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HEINZMANN®

Electronic Speed Governor

Low Cost Governor

ORION

KG-LC-D / DC 9

StG 3005 / LStG 25

Manual DG 06 005-e / 04-06

 **Warning**	Read this entire manual and all other publications appertaining to the work to be performed before installing, operating or servicing your equipment. Practice all plant and safety instructions and precautions.
 **Danger**	Failure to follow instructions may result in personal injury and/or damage to property. HEINZMANN will refuse all liability for injury or damage which results from not following instructions
 **Danger! High Voltage**  **Danger**	**Please note before commissioning the installation:** Before starting to install any equipment, the installation must have been switched dead! Be sure to use cable shieldings and power supply connections meeting the requirements of the *European Directive concerning EMI*. Check the functionality of the existing protection and monitoring systems.
 **Danger**	**To prevent damages to the equipment and personal injuries, it is imperative that the following monitoring and protection systems have been installed:** Overspeed protection acting independently of the speed governor Overtemperature protection HEINZMANN will refuse all liability for damage which results from missing or insufficiently working overspeed protection **Generator installation will in addition require:** Overcurrent protection Protection against faulty synchronization due to excessive frequency, voltage or phase differences Reverse power protection
	Overspeeding can be caused by: Failure of the voltage supply Failure of the actuator, the control unit or of any accessory device Sluggish and blocking linkage

 **Warning**	The examples, data and any other information in this manual are intended exclusively as instruction aids and should not be used in any particular application without independent testing and verification by the person making the application.
 **Danger**	Independent testing and verification are especially important in any application in which malfunction might result in personal injury or damage to property.
	HEINZMANN make no warranties, express or implied, that the examples, data, or other information in this volume are free of error, that they are consistent with industry standards, or that they will meet the requirements for any particular application.
	HEINZMANN expressly disclaim the implied warranties of merchantability and of fitness for any particular purpose, even if **HEINZMANN** have been advised of a particular purpose and even if a particular purpose is indicated in the manual.
	HEINZMANN also disclaim all liability for direct, indirect, incidental or consequential damages that result from any use of the examples, data, or other information contained in this manual.
	HEINZMANN make no warranties for the conception and engineering of the technical installation as a whole. This is the responsibility of the user and of his planning staff and specialists. It is also their responsibility to verify whether the performance features of our devices will meet the intended purposes. The user is also responsible for correct commissioning of the total installation.

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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

persons

product and engine

environment.

The symbols used in this publication are in the first place intended to direct your attention to the safety instructions!

Warning

This symbol is to indicate that there may exist dangers to the engine, to the material and to the environment.

Danger

This symbol is to indicate that there may exist dangers to persons. (Danger to life, personal injury))

Danger! High Voltage

This symbol is to indicate that there exist particular danger due to electrical high tension. (Mortal danger).

Note

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. The respective text is printed in italics.

The primary issue of these safety instructions is to prevent personal injuries!

Whenever some safety instruction is preceded by a warning triangle labelled “Danger” this is to indicate that it is not possible to definitely exclude the presence of danger to persons, engine, material and/or environment.

If, however, some safety instruction is preceded by the warning triangle labelled “Caution” this will indicate that danger of life or personal injury is not involved.

The symbols used in the text do not supersede the safety instructions. So please do not skip the respective texts but read them thoroughly!

In this publication the Table of Contents is preceded by diverse instructions that among other things serve to ensure safety of operation. It is absolutely imperative that these hints be read and understood before commissioning or servicing the installation.

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 Works

- 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 Further Information

Technical data and ports of control devices, sensors, transducers and actuators are described in detail in this manual.

In addition, this manual describes the commissioning procedure and the error messages for the analog control device **KG-LC-D**.

For the digital control device **DC 9**, the functions of single parameter settings and characteristic curves, commissioning and errors are described in detail in the manual **Basic information on DC 9.**

To put the digital control device **DC 9** into operation, either a handheld programming device or the communications software DcDesk 2000 by HEINZMANN installed on a laptop are required.

Operation of the handheld programming device is described in the manual

Handheld programming device HP 03, manual no. DG 04 003-e

The easy-to-use communication application DcDesk 2000 is described in the manual

Operating Instructions Communication Programme DcDesk 2000,
manual no. DG 00 003-e

3 Application of System ORION

The electronic **HEINZMANN-**governors of the series ORION are fully electronic and therefore do not require mechanical drive. This provides for very simple and cost- efficient installation on the engine.

The use of electronic speed governing systems is recommended whenever superior regulating accuracy is required, since short recovery times with reduced overshoot amplitudes and high speed constancy are possible both in applications with or without droop.
Electronic speed governors of the **ORION** series are conceived especially for speed control of small diesel engines. To this purpose, actuator **StG 3005** is connected to the injection pump / throttle valve via a regulating lever and linkage. Actuator **LStG 25** is mounted directly onto the regulating bar, no external linkage is necessary.

Similarly controlled engines are used in particular with generators in isolated and mains operation. For this purpose the single-phase synchronizing and load measuring unit HEINZMANN AT 10 can be used in addition.

3.1 Application of Analogue Governor KG-LC-D

The analogue governor **KG-LC-D** is suited for the following applications:

- applications using actuators **LStG 25** or **StG 3005** with small diesel or gas engines
- engines with fixed or variable speed
- isochronous speed control or speed control with droop
- speed setpoint set analoguely with **AT 10,** setpoint potentiometer, 0..5 V or 4..20 mA
- speed point set digitally via switch inputs "Speed increase / decrease".
- internal control settings via potentiometer
- fixed starting fuel limit

3.2 Application of Digital Governor DC 9

The digital governor **DC 9** is suited for the following applications:

- applications using actuators **LStG 25** or **StG 3005** with small diesel or gas engines
- engines with fixed or variable speed
- isochronous speed control or speed control with droop
- variable speed setpoint set by setpoint potentiometer, 0..5 V, 4..20 mA
- speed setpoint set by fixed speed with digital offset by switch inputs "Speed increase / decrease".
- speed setpoint set by fixed speed with analogue offset by **AT 10** for generator application
- switching between two analogue speed setpoints
- switching between idle/maximum speed governor and variable speed governor

Other function can be implemented additionally with the digital control device **DC 9.**

- variable starting fuel
- speed Ramp
- boost pressure or speed dependent limiting functions
- map for dynamic parameters
- oil pressure monitoring
- error recognition and indication


Note

Due to the limited number of inputs not all the applications listed above are possible at the same time.

In comparison to the analogue control device **KG-LC-D**, the digital control device **DC 9** in addition has the following advantages:

- comfortable set-up and putting into operation with handheld programmer or DcDesk 2000 communication program
- for greater numbers a data record once determined can be used again and again.

4 Block Diagram of Control Circuit

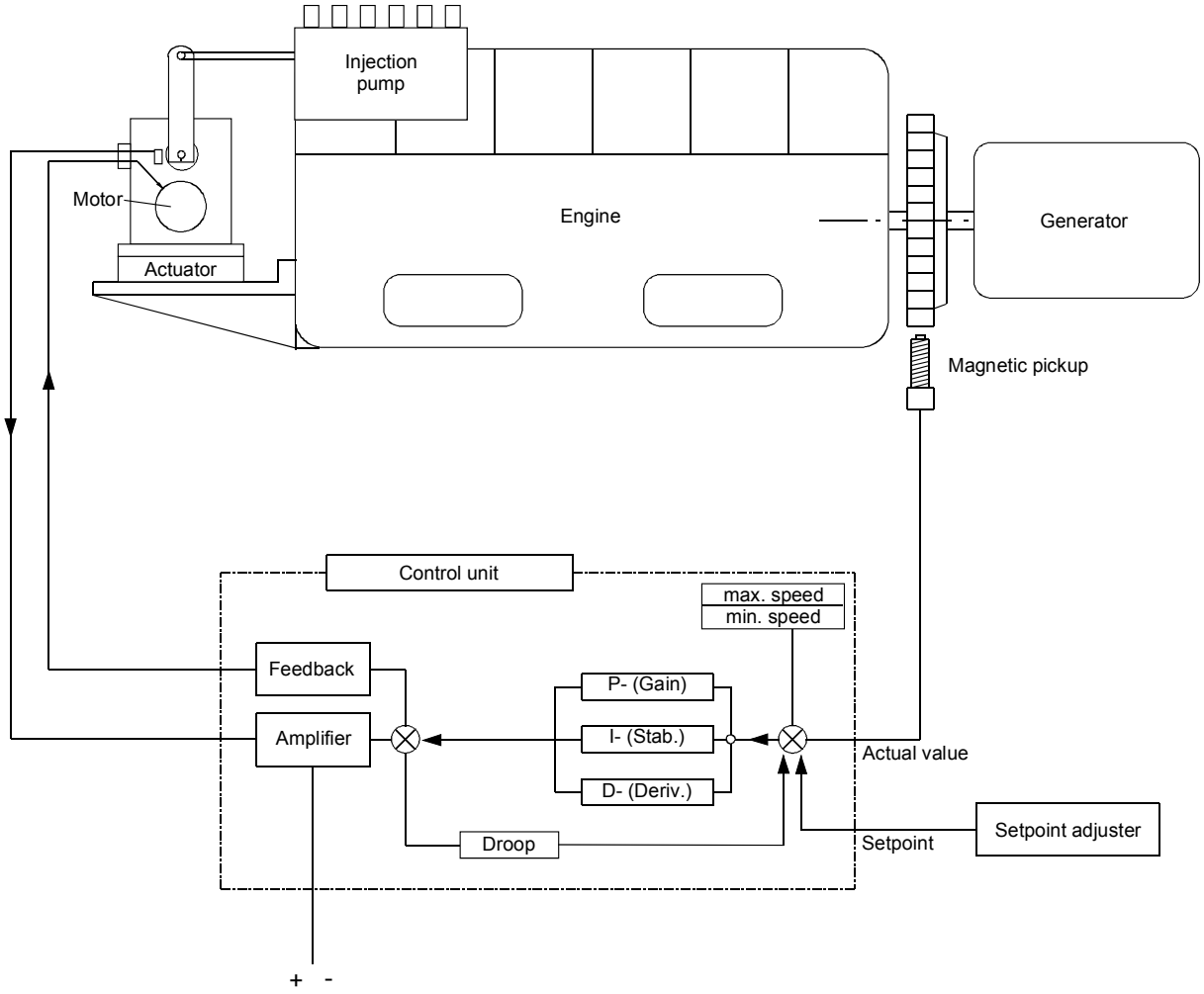


Figure 1: Block Diagram of Control Circuit

5 Mode of Operation

The electric actuators **StG 3005** and **LStG 25** belonging to the system feature an integrated feedback system for position sensing and are adjusted in direction 100% active by 2-quadrant-power output stage (2Q), for the opposite direction a strong integrated return spring is used.

5.1 Analogue Governor KG-LC-D

When the engine is started, a magnetic pickup on the starter gear induces a voltage and transmits it to the control device. The voltage activates the control device and the frequency of the voltage signal is read as actual speed.

When the engine starts, the actuator goes to the set limited fuel value.

The actual setpoint is adjusted by an analogue signal (e.g. potentiometer)

As soon as the engine runs at rated speed, the speed setpoint may be adjusted with by an offset of ± 4 % using two digital switching inputs (speed increase/decrease). At each new engine start this offset is automatically returned to zero.

The control device is executed as PID control device, according to application the functions droop zero (isochronous operation) or droop are possible.

Droop, i.e. a continuous speed deviation dependent on engine load, is necessary for vehicle applications but also when existing generator systems are retrofitted or modernized whereby a mechanical speed governor is substituted with an electronic one but a generator control device not by HEINZMANN used for synchronization and power output setting is kept.

For synchronization and load sharing the HEINZMANN unit **AT 10-01** can be used and connected. This device measures the KW performance in single-phase mode (and is therefore suited for three-phase loads!), load sharing is isochronous. For more information on this device see the manual "**AT 10-01**" (manual no. E 05 001-d).

