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HEINZMANN®

Digital Electronic Speed Governor

Digital Control System

ARTEMIS VI

Dual fuel extension for vehicles with electronic diesel fuel injection

Manual DG 06 008-e / 06-06

 **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**	**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

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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 General

HEINZMANN digital control systems of the ARTEMIS series have been developed for dual fuel and pilot fuel engines.

ARTEMIS VI is a dual fuel extension for industrial vehicle diesel engines with electronic fuel injection. It may be used with any (also non-HEINZMANN) EFI control based on PPN or Common Rail technology. Speed control, engine monitoring and protection remain with the original EFI control system. Gas quantity is controlled by an additional HEINZMANN control unit, based on engine speed and actual diesel fuel injection time.

Various sensors provide engine status information for the governor. For example, cooling media temperature, lube oil temperature, charge air pressure and temperature, gas pressure and temperature and exhaust gas temperature may be used to protect the engine by limiting the gas quantity.

ARTEMIS VI was made for naturally aspirated and turbocharged engines.

All ARTEMIS speed governor systems are based on a common basic software structure. Most parameters, measuring values and functions are similar, and the DcDesk 2000 communication program may be used with all digital electronic HEINZMANN governors.

3 Further Informations

This manual gives an overview of functions, system components and setup of ARTEMIS VI dual fuel system. For detailed informations about technical data, programming and basic parameters, refer to the following manuals:

Basic Information 2000 for digital speed governors	Manual no. DG 00 001-e
Basic Information SATURN remote communication	Manual no. DG 05 006-e
Digital Basic System HELENOS I	Manual no. DG 95 102-e
Digital Basic System HELENOS II	Manual no. DG 95 100-e
Digital Basic System HELENOS III	Manual no. DG 96 005-e

The HEINZMANN communication program *DcDesk 2000* is described in manual no. DG 00 003-e. The latest informations regarding new program versions are available in the DcDesk 2000 Online Help.

HEINZMANN dual fuel governors usually are customized and pre-adjusted as far as possible. For dual fuel extension systems like ARTEMIS VI, the customer is kindly requested to provide informations about existing control system, engine and vehicle. Use the HEINZMANN manual “Order information for digital governors, no. DG 96 012-e”.

ARTEMIS VI control system requires a setup procedure on an engine test stand. It is necessary to run the engine in the complete speed and load range, both in diesel mode and in dual fuel mode.

4 ARTEMIS VI - Hardware

A certain set of components is required for the system´s basic functionality. Additional parts are available, depending on the application.

The basic system consists of:

1 gas position control unit DC 2-01

1 gas actuator StG 6/10/16/30/40 (depending on type of engine and vehicle)

1 lever arm RH …-01

1 magnetic speed pickup IA .. (size depending on engine type)

1 exhaust temperature sensor

1 injection time measuring module ITM-01.

Optional components:

1 2nd magnetic speed pickup IA .. (redundant speed pickup)

1 cooling water temperature sensor, or gas / mixture temperature sensor

1 boost pressure sensor

1 gas train, including gas valve, filters, pressure regulator, throttle valve and mixer

1 knock detection device

1 relay interface RIF-01

1 ARGOS operating and display unit

1 CAN bus interface board, on request with extended error memory

1 Electronic Foot Pedal SG-03 or EFP-01

Note

ITM-01 unit and more sensors may be omitted, if a fast and reliable communication interface to the electronic fuel injection controller may be established.

The following communication protocols are available with ARTEMIS VI:

CAN bus (SAE J1939, CANopen, DeviceNet)

Modbus (RS 232 or RS 485)

Required data are actual diesel injection time or quantity, exhaust temperature, engine speed and further values like boost pressure, coolant temperature… The values must be updated regularly without delay (min. refresh rate 100 ms or faster).

The following drawing shows an ARTEMIS VI block diagram:

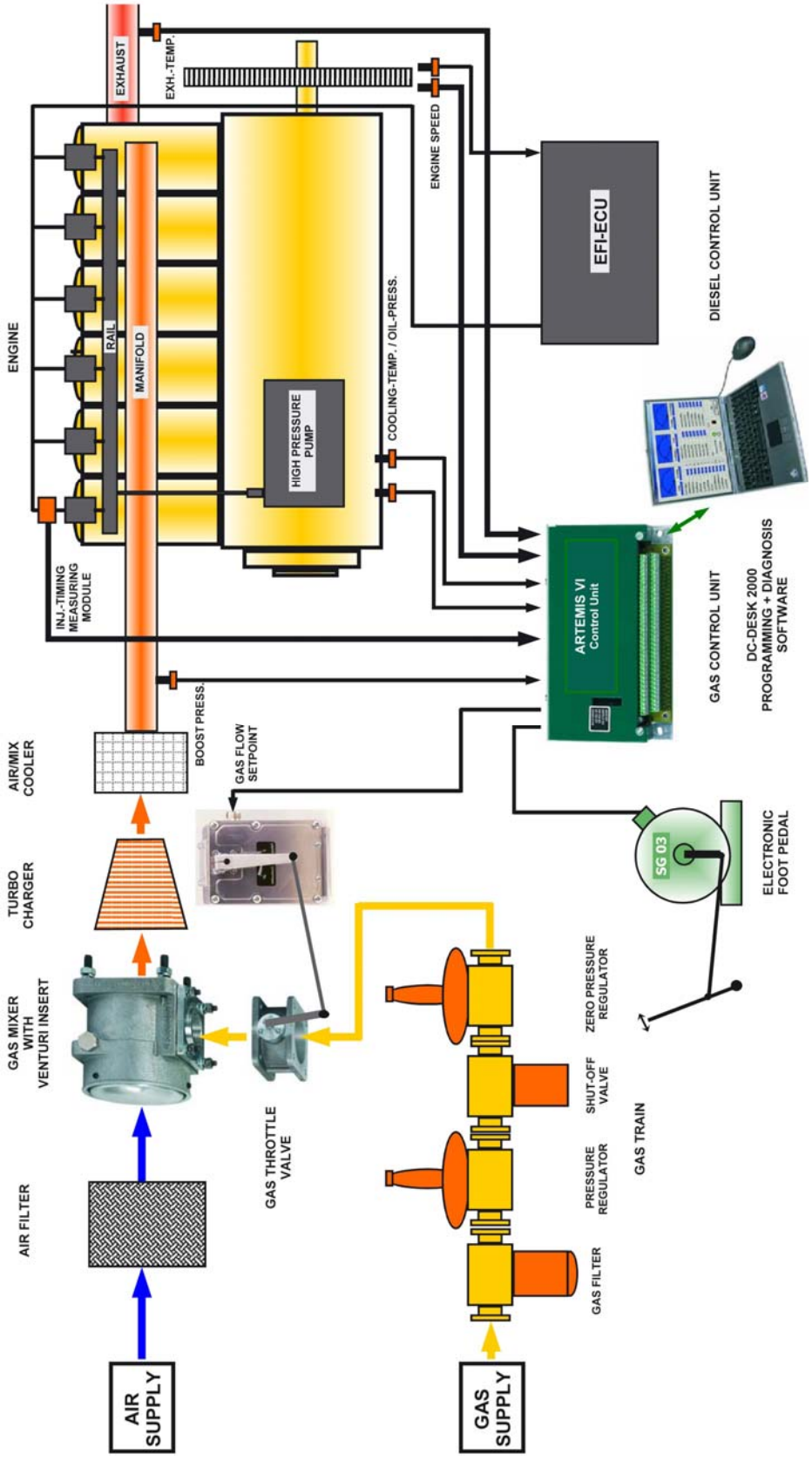


Figure 1: ARTEMIS VI Block Diagram

- ARTEMIS VI control unit drives the gas actuator, installed at the throttle valve.
- Engine signals are supplied to the control unit as shown in the drawing, being used to set the gas actuator position or to limit it. Engine speed, injection time and exhaust temperature are the most important engine signals.
- The gas train consists of gas filter, pressure regulator, governor driven gas shutoff valve and zero pressure regulator.
- Upstream of the turbocharger, the gas mixer is located. According to the Venturi characteristics, gas quantity depends on air flow through the mixer and throttle valve position.
- The electronic foot pedal is an optional device, which can be used to detect abnormal differences between actual speed and speed setpoint (in all-speed governor mode), or between actual diesel fuel quantity and fuel setpoint (in idle-maximum governor mode). This would be a sign of an engine problem and interrupt dual fuel operation.

5 Application specific Features

ARTEMIS VI has been designed for applications with variable engine speed and load.

The following features are typical for an ARTEMIS VI dual fuel control system:

- Low pressure gas is supplied at the air intake before turbocharger using a Venturi tube. The load-dependent air flow will affect the quantity of gas consumed.
- One or two gas throttle valves are connected to a HEINZMANN gas fuel actuator.
- Engine speed is measured at the flywheel by an inductive speed sensor.
- The gas actuator is controlled by a HEINZMANN DC 2-01 digital electronic control unit. Position is set in relation to diesel fuel quantity.
- Fuel quantity may be either estimated, based on measured injection time and engine speed, or received as a digital value from the EFI controller.
- Additional signals are: Boost pressure, exhaust temperature and cooling water temperature. These signals limit the gas actuator position in dual fuel mode, protecting the engine from overload and damages.

Advantages of dual fuel operation with ARTEMIS VI:

- Reduction of fuel cost (gas replacing up to 50 % of diesel fuel).
- Reduction of emissions and noise.
- No loss of engine power in dual fuel mode.
- No reduction of original diesel mode functionality. It is always possible to run the engine in pure diesel mode.

6 ARTEMIS VI Functions

The variety of functions is limited by maximum number and available types of hardware in- and outputs.

6.1 Overview

a) Dual Fuel Mode Range Limits

The operating area for gas mode is detemined by a number of physical variables. While all preset conditions are fulfilled, dual fuel mode is activated.

