIOS*
		or 0...8 A	*DC 8, DC 11, DC 12*
		or 0...12.5 A	*DC 5, DC 6, DC 9*
	Page(s):	355	x = 1...3
1920	**ServoCurrentPC**		
	Level:	6	Test mode for current specification using PC for all enabled actuators
	Range:		
		-100...100 %	*DC 1, DC 2, DC 7, DC 10, XIOS*
		or -8...8 A	*DC 8, DC 11, DC 12*
		or –12.5...12.5 A	*DC 5, DC 6, DC 9*
		or 0…200 mA	*DC 6 with 200 mA amplifier*
	Page(s):	362	5929 *ServoCurrentPCOn* cannot be saved
1950	**FeedbackxRef_0%** **FeedbackxRefLow** *(outdated)*		
1960	Level:	4	0 % reference value for feedback of actuator x
1970	Range:	0...65535	x = 1...3 (RESET)
	Page(s):	353, 355	
1951	**FeedbackxRef_100%** **FeedbackxRefHigh** *(outdated)*		
1961	Level:	4	100 % reference value for feedback of actuator x
1971	Range:	0…65535	x = 1...3 (RESET)
	Page(s):	353, 355	
1952	**FeedbackxErrLow**		
1962	Level:	4	Lower error value for feedback of actuator x
1972	Range:	0…65535	x = 1...3
	Page(s): 356, **Fehler! Textmarke nicht definiert.**		
1953	**FeedbackxErrHigh**		

No.	Name	Meaning
1963 **1973**	Level: 4 Range: 0...65535 Page(s): 356, **Fehler! Textmarke nicht definiert.**	Upper error value for feedback of actuator x x = 1...3
1955	**FeedbackReference** Level: 4 Range: 0...65535 Page(s): 353	*DC 2, DC 6, DC 9, DC 10* Reference value for the actuator reference coil with digital feedback (RESET)
1956	**FeedbackRefErrLow** Level: 4 Range: 0...65535 Page(s): 357, **Fehler! Textmarke nicht definiert.**	*DC 2, DC 6, DC 9, DC 10* Lower error value for the actuator reference coil with digital feedback
1957	**FeedbackRefErrHigh** Level: 4 Range: 0...65535 Page(s): 357, **Fehler! Textmarke nicht definiert.**	*DC 2, DC 6, DC 9, DC 10* Upper error value for the actuator reference coil with digital feedback
10000 **ff**		*Dual fuel parameters are described in the subchapter*
10900 **ff**	**AssignIn_ExhTempCyl1** **AssignIn_ExhTempCylx** Level: 4 Range: 0...117 Page(s): 239	*XIOS* Input configuration for exhaust temperature sensors via port x or communication module channel x = 1...24
11000 **ff**	**SubstExhaustTempCyl1** **SubstExhaustTempCylx** Level: 4 Range: -100...+1000 °C Page(s): 246	*XIOS* Substitution value for exhaust temperature sensor x = 1...24
11400 **ff**	**Out1:Assign** **Outx:Assign** Level: 6 Range: 0…9999 or 0…29999 or 0…65535 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*DC 8, DC 11, DC 12, XIOS* Assignment parameter for an output x = 1..120 or lower, application-specific, by default total outputs in own hardware and all connected communication modules
11401 **ff**	**Out1:ValueMin** **Outx:ValueMin**	*DC 8, DC 11, DC 12, XIOS*

No.	Name	Meaning
	Level: 6 Range: 0...100.0 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Minimum value in percent of value range of output parameter x see 11400 *Out1:Assign*
11402 ff	**Out1:ValueMax** **Outx:ValueMax**	*DC 8, DC 11, DC 12, XIOS*
	Level: 6 Range: 0...100.0 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Maximum value in percent of value range of output parameter x see 11400 *Out1:Assign*

No.	Name	Meaning
11403 ff	**Out1:DigOutBitMask** **Outx:DigOutBitMask** Level: 6 Range: 0...FFFF Hex Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Mask for error bits if an error parameter is assigned x see 11400 *Out1:Assign*
20810 ff	**Comm...** Level: 6 Range: 0...x or –x...x Page(s): 248, 254, 257, 258	Configuration of input channel number for a switching function received by a communication module x Number of possible input channels, depending on application Switching functions see 2810 *Switch...* ff

Tab. 158: Parameters

28.1.1 DC 1

Here, the parameters are described which are only available in DC 1 type control units due to the special hardware requirements.

No.	Name	Meaning
22	**SpeedOverCPU2** Level: 6 Range: 0...4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Overspeed for monitoring by CPU2 (RESET)
23	**SpeedIdleCPU2** Level: 6 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Idle speed for monitoring by CPU2 (RESET)
1200	**CPU2StartTimOutDelay** Level: 4 Range: 0...100 s Page(s):**Fehler! Textmarke nicht definiert.**	Delay time for start of monitoring by CPU2 (RESET)
1921	**ServoCurrentCPU2** Level: 4 Range: 0...100 s Page(s):**Fehler! Textmarke nicht definiert.**	Maximum actuator current for monitoring by CPU2 (RESET)

Tab. 159: DC 1 parameters

28.1.2 DC 5

Here, the parameters are described which are only available in DC 5 type control units due to the special hardware requirements.

No.	Name		Meaning
50	**SpeedFreqOut1SwOff**		
	Level:	6	Lower speed below which the speed output 1 is
	Range:	0...4000 rpm	disabled (static high)
	Page(s):**Fehler! Textmarke nicht definiert.**		only if 4801 *FREQOut1OrDigOut8* = 1
51	**SpeedFreqOut2SwOff**		
	Level:	6	Lower speed below which the speed output 2 is
	Range:	0...4000 rpm	disabled (static high)
	Page(s):**Fehler! Textmarke nicht definiert.**		only if 4802 *FREQOut2OrPWMO2_DO9* = 1
52	**SpeedFreqOut1SwOn**		
	Level:	6	Upper speed above which the speed signal from pickup
	Range:	0...4000 rpm	1 is looped through to speed output 1
	Page(s):**Fehler! Textmarke nicht definiert.**		only if 4801 *FREQOut1OrDigOut8* = 1
53	**SpeedFreqOut2SwOn**		
	Level:	6	Upper speed above which the speed signal from pickup
	Range:	0...4000 rpm	2 is looped through to speed output 2
	Page(s):**Fehler! Textmarke nicht definiert.**		only if 4802 *FREQOut2OrPWMO2_DO9* = 1

Tab. 160: DC 5 parameters

28.1.3 DC 10

Here, the parameters are described which are only available in DC 10 type control units due to the special hardware requirements.

No.	Name		Meaning
1110	**DO_SupviseDelayTime**		
	Level:	4	Delay time after edge change for monitoring of binary
	Range:	0...5.00 s	output
	Page(s):**Fehler! Textmarke nicht definiert.**		

Tab. 161: DC 10 parameters

28.1.4 XIOS

Here, the parameters are described which are only available in type XIOS control units due to the special hardware requirements.

No.	Name		Meaning
10400	**AmplifierCurrCheckStartDelay**		
	Level:	4	Delay time after starting control unit before current monitoring starts
	Range:	0...600 s	
	Page(s):	369	
10401	**AmplifierxCurrentErrLow**		
10406	Level:	4	Lower current limit at which an error is reported
10411	Range:	0...12.5 A	x = 1...3
	Page(s):	369	
10402	**AmplifierxCurrentErrHigh**		
10407	Level:	4	Upper current limit at which an error is reported
10412	Range:	0...12.5 A	x = 1...3
	Page(s):	369	
10403	**AmplifierxCurrentDiff**		
10408	Level:	4	Limit for the difference between setpoint and actual current at which an error is reported
10413	Range:	0...12.5 A	
	Page(s):	369	x = 1...3
20000	**EthernetA_IPAddress**		
ff	Level:	4	IP address for Ethernet node A
	Range:	0...255	
	Page(s):		
20004	**EthernetA_SubnetMask**		
ff	Level:	4	Subnet mask for Ethernet node A
	Range:	0…255	
	Page(s):		
20008	**EthernetB_IPAddress**		
ff	Level:	4	IP address for Ethernet node B
	Range:	0...255	
	Page(s):		
20012	**EthernetB_SubnetMask**		
ff	Level:	4	Subnet mask for Ethernet node B
	Range:	0...255	
	Page(s):		
30000	**Px_(My.DI1)_FI_TOutFact**		
ff	Level:	4	TimeOut factor of the frequency input if the port has been configured as a frequency input
	Range:	2...50	
	Page(s):	314	x = Port 089, 090, 104, 105 y = Module C or D

No.	Name		Meaning
30001	**Px_(My.DI1)_FI_ErrLimit**		
ff	Level:	4	Error limit of the frequency input if the port has been configured as a frequency input
	Range:	0…20000 Hz	
	Page(s):	314	x = Port 089, 090, 104, 105 y = Module C or D
30002	**Px_(My.DI1)_FI_Filter**		
ff	Level:	4	Filter value of the frequency input
	Range:	0…100 s	if the port has been configured as a frequency input
	Page(s):	314	x = Port 089, 090, 104, 105 y = Module C or D
30012	**P089_(MC.DI1)_PI_RefLow**		
	Level:	4	Low duty cycle of the PWM input at port 89 (module C)
	Range:	0…100 %	
	Page(s):	313	if the port has been configured as a PWM input
30013	**P089_(MC.DI1)_PI_RefHigh**		
	Level:	4	High duty cycle of the PWM input at port 89 (module C)
	Range:	0…100 %	
	Page(s):	313	if the port has been configured as a PWM input
30014	**P089_(MC.DI1)_PI_Filter**		
	Level:	4	Filter value of the PWM input at port 89 (module C)
	Range:	0…100 s	if the port has been configured as a PWM input
	Page(s):	313	

No.	Name	Meaning
30020 ff	**P001_(SL1.1)_IO_RefLow** **Px_(wy.z)_IO_RefLow** Level: 4 Range: Analogue input: 0…5 V or 0…10 V or 0…36 V or 0...31.24 mA Temperature input: 0...5000 Ω or 0...60000 Ω Thermocouple input: -18.938...+70.47 mV or -13.801...+50.242 mV or -11.244...+43.989 mV or -22.157...+83.592 mV or -11.654…+25.722 mV or -4.308...+22.619 mV or -3.107...+16.309 mV Analogue output: 0…22.222 mA or 0…24 mA PWM output: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**, 312, 323, 256	Lower reference if the port is used as an analogue/temperature or thermocouple input or as an analogue or PWM output Slots for A modules on module C w = SL, MC, MD x = Port 1..117 y = Slot 1 to 11 for A-modules z = Channel 1..4
30021 ff	**P001_(SL1.1)_IO_RefHigh** **Px_(wy.z)_IO_RefHigh** Level: 4 Range: Page(s): **Fehler! Textmarke nicht definiert.**, 312, 323, 256	Upper reference if the port is used as an analogue/temperature or thermocouple input or as an analogue or PWM output w, x, y, z and range see 30020 *P001_(SL1.1)_IO_RefLow*
30022 ff	**P001_(SL1.1)_AI_ErrLow** **Px_(wy.z)_AI_ErrLow** Level: 4 Range: Page(s): 312	Lower error limit if the port is used as an analogue/temperature or thermocouple input w, x, y, z and range see 30020 *P001_(SL1.1)_IO_RefLow*
30023 ff	**P001_(SL1.1)_AI_ErrHigh** **Px_(wy.z)_AI_ErrHigh** Level: 4 Range: Page(s): 312	Upper Error limit if the port is used as an analogue/temperature or thermocouple input w, x, y, z and range see 30020 *P001_(SL1.1)_IO_RefLow*

No.	Name		Meaning
30024 ff	**P001_(SL1.1)_AI_Filter** **Px_(wy.z)_AI_Filter**		
	Level:	4	Filter value
	Range:	0...100 s	if the port is used as an analogue/temperature or thermocouple input
	Page(s):	312	w, x, y, z see 30020 *P001_(SL1.1)_IO_RefLow*
30025 ff	**P001_(SL1.1)_PO_Freq** **Px_(wy.z)_ PO_Freq**		
	Level:	4	Frequency
	Range:	126...15626 Hz	if the port is used as a PWM output
	Page(s):	324	w, x, y, z see 30020 *P001_(SL1.1)_IO_RefLow*

Tab. 162: Parameter XIOS

28.1.5 Dual fuel

↑*16* Speed control for dual fuel engines (ARTEMIS) and separate ARTEMIS manuals

No.	Name		Meaning
10002	**GasModeChAirTempMin**		
	Level:	4	Minimum charge air temperature for dual fuel operation
	Range:	-100…1000 °C	
	Page(s):	190	
10003	**GasModeChAirTempMax**		
	Level:	4	Maximum charge air temperature for dual fuel operation
	Range:	-100…1000 °C	
	Page(s):	190	
10004	**GasModeChAirTempHyst**		
	Level:	4	Charge air temperature hysteresis
	Range:	-100...1000 °C	
	Page(s):	191	
10005	**GasModeGasRPressMin**		
	Level:	3	Minimum gas rail pressure for dual fuel operation
	Range:	0...10 bar	
	Page(s):	194	
10006	**GasModeGasRPressMax**		
	Level:	3	Maximum gas rail pressure for dual fuel operation
	Range:	0...10 bar	
	Page(s):	179, 194	
10007	**GasModeGasRPressHyst**		
	Level:	3	Gas rail pressure hysteresis
	Range:	0...10 bar	
	Page(s):	195	
10008	**GasModeGasAtLimitMax**		
	Level:	3	Time period for how long gas rail pressure is permitted to be outside of the limits before dual fuel operation is switched off because of this
	Range:	0…100 s	
	Page(s):	194	
10010	**GasModeSpeedMin**		
	Level:	3	Minimum speed for dual fuel operation
	Range:	0...4000 rpm	
	Page(s):	195	
10011	**GasModeSpeedMax**		
	Level:	3	Maximum speed for dual fuel operation
	Range:	0…4000 rpm	
	Page(s):	195	
10012	**GasModeSpeedHyst**		
	Level:	3	Speed hysteresis
	Range:	0...4000 rpm	
	Page(s):	196	

No.	Name		Meaning
10013	**GasModePowerMin**		
	Level:	3	Minimum power for dual fuel operation,
	Range:	0…200 %	relative power
		or 0...x kW	x: Depending on application
	Page(s):	185	
10014	**GasModePowerMax**		
	Level:	3	Maximum power for dual fuel operation,
	Range:	0...200 %	relative power
		or 0...x kW	x: Depending on application
	Page(s):	185, 226	
10015	**GasModePowerHyst**		
	Level:	3	Power hysteresis,
	Range:	0...100 %	relative power
		or 0..x kW	x: Depending on application
	Page(s):	185, 225	
10016	**GasModeBoostHyst**		
	Level:	3	Boost pressure hysteresis (minimum boost pressure is
	Range:	0...5 bar	taken from characteristic)
	Page(s):	193	
10017	**GasModeExhTempMax**		
	Level:	3	Maximum exhaust temperature for dual fuel operation
	Range:	-100...1000 °C	
	Page(s):	186	
10018	**GasModeExhTempHyst**		
	Level:	3	Exhaust temperature hysteresis
	Range:	0...100 °C	
	Page(s):	187	
10019	**GasModeExhTempDiff**		
	Level:	3	Max. permissible exhaust temperature difference
	Range:	0...100 °C	between coldest and warmest cylinder in diesel
	Page(s):	187	operation to enable dual fuel operation
10020	**GasModeCoolTempMin**		
	Level:	3	Minimum coolant temperature for dual fuel operation
	Range:	-100...1000 °C	
	Page(s):	189	
10021	**GasModeCoolTempMax**		
	Level:	3	Maximum coolant temperature for dual fuel operation
	Range:	-100...1000 °C	
	Page(s):	189	
10022	**GasModeCoolTempHyst**		
	Level:	3	Coolant temperature hysteresis
	Range:	0...100 °C	
	Page(s):	190	

No.	Name		Meaning
10023	**GasModeGasTempMin**		
	Level:	3	Minimum gas temperature for dual fuel operation
	Range:	-100...1000 °C	
	Page(s):	191	
10024	**GasModeGasTempMax**		
	Level:	3	Maximum gas temperature for dual fuel operation
	Range:	-100...1000 °C	
	Page(s):	191	
10025	**GasModeGasTempHyst**		
	Level:	3	Gas temperature hysteresis
	Range:	0...100 °C	
	Page(s):	192	
10027	**GasModeGasExhTmpDiff**		
	Level:	3	Max. permissible exhaust temperature difference
	Range:	-100...1000 °C	between coldest and warmest cylinder in dual fuel
	Page(s):	187	operation
10028	**GasModeExhTempDelay**		
	Level:	4	Delay in monitoring the exhaust temperature after
	Range:	0…100 s	switching to gas
	Page(s):	188	
10055	**PilotDslAbsMinimum**		
	Level:	6	Absolute minimum value for diesel ignition oil quantity
	Range:	0...100 %	in dual fuel operation
	Page(s):	164, 197, 217	
10056	**KnockModulACIndex**		
	Level:	6	Index for ARIADNE knock module in 430
	Range:	0…5	*CanACNodeNumber* / 435 *CanACNodeType*
	Page(s):	199	
10080	**GasValveCheckDelay**		
	Level:	4	Delay time within which the external gas release must come once it has been released internally *x = XIOS: 600 s, others 1000 s*
	Range:	0...x s	
	Page(s):	184	
10100	**GasReductChAirTmpDec**		*Not XIOS*
	Level:	4	Charge air temperature dependent reduction of the gas
	Range:	0...100 s	fuel quantity setpoint: Max. reduction value with 10102
	Page(s):	228	*GasRedChAirTHotHigh*
10103	**GasReductExhTempDec**		*Not XIOS*
	Level:	4	Exhaust temperature dependent reduction of the gas
	Range:	0...100 s	fuel quantity setpoint: Max. reduction value with 10105
	Page(s):	229	*GasReductExhTHotHigh*

No.	Name		Meaning
10106	**GasReductCoolTempDec**		*Not XIOS*
	Level:	4	Coolant temperature dependent reduction of the gas fuel quantity setpoint: Max. reduction value with 10108 *GasRedCoolTHotHigh*
	Range:	0…100 s	
	Page(s):	230	

Tab. 163: Dual fuel parameters (general)

28.1.5.1 Gas speed governor

No.	Name		Meaning
10030	**GasGain**		
	Level:	2	Gain for gas speed governor
	Range:	0…100 %	
	Page(s):	208	
10031	**GasStability**		
	Level:	2	Stability for gas speed governor
	Range:	0...100 %	
	Page(s):	208	
10032	**GasDerivative**		
	Level:	2	Derivative for gas speed governor
	Range:	0...100 %	
	Page(s):	208	
10033	**ConversionStability**		*Gas speed governor*
	Level:	2	Stability increase for diesel speed governor during switching diesel ←→ gas
	Range:	0...100 %	
	Page(s): **Fehler! Textmarke nicht definiert.**, 207, 210		
10034	**GasSpeedDT1**		
	Level:	2	DT1-factor for speed gradient for gas speed governor
	Range:	0...100 %	
	Page(s):	208	
10035	**GasPowerDT1**		
	Level:	2	DT1-factor for power gradient for gas speed governor
	Range:	0...100 %	
	Page(s):	208, 217	
10036	**GasStaticCorrFactor**		
	Level:	2	Correction factor for gas PID values in static operation of the gas speed governor
	Range:	0...100 %	
	Page(s):	208	
10037	**GasStaticCorrRange**		
	Level:	2	Speed range for correction factor of the gas speed governor
	Range:	0...4000 rpm	
	Page(s):	208	

No.	Name		Meaning
10050	**DieselToGasRampLow**		
	Level:	6	Gas ramp during switch from diesel to gas with low gas proportion (fast)
	Range:	0…800%/s	
	Page(s):	209	Ramp becomes slower as gas fuel quantity increases
10051	**DieselToGasRampHigh**		
	Level:	4	Gas ramp during switch from diesel to gas with high gas proportion (slow)
	Range:	0…800%/s	
	Page(s):	209	Ramp becomes slower as gas fuel quantity increases
10052	**GasToDieselRampLow**		
	Level:	4	Gas ramp during switch from gas to diesel with low gas proportion (slow)
	Range:	0...800 %/s	
	Page(s):	210	Ramp becomes slower as gas fuel quantity decreases
10053	**GasToDieselRampHigh**		
	Level:	4	Gas ramp during switch from gas to diesel with high gas proportion (fast)
	Range:	0…800%/s	
	Page(s):	210	Ramp becomes slower as gas fuel quantity decreases
10054	**FastGasToDieselRamp**		
	Level:	4	Fast ramp from gas to diesel on request with 2838 *SwitchFastToDiesel*
	Range:	0…800%/s	
	Page(s):	210	
10057	**KnockPilotDslOffset**		
	Level:	6	Gradual increase in ignition oil quantity with Ariadne knock warning in dual fuel operation
	Range:	0...100 %	
	Page(s):	200	
10058	**KnockPilotDslOffsMax**		
	Level:	6	Max. cumulative offset for ignition oil quantity
	Range:	0…100 %	
	Page(s):	200	
10059	**KnockPilotDOffsDelay**		
	Level:	6	Delay between two increases of the offset value for the ignition oil quantity
	Range:	0...100 s	
	Page(s):	200	
10060	**PilotDieselSetpoint**		
	Level:	6	Ignition oil quantity parameter, if not derived from map
	Range:	0…100 %	
	Page(s):	165	
10061	**PilotDieslHysteresis**		
	Level:	6	Ignition oil quantity hysteresis to detect whether or not diesel is at ignition oil quantity
	Range:	0…100 %	
	Page(s):	196	
10063	**GasFuelLimitMaxAbs**		
	Level:	4	Absolute gas fuel quantity limit
	Range:	0…100 %	
	Page(s):	219	

No.	Name		Meaning
10065	**GasDecrAtDieselStart**		
	Level:	4	Reduction of the gas fuel quantity at the moment of switching to diesel to force the diesel controller
	Range:	0...100 %	
	Page(s):	198, 210	
10066	**GasFuelLimitForced**		
	Level:	4	Gas fuel quantity limitation with power limitation enabled using 2813 *SwitchForcedLimit*
	Range:	0...100 %	
	Page(s):	222	
10067	**GasFuelLimitMaxTime**		
	Level:	4	Max. permissible duration for gas limitation until the diesel speed governor is temporarily enabled (if 14076 *GasLimitReactionOn* = 1)
	Range:	0...100 s	
	Page(s):	211	
10069	**GasMinToDieselDelay**		
	Level:	4	Maximum permissible dwell time of the gas in dual fuel operation below 10065 *GasDecrAtDieselStart* before there is an automatic return to diesel (low gas value and diesel at the ignition oil quantity → no load request, potentially too much power due to diesel + gas)
	Range:	0...100 s	
	Page(s):	198	
10070	**GasPowGovGain**		*Integrated power governor*
	Level:	4	Gain for integrated power governor in dual fuel operation
	Range:	0...100 %	
	Page(s):	214	
10071	**GasPowGovStability**		*Integrated power governor*
	Level:	4	Stability for integrated power governor in dual fuel operation
	Range:	0...100 %	
	Page(s):	214	
10072	**GasPowGovDerivative**		*Integrated power governor*
	Level:	4	Derivative for integrated power governor in dual fuel operation
	Range:	0...100 %	
	Page(s):	214	
10075	**GasPowGradThreshold**		
	Level:	4	Threshold for detection of a major power jump in dual fuel operation (compare with 2029 *PowerGradientDT1*)
	Range:	0…100 %	
		or 0...y kW	y: Depending on application
	Page(s):	212, 213	
10076	**GasLoadingSpeedGrThr**		
	Level:	4	Speed threshold for detection of a major load addition in dual fuel operation (compare with 2028 *SpeedGradientDT1*)
	Range:	0...2000 rpm/s	
	Page(s):	213	
10078	**GasLoadRejSpeedGrThr**		
	Level:	4	Speed threshold for detection of major load shedding in dual fuel operation (compare with 2028 *SpeedGradientDT1*)
	Range:	0...2000 rpm/s	
	Page(s):	213	

No.	Name		Meaning
10090	**DslModeGasRPressMax**		
	Level:	4	Conditions for combustion of residual gas:
	Range:	0...100 %	Maximum permissible gas rail pressure at which
	Page(s):	232	residual gas combustion can be ended (at the latest after 10092 *GasBurnTimeMax*)
10091	**DslModeGasFuelBurn**		
	Level:	4	Conditions for combustion of residual gas:
	Range:	0…100 %	Forced gas opening (Megasol, actuator) for combustion
	Page(s):	232	of residual gas with closed gas supply valves
10092	**GasBurnTimeMax**		
	Level:	4	Conditions for combustion of residual gas:
	Range:	0...100 s	Max. permissible time for residual gas combustion (if
	Page(s):	233	gas supply valves do not close correctly)

Tab. 164: Dual fuel parameters (gas speed governor)

28.1.5.2 Diesel reduction governor

No.	Name		Meaning
10029	**GasSetpointPC**		
	Level:	4	Gas setpoint using PC
	Range:	0...100 %	
	Page(s):	216	
10030	**DieselRedGain**		
	Level:	2	Gain for diesel reduction governor
	Range:	0...100 %	
	Page(s):	217	
10031	**DieselRedStability**		
	Level:	2	Stability for diesel reduction governor
	Range:	0…100 %	
	Page(s):	217	
10032	**DieselRedDerivative**		
	Level:	2	Derivative for diesel reduction governor
	Range:	0...100 %	
	Page(s):	217	
10035	**DslRedStatCorrFactor**		
	Level:	2	Correction factor for gas PID values in static operation
	Range:	0...100 %	of the diesel reduction governor
	Page(s):	217	

No.	Name		Meaning
10036	**DslRedStatCorrRange**		
	Level:	2	Diesel range for correction factor for diesel reduction governor
	Range:	0…100 %	
	Page(s):	218	
10040	**DieselDiffGasMin**		
	Level:	2	Minimum gas position for checking for deactivated gas safety valve
	Range:	0…100 %	
	Page(s):	197	
10041	**DieselDiffMax**		
	Level:	2	Maximum permissible difference between setpoint and actual value for checking for deactivated gas safety valve
	Range:	0...100 %	
	Page(s):	197	
10042	**DieselDiffDelay**		
	Level:	2	Maximum permissible duration for difference between diesel setpoint and actual value for checking for deactivated gas safety valve
	Range:	0…100 s	
	Page(s):	197	
10050	**FastDieselSetpRampUp**		
	Level:	6	Fast upwards diesel setpoint ramp
	Range:	0…800%/s	
	Page(s):	218	
10051	**DieselSetpRampUp**		
	Level:	4	Upwards diesel setpoint ramp
	Range:	0…800%/s	
	Page(s):	218	
10052	**DieselSetpRampDown**		
	Level:	4	Downwards diesel setpoint ramp
	Range:	0...800 %/s	
	Page(s):	218	
10057	**KnockDslSetpOffset**		
	Level:	6	Gradual increase in diesel setpoint with Ariadne knock warning in dual fuel operation
	Range:	0...100 %	
	Page(s):	200	
10058	**KnockDslSetpOffsMax**		
	Level:	6	Max. cumulative offset for diesel setpoint
	Range:	0...100 %	
	Page(s):	200	
10059	**KnockDslSetOffsDelay**		
	Level:	6	Delay between two increases of the offset value for the diesel setpoint
	Range:	0…100 s	
	Page(s):	200	
10060	**DieselSetpoint**		
	Level:	6	Setpoint for diesel in dual fuel operation if not derived from map
	Range:	0...100 %	
	Page(s):	216	Corresponds to ignition oil quantity

No.	Name		Meaning
10061	**DieselHysteresis**		
	Level:	6	Ignition oil quantity hysteresis to detect whether or not diesel is at ignition oil quantity
	Range:	0...100 %	
	Page(s):	198	
10062	**GasPowerLimitMaxAbs**		*Marine operation*
	Level:	4	Absolute gas power limitation
	Range:	0...x kW	x: Depending on application
	Page(s):	185, 222	
10063	**GasFuelLimitMaxAbs**		*Not marine operation*
	Level:	4	Absolute gas fuel quantity limit
	Range:	0...100 %	
	Page(s):	223, 226	
10066	**GasFuelLimitForced**		
	Level:	4	Gas fuel quantity limitation with power limitation enabled using 2813 *SwitchForcedLimit*
	Range:	0...100 %	
	Page(s):	227	
10091	**DslModeGasFuelBurn**		
	Level:	4	Conditions for combustion of residual gas:
	Range:	0…100 %	Forced gas opening (Megasol, actuator) for combustion of residual gas with closed gas supply valves
	Page(s):	233	
10092	**GasBurnTimeMax**		
	Level:	4	Conditions for combustion of residual gas:
	Range:	0...100 s	Max. permissible time for residual gas combustion (if gas supply valves do not close correctly)
	Page(s):	233	
10094	**GasStartDelay**		
	Level:	4	Delay time for gas activation if diesel comes from a position below the ignition oil quantity back above it
	Range:	0…100 s	
	Page(s):	197	

Tab. 165: Dual fuel parameters (diesel reduction governor)

28.1.6 ICENI

↑*23.7* CAN protocol ICENI® (CANopen)

No.	Name		Meaning
21550	**Iceni:Baudrate**		
	Level:	4	Baud rate of ICENI CANopen network
	Range:	125,250,500,1000 kBaud	
21551	**Iceni:SlaveID**		
	Level:	4	Node number of slave in ICENI CANopen network
	Range:	1...127	

No.	Name		Meaning
21552	**Iceni:ModulSendRate**		
	Level:	4	Receive interval of messages from ICENI module
	Range:	0...100 s	
21560 ff	**Iceni: AI1_RefLow** **Iceni: AIx_RefLow**		
	Level:	4	Lower reference for analogue input x
	Range:	0...100.0 %	x = 1..20
21561 ff	**Iceni: AI1_RefHigh** **Iceni: AIx_RefHigh**		
	Level:	4	Upper reference for analogue input x
	Range:	0…100.0 %	x = 1..20

Tab. 166: ICENI parameters

28.1.7 WAGO

↑*23.6* CAN protocol WAGO® (CANopen) and AXIOMATIC® (CANopen)

No.	Name		Meaning
21550 ff	**Wago: AI13_RefLow** **Wago: AIx_RefLow**		*If more than four TPDOs are possible*
	Level:	4	Lower reference for analogue input x
	Range:	0...100.0 %	x = 13..74
21561 ff	**Wago: AI13_RefHigh** **Wago: AIx_RefHigh**		
	Level:	4	Upper reference for analogue input x
	Range:	0…100.0 %	x = 13..73
21680 ff	**Wago:SendRateAIx-x+3**		
	Level:	4	Receive interval of messages from WAGO module
	Range:	0…100 s	x = 13..74
21700	**Wago:Baudrate**		
	Level:	4	Baud rate of WAGO CANopen network
	Range:	125,250,500,1000 kBaud	
21701	**Wago:SlaveID**		*If only four RPDOs are possible*
	Level:	4	Node number of slave in WAGO CANopen network
	Range:	1...127	
21701	**Wago:SlaveID+0_1**		*If eight RPDOs are possible*
	Level:	4	Node number of slave in WAGO CANopen network
	Range:	1...127	
21701	**Wago:SlaveID+0_1_2**		*If 12 RPDOs are possible*
	Level:	4	Node number of slave in WAGO CANopen network
	Range:	1...127	

No.	Name		Meaning
21701	**Wago:SlaveID+0_1_2_3**		*If 16 RPDOs are possible*
	Level:	4	Node number of slave in WAGO CANopen network
	Range:	1..127	
21701	**Wago:SlaveID+0_1_2_3_4**		*If 20 RPDOs are possible*
	Level:	4	Node number of slave in WAGO CANopen network
	Range:	1...127	
21702	**Wago:ModulSendRate**		*If only four TPDOs are possible*
	Level:	4	Receive interval of messages from WAGO module
	Range:	0...100 s	
21702	**Wago:SendRateDI01-64**		*If more than four TPDOs are possible*
	Level:	4	Receive interval of messages from WAGO module
	Range:	0...100 s	
21703	**Wago:SendRateAI01-04**		*If more than four TPDOs are possible*
	Level:	4	Receive interval of messages from WAGO module
	Range:	0…100 s	
21704	**Wago:SendRateAI05-08**		*If more than four TPDOs are possible*
	Level:	4	Receive interval of messages from WAGO module
	Range:	0...100 s	
21705	**Wago:SendRateAI09-12**		*If more than four TPDOs are possible*
	Level:	4	Receive interval of messages from WAGO module
	Range:	0...100 s	Further values see 21680
21710 ff	**Wago: AI1_RefLow** **Wago: AIx_RefLow**		*If more than four TPDOs are possible*
	Level:	4	Lower reference for analogue input x
	Range:	0...100.0 %	x = 1...12, for more see 21550
21711 ff	**Wago: AI1_RefHigh** **Wago: AIx_RefHigh**		
	Level:	4	Upper reference for analogue input x
	Range:	0...100.0 %	x = 1...12, for more see 21551
21734 ff	**Wago:DigOut1_Assign** **Wago:DigOutx_Assign**		*All except DC 8, DC 11, DC 12, XIOS*
	Level:	4	Assignment to binary output x on WAGO modules
	Range:	-29999...+29999	x = 1..16

Tab. 167: WAGO parameters

28.1.8 CANopen

↑*23.4* CAN protocol CANopen and CANopen, Manual DG 06 002-e

No.	Name		Meaning
21750	**CanOp:Baudrate**		
	Level:	4	Baud rate of CANopen network
	Range:	125,250,500,1000 kBaud	
21751	**CanOp:MyNodeNo**		
	Level:	4	Own node number in the CANopen network
	Range:	1…127	
21752	**CanOp:PartnerNodeNo**		
	Level:	4	Master / partner node number in CANopen network
	Range:	0...127	
21753	**CanOp:TimeOutDelay**		
	Level:	4	Time for which receiving telegram is suppressed –
	Range:	0…127	timeout monitoring after start-up of control unit
21754	**CanOp:HBeatConsTime**		
	Level:	4	Receiving interval for heartbeat
	Range:	0...100 s	
21755	**CanOp:HBeatProdTime**		
	Level:	4	Sending interval for heartbeat
	Range:	0...100 s	
21756	**CanOp:GuardingTime**		
	Level:	4	Receiving interval for node guarding
	Range:	0...100	
21757	**CanOp:LifeTimeFactor**		
	Level:	4	Factor for receiving interval for node guarding
	Range:	0…255	
21761	**CanOp:ID_EMCYProd**		
	Level:	4	Identifier of EMCY sending telegram
	Range:	0...255	Warning: 21751 *CanOp:MyNodeNo* is added
21762	**CanOp:ID_HBeatCons**		
	Level:	4	Identifier of life guarding or heartbeat receiving
	Range:	0...255	telegram
			LifeGuarding: 21751 *CanOp:MyNodeNo* is added
			Heartbeat: 21752 *CanOp:PartnerNodeNo* is added
21763	**CanOp:ID_HBeatProd**		
	Level:	4	Identifier of heartbeat sending telegram
	Range:	0...255	Warning: 21751 *CanOp:MyNodeNo* is added
21764	**CanOp:ID_ClientSDO**		
	Level:	4	Identifier of SDO receiving telegram
	Range:	0...255	Warning: 21751 *CanOp:MyNodeNo* is added
21765	**CanOp:ID_ServerSDO**		
	Level:	4	Identifier of SDO sending telegram
	Range:	0...255	Warning: 21751 *CanOp:MyNodeNo* is added

No.	Name		Meaning
21770 ff	**CanOp:RPDOID(x)** Level: Range:	 4 0...255	*If only 4 RPDOs are possible* Identifier of RPDOs Warning: 21751 *CanOp:MyNodeNo* is added x = 0..4 *See 21790 if more than 4 RPDOs are possible*
21774 ff	**CanOp:TPDOID(x)** Level: Range:	 4 0...255	 Identifier of TPDOs Warning: 21751 *CanOp:MyNodeNo* is added to the first four standard TPDOs x = 0..15
21790 ff	**CanOp:RPDOID(x)** Level: Range:	 4 0...255	*If more than four RPDOs are possible* Identifier of RPDOs Warning: 21751 *CanOp:MyNodeNo* is added x = 0..9 *See 21770 if only 4 RPDOs are possible*

Tab. 168: CANopen parameters

28.1.9 Modbus

↑*23.8* Serial protocol Modbus and Manual DG 05 002-e

No.	Name		Meaning
21800	**Modb:Baudrate** Level: Range:	 4 9600, 19200 kBaud	 Baud rate, changes only become effective after reset
21801	**Modb:SlaveID** Level: Range:	 4 1...24	 Own device address as slave
21820	**Modb:RxTimeOut** Level: Range:	 4 0...60 s	 Receiving time limit for requests to write binary values / sensor values

Tab. 169: Modbus parameters

28.1.10 DeviceNet

↑*23.5* CAN protocol DeviceNet and Manual DG 06 003-e

No.	Name		Meaning
21850	**DNet:Baudrate**		
	Level:	4	Baud rate of DeviceNet system
	Range:	125, 250, 500 kBaud	
21851	**DNet:MacId**		
	Level:	4	Own identifier in DeviceNet system
	Range:	0…63	
21852	**DNet:NoOfRxBytes**		
	Level:	4	Number of expected bytes via polled message, standard:
	Range:	0...32	2 bytes switching functions, 15 words sensors

