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HEINZMANN®

Digital Speed Governors

Digital Control System

PEGASOS

for Locomotive Operation

 **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.
 **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 functionability 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 **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 control unit or of any accessory device Failure of the actuator Sluggish and blocking linkage

 **Warning**	**Electronically controlled injection (MVC) will in addition require to observe the following:** With **Common Rail** systems a separate mechanical flow limiter must be provided for each injector pipe. With **Pump-Pipe-Nozzle (PPN)** and **Pump Nozzle (PNE)** systems fuel release may be enabled only by the movement of control piston of the solenoid valve. This is to inhibit fuel from being delivered to the injection nozzle in case of seizure of the control piston.
 **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.

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

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 General

Locomotive Control System PEGASOS **Governor Type: Helenos III** for engines of approx. 800 kW to 4000 kW		
Basic System DG 16.2-01	Basic System DG 30.2-01	Basic System DG 40.2-01
Control Unit DC 16.2-01	Control Unit DC 30.2-01	Control Unit DC 40.2-01
Actuator StG 16-01	Actuator StG 30-01	Actuator StG 40-10
Magnetic Pickup IA ...	Magnetic Pickup IA ...	Magnetic Pickup IA ...

2.1 Scope of Delivery

The PEGASOS System provides a complete “Retrofit System” for Locomotives that permits to replace existing controls (e.g., hydraulic governors) by a modern digital control system

The Locomotive Control System consists of:

1. 1 Control Cabinet KSch including the following features:

1.1. 1 digital control device DC xx.2-01-IP00
1.2. 1 D/D converter 150 W, output voltage 24 V
1.3. 1 locomotive interface LCI 01 including:
1.3.1. 1 amplifier for generator excitation control (optional)
1.3.2. max. 8 digital isolated inputs
1.3.3. max. 4 digital isolated outputs
1.3.4. max. 6 analogue inputs (optionally isolated)
1.3.5. max. 4 analogue isolated outputs
1.4. 5 Cannon circular connectors
1.5. Dimensions width x height x depth = 400 x 400 x 130 mm

2. 1 Actuator

StG xx (size of the actuator depending on type of diesel engine)

3. 1 Speed pickup

IA xx-xx (depending on engine type)

4. Optional Components:

4.1. 1 cable set
4.2. 1 additional speed pickup
4.3. 1 set of sensors, optionally for oil pressure, boost pressure, air pressure for setpoint definition, charge air temperature, coolant temperature
4.4. 1 hand programmer HP 03
4.5. Dialogue Software DcDesk 2000 with communication cable (control ? PC)

Note

For engines with power outputs below 800kW the PEGASOS System can be combined with actuators of the E6 / E10 or E2000 series.

For engines using EDC injection pumps by Bosch the Basis System DG EDC.2-01 is available.

*For engines with electronic fuel injection (EFI) the **HEINZMANN** system DARDANOS MVC 01-10/20 can be used.*

3 Scope of Functions

Besides speed control, the **HEINZMANN** Locomotive Control System Pegasos includes the following functions:

a) Starting Fuel Adjustment

It is possible to choose between constant and variable starting fuel amount. During cranking the variable starting fuel will be increased after a certain time period until the engine starts running.

b) Speed Ramps

If speed is to react to setpoint adjustments with a certain delay the system provides speed ramps that can be parameterized separately for increasing and decreasing speeds as well as for certain speed ranges if desired.

c) Fixed Fuel Limitations

There are “electrical limit stops” provided for the stop and maximum fuel positions of the actuator. This is to prevent the positioner's moment to exert force upon the end stops of the actuator and the injection pump.

d) Speed Dependent Fuel Limitation

The system provides the possibility of programming speed dependent fuel limitation curves so that for any specific speed only that torque will be available that is admissible for the engine or desired by the user.

e) Boost Dependent Fuel Limitation

When with turbocharged engines there is insufficient charge air pressure (e.g., on taking up load) fuel should be limited to ensure smokeless operation. The respective limit curves can be freely programmed.

f) Idle/Maximum Speed Control

For diesel-hydraulic locomotive drives, the governor can be configured as an idle/maximum speed control. For this purpose, two fixed intermediary speeds are available, e.g., for steady-state operation (generator at power take-off, etc.). If required, it is possible to provide droop switching to enable, e.g., driving operation without droop and stationary operation with droop.

g) Temperature Dependent Idle Speed

With low temperatures, the engine may be operated using increased idle speed. With engine temperature rising idle speed will be reduced to its normal value.

h) Oil Pressure Monitoring

The system permits to provide speed dependent limit curves for oil pressure monitoring. If oil pressure is low an alarm will be output, and if there is a further drop of oil pressure the engine is shut down. It is possible to parameterize delayed reactions for either case.

i) Load Control System

For diesel-electric locomotive operation power control can be provided which allows to control generator output in dependence of speed and load.

j) Slide Protection

It is possible to parameterize slide protection. This will, however, require a signal from an external sensor device.

k) Accessory Devices

Accessory devices like cab indication panels, data logger or remote communication can be connected via an optional CAN bus included in the control unit.

l) Output Signals

For engine signals such as speed or actuator position, there exist proportional output signals with ranges of 0–5 V and 4–20 mA that can be used for indication or for further processing.

In addition, alarms will be issued via relais outputs whenever errors of the sensors or the control system occur.

Note

When specifying the functions it must be verified whether the hardware allows to implement the total scope of the desired functionality.

4 Further Informations

This publication describes in detail the technical data and connections of the control electronics, of the sensors, of the setpoint adjusters and of the actuators.

The functions of the different adjustment parameters and characteristics are described in detail in the manual

Basic Information 2000, Level 6, Manual-No. DG 00 001-e

The mode of operation of the communication programme DC-Desk is described in detail in the manual

Operating Instructions Communication Programme DcDesk 2000,
Manual-No. DG 00 003-e

The governor system PEGASOS is shipped custom made and will have been pre-set at the factory as far as possible. For satisfactory execution of an order, it is therefore absolutely necessary that the document

Order Information for Digital Governors, Manual-No. DG 96 012-e

be carefully completed by the customer and returned to **HEINZMANN**.

5 Mode of Function

At the core of the control unit is a very fast and powerful microprocessor. The actual controller programme based on which the processor operates is permanently stored in a FLASH-EPROM.

A magnetic pickup located at a tooth gear with a number of teeth as large as possible (preferably the starter gear rim) is used to sense actual engine speed. The microprocessor (CPU) within the control unit compares the actual speed value with the pre-set value. If there is any difference the CPU will calculate the proper actuator signal and transmit it to the actuator via the amplifier. The actuator feedback indicates the current position of the control rod thus enabling the CPU to achieve optimum signal adjustment.

Engine speed is being set by one or more setpoint adjusters. The setpoints can be implemented either directly by analogue or digital signals. Additional digital inputs are provided permitting to switch functions on or over.

Since the control unit includes an I-factor and since for every load level speed is compared with a fixed preset value, speed will be equal to the setpoint value also in steady-state operation, i.e., droop will be zero.

Various sensors feed data to the governor based on which the governor will adjust the operating state of the engine. Thus, it is possible to have several temperature and pressure sensors transmitting signals from the engine.

For applications requiring droop the CPU will calculate the speed corresponding to the respective fuel amount and use it as a setpoint correction.

The control unit generates analogue and digital output signals that can be used for indicating the engine's operating states or for other purposes and functions. Communication with the other devices is established via one serial interface and a CAN- bus.

When the engine is stopped a special circuit will ensure that no current is flowing from the governor to the actuator drive.

6 Functional Block Diagrams

6.1 General Block Diagram for Digital Governor DG 16.2-01 to DG 40.2-01

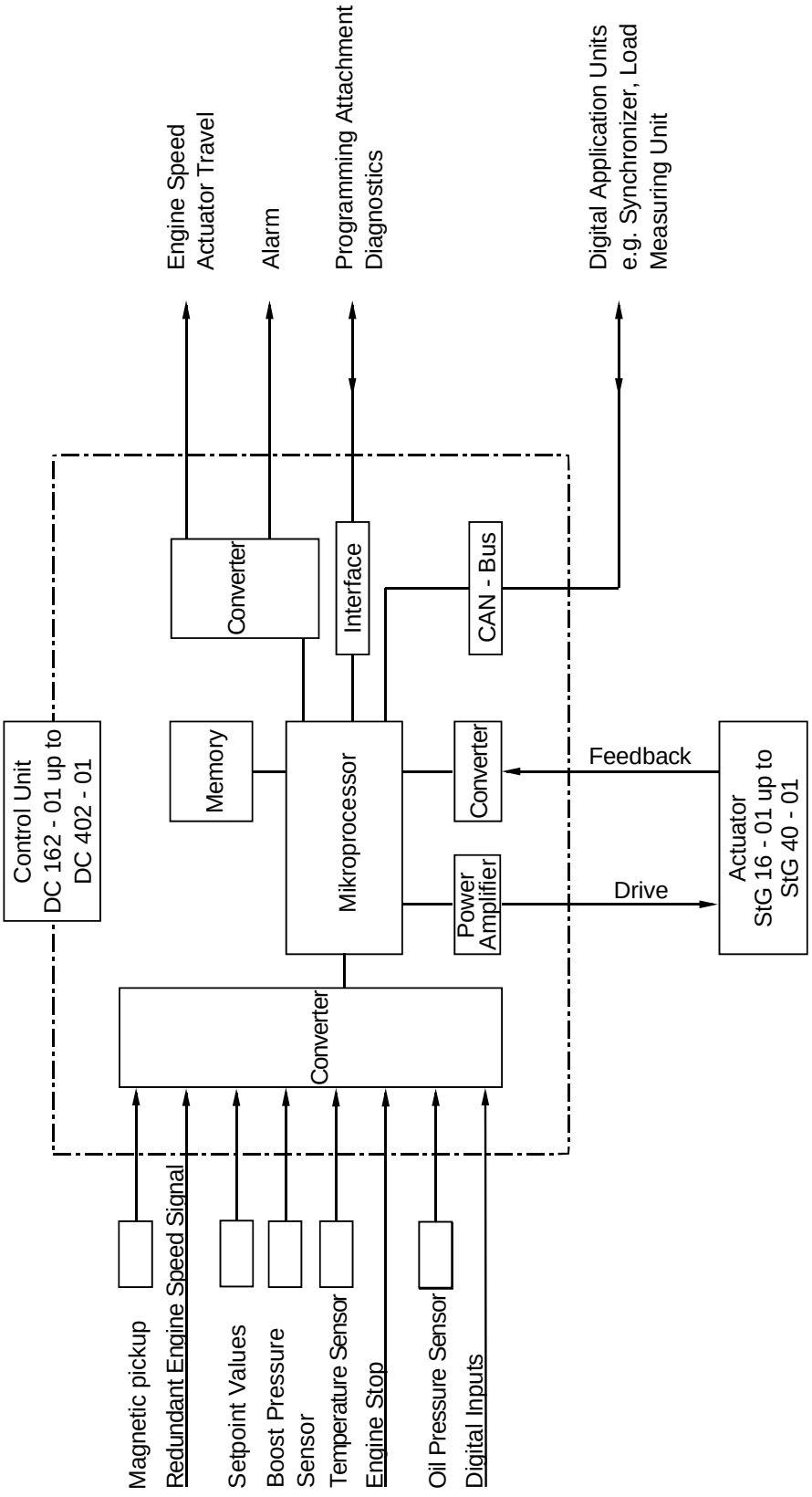

Fig. 1: General Block Diagram DG 16.2 - 01 to DG 40.2 - 01

6.2 Block Diagram for Diesel-Electric Drive

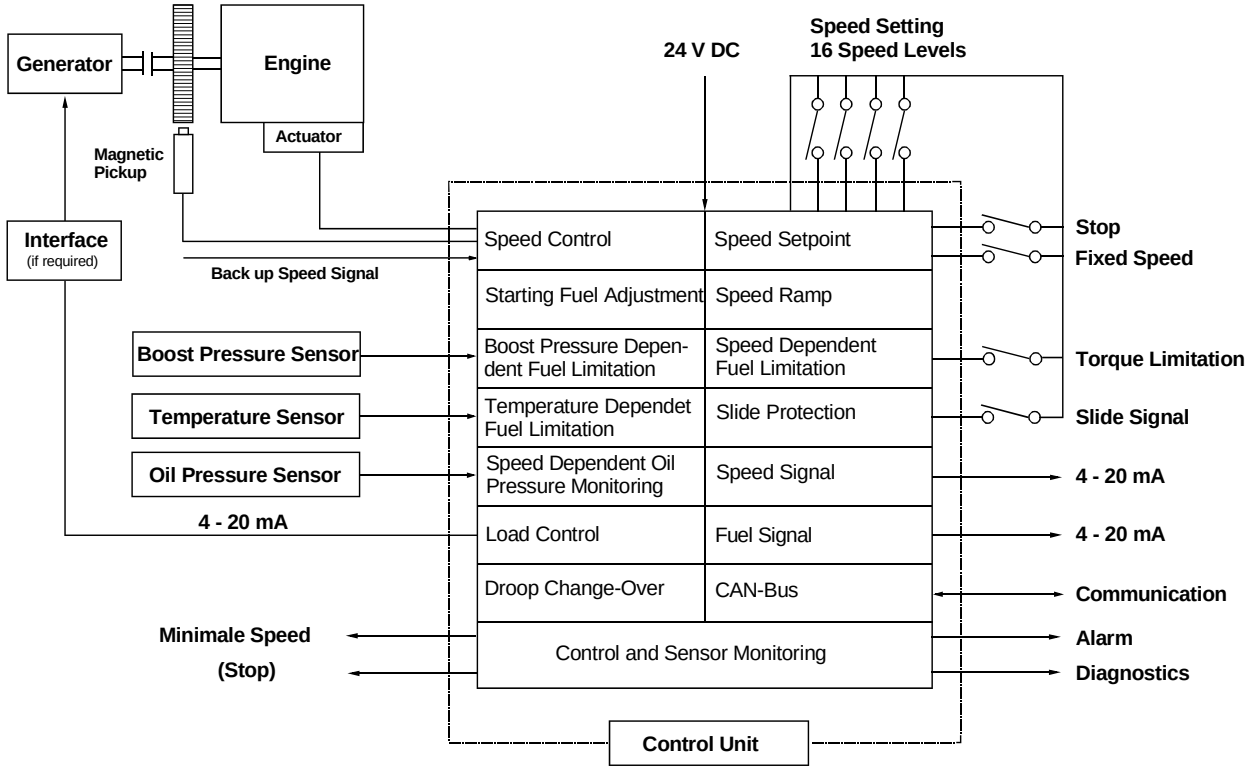

Fig. 2: Block Diagram for Diesel-Electric Drive

As an example, Figure 2 shows the control configuration of a variable speed control for a diesel-electric locomotive drive. In this case, speed is being set by 4 switches for a total of 16 velocities. Alternatively, speed setting can be programmed by means of a current signal (4–20mA).

