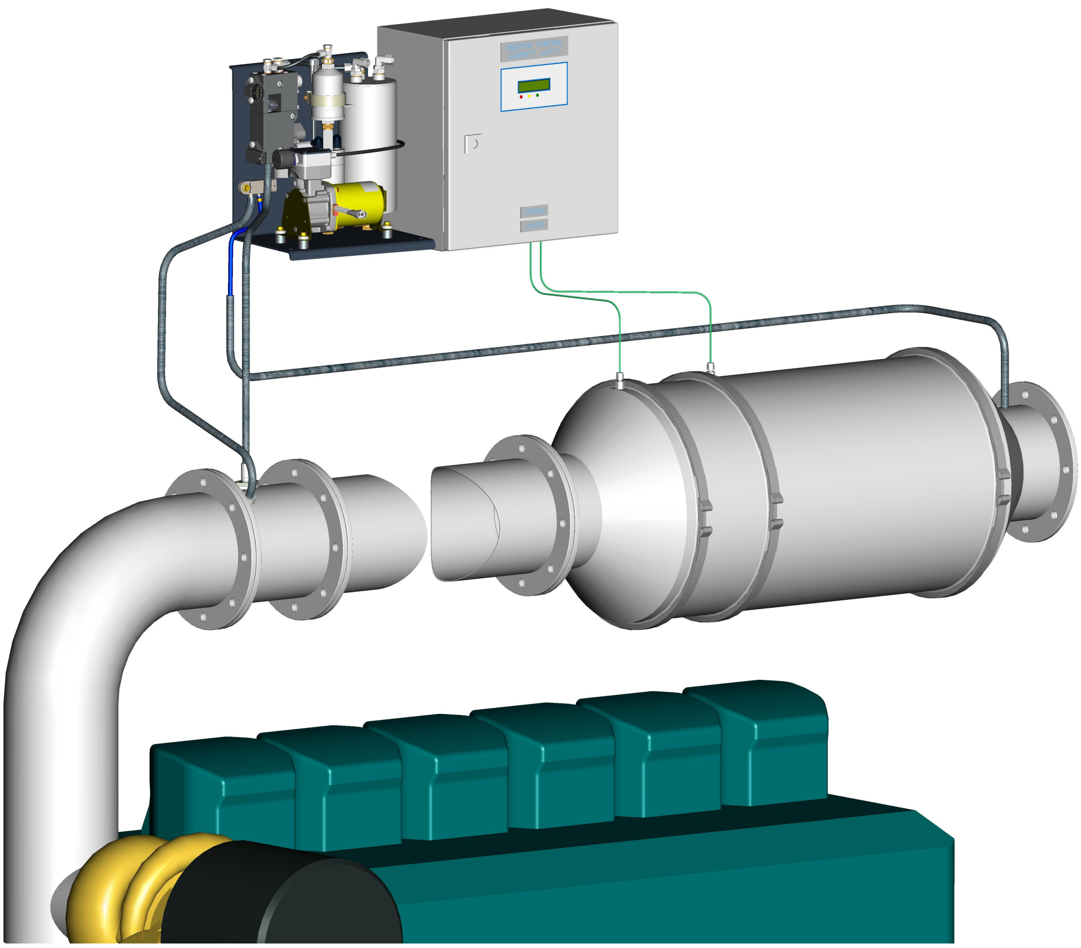
CCT*marine*

PM reduction technology by STT Emtec AB

Installation Guideline



This guideline describes the recommended installation procedure and maintenance for the STT CCT*marine* system
Latest version available at www.sttemtec.com

STT Emtec AB (pbl)
Kontorsvägen 9
SE-852 29 SUNDSVALL
SWEDEN

Tel: +46 (0)60-64 10 40
Fax: +46 (0)60 64 10 45
e-mail: info@sttemtec.com
Internet: www.sttemtec.com

Head office: Sundsvall
Org.nr: 55 62 05 – 2927
VAT ID: SE556205292701
ISO-cetrifikat nr: 15627

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1 Purpose

The purpose of this document is to give sufficient information on how to use and install the key components of the CCT*marine* system. The installation guideline also describes the post adjustments and inspection processes and gives general information on service and maintenance.

2 CCT*marine* technology

2.1 Operating principles

The core component of the CCT*marine* system is the DPF (Diesel Particulate Filer). The DPF collects +90% of the particulates produced by the engine so that the exhaust stream is virtually free from soot when emerging to the atmosphere. Eventually the DPF is filled up with soot and must be cleaned. The cleaning process is called regeneration and is performed by the control system heating up the exhaust stream to ~650°C. The actual heating of the exhaust gas is achieved by spraying a mixture of diesel and compressed air over an oxidation catalyst (DOC) mounted just upstream of the DPF. The diesel fuel will then combust and raise the gas temperature sufficiently. This mechanism enables the use of diesel particulate filters in applications where passive DPF systems normally fail. The regeneration process produces no emissions except CO_2 and H_2O.
The soot holds much energy and if too much soot is trapped in the DPF when performing the regeneration there can be enough heat released from the soot to damage the filter. The control system monitors this condition as well as other possible trouble conditions and it is therefore important to respond swiftly to any trouble codes indicated by the control system.

Note! The fuel quality for the CCT*marine* system must be < 50ppm sulphur.

2.2 System layout

The schematic diagram in *Figure 1* shows the layout of the CCT*marine* system. It is an automatic periodically regeneration system developed to enable the use of diesel particulate filters (DPFs) in applications where passive DPF systems fail. CCT*marine* can be used alone or in conjunction with low-pressure EGR systems.

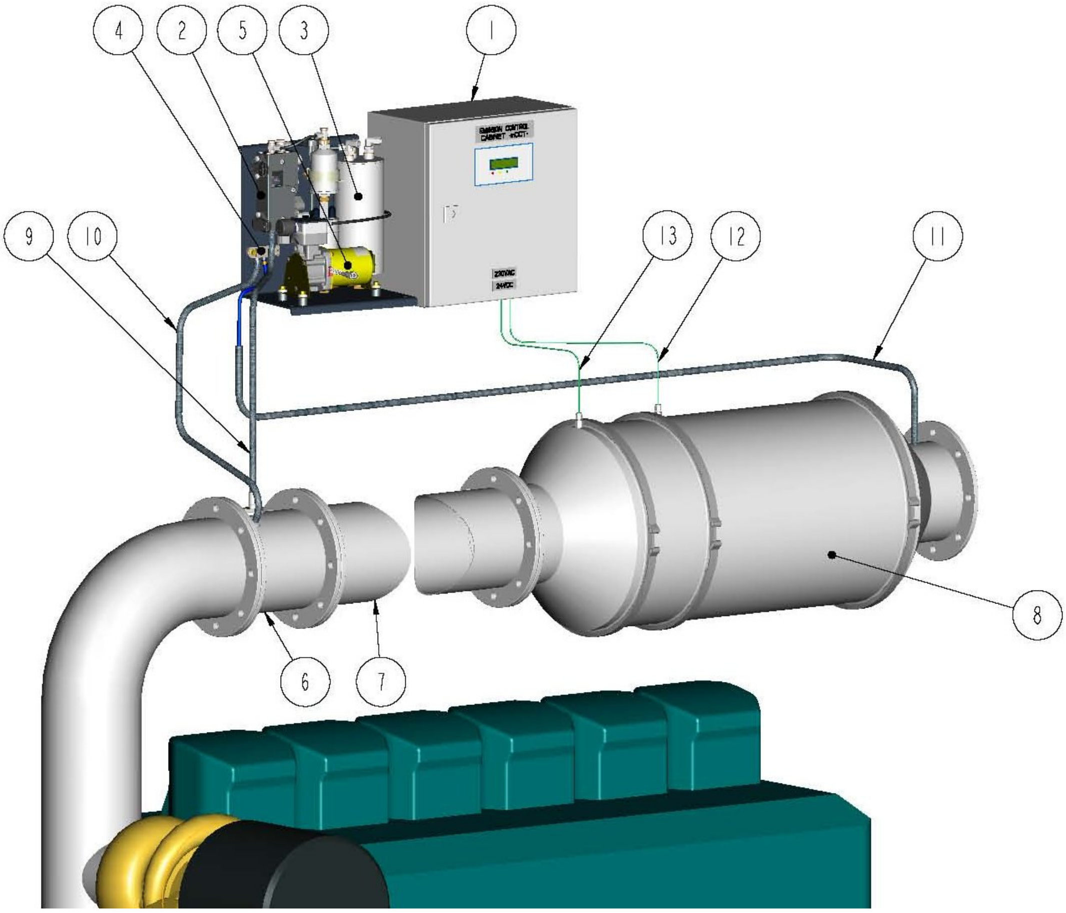


Figure 1 System overview

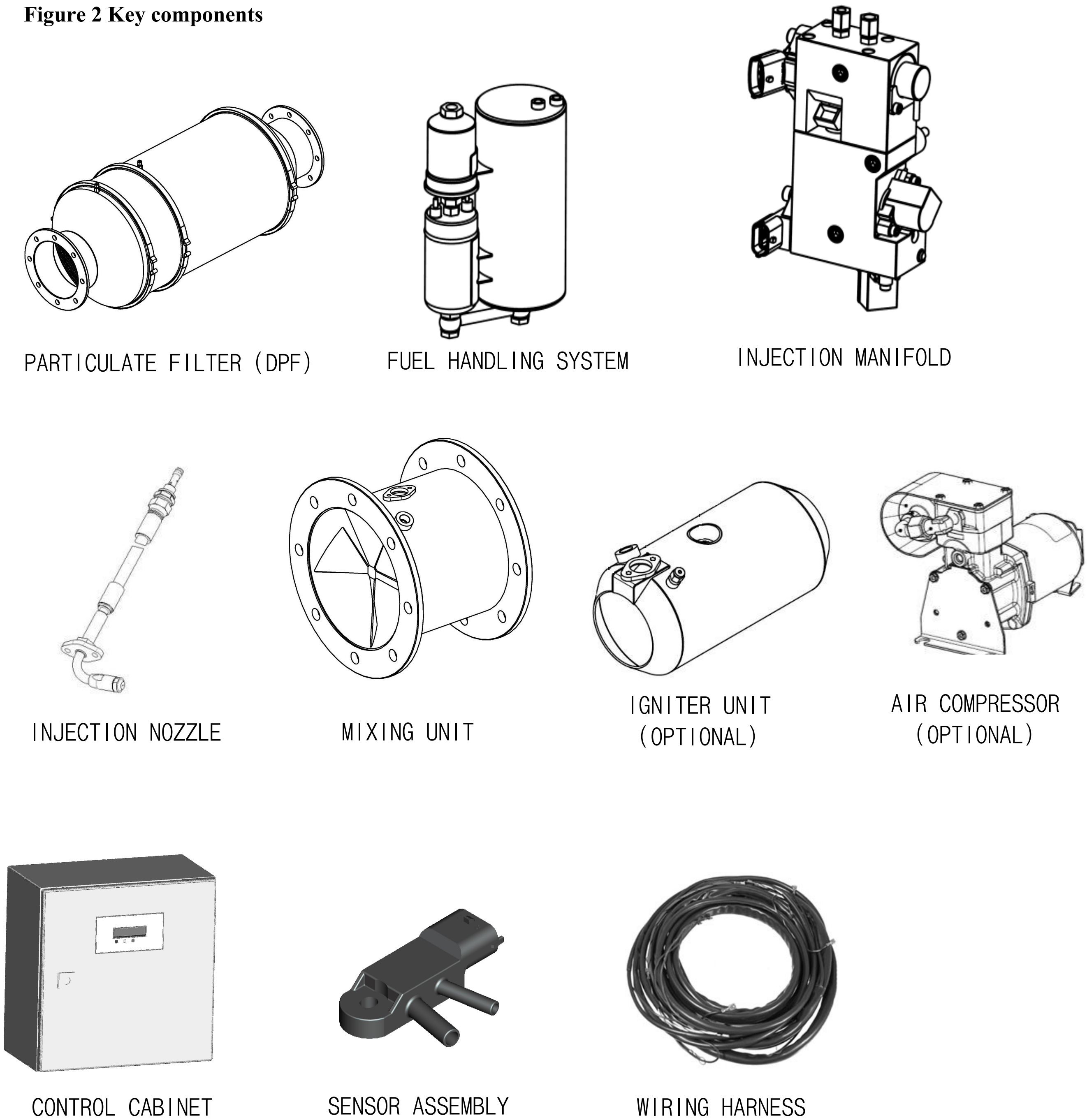
1. Control cabinet, 2. Injection manifold, 3. Fuel handling system,
4. Backpressure sensor, 5. Air compressor (optional),
6. Mixing unit (or optional Igniter unit), 7. Distance pipe, 8. Particulate filter,
9. Injection nozzle, 10-11. Backpressure sensor hoses, 12-13. Temperature sensors

3 System key components

3.1 Components overview

The following are the key components of the CCT*marine* control system. Some parts are optional, such as the Igniter unit. Appearance may vary slightly between specific systems.

Figure 2 Key components



3.2 Particulate filter (DPF)

Function

The particulate filter (DPF) is designed to accumulate soot from the exhaust stream produced by the engine. The soot trapping efficiency is very high (+90%). The DPF can store a limited amount of soot before cleaning (regeneration) is required. If regeneration is not regularly performed the DPF may be severely damaged.

Regeneration is performed by spraying diesel over an oxidation catalyst (DOC) which is mounted in the filter assembly upstream of the DPF

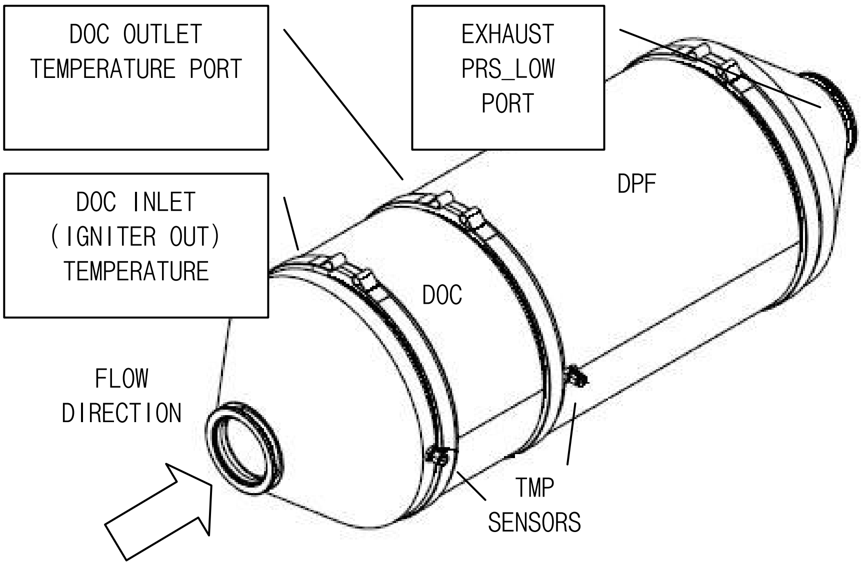


Figure 3 Particulate filter

Installation

The canning is produced of stainless steel with flanges on the in- and outlet ports. Bolt flanges are used to ensure gas tight operation. The flange pairs are mounted with a 1mm stainless steel reinforced graphite gasket. Additional brackets to support the DOC/DPF assembly are required. Simply fixating the bolt flanges is not adequate support for the entire canning.

STT Emtec recommends the use of metal resilient elements type Vibratec® or similar. To absorb vibrations,relative movements and heat extention, use gastight flexible parts and compensators on the connecting exhaustpipes.

Additional insulation may be used according to regulations and/or customer demands. It is important to leave space for the insulation at the installation. In a typical installation the insulation is minimum 50 mm thick. The Exhaust pressure low and DOC inlet/outlet temp sensors are mounted on the DPF assembly. In applications where an Igniter module is used the DOC inlet temp sensor is replaced with the Igniter outlet temp sensor.

Maintenance
The DPF will trap both combustible soot particulates (from diesel fuel) as well as non-combustible, ash-, particulates (engine wear and lube oil etc). Ash particulates will eventually cause increased backpressure and regeneration frequency and the DPF must therefore be dismounted and manually cleaned from ash at a minimum every 6000 operating hours.

Engine condition and wear affects the ash production rate and more frequent service may be required. Ash cleaning can be performed using a compressed air gun at the DPF outlet surface and a regular vacuum cleaner at the DPF inlet surface. This cleaning process is also feasible when the DPF soot load is too high to allowing regular regeneration. A severely clogged filter may require a different cleaning method.

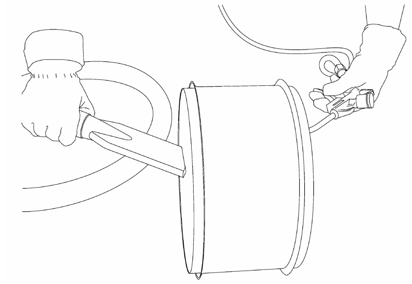


Figure 4 DPF ash cleaning

Note! Make sure that you do not damage the ceramic surface of the DPF when performing the manual cleaning. Always use new gaskets and clamps when reassembling the DPF unit

3.3 Piping

Relative movements and heat extension must always be considered when routing and installing exhaust pipes. Use gastight flexible parts and compensators when necessary. In general a heat expansion of 1-2 mm /meter piping for every 100°C can be used as a rule of thumb.

Flanges and gaskets

Flanges are welded on the pipe ends. The flange pairs are mounted together with a 1mm stainless steel reinforced graphite gasket. For attachment, 8 - 16 pcs of zinc plated screws (or stainless) M16x60 8.8 with nuts and washers are used. The shape of the flanges can differ due to regulations and/or customer demands.

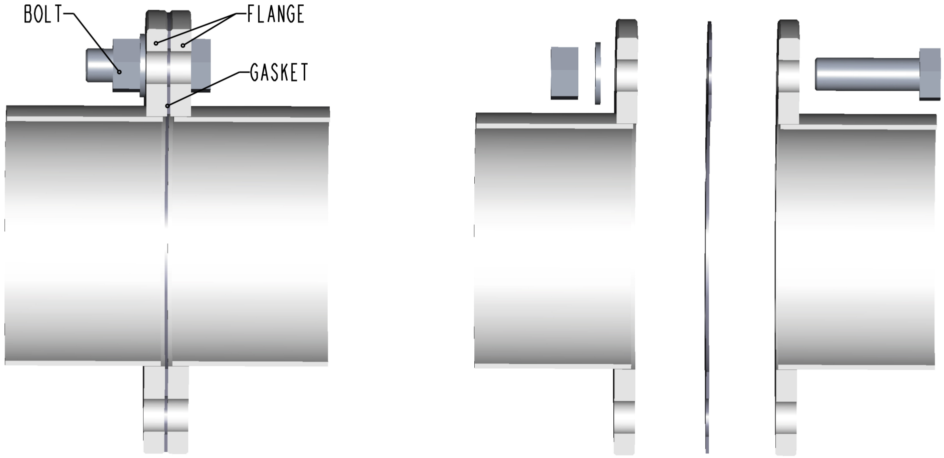


Figure 5 Flange pair **(exploded view)**

Insulation

For the engine crew safety and protection of the surrounding areas, it is very important to insulate the exhaust system. The exhaust temperature can exceed 500ºC upstream the DPF assembly and 700ºC downstream the DPF (or Igniter module, when installed) so the complete CCT*marine* system will radiate a considerable amount of heat to the engine room if the insulation is not done properly.

The insulation has to fulfil the stated regulations, e.g. surface temperature. The insulation is not within STT Emtec's scope of supply but must be designed for easy access to the covered parts and clamps if service is needed. Typically at least 50mm of insulation is required.

Noise reduction

The DOC catalyst and DPF assembly will contribute to the total exhaust system noise reduction and typically replace the muffler in an existing configuration.

3.4 Fuel handling system

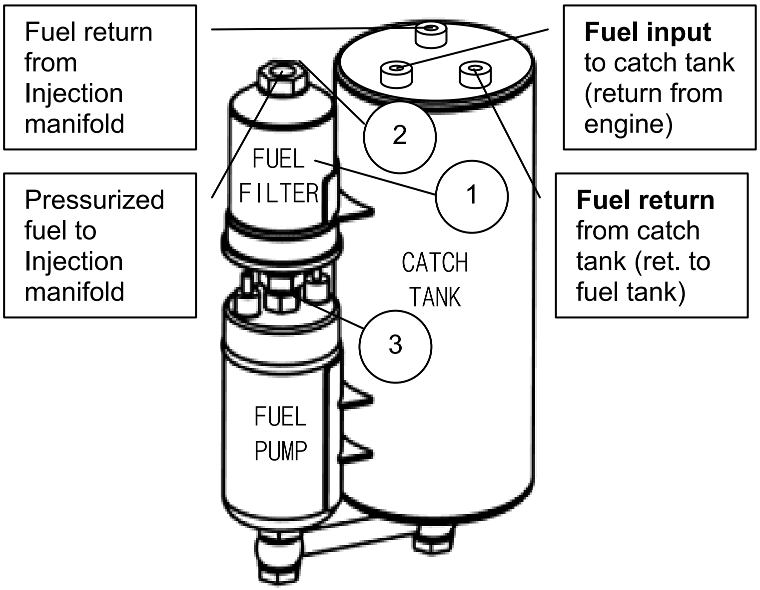


Figure 6 Fuel handling system

Function

Return fuel from the engine is connected to a catch tank which stores enough fuel to perform a DPF regeneration. During regeneration a fuel pump circulates the fuel against a built-in regulator in the injection manifold to a given pressure. No pressure difference, negative or positive, is imposed on the engine fuel lines.