Tab. 170: DeviceNet parameters

28.1.11 SAE J1939

↑*23.3* CAN protocol SAE J1939 and Manual DG 06 004-e

No.	Name		Meaning
21900	**J1939:Baudrate**		
	Level:	4	Baud rate in SAE J1939 bus system
	Range:	125, 250, 500 kBaud	
21901	**J1939:MyNodeNumber**		
	Level:	4	Own node number in SAE J1939 bus system
	Range:	1…31	
21902	**J1939:StartTOutDelay**		
	Level:	4	Time for which receiving telegram is suppressed –
	Range:	0...100 s	timeout monitoring after start-up of control unit
21909	**J1939:LossFuelOffset**		*EEC3*
	Level:	4	Offset for speed and temperature dependent torque
	Range:	0…100 %	friction, defined loss due to pumps etc.
21910	**J1939:RefEngTorque**		*EC1*
	Level:	4	Maximum engine torque
	Range:	0...64255 Nm	
21911	**J1939:TorqueMinFuel**		*EC1, EEC1, EEC2, EEC3*
	Level:	4	Fuel quantity at zero-fuel
	Range:	0...100 %	
21912	**J1939:TorqueMaxFuel**		*EC1, EEC1, EEC2, EEC3*
	Level:	4	Fuel quantity at full load
	Range:	0...100 %	
21913	**J1939:SpeedPoint4**		*EC1*

No.	Name		Meaning
	Level:	4	Speed point 4 (for EngineConfiguration telegram)
	Range:	0...4000 rpm	
21914	**J1939:SpeedPoint5**		*EC1*
	Level:	4	Speed point 5 (for EngineConfiguration telegram)
	Range:	0...4000 rpm	
21915	**J1939:SpeedPoint4_2**		*EC1*
	Level:	4	Speed point 4 for second envelope curve (for
	Range:	0...4000 rpm	EngineConfiguration telegram)
21916	**J1939:SpeedPoint5_2**		*EC1*
	Level:	4	Speed point 5 for second envelope curve (for
	Range:	0...4000 rpm	EngineConfiguration telegram)

Tab. 171: SAE J1939 parameters

28.1.12 HZM-CAN customer module

↑*23.2* CAN protocol HZM-CAN customer module and Manual DG 05007-e

No.	Name		Meaning
21950	**CMRxTelxTimeout**		
ff	Level:	4	Receiving telegram x timeout
	Range:	0…100 s	x = 10..25
21960	**CMTxTelxSendRate**		
ff	Level:	4	Send rate of sending telegram x
	Range:	0…100 s	x = 20..58

Tab. 172: HZM-CAN customer module parameters

28.2 : List 2: Measured values and display values

No.	Name	Meaning
2000	**Speed** Level: 1 Range: 0...4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 195, 220, 224, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 409	Current speed value
2001	**SpeedPickUp1** Level: 1 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Current speed signal from speed pickup 1
2002	**SpeedPickUp2** Level: 1 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Current speed signal from speed pickup 2
2003	**SpeedPickUp1Value** Level: 4 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Unfiltered speed signal from speed pickup 1
2004	**SpeedPickUp2Value** Level: 4 Range: 0…4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Unfiltered speed signal from speed pickup 2
2005	**PickUp2Or1Active** **ActivePickUp**	

	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Monitoring of speed pickups 0 = Pickup 1 active 1 = Pickup 2 active
2009	**SpeedCamIndex**	
	Level: 1 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Speed signal from camshaft index sensor
2014	**PickUpSpeedDiff**	
	Level: 1 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Current difference between 2001 *SpeedPickUp1* and 2002 *SpeedPickUp2*
2022	**SpeedGradientPickUp1**	
	Level: 4 Range: -4000…+4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Current unfiltered change in speed per second at speed pickup 1

2023	**SpeedGradientPickUp2**		
	Level: 4 Range: -4000…+4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**		Current unfiltered speed gradient per second at speed pickup 2
2025	**SpeedGradient**		
	Level: 4 Range: -4000...+4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		Current unfiltered speed gradient per second
2028	**SpeedGradientDT1**		
	Level: 4 Range: -2000...+2000 rpm/s Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 213, 213		Filtered speed gradient
2029	**PowerGradientDT1**		
	Level: 4 Range: -50…+50 %/s Page(s):**Fehler! Textmarke nicht definiert.**, 212, 213		Filtered load gradient
2031	**SpeedSetp**		
	Level: 1 Range: 0...4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		Speed setpoint determined with droop
2032	**SpeedSetpRamp**		
	Level: 1 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		Speed setpoint determined after speed ramp
2033	**SpeedSetpSelect**		

	Level: 1 Range: 0...4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Speed setpoint determined by external setpoint potentiometer or switch, such as idle speed or fixed speed
2035	**SpeedSetpLimit**	*See SAE J1939, Manual DG 06 004-e*
	Level: 1 Range: 0...4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Maximum speed
2040	**DroopOffset**	
	Level: 1 Range: -2000...+2000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Speed offset caused by droop
2041	**DigitalPotOffset**	
	Level: 1 Range: -4000...+4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Speed offset caused by digital potentiometer
2042	**GenSetOffset**	
	Level: 1 Range: -4000...+4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Speed offset due to synchronisation and power control in generator operation

2050	**SpeedVariance**		
	Level:	1	Speed variation for detection of misfires
	Range:	0...65.535	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 413		
2051	**VarianceElementx**		
ff	Level:	1	Speed variation of single element
	Range:	-32.768...32.767	x = 1..24
	Page(s):**Fehler! Textmarke nicht definiert.**		
2080	**VarianceMaxAngle**		
	Level:	1	Calculated angle with greatest variance
	Range:	0...720.0°crank	
	Page(s):		
2081	**MisfireCylinderNo**		
	Level:	1	Number of cylinder responsible for misfiring
	Range:	0...20	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2082	**MisfireCylinderAngle**		
	Level:	1	Angle of cylinder responsible for misfiring
	Range:	0...720.0°crank	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2083	**NumberOfCylinders**		
	Level:	1	Effective number of cylinders in engine, determined from ignition sequence starting from 6050 *AngleCylinder1*
	Range:	0...20	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2090	**SpeedSwitchxActive**		
ff	Level:	1	Marker that the speed threshold 90..92 *SpeedSwitchx* has been exceeded
	Range:	0/1	x = 1..3
	Page(s):**Fehler! Textmarke nicht definiert.**		

2100	**PID_CorrFactor**		
	Level:	1	Determined PID correction factor
	Range:	0...400 %	
	Page(s): **Fehler! Textmarke nicht definiert.**		
2110	**FuelSetpSpeedGov**		
	Level:	3	Fuel quantity setpoint calculated by speed governor
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2111	**FuelSetpLoadGov**		*Integrated power governor*
	Level:	3	Fuel quantity setpoint in mains operation
	Range:	0...100 %	
	Page(s): **Fehler! Textmarke nicht definiert.**		
2114	**FuelSetpUnlimited**		
	Level:	3	Unlimited fuel quantity setpoint
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2120	**DroopPresent**		
	Level:	1	Current droop used by control unit
	Range:	-100...+100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2121	**SpeedJumpActive**		
	Level:	1	Speed jump detected
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2122	**PowerJumpActive**		
	Level:	1	Load jump detected
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2130	**IMFuelSetp**		
	Level:	1	Current fuel quantity setpoint from idle / maximum speed governor after ramp
	Range:	0…100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
2131	**IMFuelSetpUnlimited**		*Speed governor*
	Level:	1	Unlimited fuel quantity setpoint from idle / maximum speed governor
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		

2132	**IMFuelSetpSelect**		
	Level:	1	Current fuel quantity setpoint from idle / maximum speed governor based on speed-dependent map / zero delivery characteristic
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
2133	**IMFuelSetpExtern**		
	Level:	1	Externally pre-set fuel quantity setpoint for idle / maximum speed governor
	Range:	0...100 %	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		

2140	**GoverningAtMaxOrIdle**		
	Level:	1	Indication of whether governing is at maximum or idle speed
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2141	**IMOrAllSpeedGov**		
	Level:	1	Indication of whether idle / maximum speed governor or variable speed governor is active
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2142	**IMFuelSetOrGovernor**		
	Level:	1	Indication of whether the fuel quantity adjuster or the speed governor is active in idle / maximum speed governor mode
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2200	**PEGasQuantity**		*Use of MVC periphery module*
	Level:	1	Currently used fuel quantity for HZM-CAN periphery module
	Range:	0...100 %	
	Page(s):	172, 365	Previously 2305
2200ff	**PEActPos(x)**		*Use of actuator periphery module*
	Level:	1	Current actuator positions of HZM-CAN periphery modules (corresponds to 2300 *ActPos* in periphery module)
	Range:	0...100 %	
	Page(s):	172, 365	x = 0..2 Previously 2305
2210ff	**PEActuatorOn(x)**		*Use of actuator periphery module*
	Level:	1	Indication of whether actuators of HZM-CAN periphery modules are enabled (corresponds to 5910 *ActuatorOn* in periphery module)
	Range:	0/1	
	Page(s):	172, 365	x: Depending on application Previously 2320
2220ff	**PEFuelSetp**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10*
	Level:	2	Injection quantity setpoints for HZM-CAN periphery modules, current values of parameters assigned from 9700 *PEFuelOut:Assign(x)*
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		Previously from 2355
2250	**EngineStartCounter**		*All except DC 1 (DC 2 with additional PCB)*
	Level:	1	Number of engine starts since operational data memory was last cancelled
	Range:	0...65535	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 380		
2300	**ActxPos**		

2302 **2303**	Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	1 0...100 %	Current actuator position x = 1..3
2305	**PEGasQuantity**		*Use of MVC periphery module*
	Level: Range: Page(s):	1 0...100 % 172	Currently used fuel quantity for of HZM-CAN periphery module Outdated, now see 2200

2305ff	**PEActPos(x)**	*Use of actuator periphery module*
	Level: 1 Range: 0...100 % Page(s): 172, 365	Current actuator positions of HZM-CAN periphery modules (corresponds to 2300 *ActPos* in periphery module) x = 0..2 Outdated, now see 2200
2320ff	**PEActuatorOn(x)**	*Use of actuator periphery module*
	Level: 1 Range: 0/1 Page(s): 172, 365	Indication of whether actuators of HZM-CAN periphery modules are enabled (corresponds to 5910 *ActuatorOn* in periphery module) x: Depending on application Outdated, now see 2210
2330	**ActxPosSetpoint**	
2331 **2332**	Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 358	Actuator travel setpoint for actuator x x = 1..3
2340	**ActPosAtZeroFuel**	
	Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	Value from the zero-fuel delivery characteristic
2341	**MinFuelAtRunEngine**	
	Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Indication of minimum injection quantity that the running engine requires (zero-fuel quantity)
2350	**FuelQuantity**	
	Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 162, 168, 196, 215, 218, 233, 233, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 358	Resulting injection quantity
2355ff	**PEFuelSetp**	*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10*

	Level:	2	Fuel quantity setpoints for HZM-CAN periphery modules, current values of parameters assigned from 9700 *PEFuelOut:Assign(x)* Outdated, now see 2220
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2360	**FuelQuantityLimited**		
	Level:	1	Limited injection quantity before fuel temperature compensation
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2380ff	**PEActuatorError(x)**		*Not XIOS*
	Level:	1	Error status of actuators on currently connected HZM-CAN periphery modules
	Range:	0…FFFF Hex	
	Page(s):	365	

2401	**CanTxBufferState**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Status of HZM-CAN device type sending buffer
	Range:	0...FFFF Hex	Bit 0: DC Bit 4: MC
	Page(s):	416	Bit 1: GC Bit 5: AC
			Bit 2: PE Bit 6: CM
			Bit 3: IM Bit 7: PC
2402	**CanRxBufferState**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Status of HZM-CAN device type receiving buffer
	Range:	0...FFFF Hex	Bits see 2401 *CanTxBufferState*
2403	**CanRxTimeout**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Status of HZM-CAN device type receiving timeout monitoring
	Range:	0..FFFF Hex	Bits see 2401 *CanTxBufferState*
2404	**CanTypeMismatch**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Status of HZM-CAN device type monitoring (double node numbers)
	Range:	0/1	Bits see 2401 *CanTxBufferState*
2405ff	**CanxOnline**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Indication that HZM-CAN controller x is initialised and there is no bus error
	Range:	0/1	x = 1..2
2406	**CanxState**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	General status of HZM-CAN CAN controller x
	Range:	0/1	x = 1..2
2410ff	**CanDCNodeState31to16** **CanxxNodeState31to16**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	HZM-CAN: Activity indicator node number 16..31
	Range:	0...FFFF Hex	xx =
			DC: Speed governor
			GC: Generator control units
			PE: Periphery modules
			IM: Inverter modules
			MC: Engine and hybrid control units
			AC: Add-on module
			CM: Customer module
			PC: PC, ARGOS, hand programmer
2411ff	**CanDCNodeState15to01** **CanxxNodeState15to01**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	HZM-CAN: Activity indicator node number 1..15
	Range:	0...FFFF Hex	xx see 2410 *CanDCNodeState31to16*
2440ff	**CanPEError(x)**		*All except XIOS* *See basic information HZM-CAN DG 13 002-d*
	Level:	1	Error indication of HZM-CAN periphery module x
	Range:	0/1	x = 0..2

2443ff	**CanACError(x)**		*All except XIOS* *See basic information HZM-CAN DG 13 002-d*
	Level:	1	Error indication of HZM-CAN add-on module x
	Range:	0/1	x = 0..4
2470ff	**PEDigitalOutx**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	1	Indication of current value of binary output x of HZM-CAN periphery modules
	Range:	0/1	x: Depending on application
2475ff	**PEPWMOutx**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	1	Indication of current value of PWM output x of HZM-CAN periphery modules
	Range:	0...100 %	x: Depending on application
2480ff	**PEAnaOutx**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	1	Indication of current value of analogue output x of HZM-CAN periphery modules
	Range:	0...100 %	x: Depending on application
2489	**PEModulesMax**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Indication of maximum number of HZM-CAN periphery modules that can be connected in this firmware version
	Range:	0...3	
2490ff	**PEModulesMaxType(x)**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Indication of maximum admissible HZM-CAN periphery modules per module type in this firmware
	Range:	0...3	x = 0..18 0 = PE 2 12 PE MVC03 1 = PE 6-07 13 PE 11 3 = PE 1-03 14 PE 10 4 = PE 1-04 15 PE 8 6 = PE MVC01 16 PE MVC04 8 = PE XIOS 18 PE 12 Only module types with a number not equal to 0 can be assigned as PE modules from 407 *CanPENodeType*
2541	**ACModulesMax**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Indication of maximum number of HZM-CAN add-on modules that can be connected in this firmware
	Range:	0...5	
2550ff	**ACModulesMaxType(x)**		*See basic information HZM-CAN DG 13 002-d*
	Level:	1	Indication of the maximum admissible HZM-CAN add-on modules for each module type in this firmware
	Range:	0...5	x = 0..1 0 = Undefined 1 = Elektra FlowControl Only module types with a number not equal to 0 can be assigned as AC modules from 435 *CanACNodeType*

2600	**ExcitationSetpoint** Level: 1 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Current excitation signal
2600	**PitchSetpoint** Level: 1 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation* Current signal for the adjustable propeller
2601	**ExcitControlLimit** Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	Current limitation of excitation signal in locomotive operation
2602	**ExcitFuelSetpoint** Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Current fuel quantity setpoint for excitation signal calculation
2602	**PitchFuelSetpoint** Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation* Current fuel quantity setpoint for calculation of adjustable propeller signal
2603	**ExcitTrPowSetpoint** Level: 1 Range: 0...x kW Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Current traction power setpoint for excitation signal calculation x: Depending on application

2605	**ExcitGovTrPowOrFuel** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 177, 182	*Locomotive operation* Indication of whether excitation signal is calculated from traction power or fuel quantity control loop
2630	**ExcitPI_CorrFactor** Level: 1 Range: 0...400 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Calculated PI correction factor for governing the excitation signal
2630	**PitchPI_CorrFactor** Level: 1 Range: 0...400 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Calculated PI correction factor for governing adjustable propeller signal
2640	**ExcitLimitMaxActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Indication of whether excitation signal is being limited
2640	**PitchLimitMaxActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Indication of whether adjustable propeller signal is being limited

2641	**ExcitFuelLimActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Indication of whether actual fuel value for calculation of excitation signal is being limited (= fuel quantity setpoint from speed control loop)
2641	**PitchSpeedLimActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Indication of whether adjustable propeller signal is being limited depending on speed
2642	**ExcitForceLim1Active** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Indication of whether excitation signal is being limited by switching function, “1st excitation signal limitation”
2642	**PitchLimitSpeed** Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Current speed-dependent limit value for adjustable propeller signal
2643	**ExcitForceLim2Active** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Indication of whether excitation signal is being limited by switching function, “2nd excitation signal limitation”
2644	**ExcitSlideLimActive** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Indication of whether excitation signal is being limited by slide protection
2645	**ExcitTempLimActive** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Indication of whether excitation signal is being limited by temperature
2646	**ExcitBoostLimActive** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Indication of whether excitation signal is being limited by boost pressure
2647	**ExcitSpeedLimActive**	*Locomotive operation*

	Level:	1	Indication of whether excitation signal is being limited depending on speed
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
2648	**ExcitTractLimActive**		*Locomotive operation*
	Level:	1	Indication of whether excitation signal is being limited depending on traction voltage or current
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
2650	**ExcitFuelLimitTemp**		*Locomotive operation*
	Level:	1	Current fuel quantity setpoint for excitation signal by temperature dependent fuel quantity reduction
	Range:	0…100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		

2655	**ExcitFuelLimitBoost**	*Locomotive operation*
	Level: 1 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**	Current fuel quantity setpoint for excitation signal by boost pressure dependent fuel quantity limitation
2656	**ExcitationLimitSpeed**	*Locomotive operation*
	Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Current speed-dependent limit value for excitation signal
2657	**ExcitationLimitVolt**	*Locomotive operation*
	Level: 1 Range: 0...x V Page(s):	Current speed-dependent limit for the traction voltage x: Depending on application
2658	**ExcitationLimitCurr**	*Locomotive operation*
	Level: 1 Range: 0...x A Page(s):	Current speed-dependent limit for the traction current x: Depending on application
2670	**ExcitTrPowLimitTemp**	*Locomotive operation*
	Level: 1 Range: 0...x kW Page (s): **Fehler! Textmarke nicht definiert.**	Temperature dependent limitation of traction power setpoint x: Depending on application
2675	**ExcitTrPowLimitBoost**	*Locomotive operation*
	Level: 1 Range: 0..x kW Page (s): **Fehler! Textmarke nicht definiert.**	Boost pressure dependent limitation of traction power setpoint x: Depending on application
2676	**ExcitTrPowLimitVolt**	*Locomotive operation*
	Level: 1 Range: 0..x kW Page (s): **Fehler! Textmarke nicht definiert.**	Current speed and traction voltage dependent limit value for traction power x: Depending on application
2677	**ExcitTrPowLimitCurr**	*Locomotive operation*
	Level: 1 Range: 0..x kW Page (s): **Fehler! Textmarke nicht definiert.**	Current speed and traction current dependent limit value for traction power x: Depending on application
2680	**EGRActive**	
	Level: 1 Range: 0/1 Page(s):	Indication that exhaust gas recirculation is active (on request)
2681ff	**EGRValveSetpoint(x)**	

	Level:	1	Exhaust gas recirculation setpoint
	Range:	0...100 %	(on request)
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		x = 0..1
2683	**InletAirActive**		
	Level:	1	Indication that inlet air throttle valve is active
	Range:	0/1	(on request)
	Page(s):		

2684	**InlAirThrottleSetp**		
	Level:	1	Inlet air throttle valve setpoint
	Range:	0...100 %	(on request)
	Page(s):		
2685	**Wastegate**		
	Level:	1	Wastegate setpoint
	Range:	0...100 %	(on request)
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
2686	**BypassValve**		
	Level:	1	Bypass valve setpoint
	Range:	0...100 %	(on request)
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
2687ff	**EGRValvePosition(x)**		
	Level:	1	Current position of EGR valve (Sonceboz)
	Range:	0...100 %	(on request)
	Page(s):		x = 0..1
2689ff	**EGRValveStatus(x)**		
	Level:	1	Current status of EGR valve (Sonceboz)
	Range:	0…255	(on request)
	Page(s):		x = 0..1
2691ff	**EGRValveFaultCode(x)**		
	Level:	1	Current error code of EGR valve (Sonceboz) (on request)
	Range:	0…255	
	Page(s):		x = 0..1
2701	**FuelLimitMax**		
	Level:	1	Current upper fuel limit
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2702	**FuelLimitStart**		
	Level:	1	Current fuel limit by starting fuel limitation
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
2703	**FuelLimitSpeed**		
	Level:	1	Current fuel quantity limit using speed dependent fuel quantity limitation
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 220		
2704	**FuelLimitBoost**		

	Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Current fuel quantity limit using boost pressure dependent fuel quantity limitation
2705	**FuelLimitForced**	
	Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Current fuel limit by external specification

2706	**FuelLimitPower** Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, 225	*Not XIOS* Current fuel limit by power limitation *XIOS see 2727 FuelLimitPower*
2706	**FuelRedCoolantTemp** Level: 1 Range: 0...100 % Page(s): 96	*XIOS* Current reduction value for speed dependent fuel quantity limitation using coolant temperature
2707	**FuelRedChargeAirTemp** Level: 1 Range: 0...100 % Page(s): 97	*XIOS* Current reduction value for speed dependent fuel quantity limitation using charge air temperature
2708	**FuelRedFuelTemp** Level: 1 Range: 0…100 % Page(s): 97	*XIOS* Current reduction value for speed dependent fuel quantity limitation using fuel temperature
2709	**FuelRedAmbientPress** Level: 1 Range: 0…100 % Page(s): 98	*XIOS* Current reduction value for speed dependent fuel quantity limitation using ambient pressure
2710	**FuelLimitMinActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 377	Indication of whether fuel is at lower limit
2711	**FuelLimitMaxActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 211, 219, **Fehler! Textmarke nicht definiert.**, 377	Indication of whether fuel is at upper limit
2712	**StartLimitActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Indication of whether fuel is limited by starting fuel limitation
2713	**SpeedLimitActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 220	Indication of whether fuel quantity is limited by speed-dependent fuel quantity limitation

2714	**BoostLimitActive**		
	Level:	1	Indication of whether fuel quantity is limited by boost pressure dependent fuel quantity limitation
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376		
2715	**ForcedLimitActive**		
	Level:	1	Indication of whether fuel is limited by switching function “SwitchForcedLimit”
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 222		

2716	**PowerLimitActive** Level: 1 Range: 0/1 Page(s): 221	*Not XIOS* Indication of whether fuel is limited depending on power *XIOS see 2728 PowerLimitActive*
2716	**CoolantTempRedActive** Level: 1 Range: 0/1 Page(s): 95	*XIOS* Indication of whether speed-dependent fuel quantity limitation is reduced using coolant temperature
2717	**ChAirTempRedActive** Level: 1 Range: 0/1 Page(s): 95	*XIOS* Indication of whether speed-dependent fuel quantity limitation is reduced using charge air temperature
2718	**FuelTempRedActive** Level: 1 Range: 0/1 Page(s): 95, 97	*XIOS* Indication of whether speed-dependent fuel quantity limitation is reduced using fuel temperature
2719	**AmbPressRedActive** Level: 1 Range: 0/1 Page(s): 95, 98	*XIOS* Indication of whether speed-dependent fuel quantity limitation is reduced using ambient pressure
2720	**FuelLimitExtActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Indication of whether fuel is limited by external specification
2721	**AsymmLoadLimitActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Indication of whether fuel is limited by asymmetric load
2722	**FuelLimitAsymmLoad** Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Current fuel limit by starting asymmetric load limitation
2724	**NearFuelLimitActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Indication that the engine is being operated at the power limit
2725	**FuelRedExhaustTemp**	*XIOS*

	Level:	1	Current reduction value for speed-dependent fuel quantity limitation using exhaust temperature
	Range:	0...100 %	
	Page(s):	98	
2726	**ExhaustTempRedActive**		XIOS
	Level:	1	Indication of whether speed-dependent fuel quantity limitation is reduced using exhaust temperature
	Range:	0/1	
	Page(s):	95, 98	

2727	**FuelLimitPower** Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, 225	*XIOS* Current fuel limit by power limitation *Otherwise see 2705 FuelLimitPower*
2728	**PowerLimitActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, 226	*XIOS* Indication of whether fuel is limited depending on power *Otherwise see 2716 PowerLimitActive*
2730	**SetpLimitExtActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Indication of whether speed setpoint is limited by external specification 2035 *SpeedSetpLimit*
2750	**FuelTempCorrOffset** Level: 1 Range: -100...+100 % Page(s):**Fehler! Textmarke nicht definiert.**	*XIOS* Fuel temperature dependent target quantity correction: offset evaluated with factor
2751	**FuelTempCorrMap** Level: 1 Range: -100...+100 % Page(s):**Fehler! Textmarke nicht definiert.**	*XIOS* Fuel temperature dependent target quantity correction Correction offset from map
2810	**SwitchEngineStop** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 232, 248, 251, 256, 259, 364, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	State of “Engine stop” switching function
2811	**SwitchIdleSpeed** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249	State of “Idle speed” switching function
2812	**SwitchDroop2Or1**	

	Level:	1	State of switching function "Droop 1/2" 1 = Droop2 or Droop on 0 = Droop1 or Droop off
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		
2813	**SwitchForcedLimit**		
	Level:	1	State of "Load limitation" switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 221, 227, 249		
2814	**SwitchSpeedRange2Or1**		
	Level:	1	State of switching function "Speed range 1/2" 1 = SpeedRange2 0 = SpeedRange1
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		

2815	**SwitchSpeedFix1**		
	Level:	1	State of "Fixed speed 1" switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249, 253		
2816	**SwitchSpeedFix2**		
	Level:	1	State of "Fixed speed 2" switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		
2817	**SwitchSpeedLimit2Or1**		
	Level:	1	State of "SpeedLimit 1/2" switching function
	Range:	0/1	1 = SpeedLimit2
	Page(s): **Fehler! Textmarke nicht definiert.**, 249		0 = SpeedLimit1
2818	**SwitchKnock**		*Generator operation*
	Level:	1	State of "Knocking" switching function in generator operation
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		
2818	**SwitchSlide**		*Locomotive operation*
	Level:	1	State of "Sliding wheels" switching function in locomotive operation
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 249		
2819	**SwitchNotch3**		
	Level:	1	State of "Speed notch 3" switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 249		
2820	**SwitchNotch2**		
	Level:	1	State of "Speed notch 2" switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 249		
2821	**SwitchNotch1**		*Locomotive operation*
	Level:	1	State of "Speed notch 1" switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 249		
2821	**SwitchBackwards**		*Marine operation*

	Level:	1	State of “Backwards” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		
2822	**SwitchNotch0**		
	Level:	1	State of “Speed notch 0” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 249		
2822	**SwitchForwards**		*Marine operation*
	Level:	1	State of “Forwards” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		

2823	**SwitchExcitLimit1**		
	Level:	1	State of “1st excitation signal limitation” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 249		
2824	**SwitchExcitLimit2**		
	Level:	1	State of "2nd excitation signal limitation” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 249		
2825	**SwitchSpeedInc**		
	Level:	1	State of “Speed increase (Up)” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		
2826	**SwitchSpeedDec**		
	Level:	1	State of “Speed decrease (Down)” switching function
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		
2827	**SwitchSetpoint2Or1**		

	Level:	1	State of “Speed setpoint adjuster 1/2” switching function 1 = Setpoint2 0 = Setpoint1
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 249		
2828	**SwitchErrorReset**		
	Level:	1	State of “Error reset” switching function
	Range:	0/1	
	Page(s):	250, 373	
2829	**SwitchFreezeSetp1**		
	Level:	1	State of “Freeze setpoint 1” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250		
2830	**SwitchFreezeSetp2**		
	Level:	1	State of “Freeze setpoint 2” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250		
2831	**SwitchIMOrAllSpeed**		Previously *SwitchGovernorMode*
	Level:	1	State of “IMOrAllSpeed” switching function 1 = Idle / maximum speed governor 0 = Variable speed governor
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250		
2833	**SwitchForcedStart**		
	Level:	1	State of “Forced actuator opening when engine is still” switching function
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 250, 364		

2834	**SwitchSyncEnable**		
	Level:	1	State of “Synchronization enabled” switching function
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250		
2835	**SwitchLoadEnable**		
	Level:	1	State of “Load control enabled” switching function
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250		
2836	**SwitchAutoOrManual**		
	Level:	1	State of “Switch generator operation” switching function
	Range:	0/1	1 = Automatic operation
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250		0 = Manual operation
2837	**SwitchGasOrDiesel**		*Dual fuel*
	Level:	1	State of “Switch gas / diesel operation” switching function
	Range:	0/1	1 = Dual fuel operation
	Page(s):	174, 175, 178, 182, 213, 232, 250	0 = Diesel operation
2838	**SwitchFastToDiesel**		*Dual fuel*
	Level:	1	State of “Fast switch back to diesel” switching function
	Range:	0/1	
	Page(s):	174, 175, 178, 210, 232, 250	

2839	**SwitchGasPosState**	*Dual fuel*
	Level: 1	State of “Gas positioner OK” switching function
	Range: 0/1	
	Page(s): 203, 250	
2840	**SwitchExcitationOn**	
	Level: 1	State of “Excitation signal” switching function
	Range: 0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 250	
2840	**SwitchPitchOn**	
	Level: 1	State of “Adjustable propeller signal” switching function
	Range: 0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 250	
2841	**SwitchLowIdleOn**	*Locomotive operation*
	Level: 1	State of “Low idle speed” switching function
	Range: 0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 250	
2841	**SwitchMasterOrSlave**	*Marine operation twin-engine system*
	Level: 1	State of “Master or Slave” switching function
	Range: 0/1	1 = Master
	Page(s):**Fehler! Textmarke nicht definiert.**, 250	0 = Slave

2842	**SwitchPID2Or1** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, 250	*Generator operation* State of “PID parameter set 2 or 1” switching function 1 = PID set 2 0 = PID set 1
2842	**SwitchLoadTransfer** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250	*Marine operation twin-engine system* State of “Load transfer” switching function
2842	**SwitchCommand** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, 250	*Marine operation multi-engine system* State of “Command” switching function
2843	**SwitchClutch** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250	*Marine operation twin-engine system* State of “Clutch” switching function
2843	**SwitchSynchro** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, 250	*Marine operation multi-engine system* State of “Synchro” switching function
2844	**SwitchAsymLoadEnable** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 250	*Marine operation twin-engine system* State of “Asymmetric load” switching function
2844	**SwitchEngineRelease** Level: 1 Range: 0/1 Page:**Fehler! Textmarke nicht definiert.**, 250	*Dual fuel, not XIOS* State of “Start enable” switching function
2845	**SwitchAutoAdjust** Level: 1 Range: 0/1 Page(s): 250, 354	State of “Automatic actuator calibration” switching function
2845	**SwitchGasPressReady** Level: 1 Range: 0/1 Page(s): 177, 179, 195, 250	*Dual fuel, not XIOS* State of “Gas pressure built up” switching function *XIOS see 2870*
2846	**SwitchGenBreaker**	

	Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 178, 236, 250	State of “Breaker” switching function Generator or mains breaker
2847	**SwitchAlternator**	*XIOS*
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, 250	State of “Alternator signal” switching function

2847	**SwitchExternGasAlarm** Level: 1 Range: 0/1 Page(s): 175, 178, 201, 210, 250	*Dual fuel, not XIOS* State of “External gas alarm” switching function *XIOS see 2871*
2848	**SwitchExternGasReady** Level: 1 Range: 0/1 Page(s): 179, 184, 251	*Dual fuel, not XIOS* State of “External gas ready” switching function *XIOS see 2872*
2849	**SwitchStartEngine** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, 251	*DC 5, XIOS* State of “Engine start” switching function
2849	**SwitchEmergencyStop** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, 174, 178, 251, **Fehler! Textmarke nicht definiert.**	*Dual fuel, not XIOS* State of “Emergency shutdown” switching function *XIOS see 2873*
2870	**SwitchGasPressReady** Level: 1 Range: 0/1 Page(s): 177, 251	*Dual fuel, XIOS* State of “Gas pressure built up” switching function *Otherwise see 2845*
2871	**SwitchExternGasAlarm** Level: 1 Range: 0/1 Page(s): 175, 201, 210, 251	*Dual fuel, XIOS* State of “External gas alarm” switching function *Otherwise see 2847*
2872	**SwitchExternGasReady** Level: 1 Range: 0/1 Page(s): 184, 210, 251	*Dual fuel, XIOS* State of “External gas ready” switching function *Otherwise see 2848*
2873	**SwitchEmergencyStop** Level: 1 Range: 0/1 Page(s): 174, 251, 251	*Dual fuel, XIOS* State of “Emergency shutdown” switching function *Otherwise see 2849*
2851ff	**DigitalOutx** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10* State of binary output x: DC 1-03: 1..3 DC 6: 1..2 DC 1-04: 1..5 DC 7: 1..7 DC 2: 1..5 DC 9: 1 DC 5: 1..11 DC 10: 1
2900	**Setpoint1Extern**	

Level: 1 Current value of speed setpoint adjuster 1
Range: 0...100 %
Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**,
Fehler! Textmarke nicht definiert., **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 234

2901	**Setpoint2Extern**		
	Level:	1	Current value of speed setpoint adjuster 2
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 234		
2902	**LoadControlInput**		
	Level:	1	Current load control input value
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 234, 239		
2903	**SyncInput**		
	Level:	1	Current synchronizing signal value
	Range:	0…100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 234, 239		
2904	**BoostPressure** **BoostPressure1**		

	Level: 1 Range: 0…5 bar Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 193, 231, 234		Current (first or only) boost pressure value
2905	**OilPressure**		
	Level: 1 Range: 0...20 bar Page(s): **Fehler! Textmarke nicht definiert.**, 192, 234		Current oil pressure value
2906	**AmbientPressure**		
	Level: 1 Range: 0…2000 mbar Page(s): 98, 234		Current ambient pressure value
2907	**CoolantTemp**		
	Level: 1 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 96, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 189, 229, 234		Current coolant temperature value
2908	**ChargeAirTemp**		
	Level: 1 Range: -100...+1000 °C Page(s): 97, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 190, 228, 235		Current charge air temperature value
2909	**OilTemp**		
	Level: 1 Range: -100...+1000 °C Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 235		Current oil temperature value
2910	**FuelTemp**		
	Level: 1 Range: -100...+1000 °C Page(s): 97, **Fehler! Textmarke nicht definiert.**, 235		Current fuel temperature value
2910	**GasTemp**		*Dual fuel, not XIOS*

	Level: 1 Range: -100...+1000 °C Page(s): 191, 230, 235	Current gas temperature value *XIOS see 2926*
2911	**ExhaustTemp** Level: 1 Range: -100…+1000 °C Page(s): 97, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 186, 229, 235	Current exhaust temperature value
2911	**ExhaustTempMax** Level: 1 Range: -100...+1000 °C Page(s): 97, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 186, 229, 235	*Dual fuel, not XIOS* Maximum exhaust temperature value *XIOS see 12573*
2912	**ExhaustTempMin** Level: 1 Range: -100...+1000 °C Page(s): 187	*Dual fuel, not XIOS* Minimum exhaust temperature value *XIOS see 12572*
2913	**ExhaustTempAverage** Level: 1 Range: -100...+1000 °C Page(s): 187, 229	*Dual fuel, not XIOS* Average exhaust temperature value *XIOS see 12570*
2914	**SlideExcitReduction** Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, 235	Current value for reduction of excitation signal for slide protection in locomotive operation
2915	**SlideSpeedReduction** Level: 1 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, 235	Current value for reduction of speed setpoint for slide protection in locomotive operation
2915	**AlternatorVoltage** Level: 1 Range: 0...37.2 V Page(s):**Fehler! Textmarke nicht definiert.**, 235	*DC 5* Current alternator voltage value *XIOS see 2936*
2916	**CoolantPressure** Level: 1 Range: 0...5 bar Page(s):**Fehler! Textmarke nicht definiert.**, 235	*Locomotive operation* Current value of coolant pressure
2916	**GasPosition**	*Dual fuel, not XIOS*

	Level: 1 Range: 0…100 % Page(s): 203, 235	Current gas position value (external actuator with connection via analogue or PWM input and output) *XIOS see 2927*
2917	**AsymmetricLoad** Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 235	*Marine operation twin-engine system* Current value of asymmetric load
2918	**MeasuredPower** Level: 1 Range: 0…100 % or 0…x kW Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 160, 221, 225, 235, 242	*Generator operation* Current power signal value x: Depending on application
2918	**TractionVoltage** Level: 1 Range: 0…x V Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 166, 235	*Locomotive operation* Current traction voltage value x: Depending on application
2919	**PowerSetpoint** Level: 1 Range: 0…100 % or 0…x kW Page(s):**Fehler! Textmarke nicht definiert.**, 235, 242	*Generator operation* Current power setpoint signal value x: Depending on application
2919	**TractionCurrent** Level: 1 Range: 0...x A Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 166, 235	*Locomotive operation* Current traction current value x: Depending on application
2920	**TurboOilTemp** Level: 1 Range: -100…1000 °C Page(s):**Fehler! Textmarke nicht definiert.**, 235	Current value of turbocharger oil temperature
2921	**FuelPressure**	