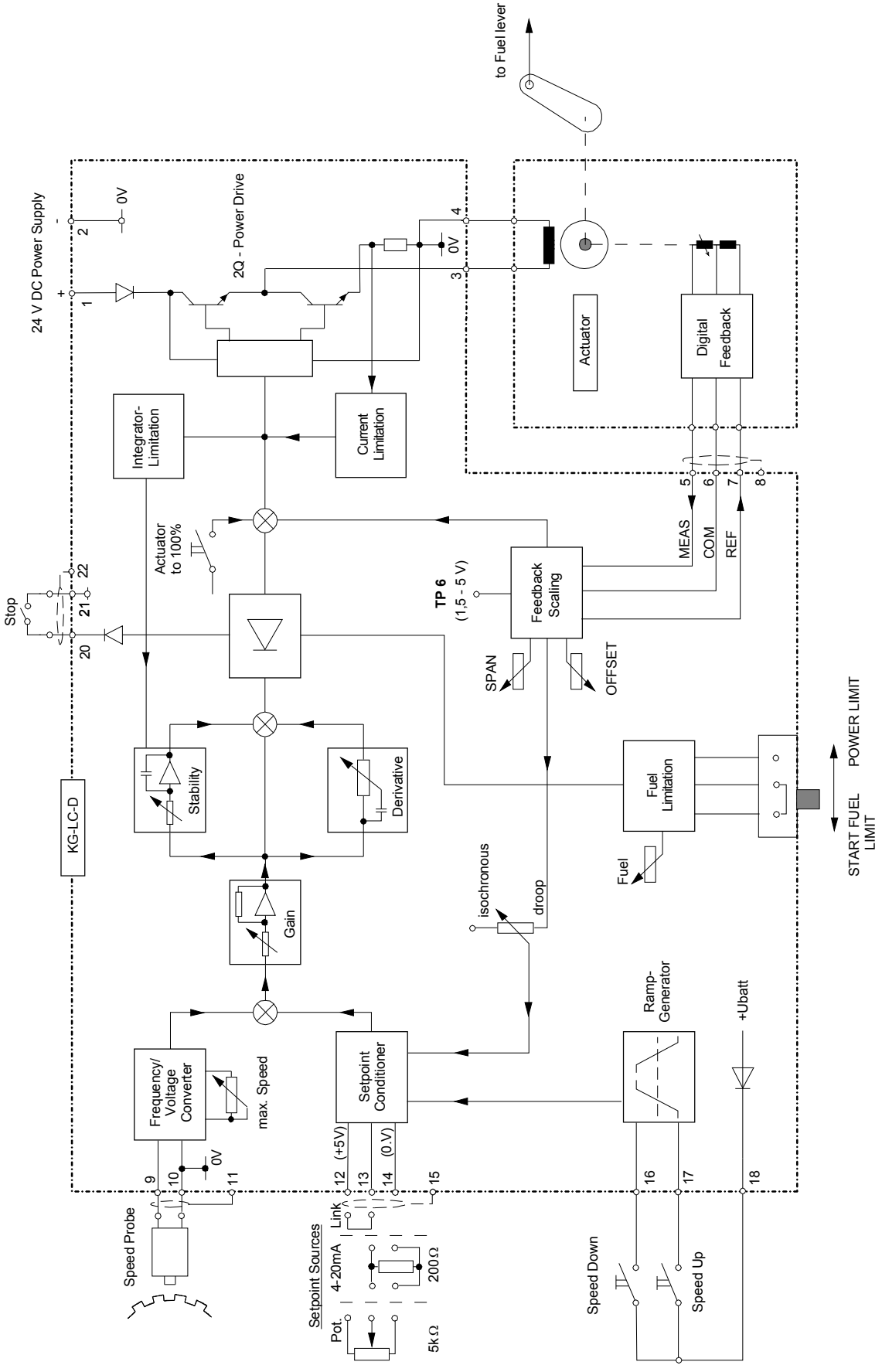


Figure 2: Block Diagram of analogue Governor KG-LC-D

5.2 Digital Governor DC 9

The control device contains the control electronics. At the core of the control unit is a very fast and powerful 16-bit microprocessor (CPU). The actual controller programme, on the basis of which the microprocessor operates, is permanently stored in a so-called FLASH-EPROM.

When the engine is started, a magnetic pickup on the starter gear induces voltage and transmits it to the control device. The voltage activates the control device and the frequency of the voltage signal is read as actual speed.

After the engine is started, the engine runs up a programmable ramp until it reaches a pre-set fixed speed or an analogue setpoint. Afterwards, the pre-set speed setpoint can be offset with the aid of two digital switch inputs (speed increase/decrease). At each new engine start this offset is automatically returned to zero.

The control device is executed as PID control device, according to application the functions droop zero (isochronous operation) or droop are possible.

Droop, i.e. a continuous speed deviation dependent on engine load, is necessary for vehicle applications but also when existing generator systems are retrofitted or modernized whereby a mechanical speed governor is substituted with an electronic one but a control device not from HEINZMANN used for synchronization and power output setting is kept.

For synchronization and load sharing the HEINZMANN unit **AT 10-01** can be used and connected. This unit carries out only a single-phase performance reading, during which the speed governor always functions in isochronous mode. For more information on this device see the manual "**AT 10-01**" (manual no. E 05 001-d).

HEINZMANN digital control devices of the **ORION** series are speed governors with limited functionality. But beside speed control several other functions are available:

a) Speed Setting

Speed setpoint may be transmitted by analogue setpoint adjusters (supply 0..5 V, voltage 4..20 mA, AT 10 or 5 kOhm potentiometer).

In addition, the speed setpoint can be modified with a push-button for speed increase and speed decrease around the fixed speed. The permissible rate of speed increase/decrease can be determined with a parameter. After start-up the engine runs up a separately parametrizable starting ramp until it reaches the pre-set fixed speed.

b) All-speed Governor with adjustable Droop

For several applications, e.g. for parallel operation of generators without a HEINZMANN load measuring unit, speed control with droop is required. This can be adjusted as desired. When the setting is droop = 0 the control device operates in isochronous mode.

c) Idling / Maximum Speed Control

For vehicle application, the governor can be made to operate as an idling and maximum speed controller. With a digital switch it is possible to switch over from allspeed governor to idle / maximum speed control.

d) Adjustment of Speed Range

The minimum and maximum speeds that can be reached with the speed setpoint can be adjusted with parameters.

e) Starting Fuel Adjustment

When setting starting fuel, starting minimum fuel or starting maximum fuel are available as alternatives. Furthermore, variable starting fuel can be provided, by which starting fuel is increased automatically during start-up.

f) Fixed Fuel Limitation

For the stop-position and the maximum fuelling position "electric catches" can be provided. This will prevent the governor's thrust from affecting the terminal stops of the injection pump, etc.

g) Speed Dependent Fuel Limitation

For variable speed governors, there is provided an option of programming speed dependent limit curves. Thus, for any speed, torque can be reduced as is permissible for the engine or desired by the user.

h) Boost Pressure dependent Fuel Limitation

For turbocharged engines, fuelling can be reduced to achieve smokeless operation in case of missing boost pressure (e.g., starting or load change). The respective limit curves can be programmed accordingly.

i) Engine Stop

When the switch input for engine stop is activated the power supply to the actuator is automatically cut, so that the internal spring can extract the actuating bar after the engine has stopped.

j) Overspeed Protection

An overspeed limit can be set. If this limit is surpassed, the control device transmits an alarm message and the power to the actuator is cut.

k) Oil Pressure Monitoring

For the purpose of oil pressure monitoring, speed/pressure dependent limit curves can be provided. If oil pressure is too low, an alarm is given; if oil pressure continues to drop, the engine is shut down.

l) Correction of PID-Parameters

To optimize dynamic behaviour for every point of operation the PID parameters can be corrected depending on speed or load with the aid of freely programmably stability maps.

m)Automatic Synchronizing and Load Sharing

For automatic synchronizing and load sharing, the single-phased synchronizing and real load sharing device **AT 10** can be connected to an analogue input.

n) Running Hour Meter

Records the sum total of hours the engine is running (speed is recognized).

o) Failure Diagnosis and Display

If a sensor error or an actuator error happens, an alarm message is transmitted; if necessary, the engine is put in emergency operation mode or stopped. Internal errors are recognized too and memorized and counted like all other errors. On each occurrence of error, in addition selectable data related to the circumstances of the error may be recorded.

All errors can be read out with an external handheld programmer or with a PC/laptop, if the communication programme and cable are available.

p) Communication

The unit may be connected to all HEINZMANN handheld programming devices or to a PC/laptop with installed communications software DcDesk 2000 using a 9-pin Sub-D connector.

Warning

For connection use only the cable provided by HEINZMANN. On one end, this cable contains an electronic circuit developed especially for HEINZMANN control devices.

If other cables are used for communication, the connected components (control device, PC, laptop) may suffer damage.

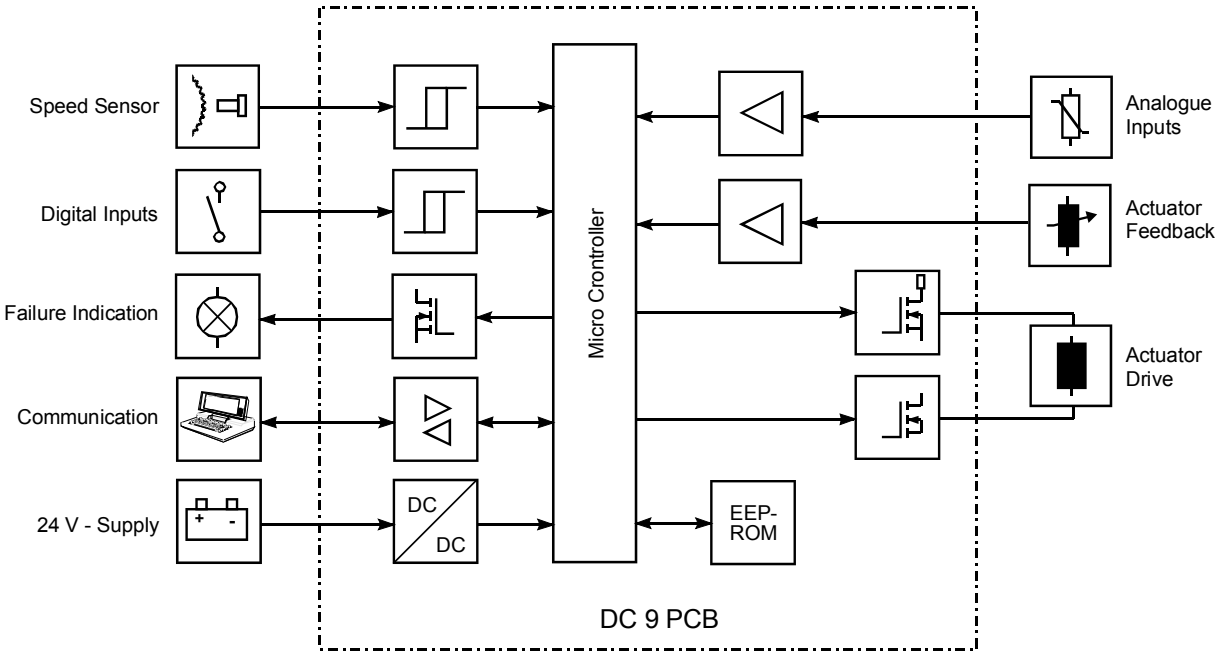


Figure 3: Blockdiagram DC 9

6 Magnetic Pickup IA ..

6.1 Specification

Principle	inductive sensor
Distance to pickup wheel	0.5 up to 0.8 mm
Output voltage	0 V up to 10 V AC
Signal form	sine (depending on tooth shape)
Resistance	approx. 52 Ohm
Temperature Range	-55°C up to +120°C
Protection grade pickup	IP 55
Protection grade plug	IP 20
Vibration	< 10g, 10 up to 100 Hz
Shock	< 50g, 11 ms half-sine
Accompanying plug	SV 6 - IA - 2K (EDV- No.: 010-02-170-00)

6.2 Installation

The installation of the pickup has to be arranged in such a way as to obtain a frequency as high as possible. Frequency (by Hz) is calculated according to the formula

$$f_{(Hz)} = \frac{n(1/\min) * z}{60}$$

z = teeth number of flywheel

Example:

n = 1.500

z = 160

$$f = \frac{1500 * 160}{60} = 4.000 \text{ Hz}$$

It is preferrable to mechanically mount the speed pickup on the starter gear of the toothed flywheel rather than on the camshaft, since the latter only runs at half-speed and therefore only half as many speed readings per rotation are possible.

The pickup gear must consist of magnetic material (e.g., steel, cast iron). Aluminium and plastic materials therefore are not suited!

6.3 Tooth Profile

Any tooth profile is admissible. The top width of the tooth should be 2.5 mm minimum, the gap and the depth of the gap at least 4 mm. For index plates the same dimensions are valid.