Installation

The fuel return line from the engine is cut and piped thru the catch tank into the ports *Fuel input to catch tank* and *Fuel return from catch tank.*

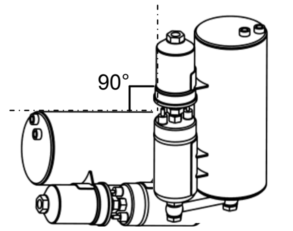


Figure 7 Max tilt

Fittings are internal thread M14x1.5.

Make sure the fittings are tight and no foreign objects enter the catch tank. The fuel handling system comes pre-installed on a bracket where it is already connected to the injection manifold. Should the installation require a different location of the fuel handling unit it may be repositioned regarding the maximum distance from the injection manifold and maximum tilt.

Maintenance

The fuel filter should be changed every 3000 operating hours or in the event of a fuel pressure problem.

Pos	P/N	Description	Qty
1	102584	Fuel filter	1
2,3	480-00-0288.0	Gasket	2

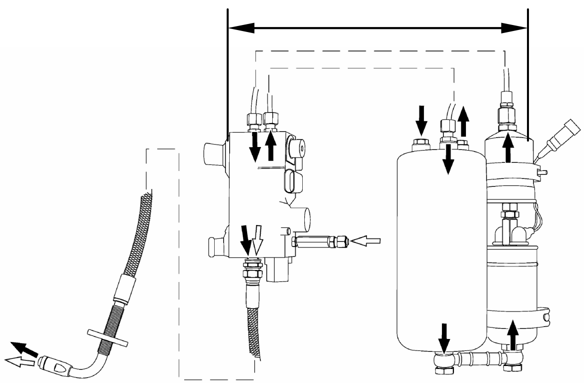


Figure 8 Max distance

3.5 Injection manifold

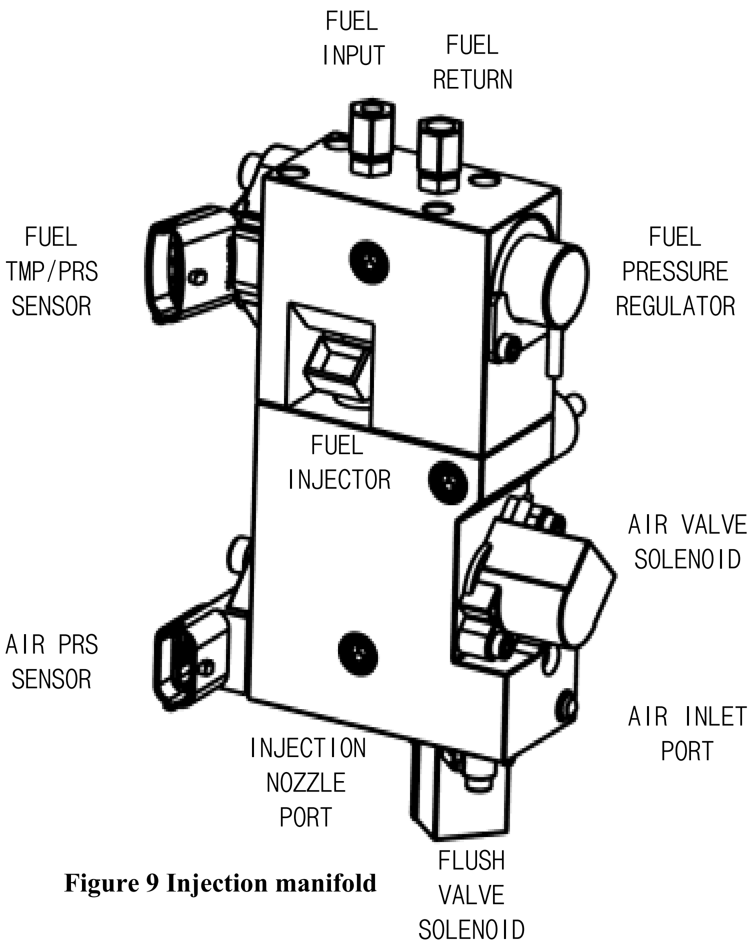


Figure 9 Injection manifold

Function
The Injection manifold meters fuel dosing during DPF regeneration. Metering is accomplished using a fuel injector in combination with a built-in pressure regulator to maintain a steady fuel pressure. Air and fuel pressure/ temperatures are continuously monitored by the control system. Compressed air is used to atomize the fuel during regeneration (Air valve) and to evacuate the manifold and nozzle after regeneration (Flush valve).

Installation
The manifold must be installed so that the Injection nozzle hose always slopes downward to the nozzle tip in the Mixer unit.

Should it therefore be required to move the Injection manifold from the bracket it must be mounted to chassis to avoid unnecessary vibrations. The allowed position is with the pressure sensors in horizontal position and an angle tilt within ±10° (*Figure 10*). The manifold is attached with (3x) M6 Allen screws and (3x) M6 bobbins. An additional bracket and/or heat protection may be required. Maximum hose length must also be considered, see Mixing unit installation for further details.

Maintenance
There are no particular maintenance instructions for the Injection manifold. Sensors and solenoids are checked or replaced on the event of a sensor or actuator error.

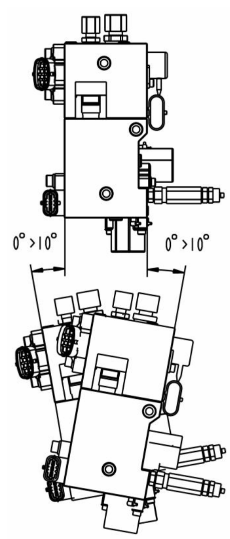


Figure 10 Max tilt

3.6 Injection nozzle

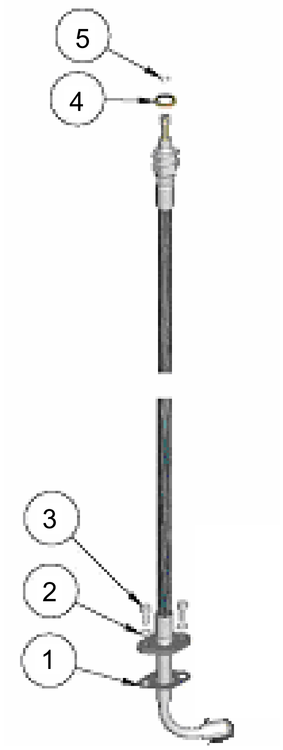


Figure 11 Injection nozzle

Pos	P/N	Description	Qty
1	102273	Gasket	1
2	104090	Washer sp	2
3	104089	Screw	2
4	102270	Washer tr	1
5	102283	O-ring	1

Function

The braided stainless steel hose from the Injection manifold to the Mixer unit is called Injection nozzle. It is transporting diesel and air from the manifold and creates a mist of diesel/air at the nozzle tip in the exhaust stream. The standard length of the Injection nozzle is 1.5 meters but other lengths are available. If a longer nozzle is required contact technical department at STT Emtec AB for evaluation. The nozzle tip is made of stainless steel and the nozzle line is made of stainless steel braided teflon tube.

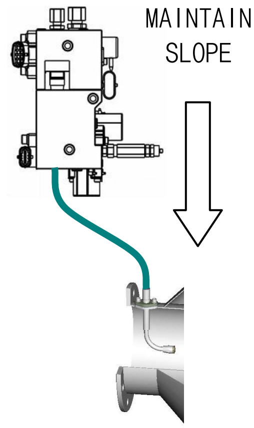


Figure 12 Nozzle mounting

Installation

For best operation and durability the Injection manifold should be placed on a level above the nozzle and ensure that the nozzle line is routed uphill from the exhaust pipe to the Injection manifold to prevent diesel residuals in the line after regeneration which may lead to the line clogging up.
The nozzle can be bent to make a proper route from the manifold to the mixer unit but make sure that the inside radius of the hose is **not bent narrower than 125mm.**

It is important that the nozzle tip is oriented in the same direction as the exhaust flow or soot from the exhaust gas may clog the nozzle tip. The orientation of the nozzle should, when possible, be fitted on the topside of the mixer above the vertical plane.

Maintenance

The Injection nozzle should be checked every 750 operating hours and, when necessary, replaced. The procedure to check the injection nozzle is described in Appendix 5.1.8. Depending on application the injection nozzle might need replacement at a shorter interval. Note that the nozzle is considered a service item and a clogged nozzle will not be covered by warranty.
When replacing the nozzle, start by releasing the air pressure and make sure that the system is powerless. The washers, screws, sealing and o-ring (pos 3-5 above) can be reused if the condition of the components are acceptable. The gasket shall always be replaced. When installing the new nozzle, check that that the nozzles tip is oriented in the same direction as the exhaust flow, see figure 12 above.

⚠ **Note! A Clogged nozzle will cause low regeneration temperatures and lead to excessive DPF soot loading which in turn may damage the filter.**

3.7 Mixer unit

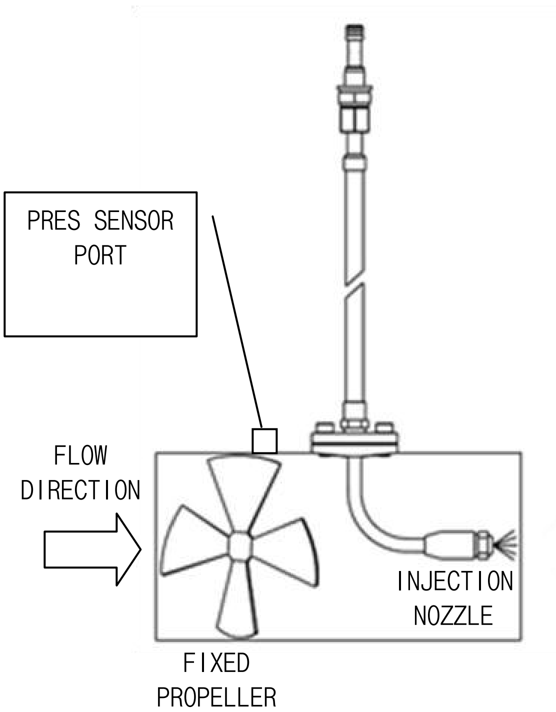


Figure 13 Mixer unit

Function

The mixer unit consists of a fixed propeller and a flange for mounting the Injection nozzle. The mixer in conjunction with the atomizing function of the nozzle helps to disperse the fuel into a homogenous mist which is beneficial for the DOC to operate properly. There must be a distance between the mixer and the DOC in order for the fuel spray to become homogenous.

Installation

The Mixer unit is installed upstream of the DOC/DPF assembly. The supplied reinforced graphite gaskets should be used with the bolt flanges. Make sure the flanges are tight; downstream the Mixer unit even very small leaks will produce a noticeable smell during regeneration. Note the mounting direction of the Injection nozzle. The minimum distance between the Mixer unit and the DPF assembly is 1.0m. The Exhaust pressure (hi) sensor is fitted on this unit. See Sensors installation for further details.

Maintenance

There are no particular maintenance instructions for the Mixer unit.

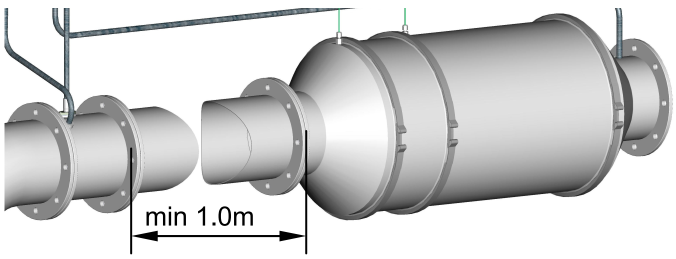


Figure 14 Mixer installation

⚠ **Note! Leaks in the flange between the nozzle and the catalyst will result in visible white smoke and is regarded as a safety hazard.**

3.8 Igniter unit (optional)

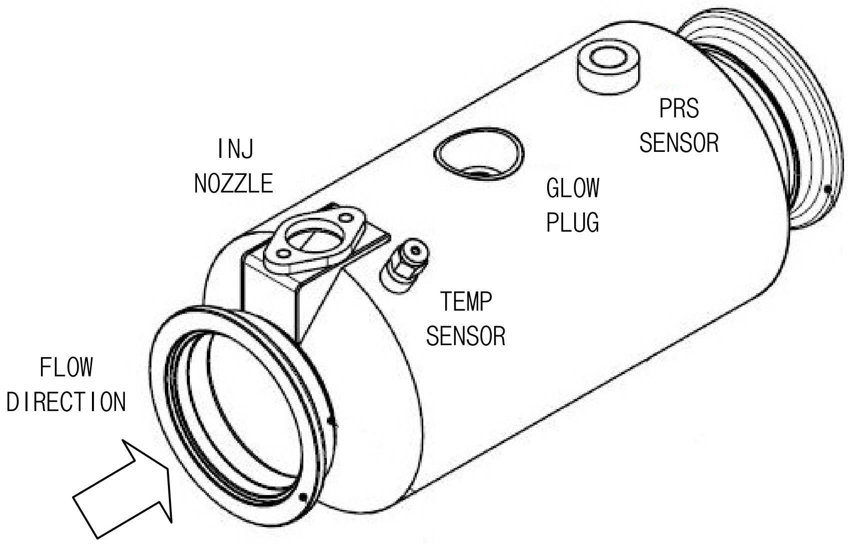


Figure 15 Igniter module

Function
Although CCT*marine* is suitable in applications where the exhaust gas is too cold for passive DPF's to regenerate there are applications which are too cold (especially at engine idling conditions) even for CCT*marine* to operate properly. In this case an Igniter unit can be added. The igniter unit replaces the normal Mixer unit and ignites the injected fuel, using a low-power glow plug, during engine idling.

This keeps the regeneration process going regardless of engine operation. An extra temperature sensor is used to monitor the Igniter operation.

Installation
In applications where the igniter function is required The Igniter unit replaces the Mixing unit. See Mixing unit installation for further details.
The DOC inlet temp sensor and Exhaust pressure (hi) sensors are fitted on this unit. See Sensors installation for further details.

Maintenance
The glow plug should be checked every 1500 operating hours and replaced in the event of an Igniter module problem. The glow plug should measure 3.0±1.0Ω in room temperature. The temperature sensor is checked or replaced in the event a sensor trouble code.

Note! The Igniter will heat up the exhaust stream to above 650˚C. Extra insulation will typically be needed between Igniter unit and DPF assembly!

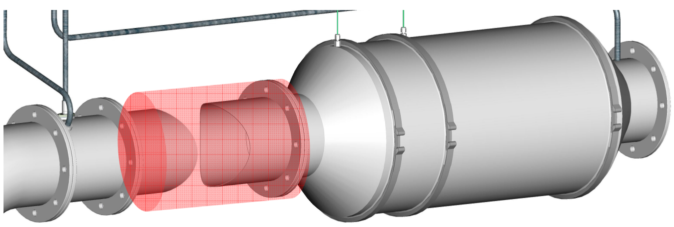


Figure 16 Hot region when using igniter

3.9 Air supply

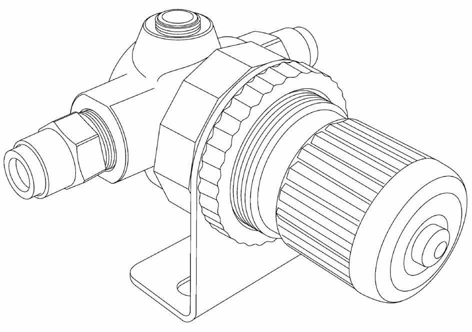


Figure 17 Air regulator

Function

During regeneration compressed air is used to atomize (spray) fuel over the DOC. It is important that the spray quality is a fine mist in order for the DOC to operate properly. A poor spray quality can lead to HC slip which may appear as white smoke or smell. Pressurized air is also used to periodically rinse the Injection manifold and nozzle from diesel. This is done in order to avoid diesel fuel carbonization and nozzle clogging between regenerations. Compressed air is taken from the vessel compressed air system, and connected to the injection manifold. If compressed air is not available a separate 24VDC electrical compressor can be fitted.

Installation - On-board air

Install the adjustable pressure regulator on the on-board pressurized air system and a 6mm hose (10m supplied in wiring harness kit) from the regulator to the Injection manifold air inlet port. The fitting on the Injection manifold is a 6mm pneumatic quick-fit with o-ring seal. Make sure the connections are tight. The air should be filtered and free from pollutants such as oil so air oilers should not be used. A water separator may be used but is not required. Requirements for the air compressor are as follows:

Figure 17 Compressor data recommendations

Capacity	Min 25 Nl/min at 1 bar absolute pressure
Tank volume	Min 150 l to reduce the number of compressor start up
Standard pressure	5-12 bar

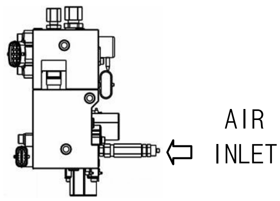


Figure 18 Manifold air port

3.9.1 Adjusting the air pressure

Connect the EmtecDiag utility to the Control cabinet. Make sure supply voltage and air pressure is turned on. Press the *Air valve* switch repeatedly until Time displays ≈ 60s. While the Air valve is open adjust the regulator so that the *Air pressure* reaches 1600±100 mbar.

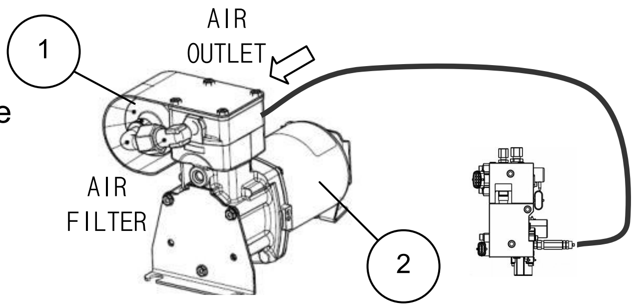


Figure 19 Compressor installation

Installation - Optional 24VDC compressor

Install a 6mm hose between the compressor and the Injection manifold inlet port. No pressure adjustment is required.

Maintenance

The air filter should be replaced every 3000 operating hours or when visibly dirty or damaged or in case of an air pressure problem.

Pos	P/N	Description	Qty
1	106623	Air filter	1
2	105225	Compressor	1

3.10 Control cabinet

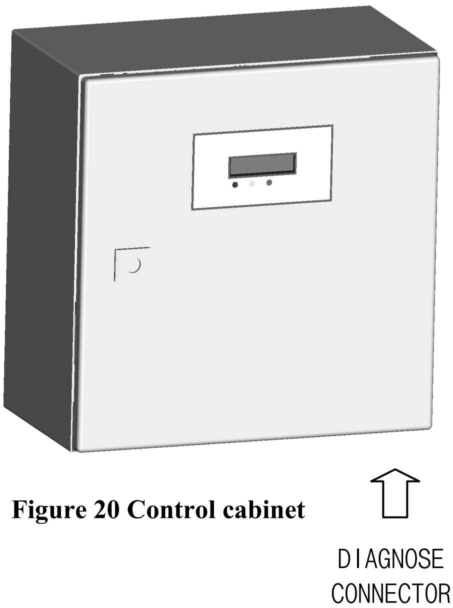


Figure 20 Control cabinet

Function
The control cabinet contains an electronic control unit (ECU), main switch, relays, 230/24V converter and a terminal block where all the wires from the sensors and power supply are installed. The control unit reads senor data from the engine and exhaust system, monitors the DPF and sensors operation and performs regeneration of the DPF when required

Installation
The control cabinet is wall mounted. M8-M12 bolts may be used. To ensure a safe 230VAC installation make sure that the cabinet is well grounded.

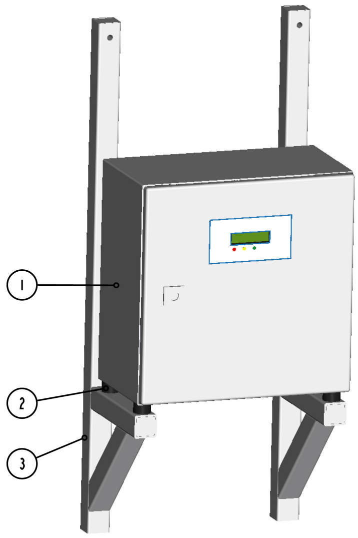


Figure 21 Control cabinet with optional mounting brackets

In case of severe vibrations, the cabinet can be mounted on 6 pcs of rubber bobbins (optional). If required, additional brackets (optional) may also be used.

Pos	P/N	Description	Qty
1	107407	Control cabinet	1
2	480-00-0753.0	Rubber bobbin	1
3	106110	Bracket	2

The control cabinet comes pre-installed with a 230VAC-24VDC voltage regulator. It is possible to re-route the cabinet for direct connection to 24VDC (battery). Should this be a requirement please contact technical department at STT Emtec AB for consultation.

Maintenance
The terminal junction screws in the electrical cabinet shall be checked and tightened every 24 mon. The diagnose connector on the cabinet is the main access point for fault mending.

3.11 Sensor assembly

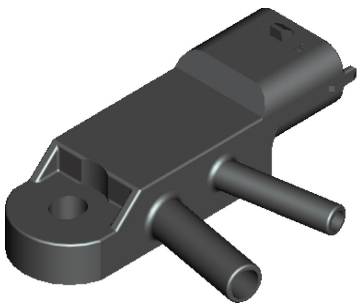


Figure 22 Sensor assembly

Function

In order to perform a DPF regeneration the control system requires information on the exhaust gas flow from the engine as well as temperatures and backpressure in the exhaust stream. Exhaust gas flow can be obtained by placing a MAF sensor on the TC inlet or by discrete measurement of Engine speed, boost air temp and boost air pressure. The latter is typically more straight-forward to install. In case of an electronically controlled engine the above mentioned signals can typically be derived from the J1939 (CAN) databus.

