Handling a complex world.

Product Manual VDO CANcockpit

Product Manual VDO CANcockpit

Overview of Chapter

▼ = will follow

1. Safety Instructions

Contents

1. Safety Instructions

1.1 Installation

No smoking!
No naked flames or lights!

- The product is only designed for use in land-bound vehicles (except motorcycles).
- Make sure that the engine cannot be unintentionally started during installation.

Before installation

- Withdraw ignition key from ignition lock.
- Note down all data in temporary electronic memories.
- Before installation refer to the vehicle documents for details of vehicle type and any special features.
- Refer to the construction diagrams to find out the positions of the fuel/hydraulic/pneumatic and electrical lines.
- Take account of any modifications to the vehicle which have to be considered during installation.
- Failure to use the product correctly may cause harm to people, property and the environment. Therefore make sure you use our product correctly.
- Basic knowledge of vehicle electrics and mechanics is necessary for installation to prevent harm to people, property and the environment.
- The product has been developed, manufactured and tested in accordance with the basic safety requirements of EC directives and the acknowledged state of the art.
- Short circuits
  Short circuits in the vehicle's wiring can cause cable fires, battery explosions and damage to other electronic systems. Therefore disconnect the minus pole of the vehicle battery before starting work.
  If the vehicle has supplementary batteries, the minus poles of these batteries should also be disconnected.
- Modifying or tampering with the product may affect safety. Therefore it must not be modified or tampered with.
- When removing/installing seats, covers and the like, make sure that you do not damage lines or release plug connections.
- Possible data loss
  When the batteries' minus poles are disconnected, all the temporary electronic memories lose their entered data. Therefore, note down all the relevant data for re-programming before disconnection.

1. Safety Instructions

1.1 Installation

During installation

- During installation make sure that the product's components do not affect or restrict vehicle functions and are themselves not damaged.
- Only install undamaged parts in vehicles.
- During installation make sure that the product does not impair the field of vision and that the product is not positioned within the impact range of the driver's or passenger's heads.
- When selecting the installation location, make sure there is sufficient space behind the drilled holes and the installation opening.
- Take account of the routing of lines and cable leads.
- Do not select an installation location within the mechanical and electrical range of the airbag.
- Do not drill holes or cut openings in load-bearing or stabilizing struts or members.
- Err on the small side when predrilling installation apertures with cone-type cutters, compass or jig saws, or files, enlarge if necessary and complete. Deburr edges. Always follow the tool manufacturer's safety instructions.
- When working beneath the vehicle, secure the vehicle in accordance with the vehicle manufacturer's instructions.
- If any work is necessary while the engine is running, take special care. Only wear suitable working clothes because of the risk of injury due to pinching and burning. Long hair should be worn in a hair net.
- Only use the envisaged multimeters or diode-test lamps to measure wattages and currents in motor vehicles. The use of conventional test lamps can cause damage to control units and other electronic systems.

After installation

- Firmly connect the earth cable to the minus pole of the vehicle battery.
- (Re-)program the data in the temporary electronic memories.
- Test all(!) vehicle functions.
- VDO D'MAC components to be cleaned with clear water only.
  Observe the IP-degrees of protection (DIN 40050).

1. Safety Instructions

1.2 Electrical Connection

Connect the cables in accordance with the electrical connection diagram.

- Take account of the cable cross section
  A reduction in the cable cross section results in a higher current density. This can cause the cable to heat up.
- When laying electric cables, use existing cable ducts and routes but without laying cables parallel to ignition cables or cables leading to high current consumers. Fix the cables with cable tape or adhesive tape.
- Do not route cables over mobile components. Do not fasten cables to the steering column.
- Make sure that the cables are not exposed to tensile, compressive or shear forces.
- If the cables are routed through drilled holes, protect them with rubber sleeves or the like.
- Strip cables only with a cable stripper. Adjust the stripper so that no strands are damaged or severed.

  Solder new cable connections only with the soft soldering process or use standard crimp connectors.
- Crimp connections should only be made with a crimping tool. Follow the tool manufacturer's safety instructions.
- Insulate exposed strands so that no short circuiting can occur.
- Faulty wiring can cause short circuiting. Wire the cables only in accordance with the electrical connection diagram.

1. Safety Instructions

1.3 Sensors

1.3.1 VDO Pressure Sensor for Oil

- ❒ Sensor installation location: At the place provided by the engine manufacturer, equipment manufacturer or car manufacturer in the oil circulation system (most often in place of the oil pressure switch).
- ❒ Sensor installation only when engine is cold.
- ❒ When removing the oil pressure switch or the screw from the drilled hole for the oil pressure measuring system, collect the oil running out of the system in a proper container and dispose of it in accordance with legal regulations.
- ❒ The values mentioned in the following table for the maximum tightening torque (Nm max.) refer exclusively to the load-bearing capacity of VDO products.
  Prior to using the VDO product, it is important to ask the manufacturer of the vehicle, equipment system or engine in each instance for the maximum torque (? Nm max.) value for the threaded hole into which the VDO product is to be screwed. Non-observance of the maximum tightening torque specified for the threaded hole in each instance can result in damage to the vehicle, engine or equipment system.

	max.
M10 x 1	30 Nm
1/8 in. BSPF	30 Nm
1/8 - 27 NPTF	30 Nm
R 1/8 DIN 2999	30 Nm
M12 x 1,5	40 Nm
M12 x 1	50 Nm
M14 x 1,5	50 Nm
1/4 in. BSPF	60 Nm
1/4 - 18 NPTF	60 Nm
3/8 - 18 NPTF	60 Nm
M16 x 1,5	80 Nm
3/8 - 18 Dryseal NPTF	80 Nm
M18 x 1,5	100 Nm

- ❒ If the connection thread is cylindrical, a sealing washer or a sealing ring made of copper must be fitted.
- ❒ Following sensor installation, fill up the system with the required quantity of specified oil.

1. Safety Instructions

1.3 Sensors

1.3.2 VDO Temperature Sensor for Oil

- Sensor installation location: At the place provided by the engine manufacturer, equipment manufacturer or car manufacturer in the oil circulation system (e. g. oil drain plug).
- Sensor installation only when engine is cold.
- When removing the oil drain plug, collect the oil running out of the system in a proper container and dispose of it in accordance with legal regulations.
- The values mentioned in the following table for the maximum tightening torque (Nm max.) refer exclusively to the load-bearing capacity of VDO products.
  Prior to using the VDO product, it is important to ask the manufacturer of the vehicle, equipment system or engine in each instance for the maximum torque (? Nm max.) value for the threaded hole into which the VDO product is to be screwed. Non-observance of the maximum tightening torque specified for the threaded hole in each instance can result in damage to the vehicle, engine or equipment system.

	max.
M10 x 1	10 Nm
M10 x 1.5	10 Nm
1/8 - 27 NPTF	10 Nm
M12 x 1.5	15 Nm
1/2 - 20 Gang	15 Nm
M14 x 1.25	20 Nm
M14 x 1.5	20 Nm
5/8 - 18 UNF - 3A	20 Nm
1/2 In. 20 Whit. S	20 Nm
1/4 - 18 NPTF	20 Nm
M16 x 1.5	30 Nm
M18 x 1.5	30 Nm
M20 x 1.5	30 Nm
M22 x 1.5	30 Nm
M24 x 1.5	30 Nm
M26 x 1.5	30 Nm
1/2 - 14 NPTF	30 Nm
3/8 - 18 NPTF	30 Nm
R 1/2	30 Nm
R 3/8	30 Nm
3/8 - 18 Dryseal NPTF	30 Nm
3/4 - 16 UNF-3A	30 Nm

- If the connection thread is cylindrical, a sealing washer or a sealing ring made of copper must be fitted.
- Following sensor installation, fill up the system with the required quantity of specified oil.

1. Safety Instructions

1.3 Sensors

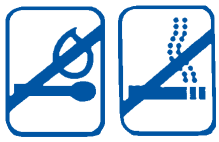
1.3.3 VDO Temperature Sensor for Engine Coolant

- Sensor installation location: At the place provided by the engine manufacturer, equipment manufacturer or car manufacturer in the coolant circulation system (e.g. in place of the temperature warning switch) or in the coolant hose.
- Sensor installation only when engine is cold.
- Collect the coolant running out of the system in a proper container and dispose of it in accordance with legal regulations.
- The values mentioned in the following table for the maximum tightening torque (Nm max.) refer exclusively to the load-bearing capacity of VDO products.
  Prior to using the VDO product, it is important to ask the manufacturer of the vehicle, equipment system or engine in each instance for the maximum torque (? Nm max.) value for the threaded hole into which the VDO product is to be screwed. Non-observance of the maximum tightening torque specified for the threaded hole in each instance can result in damage to the vehicle, engine or equipment system.

	max.
M10 x 1	10 Nm
M10 x 1.5	10 Nm
1/8 - 27 NPTF	10 Nm
M12 x 1.5	15 Nm
1/2 - 20 Gang	15 Nm
M14 x 1.25	20 Nm
M14 x 1.5	20 Nm
5/8 - 18 UNF - 3A	20 Nm
1/2 In. 20 Whit. S	20 Nm
1/4 - 18 NPTF	20 Nm
M16 x 1.5	30 Nm
M18 x 1.5	30 Nm
M20 x 1.5	30 Nm
M22 x 1.5	30 Nm
M24 x 1.5	30 Nm
M26 x 1.5	30 Nm
1/2 - 14 NPTF	30 Nm
3/8 - 18 NPTF	30 Nm
R 1/2	30 Nm
R 3/8	30 Nm
3/8 - 18 Dryseal NPTF	30 Nm
3/4 - 16 UNF-3A	30 Nm

- If the connection thread is cylindrical, a sealing washer or a sealing ring made of copper must be fitted.
- Following sensor installation, fill up the system with the required quantity of the compositon specified coolant.

1. Safety Instructions



1.3 Sensors

1.3.4 VDO Fuel Level Sensor (Lever Type Sensor/Tubular Type Sensor)

- ❒ An installation opening remaining to be made in the tank at a suitable point for supply level measurement or at an installation flange or installation opening already provided by the tank manufacturer.
- ❒ If an installation opening must be made, the tank must be completely drained first. Fill the fuel into an approved container.
- ❒ ⚠ Risk of explosion exists due to presence of residual gases in the tank! Make sure that the tank is aired sufficiently (approx. 10 minutes).
- ❒ Make a preliminary hole in the installation opening using a drill and then finish the hole using a compass saw or piercing saw. Comply with the safety instructions of the tool manufacturer. Clean the tank of residue from the drilling or sawing work.
- ❒ The safety instructions given by the welding equipment manufacturer and the working regulations applying to welding work must be respected when welding the tank flange.

Produkt Manual VDO CANcockpit

2. Functional Specification

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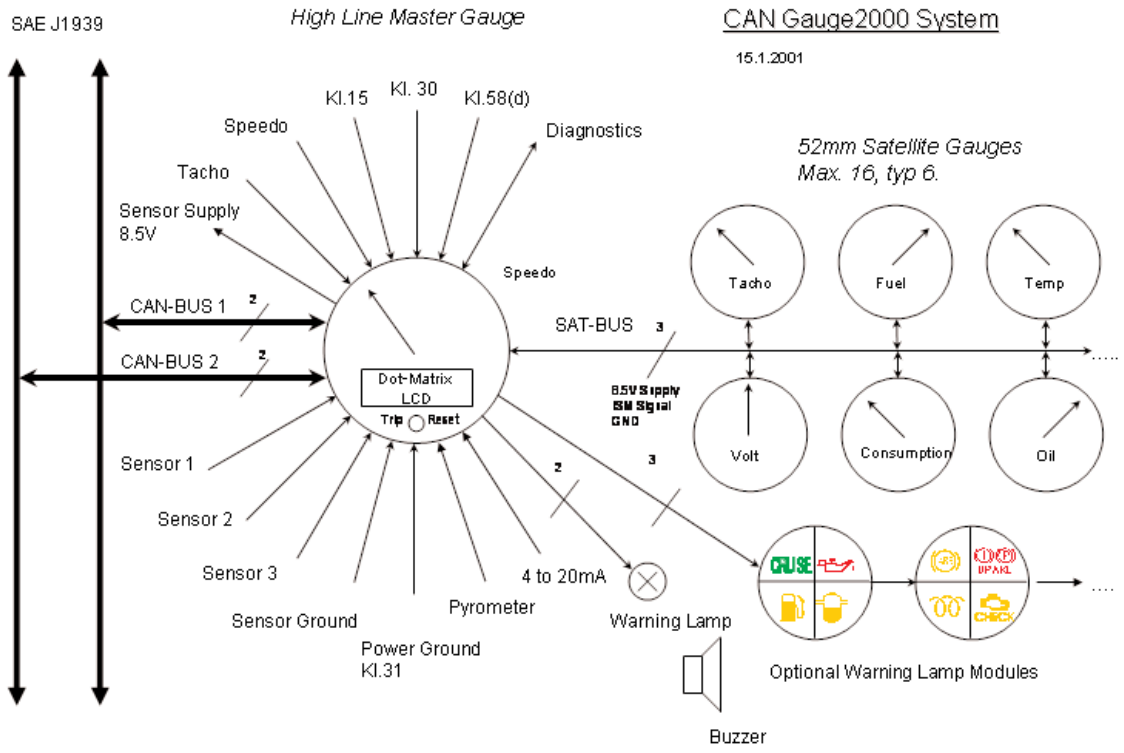
2. Functional Specification

1 System

1.1 Main Features

- Master-Slave relationship between Master gauge and other instruments
- Up to 16 Slave functions on one Master instrument or 32 with the use of two Master instruments
- CAN protocol flexibility (processing two protocols simultaneously)
- Modular "plug & play" as needed
- Analogue sensor compatible
- Frequency inputs
- Dot-matrix information display
- Switch outputs available
- Flexible to customer needs

1.1.1 Block Diagram CANcockpit



1.2 Mechanical Concept

The Masters are 80, 85 and 100 mm in diameter, the standard Satellite gauges ø 52 mm. As future options Master in 110 mm and Slaves in 80, 85 and 100 mm diameters are being considered.

The dials are translucent backlighted. The illumination of the gauges is realised with white LED's.

The backlighting of the LCD has a yellow LED. The warning lamp in the slave can have a red or

yellow LED.

The housing and bezel are made of non-flammable plastic, the design is like a triangle with the black color RAL 9005. The bezel is clipable. The lens is flat and frosted. The pointer has a PC hub in black and the pointer arm is OL 5105 (white -coated on the underside). The pointer type is translucent illuminated.

The housings have an indent in the thread at 6 o'clock position, so that an optional key can be

used according to SAE J1226 and SAE J 1399.

The movements are front-mounted stepper motors MW2000, only clockwise indication.

2. Functional Specification

1.3 Safety Concept

1.3.1 Sensors

Analog sensors can be checked for short and open circuit.

1.3.2 System Check

When the trip-reset button is pressed while ignition is being turned on, the system-check function is activated and clears the contents of the DTC List.

If there are any active service messages, they will be displayed on the Dot-Matrix Display starting with the first active service message. If the reset button is then pressed and held for 5 seconds or longer, this service message will be reset. The next active service message is displayed thereafter.
To proceed to the next active service message without resetting the displayed code, the button needs to be pressed shortly (<5 sec). If all active service codes have been displayed, the system check function is started as described below:

1. All warning lamps and illumination of all gauges are activated for 3 seconds.
2. The Master gauge initializes all configured satellite gauges and waits until they are ready or a Satbus timeout occurs.
3. During time.this, all LCD-Dots are turned on for about 1.5 sec, all pointers are moved to their end value
4. Then all LCD-Dots are turned off and the pointers move back to zero, for about 1.5 sec too, and all warning lamps and illumination will be turned off
5. Firmware version and Check sum of the EEPROM in hexadecimal format are displayed for about 10 sec.

The display format is as follows:
XX represents a hex-coded value

Small display line	Format	Description
2	hXX sXX.XX dd_mm_yyyy	hXX specifies the Hardware version relevant to the Firmware sXX.XX refers to the Firmware version, for example s01.10 stands for V1.10. dd_mm-yyyy is the Firmware date in day, month and full-year format.
4	nXXXXwXXyXX cXXXXXX	nXXXX is the WINgauge serial number of the device as programmed into the EEPROM. wXXyXX displays the production week and year in short format. cXXXXXX shows the actual 3-byte Checksum of the EEPROM as calculated during the system check.

1.3.3 Satbus

After ignition for synchronisation the Master gets feedback from the satellites.
A timeout function can be programmed too. If more satellites are configured, the Master will not get feedback from all gauges. After a timeout of about 14 seconds, the Master will act as described before, when the Master gets feedback from all satellites.

During normal operation there is no feedback from the satellites.

1.3.4 WINgauge

A system diagnosis function for testing all in- and outputs is implemented in the WINgauge Software.

2. Functional Specification

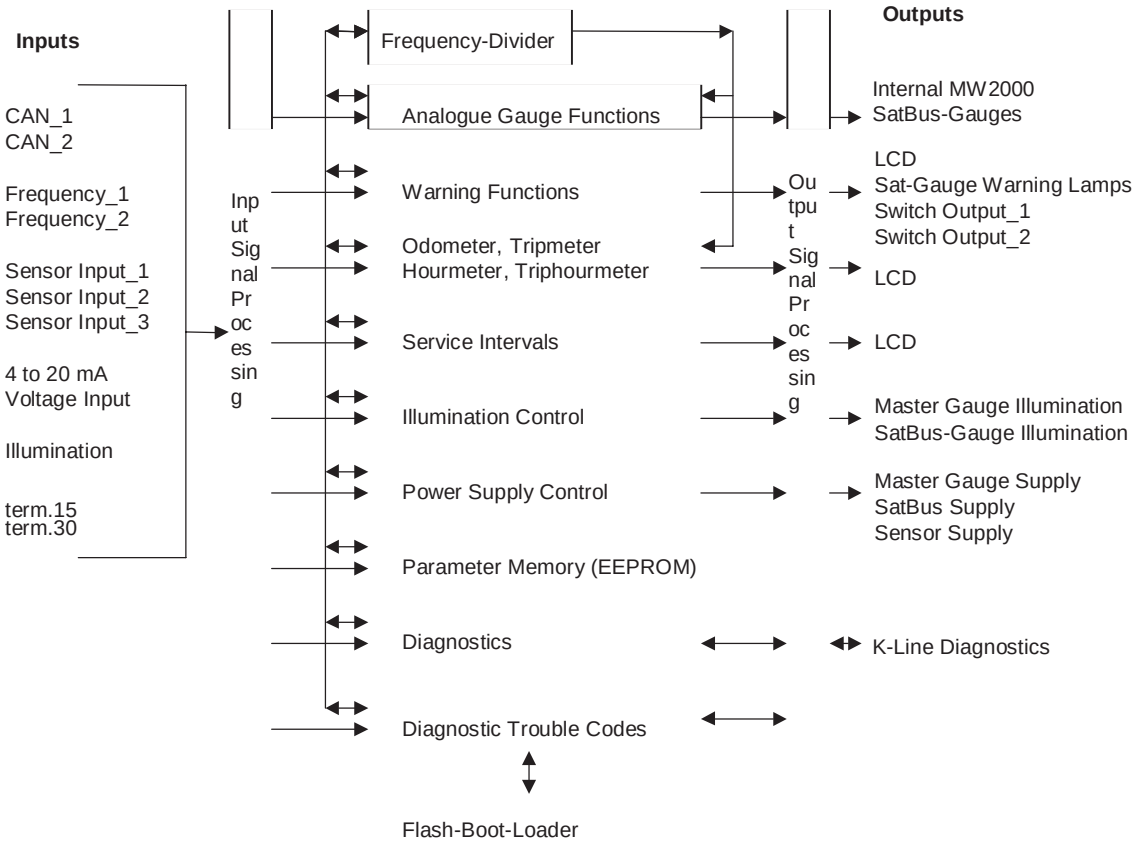
2 Master

2.1 Common Features

The VDO design concept for this design includes:

- High-speed Full-CANbus interface V2.0B compatible (High-Line has two CANbus interfaces).
- Half-duplex serial link to satellite gauges.
- VMC SCAL CDVV Microcontroller with identical firmware.
- Stepper motor MW2000 directly controlled by Microcontroller.
- Satellite gauges use SM2 stepper motor driven by ISM IC.
- LED illumination concept.
- 132 x 33 dots matrix LCD.
- Wide input voltage range switch mode power supply.
- Diagnostic Interface for configuration.

2.1.1 Main Functions



2. Functional Specification

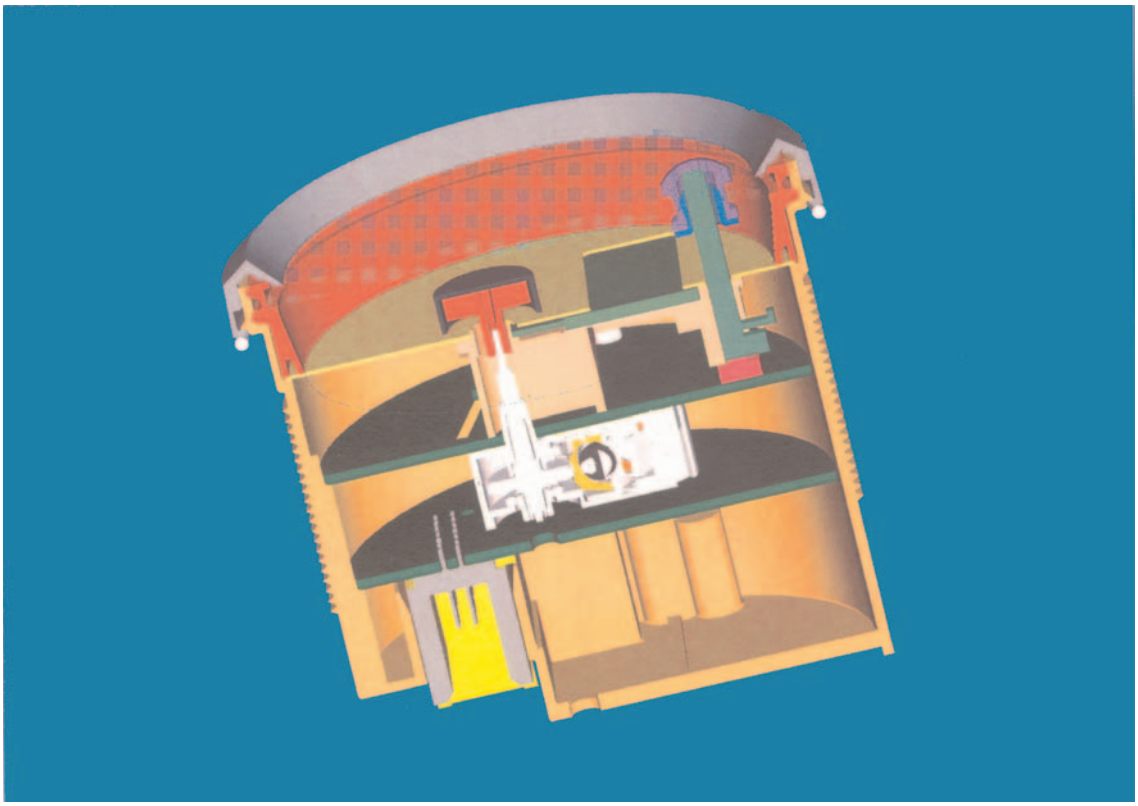
2.2 Mechanical Concept

As the same LCD is used for different Master gauge diameters the pointer position has different eccentricities and indication angles.

Gauge diameter [mm]	Eccentricity [mm]	Indication angle
80	7	210°
85	4.5	216°
100	0	206°

The connectors are 26-Pin MODU II-Connector and 4-Pin MATE-N-LOK from AMP.

2.2.1 Master dia. 80 mm



Two PCB's are necessary for this diameter. They are connected with a standard pin connector and two distance towers.

2.2.2 Master dia. 85 mm

The PCB assemblies and their corresponding parts of the Ø 80 mm and Ø 85 mm gauges are identical. The difference between the two gauges is the position of the stepper motor on the PCB so that the eccentricity of 7 mm in the Ø 80 mm gauge can be reduced to 4.5 mm in the Ø 85 mm gauge.

2.2.3 Master dia. 100 mm

For this size, only one PCB assembly is necessary. Input Signal Processing.

2. Functional Specification

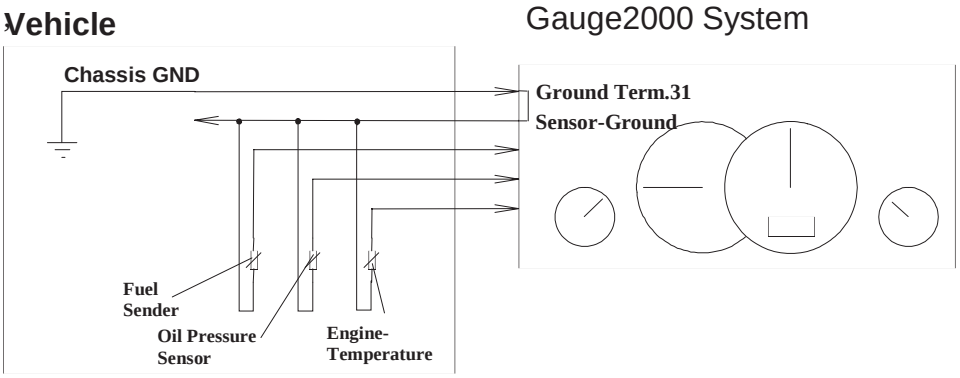
2.3 Input Signal Processing

2.3.1 Analog Inputs

All sensor characteristics can be defined with the WINgauge Software.

2.3.1.1 Grounding Concept

The Master gauge has two main ground lines. Ground term.31 is connected to the vehicle's body (negative battery terminal) and Sensor Ground is supplied from the instrument; insulated return sender are necessary. The Sensor Ground should not be connected to vehicle ground, which would result in a higher current flowing through this line and thus produce a signal noise and measurement error. Sensor Ground and Ground term.31 are joined together inside the Master Gauge. This grounding principle is necessary to accurately measure analog values. Ground shift on Sensor Ground is minimized by this concept.



2.3.1.2 Sensors

The static and dynamic voltage drop of the sensors should not exceed 0.5 V.

Pressure:	10 - 184 Ohms
Temperature:	10 - 700 Ohms
Fuel lever type:	3 - 180 Ohms
Fuel dip-pipe:	0.5 - 90 Ohms
Other sensors:	4 - 20 mA
Other sensors:	0 - 5 V

2.3.2 Input Signal Processing applied to the two frequency inputs

Frequency 1:
The standard modules can be changed to 500 < k < 400 000 pulses/km or miles for the Speedometer and 0.5 - 400 pulses/rev for the Tachometer.

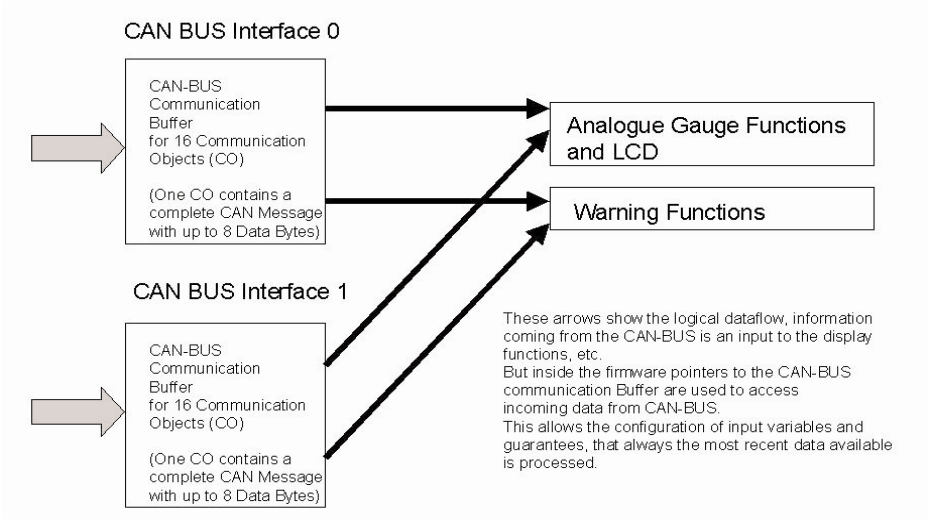
Maximum frequency is 40 kHz (2 kHz via internal divider).

Frequency 2 as Hall Sensor / Terminal W:
500 < k < 65000 pulses/km or miles for Speedometer and 0.5 - 65 pulses/rev for Tachometer.

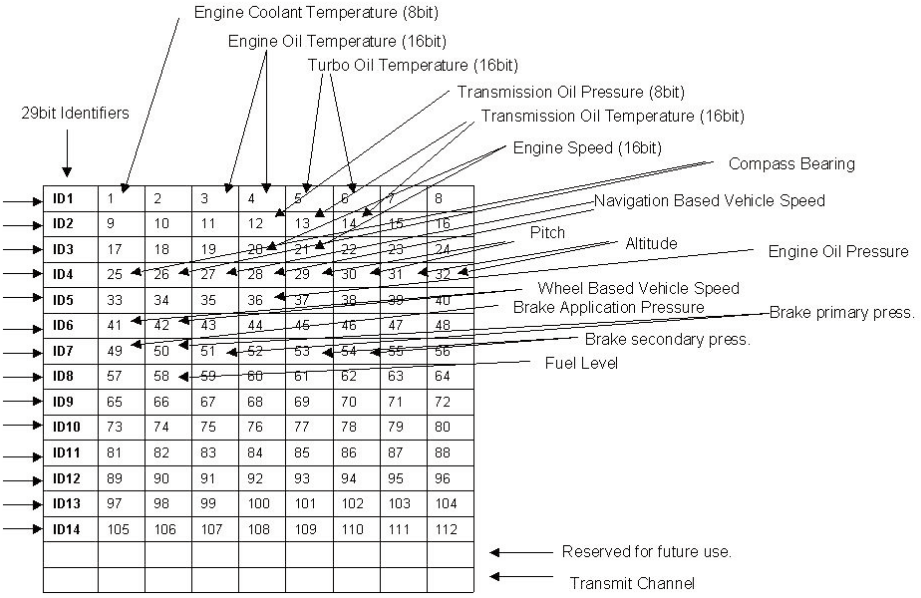
Maximum frequency is 2 kHz.

2. Functional Specification

2.3.3 Input Signal Processing for CANbus messages



Example of SAE J1939 Messages received on one of the two CANbus Interfaces.



The Master Gauge CANbus interface conforms to CAN 2.0B specification and supports extended (29Bit) identifiers. The Gauge acts as a "Standard ECU, which is non-configurable as defined in SAE J1939. The application layer is based on SAE J1939/71 Rev 98-10.

Future Options:
Additional communication protocol to be considered: CAN Open
For this the different CANbus data bases will be provided by the WINgauge configuration.

2. Functional Specification

2.4 PIN Assignment Description

Master:

Pin	Description	Pin	Description
1	Power Supply (terminal 30)	14	+ 8 V DC for sensor supply
2	Ground (terminal 31)	15	0 - 5 V DC Input
3	CAN1 _High	16	Illumination (terminal 58 (d))
4	CAN1 _Low	17	Ignition (terminal 15)
5	CAN2 _High	18	Frequency Input 2 (0-2 kHz)
6	CAN2 _Low	19	Frequency Input 1 (0-40 kHz)
7	NC	20	Switch-Output_1
8	k-Line	21	Switch-Output_2
9	Analog Input 1 (0,5 - 200 Ω)	22	SCK-Out
10	Analog Input 2 (0,5 - 300 Ω)	23	Latch
11	Analog Input 3 (10 - 700 Ω)	24	SIO
12	4 - 20 mA Input	25	Analog GND
13	4 - 20 mA GND	26	Frequency GND

2.4.1 Technical Description

PIN 1: Power Supply (terminal 30)
V_{Batt} = + 9 V to + 32 V
The instrument is supplied with permanent power through this terminal. Current consumption varies depending on the instruments operating mode (standby or active) and number of Slaves.

PIN 2: Ground (terminal 31)
Power ground of the instrument.

PIN 3, 4: CANbus Interface 1
High-Speed Full CANbus V2.0B compatible (10, 20, 50, 125, 250, 500 kbit/s, 1 Mbit/sec.).
12 V and 24 V system compatible.
Maximum No. of nodes: 30
Cable: shielded, twisted pair with a drain.
Cable Impedance: nom. 120 Ω.
Topology: linear Bus
Trunk Length: max. 40 meters
Drop Length: max. 1 meter
Termination: 2 resistors 120 Ω at each end of the bus.
Related documents: ISO 11898, SAE J1939/11

A combination of 29 bit ID and 11 bit ID can`t be processed!

PIN 5, 6: CANbus Interface 2
See on CANbus Interface 1.

PIN 7: Not connected

PIN 8: K-Line Diagnostic Interface
Programming of the EEPROM and the diagnostics carried out via serial diagnostic interface K-Line.

PIN 9, 25: Analog Input 1
Range: 0.5 - 200 Ω
Standard sensors: Tube-type Sensor: 0,5 Ω to 90 Ω
Lever-type Sensor: 3 Ω to 180 Ω.
Sensor has to be connected between theese pins.

2. Functional Specification

PIN 10, 25: Analog Input 2
Range: 0.5 - 300 Ω
Standard sensors: Pressure sensor(10 - 184 Ω)
Sensor has to be connected between theese pins.

PIN 11, 25: Analog Input 3
Range: 10 - 700 Ω
Standard sensors: Temperature sensor (38 - 700 Ω)
Sensor has to be connected between theese pins.

PIN 12, 13: 4 to 20 mA Input
Range: 4 to 20 mA
A resistor converts the 4 - 20 mA current into proportional voltage. Results are sampled every 31.25 msec by the Microprocessor.

PIN 14: +8 V sensor power supply:
Voltage: +8 V - 0 %, +10 %
Max. current: 50 mA

This output can be used only at 24 V power supply.

PIN 15: 0 - 5 V Input :
Range: 0 - 5 V
Results are sampled every 31.25 msec by the Microprocessor.

PIN 16: Illumination Input (terminal 58 (d):
Range: 0 to $U_{Bat.}$ (battery voltage)
Dimming of Master gauge illumination and attached Satellite gauges is controlled by the voltage amplitude at the Illumination input.

PIN 17: Ignition (terminal 15)
Vign.= + 9 V to + 32 V
The Microprocessor senses the voltage at the input and turns it into active mode, if the ignition is turned on.

PIN 18, 26: Frequency Input 2
Hall Sensor and terminal W:

Max. Frequency:	2 kHz
U high min.:	5 - 7 V according to the configurated pulses
Signal type:	square, sinus
Max. offset:	0.5 V
Off current max.:	100 µA
Duty cycle:	50 ± 15 %
Pulse ratio:	500 - 65 000 pulses/km or miles
Pulse/rev:	0.5 - 65 pulses/revolution

The Instrument has a pull-up resistor at the ignition in the input circuit. Input can be either road speed or engine speed. Selection by configuration.

Only one frequency input (either Input 1 or 2) can be defined as road speed input.

PIN 19, 26: Frequency Input 1
Universal Frequency Input

Max. Frequency:	40 kHz (2 kHz via internal divider, 1:1; 1:2; ... 1:20)
U_{high} min:	1.5 - 10 V according to the configurated pulses
Signal type:	square, sinus
Max. offset:	0.5 V
Off current max.:	100 µA
Duty cycle:	50 ± 15%
Pulse ratio:	0.5 - 400 pulses/revolution

2. Functional Specification

The instrument has a pull-up resistor at ignition in the input circuit. Input can be either road speed or engine speed. Selection by configuration. An adjustable frequency divider reduces input frequency, so that it can be processed by the Microprocessor.

Only one frequency input (either Input 1 or 2) can be defined as road speed input.

PIN 20: Switch Output 1
Maximum voltage: 32 V
Maximum current: 0.5 A
Warning lamp to be connected between output and supply voltage (terminal 15 or terminal 30).
Switch output controlled by the Microprocessor. The pin turns the output either on or off (static). The output is an open drain and acts like a low switch to ground.

Save against high current with a Fuse 0.5 A!

PIN 21: Switch Output 2
Identical with Switch output 1

PIN 22: High-Port Output "SCK_OUT"
Maximum voltage: 32 V
Maximum current: 0.5 A
Uni-directional clock line of the synchronous serial interface, to be used for connection to external shift registers. Output driver is an "open-drain" output.

PIN 23: High-Port-Ausgang "LATCH"
Maximum voltage: 32 V
Maximum current: 0.5 A
Uni-directional latch signal line of the synchronous serial interface, to be used for connection to external shift registers. Output driver = "open-drain" output.

PIN 24: High-Port In/Output "SIO":
Maximum voltage: 32 V
Maximum current: 0.5 A
Bi-directional data line of the synchronous serial interface, to be used for connection to external shift registers for I/O extension.
Output driver = "open-drain" output with a pull-up resistor at ignition voltage.

Slave

Pin	Description	Pin	Description
1	Supply	3	GND
2	Satellite - Bus	4	-

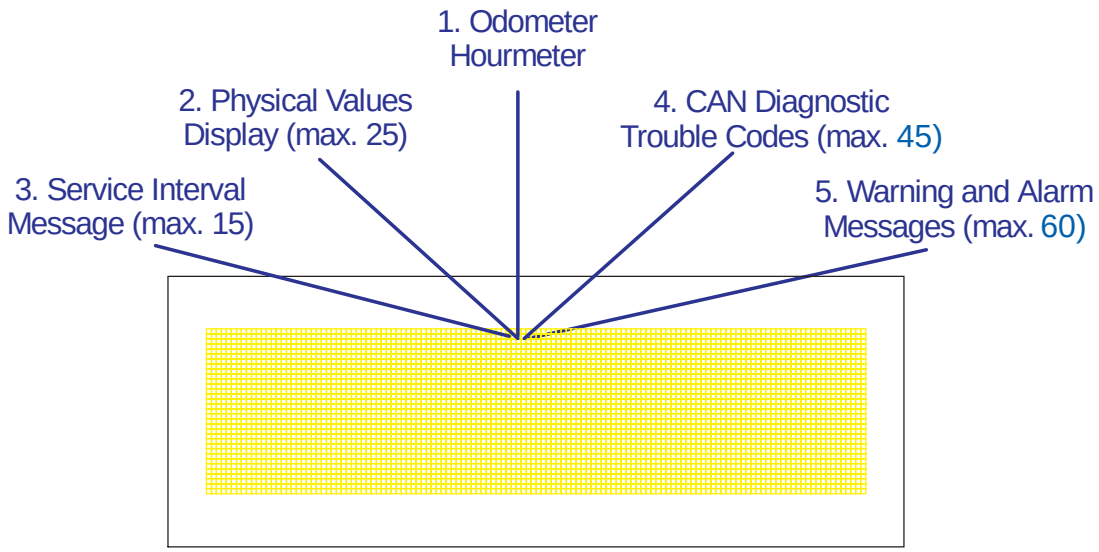
PIN 1-3: Satellite Bus Interface (Satbus):
Bus signal levels: 5 V ± 10%
Ground reference: ± 100 mV
Max. Bus length: 10 m
Cable impedance: Standard cable
Connector: 4-Pin MATE-N-LOK AMP

Satbus is used in a Master-/ Slave-configuration and is bi-directional with half-duplex communication. When the system is active, a constant clock signal is produced on the bus by the Master gauge.
Bit-rate on Satbus = 31.25 kHz.

2. Functional Specification

2.5 Display Functions

Five main display functions have been specified for the Master gauge. (s. picture below) As the number of displays in each main function is configurable (except for odometer and hourmeter), the actual number of displays can be up to a maximum of 146.



A maximum of 30 Warnings and 30 Alarms can be set. The Physical Values of the defined Satellite gauges can be shown on the display (if configured). A total of 25 physical value Displays (PVD) are possible, including the physical values inidcated by the Satellite gauges. Thus with increasing numbers of Slaves defined by WINgauge, the number of freely selectable physical values to be displayed on the dot-matrix decreases.

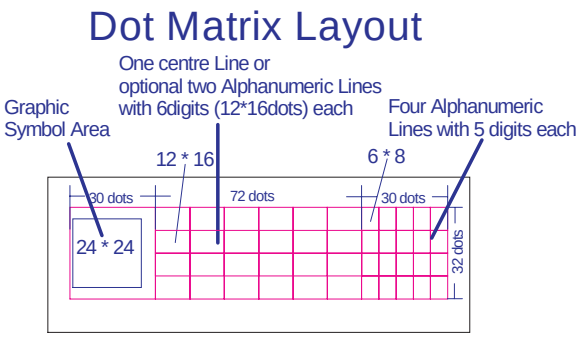
2.5.1 Navigation through Display

The order of the display groups is: Odometer / Hourmeter, Alarms, CAN DTCs, Service Messages, Physical Values, Warnings and then back to Odometer / Hourmeter. The Alarms, CAN-DTCs, Service Messages and Warnings are being monitored and appear only if they are activated. If the button is pressed more than 2 sec., the LCD shows the main display which is Odometer / Hourmeter.

2.5.2 Display Layout

The Dot-matrix Display has 132 x 33 dots.
The following picture shows the proposed display layout. The outer line represents the LCD glass and the inside marks the active display area. The structure inside has only been drawn for illustration; it is not visible on the display itself

2. Functional Specification



The display is structured into three main areas:

1. Symbol Area
This 30 x 32 pixel area is reserved for graphic symbols. The symbols are left aligned to optically enlarge the appearance of the symbol.

2. Central Area
The centre of the display is organised as one or two lines with 6 digits each. Here it is possible to show alphanumeric ASCII characters using the large font (12 x 16 pixel). If only one line is displayed, then this line will be centred in vertical direction.
Short text (up to 6 letters) can be used to provide identification for the value displayed. This area is best suited to communicate important numeric values to the user. Values will be shown in the second line on the right, where units appear on the left.
One or two centre lines are configured via WINgauge as well as the description of the short text.

3. Physical Unit Area
The physical unit area is located right of the alphanumeric Centre Lines. In general the unit belonging to the value displayed on the centre lines is shown here as text. This area is organised as four lines of 5 characters of the small font. If the Unit can be displayed with less than three ASCII characters, then the large font is applied, else the small font is used. Units will not be wrapped into the next line.

If there are two Centre Lines, then there will also be two-unit Lines (small Line 2 and Line 4). In case only one Centre Line is displayed, then only one corresponding Unit Line will be visible (small Line 3).

It is therefore possible to show the following parameters and units to give a clear indication of the valid physical unit which can be chosen via WINgauge:

Parameter	Units
Revolution / rotation	1/min, rpm
Speed	km/h, mph, knots
Distances	km, m (Meter), mm, miles, mi, M, m (landmile = 1.609 km), nm (nautical mile = 1.852 km)
Power supply	Volt, V, A, mA
Time	h, hours, min, sec
Temperatures	°C, °F
Pressures	bar, psi, kPa, Mpa,
Level of liquids	%, l, gal (US-gallons)
Fuel consumption	l/h, gal/h, km/l, l/100, kg/h, km/kg
Weight	kg
Power	N, kN, Nm
Diverse	Ohm, Grad, deg, appl, Count, qm/h, Gear, Code, SPN, FMI

2. Functional Specification

2.5.3 Display Functions

2.5.3.1 Main Display (Odometer, Hourmeter)

The display shows total and trip in two lines. Total has 6 digits and trip has 4 plus 1 digit. The figures roll over to 0.0 after a distance of 999.999 / 9.999 or 100.000 / 1.000 hours. Pressing the button longer than 2 seconds will reset trip odometer or hourmeter.
A part of the Display can be used to show the company logo as a start-up display configured by WINgauge

Main Display for Speedometer

The centre of the display shows the value of the odometer in the first line and the tripmeter underneath. The physical unit is displayed right to it and can be either miles or km.
In case more than one alarm are active, the alarm symbol with the highest priority is displayed. The service symbol is shown here, if there is a service due, but no confirmed alarm exists.

Main Display for Tachometer

The main display of the tachometer is similar to the speedometer, except that it shows operating hours instead of odometer and trip meter.
The physical unit is "h" for hours. The digit after the decimal point of the trip hourmeter shows 1/10h.

Alarm Display

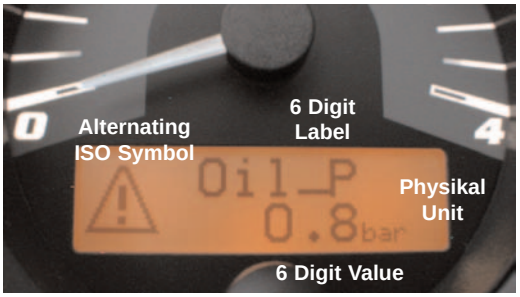
2.5.3.2 Alarm Display

If an alarm is triggered the Alarm Display is shown. To alert the user, the General- Alarm-Symbol is flashing, alternating with the symbol that indicates the type of alarm.
The Central area of the display shows the actual physical value (6digits). The physical unit appears to the right.

When the customer quits the alarm longer two seconds the Display will change to the last displayed value (if no other Alarm and Warning is existing which weren't quitted). The General Alarm Symbol will remain in the graphic Symbol Area with a vertical line on the right side of the symbol to indicate that the Alarm doesn't correspond to the main display but to another Physical Value.

When different Alarms are present the highest priority will be shown. The priority of the alarms is defined with the WINgauge Software. If the Alarm is confirmed and the Alarm condition does not exist anymore then the Alarm is cleared in the list of active Alarms. If the Alarm is not confirmed but the Alarm conditon does not exist anymore then the Alarm is still in the list of active Alarms.

To see the different Alarms in the Alarm display group the button has to be pressed shortly (>50 msec).



Configuration Option:

- To provide additional information two Centre Lines can be programmed. The top line displays a label for identification.
- If no physical value should appear on the display, then a configuration allows a display, which only shows the alternating graphic symbol in the centre of the display.

This option is useful, if a digital input triggers an alarm.

2. Functional Specification

2.5.3.3 CAN DTC Display

1 to 5 independent DTC channels can be configured. Every channel is able to receive the DTCs from one CAN device (Source Address).
If DTCs are received from any of the configured CAN devices, they will be stored into a DTC receive buffer. The buffer will be able to hold a total of 40 DTCs and will be implemented as a ring buffer, so that old DTCs can be overwritten by newly received DTCs

CAN DTC Display

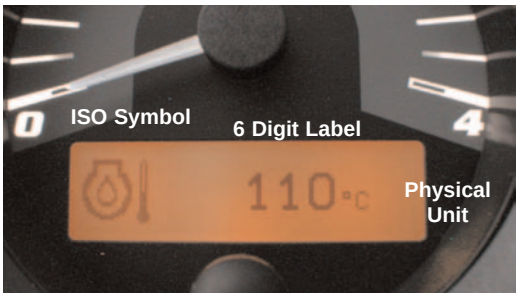
2.5.3.4 Warning Display

In the Warning display the Specific Graphic Symbol (ISO) is flashing at 1 Hz. There is no alternating.

The operator can acknowledge the Warning by pressing the button longer than two seconds. The Display will change to the Display, which was active before, if no other Alarms and Warnings are existing, which have not been acknowledged yet.

When different Warnings are present the highest priority will be shown. The priority of the Warnings is defined with the WINgauge Software. Alarms have higher priorities than the Warnings. If the Warning condition vanishes also the Warning will vanish, if it has been acknowledged.
To see the different Warnings in the Warning display group the button has to be pressed longer than 50 msec.

Warning Display



Configuration Option:

- To provide additional information two Centre-Lines can be programmed. The top line displaying a label for identification.
- If no phsyical value should appear on the display, then a configuration allows a display, which only shows the flashing graphic symbol in the centre of the display.
- This option is usefull, if a digital input triggers a warning.

2. Functional Specification

2.5.3.5 Service Message

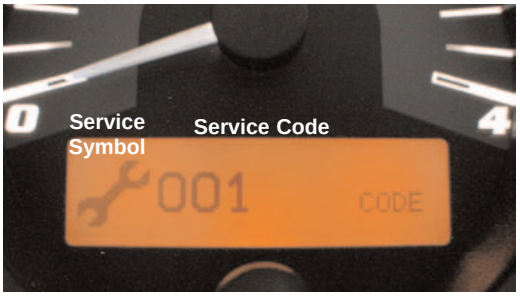
The Service Message indication is based on operating hours and odometer.

The Graphic Symbol Area displays the "Service Symbol" in case a Service Message becomes due.

The corresponding service code is shown on the centre line of the display centre. As a "unit" the word "CODE" appears to indicate, that the value is a code number.

To see the different active Service Messages in the Service Message display group the button has to be pressed longer than 50 msec.

Service Message



Configuration Option:
The Service Message indication can be configured as stand- alone or interval message.

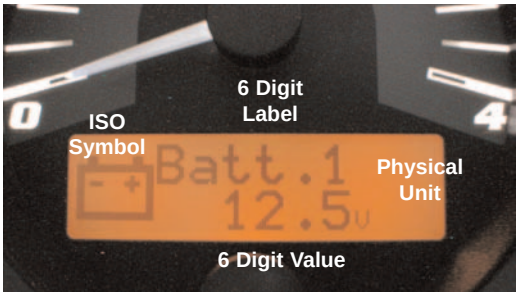
2.5.3.6 Physical Value Display

The graphic display area shows a symbol relating to the physical value displayed. The symbol can be selected via configuration from the defined symbols in ROM or EEPROM.
In the standard form the physical value is shown on a single Centre-Line, followed by the physical unit. This unit text can be selected from ROM during configuration. If the value is outside of the configurated range, then "------" is shown.

To see the different Physical Values in the Physical Value display group the button has to be pressed longer than 50 msec

Physical Value Display

Physical Value Display

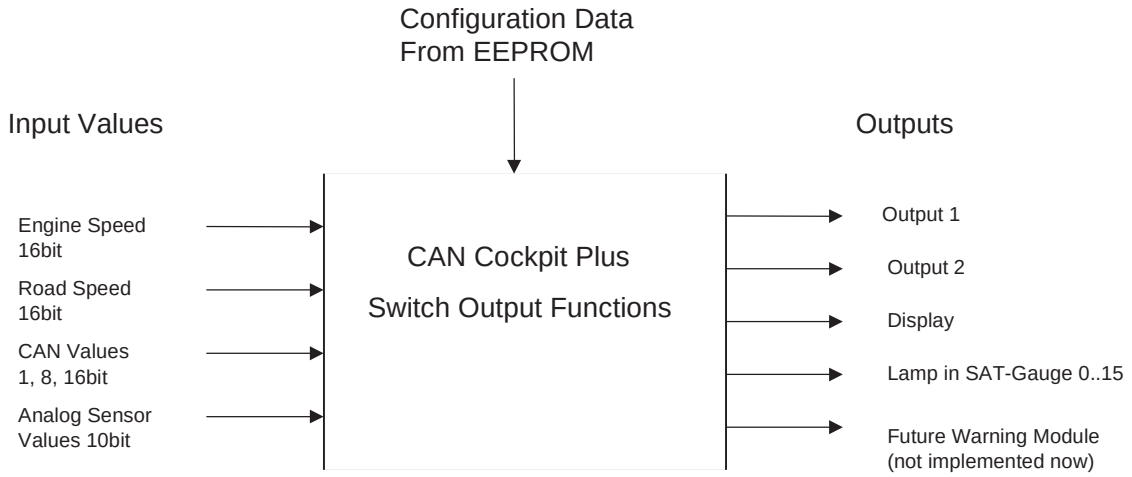


Configuration Option:
As an option a text label can provide identification for the value displayed. For example Battery one of two batteries, or Motor-2 of two motors. The text label can be configured via WINgauge with maximum 6 letters.