Due to tolerances, a radial arrangement of the magnetic pickup is preferable.

6.4 Clearance of Magnetic Pickup

The distance between the magnetic pulse pickup and the tooth top should range from 0.5 to 0.8 mm. (It is possible to screw in the magnetic pickup till it touches the tooth and then unscrew it for about half a turn.)

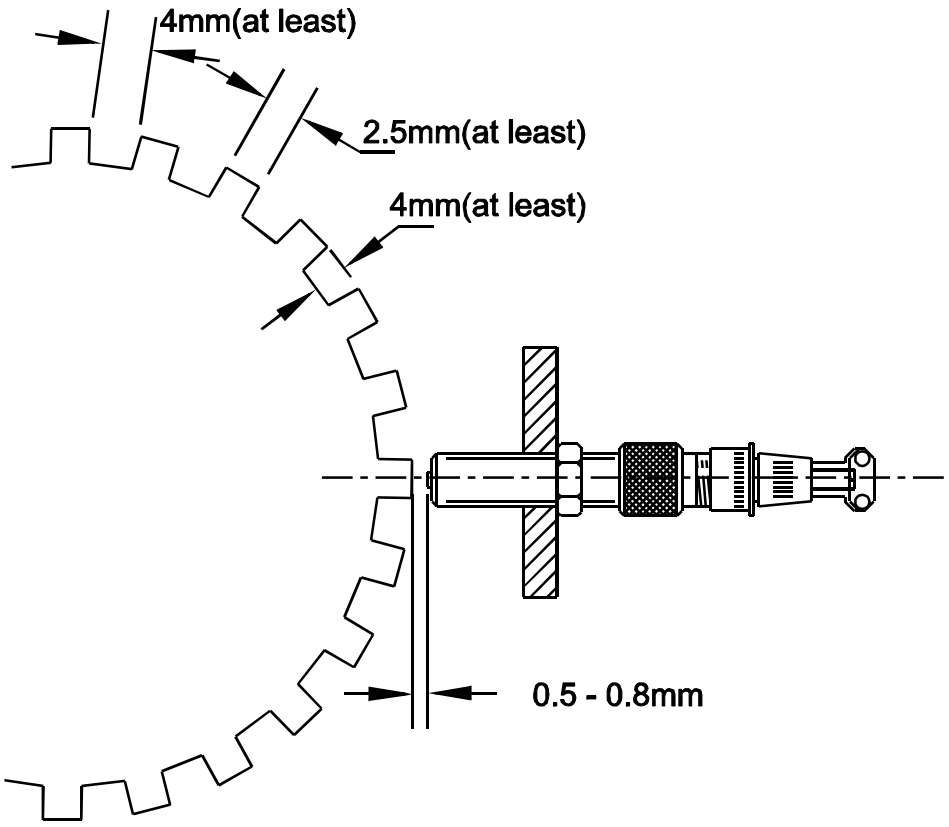


Figure 4: Clerance of Pickup

6.5 Mounting Measurements

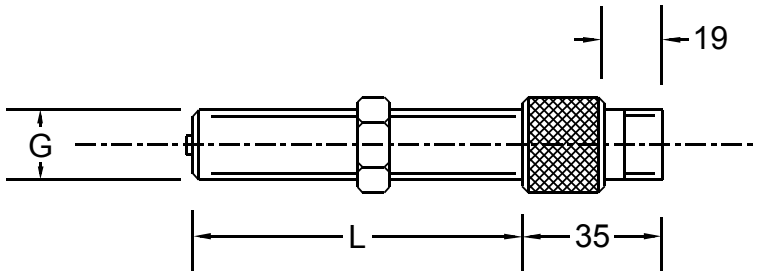


Figure 5: Magnetic Pickup

TYP	Thread Length (mm)	Thread Type	Remarks
IA 01-38	38	M 16 x 1,5	Accompanying plug: SV6-IA-2K
IA 02-76	76	M 16 x 1,5	
IA 03-102	102	M 16 x 1,5	
IA 04-125	125	M16 x 1,5	
IA 11-38	38	5/8"-18UNF-2A	
IA 12-76	76	5/8"-18UNF-2A	
IA 13-102	102	5/8"-18UNF-2A	

The ordering designation is e.g. IA 02-76

7 Setpoint Adjuster

For the control devices of the **ORION** series different speed setpoint adjusters are available, depending on the application.

7.1 Link for Constant Speed Governor with Generator Application

In the standard version the control devices of the **KG-LC-D** are delivered as fixed speed controllers for generator applications in isolated operation and in this type of application no additional transducer is needed, with exception of a bridge between terminals 12 (+4V) and setpoint 13 (SP).

7.2 Setpoint Potentiometer SW 01 - 1 - o (1- turn)

Displacement angle	approx. 312°
Resistance	5 kOhm
Temperature range	-55°C up to +120°C
Protection grade	IP 00

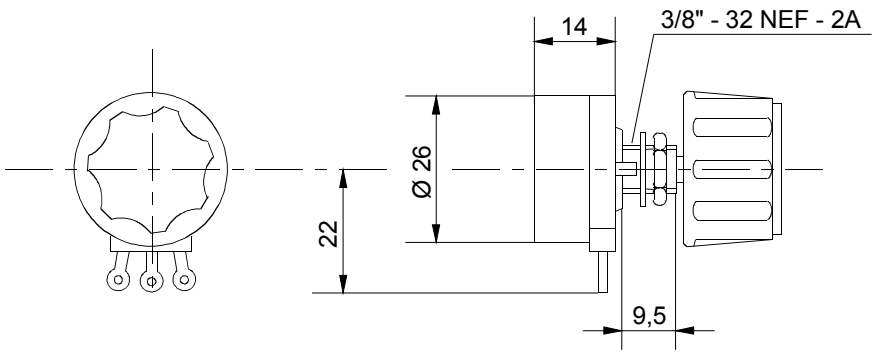


Figure 6: Potentiometer SW 01 - 1

7.3 Setpoint Potentiometer SW 02 - 10 - o (10- turn)

Displacement angel	10 turns
Resistance	5 kOhm
Temperature range	-55°C up to +105°C
Protection grade	IP 00

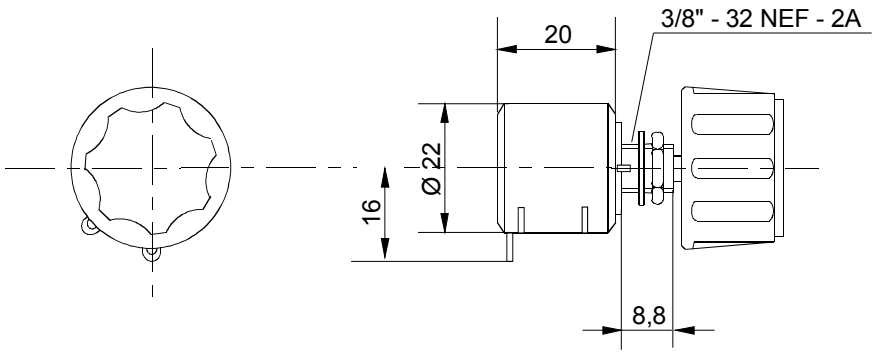


Figure 7: Potentiometer SW 02 - 10

On request, the potentiometers, as specified under 7.2 and 7.3 can be supplied with analogue adjustment knob with lock in place of the standard rotating knob. In this case, ordering specification is SW..-..-m.

Equally, instead of the knob a clamping fixture can be installed. Ordering specification must be changed to SW ..-..-k.

7.4 Speed Adjustment by Voltage Signal

Instead of a setpoint potentiometer a voltage signal can be connected directly. The analogue control device **KG-LC-D** works with an input signal range of ca. 2..5 V. The digital control device **DC 9** uses an input signal range of max. ca. 0..5 V.

7.5 Speed Adjustment by Current Signal

Instead of a setpoint potentiometer, a voltage signal can be connected directly to the **DC-9.** This is set by parameters. A maximum input signal range of ca 3..22 mA is allowed.

In order to directly connect a 4..20 mA signal to the analogue control device **KG-LC-D,** an additional ampere measuring resistance of 200 Ohm must be connected to terminals 13 "SP" and 14 "GND". Maximum speed at 20 mA is adjusted with the potentiometer "SPEED", the required minimum speed must be determined with the control signal.

7.6 Pneumatic Setpoint Adjuster

For pneumatic setpoint adjustment the setpoint adjuster SW 05-P can be used with a pressure range from 1 to 6 bars. For more informations refer to the manual E 81 002 - e.

7.7 Setpoint Adjustment by Foot Pedal

The non- contact signal transducer unit EFP is basically an angular position transducer that translates a foot pedal into a proportional current or voltage for 0 - 45° rotation. The resulting output can be used for speed setting. For more information refer to the manual E 83 005 - e.

8 Actuators

Warning

The control devices of the ORION series are suited exclusively for use with the actuators StG 3005 and LStG 25.

8.1 Design and Mode of Operation of Actuator StG 3005 in 2Q-Operation

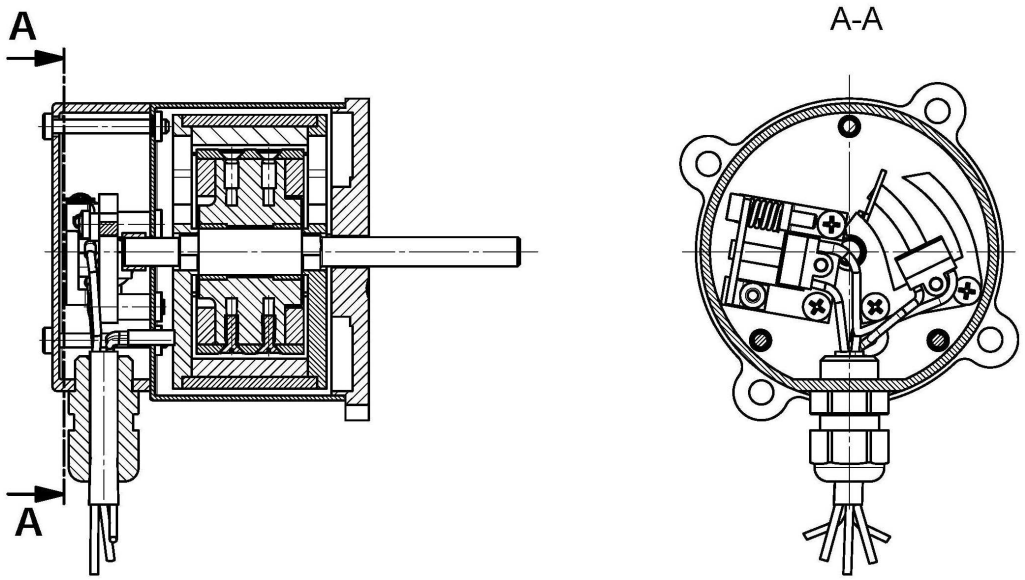


Figure 8: Sectional Drawing of Actuator StG 3005

Four permanent magnets are attached to the output shaft of the actuator. Opposite the permanent magnet, a coil core with four work coils is mounted. If current is applied to the work coils, a rotational movement in direction 100% results. The stronger the current signal is, the stronger is the magnetic power. An internal spiral return spring turns the output shaft in the opposite position (Stop position). The actuator therefore works in 2Q mode and mantains the position in which magnetic power and the power of the spring are in balance.

Changing the polarity of the coils and at the same time mounting the spiral return spring in the opposite sense inverts the actuator's action.

With the aid of a non-contact measuring system, the position of the output shaft is read and transmitted to the control device as feedback signal.

To the output shaft a regulating lever is attached. This must be connected to the injection pump or throttle valve by way of a linkage.

In this way, in case of speed or load change, the control device is able to change the position of the regulating lever or throttle valve by increasing or decreasing the current until speed setpoint and actual speed are level.

8.2 Design and Mode of Operation of Actuator LStG 25

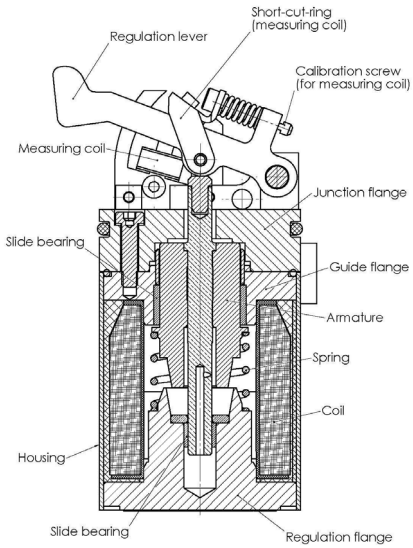


Figure 9: Sectional Drawing of Actuator LStG 25

The current applied to the coil generates a magnetic field. This pulls the armature towards the control flange (100%). The stronger the current signal is, the stronger is the magnetic power. An internal pressure spring presses the armature in the opposite direction (Stop position). The actuator therefore works in 2Q mode and mantains the position in which magnetic power and the power of the spring are in balance.