- actual engine speed,
- exhaust temperature,
- charge air pressure,
- cooling media temperature,
- gas pressure (before or after pressure regulator),
- speed difference (to setpoint, if available),
- lube oil pressure.

b) Gas Setpoint by PC

Manual setting of gas actuator position during dual fuel mode setup procedure.

c) Gas Fuel to Actuator Position Conversion

The calculated gas fuel setpoint may be corrected or limited by the following optional curves:

- dual fuel transfer ramps,
- gas fuel to actuator setpoint conversion curve,
- gas temperature dependent gas fuel correction curve,
- gas pressure dependent gas fuel correction curve.

d) Injection Duration Map

This map consists of injection time (z) versus engine speed (x) and load (y). These values are measured during dual fuel engine setup procedure. The map is a basis for other settings and has no executive function.

e) Minimum Injection Time Curve

A curve “min. injection time vs. engine speed” is used to shut off the gas actuator, whenever diesel fuel injection time falls below a certain minimum value. This function keeps the engine from being exposed to a gas/air mixture without a sufficient diesel fuel portion for a controlled ignition.

f) Injection Time dependent Gas Fuel Curves

Curves “Gas fuel vs. injection time” are available for up to 7 engine speed levels. A linear intepolation is carried out for intermediate engine speeds. These curves provide the gas actuator position setpoint in operation.

g) Fault Diagnosis and Display

In case of any error (engine, sensors, actuators, communication), a common alarm is activated. If possible and programmed, substitution values will be used for emergency operation. Fatal errors initiate a fast return to diesel. Internal control unit errors are recognized as well and stored in a memory together with external errors. All errors can be displayed and cleared using a HEINZMANN hand programmer or the DcDesk 2000 HEINZMANN communication program.

6.2 Dual Fuel Mode Transfer

6.2.1 Conditions for Transfer to Dual Fuel Mode

The gas positioner will start dual fuel operation under the following conditions:

- Selector switch “Diesel / Gas” is set to “Gas”.
- Switch “Fast return to diesel” is not on.
- Speed pickup signals are received, engine speed is within the range for dual fuel mode.
- No actual errors in gas positioner.

- Engine load (resp. injection time) is equal to / higher than preset minimum.
- Exhaust temperature is lower than the maximum temperature for dual fuel mode.
- Charge air pressure and gas pressure are within the range for dual fuel mode.

Transfer to dual fuel may be started manually or automatically.

A manual transfer is initiated by setting the switch “Diesel or Gas” to “Gas”, when all conditions are fulfilled. If “Gas” is selected, while one or more conditions are missing, the governor will send an error message. The transfer cannot start, unless all premises permit to.

Automatic transfer will be carried out, as soon as all conditions allow dual fuel mode. The selector switch must remain on “Gas” permanently. The automatic transfer function will maintain dual fuel mode, as long as conditions allow.

A transfer ramp for gas position ensure a soft transition into dual fuel mode. Transfer time depends on actual engine load and ramp rate. The transfer to dual fuel is finished, when the gas actuator has reached a position according to the curves “gas fuel vs. injection time”.

In dual fuel mode, all speed governor functions remain with the diesel control unit, the gas control unit operating as a throttle valve positioner only. The diesel control unit will reduce the fuel quantity, to keep the engine speed at the setpoint.

6.2.2 Conditions for Automatic Return to Diesel

The governor will return to diesel mode in the following conditions:

- “Diesel or Gas” switch is not in “Gas” (off or contact lost).
- “Fast return to diesel” switch is active.
- Engine speed is out of range, or no speed pickup signal.
- An error has occurred in the gas positioner.
- The load (injection time) signal is out of range or got lost.
- Exhaust temperature is higher than maximum allowed for dual fuel mode.
- Charge air pressure or gas pressure are out of range for dual fuel mode.

For transfer to diesel, the gas actuator position is reduced to minimum (fast position ramp). This will force the diesel governor to increase the fuel quantity, in order to compensate the engine speed drop.

6.2.3 Max. Load Limitation in Dual Fuel Mode

A maximum load limitation in vehicle operation is usually set in the diesel control unit as an engine speed related fuel limitation, a derating by cooling water and/or lube oil overtemperature may be included.

In dual fuel mode without direct communication between diesel ECU and gas positioner control unit, the additional gas fuel would lead to engine overload.

There are two basic ways to protect the engine from being exposed to overload:

1) Reducing the gas quantity to zero at high engine load over the whole speed range. This will protect the engine, but not save any diesel fuel in the most interesting operating area.
2) Activating an externally accessable diesel fuel limitation. This may be a binary maintenance request input (example: “change air filter”) or anything similar. The diesel full load quantity should be limited by 20 % or more.

Dual fuel operation at full load without limiting diesel fuel quantity (relying just on engine monitoring like exhaust gas, cooling water or lube oil temperature) is not recommended.

6.2.4 Load Steps in Dual Fuel Mode

A sudden increase of load will cause an engine speed drop and a reaction of the diesel ECU. Depending on load difference and system settings, diesel fuel quantity will be increased at a certain rate. This rate will not affect the gas quantity increase rate, because the gas actuator position increase rate is limited by a relatively slow ramp.

An increase of speed demand (in all-speed governor mode) or fuel demand (in idle-maximum governor mode) by the operator will have a similar effect.

A sudden large-scale load reduction or idle speed/fuel request will shut down the gas actuator, soon as diesel fuel injection falls below the minimum injection time curve.

7 Electric Wiring Diagram of an ARTEMIS VI System

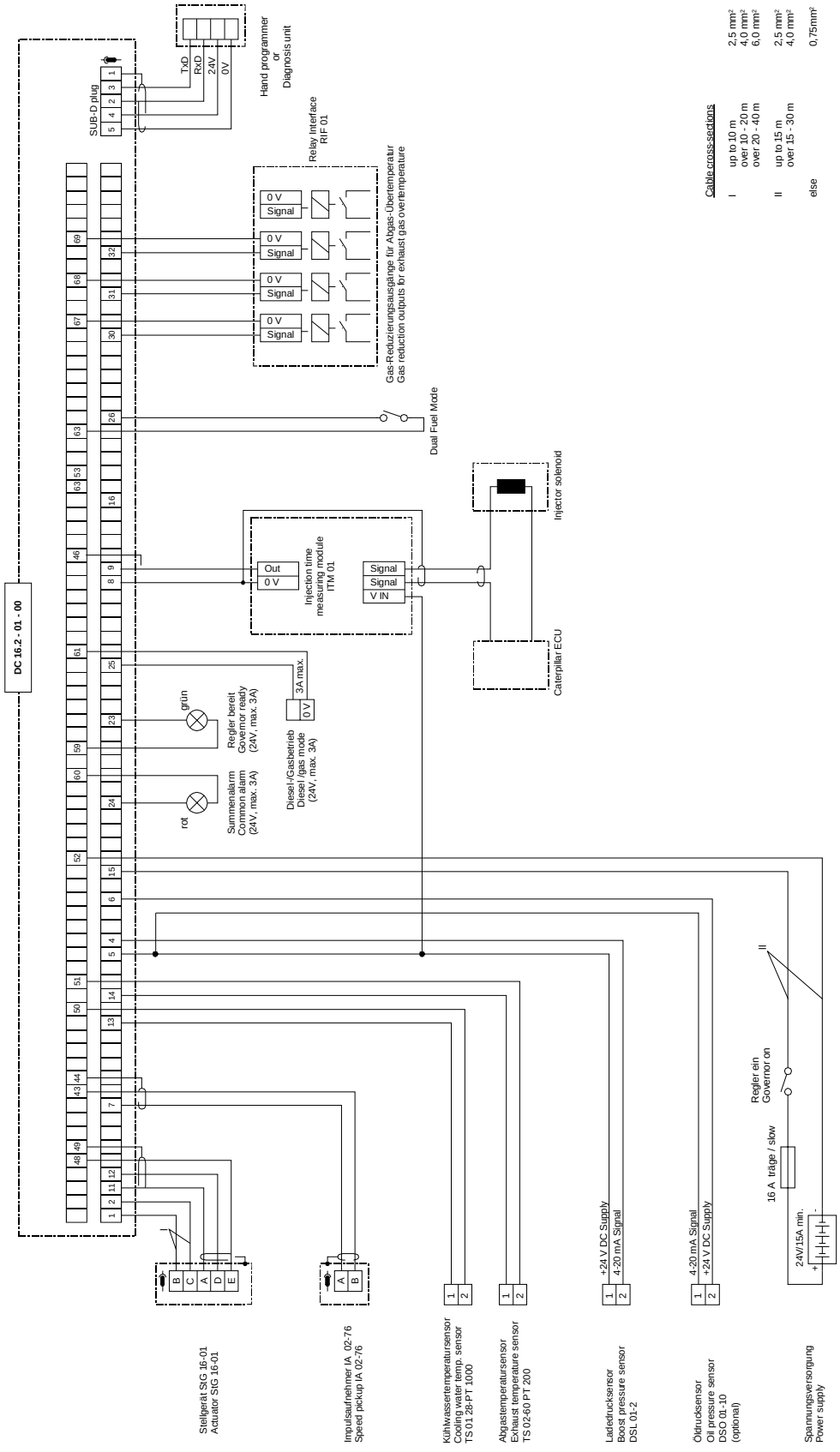


Figure 2: Gas Positioner, HELENOS Series with StG 16 Actuator

- The electric StG 16 actuator receives a position drive current from the DC 2-01 control unit. A position feedback signal is returned to the controller via shielded cable.
- Inductive speed pickup IA 02-76 detects impulses at the engine flywheel and sends them to the controller as a frequency signal via shielded cable.
- Cooling water sensor (PT1000) and exhaust gas sensor (PT200) supply temperature values as DC voltage signals.
- Charge air pressure and oil pressure are both transmitted as 4...20 mA signals.
- Power supply voltage is 24 VDC with a 16 A slow-blow fuse protection. Steady state current level lies below 2 Amp.
- There are three status (display) outputs:
  common alarm (on = alarm)
  governor ready (off = gas emergency shutdown)
  Diesel/gas mode (on = dual fuel)
- Injection time measuring module is in-line with a fuel injection solenoid.
- Dual fuel mode selector switch.
- Gas reduction outputs with RIF-01 relay interface (up to 4 stages).
- 9 pin sub-D connector for communication with a PC using the HEINZMANN DcDesk 2000 program (or hand programmer HP-03)


Note

*The two cables for actuator and speed pickup should always be supplied by **HEINZMANN**. Quality and reliability of these cables are especially important for the system´s performance and safety.*