The physical value is displayed in the lower centre line.

2. Functional Specification

2.5.4 Alarm- and Warning Functions



The Alarms and Warnings are triggered by the input values. Configuration parameters in EEPROM select the input values. These variables can have a size of 1, 8 and 16 bit. Possible inputs are engine speed, road speed, data in CAN messages and analogue sensor values. Input values are then monitored and if the configured thresholds are exceeded, then an Alarm or Warning action is triggered, resulting in switch outputs being activated.

2.5.4.1 Description of the Outputs

Definitions:
Warning: Is a message to make the operator aware of a condition, which requires his attention.
Alarm: Is a message to alert the operator about a condition, which requires his attention and immediate action. The Alarm is more severe than a Warning.
The switch outputs are only controlled by the Alarm- and Warning Functions.

The following switch outputs are provided:
a. Output 1 and Output 2
These are two outputs, which act like two switches to ground. The switch output can control i.e. a warning lamp, a buzzer or a relay. It turns off, when the Alarm condition is not existing anymore, or if the Alarm has been acknowledged and it was configured. It stays on, if another Alarm condition also configured to turn on this output is still active.

b. Display
Every Alarm or Warning activates a display on the dot matrix. When the Alarm is triggered, then the associated display appears on the dot matrix, overwriting the previous display. The display combines a graphic symbol with a physical value (numerical value plus physical unit), describing the input value, which has caused the Alarm or Warning.

c. Warning Lamps in the Satellite Gauges
The Satellite Gauges include a warning lamp. This warning lamp can be turned on and off via the Sat-Bus. An Alarm or Warning could be configured to activate a warning lamp in each of the Satellite Gauges. The selected warning lamp in the Satellite Gauge remains on as long as the trigger condition remains, and turns off as soon as the trigger condition is not existing anymore. Flashing of the warning lamp can be configurated.

2.5.4.2 Switch Output Acknowledgement Function

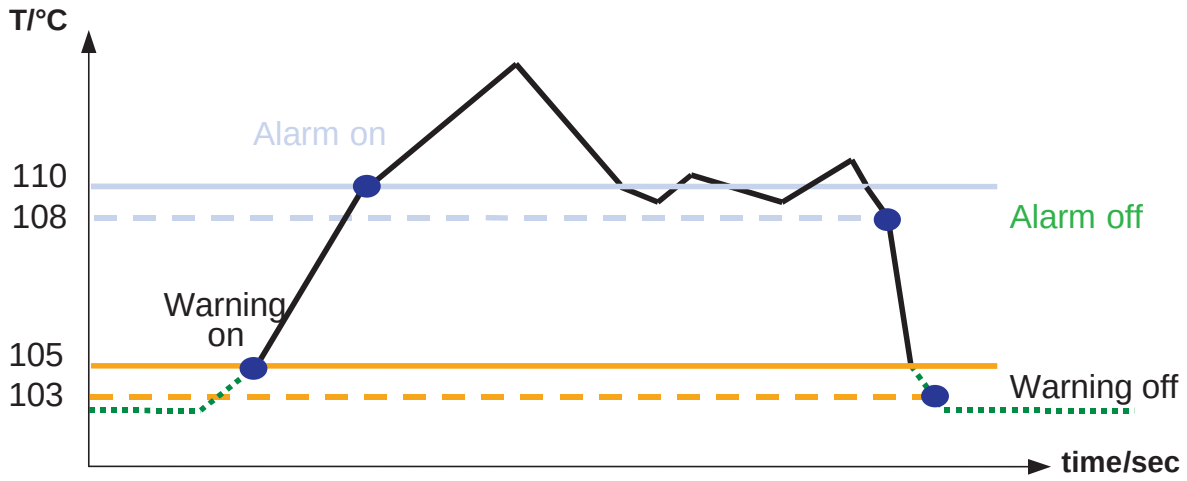
The Acknowledgement Function provides a means to turn off some of the switch output action. This may be desired, if the Alarm activates a buzzer and the operator wants to turn the buzzer off.

To acknowledge a switch output, the operator must press the button for more than 2 sec, while the Alarm or Warning is active.

When a Warning or Alarm has been acknowledged, then the Switch Outputs (1, 2) will be deactivated, if they have been configured to turn off these outputs.

2. Functional Specification

2.5.4.3 Alarm and Warning Trigger Conditions



The diagram above illustrates the Alarm and Warning trigger conditions for the engine coolant temperature as an example. The Warning threshold is set at 105° C, where the Alarm threshold is reached at 110° C. To prevent repeated on/off cycles of the Warning or the Alarm an activation hysteresis is applied. Therefore in above example an Alarm is turned off, if the temperature falls below 108° C and the warning is cancelled at 103° C. The hysteresis is 2° C in this case and is the same for both Alarm- and Warning condition. In addition a turn-on delay from 1 sec to 4 minutes can be configured. The delay time starts, when the threshold is reached. If the input value falls below the threshold value, then the delay time restarts from this point in time.

It can be configured, that the Warning is triggered, if a value rises above a threshold (as in the case of the engine coolant temp.), or if the input value falls below a threshold (e.g. fuel level).

2.5.4.4 Alarm and Warning Trigger enabling with Engine running

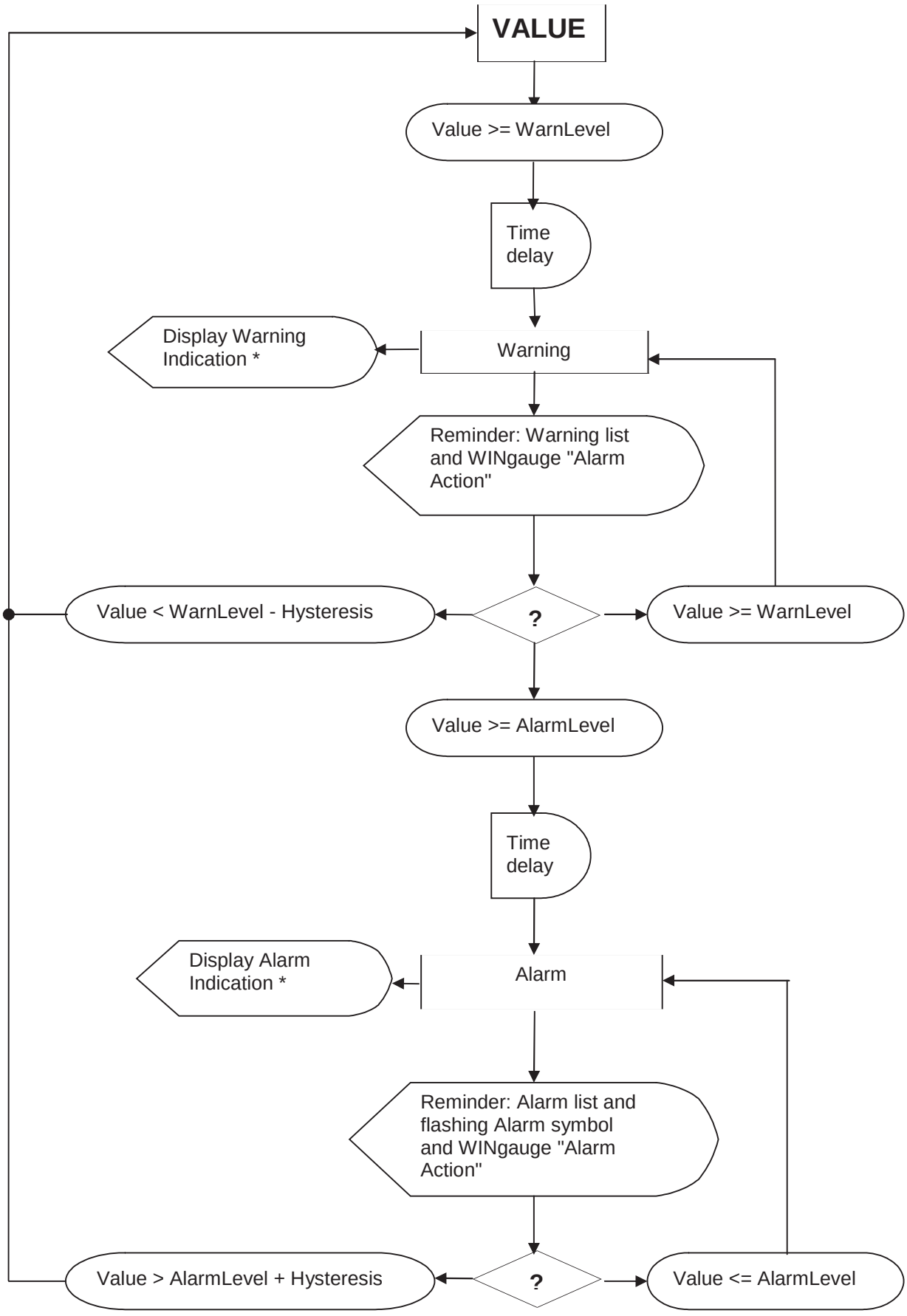
Triggering of some Alarms and Warnings only makes sense, when the engine is actually running. Examples are engine oil pressure or hydraulic pressure. For these situations triggering an Alarm and Warning can be disabled until the engine is running. This conditional trigger enable is selectable for every Alarm and Warning (together) during configuration.

Engine running is detected, by exceeding a separately configurable threshold value: the Alarm and Warning enable engine speed threshold. The minimum threshold is 0 rpm and the maximum is 32.000 rpm.

An additional trigger-enable time delay starting from engine running condition can be configured. This is helpfull in cases, where it takes a while until a pressure is built up.
This delay time is settable from 0 to 250 sec with a resolution of 1sec.

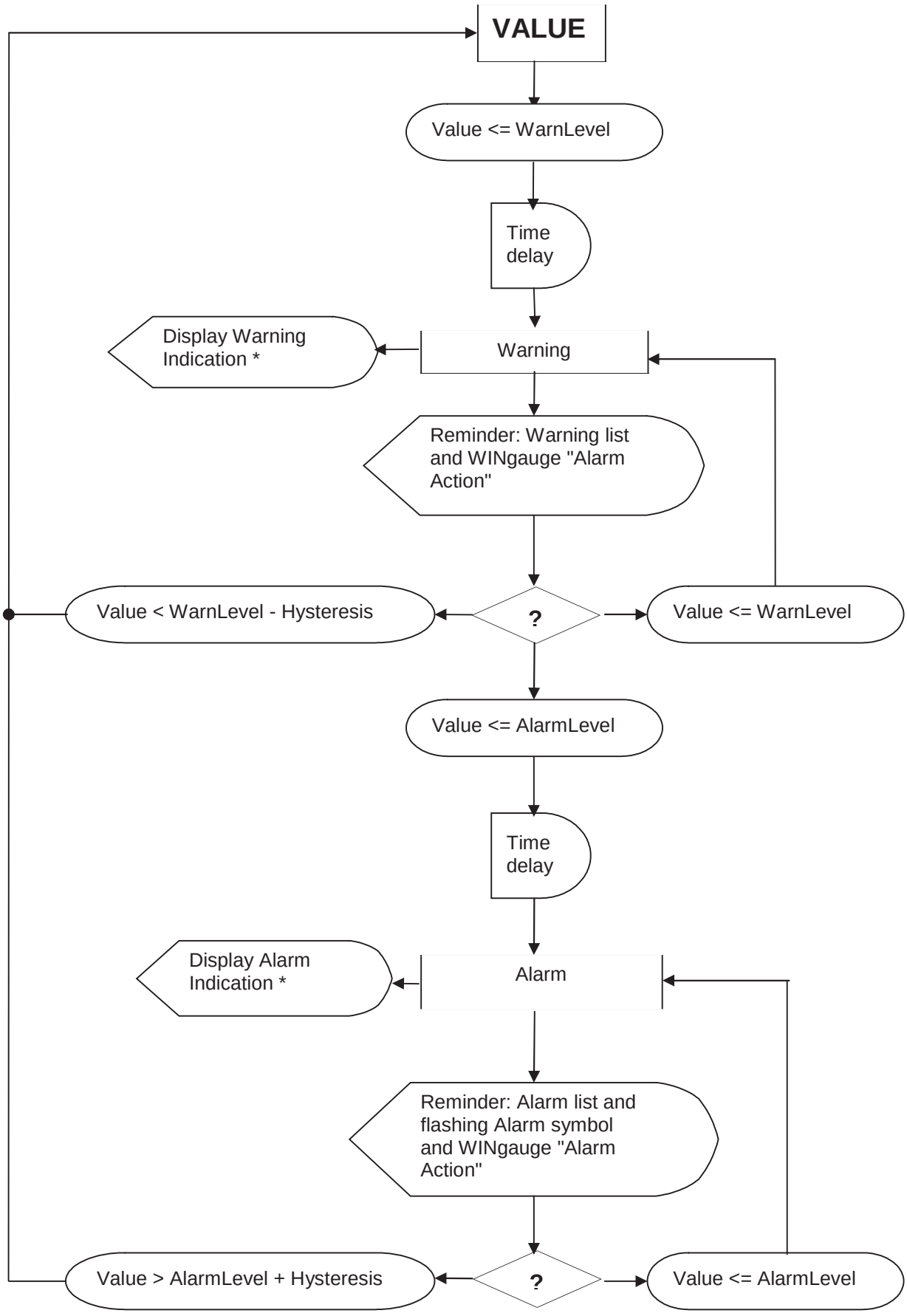
2. Functional Specification

2.5.4.5 Alarm and Warning State Diagram (Maximum Value Algorithm)



2. Functional Specification

Alarm and Warning State Diagram (Minimum Value Algorithm)



2. Functional Specification

2.5.5 Service

The Service message is based on the Hourmeter or Odometer.The service message indication can be configured via WINgauge. There are 15 independent service messages with customer specific settings, which can be configured via WINgauge. The service messages are implemented as periodic intervals. A message which should be indicated only once, the quantity of intervals would then be 0. Configuration data is stored in EEPROM.

For each of the 15 Service messages following can be specified in a table:

1. Service code number: Range: 1 to 255. 0 needs to be entered to disable this service function.
2. First message after x hours: (1h <= x <= 65.000 h)
3. Periodic service time: Range: 1h to 4.095h. If 0h is selected, it means only once (not periodic).

If a Service message has expired, this service code is displayed as a decimal number together with the common service symbol on the dot-matrix display. The Service message display remains active until this service code is reseted.

2.5.5.1 Reset of Service messages

The reset of the service message function is possible first if it occured and not before.

When a one-time service message will be reseted, then this Service message will be disabled by writing 0 into the service code field of the Service message table in EEPROM.

When a periodic interval will be reseted then the periodic service time will be added to the hours of the current hourmeter value. This will ensure, that even if a Service message is reseted later than required, the time to the next service indication will be the periodic interval time as specified.

Example: Service message No.: 12
Service code: 153
First service after: 300 h
Periodic service: 100 h

Event	Time (hourmeter)	Display
First service code displayed after	300 h	153
Reset of this service at	340 h	
Next service display at	440 h	153

The reset of the Service message is part of the system check function (part of safety check).

Procedure for resetting a Service message:

1. With ignition switched off, push the button and hold down while ignition is being turned on, then the system check function is activated and clears the contents of the DTC List.
2. If there are any service messages active, then they will be displayed on the Dot-Matrix Display starting with the first active service message. If the button is then pressed and held for 5 seconds or longer, then this Service message will be reseted. The next active Service message is displayed afterwards. To proceed to the next active service message without resetting the displayed code the button needs to be pressed shortly (<5 sec). If all active service codes have been displayed, then the system check function is started.

2. Functional Specification

2.5.6 CAN (SAE J1939) DTC (Diagnostic Trouble Codes) messages

It will be required to know the CAN source address (SA) of the controller (ECU), which has sent a DTC message, so that the problem can be located.

The SAE J1939 specifies 13 different diagnostic modes (DM1 to DM13). But for CANcockpit only DM1 is relevant. In DM1 active DTCs are broadcast on the CAN-Bus. Active means, that these faults are existing at the moment, compared to faults, which existed sometime in the past.

2.5.6.1 CAN SAE J1939 Elements

DTCs consist of 4 elements defined in SAE J1939:

1. Suspect Parameter Number (SPN) 19 bits
In the DTC, the SPN identifies the faulty element, component, sensor or parameter of a device (ECU).

2. Failure Mode Indicator (FMI) 5bits
The FMI defines the type of failure detected. It provides additional information about the nature of the fault. There are 32 predefined FMIs.
Examples are:
"Out of calibration", "Data Valid but above normal operational range", "Mechanical System not responding or out of adjustment"….

3. Occurrence Count (OC) 7bits
Zeigt an, wie häufig ein Fehler aufgetreten ist.

4. SPN Conversion Method (CM) 1bit
The February 1996 version of SAE J1939-73 contained inadequate definitions to assure consistent implementations. Consequently the specification of the DTC format was changed. To indicate the new consistent format this bit must be set to 0.
Due to the interpretation problems of the previous version, the old version will not be supported by CANcockpit.

DTC			
Data Byte 3 8 least significant bits of SPN	Data Byte 4 8 medium significant bits of SPN	Data Byte 5 3 most significant bits of SPN plus 5 bit FMI	Data Byte 6 Conversion Method bit plus 7 bit Occurrence Count.

The number of possible DTCs is very large, therefore efficient filtering is important for this function.

There are two main applications for DTCs (Diagnostic Trouble Codes):
- To inform the operator, that something is not as expected.
  Depending on the DTC it can have the nature of an Alarm (most severe), Warning or only Information
- To provide diagnostic information for the workshop, so that system faults can be analyzed and repaired.

2. Functional Specification

2.5.6.2 CAN DTC Information Display Requirements

1. Information for the operator needs to be brief and clear, so that action can be taken quickly, if required.

- Activate Warning Lamp
- Activate Switch-Output
- Display Short Text

2. For the workshop it is more important to get detailed information, so the cause can be found and fixed.

- DTC List with SPN, FMI and Occurrence Count

The DTC List can also be viewed by the operator, but requires detailed knowledge of the CAN devices reporting the DTCs. Also it can be expected, that the workshop will have other diagnostic tools, which can access even more Information than J1939 DM1.

2.5.6.3 CAN DTC Display Functions

2.5.6.3.1 DTC Reception

0ne to five independent DTC channels can be configured. Every channel is able to receive the DTCs from one CAN device (Source Address).
If DTCs are received from any of the configured CAN devices, they will be stored into a DTC receive buffer. The buffer will be able to hold a total of 40 DTCs and will be implemented as a ring buffer, so that old DTCs can be overwritten by newly received DTCs.
Every newly received DTC will be compared with latest DTC`s in the ring buffer. If they are different it will be stored in the ring buffer. Thus avoid overflowing of the ring buffer by toggling transmitted DTC`s.

2.5.6.3.2 DTC List

If the service personnel or the operator wants to check for received DTCs, he can step through the display list until coming to the DTC-Displays. There will be no automatic display, which comes up and must then be acknowledged. Therefore it is possible to prevent annoying displays coming up, if DTCs are received, which have no actual relevance.

The DTC List function will provide access to the DTCs inside the DTC receive buffer. One DTC Display will exist in the display list for every configured DTC channel (channel 1 to 5).

To see the received DTCs of one channel the operator presses and holds the button for longer than 2sec. At this time the processor will transfer the received DTCs from the DTC Receive Ring Buffer to the DTC List. Only the DTCs of the selected channel will appear in the DTC List. The most recent DTC will be shown first. Every short press will lead to earlier received DTCs, until all DTCs have been shown or the button is pressed and held for more than 2sec.

The DTC List will be cleared at ignition off/ on (configurable).

2. Functional Specification

2.5.6.3.3 DTC List Display Format

One Graphic Symbol per DTC Channel (Source Address) can be configured and will be shown together with the DTC in the upper and lower level. It indicates, where the DTC message comes from.
Also the number of received DTC`s on this channel (0-40) which are currently inside the DTC Ring Buffer will be displayed.

Examples:

Electronic Engine Controller (EEC) reports Pre-Filter Oil Pressure (SPN=1208) was 102 times (occurrence count) above normal operating range - most severe level (FMI=0).
Index 10 provides information about the position inside the Ring Buffer.

Electronic Engine Controller (EEC) reports System Diagnostic Code #1 (SPN=611), occurrence count information not available (OC=127) and Special Instructions (FMI=14).
Index 15 provides information about the position inside the Ring Buffer.

Electronic Transmission Controller (ETC) reports Clutch Actuator (SPN=788) was 2 times Out of Adjustment ((FMI=7)
Index 18 provides information about the position inside the Ring Buffer.

Hydraulic Controller reports Hydraulic Reservoir Temperature (SPN=1508) one time Above Normal (FMI=3)
Index 40 provides information about the position inside the Ring Buffer.

2. Functional Specification

2.5.6.3.4 Diagnostic Lamp Status

The following diagnostic lamps are defined in SAE J1939:

1. Red Stop Lamp —> Stop Engine
2. Orange Warning Lamp
3. Protect Lamp
4. Malfunction Indicator Lamp

The status information of all configured DTC received channels are collected and the result will be stored in a 16bit status variable (Byte1 and Byte2). It is then possible to configure alarm or warning functions to react on the diagnostic lamp status.
This also has the advantage that normal Alarm- or Warning-Functions are integrated with Alarms or Warnings (DTC Lamp Status) from the CAN Bus.

2.5.6.3.5 DTC Scan

When DTC`s are received via interrupt, they are immediately stored into the DTC-receive ring buffer. This ring buffer will then be scanned for 8 specific DTC`s. These DTC`s can be configured via WINgauge with unique icons and labels. Alarm and/ or Warning Functions can then be configured to trigger on the status of certain bits inside the DTC scan result register.

2.5.6.4 Speedometer Master Gauge

2.5.6.4.1 Tolerance

The overall speedometer accuracy is within 0% to +4% of full scale reading for each indicated value over the operating range of the instrument.
This fulfills SAE J1226 for the American market and for the European market DIN 75521-2.

	SAE J1226		**DIN 75 521 - 2**	
	-4%	4%	0 <= v1-v2 <= v2/25+5km/h	
Actual speed	u. Tol.	o. Tol.	u. Tol.	o. Tol.
0	0	0		
10	9 ,6	10,4		
20	19,2	20,8		
30	28,8	31,2		
40	38,4	41,6	40	46,6
50	48	52	50	57
60	57,6	62,4	60	67,4
70	67,2	72,8	70	77,8
80	76,8	83,2	80	88,2
90	86,4	93,6	90	98,6
100	96	104	100	109
110	105,6	114,4	110	119,4
120	115.2	124.8	120	129,8

2. Functional Specification

2.5.6.4.2 Speedometer Gauge Operation

The Master gauge receives speed information either via CAN or via one of the frequency inputs. During configuration the source of the speed information has to be defined. The input signal is first converted into a physical speed value. The micro-controller calculates the deflection angle of the speedometer based on this physical speed value and gauge output characteristic.

Specification of odometer storag

The standard Speedometer version of the Master gauge contains an Odometer. It can be configured that also the Tachometer can have an Odometer instead of an Hourmeter. The Odometer consists of a total Odometer and a Tripodometer. Both can be displayed on the dot matrix LCD as two lines. Format is 6 digits for total km, landmiles, nautical miles or meter and 4 digits, decimal point and 1 digit for 1/10 kilometer, land mile or nautical mile. The resolution of meter is 1m.

a. Information comes from CAN-Bus Interfaces (one of two):
For the Odometer indication it must be ensured that a ECU is broadcasting this information on the CAN-Bus. If no signal is received only dashes will be indicated.

b. Total odometer information generated by master gauge:
The Odometer information will be written to EEPROM every 1km. A ring counter algorithm is applied to save and recover the information from EEPROM. The rest-distance is written to EEPROM 10 sec after ignition has been turned off.

A special VDO 16-word-ring-counter algorithm is applied to recover the odometer in case the battery was disconnected.
With nominal input frequency applied, the odometer shall indicate calculated mileage within ± 0.3% [SAE J1226].

2. Functional Specification

2.5.6.5 Tachometer Master Gauge

2.5.6.5.1 Tolerance

The Tachometer indication must be within ± 2% of full scale with nominal voltage applied at temperature of 24 ± 3° C. [SAE J1399].

2.5.6.5.2 Tachometer Gauge Operation

The Master gauge receives the engine speed information either via CAN-Bus or via one of two frequency inputs. During configuration the source of the engine speed information has to be defined. The input signal is first converted into a physical engine speed value. The micro-controller calculates the deflection angle of the Tachometer.

2.5.6.5.3 Specification of the hourmeter

The standard Tachometer version of the Master gauge contains an Hourmeter. It can be also configured with the WINgauge that also the Speedometer can contain an Hourmeter.

Legal demands are to fulfil!

a. Information comes from CAN-Bus Interfaces (one of two):
For the Hourmeter indication it must be ensured that a ECU is broadcasting this information on the CAN-Bus. If no signal is received only dashes will be indicated.

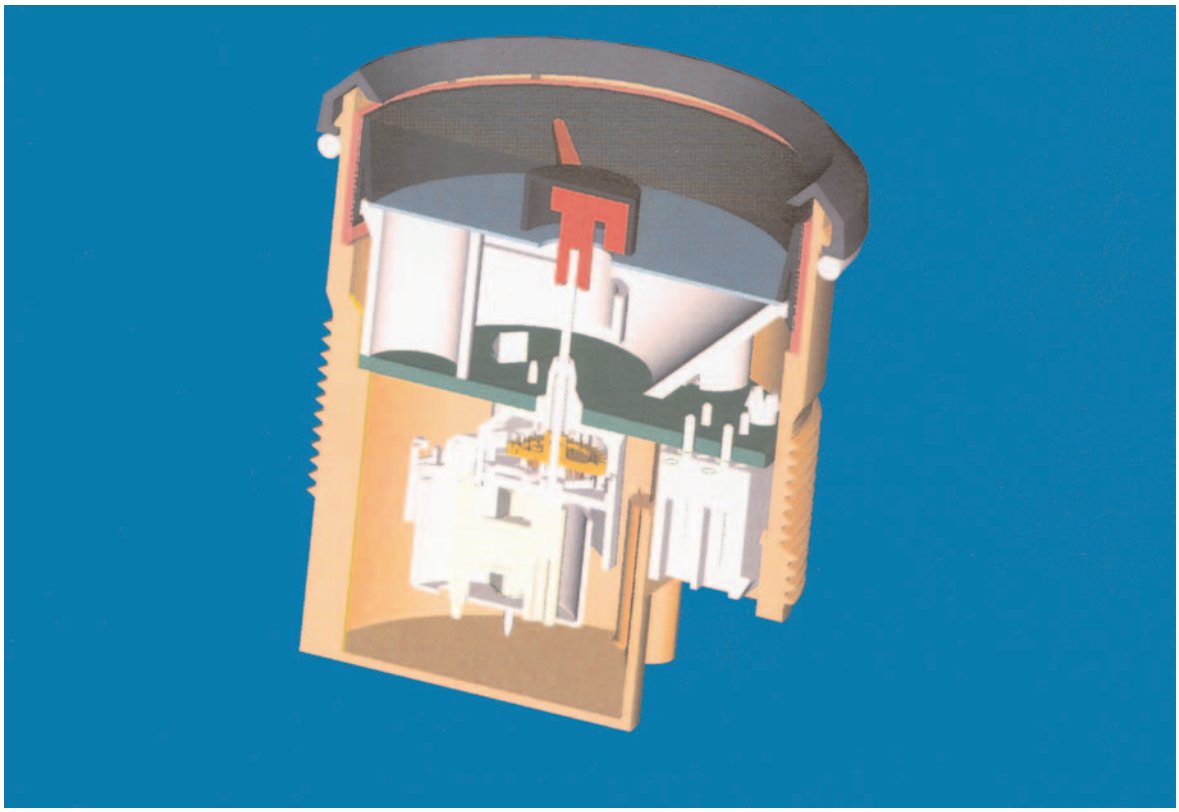
b. Total hours information generated by master gauge:
The Hourmeter counts the number of engine hours, when the engine speed exceeds a threshold value configurable via WINgauge (default value 300 rpm). If the engine speed is below the threshold value the hour counting stops (total and trip). The last value willl be stored within 10 sec in EEPROM after the ignition is turned off, then counting stops, no matter if the engine is running or not.

The time indication is within + 5 sec with nominal voltage supplied at 25 degrees C and within + 10 sec with nominal voltage supplied over the full operating temperature range.
The total hour information is backed-up in EEPROM every 7.5 minutes. A special VDO 16-word-ring-counter algorithm is applied to recover total hours in case battery had been disconnected.

2. Functional Specification

3 Satellite Gauges

3.1 Mechanical concept



The movements are front mounted stepper motors SM2, only clockwise indication.

Connectors: AMP 6 Pin MATE-N-LOK

The dials have a 240° scale and a black panel effect for the warning lamps, so without activating of the warning lamp no sign is visible.

3.2 Fault modes

When ignition is off, the pointers are positioned 6° below the left side of the scales. With ignition on the pointers are moving to the scale start value. When the gauges receive wrong informations or the analog signals are out of range (configured by WINgauge), the pointers are moving 6° below the scale start value

2. Functional Specification

3.3 Satellite gauge address

Each Satellite has his fixed address. The address is defined with the Assy PCB.

The matrix of the combination of the gauge type and address:

Address numbers	Satellite gauges
00	Speedo / Tacho 1
01	Pressure Engine Oil
02	Pressure Brake 1 / Rudder / Primary air
03	Pressure Transmission Oil / Air filter
04	Pressure Turbocharger / Tacho 2
05	Temperature Engine Oil
06	Temperature Transmission Oil / Vacuume
07	Water coolant Temperature
08	Temperature Hydraulics Oil / Engine boost Pressure
09	Temperature without symbol / Gear oil Temperature
10	Pyrometer / Pressure Brake 2 / Secondary air / Turbo Temperature / Exhaust Temperature
11	Level, Fuel level 1
12	Level, Fresh Water / Cylinder head / Gear oil Pressure
13	Level, Waste Water / Fuel level 2 / Pressure Brake 3 / Application air / Fuel Pressure
14	Battery
15	Hydraulic Pressure / Ammeter

Maximum 16 Satellite gauges can be connected per Master. To avoid grave system conflicts, on each address is only one gauge allowed.

3.4 Warning Lamp inside the Satellite Gauge

All warning lamps are red except the amber fuel level warning lamp. The WINgauge allows configuration of these warning lamps.

3.5 Tolerance

The Slaves have the pointer accuracy of +/- 3°.

2. Functional Specification

A. Technical Data

Operating Temperature

Operating Temperature:	-35°C to + 75°C (at nominal voltage)
Visible restrictions:	for LCD outside -20°C and +70°C

Storage Temperature

Storage temperature:	-40°C to +85°C
LCD Humidity resistance:	+65°C ± 2°C 93% r.F. $^{+2}_{-3}$ %

Supply Voltage

Nominal Voltage:	+ 12 V and + 24 V
Operating Voltage:	+ 9 V to + 32 V as standard
Test voltage:	+ 14 V and + 28 V
Total Supply Current:	200 mA ± 20% for Master and 110 mA per Satellit
Slave supply:	+ 8 V ± 10%, current consumption max. 2 A
Sensor supply:	+ 8 V ± 10% (8 V - 0%, +10% at 24 V), Imax: 50 mA

Ground is connected to the negative battery terminal.

Idle Current
The Ignition off current (stand by mode) is < 3 mA for the System (Master and Satellites).

Ground shiftsa
Ground shift on non-analogue inputs are assumed to be < ± 0.5 V.
i.e. all digital input have to work with an additional signal offset of ± 0.5 V

EMC Requirements
See enclosures

Overvoltage Protection
The Master can withstand a voltage of 48 V for 5 minutes without damage (SAE J1810).

I/O circuit protection
The gauges are protected against reversed battery polarity.

Cable requirement
To the Master:

Type cross section:	0,5 mm²

From Master To Satellite

Type cross section:	0,75 mm²
Max quantity of gauges:	16 Satellites
Max. cable length:	**10 m from Master to the last daisy chained Satellite**

2. Functional Specification

B. Applied Standards

Accompanying Documents. For reference only		
Document	**Description**	**Version**
SAE J1226	Electric speedometer specification	1983-02
SAE J1399	Electric tachometer specification	1984-06
SAE J1810	Electrical indicating system specification	1993-01
SAE J1939	Recommended practice for truck and bus control	2000-04
SAE J1939 / 11	Physical layer	1999-10
SAE J1939 / 21	Data link layer	1998-07
SAE J1939 / 31	Network layer	1997-12
SAE J1939 / 71	Vehicle application layer	1998-10
SAE J1939 / 81	Network management	1997-07
89/336/EWG	Applied Standards, Breakdown sending to the DIN/EN standards 50 081-1, 50 082-1, 50 082-2 (applied standards, disturbance acc to DIN/EN standards 50 081-1, 50 082-1, 50 082-2)	
95/54 EWG	Motor vehicle guideline EMV (vehicle guidance emc)	1995-10
DIN 40 839	Electromagnetic compatibility (emc) in road vehicles; disturbances conducted along supply lines in 12V and 24V onboard systems	1992-10
DIN 70 005 Teil 2	Graphische symbole, Grundlagen und Übersicht (graphic symbols, basis and overview)	1993-12
DIN 75 521 Teil 2	Speedometer instrument panel mounting for motor vehicles	1992-02
DIN-EN 50081-1	Electromagnetic compatibility - generic emission	1993-03
DIN-EN 50 081-2	Electromagnetic compatibility - industrial environment	1994-03
DIN-EN 50082-1	Electromagnetic compatibility - generic immunity emission	1997-11
DIN-EN 50082-2	Electromagnetic compatibility - generic immunity industrial environment	1996-02
IEC 60068-2-11	Corrosion resistance	1995-10
EN IEC 60 529	Schutzarten durch Gehäuse	1991-10
ISO 2575	Road vehicles - symbols for controls, indicators and telltales	2000-03
ISO 3767-1	Tractors, machinery for agricultural and forestry powered lawn and garden equipment - symbols for operator controls and other displays.	1998-12
ISO 6405-1	Earth-moving machinery - symbols for operator controls and other displays	1991-12
ISO 7000	Graphic symbols for use on equipment - index and synopsis	1989-11
ISO 7637-1-2	Road vehicles - electrical disturbance by conduction and coupling:	1990-06
UL 94	Part 1: passenger cars and light commercial vehicles with nominal 12V supply voltage - electrical transient conduction along supply lines only	1998-10
VDO TPV	Part 2: commercial cars with nominal 24V supply voltage - electrical transient conduction along supply lines only	1998-10
ISM-Z	Test for flammability of plastic materials for parts in devices and appliances	2000-07
VDON 2.1954.001	Technical test specification for mechanical and electronic information systems in motor vehicles	1997-12
VDON 2.1955.070	Specification: customer specific integrated circuit in cmos technology for control of vdo-stepper motors (SM2/ MW2000)	1997-12
VDON 2.1958.001	Company sign VDO	2000-12

3. Installation Instructions

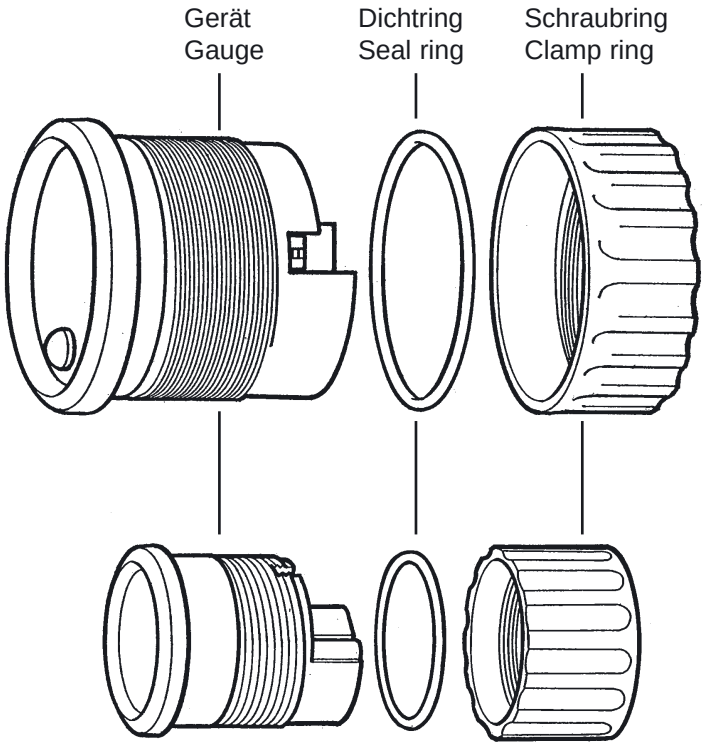
Enclosures

Installation instructions	TU00-0726-5107120	1003	(Page 1-8)

MONTAGEANLEITUNG
INSTALLATION INSTRUCTIONS

VDO CANcockpit

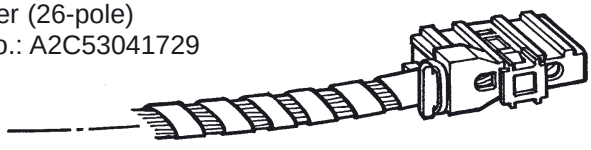
Systemkomponenten
System components

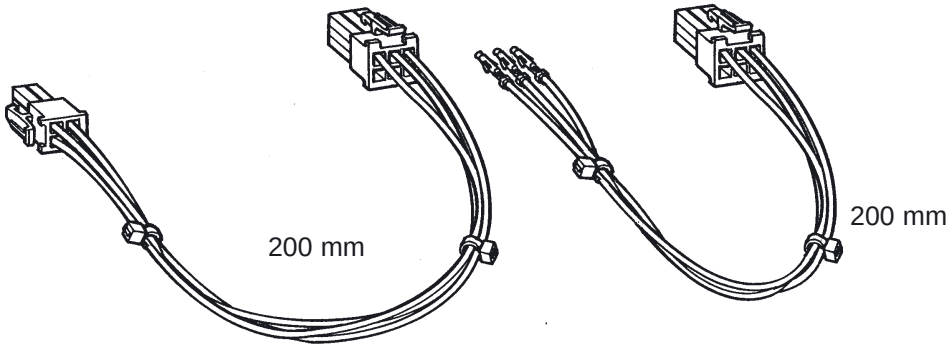


Master-Gerät
(Gehäuse Ø 80mm)
Master gauge
(housing dia. 80mm)

Slave-Gerät (Gehäuse Ø 52mm)
Satelitte gauge (housing dia. 52mm)

Kabelbaum Master (26polig),
Wiring harness master (26-pole)
Bestell-Nr. / Order No.: A2C53041729

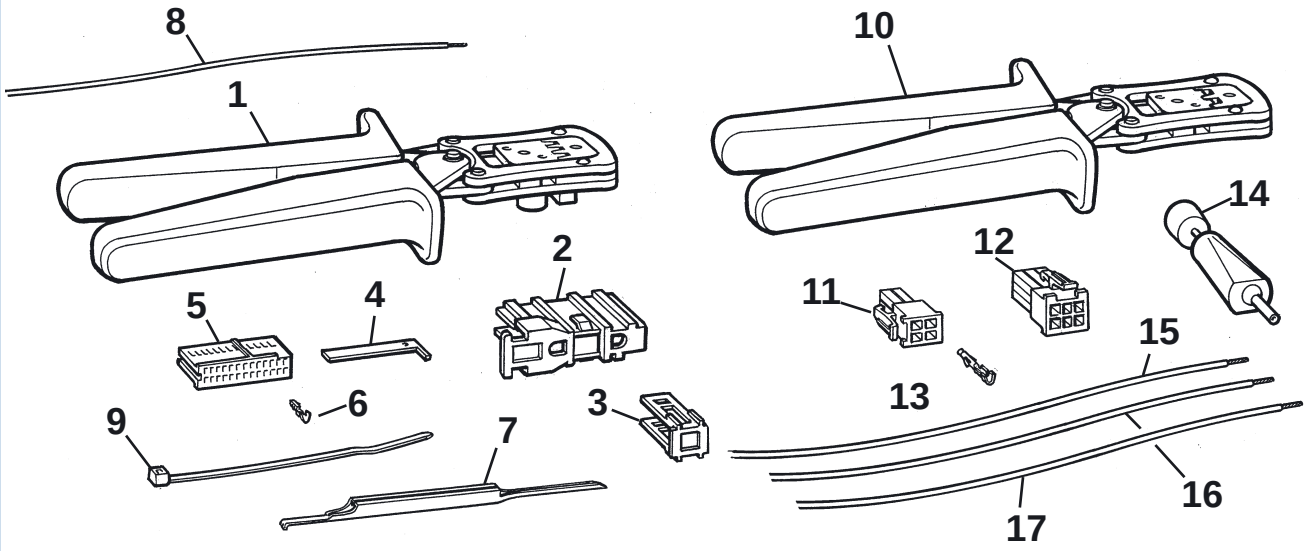




Kabelbaum Master - Slave
Wiring harness master - satelitte
Bestell-Nr. / Order No.: A2C53041726

Kabelbaum Slave - Slave
Wiring harness satelitte - satelitte
Bestell-Nr. / Order No.: A2C53041730

Oder eigener Zusammenbau der Kabelbäume. Nur mit folgenden Teilen:
Or own installation of the wiring harnesses. With following parts only:



Anwendung / Application:

A: für Kabelbaum Master (26polig) / for wiring harness master (26-pole)
B: für Kabelbaum Master - Slave / for wiring harness master - satelitte
C: für Kabelbaum Slave - Slave / for wiring harness satelitte - satelitte

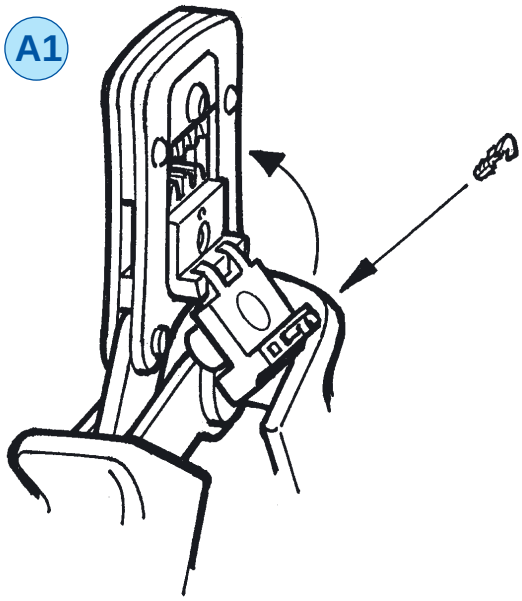
Pos. Pos.	Bezeichnung Designation		Anwendung Application	Verp.-Einheit Items / Package	Bestell-Nr. Order No.
1	Handzange / Hand tool	AMPMODU	A	(AMP-Nr./ No. 0-0169481-1)	
2	Gehäuse /Housing	AMPMODU	A	700	
3	Abzugsbügel / Draw-off bracket	AMPMODU	A	600	
4	Kontaktsicherung / Contact seal	AMPMODU	A	2000	
5	Kontaktgehäuse / Contact housing	AMPMODU	A	500	
6	Kontakt (Master) / Contact (master)	AMPMODU	A	10000	
7	Ausstoßwerkzeug / Push out tool	AMPMODU	A	2	
8	Kabel 0,5mm^2 / Wire 0.5mm^2		A	—	
9	Kabelbinder / Cable strap		A, B, C	—	
10	Handzange / Hand tool	MATE-N-LOK	B, C	(AMP-Nr./ No. 0-0734202-1)	
11	Stecker, 4polig / Connector, 4-pole	MATE-N-LOK	B	500	
12	Stecker, 6polig / Connector, 6-pole	MATE-N-LOK	B, C	1000	
13	Kontakt / Pin	MATE-N-LOK	B, C	10000	
14	Ausstoßwerkzeug / Push out tool	MATE-N-LOK	B, C	2	
15	Kabel, gelb 0,75mm^2 / Wire, yellow 0.75mm^2		B, C	—	
16	Kabel, rot 0,75mm^2 / Wire, red 0.75mm^2		B, C	—	
17	Kabel, schwarz 0,75mm^2 / Wire, black 0.75mm^2		B, C	—	

MONTAGEANLEITUNG
INSTALLATION INSTRUCTIONS

VDO CANcockpit

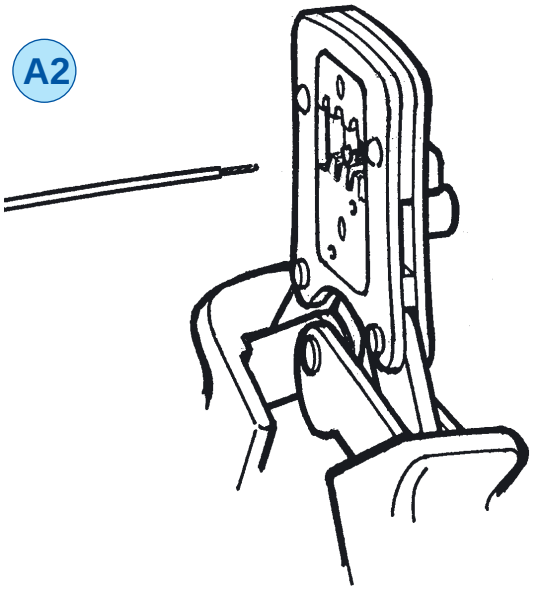
A: für Kabelbaum Master (26polig) / for wiring harness master (26-pole)

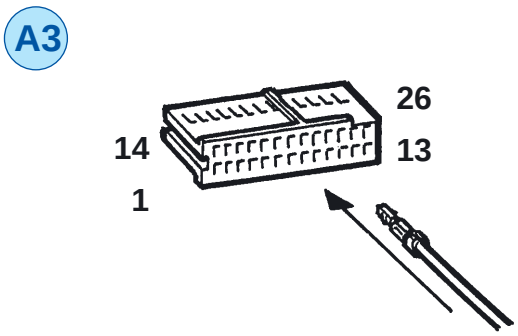
Mit den Kontakten (Pos. 6) und den entsprechenden Kabeln (Pos. 8) eine Crimpverbindung nach EN 60352-2/A1 Teil 2 herstellen.
Make a crimp connection per EN 60352-2/A1 Part 2 with the contacts (Pos. 6) and the corresponding cables (Pos. 8).



Dabei besonders darauf achten, dass alle Einzeldrähte des Kabels von der Crimphülse erfasst werden, denn sonst besteht Kurzschlussgefahr!
Take special care to contain all individual wires of the cable in the crimp socket to avoid the risk of a short-circuit!

Die Kabel je nach Belegung in das 26polige Kontaktgehäuse (Pos. 5) einstecken. Die Kontakte müssen hörbar einrasten.
Insert the cabels into the 26-pole contact housing (Pos. 5) according to connector pin allocation. The contacts must engage with an audible click.





