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HEINZMANN®
Engine & Turbine Management

ARIADNE

Knock Control
KC-01

6840 Manual DG 06 001-e / 07-13

DANGER	**The appropriate manuals must be thoroughly studied before installation, initial start-up and maintenance**. All instructions pertaining to the system and safety must be followed in full. Non-observance of the instructions may lead to injury to persons and/or material damage. HEINZMANN shall not be held liable for any damage caused through non-observance of instructions. Independent tests and inspections are of particular importance for all applications in which a malfunction could result in injury to persons or material damage. All examples and data, as well as all other information in this manual are there solely for the purpose of instruction and they may not be used for special application without the operator running independent tests and inspections beforehand. **HEINZMANN** does not guarantee, neither expressly nor tacitly, that the examples, data or other information in this manual is free from error, complies with industrial standards or fulfils the requirements of any special application.
WARNING	**To avoid any injury to persons and damage to systems, the following monitoring and protective systems must be provided:** – Overspeed protection independent of the rpm controller HEINZMANN shall not be held liable for any damage caused through missing or insufficiently rated overspeed protection. – thermal overload protection **The following must also be provided for alternator systems:** – Overcurrent protection – Protection against faulty synchronisation for excessively-large frequency, voltage or phase difference – Directional contactor The reasons for overspeeding may be: – Failure of positioning device, control unit or its auxiliary devices – Linkage sluggishness and jamming
WARNING	**The following must be observed before an installation:** – Always disconnect the electrical mains supply before any interventions to the system. – Only use cable screening and mains supply connections that correspond with the *European Union EMC Directive* – Check the function of all installed protection and monitoring systems

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

Table of contents

1 Safety instructions and related symbols

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

- Personnel
- Product and machine
- The environment

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

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

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

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

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

NOTICE — ***NOTICE indicates possible material damage.***

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

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

1.1 Basic safety measures for normal operation

- The installation may be operated only by authorized persons who have been duly trained and who are fully acquainted with the operating instructions so that they are capable of working in accordance with them.
- Before turning the installation on please verify and make sure that
  - only authorized persons are present within the working range of the engine;
  - nobody will be in danger of suffering injuries by starting the engine.
- Before starting the engine always check the installation for visible damages and make sure it is not put into operation unless it is in perfect condition. On detecting any faults please inform your superior immediately!
- Before starting the engine remove any unnecessary material and/or objects from the working range of the installation/engine.
- Before starting the engine 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 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 ARIADNE functional description

2.1 Functions

Knocking is an uncontrolled combustion process of spark ignited engines. It becomes apparent by generating high frequency pressure vibrations in the combustion chamber. Consequences are reduced engine performances and potential engine damages and of course noise emissions.

- ARIADNE monitors up to 20 separate vibration sensors (industry standard wide-band piezoelectric vibration sensors, Bosch-type or compatible ones) placed on the engine block or cylinder heads. In most cases one unit can protect a whole engine equipped with one knock sensor per cylinder. For engines with more than 20 cylinders, 2 units can easily be connected over CAN bus. ARIADNE can either monitor all cylinders using separate individual sensors or monitor several cylinders using the same sensor (low cost).
- ARIADNE makes use of dedicated digital signal processors which eliminate any kind of knock sensor signal corruptions. For instance due to vibrations caused in normal operation by engine components. Configurable knock measuring windows, digital amplifiers, band-pass filters and integrators are provided ensuring that the knock level calculated by ARIADNE fairly reflects the real knock intensity inside the cylinder.
- All parameters as limit values, gains etc. can be configured and can be speed- or load-dependent.
- ARIADNE features a large range of I/O possibilities.
  - analogue I/O (0 … 5 V / 4 … 20 mA)
  - digital I/O
  - CAN (HZM-CAN, CANopen, DeviceNet, J1939 or other proprietary protocols)
  - RS-485 (Modbus) serial interfaces.
- ARIADNE is fully compatible with other HEINZMANN products like speed and load controllers, air-fuel ratio control units, ignition modules, generator management systems and can communicate with these over CAN bus (Hzm-CAN). For flexible and extended configuration and visualization of input and output data, ARIADNE integrates a serial interface to DcDesk 2000, HEINZMANN's Windows® user interface programme, widely used on all other HEINZMANN digital products.

2.2 Proper and intended use

Knock control KC-01 ARIADNE is intended to detect and avoid knocking combustion in spark-ignited engines. This is achieved by influencing the engines speed control system.

It is to be used solely for control applications on machines and intended for use in an industrial environment. When operated outdoors, additional protective measures against weather are also required.

Signals are exchanged through electrical signals. Because transmission may be interfered with by external circumstances or influences, the user must provide additional safety devices to match the application case.

In individual cases, the following must be coordinated with the manufacturer HEINZMANN:

- Each use which deviates from the above mentioned
- Modifications to the device
- Use in extreme, ambient conditions that deviate from the specification (dust, temperature, wetness)
- Use under powerful electrical or electromagnetic fields
- Use in aggressive atmospheres or vapours
- Use in potentially explosive areas

A written opinion from the manufacturer must always be procured in the event of any obscurities, queries or missing statement.

3 Application

3.1 Stand-alone knock control unit

When used as stand-alone unit, ARIADNE's analogue output can be connected directly to the ignition system. The signal of knock severity measured on the engine acts as offset on the engine nominal spark angle. In case of heavy knocking, an engine stop signal is sent via digital output to the speed/load controller. For more precise knock control, a load signal can be connected to ARIADNE (for example an electrical load measurement or a boost pressure sensor). Optionally ARIADNE can provide a load reduction algorithm over digital output or CAN bus.

3.2 Fully integrated knock control unit

ARIADNE can also be configured as part of a highly integrated engine management. This can be used advantageous for fine tuning every cylinder individually when combustion and load can be controlled on each cylinder separately. In this case ARIADNE communicates and receives all needed information via CAN bus (cylinder knock levels, load measurement). Together with other information and sensors (ex. cylinder exhaust gas temperatures), the knock levels can be used by other units, for instance, to control the ignition angle of each cylinder or to tune the gas injection duration on each cylinder individually for best cylinder balancing. Of course communication can be established to customer units or PLC over CAN bus (CANopen, DeviceNet, J1939 …) or Mod-bus. As option, HEINZMANN advanced user interface DcDesk2000 can communicate with all HEINZMANN devices over CAN bus, making possible to monitor from the same PC all HEINZMANN gas engine control units simultaneously.

4 Technical data

Operating voltage	24 V DC, nominal range 18 … 32 VDC temporarily allowed (≤ 0.5 s) 9 … 33VDC
Residual ripple	max. 10 % with 100 Hz
Current consumption	max. 1 A
External fuse protection	2 A time lag fuse or or circuit-breaker 2A C-type
Storage temperature	-40 … 85 °C
Ambient temperature	-40 … 80 °C
Air humidity	up to 95 % , 20 … 55 °C up to 70 % , -40 … 85 °C
Vibration	max. 0.2 mm with 10 .. 20 Hz, max. 0.024 m/s with 21 .. 63 Hz max. 0.7 g with 64 .. 2000 Hz
Protection grade	IP00
Isolation resistance	> 1 MΩ with 48 V DC
Weight	approx. 1 kg
EMC	IEC/EN61000-6-2:2005, IEC/EN61000-6-4:2007, IEC/EN61326-1, FCC CFR47 , part 15 (class A)
Low-voltage directive and product safety:	IEC/EN61010-1

5 Sensors

5.1 Hall sensors

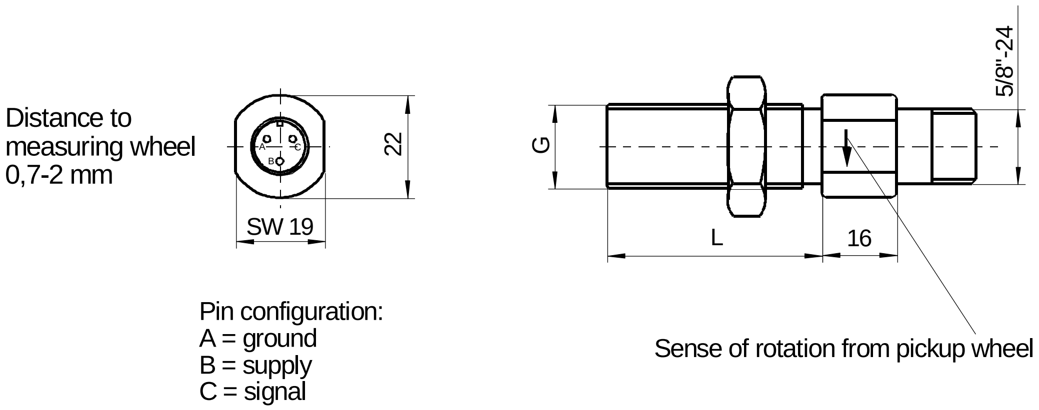


Figure 1: Hall Sensors with Plug Connection

Type	Position	Thread length L / (mm)	Thread size G	EDV-No.	Remarks
HIA 32-46	crankshaft, camshaft	46	M 18 × 1	600-00-052-00	
HIA 32-76	crankshaft, camshaft	76	M 18 × 1	600-00-060-02	standard
HIA 32-102	crankshaft, camshaft	102	M 18 × 1	600-00-065-00	

Table **1: Hall sensors**

Corresponding plug: SV 6 - HIA - 3K (EDV- No.: 010-02-355-00)

5.2 Boost Pressure Sensor

The boost pressure sensors are also available in an additional housing with terminal strip.

Measuring range	0 … 2 bar, 0 … 5 bar
Over pressure	4 bar resp. 10 bar resp.
Supply voltage	12 … 36 V DC
Output signal	4 … 20 mA resp. 0 … 5 V
Storage temperature	-55 … 100°C
Ambient temperature	-40 … 100°C
Protection grade	IP 65
Vibration	< 2 g, 5 … 500 Hz
Shock	< 50 g, 11 ms half-sine wave
Connection	DIN 43650-A or terminal strip, 2-line system

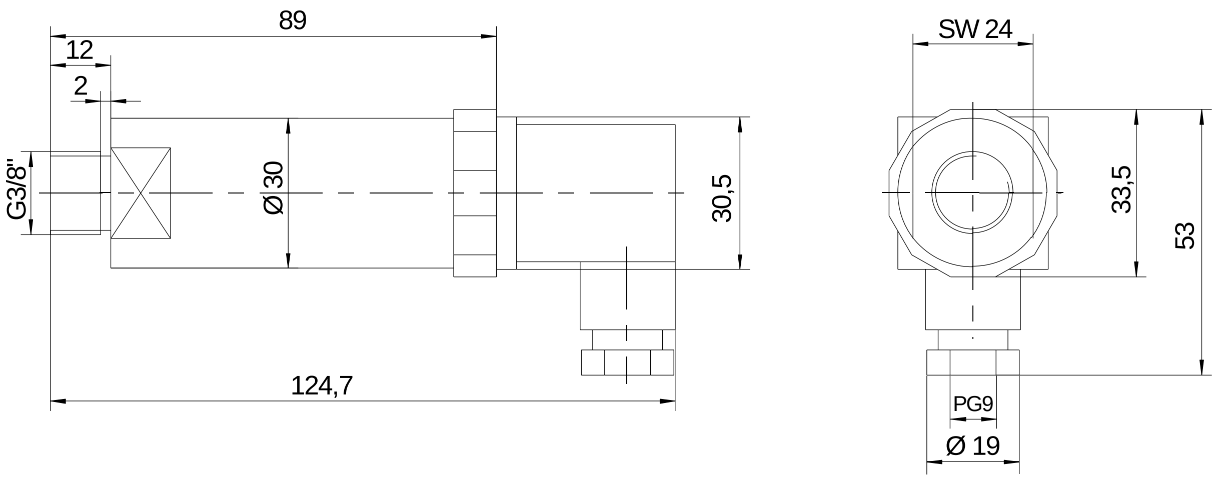


Figure 2: Boost Pressure

Type	Range		EDV-No.	Remarks
DSL 01-2	0.2 … 2 bar abs.	4 … 20 mA	600-00-057-00	
DSL 01-5	0.2 … 5 bar abs.	4 … 20 mA	600-00-057-01	
DSL	0.5 … 4.5 bar abs	0.5 … 4.5 V	600-00-095-00	standard

Table **2: Boost pressure sensors**

5.3 Knock sensor

5.3.1 Technical data

Figure 3: Typical Knock Sensor, Bosch-Type

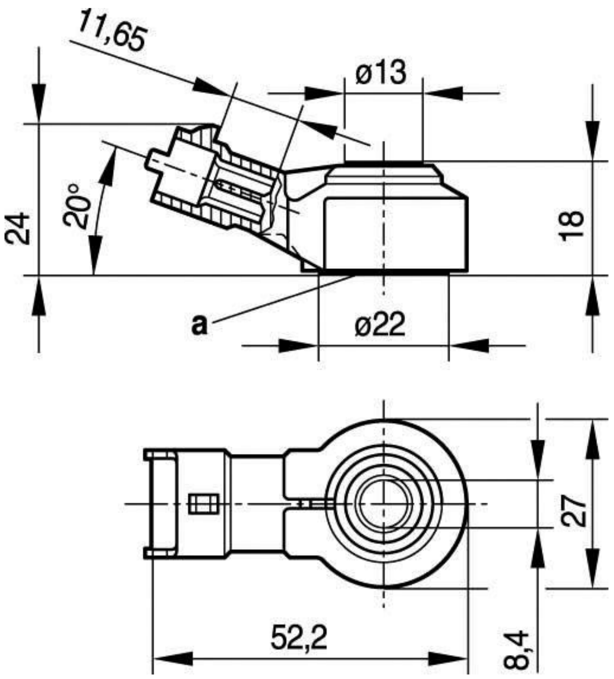


Figure 4: Sensor dimensions

Vibration sensors	2-pole, without cable
Frequency range	3 ... 22 kHz
Sensitivity at 5 kHz	26 + 8 mV/g
Linearity between 5...20 kHz at resonance	15%
Main resonance frequency	> 25 kHz
Self-impedance	> 1 MO
Capacitance range	800 ... 1400 pF
Temperature dependence of sensitivity	≤ 0,06 mV/g • K
Operating temperature range	- 40 ... 150 °C
Permissible sustained vibration	≤ 80 g
Permissible short-term vibration	≤ 400 g

5.3.2 Installation details

Grey cast iron bolt	M 8 x 25 ; Quality 8.8
Aluminium bolt	M 8 x 30 ; Quality 8.8
Tightening torque (possible with lubrication)	20 + 5 Nm
Installation direction	Any; favoured parallel to axial piston stroke axis

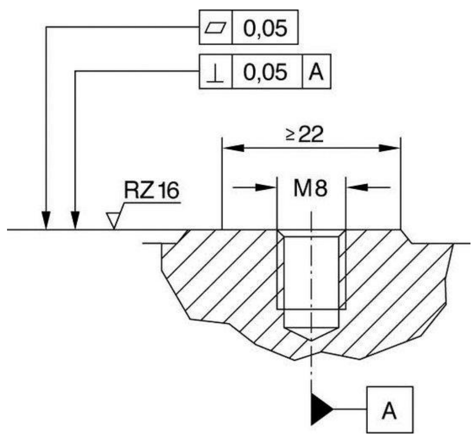


Figure 5: Mounting Instructions

5.3.3 Installation position of knock sensor

ARIADNE provides flexible knock detection which is developed for every gas and dual fuel engine. The quality of detection depends mainly on the position of the knock sensors and the sound characteristic of the engine.

Not every engine is optimized for knock detection; Heinzmann is not responsible for the mounting position and cannot guarantee proper function on every engine (due to sound characteristic of the engine).

Usually the manufacturer of the engine recommends an optimum mounting position for knock sensors. It is advisable to contact the manufacturers service for details.

If the manufacturer does not make a recommendation the optimum position can be found as follows:

- Find some different positions for the knock sensor on the engine. Take care, that the distance between combustion chamber and knock sensor is minimal and connection is directly on cylinder head or engine body.
- Measure intensity of the knock signal *)
  - in every position when the engine is knocking **)
  - and with normal combustion (at 100% load).
- Compare the results and use the position with the best measurements.