6.3 Block Diagram for Diesel-Hydraulic Drive

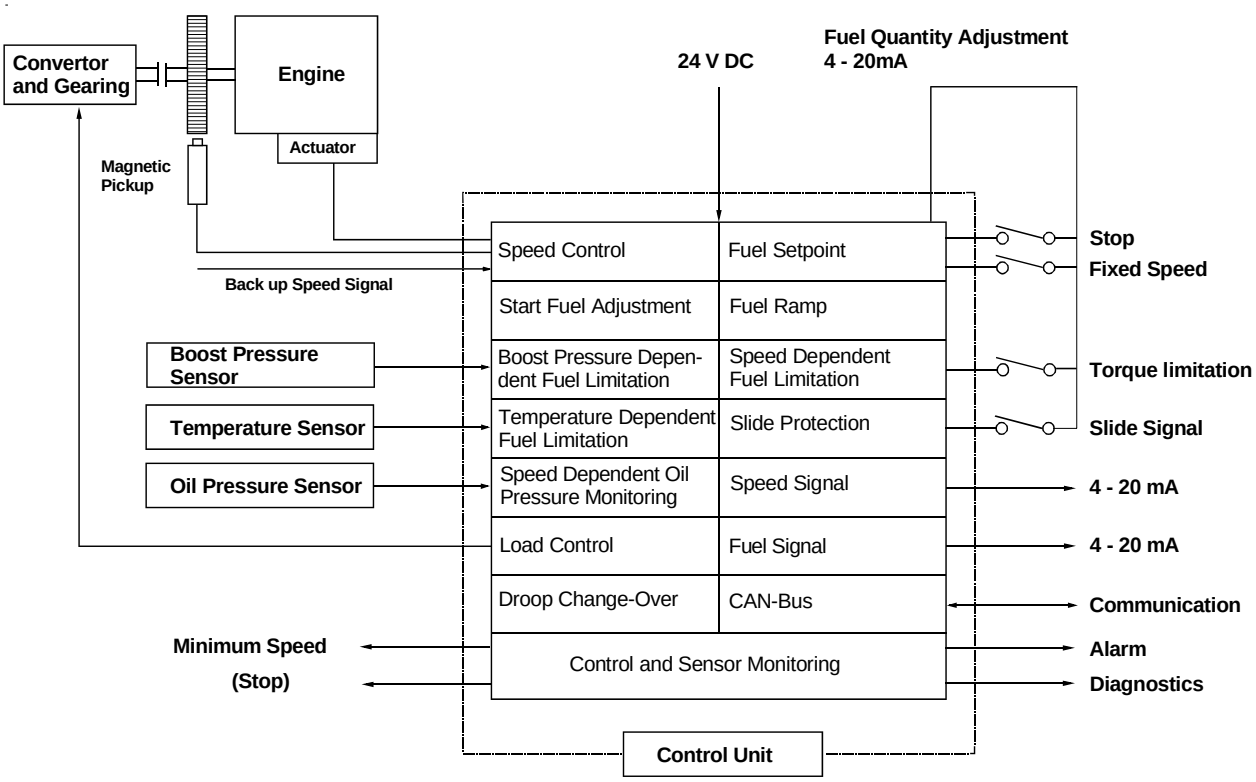

Fig. 3: Block Diagram for Diesel-Hydraulic Drive

For diesel-hydraulic locomotive drives frequently idle/maximum speed controls are being used. Above idle speed, the speed control will go over to fuel adjustment and the speed ramp change into a fuel ramp. Also in this case fuel adjustment can optionally be made by means of speed notch switches or a current signal.

Note

The diverse control functions are described in the manual DG 00 001-e "Basis Information 2000 for Digital Controls".

7 Sensors

7.1 Overview

Sensor	Speed	Coolant Temperature	Exhaust Temperature	Pressure
HZM -Designation	IA 01-38, IA 02-76 IA 03-102, IA 11-38 IA 12-76, IA 13-102 IA 22-76, IA 23-102	TS 01-28-PT1000	TS 02-60 PT 200 TS 02-100 PT 200	DSO 01-2,5, DSO 04-2,5 DSO 01-6, DSO 04-6 DSO 01-10, DSO 04-10
Connection	SV 6-IA-2K 2-polig	SV 6-IA-2K 2-pole	DIN 3-pole	DIN 43650 A 2 Line-System
Measuring Procedure	inductive sensor	PT1000, passive	PT 200, passive	active
Measuring Range	5..12.000 Hz	-50..+150°C	-40..+1000°C	0..2,5 bar 0..6 bar 0..10 bar
Supply Voltage Range		passive	passive	10..34 V DC
Output Signal Range	0.5..10 V AC	ca. 700..1500 Ohm	ca. 85..425 Ohm	4..20 mA
Operating Temperature Range	-55..+120°C	-50..+150°C	-40..+1000°C	-25..+125°C
Protection Grade	IP 55	IP 65	IP 65	IP 65
Vibration		< 20g, 10..300 Hz	< 60g, 10..100 Hz	< 20g, 10..300 Hz
Shock		< 50g, 11 ms Half-Sine	< 50g, 11 ms Half-Sine	< 50g, 11 ms Half-Sine

7.2 Magnetic Pickup IA ...

7.2.1 Technical Datas

Operating principle	inductive sensor
Distance from sensing gear	0.5..0.8 mm
Output	0..10 V AC
Signal form	Sine (depending on tooth shape)
Resistance	approx.. 52 Ohm
Temperature range	-55°C up to +125°C
Protection grade	IP 55
Vibration	< 10g, 10 .. 100 Hz
Shock	< 50g, 11 ms half sine wave
Corresponding plug	SV 6 - IA - 2K (EDV- No.: 010-02-170-00)

7.2.2 Installation

The magnetic pickup should be installed in such a way as to obtain the highest possible sensing frequency. The **HEINZMANN** Digital Controls DG 16.2-01, DG 30.2-01 and DG 40.2-01 are designed for a maximum frequency of 12,000 Hz. Frequency can be calculated by the following formula

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

z = number of teeth on the pickup wheel

Example:

n = 1.500
z = 160

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

It should be noted that engine speed may be sensed directly by the magnetic pickup, e.g., by installing it on the starter gear rim of the flywheel rather than on the injection pump gear.

The pickup wheel must be made of magnetic material (e.g., steel or cast iron).

7.2.3 Tooth profile

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

With regard to tolerances, radial installation of the speed pickup should preferably be installed radially.

7.2.4 Clearance of Magnetic Pickup

The distance between the magnetic pickup and the top of the tooth should be 0.5 to 0.8 mm. (This can be achieved by screwing the pickup on the top of the tooth and unscrewing it by about half a turn).

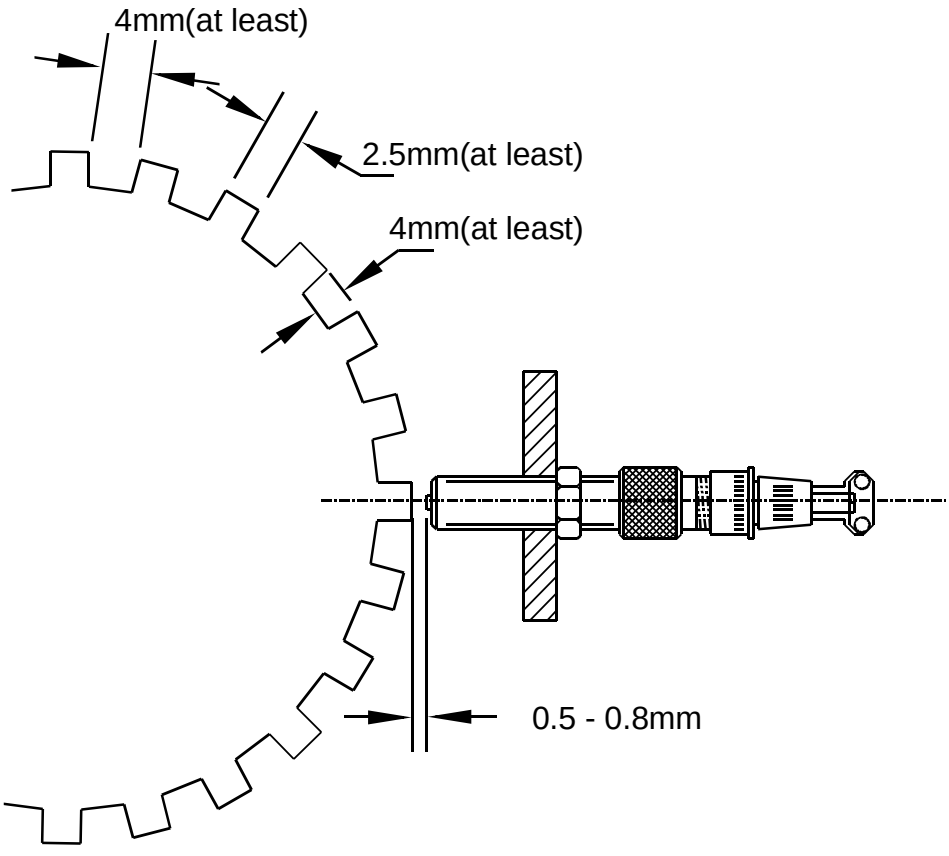

Fig. 4: Clerance of Pickup

7.2.5 Magnetic Pickup, Standard Model

Dimensions Type	L (mm)	G	Notes
01 - 38	38	M 16 x 1,5	appropriate connector SV6-IA-2K
02 - 76	76	M 16 x 1,5	
03 - 102	102	M 16 x 1,5	
11 - 38	38	5/8"-18UNF-2A	
12 - 76	76	5/8"-18UNF-2A	
13 - 102	102	5/8"-18UNF-2A	

Ordering specification, e.g., IA 02-76

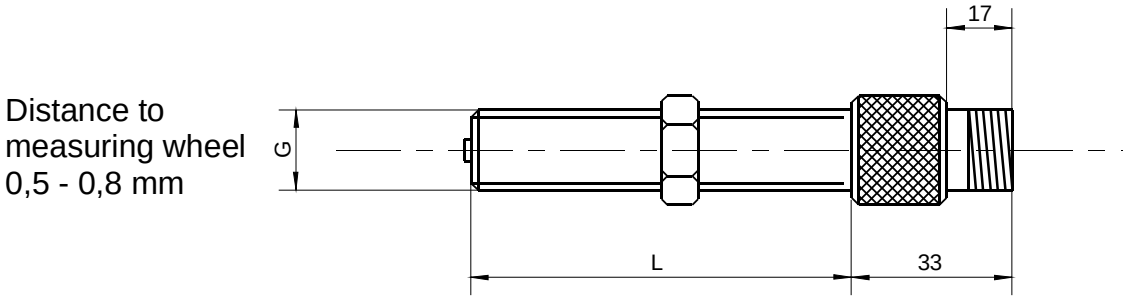

Fig. 5: Dimensions of the Magnetic Pickups

7.2.6 Magnetic Pickup, reinforced Model

With larger radial tolerances of the pickup wheel, it may happen that the speed pickup is damaged during operation. In this case, the reinforced model must be used.

The distance between the speed pickup and the top of the tooth should be 2 to 3 mm. (This can be achieved by screwing the pickup onto the top of the tooth and unscrewing it by approx. 1.5 turns.)

Dimensions Type	L (mm)	G	Notes
22 - 76	76	M 24 x 1,5	appropriate connector SV6-IA-2K
23 - 102	102	M 24 x 1,5	

Ordering specification, e.g., IA 22-76

Distance to measuring wheel maximum 3 mm

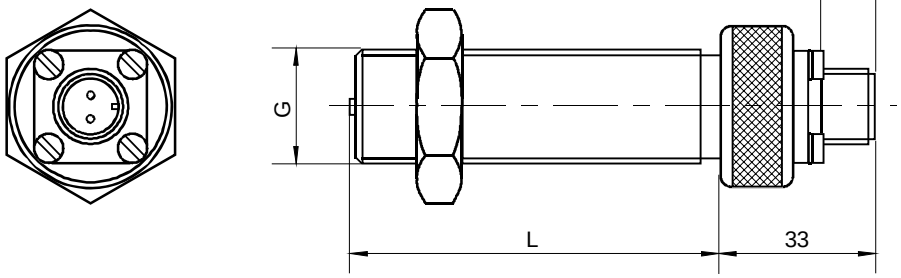

Fig. 6: Magnetic Pickup, reinforced Version

7.2.7 Redundant Speed Signal

If precautions are to be taken against possible failures of the speed pickup, a second pickup can be connected to the PEGASOS Locomotive Control System.

In case the primary pickup is at fault, the system will change over to the redundant speed signal and issue an alarm.