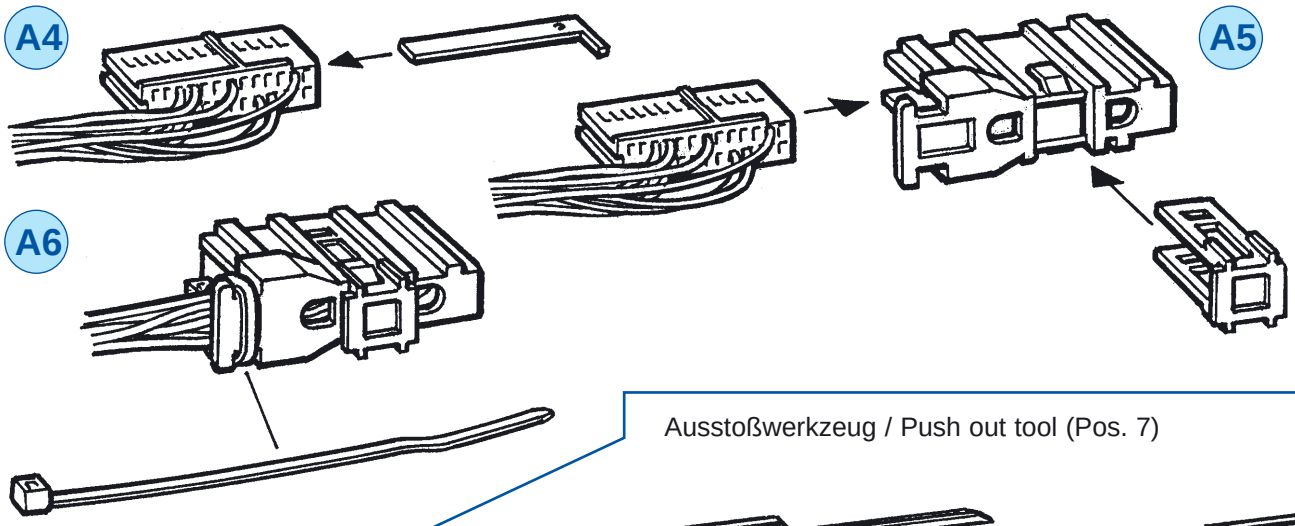
Pin-Belegung
Pin allocation

	Beschreibung / Description		Beschreibung / Description
1	Kl. 30 / Power Supply (terminal 30)	14	+ 8 V DC für Pull Up / for external pull-up
2	Kl. 31 / GND (terminal 31)	15	0 - 5 V DC Eingang / Input
3	CAN1 _High	16	Kl. 58 d / Illumination (terminal 58 d)
4	CAN1 _Low	17	Kl. 15 / Ignition (terminal 15)
5	CAN2 _High	18	Frequenzeingang 2 / Frequency Input 2 (0-2 kHz)
6	CAN2 _Low	19	Frequenzeingang 1 / Frequency Input 1 (0-40 kHz)
7	nicht belegt / not connected	20	Schaltausgang 1 / Switch-Output 1
8	k - Line	21	Schaltausgang 2 / Switch-Output 2
9	Analog Eingang 1 / Input 1 (0,5-200 Ohm)	22	nicht belegt / not connected
10	Analog Eingang 2 / Input 2 (0,5-300 Ohm)	23	nicht belegt / not connected
11	Analog Eingang 3 / Input 3 (10 -700 Ohm)	24	nicht belegt / not connected
12	4 - 20 mA Eingang / Input	25	Masse Analog / Analog GND
13	4 - 20 mA Masse / GND	26	Masse Frequenz / Frequency GND

MONTAGEANLEITUNG
INSTALLATION INSTRUCTIONS

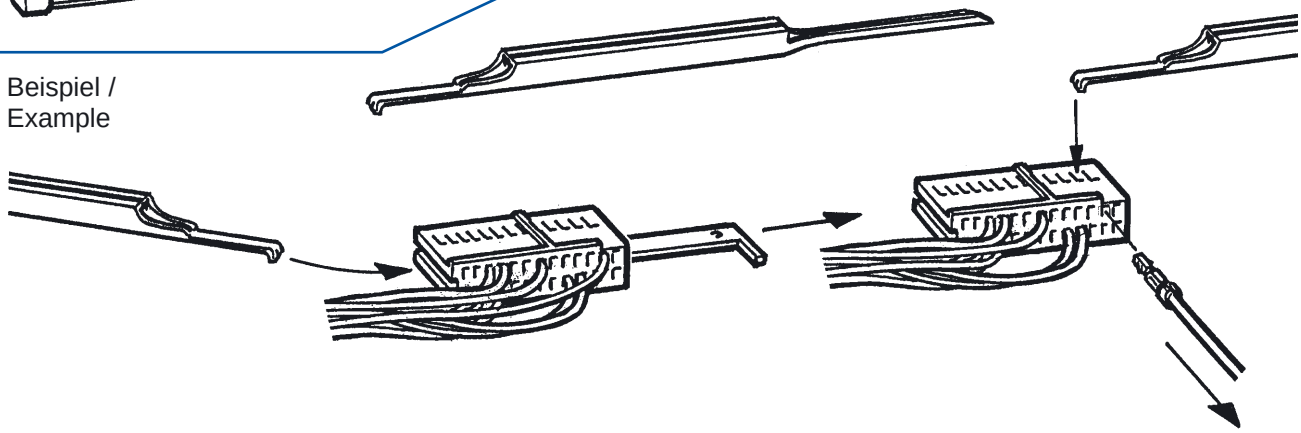
VDO CANcockpit

A: für Kabelbaum Master (26polig) / for wiring harness master (26-pole)



Ausstoßwerkzeug / Push out tool (Pos. 7)

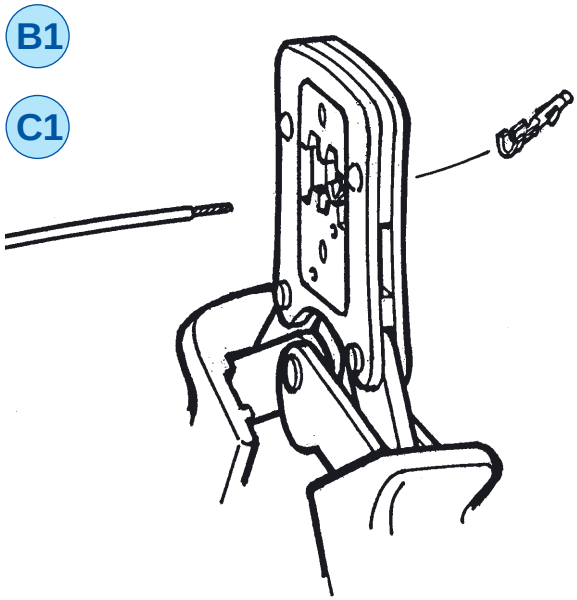
Beispiel /
Example



B: für Kabelbaum Master - Slave / for wiring harness master - satelitte
C: für Kabelbaum Slave - Slave / for wiring harness satelitte - satelitte

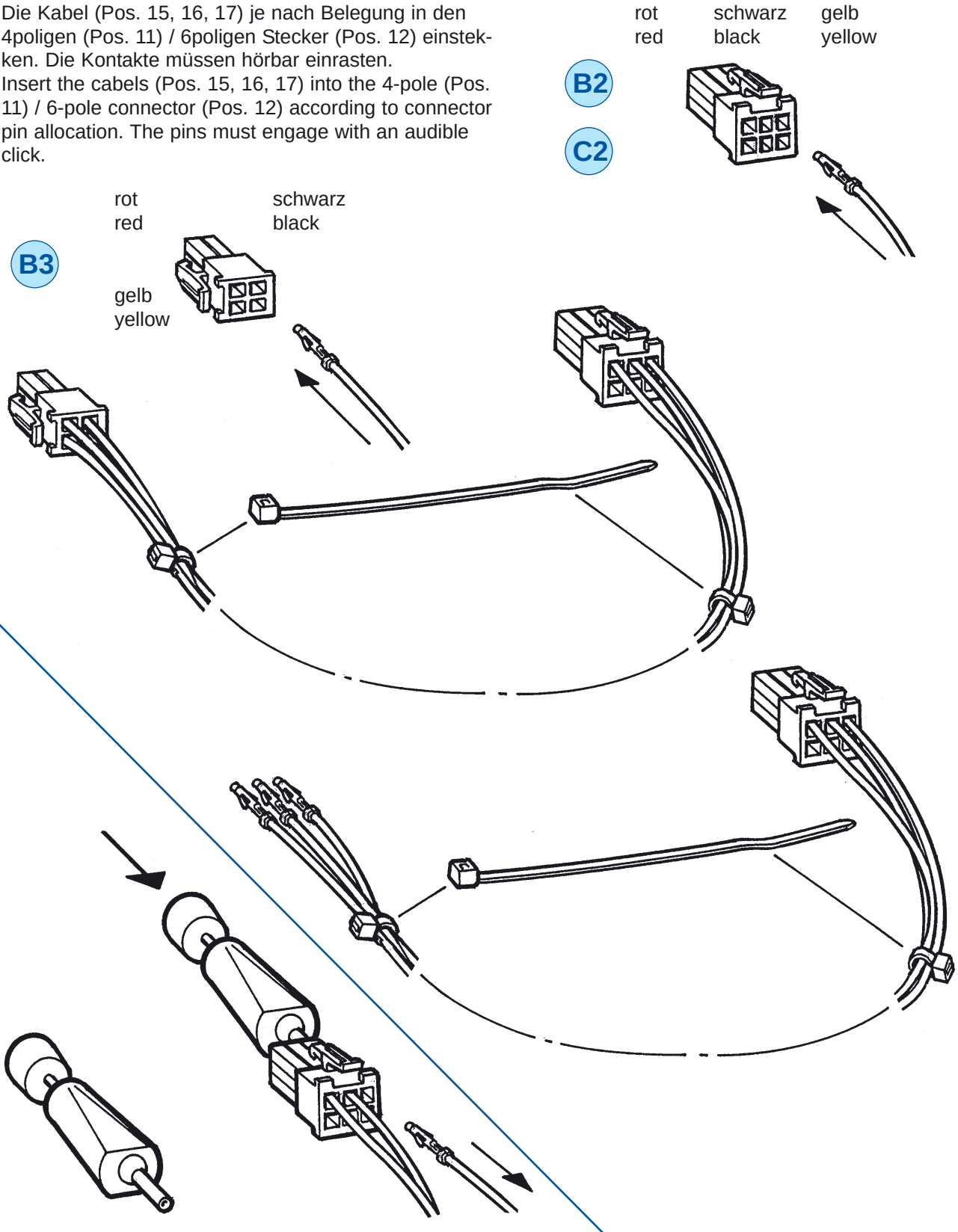
Mit den Kontakten (Pos. 13) und den entsprechenden Kabeln (Pos. 15, 16, 17) eine Crimpverbindung nach EN 60352-2/A1 Teil 2 herstellen.
Make a crimp connection per EN 60352-2/A1 Part 2 with the contacts (Pos. 13) and the corresponding cables (Pos. 15, 16, 17).

⚠ Dabei besonders darauf achten, dass alle Einzeldrähte des Kabels von der Crimphülse erfasst werden, denn sonst besteht Kurzschlussgefahr!
Take special care to contain all individual wires of the cable in the crimp socket to avoid the risk of a short-circuit!



B: für Kabelbaum Master - Slave / for wiring harness master - satelitte
C: für Kabelbaum Slave - Slave / for wiring harness satelitte - satelitte

Die Kabel (Pos. 15, 16, 17) je nach Belegung in den 4poligen (Pos. 11) / 6poligen Stecker (Pos. 12) einstekken. Die Kontakte müssen hörbar einrasten.
Insert the cabels (Pos. 15, 16, 17) into the 4-pole (Pos. 11) / 6-pole connector (Pos. 12) according to connector pin allocation. The pins must engage with an audible click.

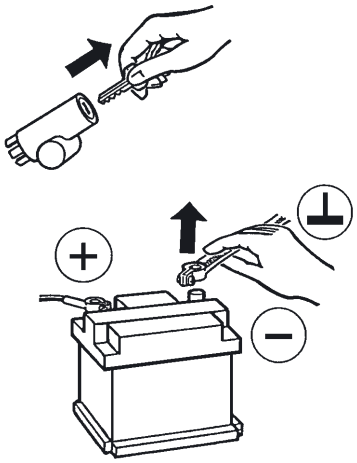


Ausstoßwerkzeug (Pos. 14)
Push out tool

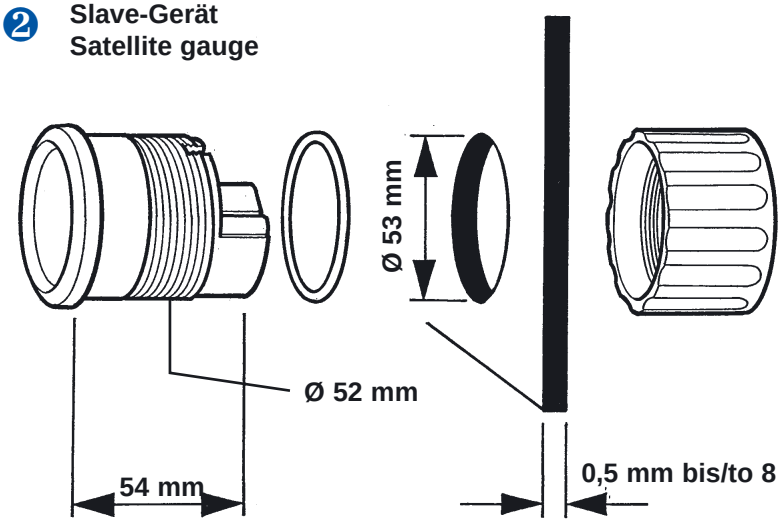
MONTAGEANLEITUNG
INSTALLATION INSTRUCTIONS

VDO CANcockpit

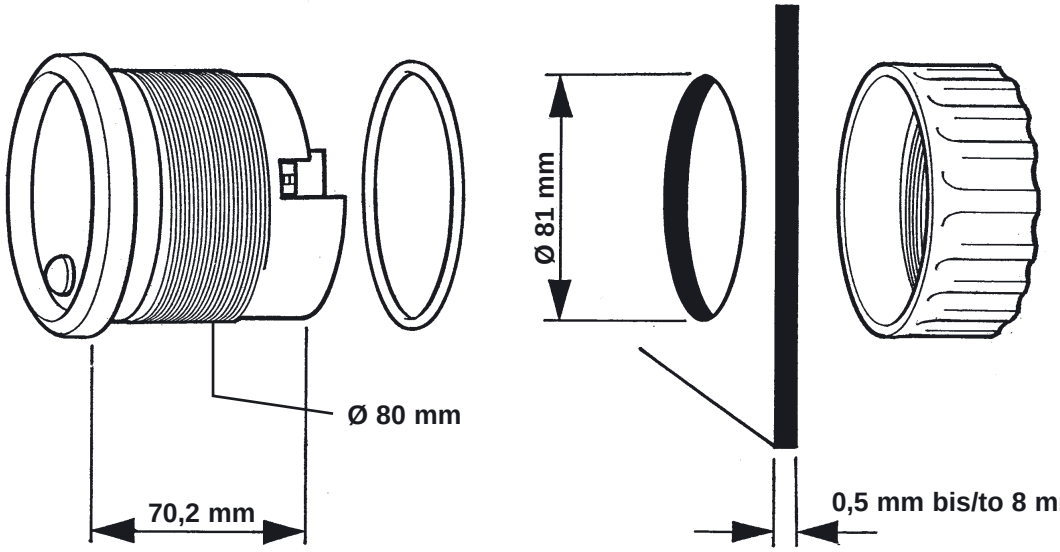
1



2 **Slave-Gerät**
Satellite gauge

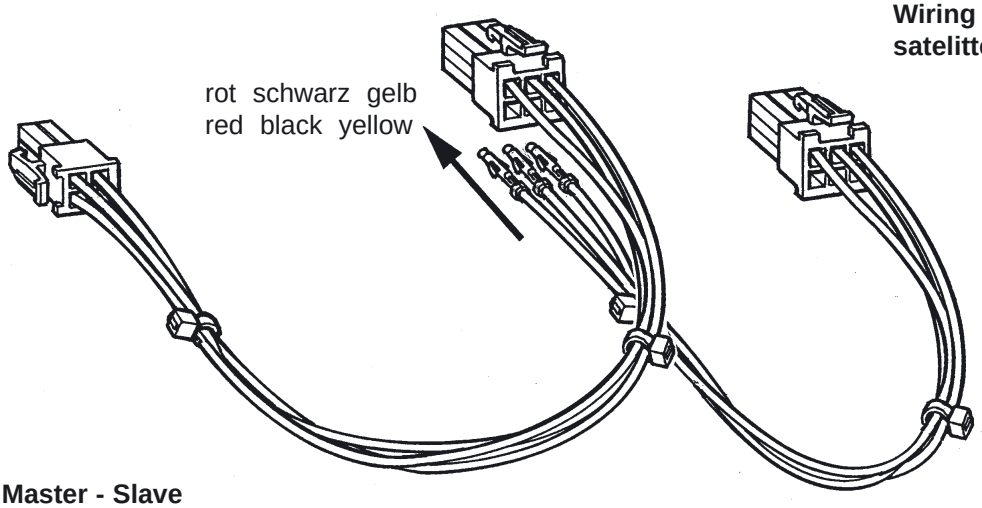


Master-Gerät
Master gauge



3

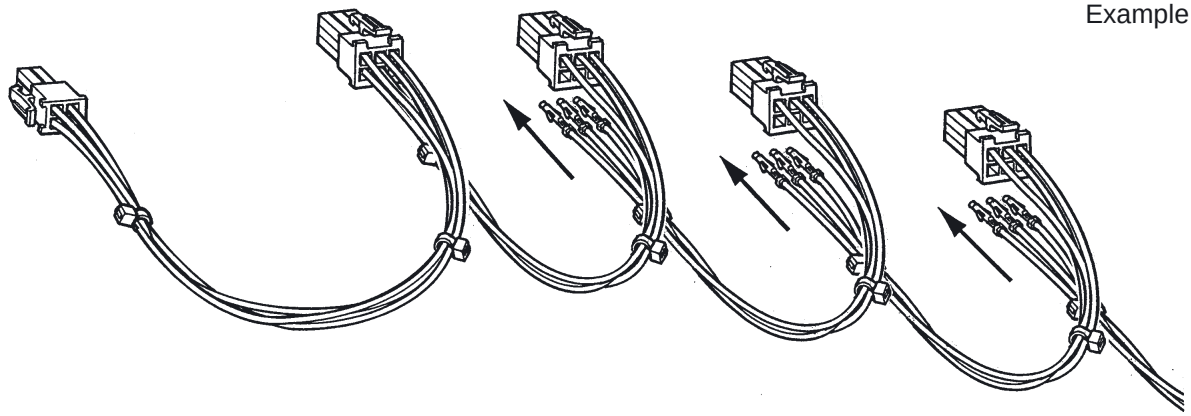
Kabelbaum
Slave - Slave
Wiring harness
satelitte - satelitte



Kabelbaum Master - Slave
Wiring harness master - satelitte

4

Beispiel /
Example



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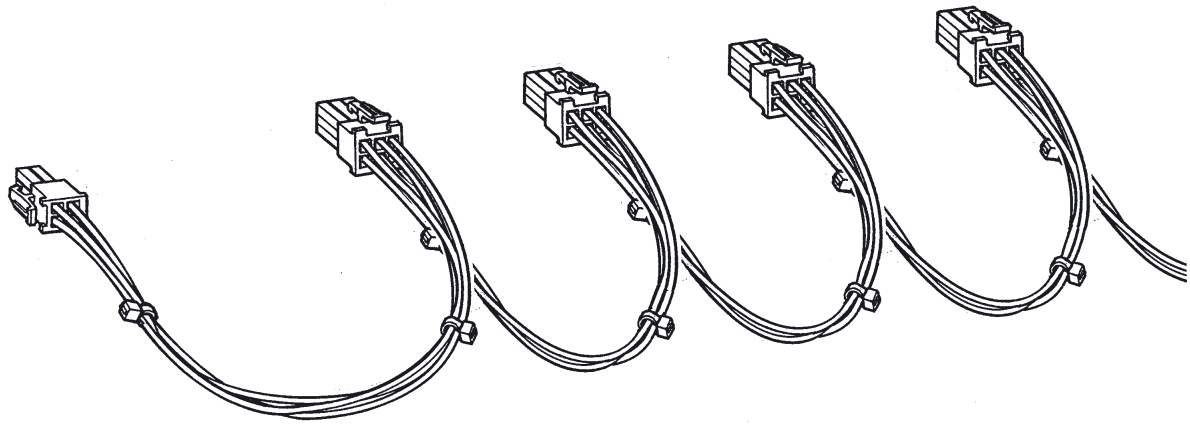
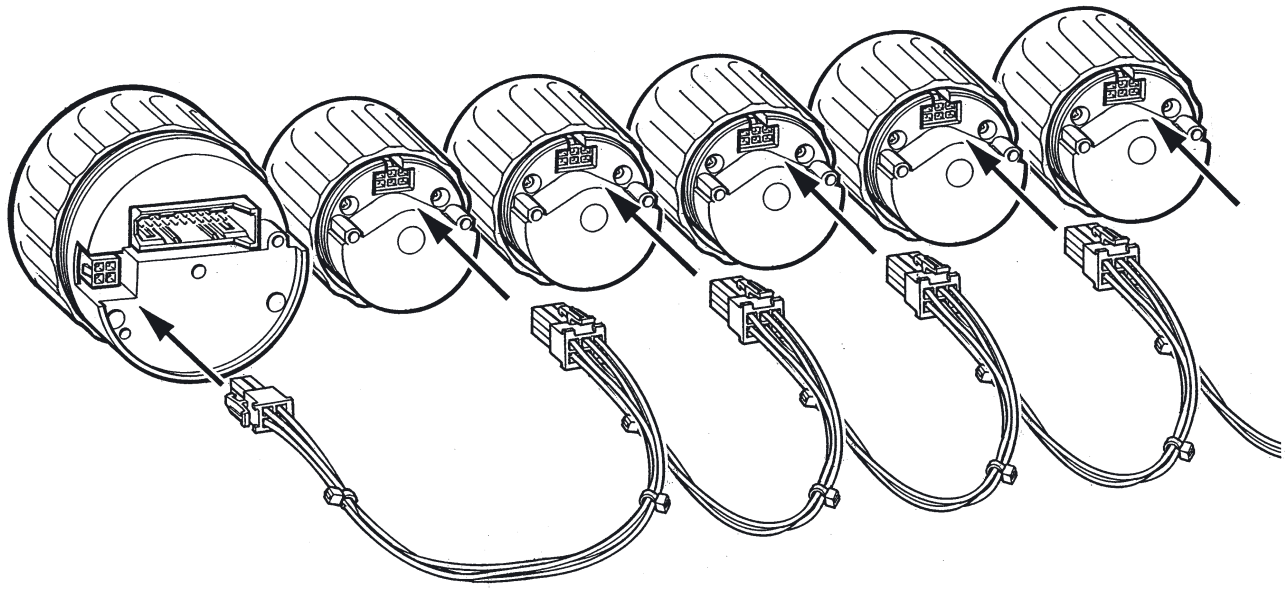
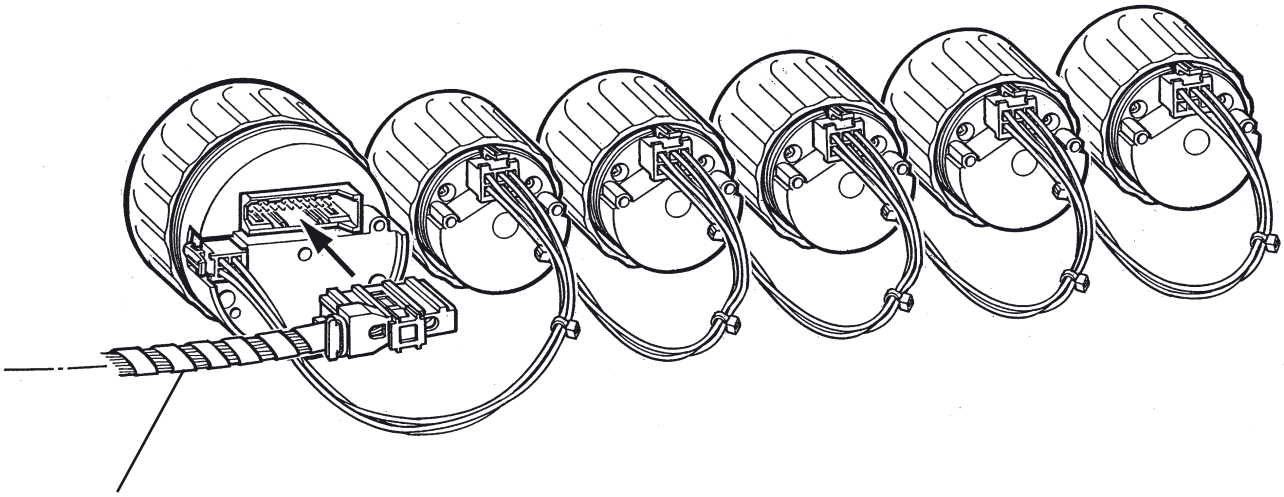


6



7 Beispiel /
Example



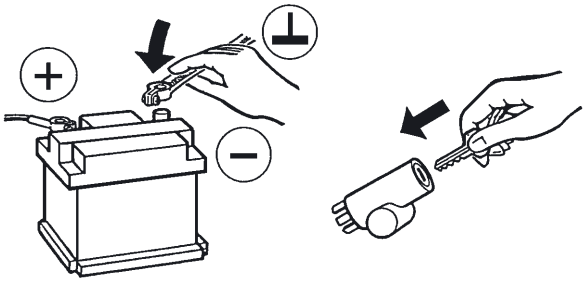
Kabelbaum Master
Wiring harness master

Kabel-Belegung
cable allocation

Geräteanschluss
Gauge connection

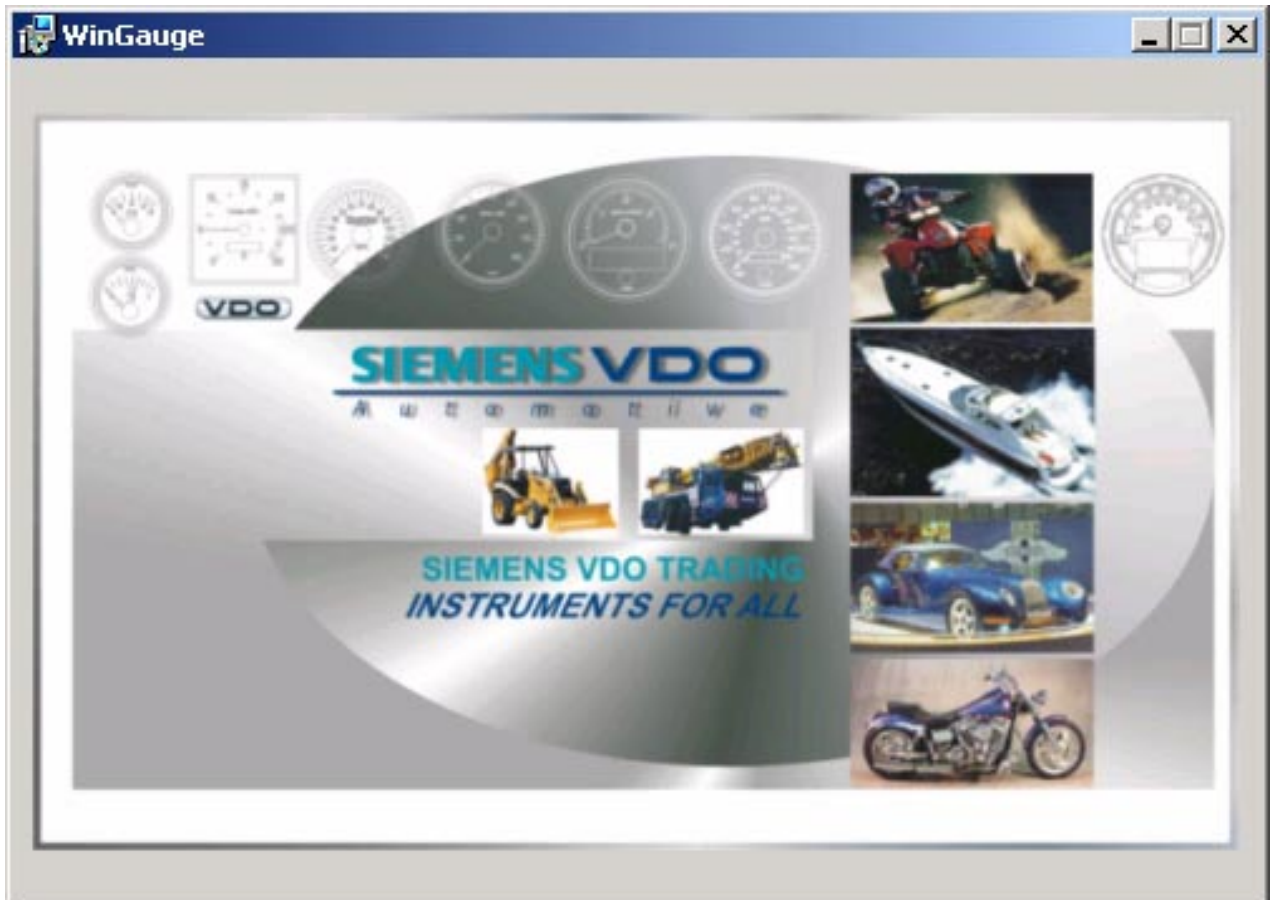
	Beschreibung / Description		Beschreibung / Description
1	Kl. 30 / Power Supply (terminal 30)	14	+ 8 V DC für Pull Up / for external pull-up
2	Kl. 31 / GND (terminal 31)	15	0 - 5 V DC Eingang / Input
3	CAN1 _High	16	Kl. 58 d / Illumination (terminal 58 d)
4	CAN1 _Low	17	Kl. 15 / Ignition (terminal 15)
5	CAN2 _High	18	Frequenzeingang 2 / Frequency Input 2 (0-2 kHz)
6	CAN2 _Low	19	Frequenzeingang 1 / Frequency Input 1 (0-40 kHz)
7	nicht belegt / not connected	20	Schaltausgang 1 / Switch-Output 1
8	k - Line	21	Schaltausgang 2 / Switch-Output 2
9	Analog Eingang 1 / Input 1 (0,5-200 Ohm)	22	nicht belegt / not connected
10	Analog Eingang 2 / Input 2 (0,5-300 Ohm)	23	nicht belegt / not connected
11	Analog Eingang 3 / Input 3 (10 -700 Ohm)	24	nicht belegt / not connected
12	4 - 20 mA Eingang / Input	25	Masse Analog / Analog GND
13	4 - 20 mA Masse / GND	26	Masse Frequenz / Frequency GND

8

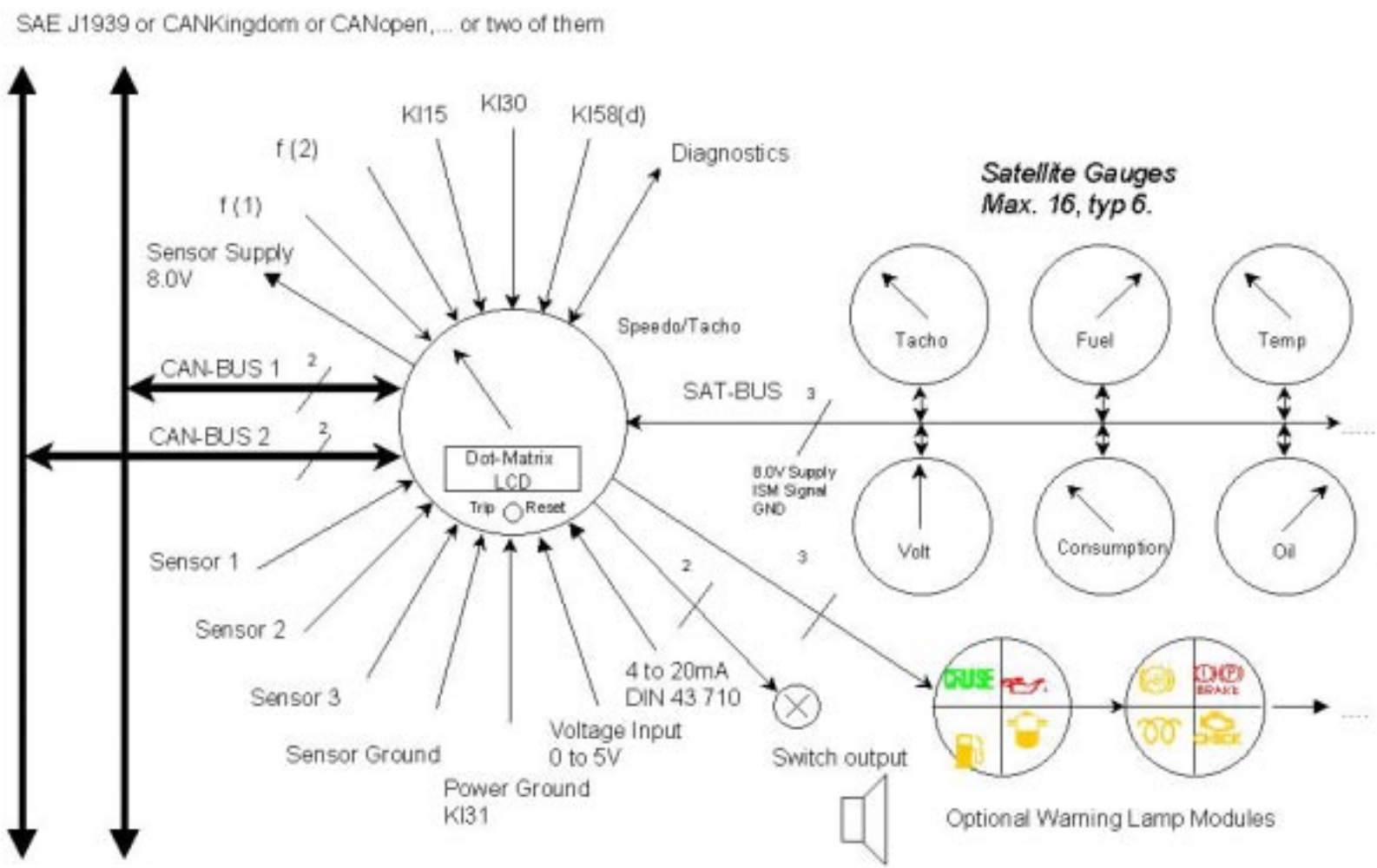


5. Software Description

Enclosures

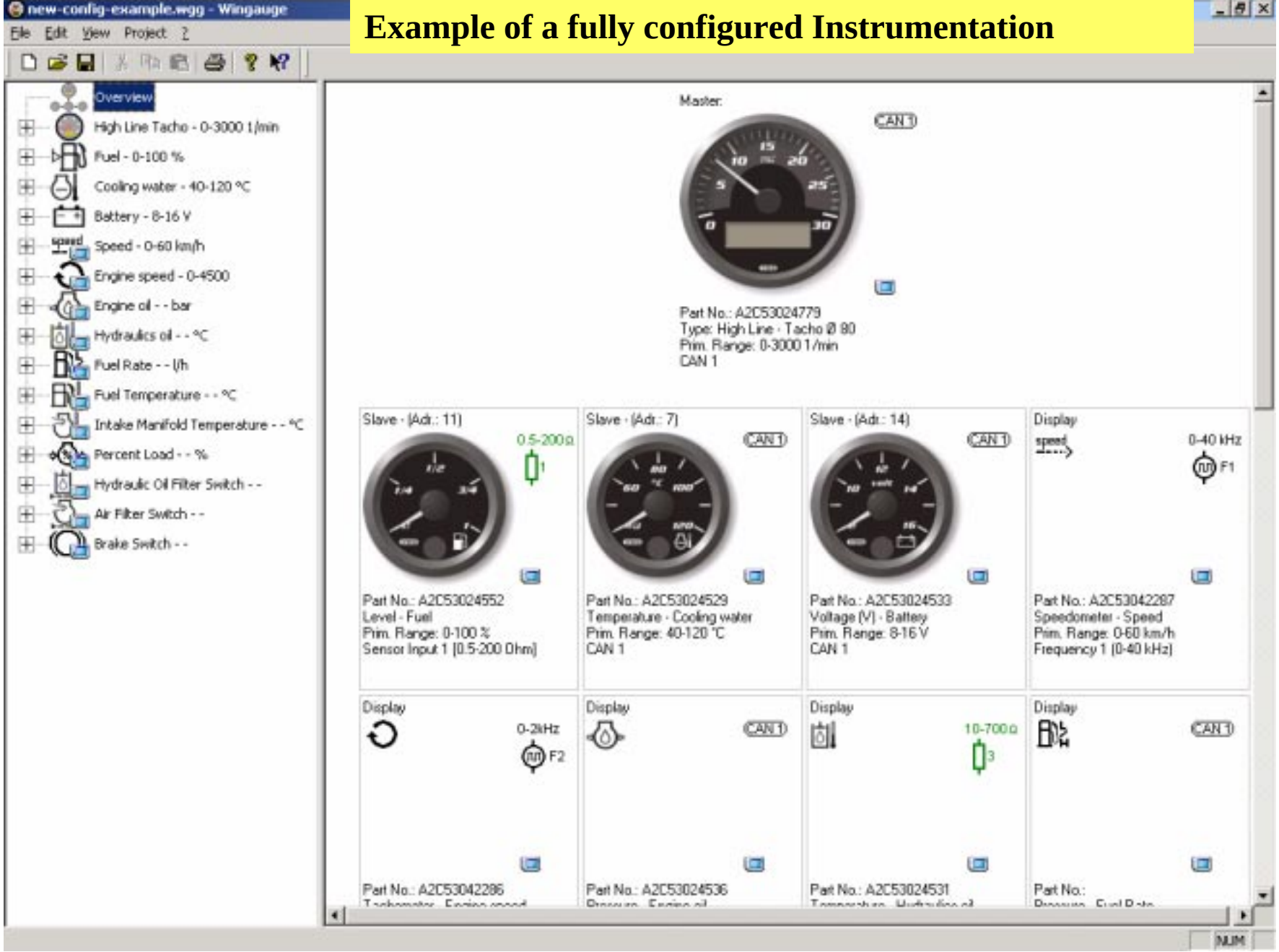

WinGauge
VDO
SIEMENS VDO
Automotive
SIEMENS VDO TRADING
INSTRUMENTS FOR ALL

Components and Concept



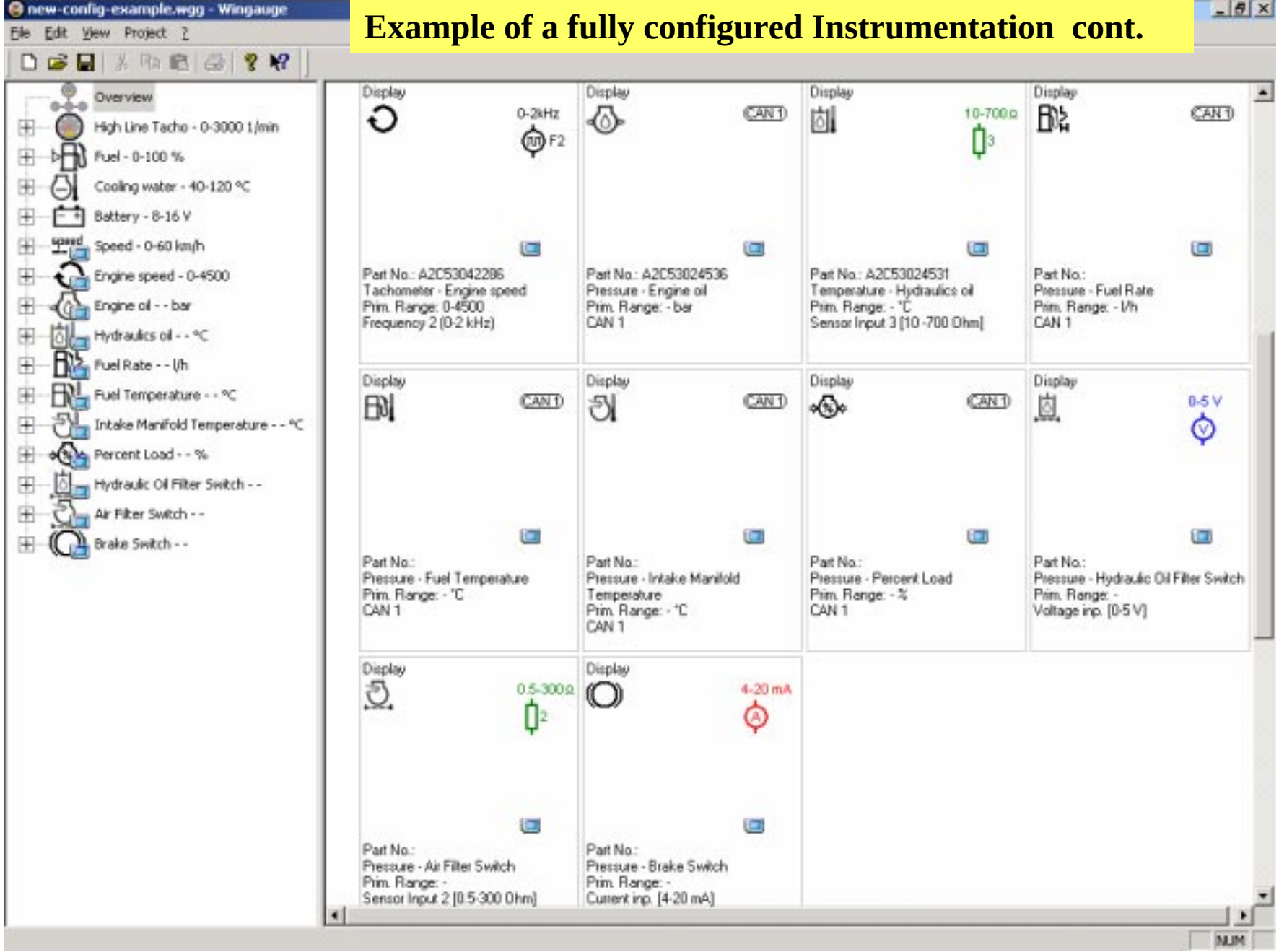
SIEMENS VDO Automotive

Example of a fully configured Instrumentation

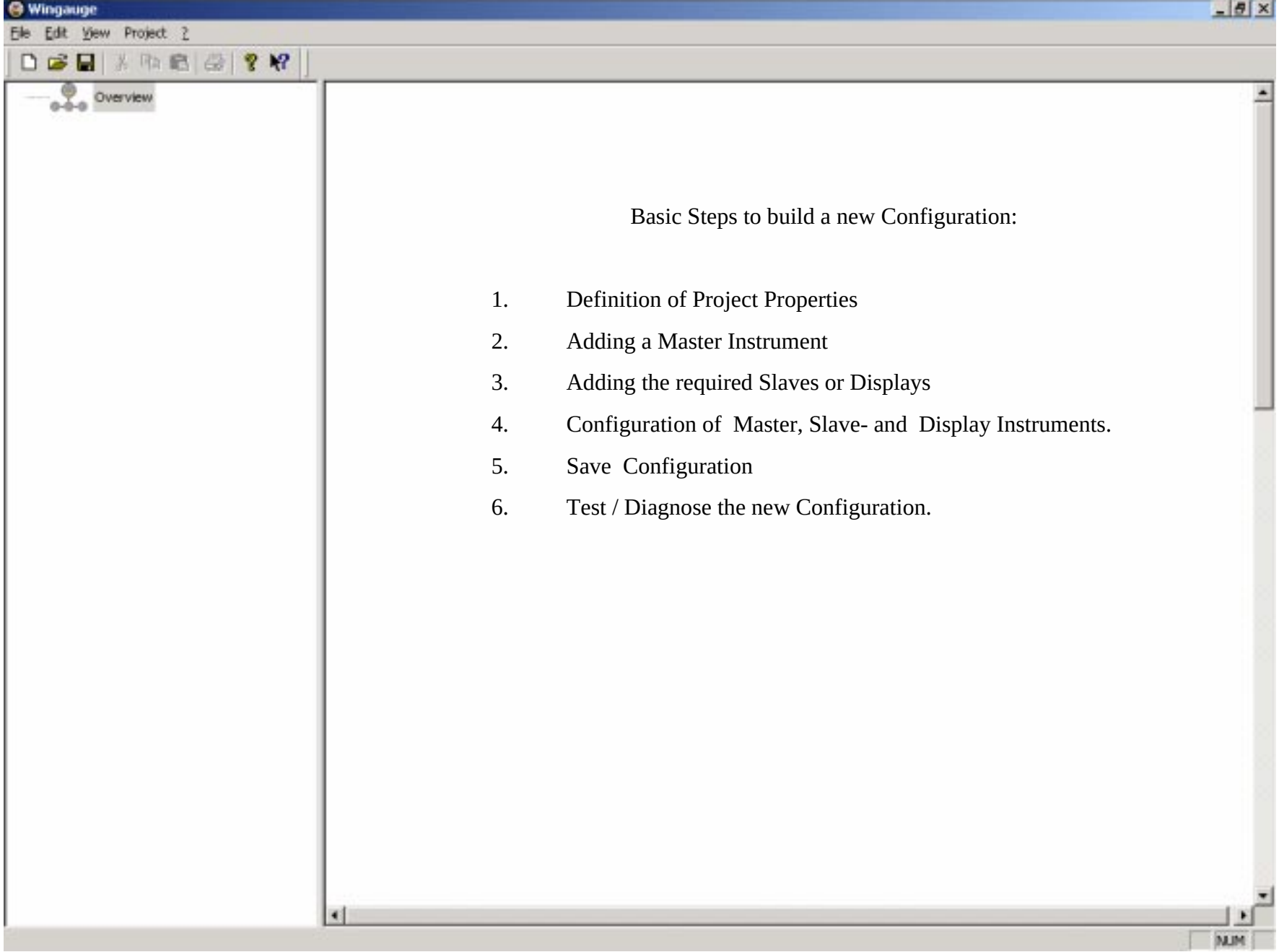


SIEMENS VDO Automotive

Example of a fully configured Instrumentation cont.

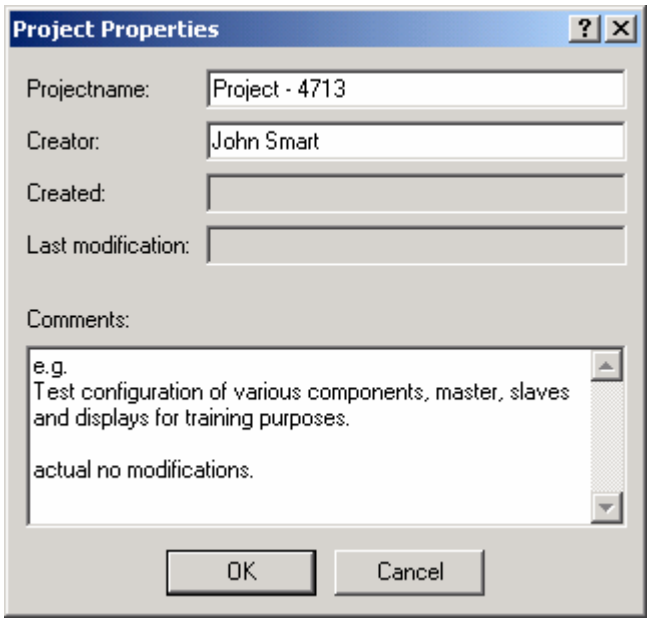


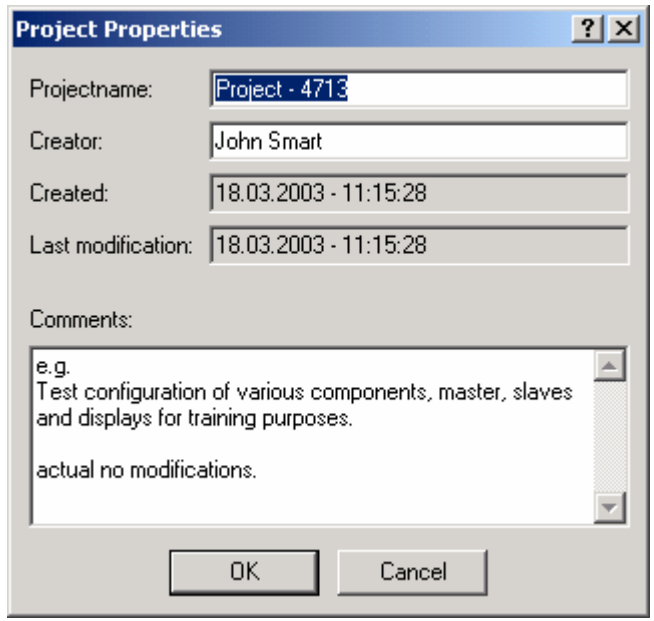
SIEMENS VDO Automotive



SIEMENS VDO Automotive

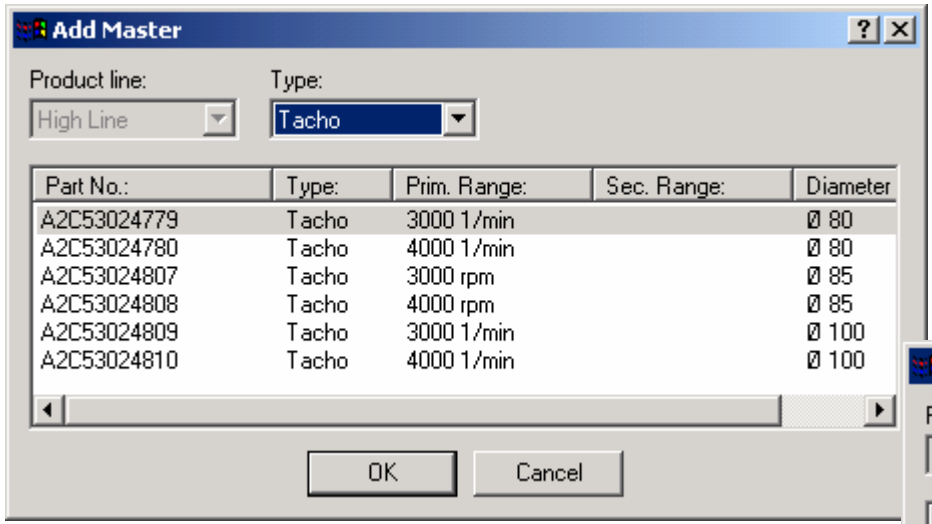
1.) Definition of Project Properties:



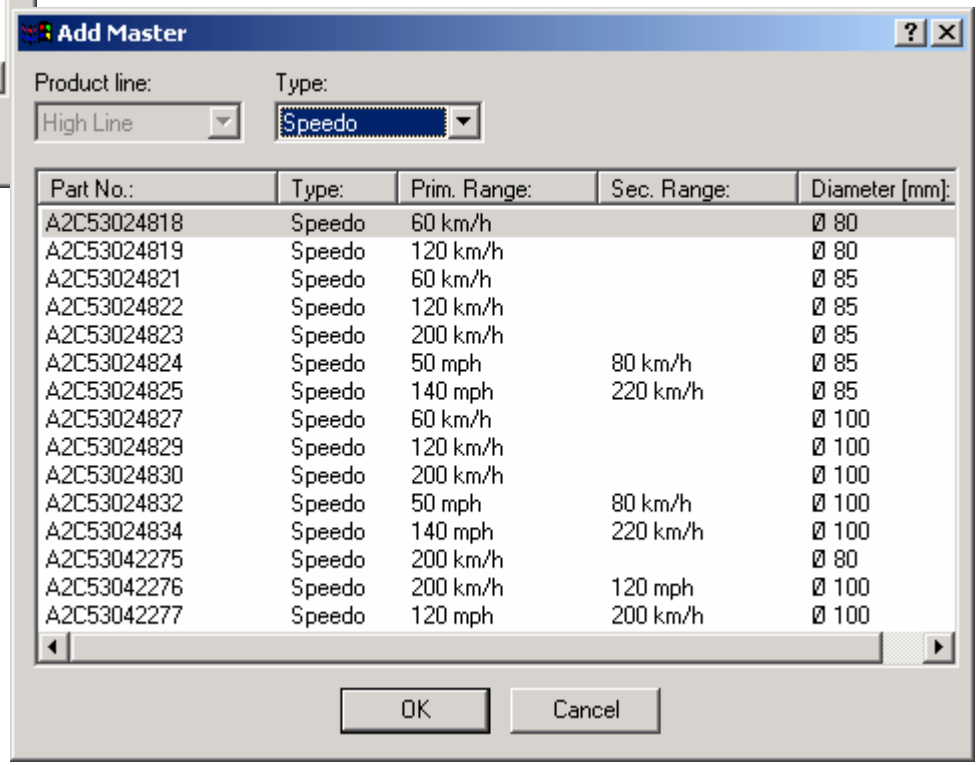


Date and Time will be added to the „Created / Last modification“ fields, after the configuration has been saved the first time. The „Last modification“ field receives an update every time changes are made to the project.