*) Ways to be sure that the engine is knocking:
Cylinder pressure signal or noise

**) Ways to get the engine in knocking: Ignition timing in early direction,
Air/ Gas mixture richer, mixture inlet temperature higher.

Typical Sensor positions:

- Mounted directly on cylinder head (best solution)

  Take care of the water jacket in cylinder head of water cooled engines!
  To avoid damages first contact engine manufacturer.

- Mounted on engine body
- Mounted on cylinder head screw or stay bolt

6 Wiring and requirements for electric installation

Requirements for mounting position of control cabinet or IP-box, according to technical data.

NOTICE

Fastening torque of terminal screws : 0.25 Nm ± 0.02 Nm

6.1 Schematic diagram for example

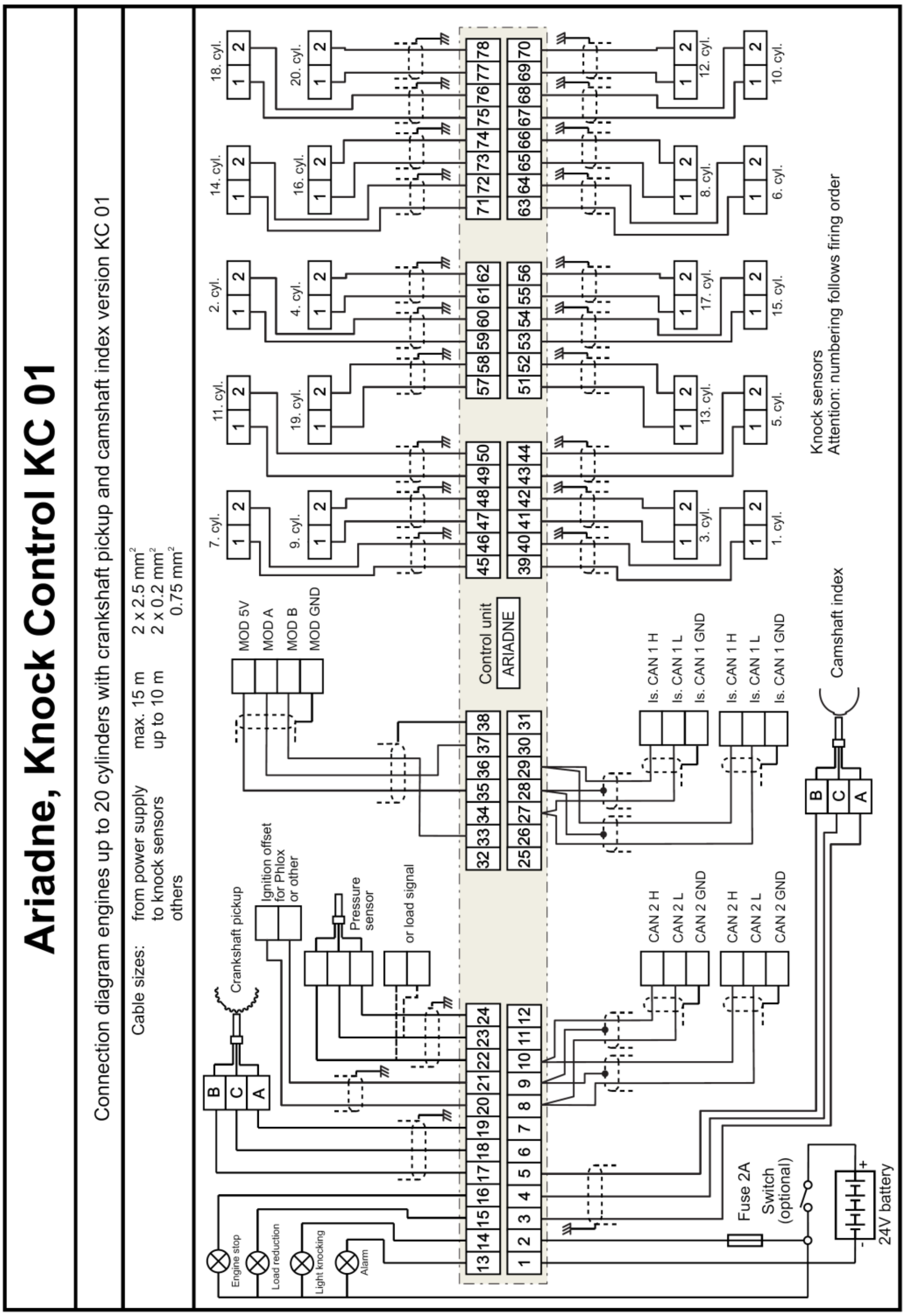


Figure 6: ARIADNE schematic diagram with crankshaft pick-up and camshaft index

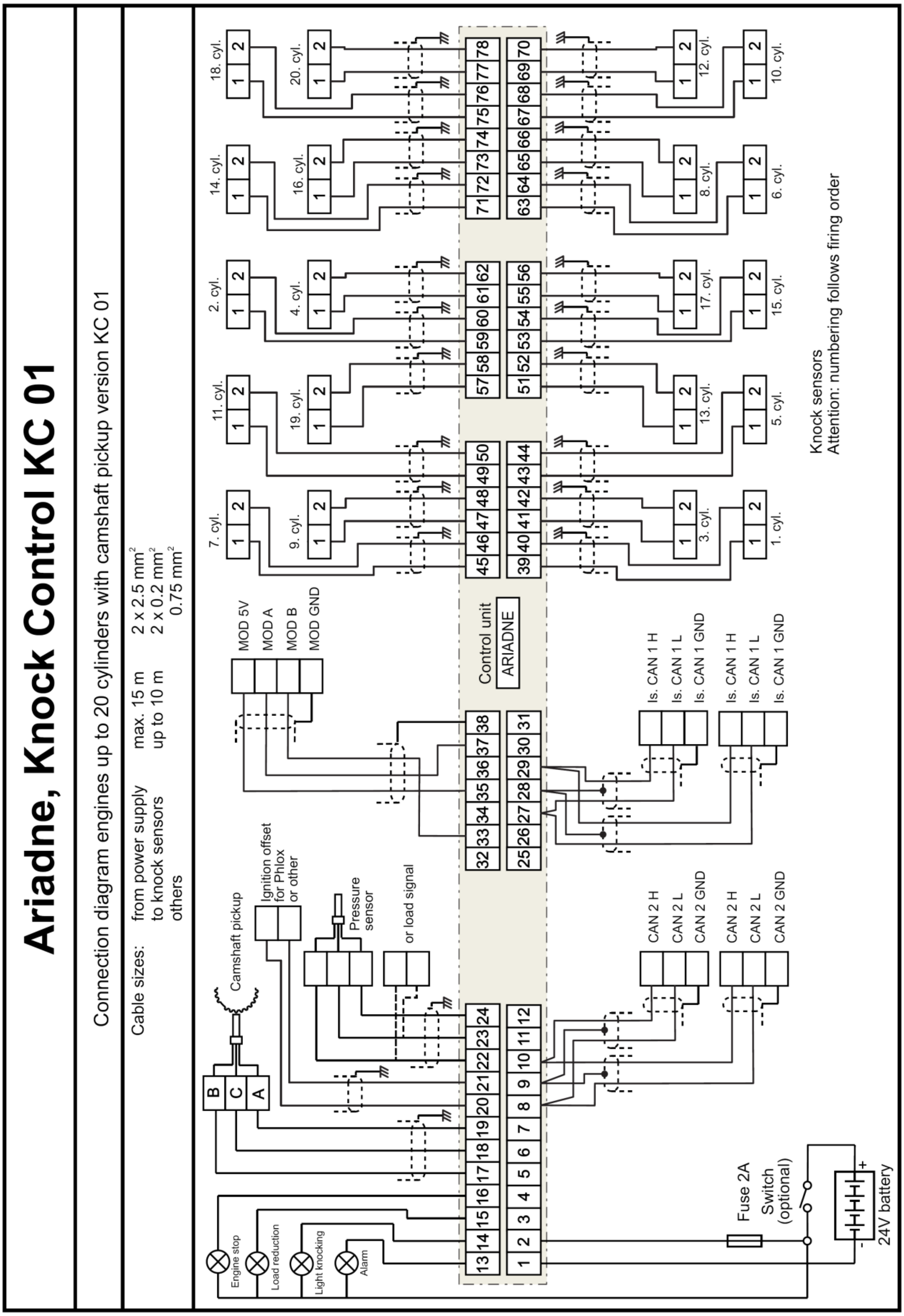


Figure 7: ARIADNE schematic diagram with camshaft pick-up

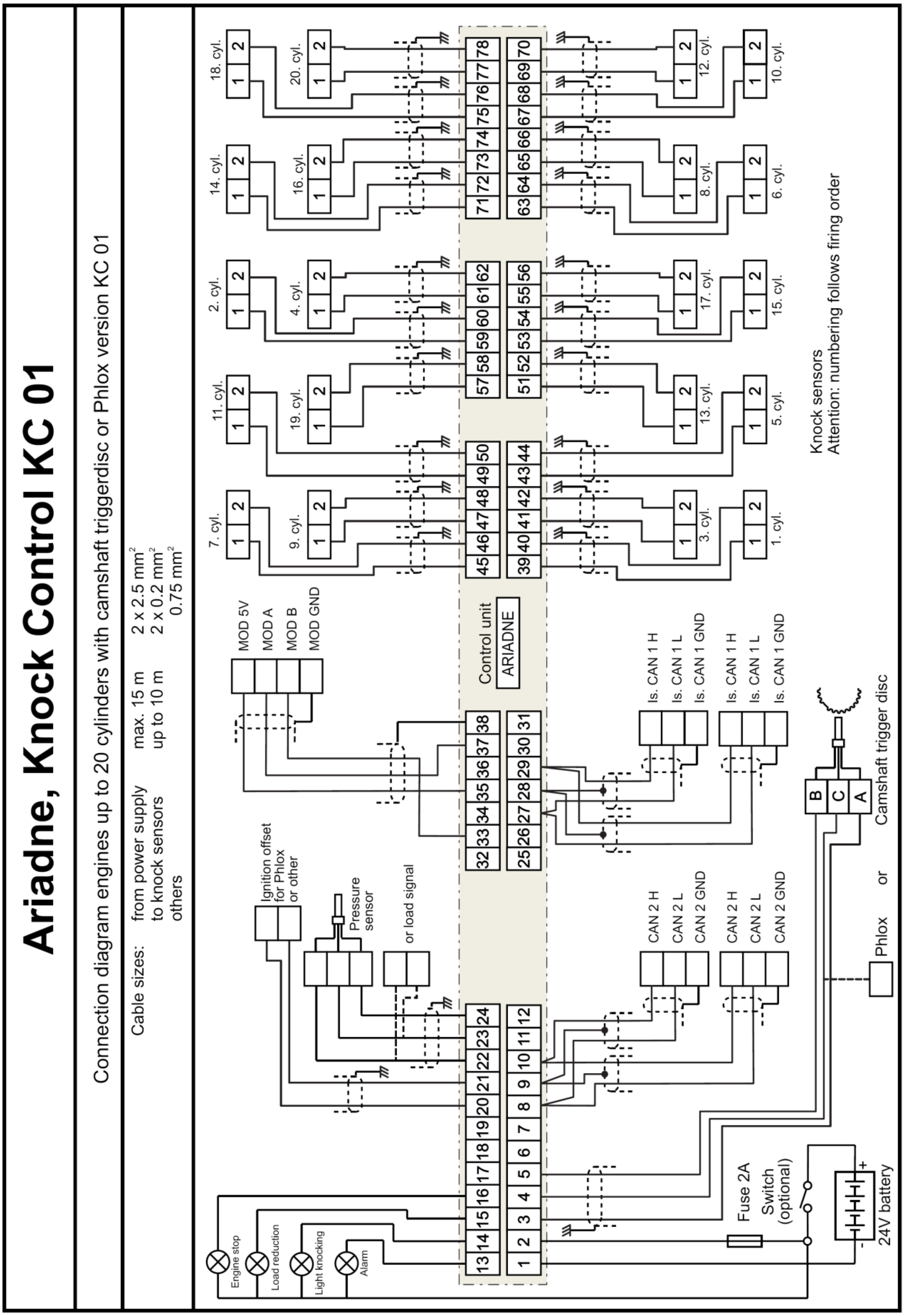
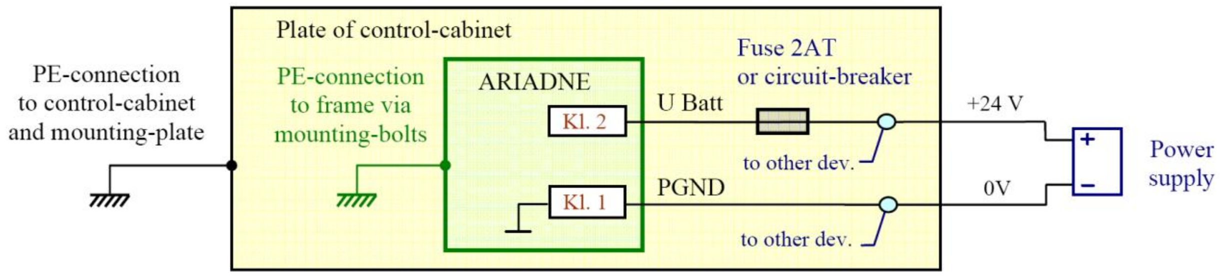


Figure 8: ARIADNE schematic diagram with camshaft trigger disc or Phlox

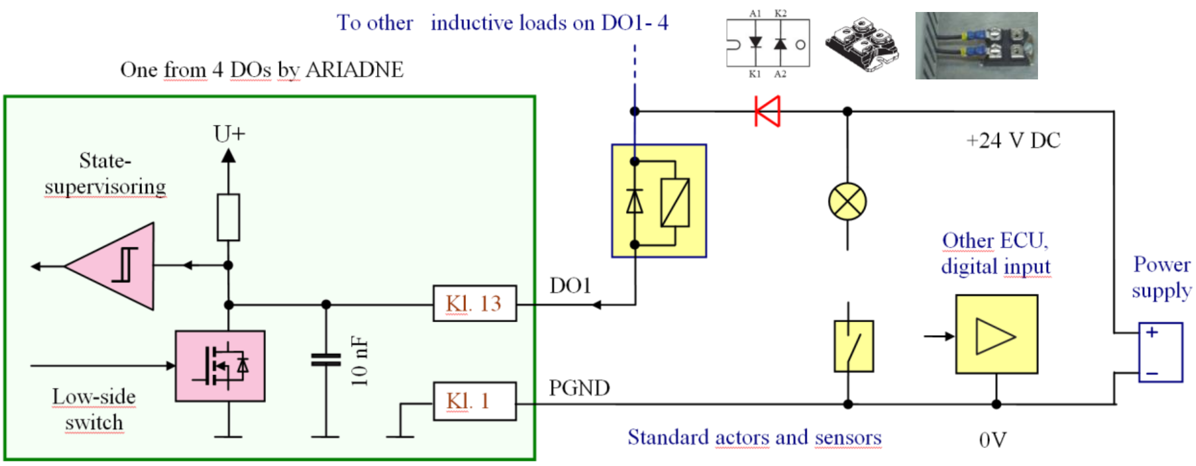
6.2 Power Supply

Designation	24 VDC power supply input: Terminal 1 (PGND), Terminal 2 (Ubatt)
Function	Power supply of control cabinet as common source from accumulator 24 VDC or PS-block
Range	16 ... 32 VDC , max. 1 A
Connected to	ARIADNE, cabinet terminals, source of power supply 24 VDC and other ECUs
Type of wire used	Outside of control cabinet: customer solution. Inside of control cabinet: Wire 1 ... 1.5 mm^2.
Total cable length	< 200 m
Requirements	- Use 2 A fuse or circuit-breaker 2 A C-type - Connect PE (protective earth) to mounting plate of control cabinet and frame of ARIADNE.