8 Gas Train Structure

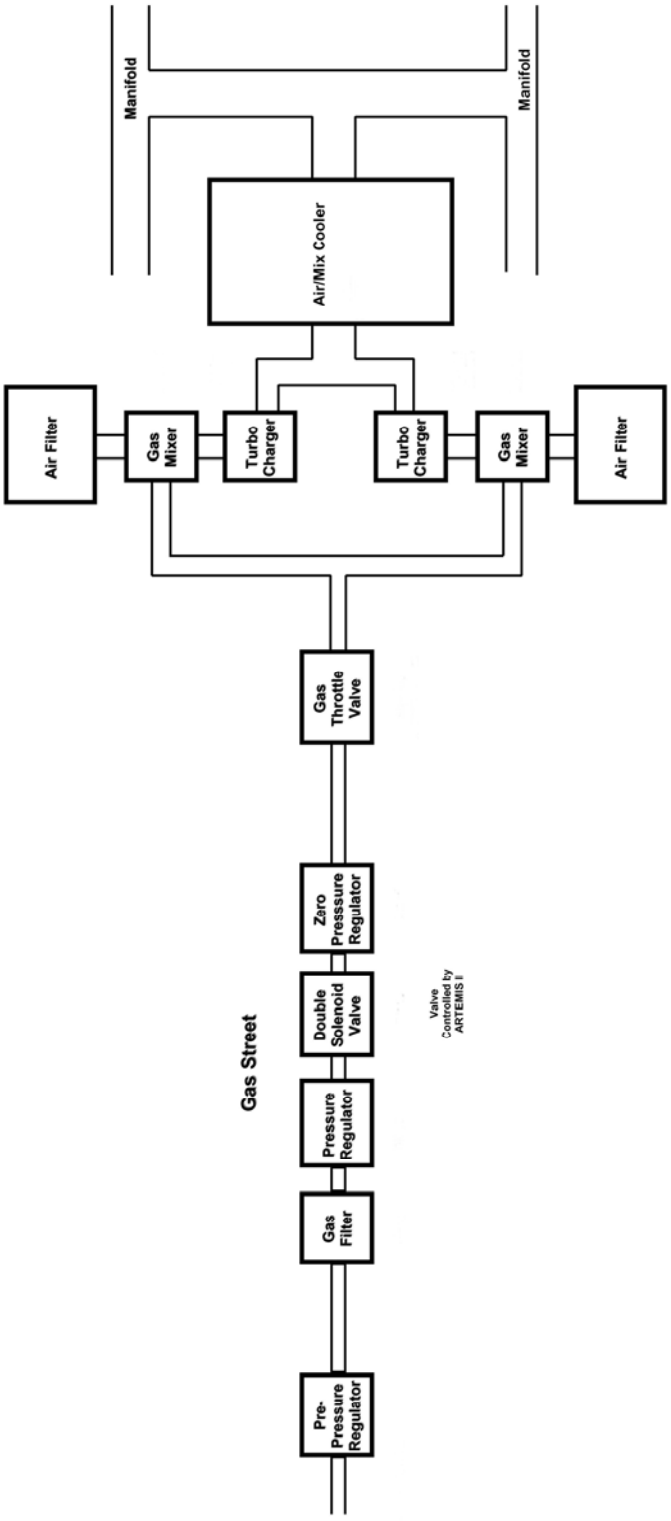


Figure 3: Typical Gas Arrangement for ARTEMIS VI Systems (V-Engine)

The diagram shows the basic structure of an ARTEMIS VI gas train for a V-engine. A pressure reducing unit with pre-pressure regulator, filter, gas solenoid valve, zero pressure regulator and throttle valve supplies the gas to two gas mixers.

Depending on diesel engine type and vehicle, the gas train structure may be different. The ARTEMIS VI system will only be affected regarding actuator type/size.

9 Software Parameter Overview

The following tables show all dual fuel related parameters. Standard parameters are described in “Basic Information 2000, DG 00 001-e”. Some parameters may be added, omitted or modified, depending on software version.

Parameters listed here are typical for a dual fuel truck software.

No.	Name	Range	Description
1. Parameters			
813	*FunctForcedLimit*	[-8,8]	Digital input number for “Forced gas position limit”
837	*FunctGasOrDiesel*	[-8,8]	Digital input number for „Gas or diesel request“
838	*FunctFastToDiesel*	[-8,8]	Digital input number for „Fast return to diesel“
840	*FunctExternGasAlarm*	[-8,8]	Digital input number for "External gas alarm"
900	*AssignIn_Setp1Ext*	[0,6]	Analogue input number for speed/fuel setpoint (optional foot pedal or signal transmitter)
904	*AssignIn_BoostPress*	[0,6]	Analogue input number for boost pressure sensor
905	*AsssignIn_OilPress*	[0,6]	Analogue input number for oil pressure sensor
907	*AssignIn_CoolantTemp*	[0,6]	Analogue input number for coolant temperature sensor
910	*AssignIn_GasTemp*	[0,6]	Analogue input number for gas temperature sensor
911	*AssignIn_ExhTemp*	[0,6]	Analogue input number for exhaust temperature sensor
914	*AssignIn_GasPress*	[0,6]	Analogue input number for gas pressure sensor
10002	*GasSetpointPC*	[0,100.0] %	Manual gas actuator position during setup procedure (PC with DcDesk 2000 communication program)
10005	*GasModeGasPressMin*	[0,2.0] bar	Min. gas pressure for dual fuel mode
10006	*GasModeGasPressMax*	[0,2.0] bar	Max. gas pressure for dual fuel mode
10007	*GasModeGasPressHyst*	[0,2.0] bar	Gas pressure range hysteresis
10010	*GasModeSpeedMin*	[0,4000] rpm	Min. engine speed for dual fuel mode
10011	*GasModeSpeedMax*	[0,4000] rpm	Max. engine speed for dual fuel mode
10012	*GasModeSpeedHyst*	[0,4000] rpm	Engine speed range hysteresis
10013	*GasModeSpeedDiffMax*	[0,2000] rpm	Max. actual difference between engine speed and speed setpoint for dual fuel mode
10014	*GasModeSpeedDifDelay*	[0,100] s	Max. time for speed/setpont difference to exceed 10013 parameter value, allowed for dual fuel mode
10015	*GasModeOilHyst*	[0,10] bar	Hysteresis, minimum oil pressure curve for dual fuel mode [16000 16250]
10016	*GasModeBoostHyst*	[0,10] bar	Hysteresis, minimum boost pressure curve for dual fuel mode [16000 16260]
10017	*GasModeExhTempMax*	[-100,1000] °C	Maximum exhaust temperature for dual fuel mode
10018	*GasModeExhTempHyst*	[0,50] °C	Hysteresis of maximum exhaust temperature for dual fuel mode
10019	*GasModeCoolTempMin*	[-100,1000] °C	Minimum coolant temperature for dual fuel mode
10020	*GasModeCoolTempMax*	[-100,1000] °C	Maximum coolant temperature for dual fuel mode
10021	*GasModeCoolTempHyst*	[0,50] °C	Hysteresis of coolant temperature for dual fuel mode
10035	*ExhTempGasReduct1*	[-100,1000] °C	Exhaust temperature limit for gas reduction stage 1
10036	*ExhTempGasReduct2*	[-100,1000] °C	Exhaust temperature limit for gas reduction stage 2
10037	*ExhTempGasReduct3*	[-100,1000] °C	Exhaust temperature limit for gas reduction stage 3
10038	*ExhTempGasReduct4*	[-100,1000] °C	Exhaust temperature limit for gas reduction stage 4
10050	*DieselToGasRamp*	[0,800.0] %/s	Gas actuator ramp rate, upwards
10052	*GasToDieselRamp*	[0,800.0] %/s	Gas actuator ramp rate, downwards
10054	*FastGasToDieselRamp*	[0,800.0] %/s	Gas actuator ramp rate for “Fast return to diesel”
10055	*InjectionDurationFilter*	[1,255]	Filter time constants for injection time measurement

No.	Name	Range	Description
2. Measuring values			
2000	*Speed*	[0,4000] 1/min	Actual engine speed
2031	*SpeedSetp*	[0,4000] 1/min	Speed setpoint information from foot pedal or signal transmitter (optional)
2300	*ActPos*	[0,100.0] %	Gas actuator position
2330	*ActPosSetpoint*	[0,100.0] %	Gas actuator position setpoint (corrected gas fuel setpoint)
2350	*FuelQuantity*	[0,100.0] %	Current gas fuel setpoint
2700	*FuelLimitMin*	[0,100.0] %	Current minimum allowed gas fuel setpoint
2701	*FuelLimitMax*	[0,100.0] %	Current maximum allowed gas fuel setpoint
2705	*FuelLimitForced*	[0,100.0] %	Current maximum gas fuel limit, allowed by switch 2813 *SwitchForcedLimit*
2706	*FuelLimitCoolantTemp*	[0,100.0] %	Current coolant temperature dependent maximum gas fuel limit
2710	*FuelLimitMinActive*	[0,1]	Current minimum gas fuel limit is active (1) or inactive (0)
2711	*FuelLimitMaxActive*	[0,1]	Current maximum gas fuel limit is active (1) or inactive (0)
2715	*ForcedLimitActive*	[0,1]	Current forced maximum gas fuel limit is active (1) or inactive (0)
2716	*CoolTempLimitActive*	[0,1]	Current coolant temperature dependent maximum gas fuel limit is active (1) or inactive (0)
2813	*SwitchForcedLimit*	[0,1]	Switch status “Forced limit” (gas fuel limitation)
2837	*SwitchGasOrDiesel*	[0,1]	Switch status „Gas or diesel mode“ (transfer to dual fuel only following a switch status change)
2838	*SwitchFastToDiesel*	[0,1]	Switch status „Fast return to diesel“
2840	*SwitchExternGasAlarm*	[0,1]	Switch status “External gas alarm”
2900	*SetpointExtern*	[0,100,0] %	Foot pedal position (speed or fuel demand signal)
2904	*BoostPressure*	[0,10.0] bar	Actual boost pressure (charge air pressure)
2905	*OilPressure*	[0,10.0] bar	Actual lube oil pressure
2907	*CoolantTemp*	[-100,1000.0] °C	Actual coolant temperature
2908	*ChargeAirTemp*	[-100,1000.0] °C	Actual charge air temperature
2909	*OilTemp*	[-100,1000.0] °C	Actual lube oil temperature
2910	*GasTemp*	[-100,1000.0] °C	Actual gas temperature
2911	*ExhaustTemp*	[-100,1000.0] °C	Actual exhaust gas temperature
2914	*GasPressure*	[0,2.0] bar	Actual gas pressure
3005	*ErrSetpointExtern*	[0,1]	Error “Speed setpoint signal out of range”
3009	*ErrBoostPressure*	[0,1]	Error “Boost pressure signal out of range”
3010	*ErrOilPressure*	[0,1]	Error “Lube oil pressure signal out of range”
3012	*ErrCoolantTemp*	[0,1]	Error “Coolant temperature signal out of range”
3013	*ErrChargeAirTemp*	[0,1]	Error “Charge air temperature signal out of range”
3015	*ErrGasTemp*	[0,1]	Error “Gas temperature signal out of range”
3016	*ErrExhaustTemp*	[0,1]	Error “Exhaust temperature signal out of range”
3019	*ErrGasPressure*	[0,1]	Error “Gas pressure signal out of range”
3105	*SErrSetpointExtern*	[0,1]	Stored error “Speed setpoint signal out of range”
3109	*SErrBoostPressure*	[0,1]	Stored error “Boost pressure signal out of range”
3110	*SErrOilPressure*	[0,1]	Stored error “Lube oil pressure signal out of range”
3112	*SErrCoolantTemp*	[0,1]	Stored error “Coolant temperature signal out of range”
3113	*SErrChargeAirTemp*	[0,1]	Stored error “Charge air temperature signal out of range”
3115	*SErrGasTemp*	[0,1]	Stored error “Gas temperature signal out of range”
3116	*SErrExhaustTemp*	[0,1]	Stored error “Exhaust temperature signal out of range”
3119	*SErrGasPressure*	[0,1]	Stored error “Gas pressure signal out of range”
12005	*GasPresInRangeForGas*	[0,1]	Current gas pressure is in range for dual fuel mode, or function is not activated
12010	*SpeedInRangeForGas*	[0,1]	Current engine speed is in range for dual fuel mode, or function is not activated
12011	*SpeedDiffInRangeForGas*	[0,1]	Current engine speed is in range for dual fuel mode, or function is not activated