Through the internal spring, the shaft impressed into the armature exerts pressure onto the orientable regulating lever.

With the aid of a non-contact measuring system, the position of the regulating lever is read and transmitted to the control device as feedback signal.

The actuator is flange-mounted directly to the pump. The regulating lever exerts pressure on the injection pump's regulating bar.

In this way, in case of speed or load change, the control device is able to change the position of the regulating bar by increasing or decreasing the current until speed setpoint and actual speed are level.

8.3 Specifications

Actuator	**StG 3005**
Rotation angle	53°
Max. torque in direction stop in direction 100 %	 approx. 0.35 Nm approx. 0.55 Nm
Torque in steady state condition	approx. 0.20 Nm
Current consumption of governor maximum steady state	 5 1.7
Storage temperature	-40°C up to +130°C
Operation temperature	-40°C up to +100°C
Humidity	up to 98%
Protection grade housing plug connector	 IP65 IP 55
Weight	0.8 kg

Actuator	**LStG 25 (Standard)**
Stroke	19.5 mm
Max. power	6.5 N
Power in steady state condition	2,1 N
Current consumption of governor maximum steady state	 5 1.7
Storage temperature	-55°C up to +110°C
Operation temperature	-25°C up to +95°C
Humidity	up to 98%
Protection grade housing plug connector	 IP65 IP 55
Weight	0.7 kg

Explanation:

Current consumption is measured on the positive line of the respective actuator supply.

To find out in specific cases with the aid of measurement if the power of an actuator is sufficient for the intended application, the above tables also show **torque / max. displacement power in steady state condition** with the relative **max. admissible current.**

Especially for modern gas engine it is recommended to verify if the power of the actuator is sufficient along the whole load range.

Warning

If consumption exceeds 1.7 A, the actuator overheats and is subjected to increased wear. A shorter useful life is the inescapable consequence!

8.4 Measurements

8.4.1 StG 3005

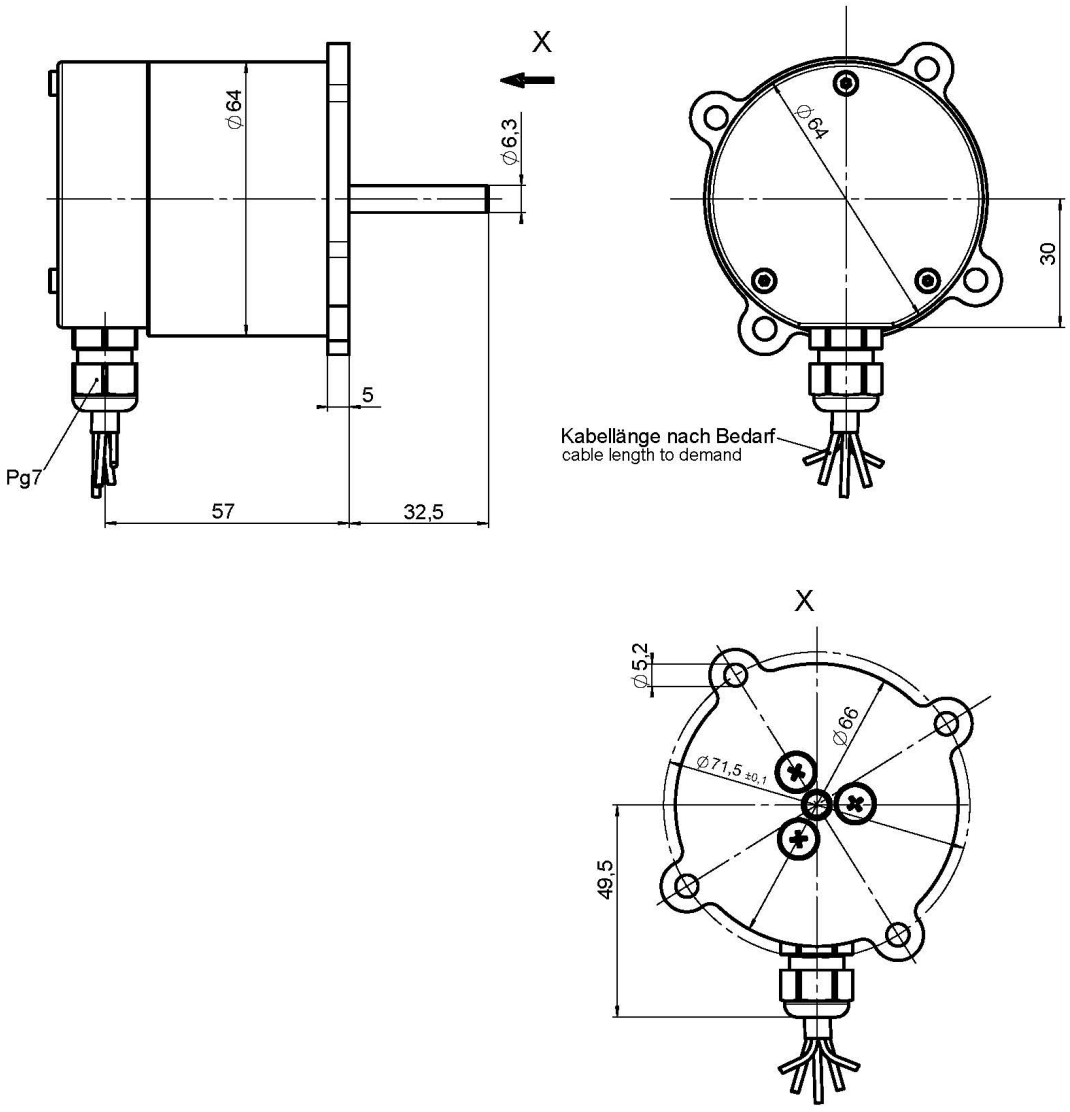


Figure 10: Measurements of Actuator StG 3005 - 01

8.4.2 LStG 25

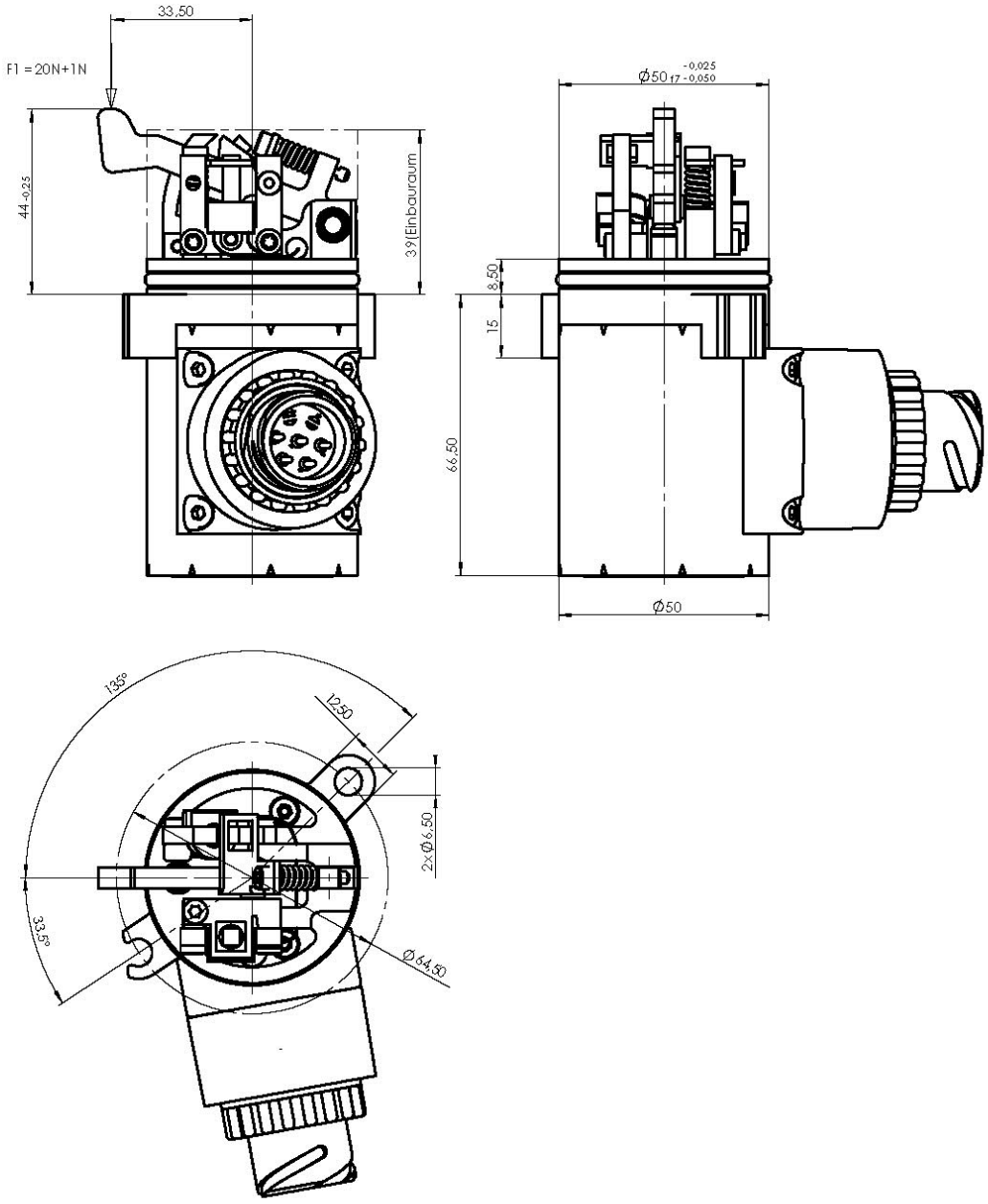


Figure 11: Measurements of Actuator LStG25

9 Mounting of Actuator and Installation of Linkage

The **LStG 25** actuator is conceived only for direct mounting onto an injection pump. This mounting is possible only if actuator and injection pump have been adapted to each other. This can only be done by HEINZMANN, together with the engine manufacturer.

In the following figure is an example of a mounting drawn.

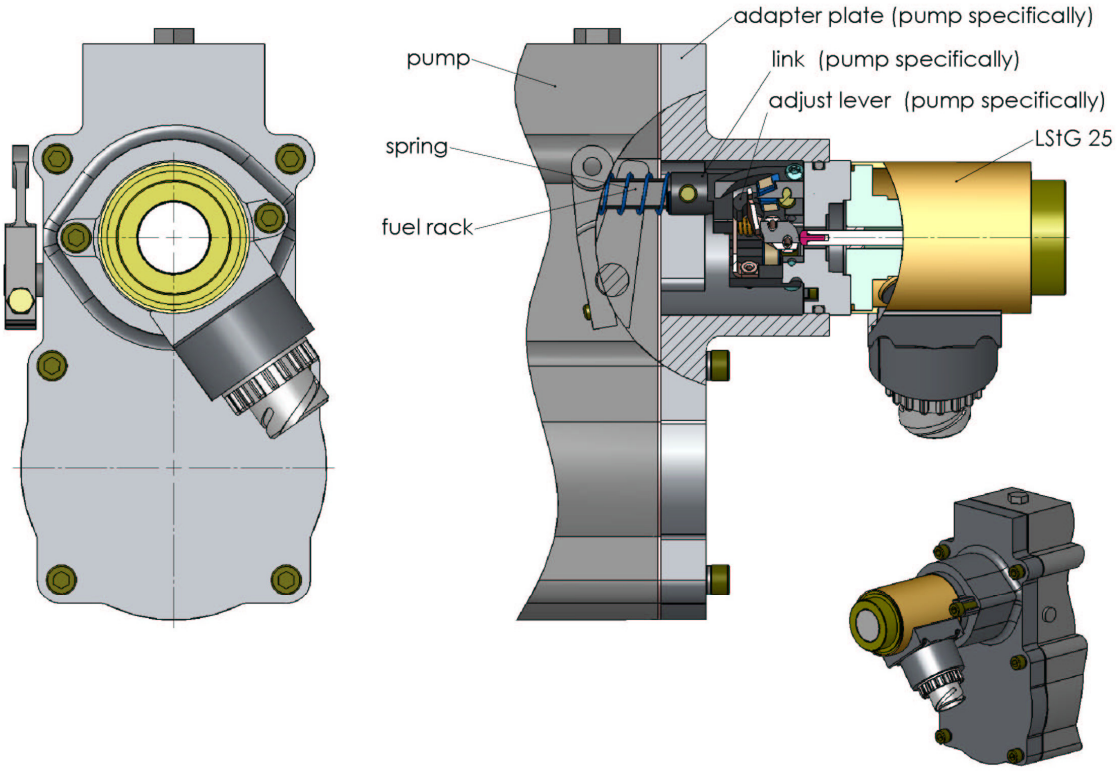


Figure 12: Example of Mounting of LStG 25

With a regulating lever, the actuator **StG 3005** can be connected directly to an injection pump, to the stop lever of a mechanical governor or with a throttle valve.