Temperature and pressure sensors on the exhaust system are for monitoring DPF soot load and controlling the regeneration process.

Installation

All electrical and pneumatic connections are subject to changes and differences can occur between applications. Make sure that the correct wiring diagram is used for the application at hand. The general wiring diagram details are given in Appendix 4.

Engine sensors

There are several methods to derive the required operating data from the engine. Below are a few typical methods whereof combinations are possible.

Due to variations between different applications always make sure that that sufficient and correct documentation are at hand before using any of the below methods. Detailed sensor installation requirements can be found in Appendix 13.

Method 1. Using the J1939 CAN data bus:

A twisted-pair cable is connected from the engine J1939 port to the Control cabinet. The control system can read Engine speed, Engine boost temperature and Engine boost pressure from the CAN bus. No further engine sensors must be fitted.

Method 2. Using discrete sensors

Should the engine lack some, or all, of the above mentioned sensors it is possible to mount a boost air pressure sensor hose and a boost air temperature sensor on the inlet manifold. An inductive sensor for Engine speed may be placed at the staring gear or at the alternator fan.

Method 3. Piggy-backing onto existing sensors:

If the engine has the above mentioned sensors but no CAN databus it is possible to configure the control system to read those sensors without affecting the engines. Engine speed can be picked up from the alternator at the W pin.

Method 4. Using a MAF sensor

When possible a mass airflow sensor may be inserted between the inlet air filter and the TC inlet. In this case no further engine sensors are required.

Exhaust temperature sensors (thermocouple type)

Two temperature sensors (3 when using the Igniter module) are mounted on the exhaust system. The mixer and catalyst is pre-assembled with fittings for the temperature sensors.

Install the sensors the following way:

1.) Slide the sensor into the fitting as far as it will go and then pull it out approx. 2 cm.
2.) Tighten the lock nut finger tight and then with a key ¾ of a turn, only.
   Further tightening will make the thermocouple break or wear out prematurely!
3.) The sensor can be bent up to 90º in any direction.
  The inside radius of the thermocouple must not be bent narrower than 15mm!

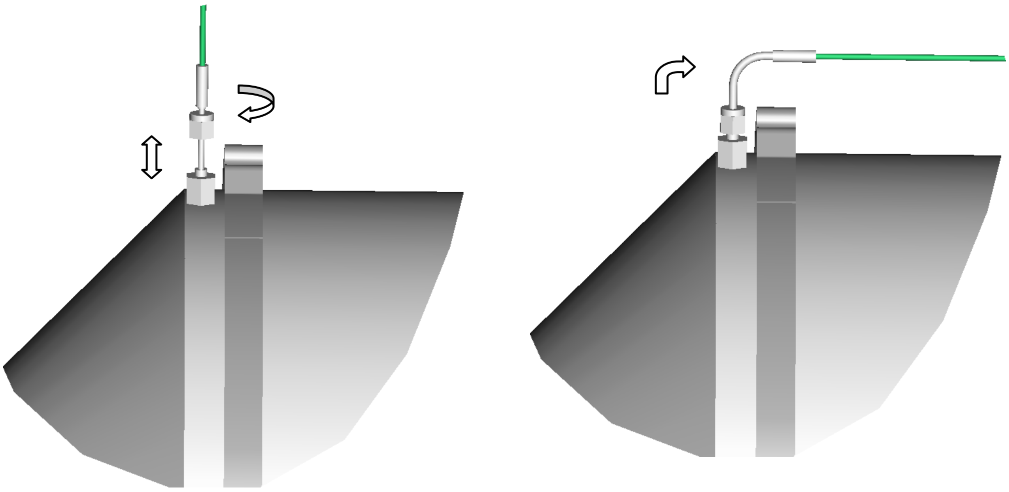


Figure 23 Temperature sensor installation

The same installation method is valid when installing the temperature sensor on the Igniter module (option)

Note! Do not try to straighten the thermocouple after it has been bent once.

The temperature sensors have a wire length of 1.5 meters, see figure 24 below.

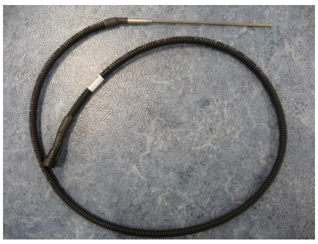


Figure 24 Temperature sensor

Pos	P/N	Description	Qty
1	107792	DOC inlet temp	1
2	107523	DOC outlet temp	1

Exhaust back pressure sensor

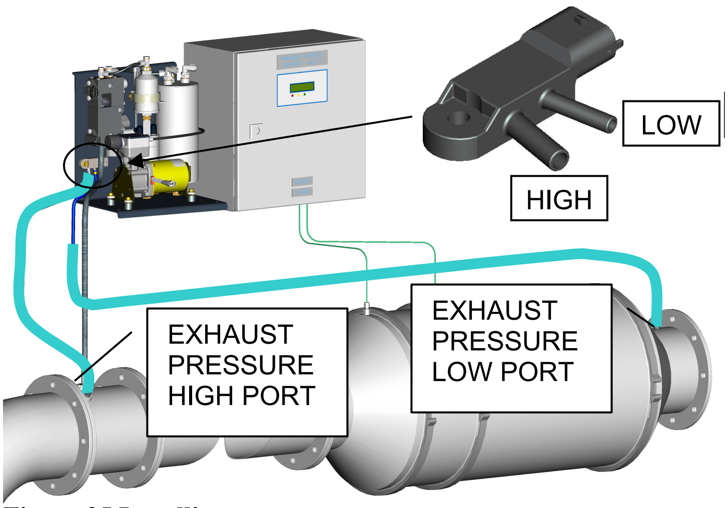


Figure 25 Installing pressure sensor

It is important to maintain a slope on the pressure lines from the sensor to the exhaust line ports in order to drain moist from the sensor hoses.

The high pressure hose (larger sensor port) is connects upstream the DPF assembly and the low pressure hose (smaller connection) connects downstream the DPF assembly.

The sensor must be mounted with the sensor ports facing downwards.

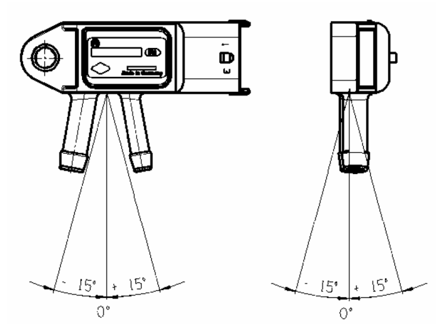


Figure 26 Pressure sensor mounting direction

Apply anti-seize (high temperature graphite paste) on the thread of the mounting boss and on the hose end. Install the threaded end of the metal hose into the mounting boss. The other end should be connected with the hose routed to the sensor. The length of the metal hose is 1 m.

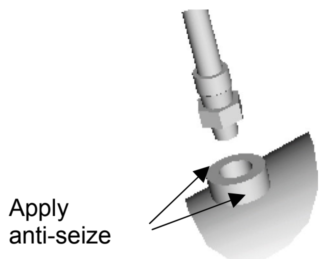


Figure 27 Pressure sensor mounting boss

Pos	P/N	Description	Qty
1	103407	Prs sensor	1

Note! Ensure that the exhaust back pressure hoses are routed uphill from the exhaust pipe to the pressure sensor to enable drainage of condensed water.

Engine running

A 24VDC (relay) input from the engine or engine controller, indicating that the engine is running and supplying SAE-J1939 (CAN) data signals when applicable, is required for the system to perform regeneration and system diagnose

System alarm

In case of an active trouble code with an Alarm severity level (corresponding to a red lamp on the diagnose display) a relay output that may connect to on-board instrumentation will be activated. Relay properties are 6A/250VAC. Alarms are cleared from the display or the Diagnostic tool (PC)

Figure 28 System alarm example

3.12 Wiring harness

Figure 29 Wiring harness

Function

The wiring harness electrically connects all system components to the control cabinet, including the engines J1939 (CAN) databus when applicable.

Installation

All wires come pre-fabricated at 10m length with the appropriate connector fitted at one end. Cables are marked at the connector end; in Appendix 2 *Marine CCT wiring harness* the correct terminals for each cable can be found. Install the wires starting at the sensor/actuator end and then cut off the surplus wire at the control cabinet. Dismantle the wire and cut away the shield, which does not have to be connected, and make sure you leave at least 300mm of wire to route inside the cabinet. Use the supplied cable sticker to place a name tag on each cable in or near the cabinet. Strip of the cable end and use boot-strap ferrules on each wire before securing the wire to the respective terminal. Remember to tighten each cable grommet after installation.

Note! Make sure that all wires are well protected from chemicals and excessive heat and that there is no strain on the connectors and sensors. Maximum temperature allowed is +70°C

Fill out the yellow *System* field in Appendix 2 with vessel and project information

System	**CCT*marine***	Proj ####	Date	2012-05-03
Detail ref.	Leif Högberg			
Revision ref.	**APPENDIX 2**			
Vessel	**Template 230VAC**			

Figure 30 Wiring sheet header

The control cabinet has 8 terminal groups marked A-H. They are referenced in Appendix 2 under *Wire routing*. Terminals are grouped according to function.

Terminal group	**Nr of terminals**	**Function**
A	3	230VAC or 24VDC power supply
B	3	24VDC output to system actuators
C	3	0VDC output to system actuators
D	10	0VDC output to system sensors
E	5	5VDC output to system sensors
F	9	Databus connections (CAN, RS232)
G	20	Sensor inputs (analog, digital)
H	8	Actuator outputs

Figure 31 Control cabinet pinout

The Wire pinout chart show the routing for each cable.

No	Label (from)	Wire type	Wire routing 1	2	3	4	5	6	7	8	9	10	Function
1	EBP	2x2x0.75	D1 0V	E1 5V	G4 A4								Pressure drop over DOC+DPF
2	PMP	2x2x0.75	C1 VSS										CCT fuel pump power supply
3	RUN	2x2x0.75	G19 RN+										Engine running contact
4	CAN	2x2x0.75	C3 VSS										Engine J1939 CAN bus
5	HTR	2x2x0.75	B3 24V	O2									CCT igniter power supply
6	THT	2x2x0.75	D2 0V	G5 A5									Temperature downstream igniter
7	MIT	2x2x0.75	D4 0V	G7 A7									Engine boost air temp
8	MAP	2x2x0.75	D3 0V	E2 5V	G6 A6								Engine boost pressure
9	RPM	2x2x0.75	D9 0V	G16 D1									Engine speed
10	EGR	2x2x0.75	C2 VSS	B1 24V	F5 C1-	F3 C1+							EGR valve control
11	TPS	2x2x0.75	D8 0V	E4 5V	G11 A11								Engine load
12	PIN	2x2x0.75	D5 0V	E3 5V	G8 A8								Pressure drop over engine inlet filter
13	TIN	2x2x0.75	D6 0V	G9 A9									Engine inlet air temperature
14	CWT	2x2x0.75	D7 0V	G10 A10									Engine coolant water temperature
15	INJ	6x2x7.75	D10 0V	E10 5V	G21 [illegible]	G23 O3	G24 O4	G1 A1	G2 A2	G3 A3	B2 24V	G25 24S	HC dosing unit
16	T_DOC_I	2x0.22/K	G12 T1-	G13 T1+									DOC inlet temperature
17	T_DOC_O	2x0.22/K	G14 T2-	G15 T2+									DOC outlet temperature
18	PWR	4G1.5	A1 GND	A2 230V	A3 230V								CCT supply voltage

Cable name shall match this label

Route the wire to these terminals

Figure 32 Wiring sheet pinout

Match the name on each cable to the name in column *Label (from)* and run it to the correct terminal according to column *Wire routing.* Columns *Wire type* and *Function* provide additional information on the kind of cable used and the purpose of the connection.

The *Wire colour* is an aide for colour codes

Nr	1	2	3	4
2x0.22/K	White	Green		
4G1.5	Green/ Yellow	Black	Brown	White

Figure 33 Pinout sheet colours

Match the colours to the wire numbers according to this table.

The *Engine control wiring* provide additional information on where to connect the interface cables for the engine.

Engine/CAN and power supply connection				
Colour	SCR cab	VP cab	Function	Location
1 (white)	CAN1		24VDC	(in VP ctrl cabinet on bb side of engine, on lowest relay)
2 (blue)	CAN2		DIG2/Eng running	(in VP ctrl cabinet on bb side of engine, on lowest relay)
3 (white)	CAN3	PIN 4	CAN-	(in VP ctrl cabinet on bb side of engine, on lowest terminal row)
4 (blue)	CAN4	PIN 5	CAN+	(in VP ctrl cabinet on bb side of engine, on lowest terminal row)
(gn/br)	24VDC		230VAC	(in fuse floor cabinet to the right of eng room ladder)

Figure 34 Pinout sheet engine info

CAN wires are for interfacing the SAE-J1939 databus, when applicable, and the RUN wires are for the engine running and alarm signals respectively.

Maintenance

There are no particular maintenance instructions for the wiring harness. Continuity and/or short circuit check should be performed in the event of sensor or actuator trouble codes.

4 DPF dimensioning and backpressure

Dimensioning

The STT CCT*marine* system is a modular system based on the same type of key components for each engine size. Different DPF and DOC catalyst diameters and lengths are used for the different configurations. See appendix 6 for more information on canning size and weight.

3 module sizes are available:

Module size	Diameter
1	15”
2	11.25”
3	9”

The size of the DPF and DOC assembly is determined by engine specifications and operation (operating cycle).

This recommendation table is based on the rated power of the engine.

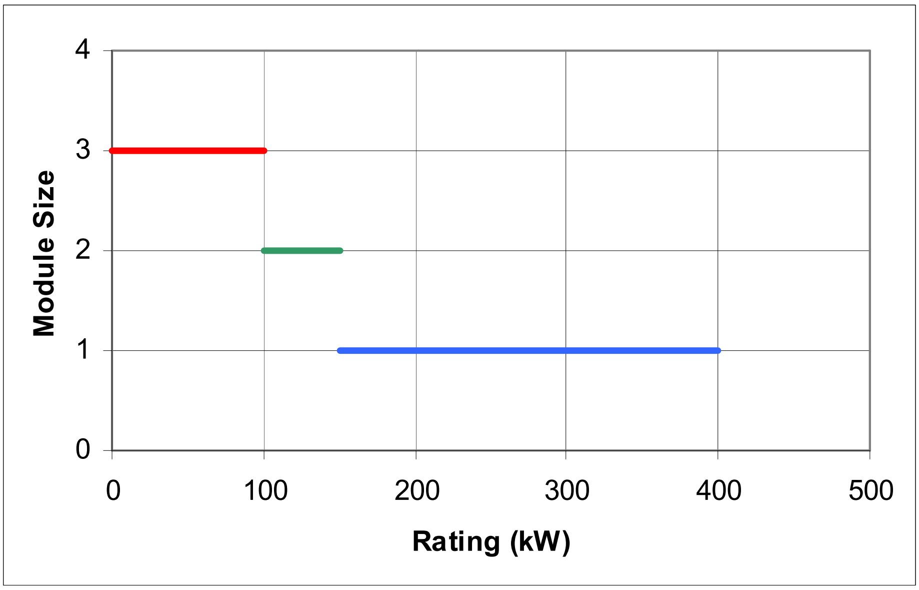


Figure 35 Power range

Engine specifications include, but are not restricted to, exhaust temperature profile, soot production and maximum allowable exhaust backpressure. The typical operating conditions (load points) also impact on system selection.

Backpressure
The size of the DPF and the engine power and exhaust temperature profile determines the resulting pressure drop over the DPF.

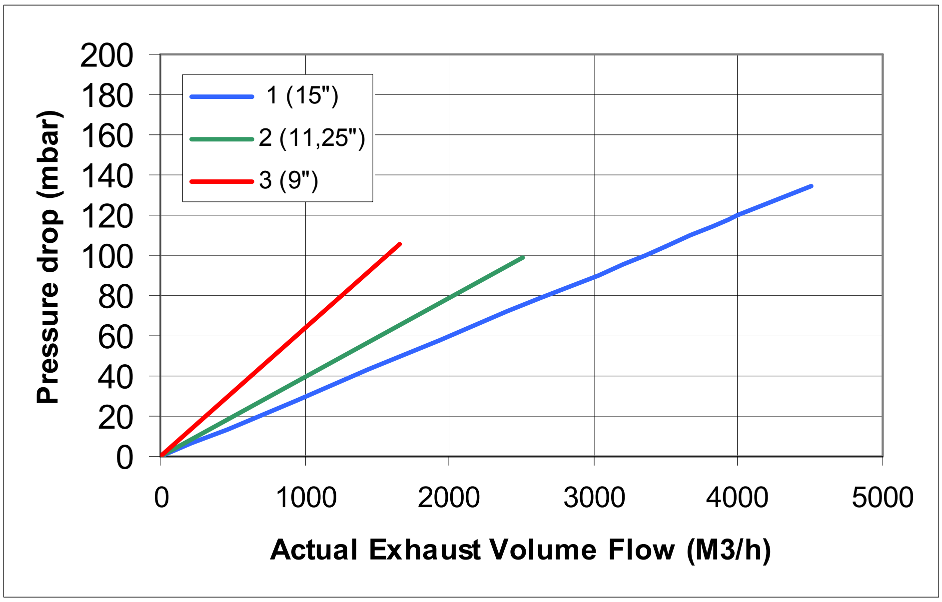


Figure 36 Exhaust backpressure

Typical exhaust mass flow rates versus rated engine power together with the corresponding volume flows at exhaust temperatures from 300 to 500°C.
Note that this data is a guideline only and that data from the engine manufacturer are to be used to determine the proper DPF configuration.

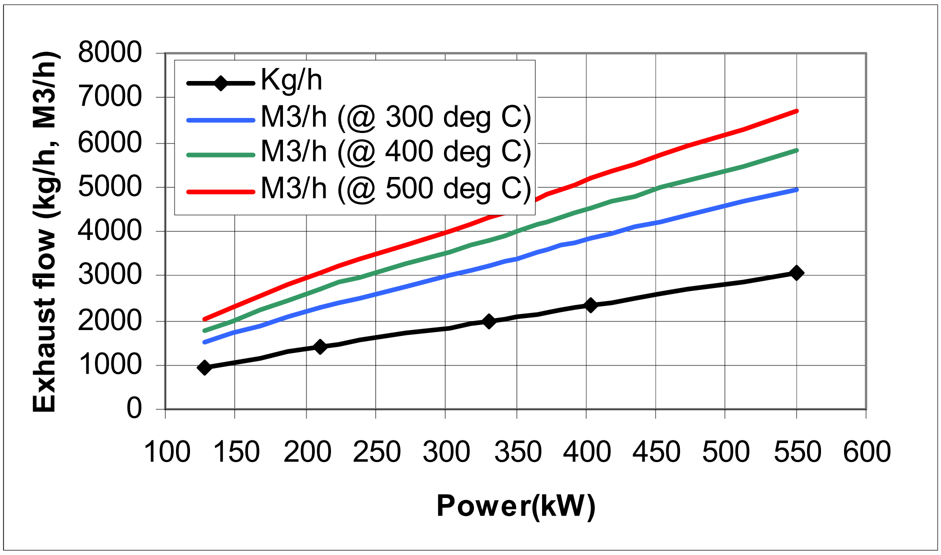


Figure 37 Volumetric flow

5 System monitoring

5.1 EmtecDiag

A maintenance tool for the vessel operator is available. It is a PC software called EmtecDiag and features system monitoring and trouble code reading. This is the primary choice for on-board fault mending. No changes can be made to the CCT*marine* control system using this tool.

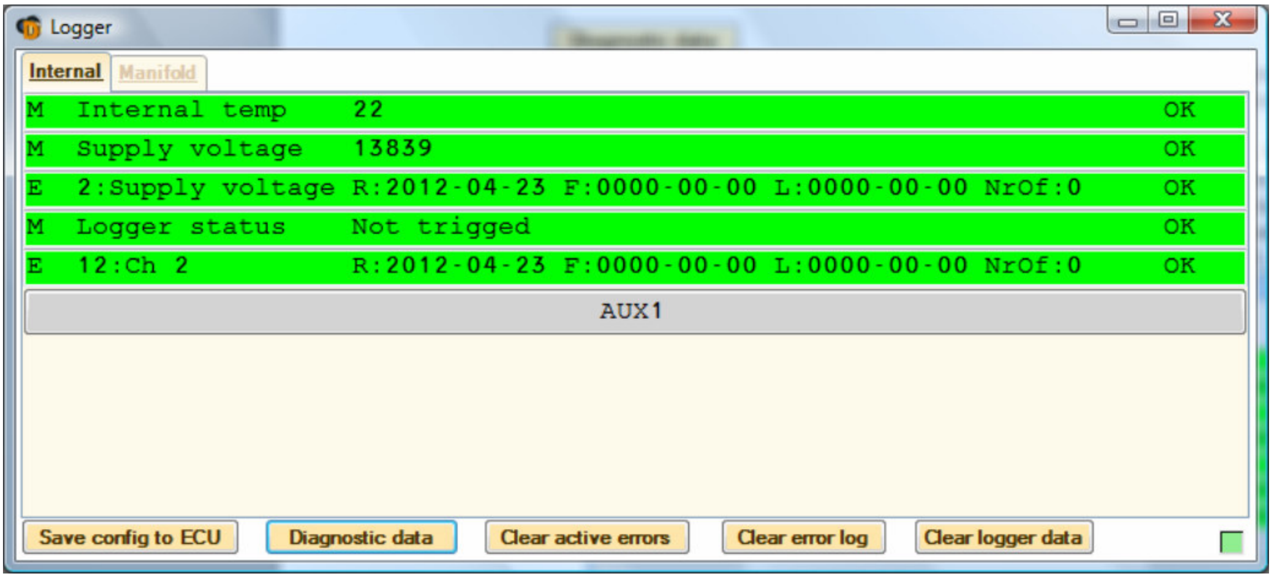


Figure 38 EmtecDiag desktop

5.2 Modem

A modem for remote monitoring of the CCT*marine* control system is available. The modem connects to the same diagnose port as the PC diagnostic tool. The modem and the Diagnose tool can not be connected at the same time. Two communication cable lengths are available: 1m and 10m. The antenna must be installed in a location where good radio coverage can be obtained, i.e. typically not in the engine room. A SIM-card setup for CSD data communication must be purchased and installed in the modem, see Appendix 10 for details on obtaining the SIM card.