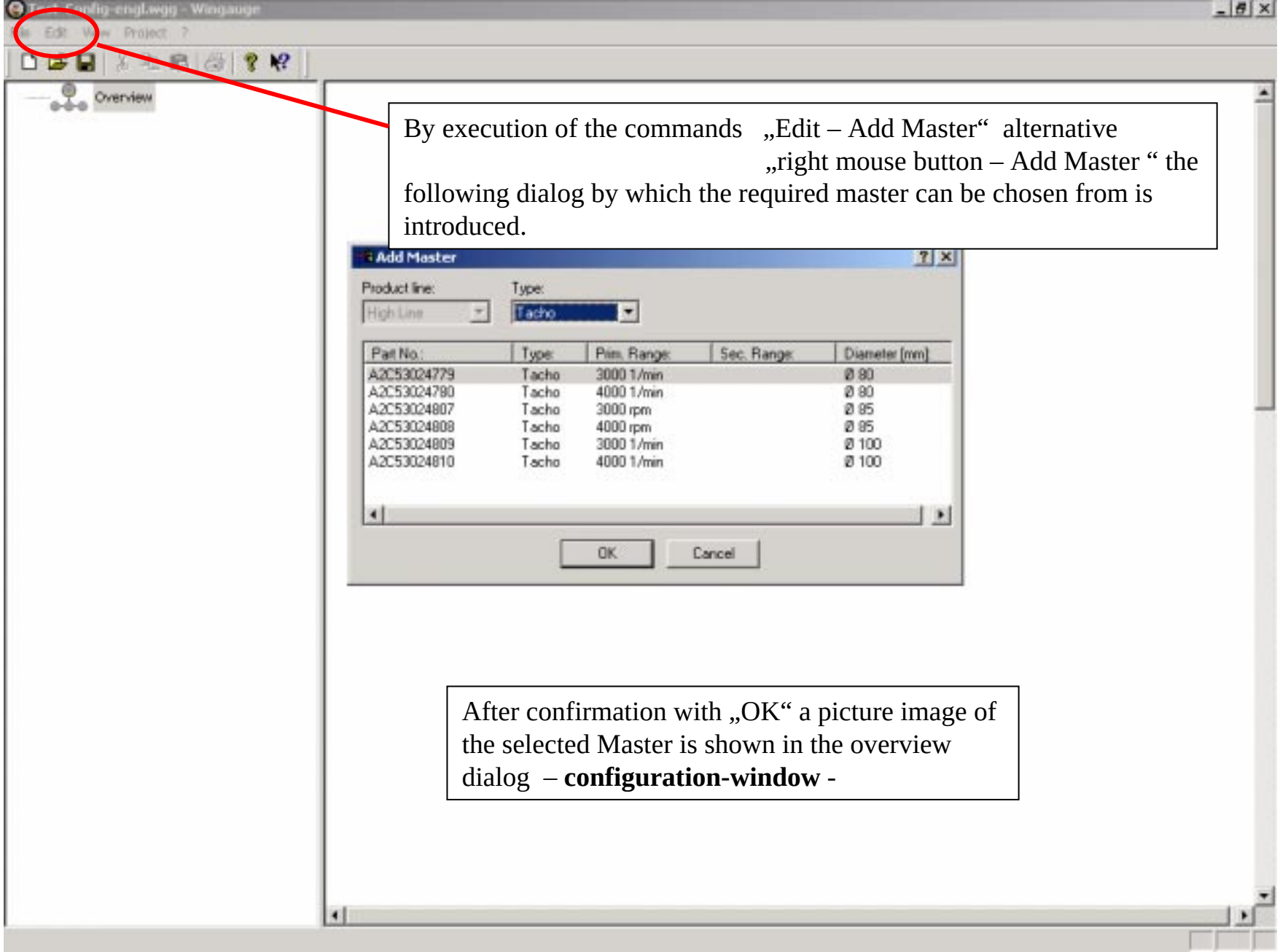
2.) Adding a Master Instrument



TACHO and **SPEEDO** can be chosen from a broad variety of instruments.



SIEMENS VDO Automotive



By execution of the commands „Edit – Add Master“ alternative „right mouse button – Add Master “ the following dialog by which the required master can be chosen from is introduced.

After confirmation with „OK“ a picture image of the selected Master is shown in the overview dialog – **configuration-window** -

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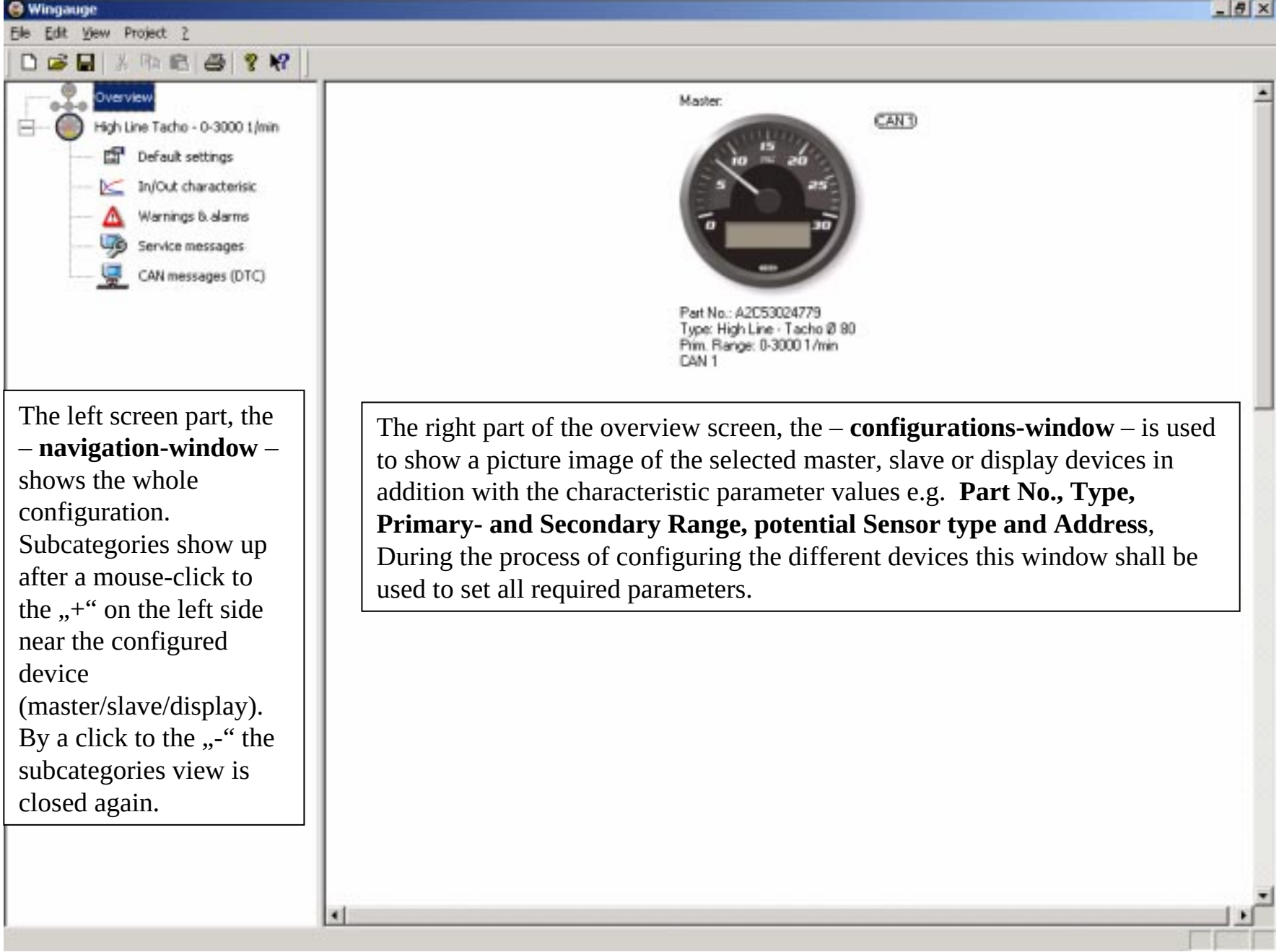
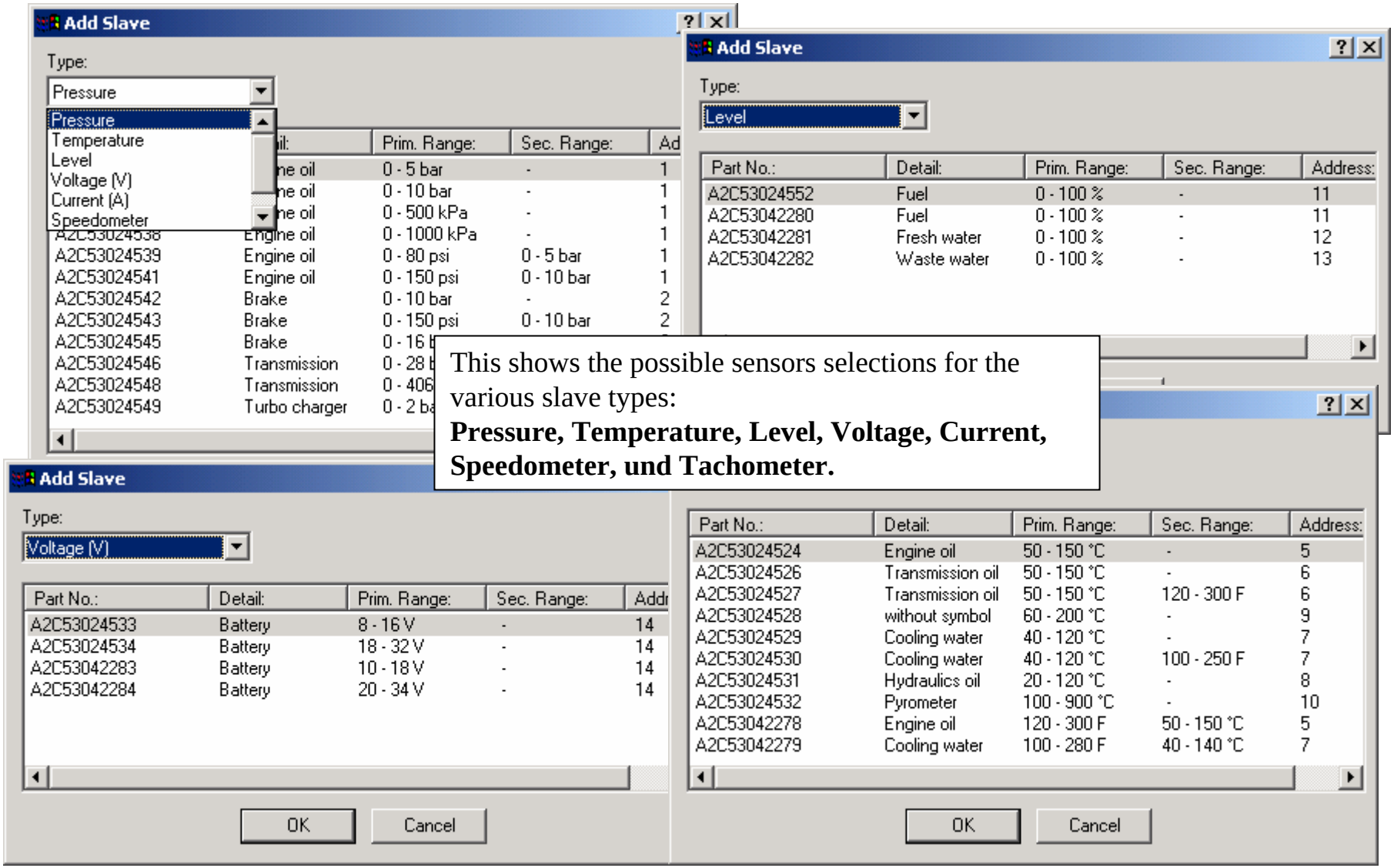


The left screen part, the – **navigation-window** – shows the whole configuration. Subcategories show up after a mouse-click to the „+“ on the left side near the configured device (master/slave/display). By a click to the „-“ the subcategories view is closed again.

The right part of the overview screen, the – **configurations-window** – is used to show a picture image of the selected master, slave or display devices in addition with the characteristic parameter values e.g. **Part No., Type, Primary- and Secondary Range, potential Sensor type and Address**, During the process of configuring the different devices this window shall be used to set all required parameters.

3.) Adding the required Slaves



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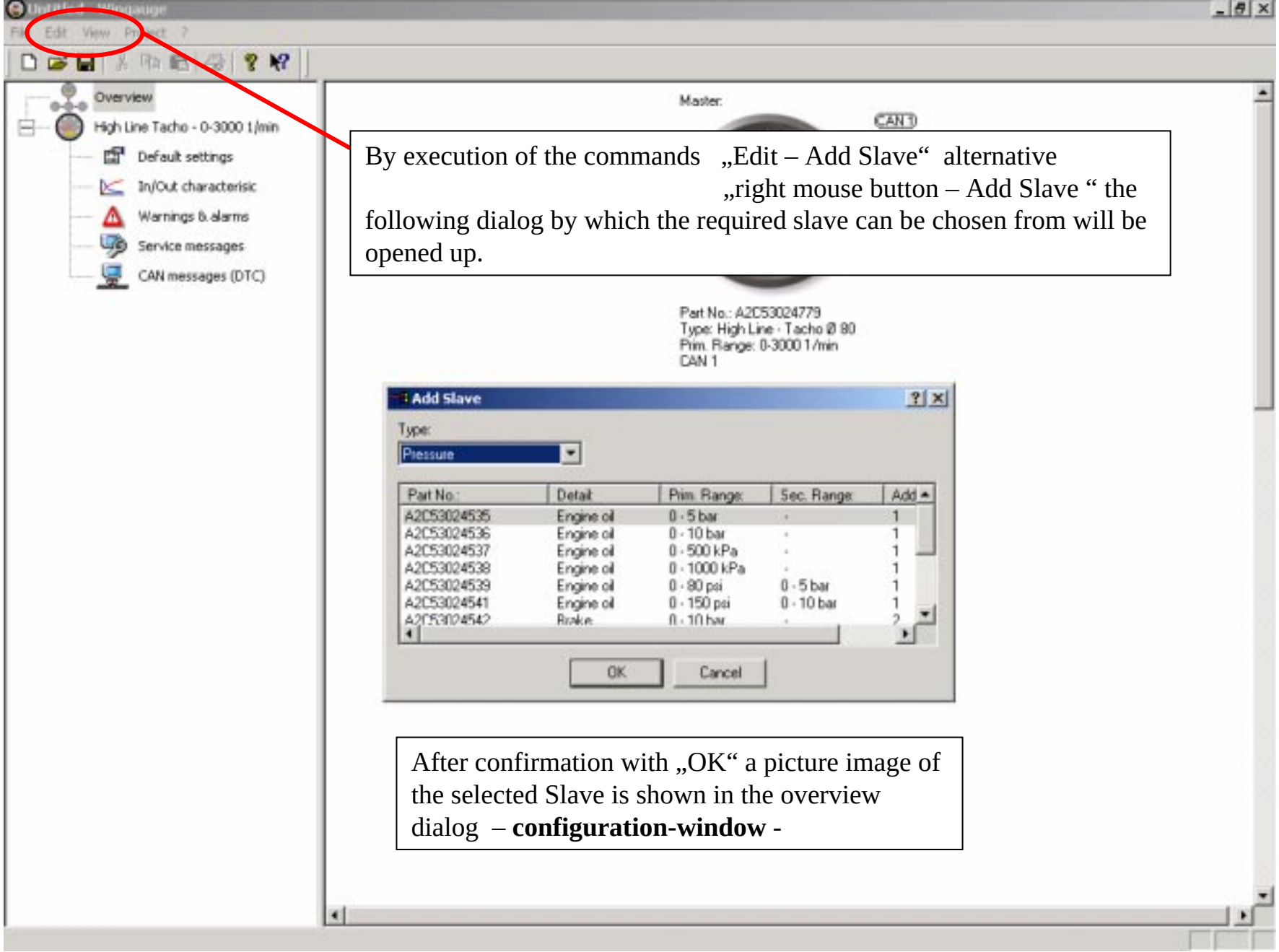
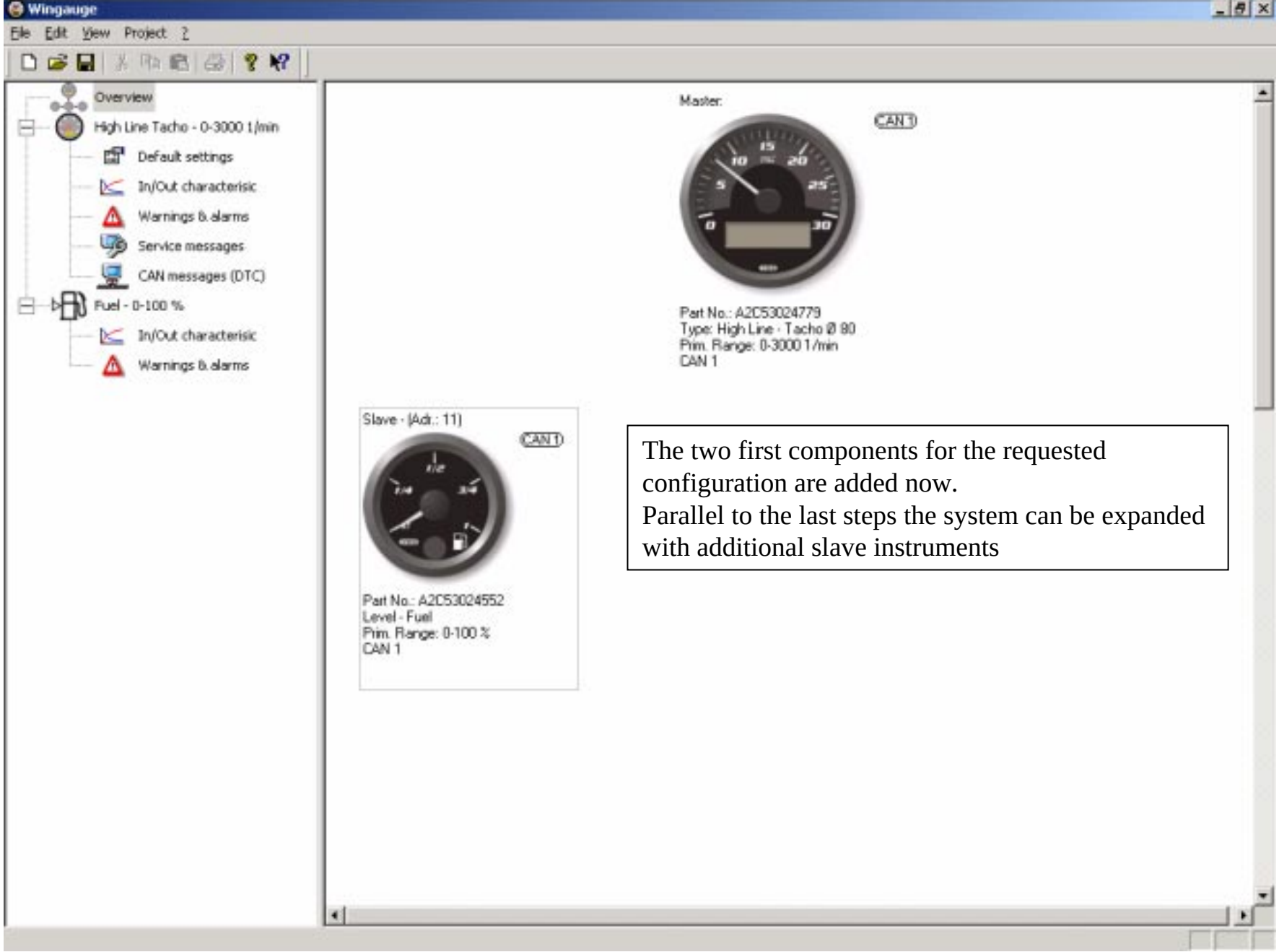


By execution of the commands „Edit – Add Slave“ alternative „right mouse button – Add Slave “ the following dialog by which the required slave can be chosen from will be opened up.

After confirmation with „OK“ a picture image of the selected Slave is shown in the overview dialog – **configuration-window** -



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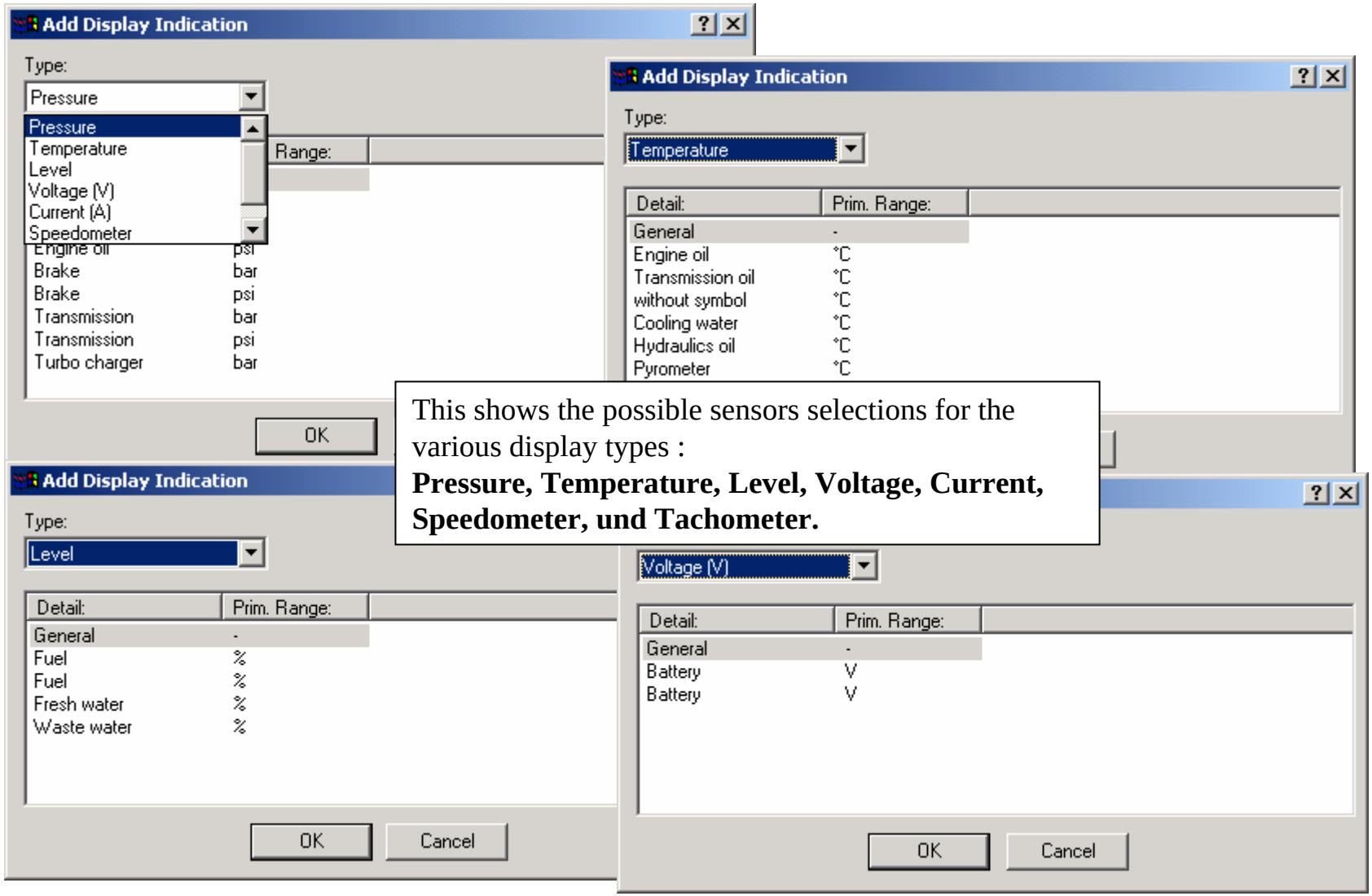
3.) Adding the required Displays



This shows the possible sensors selections for the various display types :
Pressure, Temperature, Level, Voltage, Current, Speedometer, und Tachometer.

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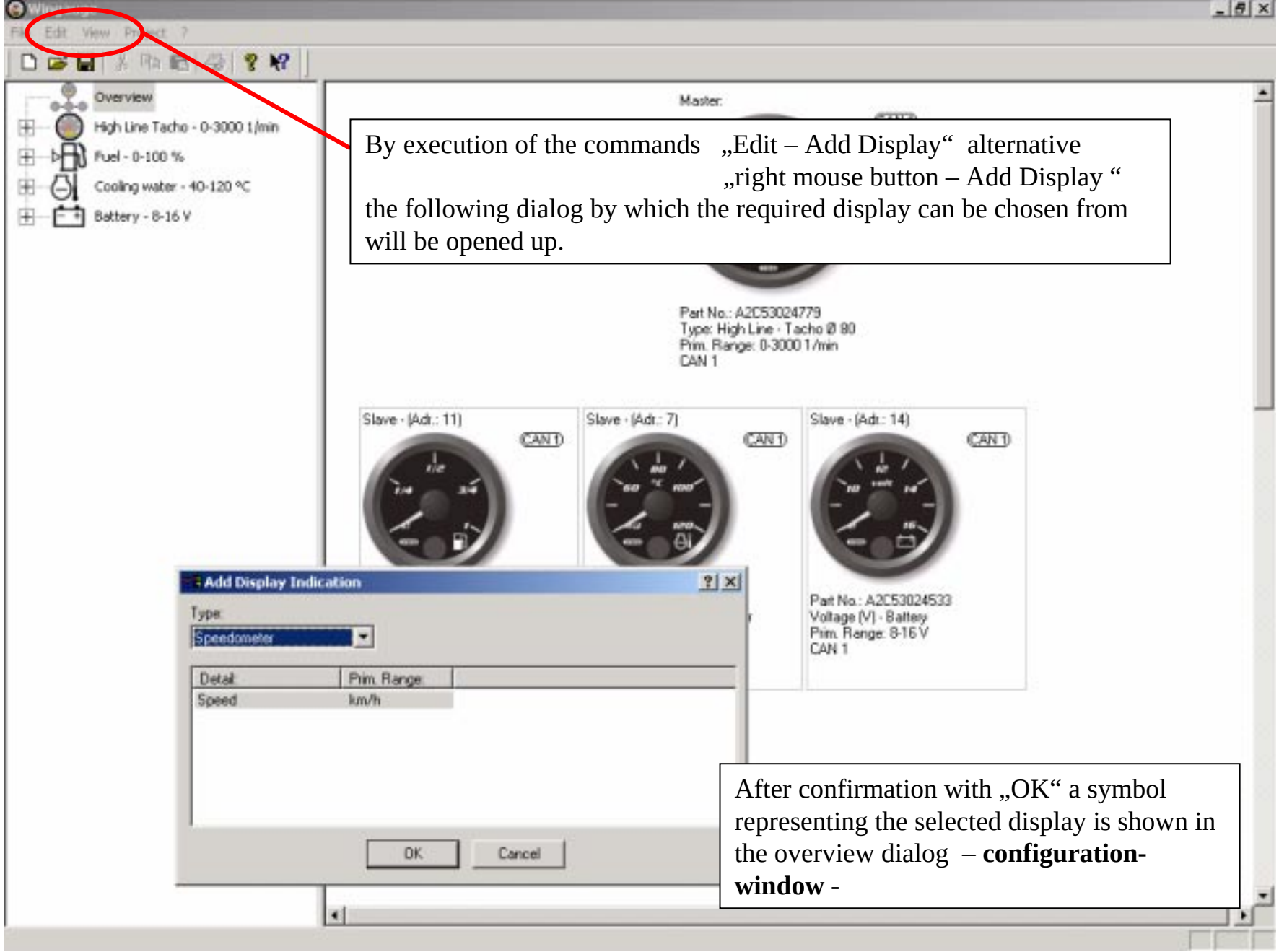

By execution of the commands „Edit – Add Display“ alternative „right mouse button – Add Display “ the following dialog by which the required display can be chosen from will be opened up.

After confirmation with „OK“ a symbol representing the selected display is shown in the overview dialog – **configuration-window** -

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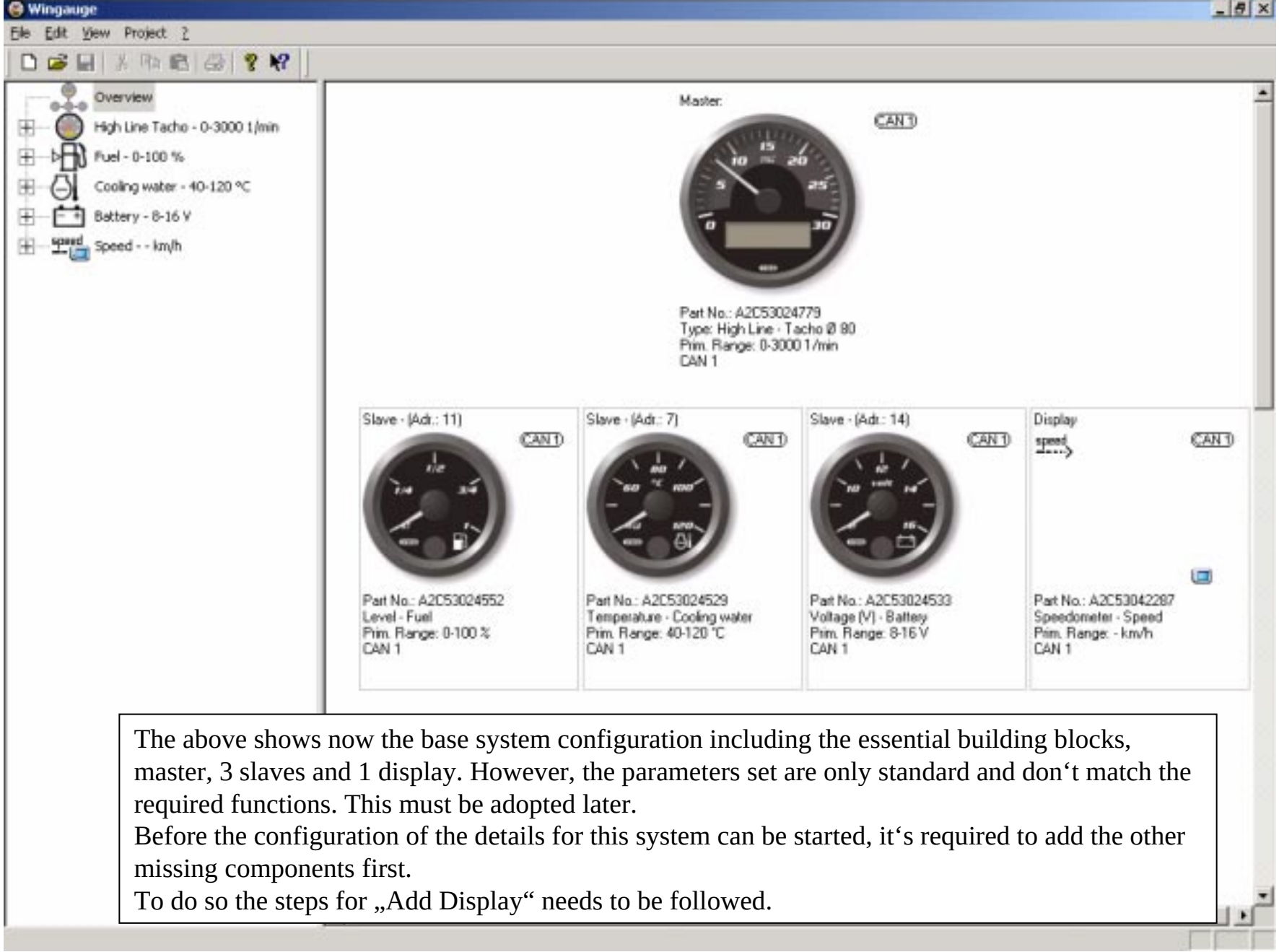
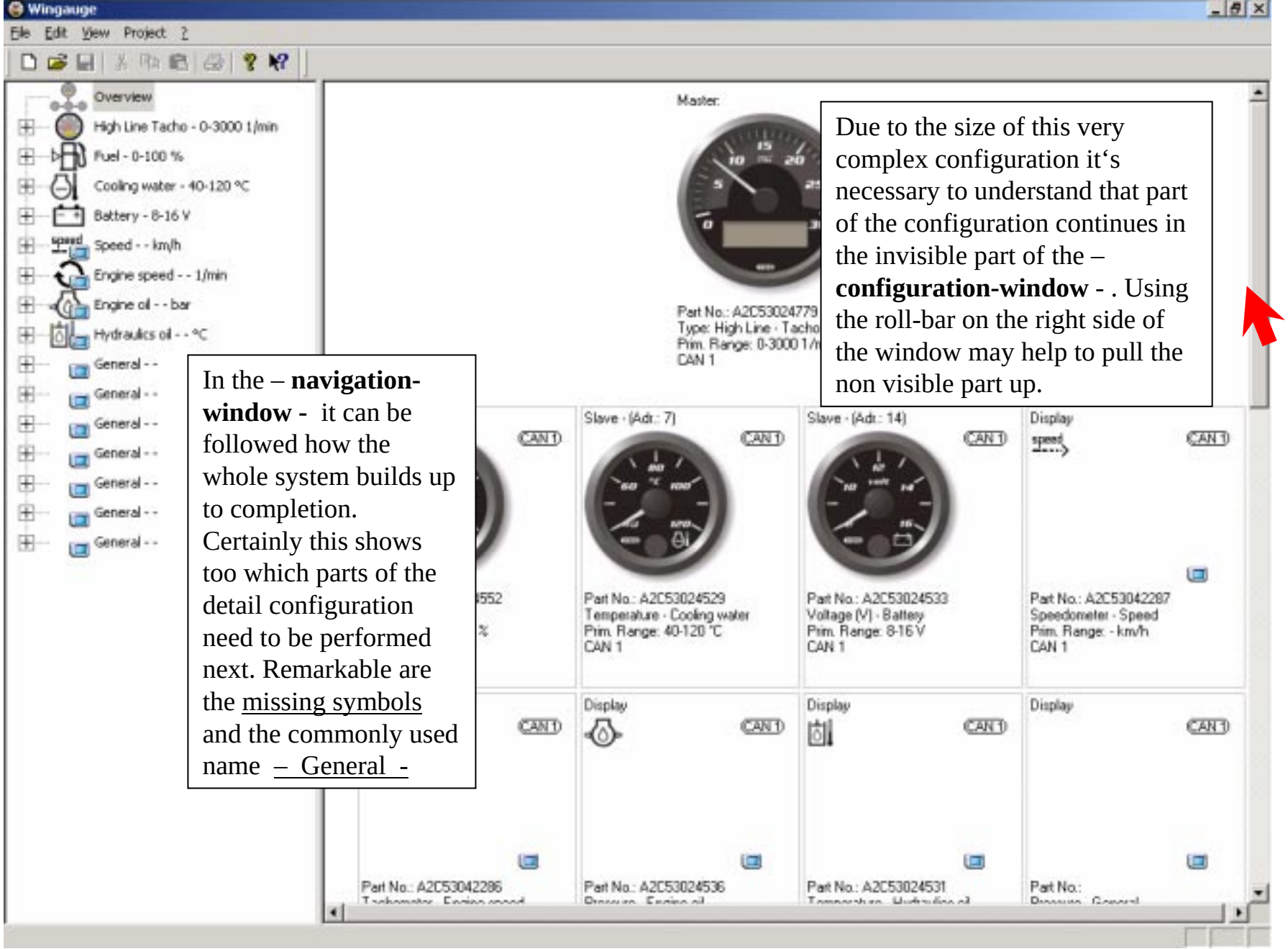


The above shows now the base system configuration including the essential building blocks, master, 3 slaves and 1 display. However, the parameters set are only standard and don‘t match the required functions. This must be adopted later.
Before the configuration of the details for this system can be started, it‘s required to add the other missing components first.
To do so the steps for „Add Display“ needs to be followed.



In the – **navigation-window -** it can be followed how the whole system builds up to completion. Certainly this shows too which parts of the detail configuration need to be performed next. Remarkable are the <u>missing symbols</u> and the commonly used name <u>– General -</u>

Due to the size of this very complex configuration it‘s necessary to understand that part of the configuration continues in the invisible part of the – **configuration-window -** . Using the roll-bar on the right side of the window may help to pull the non visible part up.

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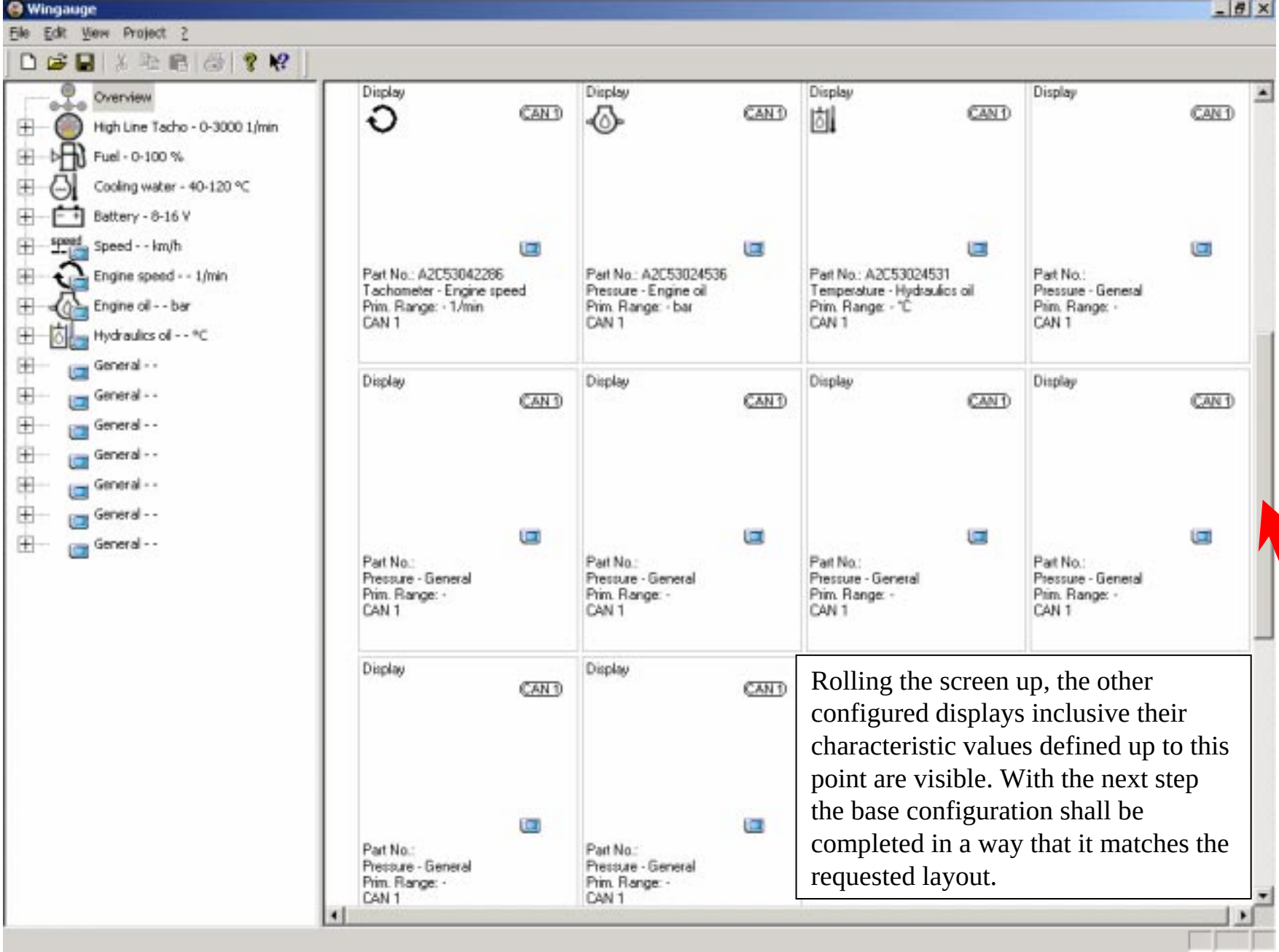

Rolling the screen up, the other configured displays inclusive their characteristic values defined up to this point are visible. With the next step the base configuration shall be completed in a way that it matches the requested layout.

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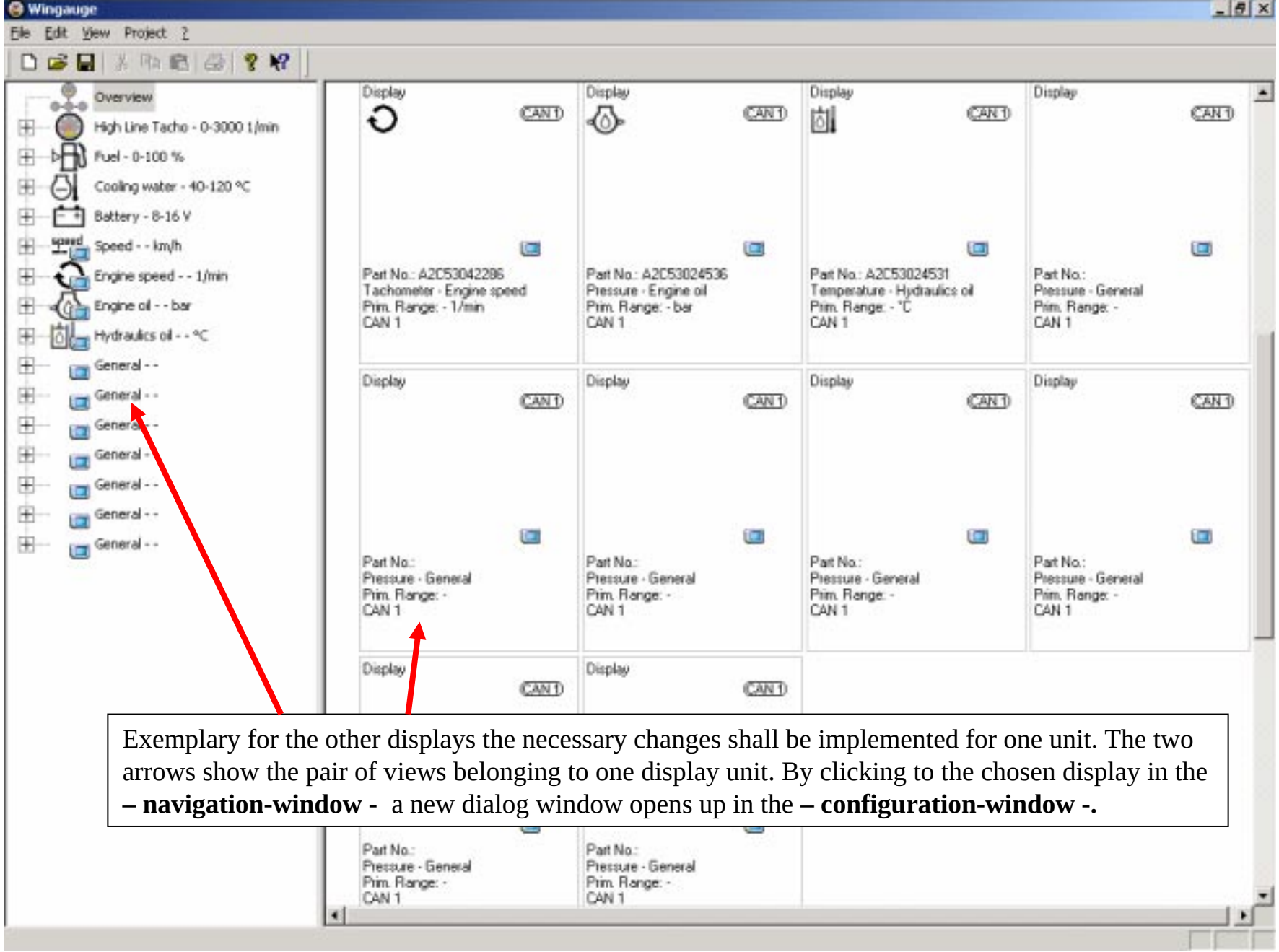
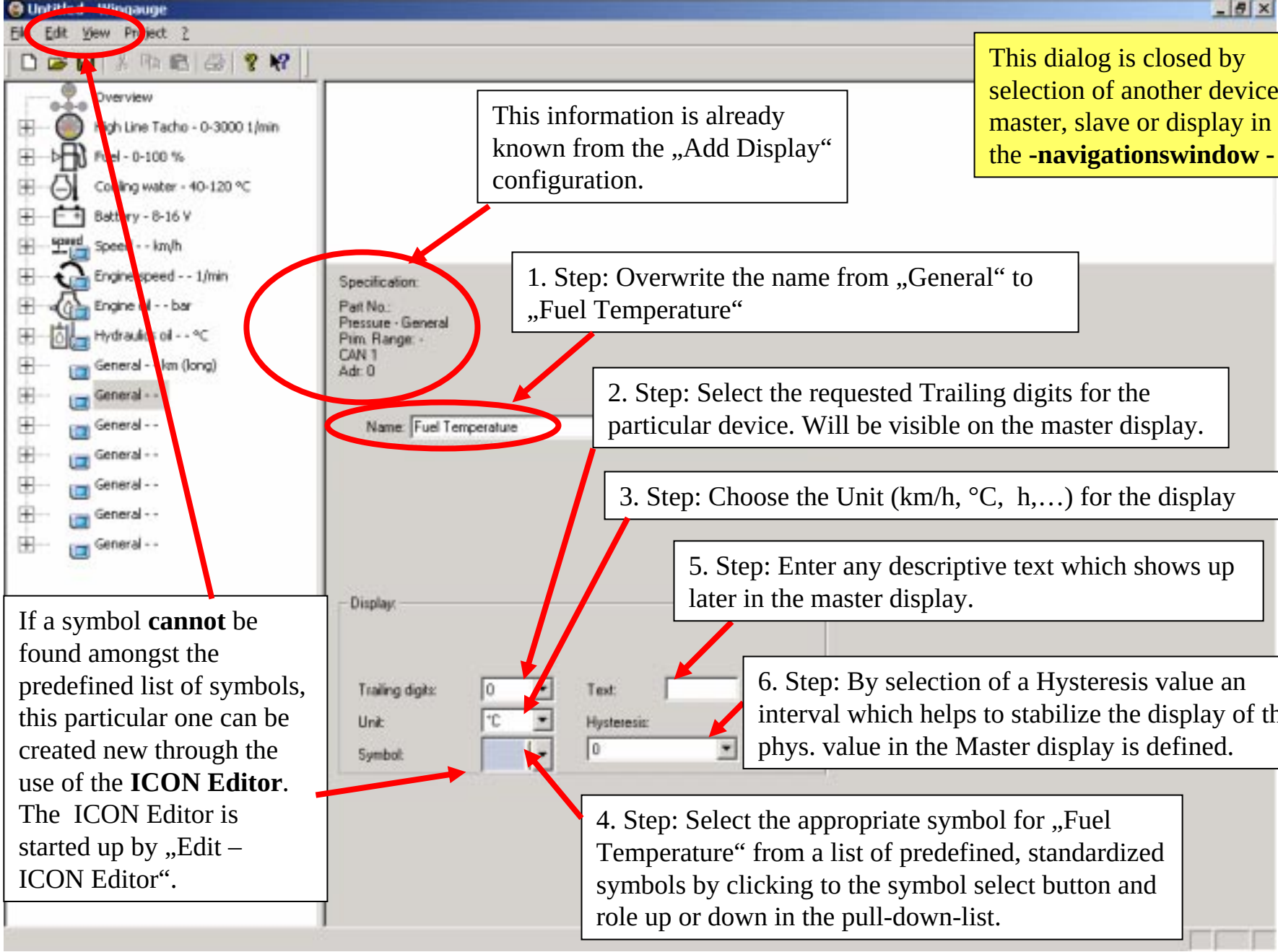
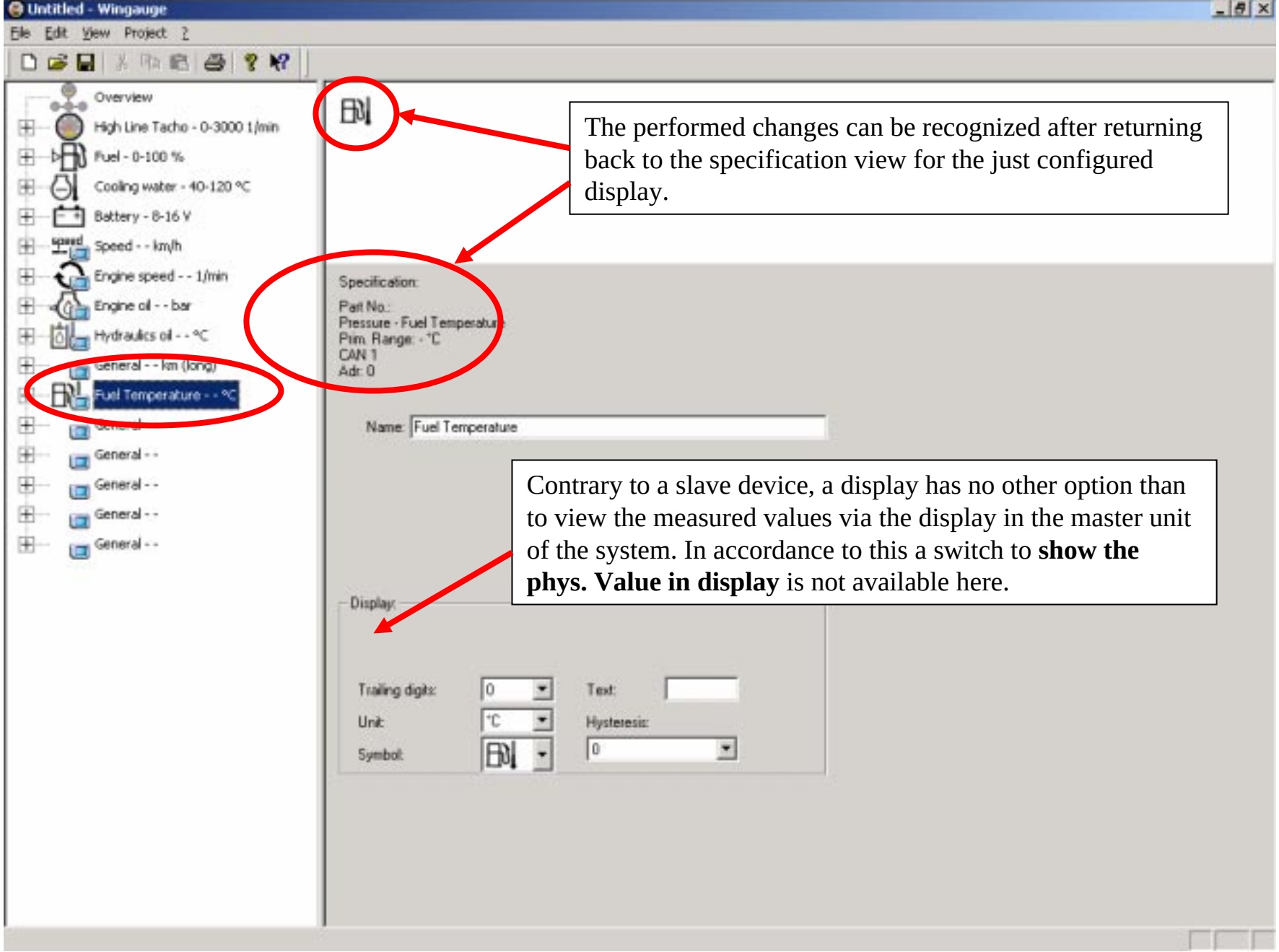
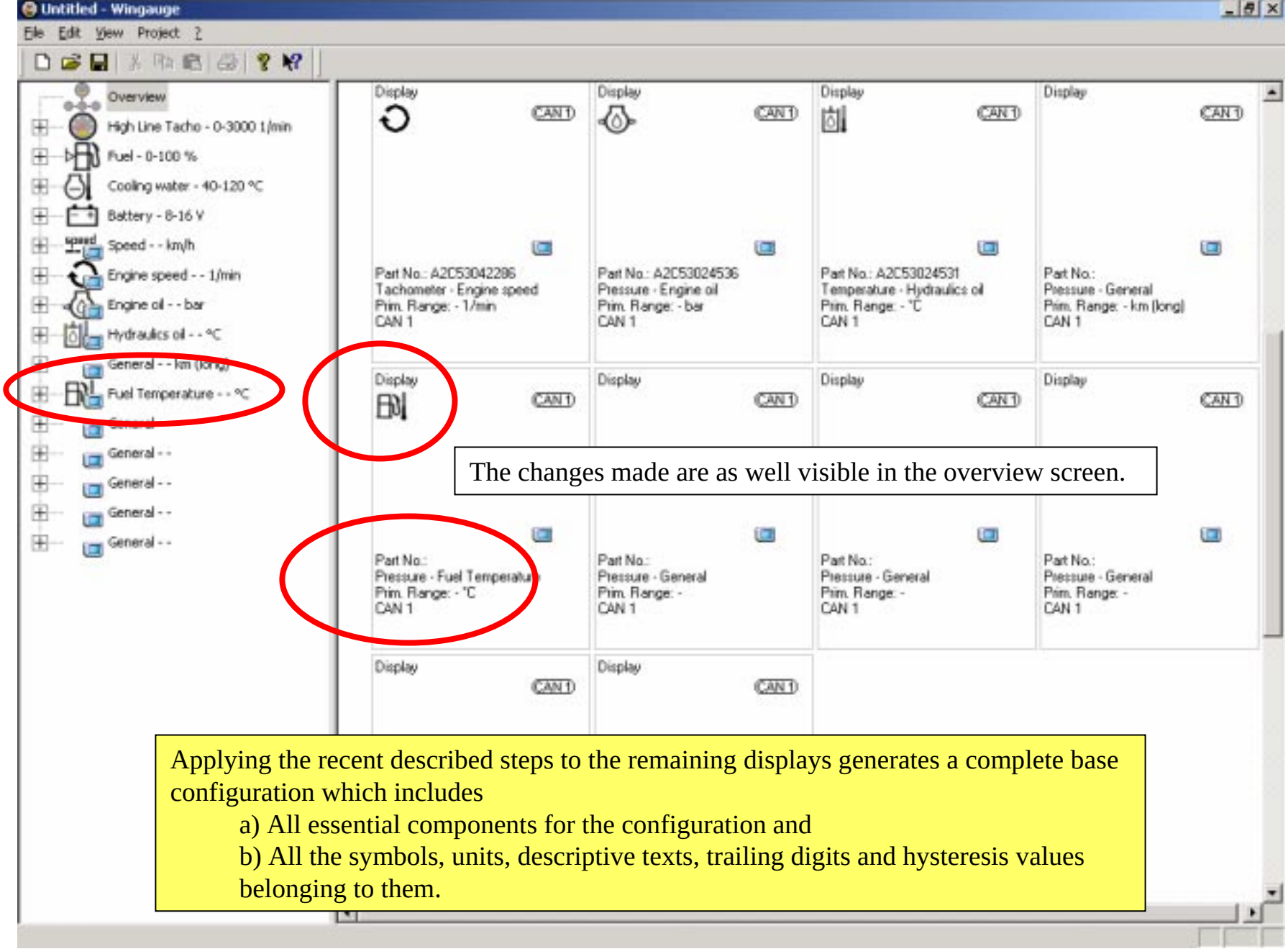