The connecting linkage from the governor to the injection pump or the carburettor should be lengthwise adjustable. If possible, joint rod heads to DIN 648 should be used as connecting links. The linkage must operate easily and without clearance.

In case of friction or backlash in the linkage connecting the actuator and the injection pump or throttle valve optimum control will not be possible.

9.1 Order Specification for Lever Arm for StG 3005

As a standard version, the lever arm as shown below is available.

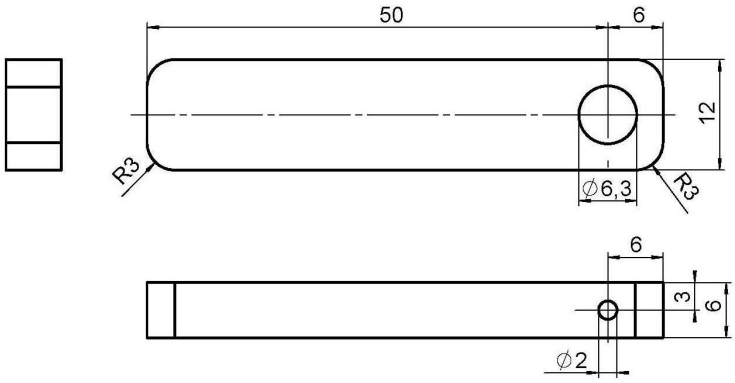


Figure 13: Lever Arm for StG 3005

The order specification is RH 3005-01.

9.2 Un-linear Linkage at StG 3005 for Gas and Gasoline Engines

The throttle characteristic of gas engines and Otto engines is non-linear. This means that within the zero load range but small changes of the throttle position will already result in large changes of speed or load whereas with the throttle nearly fully open only larger changes of the throttle position will lead to distinct changes of speed or load.

To obtain the best possible control performance across the entire operating range it will be necessary to compensate for the non-linear behaviour of the throttle by means of a non-linear linkage. In this case, the length of the linkage is adjusted in such a way that with the control unit in full load position the throttle is completely open and at least 80% of the rotation angel of the output shaft of actuator is used as a working angle. The below figure shows the correct assembly.

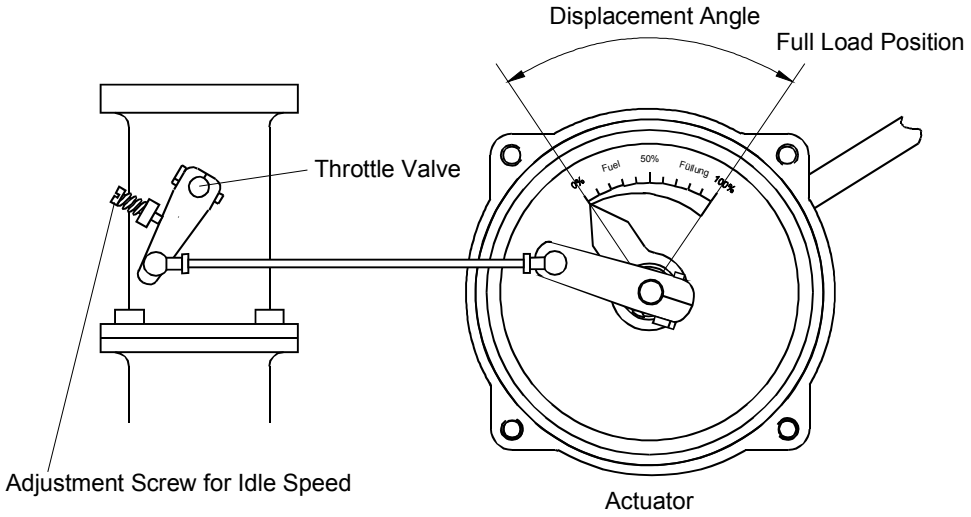


Figure 14: Linkage at StG 3005 with Gas Engines

9.3 Linear Linkage at StG 3005 for Diesel Engines

The **StG 3005** can be installed on diesel engines with distributor injections pumps (such as Bosch, CAV, Lucas) or inline pumps up to 4 cylinders with RS mechanical regulators. To this purpose, the pump's stop position must be determined by testing. The linkage has to be adjusted so that the stop positions of actuator and pump correspond.

Older distributor injection pumps (produced before 1990 approx.) have a stop lever. In this case, the linkage connecting the actuator must be attached to this stop lever.

More recent pumps have an electric magnetic valve for shutting the engine down. With these pumps, it is only the speed adjustment lever that the linkage may be connected to. This means that the mechanical control will still be active and receive just the setting value from the electronic control.

On engines with inline pumps and RS mechanical controls the linkage must be connected to the stop lever, and the internal spring provided to pull the stop lever into maximum position must be removed.

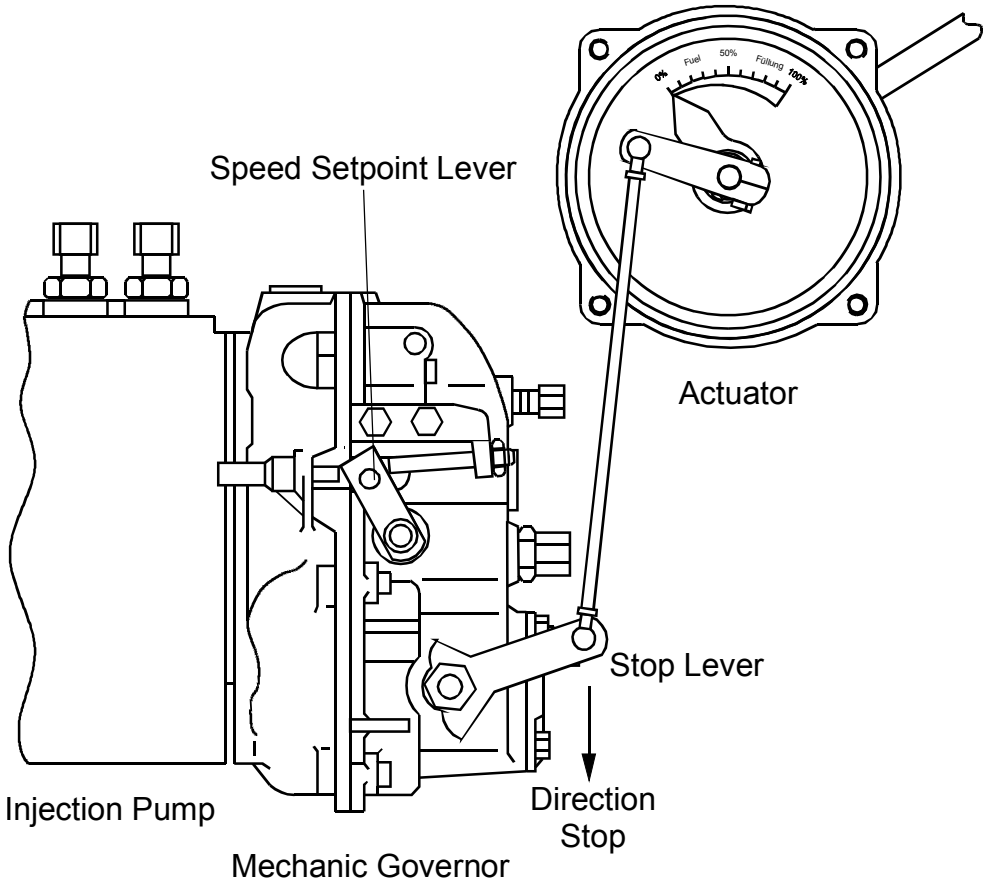


Figure 15: Linkage at StG 3005 for Diesel Engines

10 Control Units

10.1 Control Unit KG-LC-D

10.1.1 Specification

Operating voltage	24 V DC
Maximum voltage	35 V DC
Minimum voltage	20 V DC
supply voltage	24 V DC 35 V DC
Maximum ripple voltage at maximum actuator current	max. 10 % at 100 Hz
Acceptable voltage drop at maximum actuator current	max. 10 % in control unit
Fuse protection of governor	8 A
Overall curent consumption	
maximum	5 A
in steady state condition	1.7 A
Storage temperature	-55°C up to +85°C
Ambient temperature in operation	-40°C up to +70°C
Humidity	up to 80 %
Frequency range	
standard version	3100 up to 7000 Hz
special version	on request!
Steady state variation	±0,25 %
Speed variation due to temperature for frequency greater than than 500 Hz between -40°C and +70°C	±1 %
Droop	0 up to 15 % (depending on used actuator travel!)
1 analogue setpoint input from potentiometer or AT 10	0..4 V / 4..20 mA
TP 6	testpoint for measuring the feedback voltage or to connect the simulator PG 01
Protection grade	IP 20

Weight	approx. 0.5 kg

10.1.2 Potentiometers, Switches and Displays

Potentiometer:

SPEED	adjustment of max. speed / rated speed for generator applications
GAIN	dynamic P-optimizing
STABILITY	dynamic I-optimization
DERIVATIVE	dynamic D-optimization
DROOP	droop Adjustment (Pot. to min = Droop zero)
FUEL LIMIT	adjustment fuel limit
OFFSET	feedback adjustment to 1.5 V on TP 6 for actuator 0%
SPAN	feedback adjustment to 5 V on TP 6 for actuator 100%

Slide switch:

POWER LIMIT	power limitation for naturally aspirating engines with excess quantity of fuel
START FUEL LIMIT	start fuel adjustment for supercharged engines

LEDs:

CONTROL LAMP	indication of supply voltage before engine start-up, indication of missing pick-up impulse, indication of missing speed setpoint
FUEL LIMIT ACTIVE	indication of active fuel limit
OVER CURRENT	indication of active current limit (actuator on mechanical end position!)

Measuring point:

TP 6	measuring point for measurement of feedback (1,5..5 V)

Push-button:

ACTUATOR OPEN	forced opening of actuator to 100% position to adjust feedback voltage

10.2 Control Unit DC 9

10.2.1 Specifications

Operating voltage	12/24 V DC
Maximum voltage	32 V DC
Minimum voltage (shortly at start-up)	9 V DC
Maximum ripple voltage at maximum actuator current	max. 10 % at 100 Hz
Acceptable voltage drop at maximum actuator current	max. 10% in control unit
Fuse protection of governor	12 A
Overall current consumption maximum in steady state condition	 5 A 1.7 A
Storage temperature	-40°C up to +85°C
Ambient temperature in operation	-40°C up to +80°C
Humidity	up to 98% at 55°C, with thawing
Frequency range	0 up to 9000 Hz
Steady state variation	±0,25 %
Droop	parametrizable
Vibration resistance	max. 2 mm at 10 up to 20 Hz, max. 0.24 mm at 21 up to 63 Hz, max. 7 g at 64 up to 2000 Hz,
Shock	30 g, 11 ms- half-sine
Protection	IP 00
Dielectric resistance	> 1 MOhm at 48 V DC
Weight	approx. 0.5 kg
EMC CE	89/33/EEC EN 61000-6-2, EN 61000-6-4

10.2.2 Inputs and Outputs

All inputs and outputs are protected against cross-connection and short-circuit against battery positive and negative.