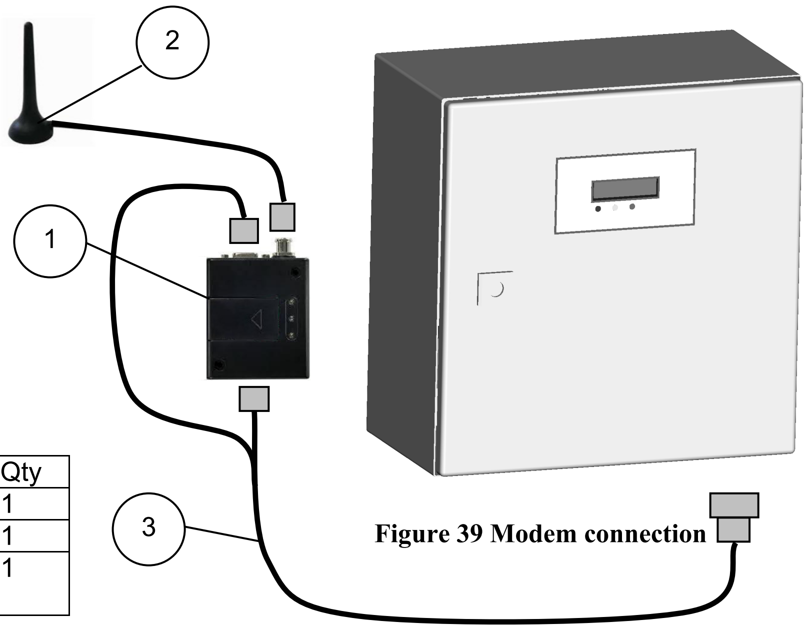


Figure 39 Modem connection

Pos	P/N	Description	Qty
1	108761	GSM modem	1
2	105212	Antenna mag. foot	1
3	108224	Comm cable 1m	1
alt.	108782	Comm cable 10m	

5.3 Cabinet display

A diagnostic display (see figure 40 below) is mounted at the front of the CCT*marine* control cabinet. This display shows the current state of the system. If an error occurs, the display is showing an error code number with an error code description. The display has three LED's *(Light Emitting Diode)*, System On (green), warning (yellow) and alarm (red).

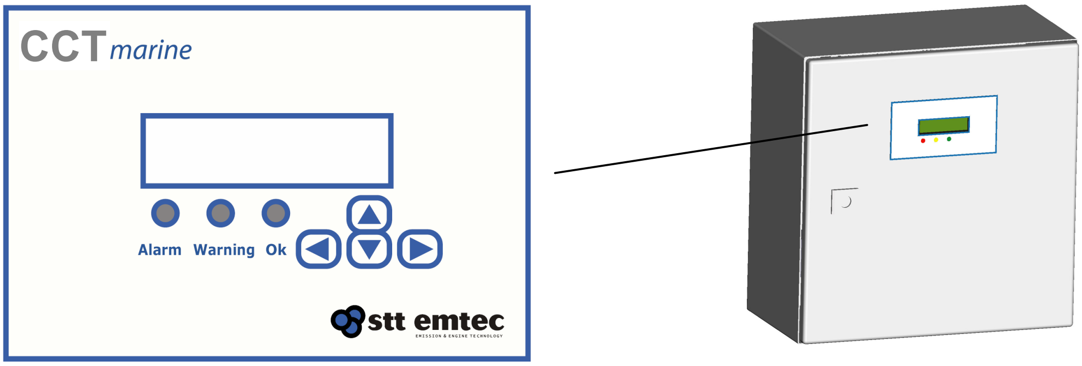


Figure 40 Diagnose display

5.4 Extra display

In addition to the display on the control cabinet front an extra discrete display may be fitted in parallel. This display will show the same information as the cabinet display.

- Dimensions: 117mm x 79mm x 24mm
- IP classification: IP20
- Temperature range: -20ºC-+70ºC

Pos	P/N	Description	Qty
1	108330	LCD assy	1

Figure 41 Discrete display

The display cable is supplied by STT. Should a different quality be required it must meet the following specification:

- Length (max) 30m (to ctrl cabinet)
- nr of conductors (min) 3
- insulation (min) 50V
- conductor area (min) 0.5mm2
- capacitance (max) 300pF/m
- cable shield not required
- twisted pair not required

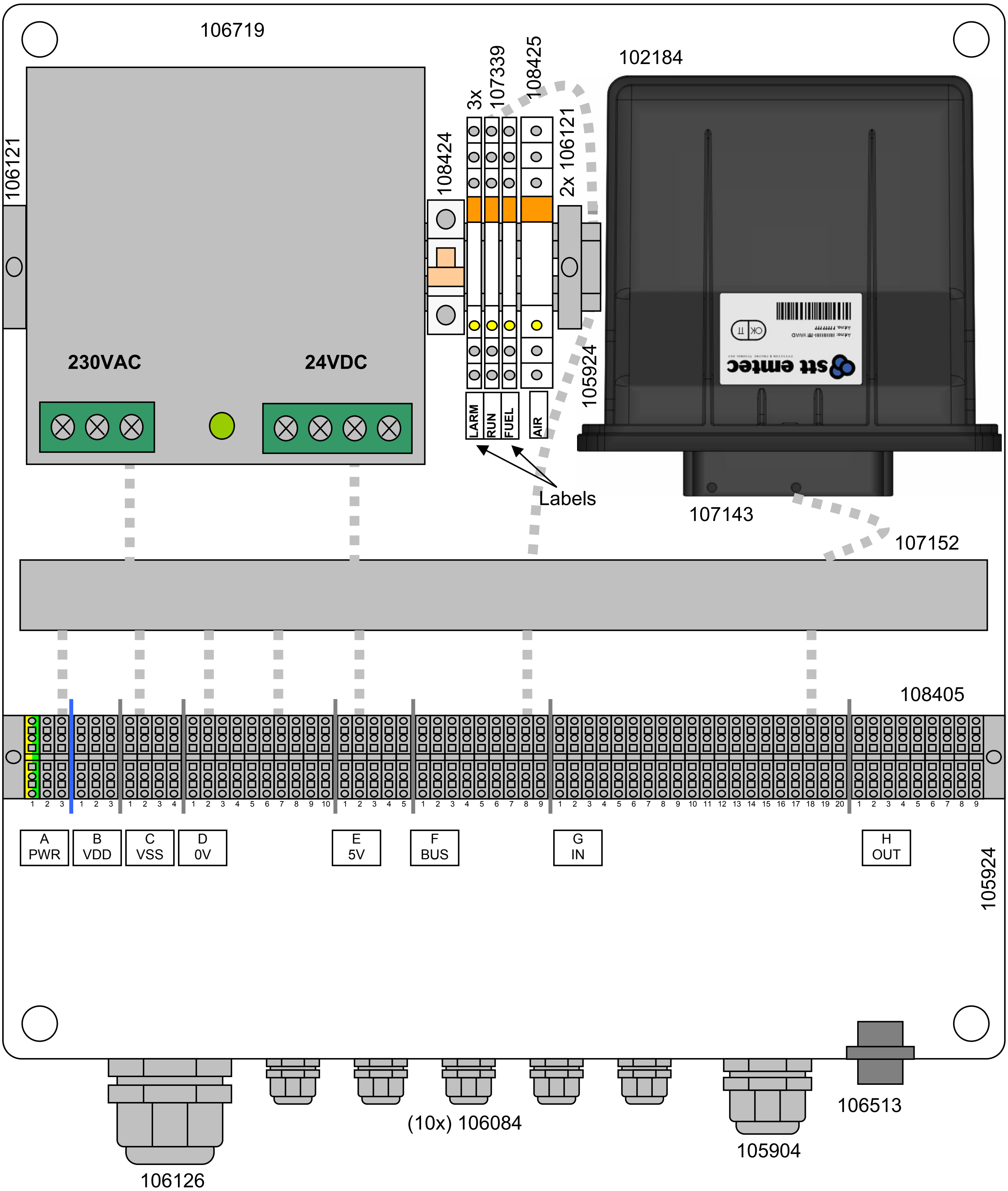
Appendix 1 Electrical installation and reference diagrams

After installation any changes made to the wiring installation, such as the location of engine CAN and RUN signals, shall be noted on the pinout sheet and returned to STT Emtec.

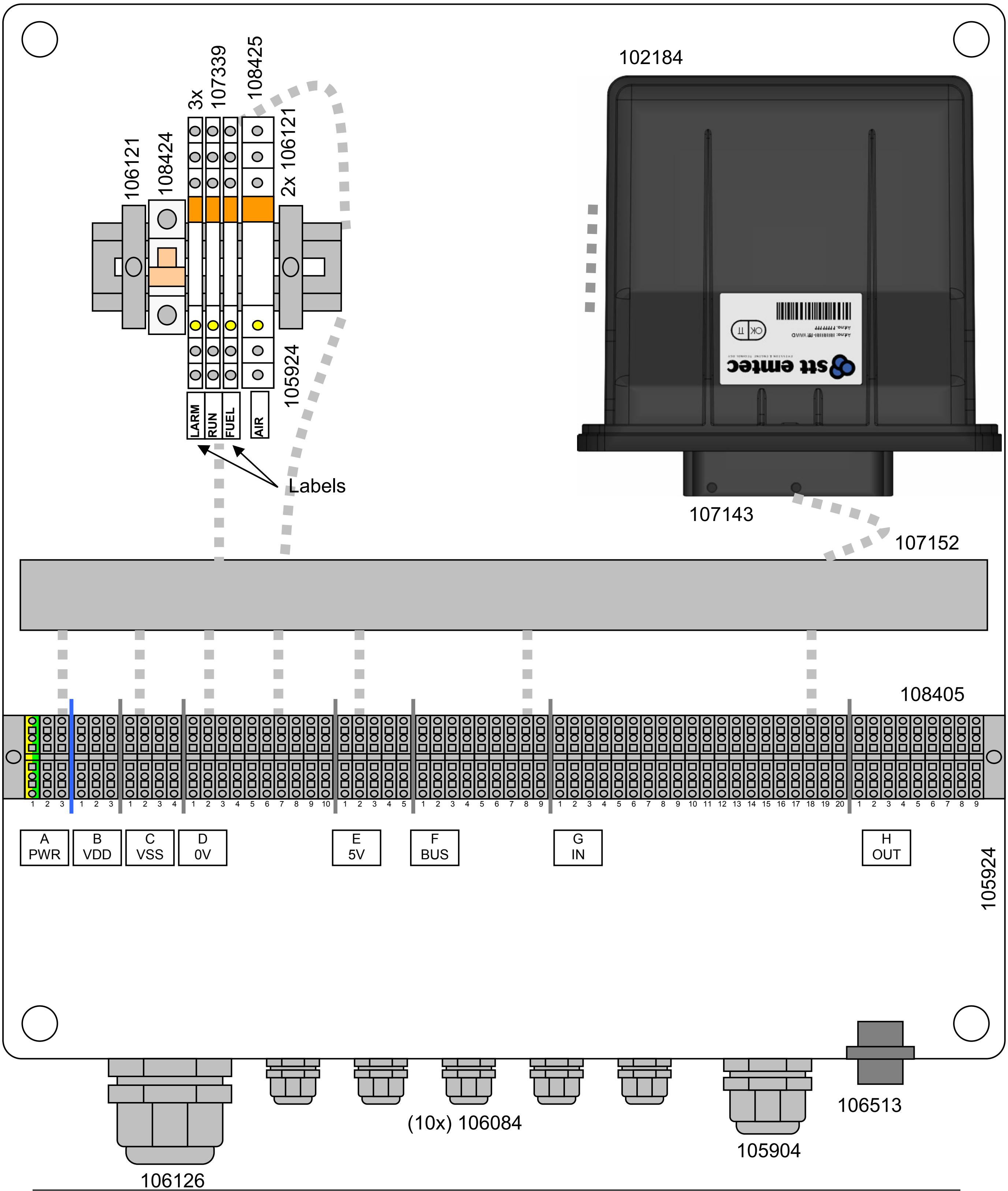
Note! Make sure that you use the appropriate pinout for your installation!

Note! Different wire colours may occur. Wire numbering takes precedence over wire colours!

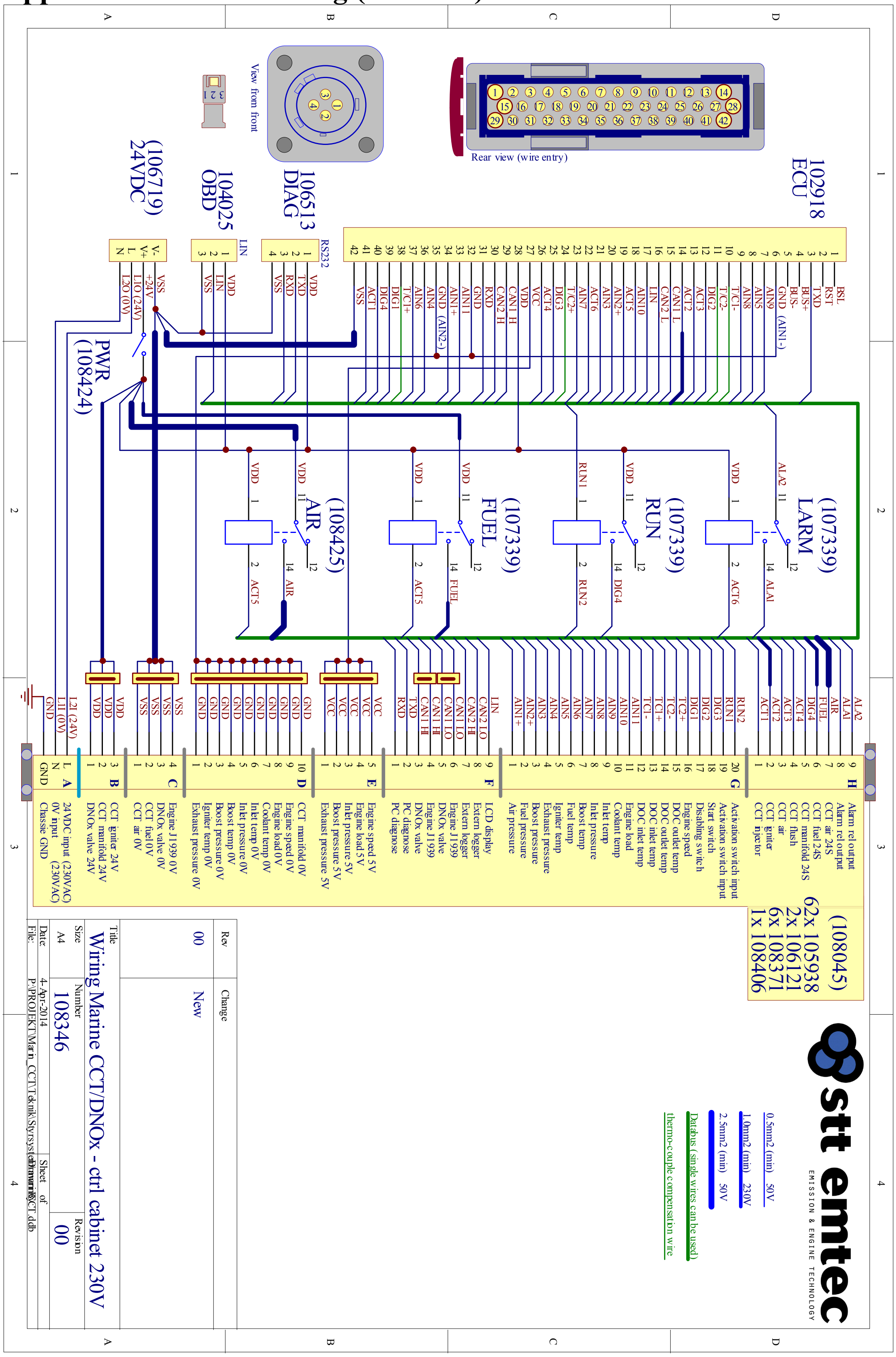
Appendix 1 Cabinet interior (230VAC)



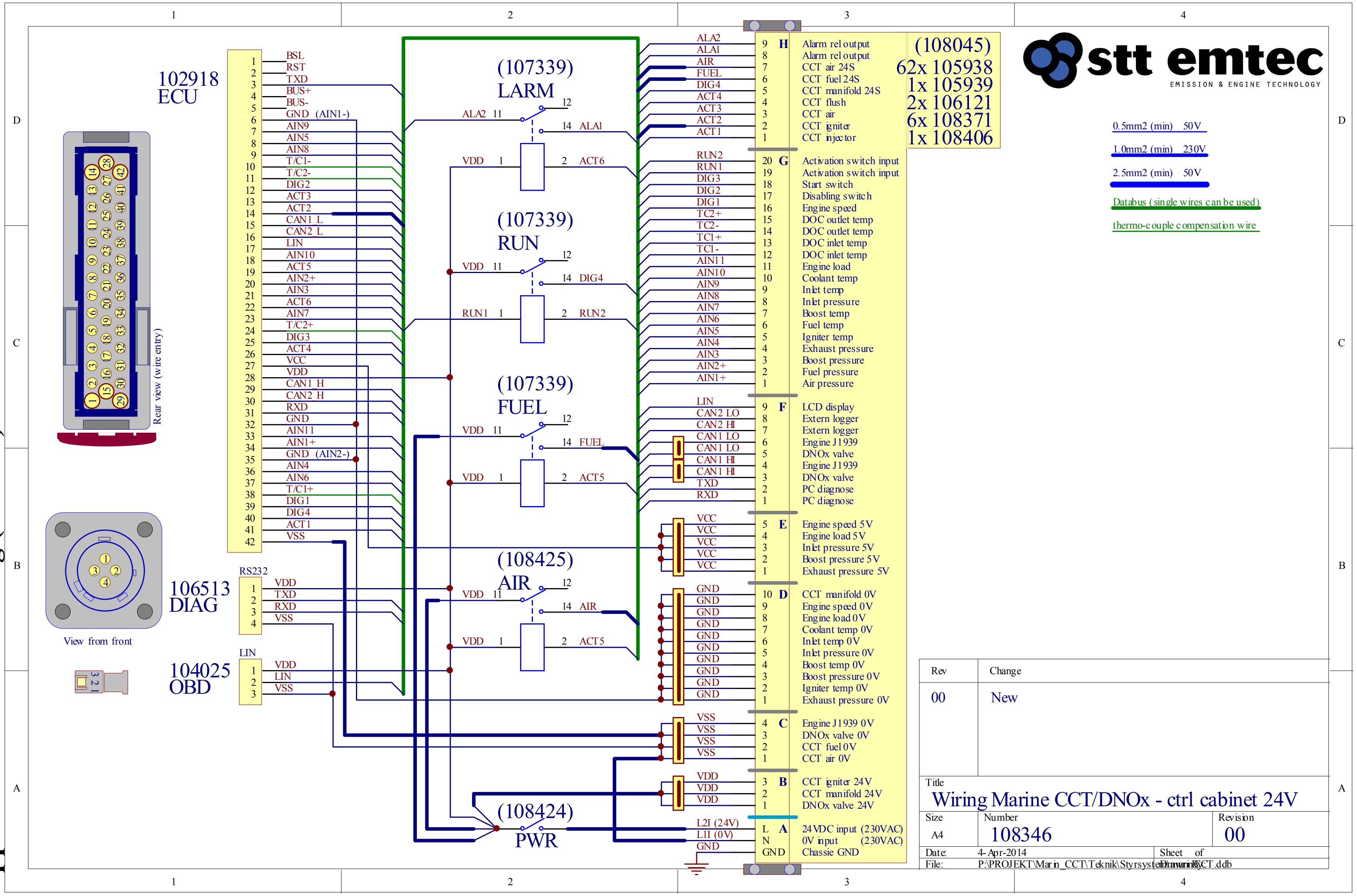
Appendix 1 Cabinet interior (24VDC)



Appendix 1 Cabinet wiring (230VAC)



Appendix 1 Cabinet wiring (24VDC)