No.	Name	Range	Description
2. Measuring values			
12015	*OilPresInRangeforGas*	[0,1]	Current oil pressure is in range for dual fuel mode, or function is not activated
12016	*BoostPrInRangeForGas*	[0,1]	Current boost pressure is in range for dual fuel mode, or function is not activated
12017	*ExhTempInRangeForGas*	[0,1]	Current exhaust temperature is in range for dual fuel mode, or function is not activated
12019	*CoolTempInRangeForGas*	[0,1]	Current coolant temperature is in range for dual fuel mode, or function is not activated
12023	*GasFuelSetpBeforCorr*	[0,100.0] %	Limited and ramped gas fuel setpoint, before correction by gas temperature and/or gas pressure
12024	*GasFuelSetpRamp*	[0,100.0] %	Gas fuel setpoint, slowed down by ramp
12025	*GasFuelSetpUnlimited*	[0,100.0] %	Current speed and injection time dependent gas fuel setpoint from position curves [16080 .. 16188]
12030	*DieselActive*	[0,1]	Diesel mode is active (1) or inactive (0)
12031	*GasActive*	[0,1]	Gas (dual fuel mode) is active (1) or inactive (0)
12032	*PromptReturnToDiesel*	[0,1]	Security function "Immediate return to diesel" is activated (1) or deactivated (0)
12033	*FastReturnToDiesel*	[0,1]	Security function "Fast return to diesel" is activated (1) or deactivated (0)
12035	*ExhTempReduct1*	[0,1]	Exhaust temperature dependent gas reduction stage 1 is actvated (1) or deactivated (0)
12036	*ExhTempReduct2*	[0,1]	Exhaust temperature dependent gas reduction stage 2 is actvated (1) or deactivated (0)
12037	*ExhTempReduct3*	[0,1]	Exhaust temperature dependent gas reduction stage 3 is actvated (1) or deactivated (0)
12038	*ExhTempReduct4*	[0,1]	Exhaust temperature dependent gas reduction stage 4 is actvated (1) or deactivated (0)
12040	*InjectionDuration*	[0,15.625] ms	Measured actual diesel fuel injection duration (filtered value)
12041	*InjectionDurationVal*	[0,15.625] ms	Measured actual diesel fuel injection duration (raw value)
12042	*InjectionDisabled*	[0,1]	Diesel fuel injection is disabled (1)
12043	*InjectionMinimum*	[0,15.625] ms	Current speed dependent minimum of injection duration for dual fuel mode from position curves [16080 .. 16188]
12044	*IgnitionInjection*	[0,15.625] ms	Current minimum diesel injection duration from speed dependent minimum injection duration curve [16000, 16270]
12045	*DieselAtIgnDuration*	[0,1]	Current diesel injection value is below speed dependent minimum injection duration curve [16000, 16270]

No.	Name	Range	Description
3. Functions			
4711	*CoolantTempLimitOn*	[0,1]	Activation of coolant temperature dependent gas position limit function (overload protection)
14000	*DualFuelOn*	[0,1]	Activation of dual fuel mode
14001	*GasAutomaticModeOn*	[0,1]	Activation of automatic transfer to dual fuel mode
14002	*GasSetpointPCOn*	[0,1]	Activation of manual gas position setting
14005	*CheckGasPressInRange*	[0,1]	Activation of check "gas pressure in range for dual fuel mode"
14010	*CheckSpeedInRange*	[0,1]	Activation of check "engine speed in range for dual fuel mode"
14011	*CheckSpeedDifInRange*	[0,1]	Activation of check "speed - speed setpoint difference in range for dual fuel mode"
14015	*CheckOilPressInRange*	[0,1]	Activation of check "lube oil pressure in range for dual fuel mode"
14016	*CheckBoostPrInRange*	[0,1]	Activation of check "boost pressure in range for dual fuel mode"
14017	*CheckExhTempInRange*	[0,1]	Activation of check "exhaust temperature in range for dual fuel mode"
14019	*CheckCoolTempInRange*	[0,1]	Activation of check "coolant temperature in range for dual fuel mode"
14027	*GasFuelToActPosCrvOn*	[0,1]	Activation of curve [16210, 16225], actuator position vs. gas fuel setpoint (correction/linearisation curve)
14028	*GasTempFactorOn*	[0,1]	Activation of curve [16440, 16450], gas temperature dependent gas fuel quantity correction
14029	*GasPressFactorOn*	[0,1]	Activation of curve [16460, 16470], gas pressure dependent gas fuel quantity correction

4. Curves			
6440 … 6449	*CoolTempLimit:T(x)*	[-100,1000.0] °C	Coolant temperature dependent limit for gas fuel quantity (temperature values)
6460 … 6469	*CoolTempLimit:f(y)*	[0,100.0] %	Coolant temperature dependent limit for gas fuel quantity (gas fuel values)
16000 .. 16006	*InjDuration:n(x)*	[0,4000.0] 1/min	Speed setpoint values for all speed dependent curves and maps
16008.. 16012	*Inj:Pow(y)*	[0,100.0] %	Map: speed and load dependent injection time in diesel mode, relative load values
16016.. 16050	*InjDuration:t (z)*	[0,15.625] ms	Map: speed and load dependent injection time in diesel mode, measured injection time values
16080ff. … 16180ff.	*GasFuel@n(1…):t (x)*	[0,15.625] ms	Diesel injection time dependent gas fuel setpoint curve for speed n(1…), injection time values (number of curves depending on software version)
16088ff. … 16188ff.	*GasFuel@n(1…):f (y)*	[0,400,0] %	Diesel injection time dependent gas fuel setpoint curve for speed n(1…), gas fuel values (number of curves depending on software version)
16210..16220	*GasFToActSetp:f(x)*	[0,100.0] %	Gas fuel to actuator setpoint conversion curve, fuel quantity values
16225..16235	*GasFToActSet:Pos(y)*	[0,100.0] %	Gas fuel to actuator setpoint conversion curve, actuator position values
16250..16256	*GasModeOilPress:p(y)*	[0,10.0] bar	Minimum speed dependent oil pressure for dual fuel mode (speed base points: 16000..16006)
16260..16266	*GasModeBoostPr:p(y)*	[0,10.0] bar	Minimum speed dependent boost pressure for dual fuel mode (speed base points: 16000..16006)
16270..16276	*IgnitInjectTime:t(y)*	[0,15.625] ms	Minimum injection time (ignition quantity) for dual fuel mode (speed base points: 16000..16006)
16440.. 16449	*GasTempFactor:T(x)*	[-100,1000.0] °C	Gas temperature dependent correction factor for gas fuel (temperature values)
16450.. 16459	*GasTempFactor:F(y)*	[-50.0,50.0] %	Gas temperature dependent correction factor for gas fuel (setpoint offset values)
16460..16469	*GasPressFactor:p(x)*	[0,2.0] bar	Gas pressure dependent correction factor for gas fuel (temperature values)
16470.. 16479	*GasPressFactor:F(y)*	[-50.0,50.0] %	Gas pressure dependent correction factor for gas fuel (setpoint offset values)

10 Sensors

The following table gives an overview of recommended HEINZMANN sensors.

Sensor	Engine speed	Pressure	Exhaust Temperature	Engine Temperature
HEINZMANN designation	IA 01-38, IA 02-76 IA 03-102, IA 11-38 IA 12-76, IA 13-102	DSO 01-2,5, DSO 04-2,5 DSO 01-6, DSO 04-6 DSO 01-10, DSO 04-10	TS 02-60 PT 200 TS 02-100 PT 200	TS 01-28 PT 1000
Connector	SV 6-IA-2K 2 pin	DIN 43650 A 2 wire terminal	DIN 3 pin	DIN 3 pin
Measuring principle	Inductive, active	active	PT 200, passive	PT 1000, passive
Measuring range	5..12.000 Hz	0..2,5 bar 0..6 bar 0..10 bar	-40 ... +800 °C	-40 ... +150 °C
Supply voltage	---	10 ... 34 VDC	5 VDC	5 VDC
Output signal range	0,5 ... 10 VAC	4..20 mA	85 ... 425 Ohm	843 … 1573 Ohm
Operating temp. range	-55 ... +120°C	-25 ... +125°C	-40 ... +1000°C	-40 … +150 °C
Protection degree	IP 55	IP 65	IP 65	IP 65
Vibration		< 20g, 10..300 Hz	< 60g, 10..100 Hz	< 60g, 10..100 Hz
Shock		< 50g, 11 ms half sine	< 50g, 11 ms half sine	< 50g, 11 ms half sine

For detailed information, refer to the documents listed in chapter 1.2, or to HEINZMANN manual “Sensors – Product overview”, E 99 001-e.
Other sensor types with similar technical data may be used. HEINZMANN should be contacted in that case, especially if the customer intends to install different speed pickups.