Speed input	for inductive sensor with f_i = 25 up to 9000 Hz, U_i = 0.5 up to 30 V AC
Actuator travel reading	internal in actuator with reference feedback
Actuator magnet output	I_{max} = 6.4 A, $I_{cont.}$ = 3.5 A
Digital output error lamp	I_{sink} < 0.3 A, U_{rest} < 1,0 V, low-side switching
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

10.3 Measurements

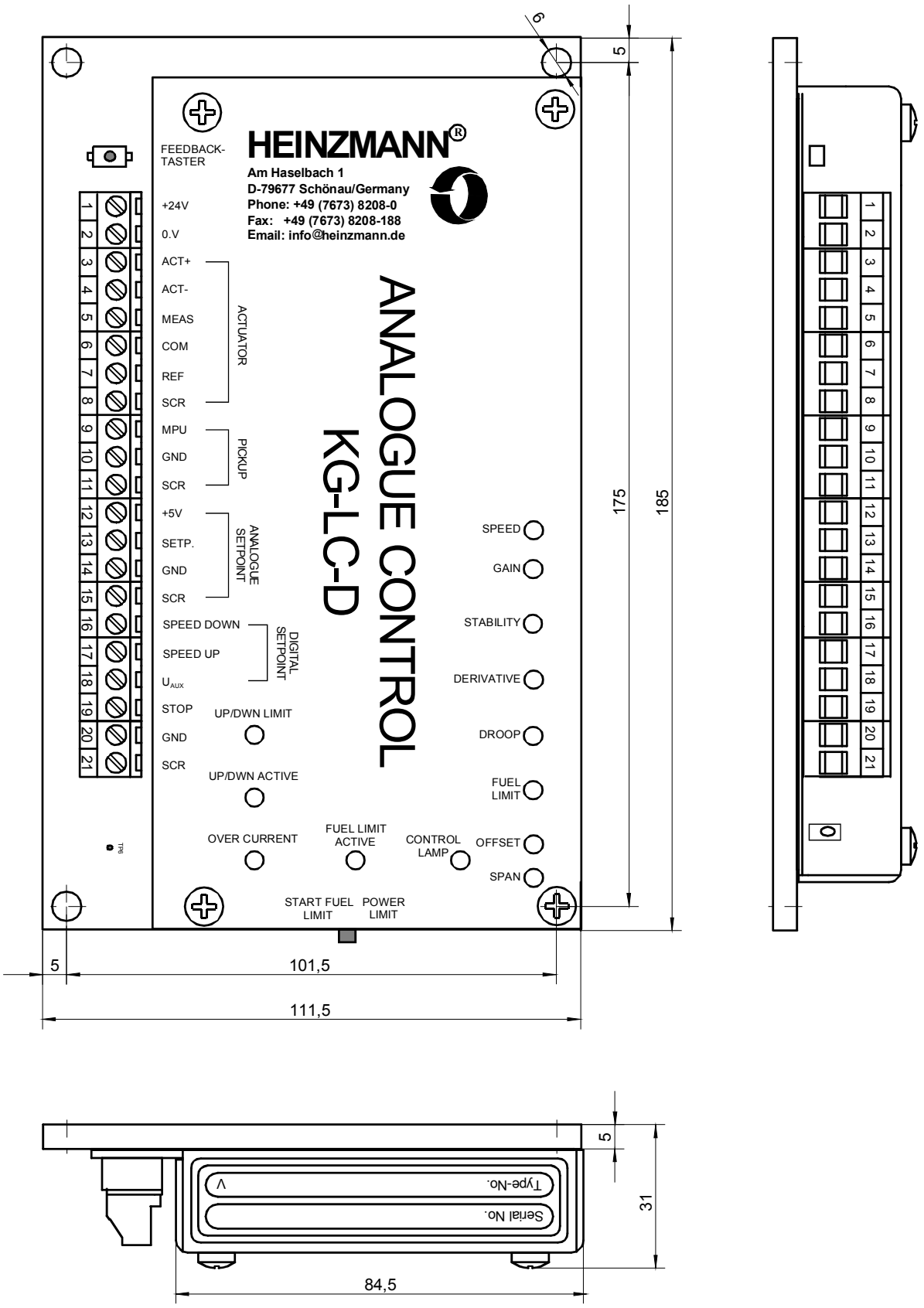


Figure 16: Housing of Control Unit KG-LC-D

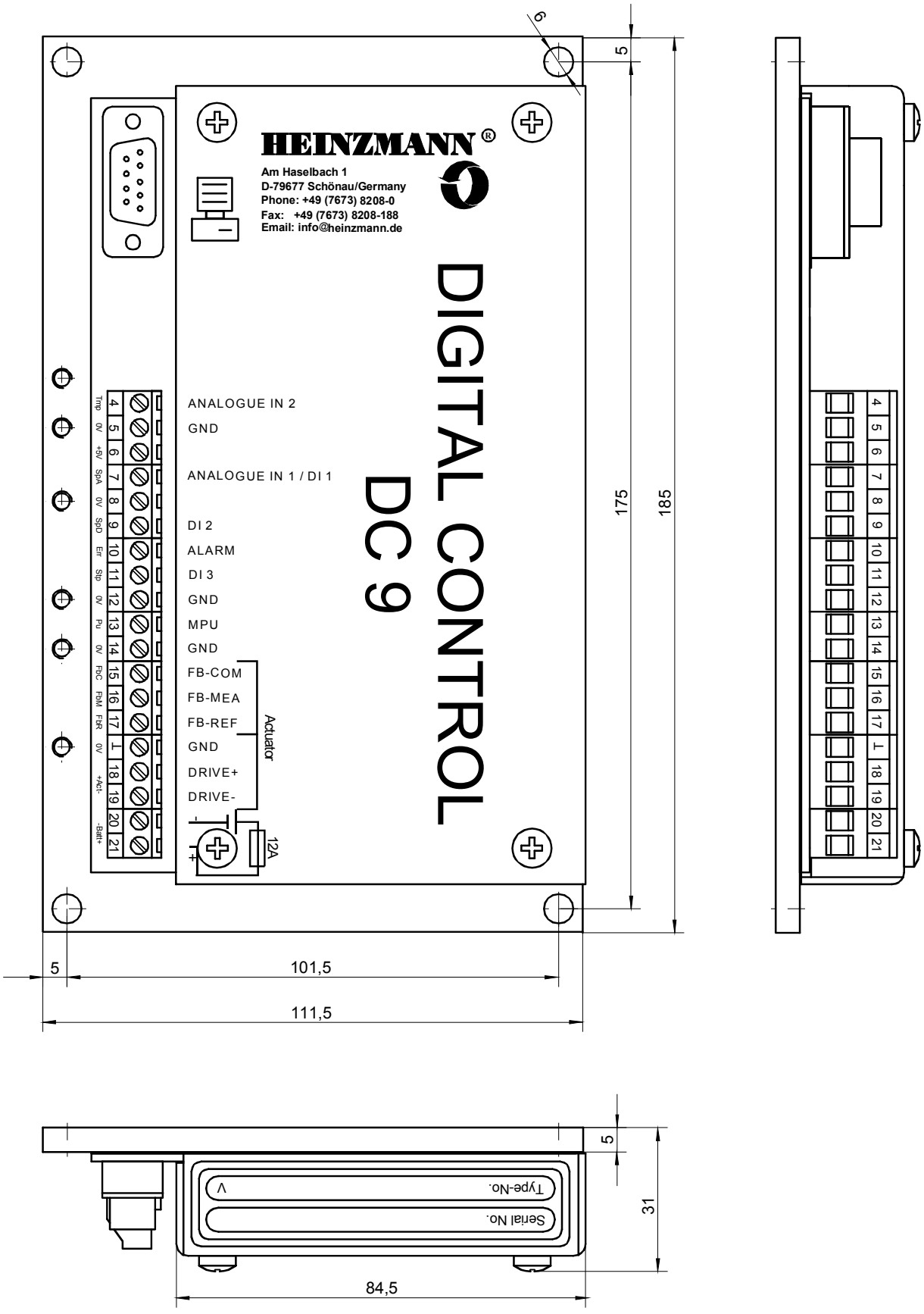


Figure 17: Housing of Control Unit DC 9

10.4 Mounting of Control Units

For installation, any place can be chosen where there is the least possible amount of vibration and the lowest possible ambient temperature. There should be no strong magnetic fields in the vicinity of the control unit to avoid disturbances.

In addition, the place chosen for mounting should be easily accessible for reading and adjusting parameters as well as for the substitution of the unit under field conditions.

Since the max. admissible cable length between the control devices and the actuators is 6 m, the control devices must be installed in immediate proximity of the engine.

11 Electrical Details

11.1 Connection of Power Supply

Inappropriate choice of power supply or insufficient battery capacitance or incorrect connection of the power supply line or too small cable sizes of the feed line and the motor line of the actuator are bound have an adverse effect upon the performance of the speed governor. In steady state operation, this will cause a heavy increase of current consumption and unnecessary vibration of the actuator drive. The high current consumption will in its turn lead to overheating of the actuator or the amplifier in the control unit, and the vibration will result in premature wear of the gear and bearing parts or of the linkage.


Note

As a rule, the lifetime of the control system is distinctly reduced by the errors described above.

In order to avoid that the voltage supply is not interfered by the „hum voltage“ of the battery charger – and as a consequence the voltage at the control unit will not suddenly drop too much when starting – the control unit must be connected **directly** over a fuse and a switch with the battery.


Warning

In case the control unit is directly connected with the battery charger or the starter there might happen a failure of the control unit or actuator after a certain time. The necessary repair of the units resulting thereof is not covered by warranty.


Warning

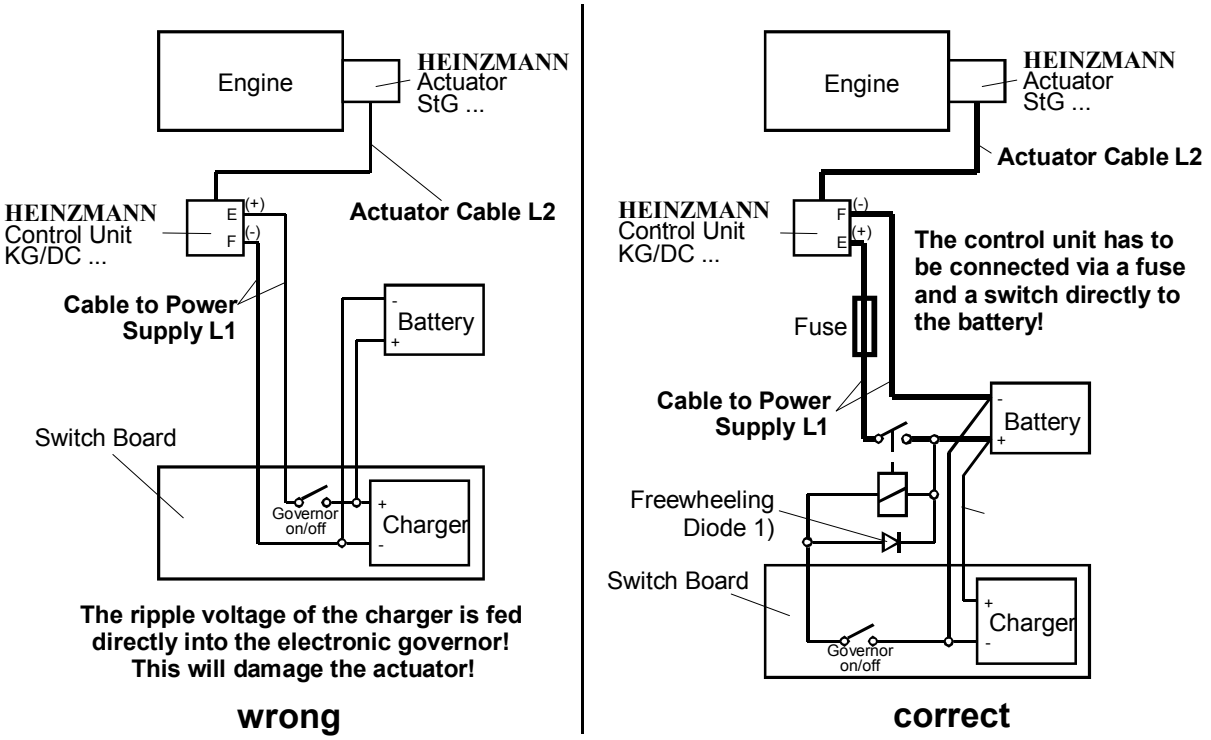
If there are battery chargers with rapid charge mode installed in the plant, the rapid charge mode should no be used during operation.

If there is no battery provided, **it is absolutely necessary** that a three phase power supply or a **stabilized** one phase power supply with at least 24 V DC, 10 Amps output power **be used** as a power source.