	Level:	1	Current value of fuel pressure
	Range:	0…10 bar	
	Page(s):**Fehler! Textmarke nicht definiert.**, 236		
2921	**GasRailPressure**		*Dual fuel, not XIOS*
	Level:	1	Current gas rail pressure value
	Range:	0…10 bar	*XIOS see 2928*
	Page(s):	230, 232, 236	
2922	**OilLevel**		
	Level:	1	Current oil level value
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, 236		
2923	**FuelLimitExtern**		
	Level:	1	Current external fuel quantity limitation value
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 236		
2924	**TransmissionOilPress**		
	Level:	1	Current transmission oil pressure value
	Range:	0...40 bar	
	Page(s):**Fehler! Textmarke nicht definiert.**, 236		

2925	**AirMass**		
	Level:	1	Current air mass sensor value
	Range:	0..1000 kg/h	
	Page(s):	236	
2925	**GasDiffPressure**		*Dual fuel, not XIOS*
	Level:	1	Gas differential pressure, relative gas pressure
	Range:	0...10 bar	
	Page(s):	179, 194, 237	*XIOS see 2942*
2926	**GasTemp**		*Dual fuel, XIOS*
	Level:	1	Current gas temperature value
	Range:	-100...+1000 °C	
	Page(s):	191, 230, 236	*Otherwise see 2910*
2927	**GasPosition**		*Dual fuel, XIOS*
	Level:	1	Current gas position value (external actuator with
	Range:	0...100 %	connection via analogue or PWM input and output)
	Page(s):	203, 236	*Otherwise see 2916*
2928	**GasRailPressure**		*Dual fuel, XIOS*
	Level:	1	Current gas rail pressure value
	Range:	0...10 bar	
	Page(s):	230, 236	*Otherwise see 2921*
2931	**BoostPressure2**		
	Level:	1	Current value of second boost pressure sensor
	Range:	0...5 bar	
	Page(s):**Fehler! Textmarke nicht definiert.**, 236		
2932	**Lambda1**		
	Level:	1	Current value of first lambda sensor
	Range:	0...30	
	Page(s):	236	
2933	**Lambda2**		
	Level:	1	Current value of second lambda sensor
	Range:	0...30	
	Page(s):	236	
2934	**NOx**		
	Level:	1	Current nitrogen oxide content value
	Range:	0…5000 ppm	
	Page(s):	236	
2935	**O2**		
	Level:	1	Current oxygen content value
	Range:	0…100 %	
	Page(s):	236	
2936	**AlternatorVoltage**		*XIOS*
	Level:	1	Current alternator voltage value
	Range:	0…36 V	
	Page(s):**Fehler! Textmarke nicht definiert.**, 236		*DC 5: see 2915*

2940	**BoostPressRelative**		
	Level:	1	Relative boost pressure
	Range:	0...5 bar	
	Page(s):	237	
2941	**AbsoluteAltitude**		
	Level:	1	Height above sea level
	Range:	-5000...+5000 m	
	Page(s):	237	
2942	**GasDiffPressure**		*Dual fuel, XIOS*
	Level:	1	Gas differential pressure, relative gas pressure
	Range:	0...10 bar	
	Page(s):	194, 237	*Not XIOS see 2925*
2943	**LambdaCalculated**		
	Level:	1	Lambda (calculated from 2935 *O2*)
	Range:	0...30	
	Page(s):	237	
3000	**ConfigurationError**		
	Level:	1	Displays configuration errors
	Range:	0…65535	
	Page(s): 297, **Fehler! Textmarke nicht definiert.**, 421, **Fehler! Textmarke nicht definiert.**		
3001	**ErrPickup1**		
	Level:	1	Error indication for speed sensor 1
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 377, **Fehler! Textmarke nicht definiert.**, 409, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3002	**ErrPickup2**		

	Level:	1	Error indication for speed sensor 21
	Range:	0/1 or 0000..FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 378, **Fehler! Textmarke nicht definiert.**, 409, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3003	**ErrCamIndex**		
	Level:	1	Error indication for camshaft sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3004	**ErrOverSpeed**		
	Level:	1	Error indication for overspeed
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 410, **Fehler! Textmarke nicht definiert.**		

3005	**ErrSetpoint1Extern**		
	Level:	1	Error indication for speed setpoint adjuster 1
	Range:	0/1 or 0000...FFFF Hex	
	Page(s): 411, **Fehler! Textmarke nicht definiert.**		
3006	**ErrSetpoint2Extern**		
	Level:	1	Error indication for speed setpoint adjuster 2
	Range:	0/1 or 0000...FFFF Hex	
	Page(s): 411, **Fehler! Textmarke nicht definiert.**		
3007	**ErrLoadCtrlInput**		
	Level:	1	Error indication for load control input
	Range:	0/ or 0000...FFFF Hex	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		
3008	**ErrSyncInput**		
	Level:	1	Error indication for synchronizing signal
	Range:	0/1 0000..FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		
3009	**ErrBoostPressure(1)**		
	Level:	1	Error indication for first or only boost pressure sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s): 411, **Fehler! Textmarke nicht definiert.**		
3010	**ErrOilPressure**		
	Level:	1	Error indication for oil pressure sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, 193, **Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		
3011	**ErrAmbientPressure**		

	Level:	1	Error indication for ambient pressure sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s): 411, **Fehler! Textmarke nicht definiert.**		
3012	**ErrCoolantTemp**		
	Level:	1	Error indication for coolant temperature sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		
3013	**ErrChargeAirTemp**		
	Level:	1	Error indication for charge air temperature sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		

3014	**ErrOilTemp**		
	Level:	1	Error indication for oil temperature sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		
3015	**ErrFuelTemp**		
	Level:	1	Error indication for fuel temperature sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		
3015	**ErrGasTemp**		*Dual fuel, not XIOS*
	Level:	1	Error indication for gas temperature sensor
	Range:	0/1	*XIOS see 13071*
	Page(s):**Fehler! Textmarke nicht definiert.**		
3016	**ErrExhaustTemp**		
	Level:	1	Error indication for exhaust temperature sensor
	Range:	0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		
3019	**ErrExcitReduct**		
	Level:	1	Error indication for reduction value for excitation signal for slide protection in locomotive operation
	Range:	0/1 or 0000...FFFF Hex	
	Page(s): 411, **Fehler! Textmarke nicht definiert.**		
3020	**ErrSpeedReduct**		*Locomotive*
	Level:	1	Error indication for reduction value for speed setpoint for slide protection in locomotive operation
	Range:	0/1 or 0000...FFFF Hex	
	Page(s): 411, **Fehler! Textmarke nicht definiert.**		
3020	**ErrAlternator**		*DC 5, vehicle*
	Level:	1	Error indication for alternator
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3021	**ErrCoolantPressure**		

	Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s): 411, **Fehler! Textmarke nicht definiert.**	Error indication for coolant pressure sensor
3021	**ErrGasPosition** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Dual fuel, not XIOS* Error indication for external gas position *XIOS see 13072*
3022	**ErrAsymmetricLoad** Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s): 411, **Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Error indication for asymmetric load
3023	**ErrMeasuredPower** Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Generator operation* Error indication for measured power
3023	**ErrTractionVoltage** Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s): 411, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Error indication for traction voltage
3024	**ErrPowerSetpoint** Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**	*Generator operation* Error indication for power setpoint sensor
3024	**ErrTractionCurrent** Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s): 411, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Error indication for traction current
3025	**ErrTurboOilTemp**	

	Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		Error indication for turbocharger oil temperature sensor
3026	**ErrFuelPressure**		
	Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		Error indication for fuel pressure sensor
3026	**ErrGasRailPressure**		*Dual fuel, not XIOS*
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**		Error indication for gas pressure sensor *XIOS see 13073*
3027	**ErrOilLevel**		
	Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**		Error indication for oil level sensor
3028	**ErrFuelLimitExtern**		
	Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s): 411, **Fehler! Textmarke nicht definiert.**		Error indication for external fuel quantity limitation sensor

3029	**ErrTransOilPressure**	
	Level: 1	Error indication for transmission oil pressure sensor
	Range: 0/1 or 0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, 411, **Fehler! Textmarke nicht definiert.**	
3030	**ErrOilPressWarn**	*All except XIOS*
	Level: 1	Indication of oil pressure warning
	Range: 0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 193, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 573	
3031	**ErrOilPressEcy**	*All except XIOS*
	Level: 1	Indication of oil pressure emergency shutdown
	Range: 0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	
3032	**ErrCoolantTempWarn**	*All except XIOS*
	Level: 1	Indication of coolant temperature warning
	Range: 0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	
3033	**ErrChargeAirTempWarn**	*All except XIOS*
	Level: 1	Indication of charge air temperature warning
	Range: 0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	
3034	**ErrOilTempWarn**	*All except XIOS*
	Level: 1	Indication of oil temperature warning
	Range: 0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	

3040	**ErrAlternatorWarn** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*DC 5* Indication of alternator warning
3041	**ErrExhaustTempWarn** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*All except XIOS* Indication of exhaust temperature warning
3043	**ErrACCommonAlarm** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*All except XIOS* Indication of common alarms in one of the add-on modules
3044	**ErrCoolPressWarn** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*All except XIOS* Indication of coolant pressure warning
3045	**ErrFailedToStart** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Vehicle operation (DC 5)* Indication of start abort
3045	**ErrCoolPressIdle** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation (all except XIOS)* Indication of forced idle speed due to low coolant pressure
3045	**ErrPowerPercentCan** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Generator operation (all except XIOS)* The relative power was either not received via the HMZ-CAN bus or a sensor error has occurred on the sender side.
3046	**ErrMisfireWarn** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, 175	*Generator operation (all except XIOS)* Indication of misfire warning

3047	**ErrMisfireDetection** Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 175, 180, **Fehler! Textmarke nicht definiert.**, 413	*Generator operation (XIOS)* Indication of errors due to misfiring
3047	**ErrMisfireEcy** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, 175, 180, **Fehler! Textmarke nicht definiert.**	*Generator operation (all except XIOS)* Indication of emergency shutdown due to misfiring
3048	**ErrPowerGovernor** Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 414	*Generator operation (XIOS)* Indication of errors in integrated power governor
3048	**ErrPowerDifference** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Generator operation (all except XIOS)* Excessive difference between power setpoint and measured power
3048	**ErrTwinEngine** Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 413, **Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Error in master / slave operation
3048	**ErrVelocity** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Vehicle or locomotive operation (all except XIOS)* Error in velocity measurement
3049	**ErrPECommonAlarm** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*All except XIOS* At least one of the HZM-CAN periphery modules is reporting a common alarm See 2440 *CanPEError(x)* for more detailed information
3050 **3051** **3052**	**ErrActuatorx** Level: 1 Range: 0...FFFF Hex Page(s): 202, 355, 357, **Fehler! Textmarke nicht definiert.**	*XIOS* Error on actuator x x = 1..3

3050	**ErrFeedbackx**	*All except XIOS (3051/3052 only DC 1-04)*
3051 **3052**	Level: 1 Range: 0/1 Page(s): 357, 376, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error in feedback from actuator x x = 1..3
3053	**ErrActuatorDiffx**	*All except XIOS (3054/3055 only DC 1-04)*
3054 **3055**	Level: 1 Range: 0/1 Page(s): 376, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Too great a difference in set actuator travel and actual actuator travel in actuator x x = 1..3
3056	**ErrFeedbackRef**	*DC 2, DC 5, DC 6, DC 7, DC 9, DC 10, DC 12*
	Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error in reference value for digital actuator feedback
3057	**ErrBrakeStatus**	*DC 1, control unit with brake function*
	Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error in brake status
3059	**ErrFeedbackAdjustx**	*All except XIOS (3060/61 only DC 1-04)*
3060 **3061**	Level: 1 Range: 0/1 Page(s): 355, 376, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error during auto-adjustment of actuator x or input of feedback reference values x = 1..3
3060	**ErrAmplifier**	*All except DC 1, DC 2, and XIOS*
	Level: 1 Range: 0/1 Page(s): 364, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error indication for amplifier
3070ff	**ErrCanBusx**	

	Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 202, 413, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error indication for CAN bus x = 1..2
3071ff	**ErrHzmCanCommx**	*HZM-CAN*
	Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 202, 413, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error indication for CAN communication See 2401 *CanTxBufferState*, 2402 *CanRxBufferState*, 2403 *CanRxTimeout* and 2404 *CanTypeMismatch* *x = 1..2*
3071	**ErrWagoCanComm**	*WAGO, not XIOS*
	Level: 1 Range: 0/1	Error indication for WAGO-CAN communication without HZM-CAN communication, *Otherwise 23013* *XIOS see 23013*
3071	**ErrCANopenComm**	*CANopen, not XIOS*
	Level: 1 Range: 0/1	Error indication for CANopen communication without HZM-CAN communication, *others 23000* *XIOS see 23000*

3071	**ErrIceniCanComm** Level: 1 Range: 0/1		*ICENI, not XIOS* Error indication for ICENI-CAN communication without HZM-CAN communication, *others 23015* *XIOS see 23015*
3071	**ErrSAEJ1939Comm** Level: 1 Range: 0/1		*SAE J1939, not XIOS* Error indication for SAE J1939-CAN communication
3071	**ErrDeviceNetComm** Level: 1 Range: 0/1		*DeviceNet, not XIOS* Error indication for DeviceNet-CAN communication
3074	**ErrModbusComm** Level: 1 Range: 0/1		*Modbus, not XIOS* Error indication for Modbus communication *XIOS see 23001*
3075	**ErrACFatalError** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**		*DC 5* Error indication for fatal error in one of the add-on modules
3075	**ErrClearFlash** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		*DC 1, DC 2* Error indication for clearing the read-only memory
3076	**ErrParamStore** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		Error indication for programming the read-only memory
3077	**ErrProgramTest** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		Error indication for checking the checksum for the firmware program
3078	**ErrRAMTest** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		Error indication for the RAM test
3080 ff			*Hardware-specific errors are described in the associated subchapters*

3080	**ErrACFatalError** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*DC 10* Error indication for fatal error in one of the add-on modules
3084	**ErrACFatalError** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*DC 1*, *DC 2*, *DC 6. DC 7*, *DC 12* Error indication for fatal error in one of the add-on modules

3087	**ErrMainCheckSum**		*(only visible in boot loader)*
	Level:	1	Checksum for control unit program is wrong
	Range:	0/1	
	Page(s): 382, **Fehler! Textmarke nicht definiert.**		
3087	**ErrEEPROM**		*XIOS*
	Level:	1	Indication of erroneous E^2PROM pages
	Range:	0000...FFFF Hex	*Otherwise see 3099 EEPROMErrorCode*
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 418, **Fehler! Textmarke nicht definiert.**, 527		
3088	**ErrACFatalError**		*DC 11*
	Level:	1	Error indication for fatal error in one of the HZM-CAN add-on modules
	Range:	0/1	
	Page(s):		
3089	**ErrPEFatalError**		
	Level:	1	Error indication for fatal error in one of the HZM-CAN periphery modules
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3089	**ErrWatchdog**		*(only visible in boot loader)*
	Level:	1	Internal so-called “Watchdog error”
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 382, **Fehler! Textmarke nicht definiert.**		
3090	**ErrData**		
	Level:	1	Error indication for the data record
	Range:	0/1	
	Page(s): 376, **Fehler! Textmarke nicht definiert.**		
3091	**ErrEngine**		*XIOS*
	Level:	1	Error indication for engine (alternator, starter)
	Range:	0000..FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, 420		
3092	**ErrConfiguration**		
	Level:	1	Configuration errors
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 421, **Fehler! Textmarke nicht definiert.**		
3093	**ErrStack**		

	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error indication for the "Stack Overflow" error
3094	**ErrIntern**	
	Level: 1 Range: 0/1 or 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**, 421, **Fehler! Textmarke nicht definiert.**	Error indication for internal software error further information from 3095/3195
3095	**ExceptionNumber**	*DC 1, DC 2*
	Level: 1 Range: 0...255 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error number for software error
3096	**ExceptionAddr1High**	*DC 1, DC 2*
	Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**	Upper extended error number 1 for software error
3097	**ExceptionAddr1Low**	*DC 1, DC 2*
	Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**	Lower extended error number 1 for software error
3098	**ExceptionAddr2High**	*DC 1, DC 2*
	Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**	Upper extended error number 2 for software error
3099	**ExceptionAddr2Low**	*DC 1, DC 2*
	Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Lower extended error number 2 for software error
3099	**EEPROMErrorCode**	*All except DC 1, DC 2, and XIOS*

	Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Indication of erroneous E^2PROM pages *XIOS see 3087ErrEEPROM*
3101 **…** **3194**	**SErr...** Level: 1 Range: 0/1 or 0...255	*All except XIOS* Error marker / error counter Related current errors see 3001 ff
3190	**ExceptionNumber** Level: 1 Range: 0000…FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 421	*XIOS* Error marker: Error number for software error
3191	**ExceptionAddr1High** Level: 1 Range: 0000...FFFF Hex Page(s): 421	*XIOS* Error marker: Upper extended error number 1 for software error
3192	**ExceptionAddr1Low** Level: 1 Range: 0000...FFFF Hex Page(s): 421	*XIOS* Error marker: Lower extended error number 1 for software error
3193	**ExceptionAddr2High** Level: 1 Range: 0000...FFFF Hex Page(s): 421	*XIOS* Error marker: Upper extended error number 2 for software error
3194	**ExceptionAddr2Low** Level: 1 Range: 0000...FFFF Hex Page(s): 421	*XIOS* Error marker: Lower extended error number 2 for software error

3195	**ExceptionInfo1High** Level: 1 Range: 0000...FFFF Hex Page(s): 421	*XIOS* Error marker: Upper error identifier 1 for software error
3195ff	**SException...** Level: 1 Range: 0...1 or 0...255 Page(s):**Fehler! Textmarke nicht definiert.**	*DC 1 and DC 2* Error marker Related current errors see 3095 ff
3195	**SExceptionNumber** Level: 1 Range: 0...255 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*All except DC 1, DC 2, and XIOS* Error number for software error
3196	**SExceptionAddrLow** Level: 1 Range: 0000…FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**	*All except DC 1, DC 2, and XIOS* Error marker: Lower extended error number for software error
3196	**ExceptionInfo1Low** Level: 1 Range: 0000...FFFF Hex Page(s): 421	*XIOS* Error marker: Lower error identifier 1 for software error
3197	**SExceptionAddrHigh** Level: 1 Range: 0000…FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**	*All except DC 1, DC 2, and XIOS* Error marker: Upper extended error number for software error
3197	**ExceptionInfo2High** Level: 1 Range: 0000…FFFF Hex Page(s): 421	*XIOS* Error marker: Upper error identifier 2 for software error
3198	**SExceptionFlag** Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**	*All except DC 1, DC 2, and XIOS* Error marker: Error identifier for software error
3198	**ExceptionInfo2Low** Level: 1 Range: 0000…FFFF Hex Page(s): 421	*XIOS* Error marker: Lower error identifier 2 for software error
3200	**GenCtrlMainsOrIsland**	

	Level:	1	0: Island operation
	Range:	0/1	1: Mains parallel operation
	Page(s): **Fehler! Textmarke nicht definiert.**		in generator sets
3201	**GenCtrlAutoOrManual**		
	Level:	1	0: Manual mode
	Range:	0/1	1: Automatic mode
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		in generator sets

3231	**RelativePowerSetp** Level: 1 Range: 0...200 % Page(s): 243	*Generator operation, integrated power governor* Power setpoint relative to nominal power 1232 *RatedPower*
3231	**TractionPower** Level: 1 Range: 0...x kW Page(s):**Fehler! Textmarke nicht definiert.**, 160, 166, 186, 193, 225, 237	*Locomotive operation* Traction power x: Depending on application
3231	**EnginePower** Level: 1 Range: 0…x kW Page(s): 169	*Dual fuel Marine operation* Engine power x: Depending on application
3232	**RelativePower** Level: 1 Range: 0...200 % Page(s):**Fehler! Textmarke nicht definiert.**, 160, 185, 193, 243	*Generator operation* Relative power in relation to nominal power 1232 *RatedPower*
3232	**RelativTractionPower** Level: 1 Range: 0...200 % Page(s):**Fehler! Textmarke nicht definiert.**, 167	*Locomotive operation* Relative traction power in relation to maximum traction power 1232 *TractionPowerHigh*
3233	**PowerSetpEffective** Level: 1 Range: 0...200 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Integrated power governor* Effective power setpoint after ramp
3234	**GovernorPowerOrSpeed** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Integrated power governor* Power governor is active (1) or not active (0)
3235	**PowerPIDCorrFactor** Level: 1 Range: 0...400 % Page(s):**Fehler! Textmarke nicht definiert.**	*Integrated power governor* Correction factor for integrated power governor
3245	**KnockPowerRedActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Integrated power governor* Power reduction due to knocking is active
3247	**JetAssistActive**	

	Level:	1	Boost signal is active
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 465		
3248	**JetAstCurrBoostDiff**		
	Level:	2	Current difference between minimum boost pressure curve and 2904 *BoostPressure*
	Range:	0...5 bar	
	Page(s):**Fehler! Textmarke nicht definiert.**		

3250	**TwinEnginePhase** Level: 1 Range: 0...5 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Phase of master / slave operation
3250	**LeverSetpoint** Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* Setpoint after evaluation of directional information
3251	**CloseClutchPossible** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* 0→1: Closing clutch is possible 1→0: Opening clutch is possible
3251	**SetpointNeutralPos** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* 0: Throttle lever is not in neutral position 1: Throttle lever is in neutral position
3252	**PositionerOrGovernor** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* 0: Speed governor 1: Slave in positioning mode
3252	**SetpBackwOrForw** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* 0: Lever in forward direction 1: Lever in reverse direction if not in neutral position
3253	**MyLoadSetpoint** Level: 1 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Current load setpoint
3253	**GearShiftingOff** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* 1: Gear shifting is disabled
3254	**OtherLoadSetpoint** Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Load setpoint of other engine
3254	**SetpointPositionI**	*Marine operation multi-engine system*

	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Lever in position I (engage forward gear)
3255	**SlaveFuelSetpoint**	*Marine operation twin-engine system*
	Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	Fuel quantity setpoint for slave

3255	**SetpointPosition0** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* Lever in position 0 (neutral)
3256	**Slave&MasterLimited** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation twin-engine system* Slave and master are in fuel quantity limitation
3256	**SetpointPositionIII** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* Lever in position III (engage reverse gear)
3257	**SetpointCommandActiv** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* COMMAND button pressed on this lever
3258	**SetpointSynchroActiv** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* SYNCHRO button pressed on this lever
3259	**SetpointActive** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* This lever determines setpoint for multiple engines (active setpoint adjuster)
3260ff	**CanSetpxSetpoint** Level: 1 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation multi-engine system* Setpoint of lever x after evaluation of directional information x = 2..4, see 3250 *LeverSetpoint*
3261ff	**CanSetpxNeutralPos** Level: 1 Range: 0/1	*Marine operation multi-engine system* 0: Lever x is not in neutral position 1: Lever x is in neutral position x = 2..4, see 3251 *SetpointNeutralPos*
3262ff	**CanSetpxBackwOrForw** Level: 1 Range: 0/1	*Marine operation multi-engine system* 0: Lever in forward direction 1: Lever in backward direction if not in neutral position, x = 2..4, see 3252
3263ff	**CanSetpxGearShiftOff**	*Marine operation multi-engine system*

	Level:	1	1: Gear shifting on lever x is disabled
	Range:	0/1	x = 2..4, see 3253 *GearShiftingOff*
3264ff	**CanSetpxPositionI**		*Marine operation multi-engine system*
	Level:	1	Lever x in position I (engage forward gear)
	Range:	0/1	x = 2..4, see 3254 *SetpointPositionI*

3265ff	**CanSetpxPosition0**		*Marine operation multi-engine system*
	Level:	1	Lever x in position 0 (neutral)
	Range:	0/1	x = 2..4, see 3255 *SetpointPosition0*
3266ff	**CanSetpxPositionIII**		*Marine operation multi-engine system*
	Level:	1	Lever x in position III (engage reverse gear)
	Range:	0/1	x = 2..4, see 3256 *SetpointPositionIII*
3267ff	**CanSetpxCommandActiv**		*Marine operation multi-engine system*
	Level:	1	COMMAND button pressed on lever x
	Range:	0/1	x = 2..4, see 3257 *SetpointCommandActiv*
3268ff	**CanSetpxSynchroActiv**		*Marine operation multi-engine system*
	Level:	1	SYNCHRO button pressed on lever x
	Range:	0/1	x = 2..4, see 3258 *SetpointSynchroActiv*
3269ff	**CanSetpxActive**		*Marine operation multi-engine system*
	Level:	1	Lever x determines setpoint for multiple engines (active setpoint adjuster)
	Range:	0/1	x = 2..4, see 3259 *SetpointActive*
3290	**CommonLeverSetpoint**		*Marine operation multi-engine system*
	Level:	1	Resulting setpoint
	Range:	0…100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3291	**CommandLED**		*Marine operation multi-engine system*
	Level:	1	State of COMMAND-LED on throttle lever
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3292	**SynchroLED**		*Marine operation multi-engine system*
	Level:	1	State of SYNCHRO-LED on throttle lever
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3295	**ForwardGearValve**		*Marine operation multi-engine system*
	Level:	1	Forward gear
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3296	**BackwardGearValve**		*Marine operation multi-engine system*
	Level:	1	Reverse gear
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3300	**Velocity**		

	Level:	1	Travel speed
	Range:	0...x km/h	x: Depending on application
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3301	**Velocity_Value**		
	Level:	1	Unfiltered travel speed
	Range:	0...x km/h	x: Depending on application
	Page(s):**Fehler! Textmarke nicht definiert.**		

3302	**VeloGov:FuelLimit**		
	Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Speed governor: current fuel quantity limitation	
3350	**Notch**		
	Level: 1 Range: 0...15 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Current speed notch in locomotive operation	
3500ff	**PWMInx**		
	Level: 1 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Current value of PWM input x: DC 1-03: 1 DC 1-04: 1..2 DC 2: 1..4 DC 5: 1 DC 6: 1..3 DC 7: 1..2 DC 8: 1..2 DC 9: 1 DC 10 1 DC 11: 1..3 DC 12: 1	
3501ff	**FrequencyInx**		
	Level: 1 Range: 0…1000 Hz or 0...500 Hz Page(s):**Fehler! Textmarke nicht definiert.**	Current frequency at PWM input x *DC 1*, *DC 2* *DC 5*, *DC 6*, *DC 7*, *DC 8*, *DC 9*, *DC 11*, *DC 12* (x: See 3500 *PWMInx*)	

3510ff	**AnalogInx** **TempIny**		
	Level:	1	Standardised value of analogue input x
	Range:	0...100 % -100...1000 °C	DC 1-03: 1..5 DC 1-04: 1..8
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		DC 2: 1..4 DC 5: 1..6 DC 6: 1..3 DC 7: 1..4 DC 8: 1..6 DC 9: 1..2 DC 10 1..6 DC 11: 1..5 DC 12: 1..3 Standardised value of temperature input y: DC 1: 1..2 DC 2: 1..2 DC 5: 1..4 DC 6: 1 DC 7: 1..3 DC 8: 1..2 DC 10 1 DC 11: 1 DC 12: 1..2
3511ff	**AnalogInx_Value** **TempIny_Value**		
	Level:	1	Raw value of analogue input x
	Range:	0...65535 or 0...5 V or 0...10 V or 0…37.2 V or 0...z mA or 0...65535 or 0...w Ω	Current range z: DC 5: 25 mA Others: 22.7 mA Raw value of temperature input y Resistance range w: DC 10: 65000 Ω
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 256		Others: 60000 Ω (x: See 3510 *AnalogInx,* y: See 3510 *TempIny*)
3600 ff			*These hardware-specific parameters are described in the associated subchapters*
3799	**CommandWarning**		*XIOS*
	Level:	1	Indication that all errors in 3801 *CommonAlarm* are only warnings
	Range:	0/1	
	Page(s):	374	
3800	**Emergency Alarm**		

	Level: 1 Range: 0/1 Page(s): 175, 178, 232, 374, 378, **Fehler! Textmarke nicht definiert.**	Display of the emergency alarm
3801	**CommonAlarm**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 374, 376, 378	Display of the common alarm
3802	**EngineStopRequest**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 210, 252	Indication that the engine is being stopped by an internal or external engine stop (engine stop request is active)
3803	**EngineStopped**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 252	Indication that engine has stopped
3804	**EngineStarting**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Indication that engine is being started
3805	**EngineRunning**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 175	Indication that engine is running
3806	**EngineReleased**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Indication that fuel quantity has been released
3808	**EngineStarterActive**	*DC 5, XIOS*

	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Indication that starter has been enabled	
3810	**OperationMode**		
	Level: 1 Range: 0...4 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Operation mode 0 = Standard 1 = Vehicle 2 = Locomotive	 3 = Generator set 4 = Marine
3811	**SNSNOxStable**		
	Level: 1 Range: 0/1 Page(s):	Indication of stable NO_x signal	
3812	**SNSO2Stable**		
	Level: 1 Range: 0/1 Page(s):	Indication of stable O_2 signal	
3813	**SNSHeaterOn**		
	Level: 1 Range: 0/1 Page(s):	Indication that heating is active	
3830	**Phase**		
	Level: 1 Range: 0..9 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 175, 375	Current phase of engine or speed governor 0: Waiting for engine start 1: Starting phase 1 2: Starting phase 2 3: Starting phase 3 4: Speed governor active, limitation functions inactive 5: Speed governor active, limitation functions active 6: Speed governor active, lower limitation active 7: Speed governor active, upper limitation active 8: Automatic calibration 9: Positioner operation	
3840	**HardwareVersion**		

	Level: 1 Range: 00.00...99.99 Page(s):**Fehler! Textmarke nicht definiert.**		Version number of the control unit hardware
3842	**SoftwareVersion**		
	Level: 1 Range: 00.0.00...64.9.99 or 0000.00.00...6552.99.99 and 6553.00.00...6553.59.99 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		Version number of software (firmware) 2 digits customer number, 1 digit variant, 2 digits modification index or 4 digits customer number, 2 digits variant, 2 digits modification index
3843	**BootSoftwareVersion**		
	Level: 1 Range: 65.0.00….65.5.35 Page(s):**Fehler! Textmarke nicht definiert.**		Version number of the boot loader software
3844	**SerialDate**		
	Level: 1 Range: 0000...9912 Page(s):**Fehler! Textmarke nicht definiert.**		Serial date of the control unit hardware
3845	**SerialNumber**		
	Level: 1 Range: 00000...65535 Page(s):**Fehler! Textmarke nicht definiert.**		Serial number of the control unit hardware
3850	**Identifier**		
	Level: 1 Range: 0...65535 Page(s):**Fehler! Textmarke nicht definiert.**		Current identification number of the PC software (dongle) or hand programmer
3851	**LastIdentifier**		
	Level: 1 Range: 0…65535 Page(s):**Fehler! Textmarke nicht definiert.**		Identification number of the PC software (dongle) or hand programmer at last save operation
3857	**CompileTime**		
	Level: 1 Range: 00.00...23.59 Page(s):**Fehler! Textmarke nicht definiert.**		Compilation time of currently loaded firmware
3858	**CompileDate**		

	Level: 1 Range: 01.01...31.12 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Compilation date of currently loaded firmware: Day.Month
3859	**CompileYear** Level: 1 Range: 2000...3000 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Compilation year of currently loaded firmware
3860	**Flash250ms** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	4 Hz indicator, can be assigned to a multiple binary output or a BitCollection
3861	**Flash500ms** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	2 Hz indicator, can be assigned to a multiple binary output or a BitCollection
3862	**Flash1000ms** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	1 Hz indicator, can be assigned to a multiple binary output or a BitCollection
3865	**CalculationTime** Level: 1 Range: 0...15.625 ms or 0...16.384 ms or 0...10 ms Page(s):**Fehler! Textmarke nicht definiert.**	Required processing time for main loop *DC 1, DC 2* *DC 5, DC 6, DC 7, DC 8, DC 9, DC 10, DC 11, DC 12* *XIOS*
3870	**Timer** Level: 1 Range: 0...65.535 s Page(s):**Fehler! Textmarke nicht definiert.**	Internal millisecond timer
3871	**OperatingHourMeter** Level: 1 Range: 0...65535 h Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 380	*All except DC 1, DC 2 only on request* Number of operating hours of running engine
3872	**OperatingSecondMeter**	*All except DC 1, DC 2 only on request*

	Level:	1	Seconds of running engine to next full operating hour
	Range:	0...3599 s	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 380		
3895	**RAMTestAddrHigh**		
	Level:	6	Upper value of currently tested RAM address
	Range:	0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, 422, **Fehler! Textmarke nicht definiert.**		
3896	**RAMTestAddrLow**		
	Level:	6	Lower value of currently tested RAM address
	Range:	0000...FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, 422		
3897ff	**StackTestFreeBytes**		*DC 1, DC 2, XIOS*
	C/IStackTestFreeBytes		*DC 5, DC 6, DC 7, DC 8, DC 9, DC 10, DC 11, DC 12*
	Level:	6	Indication of free bytes in relevant stack memory
	Range:	0000…FFFF Hex	
	Page(s): 421, **Fehler! Textmarke nicht definiert.**		
3905	**ServoxPIDCorr**		
3934	Level:	6	Correction factor for servo loop PID parameters
3944	Range:	0...400 %	x = 1..3
	Page(s):	361	
3913	**ServoxCurrentLimit**		
3933	Level:	1	Limit for the current through the actuator
3934	Range:	-100...100 %	*DC 1, DC 2, XIOS*
		or 0...100 %	*DC 7, DC 10*
		or -8...8 A	*DC 8, DC 11, DC 12*
		or -12.5...12.5 A	*DC 6, DC 9*
		or 0...12.5 A	*DC 5*
	Page(s):		x = 1..3
3916	**ServoxCurrentSetpoint**		
3936	Level:	1	Current setpoint for amplifier (current through the actuator)
3946			
	Range:	-100...100 %	*DC 1, DC 2, XIOS*
		or 0...100 %	*DC 7, DC 10*
		or -8…8 A	*DC 8, DC 11, DC 12*
		or -12.5...12.5 A	*DC 6, DC 9*
		or 0...12.5 A	*DC 5*
		or 0…200 mA	*DC 6 with 200 mA amplifier*
		or 0…1000 mA	*DC 8 with 1 A amplifier*
	Page(s):	361, 363, 367	x = 1..3
3917	**ServoxCurrentCorr**		

3937 **3947**	Level:	1	Current setpoint corrected by voltage for actuator x *DC 1, DC 2, XIOS*
	Range:	-100...100 % or 0...100 %	*DC 7, DC 10* x = 1..3
	Page(s):	363	
3918	**ServoxCurrentShutOff**		
3938	Level:	1	Indication that current shutoff is active
3948	Range:	0/1	x = 1..3
	Page(s):**Fehler! Textmarke nicht definiert.**		
3920	**ServoCurrLowSidePos**		*DC 8, DC 11, DC 12*
	Level:	1	Current amplifier current LowSide positive
	Range:	-8.000...+8.000 V	
	Page(s):	362	
3921	**ServoCurrLowSideNeg**		*DC 8, DC 11, DC 12*
	Level:	1	Current amplifier current LowSide negative
	Range:	-8.000...+8.000 V	
	Page(s):	362	

3922	**ServoCurrHighSide**		*DC 8, DC 11, DC 12*
	Level:	1	Current amplifier current HighSide
	Range:	-8.000...+8.000 V	
	Page(s):	362	
3950	**Feedbackx**		
3960	Level:	1	Raw value of feedback for actuator x
3970	Range:	0...65535	x = 1..3
	Page(s):	353	
3951	**FeedbackCorrection**		*DC 2, DC 5, DC 6, DC 7, DC 9, DC 10, DC 12*
	Level:	1	Digital feedback value corrected by reference
	Range:	0…65535	
	Page(s):	353	
3955	**FeedbackReference**		*DC 2, DC 5, DC 6, DC 7, DC 9, DC 10, DC 12*
	Level:	1	Raw value for reference coil for digital feedback
	Range:	0...65535	
	Page(s):	353	
12000 ff			*Dual fuel parameters are described in the subchapter*
12570	**ExhaustTempAverage**		*XIOS*
	Level:	1	Average value of exhaust temperatures
	Range:	-100...+1000 °C	Others see 2913
	Page(s):	187, 237	
12572	**ExhaustTempMin**		*XIOS*
	Level:	1	Minimum exhaust temperature value
	Range:	-100...+1000 °C	Otherwise see 2912
	Page(s):	187, 237	
12573	**ExhaustTempMax**		*XIOS*
	Level:	1	Maximum exhaust temperature value
	Range:	-100...+1000 °C	Otherwise see 2911
	Page(s):	97, 187, 229, 237, 237	
12900	**ExhaustTempCylx**		*XIOS*
ff	Level:	1	Current value from exhaust temperature sensors
	Range:	-100...+1000 °C	x = 1..24
	Page(s):	236	
13033	**ErrSNSNOx**		*XIOS*
	Level:	1	Extended error indication for NO_x sensor
	Range:	0000…FFFF Hex	
	Page(s):	427	
13034	**ErrSNSO2**		XIOS
	Level:	1	Extended error indication for O_2 sensor
	Range:	0000…FFFF Hex	
	Page(s):	427	
13039	**ErrExhaustTempMax**		*XIOS*
	Level:	1	Error indication for maximum exhaust temperature
	Range:	0000...FFFF Hex	
	Page(s):	427	

13040 ff	**ErrExhaustTempCylx** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for exhaust temperature x x = 1...24
13064	**ErrAirMass** Level: 1 Range: 0000…FFFF Hex Page(s): 411	*XIOS* Error indication for air mass sensor
13065	**ErrAlternatorVoltage** Level: 1 Range: 0000...FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, 411	*XIOS* Error indication for alternator voltage
13066	**ErrBoostPressure2** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for second boost pressure sensor
13067	**ErrLambda1** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for lambda sensor 1
13068	**ErrLambda2** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for lambda sensor 2
13069	**ErrNOx** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for nitrogen oxide sensor
13070	**ErrO2** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for oxygen content measurement
13400 ff	**Out1:Value** **Outx:Value** Level: 1 Range: 0...100.0 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*DC 8, DC 11, DC 12, XIOS* Indication of current output value for Out x in percentage of output parameter x = 1..120 or lower, application-specific, by default total of outputs on own hardware and all connected communication modules
13520 ff	**DOColl_1** **DOColl_x** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*DC 8, DC 11, DC 12, XIOS* Indication of current value for DO collection x x = 1..25 or lower, application-specific

23000	**ErrCANopen**		*CANopen, XIOS*
	Level:	1	CANopen error status
	Range:	0...FFFF Hex	
23001	**ErrModbus**		*Modbus, XIOS*
	Level:	1	Modbus error status
	Range:	0...FFFF Hex	
23002	**ErrCanPEx**		*XIOS*
23020 ff	Level:	1	HZM-CAN periphery module error status
	Range:	0...FFFF Hex	23002 ff with up to three periphery modules
	Page(s):**Fehler! Textmarke nicht definiert.**		23020 ff with more than 3 periphery modules
23005	**ErrSAEJ1939**		*SAE J1939, XIOS*
	Level:	1	SAE J1939 error status
	Range:	0...FFFF Hex	
23006 ff	**ErrCanACx**		*XIOS*
	Level:	1	HZM-CAN add-on module error status
	Range:	0...FFFF Hex	x = 1..5
	Page(s):**Fehler! Textmarke nicht definiert.**		
23013	**ErrWagoCan**		*WAGO, XIOS*
	Level:	1	Wage error status
	Range:	0...FFFF Hex	
23013	**ErrWagoCanComm**		*WAGO, not XIOS*
	Level:	1	Error indication for WAGO-CAN communication, if HZM-CAN is running on same bus (otherwise 3071)
	Range:	0/1	*XIOS see 23013*
23014	**ErrCANopenComm**		*CANopen, not XIOS*
	Level:	1	Error indication for CANopen communication, if HZM-CAN is running on same bus (otherwise 3071)
	Range:	0/1	*XIOS see 23000*
23015	**ErrIceniCan**		*ICENI, XIOS*
	Level:	1	ICENI error status
	Range:	0...FFFF Hex	
23015	**ErrIceniCanComm**		*ICENI, not XIOS*
	Level:	1	Error indication for ICENI-CAN communication if HZM-CAN is running on the same bus (otherwise 3071)
	Range:	0/1	
23680 ff	**ErrorState(x)**		*XIOS* *DeviceNet, Manual DG 06 003-e* *Modbus, Manual DG 05 002-e*

	Level: 1 Range: 0…FFFF Hex Page(s): 345		Summary of error structures (1 bit per structure) from 3001 to 3099, 13000 to 13099, 23000 to 23099, 33000..33099, 43000..43099 and 53000..53011 for transmission via DeviceNet or Modbus x = 0..31 (max.) Bit 0 of index 0 is always 0 Error 3001 appears at bit 1 of index 0
23700 ff	**ErrorState(x)**		*All except XIOS* *DeviceNet, Manual DG 06 003-e* *Modbus, Manual DG 05 002-e*
	Level: 1 Range: 0...FFFF Hex Page(s): 345		Summary of error bits from 3001 to 3094, 13000 to 13094, 23000 to 23094 for transmission via DeviceNet or Modbus x = 0..17 (max.) Bit 0 of Index 0 is always 0 Error 3001 appears at bit 1 of index 0
23720 ff	**BitCollection(x)**		*HZM CAN Customer Module, Manual DG 05007-e* *CANopen, Manual DG 06 002-e* *DeviceNet, Manual DG 06 003-e* *Modbus, Manual DG 05 002-e*
	Level: 1 Range: 0...FFFF Hex Page(s): 344		Collection of bit states based on definition starting at 29900 *BitCollParamSet(x)* *x = 0..1*

Tab. 173: Measured values and display values

28.2.1 DC 1

Here, measured values and display values are described which are only available in DC 1 type control units due to the special hardware requirements.