11 Control Units and Actuators

11.1 Control Unit Versions

Digital electronic position control units for gas actuators are:

HELENOS DC 16.2-01-00 (IP 00)

HELENOS DC 16.2-01-55 (IP 55)

StG 16 is the standard gas actuator for vehicle engines with more than 500 kW. Gas positioner control units with other HEINZMANN actuators are available on request. HELENOS controllers may be supplied with the following actuators:

StG 6..StG 40 (max. torque: 4..44 Nm)

StG 2005..StG 2080 (max. torque: 0.8..11 Nm)

HELENOS I/O Description:

4 analogue inputs (0..5 VDC or 4..20 mA)

2 temperature inputs (PT, NTC)

4 digital inputs

4 digital I/Os (binary or PWM)

1 power output (digital, analogue or PWM)

2 status outputs (“Common alarm” and “Governor ready”)

4 analogue outputs (2x 4 … 20 mA, 2x 0 … 5 VDC or 10 VDC)

11.2 Actuator Types

Calculation of actuator type and size should be made for 30 % of the maximum torque value. Example: StG 16 may be used for up to 5 Nm steady state torque requirement.

There are two different series of HEINZMANN actuators for ARTEMIS VI dual fuel applications:

1) Motor driven actuators of StG 6..StG 40 series, consisting of electric DC disk motor and gear. Maximum torque is between 4 and 44 Nm. These actuators are suitable for gas throttle valve positioning systems, because of their excellent position stability.

2) Electromagnetic actuators of the StG 2000 series, equipped with coil and permanent magnets. The output shaft is directly connected to the drive system. Maximum output torque is lower (up to 11 Nm), compared to weight and size of the actuator. Output shaft reaction is faster than with the disc motor types, while position stability is not quite as good.

Both actuator series have a contactless electronic position feedback system.

Refer to HEINZMANN manual “Product overview – actuators and solenoids”, DG 99 002-e for technical data and dimensional drawings. The HELENOS series hardware manuals include detailed actuator descriptions as well.

12 Gas Mixers

12.1 Design and Operation

The HEINZMANN gas mixers are designed for a gas air mixture, as homogenous as possible. Employing the Venturi principle allows operation at low gas pressure. The pressure drop in the mixer is very small, so the flow conditions in the intake are not affected considerably. All relevant parts are made of aluminium or corrosion resistant materials. So, protection against corrosion is ensured for the most applications using common gas types. The nozzle inserts are exchangeable and may be adapted to the specific application.

Selection of mixer size and nozzle insert may be done by HEINZMANN. Engine data and gas characteristics are to be provided by the customer.

On the gas side, the housing flange or an optional mounting plate with 1” or 2” inside thread may be used.

The HEINZMANN gas mixers have the following advantages:

- Very homogenous gas air mixture,
- Cost effective and maintenance-free without moving parts,
- Standard flange dimensions allow easy adaption to existing conditions,
- Large temperature range: -20..+90 °C.

12.2 Dimensional Drawings

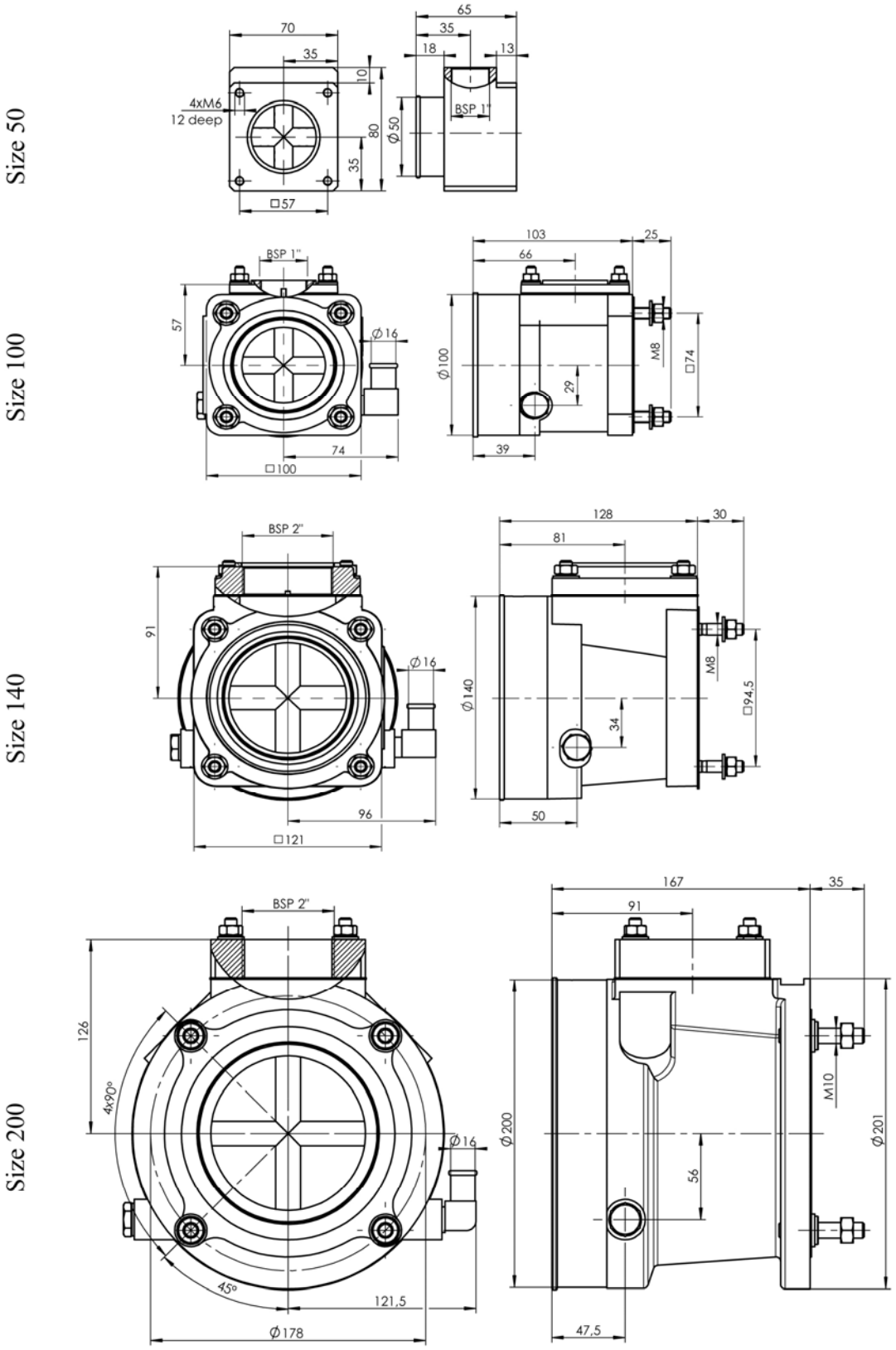


Figure 4: Gas Mixers GM 50..200

13 Gas Throttle Valves

13.1 Design and Operation

The gas quantity is metered by a gas throttle valve. The throttle valve is controlled by the ARTEMIS VI position control unit via the gas fuel actuator.

The HEINZMANN throttle valve housing is made of aluminium, flap and shaft consist of stainless steel. So, protection against corrosion is ensured for the most applications using common gas types.

Flow direction and mounting position are free to choose.

The linkage should be installed in a way, that actuator and valve zero position are congruent. Otherwise, increased throttle valve wearout or reduced control quality may occur.

At maximum load, the linkage should allow 80 % actuator position.

The gas throttle valves have the following advantages:

- Low friction bearing ensuring good controllability and long lifetime
- Reliable and pressure resistive shaft sealing
- Shaft accessible on both sides allowing flexible linkage configuration
- Large temperature range: -20..+90 °C