Exemplary for the other displays the necessary changes shall be implemented for one unit. The two arrows show the pair of views belonging to one display unit. By clicking to the chosen display in the **– navigation-window -** a new dialog window opens up in the **– configuration-window -.**


This dialog is closed by selection of another device master, slave or display in the **-navigationswindow -**
This information is already known from the „Add Display“ configuration.
1. Step: Overwrite the name from „General“ to „Fuel Temperature“
2. Step: Select the requested Trailing digits for the particular device. Will be visible on the master display.
3. Step: Choose the Unit (km/h, °C, h,…) for the display
5. Step: Enter any descriptive text which shows up later in the master display.
6. Step: By selection of a Hysteresis value an interval which helps to stabilize the display of the phys. value in the Master display is defined.
4. Step: Select the appropriate symbol for „Fuel Temperature“ from a list of predefined, standardized symbols by clicking to the symbol select button and role up or down in the pull-down-list.
If a symbol **cannot** be found amongst the predefined list of symbols, this particular one can be created new through the use of the **ICON Editor**. The ICON Editor is started up by „Edit – ICON Editor“.
Specification:
Part No.:
Pressure - General
Prim. Range: -
CAN 1
Adr: 0
Name: Fuel Temperature
Display:
Trailing digits:
Unit:
Symbol:
Text:
Hysteresis:
Edit
View
Overview
General - - km (long)



SIEMENS VDO Automotive

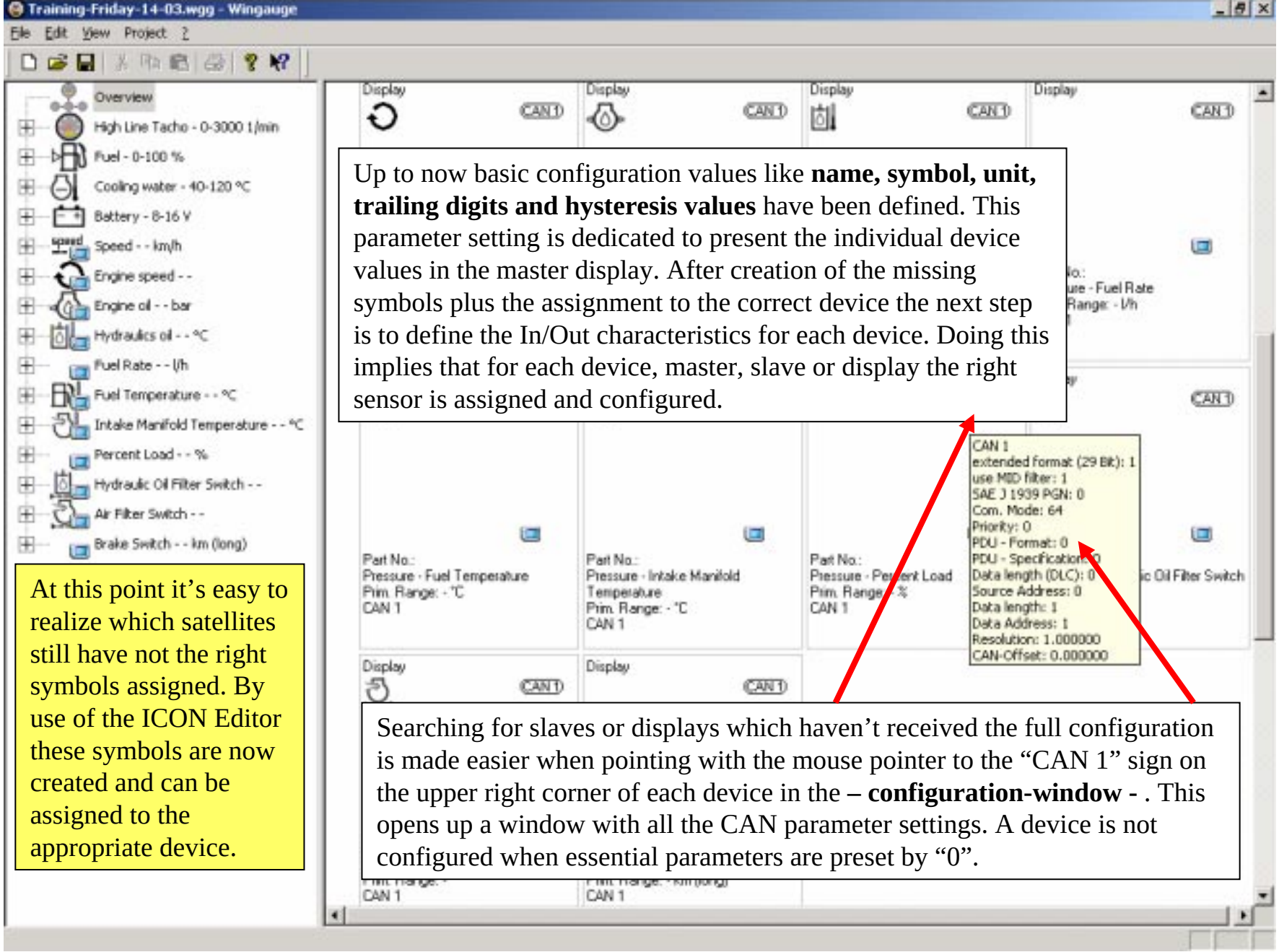


The changes made are as well visible in the overview screen.

Applying the recent described steps to the remaining displays generates a complete base configuration which includes

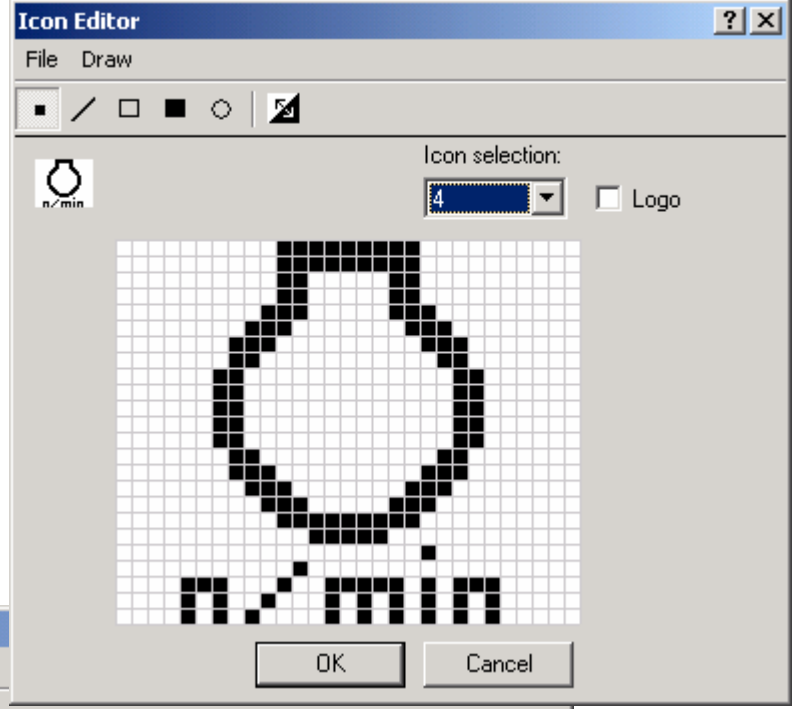
a) All essential components for the configuration and

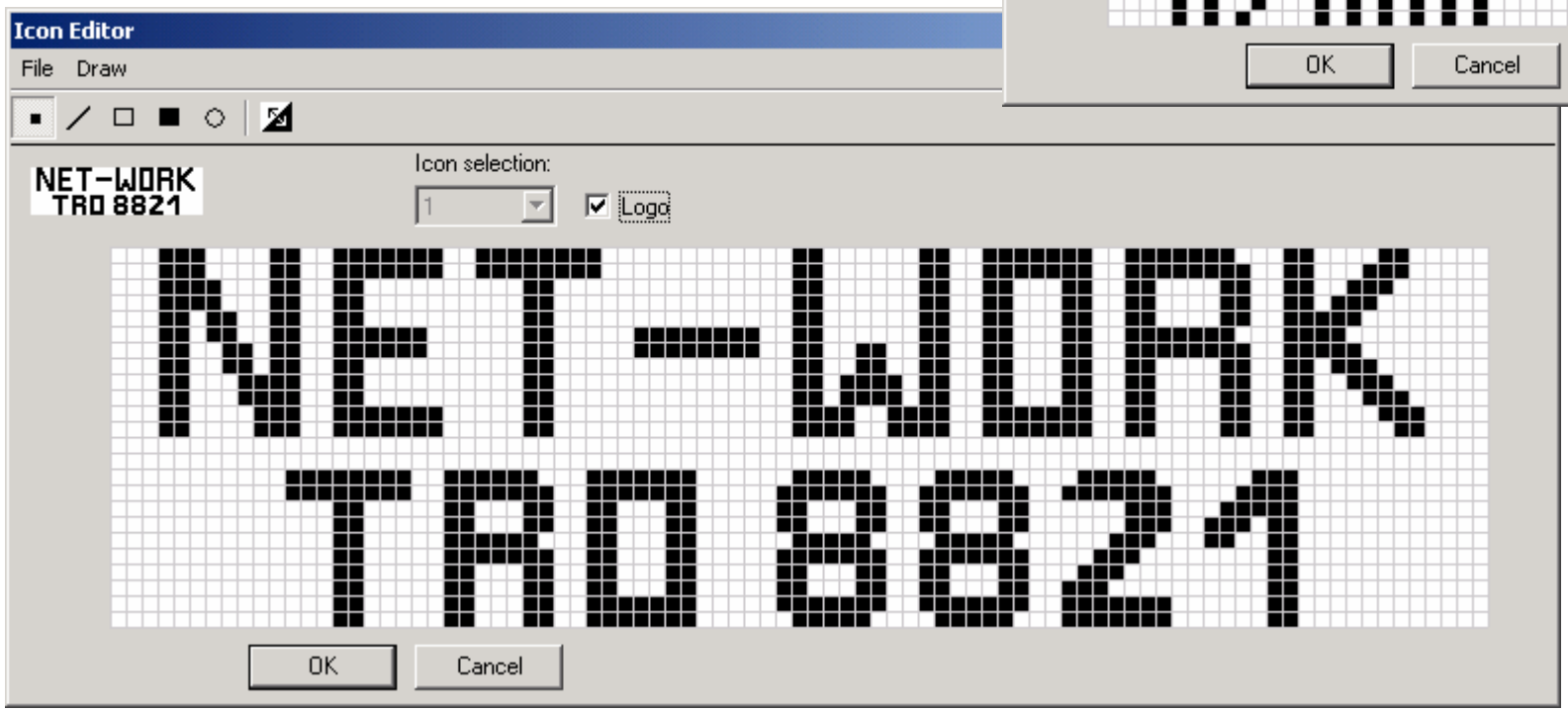
b) All the symbols, units, descriptive texts, trailing digits and hysteresis values belonging to them.

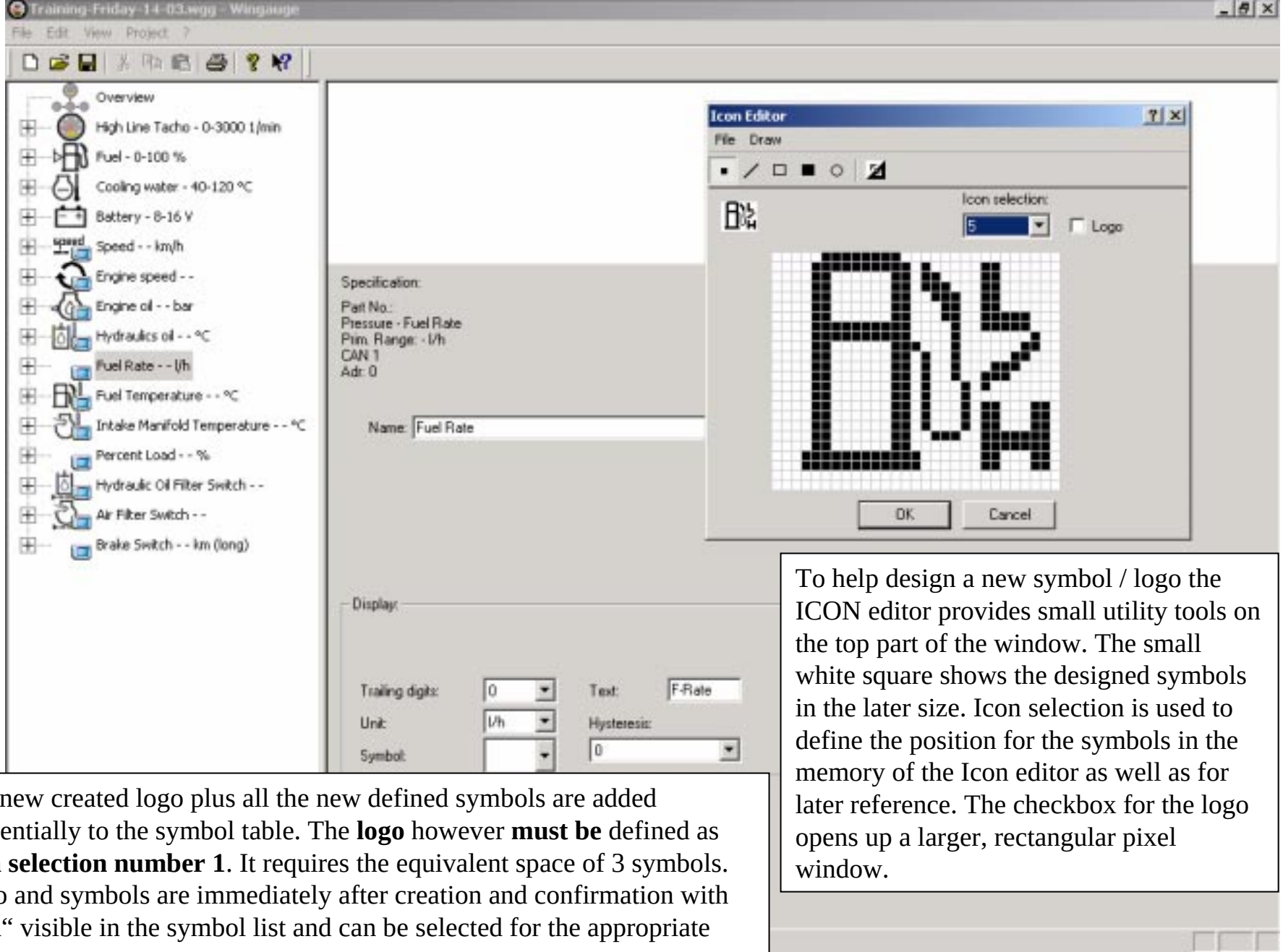

Training-Friday-14-03.wgg - Wingauge
File Edit View Project ?
Overview
High Line Tacho - 0-3000 1/min
Fuel - 0-100 %
Cooling water - 40-120 °C
Battery - 8-16 V
Speed - - km/h
Engine speed - -
Engine oil - - bar
Hydraulics oil - - °C
Fuel Rate - - l/h
Fuel Temperature - - °C
Intake Manifold Temperature - - °C
Percent Load - - %
Hydraulic Oil Filter Switch - -
Air Filter Switch - -
Brake Switch - - km (long)
Display
CAN 1
Up to now basic configuration values like name, symbol, unit, trailing digits and hysteresis values have been defined. This parameter setting is dedicated to present the individual device values in the master display. After creation of the missing symbols plus the assignment to the correct device the next step is to define the In/Out characteristics for each device. Doing this implies that for each device, master, slave or display the right sensor is assigned and configured.
At this point it's easy to realize which satellites still have not the right symbols assigned. By use of the ICON Editor these symbols are now created and can be assigned to the appropriate device.
Part No.:
Pressure - Fuel Temperature
Prim. Range: - °C
CAN 1
Part No.:
Pressure - Intake Manifold Temperature
Prim. Range: - °C
CAN 1
Part No.:
Pressure - Percent Load
Prim. Range: - %
CAN 1
CAN 1
extended format (29 Bit): 1
use MSD filter: 1
SAE J 1939 PGN: 0
Com. Mode: 64
Priority: 0
PDU - Format: 0
PDU - Specification: 0
Data length (DLC): 0
Source Address: 0
Data length: 1
Data Address: 1
Resolution: 1.000000
CAN-Offset: 0.000000
Searching for slaves or displays which haven't received the full configuration is made easier when pointing with the mouse pointer to the "CAN 1" sign on the upper right corner of each device in the – configuration-window - . This opens up a window with all the CAN parameter settings. A device is not configured when essential parameters are preset by "0".

ICON Editor

The ICON Editor is accessible via the function
„Edit – ICON Editor“.
This routine is used to define nonexistent new symbols or any kind of logo. While the symbols are represented in a square of 24 x 24 pixel, the logo is defined in a rectangle of 24 x 87 pixel. Any new defined symbol / logo will be automatically added to the existent symbol-list and is saved together with the project information. New defined logos and symbols can be saved to disc too.



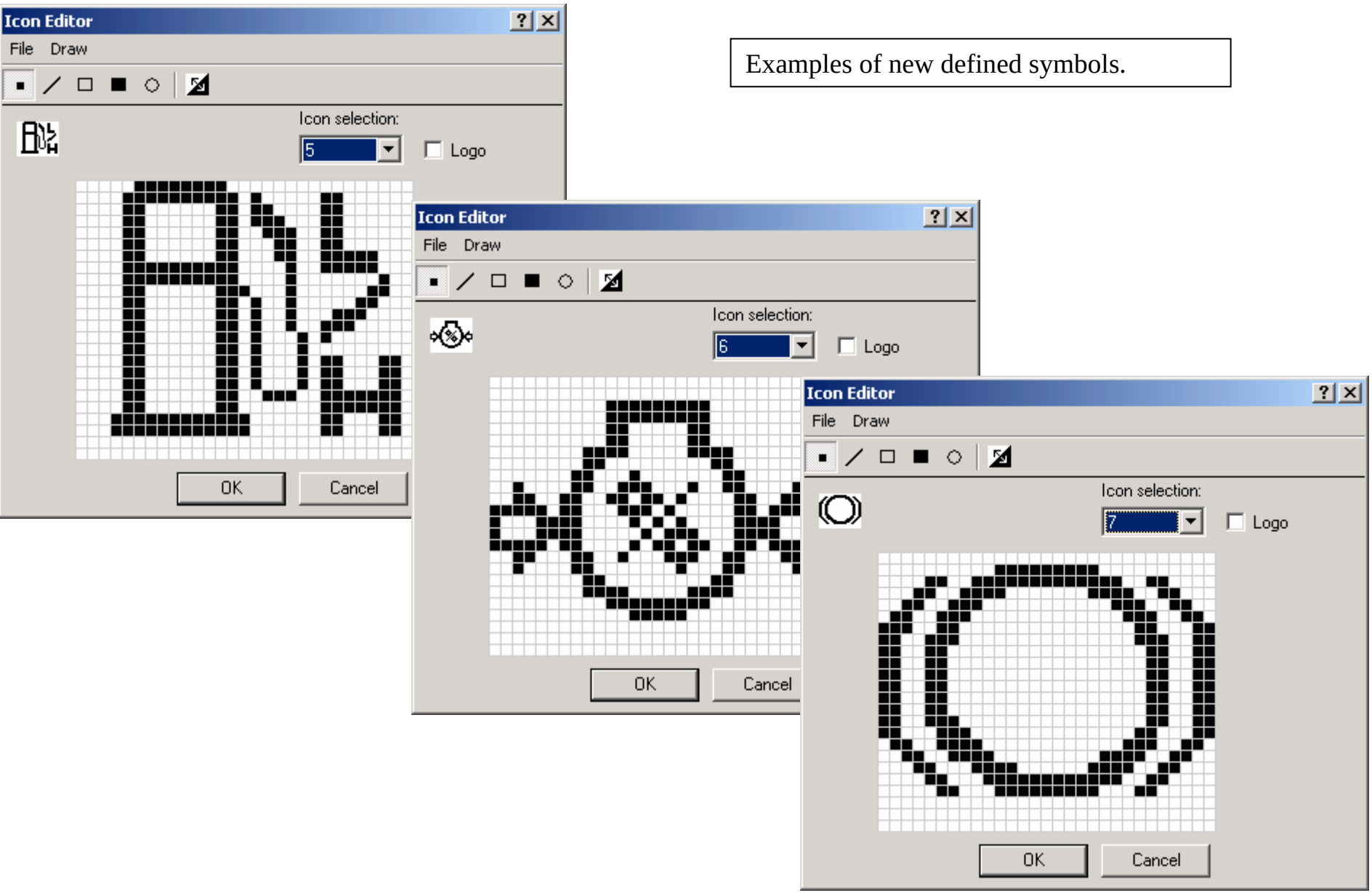




To help design a new symbol / logo the ICON editor provides small utility tools on the top part of the window. The small white square shows the designed symbols in the later size. Icon selection is used to define the position for the symbols in the memory of the Icon editor as well as for later reference. The checkbox for the logo opens up a larger, rectangular pixel window.

The new created logo plus all the new defined symbols are added sequentially to the symbol table. The **logo** however **must be** defined as **Icon selection number 1**. It requires the equivalent space of 3 symbols. Logo and symbols are immediately after creation and confirmation with „OK“ visible in the symbol list and can be selected for the appropriate device.

Examples of new defined symbols.



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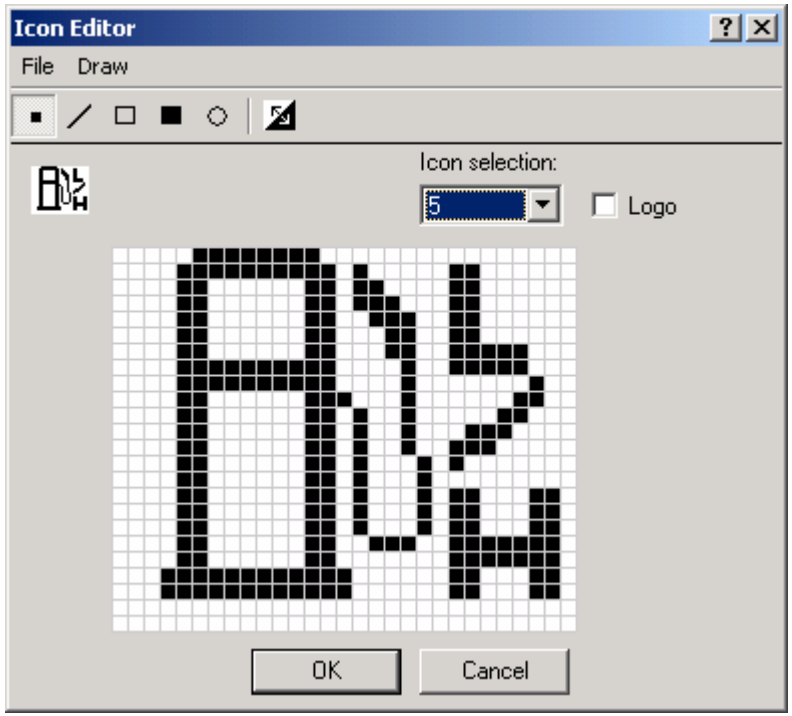


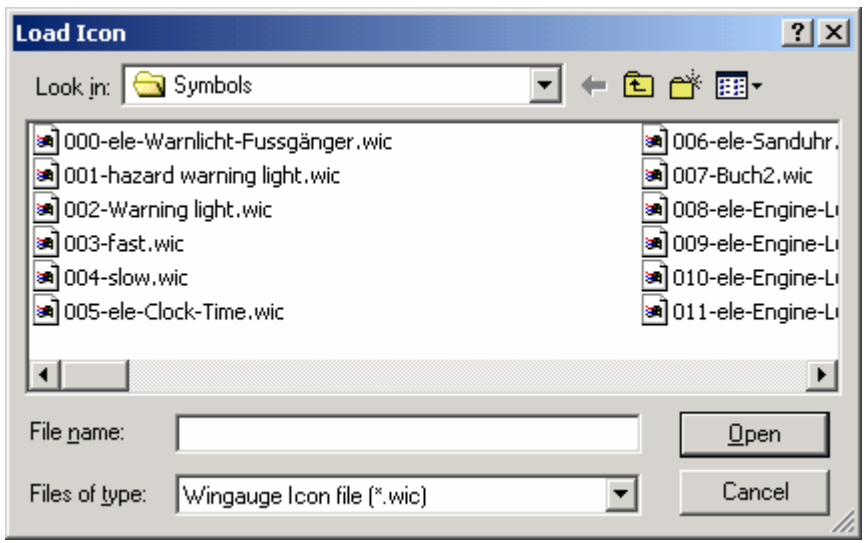
New created symbols may be saved in a file for later use by the function:

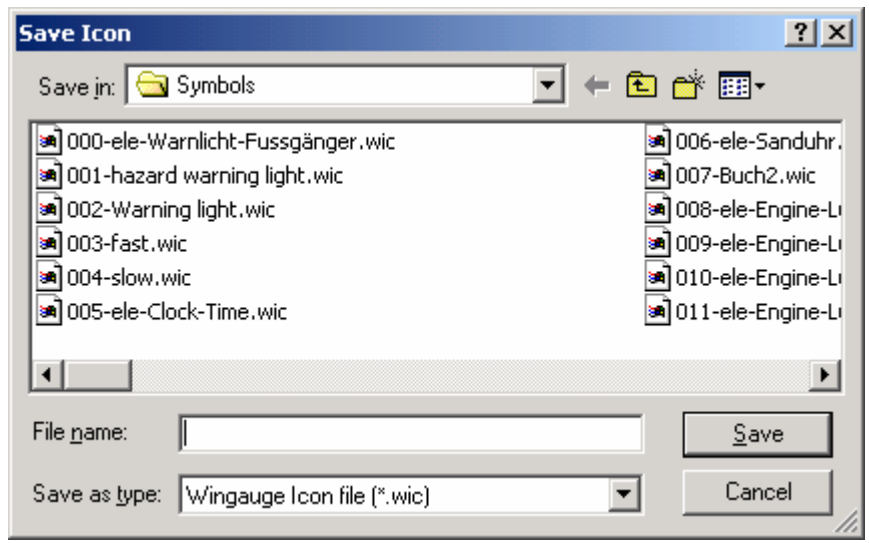
"File – Save Icon".

In the same way the function

„File – Load Icon"

may be used to load a symbol which has been defined at an earlier state. It is important to watch if the checkbox for logo is checked or not. If it's checked, a logo is expected to be loaded. This differentiation is necessary because a Logo occupies the space for 3 symbols and requires different treatment.





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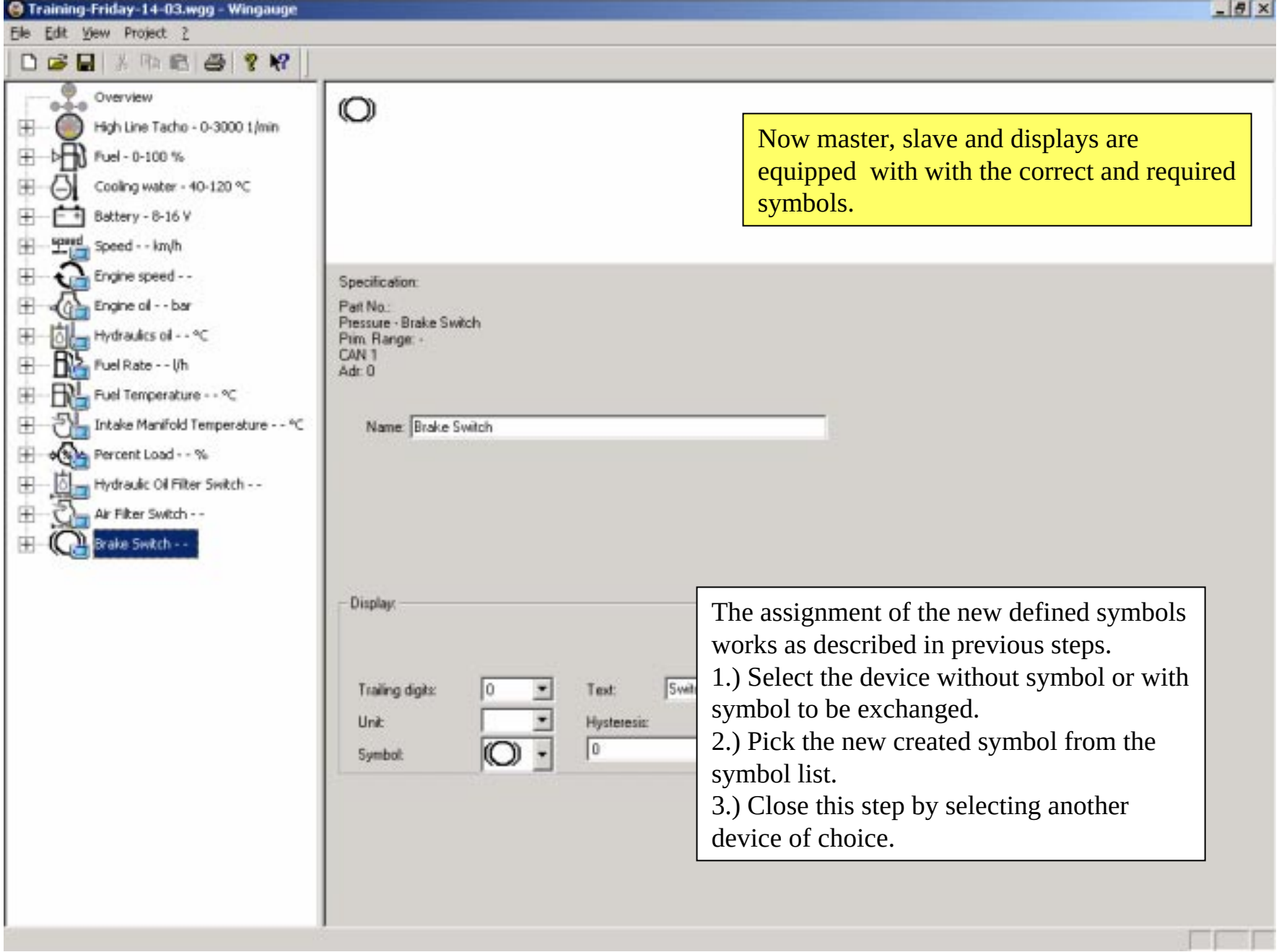
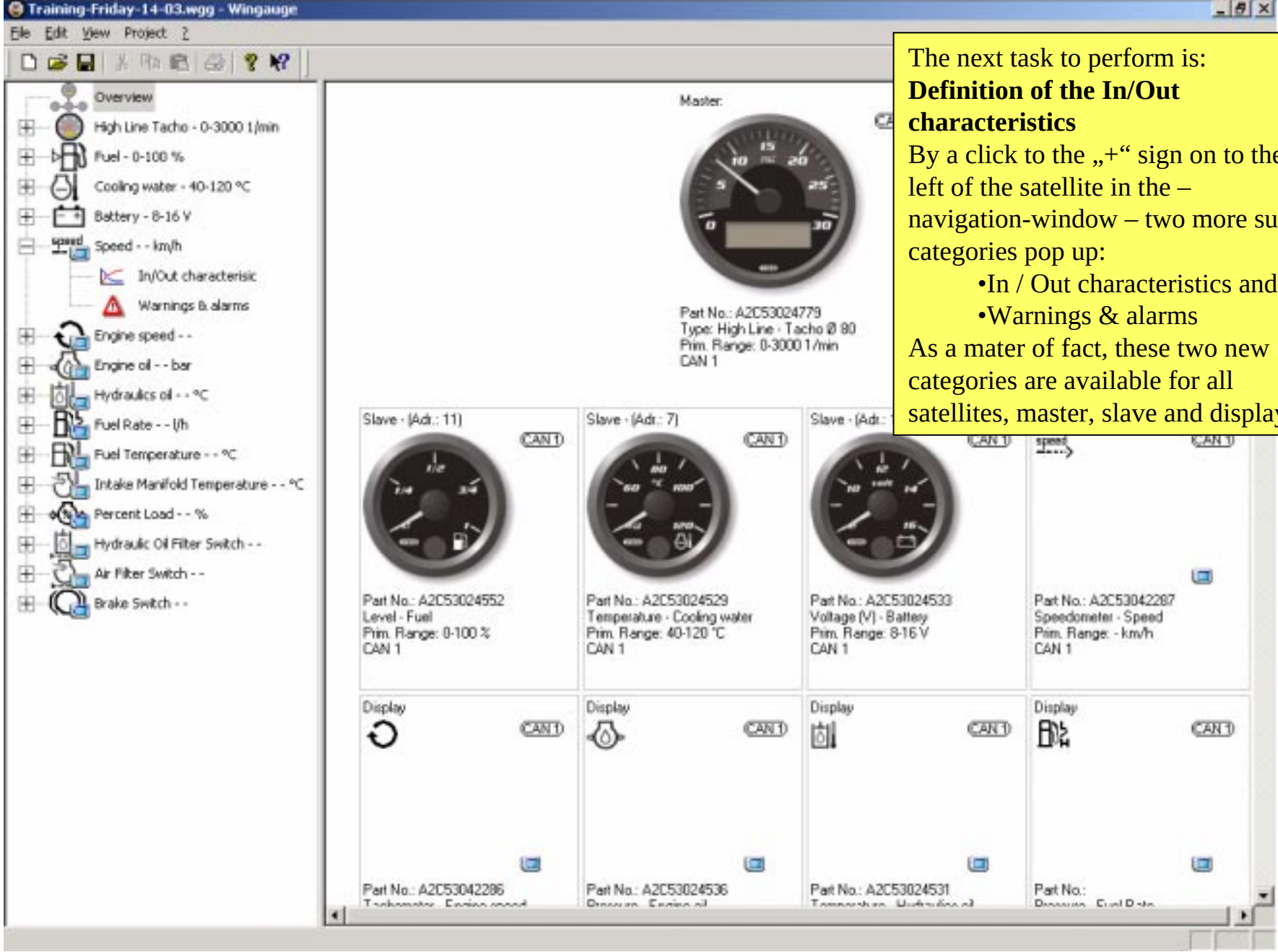
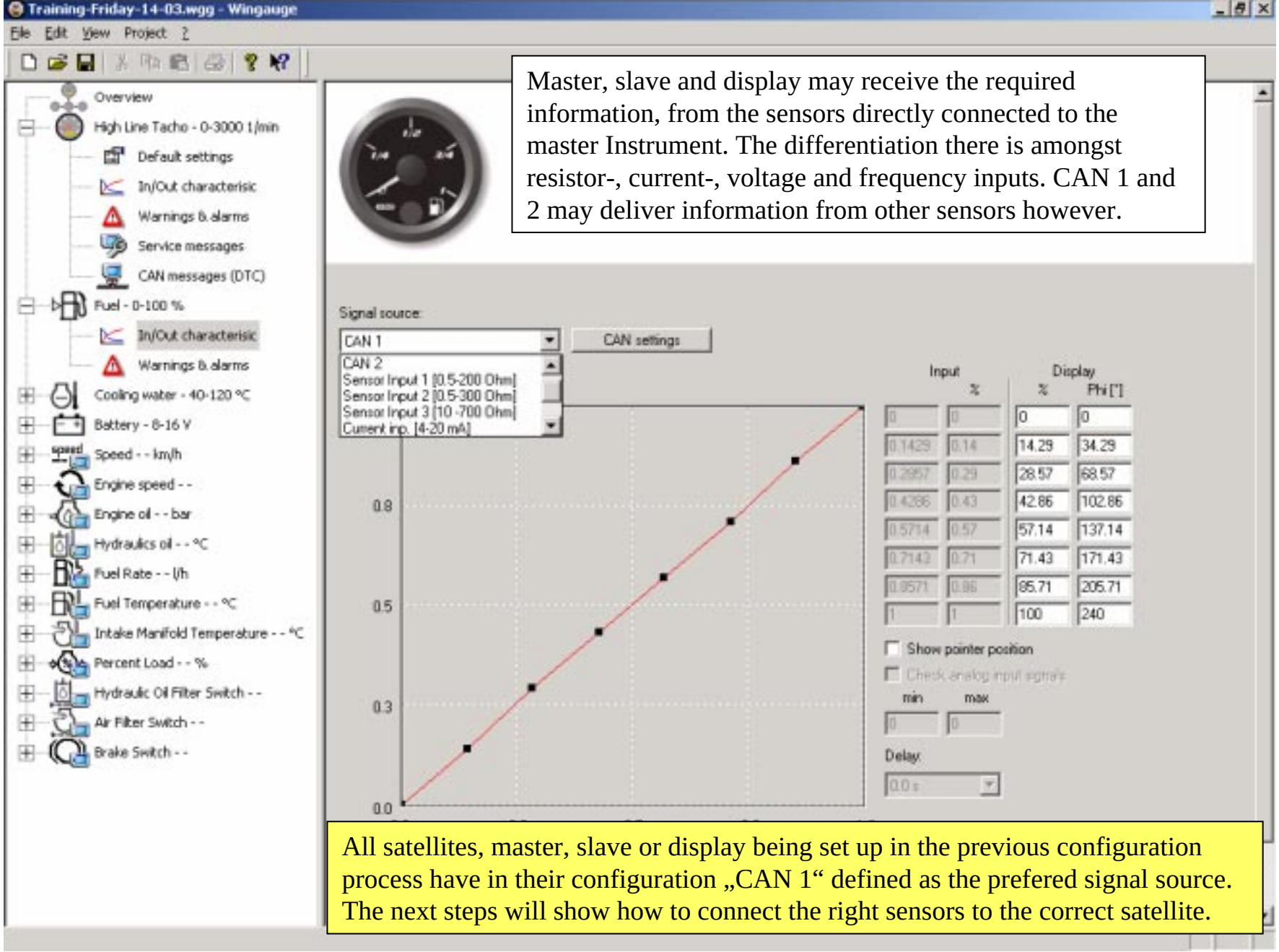

Training-Friday-14-03.wgg - Wingauge
File Edit View Project ?
Overview
High Line Tacho - 0-3000 1/min
Fuel - 0-100 %
Cooling water - 40-120 °C
Battery - 8-16 V
Speed - - km/h
Engine speed - -
Engine oil - - bar
Hydraulics oil - - °C
Fuel Rate - - l/h
Fuel Temperature - - °C
Intake Manifold Temperature - - °C
Percent Load - - %
Hydraulic Oil Filter Switch - -
Air Filter Switch - -
Brake Switch - -
Now master, slave and displays are equipped with with the correct and required symbols.
Specification:
Part No.:
Pressure - Brake Switch
Prm. Range: -
CAN 1
Adr: 0
Name: Brake Switch
Display:
Trailing digits: 0
Text:
Unit:
Hysteresis:
Symbol:
0
The assignment of the new defined symbols works as described in previous steps.
1.) Select the device without symbol or with symbol to be exchanged.
2.) Pick the new created symbol from the symbol list.
3.) Close this step by selecting another device of choice.



The next task to perform is:
Definition of the In/Out characteristics
By a click to the „+“ sign on to the left of the satellite in the – navigation-window – two more sub categories pop up:

- In / Out characteristics and
- Warnings & alarms

As a mater of fact, these two new categories are available for all satellites, master, slave and displays.



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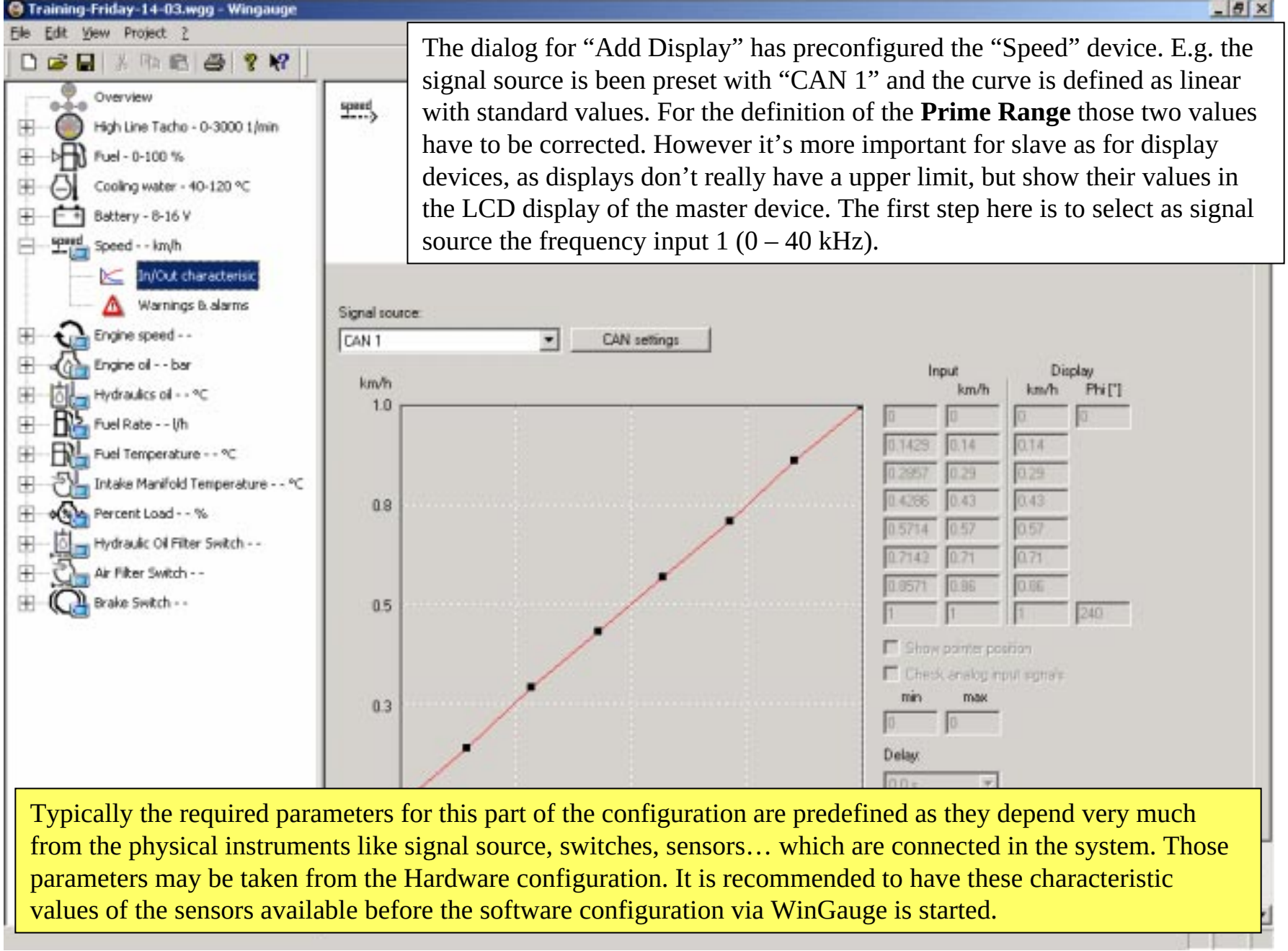
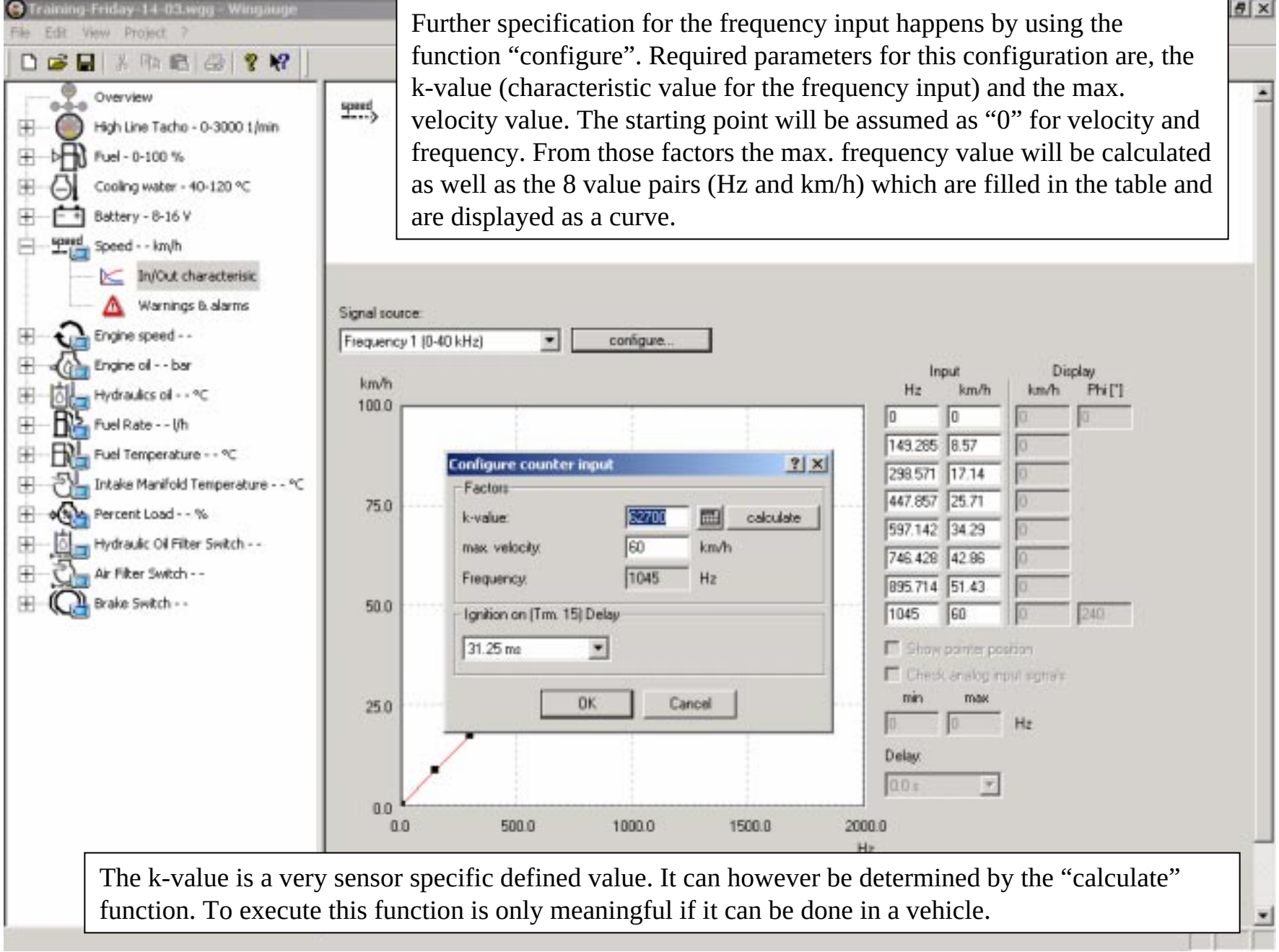


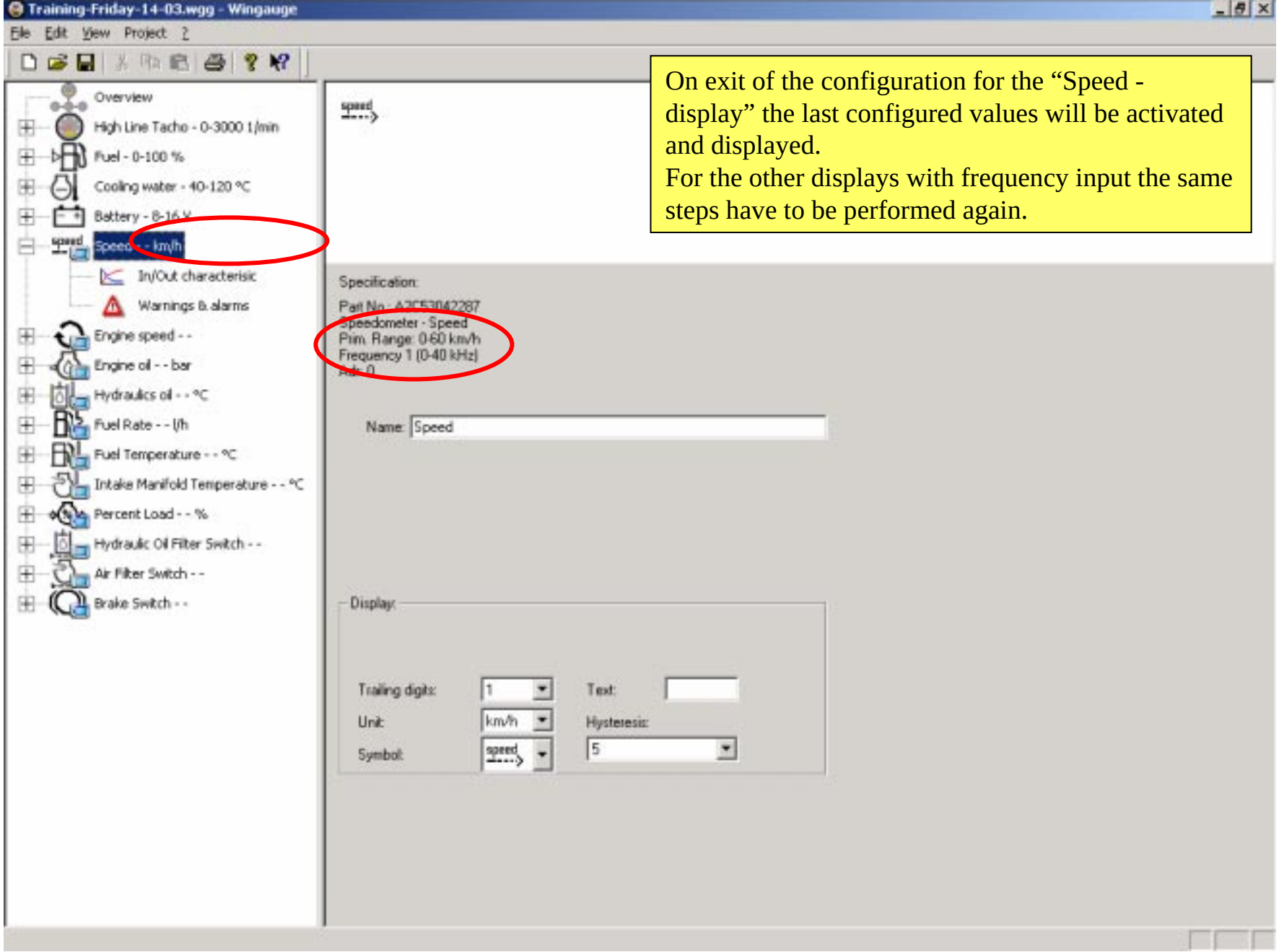
The dialog for “Add Display” has preconfigured the “Speed” device. E.g. the signal source is been preset with “CAN 1” and the curve is defined as linear with standard values. For the definition of the **Prime Range** those two values have to be corrected. However it’s more important for slave as for display devices, as displays don’t really have a upper limit, but show their values in the LCD display of the master device. The first step here is to select as signal source the frequency input 1 (0 – 40 kHz).