No.	Name	Meaning
2800	**RotarySwitch**	
	Level: 1 Range: 0...15 Page(s):**Fehler! Textmarke nicht definiert.**	Indication of current value of rotary switch on PCB
3085	**ErrPowerSupply**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**	Error indication for voltage supply
3086	**ErrPowerSupplyExt**	*DC 1-04*

	Level:	1	Error indication for voltage supply to additional PCB
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**		
3087	**ErrCPU2**		
	Level:	1	Error indication for CPU 2
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3091	**ErrLogical**		
	Level:	1	Error indication for data set structure
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**		

3600	**PowerSupply**		
	Level:	1	Current value of filtered supply voltage
	Range:	0...50 V	
	Page(s):**Fehler! Textmarke nicht definiert.**, 363		
3601	**PowerSupplyExt**		*DC 1-04*
	Level:	1	Current value of filtered supply voltage for additional PCB
	Range:	0..50 V	
	Page(s):**Fehler! Textmarke nicht definiert.**, 363		
3821	**LED_CPU**		
	Level:	1	Indication that main processor is working
	Range:	0/1	
	Page(s):	376	
3822	**LED_SpeedPickup1Off**		
	Level:	1	Indication that no pulses are coming from speed pickup 1
	Range:	0/1	
	Page(s):	376	
3823	**LED_SpeedPickup2Off**		
	Level:	1	Indication that no pulses are coming from speed pickup 2
	Range:	0/1	
	Page(s):	376	
3824	**LED_ActuatorError**		
	Level:	1	Indication of actuator error
	Range:	0/1	
	Page(s):	376	
3825	**LED_PowerSupply**		
	Level:	1	Indication of error in supply voltage
	Range:	0/1	
	Page(s):	376	
3826	**LED_CommonAlarm**		
	Level:	1	Indication that at least 1 error is present
	Range:	0/1	
	Page(s):	376	
3827	**LED_BoostLimit**		
	Level:	1	Indication that fuel quantity is limited by boost pressure dependent fuel quantity limitation
	Range:	0/1	
	Page(s):	376	
3828	**LED_FuelLimitMax**		
	Level:	1	Indication that fuel quantity is limited by speed-dependent fuel quantity limitation
	Range:	0/1	
	Page(s):	377	
3829	**LED_FuelLimitMin**		
	Level:	1	Indication that fuel quantity setpoint = 0 %
	Range:	0/1	
	Page(s):	377	

Tab. 174: DC 1 measured values and display values

28.2.2 DC 2

Here, measured values and display values are described which are only available in DC 2 type control units due to the special hardware requirements.

No.	Name		Meaning
3061ff	**ErrDigiIOx**		
	Level:	1	Error indication at port DigiIO x
	Range:	0/1	x = 1..4
	Page(s): **Fehler! Textmarke nicht definiert.**		
3065	**ErrISOCommLine**		
	Level:	1	Error indication for interface connection
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3085	**ErrPowerSupply**		
	Level:	1	Error indication for voltage supply
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**		
3091	**ErrLogical**		
	Level:	1	Error indication for data set structure
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**		
3600	**PowerSupply**		
	Level:	1	Current value of filtered supply voltage
	Range:	0... 83.6 V	
	Page(s):**Fehler! Textmarke nicht definiert.**, 363		
3821	**LED_CPU**		
	Level:	1	Indication that main processor is working
	Range:	0/1	
	Page(s):	377	
3822	**LED_SpeedPickup1Off**		
	Level:	1	Indication that no pulses are detected at speed pickup 1
	Range:	0/1	
	Page(s):	377	
3823	**LED_SpeedPickup2Off**		
	Level:	1	Indication that no pulses are detected at speed pickup 2
	Range:	0/1	
	Page(s):	377	
3824	**LED_ActuatorError**		

Level:	1	Indication of actuator error
Range:	0/1	
Page(s):	377	

3825	**LED_CommonAlarm**		
	Level:	1	Indication that at least 1 error is present
	Range:	0/1	
	Page(s):	377	

Tab. 175: DC 2 measured values and display values

28.2.3 DC 5

Here, measured values and display values are described which are only available in DC 5 type control units due to the special hardware requirements.

No.	Name		Meaning
3079	**ErrDigitalOut**		
	Level:	1	Error indicationfor binary outputs
	Range:	0/1	See 3631 *DigitalOutx:ErrType* for detailed error indication
	Page(s):**Fehler! Textmarke nicht definiert.**		
3080	**ErrPowerSupply**		
	Level:	1	Error indication for voltage supply
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
3081	**ErrSupply7.5V**		
	Level:	1	Error indication for 7.5 V rail
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3082	**ErrPowerSupplyEDCFb**		
	Level:	1	Error indication for EDC feedback voltage supply
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3083ff	**Err5VSensorSupplyx**		
	Level:	1	Error indication for sensor supply voltages
	Range:	0/1	x = 1...4
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3087ff	**ErrInternTempx**		
	Level:	1	Error indication for internal temperature x
	Range:	0/1	x = 1..2
	Page(s):**Fehler! Textmarke nicht definiert.**		
3600	**PowerSupply**		

	Level:	1	Current value of filtered supply voltage
	Range:	0...55 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3601	**Supply7.5V**		
	Level:	1	Current value of 7.5 V voltage
	Range:	0...10 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3602	**PowerSupplyEDCFeedb**		
	Level:	1	Current value of amplifier supply voltage
	Range:	0...10 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3603ff	**5VSensorSupplyx**		
	Level:	1	Current value of sensor reference voltages
	Range:	0…7.35 V	x = 1..4
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3607ff	**InternTempInx**		
	Level:	1	Current value of internal temperature x
	Range:	-50 …150 °C	x = 1..2
	Page(s):**Fehler! Textmarke nicht definiert.**		
3611ff	**DigitalOutx:Feedback**		
	Level:	1	Current value of feedback for binary output x
	Range:	0/1	x = 1..11
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3622	**DiagnosePort:Feedbck**		
	Level:	1	Current value of feedback for diagnostic port
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3631ff	**DigitalOutx:ErrType**		
	Level:	1	Error type at binary output x
	Range:	0...FF	x = 1..11
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3642	**DiagnosePort:ErrType**		

Level:	1	Error type at diagnostic port
Range:	0...FF	
Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		

Tab. 176: DC 5 measured values and display values

28.2.4 DC 6

Here, measured values and display values are described which are only available in DC 6 type control units due to the special hardware requirements.

No.	Name	Meaning
3064	**ErrAmplCurrent** Level: 1 Range: 0/1 Page(s): 367, **Fehler! Textmarke nicht definiert.**	*With 200 mA amplifier* Error indication for amplifier current
3066	**ErrAmplTempWarn** Level: 1 Range: 0/1 Page(s): 368, **Fehler! Textmarke nicht definiert.**	*With 200 mA amplifier* Error indication for amplifier temperature, warning level exceeded
3067	**ErrAmplTemp** Level: 1 Range: 0/1 Page(s): 368, **Fehler! Textmarke nicht definiert.**	*With 200 mA amplifier* Error indication for amplifier temperature
3068	**ErrAmplSupply** Level: 1 Range: 0/1 Page(s): 368, **Fehler! Textmarke nicht definiert.**	*With 200 mA amplifier* Error indication for amplifier supply voltage
3069	**ErrInt13V** Level: 1 Range: 0/1 Page(s): 368, **Fehler! Textmarke nicht definiert.**	*With 200 mA amplifier* Error indication for 13V rail
3085	**ErrPowerSupply** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**	Error indication for voltage supply
3081	**Err5VSensorSupply** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error indication for 5V sensor supply voltage
3600	**PowerSupply**	

	Level: 1 Range: 0...55 V Page(s):**Fehler! Textmarke nicht definiert.**	Current value of filtered supply voltage
3601	**AmplifierTemp** Level: 1 Range: -100…1000 °C Page(s): 368, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*With 200 mA amplifier* Current amplifier temperature value
3602	**AmplifierSupply** Level: 1 Range: 0..75 V Page(s): 368	*With 200 mA amplifier* Current amplifier supply voltage value

3604	**Int13V** Level: 1 Range: 0..75 V Page(s): 368	*With 200 mA amplifier* Current value of 13 V bar
3605	**AmplifierVoltage** Level: 1 Range: 0..75 V Page(s): 368	*With 200 mA amplifier* Amplifier voltage back measurement
3920	**ServoCurrHighSide** Level: 1 Range: 0…200 mA Page(s): 367	*With 200 mA amplifier* HighSide current
3921	**ServoCurrLowSide** Level: 1 Range: 0…200 mA Page(s): 367	*With 200 mA amplifier* LowSide current

Tab. 177: DC 6 measured values and display values

28.2.5 DC 7

Here, measured values and display values are described which are only available in DC 7 type control units due to the special hardware requirements.

No.	Name	Meaning
2861	**StatusDigitalOutx** Level: 6 Range: 0...4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Status of binary outputs x = 1..7
3079	**ErrInternTemp** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Error indication for internal temperature
3080	**Err5VSensorSupplyx** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error indication for sensor supply voltage x x = 1, 2, 4
3085	**ErrPowerSupply**	

	Level:	1	Error indication for voltage supply
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**		
3083	**ErrInternSupply_7V**		
	Level:	1	Error indication for 7V rail
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		

3512ff	**5VSensorSupplyx**	
	Level: 1	Current sensor supply voltage value
	Range: 0...10.000 V	x = 1, 2, 4
	Page(s):**Fehler! Textmarke nicht definiert.**	
3600	**PowerSupply**	
	Level: 1	Current value of filtered supply voltage
	Range: 0...55 V	
	Page(s):**Fehler! Textmarke nicht definiert.**, 363	
3601	**InternTempIn**	
	Level: 1	Current value of the internal temperature
	Range: -100...+1000 °C	
	Page(s):**Fehler! Textmarke nicht definiert.**	
3603	**Reference7V**	
	Level: 1	Current value of 7V bar
	Range: 0...10.000 V	
	Page(s):**Fehler! Textmarke nicht definiert.**	

Tab. 178: DC 7 measured values and display values

28.2.6 DC 8

Here, measured values and display values are described which are only available in DC 8 type control units due to the special hardware requirements.

No.	Name	Meaning
2858	**LED_PowerSupply**	
	Level: 1	Voltage supply
	Range: 0/1	Flashing: one of the voltage supplies is interrupted
	Page(s): 377	
2859	**LED_SpeedPickUp1**	
	Level: 1	Indication that pulses are detected at speed pickup 1
	Range: 0/1	
	Page(s): 377	
2860	**LED_SpeedPickUp2**	
	Level: 1	Indication that pulses are detected at speed pickup 2
	Range: 0/1	
	Page(s): 377	
2861	**LED_OverTemp**	

Level:	1	Indication of excess temperature (PCB temperature)
Range:	0/1	
Page(s):	378	

2862	**LED_Feedback**		
	Level:	1	Actuator error
	Range:	0/1	Off: No error
	Page(s):	378	Flashing: Setpoint and actual value differ
			Lit: Feedback error
2863	**LED_Alarm**		
	Level:	1	Indication that there is at least one error
	Range:	0/1	Flashing: CommonAlarm
	Page(s):	378	Lit: Fatal error
3064	**ErrAmplCurrent**		*With 1 A amplifier*
	Level:	1	Error indication for amplifier current
	Range:	0/1	
	Page(s): 367, **Fehler! Textmarke nicht definiert.**		
3069	**ErrInternalBus1**		
	Level:	1	Error indication for UART interface
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3081	**Err5VSensorSupply**		
	Level:	1	Error indication for 5 V sensor supply
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3082	**ErrInternVoltage**		
	Level:	1	Error indication for internal voltages
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3083	**ErrUZKVoltage**		
	Level:	1	Error indication for intermediate circuit voltage
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3085	**ErrPowerSupply1**		
	Level:	1	Error indication for 1st voltage supply
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3086	**ErrPowerSupply2**		

	Level:	1	Error indication for 2nd voltage supply
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
3087	**ErrInternTemp**		
	Level:	1	Error indication for PCB temperature
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3088	**Err24VSensorSupply**		
	Level:	1	Error indication for 24 V sensor supply
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		

3600	**PowerSupply_1**		
	Level:	1	Current value of filtered supply voltage
	Range:	0..75 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3601	**PowerSupply_2**		
	Level:	1	Current value of filtered 2nd supply voltage
	Range:	0..75 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3602	**UZK_In**		
	Level:	1	Intermediate circuit voltage
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3603	**Int24V**		
	Level:	1	24 V rail
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3604	**Int12V**		
	Level:	1	12 V rail
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3605	**Int5V**		
	Level:	1	5 V rail
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3606	**Int3.3V**		
	Level:	1	3.3 V rail
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3607	**5VSensorSupply**		
	Level:	1	5 V sensor supply voltage
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3608	**24VSensorSupply1**		
	Level:	1	24 V sensor supply voltage 1
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3609	**24VSensorSupply2**		

	Level:	1	24 V sensor supply voltage 2
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3612	**Int2.5V**		
	Level:	1	2.5 V rail
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		

3613	**PCB Temperature**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	PBC temperature
3920	**ReadBackAmpl1000**	*DC 8 with 1 A amplifier*
	Level: 1 Range: -8.000 …+8.000 V Page(s): 538	Current amplifier current bach measurement

Tab. 179: DC 8 measured values and display values

28.2.7 DC 9

Here, measured values and display values are described which are only available in DC 9 type control units due to the special hardware requirements.

No.	Name	Meaning
3081	**Err5VSensorSupply**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Error indication for 5 V sensor supply
3085	**ErrPowerSupply**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**	Error indication for voltage supply
3600	**PowerSupply**	
	Level: 1 Range: 0...55 V Page(s):**Fehler! Textmarke nicht definiert.**	Current value of filtered supply voltage
3603	**5VSensorSupply**	
	Level: 1 Range: 0...10 V Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Current value of sensor supply voltage

Tab. 180: DC 9 measured values and display values

28.2.8 DC 10

Here, measured values and display values are described which are only available in DC 10 type control units due to the special hardware requirements.

No.	Name		Meaning
3061	**ErrOverCurLowSide**		
	Level:	1	Error indication for amplifier
	Range:	0/1	Hardware detects low side overcurrent
	Page(s):**Fehler! Textmarke nicht definiert.**		
3062	**ErrOverCurHighSide**		
	Level:	1	Error indication for amplifier
	Range:	0/1	Hardware detects high side overcurrent
	Page(s):**Fehler! Textmarke nicht definiert.**		
3081	**Err5VSensorSupply**		
	Level:	1	Error indication for sensor supply voltage
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3082	**ErrInternalTemp**		
	Level:	1	Error indication for internal temperature
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3084	**ErrLowSideCurrent**		
	Level:	1	Error indication for amplifier
	Range:	0/1	Software detects low side overcurrent
	Page(s): 364, **Fehler! Textmarke nicht definiert.**		
3085	**ErrPowerSupply**		
	Level:	1	Error indication for voltage supply
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**		
3086	**ErrDOShortToGnd**		
	Level:	1	Binary output error indication
	Range:	0/1	Short circuit to ground
	Page(s):**Fehler! Textmarke nicht definiert.**		
3087	**ErrDOShortToPower**		

	Level:	1	Binary output error indication
	Range:	0/1	Short circuit to battery positive
	Page(s):**Fehler! Textmarke nicht definiert.**		
3600	**PowerSupply**		
	Level:	1	Current value of filtered supply voltage
	Range:	0...55 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3601	**InternalTemp**		
	Level:	1	Current value of the internal temperature
	Range:	-50...150 °C	
	Page(s): **Fehler! Textmarke nicht definiert.**		

3603	**5VSensorSupply**	
	Level: 1 Range: 0...10.000 V Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Current sensor supply voltage value
3609	**ServoCurrentLowSide**	
	Level: 1 Range: 0...8.000 A Page(s): 362	Current amplifier current value (low side)
3615	**DigitalOut_Feedback**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Current value of feedback for binary output
3833	**TempInAvailable**	
	Level: 1 Range: 0/1 Page(s):	1: Hardware contains temperature input
3834	**CanBusAvailable**	
	Level: 1 Range: 0/1 Page(s):	1: Hardware contains CAN controller
3835	**ActuatorAvailable**	
	Level: 1 Range: 0/1 Page(s):	1: Hardware controls actuator
3836	**FeedbDigitalOrAnalog**	
	Level: 1 Range: 0/1 Page(s):	0: Analogue actuator feedback 1: Digital actuator feedback
3837	**LedAvailable**	
	Level: 1 Range: 0/1 Page(s):	1: Hardware controls status LED
3838	**Port5Pull-upAvailable**	
	Level: 1 Range: 0/1 Page(s):	1: Pull-up resistance at port 5 can be connected using 4808 *Port5_Pull-up5VOn*
3839	**Port6Available**	
	Level: 1 Range: 0/1 Page(s):	1: Multi-function port 6 can be used as analogue input, digital input or pickup 1

Tab. 181: DC 10 measured values and display values

28.2.9 DC 11

Here, measured values and display values are described which are only available in DC 11 type control units due to the special hardware requirements.

No.	Name		Meaning
3058	**ErrFeedbackVoltRef**		
	Level:	1	Error indication for analogue feedback
	Range:	0/1	
	Page(s):		
3061	**ErrAmplLowSideNeg**		
	Level:	1	Error indication for amplifier
	Range:	0/1	LowSide negative overcurrent
	Page(s):**Fehler! Textmarke nicht definiert.**		
3062	**ErrAmplLowSidePos**		
	Level:	1	Error indication for amplifier
	Range:	0/1	LowSide positive overcurrent
	Page(s): **Fehler! Textmarke nicht definiert.**		
3063	**ErrAmplHighSide**		
	Level:	1	Error indication for amplifier
	Range:	0/1	HighSide overcurrent
	Page(s): **Fehler! Textmarke nicht definiert.**		
3064	**ErrAmplSupply**		
	Level:	1	Error indication for amplifier
	Range:	0/1	Internal supply voltage too high
	Page(s): **Fehler! Textmarke nicht definiert.**		
3079	**ErrInternalTemp**		
	Level:	1	Error indication for internal temperature
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
3080	**ErrInternSupply2.5V**		
	Level:	1	Error indication for internal 2.5 V voltage
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
3081ff	**Err5VSensorSupplyx**		
	Level:	1	Error indication for 5 V reference voltages
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
3083	**ErrInternSupply3.3V**		

No.	Name	Meaning
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Error indication for internal 3.3 V voltage
3084	**ErrInternSupply14V** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Error indication for internal 14 V voltage
3085	**ErrPowerSupply** Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**	Error indication for voltage supply
3086	**ErrErrorOutVoltage** Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Error indication for error output
3512ff	**5VSensorSupplyx** Level: 1 Range: 0...10.000 V Page(s):**Fehler! Textmarke nicht definiert.**	Current value of 5 V reference for analogue inputs 1...3 and the temperature input
3600	**PowerSupply** Level: 1 Range: 0...55 V Page(s):**Fehler! Textmarke nicht definiert.**	Current value of filtered supply voltage
3601	**InternTempIn** Level: 1 Range: -100.0...+1000.0 °C Page(s): **Fehler! Textmarke nicht definiert.**	Current value of filtered internal temperature measurement
3602	**AmplifierSupply** Level: 1 Range: 0...55.000 V Page(s):**Fehler! Textmarke nicht definiert.**	Current amplifier voltage value
3603	**FeedbackSupply** Level: 1 Range: 0...30.000 V Page(s):**Fehler! Textmarke nicht definiert.**	Current feedback voltage value

No.	Name	Meaning
3604	**ErrorOutVoltage**	
	Level: 1	Current value of voltage at error output
	Range: 0...30.000 V	
	Page(s):**Fehler! Textmarke nicht definiert.**	
3605	**Reference14V**	
	Level: 1	Current value of internal 14 V voltage
	Range: 0...30.000 V	
	Page(s):**Fehler! Textmarke nicht definiert.**	
3606	**Reference2.5V**	
	Level: 1	Current value of internal 2.5 V voltage
	Range: 0…5.000 V	
	Page(s):**Fehler! Textmarke nicht definiert.**	
3607	**Reference3.3V**	
	Level: 1	Current value of internal 3.3 V voltage
	Range: 0…5.000 V	
	Page(s):**Fehler! Textmarke nicht definiert.**	

No.	Name		Meaning
3608	**InternTempIn_Value**		
	Level:	1	Current resistance value for internal temperature measurement
	Range:	0...60000 Ω	
	Page(s): **Fehler! Textmarke nicht definiert.**		

Tab. 182: DC 11 measured values and display values

28.2.10 DC 12

Here, measured values and display values are described which are only available in DC 12 type control units due to the special hardware requirements.

No.	Name		Meaning
3061	**ErrAmplLowSideNeg**		
	Level:	1	Error indication for amplifier LowSide negative overcurrent
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
3062	**ErrAmplLowSidePos**		
	Level:	1	Error indication for amplifier LowSide positive overcurrent
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
3063	**ErrAmplHighSide**		
	Level:	1	Error indication for amplifier HighSide overcurrent
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
3064	**ErrDigitalOut**		
	Level:	1	Error indication for binary output
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
3079	**ErrInternTemp**		
	Level:	1	Error indication for internal temperature
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
3080	**ErrInternSupply2.5V**		
	Level:	1	Error indication for internal 2.5 V voltage not within [2, 3] V
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		

No.	Name		Meaning
3081	**Err5VSensorSupply**		
	Level:	1	Error indication for 5 V reference voltage
	Range:	0/1	not within [4.5, 5.5] V
	Page(s): **Fehler! Textmarke nicht definiert.**		

No.	Name	Meaning
3082	**ErrInternSupply14V**	
	Level: 1 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Error indication for internal 14 V voltage not within [10, 16] V
3085	**ErrPowerSupply**	
	Level: 1 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 376, **Fehler! Textmarke nicht definiert.**	Error indication for voltage supply
3600	**PowerSupply**	
	Level: 1 Range: 0...55 V Page(s):**Fehler! Textmarke nicht definiert.**	Current value of filtered supply voltage
3601	**InternalTempIn**	
	Level: 1 Range: -100.0…+1000.0 °C Page(s): **Fehler! Textmarke nicht definiert.**	Current value for internal temperature measurement
3603	**5VSensorSupply**	
	Level: 1 Range: 0...10.000 V Page(s):**Fehler! Textmarke nicht definiert.**	Current value of 5V reference for temperature inputs
3605	**Int14V**	
	Level: 1 Range: 0...30.000 V Page(s):**Fehler! Textmarke nicht definiert.**	Current value of internal 14 V voltage
3606	**Int2.5V**	
	Level: 1 Range: 0...5.000 V Page(s):**Fehler! Textmarke nicht definiert.**	Current value of internal 2.5 V voltage

Tab. 183: DC 12 measured values and display values

28.2.11 XIOS

Here, measured values and display values are described which are only available in type XIOS control units due to the special hardware requirements.

No.	Name		Meaning
3079	**ErrInternTemp**		
	Level:	1	Error indication for internal temperature
	Range:	0000...FFFF Hex	
	Page(s):		

3080	**ErrEthernetA**		
	Level:	1	Error indication at Ethernet node A
	Range:	0000...FFFF Hex	
	Page(s):		
3081	**ErrEthernetAComm**		
	Level:	1	Error indication for communication at Ethernet node A
	Range:	0000...FFFF Hex	
	Page(s):		
3082	**ErrEthernetB**		
	Level:	1	Error indication at Ethernet node B
	Range:	0000...FFFF Hex	
	Page(s):		
3083	**ErrEthernetBComm**		
	Level:	1	Error indication for communication at Ethernet node B
	Range:	0000...FFFF Hex	
	Page(s):		
3085	**ErrPowerSupply**		
	Level:	1	Error indication for voltage supply
	Range:	0… FFFF Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 417		
3087	**ErrEEPROM**		
	Level:	1	Indication of incorrect E^2PROM pages
	Range:	0000…FFFF Hex	
	Page(s):		
3088	**ErrFilesys**		
	Level:	1	File system error indication
	Range:	0000...FFFF Hex	
	Page(s):		
3089	**ErrUSBHost**		
	Level:	1	USB host error indication
	Range:	0000...FFFF Hex	
	Page(s):		
3090	**ErrFPGA**		
	Level:	1	FPGA error indication
	Range:	0000...FFFF Hex	
	Page(s):		
3199	**SMXError**		
	Level:	1	Operating system error indication
	Range:	0000...FFFF Hex	
	Page(s):		
3600	**PowerSupply**		

Level:	1	Current value of filtered supply voltage
Range:	0...50.50 V	
Page(s):		

3601	**InternTemperature**		
	Level:	1	Current value of the internal temperature
	Range:	-100...1000 °C	
	Page(s):		
3602	**BoardVoltage3.3V**		
	Level:	1	Current value of 3.3 V bar
	Range:	0...5.00 V	
	Page(s):		
3603	**BoardVoltage5V**		
	Level:	1	Current value of 5 V bar
	Range:	0...10.00 V	
	Page(s):		
3604	**BoardVoltage1.5V**		
	Level:	1	Current value of 1.5 V bar
	Range:	0...2.50 V	
	Page(s):		
3605	**BoardVoltage12V**		
	Level:	1	Current value of 12 V bar
	Range:	0…20.16	
	Page(s):		
3606	**BoardVoltage5V_REF**		
	Level:	1	Current value of 5V reference voltage
	Range:	0…6.25V	
	Page(s):		
3607	**BoardVoltageVBAT**		
	Level:	1	Current value of the supply voltage
	Range:	0…36.00V	
	Page(s):		
3608	**BoardCurrentSupply**		
	Level:	1	Current total current value
	Range:	0…32.50A	
	Page(s):		
3609	**BoardMessVBAT**		
	Level:	1	Current value for supply voltage at terminal
	Range:	0…50.50V	
	Page(s):		
3610	**BoardMessVBAT_P**		
	Level:	1	Current value for power supply at terminal
	Range:	0…50.50V	
	Page(s):		
3611	**SensorSupplyStgA**		
	Level:	1	Current sensor supply value for actuator at slot 1
	Range:	0…10.00V	
	Page(s):		

3612	**SensorSupplyStgB**			
	Level:	1	Current sensor supply value for actuator at slot 2
	Range:	0…10.00V	
	Page(s):		
3613	**SensorSupplyStgC**		
	Level:	1	Current sensor supply value for actuator at slot 5
	Range:	0…10.00V	
	Page(s):		
3614	**SensorSupply_+12V_L**		
	Level:	1	Current voltage value at sensor supply 12V L
	Range:	0…20.16V	
	Page(s):		
3615	**SensorSupply_+5V_L**		
	Level:	1	Current voltage value at sensor supply 5V L
	Range:	0…20.16V	
	Page(s):		
3616	**SensorSupply_12V_R**		
	Level:	1	Current voltage value at sensor supply 12V R
	Range:	0…20.16V	
	Page(s):		
3617	**SensorSupply_5V_R**		
	Level:	1	Current voltage value at sensor supply 5V R
	Range:	0…20.16V	
	Page(s):		
3618	**SensorSupply_HIA1**		
	Level:	1	Current voltage value at sensor supply HIA1
	Range:	0…20.16V	
	Page(s):		
3619	**SensorSupply_HIA2**		
	Level:	1	Current voltage value at sensor supply HIA1
	Range:	0…20.16V	
	Page(s):		
3609	**ColdJunctionTemp1**		
	Level:	1	Current value
	Range:		
	Page(s):		
3610	**ColdJunctionTemp2**		
	Level:	1	Current value
	Range:		
	Page(s):		
3611	**ColdJunctionTemp3**		
	Level:	1	Current value
	Range:		
	Page(s):		

3612	**ColdJunctionTemp4**		
	Level:	1	Current value
	Range:		
	Page(s):		
3613	**ColdJunctionTemp5**		
	Level:	1	Current value
	Range:		
	Page(s):		
3614	**ColdJunctionTemp6**		
	Level:	1	Current value
	Range:		
	Page(s):		
3615	**ColdJunctionTemp7**		
	Level:	1	Current value
	Range:		
	Page(s):		
3616	**ColdJunctionTemp8**		
	Level:	1	Current value
	Range:		
	Page(s):		
3617	**ColdJunctionTemp9**		
	Level:	1	Current value
	Range:		
	Page(s):		
3618	**ColdJunctionTemp10**		
	Level:	1	Current value
	Range:		
	Page(s):		
3619	**ColdJunctionTemp11**		
	Level:	1	Current value
	Range:		
	Page(s):		
3620	**ColdJunctionResist1**		
	Level:	1	Current value
	Range:		
	Page(s):		
3621	**ColdJunctionResist2**		
	Level:	1	Current value
	Range:		
	Page(s):		
3622	**ColdJunctionResist3**		
	Level:	1	Current value
	Range:		
	Page(s):		

3623	**ColdJunctionResist4**			
	Level:	1	Current value	
	Range:			
	Page(s):			
3624	**ColdJunctionResist5**			
	Level:	1	Current value	
	Range:			
	Page(s):			
3625	**ColdJunctionResist6**			
	Level:	1	Current value	
	Range:			
	Page(s):			
3626	**ColdJunctionResist7**			
	Level:	1	Current value	
	Range:			
	Page(s):			
3627	**ColdJunctionResist8**			
	Level:	1	Current value	
	Range:			
	Page(s):			
3628	**ColdJunctionResist9**			
	Level:	1	Current value	
	Range:			
	Page(s):			
3629	**ColdJunctionResist10**			
	Level:	1	Current value	
	Range:			
	Page(s):			
3630	**ColdJunctionResist11**			
	Level:	1	Current value	
	Range:			
	Page(s):			
3790	**IgnitionOn**			
	Level:	1	State of the terminal 15	
	Range:	0/1		
	Page(s):			
3847	**DownloadCounter**			
	Level:	1	Number of firmware downloads	
	Range:	0...65535		
	Page(s):			
12400	**AmplifierxCurrentSetp**			
12405	Level:	1	Current output setpoint for current controlled	
12410	Range:	0...1.000 A	proportional valve on hydraulic adjusters	
	Page(s):	368	x = 1..3	

12401	**AmplifierxCurrent**		
12406	Level:	1	Current back measured actual current
12411	Range:	0...12.500 A	
	Page(s):	368	x = 1..3
12402	**AmplifierxVoltage**		
12407	Level:	1	Current back measured actual voltage
12412	Range:	0...25.000 V	
	Page(s):	368	x = 1..3
12403	**AmplifierxCurrentDiff**		
12408	Level:	1	Current difference between current setpoint and actual value
12413	Range:	0...1.000 A	
	Page(s):	369	x = 1..3
13080	**ErrAmplifierx**		
13081	Level:	1	Error at current output
13082	Range:	0000...FFFF Hex	
	Page(s): 369, **Fehler! Textmarke nicht definiert.**		
13800	**EthernetA_MAC_Address**		
ff	Level:	1	MAC address Ethernet node A
	Range:	00…FF Hex	
	Page(s):		
13810	**EthernetB_MAC_Address**		
ff	Level:	1	MAC address Ethernet node B
	Range:	00...FF Hex	
	Page(s):		
22000	**P001_(SL1.1)_Function** **Px_(SLy.z)_ Function**		
	Level:	1	Internally determined function of ports on module C and D
	Range:	0...38	x = 1..88
	Page(s):		y = 1..11 z = 1..8
22040	**P041_(D1.1)_Function** **Px_(Dy.z)_ Function**		
	Level:	1	Internally determined function of ports on module C
	Range:	0…38	x = 41..88
	Page(s):		y = 1..6 z = 1..8
22088 **22089**	**P089_(MC.DI1)_Function** **P090_(MC.DI2)_Function**		
	Level:	1	Internally determined function of the binary input ports on module C
	Range:	0…38	
	Page(s):		

22090	**P091_(MC.DO1)_Function**		
22091	**P092_(MC.DO2)_Function**		
	Level:	1	Internally determined function of the binary output
	Range:	0...38	ports on module C
	Page(s):		
22092	**P093_(MC.AI1)_Function**		
ff	**Px_(MC.AIy)_Function**		
	Level:	1	Internally determined function of the analogue input
	Range:	0...38	ports on module C
	Page(s):		x = 93..103
			y = 1..11
22103	**P104_(MD.DI1)_Function**		
ff	**Px_(MD.DIy)_Function**		
	Level:	1	Internally determined function of the binary input ports
	Range:	0...38	on module D
	Page(s):		x = 104..106
			y = 1..4
22107	**P104_(MD.DO1)_Function**		
22108	**P104_(MD.DO2)_Function**		
	Level:	1	Internally determined function of the binary output
	Range:	0...38	ports on module D
	Page(s):		
22109	**P110_(MD.AI1)_Function**		
ff	**Px_(MD.AIy)_Function**		
	Level:	1	Internally determined function of the analogue input
	Range:	0...38	ports on module D
	Page(s):		x = 110..117
			y = 1..8
22120	**SlotSL1_TypeModulA**		
ff	**SlotSLx_TypeModulA**		
	Level:	1	Type of A-modules at slots on module C and D
	Range:	0...15	x = 1..11
	Page(s):		
22131	**ModulDAvailable**		
	Level:	1	FPGA configuration: Module D is equipped
	Range:	0/1	
	Page(s):		
22132	**ElysionAvailable**		
	Level:	1	FPGA configuration: Port 104 and 105 on module D 0:
	Range:	0/1	can be used for speed/frequency/binary inputs
	Page(s):		1: can be used for Elysion PWM feedback