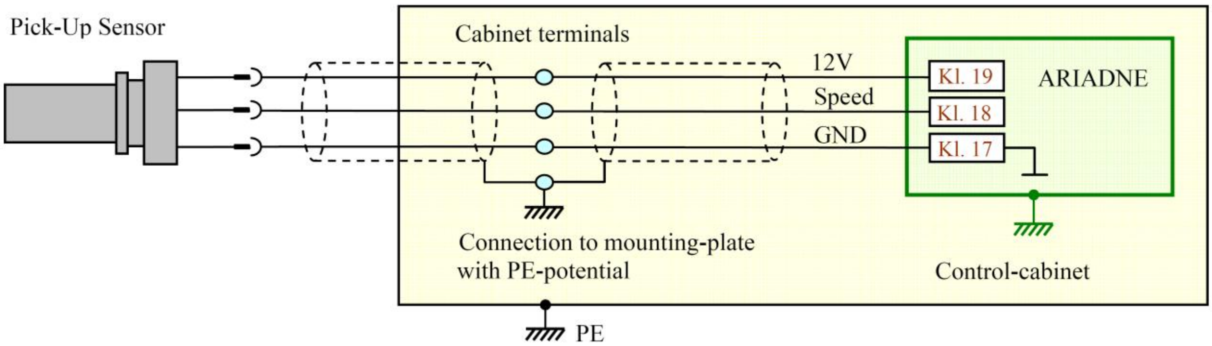
6.3 Digital Outputs

Designation	4× independent low-side digital outputs with state supervision and protection: Terminal 13 (DO1), Terminal 14 (DO2), Terminal 15 (DO3), Terminal 16 (DO4)
Function	control and indication of components such as solenoids, relays, lamps, DIs etc.
Range	On-State: output voltage < 1 V, output current 0 ... 0.3 A. Clamping energy, stored in inductive load, will be absorbt by turn-off: E < 500 mJ Off-State: output voltage 0 ... 40 V, current < 0.1 mA (to calculate by use of LED-lamps).
Connected to	ARIADNE, cabinet terminals and relays, lamps, switches or other ECU.
Type of wire used	Outside of control cabinet: unshielded cable. Inside of control cabinet: wire 0.75 ... 1.5 mm^2.
Total cable length	< 30 m
Requirements	For reverse protection of all relays use a common diode (IXYS, DSEI 2×30). Such diodes can be ordered as HZM.Nr.: 300-36-015-01.



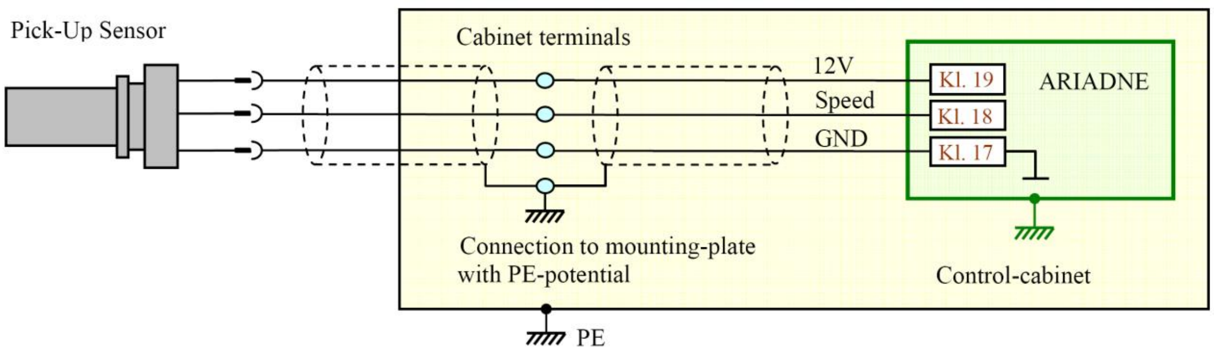
6.4 Speed sensor input

Designation	Speed pick-up (crankshaft) sensor terminal: Terminal 17 (GND), Terminal 18 (apeed), Terminal 19 (12 V), Frame with PE-contact
Function	Terminal for connection to Hall sensor, placed at crankshaft for detecting shaft position
Connected to	ARIADNE, cabinet terminals and crankshaft Hall sensor or other isolated pick-up output (pick-up splitter-device etc.)
Type of wire used	Outside of control cabinet: twisted 3 core shielded cable Inside of control cabinet: 3 core shielded cable
Total cable length	< 30 m
Requirements	Cable shielding should be terminated only inside of mounting plate, where ARIADNE is mounted For sensor: insulation between signals and metal case, PE or other external networks is required



6.5 Phase Sensor Input

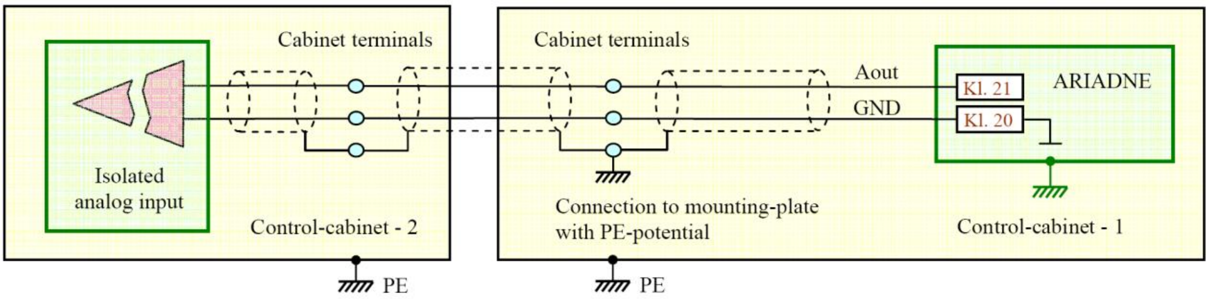
Designation	Index pick-up (camshaft) sensor terminal: Terminal 3 (GND), Terminal 4 (Index), Terminal 5 (12 V), Frame with PE-contact
Function	Terminal for connection to Hall sensor, placed by camshaft for detecting of motor driving shaft position
Connected to	ARIADNE, cabinet terminals and camshaft Hall sensor or other isolated pick-up output (pick-up spliter device etc.)
Type of wire used	Outside of control cabinet: twisted 3 core shielded cable Inside of control cabinet: 3 core shielded cable
Total cable length	< 30 m
Requirements	Cable shielding should be terminated only inside of mounting plate, where ARIADNE is mounted For sensor: insulation between signals and metal case, PE or other external networks is required



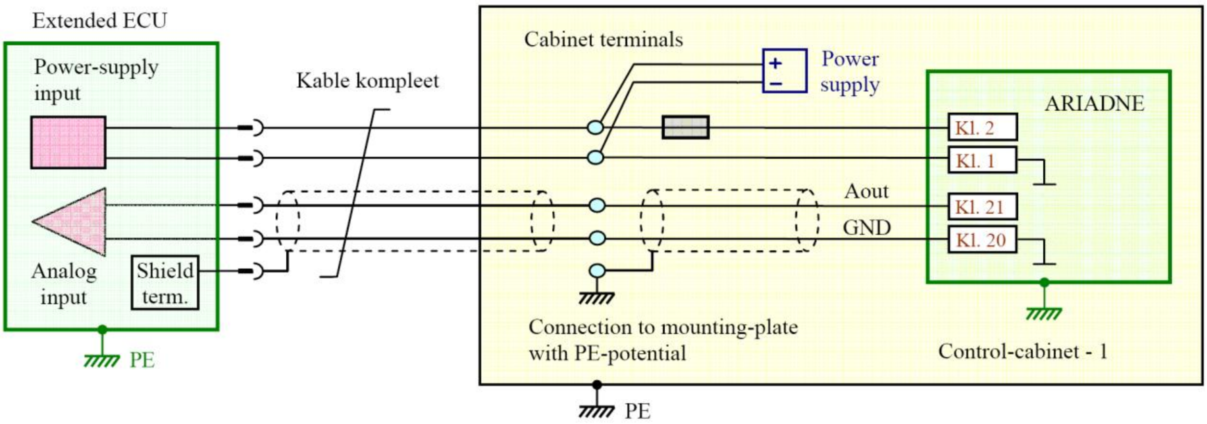
6.6 Analogue Outputs

Designation	Analog output, configurable for voltage mode (0 … 5 V) or current mode (4 … 20 mA): Terminal 20 (GND), Terminal 21 (analogue out), Frame with PE-contact
Function	Terminal for signal conversion to voltage signal 0.5 … 4.5 V or current signal 4 … 20 mA, for control or indication. Such as other ECU (ignition system, etc.) or indicator (panel meter, etc.)
Range	Operating range of signal (quadrant): current compatibility 0 … 25 mA, voltage compatibility 0 ... 7 V
Connected to	ARIADNE, cabinet terminals and sensor or other ECU
Type of wire used	Outside of control cabinet: twisted 2 core shielded cable. Inside of control cabinet: 2 core shielded cable.
Total cable length	< 30 m
Requirements	Cable shield should be terminated in one point only - to PE (mounting plate) or Shield terminal of ECU. For actor: DC-entcoupling between signals and PE (frame) is required.

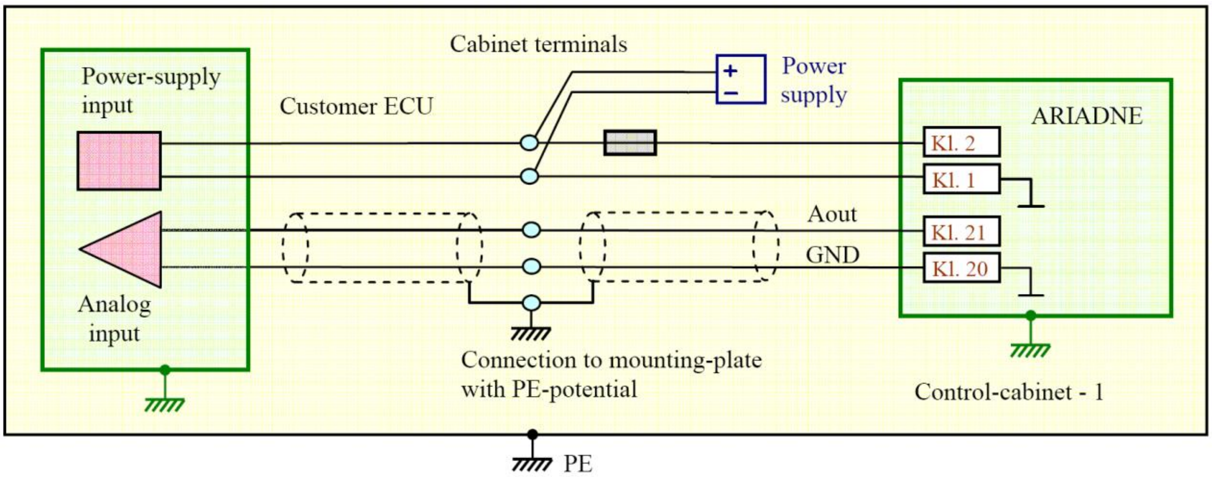
System with actor in outside and undefined connection of power–supply. Example: remote customer control unit.



System with actor in outside and common power –supply. Example: ignition system on the engine-block.



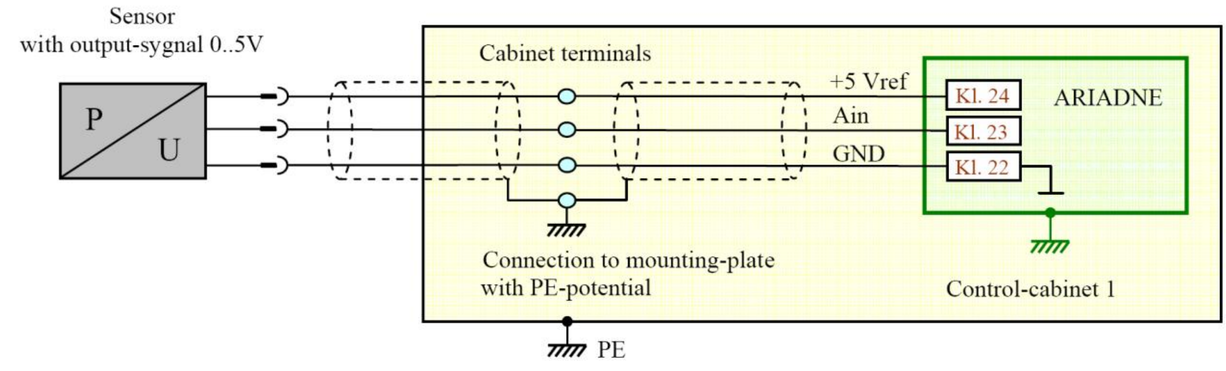
System with actor in inside and common power –supply. Example: other ECU in common control cabinet.



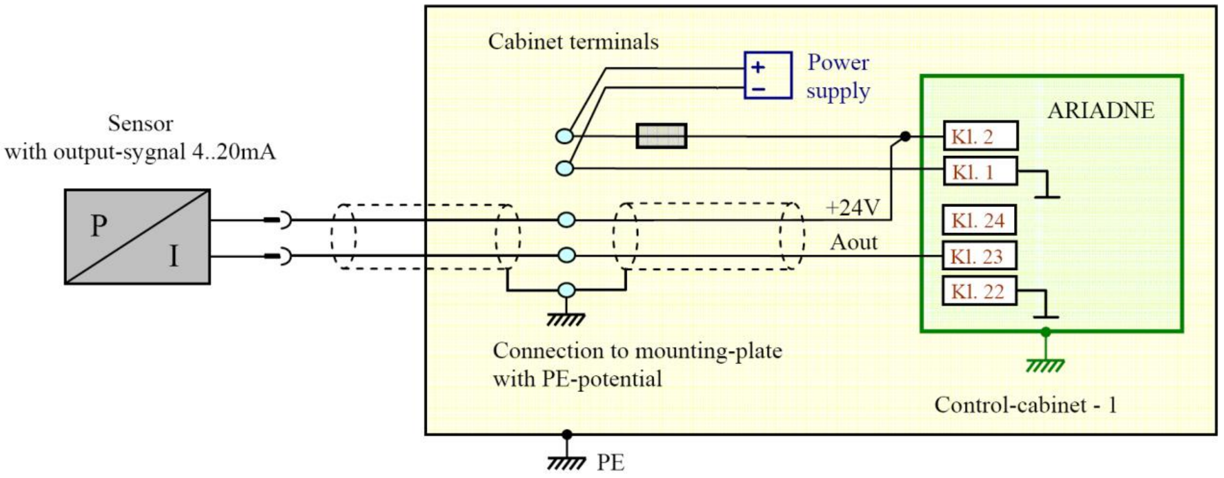
6.7 Analogue Inputs

Designation	Analog input, configurable for voltage-mode (0 … 5 V) or current-mode (4 … 20 mA): Terminal 22 (GND) Terminal 23 (analogue in) Terminal 24 (+5 Vref) Frame with PE-contact
Function	Terminal for sensors with signal 0.5 … 4.5 V or 4 … 20 mA (Setpoin unit, pressure sensor, temperature sensor etc.) or from analogue output of other ECU
Connected to	ARIADNE, cabinet terminals and sensor or other ECU
Type of wire used	Outside of control cabinet: twisted 2 or 3 core shielded cable. Inside of control cabinet: 2 or 3 core shielded cable.
Total cable length	< 30 m
Requirements	Cable shield should be terminated only inside of mounting plate, where ARIADNE is mounted. For sensor outside control cabinet 1: Insulation required between signals and metal-case (or other external networks) of sensor. For ECU inside control cabinet 1: DC-entcoupling between signals and PE (frame) by ECU is required.