Typically the required parameters for this part of the configuration are predefined as they depend very much from the physical instruments like signal source, switches, sensors… which are connected in the system. Those parameters may be taken from the Hardware configuration. It is recommended to have these characteristic values of the sensors available before the software configuration via WinGauge is started.

Further specification for the frequency input happens by using the function “configure”. Required parameters for this configuration are, the k-value (characteristic value for the frequency input) and the max. velocity value. The starting point will be assumed as “0” for velocity and frequency. From those factors the max. frequency value will be calculated as well as the 8 value pairs (Hz and km/h) which are filled in the table and are displayed as a curve.



The k-value is a very sensor specific defined value. It can however be determined by the “calculate” function. To execute this function is only meaningful if it can be done in a vehicle.



On exit of the configuration for the “Speed - display” the last configured values will be activated and displayed.
For the other displays with frequency input the same steps have to be performed again.

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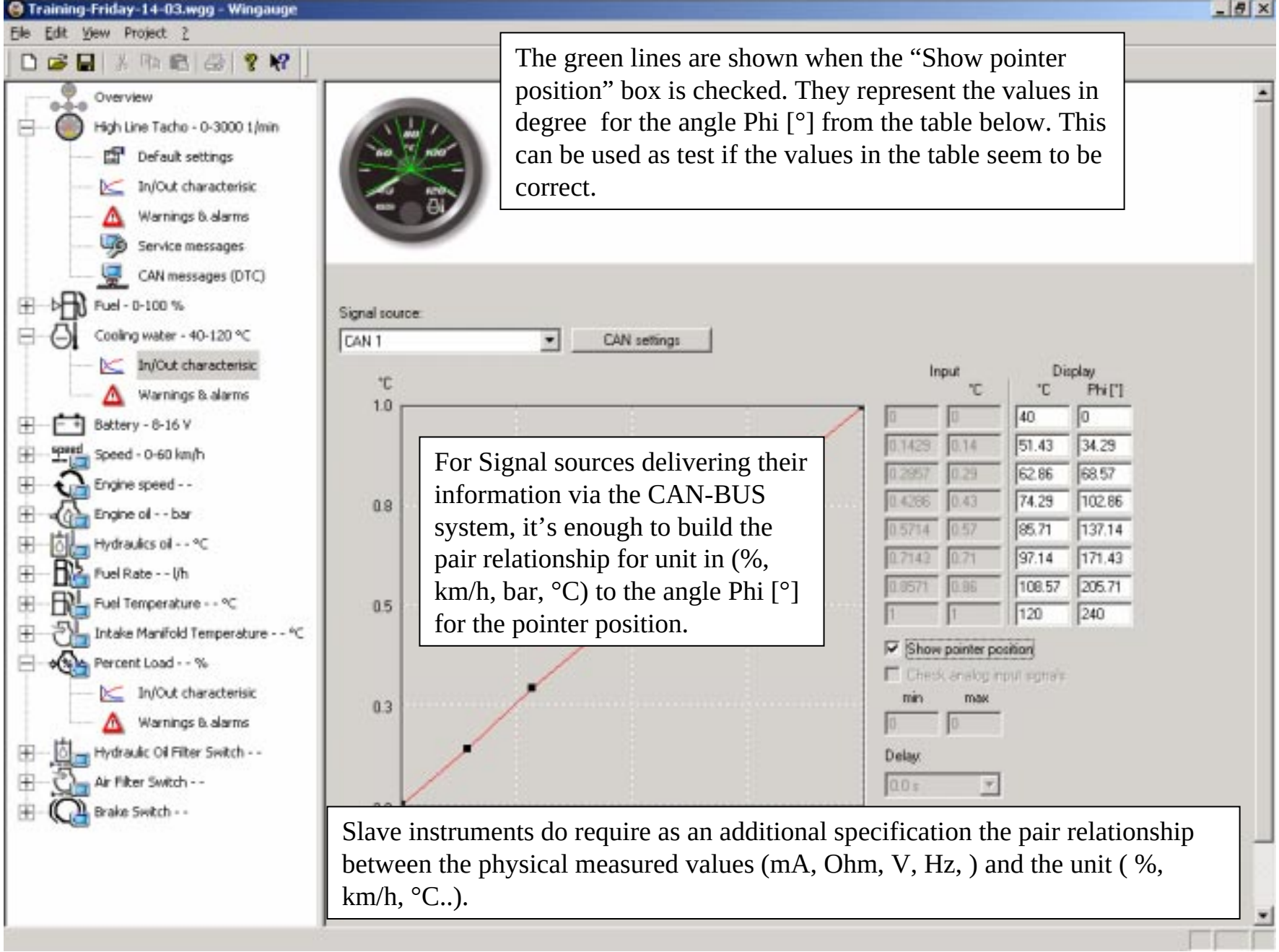

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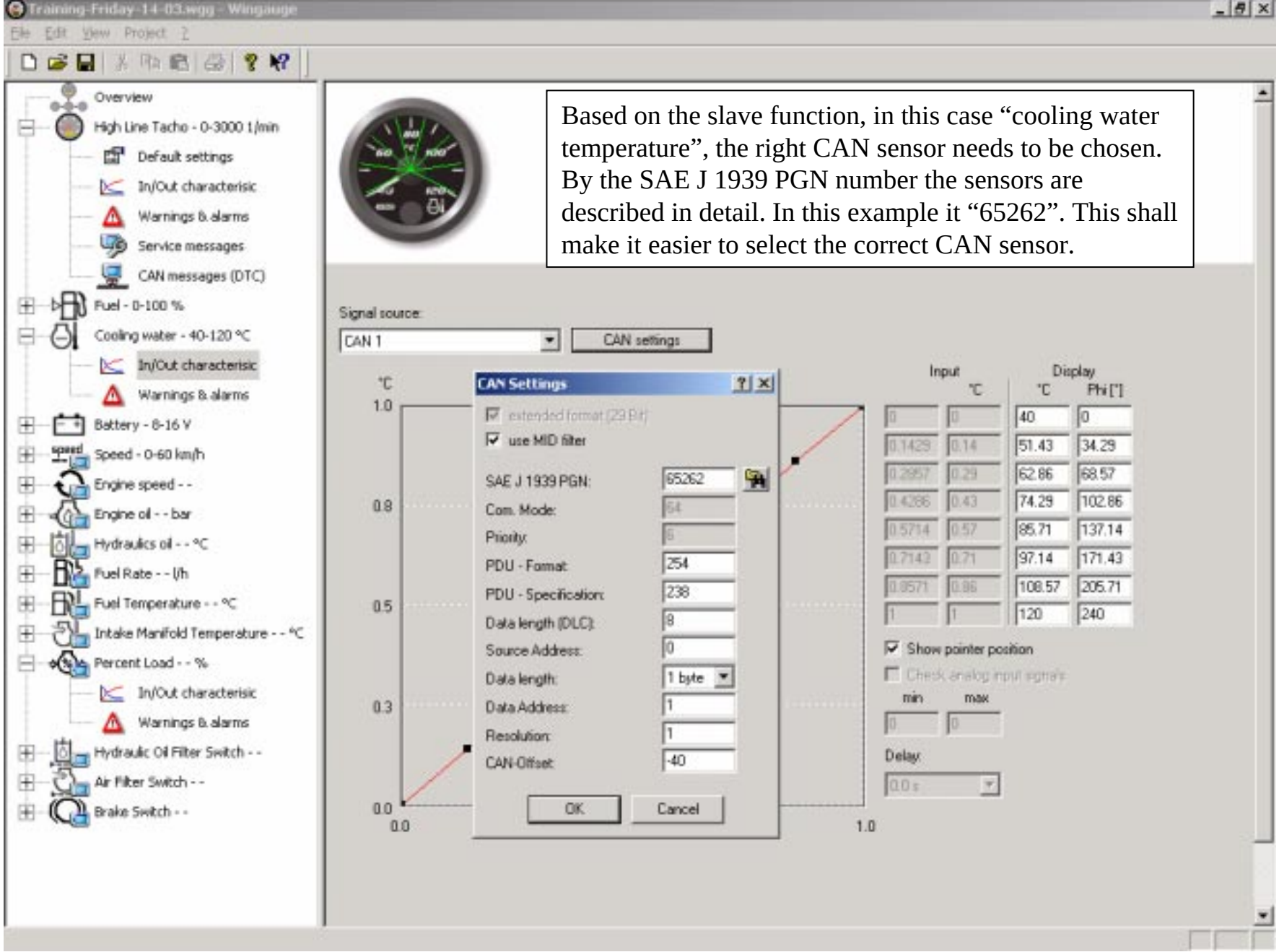

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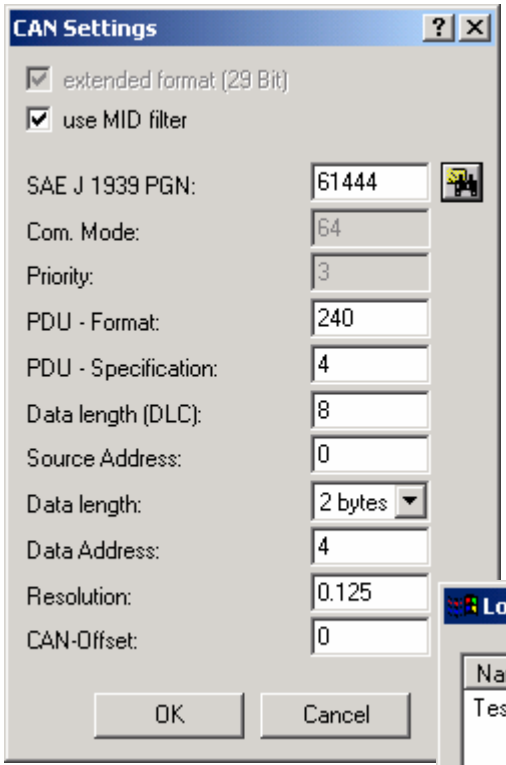
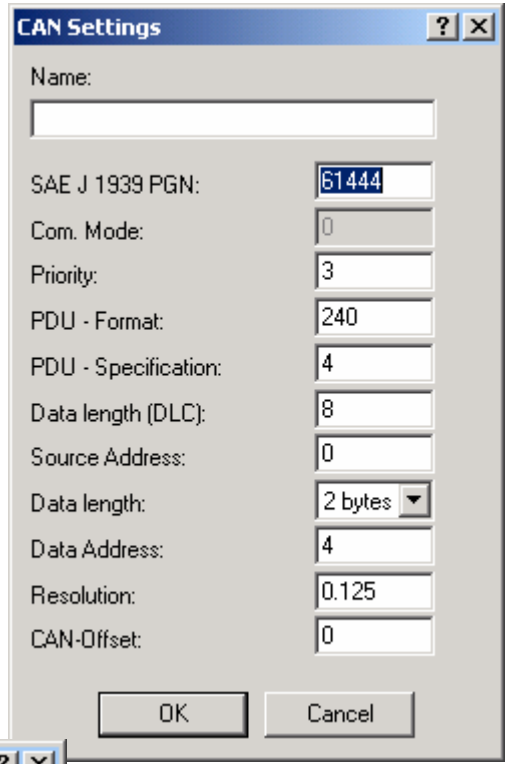
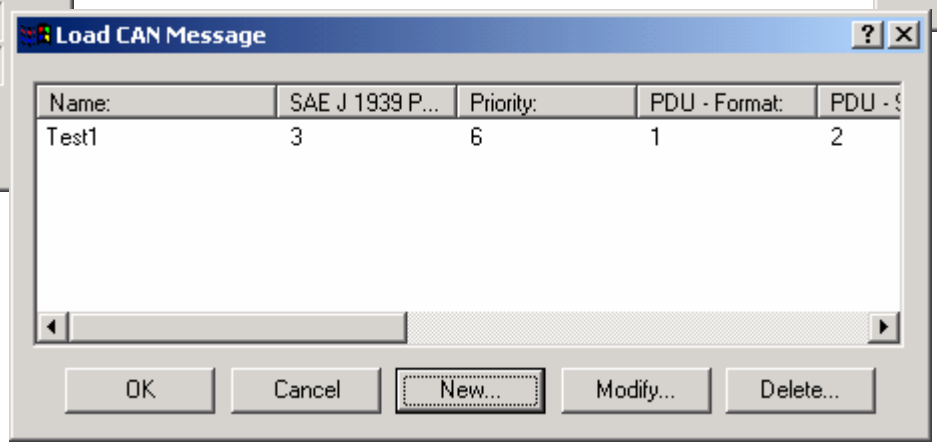
CAN settings, Load CAN Message and define new CAN sensor.



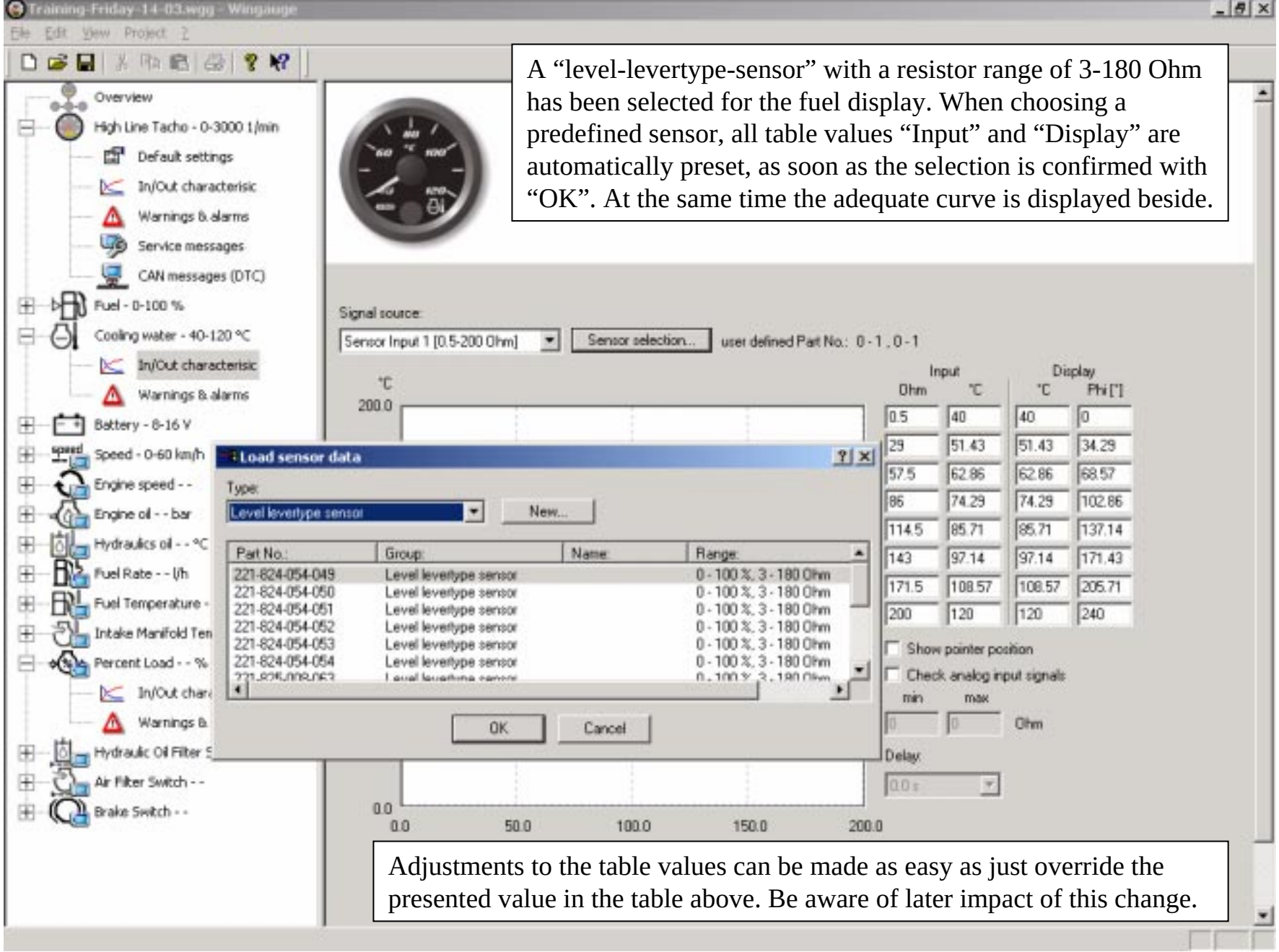
The function “CAN Settings” shows up in various dialogs. From there other dialogs can be opened to get into a more detailed specification mode for the CAN sensors. To configure those sensors however, very detailed and specific knowledge about the sensors, the environment where they are used as well as the specific parameters is required.

Note: Changes to the predefined parameters shall only be made if the adequate level of knowledge is avail.





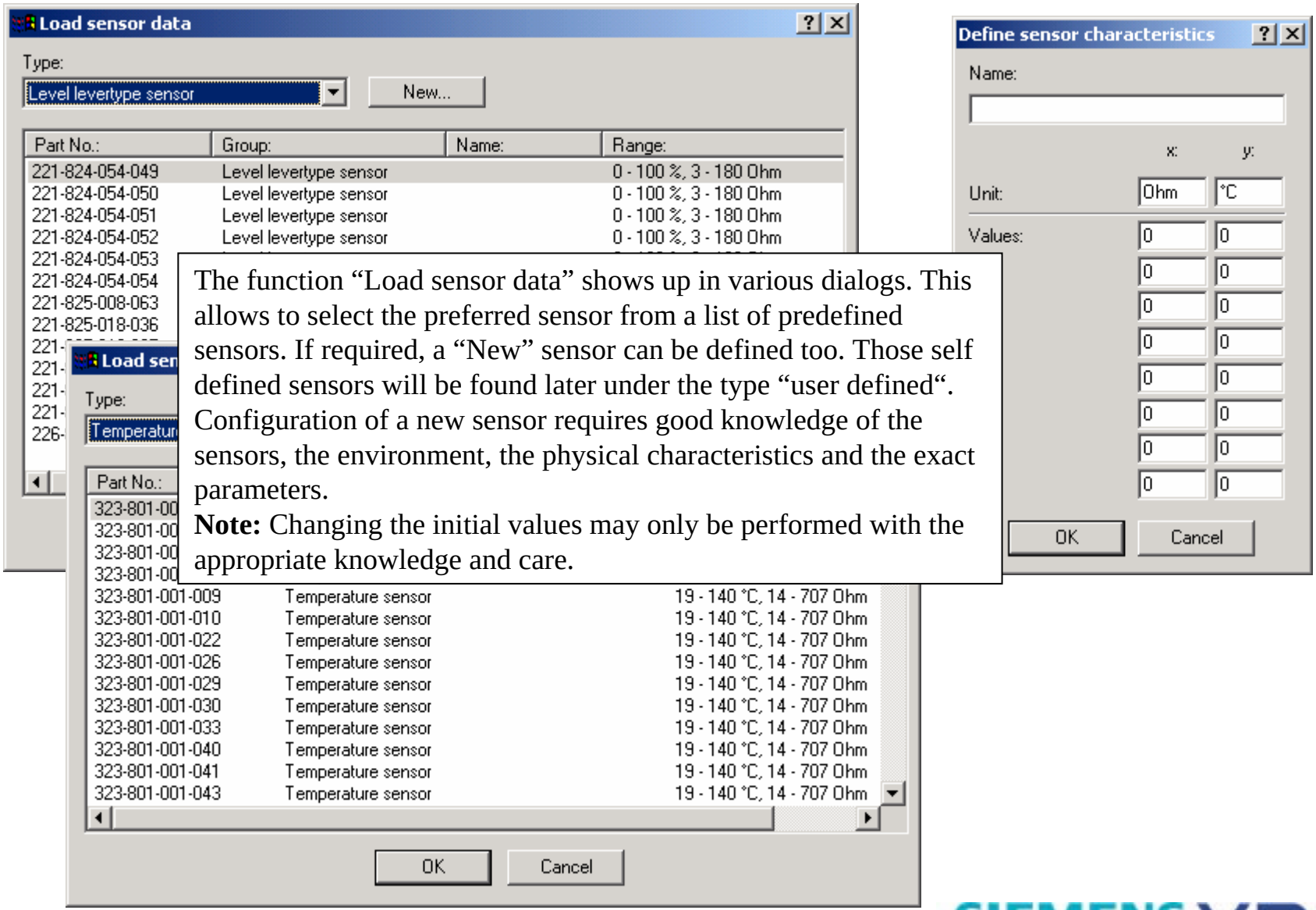
SIEMENS VDO Automotive



A “level-levertype-sensor” with a resistor range of 3-180 Ohm has been selected for the fuel display. When choosing a predefined sensor, all table values “Input” and “Display” are automatically preset, as soon as the selection is confirmed with “OK”. At the same time the adequate curve is displayed beside.

Adjustments to the table values can be made as easy as just override the presented value in the table above. Be aware of later impact of this change.

Add Sensor data / Define Sensor characteristics



The function “Load sensor data” shows up in various dialogs. This allows to select the preferred sensor from a list of predefined sensors. If required, a “New” sensor can be defined too. Those self defined sensors will be found later under the type “user defined“. Configuration of a new sensor requires good knowledge of the sensors, the environment, the physical characteristics and the exact parameters.

Note: Changing the initial values may only be performed with the appropriate knowledge and care.

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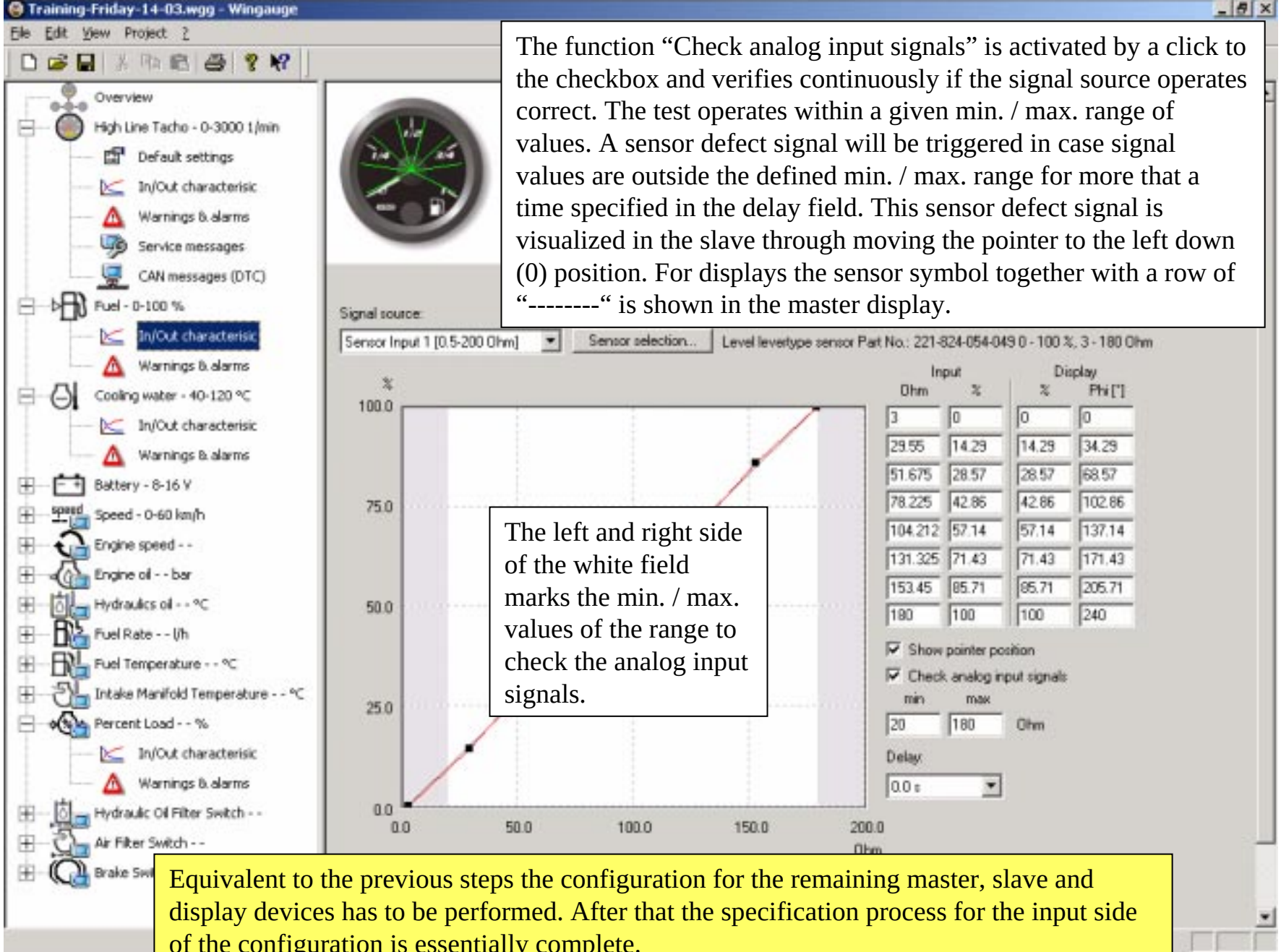
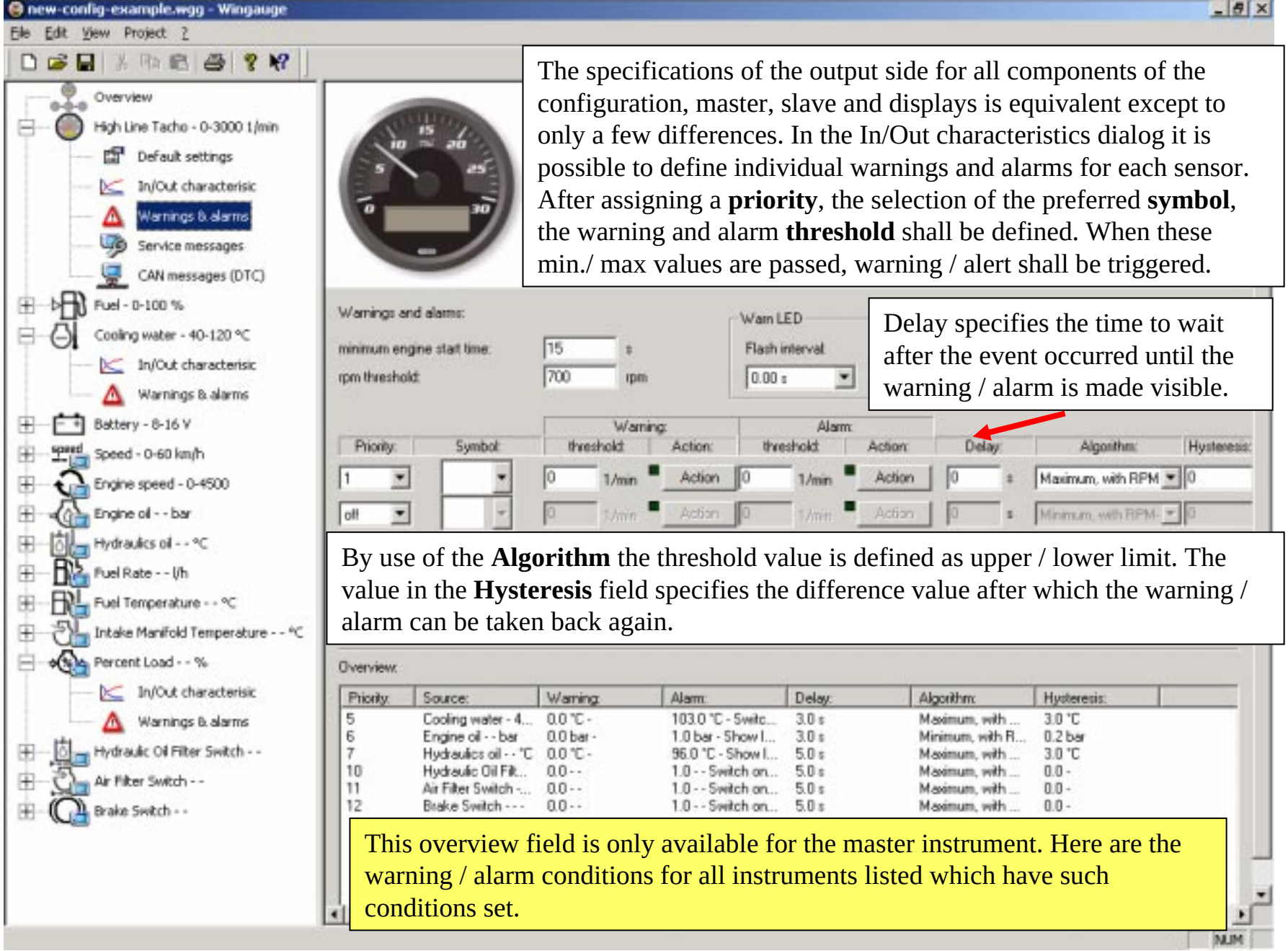


The function “Check analog input signals” is activated by a click to the checkbox and verifies continuously if the signal source operates correct. The test operates within a given min. / max. range of values. A sensor defect signal will be triggered in case signal values are outside the defined min. / max. range for more that a time specified in the delay field. This sensor defect signal is visualized in the slave through moving the pointer to the left down (0) position. For displays the sensor symbol together with a row of “--------“ is shown in the master display.

The left and right side of the white field marks the min. / max. values of the range to check the analog input signals.

Equivalent to the previous steps the configuration for the remaining master, slave and display devices has to be performed. After that the specification process for the input side of the configuration is essentially complete.



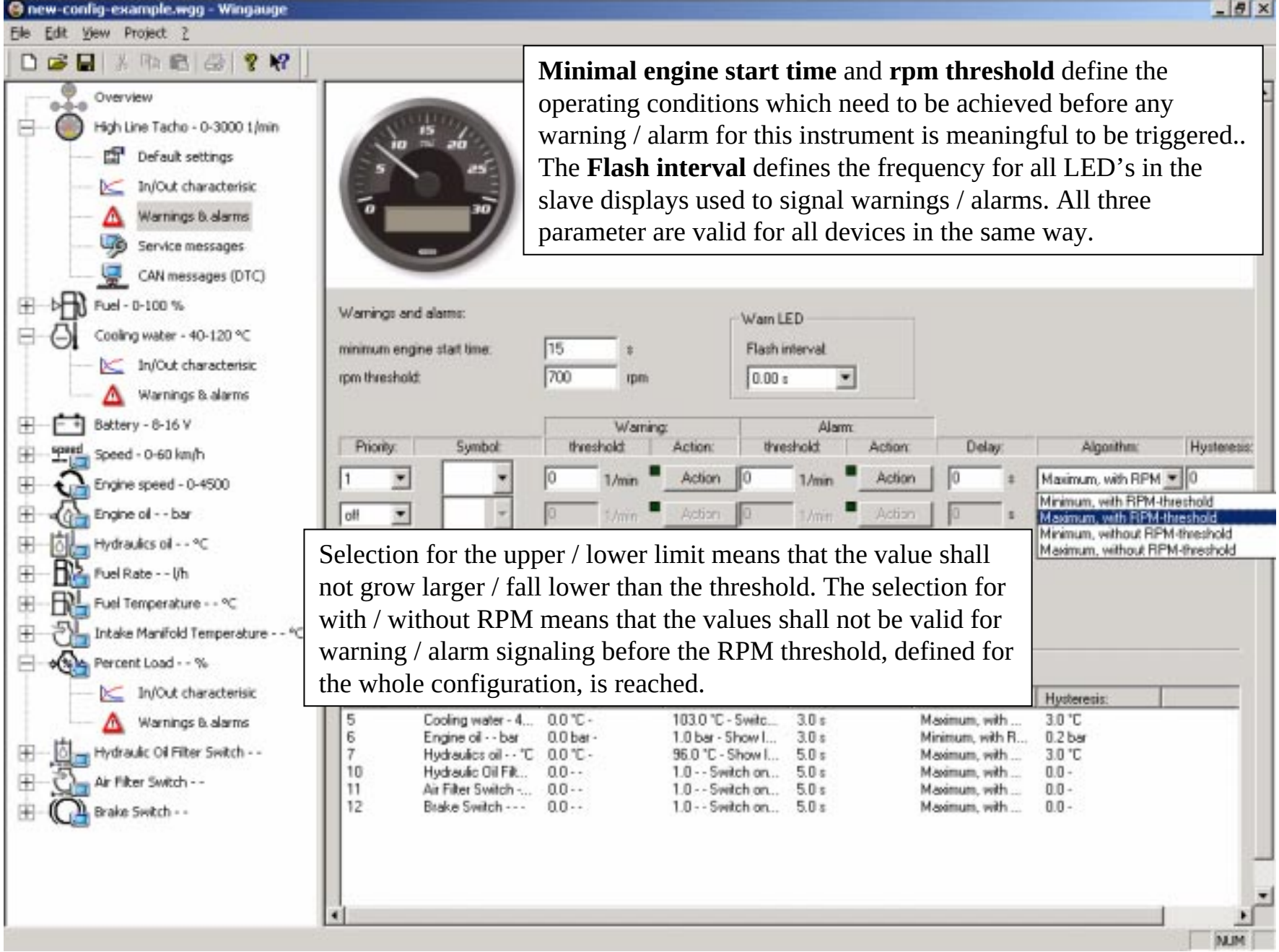
The specifications of the output side for all components of the configuration, master, slave and displays is equivalent except to only a few differences. In the In/Out characteristics dialog it is possible to define individual warnings and alarms for each sensor. After assigning a **priority**, the selection of the preferred **symbol**, the warning and alarm **threshold** shall be defined. When these min./ max values are passed, warning / alert shall be triggered.

Delay specifies the time to wait after the event occurred until the warning / alarm is made visible.

By use of the **Algorithm** the threshold value is defined as upper / lower limit. The value in the **Hysteresis** field specifies the difference value after which the warning / alarm can be taken back again.

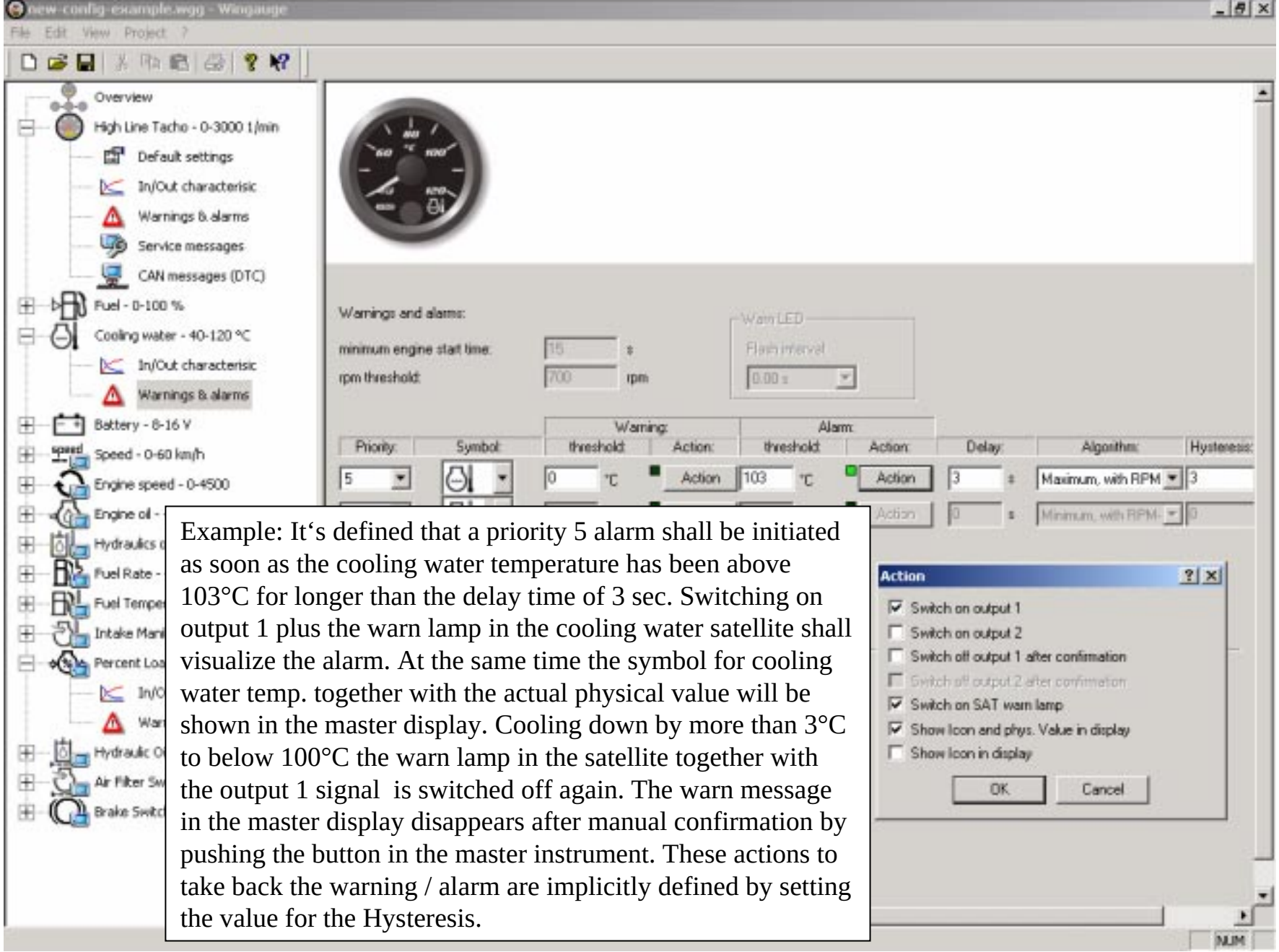
This overview field is only available for the master instrument. Here are the warning / alarm conditions for all instruments listed which have such conditions set.

SIEMENS VDO Automotive



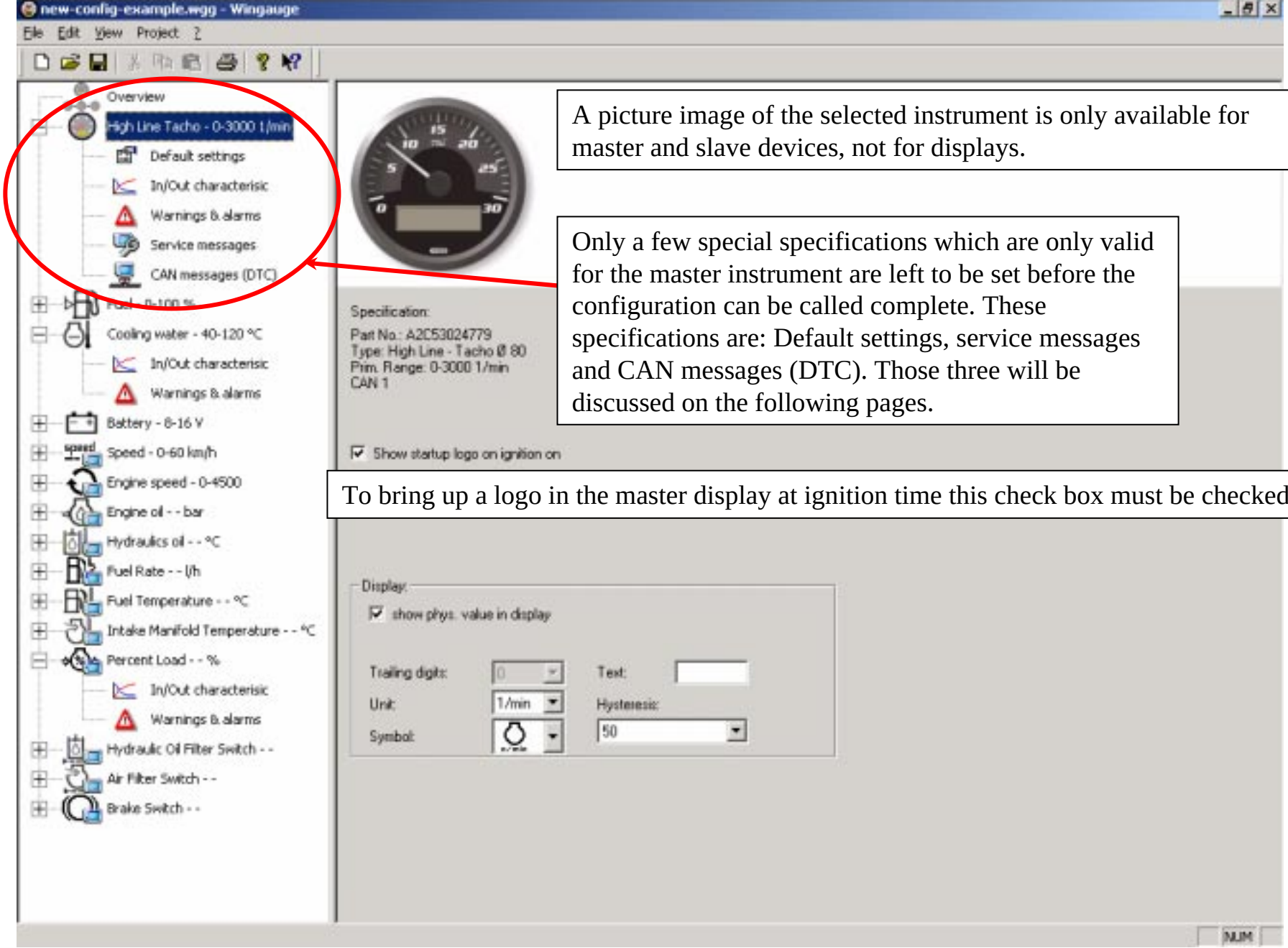
Minimal engine start time and **rpm threshold** define the operating conditions which need to be achieved before any warning / alarm for this instrument is meaningful to be triggered.. The **Flash interval** defines the frequency for all LED's in the slave displays used to signal warnings / alarms. All three parameter are valid for all devices in the same way.

Selection for the upper / lower limit means that the value shall not grow larger / fall lower than the threshold. The selection for with / without RPM means that the values shall not be valid for warning / alarm signaling before the RPM threshold, defined for the whole configuration, is reached.



Example: It‘s defined that a priority 5 alarm shall be initiated as soon as the cooling water temperature has been above 103°C for longer than the delay time of 3 sec. Switching on output 1 plus the warn lamp in the cooling water satellite shall visualize the alarm. At the same time the symbol for cooling water temp. together with the actual physical value will be shown in the master display. Cooling down by more than 3°C to below 100°C the warn lamp in the satellite together with the output 1 signal is switched off again. The warn message in the master display disappears after manual confirmation by pushing the button in the master instrument. These actions to take back the warning / alarm are implicitly defined by setting the value for the Hysteresis.

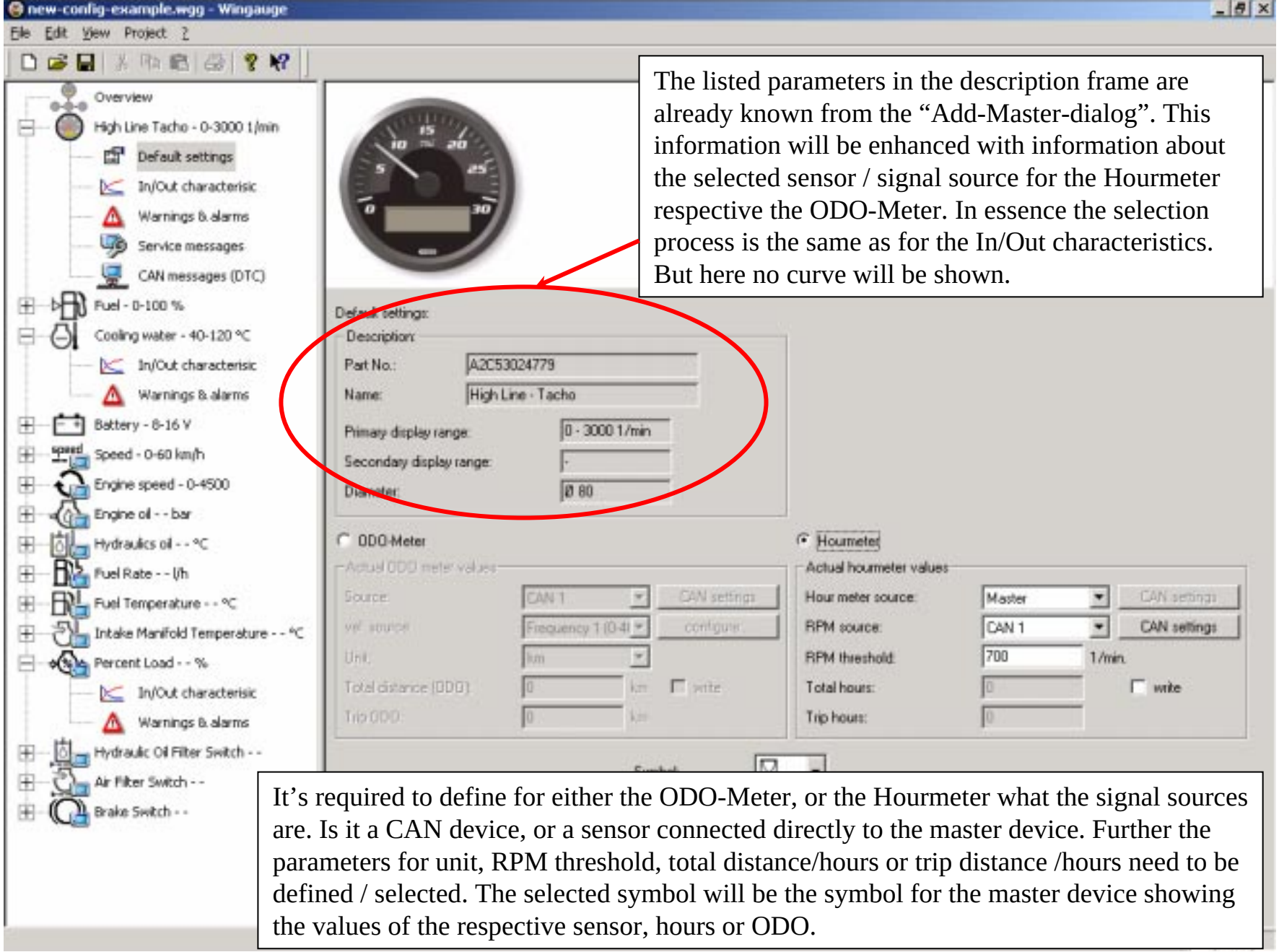
SIEMENS VDO Automotive



A picture image of the selected instrument is only available for master and slave devices, not for displays.