7.3 Cooling Medium Temperature Sensor TS 01 - 28 - PT 1000

Measuring range	-50°C up to +150°C
Precision	±1.5°C
Resistance at 25 °C (R25)	1000 Ohm ±0.5 %
Maximum operating voltage	5 V
Maximum operating current	3 mA
Recommended operating current	approx 1mA
Time constant in fluids	approx. 13 seconds
Ad. temperature range connector socket	-40°C up to +105°C
Protection grade	IP 65
Vibration	< 20 g, 10 - 300 Hz
Shock	< 50 g, 11 ms half-sine wave
Tightening torque	50 Nm ±15 %
Connector	SV 6 - IA - 2K (EDV- No.: 010 02 170 00)

Temperature Sensor	EDV- No.	L1 (mm)	L2 (mm)	Thread G
TS 01-28 - PT 1000	600-00-053-00	12	16	M 14 x 1,5

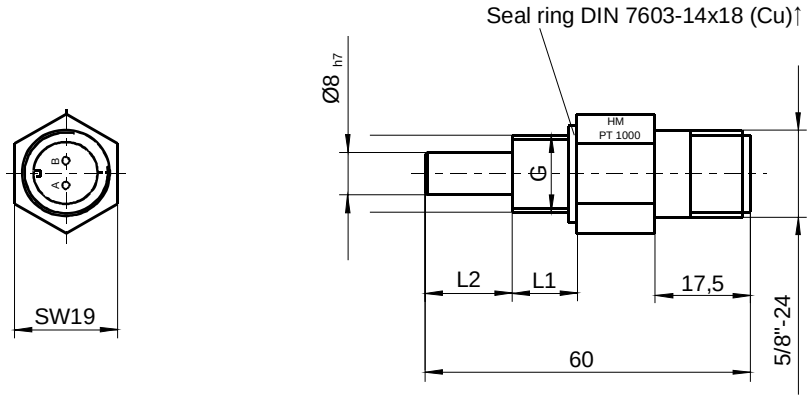

Fig. 7: Temperature Sensor TS 01 - 28 - PT 1000

7.4 Exhaust Temperature Sensors PT 200 (-40°C up to +800°C)

The following specifications are valid for all PT 200 - sensors:

Measuring range	-40°C up to +1000°C
Precision	±4.5°C at 20°C, ±13.5°C at 900°C
Resistance at 0 °C	200 Ohm
Maximum operating current	4 mA
Recommended operating current	approx. 1..2 mA
Time constant in gas	approx. 13 seconds at 900°C
Ad. temperature range connector socket	-40°C up to +150°C
Protection grade	IP 69 K
Vibration	< 60 g, 10 - 300 Hz
Shock	< 50 g, 11 ms half-sine wave
Tightening torque	35 Nm ±15 %

7.4.1 PT 200 - Sensor with Cable and End Sleeves

Temperature Sensor	EDV- No.	L (mm)	EL (mm)	Thread G
TS 02-60 - PT 200 -KV	600-00-063-00	60	40	M 16 x 1,5
TS 02-100 - PT 200 - KV	600-00-063-01	100	80	M 16 x 1,5

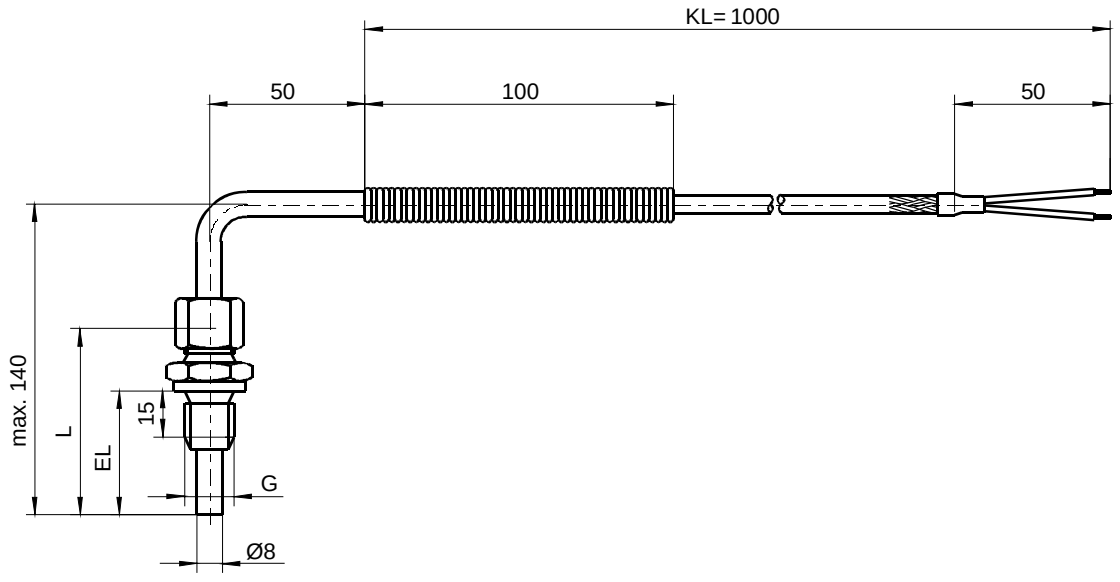

Fig. 8: PT 200 - Sensor with Cable and End Sleeves

7.4.2 PT 200 - Sensors with Plug Connector

Temperature Sensor	EDV- No.	L (mm)	EL (mm)	Thread G	Notes
TS 02-60 - PT 200 -SV	600-00-063-02	60	40	M 16 x 1,5	appropriate connector
TS 02-100 - PT 200 - SV	600-00-063-03	100	80	M 16 x 1,5	SV6-IA-2K

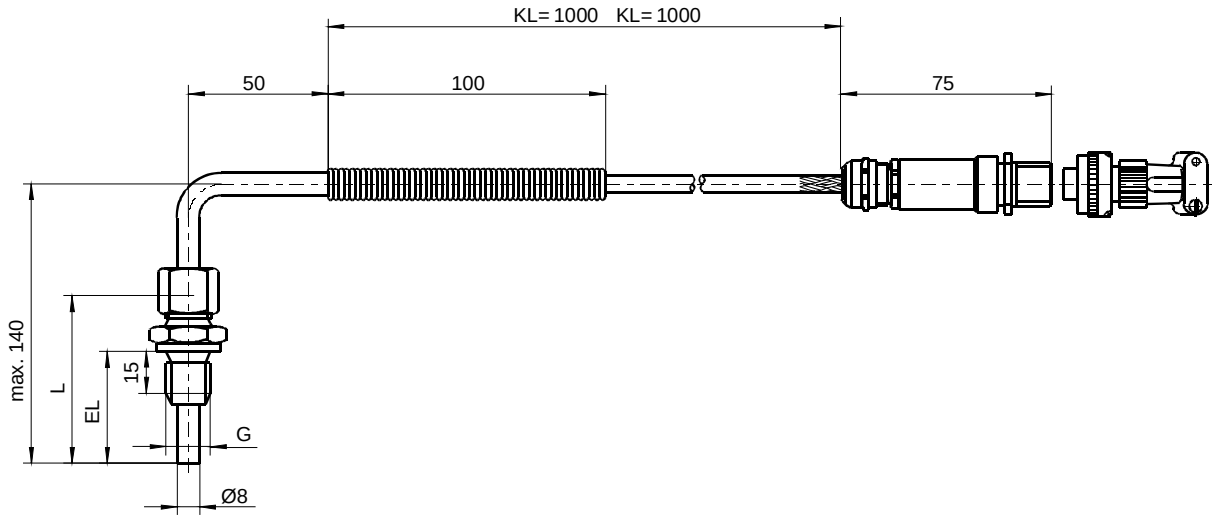

Fig. 9: PT 200 - Sensor with Plug Connector

7.5 Oil Pressure and Boost Pressure Sensors

All pressure sensors are also available enclosed in an extra case with interconnection terminal strip.

Note

The pressure sensors can also be used as pneumatic setpoint adjusters.

The following specifications are valid for all pressure sensors:

Measuring range	0..2.5 bar, 0..6 bar or 0..10 bar
Over pressure	6 bar resp. 15 bar resp. 20 bar
Supply voltage	10..34 V DC
Output signal	4..20 mA
Storage temperature	-25°C up to +85°C
Ambient temperature	-25°C up to +85°C
Oil temperature	-25°C up to +125°C
Protection grade	IP 65
Vibration	< 6 g, 20..2000 Hz
Shock	< 50 g, 11 ms half-sine wave
Tightening torque	max. 25 Nm
Connection	DIN 43650-A, 2-line system

7.5.1 Pressure Sensors with Plug Connector

Pressure Sensor	EDV- No.	Max. oper. Pressure (bar rel.)
DSO 01 - 2,5	600-00-058-02	2,5
DSO 01 - 6	600-00-058-00	6
DSO 01 - 10	600-00-058-01	10

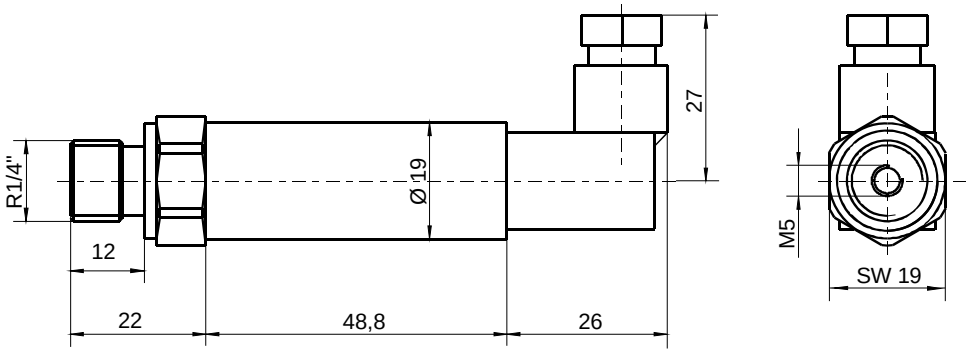

Fig. 10: Pressure Sensor with Plug Connector

7.5.2 Pressure Sensor with Housing and Treminal Strip

Pressure Sensor	EDV- No.	Max. oper. Pressure (bar rel.)
DSO 04 - 2,5	600-00-076-02	2,5
DSO 04 - 6	600-00-076-01	6
DSO 04 - 10	600-00-076-00	10

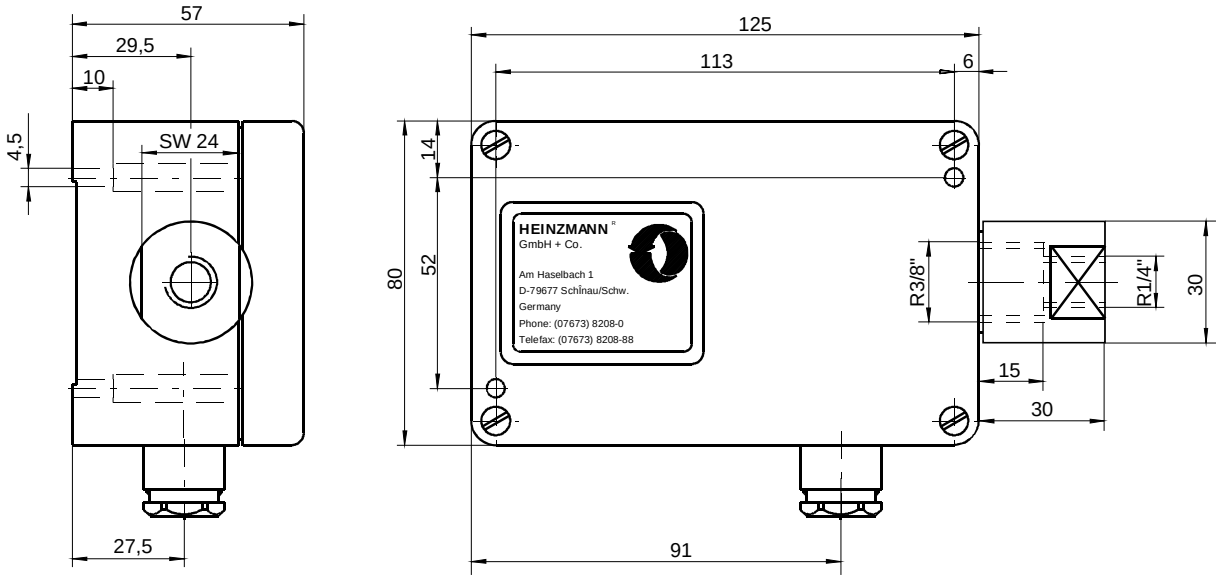

Fig. 11: Pressure Sensor with Housing

8 Setpoint Potentiometer

8.1 Setpoint Potentiometer SW 01 - 1 - b (1- turn) (EDV- No.: 600 00 041 01)

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

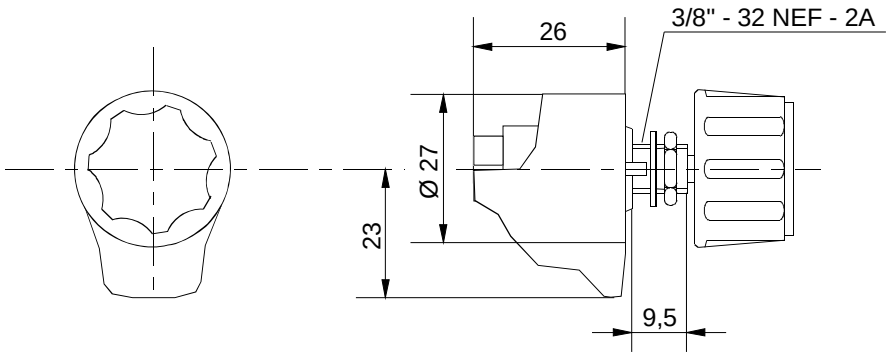

Fig. 12: Potentiometer SW 01 - 1 - b

8.2 Setpoint Potentiometer SW 02 - 10 - b (10- turn) (EDV- No.: 600 00 042 01)

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

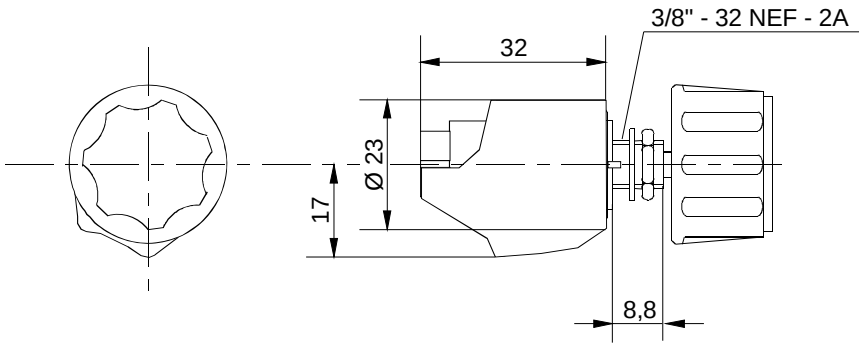

Fig. 13: Potentiometer SW 02 - 10 - b

On request, the potentiometers, as specified under 8.1. and 8.2. can be supplied with analogue adjustment knob with lock in place of the standard rotating knob. In this case, ordering specification is SW..-..-m.