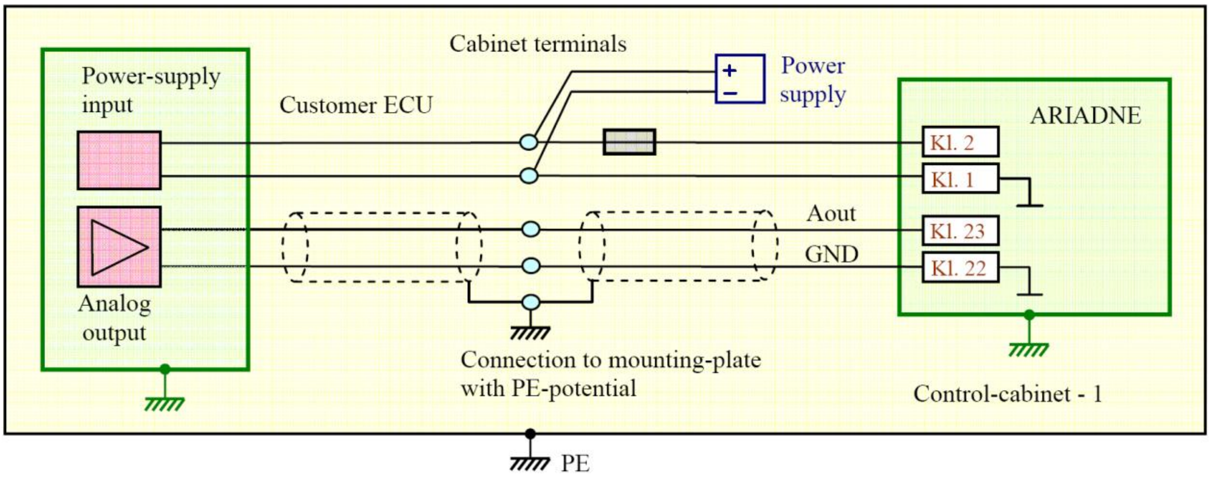
Connection to sensor with voltage-sygnal



Connection to sensor with current-sygnal



Connection to ECU inside control-cabinet 1 and common power –supply.



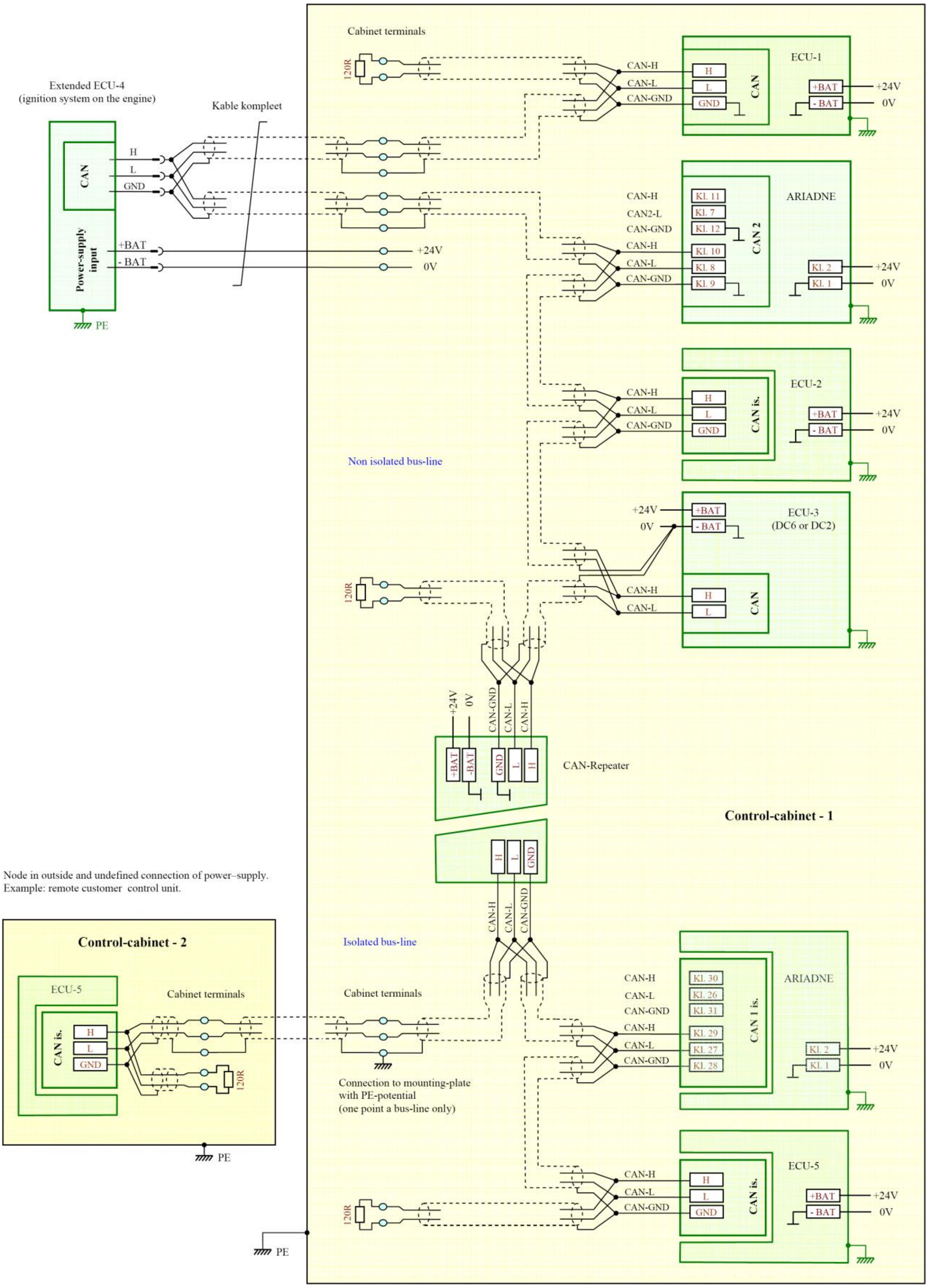
6.8 Communication-Ports CAN1 and CAN2

Designation	Terminal CAN1, isolated: Terminal 25-28-31 (GND), Terminal 26-27 (CANL), Terminal 29-30 (CANH)
Function	CAN-Communication to devices inside and/or outside control cabinet. Phisical layer: ISO 11898-1, -2 and CAN-Specification 2.0B.
Connected to	ARIADNE, cabinet terminals and other ECUs
Total cable length	Depends on data transmission baud rate: 1 Gb/s – 40 m max., 500 Mb/s – 70 m max., 250 Mb/s – 150 m max and by 125 Mb/s – 300 m max.

Designation	Terminal CAN2 Terminal 6-9-12 (GND), Terminal 7-8 (CANL), Terminal 10-11 (CANH)
Function	CAN-Communication to devices inside control cabinet. Phisical layer: ISO 11898-1, -2 and CAN-Specification 2.0B.
Connected to	ARIADNE, cabinet terminals and other ECUs
Total cable length	< 30 m

Requirements for building of CAN bus	
Type of wire used	Outside and inside of control cabinet: CAN-cable (shielded twisted pare, wave-impedance 120Ω).
Electrical requirements for CAN bus (see picture next page)	1.) Organisation of electrical bus line: The CAN-H, CAN-L and shield (CAN-GND) must be looped through from node to node. CAN bus line must be organised according to line-structure (node-1, node-2 … node-N)., see picture. 2.) Termination of twisted-pare in bus line: connect between CAN-H and CAN-L one resistor 120Ω on the begin of bus line and one resistor 120Ω on the end of bus line. 3.) Conditions by each node (CAN-Port by ECU) on the bus line: - shield must be connected to terminal “CAN-GND”, signal lines CAN-H and CAN-L to signal terminals (the names are the same). - By removing of one node-device the CAN-communication between other nodes must work without interrupt (requirements acc. ISO 11898-2:2003). - DC-decoupling between CAN-port (CAN-GND, -H, -L) and PE (frame) is required. 4.) Type of bus line isolation and the application fields: There are generally two different types of bus lines: - isolated and non isolated. If one or more nodes on the line don’t have galvanic isolation – this bus is called non isolated. Generally: - use isolated bus line for communication with external customer modules. - for communication, localised internally in one control cabinet only, it is allowed to use a non isolated bus line. 5.) Connection to PE by isolated bus line (see point-4): the shield of can-bus must be connected to PE (mounting plate) in one point only. 6.) If required, use a CAN-repeater for isolation. Consider time delay for signal conversion by CAN-repeaters and limit the cable length or reduce the data transmission baud rate

Example of CAN bus setting up

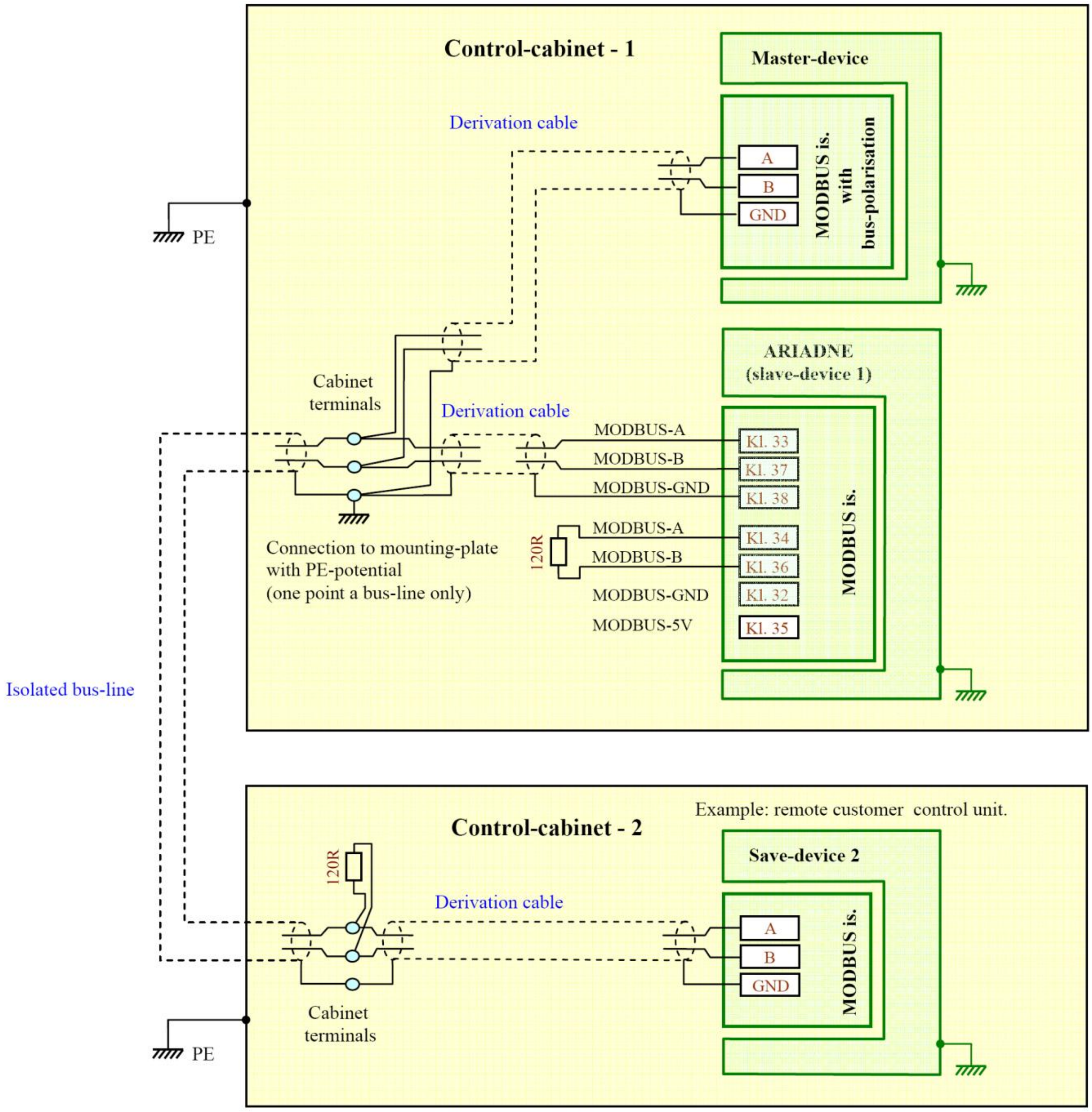


6.9 Communication-Port Modbus

Designation	Terminal Modbus, isolated: Terminal 32-38 (GND), Terminal 33-34 (A), Terminal 36-37 (B), Terminal 35 (+5 V)
Function	Modbus-communication to devices inside and/or outside control cabinet. Phisical layer: EIA/TIA RS485, 2-wire mode only.
Connected to	ARIADNE, cabinet terminals and other ECUs
Type of wire used	For bus line outside and inside of control cabinet: - Modbus-cable (shielded twisted pair, wave-impedance 150Ω). - Exception for short bus lines (up to 100 m) : some non standard Modbus-cable as shielded twisted pair with wave impedance 120Ω (see CAN-cable) is allowed to use. For derivation-cable between node and bus line (up to 20 m): - shielded twisted pair
Total cable length	< 1000 m for data-translation with baud rate up to 19,2 kB/s
Electrical requirements for Modbus (see picture following page)	See guide “DG 05 002-d 11-07 Modbus” for 2-wire mode of Modbus: - look after bus structure as line with short derivation-cables - look after conversion of tri potentials to each node: Modbus-GND (shield), Modbus-A and Modbus-B - look after cable type - look after connection to PE (frame) by master control cabinet in one point only - look after galvanic isolation of each modbus node - look after right polarity of signals by connection to each node - look after possible bus polarisation inside of master device - look after termination at begin and end of bus line.

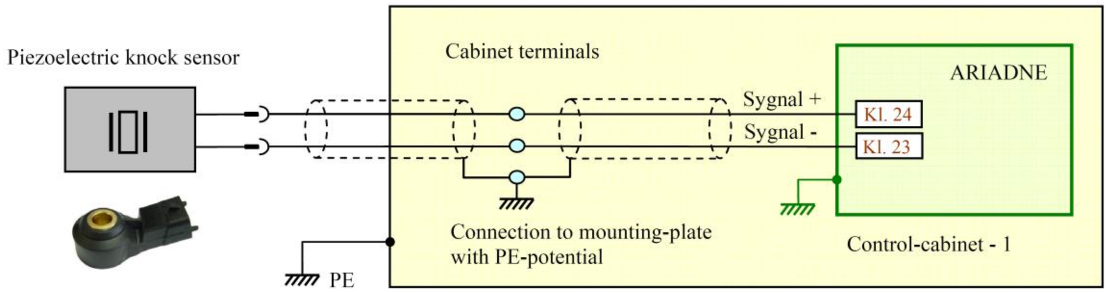
Inspection of A- and B-L-signals by oscilloscope refering to Modbus-GND isrecommended for diagnostic of communication.

Example of Modbus setting up



6.10 Knock Sensor Inputs

Designation	20× Knock sensor terminal: for sensor-1: Terminal 39 (Sen+), Terminal 40 (Sen-), Frame with PE-contact ; for sensor-3: Terminal 41 (Sen+), Terminal 42 (Sen-), Frame with PE-contact ; for sensor-5: Terminal 43 (Sen+), Terminal 44 (Sen-), Frame with PE-contact ; for sensor-7: Terminal 45 (Sen+), Terminal 46 (Sen-), Frame with PE-contact ; for sensor-9: Terminal 47 (Sen+), Terminal 48 (Sen-), Frame with PE-contact ; for sensor-11: Terminal 49 (Sen+), Terminal 50 (Sen-), Frame with PE-contact ; for sensor-13: Terminal 51 (Sen+), Terminal 52 (Sen-), Frame with PE-contact ; for sensor-15: Terminal 53 (Sen+), Terminal 54 (Sen-), Frame with PE-contact ; for sensor-17: Terminal 55 (Sen+), Terminal 56 (Sen-), Frame with PE-contact ; for sensor-19: Terminal 57 (Sen+), Terminal 58 (Sen-), Frame with PE-contact ; for sensor-2: Terminal 59 (Sen+), Terminal 60 (Sen-), Frame with PE-contact ; for sensor-4: Terminal 61 (Sen+), Terminal 62 (Sen-), Frame with PE-contact ; for sensor-6: Terminal 63 (Sen+), Terminal 64 (Sen-), Frame with PE-contact ; for sensor-8: Terminal 65 (Sen+), Terminal 66 (Sen-), Frame with PE-contact ; for sensor-10: Terminal 67 (Sen+), Terminal 68 (Sen-), Frame with PE-contact ; for sensor-12: Terminal 69 (Sen+), Terminal 70 (Sen-), Frame with PE-contact ; for sensor-14: Terminal 71 (Sen+), Terminal 72 (Sen-), Frame with PE-contact ; for sensor-16: Terminal 73 (Sen+), Terminal 74 (Sen-), Frame with PE-contact ; for sensor-18: Terminal 75 (Sen+), Terminal 76 (Sen-), Frame with PE-contact ; for sensor-20: Terminal 77 (Sen+), Terminal 78 (Sen-), Frame with PE-contact ;
Function	Terminals for piezo-electric knock sensors for detection of knock-appirions by combustion-prozess on the running engine.
Connected to	ARIADNE, wire-terminals in control cabinet and piezo-electric knock sensor
Type of wire used	Outside of control-cabinet: - twisted 2 core shielded cable with signal-wire 0,5..0,75mm^2 ; - capacitance between signal-wires: < 150pF/m; - asymmetry of capacitance between signals and shield: < 5% - resistance to influences from environment on the engine. Recommendation: NKT Cables, Type TBVFV 2x0,56 (available as HZM.Nr.: 010-00-339-00). Inside of control cabinet: twisted 2 core shielded cable with signal-wire 0,5..0,75mm^2, max. length 4m. Recommendation: Belden, Type 9501 (available as HZM.Nr.: 010-00-387-00).
Total cable length	3..30m
Requirements	Cable shield should be terminated only inside of mounting plate, where ARIADNE is mounted. For sensor: - the insulation between signals and metal-case, PE or other external networks is required; - see requirements to technical performaces of knock sensor on the page 17.