22150	**P001_(SL1.1)_DO_State** **Px_(SLy.z)_DO_State**		
	Level:	1	Value of the output at port x on C and D module if used
	Range:	0/1	as binary output
	Page(s):		x = 1..4, 9..12, 17..20, 25..28, 33..36, 41..44, 49..52, 57..60, 65..68, 73..76, 81..84 y = 1..11 z =1..4
22240 **22241**	**P091_(MC.DO1)_DO_State** **P092_(MC.DO2)_DO_State**		
	Level:	1	Value of the output on port 91, 92 of the C-module if
	Range:	0/1	used as a binary output
	Page(s):		
22257 **22258**	**P108_(MD.DO1)_DO_State** **P109_(MD.DO2)_DO_State**		
	Level:	1	Value of the output on port 108, 109 of the D module if
	Range:	0/1	used as a binary output
	Page(s):		

Tab. 184: Measured values and display values XIOS

↑*16* Speed control for dual fuel engines (ARTEMIS) and separate ARTEMIS manuals

No.	**Name**		**Meaning**
12020	**GasActPos** **GasFuelActual**		
	Level:	1	Current position of gas actuators or current gas fuel
	Range:	0..100 %	quantity in electronic fuel injection
	Page(s):	202, 202	from actuator or HEINZMANN-CAN periphery modules
12021	**GasActSetpoint(x)**		
ff	Level:	1	Current setpoint for own gas actuators, corresponding to
	Range:	0…100 %	12023 *GasFuelQuantity* or 12026
	Page(s):	170, 173	*GasFuelQuantityBankx*, if not also stored in characteristic 16210/16225
12032	**PromptReturnToDiesel**		
	Level:	1	Indication: Immediate return to diesel, can only be
	Range:	0/1	cleared if the gas switch is opened
	Page(s):	175, 178, 183	
12033	**FastReturnToDiesel**		
	Level:	1	Indication: Return to diesel using fast ramp
	Range:	0/1	
	Page(s):	183	

12034	**GasConsumptionActive**		
	Level:	1	Indication: gas is being consumed
	Range:	0/1	12023 *GasFuelSetpoint* > 0%
	Page(s):	174, 207, 209	
12035 ff	**GasValvexOpen GasValvesOpen**		
	Level:	1	x = 1..2: Double gas valves are operated individually
	Range:	0/1	Otherwise: Double gas valves are operated together
	Page(s):	184, 232, 232, 233, 233	
12050	**DieselPower**		
	Level:	1	Indication of current diesel power proportion
	Range:	0...100 %	
		or 0...x kW	x: Depending on application
	Page(s):	166, 168, 222, 226	
12051	**GasPower**		
	Level:	1	Indication of current gas power proportion
	Range:	0…100 %	
		or 0…x kW	x: Depending on application
	Page(s):	166, 169	
12055	**PilotDslAbsMinimum**		
	Level:	1	Minimum ignition oil quantity, which must be met
	Range:	0…100 %	
	Page(s):	165, 169, 197, 233	
12068	**EngStopRequWithGas**		
	Level:	1	Indication: Engine stop request is delayed due to
	Range:	0/1	activation in dual fuel operation until gas has reached 0
	Page(s):	180, 232	% and any residual gas combustion has been performed
12080	**GasValveCheckDelay**		*External gas section monitoring*
	Level:	1	Progression of delay time before signal has to be received to confirm that the gas section is OK
	Range:	0…600 s	*XIOS*
		or 0...1000 s	*Others*
	Page(s):	184	
12081	**GasValveCheckActive**		
	Level:	1	Indicates that gas valve test is active
	Range:	0/1	
	Page(s):	184	
12082	**GasTrainReady**		
	Level:	1	Indicates that gas section test has completed
	Range:	0/1	successfully
	Page(s):	176, 184	
12084	**GasConditionStatHigh**		
	Level:	1	Compressed indication of the gas conditions status
	Range:	0…FFFF Hex	(high proportion)
	Page(s):	204	

12085	**GasConditionStateLow**		
	Level:	1	Compressed indication of gas conditions status (low proportion)
	Range:	0...FFFF Hex	
	Page(s):	204	
12086	**DualFuelState1High**		
	Level:	1	Compressed indication of dual fuel status, word 1 (high proportion)
	Range:	0...FFFF Hex	
	Page(s):	204	
12087	**DualFuelState1Low**		
	Level:	1	Compressed indication of dual fuel status, word 1 (low proportion)
	Range:	0...FFFF Hex	
	Page(s):	205	
12088	**DualFuelState2High**		
	Level:	1	Compressed indication of dual fuel status, word 2 (high proportion)
	Range:	0...FFFF Hex	
	Page(s):		
12089	**DualFuelState2Low**		
	Level:	1	Compressed indication of dual fuel status, word 2 (low proportion)
	Range:	0...FFFF Hex	
	Page(s):		
12090	**AriadneKnockControl**		
	Level:	1	Indication that Ariadne knock detection module is configured in dual fuel control unit
	Range:	0/1	
	Page(s):	199	
12091	**ADPWMGasPositioner**		
	Level:	1	Gas positioner enabled via analogue or PWM output
	Range:	0/1	
	Page(s):	173	
12091	**CanGasFlowControl**		*Marine operation*
	Level:	1	Indication that Elektra FlowControl is configured in dual fuel control unit
	Range:	0/1	
	Page(s):	173	
12092	**ActuatGasPositioner**		
	Level:	1	Gas positioner is enabled by its own actuator
	Range:	0/1	
	Page(s):	170, 201	
12093	**ActuatGasPositioner2**		
	Level:	1	Gas positioner is also enabled by a second own actuator (V motor)
	Range:	0/1	
	Page(s):	170, 201	
12094	**CanGasPositioner**		
	Level:	1	Gas positioner on HZM-CAN actuator periphery module enabled
	Range:	0/1	
	Page(s):	172	

12095	**EFIGasPositioner**		
	Level:	1	Gas positioner on HZM-CAN EFI periphery module enabled
	Range:	0/1	
	Page(s):	172	
12096	**CanGasPositioner2**		
	Level:	1	Gas positioner on second HZM-CAN actuator periphery module enabled (V motor)
	Range:	0/1	
	Page(s):	172	
12097	**EFIGasPositioner2**		
	Level:	1	Gas positioner on second HZM-CAN EFI periphery module enabled
	Range:	0/1	
	Page(s):	172	
13000	**ErrGasConditions**		*Not XIOS*
	Level:	1	Conditions for dual fuel operation are not met
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
13001	**ErrGasPositioner**		*Not XIOS*
	Level:	1	Error on gas positioner
	Range:	0/1	
	Page(s):	175, 179, 202, **Fehler! Textmarke nicht definiert.**	
13007	**ErrHeavyKnocking**		*Not XIOS*
	Level:	1	Ariadne reporting heavy knocking
	Range:	0/1	
	Page(s):	179, 199, **Fehler! Textmarke nicht definiert.**	
13008	**ErrGasPressTooLow**		*Not XIOS*
	Level:	1	Gas pressure too low
	Range:	0/1	
	Page(s): 195, **Fehler! Textmarke nicht definiert.**		
13009	**ErrKnockControlOff**		*Not XIOS*
	Level:	1	ARIADNE knock monitoring system is out of service
	Range:	0/1	
	Page(s):	175, 179, 199, **Fehler! Textmarke nicht definiert.**	
13010	**ErrGasTrain**		*Not XIOS*
	Level:	1	Gas section not OK
	Range:	0/1	
	Page(s): 184, **Fehler! Textmarke nicht definiert.**		
13011	**ErrLightKnocking**		*Not XIOS*
	Level:	1	Ariadne reporting light knocking
	Range:	0/1	
	Page(s):	182, 199, 201	

13017	**ErrGasPrRangeForGas**		*Not XIOS*
	Level:	1	Gas pressure is not in range for dual fuel operation
	Range:	0/1	see 10005-10007
	Page(s):	177, 179, **Fehler! Textmarke nicht definiert.**	

13022	**ErrEFIGasPosDiff** Level: 1 Range: 0/1 Page(s): 175, 179, 202, **Fehler! Textmarke nicht definiert.**	*Not XIOS* MEGASOL gas positioner is not synchronised, actual gas value is 0 for 1 s, although a gas setpoint has been set
13024	**ErrExternGasAlarm** Level: 1 Range: 0/1 Page(s): 178, 201, **Fehler! Textmarke nicht definiert.**	*Not XIOS* “External gas alarm” switching function is active
13026	**ErrGasTRangeForGas** Level: 1 Range: 0/1 Page(s): 178, 201, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Gas temperature is not in range for dual fuel operation see 10023-10025
13030	**ErrGasRailStatus** Level: 1 Range: 0000…FFFF Hex Page(s): 178, 184, 191, 201, 206, 422	*XIOS* Error status of the gas section
13031	**ErrGasConditions** Level: 1 Range: 0000…FFFF Hex Page(s): 175, 179, 182, 185,187, 188, 192, 196, 197, 200, 206, 423	*XIOS* Error status of the conditions for dual fuel operation
13032	**ErrDualFuelStatus** Level: 1 Range: 0000...FFFF Hex Page(s): 175, 179, 202, 206, 426	*XIOS* Error status of dual fuel operation
13071	**ErrGasTemp** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for gas temperature sensor
13072	**ErrGasPosition** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for external gas position
13073	**ErrGasRailPressure** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Error indication for gas pressure sensor
13074	**ErrGasValveCheckPr** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Gas section test: Error indication for valve test sensor (absolute pressure sensor in pressure compensation chamber)

13075	**ErrPilotFuelOffset** Level: 1 Range: 0000...FFFF Hex Page(s): 411	*XIOS* Ignition oil quantity offset error indication
13100 ff	**SErrGasConditions** Level: 1 Range: 0/1 or 0...255 Page(s):	*Not XIOS* Error marker / error counter Related current errors see 13000 ff

Tab. 185: Measured values and display values for dual fuel (general)

28.2.11.1 Gas speed governor

No.	Name	Meaning
12023	**GasFuelQuantity** Level: 1 Range: 0..100 % Page(s): 170, 173, 202, 208, 211, 219, 230, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Fuel quantity setpoint for gas actuator or gas valve
12024	**GasFuelQuantUncorr** Level: 1 Range: 0..100 % Page(s): 208, 212, 219, 230	Gas injection quantity not yet corrected by gas pressure and gas temperature
12025	**GasFuelSetpUnlimited** Level: 1 Range: 0..100 % Page(s): 208, 211, 219, 231	Gas injection quantity before limitation
12030	**DieselGovernorActive** Level: 1 Range: 0/1 Page(s): 174, 207, 209, 212	Indicates that diesel controller is active
12031	**GasGovernorActive** Level: 1 Range: 0/1 Page(s): 174, 207, 209, 211, 220	Indicates that gas governor is active, diesel only ignition oil quantity
12059	**DieselKnockOffset** Level: 1 Range: 0..100 % Page(s): 200, 200	Offset for the ignition oil quantity to rectify light knocking (increase of diesel proportion)
12060	**PilotDieselPresent** Level: 1 Range: 0…100 % Page(s): 165, 196	Current ignition oil quantity

12061	**DieselAtPilotActive**		
	Level:	1	Indication: diesel request <= ignition oil quantity
	Range:	0/1	
	Page(s):	197	
12062	**GasFuelLimitMax**		
	Level:	1	Current gas fuel quantity limitation
	Range:	0…100 %	
	Page(s):	208, 211, 219, 231	
12063	**GasAtUpperLimit**		
	Level:	1	Diesel support active because gas is at upper limit
	Range:	0/1	
	Page(s):	211	
12064	**DieselSupportActive**		
	Level:	1	Indication that diesel support is active, gas is held – for whatever reason
	Range:	0/1	
	Page(s):	212	
12069	**RemainGasBurning**		
	Level:	1	Indicates that residual gas combustion is in progress
	Range:	0/1	
	Page(s):	233	
12075	**GasLoadingActive**		
	Level:	1	Load addition in dual fuel operation
	Range:	0/1	
	Page(s):	213	
12076	**GasLoadingReactionOn**		
	Level:	1	Reaction to load addition in dual fuel operation active (diesel support)
	Range:	0/1	
	Page(s):	213	
12077	**GasLoadRejectActive**		
	Level:	1	Load shedding in dual fuel operation
	Range:	0/1	
	Page(s):	213	
12078	**GasLoadRejReactionOn**		
	Level:	1	Reaction to load shedding in dual fuel operation active
	Range:	0/1	
	Page(s):	214	
12083	**ReadyForChangeOver**		
	Level:	1	Indicates that gas conditions are met, switch to gas can be made
	Range:	0/1	
	Page(s):	218	
12089	**RemainGasBurning**		
	Level:	1	Indication that residual gas combustion is active
	Range:	0/1	
	Page(s):		

13012	**ErrSpeedRangeForGas** Level: 1 Range: 0/1 Page(s): 177, 181, 196, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Speed is not in range for dual fuel operation see 10010-10012
13013	**ErrPowerRangeForGas** Level: 1 Range: 0/1 Page(s): 176, 180, 185, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Power is not in range for dual fuel operation see 10013-10015
13014	**ErrFuelRangeForGas** Level: 1 Range: 0/1 Page(s): 177, 196, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Diesel fuel quantity is below PilotFuel, which means it is not possible to switch to dual fuel operation see 12060 *PilotFuelPresent*
13015	**ErrBoostRangeForGas** Level: 1 Range: 0/1 Page(s): 177, 181, 193, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Boost pressure is not in range for dual fuel operation see 16100/16115/10016
13016	**ErrOilPrRangeForGas** Level: 1 Range: 0/1 Page(s): 181, 192, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Oil pressure is not in range for dual fuel operation Oil pressure warning is active, see 3010 *ErrOilPressure* (XIOS) or 3030 *ErrOilPressWarn* (others)
13018	**ErrCoolTRangeForGas** Level: 1 Range: 0/1 Page(s): 176, 181, 189, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Coolant temperature is not in range for dual fuel operation see 10020-10022
13019	**ErrExhTRangeForGas** Level: 1 Range: 0/1 Page(s): 176, 180, 187, 188, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Exhaust temperature is not in range for dual fuel operation see 10017-10018
13020	**ErrExhTDRangeForGas** Level: 1 Range: 0/1 Page(s): 176, 181, 188, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Exhaust temperature difference between coldest and hottest cylinder is not in range for dual fuel operation See 10019
13021	**ErrChAirTRangeForGas** Level: 1 Range: 0/1 Page(s): 176, 181, 190, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Charge air temperature is not in the range for dual fuel operation see 10002-10004
13023	**ErrBelowPilotFuel**	*Not XIOS*

	Level: 1 Range: 0/1 Page(s): 179, 179, 197, **Fehler! Textmarke nicht definiert.**	Diesel fuel quantity is below PilotFuel, which means it is necessary to terminate dual fuel operation see 12060 *PilotFuelPresent*

Tab. 186: Measured and display values for dual fuel (gas speed governor)

28.2.11.2 Diesel reduction governor

No.	Name	Meaning
12002	**ChAirTInRangeForGas** Level: 1 Range: 0/1 Page(s): 176, 181, 191	Charge air temperature in range for dual fuel operation
12005	**GasPresInRangeForGas** Level: 1 Range: 0/1 Page(s): 177, 195	Gas pressure in range for dual fuel operation
12006	**GasPosNotActive** Level: 1 Range: 0/1 Page(s): 177, 182, 203	*Marine operation* ELEKTRA FlowControl is not active
12010	**SpeedInRangeForGas** Level: 1 Range: 0/1 Page(s): 177, 181, 196	Speed in range for dual fuel operation
12011	**DieselBelowPilotFuel** Level: 1 Range: 0/1 Page(s): 179	Diesel fuel quantity is below ignition oil quantity
12012	**DieselInRangeForGas** Level: 1 Range: 0/1 Page(s): 177, 198	Diesel fuel quantity in range for dual fuel operation
12013	**PowerInRangeForGas** Level: 1 Range: 0/1 Page(s): 176, 180, 185	Power in range for dual fuel operation
12014	**LightKnocking** Level: 1 Range: 0/1 Page(s): 182, 201	Ariadne reporting light knocking
12015	**OilPresInRangeForGas**	

	Level:	1	Oil pressure in range for dual fuel operation
	Range:	0/1	
	Page(s):	176, 181, 192	
12016	**BoostPrInRangeForGas**		
	Level:	1	Boost pressure in range for dual fuel operation
	Range:	0/1	
	Page(s):	177, 181, 193	

12017	**ExhTInRangeForGas**		
	Level:	1	Exhaust temperature in range for dual fuel operation
	Range:	0/1	
	Page(s):	176, 180, 187, 189	
12018	**ExhTDInRangeForGas**		
	Level:	1	Exhaust temperature difference between hottest and coldest cylinder is not in range for dual fuel operation
	Range:	0/1	
	Page(s):	176, 181, 189	
12019	**CoolTInRangForGas**		
	Level:	1	Coolant temperature in range for dual fuel operation
	Range:	0/1	
	Page(s):	176, 181, 190	
12023	**GasFuelQuantity**		*Locomotive operation*
	Level:	1	Fuel quantity setpoint for gas actuator or gas valve
	Range:	0...100 %	
	Page(s): 170, 202, 208, 211, 215, 217, 219, 225, 230, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
12023	**GasPowerSetpoint**		*Marine operation*
	Level:	1	Power setpoint for Elektra FlowControl
	Range:	0...x kW	
	Page(s):	173, 222	
12024	**GasFuelQuantUncorr**		*Locomotive operation*
	Level:	1	Gas injection quantity not yet corrected by gas pressure and gas temperature
	Range:	0...100 %	
	Page(s):	208, 212, 217, 219, 230	
12024	**GasPowerUncorr**		*Marine operation*
	Level:	1	Power setpoint for Elektra FlowControl not yet corrected by gas pressure and gas temperature
	Range:	0...100 %	
	Page(s):	222	
12025	**GasFuelSetpUnlimited**		*Locomotive operation*
	Level:	1	Gas injection quantity before limitation
	Range:	0...100 %	
	Page(s):	208, 211, 219, 231	
12031	**GasActive**		
	Level:	1	Indication that gas is being added
	Range:	0/1	
	Page(s):	174, 207, 209, 211, 220	
12039	**RampToDieselActive**		
	Level:	1	Indication: Ramped return to diesel
	Range:	0/1	
	Page(s):	219	
12048	**PowerMax**		*Locomotive operation*

Level:	1	Indication of speed-dependent maximum traction power
Range:	0...x kW	x: depending on application
Page(s):	166, 225, 226	

12049	**DieselPowerMap**		*Locomotive operation*
	Level:	1	Indication of diesel power from speed and fuel quantity
	Range:	0...x kW	dependent map
	Page (s):	167	x: Depending on application
12049	**NegDieselPower**		*Marine operation, at request of engine manufacturers*
	Level:	1	Indication of negative diesel power in dual fuel
	Range:	0...x kW	operation if PilotFuel is below zero power curve
	Page (s):	222	x: Depending on application
12052	**GasPowerMax**		*Locomotive and generator operation*
	Level:	1	Indication of maximum permissible gas power
	Range:	0...x kW	x: Depending on application
	Page (s):	226	
12052	**DF:EnginePowerLimit**		*Marine operation*
	Level:	1	Indication of maximum permissible engine power in
	Range:	0...x kW	dual fuel operation
	Page (s):	222	x: Depending on application
12053	**RelativeDieselPower**		*Locomotive operation*
	Level:	1	Indication of diesel power relative to nominal power
	Range:	0...100 %	1232 *TractionPowerHigh*
	Page(s):	167	
12059	**DieselKnockOffset**		
	Level:	1	Offset for the diesel quantity setpoint to rectify light
	Range:	0...100 %	knocking (increase of diesel proportion)
	Page(s):	200	
12060	**DieselRedGovSetp**		
	Level:	1	Current diesel setpoint
	Range:	0…100 %	
	Page(s):	165, 196, 197, 215, 217	
12061	**DieselRedGovActive**		
	Level:	1	Indication: Diesel reduction governor is active
	Range:	0/1	
	Page(s):	197	
12062	**GasFuelLimitMax**		*Locomotive and generator operation*
	Level:	1	Current gas fuel quantity limitation
	Range:	0…100 %	
	Page(s):	217, 222, 223, 231	
12062	**GasPowerLimitMax**		*Marine operation*
	Level:	1	Current gas power limit
	Range:	0…x kW	x: Depending on application
	Page(s):	223	
12063	**GasFuelLimitSpeed**		*Locomotive and generator operation*
	Level:	1	Speed-dependent gas fuel quantity limitation
	Range:	0...100 %	
	Page(s):	224	

12063	**GasPowerLimitSpeed**		*Marine operation*
	Level:	1	Speed-dependent gas power limit
	Range:	0...x kW	x: Depending on application
	Page (s):	222	
12064	**GasFuelLimitPower**		*Locomotive and generator operation*
	Level:	1	Traction power dependent gas fuel quantity limitation
	Range:	0...100 %	
	Page(s):	221, 226	
12065	**GasSpeedLimitActive**		
	Level:	1	Indicates that speed-dependent gas power limitation is active
	Range:	0/1	
	Page(s):	222, 224	
12066	**GasPowerLimitActive**		*Locomotive and generator operation*
	Level:	1	Indicates that (traction) power dependent gas power limitation is active
	Range:	0/1	
	Page(s):	226	
12067	**GasForcedLimitActive**		*Locomotive operation*
	Level:	1	Indicates that gas power limitation using the switching function 2813 *SwitchForcedLimit* is active
	Range:	0/1	
	Page(s):	227	
12069	**RemainGasBurning**		
	Level:	1	Indicates that residual gas combustion is in progress
	Range:	0/1	
	Page(s):	233	
12083	**GasReleased**		
	Level:	1	Indicates that gas is released
	Range:	0/1	
	Page(s):	218	
13025	**ErrGasPosFatal**		*Not XIOS*
	Level:	1	Fatal error on the gas positioner
	Range:	0/1	
	Page(s):	179, 202, **Fehler! Textmarke nicht definiert.**	
13027	**ErrGasNoPower**		*Not XIOS*
	Level:	1	Gas does not produce any power proportion
	Range:	0/1	
	Page(s):	182, 197, **Fehler! Textmarke nicht definiert.**	

Tab. 187: Measured and display values for dual fuel (diesel reduction governor)

28.2.12 CANopen

↑*23.4* CAN protocol CANopen and CANopen, Manual DG 06 002-e

No.	Name		Meaning
23750	**CanOp:Init**		
	Level:	1	CANopen state Init
	Range:	0/1	
23751	**CanOp: PreOperational**		
	Level:	1	CANopen state Preoperational
	Range:	0/1	
23752	**CanOp: Operational**		
	Level:	1	CANopen state Operational
	Range:	0/1	
23753	**CanOp: Stopped**		
	Level:	1	CANopen state Stopped
	Range:	0/1	
23754	**CanOp:HBeatConsumer**		
	Level:	1	Heartbeat consumer is enabled
	Range:	0/1	
23755	**CanOp:HBeatProducer**		
	Level:	1	Heartbeat producer is enabled
	Range:	0..1	
23756	**CanOp:LifeGuarding**		
	Level:	1	Life guarding is enabled
	Range:	0..1	
23757	**CanOp:ErrLifeSign**		
	Level:	1	Life sign error
	Range:	0/1	
23758	**CanOp:ErrRPDOTimeOut**		
	Level:	1	At least one RPDO has timed out
	Range:	0/1	
23759	**CanOp:RxIRCount**		
	Level:	1	Counter for receive interrupts (receiving telegrams)
	Range:	0…65535	
23760	**CanOp:SwitchMask(x)**		
ff	Level:	4	Mask for receiving switching functions resulting from assignments in 20810 *Comm.*. and 24810 *ChanTyp.* = 4 (for comparison with sender) x = 0: Switching functions 16...1 x = 1: Switching functions 32...17 x = 2: Switching functions 48...33 x = 3: Switching functions 64...49
	Range:	0...FFFF Hex	

No.	Name		Meaning
23764 ff	**CanOp:SensorMask(x)**		
	Level:	4	Mask for receiving sensors resulting from assignments in 900 *Assign…* and 4900 *ChanTyp…* = 4 (for comparison with sender) x = 0: Sensors 4...1 x = 1: Sensors 8...5 x = 2: Sensors 12...9
	Range:	0...0F Hex	
23770 ff	**CanOp:RPDOTelLen(x)**		
	Level:	4	Expected telegram length of RPDO x+1
	Range:	0...8	x = 0...3 or x = 0...9
23774 ff	**CanOp:TPDOTelLen(x)**		*If only 4 RPDOs are possible*
	Level:	4	Expected telegram length of TPDO x+1
	Range:	0…8	x = 0…15
23780 ff	**CanOp:TPDOTelLen(x)**		*If more than 4 RPDOs are possible*
	Level:	4	Expected telegram length of TPDO x+1
	Range:	0…8	x = 0...15
23790	**CanOp:TxCount**		*If only 4 RPDOs are possible*
	Level:	1	Counter for transmissions (transmit telegrams)
	Range:	0...65535	
23796	**CanOp:TxCount**		*If more than 4 RPDOs are possible*
	Level:	1	Counter for transmissions (transmit telegrams)
	Range:	0...65535	
23799	**CanOp:MaxLevel**		
	Level:	1	Maximum level for configuration using CANopen if this is permitted in the firmware
	Range:	0...65535	
23799	**CanOp:MaxLevelTPDO**		
	Level:	1	Maximum level for configuration of the TPDOs if general configuration using CANopen is not permitted in the firmware
	Range:	0...65535	

Tab. 188: Measured and display values for CANopen

28.2.13 Modbus

↑*23.8* Serial protocol Modbus and Manual DG 05 002-e

No.	Name		Meaning
23800	**Modb:Baudrate**		
	Level:	4	Display value for set baud rate
	Range:	9600, 19200 Baud	
23801	**Modb:BusMessageCnt**		
	Level:	4	Number of valid received messages
	Range:	0...65535	

No.	Name		Meaning
23802	**Modb:CommErrorCnt**		
	Level:	4	Number of erroneous received messages
	Range:	0...65535	
23803	**Modb:ExceptErrCnt**		
	Level:	4	Number of sent exception messages
	Range:	0...65535	
23804	**Modb:SlaveMessageCnt**		
	Level:	4	Number of sent messages
	Range:	0...65535	
23805	**Modb:SlaveNoRespCnt**		
	Level:	4	Number of received messages that require no answering message (here: send-only message from master)
	Range:	0...65535	
23806	**Modb:BusCharOvrCnt**		
	Level:	4	Number of messages that were not received correctly due to character overrun
	Range:	0…65535	
23810	**Modb:NoOfTxParams**		
	Level:	4	Number of valid parameter numbers that are entered in the data field for read access 29200 *Modb:TxParamSet(x)*
	Range:	0...100	
23820 ff	**Modb:RxBinary(x)**		
	Level:	4	Received values for switching functions
	Range:	0...FF Hex	
23822 ff	**Modb:RxSensor(x)**		
	Level:	4	Received sensor values
	Range:	0...100 %	

Tab. 189: Measured and display values for Modbus

28.2.14 DeviceNet

↑*23.5* CAN protocol DeviceNet and Manual DG 06 003-e

No.	Name		Meaning
23850	**DNet:LED_Green**		
	Level:	1	Current value of green LED
	Range:	0/1	
23851	**DNet:LED_Red**		
	Level:	1	Current value of red LED
	Range:	0/1	
23852	**DNet:Flag**		
	Level:	1	State flag
	Range:	0...FF Hex	

No.	Name		Meaning
23853	**DNet:Status**		
	Level:	1	Status indicator
	Range:	0...FF Hex	
23860	**DNet:NoOfPollParams**		
	Level:	4	Number of send parameters via polled message
	Range:	0…100	
23861	**DNet:Baudrate**		
	Level:	4	Current baud rate
	Range:	125,250,500	
23862	**DNet:RxBinary(x)**		
ff	Level:	4	Received values for switching functions
	Range:	0...FF Hex	
23864	**DNet:RxSensor(x)**		
ff	Level:	4	Received sensor values
	Range:	0…65535	

Tab. 190: Measured and display values for DeviceNet

28.2.15 SAE J1939

↑*23.3* CAN protocol SAE J1939 and Manual DG 06 004-e

No.	Name		Meaning
23900	**J1939:Online**		
	Level:	1	General state SAE J1939
	Range:	0/1	
23903	**J1939:TSC1RxBufOvfl**		*TSC1*
	Level:	1	Receive buffer overflow for TSC1 messages
	Range:	0/1	
23904	**J1939:RxBufOvfl**		
	Level:	1	General receive buffer overflow
	Range:	0/1	
23905	**J1939:TxBufOvfl**		
	Level:	1	Send buffer overflow
	Range:	0/1	
23906	**J1939:RxTimeout**		
	Level:	1	Indication of receiving telegrams in timeout state
	Range:	0...FFFF Hex	
23907	**J1939:MsgStatus**		
	Level:	1	Indication of receiving telegrams in OK state
	Range:	0...FFFF Hex	

No.	Name		Meaning
23908	**J1939:Active**		
	Level:	1	Indication of whether SAE J1939 communication is
	Range:	0...FFFF Hex	active (only if address claim was successful)
23910	**J1939:EEC1TorqueMode**		*EEC1*
	Level:	4	Torque mode
	Range:	0...15	
23911	**J1939:EEC1TorqueSetp**		*EEC1*
	Level:	4	Current torque setpoint relative to the maximum torque
	Range:	0...100 %	limitation
23912	**J1939:EEC1TorqueMax**		*EEC1*
	Level:	4	Current torque relative to the maximum torque
	Range:	0...100 %	limitation
23913	**J1939:EEC2PercntLoad**		*EEC2*
	Level:	4	Percentage load at current speed
	Range:	0…100 %	
23914	**J1939:EEC3Friction**		*EEC3*
	Level:	4	Torque friction
	Range:	0…100 %	
23920	**J1939:TSC1Status**		*TSC1*
	Level:	4	Activity status of TSC1 telegrams
	Range:	0…0F	
23921	**J1939:TSC1IMOrAllGov**		*TSC1*
	Level:	4	Governor mode resulting from TSC1 telegrams
	Range:	0/1	
23922	**J1939:TSC1SpeedSet**		*TSC1*
	Level:	4	Speed setpoint resulting from TSC1 telegrams
	Range:	0...100 %	
23923	**J1939:TSC1SpeedLim**		*TSC1*
	Level:	4	Speed limit setpoint resulting from TSC1 telegrams
	Range:	0…100 %	
23924	**J1939:TSC1FuelLim**		*TSC1*
	Level:	4	Fuel quantity limit resulting from TSC1 telegrams
	Range:	0...100 %	

Tab. 191: Measured and display values for SAE J1939

28.3 List 3: Functions

	Name		Meaning
4000	**PickUp1On**		
	Level:	4	Enable/disable first speed pickup as redundant speed signal (RESET)
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 301		
4001	**PickUpFilter2Or1Rev**		
	Level:	1	Filtering of speed signals
	Range:	0/1	0: Over one crankshaft revolution
	Page(s):**Fehler! Textmarke nicht definiert.**		1: Over two crankshaft revolutions (RESET)
4002	**PickUp2On**		
	Level:	4	Enable/disable second speed pickup as redundant speed signal (RESET)
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 301		
4003	**PickUp2AtAlternator**		
	Level:	4	Redundant speed signal (2nd speed pickup input) is taken from alternator
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		(RESET)
4005	**CamIndexOn**		
	Level:	4	Enable/disable camshaft index sensor for individual cylinder identification with misfire monitoring at pickup 2 (only if 4002 *Pickup2On* = 0) (RESET)
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
4010	**PickUp1AtCamOrCrank**		
	Level:	4	The first speed pickup is connected to the camshaft (1) or to the crankshaft (0)
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		(RESET)
4011	**PickUp2AtCamOrCrank**		

	Name		Meaning
	Level:	4	The second speed pickup is connected to the camshaft (1) or to the crankshaft (0)
	Range:	0/1	(RESET)
	Page(s):**Fehler! Textmarke nicht definiert.**		
4014	**CheckPickUpDiffOn**		
	Level:	4	Enable / disable reciprocal pickup monitoring
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
4020	**SpeedSetpPCOn**		
	Level:	2	Enable /disable speed setpoint specification by PC
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		

	Name		Meaning
4025	**SpeedGradientOn**		
	Level:	4	Enable speed gradient monitoring
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
4028	**SpeedGradientDT1On**		
	Level:	2	Enable /disable DT1-factor during speed jump recognition
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 213, 213		
4029	**PowerGradientDT1On**		
	Level:	2	Enable /disable DT1-factor during load jump recognition
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 213, 213		
4050	**SpeedVarDetectOn**		
	Level:	4	Enable /disable detection of speed variance
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
4055	**MisfireWarnCurveOn**		
	Level:	4	Enable / disable misfire warning curve
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 413		
4056	**MisfireEcyCurveOn**		
	Level:	4	Enable misfire emergency shutdown curve
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, 413		
4060	**SpeedMinTempOn**		
	Level:	2	Enable temperature dependent idle speed
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4100	**PIDMapOn**		
	Level:	3	Enable / disable PID map for speed governor
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
4101	**PIDMapPowerOrFuel**		
	PIDMapSpGovPowOrFuel		*If integrated power governor is available*

	Name		Meaning
	Level:	3	Stability map for speed control loop
	Range:	0/1	0: Speed and fuel quantity dependent
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		1: Speed and power dependent
4110	**StaticCorrOn**		
	Level:	2	Enable / disable PID correction for static operation
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		

	Name		Meaning
4120	**DroopOn**		
	Level:	2	Enable / disable droop
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
4121	**DroopPowerOrFuel**		
	Level:	2	Droop calculation
	Range:	0/1	0: Based on fuel reference
	Page(s): **Fehler! Textmarke nicht definiert.**, 243		1: Based on power measurement
4122	**Droop@ZeroOrFullLoad**		
	Level:	2	Droop calculation
	Range:	0/1	0: At full load reference point
	Page(s): **Fehler! Textmarke nicht definiert.**		1: At zero load reference point
4130	**IMGovernorOn**		
	Level:	2	Enable / disable idle / maximum speed governor
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
4131	**IMFuelRampOn**		
	Level:	2	Enable / disable fuel ramp for idle / maximum speed governor
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4132	**IMDriveMapOn**		
	Level:	2	Enable / disable drive map
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4160	**PIDTempOn**		
	Level:	3	Enable / disable temperature dependent speed governor PID correction
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
4230	**SpeedRampOn**		

	Name	Meaning
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Enable / disable speed ramp
4232	**SectionalOrFixedRamp**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Selection of speed ramp 0 = Simple fixed speed ramp 1 = Sectional speed ramp
4240	**StartSpeedRampOn**	
	Level: 3 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable separate speed ramp for engine start

	Name		Meaning
4300	**InjectorPumpMapOn**		*At request of engine manufacturers*
	Level:	6	Enable / disable pump map
	Range:	0/1	
	Page(s):	359	
4320	**CurrentShutOffOn**		
	ActxCurrentShutOffOn		
4323	Level:	6	Enable /disable current shutoff on actuator x
4326	Range:	0/1	x = 1...3
	Page(s): **Fehler! Textmarke nicht definiert.**		Only applies for speed governor actuator
4330	**AllSendSpeedOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable / disable sending of current speed 2000 *Speed* via HZM_CAN_ALL
	Range:	0/1	
4332	**AllSendPowPercentOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable / disable sending of current relative power 3232 *RelativePower* via HZM_CAN_ALL
	Range:	0/1	
4335	**AllSendStatusOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable /disable sending of current speed governor status via HZM_CAN_ALL
	Range:	0/1	
4336	**AllSendSpeedSetpOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable /disable sending of current speed governor setpoint 2031 *SpeedSetp* via HZM_CAN_ALL
	Range:	0/1	
4338	**AllSendBoostPressOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable /disable sending of current boost pressure 2904 *BoostPressure* via HZM_CAN_ALL
	Range:	0/1	
4340	**AllSendAutoResetOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable /disable sending of AutoReset request via HZM_CAN_ALL
	Range:	0/1	
4341	**AllSendErrorResetOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable / disable sending of error clearing request via HZM_CAN_ALL
	Range:	0/1	
	Page(s):		
4342	**AllSendExhaustTempOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable /disable sending of current exhaust temperature 2911 *ExhaustTemp* or – if available – maximum exhaust temperature 12573 *ExhaustTempMax* via HZM_CAN_ALL
	Range:	0/1	
4344	**AllSendFuelSetpOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	Enable / disable sending of current fuel quantity setpoint 2350 *FuelQuantity* via HZM_CAN_ALL
	Range:	0/1	
4375	**ACxSetpointOn**		*See basic information HZM-CAN DG 13 002-d*
ff	Level:	4	HZM-CAN: Enable /disable transmission of setpoint to add-on module x (only relates to type 1 AC modules) x = 1…5
	Range:	0/1	