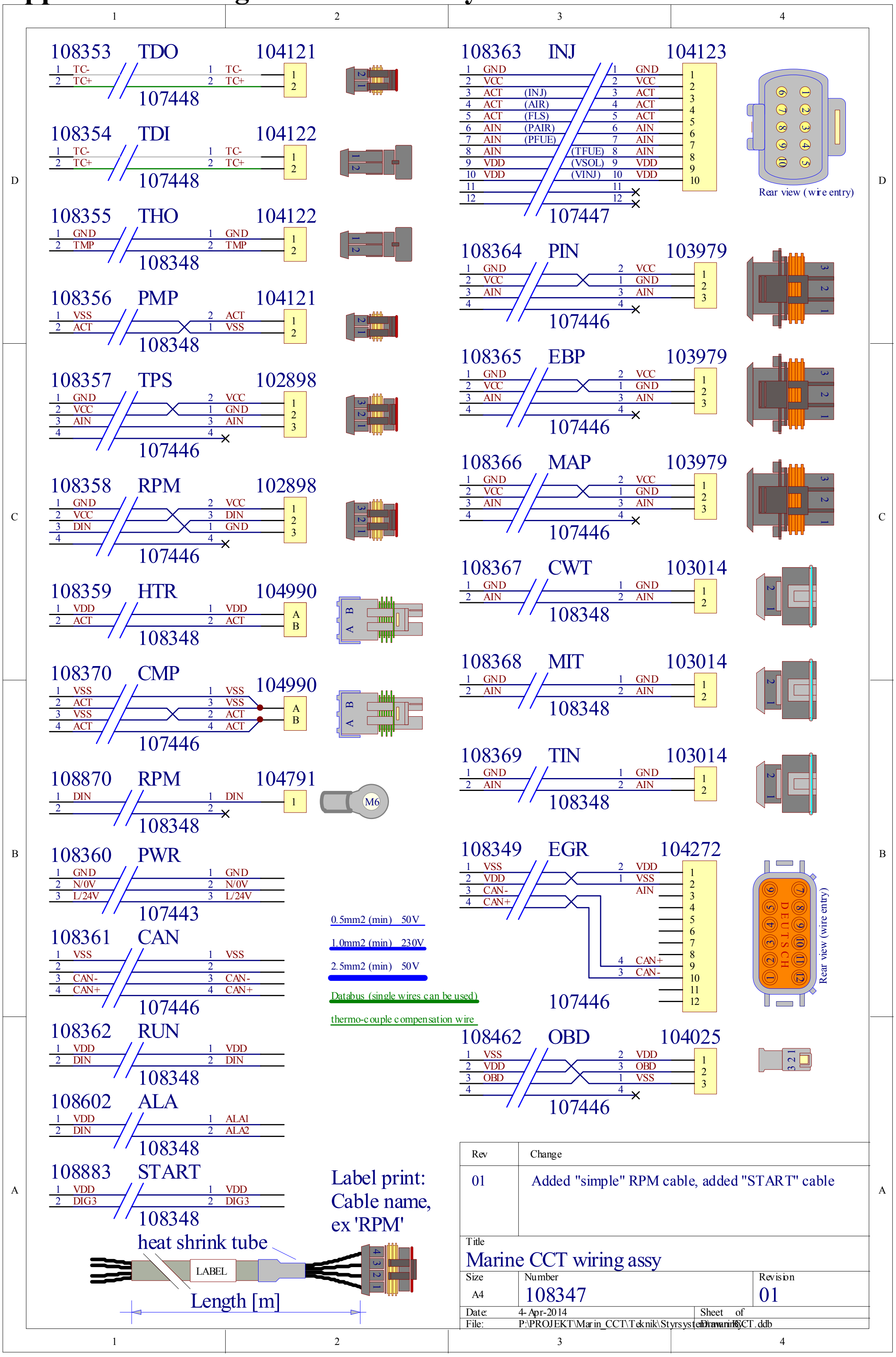


Head office: Sundsvall
Org.nr: 55 62 05 – 2927
VAT ID: SE556205292701
ISO-cetrifikat nr: 15627

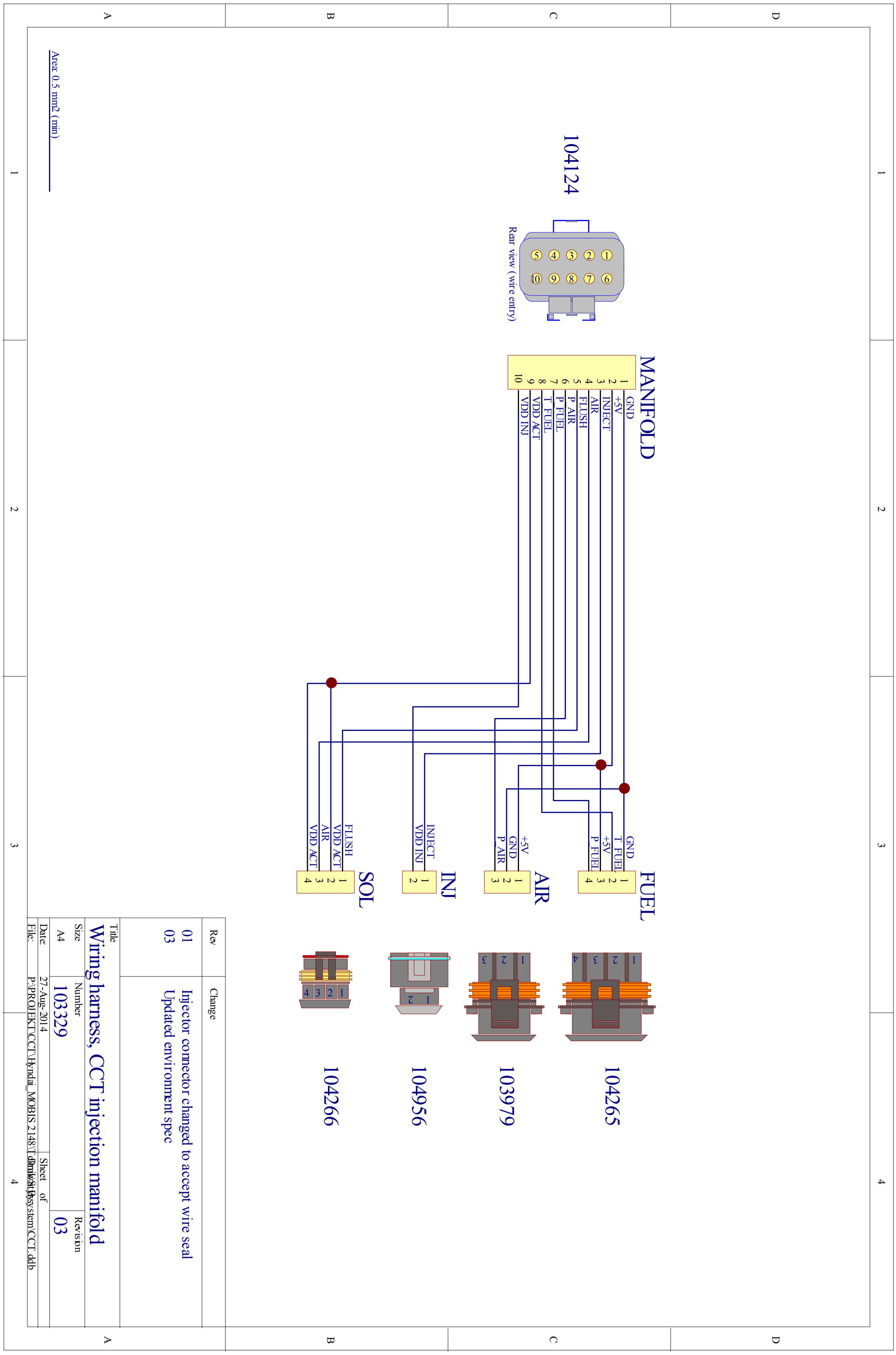
Tel: +46 (0)60-64 10 40
Fax: +46 (0)60 64 10 45
e-mail: info@sttemtec.com
Internet: www.sttemtec.com

STT Emtec AB (pbl)
Kontorsvägen 9
SE-852 29 SUNDSVALL
SWEDEN

Appendix 1 Wiring harness assembly



Appendix 1 Injection manifold wiring



Appendix 1 wiring installation (230VAC)

System	**CCTmarine**	Proj #### Date	2015-08-11
Detail ref.	Leif Högberg	stt emtec EMISSION & ENGINE TECHNOLOGY	
Revision ref.	**APPENDIX 4**		
Vessel	**Template 230VAC**		

Table 1 Wire pinout

No	Label (from)	Wire type	Wire routing 1	2	3	4	5	6	7	8	9	10	Function
1	EBP	2x2x0.75	D1 0V	E1 5V	G4 A4								Pressure drop over DOC+DPF
2	PMP	1x2x0.75	C2 VSS	H6 24S									CCT fuel pump power supply
3	RUN	1x2x0.75	G19 RN+	G20 RN-									Engine running contact
4	CAN	2x2x0.75	C4 VSS		F6 C1-	F4 C1+							Engine J1939 CAN bus
5	HTR	1x2x0.75	B3 24V	H2 O2									CCT igniter power supply
6	THO	1x2x0.75	D2 0V	G5 A5									Temperature downstream igniter
7	MIT	1x2x0.75	D4 0V	G7 A7									Engine boost air temp
8	MAP	2x2x0.75	D3 0V	E2 5V	G3 A3								Engine boost pressure
9	RPM	1x2x0.75	D9 0V	G16 D1									Engine speed
10	TPS	2x2x0.75	D8 0V	E4 5V	G11 A11								Engine load
11	START	1x2x0.75	B1 24V	G18 D3									Start switch
12	OBD	2x2x0.75	C3 VSS	B3 24V	F9 LIN								External LCD display
13	INJ	6x2x0.75	D10 0V	E5 5V	H1 O1	H3 O3	H4 O4	G1 A1	G2 A2	G6 A6	B2 24V	H5 24S	HC dosing unit
14	TDI	2x0.22/K	G12 T1-	G13 T1+									DOC inlet temperature
15	TDO	2x0.22/K	G14 T2-	G15 T2+									DOC outlet temperature
16	PWR	3G1.5	A1 GND	A2 0VAC	A3 230VAC								CCT supply voltage

Table 2 Wiring colours

Nr	1	**2**	**3**
2x0.22/K	White	Green	
3G1.5	Gn/Yw	Blue	Brown

Table 3 Engine control Wiring

Pin	CC	Engine/Vessel control	Location
CAN 1	C4	0V (from engine)	Engine control cabinet
CAN 2	N/C	N/C	-
CAN 3	F6	CAN LO	Engine control cabinet
CAN 4	F4	CAN HI	Engine control cabinet
RUN 1	G19	From Engine running relay contect	Engine control cabinet
RUN 2	G20	From Engine running relay contact	Engine control cabinet
RUN 3	H8	To Alarm relay solenoid	Engine control cabinet
RUN 4	H9	To Alarm relay solenoid	Engine control cabinet

Appendix 1 wiring installation (24VDC)

System	CCTmarine	Proj #### Date	2015-08-11
Detail ref.	Leif Högberg		
Revision ref.	**APPENDIX 4**		
Vessel	**Template 12-24VDC**		

Table 1 Wire pinout

No	Label (from)	Wire type	Wire routing 1	2	3	4	5	6	7	8	9	10	Function
1	EBP	2x2x0.75	D1 0V	E1 5V	G4 A4								Pressure drop over DOC+DPF
2	PMP	1x2x0.75	C2 VSS	H6 24S									CCT fuel pump power supply
3	RUN	1x2x0.75	G19 RN+	G20 RN-									Engine running contact
4	CAN	2x2x0.75	C4 VSS		F6 C1-	F4 C1+							Engine J1939 CAN bus
5	HTR	1x2x0.75	B3 24V	H2 O2									CCT igniter power supply
6	THO	1x2x0.75	D2 0V	G5 A5									Temperature downstream igniter
7	MIT	1x2x0.75	D4 0V	G7 A7									Engine boost air temp
8	MAP	2x2x0.75	D3 0V	E2 5V	G3 A3								Engine boost pressure
9	RPM	1x2x0.75	D9 0V	G16 D1									Engine speed
10	TPS	2x2x0.75	D8 0V	E4 5V	G11 A11								Engine load
11	START	1x2x0.75	B1 24V	G18 D3									Start switch
12	CMP	2x2x0.75	C1 VSS	H7 AIR	C1 VSS	H7 AIR							CCT air compressor power supply
13	OBD	2x2x0.75	B3 24V	C3 D3	F9 LIN								External LCD display
14	INJ	6x2x0.75	D10 0V	E5 5V	H1 O1	H3 O3	H4 O4	G1 A1	G2 A2	G6 A6	B2 24V	H5 24S	HC dosing unit
15	TDI	2x0.22/K	G12 T1-	G13 T1+									DOC inlet temperature
16	TDO	2x0.22/K	G14 T2-	G15 T2+									DOC outlet temperature
17	PWR	3G1.5	A1 GND	A2 0V	A3 24V								CCT supply voltage

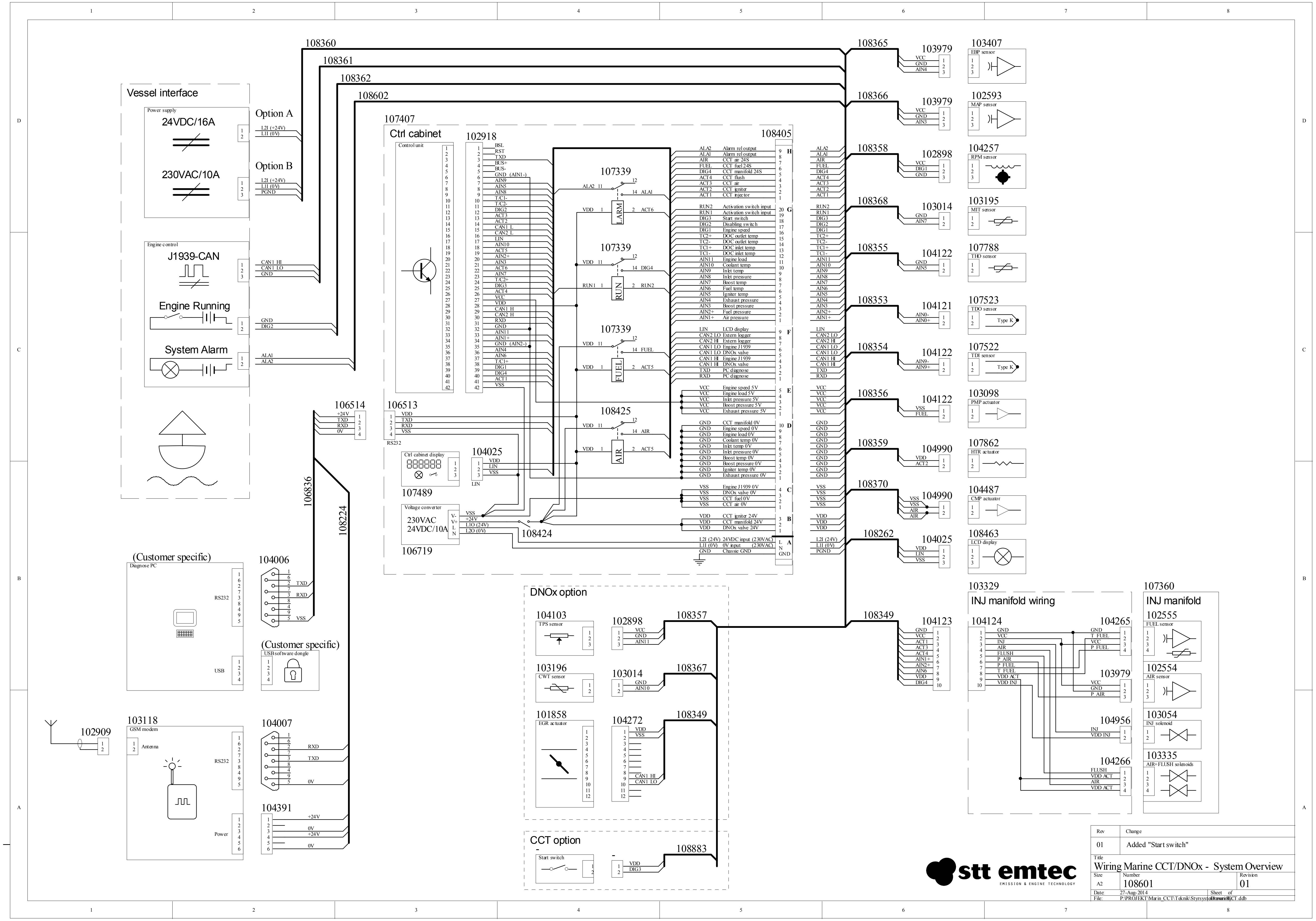
Table 2 Wiring colours

Nr	1	2	3
2x0.22/K	White	Green	
3G1.5	Gn/Yw	Blue	Brown

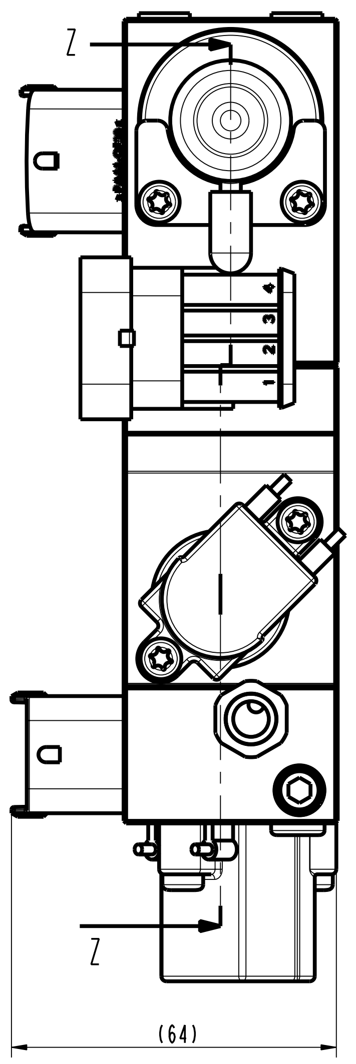
Table 3 Engine control Wiring

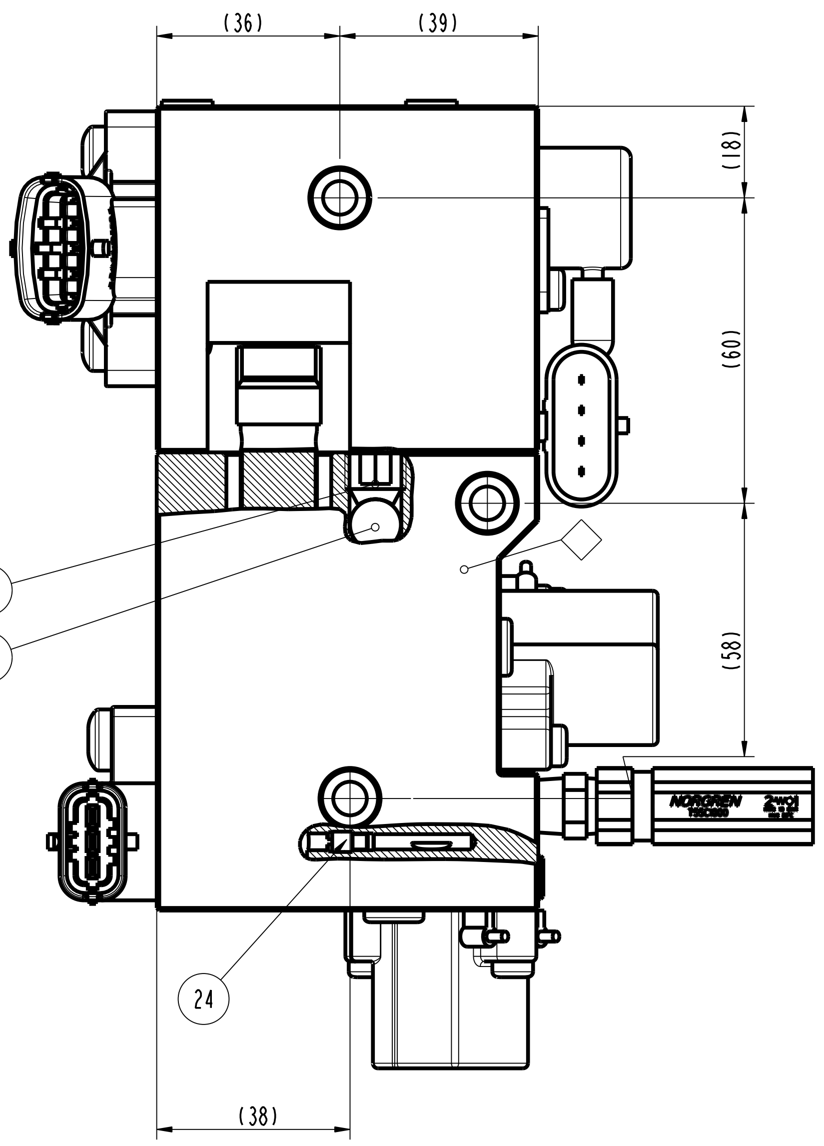
Pin	CC	Engine/Vessel control	Location
CAN 1	C4	0V (from engine)	Engine control cabinet
CAN 2	N/C	N/C	-
CAN 3	F6	CAN LO	Engine control cabinet
CAN 4	F4	CAN HI	Engine control cabinet
RUN 1	G19	From Engine running relay contect	Engine control cabinet
RUN 2	G20	From Engine running relay contact	Engine control cabinet
RUN 3	H8	To Alarm relay solenoid	Engine control cabinet
RUN 4	H9	To Alarm relay solenoid	Engine control cabinet