7 Dimensions

NOTICE Fastening torque of terminal screws : **0.25 Nm** ± 0.02 Nm

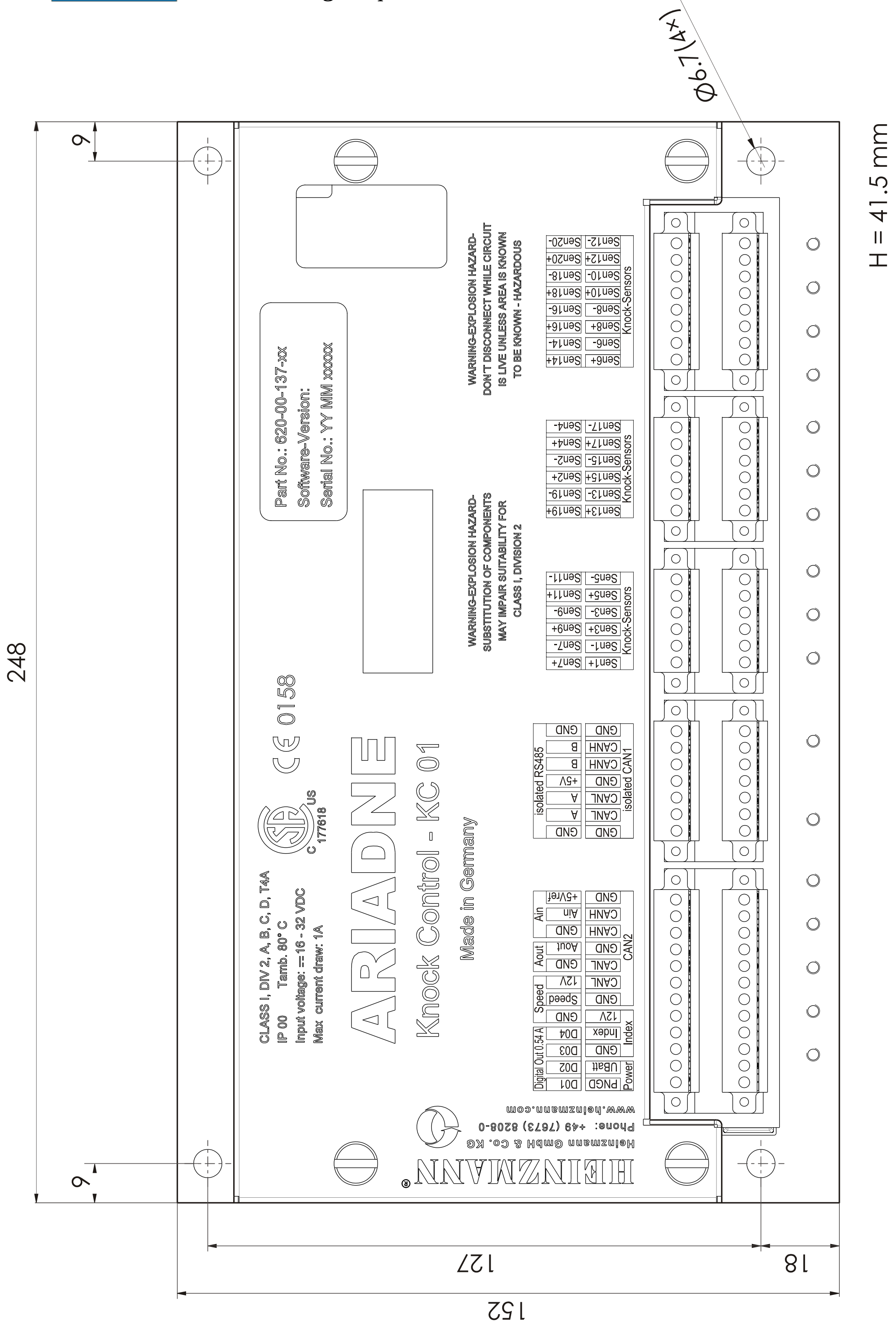


Figure 9: ARIADNE dimensions (for binding data see drawing 620-00-137-xx)

8 Sensor configuration

In all **HEINZMANN** control units there is a clear distinction between analogue or PWM inputs on the one hand and sensors on the other. This means that engine or application control is determined by the current values read by the sensors, but where those sensors take their values from is configured separately.

8.1 Sensor overview

Sensors are required to measure set values, pressures, etc., and to execute functions depending on these quantities. The following table provides an overview:

Parameter	**Meaning**	**Usage**
2900 *MeasuredPower*	Measured power	Measured power used for load dependent maps or curves
2901 *ManifoldPressure*	Manifold pressure	Calculation of the engine power based on the manifold pressure
2902 *MeasuredTorque*	Measured torque	Calculation of the engine power based on the measured torque

Table **3: Sensors overview**

8.2 Configuration of sensors

Sensors and setpoint adjusters supply an analogue signal (current or voltage) or a PWM signal. It is also possible to measure this signal somewhere else and have it transmitted to the control via CAN-Bus. The firmware determines which possibilities are available for selection. HZM-CAN customer module communication is integrated in the KC-01 basis software. Other CAN protocols may only be implemented on request.

Selection and configuration of the sensors as analogue, PWM or "communication" sensors are carried out with the parameters starting from 4900 *ChanTyp...* where one of the following values must be entered, depending on the firmware variant used:

ChanTyp	**Sensor source**
0	analogue signal (current or voltage)
1	PWM signal
2	HZM-CAN periphery module
3	custom defined CAN protocol
4	CANopen protocol (CANopen slave)

ChanTyp	Sensor source
5	DeviceNet-CAN protocol (slave)
6	Modbus protocol
7	SAE J1939-CAN-Protokoll
8	HZM-CAN customer module
9	HZM-CAN second control device of the same type (twin system)
10	WAGO module protocol (CANopen master)

Table **4: Sensors – Sources**

Parameterising: example:

The signal for the measured power is received from an analogue signal, and the Manifold pressure is received from a HZM-CAN customer module via the HZM-CAN bus.

Number	Parameter	Value	Unit
4900	*ChanTypMeasPower*	*0*	
4901	*ChanTypMnfldPress*	*8*	
4912	*ChanTypMeasTorque*	*0*	

8.3 Assigning inputs to sensors and setpoint adjusters

Assignment of inputs to sensors and setpoint adjusters is made by entering the desired channel number of the analogue or PWM input channels or the channel number of the communication module in the assigning parameters from 900 *AssignIn...* onwards. The channel numbers will run from 1 up to the maximum number, which depends on the type of control unit/communication module used.

Entering the number 0 in the assignment parameter signifies that the respective sensor has neither been connected nor activated. Consequently, the input will not be monitored. The assignment parameters of any sensors which are not required should therefore be set to 0. The sensor value during operation will then constantly be equal to the minimum value.

Double assignments will not be intercepted. But the HEINZMANN communications programme DcDesk 2000 reports such multiple configurations in its sensor window.

Parameterising Example:

The measured power (indication parameter 2900) is to be connected to the analogue input, the manifold pressure (indication parameter 2901) to HZM-CAN customer module input 3, and the measured torque (indication parameter 2912) is not connected. For all other sensors which remain unused the value 0 is to be entered.

Number	Parameter	Value	Unit
900	*AssignIn_MeasPower*	*1*	
901	*AssignIn_MnfldPress*	*3*	
912	*AssignIn_MeasTorque*	*0*	

8.4 Measuring ranges of sensors

In **HEINZMANN** controls, all sensor parameters and all relating values are provided with the maximum possible value range. For example manifold pressure covers a maximum range of 0 to 5 bar. But for the measured power the range is defined to 0 % till the rated power.

Since pressure sensors exist with different measuring ranges, the control unit must be informed of the particular value ranges which may differ from the maximum possible physical value range. These ranges are defined as the physical values corresponding to minimum and maximum input values such as 0.5 to 4.5 Volts or 4 to 20 mA for analogue inputs or 10 % and 90 % for PWM inputs.

Sensor	**Minimum measuring value**	**Maximum measuring value**
Measured power	Defined to 0 %	1232 *RatedPower*
Manifold pressure	952 *MnfldPressSensorLow*	953 *MnfldPressSensorHigh*
Measured torque	974 MeasTorqueSensorLow	975 *MeasTorqueSensorHigh*

Table **5: Sensors – Measuring ranges**

Parameterising Example:

A manifold pressure sensor with a measuring range from 0.5 to 3.5 bar is to be used.

Number	Parameter	Value	Unit
952	*MnfldPressSensorLow*	*0.5*	*bar*
953	*MnfldPressSensorHigh*	*3.5*	*bar*

8.5 Modifying reactions to sensor errors

The valid measuring ranges of setpoint adjusters and sensors are monitored. If they exceed these ranges in either direction, a sensor error is detected. If any error is detected, the appropriate response to this error can be modified by the correct configuration, which will allow adjustment of the control's behaviour to the specific application and mode of operation in case of failure.

Substitute values may be set for setpoint adjusters and sensors by means of the parameters 1000 *Subst…* This will permit the control to continue operation should the sensor in question fail. It is also possible to return to the last valid value before the error occurred rather than to maintain operation by resorting to a default value. The parameters 5000 *SubstOrLast...* are used to decide by which value the control is to continue operation in case the setpoint adjuster or the sensor is at fault. If the respective parameter is set to "1" the substitute value will be used as defined, if set to "0" the last valid value will be used. This method of error handling will in most cases be sufficient to sustain safe emergency operation of the installation.

The table below lists both the parameters where the substitute values are stored and the associated parameters for selecting operation by default value or by the last valid value.

Substitute value	**Selection of substitute value**	**Substitute value for**
1000 *SubstMeasuredPowers*	5000 *SubstOrLastMeasPower*	Measured power
1001 *SubstMnfldPress*	5001 *SubstOrLastMnfldPres*	Manifold pressure
1012 *SubstMeasuredTorque*	5012 *SubstOrLastMeasTorq*	Measured torque

Table **6: Sensor default values in case of error**

With setpoint and sensor inputs, the parameters 5040 *HoldOrReset…* offer the option to decide how the control is to react if an error clears itself (e.g., loose contact in wiring). If the respective parameter is set to "1" the error will be regarded to be latching. Therefore, the control unit will not react if the sensor measurement falls back within the valid range. If the parameter is set to "0" the error will be reset and operation continues using the signal coming from the sensor.

Parameter	**Reaction to error at**
5040 *HoldOrResetMeasPower*	Measured power
5041 *HoldOrResetMnfldPres*	Manifold pressure
5052 *HoldOrResetMeasTorq*	Measured torque

Table **7: Sensor error, latching**

9 Switching functions

In **HEINZMANN** control units a strict distinction is made between external switches and internal switching functions. This means that engine or application control is determined by the current values read by switching functions but these values come from is configured separately.

Normally, they will be influenced by digital inputs, but in specific applications their values may be assigned by serial or CAN protocols. For this reason the switching functions need to be configured and the sources they are receiving their actual states from specified.

For each switching function there are up to four parameters which define the external source and the current value. The last three digits of the four parameter numbers are identical for any one specific switching function.

Parameter	Meaning
810 *Funct...*	Assigning a digital input number (own hardware or HZM-CAN periphery module)
2810 *Switch...*	Indication of current value of switching function
20810 *Comm...*	Assigning an input number of a communication module
24810 *ChanTyp...*	Assigning a channel type of the external source

Table **8: Switching functions parameters**

If the firmware currently used does not use a communications module or only the HZM-CAN periphery module is used, the parameters starting from 20810 Comm... and 24810 ChanTyp... will not be available.

9.1 Complete overview of all switching functions

Switching functions may be defined as on-off switches or as selector switches. The name of a switching function will indicates its meaning. The name of a selector switch always includes the operator *Or*, where the expression preceding *Or* will be valid when the value of the switching function is 1 and where the expression following *Or* will be valid when the switching function has a value of 0. With on-off switches the name is equivalent to the label *On*. State “1” will always define *On* and state “0” *Off*.

For each of the switching functions there is a parameter to indicate whether the function is active.

A complete overview of all existing switching functions is given in the following ↑Table 9: Switching functions. For an explanation of each individual function and switch priority, please refer to the respective chapters.

Switching function	Meaning
2828 *SwitchErrorReset*	0→1 = current errors are cleared (at edge change)

Table **9: Switching functions**

9.2 Assignment of digital inputs

A digital input can be assigned to a switching function by entering the number of the digital input in the assignment parameter of the respective function, starting from 810 *Funct..*.

The number of digital inputs always runs from 1 to the maximum number for that particular control device.

These assignment parameters are parallel to the indication parameters for switching functions that start from 2810 *Switch...*.

Assignment of the value 0 means that the switching function in question has not been allocated to a digital input. Such a switching function will always have the value 0, except when it is received via a communications module.

The pin state, which activates the switching function, must be configured. There are 2 cases depending if a normal digital input or a tristate switch is used.

- Normal digital input

  A normal digital input is configured by setting Par. 4802 / 4806 to 0. The digital inputs can be configured as high-active, i.e., active when the voltage at the corresponding pin is higher than 7V, or low-active, i.e., active when the voltage at the corresponding pin is lower than 6V. High-active inputs are designated by positive digital input numbers in the assignment parameters, low-active ones with negative digital input numbers.

  The assignment parameter itself indicates only which channel is to be used for the switching function. If, in addition the pin-state has to be negated to activate the switching function, the channel number shall also be negated.

One single switch may simultaneously activate or be changed over several functions. In this case, the functions involved will have to be assigned the same input number, possibly with the activity inverted (negative sign).

If a switching function is required that is permanently active, any unused (disconnected) digital input may be utilised to activate this function by assigning the negative number of the digital input to the switching function.

Switching pulses must have a duration of at least 20 ms in order that the control electronics recognises them. Any switching function will remain active only as long as the switch input is active (with the exception of ignition stop).

Parameterising Example:

By closing the switch of input no. 1 you will reset the errors.

Number	Parameter	Value	Unit
828	*FunctErrorReset*	*1*	

Indication:		Switch open	Switch closed
2828	*SwitchErrorReset*	*0*	*1*

9.2.1 HZM-CAN periphery module

The digital inputs of periphery modules connected with HZM-CAN protocol are considered extensions of the digital inputs to its own hardware. The digital inputs of the periphery module are therefore added to the digital inputs already available.

If the system includes several periphery modules the number of digital inputs increases by the same number as the number of digital inputs on all periphery modules, while the node types of the periphery modules are as set in parameters starting with 407 *CanPE-NodeType* determine the sequence. The maximum number is limited to 32.