13.2 Dimensional Drawings

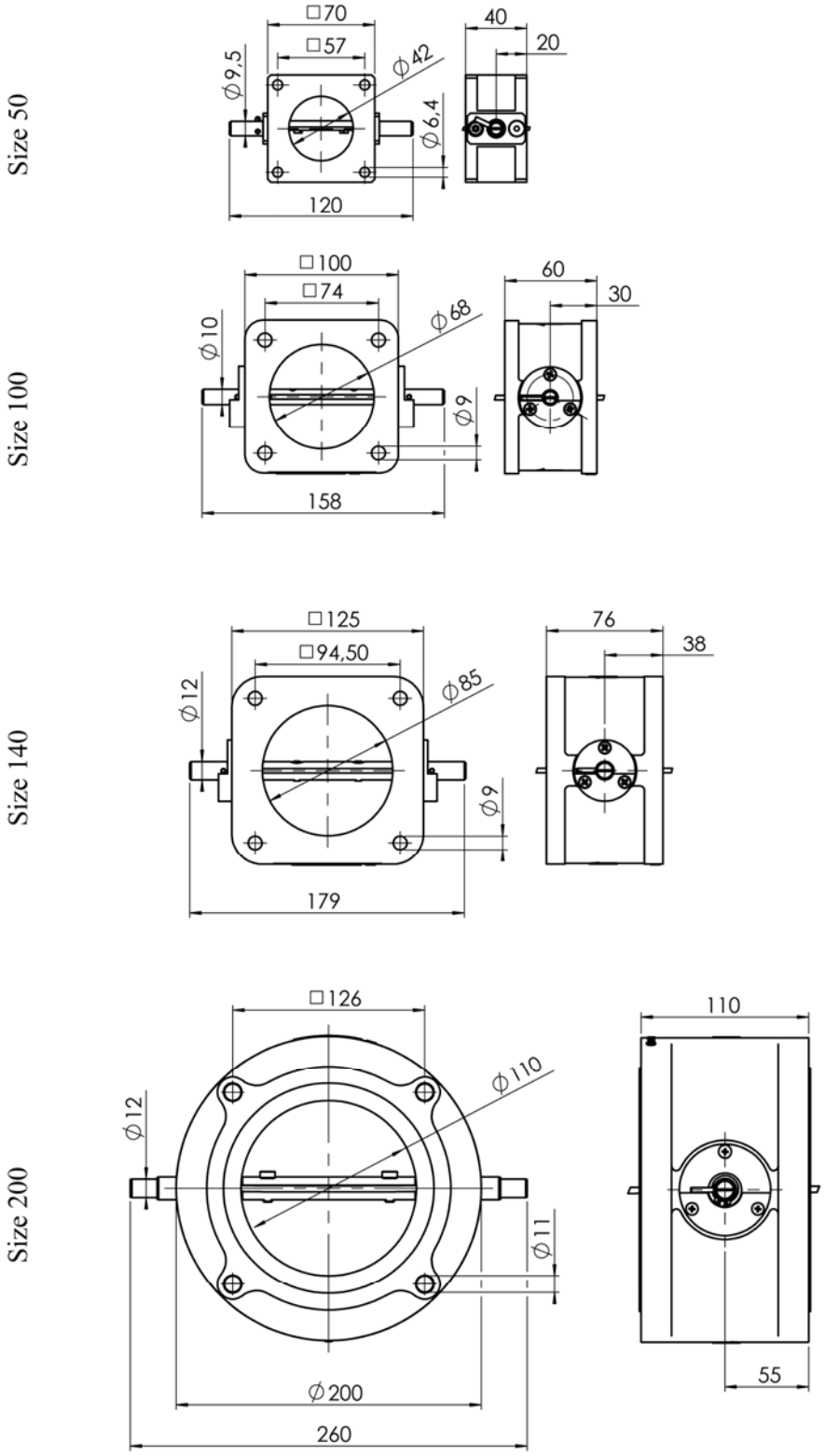


Figure 5: Gas Throttle Valves DK 50..200

14 Fuel Linkage to Throttle Valve

14.1 Lever Arm Length of Actuator

The effective lever arm length is to be determined for 90 % actuator output shaft travel.

14.2 Linkage Geometry

The linkage from actuator to gas throttle valve should be as short as possible and it´s length adjustable. Ball ends according to DIN 648 are recommended for connections.

Friction or slackness in the fuel linkage between actuator and gas throttle valve may affect the speed control quality.

Butterfly valves have a non-linear relation between opening angle and flow quantity. The highest flow increase rate is in closed valve position. Flow rate is reduced, the more the valve is opened. This may be compensated by a non-linear linkage configuration.

In stop position, actuator lever and connecting rod must be in line, connecting rod and throttle lever in rectangular relation. Respecting all additional limiting conditions, there are 4 basic arrangements for a non-linear linkage:

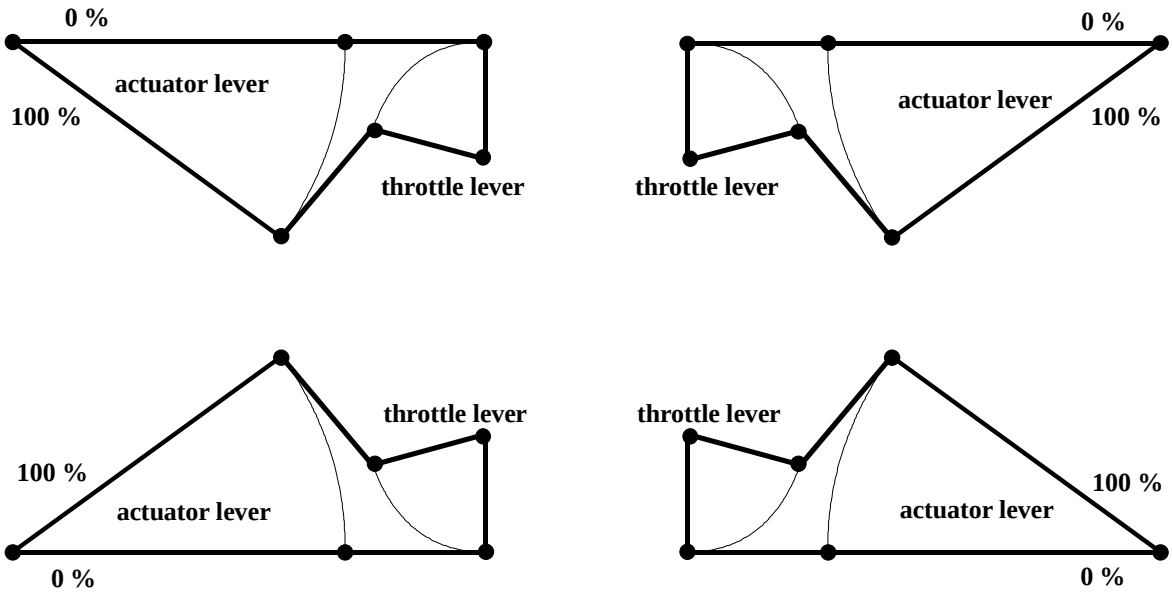


Figure 6.: Gas Linkage Arrangements

Calculation of a non-linear butterfly valve linkage for a gas engine with electronic actuator:

(Zero coordinates are assigned to actuator output shaft location in the drawing below.)

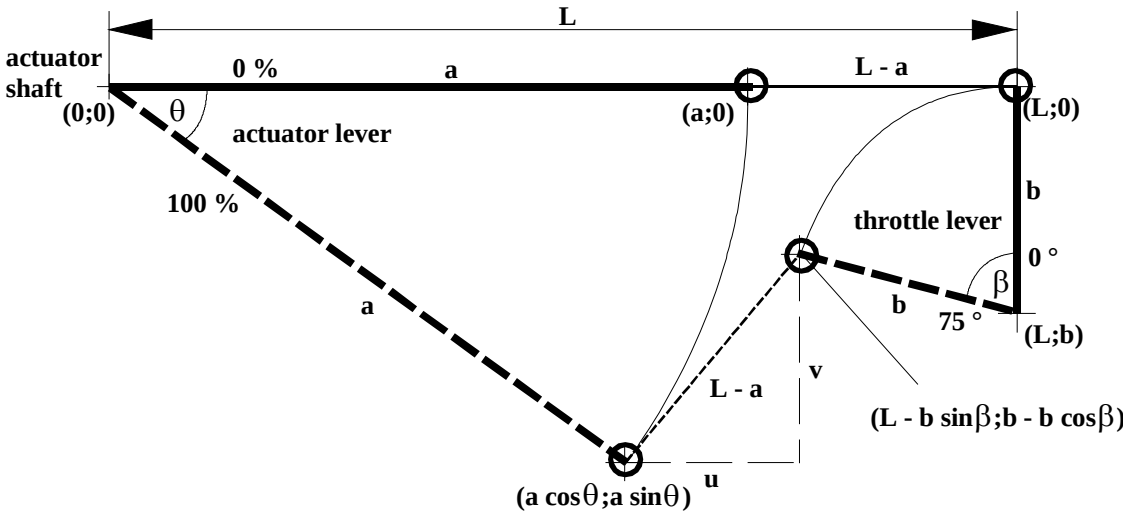


Figure 7: Gas Linkage Dimension Relations

θ = actuator lever travel in °

β = throttle lever travel in °

L = distance between actuator shaft and throttle valve lever
(measured with actuator lever and throttle lever in rectangular position)

a = actuator lever length (to be calculated)

L – a = connecting rod length

b = given butterfly valve lever length

$u = (L - b*\sin\beta) - (a*\cos\theta)$ $\qquad$ $v = (a*\sin\theta) - (b - b*\cos\beta)$

$(L - a)^2 = u^2 + v^2$

$(L - a)^2 = (L - b*\sin\beta - a*\cos\theta)^2 + (a*\sin\theta - b + b*\cos\beta)^2$

. . .

$a = [L*\sin\beta - b(1 - \cos\beta)] \ / \ [L/b(1 - \cos\theta) + \sin\beta*\cos\theta - \sin\theta + \sin\theta*\cos\beta]$

With an actuator travel of θ = 36° and a desired throttle valve travel of β = 75°,

the calculation formula is as follows:

$a = (0.97\ L - 0.74\ b) / (0.19\ L/b + 0.79 - 0.59 + 0.15)$

$a = (0.97\ L - 0.74\ b) / (0.19\ L/b + 0.35)$

Example:

Throttle lever length b = 30 mm; distance L = 120 mm;

→ actuator lever length a = 84.8 mm

→ connecting rod length L – a = 35.2 mm

With an actuator travel of θ = 68° and a desired throttle valve travel of β = 75°,

the calculation formula is as follows:

a = (0.97 L – 0.74 b) / (0.63 L/b + 0.36 – 0.93 + 0.24)

a = (0.97 L – 0.74 b) / (0.63 L/b – 0.33).

Example:

Throttle lever length b = 30 mm; distance L = 120 mm

→ actuator lever length a = 43.0 mm

→ connecting rod length L – a = 77.0 mm.

15 Setup Procedure for ARTEMIS VI

ARTEMIS VI, as an additional gas fuel system, can be used without changing the diesel engine design or the existing control unit. ARTEMIS must be adapted to the given engine parameters and operating mode. The settings must be found and tested on a stationary engine test stand, equipped with a water brake or an electric generator and load bank. The dual fuel system can only be set up testing the engine repeatedly on load under pursuable conditions. If the existing diesel control unit is an idle-maximum speed governor, the load bank must allow constant torque operation. The diesel engine has to be run in diesel mode at various speed and load levels to deliver initial values like injection timing, engine pressures and temperatures. Based on these measurements, dual fuel mode can be tried manually to find gas parameters, gas actuator position setpoint curves and limitation curves.

Proposal for a setup procedure:

1.) Install all gas components and safety systems according to local regulations. Check for leakages and set/check gas pressure control devices.

2.) Install HEINZMANN gas actuator, gas control unit and sensors.

3.) Connect all cables according to wiring diagrams. Check the wiring carefully.

4.) Switch on the power supply voltage and check control unit display (for details regarding LEDs refer to the relevant HELENOS manual).

5.) Start communication between gas control unit and a PC with DcDesk 2000 HEINZMANN communication program.