Likewise, a clamping fixture can be installed instead of the knob. The ordering specification will then be SW ..-..-k.

9 Control Units PEGASOS DC 16.2 - 01, DC 30.2 - 01 and DC 40.2 - 01

9.1 Specifications

Operating voltage	24..110 V DC (according to order)
Data for nominal voltage 24 V:	
minimum voltage	18 V DC
governor fusing	16 A (slow)
current consumption	approx. 300 mA + actuator current
Data for nominal voltage from 72 to 110 V:	
minimum voltage	28 V DC
governor fusing	6 A (slow)
current consumption	approx. 200 mA + actuator current
Frequency range of speed input	200 to 12.000 Hz
Steady-state variation	±0.25 %
Frequency drift due to temperature for frequencies above 500 Hz and temperatures between –40°C and +70°C	±1 %
Storage temperature	-55°C up to +85°C
Ambient operating temperature	-40°C up to +70°C
Air humidity	up to 100 %
Protection grade	IP 44
Weight	approx. 15 kg

9.2 Dimensional Drawing

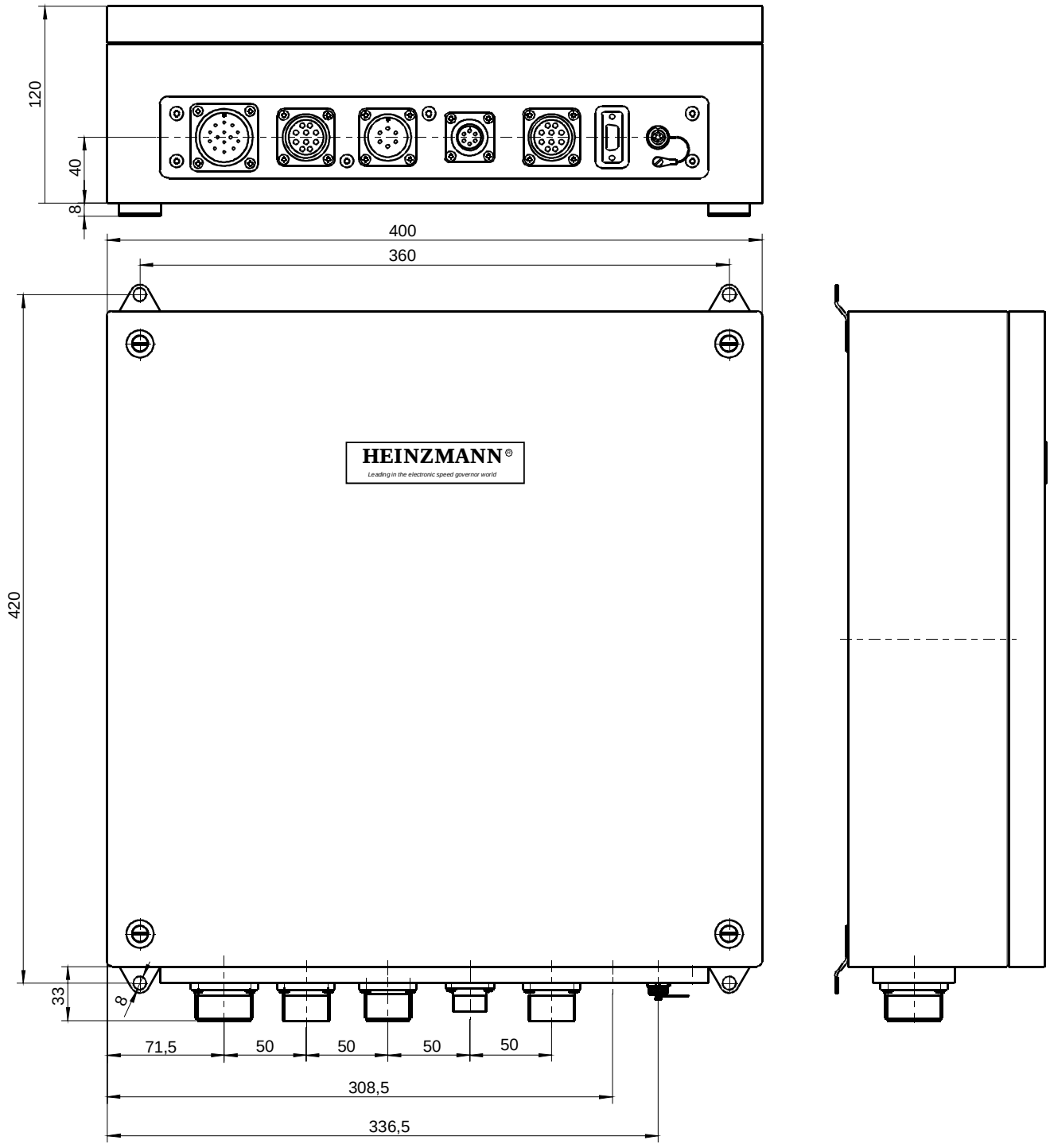

Fig. 14: Cabinet (KL 1511 from Rittal) with Digital Governor PEGASOS

10 Actuators StG 16..40

10.1 Design and Functions

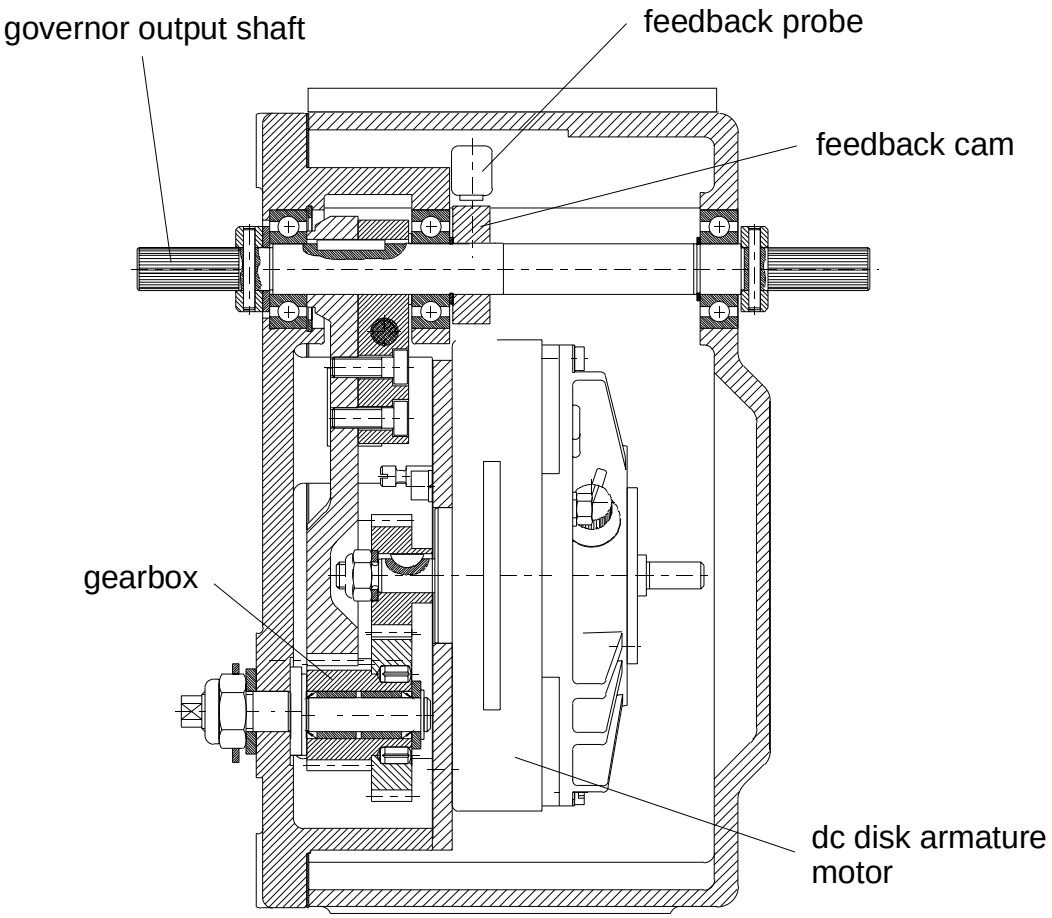

Fig. 15: Actuator Sectional Drawing

The power source of the actuators are DC disk motors whose torque is transmitted to the control output shaft via an intermediate gearing.

By using special materials and long-term lubricants the actuators are maintenance-free and have a long service life.

A feedback cam is mounted on the control output shaft for contactless sensing by a probe transmitting the position of the accurate output shaft to the control unit.

When the actuator is driven to a mechanical stop, e.g., due to overload of the diesel engine or failure of a cylinder, current limitation will take effect after about 20 seconds and reduce current to the actuator to a value sufficiently low to prevent damage to the actuator.

This actuator design offers the following benefits:

- High regulation power working in either direction.
- Extremely low current consumption in steady-state operation and relatively low current consumption on load changes.
- Indifference to slow voltage changes of power supply (abrupt voltage changes will cause governor troubles).

10.2 Installation

The actuator must be firmly mounted on the engine using a support with stiffened brackets. Vibrating arrangements as may be caused by weak bracket material or missing braces must be avoided by all means as this will increase vibrations and result in faster wear of the actuator and linkage.

In general, any mounting position is admissible. Care should, however, be taken to avoid installing the actuator in such a way as to make the plug connection point vertically upwards.

10.3 Technical Data of the PEGASOS Actuators

	StG 16 - 01	StG 30 - 01
Effective rotational angle of output shaft	42°	42°
Maximum torque at output shaft (direction stop)	approx. 15 Nm	approx. 28 Nm
Holding moment during current limitation	approx. 7.5 Nm	approx. 14 Nm
Response time 0-100% without load	approx. 120 ms	approx. 170 ms
Current consumption of governor (U_B = 24V)		
steady-state operation	approx. 1 A	approx. 1 A
on load changes	approx. 3..4 A	approx. 3..4 A
max. current	approx. 4.5 A	approx. 4.5 A
in current limitation	approx. 2.5 A	approx. 2.5 A
Storage temperature	-55°C up to +110°C	-55°C up to +110°C
Ambient temperature during operation	-25°C up to +90°C	-25°C up to +90°C
Ambient temperature, special version	-40°C up to +90°C	-40°C up to +90°C
Air humidity	up to 100 %	up to 100 %
Protection grade	IP 44	IP 44
Weight without socket	approx. 12.3 kg	approx. 12.3 kg
Weight of socket (UG 8)	approx. 1.3 kg	approx. 1.3 kg

	StG 40 - 01
Effective rotational angle of output shaft	42°
Maximum torque at output shaft (direction stop)	approx. 44 Nm
Holding moment during current limitation	approx. 22 Nm
Response time 0-100% without load	approx. 190 ms
Current consumption of governor (U_B = 24V)	
steady-state operation	approx. 1.5 A
on load changes	approx. 4..5 A
max. current	approx. 6 A
in current limitation	approx. 3 A
Storage temperature	-55°C up to +110°C
Ambient temperature during operation	-25°C up to +90°C
Ambient temperature, special version	-40°C up to +90°C
Air humidity	up to 100 %
Protection grade	IP 44
Weight without socket	approx. 12.3 kg
Weight of socket (UG 8)	approx. 1.3 kg

10.4 Dimensional Drawing

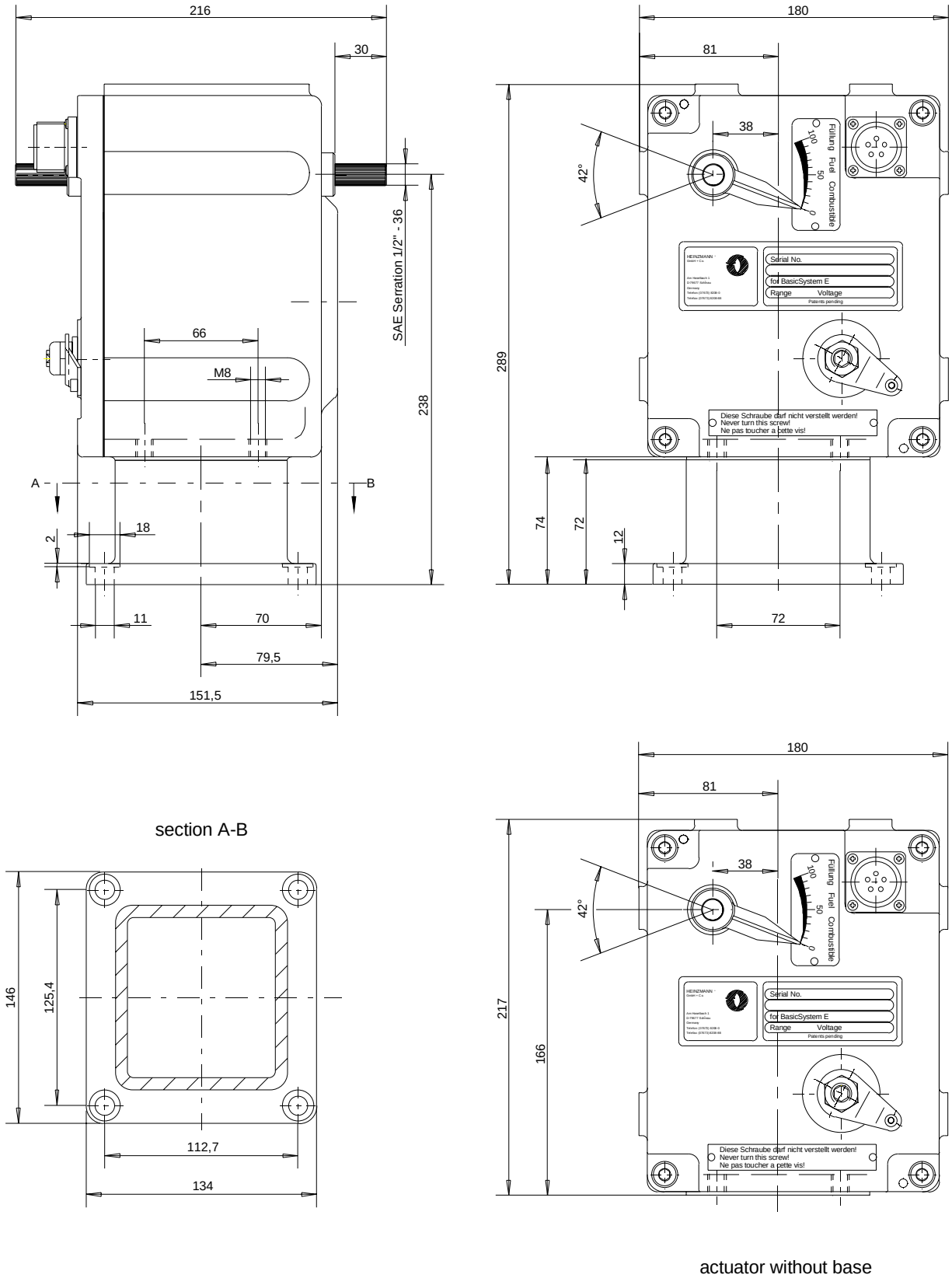

Fig. 16: Actuator StG 16 - 01, StG 30 - 01 and StG 40 - 10

11 Regulating Linkage

11.1 Length of Lever Arm

The length of the lever arm is determined in such a way that approx. 90 % of the governor output shaft adjustment angle can be used. Based on this, the rack length L of governors with 42° adjustment angle is calculated as L = 1.5 a, "a" being the travel distance of the injection pump or the carburettor.