If, for instance

404 *CanPENodeNumber*(0) = 1

405 *CanPENodeNumber*(1) = 2

406 *CanPENodeNumber*(2) = 0

407 *CanPENodeType*(0) = 1 type 1 (DC 6-07 with max. 5 digital inputs)

408 *CanPENodeType*(1) = 0 type 0 (PE 2-01 with max. 8 digital inputs)

two periphery modules are connected to a control unit of the type KC-01, the resulting number of available digital inputs is 15: numbers from 1 to 2 in its own hardware, with numbers 3 to 7 in the DC 6-07 periphery module and numbers and 8 to 15 in the PE 2-01. In this case it does not matter whether all possible ports of the periphery modules have actually been configured as digital inputs, the maximum number is always used.

9.3 Assignment of communication modules

A switching function may also receive its current value from a communication module, e.g., a CAN protocol such as DeviceNet or a serial protocol like Modbus.

The type of the communication module is indicated for each switching function in 24810 *ChanTyp...* These assignment parameters are parallel to the indication parameters for switching functions that start from 2810 *Switch...*.

ChanTyp	Switching function source
0	no receipt from communications module
3	custom defined CAN protocol
4	CANopen protocol
5	DeviceNet CAN protocol
6	Modbus serial protocol
7	SAE J1939 CAN protocol
8	HZM-CAN Customer Module
9	HZM-CAN second control device of the same type (twin system)
10	WAGO module protocol (CANopen)

Table **10: Switching functions – Sources**

Which switching functions are addressed by which bit of the communications telegram is determined by the manufacturer of the sending module and must be agreed with the manufacturer. The switching functions received from the communications module are then numbered from 1 onwards and the respective number is entered in the assignment parameters starting from 20810 *Comm...* These assignment parameters are parallel to the indication parameters for switching functions that start from 2810 *Switch...*.

Assignment of a value of 0 to 20810 *Comm...* means that the respective switching function is not addressed by a communications module (but possibly by a digital input, see ↑*9.2* Assignment of digital inputs). For communication purposes, such a switching function always has a value of 0.

For safety reasons, a function must be activated deliberately via a communications module. For this reason, the switching functions addressed by communications modules can be only high-active, i.e. become active on receipt of a "1", as opposed to digital inputs (↑*9.2* Assignment of digital inputs). When the connection to the communication module is interrupted, the switching function automatically adopts a value of 0.

9.4 Value of a switching function

With on-off switches the name is equivalent to the label *On*. State "1" of the switching function will always define *On* and state "0" *Off*. The identifiers of change-over switches or of parameters selecting between two functions always include the operator "Or", where the expression preceding "Or" will is valid when the value of the switching function is "1" and where the expression following "Or" will be valid when the switching function has the value "0".

If no communication module is enabled in the current firmware, the value of the switching function is determined exclusively by digital input. The parameters starting from 20810 *Comm...* and 24810 *ChanTyp...* do not exist.

If, on the other hand, a communication module must be taken into account, then each switching function can be addressed either by a digital input or by the communications module, or even by both.

1. Digital input only
   Parameter 20810 *Comm...* must be set to 0.
   When 810 *Funct...* = 0, then the switching function always has the value 0, otherwise it has the current value of the digital input (possibly with inverted activity).

2. Communication module only
   Parameter 810 *Funct...* must be set to 0 and 24810 *ChanTyp...* >= 3.
   If 20810 *Comm...* = 0, then the switching function always has the value 0, otherwise it has the current value of the received message. If the connection to the communication module is interrupted, the switching function automatically adopts the value 0.

3. Both digital input and communication module
   Parameter 810 *Funct...* is not equal 0, 20810 *Comm...* > 0 and 24810 *ChanTyp...* >= 3. The current value from the digital input (possibly inverted) and from the communications module are linked by OR. The switching function will therefore be = 0 only if both sources send the value 0; it will be = 1 if at least one source sends the value 1. When the connection to the communication module is interrupted, the switching function automatically adopts the value 0 for this transmission path. In this case, the digital input alone decides on the overall value.

i *For safety reasons HEINZMANN recommends connecting the ignition stop directly at all times, regardless of a possible additional transmission via a communication module. On the other hand, HEINZMANN advises that you never connect change-over switches that select between two functions (with "Or" in their identifier) with two signal paths.*

10 Inputs and outputs

10.1 Selectable inputs/outputs

The KC-01 control unit is equipped with 2 pickup inputs, 1 analogue input and 2 selectable digital ports. These can function as input or output, digital or PWM.

Connection name	**Terminal**	**Configuration parameters**	**Configuration**
DIO1	13	4800 *DigChannel1OutOrIn*	0 = Input 1 1 = Output 1
DIO2	14	4801 *DigChannel2OutOrIn*	0 = Input 2 1 = Output 2
DIO3	15	4802 *DigChannel3OutOrIn*	0 = Input 3 1 = Output 3
DIO4	16	4803 *DigChannel4OutOrIn*	0 = Input 4 1 = Output 4

Table **11: KC-01: selectable inputs / outputs**

Parameterising Example:

Port 1 till 3 are used as output (for example to transmit different error levels like light knocking, heavy knocking and emergency alarm). Port 4 is used as input to reset errors.

Number	Parameter	Value	Unit
4800	*DigChannel1OutOrIn*	*1*	
4801	*DigChannel2OutOrIn*	*1*	
4802	*DigChannel3OutOrIn*	*1*	
4803	*DigChannel4OutOrIn*	*0*	

10.2 Pickup inputs

Depending on the firmware used, the KC-01 control unit can make use of 1 or 2 pickup inputs.

- Firmware with support pins or measuring wheels on camshaft

00.00.xx	00.10.xx	00.80.xx
00.01.xx	00.11.xx	00.81.xx
00.02.xx	00.12.xx	00.82.xx

Connection name	Terminal	Configuration parameters	Configuration
Speed	18	4000 *MeasWheelBoreOrTeeth*	Indicates if the measuring wheel consists of holes or teeth 0 = Teeth 1 = Holes
		4001 *PickIpAtCamOrCrank*	Indicates if the measuring wheel is mounted on the camshaft or the crankshaft 0 = Crank 1 = Cam
		4002 *PickUpOn*	0 = pickup deactivated 1 = pickup activated
Index	4	4005 *CamIndexOn*	0 = pickup deactivated 1 = pickup activated
		4006 *CamIndexGapOrPin*	0 = Pin 1 = Gap
		4015 *CheckPickUpDirection*	Checks the Pickup direction 0 = Off 1 = On
		4016 *CheckIndexDirection*	Checks the trigger disc direction 0 = Off 1 = On

Table **12: KC-01: pickup inputs**

- Firmware with support of Triggerdisc on Camshaft

00.03.xx	00.13.xx	00.83.xx
00.04.xx	00.14.xx	00.84.xx
00.05.xx	00.15.xx	00.85.xx

Connection name	Terminal	Configuration parameters	Configuration
Speed	18	4000 *MeasWheelBoreOrTeeth*	Indicates if the measuring wheel consists of holes or teeth 0 = Teeth 1 = Holes
		4001 *PickIpAtCamOrCrank*	Indicates if the measuring wheel is mounted on the camshaft or the crankshaft 0 = Crank 1 = Cam
		4002 *PickUpOn*	0 = pickup deactivated 1 = pickup activated
Index	4	4005 *CamIndexOn*	0 = pickup deactivated 1 = pickup activated
		4006 *CamIndexGapOrPin*	0 = Pin 1 = Gap
		4009 *TrigDiskInvOrNormal*	Indicates if the trigger disc runs in normal or inverse direction 0 = Normal 1 = Inverse
		4015 *CheckPickUpDirection*	Checks the Pickup direction 0 = Off 1 = On
		4016 *CheckIndexDirection*	Checks the trigger disc direction 0 = Off 1 = On

Table **13: KC-01: pickup inputs**

10.3 Analogue input

KC-01 is equipped with 1 analogue input which can be configured for current or voltage

Connection name	Terminal	Configuration parameters	Configuration
AI	23	5510 *AIWithSensorSupply*	0 = deactivates control of sensor supply 1 = activates control of sensor supply
		5511 *AIVoltOrCurrent*	Selects sensor type (voltage or current) 0 = Current (0 ... 25 mA) 1 = Voltage (0 ... 5 V)

* Configurable as digital input/output or PWM input/output

10.4 Digital inputs

The KC-01 control unit feature a maximum of four digital inputs, ↑*10.1* Selectable inputs/outputs.

Input	Designation	Terminal
Digital input 1*	P1	13
Digital input 2*	P2	14
Digital input 3*	P3	15
Digital input 4*	P4	16

* Configurable as digital input/output or PWM input/output

Table **14: KC-01: Digital inputs**

10.5 Digital outputs

The KC-01 control unit feature a maximum of two digital outputs. The required parameter settings for the assignment are described in chapter ↑ *10.1* Selectable inputs/outputs.

Input	Designation	Terminal	Type	Power (max.)
Digital output 1*	P1	13	low side	0.5 A
Digital output 2*	P2	14	low side	0.5 A
Digital output 3*	P3	15	low side	0.5 A
Digital output 4*	P4	16	low side	0.5A

* Configurable as digital input/output or PWM input/output

Table **15: KC-01: Digital outputs**

11 Configuring inputs and outputs

11.1 Digital inputs

Configuring of digital inputs is described in detail in chapter ↑*9* Switching functions.

11.2 Analogue inputs

11.2.1 Calibration of current/voltage inputs

Sensors convert physical quantities (e.g. pressure) to electric quantities (voltage, current). The KC-01 control unit measures voltage/current and indicates them directly in V or mA. To enable the control to operate with the physical value transmitted by the sensor, it is necessary that the control be provided with two reference values informing it about the relation between the electrically measured values and the actual physical quantities. The two reference values are the sensor output values associated with the minimum and maximum measuring values as described in ↑*0*

Measuring ranges of sensors. With this information, the control is capable of normalising the measured values and of displaying them specified in percentage terms of the sensor range or directly in terms of their physical values.

The KC-01 voltage/current input is associated with a low reference value (parameter 1510 *AnalogIn1_RefLow*) and a high reference value (parameters 1511 *AnalogIn1_RefHigh*). If the sensor signal is inverted the low reference value absolutely may be higher than the high reference value.

Parameterising example:

A manifold pressure sensor has been connected to the analogue input. Its measuring range should be from 0.5 bar to 3.5 bar and is to be converted into a voltage ranging from 0.5 V to 4.5 V. The parameter 3510 *AnalogIn1* displays the voltage as measured and the parameter 2912 *ManifoldPressure* will read the converted measuring value by bar.

Number	Parameter	Value	Unit
912	*AssignIn_MnfldPress*	*1*	
974	*MnfldPressSensorLow*	*0.5*	*bar*
975	*MnfldPressSensorHigh*	*3.5*	*bar*
1510	*AnalogIn1_RefLow*	*0.5*	*V*
1511	*AnalogIn1_RefHigh*	*4.5*	*V*
4912	*ChanType_MnfldPress*	*0*	
5512	*AIVoltOrCurrent*	*1*	

11.2.2 Filtering of analogue inputs

The measured value of the analogue input can be filtered through a digital filter. The respective parameter is stored at number 1514 *AnalogIn1_Filter*.

In this parameter the time constant is entered in seconds. A value of 0.00 s corresponds to no filtering. For normally fast sensor changes, a filter value 0.10 s will be appropriate. For measuring quantities that change more slowly, such as temperatures, a filter value of about 1.00 s may be used. The filtering time constant should correspond approximately to the sensor's time constant.

Parameterising Example:

Number	Parameter	Value	Unit
1514	*AnalogIn1_Filter*	*0,10*	*s*

11.2.3 Error detection in analogue inputs

If a sensor fails (e.g., due to a short circuit or cable break), the control will read all voltages or currents lying outside the normal measuring range. These irregular measuring values can be used to define inadmissible operating ranges via which the control can recognize that the sensor is faulty.

For the analogue input, the error limits are entered in the relevant electric unit

The parameter 1512 *AnalogIn1_ErrorLow* defines the lower error limit.

The parameter 1513 *AnalogIn1_ErrorHigh* defines the upper error limit.

Parameterising Example:

The manifold pressure sensor connected to the analogue input and operating within a normal voltage range of 0.5 V to 4.5 V is assumed to supply a voltage of 5 V in case of cable break and a voltage of 0 V in case of a short circuit. The ranges below 0.3 V and above 4.7 V are defined as inadmissible by the following parameters:

Number	Parameter	Value	Unit
912	*AssignIn_MnfldPress*	*1*	
1510	*AnalogIn1_RefLow*	*0.50*	*V*
1511	*AnalogIn1_RefHigh*	*4.50*	*V*
1512	*AnalogIn1_ErrorLow*	*0.30*	*V*
1513	*AnalogIn1_ErrorHigh*	*4.70*	*V*

These error limits chosen should not be too close to the minimum and maximum values, in order to prevent natural fluctuations of the values measured by the sensors from being mistaken as errors. On the other hand, it must be ensured that short circuits or cable breaks are unambiguously recognized as such.

KC-01 offers the possibility to supply the connected sensors and setpoint adjusters with a 5Vor a 24V voltage from the control unit. This must be communicated to the control with parameter

5510 *AIWithSensorSupply* = 1 sensor is powered with 5V / 24V by the control

5511 *AISupply24VOr5V* = 0/1 sensor is powered with 5V (0) or 24V (1)

When a sensor is connected to such a reference, the relevant reference voltage is monitored. The supplied voltage is measured back and displayed in parameter 3512 *SensorSupplyAI1*

Once an error is detected, the error parameter associated with the analogue input and with the relevant sensor is set. To learn more about what action to take in the event that any such error occurs, please refer to the chapter. If an analogue input is not used due to not being assigned to a sensor it will not be monitored for errors.

The following table provides an overview of possible errors:

Error	Meaning
0	**Signal short circuit to earth** - The measuring value of the relevant input value is below the lower error threshold → Reaction according to the configuration of sensor error handling • Check sensor cable • Check sensor • Check parameters for error thresholds
1	**Signal short circuit to supply voltage** - The measuring value of the relevant input value is below the upper error threshold → Reaction according to the configuration of sensor error handling • Check sensor cable • Check sensor • Check parameters of error thresholds
2	**Sensor supply voltage, cable break or short circuit to earth** - The measured value of the relevant reference voltage is below 4V (5V supply) or 20V (24V supply) - Monitoring active only if sensor referencing is active → Reaction according to the configuration of sensor error handling • Check sensor cable • Check sensor

Error	Meaning
3	**Sensor supply voltage, short circuit to supply voltage** - The measured value of the relevant reference voltage is greater than 6V (5V supply) or 26V (24V supply) - Monitoring active only if sensor referencing is active → Reaction according to the configuration of sensor error handling • Check sensor cable • Check sensor

Table **16: Error detection for analogue inputs**

11.2.4 Overview of the parameters associated with the analogue input

For the analogue input the following parameters are provided:

Parameter	**Meaning**
1510 *AnalogIn1_RefLow*	lower reference value
1511 *AnalogIn1_RefHigh*	upper reference value
1512 *AnalogIn1_ErrorLow*	lower error limit
1513 *AnalogIn1_ErrorHigh*	upper error limit
1514 *AnalogIn1_Filter*	filtering constant
3510 *AnalogIn1*	current measuring value in %
3511 *AnalogIn1_Value*	current measuring value in electric unit
3512 *SensorSupplyAI1*	current measuring value of the sensor supply in electric unit

Table **17: Parameters for analogue inputs**

11.3 Digital outputs

A digital output may be assigned to each measurement or indication value with value range [0,1] in parameter list 2. In addition, for the output of error parameters it is possible to read out single errors of an error state. To achieve this, single bits of an error state are selected by means of a mask parameter to determine the specific errors. If more than one error bit is selected, the output becomes active as soon as at least one error bit is set.

Several values may be assigned to each digital output (so called multiple allocation).

The values currently output are displayed by parameter 2851 *DigitalOut1* and subsequent parameters.

i *The parameter settings described in the following sections – in particular multiple allocation – can be achieved in an easy and comfortable way using a dedicated window of DcDesk 2000.*

11.3.1 Multiple allocation

Using multiple allocation, anything up to 8 output values may be assigned to each digital output. The maximum amount is defined in the firmware and cannot be augmented. It is, however, possible to use fewer values that the maximum.