	Name		Meaning
4376 ff	**ACxMeasurementsOn** Level: Range:	 4 0/1	*See basic information HZM-CAN DG 13 002-d* HZM-CAN: Enable / disable transmission of measured values to add-on module x (only relates to type 1 AC modules) x = 1…5
4377 ff	**ACxAutoResetOn** Level: Range:	 4 0/1	*See basic information HZM-CAN DG 13 002-d* HZM-CAN: Enable /disable transmission of AutoReset command to add-on module x (only relates to type 1 AC modules) x = 1…5
4378 ff	**ACxErrorResetOn** Level: Range:	 4 0/1	*See basic information HZM-CAN DG 13 002-d* HZM-CAN: Enable /disable transmission of error clearing command to add-on module x (only relates to type 1 AC modules) x = 1…5
4400ff	**CanCommxxOn** Level: Range:	 6 0/1	*See basic information HZM-CAN DG 13 002-d* HZM-CAN: Enable node type xx xx = DC: Speed governor GC: Generator control units PE: Periphery modules IM: Inverter modules MC: Engine and hybrid control units AC: Add-on module CM: Customer module PC: PC, ARGOS, hand programmer
4415	**CanCommAllOn** Level: Range:	 6 0/1	*See basic information HZM-CAN DG 13 002-d* HZM-CAN: Enable /disable sending to all or reception from all For reception it is also necessary to active the unit type from which to receive, see 4400 *CanCommDCOn*
4416ff	**CanxSegmentOrBaud** Level: Range:	 4 0/1	*See basic information HZM-CAN DG 13 002-d* HZM-CAN: Selection of baud rate configuration 0: Direct baud rate specification (default) 1: Baud rate setting derived from segment settings CAN controller x = 1…2
4430	**ReceiveACErrorOn** Level: Range:	 6 0/1	*See basic information HZM-CAN DG 13 002-d* HZM-CAN: Enable /disable reception of error status information for all connected add-on modules XIOS: see 23006 *ErrCanAC* ff Others: see 2443 *CanACError(x)*
4431	**ReceiveStatusOn** Level: Range:	 6 0/1	*See basic information HZM-CAN DG 13 002-d* HZM-CAN: Enable /disable reception of error status information for all connected add-on modules see 2541 *CanACStatus(x)*

	Name		Meaning
4440ff	**PExFuelSetpointOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN: Enable / disable sending of fuel quantity setpoint to periphery module x x = 1…3
	Range:	0/1	
4441ff	**PExDigOutOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN: Enable / disable transmission of binary output values to periphery module x x = 1…3
	Range:	0/1	
4442ff	**PExAnalogOutOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN: Enable / disable transmission of analogue output values to periphery module x x = 1…3
	Range:	0/1	
4443ff	**PExPWMOutOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN: Enable / disable transmission of PWM output values to periphery module x x = 1…3
	Range:	0/1	
4444ff	**PExErrorResetOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN: Enable / disable transmission of error clearing command to periphery module x x = 1…3
	Range:	0/1	
4445ff	**PExAutoResetOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN: Enable / disable transmission of auto-reset command to periphery module x x = 1…3
	Range:	0/1	
4446ff	**PExAutoAdjustOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN: Enable / disable transmission of auto adjust command to periphery module x x = 1…3
	Range:	0/1	
4447ff	**PExMeasurementsOn**		*See basic information HZM-CAN DG 13 002-d*
	Level:	4	HZM-CAN: Enable / disable transmission of measured values to periphery module x x = 1…3
	Range:	0/1	
4460ff	**PEDigitalOutx_Logic**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level:	6	HZM-CAN: Logical link for multiple assignment to binary output x on periphery modules Bit = 0: AND function Bit = 1: OR function or 80 Hex: Flashing x: Depending on application
	Range:	0..7F Hex or 80 Hex	
	Page(s):**Fehler! Textmarke nicht definiert.**		

	Name	Meaning
4480ff	**PEDigitalOutx_Prior**	*DC 1, DC 2, DC 5, DC 6, DC 7, DC 10* *See basic information HZM-CAN DG 13 002-d*
	Level: 6 Range: 0...FF Hex Page(s):**Fehler! Textmarke nicht definiert.**	HZM-CAN: Priority assignment for multiple assignment to binary output x on periphery modules Bit = 0: Output flashing Bit = 1: Output is continuously active x: Depending on application
4500	**OilPressWarnCurveOn**	
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable oil pressure monitoring curve with oil pressure warning
4501	**OilPressEcyCurveOn**	
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable oil pressure monitoring curve with engine stop
4505	**CoolPressSupviseOn**	*XIOS*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable coolant pressure monitoring
4505	**CoolPressWarnCurveOn**	*Not XIOS*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable coolant pressure monitoring curve
4506	**CoolPLim1RiseOrFall**	*XIOS*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Coolant pressure monitoring: Monitoring for values above (1) or below (0) threshold 1
4506	**CoolPressIdleCurveOn**	*Not XIOS, locomotive operation*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable coolant pressure monitoring curve with forced idle speed in locomotive operation
4507	**CoolPLim1EcyOrWarn**	*XIOS*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Coolant pressure monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4508	**CoolPLim2RiseOrFall**	*XIOS*

	Name		Meaning
	Level:	4	Coolant pressure monitoring: Monitoring for values above (1) or below (0) threshold 2
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		In locomotive operation, threshold 2 can be used for a forced idle speed if 5362 *CoolPressWarnIdleOn* = 1
4509	**CoolPLim2EcyOrWarn**		*XIOS*
	Level:	4	Coolant pressure monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		

	Name	Meaning
4510	**CoolantTempWarnOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*All except XIOS* Enable / disable monitoring of coolant temperature
4511	**CoolantTmpWarnIdleOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Not XIOS, locomotive operation* Enable / disable forced idle speed in locomotive operation when coolant temperature is high
4515	**ChargeAirTempWarnOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Not XIOS* Enable / disable monitoring of charge air temperature
4520	**OilTempWarnOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*All except XIOS* Enable / disable monitoring of oil temperature
4521	**OilTempWarnIdleOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*All except XIOS, locomotive operation* Enable / disable forced idle speed in locomotive operation when oil temperature is high
4525	**ExhaustTempWarnOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*All except XIOS* Enable / disable monitoring of exhaust temperature
4545	**AlternatorSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable alternator monitoring
4546	**AlternLim1RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Alternator monitoring: Monitoring for values above (1) or below (0) threshold 1
4547	**AlternLim1EcyOrWarn**	*XIOS*

	Name	Meaning
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Alternator monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4548	**AlternLim2RiseOrFall**	*XIOS*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Alternator monitoring: Monitoring for values above (1) or below (0) threshold 2
4549	**AlternLim2EcyOrWarn**	*XIOS*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Alternator monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)

	Name	Meaning
4550	**CoolantTempSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable coolant temperature monitoring
4551	**CoolTLim1RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Coolant temperature monitoring: Monitoring for values above (1) or below (0) threshold 1
4552	**CoolTLim1EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Coolant temperature monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4553	**CoolTLim2RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*XIOS* Coolant temperature monitoring: Monitoring for values above (1) or below (0) threshold 2 In locomotive operation threshold 2 can be used for a forced idle speed if 5360 *CoolantTmpWarnIdleOn* = 1
4554	**CoolTLim2EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*XIOS* Coolant temperature monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
4555	**ChAirTempSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable charge air temperature monitoring
4556	**ChAirTLim1RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Charge air temperature monitoring: Monitoring for values above (1) or below (0) threshold 1
4557	**ChAirTLim1EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Charge air temperature monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4558	**ChAirTLim2RiseOrFall**	*XIOS*

	Name	Meaning
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Charge air temperature monitoring: Monitoring for values above (1) or below (0) threshold 2
4559	**ChAirTLim2EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Charge air temperature monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
4560	**OilTempSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable oil temperature monitoring
4561	**OilTLim1RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Oil temperature monitoring: Monitoring for values above (1) or below (0) threshold 1
4562	**OilTLim1EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Oil temperature monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4563	**OilTLim2RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*XIOS* Oil temperature monitoring: Monitoring for values above (1) or below (0) threshold 2 In locomotive operation threshold 2 can be used for a forced idle speed if 5361 *OilTempWarnIdleOn* = 1
4564	**OilTLim2EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*XIOS* Oil temperature monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
4565	**FuelTempSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable fuel temperature monitoring
4566	**FuelTLim1RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Fuel temperature monitoring: Monitoring for values above (1) or below (0) threshold 1

	Name	Meaning
4567	**FuelTLim1EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Fuel temperature monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4568	**FuelTLim2RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Fuel temperature monitoring: Monitoring for values above (1) or below (0) threshold 2
4569	**FuelTLim2EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Fuel temperature monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
4570	**ExhTempSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable exhaust temperature monitoring
4571	**ExhTLim1RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Exhaust temperature monitoring: Monitoring for values above (1) or below (0) threshold 1
4572	**ExhTLim1EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Exhaust temperature monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4573	**ExhTLim2RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Exhaust temperature monitoring: Monitoring for values above (1) or below (0) threshold 2
4574	**ExhTLim2EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Exhaust temperature monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
4575	**TurbOilTempSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable turbocharger oil temperature monitoring

	Name		Meaning
4576	**TuOilTLim1RiseOrFall**		*XIOS*
	Level:	4	Turbocharger oil temperature monitoring: Monitoring for values above (1) or below (0) threshold 1
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4577	**TuOilTLim1EcyOrWarn**		*XIOS*
	Level:	4	Turbocharger oil temperature monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4578	**TuOilTLim2RiseOrFall**		*XIOS*
	Level:	4	Turbocharger oil temperature monitoring: Monitoring for values above (1) or below (0) threshold 2
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4579	**TuOilTLim2EcyOrWarn**		*XIOS*
	Level:	4	Turbocharger oil temperature monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4580	**FuelPressSupviseOn**		*XIOS*
	Level:	4	Enable / disable fuel pressure monitoring
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4581	**FuelPrLim1RiseOrFall**		*XIOS*
	Level:	4	Fuel pressure monitoring: Monitoring for values above (1) or below (0) threshold 1
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4582	**FuelPrLim1EcyOrWarn**		*XIOS*
	Level:	4	Fuel pressure monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		

	Name	Meaning
4583	**FuelPrLim2RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Fuel pressure monitoring: Monitoring for values above (1) or below (0) threshold 2
4584	**FuelPrLim2EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Fuel pressure monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
4585	**OilLevelSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable oil level monitoring
4586	**OilLevLim1RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Oil level monitoring: Monitoring for values above (1) or below (0) threshold 1
4587	**OilLevLim1EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Oil level monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4588	**OilLevLim2RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Oil level monitoring: Monitoring for values above (1) or below (0) threshold 2
4589	**OilLevLim2EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Oil level monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
4590	**TrOilPressSupviseOn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Enable / disable transmission oil pressure monitoring
4591	**TrOilPLim1RiseOrFall** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Transmission oil pressure monitoring: Monitoring for values above (1) or below (0) threshold 1

	Name	Meaning
4592	**TrOilPLim1EcyOrWarn**	*XIOS*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Transmission oil pressure monitoring: Value above or below threshold 1 results in engine shutdown (1) or warning (0)
4593	**TrOilPLim2RiseOrFall**	*XIOS*
	Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Transmission oil pressure monitoring: Monitoring for values above (1) or below (0) threshold 2

	Name	Meaning
4594	**TrOilPLim2EcyOrWarn** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS* Transmission oil pressure monitoring: Value above or below threshold 2 results in engine shutdown (1) or warning (0)
4600	**ExcitationControlOn** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Enable excitation control or excitation governing in locomotive operation
4600	**PitchControlOn** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Marine operation* Enable / disable adjustable propeller governing
4601	**ExcitGovOrControl** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Selection of excitation control/excitation governing 0 = Excitation control 1 = Excitation governing
4602	**ExcitGovTrPowOrFuel** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Selection of control loop for determining excitation signal 0 = Based on fuel 1 = Based on traction power
4603	**ExcitGovFuelPossible** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Indication that the diesel governor fuel is equivalent to power
4610	**ExcitControlRampOn** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Enable / disable ramp for excitation control
4620	**DigSlideExcitCntrlOn** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*Locomotive operation* Enable / disable digital slide protection intervention in excitation signal
4621	**AnaSlideExcitCntrlOn**	*Locomotive operation*

	Name		Meaning
	Level:	2	Enable / disable analogue slide protection intervention in excitation signal
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4630	**ExcitGovPICurveOn**		*Locomotive operation*
	Level:	3	Enable / disable PI correction characteristic for excitation governing
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4630	**PitchGovPICurveOn**		*Marine operation*
	Level:	3	Enable / disable PI correction characteristic for adjustable propeller governing
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4635	**ExcitationSetpPCOn**		*Locomotive operation*
	Level:	2	Enable /disable excitation value specification by PC
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
4635	**PitchSetpPCOn**		*Marine operation*
	Level:	2	Enable / disable adjustable propeller value specification by PC
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4640	**ExcitGovSetpRampOn**		*Locomotive operation*
	Level:	2	Enable / disable fuel or traction power ramp
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4640	**PitchGovFuelRampOn**		*Marine operation*
	Level:	2	Enable / disable fuel ramp for adjustable propeller
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4642	**PitchSpeedLimitOn**		*Marine operation*
	Level:	2	Enable / disable speed-dependent limitation for adjustable propeller
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4650	**ExcitTempLimitOn**		*Locomotive operation*
	Level:	2	Enable / disable temperature dependent reduction of fuel quantity setpoint or traction power setpoint
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4655	**ExcitBoostLimitOn**		*Locomotive operation*

	Name		Meaning
	Level:	2	Enable / disable boost pressure dependent limitation of fuel quantity setpoint or traction power setpoint
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4656	**ExcitSpeedLimitOn**		*Locomotive operation*
	Level:	2	Enable / disable speed-dependent limitation of excitation signal as control loop output value
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
4657	**TractPowLimitVoltOn**		*Locomotive operation*
	Level:	2	Enable / disable speed-dependent limitation of traction power setpoint
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4658	**TractPowLimitCurrOn**		*Locomotive operation*
	Level:	2	Enable / disable speed-dependent limitation of traction current setpoint
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4680	**EGROn**		
	Level:	4	Enable / disable exhaust gas recirculation (on request)
	Range:	0/1	
	Page(s):		

	Name		Meaning
4681	**EGRCoolTempSupviseOn**		
	Level:	4	Enable / disable exhaust gas recirculation dependency
	Range:	0/1	on coolant temperature
	Page(s):		(on request)
4682	**InletAirMapOn**		
	Level:	4	Enable / disable inlet air throttle valve
	Range:	0/1	(on request)
	Page(s):		
4683	**InlAirPowCurveOrMap**		
	Level:	4	Setpoint for inlet air throttle valve derived from power-
	Range:	0/1	dependent curve (1) or from speed and fuel quantity
	Page(s):		dependent map (0) (on request)
4685	**WasteGateMapOn**		
	Level:	4	Enable /disable waste gate setpoint derived from speed
	Range:	0/1	and boost pressure dependent map
	Page(s):		(on request)
4686	**BypassValveMapOn**		
	Level:	4	Enable / disable bypass valve setpoint derived from
	Range:	0/1	speed and boost pressure dependent map
	Page(s):		(on request)
4690	**SpeedLimitChAirTmpOn**		*All except XIOS*
	Level:	4	Enable / disable charge air temperature dependent
	Range:	0/1	reduction of speed-dependent fuel quantity limitation
	Page(s): **Fehler! Textmarke nicht definiert.**		
4695	**SpeedLimitExhTempOn**		*All except XIOS*
	Level:	4	Enable / disable exhaust gas temperature dependent
	Range:	0/1	reduction of speed-dependent fuel quantity limitation
	Page(s): **Fehler! Textmarke nicht definiert.**		
4700	**SpeedLimitOn**		
	Level:	4	Enable / disable speed-dependent fuel quantity
	Range:	0/1	limitation
	Page(s): **Fehler! Textmarke nicht definiert.**		
4701	**SpeedLimitTempOn**		*All except XIOS*
	SpeedLimitCoolTempOn		
	Level:	4	Enable / disable temperature dependent reduction of
	Range:	0/1	speed-dependent fuel quantity limitation
	Page(s): **Fehler! Textmarke nicht definiert.**		
4705	**SpeedLimitOilTempOn**		*All except XIOS*

	Name		Meaning
	Level:	4	Enable / disable oil temperature dependent reduction of speed-dependent fuel quantity limitation
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4705	**FuelRedExhaustTempOn**		
	Level:	4	Enable / disable exhaust gas temperature dependent reduction of speed-dependent fuel quantity limitation
	Range:	0/1	
	Page(s):	98	
4706	**FuelRedCoolTempOn**		*XIOS*
	Level:	4	Enable / disable coolant temperature dependent reduction of speed-dependent fuel quantity limitation
	Range:	0/1	
	Page(s):	96	
4707	**FuelRedChAirTempOn**		*XIOS*
	Level:	4	Enable / disable charge air temperature dependent reduction of speed-dependent fuel quantity limitation
	Range:	0/1	
	Page(s):	97	
4708	**FuelRedFuelTempOn**		*XIOS*
	Level:	4	Enable / disable fuel temperature dependent reduction of speed-dependent fuel quantity limitation
	Range:	0/1	
	Page(s):	97	
4709	**FuelRedAmbPressOn**		*XIOS*
	Level:	4	Enable / disable ambient pressure dependent reduction of speed-dependent fuel quantity limitation
	Range:	0/1	
	Page(s):	98	
4710	**BoostLimitOn**		
	Level:	4	Enable / disable boost pressure dependent fuel quantity limitation
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4720	**ZeroFuelCurveOn**		
	Level:	4	Enable / disable zero delivery characteristic
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
4721ff	**FuelToActPosxCurveOn**		
	Level:	4	Enable / disable fuel quantity dependent actuator setpoint position for actuator x
	Range:	0/1	x = 1...3
	Page(s):	358	
4724	**CheckFuelLimitOn**		
	Level:	4	Enable / disable indication that engine is operating at power limit
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
4750	**FuelTempCorrOn**		

	Name		Meaning
	Level:	4	Enable / disable fuel temperature dependent fuel correction
	Range:	0/1	
	Page(s):**Fehler! Textmarke nicht definiert.**		
4800 ff			*Hardware-specific configuration parameters are described in the associated subchapters*
4810	**StopImpulseOrSwitch**		
	Level:	2	Selection of function mode for engine stop:
	Range:	0/1	0 = Engine stop active only as long as stop command is applied
	Page(s):	252	1 = Engine stop active after single pulse until engine is stopped

	Name	Meaning
4811	**StopOpenOrClose** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*DC 6* Engine stop switch active if 0: Closed 1: Open This function has a higher priority than the sign for 810 *FunctEngineStop* (RESET)
4849	**StartImpulseOrSwitch** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, 251	*DC 5, XIOS* Selection of function mode for engine start switch: 0 = Engine start active only as long as start command is applied 1 = Engine start active after single switch pulse until engine is running
4851ff	**DigitalOutx:Logic** Level: 6 Range: 0…7F Hex or 80 Hex Page(s): **Fehler! Textmarke nicht definiert.**	*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9* Logical link for multiple assignment to binary output x: DC 1-03: 1…3 DC 6: 1...2 DC 1-04: 1…5 DC 7: 1…7 DC 2: 1...5 DC 9: 1 DC 5: 1...11 Bit = 0: AND function Bit = 1: OR function 80 Hex: Flashing
4880ff	**DigitalOutx:Prior** Level: 6 Range: 0…FF Hex Page(s): **Fehler! Textmarke nicht definiert.**	*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9* Priority for multiple assignment to binary outputs (x: see 4851 *DigitalOutx:Logic*) Bit = 0: Output flashing Bit = 1: Output is continuously active
4900ff	**ChanTyp...** Level: 6 Range: 0...10 Page(s): 238	Configuration of input channel type for setpoint adjusters and sensors 0 = Analogue 1 = PWM 2 = HZM-CAN periphery module 3 = Custom CAN protocol 4 = CANopen 5 = DeviceNet 6 = Modbus 7 = SAE J1939 8 = HZM-CAN customer module 9 = HZM-CAN twin module 10 = WAGO module 13 = ICENI module 14= HZM-CAN ALL 15 = Frequency (XIOS only) 16 = HZM-CAN add-on module Sensors see 2900 ff

	Name		Meaning
4940	**BoostSensorRelOrAbs**		
	Level:	4	Boost pressure sensor configuration
	Range:	0/1	0: Absolute pressure sensor
	Page(s):		1: Relative pressure sensor
4950ff	**PEIx...**		
	Level:	6	Index of HZM-CAN periphery module in field 404
	Range:	0...2	*CanPENodeNumber*, which provides the setpoint
	Page(s):	238	adjuster or sensor
			Sensors see 2900 ff
5000ff	**…SubstOrLast**		
	Level:	4	Selection of substitute value for setpoint adjusters and
	Range:	0/1	sensors in case of error (0 = Last valid value, 1 =
	Page(s):	245	Substitute value)
			Sensors see 2900 ff
5040ff	**…HoldOrReset**		
	Level:	4	Selection whether error on setpoint adjuster /sensor
	Range:	0/1	is to be cleared or retained after signal return
	Page(s):	246	(0 = Error is cleared, 1 = Error is retained)
			Sensors see 2900 ff
5100	**NoStoreSErrOn**		
	Level:	6	Suppresses the storage of errors in the error memory
	Range:	0/1	until the control unit is restarted
	Page(s):	379	
5101	**CommAlarmWarnFlashOn**		
	Level:	2	Selection whether common alarm indicator should flash
	Range:	0/1	when only warnings are output
	Page(s):	374	
5102	**CommonAlarmResetOn**		
	Level:	2	Selects whether the common alarm indication will be
	Range:	0/1	briefly reset (edge change) when a new error is added
	Page(s):	374	
5103	**CommonAlarmResetBoth**		
	Level:	2	Selects whether the edge change (5102
	Range:	0/1	CommonAlarmResetOn = 1) is also generated when an
	Page(s):	374	error disappears (generally with every error change)
5150	**EcyActuatorDiffxOn**		*XIOS*
5151	Level:	6	Selects whether an actuator difference is fatal for the
5152	Range:	0/1	speed governor (engine stop)
	Page(s):	360	x = 1…3
5153	**EcyActuatorDiffxOn**		*Not XIOS*
5154	Level:	6	Selects whether an actuator difference is fatal for the
5155	Range:	0/1	speed governor (engine stop)
	Page(s):	360	x = 1…3

	Name		Meaning
5170	**EcyCanBusOn**		*All except XIOS*
	Level:	6	Selects whether the CAN bus error is fatal (engine stop)
	Range:	0/1	*See basic information HZM-CAN DG 13 002-d*
	Page(s):		
5171	**EcyCanCommOn**		*All except XIOS*
	Level:	6	Selects whether the CAN Comm error is fatal
	Range:	0/1	(engine stop)
	Page(s):		*See basic information HZM-CAN DG 13 002-d*
5184	**EcyACFatalErrorOn**		*All except XIOS*
	Level:	6	Selects whether fatal errors in one of the add-on
	Range:	0/1	modules is fatal for the speed governor (engine stop)
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		*See basic information HZM-CAN DG 13 002-d*
5189	**EcyPEFatalErrorOn**		*All except XIOS*
	Level:	6	Selects whether fatal errors in one of the periphery
	Range:	0/1	modules is fatal for the speed governor (engine stop)
	Page(s): 366, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		*See basic information HZM-CAN DG 13 002-d*
5210	**SyncAnalogOrDigital**		
	Level:	2	Synchronisation selection
	Range:	0/1	0 = Digital potentiometer
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		1 = Analogue control signal (e.g., SyG 02)
5211	**SyncInputOrHZM_SyG**		*DC 6*
	Level:	2	Synchronising signal type selection at multifunction
	Range:	0/1	port 2
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 239		0 = HZM SyG 02 1 = Device from other manufacturer (RESET)
5230	**LoadControlOrPot**		

	Name	Meaning
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Selection of load control input at MFP1 0 = Analogue load control setpoint 1 = Analogue control signal (e.g., LMG 10)
5231	**LoadControlOrHZM_LMG**	*DC 6*
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 239	Power control signal type selection at multifunction port 1 0 = HZM LMG 1 = Device from other manufacturer (RESET)
5233	**PowerGovernorOrLMG**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 414	Power control selection 0 = Selection corresponding to 5230 *LoadControlOrPot* 1 = Integrated power governor

	Name		Meaning
5234	**OffsModeFuelOrSpeed**		
	Level:	2	Selection of intervention mode with integrated power governor
	Range:	0/1	0 = Speed offset for speed governor (island operation)
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = Fuel offset (mains operation)
5235	**PowerGovPIDCurveOn**		
	Level:	2	Enable / disable PID characteristic for integrated power governor
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
5239	**SupvisePowerDiffOn**		
	Level:	2	Enable / disable power difference monitoring in integrated power governor
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
5241	**PowerSetpRampOn**		
	Level:	2	Enable / disable power setpoint ramp in integrated power governor
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
5243	**PowerSetpPCOn**		
	Level:	2	Enable / disable setpoint specification by PC for integrated power governor
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
5245	**KnockControlOn**		
	Level:	2	Enable / disable power reduction in integrated power governor in case of knocking
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
5247	**JetAssistOn**		
	Level:	2	Enable / disable boost function
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**		
5250	**ShipSetp2DigiOrAna**		
	Level:	2	Selection of setpoint adjuster 2 for maritime application
	Range:	0/1	0 = Analogue signal
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = Digital potentiometer
5251	**TwinEngineEnable**		
	Level:	2	Enable / disable master / slave mode in marine operation
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, 413		

	Name		Meaning
5252	**NoDigPotAtSetp1Err**		
	Level:	2	Disable automatic selection of digital potentiometer in case of error on setpoint adjuster 1 in marine operation
	Range:	0/1	
	Page(s): **Fehler! Textmarke nicht definiert.**, 246		

	Name	Meaning
5253	**ShipSetp1LeverOrPot**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Selection of type for setpoint adjuster 1 in marine operation 0: Without directional information (standard) 1: With directional information
5254	**NeutralGearPoweredOn**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Selection of neutral gear type in marine operation 0: Unpowered 1: Powered
5300	**VelocityOn**	*All except XIOS*
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Enable / disable velocity measurement
5305	**VelocityMaxGovOn**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable maximum velocity governor for velocity limitation
5309	**VelocityStaticCorrOn**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable static correction function in maximum velocity governor
5315	**CheckThrustOn**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable thrust monitoring
5350	**LocoSetpoint1Mode**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Selection of setpoint adjuster 1 in locomotive operation 0 = Speed notch switch 1 = Analogue signal 2 = Digital potentiometer
5351	**DigSlideSpeedSetpOn**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable slide protection intervention on speed setpoint
5352	**AnaSlideSpeedSetpOn**	

	Name	Meaning
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Enable / disable slide protection intervention by analogue slide signal
5353	**NotchAssignOrBinary**	
	Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, 251	Selection whether speed notch corresponds directly to binary value or is determined from a table.

	Name	Meaning
5360	**CoolantTmpWarnIdleOn** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS, locomotive operation* Enable / disable forced idle speed if coolant temperature warning 2 is triggered
5361	**OilTempWarnIdleOn** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS, locomotive operation* Enable / disable forced idle speed if oil temperature warning 2 is triggered
5362	**CoolPressWarnIdleOn** Level: 2 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	*XIOS, locomotive operation* Enable / disable forced idle speed if coolant pressure warning 2 is triggered
5380ff	**ErrMaskPEActuator(x)** Level: 1 Range: 0…3FFF Hex Page(s): 366	*Not XIOS* Mask for error states for actuators on currently connected HZM-CAN periphery modules that are important for the master x: Depending on application Bit = 0: Error is ignored Bit = 1: Error is observed XIOS see 25030 *ErrMaskPEActuator(x)*
5440ff	**ErrMaskPEModul(x)** Level: 1 Range: 0...3FFF Hex Page(s): 366, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Mask for error states for currently connected HZM-CAN periphery modules that are fatal for the master (engine shutdown) if 5189 *EcyPEFatalErrorOn* = 1 is set x = 0…2 Bit = 0: Error is ignored Bit = 1: Error is observed XIOS see 25002 *EcyMaskPEModul(x)*
5443ff	**ErrMaskACModul(x)** Level: 1 Range: 0...3FFF Hex Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Not XIOS* Mask for error states for currently connected HZM-CAN add-on modules that are fatal for the master (engine shutdown) if 5189 *EcyPEFatalErrorOn* = 1 is set x = 0...4 Bit = 0: Error is ignored Bit = 1: Error is observed XIOS see 25006 *EcyMaskACModul(x)*
5510 ff		*Hardware-specific configuration parameters are described in the associated subchapters*
5700	**PositionerOn**	

Name		Meaning
Level:	2	Control unit works as: 0 = Speed governor 1 = Positioner, see 1700 *PositionerSetpoint* (test mode, cannot be saved)
Range:	0/1	
Page(s):**Fehler! Textmarke nicht definiert.**, 365		

	Name		Meaning
5701	**PositionerMode**		
	Level:	2	Selection of positioning mode for the actuator
	Range:	0...3	0 = Specification from 1700
	Page(s):	365	1 = Rectangular from 1700 ± 1701
			2 = Delta from 1700 ± 1701
			3 = Sinusoidal from 1700 ± 1701
5900	**FeedbZeroPosAdjustOn**		
	ActxZeroPosAdjustOn		
5934	Level:	6	Enable / disable automatic actuator adjustment at each
5944	Range:	0/1	engine stop
	Page(s):	355	Accepted for only one actuator and only for the one to which the speed governor is assigned
			x = 1…3
5910	**ActuatorxOn**		
5930	Level:	6	Enable/disable servo loop for actuator x
5940	Range:	0/1	x = 1…3
	Page(s):**Fehler! Textmarke nicht definiert.**, 172, 351, 362		
5911	**Amplifier2QOr4Q**		*All except DC 5, DC 7, DC 10*
5931	Level:	6	Amplifier operating principle
5941	Range:	0/1	0 = 4-quadrant (energizing in both directions)
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 351		1 = 2-quadrant (energizing towards 100 %)
5915	**ServoxCurrentCorrOn**		*DC 1, DC 2, DC 7, DC 10, XIOS*
5935	Level:	6	Enable / disable voltage dependent current correction
5945	Range:	0/1	of actuator current for actuator x
	Page(s):	363	x = 1…3
5916	**ServoxCurrentPermOn**		
5936	Level:	6	Enable / disable continuous energising of actuator x
5946	Range:	0/1	x = 1…3
	Page(s):	363	
5920	**ServoCurrentPCOn**		
	Level:	6	Enable / disable actuator test mode to output the current
	Range:	0/1	from 1920 *ServoCurrentPC* to all enabled actuators as a
	Page(s):	362	test setpoint (test mode, cannot be saved)
5950	**FeedbDigitalOrAnalog**		*DC 2, DC 6, DC 9*
	Level:	6	Type of actuator feedback
	Range:	0/1	0 = DC voltage signal
	Page(s):	351	1 = coil feedback (RESET)
5951	**FeedbxSlopeFallOrRise**		
5961	Level:	6	Type of feedback signal slope for actuator x
5971	Range:	0/1	0 = Rising output signal with rising fuel quantity
	Page(s):	351	1 = Falling output signal with rising fuel quantity
			x = 1…3 (RESET)

	Name		Meaning
5952ff	**FeedbackxLinearOn**		
	Level:	6	Enable / disable linearisation characteristic for feedback
	Range:	0/1	from actuator x
	Page(s):	352	x = 1..3
14000 ff			*Dual fuel parameters are described in the subchapter*
14900	**ChanTypExhTempCylx**		*XIOS*
ff	Level:	1	Configuration of input channel type for exhaust
	Range:	0…38	temperature sensors
	Page(s):	238	x = 1…24
			Exhaust temperature sensors see 12900 ff
			Channel types see 4900 *ChanTyp…*
14950	**PEIxExhTempCylx**		*XIOS*
ff	Level:	6	Index of HZM-CAN periphery module in field 404
	Range:	0…2	*CanPENodeNumber*, which provides the exhaust
	Page(s):	238	temperature sensor
			x = 1..24, Exhaust temperature sensors see 12900 ff
15000	**ExTmpCylxSubstOrLast**		*XIOS*
	Level:	4	Selection of substitute value for exhaust temperature
	Range:	0/1	sensors in case of error (0 = Last valid value, 1 =
	Page(s):	246	Substitute value)
			x = 1..24, Exhaust temperature sensors see 2900 ff
15040	**ExTmpCylxHoldOrReset**		*XIOS*
	Level:	4	Selection whether error on exhaust temperature sensor
	Range:	0/1	is to be cleared or retained after signal return
	Page(s):	247	(0 = Error is cleared, 1 = Error is retained)
			x = 1...24, exhaust temperature sensors see 2900 ff
15400 ff	**Out1:Destination** **Outx:Destination**		*DC 8, DC 11, DC 12, XIOS*
	Level:	6	Selection of target hardware for output x
	Range:	0...y	x = 1...120 or lower, application-specific,
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		by default total outputs in own hardware and all connected communication modules y = 0: Own hardware 2: HZM-CAN periphery module 10: WAGO module 13: ICENI module
15401 ff	**Out1:PEIx** **Outx:PEIx**		*DC 8, DC 11, DC 12, XIOS*
	Level:	6	Index of associated periphery module in 404
	Range:	0...2	*CanPENodeNumber* if Outx:Destination = 2
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		x see 15400 *Outx:Destination*

	Name		Meaning
15402 ff	**Outx:OutputType**		*DC 8, DC 11, DC 12, XIOS*
	Level:	6	Type of output on target hardware
	Range:	0...y	y =
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		0: Analogue output 1: PWM output 2: Binary output 3: Actuator output or solenoid valve control
15403 ff	**Outx:OutputNo**		*DC 8, DC 11, DC 12, XIOS*
	Level:	6	Number of output corresponding to output type and target hardware
	Range:	0…x	
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		x Application-specific, corresponds to maximum possible number for all output types on all possible target hardware variations
24000 ff			*XIOS configuration parameters are described in the XIOS subchapter*
24810 ff	**ChanTyp...**		
	Level:	6	Module type configuration if a switching function is received via a communication module
	Range:	0…15 or -15…+15	0..1: Not used
	Page(s):	248, 257, 258	2: HZM-CAN periphery module 3: Custom CAN protocol 4: CANopen 5: DeviceNet 6: Modbus 7: SAE J1939 8: HZM-CAN customer module 9: HZM-CAN twin module 10: WAGO module 13: ICENI module 14..15: Not used 16: HZM-CAN add-on module Switching functions see 2810 ff
24910 ff	**PEIx...**		
	Level:	6	Index of HZM-CAN periphery module in field 404 *CanPENodeNumber*, which provides the switching function
	Range:	0...2	
	Page(s):	248, 258	Switching functions see 2810 ff
25002 ff	**EcyMaskPEModul(x)**		*XIOS*
	Level:	1	Mask for error states for currently connected HZM-CAN periphery modules that are fatal for the master (engine shutdown)
	Range:	0…3FFF Hex	x = 0…2
	Page(s): 366, **Fehler! Textmarke nicht definiert.**		Bit = 0: Error is ignored Bit = 1: Error is observed Not XIOS see 5440 *ErrMaskPEModul(x)*

25006 ff	**EcyMaskACModul(x)** Level: 1 Range: 0...3FFF Hex Page(s):**Fehler! Textmarke nicht definiert.**	*XIOS* Mask for error states for currently connected HZM-CAN add-on modules that are fatal for the master (engine shutdown) x = 0...4 Bit = 0: Error is ignored Bit = 1: Error is observed Not XIOS see 5443 *ErrMaskACModul(x)*
25030 ff	**ErrMaskPEActuator(x)** Level: 1 Range: 0...3FFF Hex Page(s): 366	*XIOS* Mask for error states for actuators on currently connected HZM-CAN periphery modules that are important for the master x: Depending on application Bit = 0: Error is ignored Bit = 1: Error is observed Not XIOS see 5380 *ErrMaskPEActuator(x)*

Tab. 192: Functions

28.3.1 DC 1

Here, the functions are described which are only available in DC 1 type control units due to the special hardware requirements.

No.	Name	Meaning
4801	**PWMInOrDigitalIn11** Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Signal type of digital input channel 1 0 = Binary input 11 1 = PWM input (RESET)
4802	**PWMIn2OrDigitalIn12** Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	*Not DC 1-04* Signal type of digital input channel 2 0 = Binary input 12 1 = PWM input 2 (RESET)
4803	**PWMOut1OrDigitalOut1** Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Signal type of digital output channel 1 0 = Binary output 1 1 = PWM output 1 (RESET)
4804	**PWMOut2OrDigitalOut2**	

No.	Name		Meaning	
	Level:	6	Signal type of digital output channel 2	
	Range:	0/1	0 = Binary output 2	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		1 = PWM output 2	(RESET)
4805	**PWMOut3OrDigitalOut3**			
	Level:	6	Signal type of digital output channel 3	
	Range:	0/1	0 = Binary output 3	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		1 = PWM output 3	(RESET)

No.	Name	Meaning
4806	**PWMIn1VelocityOrPWM**	
	Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Signal type of digital input channel 1 if 4801 PWMInOrDigitalIn1 = 1 (PWM) 0 = PWM input 1 = Speed input (RESET)
4807	**PWMIn2VelocityOrPWM**	*Not DC 1-04*
	Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Signal type of digital input channel 2 if 4802 PWMInOrDigitalIn2 = 1 (PWM) 0 = PWM input 1 = Speed input (RESET)
5512 **5522** **5532** **5542**	**AnalogInx_TempLin** Level: 4 Range: 0...4 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Selection of linearisation curve for temperature sensor at analogue input x x = 1...4
5590 **5595**	**TempInx_SensorType** Level: 4 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Selection of linearisation curve for temperature input x (0 = Linearisation curve 1, 1 = Linearisation curve 2) x = 1...2
5912	**CheckBrakeOn**	*Control unit with brake function*
	Level: 4 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	1: Brake status monitoring

Tab. 193: DC 1 functions

28.3.2 DC 2

Here, the functions are described which are only available in DC 2 type control units due to the special hardware requirements.