6.) Check the control unit´s software version (DcDesk 2000 menu “Information control unit”) and check/set the following parameters:

1	*TeethPickUp1*	(number of teeth on flywheel)
1950	*FeedbackRefLow*	(actuator feedback, lower reference)
1951	*FeedbackRefHigh*	(actuator feedback, upper reference)
1952	*FeedbackErrLow*	(actuator feedback, lower error limit)
1953	*FeedbackErrHigh*	(actuator feedback, upper error limit)

Compare measuring value 3950 *Feedback* to reference range and error limits, while the actuator is moved from min. to max. position by hand. Automatic actuator adjustment is required, if the range is does not match. Limits should be set 4000 digits apart of the feedback range.

7.) Make sure, the gas supply is shut off. Set selector switches to diesel mode: 2837 *SwitchGasOrDiesel* = 0, 2838 *SwitchFastToDiesel* = 0

8.) An independent engine overspeed protection must be installed and working.

9.) Start the engine in diesel mode. Run the engine at fixed levels (e.g. every 200 rpm) between min. and max. speed. Test different load values, from idle up to the speed-related maximum load (e.g. idle, 25% 50%, 75% and full load).

10.) Measure the following engine parameters:
Engine speed (2000 *Speed*, consider possible droop speed offset),
actual load (torque or electric power – depending on equipment),
diesel fuel injection time (12040 *InjectionDuration* from HEINZMANN ITM unit, or diesel EFI controller bus variable),
charge air pressure (2904 *BoostPressure*),
exhaust gas temperature (2911 *ExhaustTemp*),
cooling water temperature (2907 *CoolantTemp*).
Engine measurement values may be delivered by the existing engine control system. As far as necessary, separate equipment must be used.

11.) The measured injection duration values are to be stored in a 3-dimensional map “Speed and load depending injection duration” in the ARTEMIS control unit, capturing the relation between engine speed, relative power and the measured injection time for every test point: 16000..16050, *Injection:n(x), Injection:Pow(y), Injection:t(z).*

12.) The gas parameters and curves (described in chapters 4.1 and 7) must be set and activated in the ARTEMIS control unit, using DcDesk 2000. If set correctly, they protect the engine during the following procedure. Anyway, the next steps should be taken very carefully.

13.) Open the gas supply valve. Check gas pressure (2914 *GasPress*) and pressure control.

14.) Test governor switch function „Fast return to diesel“ (2838 *SwitchFastToDiesel*).

15.) Set/check conditions for gas mode (refer to chapter 7). Check error memory in control unit. When all actual errors are removed, erase error memory.

16.) Open window “Curve vs. time” in DcDesk 2000. Enter the following measuring values in the curves list (left-hand side):
2000 *Speed*, 2031 *SpeedSetpoint* (if measured),
2300 *ActPos*, 2350 *FuelQuantity*,
2904 *BoostPressure*, 2907 *CoolantTemp*, 2911 *ExhaustTemp*,
12040 *InjectionDuration*
and the following values (as far as signals available) in the list on the right-hand side:
2837 *SwitchGasOrDiesel*, 2838 *SwitchFastToDiesel*, 2840 *SwitchExternGasAlarm*,
2905 *OilPressure*, 2908 *ChargeAirTemp*, 2909 *OilTemp*,
2910 *GasTemp*, 2914 *GasPressure*.

17.) The gas actuator position can be adjusted manually entering the setpoint via PC and HEINZMANN DcDesk 2000. Set:
10002 *GasSetpointPC* = 0 %
14002 *GasSetpointPCOn* = 1

18.) Change over to gas mode: Mode selector switch on “Gas”.
2837 *SwitchGasOrDiesel* = 1.

19.) Run the engine at medium speed and 50% relative load. This is a recommended load area for a maximum gas quantity in dual fuel mode.

20.) Increase the parameter value 10002 *GasSetpointPC* slowly step by step. **The allowed max. safe gas position must be found empirically, monitoring actual diesel fuel quantity and exhaust gas temperature, comparing these values to the initial diesel mode measurements.** *Engine speed stability, sound and vibrations should be watched by a person, who is familiar with the engine.* Gas quantity must not be increased any further, as diesel injection time has dropped as far, as measured at 25 % relative load in diesel mode at the same speed.

21.) From 50% down to 25% relative engine load, gas quantity should be reduced linearly to 0. It may remain constant between 50% and 75% (these values may differ in a specific application). From 75% to max. load, the gas quantity must be reduced again.

22.) If there is a limit function available for the full load diesel quantity, a certain portion of gas may be added in that area. Gas position limits are given by exhaust overtemperature (fast return to diesel), boost pressure and cooling water temperature (gas position decrease), in order to prevent overload.

23.) Capture all relevant values, measured at the various load levels.

24.) Repeat the same manual gas test at speed levels according to initial diesel tests (setup point 9), covering the full engine speed range.

25.) The test results are to be transferred to the HEINZMANN control unit using DcDesk 2000. **The main gas control feature is a group of curves, setting the relation between injection time and gas actuator position at various speed levels: "Injection time dependent gas fuel". Between these curves, linear interpolation is made.**

26.) Adjust the gas position ramps in a way, that a low ramp-up rate is complemented by a higher ramp-down rate for normal operation, and a high rate for the (safety-related) fast return ramp to diesel mode. Example:

10050 *DieselToGasRamp* = 8.0 %/s
10052 *GasToDieselRamp* = 10.0 %/s
10054 *FastGasToDieselRamp* = 20.0 %/s

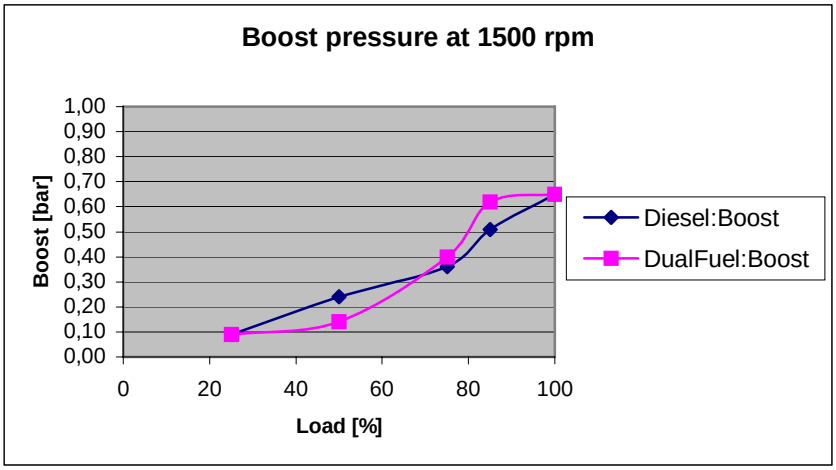
27.) Check and evaluate ARTEMIS error memory and clear it, as all required action is done.

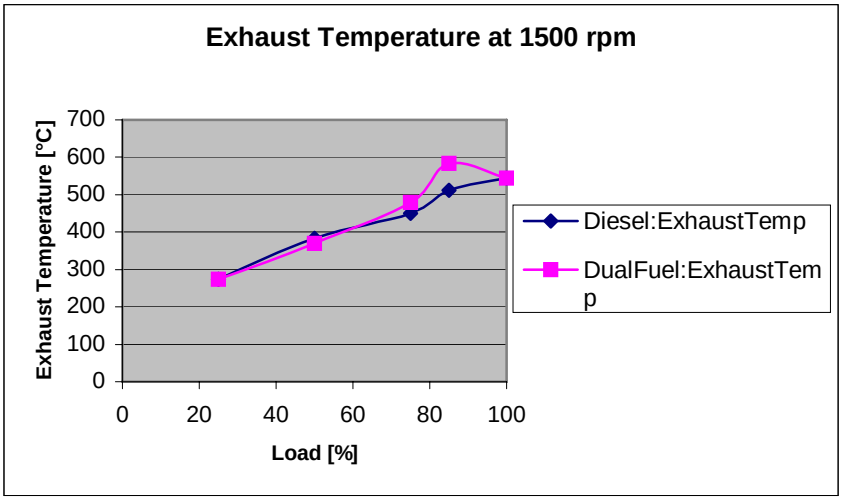
28.) Set the system to automatic dual fuel mode: 14001 *GasAutomaticModeOn* = 1.

29.) Test the system in dynamic operation, varying speed and load levels. Start at low rates, then accelarate more and more, finishing close to normal vehicle operation. Diesel/gas ratios, pressure and temperature values must be checked permanently and remain within the safe area under all operating conditions.

30.) Gas position should be reduced at any operating point, where limits are exceeded, either during speed/load changes, or in steady state condition after some time.

Examples of engine test results, comparing diesel mode to dual fuel mode:





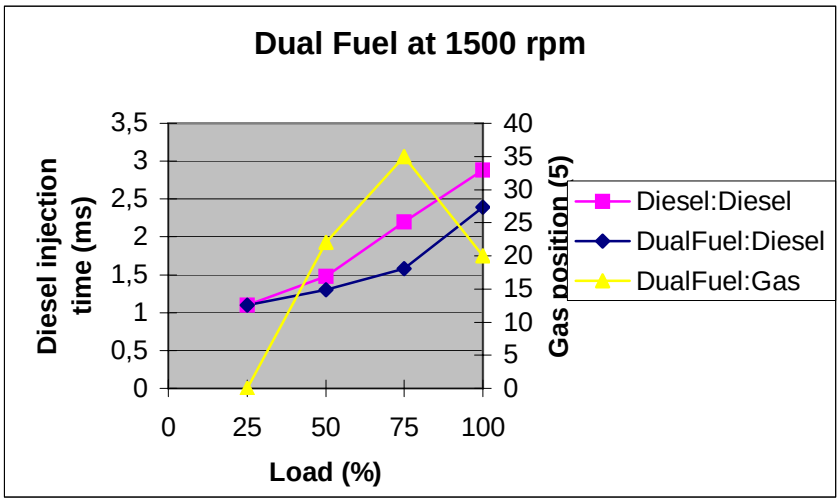


Figure 8: Example Diagrams, comparing Diesel to Dual Fuel Mode

16 Cable Types and Wiring

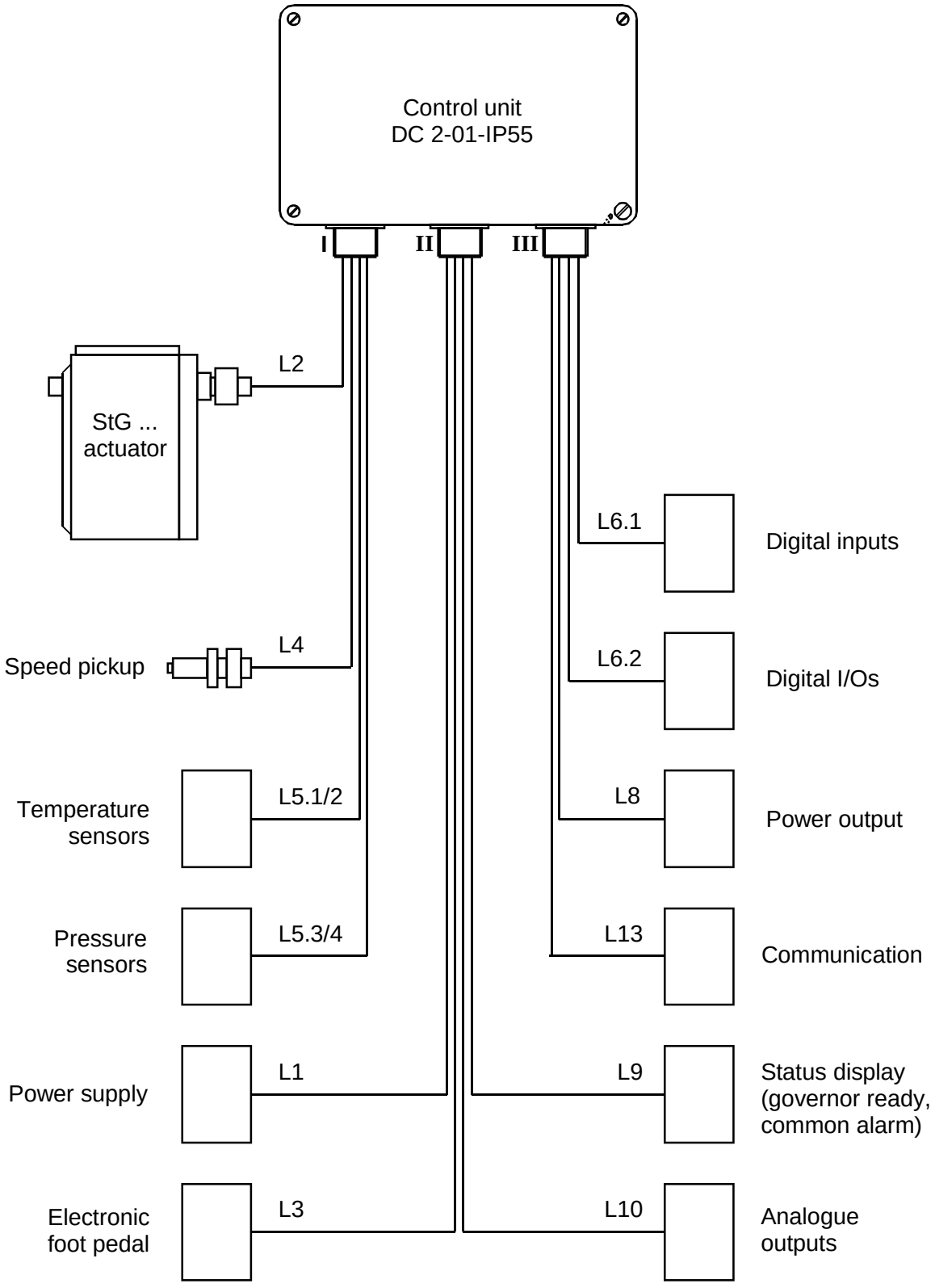


Figure 9: ARTEMIS VI, IP 55 Harness

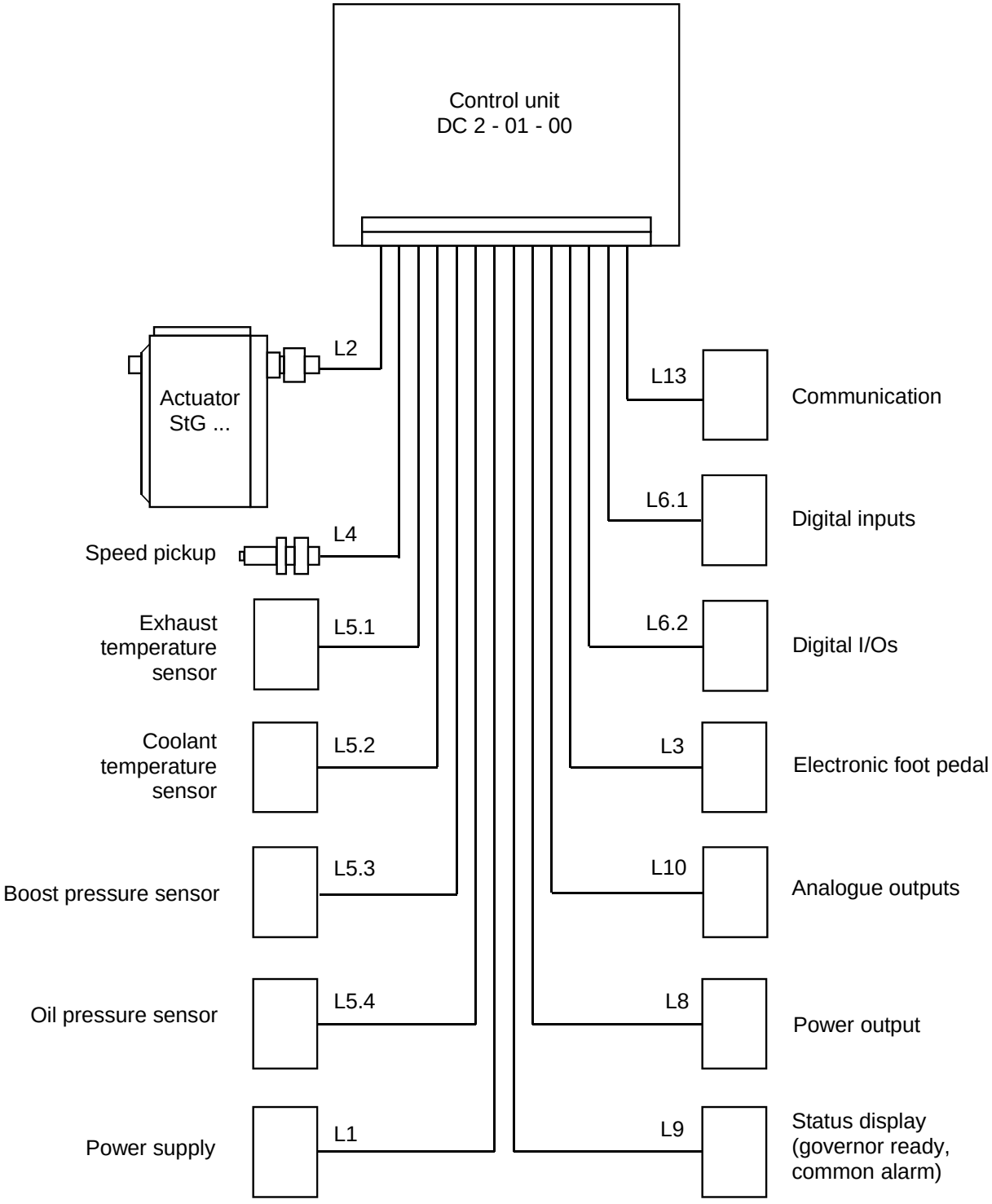


Figure 10: ARTEMIS VI IP 00 Harness

All cables may be supplied by HEINZMANN. L2 and L4 are critical connections, regarding cross-section, length restriction and shielding. They should be ordered with the hardware in any case. With the IP 55 control unit version, L2, L4 and L5.1..4 are combined at connector number I, so they should be ordered as a set.

L13 cables have to be supplied by HEINZMANN. L13.1 for CAN communication requires a special cable type, 13.2 is a pre-manufactured cable including a signal converter.

Other cables do not necessarily have to be manufactured by HEINZMANN. To order cables, use the following informations:

Control unit version:

with connectors (IP55) ☐ with terminal strip (IP00) ☐

Actuator version:

with connector (IP55) ☐ with terminals (IP00 – StG 2000 only) ☐

a) L1 = control unit – power supply

L 1	control unit – power supply		..... cm	
	cross-section	up to 15 m		2x 2,50 mm²
		over 15 - 30 m		2x 4,00 mm²

b) L2 = control unit - actuator

L 2.1	control unit - actuator (feedback)		..... cm	3x 0,75mm² shielded
L 2.2	control unit - actuator (drive)		..... cm	
	cross-section	up to 10 m		2x 2,50 mm²
		over 10 - 20 m		2x 4,00 mm²
		over 20 - 40 m		2x 6,00 mm²

c) L3 = control unit – speed setpoint (foot pedal)

L 3	control unit – speed setpoint	..... cm	3x 0,75 mm² shielded

d) L4 = control unit – speed pickup

L 4.1	control unit – speed pickup 1	..... cm	2x 0,75 mm² shielded
L 4.2	control unit – speed pickup 2	..... cm	2x 0,75 mm² shielded

e) L5 = control unit - sensors

L 5.1	control unit – exhaust temperature	.....	cm	2x 0,75 mm²
L 5.2	control unit – coolant temperature	.....	cm	2x 0,75 mm²
L 5.3	control unit – boost pressure	.....	cm	3x 0,75 mm²
L 5.4	control unit – lube oil pressure	.....	cm	3x 0,75 mm²

f) L6 = control unit - digital in- and outputs

L 6.1	control unit – input 1-4	.....	cm	2…5x 0,75 mm²
L 6.2	control unit – I/O 5-8	.....	cm	2…5x 0,75 mm²

g) L8 = control unit – power output

L 8	control unit – power output	.....	cm	2x 1,50 mm²

h) L9 = control unit – status indicators

L 9.1	control unit – common alarm	.....	cm	2x 0,75 mm²
L 9.2	control unit – governor ready	.....	cm	2x 0,75 mm²

i) L10 = control unit - analogue output

L 10.1	control unit – position display	.....	cm	2x 0,75 mm²

j) L13 = communication

L 13.1	control unit - CAN bus	.....	cm	HEINZMANN
L 13.2	control unit - PC	.....	cm	HEINZMANN

17 Figure List

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