This type of allocation makes sense whenever it is necessary to visualise a number of error parameters greater than the number of available digital outputs. The related parameter numbers must be entered in the parameter fields starting from 8800 *DigitalOut1:Param(0)..(7)*. If you wish to negate an allocation parameter, its parameter number must be entered with a minus sign.

The current values of these single output parameter now may either be linked by logic operator for output on the digital output or configured to produce different blinking codes. The preferred alternative may be chosen separately for each digital output.

To do this, indicate the logical link you wish to use or the value 80 Hex if your prefer a blinking code in the parameters starting from 4851 *DigitalOut1:Logic* Enter the value 0 if only one parameter was assigned to the output.

11.3.1.1 Logical operators

The value for the logical operation in 4851 *DigitalOut1:Logic* consists of single bits. Bit value 0 corresponds to the logic operator AND and bit value 1 to the logic operator OR. The lowest bit represents the operator between the allocation parameters 1 and 2, the following bit between assignment parameters 2 and 3 and so forth. With a maximum of eight allocation parameters this allows a maximum of seven operators, equivalent to a value between 0 and 7F Hex. The processing sequence is from the lowest to the highest allocation parameter. Bracketing is not possible.

11.3.1.2 Blinking signals

If, instead of a logical operation the value 80 Hex was entered in 4851 *Digital-Out1:Logic*, the digital output visualizes blinking signals. If the first allocation parameter is active, the output emits the following blinking signal:

2 short, 1* long, 2* short*

for the second allocation parameter

2 short, 2* long, 2* short*

for the third

2 short, 3* long, 2* short*

and so on. In between signals there is a pause to better distinguish the single errors. If, for instance, both the first and the third allocation parameters are active, the resulting blinking signal is as follows:

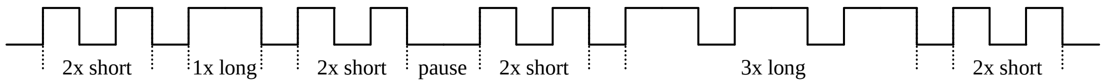


Figure 10: Blinking signal

By counting along with the long blinks it is possible to determine which parameter is active. The operator of the system must be informed about the meaning of the blink signals.

11.3.1.3 Flashing and continuous light

Operators frequently wish to display error messages in the form of flash signals, and to allocate a continuous light to one or more specific errors of particular importance. The parameters starting from 4880 *DigitalOut1:Prior* can be used for this purpose.

Each set bit means that the active state of the related parameter in 8800 *Digital-Out1:Param(0) ... (7)* is to generate a continuous light on the digital output. All other values with a value of 0 in the priority bit continue to generate flash signals – please note that these are visible only if no value of higher priority is active.

It is recommended to start the allocation of parameter numbers to the digital output from the blinking signals and to put the ones with high priority at the end of the field.

Parameterising Example:

The control unit allows indicating up to eight parameters for each digital output.

- output 1 is to
  blink 1x in case of error pickup (3003 *ErrPickUp, all error bits*),
  blink 2x in case of charge error (3909 *EngineIgnErrorState, bit 0*),
  blink 3x in case of primary short (3909 *EngineIgnErrorState, bit 1*),
  blink 4x in case of primary open (3909 *EngineIgnErrorState, bit 2*),
  blink 5x in case of secondary short (3909 *EngineIgnErrorState, bit 3*),
  blink 6x in case of secondary open (3909 *EngineIgnErrorState, bit 4*),
  blink 7x in case of spark duration low (3909 *EngineIgnErrorState, bit 5*),
  blink 8x in case of spark duration high (3909 *EngineIgnErrorState, bit 6*),

- output 2 is to
  blink 1x in case of common alarm (3801 *CommonAlarm*),
  be lit continuously in case of emergency alarm (3800 *EmergencyAlarm)*

Number	Parameter	Value	Unit
4851	*DigitalOut1:Logic*	*80*	*Hex (blinking)*
4852	*DigitalOut2:Logic*	*80*	*Hex (blinking)*
4881	*DigitalOut2:Prior*	*02*	*Hex (2. par. continuous output)*
8800	*DigitalOut1:Param(0)*	*3003*	
8801	*DigitalOut1:Param(1)*	*3909*	
8802	*DigitalOut1:Param(2)*	*3909*	
8803	*DigitalOut1:Param(3)*	*3909*	
8804	*DigitalOut1:Param(4)*	*3909*	
8805	*DigitalOut1:Param(5)*	*3909*	
8806	*DigitalOut1:Param(6)*	*3909*	
8807	*DigitalOut1:Param(7)*	*3909*	
8810	*DigitalOut2:Param(0)*	*3801*	
8811	*DigitalOut2:Param(1)*	*3800*	
8960	*DigitalOut1:Mask(0)*	*FFFF*	*Hex*
8961	*DigitalOut1:Mask(1)*	*0001*	*Hex*
8962	*DigitalOut1:Mask(2)*	*0002*	*Hex*
8963	*DigitalOut1:Mask(3)*	*0004*	*Hex*
8964	*DigitalOut1:Mask(4)*	*0008*	*Hex*
8965	*DigitalOut1:Mask(5)*	*0010*	*Hex*
8966	*DigitalOut1:Mask(6)*	*0020*	*Hex*
8967	*DigitalOut1:Mask(7)*	*0040*	*Hex*

11.3.2 Error monitoring of digital outputs

Digital outputs are monitored with cable breaks, short circuits and overcurrents. Monitoring and parameterising of digital outputs is heavily dependent on the electric characteristics of the connected loads.

Monitoring is activated with the parameter

51x0 *DOPWMy_SupviseOn* monitoring of output

The electrical characteristics of the connected load require a short interruption of output monitoring whenever output level changes. This delay time is set with the following parameter:

111x0 *DOPWMy_DelayTime* delay time after edge change

The following table provides an overview of possible errors:

Error	Meaning
0	**Signal short circuit to earth** - Governor has detected a short circuit to earth. → error message appears alone • Check wiring and connected loads.
1	**Short circuit to supply voltage** - Governor has detected a short circuit to supply voltage. → error message appears alone • Check wiring and connected loads.

Table 18: Possible digital sensor errors

The parameter

51x1 *DOPWMy_HoldOrReset* hold or reset error message

allows the user to configure whether the error message is to be reset when the error state is no longer present. This applies in common to all error messages.

11.4 Pickups Configuration

A pickup / index configuration will only be activated after saving all parameters and resetting the control unit

- 3 available measuring methods

Measuring Method 1 Measuring Method 2 Measuring Method 3

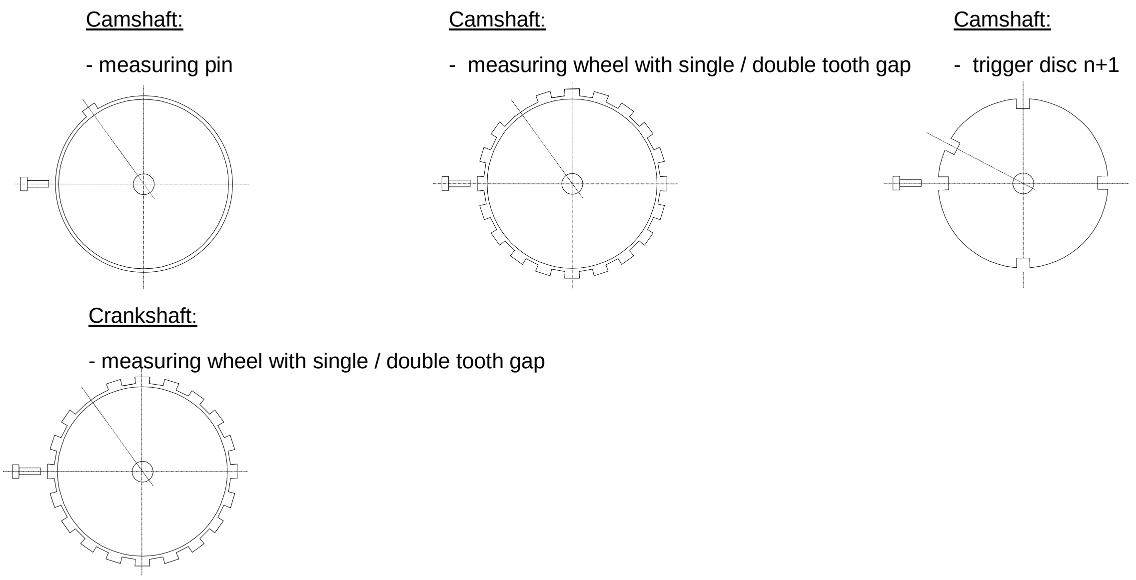


Figure 11: Pickup configuration

11.4.1 Measuring Method 1 (Software Versions AAA-B1/2-DDD)

If the measuring wheel has a single tooth gap, firmware variant B1 has to be used. If the measuring wheel has a double tooth gap, firmware variant B2 has to be used.
The pickup and measuring wheel setups are still exactly the same in both cases.

- Crankshaft pickup setup

  Activate Pickup:

  Par. 4001 = 0 (Pickup is on crankshaft)

  Par. 4002 = 1

- Camshaft index setup

  Activate Index:

  Par. 4005 = 1

- Speed measuring wheel and index setup

  Configure the speed measuring wheel according to its physical properties:

  Par. 4000 = 0 for a wheel equipped with teeth

  Par. 4000 = 1 for a wheel equipped with holes

  Par. 1 = Number of teeth / holes.

If the measuring wheel has a single tooth/hole gap (firmware variant B1), the gap is counted as 1 tooth / hole. For example for a 120-1 teeth wheel Par. 1 = 120. If the measuring wheel has a double tooth/hole gap (firmware variant B2), the gap is counted as 2 teeth / holes. For example for a 60-2 teeth wheel Par. 1 = 60

  Configure the index according to its physical properties:

  Par. 4006 = 0 for a single tooth index

  Par. 4006 = 1 for a single hole index

- Pickup and index angle position setup

  The position of the speed measuring wheel gap resp. of the index must be determined exactly. The ignition TDC of the cylinder selected first (cylinder A1, TDC is equivalent to 0° crankshaft angle) is used as a reference point. All distances (including that of the speed measuring wheel gap or of the index on the camshaft) are to be specified in **<u>degrees of crankshaft</u> angle before the compression TDC of cylinder A1**.

  Procedure to determine the distance (see pictures following):

1. The crankshaft is rotated into a position where cylinder A1 is exactly at TDC (ignition TDC).
2. **For Hall Pickups**: The distance between the centre of the sensor and the **beginning or the end (depending on Par. 4000 and 4009)** of the first tooth after gap is measured by degrees of crankshaft starting from the sensor in direction of engine rotation.

The following pictures make use of measuring wheel with single tooth gap. The set-up is still exactly the same when a measuring wheel with double tooth gap is used.

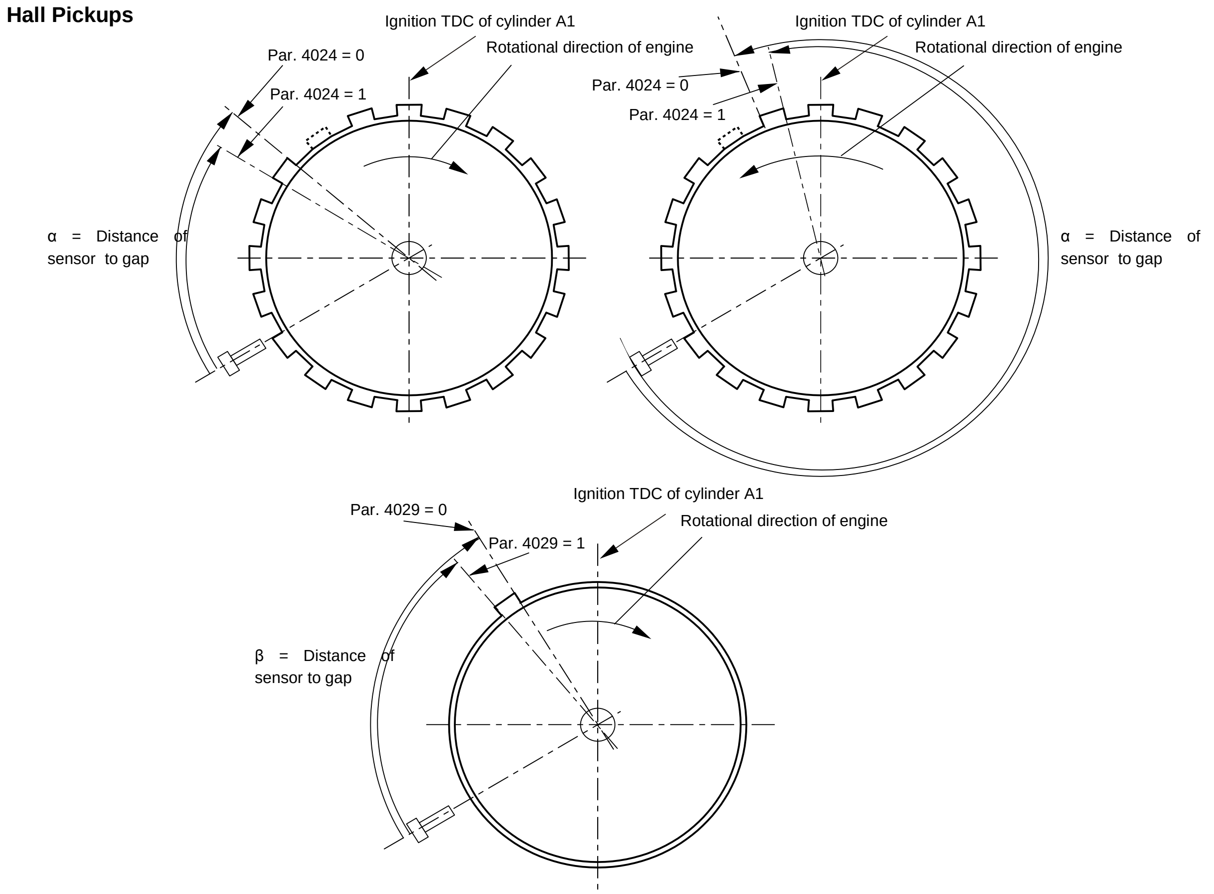


Figure 12: Hall pickups

Configure the pickup and index positions as follows:

Par. 3 = α [°crank]

Par. 5 = β [°crank]

11.4.2 Measuring Method 2 (Software Version AAA-B1/2-DDD)

If the measuring wheel has a single tooth gap, firmware variant B1 has to be used. If the measuring wheel has a double tooth gap, firmware variant B2 has to be used. Pickup and measuring wheel are set up in exactly the same way in both cases.

This method makes use of one pickup and a measuring wheel with tooth gap placed on the camshaft. The setup is very similar to that in measuring method 1 but no cam index is used.

- Camshaft pickup setup

  Activate Pickup:

  Par. 4001 = 1 (Pickup is on camshaft)

  Par. 4002 = 1

- Camshaft index setup

  This measuring method does not require a cam index:

  Par. 4005 = 0

- Speed measuring wheel setup

  Configure the speed measuring wheel according to its physical properties:

  Par. 4000 = 0 for a wheel equipped with teeth

  Par. 4000 = 1 for a wheel equipped with holes

  Par. 1 = Number of teeth / holes.

If the measuring wheel has a single tooth/hole gap (firmware variant B1), the gap is counted as 1 tooth / hole. For example for a 120-1 teeth wheel Par. 1 = 120. If the measuring wheel has a double tooth/hole gap (firmware variant B2), the gap is counted as 2 teeth / holes. For example for a 60-2 teeth wheel Par. 1 = 60

- Pickup angle position setup

  The position of the speed measuring wheel gap must be determined exactly. The ignition TDC of the cylinder selected first (cylinder A1, TDC is equivalent to 0° crankshaft angle) is to be used as a reference point. All distances (including that of the speed measuring wheel gap) are specified in **degrees of crankshaft angle before the compression TDC of cylinder A1**.