No.	Name	Meaning
4800	**DigChannel1OutOrIn**	
	Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Connection type of digital channel 1 0 = Input 1 = Output (RESET)
4801	**DigChannel1PWMOrDIO**	

No.	Name		Meaning	
	Level:	6	Signal type of digital channel 1	
	Range:	0/1	0 = Binary signal	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = PWM signal	(RESET)
4802	**DigChannel2OutOrIn**			
	Level:	6	Connection type of digital channel 2	
	Range:	0/1	0 = Input	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Output	(RESET)

No.	Name		Meaning	
4803	**DigChannel2PWMOrDIO**			
	Level:	6	Signal type of digital channel 2	
	Range:	0/1	0 = Binary signal	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = PWM signal	(RESET)
4804	**DigChannel3OutOrIn**			
	Level:	6	Connection type of digital channel 3	
	Range:	0/1	0 = Input	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Output	(RESET)
4805	**DigChannel3PWMOrDIO**			
	Level:	6	Signal type of digital channel 3	
	Range:	0/1	0 = Binary signal	
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = PWM signal	(RESET)
4806	**DigChannel4OutOrIn**			
	Level:	6	Connection type of digital channel 4	
	Range:	0/1	0 = Input	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Output	(RESET)
4807	**DigChannel4PWMOrDIO**			
	Level:	6	Signal type of digital channel 4	
	Range:	0/1	0 = Binary signal	
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = PWM signal	(RESET)
4809	**DigChannel5PWMOrDO**			
	Level:	6	Signal type of digital channel 5	
	Range:	0/1	0 = Binary	
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = PWM signal	(RESET)
5512	**AnalogInx_TempLin**			
5522	Level:	4	Selection of linearisation curve for temperature sensor	
5532	Range:	0…4	at analogue input x	
5542	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		x = 1...4	
5550	**TempInx_SensorType**			
5560	Level:	4	Selection of linearisation curve for temperature input 1	
	Range:	0/1	(0 = Linearisation curve 1, 1 = Linearisation curve 2)	
	Page(s):**Fehler! Textmarke nicht definiert.**		x = 1…2	
5651	**VoltOutxRange10Vor5V**			
5656	Level:	4	Selection of range for voltage output x	
	Range:	0/1	0 = 0...5 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = 0...10 V x = 1...2	(RESET)

Tab. 194: DC 2 functions

28.3.3 DC 5

Here, the functions are described which are only available in DC 5 type control units due to the special hardware requirements.

No.	Name		Meaning	
4800	**PWMIn1OrDigitalIn1**			
	Level:	6	Connection type of digital channel 1	
	Range:	0/1	0 = Binary input 1	
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = PWM input 1	(RESET)
4801	**FreqOut1OrDigOut8**			
	Level:	6	Signal type of selectable channel OD8	
	Range:	0/1	0 = Binary output 8	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Frequency output 1	(RESET)
4802	**FreqOut2OrDigital**			
	Level:	6	Connection type of selectable channel OD9	
	Range:	0/1	0 = Binary output	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Frequency output 2	(RESET)
4803	**PWMOut2OrDigOut9**			
	Level:	6	Signal type for selectable channel OD9 if 4802	
	Range:	0/1	*FreqOut2OrDigital* = 0	
	Page(s):**Fehler! Textmarke nicht definiert.**		0 = Binary output 9	
			1 = PWM output 2	(RESET)
4804	**PWMOut1OrDigOut10**			
	Level:	6	Signal type of digital output channel	
	Range:	0/1	0 = Binary output 10	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = PWM output 1	(RESET)
5512	**AIxWithSensorSupply**			
5522	Level:	6	Selection of whether the sensor supply is used for	
5532	Range:	0/1	analogue input x	
5542	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		x = 1…4	(RESET)
5550	**AnalogIn5_Type**			
	Level:	4	Selection of signal type for analogue input 5	
	Range:	1…2	1: 0...5 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		2: 0…25 mA	(RESET)
5552	**AnalogIn5_TempLin**			

No.	Name	Meaning
	Level: 4 Range: 0…4 Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Selection of linearisation curve for temperature sensor at analogue input 5
5570	**TempInx_SensorType**	
5575 **5580** **5585**	Level: 4 Range: 0…3 Page(s): **Fehler! Textmarke nicht definiert.**	Selection of linearisation curve for temperature input x x = 1...4

No.	Name		Meaning	
5640	**AnalogOut_Type**			
	Level:	4	Selection of signal type of analogue output	
	Range:	3/4	3: 0...5 V	
	Page(s):**Fehler! Textmarke nicht definiert.**		4: 0...25 mA	(RESET)

Tab. 195: DC 5 functions

28.3.4 DC 6

Here, the functions are described which are only available in DC 6 type control units due to the special hardware requirements.

No.	Name		Meaning	
4800	**Port1Type**			
	Level:	6	Signal type of multifunctional channel 1	
	Range:	0/1	0 = Analogue	
	Page(s): **Fehler! Textmarke nicht**		1 = PWM	
	definiert.		2 = Binary	(RESET)
4801	**Port1OutOrIn**			
	Level:	6	Connection type of multifunctional channel 1	
	Range:	0/1	0 = Input	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Output	(RESET)
4802	**Port2Type**			
	Level:	6	Signal type of multifunctional channel 2	
	Range:	0/1	0 = Analogue	
	Page(s):**Fehler! Textmarke nicht**		1 = PWM	
	definiert.		2 = Binary	(RESET)
4803	**Port2OutOrIn**			
	Level:	6	Connection type of multifunctional channel 2	
	Range:	0/1	0 = Input	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Output	(RESET)
4804	**AnalogIn3OrDigIn3**			
	Level:	6	Signal type of channel 3	
	Range:	0/1	0 = Binary input 3	
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Analogue input 3	(RESET)
4805	**PUp2_PWMIn3OrDigIn5**			
	Level:	6	Signal type of channel 5	
	Range:	0/1	0 = Binary input 5	
	Page(s): **Fehler! Textmarke nicht**		1 = Pickup2 or PWM input 3	
	definiert.		If 1: Pickup 2 if 4002 *PickUp2On* = 1,	
			Otherwise PWM input 3	(RESET)

No.	Name		Meaning
5510 5520 5530	**AnalogInx_Type** Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**	 2 1…3	 Selection of signal type of analogue input x 1: 0...5 V 2: 0...22.7 mA 3: 0...10 V (not with x = 3) x = 1...3 (RESET)
5513 5523 5533	**AnalogInx_TempLin** Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	 4 0…4	 Selection of linearisation curve for temperature sensor at analogue input x x = 1...3
5532	**AI3WithSensorSupply** Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	 6 0/1	 Selection of whether the sensor supply is used for analogue input 3 (RESET)
5540	**TempIn_SensorType** Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**	 2 0/1	 Selection of linearisation curve for temperature sensor (0 = Linearisation curve 1, 1 = Linearisation curve 2)

Tab. 196: DC 6 functions

28.3.5 DC 7

Here, the functions are described which are only available in DC 7 type control units due to the special hardware requirements.

No.	Name		Meaning
4800	**F24_ANAIn1OrDigIn6** Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	 6 0/1	 Signal type of input at vehicle connector pin 24 0: Binary input 6 1: Analogue input 1 (RESET)
4801	**M24_ANAIn2OrDigIn7** Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	 6 0/1	 Signal type of input at engine connector pin 24 0: Binary input 7 1: Analogue input 2 (RESET)
4802	**F20_ANAIn3OrDigIn8** Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	 6 0/1	 Signal type of input at vehicle connector pin 20 0: Binary input 8 1: Analogue input 3 (RESET)

No.	Name		Meaning
4803	**M21_ANAIn4OrDigIn9**		
	Level:	6	Signal type of input at engine connector pin 21
	Range:	0/1	0: Binary input 9
	Page(s): **Fehler! Textmarke nicht definiert.**		1: Analogue input 4 (RESET)

No.	Name	Meaning
4804	**F18_PWMIn1OrDigIn1** Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Signal type of input at vehicle connector pin 18 0: Binary input 1 1: PWM input 1 (RESET)
4805	**F21_PWMIn2OrDigIn2** Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Signal type of input at vehicle connector pin 21 0: Binary input 2 1: PWM input 2 (RESET)
4806	**F07_VELOInOrDigIn10** Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Signal type of input at vehicle connector pin 7 0: Binary input 10 1: Speed input (RESET)
4807	**F05_PWMOut1OrDigOut1** Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Signal type of output at vehicle connector pin 5 0: Binary output 1 1: PWM output 1 (RESET)
4808	**M07_PWMOut2OrDigOut6** Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Signal type of output at engine connector pin 7 0: Binary output 6 1: PWM output 2 (RESET)
4809	**F16SPEEDOutOrDigOut7** Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Signal type of output at vehicle connector pin 16 0: Binary output 7 1: Speed output (RESET)
5512 **5522** **5532** **5542**	**AI**x**WithSensorSupply**y Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Selection of whether the sensor supply y is used for analogue input x x = 1…4, y = 1, 2, 4 (RESET)
5550 **5555** **5560**	**TempInx_SensorType** Level: 6 Range: 0...3 Page(s): **Fehler! Textmarke nicht definiert.**	Selection of linearisation curve for temperature sensor x = 1...3

Tab. 197: DC 7 functions

28.3.6 DC 8

Here, the functions are described which are only available in DC 8 type control units due to the special hardware requirements.

No.	Name	Meaning
5542	**AIxWithSensorSupply**	
5552 **5562**	Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Selection of whether the 5V sensor supply is used for analogue input x x = 4…6
5570	**TempInx_SensorType**	
5580	Level: 6 Range: 0...3 Page(s): **Fehler! Textmarke nicht definiert.**	Selection of linearisation curve for temperature sensor x x = 1...2
5608ff	**SensorSupplyx:On**	
	Level: 6 Range: 0/1 Page(s): **Fehler! Textmarke nicht definiert.**	Selection of whether the 24 V sensor supply x is used x = 1...2

Tab. 198: DC 8 functions

28.3.7 DC 9

Here, the functions are described which are only available in DC 9 type control units due to the special hardware requirements.

No.	Name	Meaning
4804	**AnalogIn1OrDigIn1**	
	Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Signal type of channel 1 0 = Binary input 1 1 = Analogue input 1 (RESET)
4805	**PUp2_PWMInOrDigIn3**	
	Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Signal type of channel 3 0 = Binary input 3 1 = Pickup 2 or PWM input If 1: Pickup 2 if 4002 *PickUp2On* = 1, Otherwise PWM input (RESET)
4806	**AnalogIn2OrDigIn4**	
	Level: 6 Range: 0/1 Page(s):**Fehler! Textmarke nicht definiert.**	Signal type of channel 4 0 = Binary input 4 1 = Analogue input 2 (RESET)

No.	Name		Meaning
5510	**AnalogIn1_Type**		
	Level:	6	Selection of signal type of analogue input 1
	Range:	1/2	1: 0..5 V
	Page(s):**Fehler! Textmarke nicht definiert.**		2: 0..22.7 mA (RESET)

No.	Name		Meaning
5512	**AI1WithSensorSupply**		
	Level:	2	Selection of whether the 5V sensor supply is used for
	Range:	0/1	analogue input 1
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		(RESET)

Tab. 199: DC 9 functions

28.3.8 DC 10

Here, the functions are described which are only available in DC 10 type control units due to the special hardware requirements.

No.	Name		Meaning
4800	**Port1AnalogOrDigital**		
	Level:	6	Signal type of multifunctional channel 1
	Range:	0/1	0 = Binary
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Analogue (RESET)
4802	**Port2AnalogOrDigital**		
	Level:	6	Signal type of multifunctional channel 2
	Range:	0/1	0 = Binary input
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Analogue input or output (RESET)
4803	**Port2OutOrIn**		
	Level:	6	Connection type of multifunctional channel 2, if used as
	Range:	0/1	analogue
	Page(s):**Fehler! Textmarke nicht definiert.**		0 = Analogue input 1 = Analogue output (RESET)
4805	**Port3AnalogOrDigital**		
	Level:	6	Signal type of multifunctional channel 3 (input)
	Range:	0/1	0 = Binary
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Analogue (RESET)
4806	**Port4AnalogOrDigital**		
	Level:	6	Signal type of multifunctional channel 4 (input)
	Range:	0/1	0 = Binary
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Analogue (RESET)
4807	**Port5Type**		

No.	Name		Meaning
	Level:	6	Signal type of multifunctional channel 5 (input)
	Range:	0...4	0 = Analogue
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = PWM
			2 = Binary
			3 = Pickup 2
			4 = Temperature (RESET)

No.	Name		Meaning
4808	**Port5_PullUp5VOn**		
	Level:	6	Signal type of multifunctional channel 5
	Range:	0/1	(RESET)
	Page(s):**Fehler! Textmarke nicht definiert.**		
4809	**Port6Type**		
	Level:	6	Signal type of multifunctional channel 6 (input)
	Range:	0...2	0 = Analogue
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = Binary 2 = Pickup 1 (RESET)
5510	**AnalogIn1_CurrOrVolt**		
	Level:	2	Selection of signal type of analogue input 1
	Range:	0/1	0: 0..5 V
	Page(s):**Fehler! Textmarke nicht definiert.**		1: 0..22.59 mA (RESET)
5520	**AnalogIn2_10Vor5V**		
	Level:	2	Selection of signal type of analogue input 2
	Range:	0/1	0: 0..5 V
	Page(s):**Fehler! Textmarke nicht definiert.**		1: 0...10V (RESET)
5570	**TempLin_SensorType**		
	Level:	4	Selection of linearisation curve for temperature input:
	Range:	0...5	0: PT1000
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		1: Ni1000 2: PT200 3: Bosch DS-S2-TF (NTC) 4: Jumo 2K3A1-25 (NTC) 5: Freely configurable

Tab. 200: DC 10 functions

28.3.9 DC 11

Here, the functions are described which are only available in DC 11 type control units due to the special hardware requirements.

No.	Name		Meaning
4800	**Port1_Type**		
	Level:	6	Signal type of multifunctional channel 1
	Range:	0...2	0 = Analogue
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = PWM 2 = Binary (RESET)
4801	**Port1_OutputOrInput**		

No.	Name		Meaning
	Level:	6	Connection type of multifunctional channel 1
	Range:	0/1	0 = Input
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = Output (RESET)

No.	Name		Meaning
4802	**Port2_Type**		
	Level:	6	Signal type of multifunctional channel 2
	Range:	0...2	0 = Analogue
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = PWM 2 = Binary (RESET)
4803	**Port2_OutputOrInput**		
	Level:	6	Connection type of multifunctional channel 2
	Range:	0/1	0 = Input
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = Output (RESET)
4804	**Port3_InputType**		
	Level:	6	Signal type of multifunctional channel 3
	Range:	0...3	Input only
	Page(s): **Fehler! Textmarke nicht definiert.**		0 = Analogue 1 = PWM 2 = Binary 3 = Pickup 2 (if 4002 *PickUp2On* = 1) (RESET)
4805	**Port4_InputAnaOrDig**		
	Level:	6	Signal type of input channel 4
	Range:	0/1	0 = Binary
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = Analogue (RESET)
4806	**Port5_InputAnaOrDig**		
	Level:	6	Signal type of input channel 5
	Range:	0/1	0 = Binary
	Page(s): **Fehler! Textmarke nicht definiert.**		1 = Analogue (RESET)
5510	**AnalogInx_Type**		
5520	Level:	2	Selection of signal type of analogue input x
5550	Range:	1...3	1: 0..5 V
	Page(s):**Fehler! Textmarke nicht definiert.**		2: 0...22.7 mA 3: 0...10 V (not with x = 5) x = 1, 2, 5 (RESET)
5512	**AIxWithSensorSupplyy**		
5522	Level:	2	Selection of whether the sensor supply y is used for
5532	Range:	0/1	analogue input x
5542 **5552**	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		x = 1...3, y = 1, 2 (RESET)
5513	**Port1Resistor**		
	Level:	2	Selection of whether a resistor is to be connected at
	Range:	0...2	analogue input 1
	Page(s):**Fehler! Textmarke nicht definiert.**		0 = No resistor used 1 = Select HEINZMANN LMG at this port 2 = Pull-up resistor (RESET)

No.	Name		Meaning
5523	**Port2Resistor**		
	Level:	2	Selection of whether a resistor is to be connected at analogue input 2
	Range:	0...2	0 = No resistor used
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Select HEINZMANN SyG at this port
			2 = Pull-up resistor (RESET)
5533	**PortxResistor**		
5543	Level:	2	Selection of whether a resistor is to be connected at analogue input x
	Range:	0...2	0 = No resistor used
	Page(s):**Fehler! Textmarke nicht definiert.**		1 = Pull-down resistor
			2 = Pull-up resistor
			x = 3..4 (RESET)

Tab. 201: DC 11 functions

28.3.10 XIOS

Here, the functions are described which are only available in type XIOS control units due to the special hardware requirements.

No.	Name		Meaning
4030	**PickUp1PortNo**		
	Level:	4	Port that the first speed pickup is connected to
	Range:	89…105	(port 89, 90, 104 or 105 possible) (RESET)
	Page(s):	301	
4031	**PickUp2PortNo**		
	Level:	4	Port that the second speed pickup is connected to
	Range:	89…105	(port 89, 90, 104 or 105 possible) (RESET)
	Page(s):	301	
14400	**AmplifierxOn**		
14405	Level:	6	Activate / deactivate current output for current controlled valve on hydraulic adjusters
14410	Range:	0/1	x = 1…3
	Page(s):	368	
14403	**AmplifierxCurrDiffCheckOn**		
14408	Level:	6	Activate / deactivate differential current monitoring of current output for current controlled valve on hydraulic adjusters
14413	Range:	0/1	x = 1…3
	Page(s):	369	
14404	**EcyAmplifierxErrorOn**		
14409	Level:	6	Selects whether a monitoring error on the current controlled valve on hydraulic adjusters is fatal for the speed governor (engine stop)
14414	Range:	0/1	x = 1…3
	Page(s):	370	

No.	Name		Meaning
24000	**P001_(SL1.1)_Config**		
…			
24116	**P117_(MD.AI8)_Config**		
	Level:	1	Configuration of the ports
	Range:	0...39	
	Page(s):	295, 297, 303	

Tab. 202: Functions XIOS

28.3.11 Dual fuel

↑*16* Speed control for dual fuel engines (ARTEMIS) and separate ARTEMIS manuals

No.	Name		Meaning
14000	**DualFuelOn**		
	Level:	4	Switching on/off of dual fuel operation type
	Range:	0/1	
	Page(s):	173	
14002	**CheckChAirTmpInRange**		
	Level:	4	Charge air temperature must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	190	
14005	**CheckGasPressInRange**		
	Level:	4	Gas pressure must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	194	
14010	**CheckSpeedInRange**		
	Level:	4	Speed must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	195	
14012	**CheckDieslAbovePilot**		
	Level:	4	Speed must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	196	
14013	**CheckPowerInRange**		
	Level:	4	Power must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	185, 226	
14014	**CheckKnocking**		
	Level:	4	Enable / disable knock monitoring
	Range:	0/1	
	Page(s):	199	

No.	Name		Meaning
14015	**CheckOilPressInRange**		
	Level:	4	Oil pressure must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	192	
14016	**CheckBoostPrInRange**		
	Level:	4	Boost pressure must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	193	
14017	**CheckExhTempInRange**		
	Level:	4	Exhaust temperature must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	186	
14020	**CheckCoolTempInRange**		
	Level:	4	Coolant temperature must be in permissible range for dual fuel operation
	Range:	0/1	
	Page(s):	189	
14021	**GasFuelToActPosCrvOn**		
	Level:	4	Enable / disable linearisation characteristic for gas actuator setpoint (gas fuel quantity)
	Range:	0/1	
	Page(s):	170	
14023	**GasFuelLimitSpeedOn**		
	Level:	4	Enable / disable speed-dependent gas fuel quantity limitation
	Range:	0/1	
	Page(s):	220, 224	
14027	**GasFuelLimitPowerOn**		*Generator operation, locomotive operation*
	Level:	4	Enable / disable power-dependent gas fuel quantity limitation
	Range:	0/1	
	Page(s):	221, 226	
14028	**GasTempFactorOn**		
	Level:	4	Enable / disable gas temperature dependent correction of gas fuel quantity
	Range:	0/1	
	Page(s):	231	
14029	**GasPressFactorOn**		
	Level:	4	Enable / disable gas pressure dependent correction of gas fuel quantity
	Range:	0/1	
	Page(s):	231	
14050	**DieselPowerCurveOn**		
	Level:	4	Determination of current power proportion for diesel and gas
	Range:	0/1	
	Page(s):	167	
14055	**PilotAbsMinCurveOn**		
	Level:	4	Enable / disable the speed-dependent absolute minimum ignition oil quantity
	Range:	0/1	
	Page(s):	164	

No.	Name		Meaning
14057	**GasOff@AriadneFatal**		
	Level:	4	Switch off gas if Ariadne reports fatal error because
	Range:	0/1	knock monitoring is not possible
	Page(s):	199	
14070	**GasPowGovPIDCurveOn**		*Integrated power governor*
	Level:	4	Enable / disable PID curve for integrated power
	Range:	0/1	governor in dual fuel operation
	Page(s):	214	
14080	**CheckGasValveReady**		*Gas section test*
	Level:	4	Enable / disable gas section test
	Range:	0/1	
	Page(s):	184	
14090	**GasActuatorOn**		*DC 1-04*
	Level:	4	Enable / disable second actuator for gas setpoint
	Range:	0/1	
	Page(s):	170	
14091	**GasDoubleActuatorOn**		*DC 1-04*
	Level:	4	Enable / disable third actuator parallel to second
	Range:	0/1	actuator for gas setpoint
	Page(s):	170	
14100	**GasReductChAirTmpOn**		
	Level:	4	Enable / disable charge air temperature dependent
	Range:	0/1	reduction of gas limitation
	Page(s):	228	
14103	**GasReductExhTempOn**		
	Level:	4	Enable / disable exhaust temperature dependent
	Range:	0/1	reduction of gas limitation
	Page(s):	229	
14106	**GasReductCoolTempOn**		
	Level:	4	Enable / disable coolant temperature dependent
	Range:	0/1	reduction of gas limitation
	Page(s):	230	

Tab. 203: Dual fuel functions (general)

28.3.12 ICENI

↑*23.7* CAN protocol ICENI® (CANopen)

No.	Name		Meaning
25550	**IceniCommOn**		
	Level:	4	Enable / disable communication with ICENI modules
	Range:	0/1	(RESET)

Tab. 204: ICENI functions

28.3.13 WAGO

↑*23.6* CAN protocol WAGO® (CANopen) and AXIOMATIC® (CANopen)

No.	Name		Meaning
25700	**WagoCommOn**		
	Level:	4	Enable / disable communication with WAGO modules
	Range:	0/1	(RESET)

Tab. 205: WAGO functions

28.3.14 CANopen

↑*23.4* CAN protocol CANopen and CANopen, Manual DG 06 002-e

No.	Name		Meaning
25750	**CanOpenOn**		
	Level:	4	Enable / disable CANopen communication
	Range:	0/1	(RESET)
25753	**CanOp:EMCYOn**		
	Level:	4	Enable / disable sending of EMCY telegram
	Range:	0/1	(RESET)
25770	**CanOp:RPDOxOn**		*If only 4 RPDOs are possible*
ff	Level:	4	Enable / disable RPDO telegrams
	Range:	0/1	x = 1…4
			See 25790 if more than 4 RPDOs are possible
			(RESET)
25775	**CanOp:TPDOxOn**		
ff	Level:	4	Enable / disable TPDO telegrams
	Range:	0/1	x = 1...16 (RESET)

No.	Name		Meaning
25790 ff	**CanOp:RPDOxOn**		*If more than 4 RPDOs are possible*
	Level:	4	Enable / disable RPDO telegrams
	Range:	0/1	x = 1...10
			See 25770 if only 4 RPDOs are possible
			(RESET)

Tab. 206: CANopen functions

28.3.15 Modbus

↑*23.8* Serial protocol Modbus and Manual DG 05 002-e

No.	Name		Meaning
25800	**ModbusOn**		
	Level:	4	Enable / disable Modbus communication
	Range:	0/1	(RESET)
25801	**Modb:ParityBitOn**		
	Level:	4	Selection of transmission type
	Range:	0/1	0 = Without parity bit
			1 = With parity bit (RESET)
25802	**Modb:ParityOddOrEven**		
	Level:	4	Selection of parity when parity bit is enabled
	Range:	0/1	0 = Even parity
			1 = Odd parity (RESET)
25803	**Modb:OneOrTwoStopBit**		
	Level:	4	Selection of stop bits
	Range:	0/1	0 = Two stop bits
			1 = One stop bit (RESET)

Tab. 207: Modbus functions

28.3.16 DeviceNet

↑*23.5* CAN protocol DeviceNet and Manual DG 06 003-e

No.	Name		Meaning
25850	**DeviceNetOn**		
	Level:	4	Enable / disable DeviceNet communication
	Range:	0/1	(RESET)

Tab. 208: DeviceNet functions

28.3.17 SAE J1939

↑*23.3* CAN protocol SAE J1939 and Manual DG 06 004-e

No.	Name		Meaning
25900	**SAE_J1939On**		
	Level:	4	Enable / disable SAE J1939 communication
	Range:	0/1	(RESET)
25901 ff	**J1939:RxMsgTSC1_xOn**		*TSC1*
	Level:	4	Enable / disable “Torque/Speed Control 1” receiving
	Range:	0/1	telegrams
			x = 1..4 (Standard 1) (RESET)
25902	**J1939:RxMsgSNSOn**		*AT1OG1*
	Level:	4	Enable / disable “Aftertreatment 1 Outlet Gas 1”
	Range:	0/1	receiving telegram (RESET)
25903	**J1939:RxMsgEBC1On**		*EBC1*
	Level:	4	Enable / disable “Electronic Brake Controller 1”
	Range:	0/1	receiving telegram (RESET)
25905	**J1939:RxMsgEngTempOn**		*ET1*
	Level:	4	Enable / disable “Engine Temperature 1” receiving
	Range:	0/1	telegram (RESET)
25906	**J1939:RxMsgEngFlOn**		*EFL/P1*
	Level:	4	Enable / disable “Engine Fluid Level/Pressure 1”
	Range:	0/1	receiving telegram (RESET)
25907	**J1939:RxMsgTFluidsOn**		*TRF1*
	Level:	4	Enable / disable “Transmission Fluids 1” receiving
	Range:	0/1	telegram (RESET)
25908	**J1939:RxMsgInlExhOn**		*IC1*
	Level:	4	Enable / disable “Inlet/Exhaust Conditions 1” receiving
	Range:	0/1	telegram (RESET)
25910	**J1939:RxMsgPTOOn**		*PTO*
	Level:	4	Enable / disable “Power Takeoff Information” receiving
	Range:	0/1	telegram (RESET)
25915	**J1939:RxMsgRequestOn**		*RQST*
	Level:	4	Enable / disable request telegram(RESET)
	Range:	0/1	
25916	**J1939:RxClearErrorOn**		*DM11*
	Level:	4	Enable / disable “Diagnostic Data Clear/Reset for
	Range:	0/1	Active DTCs” receiving telegram
			(RESET)
25917	**J1939:RxClrErrMemOn**		*DM03*
	Level:	4	Enable / disable “Diagnostic Data Clear/Reset for
	Range:	0/1	Previously Active DTCs” receiving telegram
			(RESET)

No.	Name		Meaning
25930	**J1939:TxMsgEEC1On**		*EEC1*
	Level:	4	Enable / disable “Electronic Engine Controller 1”
	Range:	0/1	receiving telegram (RESET)
25931	**J1939:TxMsgEEC2On**		*EEC2*
	Level:	4	Enable / disable “Electronic Engine Controller 2”
	Range:	0/1	receiving telegram (RESET)
25932	**J1939:TxMsgEEC3On**		*EEC3*
	Level:	4	Enable / disable “Electronic Engine Controller 3”
	Range:	0/1	receiving telegram (RESET)
25933	**J1939:TxMsgEngTempOn**		*ET1*
	Level:	4	Enable / disable “Engine Temperature 1” sending
	Range:	0/1	telegram (RESET)
25934	**J1939:TxMsgFlLevelOn**		*EFL/P1*
	Level:	4	Enable / disable “Engine Fluid Level/Pressure 1”
	Range:	0/1	sending telegram (RESET)
25935	**J1939:TxMsgTFluidsOn**		*TRF1*
	Level:	4	Enable / disable “Transmission Fluids 1” sending
	Range:	0/1	telegram (RESET)
25936	**J1939:TxMsgAmbientOn**		*AMB*
	Level:	4	Enable / disable “Ambient Conditions” sending
	Range:	0/1	telegram (RESET)
25937	**J1939:TxMsgInlExhOn**		*IC1*
	Level:	4	Enable / disable “Inlet/Exhaust Conditions 1” sending
	Range:	0/1	telegram (RESET)
25938	**J1939:TxMsgCCVehSpOn**		*CCVS1*
	Level:	4	Enable / disable “Cruise Control/Vehicle Speed 1”
	Range:	0/1	sending telegram (RESET)
25939	**J1939:TxMsgEngConfOn**		*EC1*
	Level:	4	Enable / disable “Engine Configuration 1” sending
	Range:	0/1	telegram (RESET)
25942	**J1939:TxMsgEngInfoOn**		*EI1*
	Level:	4	Enable / disable “Engine Information 1” sending
	Range:	0/1	telegram (RESET)
25944	**J1939: TxMsgVEP1On**		*VEP1*
	Level:	4	Enable / disable “Vehicle Electrical Power 1” sending
	Range:	0/1	telegram (RESET)
25945	**J1939:TxMsgEngHourOn**		*HOURS*
	Level:	4	Enable / disable “Engine Hours, Revolutions” sending
	Range:	0/1	telegram (RESET)
25946	**J1939:TxMsgSoftwIdOn**		*SOFT*
	Level:	4	Enable / disable “Software Identification” sending
	Range:	0/1	telegram (RESET)

No.	Name		Meaning
25947	**J1939:TxMsgDM1On**		*DM01*
	Level:	4	Enable / disable “Active Diagnostic Trouble Codes”
	Range:	0/1	sending telegram (RESET)
25948	**J1939:TxMsgDM2On**		*DM02*
	Level:	4	Enable / disable “Previously Active Diagnostic Trouble
	Range:	0/1	Codes” sending telegram (RESET)
25949	**J1939:TxMsgDM4On**		*DM04*
	Level:	4	Enable / disable “Freeze Frame Parameters” sending
	Range:	0/1	telegram (RESET)

Tab. 209: SAE J1939 functions

28.3.18 HZM-CAN customer module

↑*23.2* CAN protocol HZM-CAN customer module and Manual DG 05007-e

No.	Name		Meaning
25960	**CMTxTelxOn**		
ff	Level:	4	Enable / disable sending telegram x
	Range:	0/1	x = 20...40, 50…58 and
			41...45 (all except XIOS)
			141...145 (XIOS only) (RESET)

Tab. 210: HZM-CAN customer module functions

28.4 List 4: Characteristics and maps

In the following tables, two or three-dimensional fields that belong together (x and y or x, y and z) are shown together in one colour.

	Name	Meaning
6000ff	**MisfireWarn:P(x)**	
	Level: 4 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**, 243	Load values for misfire warning
6010ff	**MisfireWarn:nVar(x)**	
	Level: 4 Range: 0...65.535 Page(s): **Fehler! Textmarke nicht definiert.**	Speed variation values for misfire warning
6020ff	**MisfireEcy:P(x)**	
	Level: 4 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**	Load grid points for misfire emergency shutdown
6030ff	**MisfireEcy:nVar(x)**	
	Level: 4 Range: 0…65.535 Page(s): **Fehler! Textmarke nicht definiert.**	Speed variation values for misfire emergency shutdown
6050ff	**AngleCylinderx**	
	Level: 4 Range: 0…720.0°crank Page(s): **Fehler! Textmarke nicht definiert.**	TDC angle of cylinders
6100ff	**PIDMap:n(x)**	
	PIDMapSpGov:n(x)	*If integrated power governor is available*
	Level: 2 Range: 0...4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Speed grid points for speed governor stability map
6150ff	**PIDMap:f(x)**	
	PIDMapSpGov:f(x)	*If integrated power governor is available*
	Level: 2 Range: 0…100 % Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Fuel quantity values for the speed governor stability map
6200ff	**PIDMap:Corr(x)**	
	PIDMapSpGov:Corr(x)	*If integrated power governor is available*

	Name	Meaning
	Level: 2 Range: 0…400 % Page(s): **Fehler! Textmarke nicht definiert.**	Correction values for the speed governor stability map
6300ff	**PICrvPowGov:P(x)**	
	Level: 2 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**, 214, 640	Power grid points for PID characteristic for integrated power governor for diesel and dual fuel operation

	Name	Meaning
6310ff	**PICrvPowGov:Corr(x)**	
	Level: 2 Range: 0...400 % Page(s): **Fehler! Textmarke nicht definiert.**	Correction values for PID characteristic for integrated power governor for diesel operation
6350ff	**PIDMap:P(x)** **PIDMapSpGov:P(x)**	 *If integrated power governor is available*
	Level: 2 Range: 0...100 % or 0...y kW Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 243	Power grid points for speed governor stability map y: Depending on application Speed grid points in 6100, correction values in 6200
6400ff	**BoostLimit:p(x)**	
	Level: 4 Range: 0...5 bar Page(s): **Fehler! Textmarke nicht definiert.**	Boost pressure grid points for boost pressure dependent fuel quantity limitation
6420ff	**BoostLimit:f(x)**	
	Level: 4 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**	Fuel quantity values for boost pressure dependent fuel quantity limitation
6440ff	**ExcitBoostLimit:p(x)**	
	Level: 2 Range: 0…5 bar Page(s):**Fehler! Textmarke nicht definiert.**	Boost pressure grid points for boost pressure dependent setpoint limitation in excitation control loop
6460ff	**ExcitBoostLimit:f(x)**	
	Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	Fuel quantity values for boost pressure dependent setpoint limitation in excitation control loop
6480ff	**JetAstBoostDiff:f(x)**	
	Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Fuel quantity grid points for fuel quantity dependent minimum boost pressure for boost function
6490ff	**JetAstBoostDiff:p (x)**	
	Level: 2 Range: 0...5 bar Page(s):**Fehler! Textmarke nicht definiert.**	Boost pressure values for fuel quantity dependent minimum boost pressure for boost function
6500ff	**OilPressWarn:n(x)**	

	Name	Meaning
	Level: 4 Range: 0...4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Speed grid points for oil pressure warning characteristic
6520ff	**OilPressWarn:p(x)**	
	Level: 4 Range: 0…10 bar Page(s): **Fehler! Textmarke nicht definiert.**	Oil pressure values for oil pressure warning characteristic

	Name	Meaning
6530ff	**CoolPressLimit1:n(x)** **CoolPressWarn:n(x)**	*XIOS* *Others*
	Level: 4 Range: 0…4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Speed grid points for coolant pressure warning characteristic or first limit value curve (XIOS)
6540ff	**CoolPressLimit1:p(x)** **CoolPressWarn:p(x)**	*XIOS* *Others*
	Level: 4 Range: 0...5 bar Page(s):**Fehler! Textmarke nicht definiert.**	Coolant pressure grid points for coolant pressure warning characteristic or first limit value curve (XIOS)
6550ff	**OilPressEcy:n(x)**	
	Level: 4 Range: 0...+4000 rpm Page(s): **Fehler! Textmarke nicht definiert.**	Speed grid points for oil pressure emergency shutoff characteristic
6570ff	**OilPressEcy:p(x)**	
	Level: 4 Range: 0...10 bar Page(s):**Fehler! Textmarke nicht definiert.**	Oil pressure values for oil pressure emergency shutoff characteristic
6580ff	**CoolPressLimit2:n(x)** **CoolPressIdle:n(x)**	*XIOS* *Others*
	Level: 4 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Speed grid points for coolant pressure forced idle speed characteristic or second limit value curve (XIOS) In XIOS this curve can trigger a forced idle speed if 5362 *CoolPressWarnIdleOn* = 1
6590ff	**CoolPressLimit2:p(x)** **CoolPressIdle:p(x)**	*XIOS* *Others*
	Level: 4 Range: 0...5 bar Page(s):**Fehler! Textmarke nicht definiert.**	Coolant pressure grid points for coolant pressure forced idle speed characteristic or second limit value curve (XIOS) In XIOS this curve can trigger a forced idle speed if 5362 *CoolPressWarnIdleOn* = 1
6600ff	**ExcitControl:n(x)**	*Locomotive operation*
	Level: 2 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Speed grid points for excitation control
6620ff	**ExcitControl:f(x)**	*Locomotive operation*

	Name	Meaning
	Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Fuel quantity grid points for excitation control or fuel quantity setpoints for excitation governing
6640ff	**ExcitControl:ES(x)**	*Locomotive operation*
	Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	Excitation signal setpoints for excitation control

	Name	Meaning
6600ff	**PitchControl:n(x)** Level: 2 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation* Speed grid points for adjustable propeller governing
6610ff	**PitchControl:f(x)** Level: 2 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Fuel quantity setpoints for adjustable propeller governing
6620ff	**PitchCtrlPI:f(x)** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**	*Marine operation* Fuel quantity grid points for fuel quantity dependent stability characteristic for adjustable propeller governing
6630ff	**PitchCtrlPI:Corr(x)** Level: 2 Range: 0…400 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Correction values for fuel quantity dependent stability characteristic for adjustable propeller governing
6640ff	**PitchSpeedLim:n(x)** Level: 2 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Speed grid points for speed-dependent fuel quantity setpoint limitation in adjustable propeller control loop
6650ff	**PitchSpeedLim:PS(x)** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Marine operation* Signal values for speed-dependent limitation in adjustable propeller control loop
6660ff	**ExcitGovPI:f(x)** Level: 2 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Fuel quantity grid points for fuel quantity dependent stability characteristic for excitation governing
6680ff	**ExcitGovPI:Corr(x)** Level: 2 Range: 0…400 % Page(s):**Fehler! Textmarke nicht definiert.**	*Locomotive operation* Correction values for fuel quantity dependent stability characteristic for excitation governing
6700ff	**SpeedLimit1:n(x)**	