Only a few special specifications which are only valid for the master instrument are left to be set before the configuration can be called complete. These specifications are: Default settings, service messages and CAN messages (DTC). Those three will be discussed on the following pages.

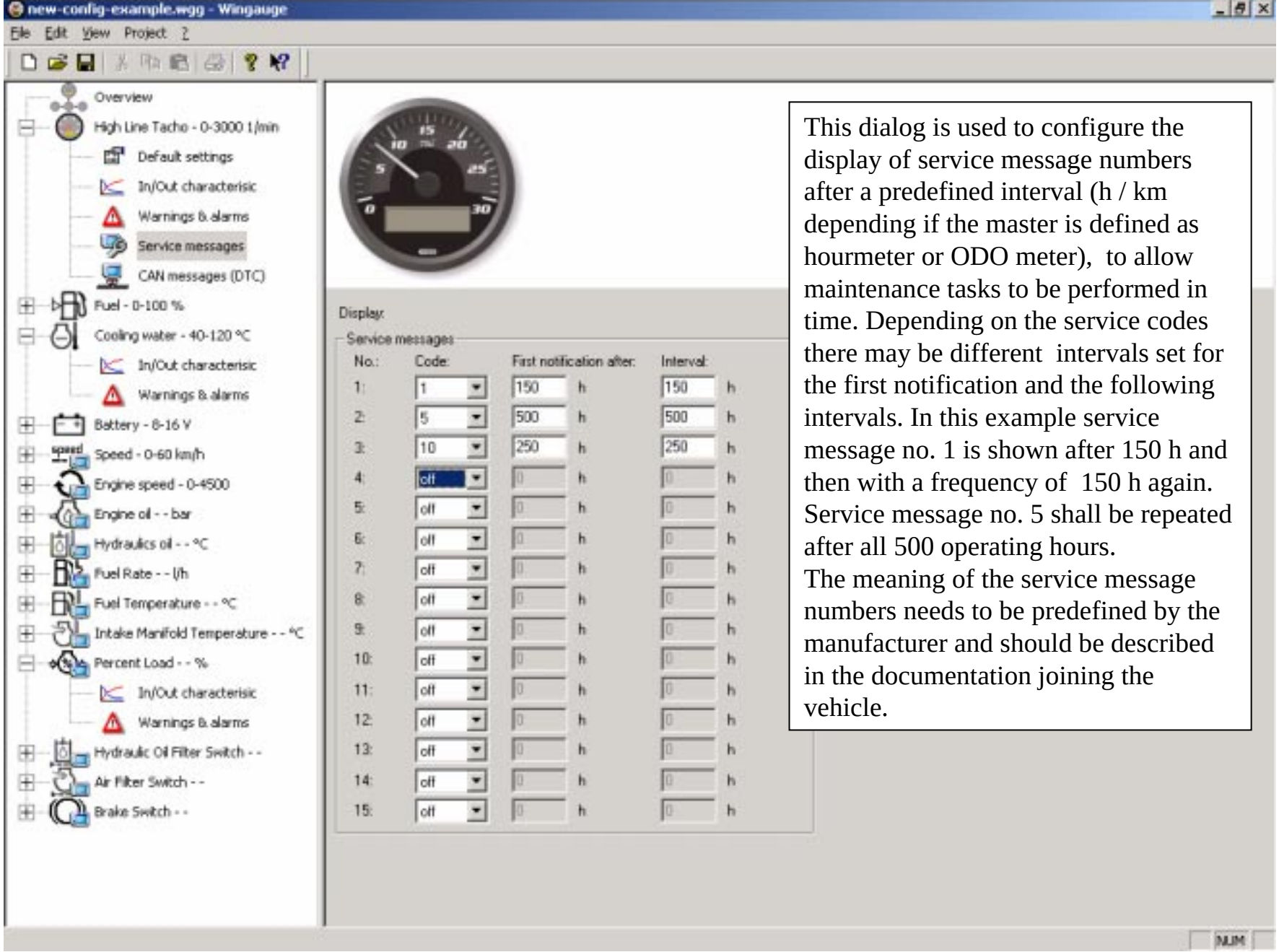
To bring up a logo in the master display at ignition time this check box must be checked.



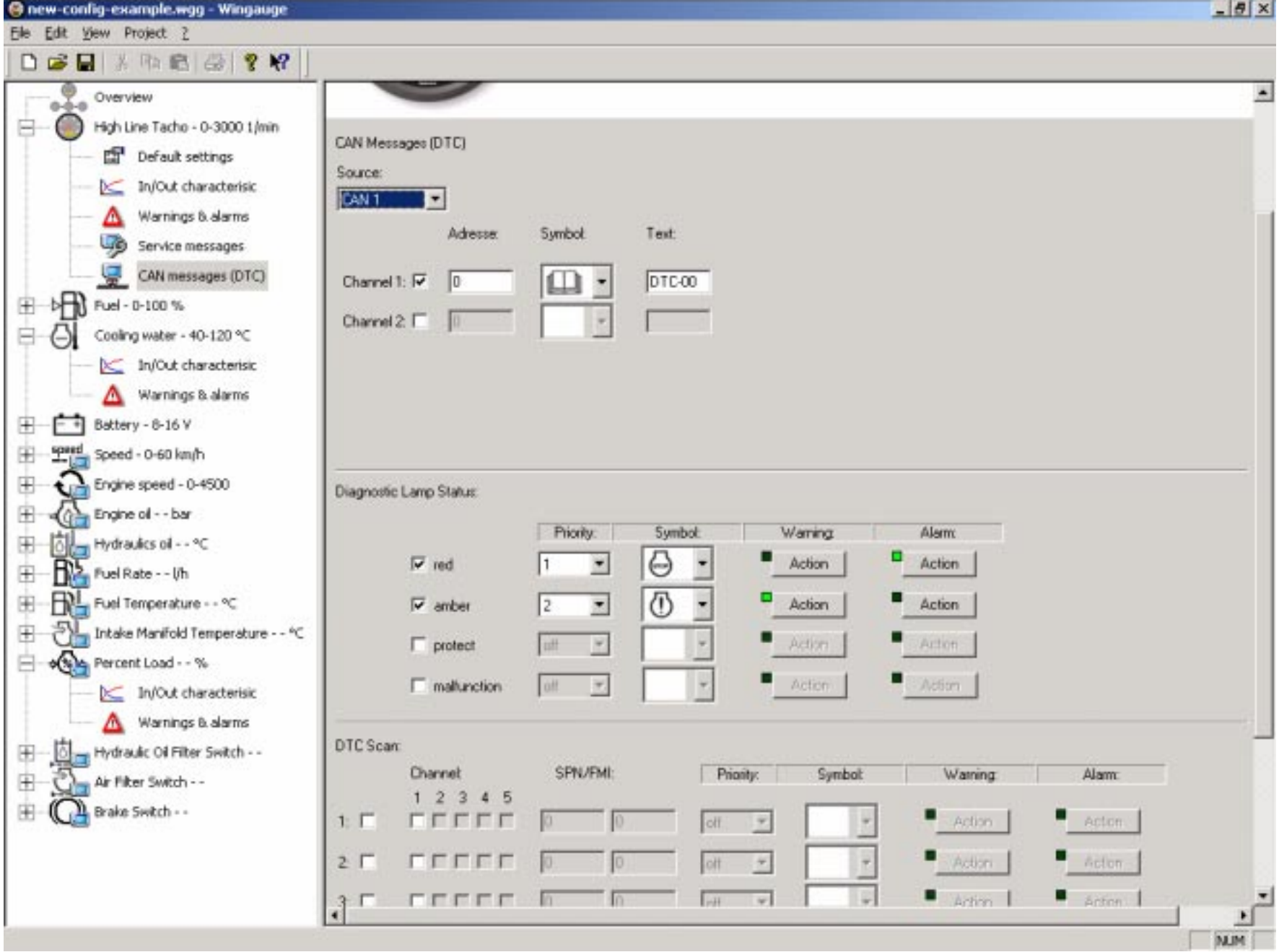
The listed parameters in the description frame are already known from the “Add-Master-dialog”. This information will be enhanced with information about the selected sensor / signal source for the Hourmeter respective the ODO-Meter. In essence the selection process is the same as for the In/Out characteristics. But here no curve will be shown.

It’s required to define for either the ODO-Meter, or the Hourmeter what the signal sources are. Is it a CAN device, or a sensor connected directly to the master device. Further the parameters for unit, RPM threshold, total distance/hours or trip distance /hours need to be defined / selected. The selected symbol will be the symbol for the master device showing the values of the respective sensor, hours or ODO.

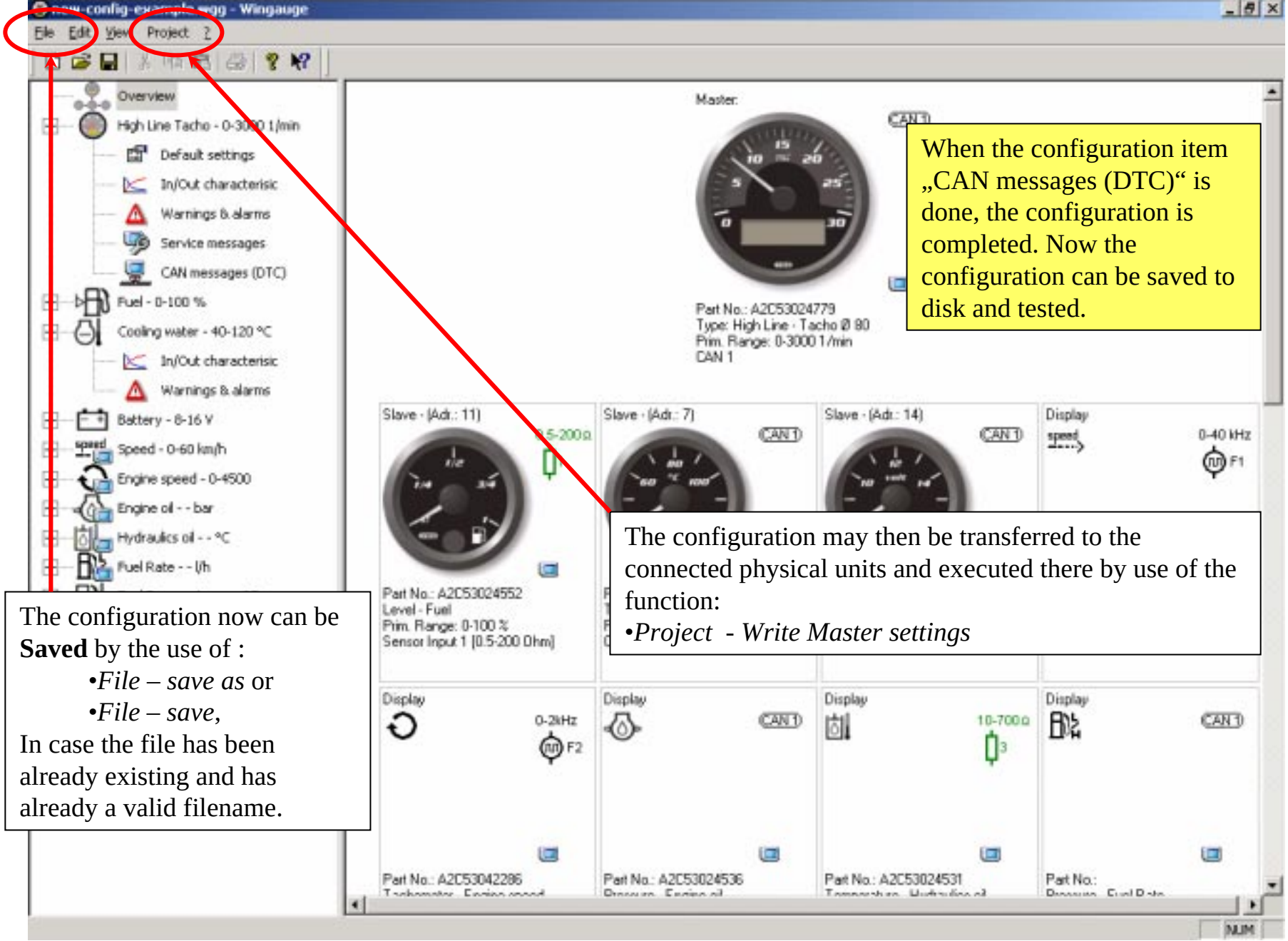
SIEMENS VDO Automotive



This dialog is used to configure the display of service message numbers after a predefined interval (h / km depending if the master is defined as hourmeter or ODO meter), to allow maintenance tasks to be performed in time. Depending on the service codes there may be different intervals set for the first notification and the following intervals. In this example service message no. 1 is shown after 150 h and then with a frequency of 150 h again. Service message no. 5 shall be repeated after all 500 operating hours.
The meaning of the service message numbers needs to be predefined by the manufacturer and should be described in the documentation joining the vehicle.



SIEMENS VDO Automotive



When the configuration item „CAN messages (DTC)“ is done, the configuration is completed. Now the configuration can be saved to disk and tested.

The configuration may then be transferred to the connected physical units and executed there by use of the function:

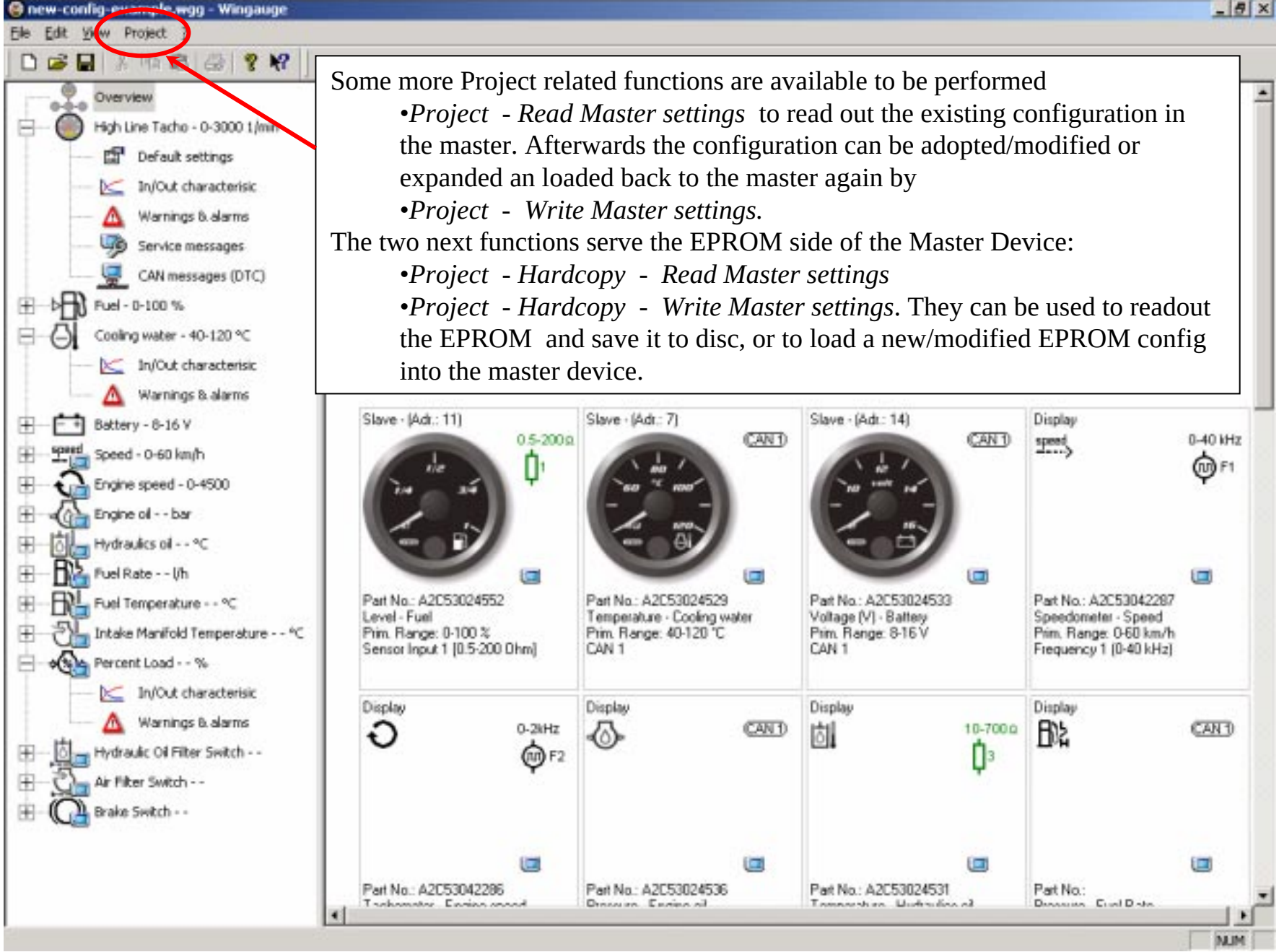
•*Project - Write Master settings*

The configuration now can be **Saved** by the use of :

•*File – save as* or

•*File – save*,

In case the file has been already existing and has already a valid filename.



Some more Project related functions are available to be performed

- *Project - Read Master settings* to read out the existing configuration in the master. Afterwards the configuration can be adopted/modified or expanded an loaded back to the master again by
- *Project - Write Master settings.*

The two next functions serve the EPROM side of the Master Device:

- *Project - Hardcopy - Read Master settings*
- *Project - Hardcopy - Write Master settings*. They can be used to readout the EPROM and save it to disc, or to load a new/modified EPROM config into the master device.

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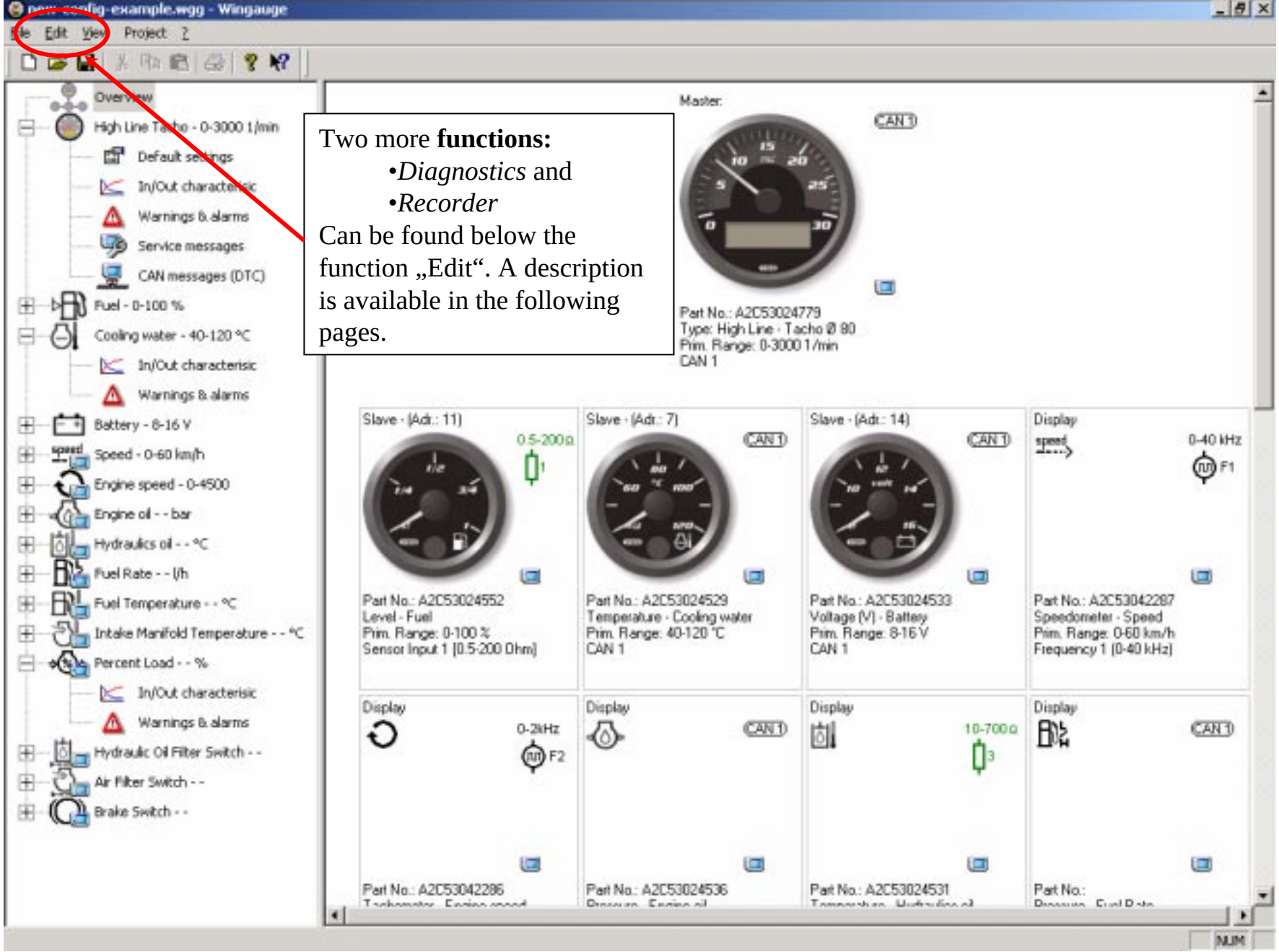

Two more **functions:**

- *Diagnostics* and
- *Recorder*

Can be found below the function „Edit“. A description is available in the following pages.

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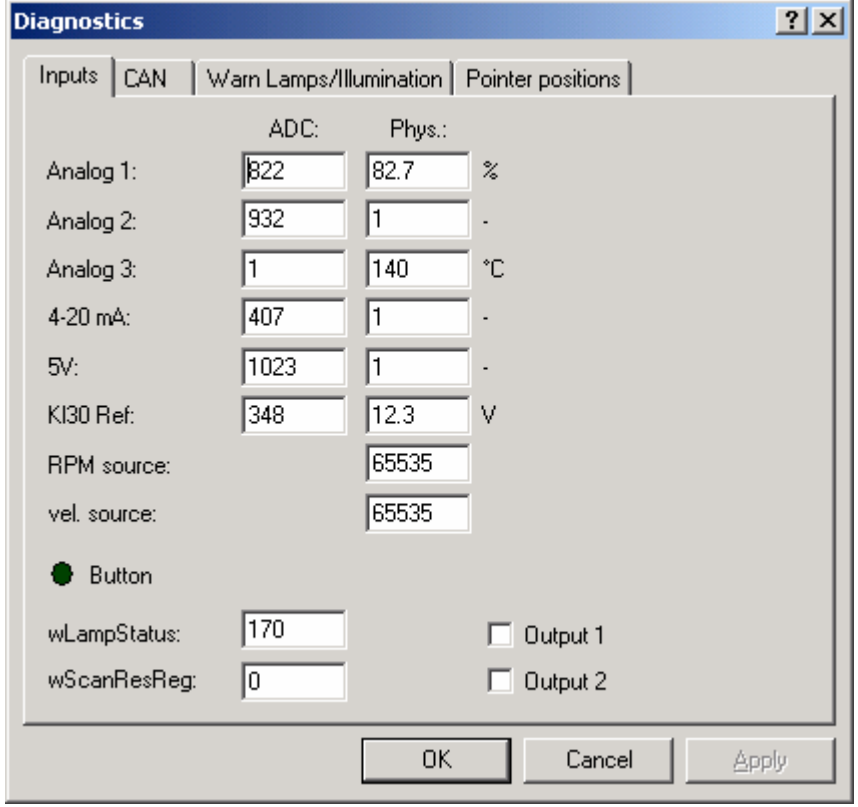
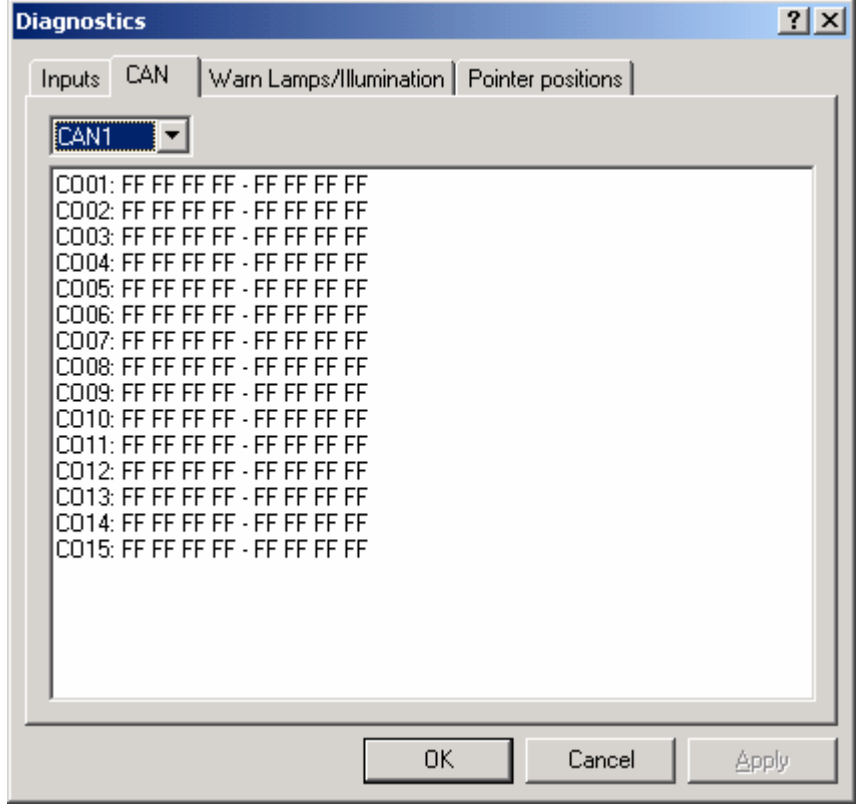




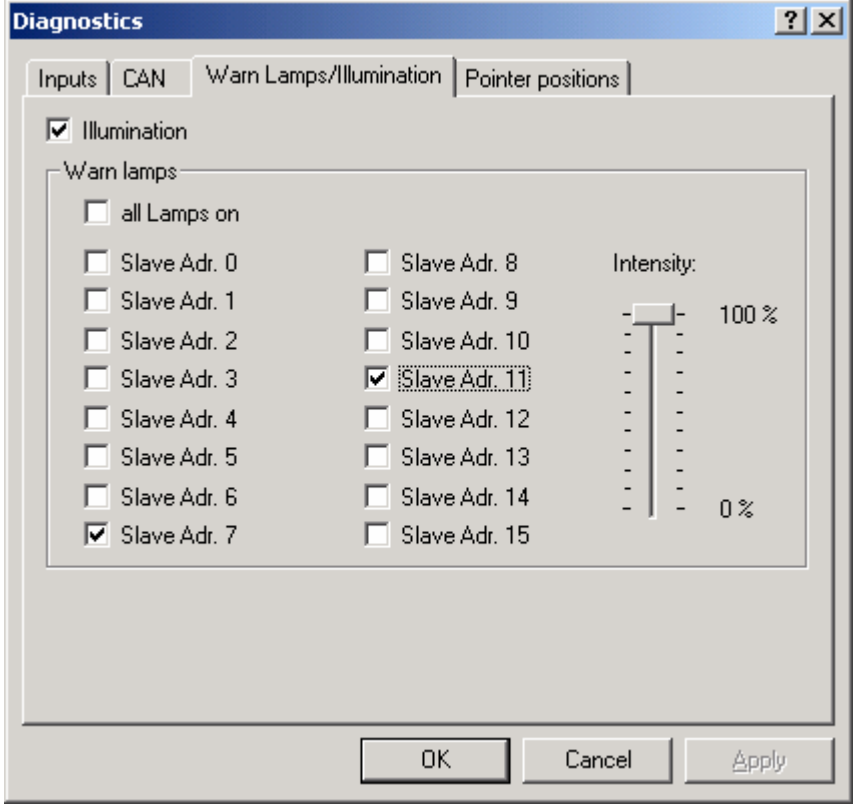
Inputs means to show all physical values generated by the connected Instruments configuration analogous to the programmed Sensor inputs on the master device:
Analog 1-3 (Resistor-sensors), Current-, Voltage- und Frequency-sensors, Output 1 and 2 , Button-function... The physical unit plus an Analog-Digital-Converted value is presented.

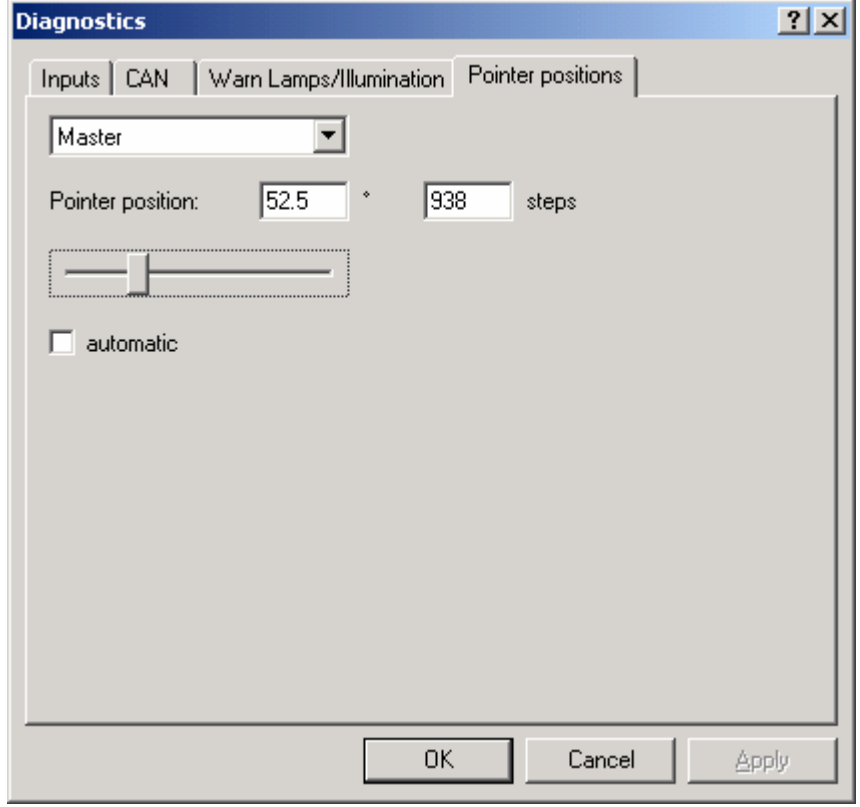
The Diagnostics function covers 4 important areas:

- Inputs
- CAN
- Warn Lamps/Illumination
- Pointer positions

with their support it is possible to diagnose an existing and connected configuration.

CAN shows the data content of 15 x 8 Bytes on the CAN-BUS. Those represent the information coming from the different CAN Objects.

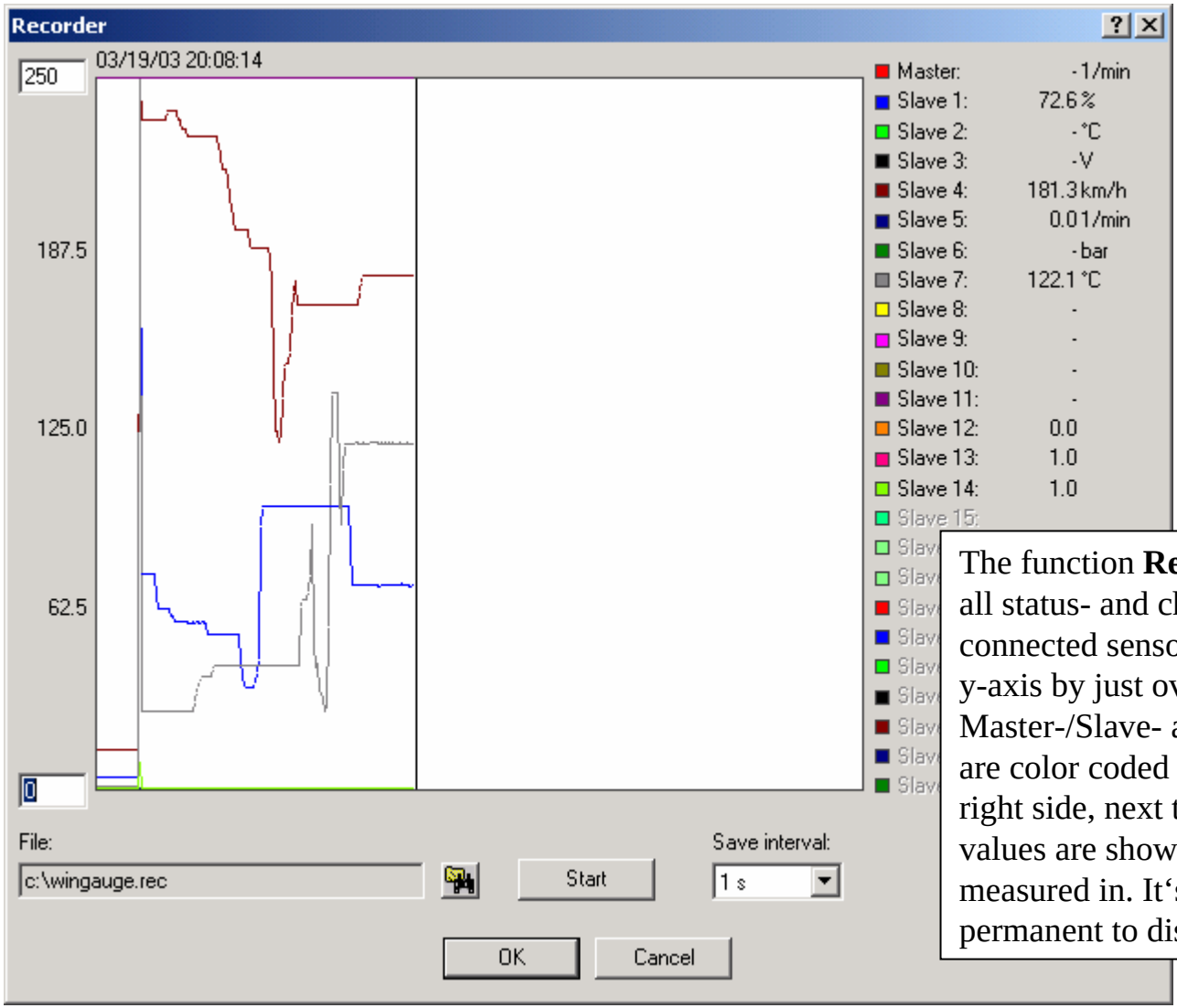




The dialog **Warn Lamps / Illumination** allows to diagnose the warn lamps and the illumination of a connected set of instruments.

- •Illumination switches the illumination for all instruments on/of.
- •All Lamps on switches all warn lamps in the connected instruments on / off.
- •Slave 0 – 15 switches individual warn lamps on / off .
- •Intensity trimms the intensity of the warn lamps.

Pointer position can be used to check out the functioning of the individual pointer instruments. After selection of the instrument to be tested in the top window the pointer position trimmer may be moved dynamically to various positions the check if the pointer in the selected device follows in accordance. The pointer position is shown in two digital values, as angle Phi [°] and in steps.. The same test may be performed automatic. If this is selected, the pointer position will move dynamically from zero, to half to full scale.



The function **Recorder** allows to log and track all status- and changing signals of all the connected sensors.Adjustable is the range of the y-axis by just overwrite the min./max. values. Master-/Slave- and the different display curves are color coded for better recognition. On the right side, next to the legend, the measured values are shown together with the units they are measured in. It‘s possible to save the logged file permanent to disc.

6. System Components, Spare Parts and Accessories

Content

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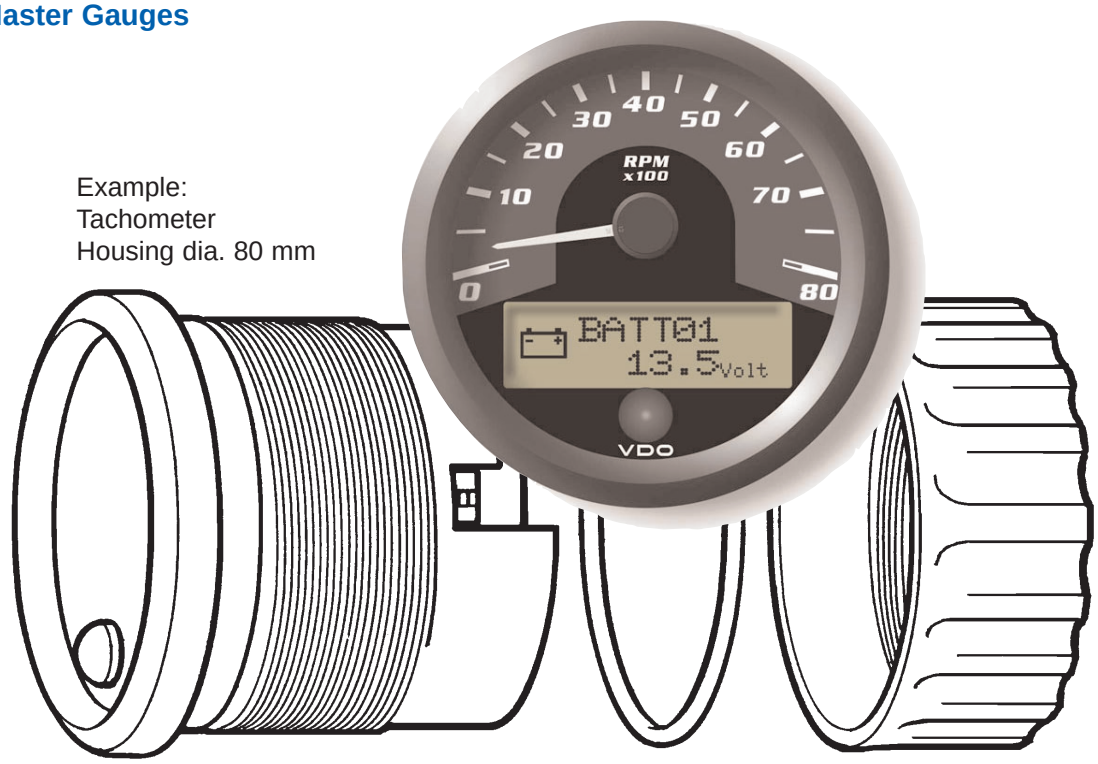
6. System Components, Spare Parts and Accessories

6.1 System Components

6.1.1 Master Gauges

Example:
Tachometer
Housing dia. 80 mm



Master gauge | Sealing ring | Clamp ring

Value	Range	Symbol	Housing Dia. (mm)	Material No. according to Wingauge	Order No. Packaging (10)
rpm	3000 min^{-1}	min^{-1} x 1000	80	**A2C53024779***	**A2C60000001**
rpm	4000 min^{-1}	min^{-1} x 1000	80	**A2C53024780***	**A2C60000002**
rpm	3000 RPM	RPM x 1000	85	**A2C53024807***	**A2C60000051**
rpm	4000 RPM	RPM x 1000	85	**A2C53024808***	**A2C60000052**
rpm	3000 min^{-1}	min^{-1} x 1000	100•	**A2C53024809***	**A2C60000101**
rpm	4000 min^{-1}	min^{-1} x 1000	100•	**A2C53024810***	**A2C60000102**
Speed	30 km/h	km/h	80	**A2C53101261***	**A2C60000007**
Speed	60 km/h	km/h	80	**A2C53024818***	**A2C60000003**
Speed	120 km/h	km/h	80	**A2C53024819***	**A2C60000004**
Speed	200 km/h	km/h	80	**A2C53042275***	**A2C60000005**
Speed	80 MPH / 120 km/h	MPH, km/h	80	**A2C53096000***	**A2C60000006**

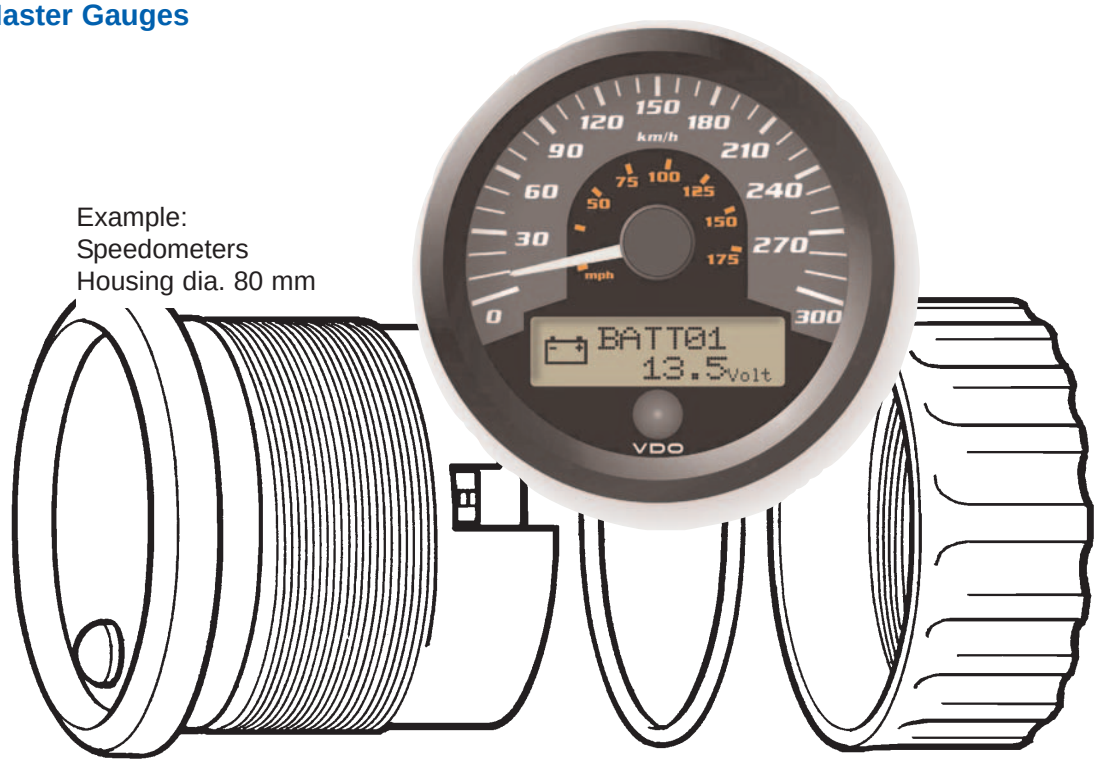
* ⚠ **No purchasing No.** • **100 mm not available**

6. System Components, Spare Parts and Accessories

6.1 System Components

6.1.1 Master Gauges

Example:
Speedometers
Housing dia. 80 mm



Master gauge Sealing ring Clamp ring

Value	Range	Symbol	Housing Dia. (mm)	Material No. according to Wingauge	Order No. Packaging (10)
Speed	120 km/h	km/h	85	**A2C53024822***	**A2C60000054**
Speed	200 km/h	km/h	85	**A2C53024823***	**A2C60000055**
Speed	80 MPH	MPH	85	**A2C53096001***	**A2C60000056**
Speed	100 MPH	MPH	85	**A2C53096006***	**A2C60000057**
Speed	120 MPH	MPH	85	**A2C53095999***	**A2C60000058**
Speed	60 km/h	km/h	100•	**A2C53024827***	**A2C60000103**
Speed	120 km/h	km/h	100•	**A2C53024829***	**A2C60000104**
Speed	200 km/h	km/h	100•	**A2C53024830***	**A2C60000105**
Speed	200 km/h / 120 MPH	km/h, MPH	100•	**A2C53042276***	**A2C60000108**
Speed	120 MPH / 200 km/h	MPH, km/h	100•	**A2C53042277***	**A2C60000109**
Speed	50 MPH / 80 km/h	MPH, km/h	100•	**A2C53024832***	**A2C60000106**
Speed	140 MPH / 220 km/h	MPH, km/h	100•	**A2C53024834***	**A2C60000107**

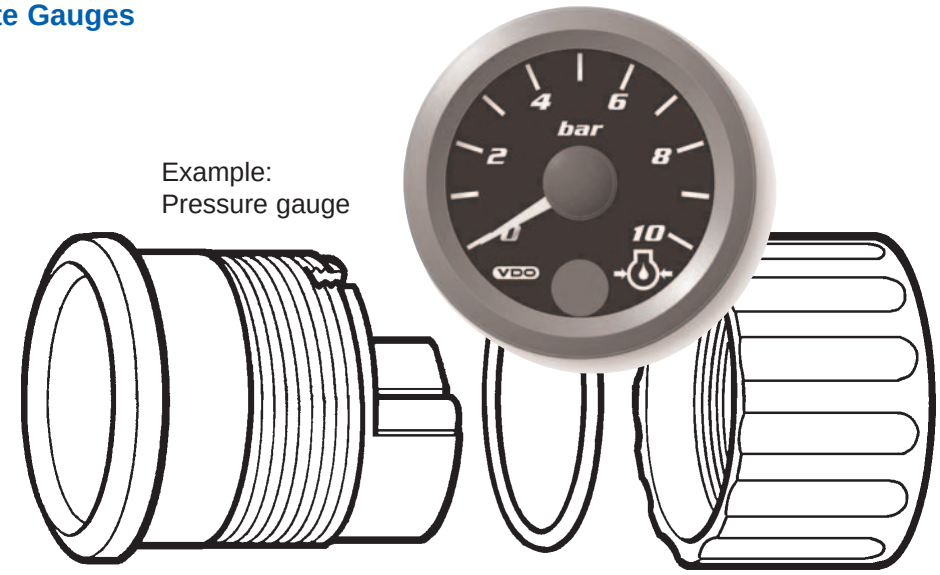
* ⚠ **No purchasing No.** • **100 mm not available**

6. System Components, Spare Parts and Accessories

6.1 System Components

6.1.2 Satelitte Gauges

Example:
Pressure gauge



Satelitte gauge | Sealing ring | Clamp ring

Value	Range	Symbol	Housing Dia. (mm)	Material No. according to Wingauge	Order No. Packaging (10)
Pressure gauges					
Engine oil press.	0 - 5 bar	Engine oil press.	52	**A2C53024535***	**A2C60000201**
Engine oil press.	0 - 10 bar	Engine oil press.	52	**A2C53024536***	**A2C60000202**
Engine oil press.	0 - 5 x 100 kPa	Engine oil press.	52	**A2C53024537***	**A2C60000203**
Engine oil press.	0 - 10 x 100 kPa	Engine oil press.	52	**A2C53024538***	**A2C60000204**
Engine oil press.	0-80 psi / 0-5 bar	Engine oil press.	52	**A2C53024539***	**A2C60000205**
	0-100 psi / 0-7 bar		52	**A2C53096027***	**A2C60000234**
Engine oil press.	0-150 psi / 0-10 bar	Engine oil press.	52	**A2C53024541***	**A2C60000206**
Brake pressure	0 - 10 bar	Brake pressure	52	**A2C53024542***	**A2C60000207**
Brake pressure 1	0 - 10 bar	Brake pressure	52	**A2C53096017***	**A2C60000236**
Brake pressure 2	0 - 10 bar	Brake pressure	52	**A2C53096019***	**A2C60000237**
Brake pressure w/o①	0 - 250 bar	Brake pressure	52	**A2C53098355***	**A2C60000238**
Brake pressure w/o②	0 - 250 bar	Brake pressure	52	**A2C53098356***	**A2C60000239**
Brake pressure	0-150 psi / 0-10 bar	Brake pressure	52	**A2C53024543***	**A2C60000208**
Brake pressure	0 - 16 bar	Brake pressure	52	**A2C53024545***	**A2C60000209**
Transmission oil p.	0 - 28 bar	Transmission oil p.	52	**A2C53024546***	**A2C60000210**
Transmission oil p.	0-400 psi / 0-28 bar	Transmission oil p.	52	**A2C53024548***	**A2C60000211**
Turbocharger p.	0 - 2 bar	Turbo pressure	52	**A2C53024549***	**A2C60000212**

* ⚠ **No purchasing No.**

6. System Components, Spare Parts and Accessories

6.1 System Components

6.1.2 Satelitte Gauges

Value	Range	Symbol	Housing Dia. (mm)	Material No. according to Wingauge	Order No. Packaging (10)
Temperature gauges					
Engine oil temp.	50-150°C	Engine oil temp.	52	**A2C53024524***	**A2C60000213**
Engine oil temp.	120-300°F 50-150°C	Engine oil temp.	52	**A2C53042278***	**A2C60000231**
Transmission oil temperature	50-150°C	Transmission oil temperature	52	**A2C53024526***	**A2C60000214**
Transmission oil temperature	50-150°C 120-300°F	Transmission oil temperature	52	**A2C53024527***	**A2C60000215**
Transmission oil temperature	120-300°F 50-150°C	Transmission oil temperature	52	**A2C53096008***	**A2C60000235**
Temperature	60-200°C	Temperature	52	**A2C53024528***	**A2C60000216**
Cooling water temperature	40-120°C	Cooling water temperature	52	**A2C53024529***	**A2C60000217**
Cooling water temperature	40-120°F 100-250°C	Cooling water temperature	52	**A2C53024530***	**A2C60000218**
Cooling water temperature	100-280°F 40-140°C	Cooling water temperature	52	**A2C53042279***	**A2C60000219**
Hydraulic oil temp.	20-120°C	Hydraulic oil temp.	52	**A2C53024531***	**A2C60000220**
Pyrometer temp.	100-900°C	Pyrometer	52	**A2C53024532***	**A2C60000221**
Level gauges					
Fuel level	0 - 1/1	Fuel level	52	**A2C53024552***	**A2C60000222**
Fuel level	E - 1/4 - 1/2 - 3/4 - F	Fuel level	52	**A2C53042280***	**A2C60000233**
Fresh water level	0 - 1/1	Fresh water	52	**A2C53042281***	**A2C60000223**
Waste water level	0 - 1/1	Waste water	52	**A2C53042282***	**A2C60000224**
Voltmeter					
Battery voltage	8 - 16 V	Battery	52	**A2C53024533C***	**A2C60000225**
Battery voltage	18 - 32 V	Battery	52	**A2C53024534C***	**A2C60000227**
Battery voltage	10 - 18 V	Battery	52	**A2C53042283C***	**A2C60000226**
Battery voltage	20 - 34 V	Battery	52	**A2C53042284C***	**A2C60000232**

* ⚠ **No purchasing No.**

6. System Components, Spare Parts and Accessories

6.1 System Components

6.1.2 Satelitte Gauges

Value	Range	Symbol	Housing Dia. (mm)	Material No. according to Wingauge	Order No. Packaging (10)
Ammeters					
Battery current	– 125 ... + 125 A	Amp	52	**A2C53024522***	**A2C60000228**
Tachometers					
rpm	3000 min^{-1}	min^{-1}	52	**A2C53042286***	**A2C60000229**
Speedometers					
Speed	60 km/h	km/h	52	**A2C53042287***	**A2C60000230**