Warning

Cable sizes and maximal cable lengths indicated in the following chapter must be respected at all costs!

The following figure shows both a wrong and a correct cabling:



1) Coils (e.g. stopping solenoid, gas valve) have to be equipped with a protective circuit to eliminate inductance voltages. Diode type e.g. 1N4002

Figure 18: Correct Cabeling of the Power Supply

When power supply, battery and cabling have been correctly dimensioned, then on starting the engine or with the actuator operating at maximum current consumption (approx. 6.4 Amps), a drop of the supply voltage directly at the control unit of approx. 2 Volts maximum only will be admissible.

11.2 Correct Connection of Shielding

Trouble-free operation of the electronic governor of the series requires a shielding for low level signal connection lines.

The shielding concept of **KG-LC-A** is different from **DC 9**.

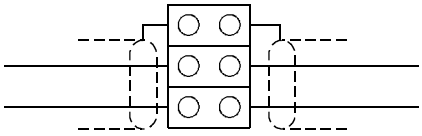
11.2.1 Connection of Shielding at KG-LC-D

In this case the shielding **has to be connected on one side only**, that means only to the control unit **KG-LC-D,** the other side has not to be connected and has not to be any connection to ground or an other potential.

Note

The separated insulated terminals on the control device are internally all directly connected to negative potential.

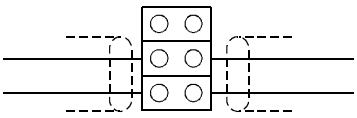
If a line with shielding is wired via a terminal strip, the shielding has to be connected to a separate isolated terminal strip without any conntact to a negative line or ground. Never use PE-terminals!



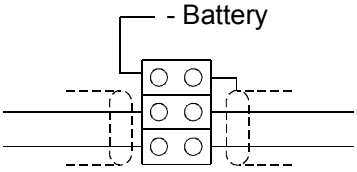
Correct shielding connection

Figure 19: Shielding via Terminal Strip

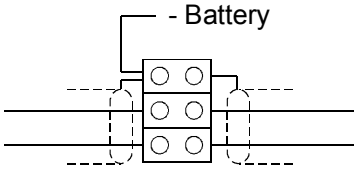
The following arrangements are frequently encountered, but they may cause governor disturbances.



Wrong! Shielding is discontinued



Wrong! Right and left side of shielding
connected to different negative terminals



Wrong! Shielding is additionally connected
to minus on the terminal strip

Figure 20: Failures at Shielding

Recapitulating:

The shielding has to be connected to the control unit on one side only. That means it may have no contact anywhere else to negative potential or ground. Failure to observe this rule causes unnecessary high currents in the actuator and considerably reduces its useful life!

11.2.2 Checking of Shielding at KG-LC-D

a) Remove the cable contacts of shielding at the control unit and check against ground. No connection has to be indicated.

b) With connected shielding to the control unit connect the other side of the shielding to the negative line via a test instrument. The test instrument must indicate a connection.

Note

Ready mounted HEINZMANN cables are checked in the factory.

11.2.3 Connection of Shielding at DC 9 according to EMC-Guideline

To avoid electromagnetic influences here it is necessary to connect cable shields at both ends directly to the housing and not to minus potential unlike described with **KG-LC-D**. This includes shielding from control housing to sensors, from control housing to potentiometers, from control housing to actuator and from control housing to accessory units. If there is a potential difference between the controller housing and any of these other componets, to avoid currents via the shielding it is necessary to run a separate wire from the controller housing to each of these components.

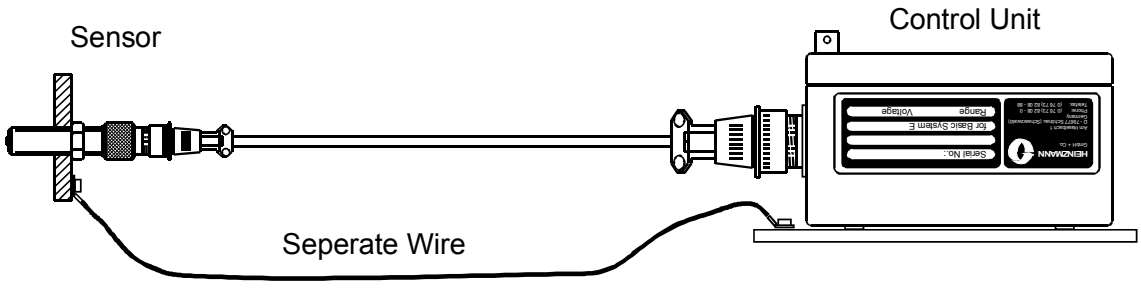


Figure 21: Connection of Seperat Wire

At cable ends without plugs (e.g. terminal strip or pins) the shielding must be connected at the housing near the contacts.

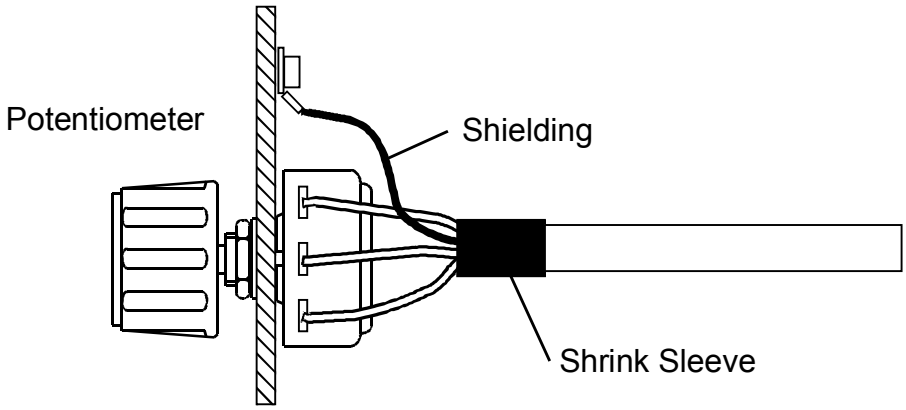


Figure 22: Shield Connection without Plug

With the plug the strain relief presses directly on the cable screen. In addition, a seperate wire connects the strain relief section to the plug housing.

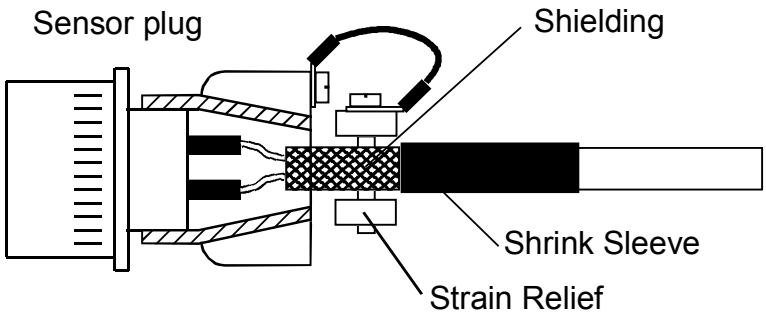


Figure 23: Shield Connection in the Plug

11.2.4 Checking of Shielding at DC 9

Remove the cable conntacts of shielding at the control unit and check against ground. Connection has to be indicated.

Note

Ready mounted HEINZMANN cables are checked in the factory.

11.3 Wiring between Control Unit and Actuator

Basically two separate cables are required for the engine lines (M+ and M-) and the disturbance-sensitive feedback signal.

For the engine lines a 2 x 1,5 mm^2 cable and for the feedback signal a shielded 3 x 0,75 mm^2 cable should be used.

Maximum cable length between actuator and electronic control unit may not exceed 6 m due to the special feedback system! Accordingly the electronic control unit has to be mounted in immediate vicinity of the engine.

As actuator cable, it is recommended to use the HIENZMANN cable with a ready mounted connector to the actuator. This cable is called L2.

11.4 Wiring between Control Unit and Magnetic Pickup

For the wiring to the speed pickup a shielded 2 x 0,75 mm^2 cable must be used. Maximum cable length is 30 meters.

It is recommended to use the ready made HEINZMANN speed pickup cable on which the connector to the magnetic pickup is already mounted. This cable is called L4.

11.5 Wiring between Control Unit and Power Supply

Cross-section of the cable between control device and battery should be 2x2.5 mm up to a length of 10 meter; and 2x4.0 mm for lengths between 10 meters and the maximum of 20 meters. When a stabilized power supply unit is used, cable length between supply unit and control device should not exceed 3 meters.

11.6 Further Wiring

For all other cables not mentioned in the section above, a cross-section of 0.75 mm is sufficient. The analogue signal lines must be shielded, as shown in the connection diagrams below.