	Name	Meaning
	Level: 4 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**, 168, 221, 223	Speed grid points for first or only speed-dependent fuel quantity limitation curve
6750ff	**SpeedLimit1:f(x)**	
	Level: 4 Range: 0...100 % Page(s):**Fehler! Textmarke nicht definiert.**	Fuel quantity values for first or only speed-dependent fuel quantity limitation curve
6800ff	**SpeedLimit2:n(x)**	
	Level: 4 Range: 0...4000 rpm Page(s):**Fehler! Textmarke nicht definiert.**	Speed grid points for second speed-dependent fuel quantity limitation curve

	Name		Meaning
6850ff	**SpeedLimit2:f(x)**		
	Level:	4	Fuel quantity values for second speed-dependent fuel quantity limitation curve
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
6880ff	**LocoNotchAssign(x)**		*Locomotive operation*
	Level:	2	Speed notch values per binary combination
	Range:	0...255	
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, 251		
6900ff	**LocoSpeedLevel(x)**		*Locomotive operation*
	Level:	2	Speed levels for selection using speed notches in variable speed governor mode
	Range:	0...4000 rpm	
	Page(s):**Fehler! Textmarke nicht definiert.**		
6916ff	**TractPowLimVolt(x)**		*Locomotive operation*
	Level:	2	Speed-dependent traction voltage limits
	Range:	0...y V	Speed grid points for 6600 *ExcitControl:n(x)*
	Page(s):**Fehler! Textmarke nicht definiert.**		y: Depending on application
6932ff	**TractPowLimCurr(x)**		*Locomotive operation*
	Level:	2	Speed-dependent traction current limits
	Range:	0...y A	Speed grid points for 6600 *ExcitControl:n(x)*
	Page(s):**Fehler! Textmarke nicht definiert.**		y: Depending on application
6950ff	**LocoFuelLevel(x)**		*Locomotive operation*
	Level:	2	Fuel levels for selection using speed notches in idle/maximum speed governor mode
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
6966ff	**ExcitSpeedLim:n(x)**		*Locomotive operation*
	Level:	2	Speed grid points for speed-dependent fuel quantity setpoint limitation in excitation control loop
	Range:	0...4000 rpm	
	Page(s):**Fehler! Textmarke nicht definiert.**		
6982ff	**ExcitSpeedLim:ES(x)**		*Locomotive operation*
	Level:	2	Excitation signal values for speed-dependent limitation in excitation control loop
	Range:	0...100 %	
	Page(s):**Fehler! Textmarke nicht definiert.**		
7000ff	**AmbPressRedMap:n(x)**		*XIOS*
	Level:	4	Speed grid points for speed and ambient pressure dependent power reduction
	Range:	0...4000 rpm	
	Page(s):	98	

	Name		Meaning
7010ff	**AmbPressRedMap:p(x)**		*XIOS*
	Level:	4	Ambient pressure grid points for speed and ambient pressure dependent power reduction
	Range:	0...2000 mbar	
	Page(s):	98	
7020ff	**AmbPressRedMap:F(x)**		
	Level:	4	Reduction factor for speed and ambient pressure dependent power reduction
	Range:	0...100 %	
	Page(s):	98	

	Name	Meaning
7030ff	**ExcitGovPI2:P(x)**	
	Level: 2 Range: 0...y kW Page (s): **Fehler! Textmarke nicht definiert.**	Traction power grid points for traction power dependent stability characteristic for excitation governing in locomotive operation y: Depending on application
7050ff	**ExcitGovPI2:Corr(x)**	
	Level: 2 Range: 0...400 % Page(s):**Fehler! Textmarke nicht definiert.**	Correction values for traction power dependent stability characteristic for excitation governing in locomotive operation
7100ff	**CoolTempReduce:T(x)**	*XIOS*
	Level: 4 Range: -100...+1000 °C Page(s): 96, 230	Coolant temperature grid points for coolant temperature dependent power reduction
7110ff	**CoolTempReduce:F(x)**	*XIOS*
	Level: 4 Range: 0...100 % Page(s): 96	Reduction factor for coolant temperature dependent power reduction
7120ff	**ChAirTempReduce:T(x)**	*XIOS*
	Level: 4 Range: -100…+1000 °C Page(s): 97, 228	Charge air temperature grid points for charge air temperature dependent power reduction
7130ff	**ChAirTempReduce:F(x)**	*XIOS*
	Level: 4 Range: 0…100 % Page(s): 97	Reduction factor for charge air temperature dependent power reduction
7140ff	**FuelTempReduce:T(x)**	*XIOS*
	Level: 4 Range: -100...+1000 °C Page(s): 97	Fuel temperature grid points for fuel temperature dependent power reduction
7150ff	**FuelTempReduce:F(x)**	*XIOS*
	Level: 4 Range: 0…100 % Page(s): 97	Reduction factor for fuel temperature dependent power reduction
7160ff	**ExhTempReduce:T(x)**	*XIOS*
	Level: 4 Range: -100...+1000 °C Page(s): 97, 229	Exhaust temperature grid points for exhaust temperature dependent power reduction
7170ff	**ExhTempReduce:F(x)**	*XIOS*
	Level: 4 Range: 0...100 % Page(s): 98	Reduction factor for exhaust temperature dependent power reduction
7200ff	**InjectorMap:n(x)**	*At request of engine manufacturers*

	Name		Meaning
	Level: Range: Page(s):	4 0...4000 rpm 359	Speed grid points for pump map
7250ff	**InjectorMap:f(x)** Level: Range: Page(s):	 4 0...100 % 359	*At request of engine manufacturers* Fuel quantity grid points for pump map
7300ff	**InjectorMap:Pos(x)** Level: Range: Page(s):	 6 0...100 % 358	*At request of engine manufacturers* Actuator position values for pump map
7200ff	**ZeroFuelCurve:n(x)** Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**	 4 0...4000 rpm	*Zero delivery characteristic* Speed grid points for zero delivery characteristic
7250ff	**ZeroFuelCurve:Pos(x)** Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**	 4 0...100 %	*Zero delivery characteristic* Actuator position values for zero delivery characteristic
7300ff **7330ff** **7360ff**	**FuelToActSpy:f(x)** Level: Range: Page(s):	 6 0...100 % 358	*Position characteristic* Grid points for fuel quantity dependent actuator position characteristic y = 1..3
7315ff **7345ff** **7375ff**	**FuelToActSp:Pos(x)** Level: Range: Page(s):	 6 0...100 % 358	*Position characteristic* Position values for fuel quantity dependent actuator position characteristic y = 1..3
7400ff	**ExcitBoostLimit:p(x)** Level: Range: Page(s):**Fehler! Textmarke nicht definiert.**	 2 0…100 %	 Traction power values for boost pressure dependent setpoint limitation in excitation control loop
7500ff	**FuelCorr:n(x)** Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	 4 0...4000 rpm	 Speed values for fuel temperature dependent target quantity correction
7508ff	**FuelCorr:f(x)** Level: Range: Page(s): **Fehler! Textmarke nicht definiert.**	 4 0...100 %	 Fuel quantity values for fuel temperature dependent target quantity correction
7516ff	**FuelCorr:df(x)**		

	Name	Meaning
	Level: 4 Range: 0...100 % Page(s): **Fehler! Textmarke nicht definiert.**	Correction values for fuel temperature dependent target quantity correction
7580ff	**FuelCorr:T(x)**	
	Level: 6 Range: 0...65535 Page(s):**Fehler! Textmarke nicht definiert.**	Fuel temperature values for fuel temperature dependent target quantity correction

	Name	Meaning
7590ff	**FuelCorrFact:F(x)**	
	Level: 6 Range: 0…100 % Page(s):**Fehler! Textmarke nicht definiert.**	Correction factor for fuel temperature dependent target quantity correction
7600ff	**AirMassLin:In(x)**	
	Level: 6 Range: 0...5.000 V Page(s):	Analogue input values for air mass sensor (on request)
7610ff	**AirMassLin:Out(x)**	
	Level: 6 Range: 0...1000.0 kg/h Page(s):	Mass values for air mass sensor (on request)
7660ff	**Lambda1Lin:In(x)**	
	Level: 6 Range: 0...100.0 % Page(s):	Standardised analogue input values for lambda sensor 1 (on request)
7670ff	**Lambda1Lin:Out(x)**	
	Level: 6 Range: 0…30.000 Page(s):	Lambda sensor 1 lambda values (on request)
7680ff	**Lambda2Lin:In(x)**	
	Level: 6 Range: 0…100.0 % Page(s):	Standardised analogue input values for lambda sensor 2 (on request)
7690ff	**Lambda2Lin:Out(x)**	
	Level: 6 Range: 0...30.000 Page(s):	Lambda sensor 2 lambda values (on request)
7900ff	**TempLiny:digit(x)**	*DC 1, DC 2, DC 5, DC 6*
	Level: 6 Range: 0...65535 Page(s):299, **Fehler! Textmarke nicht definiert.**	AD converter values for temperature linearisation characteristic y: y = 1...2
7900ff	**TempLiny:Ohm(x)**	*Dc 7, DC 8, DC 10, DC 11, DC 12, XIOS*
	Level: 6 Range: 0...60000 Ω Page(s):	Resistance values for temperature linearisation characteristic y: y=1...4
7910ff	**TempLiny:T(x)**	
	Level: 6 Range: -100...1000 °C Page(s):299, **Fehler! Textmarke nicht definiert.**	Temperature values for temperature linearisation characteristic y y see 7900 *TempLin1:digit*
7980ff	**Feedbacky:digit(x)**	

	Name		Meaning
8000ff	Level:	6	Digit values for feedback linearisation for actuator y
8020ff	Range:	0...65535	y = 1...3
	Page(s):	352	

	Name		Meaning
7990ff	**Feedbacky:Pos(x)**		
8010ff	Level:	6	Position values for feedback linearisation for actuator y
8030ff	Range:	0...100 %	y = 1...3
	Page(s):	352	
8100ff	**IMDriveMap:n(x)**		
	Level:	4	Speed grid points for drive map
	Range:	0…4000 rpm	
	Page(s): **Fehler! Textmarke nicht definiert.**		
8110ff	**IMDriveMap: Pos(x)**		
	Level:	4	Position grid points for drive map
	Range:	0…100 %	
	Page(s): **Fehler! Textmarke nicht definiert.**		
8120ff	**IMDriveMap:f(x)**		
	Level:	4	Fuel quantity values for drive map
	Range:	0...100 %	
	Page(s): **Fehler! Textmarke nicht definiert.**		
8300ff	**EGROutput:n(x)**		
	Level:	4	Speed values for speed and fuel quantity dependent
	Range:	0...4000 rpm	exhaust gas recirculation map
	Page(s):		(on request)
8310ff	**EGROutput:f(x)**		
	Level:	4	Fuel quantity values for speed and fuel quantity
	Range:	0...100 %	dependent exhaust gas recirculation map
	Page(s):		(on request)
8320ff	**EGROutput:Pos(x)**		
	Level:	4	Position values for speed and fuel quantity dependent
	Range:	0...100 %	exhaust gas recirculation map
	Page(s):		(on request)
8420ff	**InletAir:n(x)**		
	Level:	4	Speed values for speed and fuel quantity dependent
	Range:	0...4000 rpm	inlet air throttle valve map
	Page(s):		(on request)
8430ff	**InletAir:f(x)**		
	Level:	4	Fuel quantity values for speed and fuel quantity
	Range:	0…100 %	dependent inlet air throttle valve map
	Page(s):		(on request)
8440ff	**InletAir:Pos(x)**		
	Level:	4	Position values for speed and fuel quantity dependent
	Range:	0...100 %	inlet air throttle valve map
	Page(s):		(on request)
8540ff	**WasteGate:n(x)**		

Name		Meaning
Level: Range: Page(s):	4 0…4000 rpm	Speed values for speed and fuel quantity dependent wastegate map (on request)

	Name		Meaning
8550ff	**WasteGate:f(x)**		
	Level:	4	Fuel quantity values for speed and fuel quantity
	Range:	0…100 %	dependent wastegate map
	Page(s):		(on request)
8560ff	**WasteGate:Pos(x)**		
	Level:	4	Position values for speed and fuel quantity dependent
	Range:	0...100 %	wastegate map
	Page(s):		(on request)
8660ff	**BypassValve:n(x)**		
	Level:	4	Speed values for speed and fuel quantity dependent
	Range:	0...4000 rpm	bypass valve map
	Page(s):		(on request)
8670ff	**BypassValve:f(x)**		
	Level:	4	Fuel quantity values for speed and fuel quantity
	Range:	0…100 %	dependent bypass valve map
	Page(s):		(on request)
8680ff	**BypassValve:Pos(x)**		
	Level:	4	Position values for speed and fuel quantity dependent
	Range:	0...100 %	bypass valve map
	Page(s):		(on request)
8780ff	**InletAirPower:P(x)**		
	Level:	4	Power values for power dependent inlet air throttle
	Range:	0...200 %	valve curve
	Page(s):		(on request)
8790ff	**InletAirPower:Pos(x)**		
	Level:	4	Position values for power dependent inlet air throttle
	Range:	0...100 %	valve curve
	Page(s):		(on request)
8800ff	**DigitalOuty:Param(x)**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 9, DC 10*
	Level:	6	Function assignment for multiple assignment to binary output y:
	Range:	-29999…29999	DC 1-03: 1...3; DC 6: 1...2
	Page(s):**Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		DC 1-04: 1...5; DC 7: 1...7
			DC 2: 1...5; DC 9: 1
			DC 5: 1; DC 10: 1
9120ff	**PEDigOuty:Param(x)**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 10*
	Level:	6	HZM-CAN: Function assignment for multiple
	Range:	-29999…29999	assignment to binary output y on periphery modules
	Page(s): **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**, **Fehler! Textmarke nicht definiert.**		
9700ff	**PEFuelOut_Assign(x)**		*DC 1, DC 2, DC 5, DC 6, DC 7, DC 10*

Name	Meaning
Level: 6 Range: -29999…29999 Page(s):**Fehler! Textmarke nicht definiert.**	HZM-CAN: Assignment of fuel quantity setpoints for periphery modules (RESET)

	Name	Meaning
9900ff	**PIDMap2(x)**	*PIDMapSpGov2(x)* *If integrated power governor is available*
	Level: 2 Range: 0...400 % Page(s):**Fehler! Textmarke nicht definiert.**	Correction values for second stability map for speed governor, x and y values see 6100/6150 Select with 2841 *SwitchPID2Or1*
16000 ff		*Dual fuel parameters are described in the subchapter*
28500 ff	**DOColl_1:Par(x)** **DOColl_y:Par(x)**	*DC 8, DC 11, DC 12, XIOS*
	Level: 6 Range: 0...9999 or 0…29999 or 0...65535 Page(s):**Fehler! Textmarke nicht definiert.**	Assignment of parameters for compressed output x = 0...7 or lower, application-specific y= 0…25 or lower, application-specific
28508 ff	**DOColl_1: Mask(x)** **DOColl_y: Mask(x)**	*XIOS*
	Level: 6 Range: 0…FFFF Hex Page(s):**Fehler! Textmarke nicht definiert.**	Error bit mask if error parameters have been assigned x = 0...7 or lower, application-specific y= 0...25 or lower, application-specific
28516 ff	**DOColl_1:Logic** **DOColl_x:Logic**	*DC 8, DC 11, DC 12, XIOS*
	Level: 6 Range: 0...7F Hex Page(s):**Fehler! Textmarke nicht definiert.**	Logical link for DO_Collection x: Bit = 0: AND function Bit = 1: OR function x= 0..25 or lower, application-specific
28517 ff	**DOColl_1:Polarity** **DOColl_x:Polarity**	*DC 8, DC 11, DC 12, XIOS*
	Level: 6 Range: 0...FF Hex Page(s):**Fehler! Textmarke nicht definiert.**	Polarity of assigned parameters Bit = 0: Current value Bit = 1: Inverted value x= 0..25 or lower, application-specific
29900 ff	**BitCollParamSet(x)**	*HZM CAN customer module, Manual DG 05007-e* *CANopen Gateway, Manual DG 04 005-e* *DeviceNet, Manual DG 06 003-e* *Modbus, Manual DG 05 002-e*
	Level: 4	Assignment of bit parameters for compressed transmission via the relevant communication module
	Range: -29999…+29999 0…65535	*Others* *XIOS*
	Pages: 344	

	Name		Meaning
29932	**BitCollParamInverted(y)**		*XIOS*
ff	Level:	4	Identifier of parameters from 29900 *BitCollParamSet*, whose value is to be inverted and included in the BitCollection
	Range:	0000...FFFF Hex	
	Pages:	344	The bit position corresponds to the index x in 29900 *BitCollParamSet(x)* y = 0..1
29950	**ArgosLEDParamSet(x)**		
ff	Level:	4	Assignment of bit parameters to the LEDs on the ARGOS display module
	Range:	-29999...+29999	*Others*
		0...65535	*XIOS*
	Pages: **Fehler! Textmarke nicht definiert.**		
29958	**ArgosLED0Invert(gr)**		*XIOS*
	Level:	4	Identifier of whether a parameter assigned to LED 0 is to be displayed inverted
	Range:	0/1	
	Pages: **Fehler! Textmarke nicht definiert.**		
29959	**ArgosLED1Invert(or)**		*XIOS*
	Level:	4	Identifier of whether a parameter assigned to LED 1 is to be displayed inverted
	Range:	0/1	
	Pages: **Fehler! Textmarke nicht definiert.**		
29960	**ArgosLED2Invert(gr)**		*XIOS*
	Level:	4	Identifier of whether a parameter assigned to LED 2 is to be displayed inverted
	Range:	0/1	
	Pages: **Fehler! Textmarke nicht definiert.**		
29961	**ArgosLED3Invert(gr)**		*XIOS*
	Level:	4	Identifier of whether a parameter assigned to LED 3 is to be displayed inverted
	Range:	0/1	
	Pages: **Fehler! Textmarke nicht definiert.**		
29962	**ArgosLED4Invert(gr)**		*XIOS*
	Level:	4	Identifier of whether a parameter assigned to LED 4 is to be displayed inverted
	Range:	0/1	
	Pages: **Fehler! Textmarke nicht definiert.**		
29963	**ArgosLED5Invert(rd)**		*XIOS*
	Level:	4	Identifier of whether a parameter assigned to LED 5 is to be displayed inverted
	Range:	0/1	
	Pages: **Fehler! Textmarke nicht definiert.**		
29964	**ArgosLED6Invert(gr)**		*XIOS*

Name		Meaning
Level:	4	Identifier of whether a parameter assigned to LED 6 is to be displayed inverted
Range:	0/1	
Pages: **Fehler! Textmarke nicht definiert.**		

	Name		Meaning
29965	**ArgosLED7Invert(gr)**		*XIOS*
	Level:	4	Identifier of whether a parameter assigned to LED 7 is
	Range:	0/1	to be displayed inverted
	Pages: **Fehler! Textmarke nicht definiert.**		

Tab. 211: Characteristics and maps

28.4.1 Dual fuel

↑*16* Speed control for dual fuel engines (ARTEMIS) and separate ARTEMIS manuals

No.	Name		Meaning
16040	**GasPICrvPGov:Corr(x)**		*Integrated power governor*
ff	Level:	4	Correction values for PID correction for the power
	Range:	0…400 %	governor, power values in 6300 *PIDCrvPowGov:P(x)*
	Page(s):	214	
16100	**GasModeBoostPr:P(x)**		
ff	Level:	4	Power grid points of power-dependent boost pressure
	Range:	0...200%	monitoring
		or 0...y kW	y: application-dependent
	Page(s):	193	
16115	**GasModeBoostPr:p(x)**		
ff	Level:	4	Boost pressure values of power-dependent boost
	Range:	0...5 bar	pressure monitoring
	Page(s):	193	
16450	**GasTempFactor:T(x)**		
ff	Level:	4	Gas temperature grid points for characteristic for gas
	Range:	-100...1000 °C	temperature dependent correction of gas fuel quantity
	Page(s):	231	
16460	**GasTempFactor:F(x)**		
ff	Level:	4	Factors for characteristic for gas temperature dependent
	Range:	-50...50 %	correction of gas fuel quantity
	Page(s):	231	
16470	**GasPressFactor:p(x)**		
ff	Level:	4	Gas pressure grid points for characteristic for gas
	Range:	0...2 bar	pressure dependent correction of gas fuel quantity
	Page(s):	231	
16480	**GasPressFactor:F(x)**		
ff	Level:	4	Factors for characteristic for gas pressure dependent
	Range:	-50...50 %	correction of gas fuel quantity
	Page(s):	231	

No.	Name		Meaning
16670	**GasLimColTmpRed:F(x)**		*XIOS*
ff	Level:	4	Factor for coolant temperature dependent reduction of speed or power dependent gas limitation
	Range:	0..100 %	
	Page(s):	230	Coolant temperature values in 7100 *CoolTempReduce:T(x)*
16680	**GasLChAirTmpRed:F(x)**		*XIOS*
ff	Level:	4	Factor for charge air temperature dependent reduction of speed or power dependent gas limitation
	Range:	0..100 %	
	Page(s):	228	Charge air temperature values in 7120 *ChAirTempReduce:T(x)*
16700	**GasLimExhTmpRed:F(x)**		*XIOS*
ff	Level:	4	Factor for exhaust temperature dependent reduction of speed or power dependent gas limitation
	Range:	0..100 %	
	Page(s):	229	Exhaust temperature values in 7160 *ExhTempReduce:T(x)*
16780	**PilotDslAbsMin:n(x)**		
ff	Level:	6	Speed grid points for the speed-dependent absolute minimum value of ignition oil quantity
	Range:	0…4000 rpm	
	Page(s):	164	
16790	**PilotDslAbsMin:Dsl(x)**		
ff	Level:	6	Speed-dependent absolute minimum value of ignition oil quantity
	Range:	0…100 %	
	Page(s):	164	

Tab. 212: Dual fuel characteristics and maps (general)

28.4.1.1 Gas speed governor

No.	Name		Meaning
16000	**GasPIDCurve:n(x)**		
ff	Level:	4	Speed grid points for PID correction
	Range:	0...4000 rpm	
	Page(s):	209	
16010	**GasPIDCurve:Gasf(x)**		
ff	Level:	4	Gas fuel quantity grid points for PID correction
	Range:	0..100 %	
	Page(s):	209	
16020	**GasPIDCurve:P(x)**		
ff	Level:	4	Power grid points for PID correction
	Range:	0..200 %	
	Page(s):	209	
16030	**GasPIDCurve:Corr(x)**		
ff	Level:	4	Correction values for PID correction
	Range:	0...400 %	
	Page(s):	208	

No.	Name		Meaning
16050	**DieselPower:f(x)**		
ff	Level:	4	Diesel fuel quantity grid points for characteristic for determining the diesel power proportion
	Range:	0..100 %	
	Page(s):	166	
16065	**DieselPower:P(x)**		
ff	Level:	4	Diesel power values for characteristic for determining the diesel power proportion
	Range:	0...100 % or 0...y kW	y: Depending on application
	Page(s):	167	
16130	**GasSpeedLimit:f(x)**		
ff	Level:	4	Speed-dependent gas fuel quantity limitation
	Range:	0…100 %	Speed values in 6700 *SpeedLimit1:n(x)*
	Page(s):	168, 223, 224	
16150	**GasPowerLimit:P(x)**		
ff	Level:	4	Power values for power-dependent gas fuel quantity limitation
	Range:	0...200% or 0...y kW	
	Page(s):	221	
16180	**GasPowerLimit:f(x)**		
ff	Level:	4	Gas fuel quantity values for power-dependent gas fuel quantity limitation
	Range:	0..100 %	
	Page(s):	221	
16210	**GasFToActSetp:f(x)**		*DC 1-04, XIOS*
ff	Level:	4	Grid points for fuel quantity dependent gas actuator position characteristic
	Range:	0..100 %	
	Page(s):	170	
16225	**GasFToActSet:Pos(x)**		*DC 1-04, XIOS*
ff	Level:	4	Position values for fuel quantity dependent gas actuator position characteristic
	Range:	0…100 %	
	Page(s):	170	
16300	**PilotDiesel:P(x)**		
ff	Level:	4	Power grid points for power-dependent ignition oil quantity
	Range:	0...200 %	
	Page(s):	165	
16310	**PilotDiesel:Dsl(x)**		
ff	Level:	4	Ignition oil quantity for power-dependent ignition oil quantity
	Range:	0...100 %	
	Page(s):	165	

Tab. 213: Dual fuel characteristics and maps (gas speed governor)

28.4.1.2 Diesel reduction governor

No.	Name		Meaning
16050	**MaxPower:n(x)**		*Locomotive operation*
ff	Level:	4	Speed grid points for maximum permissible power characteristic
	Range:	0...100 %	
	Page(s):	166	
16060	**MaxPower:P(x)**		*Locomotive operation*
ff	Level:	4	Traction power values for maximum permissible power characteristic
	Range:	0...y kW	
	Page (s):	166	y: Depending on application
16130	**DFSpeedLimit:P(x)**		*Marine operation*
ff	Level:	4	Speed-dependent total power limitation
	Range:	0...y kW	Speed values in 6700 *SpeedLimit1:n(x)*
	Page(s):	168, 223	y: Depending on application
16130	**GasSpeedLimit:f(x)**		*Locomotive operation*
ff	Level:	4	Speed-dependent gas fuel quantity limitation
	Range:	0...100 %	Speed values for 6700 *SpeedLimit1:n(x)*
	Page(s):	224	
16150	**GasPowerLimit:P(x)**		*Locomotive operation*
ff	Level:	4	Traction power values for power dependent gas fuel quantity limitation
	Range:	0...y kW	
	Page (s):	226	y: Depending on application
16180	**GasPowerLimit:f(x)**		*Locomotive operation*
ff	Level:	4	Gas fuel quantity values for power-dependent gas fuel quantity limitation
	Range:	0...100 %	
	Page(s):	226	
16210	**GasFToActSetp:f(x)**		*Locomotive operation: DC 1-04, XIOS*
ff	Level:	4	Grid points for fuel quantity dependent gas actuator position characteristic
	Range:	0...100 %	
	Page(s):	170	
16225	**GasFToActSet:Pos(x)**		*Locomotive operation: DC 1-04, XIOS*
ff	Level:	4	Position values for fuel quantity dependent gas actuator position characteristic
	Range:	0...100 %	
	Page(s):	170	
16300	**DieselSetpGas:P(x)**		*Locomotive operation*
ff	Level:	4	Traction power grid points for power-dependent diesel setpoint
	Range:	0...y kW	
	Page (s):	216	y: Depending on application
16300	**DieselSetpGas:n(x)**		*Marine operation*
ff	Level:	4	Speed grid points for speed-dependent diesel setpoint
	Range:	0...4000 rpm	
	Page(s):	216	

No.	Name		Meaning
16310	**DieselSetpGas:Dsl(x)**		
ff	Level:	4	Diesel setpoints for power or speed-dependent diesel fuel quantity setpoint
	Range:	0...100 %	
	Page(s):	216	
16490	**DieselNegPow:f(x)**		*At request of engine manufacturers*
ff	Level:	6	Diesel fuel quantity grid points for speed and diesel fuel quantity dependent map for determining the negative power proportions for diesel if fuel quantity falls below the zero-fuel characteristic (ignition oil quantity below zero-fuel characteristic)
	Range:	0...100 %	
	Page(s):	169	Speed values in 16800 *DieselPower:n(x)*
16500	**DieselNegPow:P(x)**		*At request of engine manufacturers*
ff	Level:	6	Negative power proportions for diesel if fuel quantity falls below zero-fuel characteristic (ignition oil quantity below zero-fuel characteristic)
	Range:	0...y kW	
	Page (s):	169	y: Depending on application
16800	**DieselPower:n(x)**		
ff	Level:	4	Speed grid points for map for determining the diesel power proportion
	Range:	0...4000 rpm	
	Page(s):	166, 168	
16810	**DieselPower:f(x)**		
ff	Level:	4	Fuel quantity grid points for map for determining the diesel power proportion
	Range:	0..100 %	
	Page(s):	166, 168	
16810	**DieselPower:p(x)**		*Engines with PT pump*
ff	Level:	4	Diesel pressure grid points for map for determining the diesel power proportion
	Range:	0...40 bar	
	Page(s):	166, 168	
16835	**DieselPower:P(x)**		
ff	Level:	4	Diesel power values in map for determining diesel power proportion
	Range:	0...y kW	
	Page(s):	166, 168	y: Depending on application

Tab. 214: Dual fuel characteristics and maps (diesel reduction governor)

28.4.2 CANopen

↑*23.4* CAN protocol CANopen and CANopen, Manual DG 06 002-e

No.	Name		Meaning
29000	**CanOp:RPDOEvtTim(x)**		*If only 4 RPDOs are possible*
ff	Level:	4	Event time for RPDOs
	Range:	0...50 s	x = 0...3
			See 29180 if more than 4 RPDOs are possible

No.	Name		Meaning
29004	**CanOp:TPDOTxType(x)**		
ff	Level:	4	Transmission type of TPDOs
	Range:	253/254	x = 0…15
29020	**CanOp:TPDOEvtTim(x)**		
ff	Level:	4	Event time for TPDOs
	Range:	0...50 s	x = 0…15
29036	**CanOp:TPDOInhTim(x)**		
ff	Level:	4	Inhibit time for TPDOs
	Range:	0…50 s	x = 0…15
29052	**CanOp:TPDOyAssign(x)**		
ff	Level:	4	Assignment of send parameters to TPDOs
	Range:	0…29999	x = 0…3, y = 1...16 (RESET)
29116	**CanOp:TPDOyHyst(x)**		
ff	Level:	4	Assignment of hysteresis values to send parameters for TPDOs
	Range:	0…100 %	x = 0...3, y = 1...16
29180	**CanOp:RPDOEvtTim(x)**		*If more than 4 RPDOs are possible*
ff	Level:	4	Event time for RPDOs
	Range:	0...50 s	x = 0...9
			See 29000 if only 4 RPDOs are possible

Tab. 215: CANopen characteristics and maps

28.4.3 Modbus

↑*23.8* Serial protocol Modbus and Manual DG 05 002-e

No.	Name		Meaning
29200	**Modb:TxParamSet(x)**		
ff	Level:	4	Data field for read access, the parameter and measured value numbers whose values are to be transmitted on request are to be entered
	Range:	0...29999	

Tab. 216: Modbus characteristics and maps

28.4.4 DeviceNet

↑*23.5* CAN protocol DeviceNet and Manual DG 06 003-e

No.	Name		Meaning
29400	**DNet:TxParamSet(x)**		
ff	Level:	4	Assignment of send parameters to polled message
	Range:	0...29999	

Tab. 217: DeviceNet characteristics and maps

28.4.5 SAE J1939

↑*23.3* CAN protocol SAE J1939 and Manual DG 06 004-e

No.	Name		Meaning
29600	**J1939:RxTSC1_y:Src(x)**		*TSC1*
ff	Level:	4	Sender of “Torque/Speed Control 1” receiving telegram
	Range:	0...255	y = 1...4 (standard 1) (RESET)
29601	**J1939:RxTSC1_y:Scan**		*TSC1*
ff	Level:	4	Receive rate for “Torque/Speed Control 1” receiving
	Range:	0...10 s	telegram
			y = 1..4 (standard 1) (RESET)
29602	**J1939:RxSNS:Src**		*AT1OG1*
	Level:	4	Sender of “Aftertreatment 1 Outlet Gas 1” receiving
	Range:	0...255	telegram (RESET)
29603	**J1939:RxSNS:Scan**		*AT1OG1*
	Level:	4	Receive rate of “Aftertreatment 1 Outlet Gas 1”
	Range:	0...10 s	receiving telegram (RESET)
29604	**J1939:RxEBC1:Src**		*EBC1*
	Level:	4	Sender of “Electronic Brake Controller 1” receiving
	Range:	0…255	telegram (RESET)
29605	**J1939:RxEBC1:Scan**		*EBC1*
	Level:	4	Receive rate of “Electronic Brake Controller 1”
	Range:	0...10 s	receiving telegram (RESET)
29608	**J1939:RxEngTemp:Src**		*ET1*
	Level:	4	Sender of “Engine Temperature 1” receiving telegram
	Range:	0...255	(RESET)
29609	**J1939:RxEngTemp:Scan**		*ET1*
	Level:	4	Receive rate of “Engine Temperature 1” receiving
	Range:	0…10 s	telegram (RESET)
29610	**J1939:RxFlLevel:Src**		*EFL/P1*
	Level:	4	Sender of “Engine Fluid Level/Pressure 1” receiving
	Range:	0...255	telegram (RESET)

No.	Name		Meaning
29611	**J1939:RxFlLevel:Scan**		*EFL/P1*
	Level:	4	Receive rate of "Engine Fluid Level/Pressure 1"
	Range:	0...255	receiving telegram (RESET)
29612	**J1939:RxTFluids:Src**		*TRF1*
	Level:	4	Sender of "Transmission Fluids 1" receiving telegram
	Range:	0...255	(RESET)
29613	**J1939:RxTFluids:Scan**		*TRF1*
	Level:	4	Receive rate of "Transmission Fluids 1" receiving
	Range:	0...10 s	telegram (RESET)
29614	**J1939:RxInlExh:Src**		*IC1*
	Level:	4	Sender of "Intake/Exhaust Conditions 1" receiving
	Range:	0...255	telegram (RESET)
29615	**J1939:RxInlExh:Scan**		*IC1*
	Level:	4	Receive rate of "Intake/Exhaust Conditions 1" receiving
	Range:	0…10 s	telegram (RESET)
29623	**J1939:RxPTO:Src**		*PTO*
	Level:	4	Sender of "Power Takeoff Information" receiving
	Range:	0…255	telegram (RESET)
29624	**J1939:RxPTO:Scan**		*PTO*
	Level:	4	Receive rate of "Power Takeoff Information" receiving
	Range:	0...10 s	telegram (RESET)
29630	**J1939:TxEEC1:Send**		*EEC1*
	Level:	4	Send rate of "Electronic Engine Controller 1" sending
	Range:	0…10 s	telegram (RESET)
29631	**J1939:TxEEC2:Send**		*EEC2*
	Level:	4	Send rate of "Electronic Engine Controller 2" sending
	Range:	0…10 s	telegram (RESET)
29632	**J1939:TxEEC3:Send**		*EEC3*
	Level:	4	Send rate of "Electronic Engine Controller 3" sending
	Range:	0…10 s	telegram (RESET)
29633	**J1939:TxEngTemp:Send**		*ET1*
	Level:	4	Send rate of "Engine Temperature 1" sending telegram
	Range:	0…10 s	(RESET)
29634	**J1939:TxFlLevel:Send**		*EFL/P1*
	Level:	4	Send rate of "Engine Fluid Level/Pressure 1" sending
	Range:	0…10 s	telegram (RESET)
29635	**J1939:TxTFluids:Send**		*TRF1*
	Level:	4	Send rate of "Transmission Fluids 1" sending telegram
	Range:	0…10 s	(RESET)
29636	**J1939:TxAmbCond:Send**		*AMB*
	Level:	4	Send rate of "Ambient Conditions" sending telegram
	Range:	0…10 s	(RESET)

No.	Name		Meaning
29637	**J1939:TxInlExh:Send**		*IC1*
	Level:	4	Send rate of "Intake/Exhaust Conditions 1" sending telegram (RESET)
	Range:	0…10 s	
29638	**J1939:TxCCVehSp:Send**		*CCVS1*
	Level:	4	Send rate of "Cruise Control/Vehicle Speed 1" sending telegram (RESET)
	Range:	0…10 s	
29639	**J1939:TxEngConf:Send**		*EC1*
	Level:	4	Send rate of "Engine Configuration 1" sending telegram (RESET)
	Range:	0...FFFF Hex	
29642	**J1939:TxEngInfo:Send**		*EI1*
	Level:	4	Send rate of "Engine Information 1" sending telegram (RESET)
	Range:	0...FFFF Hex	
29644	**J1939:TxVEP1:Send**		*VEP1*
	Level:	4	Send rate of "Vehicle Electrical Power 1" sending telegram (RESET)
	Range:	0…10 s	
29705	**J1939:TorqFMap:n**		*EEC3*
	Level:	4	Speed grid points for torque friction map
	Range:	0…4000 rpm	
29715	**J1939:TorqFMap:T**		*EEC3*
	Level:	4	Coolant temperature grid points for torque friction map
	Range:	-100…1000 °C	
29720	**J1939:TorqFMap:f**		*EEC3*
	Level:	4	Torque friction values for torque friction map
	Range:	0...100 %	

Tab. 218: SAE J1939 characteristics and maps

28.4.6 HZM-CAN customer module

↑*23.2* CAN protocol HZM-CAN customer module and Manual DG 05007-e

No.	Name		Meaning
29800	**CMTelyParamSet(x)**		
ff	Level:	4	Assignment of sending parameters to sending telegram y on HZM-CAN customer module
	Range:	0...29999	y = 50..58 (RESET)

Tab. 219: HZM-CAN customer module characteristics and maps

29 Illustrations

30 Tables

31 Download of manuals

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