11.2 Connecting Linkage

The connecting linkage from the governor to the injection pump or the carburettor should be length-adjustable and have a (pressure or tension) elastic link. If possible, joint rod heads in accordance with 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 actuator and injection pump resp. throttle valve no optimal control is possible.

11.3 Linkage Adjustment for Diesel Engines with Inline Injection Pump

The length of the connecting linkage is adjusted in such a way that with the governor in stop position the injection pump is set to 0 - 2 fuel marks. (Travel of the injection pump control rack is limited by the governor.)

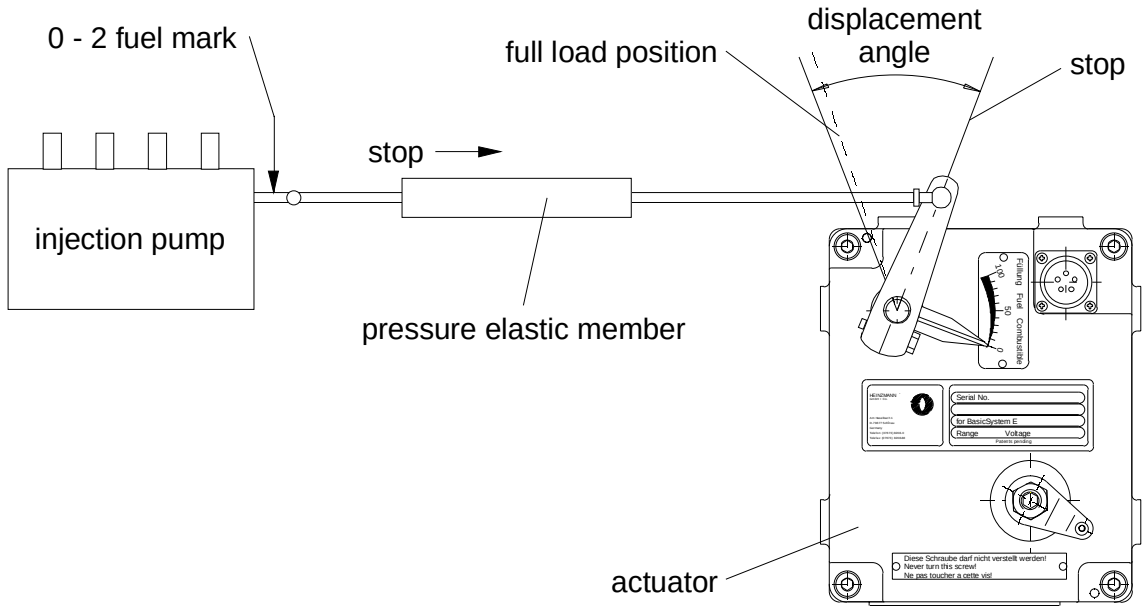

Fig. 17: Linkage for Diesel Engines

The resistance of the pressure elastic link is overcome when the control rack has reached the full load stop and the speed continues to decrease (overload). Furthermore, the elastic link is overcome when stopping via the emergency shut down.

12 Electrical Connection

The below instructions concerning screening are generally applicable to diesel-hydraulic locomotives with 24 V DC on-board supply systems.

It is normal for diesel-electric locomotives to operate by generator voltages of several hundred Volts and voltage peaks within the kV range. This is why the **HEINZMANN** electronics as well as the sensors must be connected electrically isolated from the on-board supply system provided this is technically feasible.

Since there exists a great number of different types of locomotives it will be necessary to find a solution for the cabling problems for each particular application. In doing so, the following aspects should be taken into account:

- Current supply for the governor is provided by a power D/D converter with internal overvoltage filtering. On-board voltage is converted into 24 V DC.
- Voltage supply of the sensor is to be connected to the governor (internal supply voltage 24 V or reference voltage 5 V), or else the signals must be transmitted to the governor via isolating amplifiers.
- Digital inputs as well as digital and analogue outputs are to be electrically isolated from the on-board supply by a LCI 01 Locomotive Interface within the Pegasos control unit.
- In order to avoid earth circuits the governor cabling must not establish any additional connection between engine ground and negative on-board supply.
- It is imperative that the housing of the Pegasos control unit be connected to vehicle ground. In the case of elastic suspension earthing cables should be used (cable size minimum 4 mm²).

12.1 Connection of Shielding

To prevent electromagnetic interference the shielding of either cable ends should have mass (frame) connection. This applies to the shielding of the cables from the governor to the sensors, potentiometers, actuators and accessory devices.

If there exists a potential difference between the governor housing and any of these components, a compensation line must be installed from the governor housing to each respective component in order to avoid transient currents across the shield.

In case the EMI problems cannot be eliminated by this connection method the shielding of the cables may be connected to the on-board voltage negative potential after due consultation with **HEINZMANN**. In this case the shield is to be applied to the control unit only on one side.

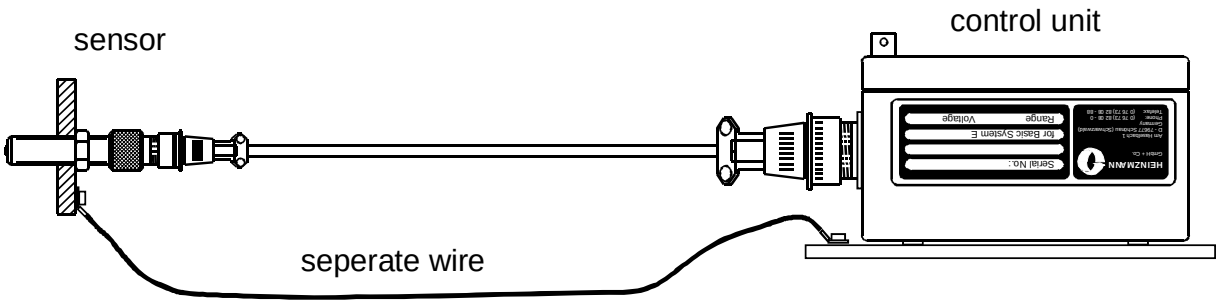

Fig. 18: Connecting a Compensation Line

For cable ends without plugs (e.g., terminal strip or soldered contacts) the shield must be attached to the housing close to the contacts.

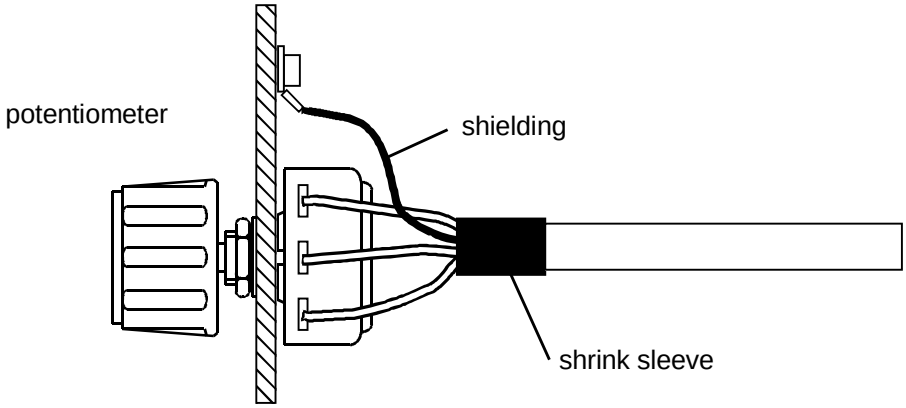

Fig. 19: Example of a Shield Installation without Plug Connectors

With plug connections the shield is to be connected to the strain relief.

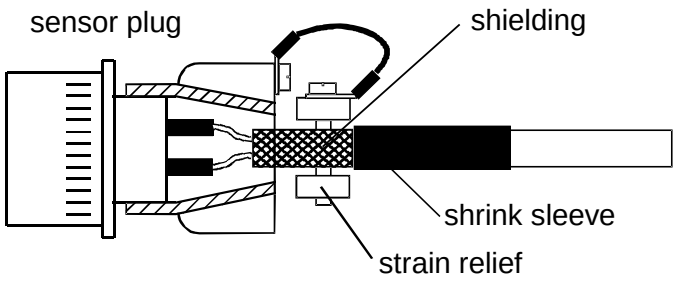

Fig. 20: Example of a Shield Installation within the Plug

12.2 Connection Diagram of the PEGASOS Control System

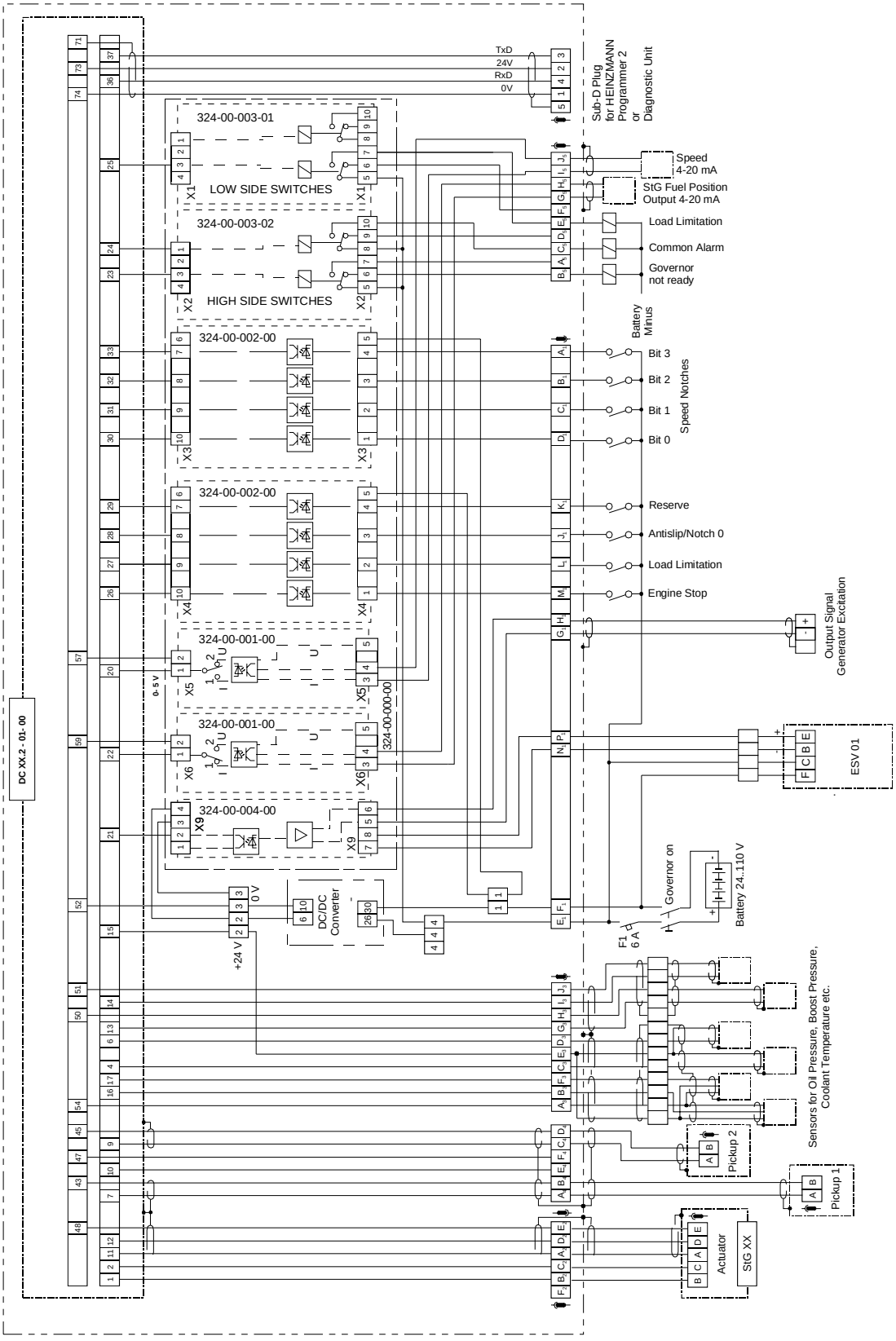

Fig. 21: Typical Connection Diagram of the PEGASOS Control System

12.3 Specification of Cable Sizes

1. Power Supply (plug 1, pins E, F):

on-board voltage 24 V:	up to 10 m	2,5 mm^2
	above 10 m	4,0 mm^2
on-board voltage 72 or 110 V:	up to 10 m	1,5 mm^2
	above 10 m	2,5 mm^2

2. Excitation Signal (plug 1, pins G, H, N, P):

The sizes must be determined for each specific project in dependence on cable length, on-board voltage and kind and size of the excitation signal..

3. Actuator Motor Line (plug 2, pins B, C):

up to 15 m	2,5 mm^2
above 15 m	4,0 mm^2

The cable length should be as short as possible and must not exceed 25 m.

4. Any other Lines: minimum 0,75 mm^2

The complete cable set can be purchased from **HEINZMANN**. At any rate, the cables for the actuator and the magnetic pickups should come from **HEINZMANN** as in this case the cables can be equipped directly at the factory with the appropriate connectors for the actuator and the magnetic pickups.