Appendix 1 Overview electrical schematic drawing



Appendix 2 Mechanical installation and reference drawings





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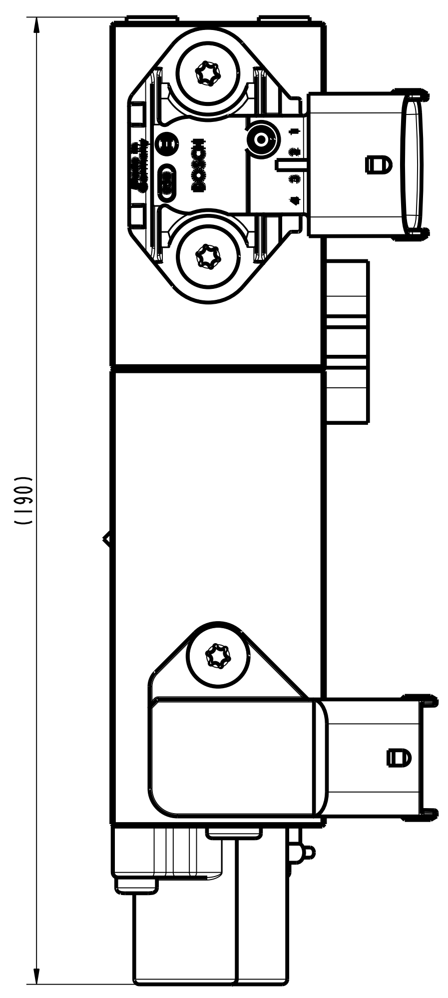

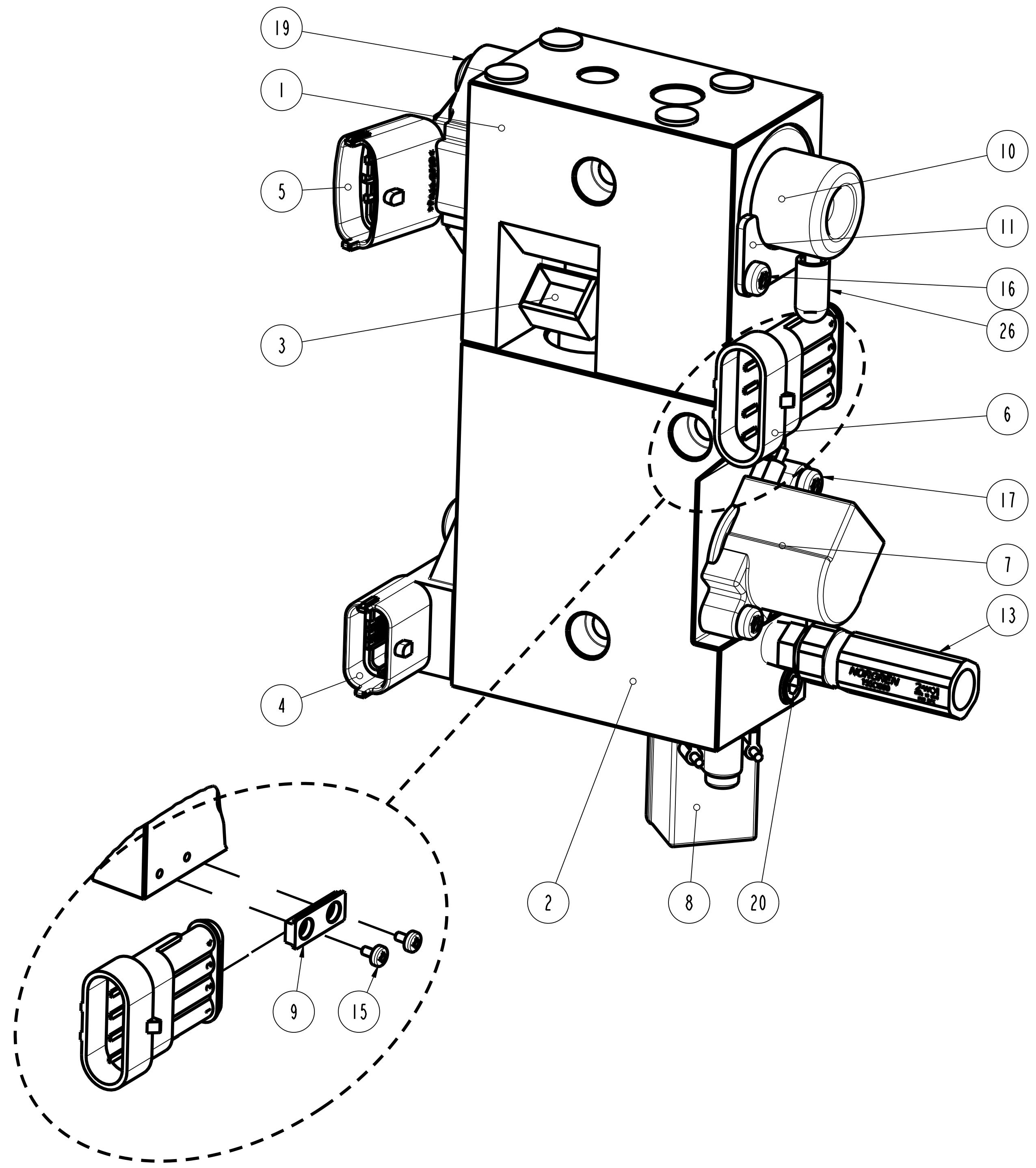

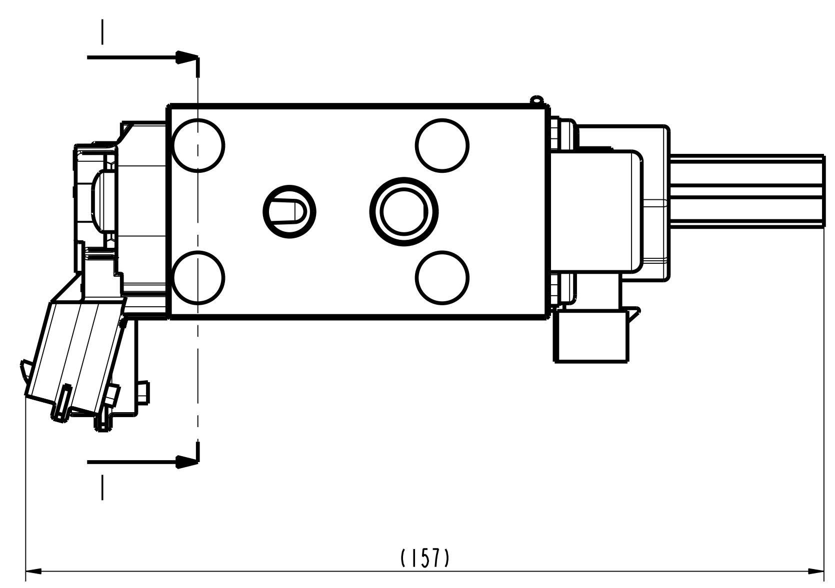

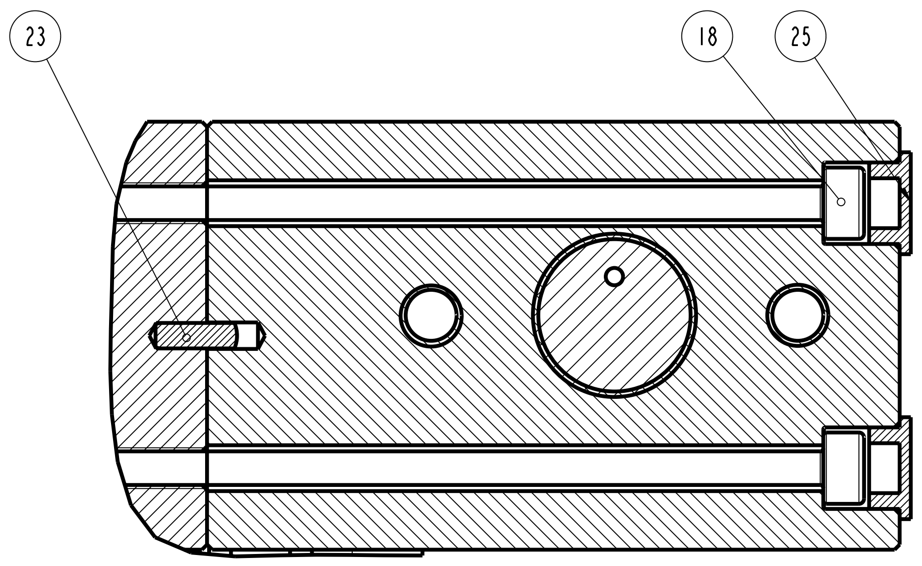

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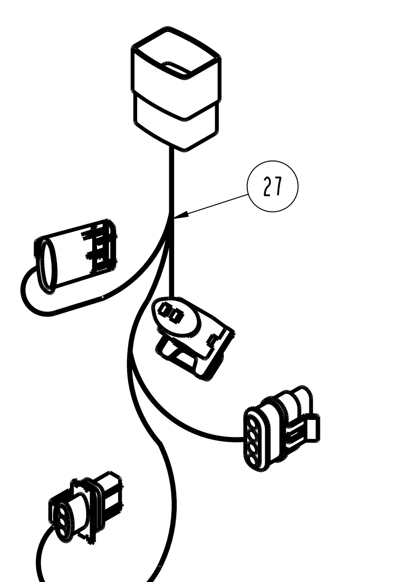


WIRING HARNESS

Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.
27	1	WIRING HARNESS	-	-	103329
26	1	CAP, RUBBER	-	-	104416
25	4	PLUG, PLASTIC	-	-	103263
24	1	JET 090	-	-	103190
23	2	PARALLEL PIN	-	-	102339
22	1	SCREW SK6SS M12x1,75 L=10	-	-	104903
21	1	BALL Ø10	-	-	104902
20	1	PLUG R1/8 BSP w SEALING	-	-	105531
19	3	SCREW MRT M6x20	-	-	104981
18	4	SCREW MC6S M4x70	-	-	102179
17	4	SCREW MRT M4x20	-	-	104982
16	2	SCREW MRT M4x10	-	-	104983
15	2	SCREW MRT 2.5x4	-	-	105512
13	1	FLOW CONTROL VALVE, ASSY	-	-	105752
11	1	BRACKET	-	-	102190
10	1	FUEL PRESSURE REGULATOR	-	-	103290
9	1	BRACKET	-	-	103321
8	1	SOLENOID VALVE 3/2 INSERT VSD7	-	-	103661
7	1	SOLENOID VALVE 2/2 INSERT VSD2	-	-	103660
6	1	SOLENOID VALVES	-	-	103335
5	1	PRESSURE SENSOR, FUEL	-	-	102555
4	1	PRESSURE SENSOR, AIR	-	-	102554
3	1	INJECTOR	-	-	103054
2	1	MANIFOLD	-	-	102168
1	1	MANIFOLD	-	-	102170

◇ MARKED WITH YEAR/WEEK/DAY/SERIAL NO
YYYY WW D SSS

Rev.	Loc.	Change note	Date	Sign.

General tolerances for dimensions without tolerance indication according to ISO 2768 -m

Surface roughness Ra µm

Projection Method

Designed	Drawn	Copy	Checked	Stand.	Appr.	Scale	Replace.	Replaced by
MT	SB		MT		-	1:1		

stt emtec

INJECTION MANIFOLD 24V MASTER, ASSY
CCT

Filename

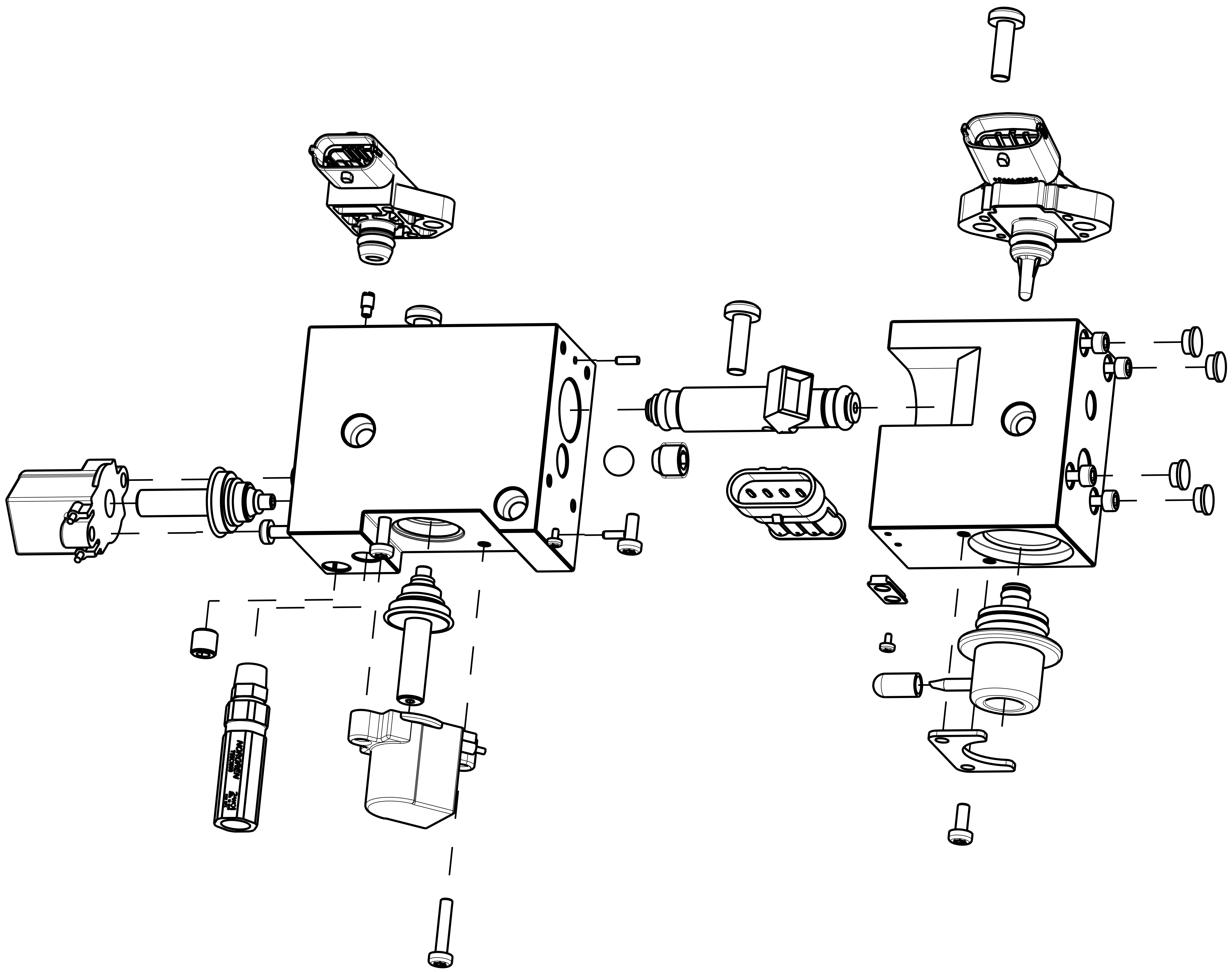
Date 080414

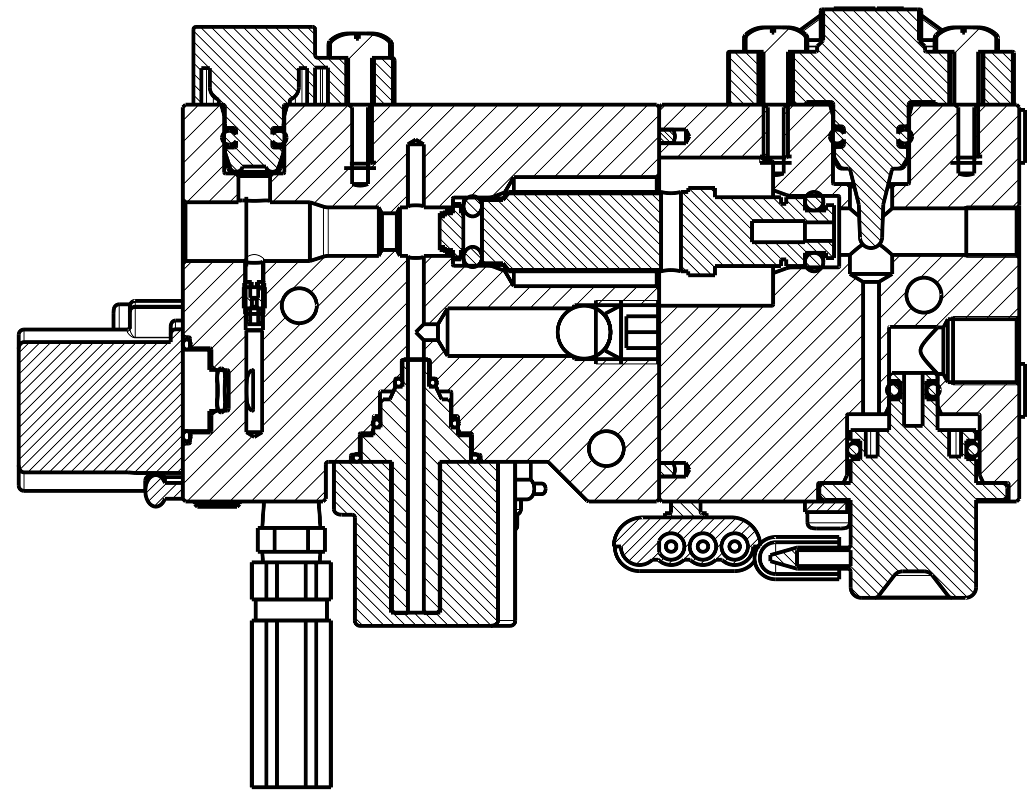
Dwg. no 105842

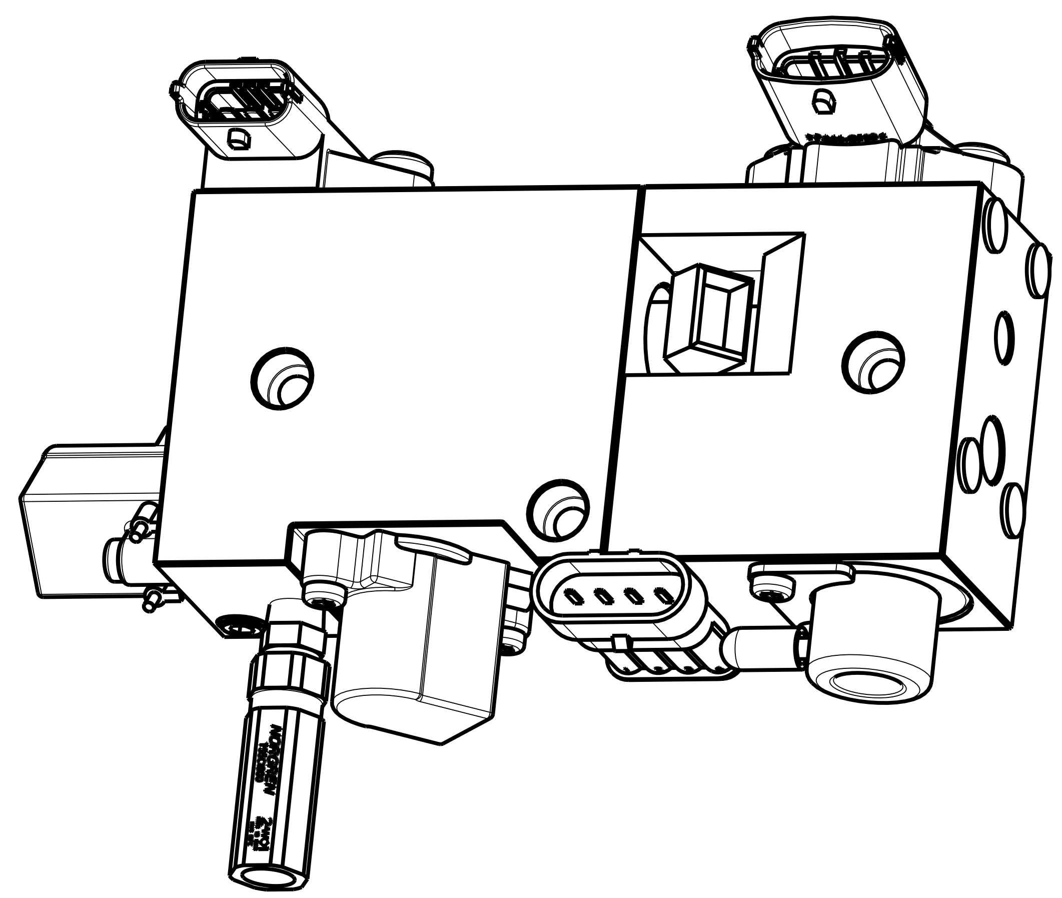
Rev 00

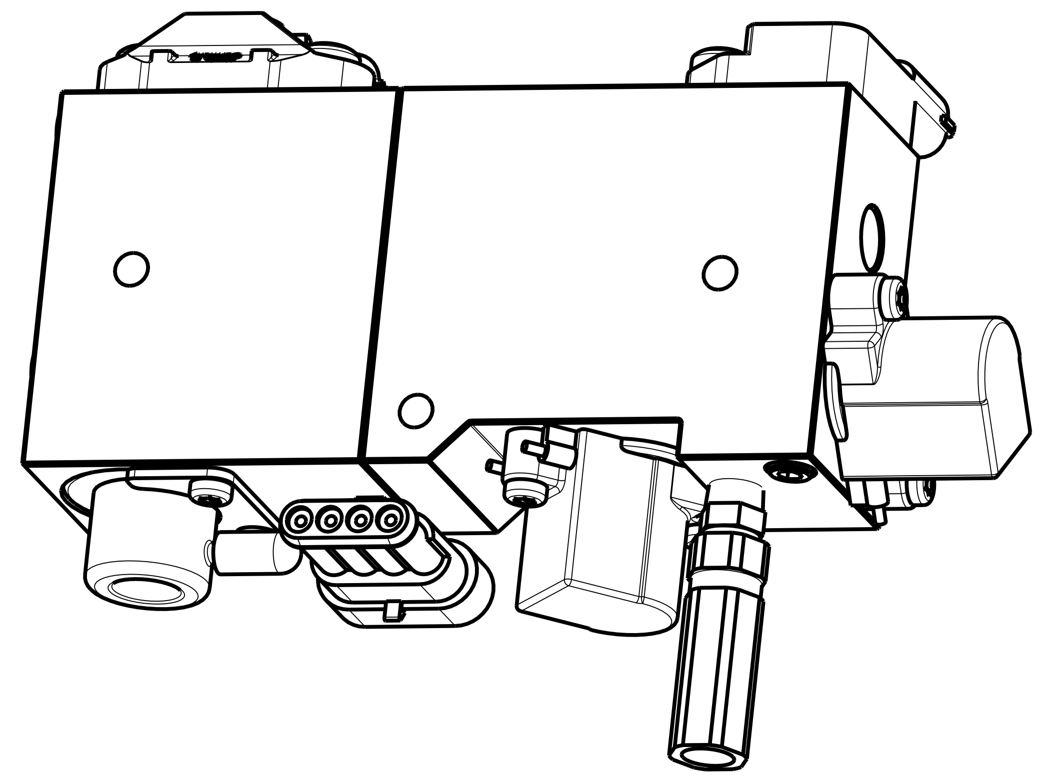
A1

Rev.	Loc.	Change note a=added, w=was d=deleted	Date	Sign.









Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.

General tolerances for dimensions without tolerance indication according to ISO 2768 -m

Surface roughness Ra µm

Projection Method

Designed	Drawn	Copy	Checked	Stand.	Appr.	Replace.	Replaced by
MT	SB		-		-		

stt emtec

INJECTION MANIFOLD 24V MASTER, ASSY
CCT

Filename

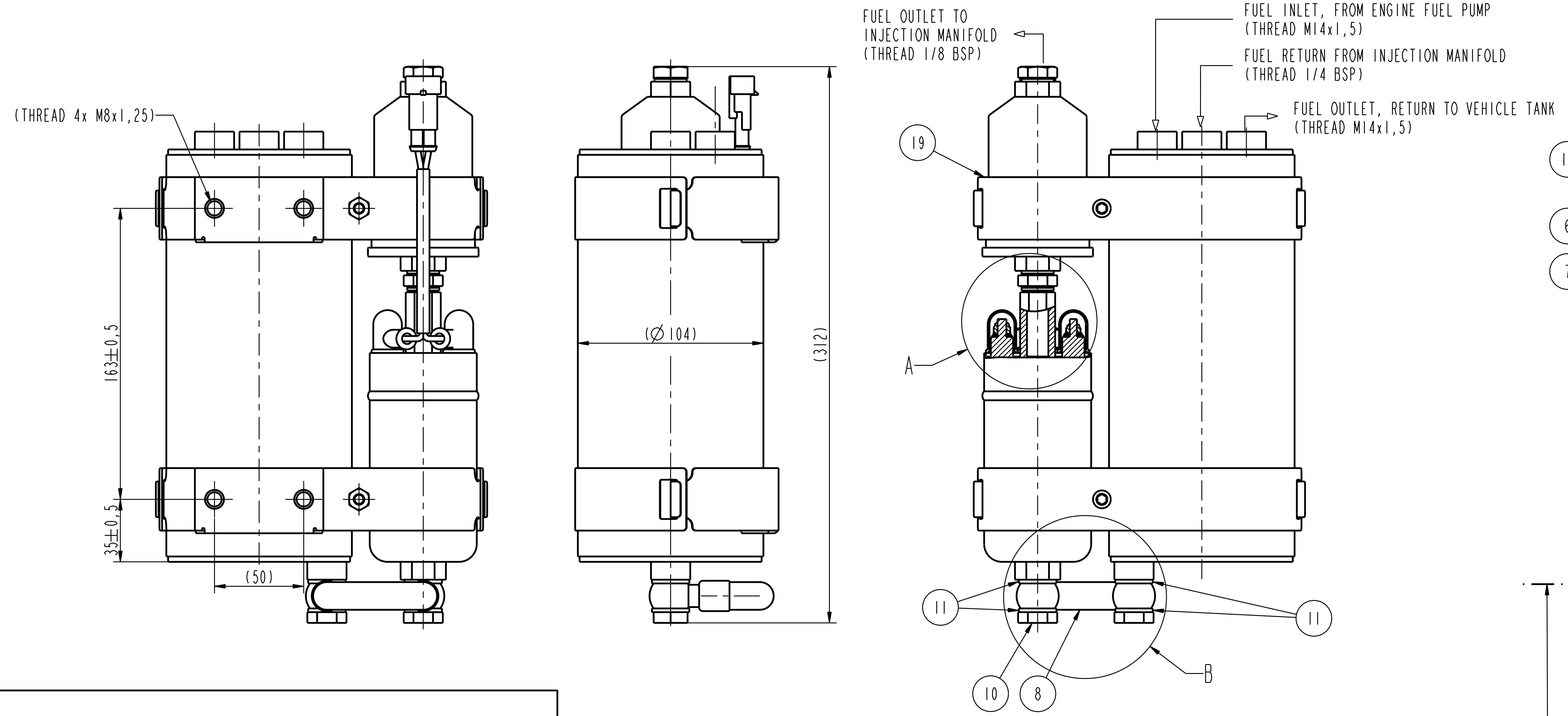
Date
080414

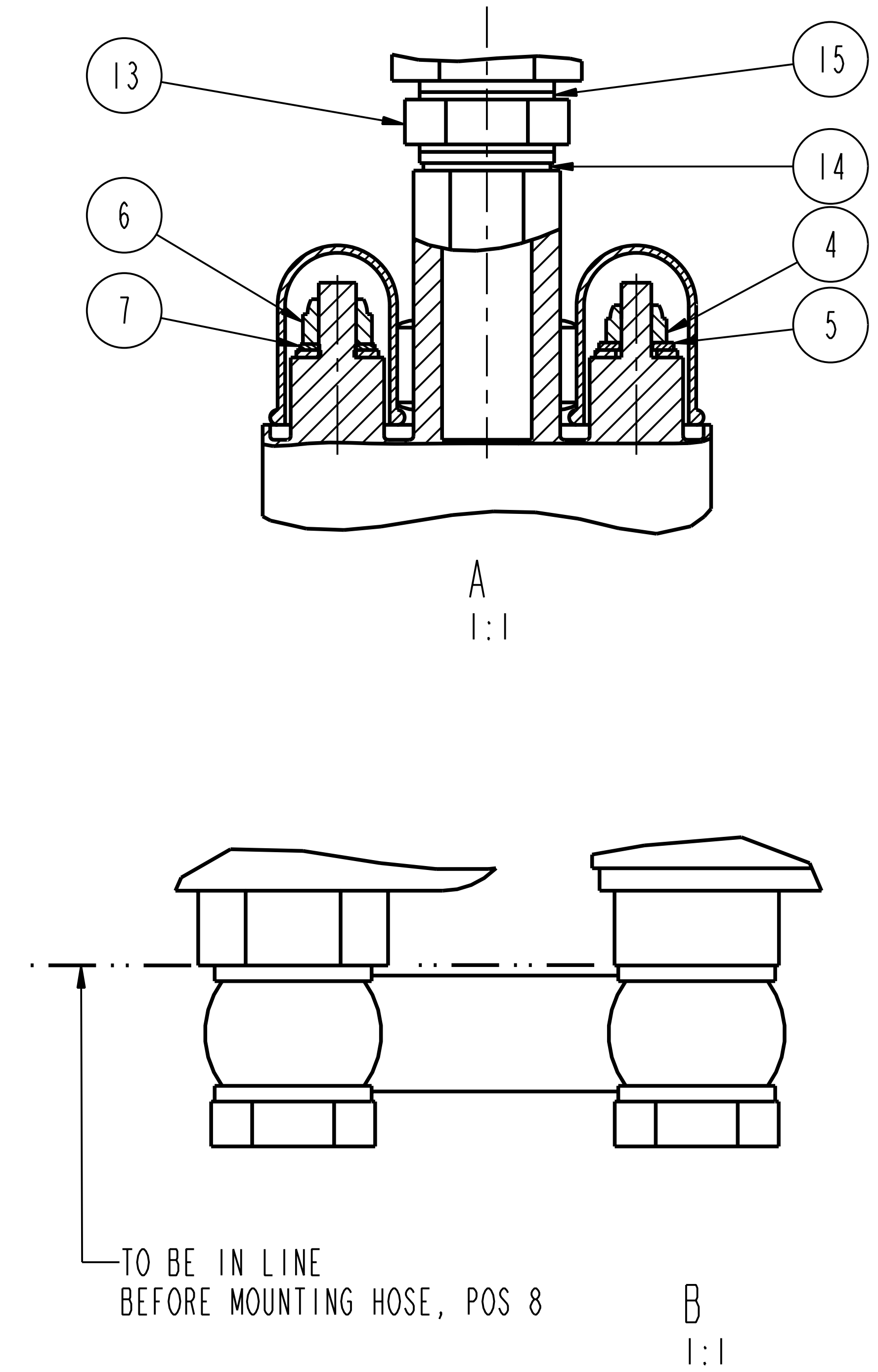
Dwg. no
105842

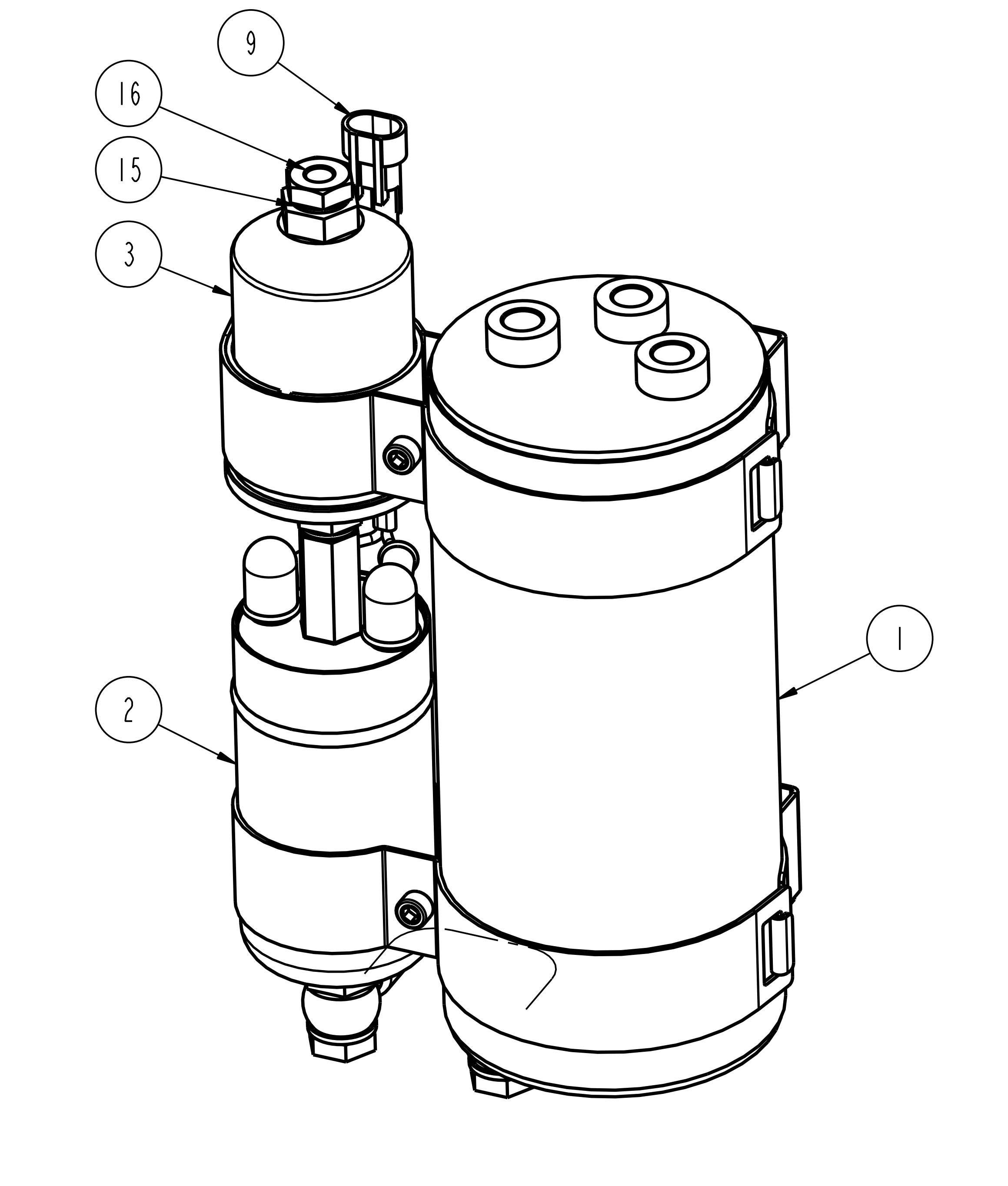
Rev
00

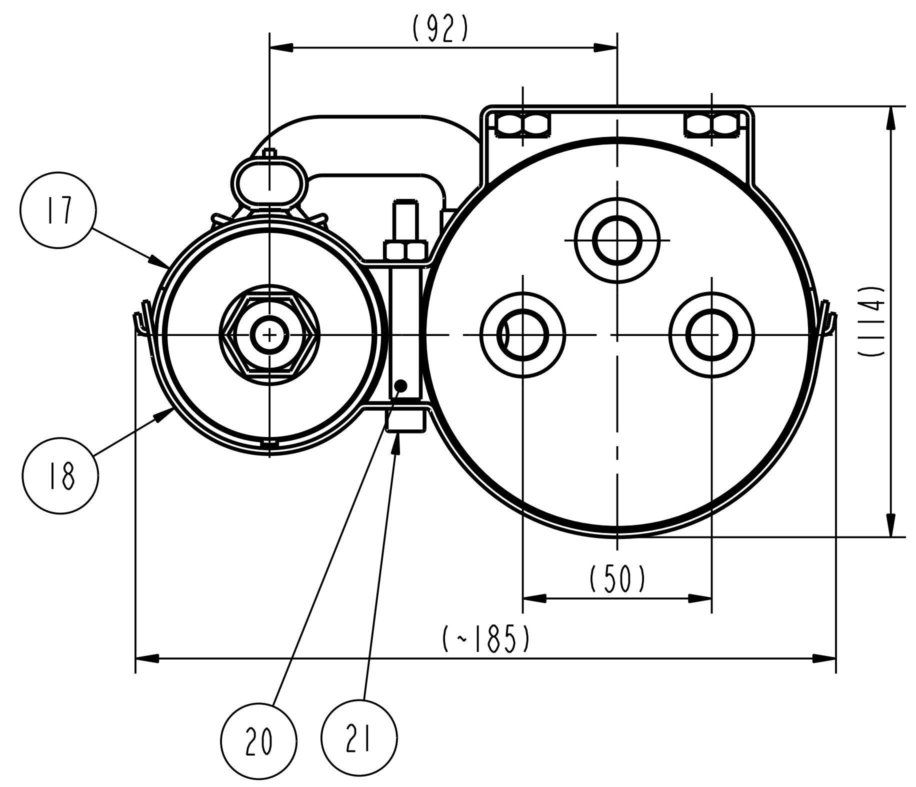
A2

Rev.	Loc.	Change note	Date	Sign.
01		TANK & CLAMPING REDESIGNED	090323	PN





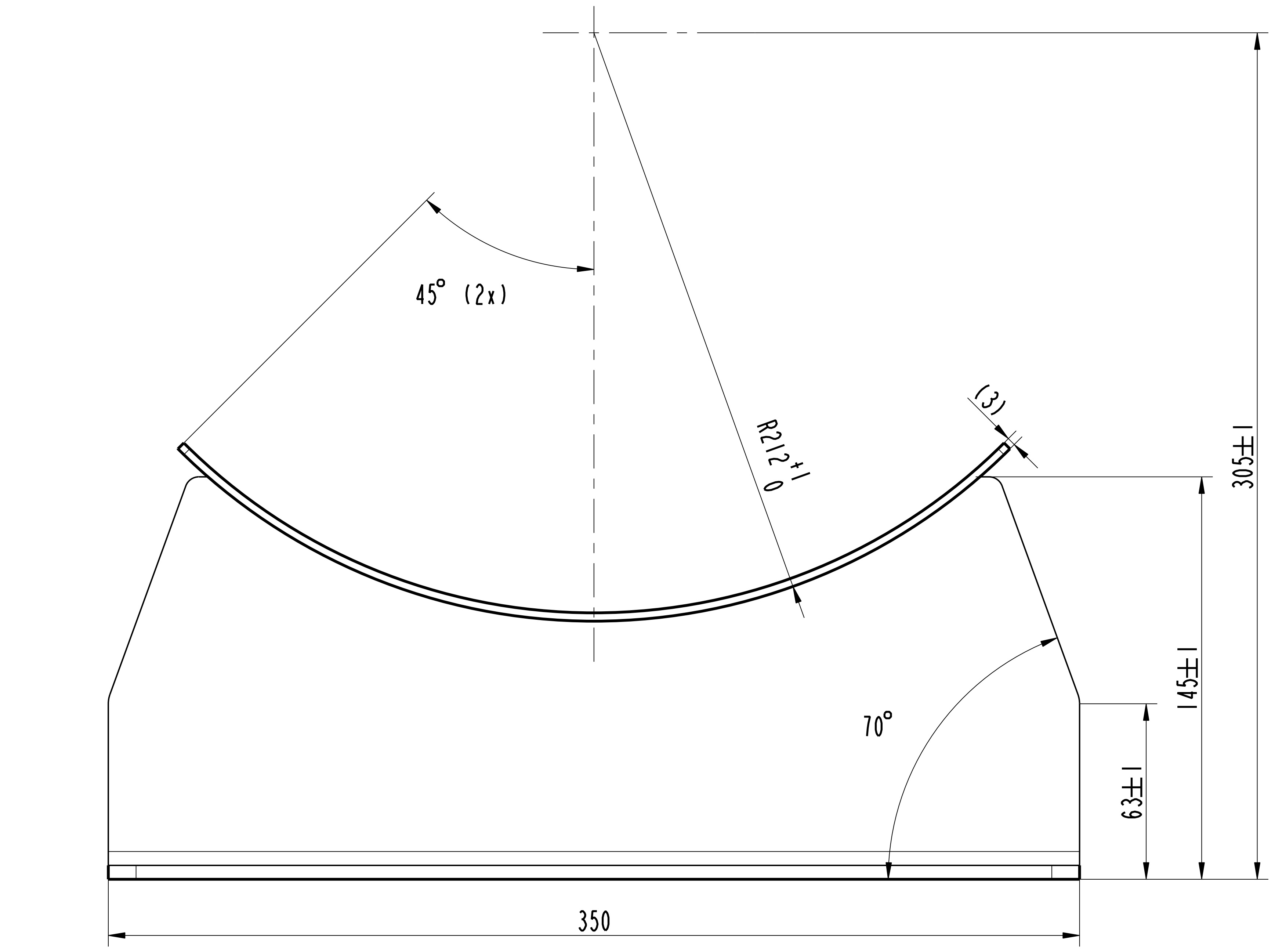


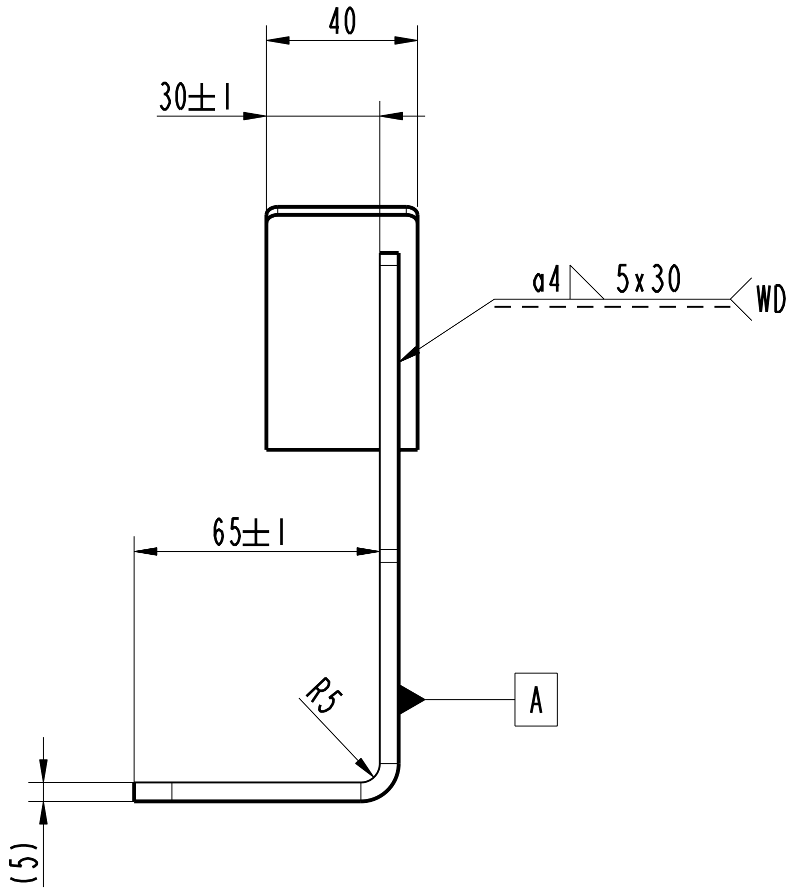


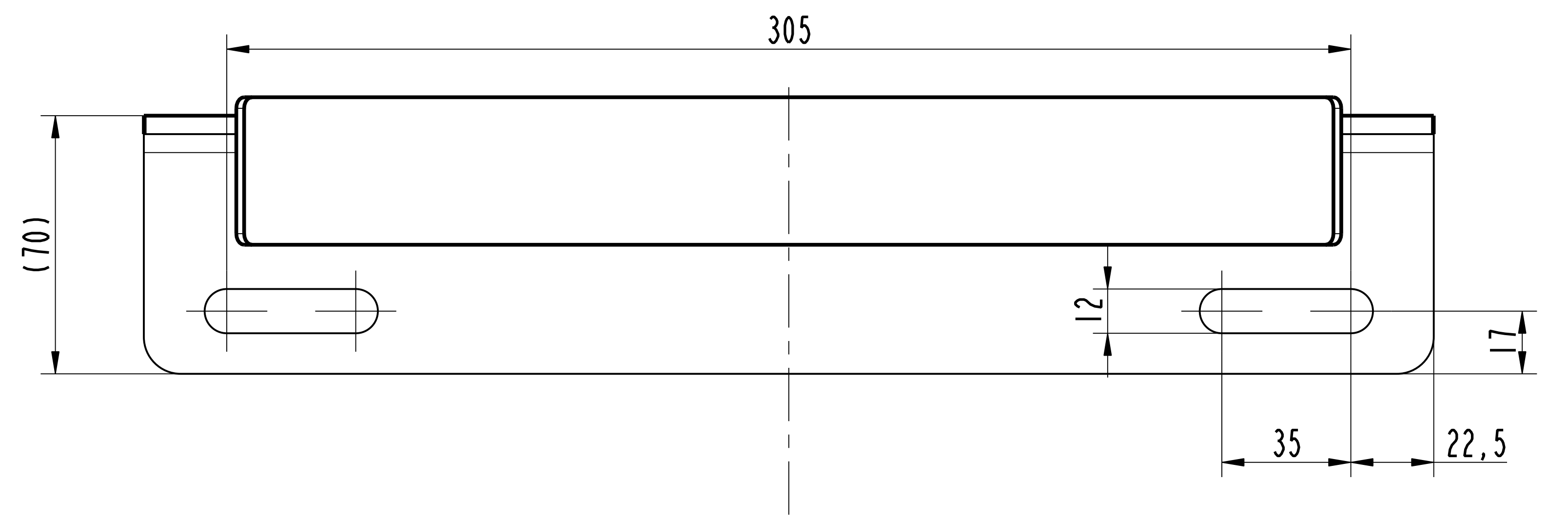
THIS DRAWING MUST NOT WITHOUT OUR WRITTEN CONSENT
BE COPIED, TRANSMITTED OR DISCLOSED TO ANY THIRD PART
STT Emtec AB, Sweden

Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.
General tolerances for dimensions without tolerance indication according to ISO 2768 -m			Surface roughness Ra μm	Projection Method	
Designed MT	Drawn SB	Copy	Checked -	Stand.	Appr. -
Scale 1:2	Replace.	Replaced by			
stt emtec	FUEL CATCH TANK, ASSY CCT / LEAN NOx		Filename	Date 081106	
			Dwg. no 106258	Rev 01	A2

Product No. Kit	Pos	Product No. Components	Description	Quantity	Sign.
106258-01	00	OP1003	Assembly	60	
	01	106577-00	Fuel Catch Tank, 1.75 litre	1	
	02	103098	Fuel Pump Diesel, 24V, 280l/h	1	
	03	102584	Fuel Filter, 0.2l	1	
	04	480-00-0312.0	Nut Lock M4 Polyamid Insert	1	
	05	480-00-0709.0	Washer Flat M4	1	
	06	480-00-0224.0	Nut M5 Lock Polyamid Insert	1	
	07	480-00-0020.0	Washer Flat 5,3x10x1,0 fzb	1	
	08	106578-01	Fuel Supply Hose	1	
	09	103623-00	Wiring Harness, Catch Tank	1	
	10	102614	Screw Hollow M14x1.5 C4	2	
	11	102384	Washer M14, Tredo 114	4	
	13	102585	Adapter nipple M12--M14 (out)	1	
	14	102934	Washer Cu 12x18x1.5	1	
	15	480-00-0288.0	Washer Cu M14x18x1.5	2	
	16	106297-01	Adapter, Utv M14 -> inv1/8 BSP	1	
	17	106348-02	Clamp	2	
	18	106349-02	Clamp	2	
	19	108053-00	Sleeve	1	
	20	106580-00	Pipe	2	
	21	106581	Screw MC6S 6x55 A4-70	2	
	25	107595	Plug M14x1,5	2	
	26	105200	Plug, Plastic, Ø11,4--Ø12,8	1	

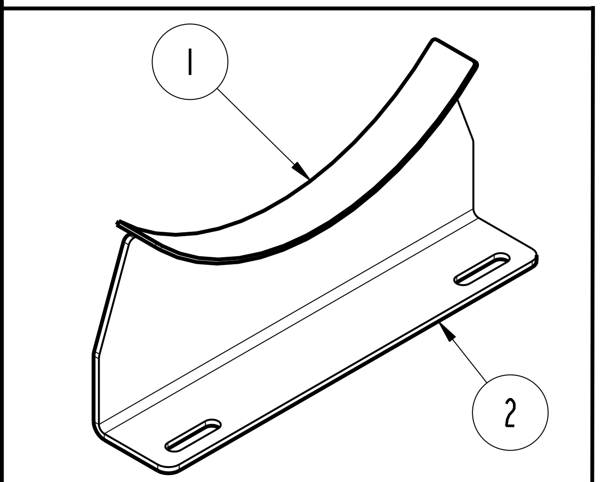






TOLERANCE UNLESS OTHERWISE STATED ±0.5

FREE FROM BURRS, SHARP EDGES BROKEN