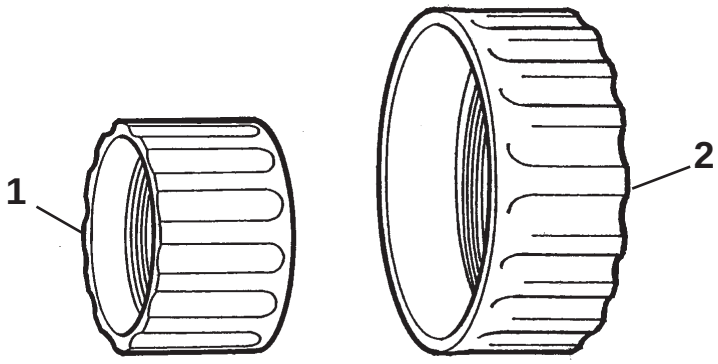
* ⚠ **No purchasing No.**

6. System Components, Spare Parts and Accessories

6.2 Spare Parts and Accessories

6.2.1 Spare Parts

Clamp rings



for gauges dia. 52 mm / dia. 80 mm

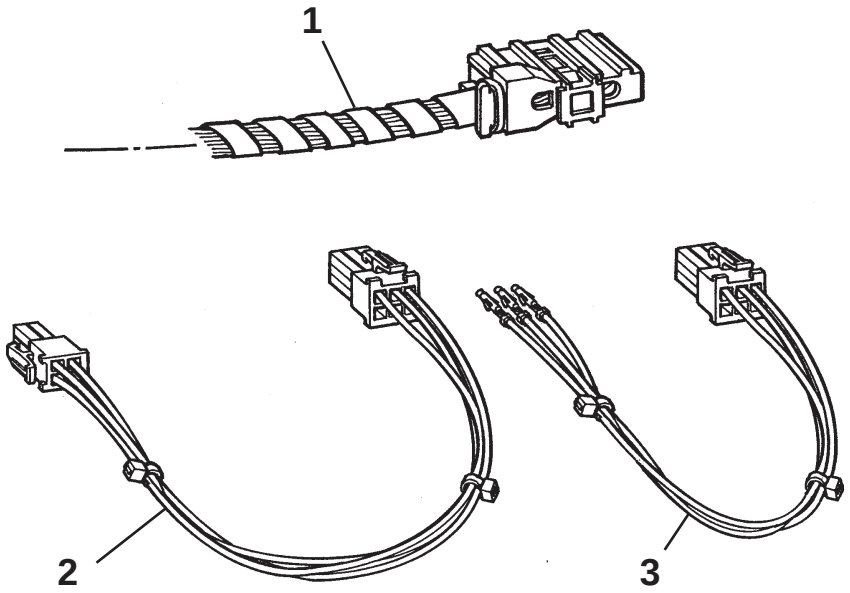
Pos.	Designation	Items / Package	Order No.
1	Clamp ring dia. 52 mm	1	**800-005-015G**
2	Clamp ring dia. 80 mm	1	**800-005-005G**

6. System Components, Spare Parts and Accessories

6.2 Spare Parts and Accessories

6.2.2 Accessories

Wiring harnesses



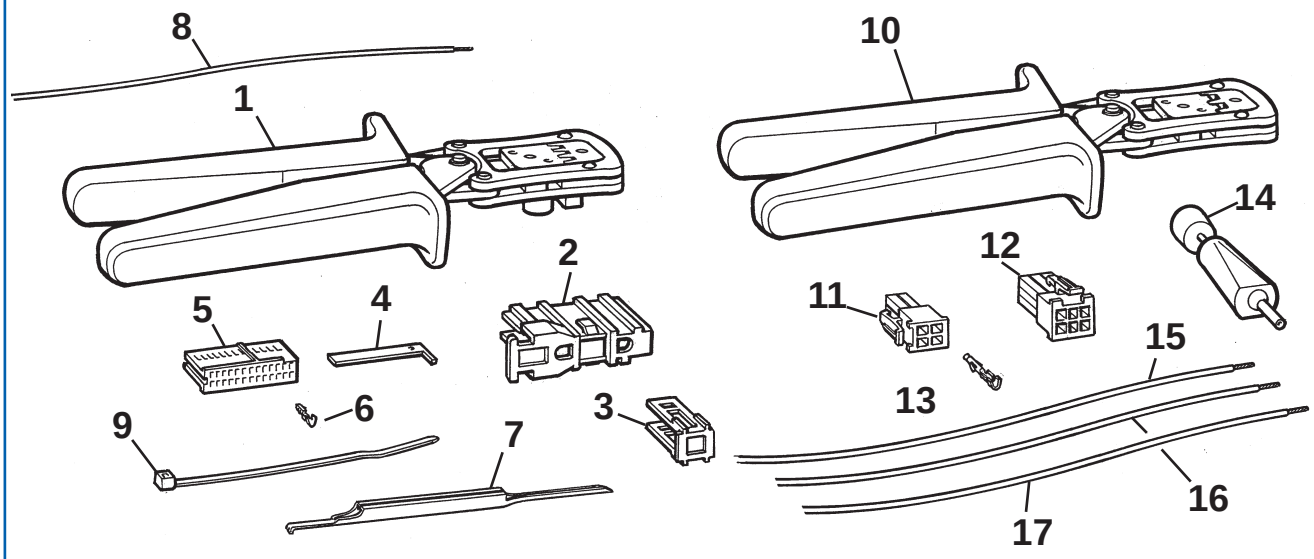
Pos.	Designation	Items / Package	Order No.
1	Wiring harness master (26-pole), 3000 mm long	10	**A2C53041729**
2	Wiring harness master-satelitte, 200 mm long	10	**A2C53041726**
3	Wiring harness satelitte-satelitte, 200 mm long	10	**A2C53041730**

6. System Components, Spare Parts and Accessories

6.2 Spare Parts and Accessories

6.2.2 Accessories

Parts for own installation of the wiring harnesses



Pos.	Designation		Items/Package	Order No.
1	Hand tool	AMPMODU (AMP-Nr. 0-0169481-1)	—	—
2	Housing	AMPMODU	100	**X11-602-000-002**
3	Draw-off bracket	AMPMODU	100	**X11-602-000-005**
4	Contact seal	AMPMODU	100	**X11-602-000-004**
5	Contact housing	AMPMODU	100	**X11-602-000-001**
6	Contact (master)	AMPMODU	200	**X11-602-000-003**
7	Push out tool	AMPMODU (AMP-No. 0-0091084-1)	—	—
8	Wire 0.5mm^2		—	—
9	Cable strap		—	—
10	Hand tool	MATE-N-LOCK (AMP-No. 0-0734202-1)	—	—
11	Connector, 4-pole	MATE-N-LOCK	100	**X11-602-000-006**
12	Connector, 6-pole	MATE-N-LOCK	100	**X11-602-000-008**
13	Pin	MATE-N-LOCK	1000	**X11-602-000-007**
14	Push out tool	MATE-N-LOCK (AMP-No. 0-0189727-1)	—	—
15	Wire, yellow 0.75mm^2		—	—
16	Wire, red 0.75mm^2		—	—
17	Wire, black 0.75mm^2	—		—

6. System Components, Spare Parts and Accessories

6.2 Spare Parts and Accessories

6.2.2 Accessories

Pos.	Designation	Items / Package	Order No.
1	VDO CANcockpit Interface (Wingauge CMD Line)	1	**X11-602-000-009**
2	VDO CANcockpit Interface (Wingauge)	1	**X11-602-000-010**

7. Data Sheets

Enclosures

Master-Geräte

Systemkomponenten

VDO CANcockpit

Tachometer oder Drehzahlmesser (Gehäuse Ø 80 / 85 / 100 mm)

Master Gauges

System Components

VDO CANcockpit

Speedometer or Tachometer (Housing dia. 80 / 85 / 100 mm)

Beispiel: Gehäuse Ø 80 mm

Tachometer / Speedometer

Example: housing dia. 80 mm

Drehzahlmesser / Tachometer

Beschreibung:

Analoge Anzeige der Geschwindigkeit oder Drehzahl.

Digitale Anzeige der Wegstrecke, Betriebsstunden, physikalische Messwerte, ISO-Symbole, Warnungen und Alarme.

High-speed Full-CAN Bus interface V2.0B kompatibel.

Verarbeitung von zwei unterschiedlichen CAN Protokollen (J 1939, ...).

Programmierung über Diagnose-Schnittstelle (k-Line).

Anschlussmöglichkeit bis zu 16 Slave-Geräte.

Description:

Analog indication of road speed or engine speed.

Digital indication of distance, operating hours, physical measured values, ISO symbols, warnings and alarms.

High-speed Full-CAN Bus interface V2.0B compatible.

Processing of two different CAN protocols (J 1939, ...).

Programming with diagnosis interface (k-line).

Possible connection of 16 satellite gauges.

Master-Geräte

Systemkomponenten

VDO CANcockpit

Tachometer oder Drehzahlmesser (Gehäuse Ø 80 / 85 / 100 mm)

Master Gauges

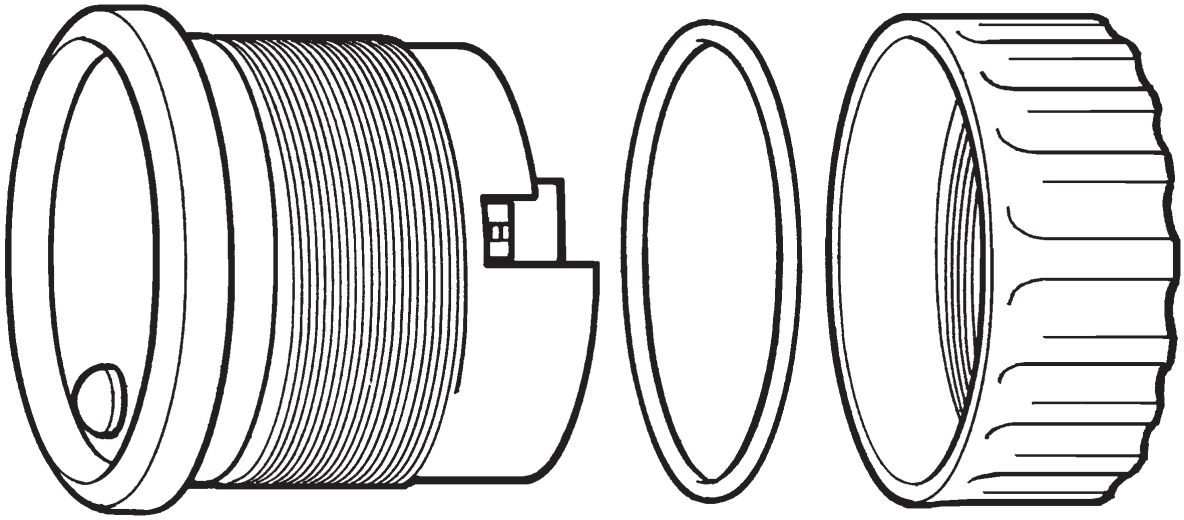
System Components

VDO CANcockpit

Speedometer or Tachometer (Housing dia. 80 / 85 / 100 mm)

Beispiel: Gehäuse Ø 80 mm

Example: housing dia. 80 mm



Master-Gerät
Master gauge

Dichtungsring
Sealing ring

Schraubring
Clamp ring

Ausführung:

Frontring:	Kunststoff, schwarz, Dreikantausführung
Deckglas:	kratzfest, entspiegelt
Einlegering:	schwarz
Zifferblatt:	Durchlicht
Aufdruck:	Grund schwarz Skala, Ziffern und Symbol weiß
Zeiger:	Durchlicht, weiß
Display:	LCD, Dot Matrix Anzeige mit 132 x 33 pixel, monochrom, gelbe Hintergrund-bleuchtung
Gehäuse:	Kunststoff, flammhemmend
Befestigung:	Schraubring, Kunststoff
Beleuchtung:	weiß
Anschlussart:	AMP 26 Pins MODU II, MATE-N-LOK 4 Pins
Einbaulage:	beliebig
Eingänge:	2 CAN-Eingänge, 2x Frequenz, 3x Widerstand, 1x 4-20 mA, 1x 0-5 V
Ausgänge:	bis zu 16 Anzeigeinstrumente (Slaves), 2x Schaltausgang

Design:

Bezel:	plastic, black, triangular version
Lens:	scratch resistant, nonreflective
Deflector :	black
Dial:	backlight
Dialgraphics:	black background with white characters
Pointer:	translucent backlighting, white
Display:	LCD, Dot Matrix display with 132 x 33 dots, monochrome, yellow backlighting
Housing:	plastic, flame retardant
Mounting:	clamp ring, plastic
Illumination:	white
Type of connection:	AMP 26 pins MODU II, MATE-N-LOK 4 pins
Nominal position:	optional
Inputs:	2 CAN inputs, 2x frequency, 3x resistance, 1x 4-20 mA, 1x 0-5 V
Outputs:	up to 16 satellite gauges, 2x switch outputs

Master-Geräte

Systemkomponenten

VDO CANcockpit

Tachometer oder Drehzahlmesser (Gehäuse Ø 80 / 85 / 100 mm)

Technische Daten:

Nennspannung:	12V und 24V DC
Betriebsspannung:	9V bis 32V DC
Stromaufnahme:	200mA ± 20%
EMV:	DIN-EN 50081/1-2,DIN-EN 50082/1-2, ISO 7637-1-2, 95/54 EWG, SAEJ 1810
Schwingungsfestigkeit:	5g, 10-500 Hz, 1 oct./min. SAE J 1810, SAE J 1399
Dauerschock:	25g, 1 Hz, 6 ms, SAE J 1810, SAE J 1399
Schutzart:	IP65, IEC 60529 vorne IP30, IEC 60529 hinten
Betriebstemperatur:	– 35°C bis + 75 °C
Lagertemperatur:	– 40°C bis + 85 °C
LCD Feuchtebeständigkeit:	+ 65°C ± 2 °C 93% r.F. $^{+2\%}_{-3\%}$
Betriebstemperatur LCD Anzeige:	– 20°C bis + 70 °C

Master Gauges

System Components

VDO CANcockpit

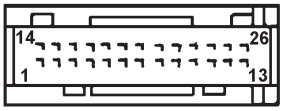
Speedometer or Tachometer (Housing dia. 80 / 85 / 100 mm)

Technical Data:

Rated voltage:	12V and 24V DC
Operating voltage:	9V to 32V DC
Current consumption:	200mA ± 20%
EMC:	DIN-EN 50081/1-2,DIN-EN 50082/1-2, ISO 7637-1-2, 95/54 EWG, SAEJ 1810
Vibration resistance:	5g, 10-500 Hz, 1 oct./min. SAE J 1810, SAE J 1399
Physical shock:	25g, 1 Hz, 6 ms, SAE J 1810, SAE J 1399
Protection:	IP65, IEC 60529 front side IP30, IEC 60529 backside
Operating temperature:	– 35°C to + 75 °C
Storage temperature:	– 40°C to + 85 °C
LCD Humidity resistance:	+ 65°C ± 2 °C 93% r.F. $^{+2\%}_{-3\%}$
Operating temperature light crystal display:	– 20°C to + 70 °C

Anschlussbelegung:
Terminal connection:

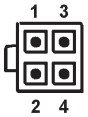
Geräteanschluss
Gauge connection



AMP 26 Pins MODU II

Pin	Beschreibung / Description	Pin	Beschreibung / Description
1	Kl. 30 / Power Supply (terminal 30)	14	+ 8 V DC für Geber / for Sensor supply
2	Kl. 31 / GND (terminal 31)	15	0 - 5 V DC Eingang / Input
3	CAN1 _High	16	Kl. 58 d / Illumination (terminal 58 d)
4	CAN1 _Low	17	Kl. 15 / Ignition (terminal 15)
5	CAN2 _High	18	Frequenzeingang 2 / Frequency Input 2 (0-2 kHz)
6	CAN2 _Low	19	Frequenzeingang 1 / Frequency Input 1 (0-40 kHz)
7	nicht belegt / not connected	20	Schaltausgang 1 / Switch-Output 1
8	k - Line	21	Schaltausgang 2 / Switch-Output 2
9	Analog Eingang 1 / Input 1 (0,5-200 Ohm)	22	nicht belegt / not connected
10	Analog Eingang 2 / Input 2 (0,5-300 Ohm)	23	nicht belegt / not connected
11	Analog Eingang 3 / Input 3 (10 -700 Ohm)	24	nicht belegt / not connected
12	4 - 20 mA Eingang / Input	25	Masse Analog / Analog GND
13	4 - 20 mA Masse / GND	26	Masse Frequenz / Frequency GND

Geräteanschluss
Gauge connection



4 Pin MATE-N-LOCK

Pin	Beschreibung / Description	Pin	Beschreibung / Description
1	Versorgungsspannung Slave / Supply Satellite	3	Masse / GND
2	Sat - Bus	4	nicht belegt / not connected

Master-Geräte

Systemkomponenten

VDO CANcockpit

Tachometer oder Drehzahlmesser (Gehäuse Ø 80 / 85 / 100 mm)

Master Gauges

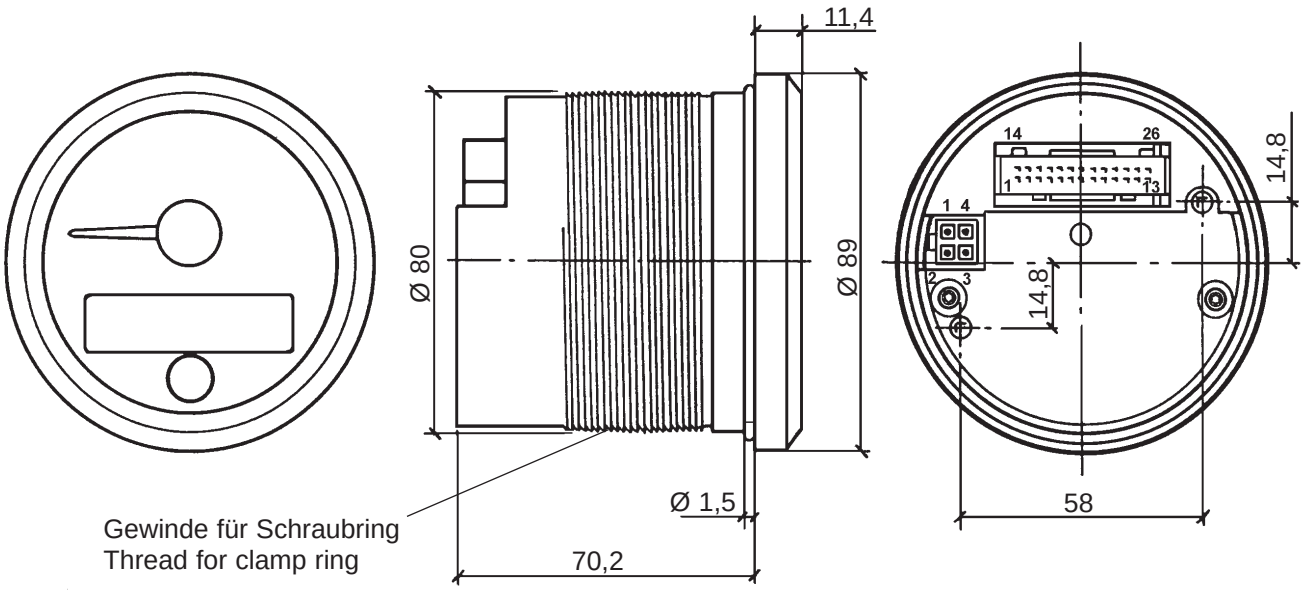
System Components

VDO CANcockpit

Speedometer or Tachometer (Housing dia. 80 / 85 / 100 mm)

Beispiel: Gehäuse Ø 80 mm
Abmaße (mm)

Exemple: housing dia. 80 mm
Dimensions (mm)



Gehäuse Ø Housing Dia.	Symbol	Messbereich Measuring Range	Material-Nr. / Material No. gemäss / according to Wingauge	Bestell-Nr. / Order Nr. 10er Verp. / Packaging (10)
Drehzahlmesser / Tachometers				
80 mm	min^{-1} x 1000	3000 min^{-1}	**A2C53024779** *	**A2C60000001**
80 mm	min^{-1} x 1000	4000 min^{-1}	**A2C53024780** *	**A2C60000002**
85 mm	RPM x 1000	3000 RPM	**A2C53024807** *	**A2C60000051**
85 mm	RPM x 1000	4000 RPM	**A2C53024808** *	**A2C60000052**
100 mm	min^{-1} x 1000	3000 min^{-1}	**A2C53024809** *	**A2C60000101**
100 mm	min^{-1} x 1000	4000 min^{-1}	**A2C53024810** *	**A2C60000102**
Tachometer / Speedometers				
80 mm	km/h	30 km/h	**A2C53101261** *	**A2C60000007**
80 mm	km/h	60 km/h	**A2C53024818** *	**A2C60000003**
80 mm	km/h	120 km/h	**A2C53024819** *	**A2C60000004**
80 mm	km/h	200 km/h	**A2C53042275** *	**A2C60000005**
80 mm	MPH, km/h	80 MPH / 120 km/h	**A2C53096000** *	**A2C60000006**

* ⚠ **keine Bestell-Nr. / No purchasing No.**

Master-Geräte

Systemkomponenten

VDO CANcockpit

Tachometer oder Drehzahlmesser (Gehäuse Ø 80 / 85 / 100 mm)

Master Gauges

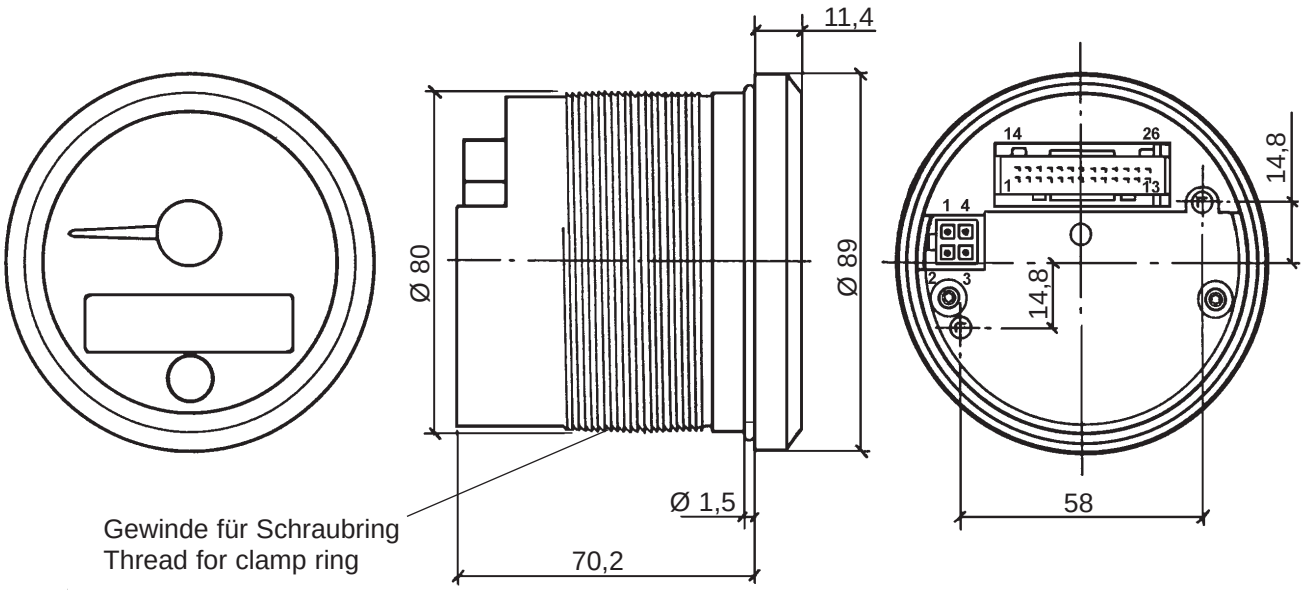
System Components

VDO CANcockpit

Speedometer or Tachometer (Housing dia. 80 / 85 / 100 mm)

Beispiel: Gehäuse Ø 80 mm
Abmaße (mm)

Exemple: housing dia. 80 mm
Dimensions (mm)



Gehäuse Ø Housing Dia.	Symbol	Messbereich Measuring Range	Material-Nr. / Material No. gemäss / according to Wingauge	Bestell-Nr. / Order Nr. 10er Verp. / Packaging (10)
Tachometer / Speedometers				
85 mm	km/h	120 km/h	**A2C53024822 ***	**A2C60000054**
85 mm	km/h	200 km/h	**A2C53042223 ***	**A2C60000055**
85 mm	MPH	80 MPH	**A2C53096001 ***	**A2C60000056**
85 mm	MPH	100 MPH	**A2C53096006 ***	**A2C60000057**
85 mm	MPH	120 MPH	**A2C53095999 ***	**A2C60000058**
100 mm●	km/h	60 km/h	**A2C53024827 ***	**A2C60000103**
100 mm●	km/h	120 km/h	**A2C53024829 ***	**A2C60000104**
100 mm●	km/h	200 km/h	**A2C53024830 ***	**A2C60000105**
100 mm●	km/h, MPH	200 km/h / 120 MPH	**A2C53042276 ***	**A2C60000108**
100 mm●	MPH, km/h	120 MPH / 200 km/h	**A2C53042277 ***	**A2C60000109**
100 mm●	MPH, km/h	50 MPH / 80 km/h	**A2C53024832 ***	**A2C60000106**
100 mm●	MPH, km/h	140 MPH / 220 km/h	**A2C53024834 ***	**A2C60000107**

* ⚠ **keine Bestell-Nr. / No purchasing No.** ● **100 mm nicht lieferbar / not available**

Slave-Geräte

Systemkomponenten

VDO CANcockpit

Analoge Anzeigegeräte in verschiedenen Versionen (Gehäuse Ø 52 mm)

Satellite Gauges

System Components

VDO CANcockpit

Various versions of analog indication gauges (Housing dia. 52 mm)

Beispiel / Examples:

Druckanzeiger / Pressure gauge

Temperaturanzeiger / Temperature gauge

Vorratsanzeiger / Fuel level gauge

Beschreibung:

Analoge Anzeige von Druck, Temperatur, Vorrat, Batteriespannung, Ampere, Geschwindigkeit, Drehzahl.

Programmierung über Diagnose-Schnittstelle (k-Line).

Description:

Analog indication of pressure, temperature, fuel, battery, ampere, speed, engine speed.

Programming with diagnosis interface (k-line).

Slave-Geräte

Systemkomponenten

VDO CANcockpit

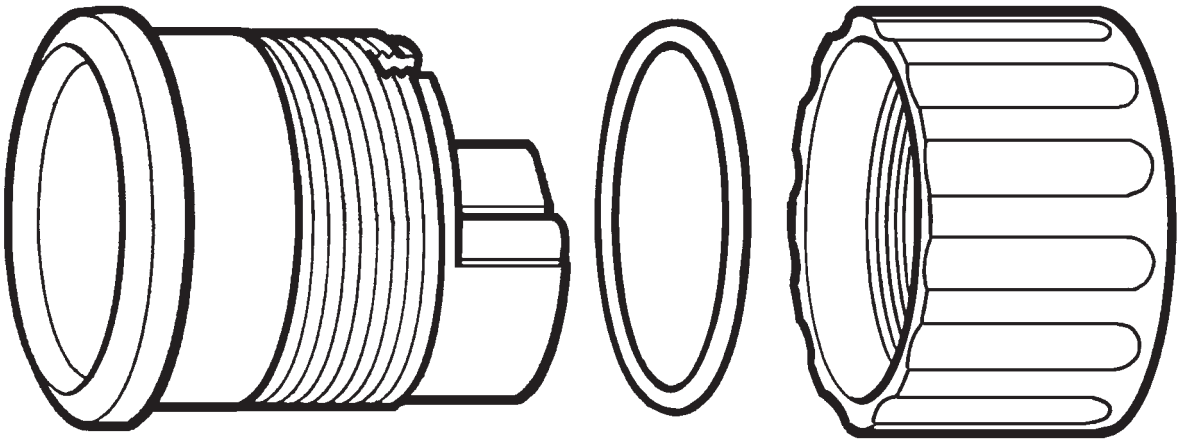
Analoge Anzeigegeräte in verschiedenen Versionen (Gehäuse Ø 52 mm)

Satellite Gauges

System Components

VDO CANcockpit

Various versions of analog indication gauges (Housing dia. 52 mm)



Slave-Gerät
Satellite gauge

Dichtungsring
Sealing ring

Schraubring
Clamp ring

Ausführung:

Frontring:	Kunststoff, schwarz, Dreikantausführung
Deckglas:	kratzfest, entspiegelt
Einlegering:	schwarz
Zifferblatt:	Durchlicht
Aufdruck:	Grund schwarz Skala, Ziffern und Symbol weiß
Zeiger:	Durchlicht, weiß
Gehäuse:	Kunststoff, flammhemmend
Befestigung:	Schraubring, Kunststoff
Beleuchtung:	weiß
Anschlussart:	AMP MATE-N-LOK 6 Pins
Einbaulage:	0 - 85° Winkel

Design:

Bezel:	plastic, black, triangular version
Lens:	scratch resistant, nonreflective
Deflector :	black
Dial:	backlight
Dialgraphics:	black background with white characters
Pointer:	translucent backlighting, white
Housing:	plastic, flame retardant
Mounting:	clamp ring, plastic
Illumination:	white
Type of connection:	AMP MATE-N-LOK 6 pins
Nominal position:	0 - 85° angle

Slave-Geräte

Systemkomponenten

VDO CANcockpit

Analoge Anzeigegeräte in verschiedenen Versionen (Gehäuse Ø 52 mm)

Technische Daten:

Versorgungsspannung:	8V DC von Master
Stromaufnahme:	110mA ± 10%
EMV:	DIN-EN 50081/1-2,DIN-EN 50082/1-2, ISO 7637-1-2, 95/54 EWG, SAEJ 1810
Schwingungsfestigkeit:	5g, 10-500 Hz, 1 oct./min. SAE J 1810, SAE J 1399
Dauerschock:	25g, 1 Hz, 6 ms, SAE J 1810, SAE J 1399
Schutzart:	IP65, IEC 60529 vorne IP30, IEC 60529 hinten
Betriebstemperatur:	– 35°C bis + 75 °C
Lagertemperatur:	– 40°C bis + 85 °C

Satellite Gauges

System Components

VDO CANcockpit

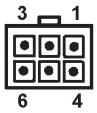
Various versions of analog indication gauges (Housing dia. 52 mm)

Technical Data:

Power supply:	8V DC from Master
Current consumption:	110mA ± 10%
EMC:	DIN-EN 50081/1-2,DIN-EN 50082/1-2, ISO 7637-1-2, 95/54 EWG, SAEJ 1810
Vibration resistance:	5g, 10-500 Hz, 1 oct./min. SAE J 1810, SAE J 1399
Physical shock:	25g, 1 Hz, 6 ms, SAE J 1810, SAE J 1399
Protection:	IP65, IEC 60529 front side IP30, IEC 60529 backside
Operating temperature:	– 35°C to + 75 °C
Storage temperature:	– 40°C to + 85 °C

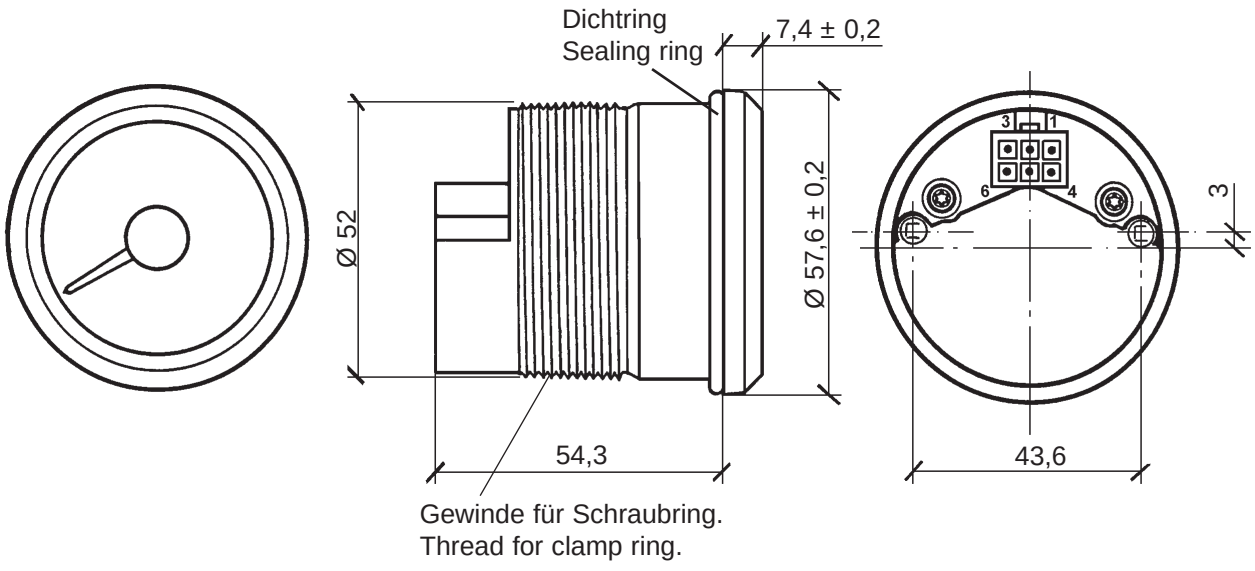
Anschlussbelegung:
Terminal connection:
AMP MATE-N-LOCK 6 Pins

Geräteanschluss
Gauge connection



Pin	Beschreibung / Description	Pin	Beschreibung / Description
1	Data	4	Data
2	Masse / GND	5	Masse / GND
3	Versorgungsspannung Slave / Supply Satellite	6	Versorgungsspannung Slave / Supply Satellite

Abmaße / Dimensions (mm)



Slave-Geräte

Systemkomponenten

VDO CANcockpit

Analoge Anzeigegeräte in verschiedenen Versionen (Gehäuse Ø 52 mm)

Satellite Gauges

System Components

VDO CANcockpit

Various versions of analog indication gauges (Housing dia. 52 mm)

Benennung Designation	Messbereich Measuring Range	Material-Nr. / Material No. gemäss / according to Wingauge	Bestell-Nr. / Order No. 10er Verp. / Packaging (10)
Druckanzeiger / Pressure Gauges			
Motoröldruck / Engine oil pressure	0-5 bar	A2C53024535 *	A2C60000201
Motoröldruck / Engine oil pressure	0-10 bar	A2C53024536 *	A2C60000202
Motoröldruck / Engine oil pressure	0-5 x 100 kPa	A2C53024537 *	A2C60000203
Motoröldruck / Engine oil pressure	0-10 x 100 kPa	A2C53024538 *	A2C60000204
Motoröldruck / Engine oil pressure	0-80 psi, 0-5 bar	A2C53024539 *	A2C60000205
Motoröldruck / Engine oil pressure	0-100 psi, 0-7 bar	A2C53096027 *	A2C60000234
Motoröldruck / Engine oil pressure	0-150 psi, 0-10 bar	A2C53024541 *	A2C60000206
Bremsdruck / Brake pressure	0 - 10 bar	A2C53024542 *	A2C60000207
Bremsdruck 1 / Brake pressure 1	0 - 10 bar	A2C53096017 *	A2C60000236
Bremsdruck 2 / Brake pressure 2	0 - 10 bar	A2C53096019 *	A2C60000237
Bremsdruck w/o① / Brake press. w/o①	0 - 250 bar	A2C53098355 *	A2C60000238
Bremsdruck w/o② / Brake press. w/o②	0 - 250 bar	A2C53098356 *	A2C60000239
Bremsdruck / Brake pressure	0-150 psi, 0-10 bar	A2C53024543 *	A2C60000208
Bremsdruck / Brake pressure	0-16 bar	A2C53024545 *	A2C60000209
Getriebeöldruck / Transmission oil press.	0-28 bar	A2C53024546 *	A2C60000210
Getriebeöldruck / Transmission oil press.	0-400 psi, 0-28 bar	A2C53024548 *	A2C60000211
Turboladerdruck / Turbocharger press.	0 - 2 bar	A2C53024549 *	A2C60000212
Temperaturanzeiger / Temperature Gauges			
Motoröltemp. / Engine oil temperature	50-150 °C	A2C53024524 *	A2C60000213
Motoröltemp. / Engine oil temperature	120-300 °F, 50-150 °C	A2C53042278 *	A2C60000231
Getriebeöltemp. / Transmission oil temp.	50-150 °C	A2C53024526 *	A2C60000214
Getriebeöltemp. / Transmission oil temp.	50-150 °C, 120-300 °F	A2C53024527 *	A2C60000215
Getriebeöltemp. / Transmission oil temp.	120-300 °F, 50-150 °C	A2C53096008 *	A2C60000235
Temperatur / Temperature	60-200 °C	A2C53024528 *	A2C60000216
Kühlwassertemp. / Cooling water temp.	40-120 °C	A2C53024529 *	A2C60000217
Kühlwassertemp. / Cooling water temp.	40-120 °C, 100-250 °F	A2C53024530 *	A2C60000218

* ⚠ **keine Bestell-Nr. / No purchasing No.**

Slave-Geräte

Systemkomponenten

VDO CANcockpit

Analoge Anzeigegeräte in verschiedenen Versionen (Gehäuse Ø 52 mm)

Satellite Gauges

System Components

VDO CANcockpit

Various versions of analog indication gauges (Housing dia. 52 mm)

Benennung Designation	Messbereich Measuring Range	Material-Nr. / Material No. gemäss / according to Wingauge	Bestell-Nr. / Order No. 10er Verp. / Packaging (10)
Temperaturanzeiger / Temperature Gauges			
Kühlwassertemp. / Cooling water temp.	100-280 °F, 40-120 °C	**A2C53042279 ***	**A2C60000219**
Hydrauliköltemp. / Hydraulic oil temp.	20-120 °C	**A2C53024531 ***	**A2C60000220**
Pyrometertemp. / Pyrometer temp.	100-900 °C	**A2C53024532 ***	**A2C60000221**
Vorratsanzeiger / Level Gauges			
Kraftstoffstand / Fuel level	0 - 1/1	**A2C53024552 ***	**A2C60000222**
Kraftstoffstand / Fuel level	E - 1/4 - 1/2 - 3/4 - F	**A2C53042280 ***	**A2C60000233**
Frischwasserstand / Fresh water level	0 - 1/1	**A2C53042281 ***	**A2C60000223**
Schmutzwasserstand / Waste water level	0 - 1/1	**A2C53042282 ***	**A2C60000224**
Voltmeter / Voltmeters			
Batteriespannung / Battery voltage	8 - 16 V	**A2C53024533 ***	**A2C60000225**
Batteriespannung / Battery voltage	18 - 32 V	**A2C53024534 ***	**A2C60000227**
Batteriespannung / Battery voltage	10 - 18 V	**A2C53042283 ***	**A2C60000226**
Batteriespannung / Battery voltage	20 - 34 V	**A2C53042284 ***	**A2C60000232**
Amperemeter / Ammeters			
Batteriestrom / Battery current	– 125 ... + 125 A	**A2C53024522 ***	**A2C60000228**
Tachometer / Speedometers			
Geschwindigkeit / Speed	60 km/h	**A2C53042287 ***	**A2C60000230**
Drehzahlmesser / Tachometers			
Drehzahl / Engine speed	3000 min^{-1}	**A2C53042286 ***	**A2C60000229**

* ⚠ **keine Bestell-Nr. / No purchasing No.**

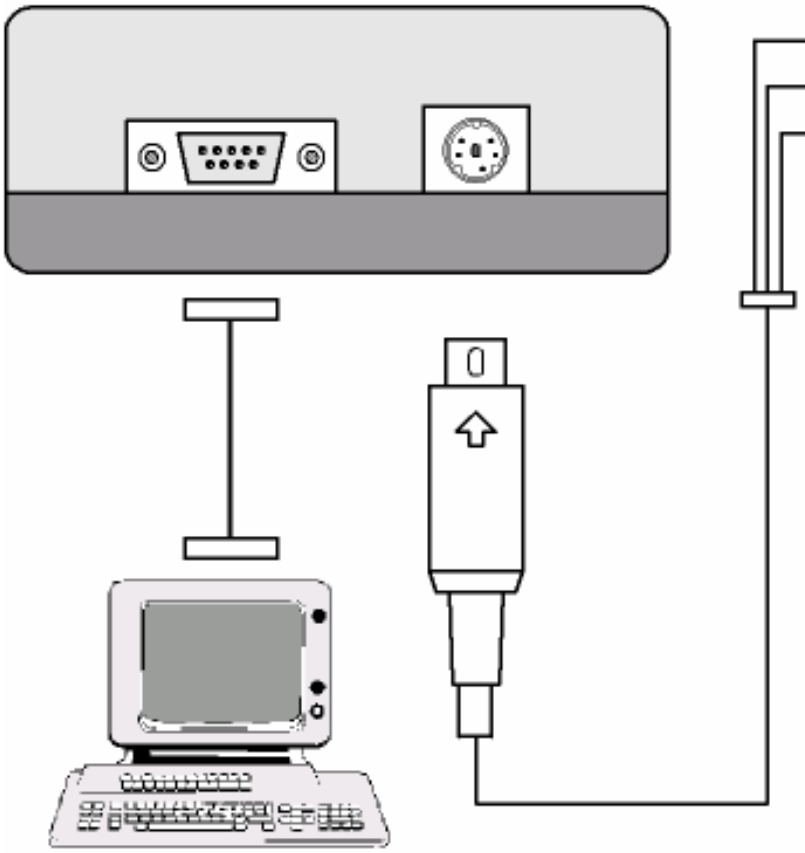
Datenblätter für VDO CANcockpit
Data Sheets For VDO CANcockpit

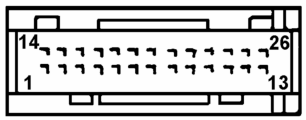
Änderungsübersicht / Change Overview

Datum Date	Doku-Nr. Documentation No.	Seite Page	Bemerkung Comment	
0603	TU00-0726-5104620	4, 5	*neu/new*	Bestell-Nr. / Order no.
	TU00-0726-5304620	4, 5	*neu/new*	Bestell-Nr. / Order no.
0703	TU00-0726-5104620	4, 5	*neu/new*	Bestell-Nr. / Order no.
	TU00-0726-5304620	4, 5	*neu/new*	Bestell-Nr. / Order no.
1003	TU00-0726-5104620	3	*neu/new*	LCD Feuchtebeständigkeit / + 65°C ± 2 °C LCD Humidity resistance: 93% r.F. $^{+2\%}_{-3\%}$
		4, 5	*entfernt* *removed*	Bestell-Nr. / Order no.
	TU00-0726-5304620	4, 5	*entfernt* *removed* *neu/new*	Bestell-Nr. / Order no. A2C60000231, ... 232, ... 233
1103	TU00-0726-5104620	3	*war/was*	Stromaufnahme/Current consumption: 150mA ± 10% Betriebstemperatur/Operating temperature: – 40°C to + 85 °C
		4, 5	*war/was*	Material-Nr./Material No. Bestell-Nr. Einzelgeräte / Order No. Single instr.
	TU00-0726-5304620	3	*war/was*	Stromaufnahme/Current consumption: 40mA ± 10% Betriebstemperatur/Operating temperature: – 40°C to + 85 °C
		4, 5	*war/was*	Material-Nr./Material No. Bestell-Nr. Einzelgeräte / Order No. Single instr.
0404	TU00-0726-5104620	4, 5	*neu/new*	100 mm nicht lieferbar / not available
0704	TU00-0726-5104620	4, 5	*entfernt* *removed* *neu/new*	Bestell-Nr. / Order no. A2C60000053 A2C60000006, ... 007, ... 056, ... 057, ... 058
	TU00-0726-5304620	4, 5	*neu/new*	Bestell-Nr. / Order no. A2C60000234, ... 235, ... 236, ... 237, ... 238, ... 239
0904	TU00-0726-5104620	2	*neu/new*	Einbaulage: beliebig / Nominal positon: optional
	TU00-0726-5304620	2 3	*neu/new*	Einbaulage: 0 - 85° Winkel / Nominal positon: 0 - 85° angle; vom Master / from Master
0205	TU00-0726-5304620	5	*changed*	Bestell-Nr. / Order no. A2C60000229 ...230

CANcockpit

K-Line Connection





26 Pin MODU II

Pin	Description	Pin	Description
1	Kl. 30 / Power Supply	14	+8V DC for external Sensor Supply
2	Kl. 31 / GND	15	0 – 5V DC
3	CAN0 _H	16	Kl. 58 / Illumination
4	CAN0 _L	17	Kl. 15 / Ignition
5	CAN1 _H	18	Frequency Input 2
6	CAN1 _L	19	Frequency Input 1
7	NC	20	Switch-Output_1
8	k-Line	21	Switch-Output_2
9	Geber 1 / Sensor 1	22	NC
10	Geber 2 / Sensor 2	23	NC
11	Geber 3 / Sensor 3	24	NC
12	4-20mA	25	Analog GND
13	4-20mA Masse / GND	26	Speed GND

4 Pin MATE-N-LOCK

Pin	Description	Pin	Description
1	Slave Supply	3	GND
2	Sat - Bus	4	NC

SIEMENS VDO
Automotive

Siemens VDO Instruments MY Sdn Bhd
MY Penang

EC – Declaration of Conformity

according to the guidelines of the European Community for electromagnetic compatibility 89/336/EEC.

We declare that the following products conform with the protection requirements of Council Directive 89/336/EEC relating to the electromagnetic compatibility.

This declaration will lose its validity with improper usage or resale and modifications, which are not approved by the manufacturer and supplier.

Name of the product: CANcockpit Gauges

Utilisation area: For land and water based vehicles

Types:	**Master**	**Slaves**		
Packaged gauge no.:	Diverse	Diverse		
Unpackaged gauge no.:	Diverse	Diverse		

Year of assembly: 2003

This device has been designed and produced according to the following official standards:

Emission of interference: DIN – EN 61000-6-3

Immunity to interference: DIN – EN 61000-6-2

Manufacturer: Siemens VDO Instruments MY Sdn Bhd
2455, Mk., Tingkat Perusahaan 2A
Prai Industrial Estate, 13600 Prai
Penang
Malaysia

zertifiziertes Qualitätssystem SQS ISO 9001/ EN 29001

Reg.No.: AR 0183

Place and date of issue: Penang, 14. November 2003

Signature:
Position Management

Quality Management

Kraftfahrt-Bundesamt

D-24932 Flensburg

E1

MITTEILUNG

ausgestellt von:
Kraftfahrt-Bundesamt

über die Genehmigung
eines Typs eines elektrischen/elektronischen Bauteiles nach der Regelung Nr. 10

COMMUNICATION

issued by:
Kraftfahrt-Bundesamt

concerning approval granted
of a type of electrical/electronic sub-assembly with regard to Regulation No. 10

Nummer der Genehmigung: **023429**
Approval No.:

Erweiterung Nr.: **--**
Extension No.:

1. Fabrikmarke (Handelsname des Herstellers):
Make (trade name of manufacturer):
Siemens

2. Typ:
Type:
CANcockpit

Handelsbezeichnung(en):
General commercial description(s):
CANcockpit

3. Merkmale zur Typidentifizierung, sofern am Bauteil vorhanden:
Means of identification of type, if marked on the component:
entfällt
not applicable

3.1 Anbringungsstelle dieser Merkmale:
Location of that marking:
entfällt
not applicable

Kraftfahrt-Bundesamt

D-24932 Flensburg

Nummer der Genehmigung:023429
Approval No.:

4. Klasse der Fahrzeuge:
Category of vehicle:
entfällt
not applicable

5. Name und Anschrift des Herstellers:
Name and address of manufacturer:
Siemens VDO Trading AG
CH-9464 Rüthi SG

6. Bei Bauteilen und selbständigen technischen Einheiten, Lage und Anbringungsart des ECE-Genehmigungszeichens:
In the case of components and separate technical units, location and method of affixing of the ECE approval-mark:
eingetragen auf einem Etikett auf der Gehäuseseite der Einheit
incorporated into a label on site of the housing of the unit

7. Anschrift(en) der Fertigungsstätte(n):
Address(es) of assembly plant(s):
Siemens VDO Components MY Sdn. Bhd.
MY-13600 Prai, Penang

8. Zusätzliche Angaben (erforderlichenfalls):
Additional information (where applicable):
siehe Anlage
see appendix

9. Für die Durchführung der Prüfungen zuständiger technischer Dienst:
Technical service responsible for carrying out the tests:
TÜV Automotive GmbH
Unternehmensgruppe TÜV Süddeutschland
DE-80339 München

10. Datum des Prüfprotokolls:
Date of test report:
26.01.2004

11. Nummer des Prüfprotokolls:
Number of test report:
377-0165-03-FBKA

12. Gegebenenfalls Bemerkungen:
Remarks (if any):
siehe Anlage
see appendix

Kraftfahrt-Bundesamt

D-24932 Flensburg

Nummer der Genehmigung:023429
Approval No.:

13.	Ort: Place:	**DE-24932 Flensburg**
14.	Datum: Date:	**25.08.2004**
15.	Unterschrift: Signature	**Im Auftrag**

(Hansen)

KRAFTFAHRT-BUNDESAMT
407

Product Manual VDO CANcockpit

Change Overview

Date	Chapter-Page	Comment
0303	3	*new:* installation instructions TU00-0726-5107120 (1-8)
	6	*new:* complete
0603	7 - 1	*new:* master gauges 0603 (pages 1-5) satelitte gauges 0603 (pages 1-5)
0703	6-2 to 6-6	*new:* order no.
	7 - 1	*new:* master gauges 0703 (pages 1-5) satelitte gauges 0703 (pages 1-5)
1003	2	*new:* complete
	6-2 to 6-6	*removed:* order no. last letter C
	6-8	*new :* items / package 10
	6-9	*new :* items / package and order no.
	7-1	*new :* master gauges 1003 (pages 1-5), satelitte gauges 1003 (pages 1-5)
0204	2-11	*new :* Pin 20: Save against high current with a Fuse 0.5 A!
0404	6-2 to 6-6 6-2 to 6-4	*new :* * ⚠ No purchasing No. • 100 mm not available
0704	6-2 to 6-5 6-3	*new :* Order no. A2C60000006, ... 007, ... 056, ... 057, ... 058 A2C60000234, ... 235, ... 236, ... 237, ... 238, ... 239 *removed:* Order no. A2C60000053
0904	8 (3-5)	*new :* E1 Approval