All lines installed on the engine must be protected by special measures against overheating, exposure to chemicals and damages (by installation in flexible plastic conduits, etc.). Otherwise it is recommended to use special cables for any such lines.

13 Determination of Speed Setpoint

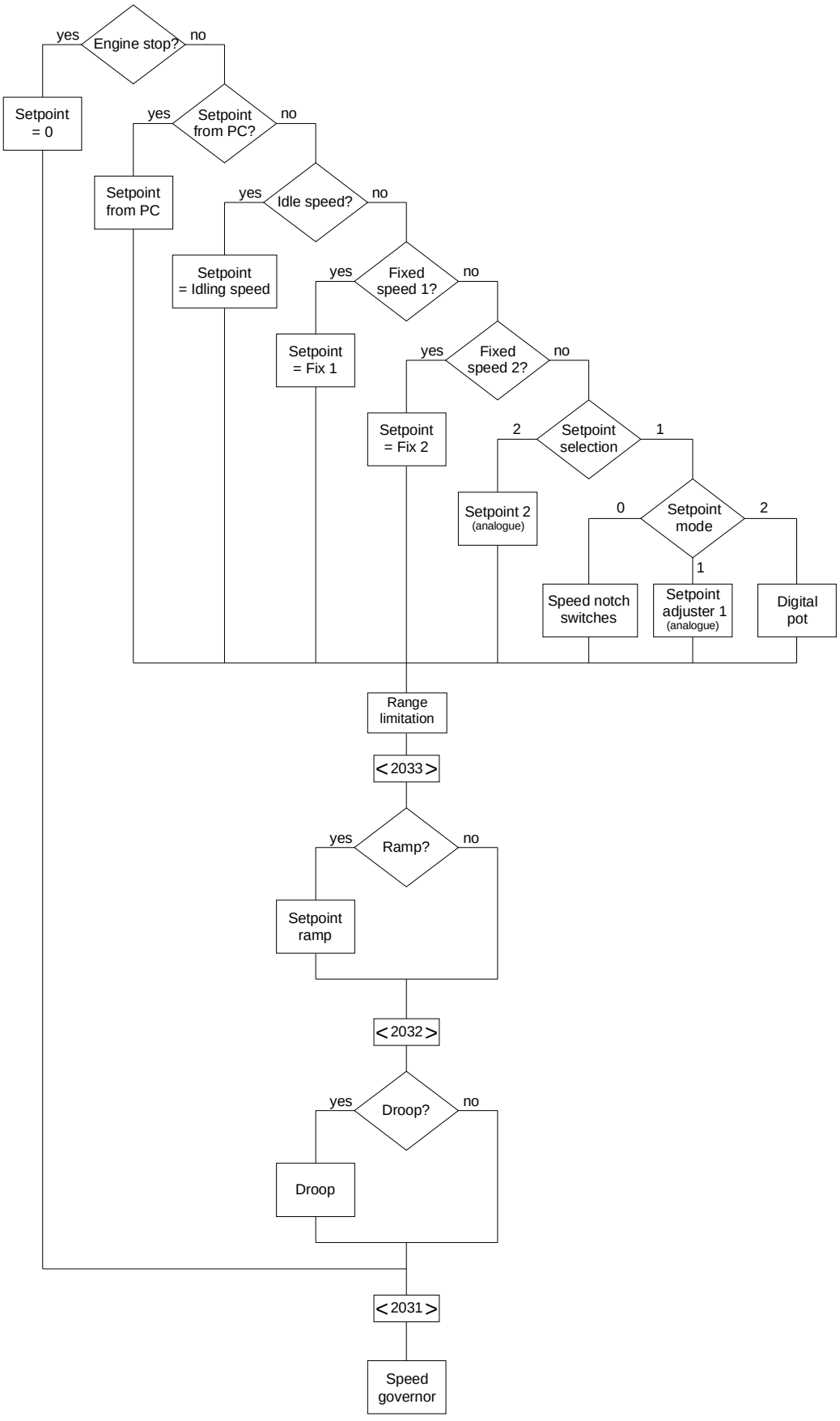

Fig. 22: Flow Chart Determination of Speed Setpoint

13.1 Possibilities of Setpoint Adjustment

Depending on the type of application, there are different setpoint adjusters available.

In simple applications, setpoint potentiometers may be used for presetting analogue setpoints. Furthermore it is possible to connect a current signal 4–20mA directly to the control unit. If a pneumatic speed setpoint signal is being used, it can be converted into a current signal 4-20 mA by means of a pressure sensor DSO 04. If the signal fails the control will resort to the minimum value or set a programmed default value.

It is also possible to connect a 4-bit-control for 16 speed levels (speed notch switches) from n_{min} to n_{max} directly to the control unit.

For a so-called digital potentiometer two switch inputs (digital inputs) are used by which it will be possible to increase and decrease speed via speed ramps that can be parameterized.

The CAN bus requires an additional circuit board to be installed in the DC 2-01 governor. The transmission protocol and the baud rate must be decided upon in consultation with **HEINZMANN**. They will depend, among other things, on line lengths as well as number and types of the devices connected.

13.2 Selection of Type of Setpoint Determination for Setpoint 1

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

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

Note

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

13.3 Speed Notch Switches

For operation by speed notch switches, the parameter 5350 *LocoSetpoint1Mode* must be set to “0”.

For configuring the speed notch switches, there must be up to four switch inputs available and assigned to the parameters 819 *FunctNotch3* through 822 *FunctNotch0*. 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

With four speed notch switches available, 16 speed notches can be set. The current speed notch is indicated via the parameter 3350 *Notch*. The following table shows how to select the different speed notches.

2819 *SwitchNotch3*	2820 *SwitchNotch2*	2821 *SwitchNotch1*	2822 *SwitchNotch0*	3350 *Notch*
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

The speeds pertaining to the different speed notches must be entered in the parameters 6900 through 6915 *LocoSpeedLevel(x)* with the index indicating the respective speed notch.

For 8 speed notches, the parameters 820 *FunctNotch2* through 822 *FunctNotch0* are to be utilized, for 4 running notches, the parameters 821 *FunctNotch1* and 822 *FunctNotch0* are to be used. The parameters 6900 to 6907 resp. 6900 to 6903 *LocoSpeedLevel(x)* are provided to hold the associated speeds.

14 Important Parameters for Locomotive Operation

14.1 Parameter Overview

The following diagrams exhibit the parameters provided for locomotive operation. They are split up with regard to variable speed controls and idle/maximum speed controls.

General control parameters, indication parameters (measurements) and parameters for error thresholds of sensors and for error handling have not been included. Information about these parameters are to be found in our manual DG 00 001 “Basis Information 2000 for Digital Controls”.