11.7 Connection Diagrams

11.7.1 Connection Diagram of KG-LC-D

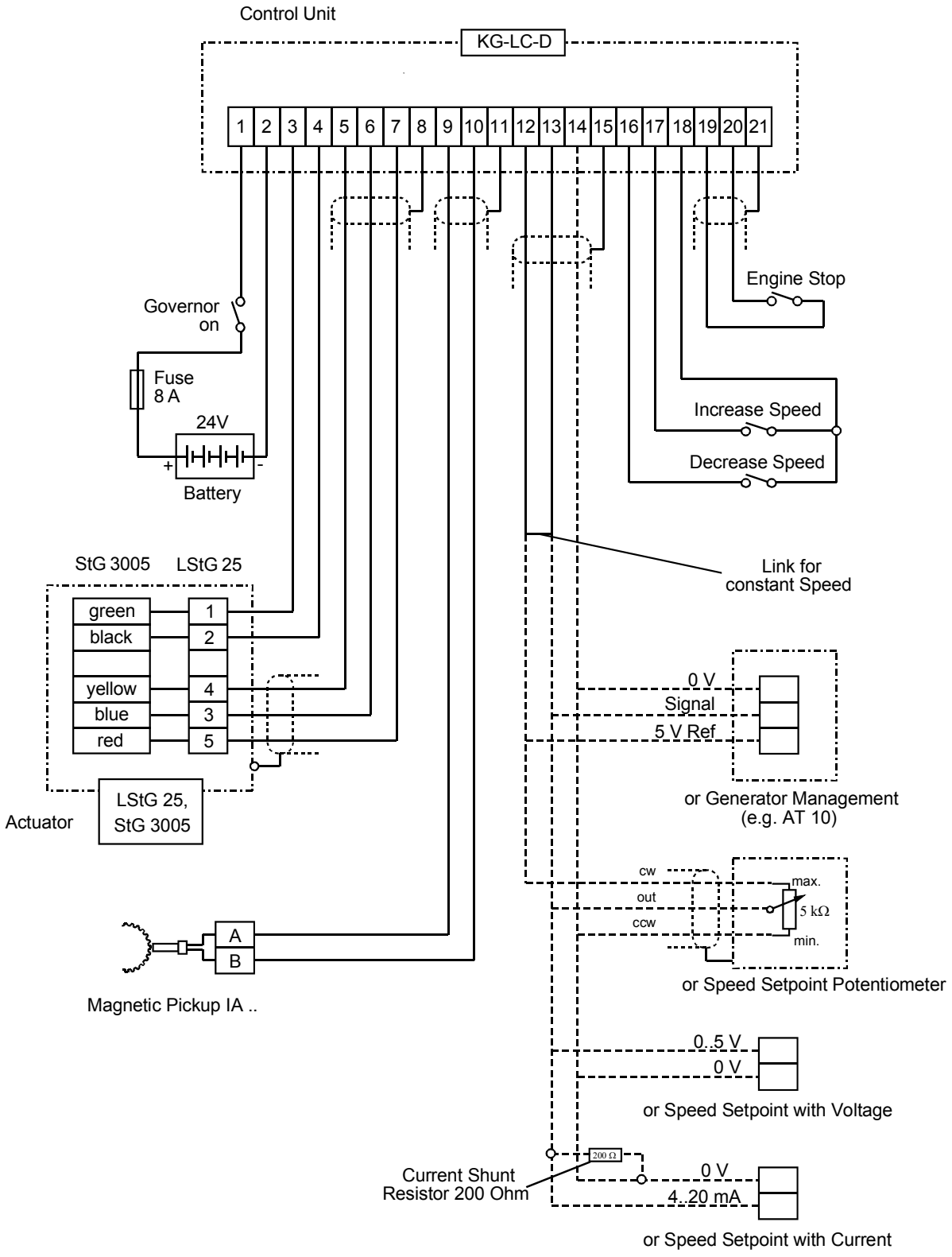


Figure 24: Connection Diagram of KG-LC-D

11.7.2 Connection Diagram of DC 9

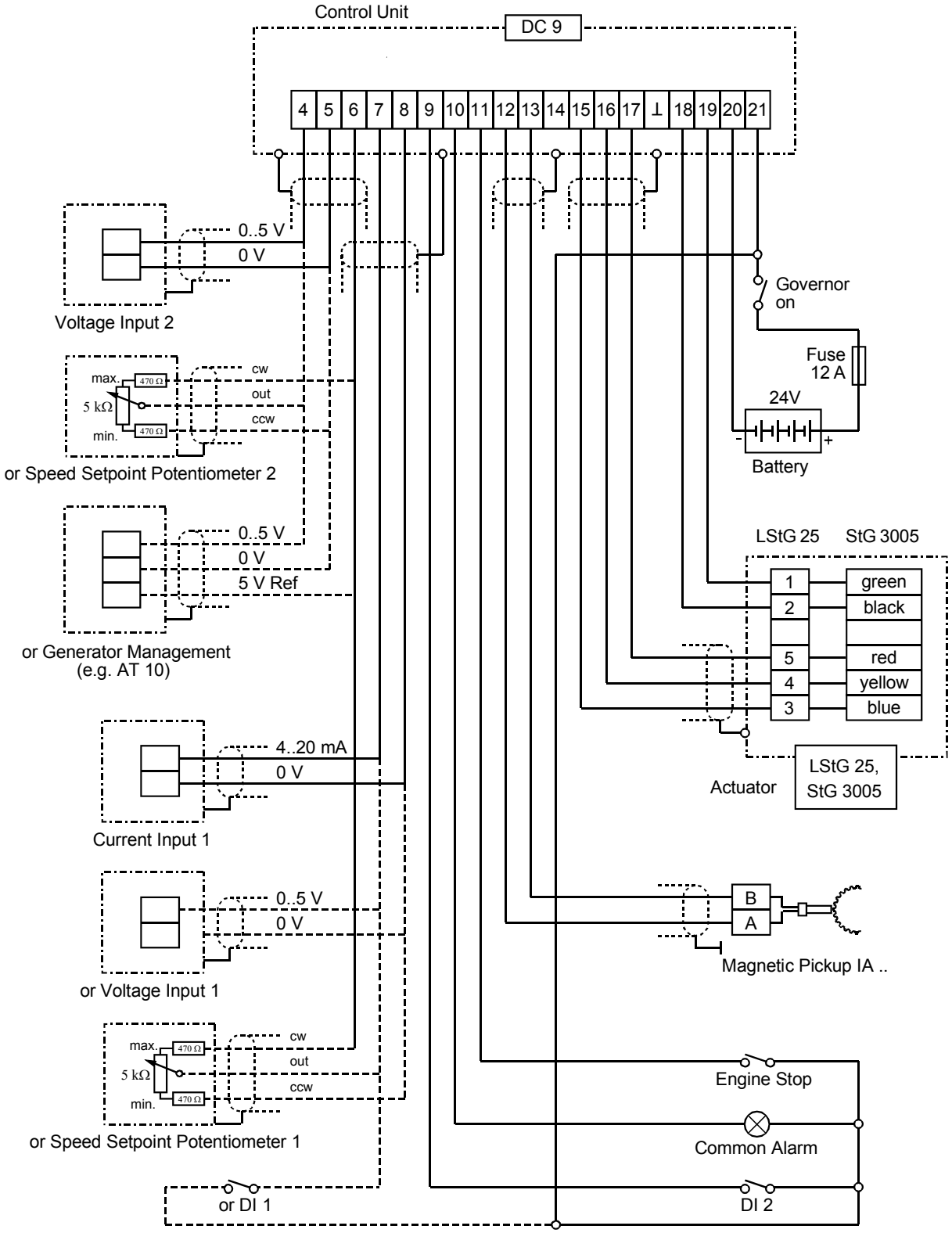


Figure 25: Connection Diagram of DC 9

12 Commisioning of Governor KG-LC-D

12.1 Magnetic Pickup

Set the pickup distance on 0.3 to 0.6 mm from the highest point of the gear wheel (refer chapter 6.4). At cranking speed the sine-wave voltage must be 0.5 V AC or more.

12.2 Electrical Connections

Connect control unit with refering to chapter 11.

12.3 Linkage

Connect the actuator and in doing so check that the linkage is correctly mounted (see Chapter 9). After mounting check that the linkage can move freely and runs smoothly.

12.4 Switch on Power Supply

The red LED "Control Lamp" is on, indicating that supply voltage reaches the control device.

The "Control Lamp" goes out during start-up above approx. 50 revolutions.

If the LED does not go out during engine start-up either the signal from the magnetic pickup is missing, the distance of the pickup to the toothed wheel is too big, or no speed setpoint transmitting device is connected.

12.5 Feedback Adjustment

1. Connect voltmeter to TP 6 and voltage supply negative. Put the fuel limitation switch in the position POWER LIMIT.
2. With actuators in zero position, adjust voltage of 1.5 V with OFFSET potentiometer on TP 6.
3. Keep the adjustement push button pressed with your left hand (this forces the actuator in 100% position!) and adjust 5 V on TP 6 with SPAN potentiometer.
4. Repeat the adjustment for inverse sides.

12.6 Starting Fuel Adjustment

12.6.1 Unsupercharged Engines

Since engines with natural aspiration require an extra quantity of fuel for start-up, the slide switch must be put in the position "Power Limit". During engine start-up the actuator opens to 100% without limit. After half the actual setpoint speed is reached, the limit is activated automatically and remains active for the remaining duration of operation. The adjustable fuel limitation is optimal when the engine reaches its full-load point safely.

12.6.2 Supercharged Engines

If supercharged engines get too much fuel during start-up, they cannot burn it due to the lack of boost pressure. This results in a black smoke burst of unburnt fuel.

To eliminate this problem, put the limit selection switch in position "Start Fuel Limit" and find out the limit that allows to start the cold engine with minimum smoke bursts out by trial-and-error using the respective potentiometer.

After start-up the limit is deactivated automatically as soon as approx. 50% of the actual speed setpoint value is reached and the actuator becomes free to move up to 100%, depending on the load on the engine.

12.7 Speed Adjustment

There are basically two methods to adjust the rated speed (speed pickup frequency at rated speed):

1.) HEINZMANN has been told the number of teeth and the operating speed with the order. In this case, the operating frequency of the control device will be adjusted to the value communicated by the customer in the factory and the value will be inscribed in the nameplate.

2.) If the required operating frequency is not communicated to HEINZMANN in order to carry out the adjustment at the factory, the control device is adjusted to 4000 Hz. If necessary, speed may be corrected during commissioning with the internal multiturn potentiometer "Speed".

12.8 Dynamic Adjustment

Before the first start-up, the respective potentiometers should be pre-set as follows:

Gain		20 %
Stability		40 %
D-factor	for diesel engines	0 %
	for gas engines	70 %

Be prepared to activate an emergency cutout during the first start-up of the engine, if it should be necessary!

Start the engine cautiously. In case of oscillations, turn Gain ↶. Adjust operating speed with the speed potentiometer.

Gain	turn clockwise ↷ until unstable, then counterclockwise ↶ until stable
Stability	turn clockwise ↷ until unstable, then counterclockwise ↶ until stable
Derivative	turn clockwise ↷ until unstable, then counterclockwise ↶ until stable

Fine-tuning of dynamic adjustment is carried out when the engine is warmed-up and without load, for these are the most critical conditions.

It is recommended to check the regulation behaviour of the fine-tuned system by introducing short disturbances.

1. Either apply excessive force for a short time to the lever arm of the actuator and then lib erate it, or

2. activate the STOP input (terminals 21 and 22) for a short time.

In both cases the regulating system must fall back to original speed after a short reaction, without hunting or building up oscillations.

12.9 Droop Adjustment

The droop value depends exclusively on the actuator travel used, i.e. the difference between zero load position and full load position. For this reason the provided dial is only an aid for adjustment and does not represent the actual droop scale factor!

Droop potentiometer ↶ in min. end position corresponds to droop 0 (isochronous).

Droop potentiometer ↷ in max. end position corresponds to a droop of approx. 15% over the whole deplacement angle of the actuator. But if, for instance, only 40% of the actuator angle between zero load and full load are used, the max. droop obtainable is correspondigly smaller (approx. 6 %).

13 Parametrization of Governor DC 9

The software for the HEINZMANN digital controller **DC 9** is conceived so that parametrizing can be done either by the engine manufacturer or by the final customer if the necessary instruments (communications tool) are available. Only a few basic parameters are pre-set in the HEINZMANN factory. This means that the digital governor usually gets its definitive set of data from a source external to HEINZMANN.

An exception is made for control units delivered in greater numbers. If HEINZMANN has been provided in advance with a definitive set of data, this data can be trasferred to the units in the factory.

As a principle, initial programming should always be conducted by experienced personnel and must be checked before first commissioning the engine.

How parameter are adjusted and what meaning they have is explained in detail in the manual "Basic information DC 9".

The following sections describe the possibilities of parametrizing the control unit:

13.1 Parametrization with the Hand Held Programmer 3

All parametrization can be done by means of the hand held programmer ‘Programmer 3’. This handy device is particularly suited for development and series calibration as well as for servicing. This unit needs no external power supply.

13.2 Parametrization with the PC / Laptop

Parametrization can also be conducted using a PC and the comfortable **HEINZMANN** communication software DcDesk 2000. As compared with the hand held programmer, it offers the great advantage of having various curves graphically represented on the screen and being at the same time able to introduce changes as well as of having time diagrams displayed without an oscilloscope when commissioning the control unit on the engine. Furthermore, the PC offers a better overview as the PC programme has a menu structure and allows to have several parameters continuously displayed.

Besides, the PC programme permits to save and download the operational data to and from data mediums. Additional there is the following usefull application:

Once parameterization has been completed for a specific engine type and its application, the data set can be stored to disk. For future applications of similar type, the data sets can be downloaded and re-used with the new control units.

14 Troubleshooting

Symptoms	Possible Causes
Governor does not open on starting	Engine stop switch activated Power supply not activated Measure voltage at the corresponding terminals At **KG-LC-D**: Control lamp must be lit when power supply is on and must go out from starting frequency upwards No signal from magnetic pickup Resistance of pickup 52 Ohm Starting speed voltage minimum 0.5 V ~ (Multimeter) At **KG-LC-D**: no link or setpoint source connected Control unit defective Actuator defective
Governor moves to maximum fuel when power supply is switched on	Wrong mounting of actuator (turn direction) Wiring of actuator wrong Control unit defective
Engine overspeeds on starting	Speed setting too high At **DC 9**: Idle speed is speed setpoint plus droop offset Actuator has only power in direction 100 % , replace control unit and measure actuator resistance
Governor is not working stably	Cable of magnetic pickup or setpoint receive disturbance Linkage between actuator and fuel system has backlash or to much friction Voltage is unstabil, check residual ripple of max. 10 %

Symptoms	Possible Causes
Governor is not working stably	In case of carburetor and gas engines, check ignition and spark plugs. At diesel engines check injection system. Governor adjusted incorrectly.
Reduced speed with load	Droop is activated. At **KG-LC-D** check position of droop potentiometer. ↶ at counter-clockwise stop is droop zero. At **DC 9** check parameters of droop Engine is overloaded, actuator is at maximum position Control unit defective

Note

*The digital governor **DC 9** offers the additional possibility to export error texts via a communications tool. The appropriate reaction to the respective error is described in the Section "Troubleshooting" of manual "Basic information DC 9".*

15 Order Specification

The Basic System **ORION** consists of the following components:

Control unit	KG-LC-D or DC 9
Actuator	StG 3005 or LStG 25
Magnetic pickup	IA ..

Harness:
Basically, it is recommended to use a harness prepared by HEINZMANN. To this purpose the cable lengths required for each connection must be indicated.

The cabling to the actuator and to the speed pickup should always be prepared by HEINZMANN since these connections use HEINZMANN connectors and the cables are soldered to their terminals. For ordering, please indicate the respective cable lengths for cable L2 (to actuator) and L4 (to pickup).

Further Options:
Setpoint potentiometer for all-speed governors

Setpoint potentiometer	SW 01 - 1 - 0 (5k) (1-turn)
or	
Setpoint potentiometer	SW 02 - 10 - 0 (5k) (10-turn)


Note

The control devices are delivered as fitting to the actuator. All other required adjustments must be made by the customer during commissioning.

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