  Procedure to determine the distance (see following images):

1. The crankshaft is rotated into a position where cylinder A1 is exactly at TDC (ignition TDC).
2. **For Hall Pickups**: The distance between the centre of the sensor and the **beginning or the end** of the first tooth after gap is measured by degrees of crankshaft starting from the sensor in the direction in which the engine rotates.

The following pictures make use of a measuring wheel with single tooth gap. The setup remains exactly the same of a measuring where a wheel with double tooth gap is used

Attention: angles must be converted into ***degrees of crankshaft****.*

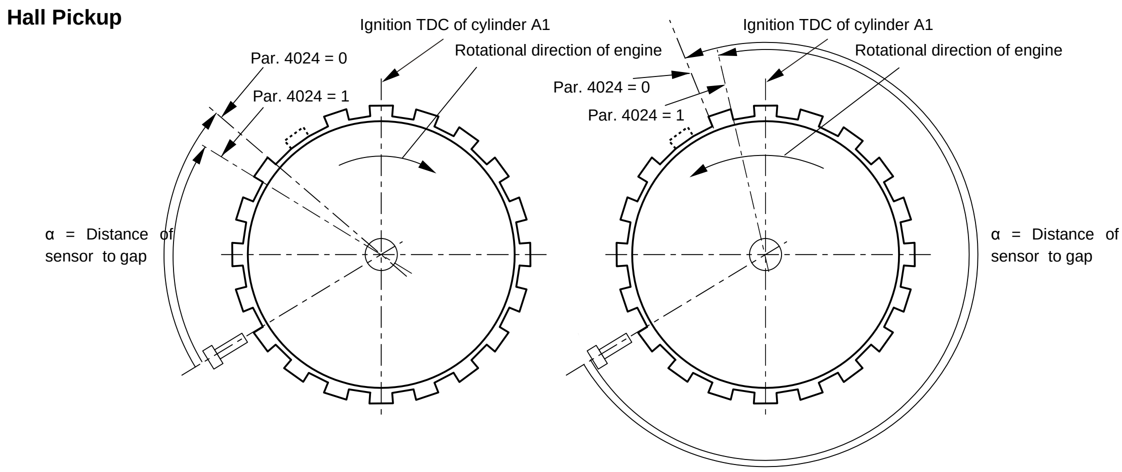


Figure 13: Crankshaft angle Hall pickups

Configure the pickup position as follows:

Par. 3 = α [°crank]

11.4.3 Measuring Method 3 (Software Version AAA-B0-DDD)

- Trigger disk setup

  Configure the trigger disk according to its physical properties:

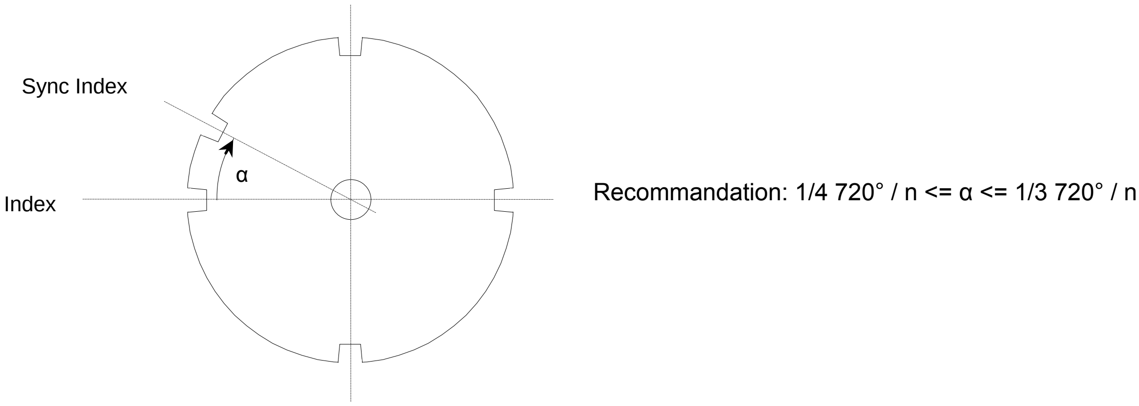
  Par. 4009 = 0 for a trigger disk with teeth

  Par. 4009 = 1 for a trigger disk with holes

  Par. 1 = Number of teeth / holes (synchronisation index not counted). For example for a 6+1 trigger disk Par. 1 = 6

- Pickup angle position setup

  Method 3 uses one pickup on a timing trigger disc installed on the camshaft. The trigger disc has n equidistant indexes (teeth / holes) and one additional synchronization index used as phase reference.

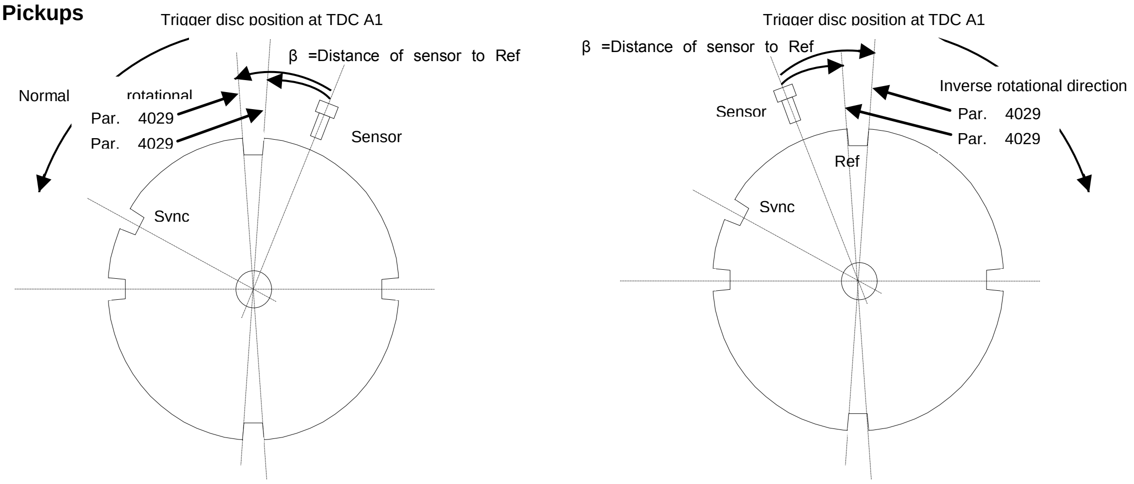


To determine the TDC of all cylinders, the ignition TDC of the cylinder selected first (cylinder A1, TDC is equivalent to 0° crankshaft angle) is to be used as a reference point. Depending on the rotational direction of the disc, a reference index is defined as the index just after or just before the synchronisation index. The distance between the sensor and the reference index must be determined in **degrees of crankshaft**. The rotational direction of the disc is called “normal” when following angle sequence is detected by the pickup: normal – small (α) – middle (720/n - α) – normal. In this case, the reference index is the one which follows the synchronisation index. The rotational direction of the disc is called “inverse” when following angle sequence is detected by the pickup: normal – middle (720/n - α) – small (α) – normal. In this case the reference index is the one before the synchronisation index.

Procedure to determine the distance (see following images):

1. The crankshaft is rotated into a position where cylinder A1 is exactly at TDC (ignition TDC).
2 **For Hall Pickups**: The distance between the centre of the sensor and the **beginning or the end** of the reference index is measured by degrees of crankshaft starting from the sensor in direction of engine rotation.

Hall Pickups



Configure the rotational direction:

Par. 4009 = 0 for normal rotational direction

Par. 4009 = 1 for inverse rotational direction

Configure the pickup position:

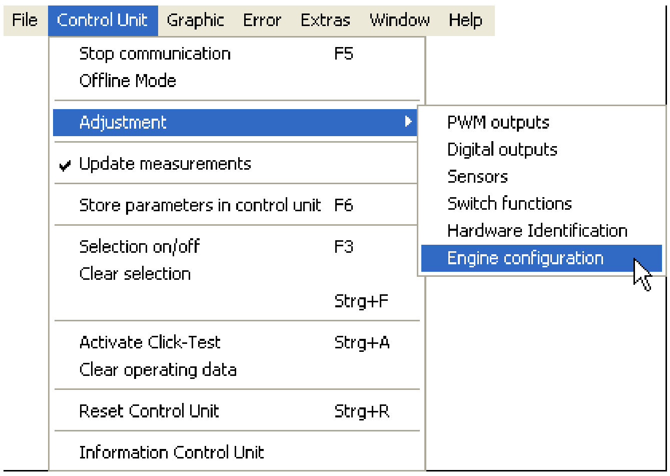
Par. 3 = β [° Crank]

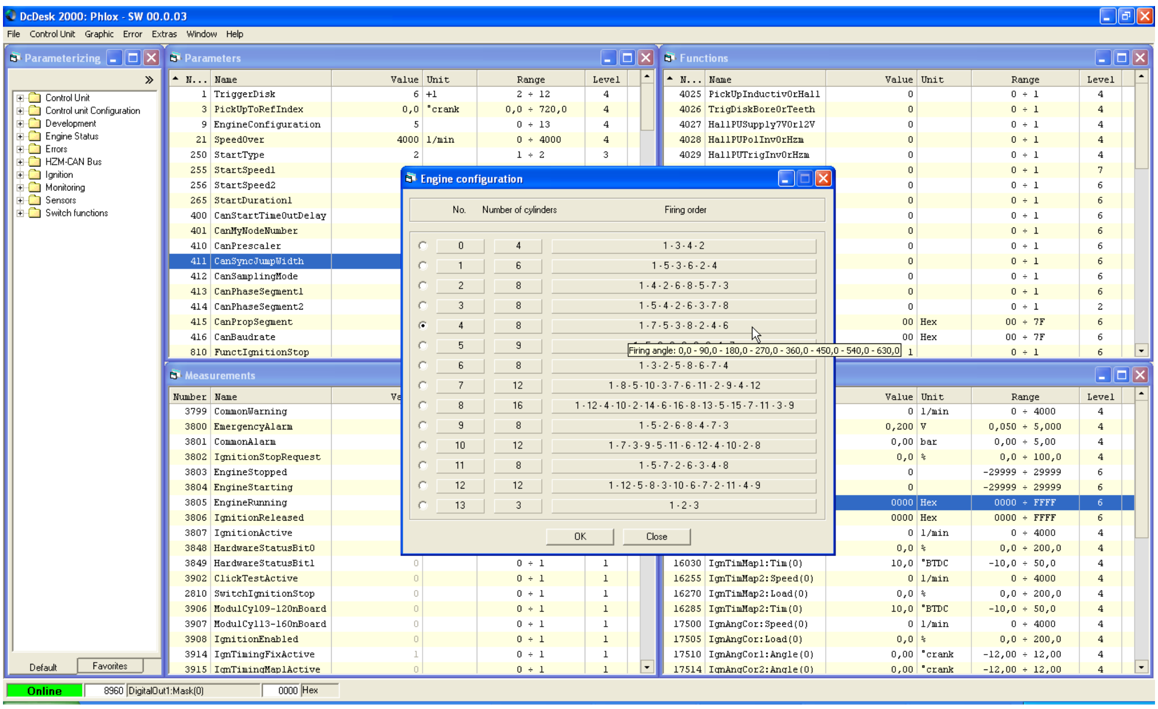
12 Engine configuration

The selected engine configuration will only be activated after saving all parameters and resetting the control unit

To select the engine firing order and cylinder numbers open the menu Control Unit -> Adjustment -> Engine Configuration and select the correct engine configuration. Note: moving the mouse over the different configurations will display the TDC angles of all cylinders.

Example: Configuration for firing order 1-7-5-3-8-2-4-6 and
TDC angles 0°-90°-180°-270°-360°-450°-540°-630° crank





13 Quick diagnostic display

- For quick diagnostic, ARIADNE is equipped of a 2-digits display (7-segment LEDs), giving to customers or service engineers first indication on knock occurrences (light or heavy knocking combustion detected, cylinder(s) concerned) or on other errors detected by the unit, without connecting a PC.

Figure 14: ARIADNE quick diagnostic display

Display	Error Number	Error Name
c0-01	3001	ErrPickUp1
c0-03	3003	ErrPickUpIndex
c0-04	3004	ErrOverSpeed
c0-05	3005	ErrMeasuredPower
c0-06	3006	ErrMnfldPress
c0-07	3007	ErrMeasuredTorque
c0-35	3035	ErrBankOverlapping
c0-36	3036	ErrSynchronisation
c0-70	3070	ErrCanBus1
c0-71	3071	ErrCanComm1
c0-79	3079	ErrInternTemp1
c0-80	3080	ErrInternTemp2
c0-85	3085	ErrPowerSupply
c0-86	3086	ErrIntVoltSupply
c0-87	3087	ErrEEPROM
c0-92	3092	ErrConfiguration
c0-94	3094	ErrIntern
c1-00	13000	ErrDigitalOut1
c1-01	13001	ErrDigitalOut2
c1-02	13002	ErrDigitalOut3
c1-03	13003	ErrDigitalOut4
c1-50	13050	ErrKnockCylinder1
c1-51	13051	ErrKnockCylinder2
c1-52	13052	ErrKnockCylinder3
c1-53	13053	ErrKnockCylinder4
c1-54	13054	ErrKnockCylinder5
c1-55	13055	ErrKnockCylinder6
c1-56	13056	ErrKnockCylinder7
c1-57	13057	ErrKnockCylinder8
c1-58	13058	ErrKnockCylinder9
c1-59	13059	ErrKnockCylinder10
c1-60	13060	ErrKnockCylinder11
c1-61	13061	ErrKnockCylinder12
c1-62	13062	ErrKnockCylinder13
c1-63	13063	ErrKnockCylinder14
c1-64	13064	ErrKnockCylinder15
c1-65	13065	ErrKnockCylinder16
c1-66	13066	ErrKnockCylinder17
c1-67	13067	ErrKnockCylinder18
c1-68	13068	ErrKnockCylinder19
c1-69	13069	ErrKnockCylinder20

14 Parameter description

1905	KnockCtrlSpeedMin	
1906	KnockCtrlPowerMin	
1908	KnockCtrlOffLimitHys	Knock control will be activated if: Speed >= par. 1905 and RelativePower >= Par. 1906 Knock control will be deactivated if : Speed <= Par.1905 – Par. 1908 and RelativePower <= Par. 1906 – Par. 1908
1910	KnockWindowStart	
1911	KnockWindowWidth	Start of knock measurement window in ° crank angle pre top dead center Width of the knock measurement window in ° crank angle
1912	KnockFrequency	Mid-frequency of the band-pass filter
1913	KnockGain	
1914	KnockIntTimeConstant	Amplifying factor and time constant for the integration at knock DSP
1915	KnockValueHighLimit	At knock value > Par. 1915 the accordant cycle fort he cylinder is identified as knocking cycle
1916	KnockValueLowLimit	
1917	KnockValueLowDelay	Parameter failure detection of knock sensor: if Knock-Value < Par. 1916 for a time greater than Par. 1917, the accordant sensor is identified as defect

3910	KnockControlActive	Display of knock controls status
3912	KnockBandPassFreq	
3913	KnockGain	
3914	KnockIntTimeConstant	Displaying of mid-frequency, amplifying factor and integration time limit at DSP
3915	LightKnockLevelLimit	
3916	HeavyKnockLevelLimit	Limit of knock level for light and heavy knocking
3917	EngineLightKnock	
3918	EngineHeavyKnock	Displaying of the knock level of the engine
3940 - 3959	KnockValue1-20	Displaying of the actual, cylinder specific knock values
3970 - 3989	KnockLevel1-20	Displaying of the actual, cylinder specific knock values (amount of knock cycles during the last 100 cycles)
3990	EngineKnockLevel	Engine knock level = Max(Par. 3970-3989)
13050 - 13069	ErrKnockCylinder1-20	Cylinder knock-error (light knocking / heavy knocking / sensor-failure)

5901	MeasPowerOverCanOn	At Par. 5901 = 1, the load (RelativePower) will be taken over from master speed control via CAN
5910	KnockControlOn	Activates knock control

7900 - 8019	LightKnock1:Speed()/Load()/Lim()	Speed- and load depending look-up table for light knocking limit
8300 - 8419	HeavyKnock1:Speed()/Load()/Lim()	Speed- and load depending look-up table for heavy knocking limit

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