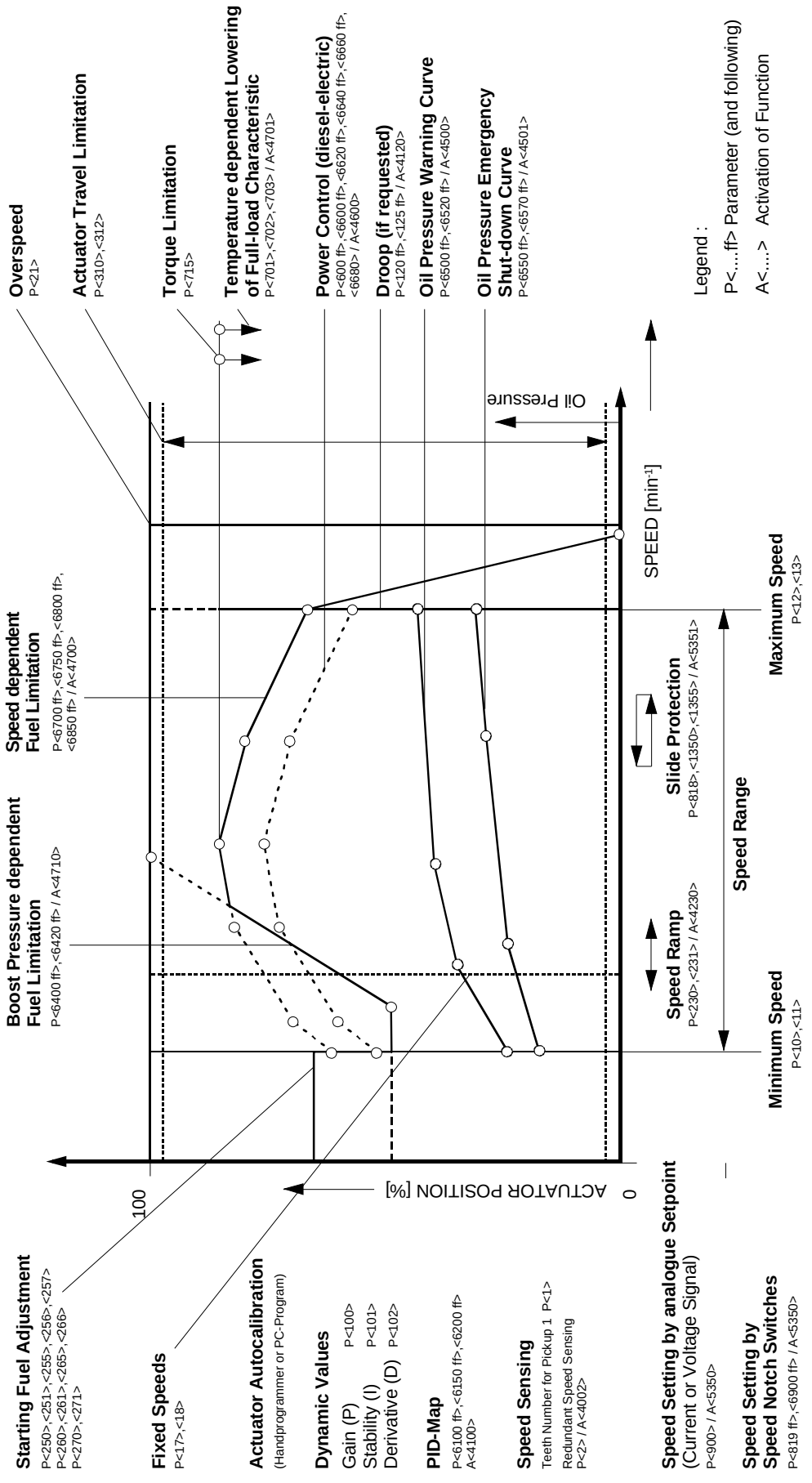

Fig. 23: Parameter Overview All Speed Governor

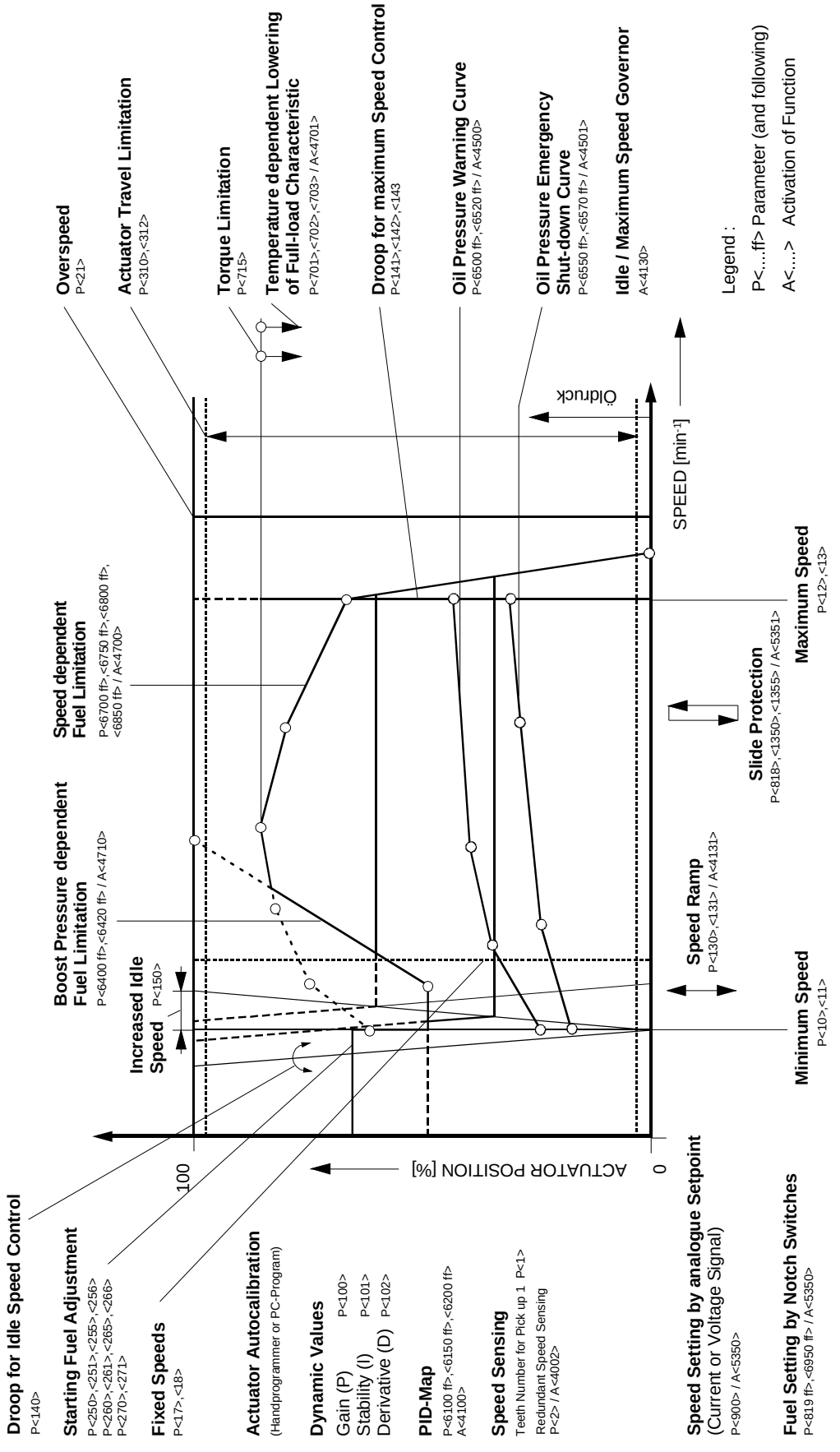

Fig. 24: Parameter Overview Idle-/Maximum Speed Governor

14.2 List 1: Parameters for Locomotive Applications

600	**PowerControlFactor**		
	Level:	2	Amplification factor for excitation control
	Range:	-400..400 %	
605	**PowerLimitForced**		
	Level:	2	Limitation of excitation signal for excitation control,
	Range:	0..100 %	to be activated via a switch input
610	**PowerControlRampUp**		
	Level:	2	Factor for up ramp for excitation control
	Range:	0..800 %/s	(Excitation setpoint by per cent per second)
611	**PowerControlRampDown**		
	Level:	2	Factor for down ramp for excitation control
	Range:	0..800 %/s	(Excitation setpoint by per cent per second)
620	**PowerSlideDec**		
	Level:	2	Amount of excitation reduction on detecting that wheels
	Range:	-50..+50 %	are sliding
621	**PowerSlideDuration**		
	Level:	2	Waiting time after reducing excitation setpoint signal
	Range:	0..100 s	on detecting sliding of wheels.
630	**PowerGovGain**		
	Level:	2	Proportional factor for excitation governing
	Range:	0..100 %	
631	**PowerGovStability**		
	Level:	2	Integral factor for excitation governing
	Range:	0..100 %	
632	**PowerGovDerivative**		
	Level:	2	Differential factor for excitation governing
	Range:	0..100 %	
633	**PowerControlFilter**		
	Level:	4	Filter value for excitation signal 2600 *PowerControl-*
	Range:	0..255	*Setpoint*
635	**PowerSetpPC**		
	Level:	2	Direct definition of the excitation signal setpoint
	Range:	0..100 %	
636	**PowerFuelOffset**		
	Level:	2	Offset value for excitation control: Fuel characteristic
	Range:	-50..50 %	(Shifting the characteristic along the fuel axis)
637	**PowerFuelLimitForced**		
	Level:	2	Setpoint limitation for excitation governing,
	Range:	0..100 s	to be activated by switch input
640	**PowerGovFuelRampUp**		
	Level:	2	Factor for upward ramp for excitation governing
	Range:	0..800 %/s	(Fuel setpoint by per cent per second)
641	**PowerGovFuelRampDown**		
	Level:	4	Factor for downward ramp for excitation governing
	Range:	0..800 %/s	(Fuel setpoint by per cent per second)

813	**FunctForcedLimit**		
	Level:	6	Switch assignment to function “Fuel limitation”
	Range:	-8..8	
818	**FunctSlide**		
	Level:	6	Switch assignment to function “Slide protection”
	Range:	-8..8	
819	**FunctNotch3**		
	Level:	6	Switch assignment to function “Speed notch switch 3”
	Range:	-8..8	
820	**FunctNotch2**		
	Level:	6	Switch assignment to function “Speed notch switch 2”
	Range:	-8..8	
821	**FunctNotch1**		
	Level:	6	Switch assignment to function “Speed notch switch 1”
	Range:	-8..8	
822	**FunctNotch0**		
	Level:	6	Switch assignment to function “Speed notch switch 0”
	Range:	-8..8	
823	**FunctPowerLimit**		
	Level:	6	Switch assignment to function “Power Limitation”
	Range:	-8..8	
	. . .		
1350	**SlideSpeedDec**		
	Level:	2	Speed reduction for sliding of wheels
	Range:	0..4000 min^{-1}	
1355	**SlideDuration**		
	Level:	2	Waiting time for slide protection after reducing the speed setpoint
	Range:	0..100 s	
	. . .		

14.3 List 2: Measurements for Locomotive Applications

2600	**PowerControlSetpoint**		
	Level:	1	Current output signal value for excitation control and excitation governing
	Range:	0..100 %	
2601	**PowerControlLimit**		
	Level:	1	Current maximum excitation signal value (2600 *PowerControlSetpoint*) for excitation control
	Range:	0..100 %	
2602	**PowerFuelSetpoint**		
	Level:	1	Current fuel setpoint from fuel characteristic for excitation governing
	Range:	0..100 %	
2640	**PowerLimitMaxActive**		
	Level:	1	0 = power limitation not enabled
	Range:	0/1	1 = power limitation enabled

2641	**FuelPowerLimitActive**		
	Level:	1	1 = power limitation due to fuel limitation is active
	Range:	0/1	
2642	**ForcedPowerLimitActive**		
	Level:	1	1 = power limitation due to external selection is active
	Range:	0/1	
2643	**SlidePowerLimitActive**		
	Level:	1	1 = power limitation due to slide signal is active
	Range:	0/1	
	. . .		
2813	**SwitchForcedLimit**		
	Level:	1	Switch state “Fuel limitation”
	Range:	0/1	
	. . .		
2818	**SwitchSlide**		
	Level:	1	Switch state “Sliding Wheels”
	Range:	0/1	
2819	**SwitchNotch3**		
	Level:	1	Switch state “Speed level 3”
	Range:	0/1	
2820	**SwitchNotch2**		
	Level:	1	Switch state “ Speed level 2”
	Range:	0/1	
2821	**SwitchNotch1**		
	Level:	1	Switch state “ Speed level 2”
	Range:	0/1	
2822	**SwitchNotch0**		
	Level:	1	Switch state “ Speed level 0”
	Range:	0/1	
2823	**SwitchPowerLimit**		
	Level:	1	Switch state “Power limitation”
	Range:	0/1	
	. . .		

14.4 Liste 3: Functions for Locomotive Operation

4600	**PowerControlOn**		
	Level:	2	Activation of excitation control or governing
	Range:	0/1	
4601	**PowerGovOrControl**		
	Level:	**2**	**0: Excitation control**
	Range:	**0/1**	**1: Excitation governing**
4610	**PowerControlRampOn**		
	Level:	2	Activation of the ramp for excitation control
	Range:	0/1	

4620	**PowerControlSlideOn**		
	Level:	2	Activation of slide protection effect on
	Range:	0/1	excitation signal
4630	**PowerGovPIDCurveOn**		
	Level:	3	Activation of speed dependent PID correction
	Range:	0/1	of excitation governing
4635	**PowerControlSetpPCOn**		
	Level:	2	Activation of excitation signal adjustment by PC
	Range:	0/1	(non-storing)
4640	**PowerGovFuelRampOn**		
	Level:	2	Activation of fuel setpoint ramp for
	Range:	0/1	excitation governing
	. . .		
5350	**LocoSetpoint1Mode**		
	Level:	2	Selection of setpoint adjuster 1 for locomotive
	Range:	0..2	application 0 = speed notch switches 1 = analogue signal 2 = digital potentiometer
5351	**SpeedSetpSlideOn**		
	Level:	2	Activation of slide protection effect on speed setpoint
	Range:	0/1	

14.5 List 4: Curves and Maps for Locomotive Applications

6600	**PowerControl:n(x)**		
to	Level:	2	Speed base points for excitation control
6615	Range:	0..4000 min^{-1}	
6620	**PowerControl:f(x)**		
to	Level:	2	Fuel values for excitation control and excitation
6635	Range:	0..100 %	governing
6640	**PowerControlSetp(x)**		
to	Level:	2	Excitation signal setpoints for excitation control
6655	Range:	0..100 %	
	. . .		
6900	**LocoSpeedLevel(x)**		
to	Level:	2	Speed levels for setpoint selection via speed notches
6915	Range:	0..4000 min^{-1}	
6950	**LocoFuelLevel(x)**		
to	Level:	2	Fuel levels for setpoint selection via speed notch
6965	Range:	0..100 %	switches (alternatively to speed levels)

15 Parameterizing

The software for the **HEINZMANN** speed governors has been designed in a way that will allow programming both at the **HEINZMANN** factory and by the engine manufacturer.

There exist various methods of parameterizing **HEINZMANN** Digital Controls. For testing purposes and commissioning **HEINZMANN** recommend to use DcDesk 2000 as a diagnostics and parameterizing tool. For servicing purposes, however, use can also be made of the Hand Programmers PG 2 and HP 03 as well as of DcDesk 2000.

The following list offers an overview of all existing possibilities of parameterizing Digital Controls.

15.1 Parameterizing at the Factory

During end-of-line control at the factory, the functionability of the unit is checked by a test programme. If the operational data for the control unit is available, the test programme is carried out using this data. It is then only the dynamics data and if need be the fuel limitations and sensors that will have to be calibrated on the engine.

15.2 Parameterizing with the Hand Held Programmer

All parameterizing can also be done by means of the hand held programmers PG 2 resp. HP 03. These handy devices are particularly suited for servicing.

15.3 Parameterizing by PC

Parameterizing by PC is recommended for series adjustment. Compared with the Hand Programmer, it offers the advantage of graphically displaying and easily modifying characteristics and of visualizing time diagrams when commissioning the governor on the engine. Besides, the PC offers a better survey due to the menu architecture of the PC programme DcDesk 2000 and its capability of displaying several parameters at the same time. Furthermore, the PC programme permits to download control data from and to store them on data carriers.

15.4 Parameterizing by User Mask

Parameterization can generally be performed with the help of user masks that have been provided by **HEINZMANN** or that the user may conveniently create himself. User masks serve to display only those parameters that are actually needed.

15.5 Downloading Data Sets

Once parameterizing is definitely completed for a specific engine type and its application, this data set can be stored within the Hand Programmer or on a data medium. For future applications of the same type, these data sets can then be downloaded to the new controls.
Attention: Actuator autoadjust must be executed separately for each single governor.

15.6 End-of-Line (EOL) Programming

This type of programming is performed by the engine manufacturer during the final bench tests of the engine. By this procedure, the control is tuned to engine requirements and to ordering specifications.

Note

For more detailed information, please refer to the separate manual "Operating Instructions for the Communication Programme DcDesk 2000", DG 00 003-e.

16 Starting the Engine – Brief Instructions

1. Adjust clearance of the magnetic pickup.

2. Check data set with regard to relevant parameters: number of teeth, speed, etc.

3. Setpoint adjustment: Idle speed
On commissioning the control system preset its dynamics values as follows:

Gain	100 *Gain*	to	10 %
Stability	101 *Stability*	to	5 %
Derivative	102 *Derivative*	to	5 %

If there exist dynamics values that have been determined for an installation of the same type they may be taken over at this point.

Danger

Make sure there is an independent overspeed protection!

4. Start the engine and test it within the lower speed range.

5. Increase *Gain* until the engine becomes unstable, then reduce it until stability is restored.
Increase S*tability* until the engine begins to become unstable.
Increase *Derivative* until stability is restored.

With this adjustment, run the engine shortly on-load and off-load and observe the transient response. Repeated oscillations of speed and actuator travel will be a symptom of too high dynamics values.

Note: With diesel-electric locomotives, the I-factor (*Stability*) of the speed governor should be set to a value just high enough to permit elimination of speed differences within a reasonable time. Otherwise, the stability of power control may be adversely affected.

6. Check across the entire speed range.

If for an analogue setpoint signal this checking procedure yields values for minimum and maximum speeds that differ from the programmed ones, this will be caused by tolerances of the setpoint adjuster. If the speed variances are larger than admissible, the setpoint adjuster needs to be calibrated.

7. Correct gain within the upper speed range; use a PID map, if necessary.

8. Check the remaining programming instances, e.g., starting fuel, ramping rates, etc.

Note

*The required adjustment procedures for the above items 2 through 8 and all other adjustments are described in detail in the **HEINZMANN** manual DG 00 001-e "Basic Information for Digital Controls".*

17 Adjustment of Power Control – Brief Instructions

With diesel-electric locomotives, the Pegasos Control System permits to output a signal to control generator excitation. By this, it will be possible to control power output. There exist two ways of implementing this function:

1. Excitation control: Power control in dependence of speed; stabilization of load changes by means of a P-control.
2. Excitation governing: Power control by means of a PID controller comparing preset and actual fuel quantity.

17.1 Excitation Control

The excitation signal 2600 *PowerControlSetpoint* is a function of current speed 2000 *Speed*, of current fuel quantity 2350 *FuelQuantity* and of the amplification factor 600 *PowerControlFactor*. Every triple of values consists of one speed value, one fuel value and one excitation value, all of which are assigned the same index (0 ... 15). Starting from current speed 2000 *Speed*, two characteristics must be adjusted.

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

6600 to 6615 *PowerControl:n(x)* :	Speed values for fuel characteristic and excitation signal characteristic
6620 to 6635 *PowerControl:f(x)* :	Fuel quantity values for fuel characteristic
6640 to 6655 *PowerControlSetp(x)* :	Signal values for excitation signal characteristic

Procedure:

1. For conveniently plotting the two characteristics make use of the parameter 635 *PowerSetpPC*. To do so, set the respective function 4635 *PowerSetpPC* = 1.
2. This done, the speed points for which certain power outputs have been defined should be run up to. At each speed base point the excitation signal should be modified by 635 *PowerSetpPC* until the desired power output is obtained.
3. The resulting fuel quantity can then be read from 2350 *FuelQuantity*.
4. The speed base points are then to be entered as x-values of the characteristic *Excitation Control:Signal Characteristic, X(0) ff.,* and the respective excitation signal value for the speed base point in *Y(0) ff.*
5. Next, the fuel quantity belonging to each power stage is to be entered in *Excitation Control: FuelCharacteristic, Y(0) ff.* under the index of the speed value.

6. Set function 4635 *PowerSetpPC* = 0 (to switch it off).
7. When the curves have been completely plotted, power control via fuel quantity is to be enabled by setting the factor 600 *PowerControlFactor ≠ 0*. For a negative weighting factor a value smaller than the excitation signal value is output when current fuel quantity is above the fuel characteristic value. For a positive weighting factor a value larger than the excitation signal value is output in the same case (< 0: generator excitation; > 0: generator de-excitation).
8. The greater this factor is, the greater the amplification of the control circuit will be. The final value is to be determined by running up to all speeds on-load: Control should be fast without becoming unstable.

17.2 Excitation Governing

With excitation governing, the excitation signal 2600 *PowerControlSetpoint* 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. The reference value for the excitation control circuit is derived from a speed dependent characteristic where the fuel quantities corresponding to the required generator output are stored:

6600..6615 *PowerControl:n(x)*: Speed values for the control characteristic

6620..6635 *PowerControl:f(x)*: Fuel quantity values for the control characteristic

Starting from current speed 2000 *Speed* the characteristic is evaluated, and the fuel quantity setpoint thus determined is indicated by 2602 *PowerFuelSetpoint*. The actual fuel quantity value that is to be compared with the latter corresponds to the current fuel quantity 2350 *FuelQuantity* as determined by the speed control circuit.

Procedure:

1. For plotting the characteristic, the parameter 635 PowerSetpPC is to be used. To do so, set the function 4635 PowerSetpPC = 1.
2. This done, the speed points for which certain power outputs have been defined should be run up to. At each speed base point the excitation signal should be modified by 635 *PowerSetpPC* until the desired power output is obtained.
3. The resulting fuel quantity can then be read from 2350 *FuelQuantity*.
4. The speed base points are then to be entered as x-values of the characteristic *Excitation Control:Signal Characteristic, X(0) ff.* The values *Y(0) ff.* are to be left blank.
5. Next, the fuel quantity belonging to each power stage is to be entered in *Excitation Control: FuelCharacteristic, Y(0) ff.* under the index of the speed value.
6. Set function 4635 *PowerSetpPC* = 0 (to switch it off).

7. The PID parameters of the excitation control are stored at 630 *PowerGovGain*, 631 *PowerGovStability* and 632 *PowerGovDerivative*. The greater these factors are, the "faster" the control circuit will respond. The final values are to be determined by running up to all speeds on-load: Control should be fast without becoming unstable.

8. In order to adapt the control circuit to varying conditions, 630 *PowerGovGain* and 631 *PowerGovStability* can be corrected in dependence of speed. The respective correction factors are to be entered in the following characteristic:

   6600 to 6615 *PowerControl:n(x)* Speed values for PI correction

   6660 to *6675 PowerGov:Corr(x)* Correction values for P and I

Enable correction of the PI values by setting 4630 *PowerGovPIDCurveOn* = 1.

Note

*The above procedures and any other possibilities of adjustment are described in detail in the **HEINZMANN** manual DG 00 001-e "Basic Information for Digital Controls".*

18 Ordering Specifications

18.1 General Specification

Specifications such as locomotive design and type as well as supply voltage,

Mounting location of the magnetic pickup (flywheel, camshaft wheel, etc.),

Engine specific parameters such as speeds and number of teeth on flywheel,

Specifications regarding sensor such as pickup, pressure and temperature sensors,

Limitation curves,

Additional functions such as power reductions for engine protection,

Monitoring functions,

Assignment of inputs and outputs.

All of these specifications should be entered in the manual “Ordering Information for Digital Controls”, No. DG 96 012-e, which can separately be obtained as a manual or via e-Mail and which should after completion be returned to **HEINZMANN**.

18.2 Special Specifications for Diesel-Electric Locomotives

On-board voltage including maximum possible voltage drop on engine start

Starting device (pneumatic, electrical using starter or main generator)

Design and type of the main generator (three-phase alternator or DC generator)

Output voltage range of main generator

Maximum generator current

Design of traction motors (three-phase or DC motors)

Method of generating the generator excitation signal (e.g., separate auxiliary generator)

Previous adjusting mode of the generator excitation signal (switched resistors,

rheostat, electronically)

Type of generator excitation signal (voltage, current)

Range of generator excitation signal (by Amps or Volts)

Engagement point of the generator excitation signal incl. type and size of load impedance

Necessary or desirable additional functions of the control system such as:

Power limitation due to:

Cooling water or oil temperature, boost pressure, charge air temperature, signal for sliding wheels, atmospheric pressure, etc.

Note

If possible, the order should include schematic circuit diagrams and manufacturing documentation (e.g., manuals and publications).

18.3 Cable Harness

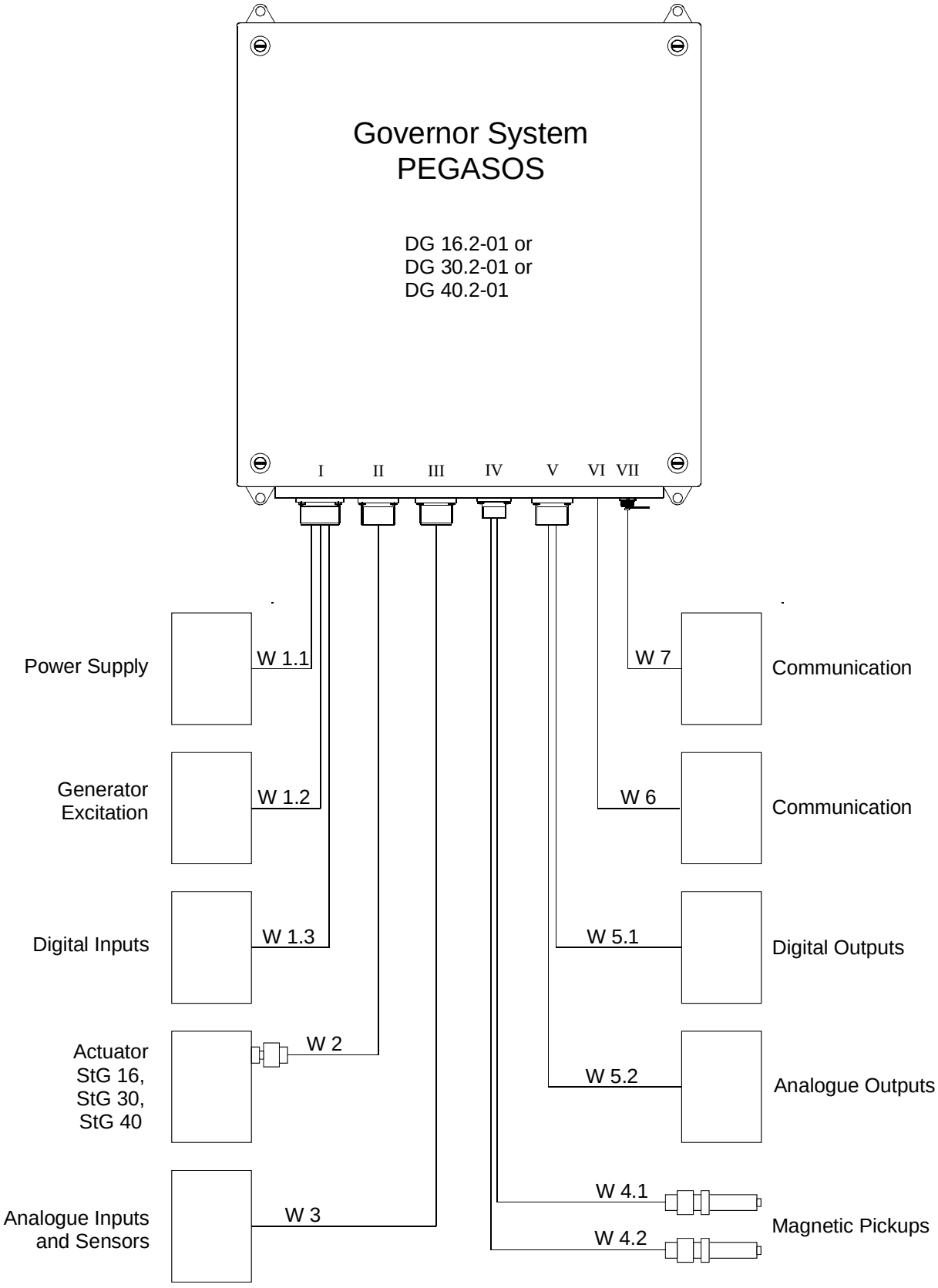

Fig. 25: Cable Harness with Cable Numbers

18.4 Plug Connectors

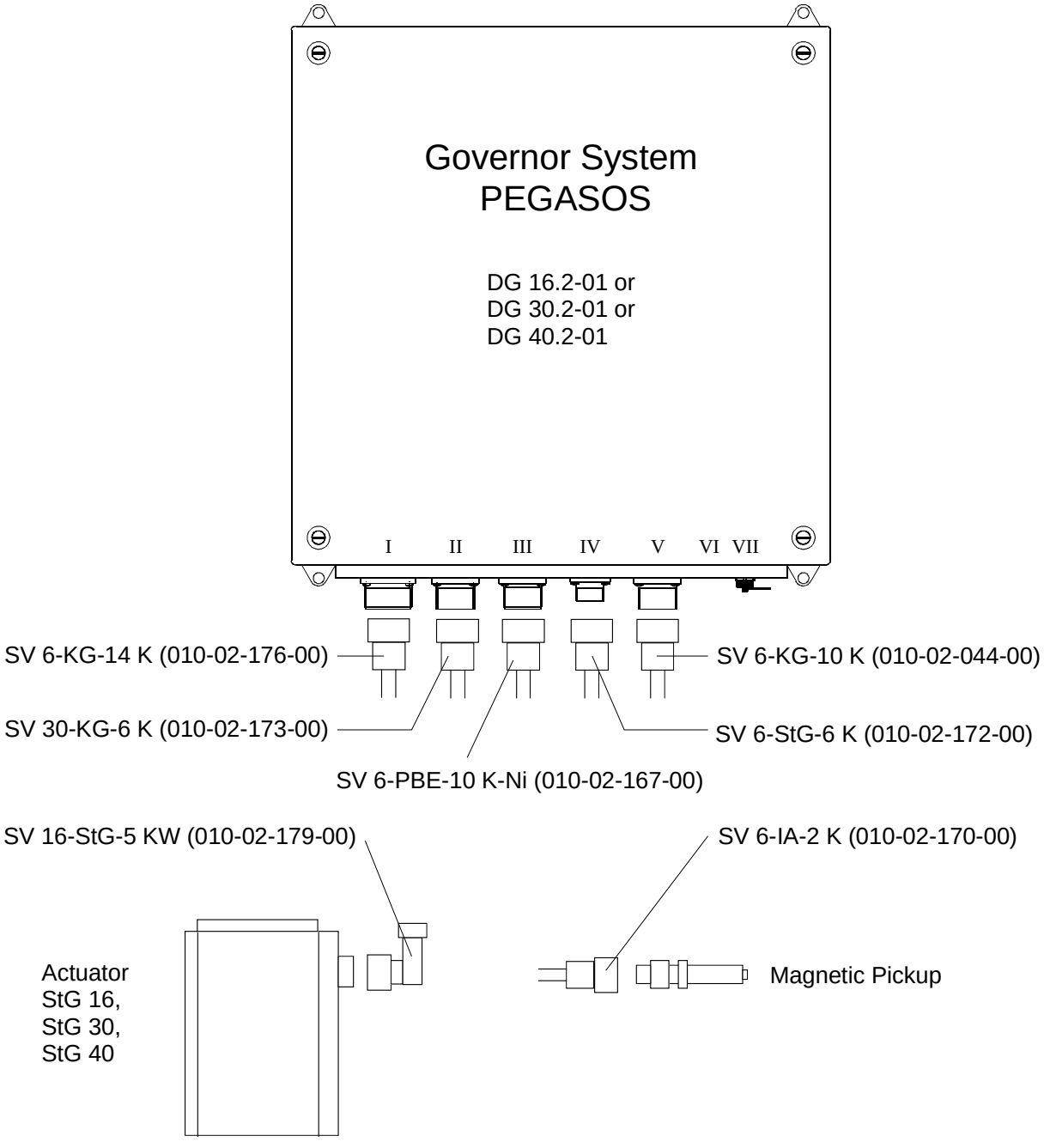

Fig. 26: Connector Designations

18.5 Cable Lengths

We urgently recommend to purchase the cable harness together with the control unit.

The required cable lengths can be ordered from Heinzmann using the following schedule.

Note

It is not possible to use at the same time all of the signals that are in principle available because depending on the particular application diverse inputs and outputs have to be assigned to different functions.

Plug 1

Power Supply

W 1.1 Control Unit - Battery ..... cm, size depending on project

Generator Excitation

W 1.2 Control Unit - Generator Control ..... cm, size depending on project

Digital Inputs

W 1.3 Control Unit - Digital Inputs ..... cm, 8 x 1,0 mm^2

Plug 2

Actuator

W 2.1 Control Unit - Actuator (Feedback) ..... cm, 3 x 0,75 mm^2 shielded

W 2.2 Control Unit - Actuator (DC-Motor) ..... cm,

size up to 15 m, 2 x 2,50 mm^2

15 - 30 m, 2 x 4,00 mm^2

Plug 3

Analogue Inputs

W 3.1 Control Unit - analogue Setpoint Adjuster ..... cm, 2 x 0,75 mm^2 shielded

Sensors

W 3.2 Control Unit - Current Sensors ..... cm, 2 x 0,75 mm^2 shielded

W 3.3 Control Unit - Voltage Sensors ..... cm, 3 x 0,75 mm^2 shielded

W 3.4 Control Unit - Resitance Sensors ..... cm, 2 x 0,75 mm^2 shielded

Note

Specify type and number of sensors / setpoint adjusters.

Plug 4

Magnetic Pickup

W 4.1 Control Unit - Magnetic Pickup 1 ..... cm, 2 x 0,75 mm² shielded
W 4.2 Control Unit - Magnetic Pickup 2 ..... cm, 2 x 0,75 mm² shielded

Plug 5

Digital Outputs

W 5.1 Control Unit - digital Outputs ..... cm, 1,0 mm^2

Analogue Outputs

W 5.2 Control Unit - analogue Outputs ..... cm, 2 x 0,75 mm² shielded
W 5.3 Control Unit - Power Output ..... cm, 1,0 mm²

Plug 6

Communication

W 6 Control Unit – PC ..... cm, 4 x 0,14 mm² shielded
(max. length: 15 m)

Plug 7

Communication

W 7 Control Unit – PC ..... cm, 4 x 0,14 mm² shielded
(max. Length: 15 m)

Note

Depending on the specific version of the control unit additional lines may be required.

19 Order Specifications for Manuals

There is no charge for technical manuals ordered in reasonable quantities.

Order the necessary manuals on our speed governors from your nearest

HEINZMANN location.

(Please click on “HEINZMANN location” to see the list of our subsidiaries and agents in the world).

Please include the following information:

- your name,
- the name and address of your company (you can simply include your business card),
- The address where you want the manuals sent (if different from above),
- the number(s) and title(s) of the desired manual(s),
- or the technical data of your **HEINZMANN** equipment,
- the quantity you want.

You can directly use the following fax-form for ordering one or several manuals.

Most of the manuals are available as Acrobat PDF-files, too. On request they can be send via e-mail.

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