Rev.	Loc.	Change note a:added, w:was d:deleted	Date	Sign.

Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.
2	1	PLATE	EN 1.4301	T=5	
1	1	FLAT BAR	EN 1.4301	50x3	

General tolerances for dimensions without tolerance indication according to ISO 2768 -m

Surface roughness Ra µm

Projection Method

Designed	Drawn	Copy	Checked	Stand.	Appr.	Scale	Replace.	Replaced by
DZ	DZ		-		-	1:2		

stt emtec

BRACKET OUTLET
DPF EQ

Filename:

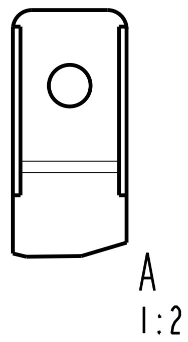
Date: 081125

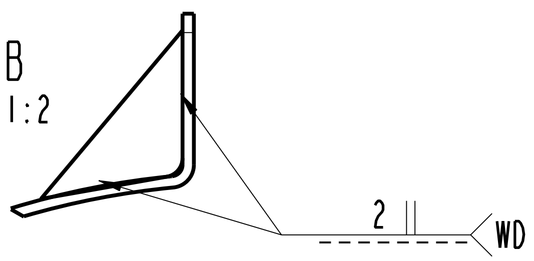
Dwg. no: 106351

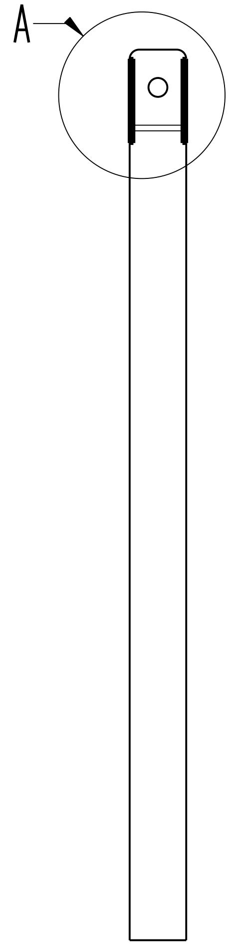
Rev: 01

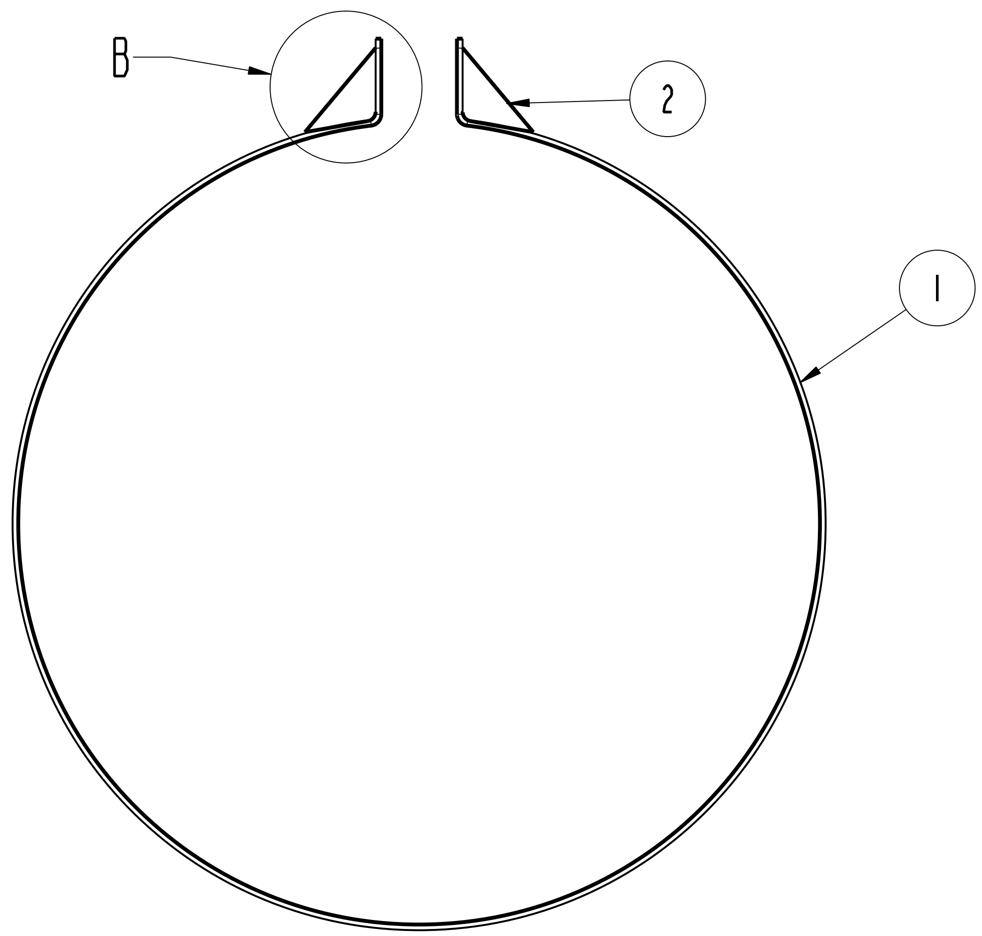
A2

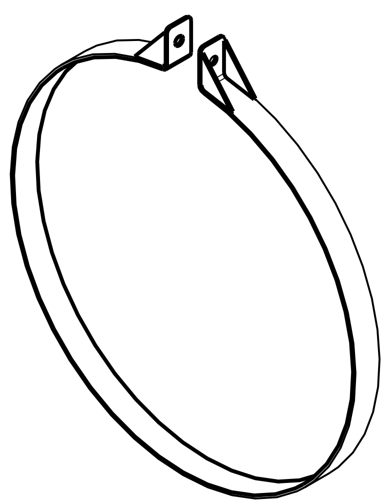
Rev.	Loc.	Change note a=added, w=was d=deleted	Date	Sign.











FREE FROM BURRS, SHARP EDGES BROKEN

Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.
2	4	PLATE	-	-	106361
1	1	CLAMP ∅ 424	-	-	106354

General tolerances for dimensions without tolerance indication according to ISO 2768 -m

Surface roughness Ra µm

Projection Method

Designed	Drawn	Copy	Checked	Stand.	Appr.	Scale	Replace.	Replaced by
DZ	DZ		-		-	1:4		

stt emtec

CLAMP ASSY
DIAM 424

Filename

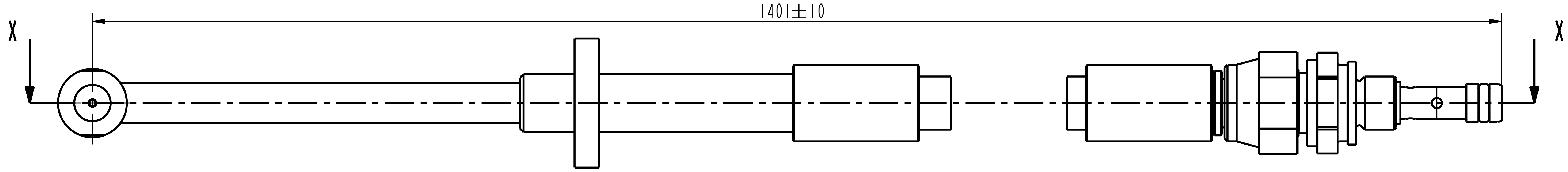
Date 081106

Dwg. no 106355

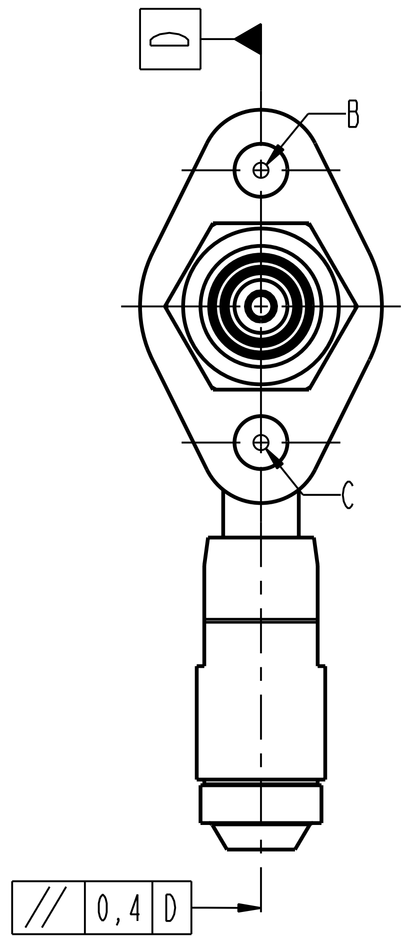
Rev 00

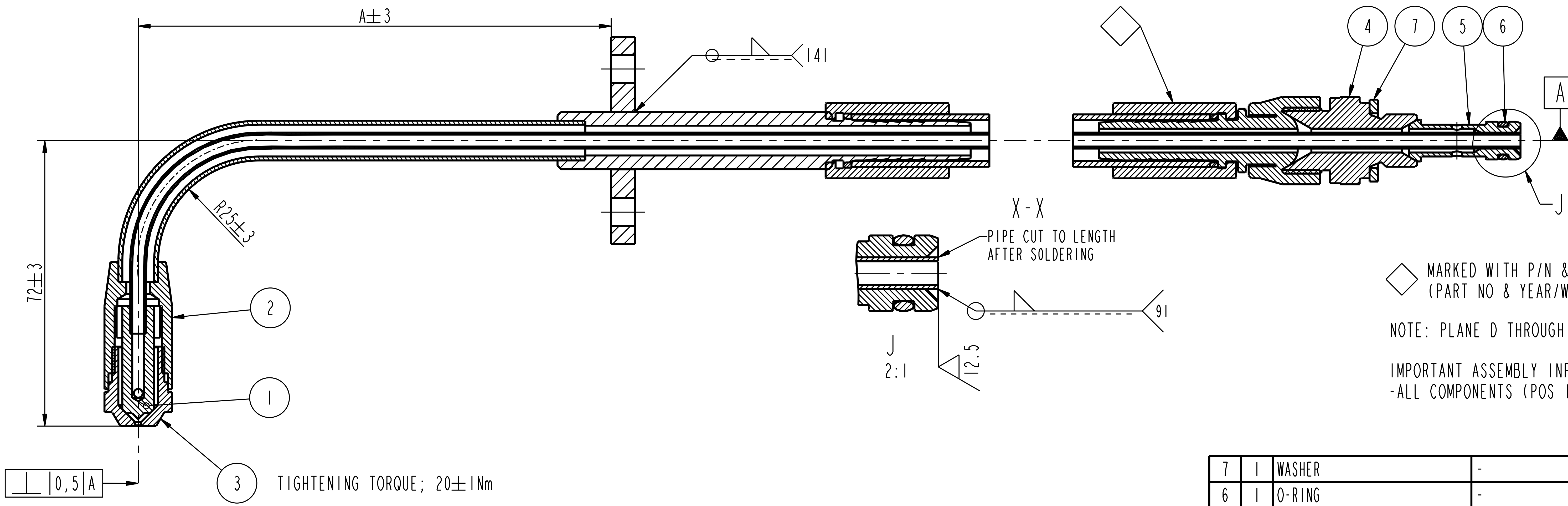
A3

Rev.	Loc.	Change note a=added, w=was d=deleted	Date	Sign.
01	I8	108581 a	130107	UE



FLANGE ALIGNED
BEFORE WELDING





TIGHTENING TORQUE; 20±1Nm

◇ MARKED WITH P/N & YYYY WW D SSS
(PART NO & YEAR/WEEK/DAY/SERIAL NO)

NOTE: PLANE D THROUGH B AND C

IMPORTANT ASSEMBLY INFORMATION:
-ALL COMPONENTS (POS 1-7) PREASSEMBLED BEFORE BENDING

Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.
7	1	WASHER	-	-	102270
6	1	O-RING	-	-	102283
5	1	PISTON	-	-	102259
4	1	ADAPTER 1/4 BSP- - 3/8 BSP	-	-	104176
3	1	NOZZLE CAP	-	-	102130
2	1	AIR SUPPLY, ASSY	-	-	108551
1	1	FUEL SUPPLY, ASSY	-	-	105566

SIZE	A (mm)	STT NO.
8"	107	108548
Ø219	115	108581

General tolerances for dimensions without tolerance indication according to ISO 2768 -m

Surface roughness Ra µm

Projection Method

Designed	Drawn	Copy	Checked	Stand.	Appr.	Scale	Replace.	Replaced by
MT	UE		-		-	1:1		

stt emtec

INJECTION NOZZLE L=1400
CCT

Filename:

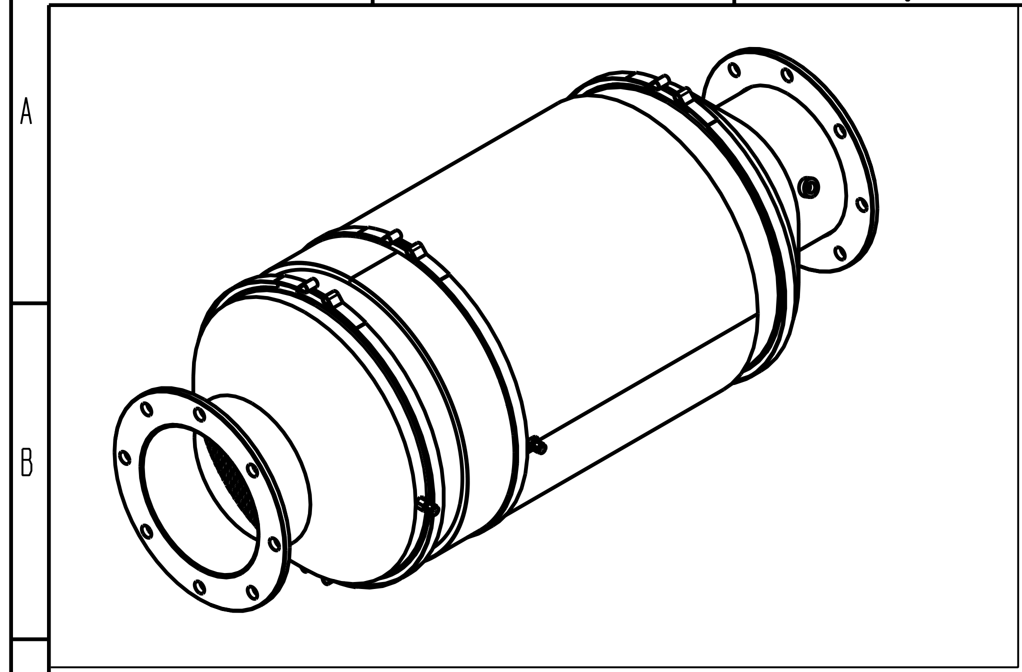
Date: 121123

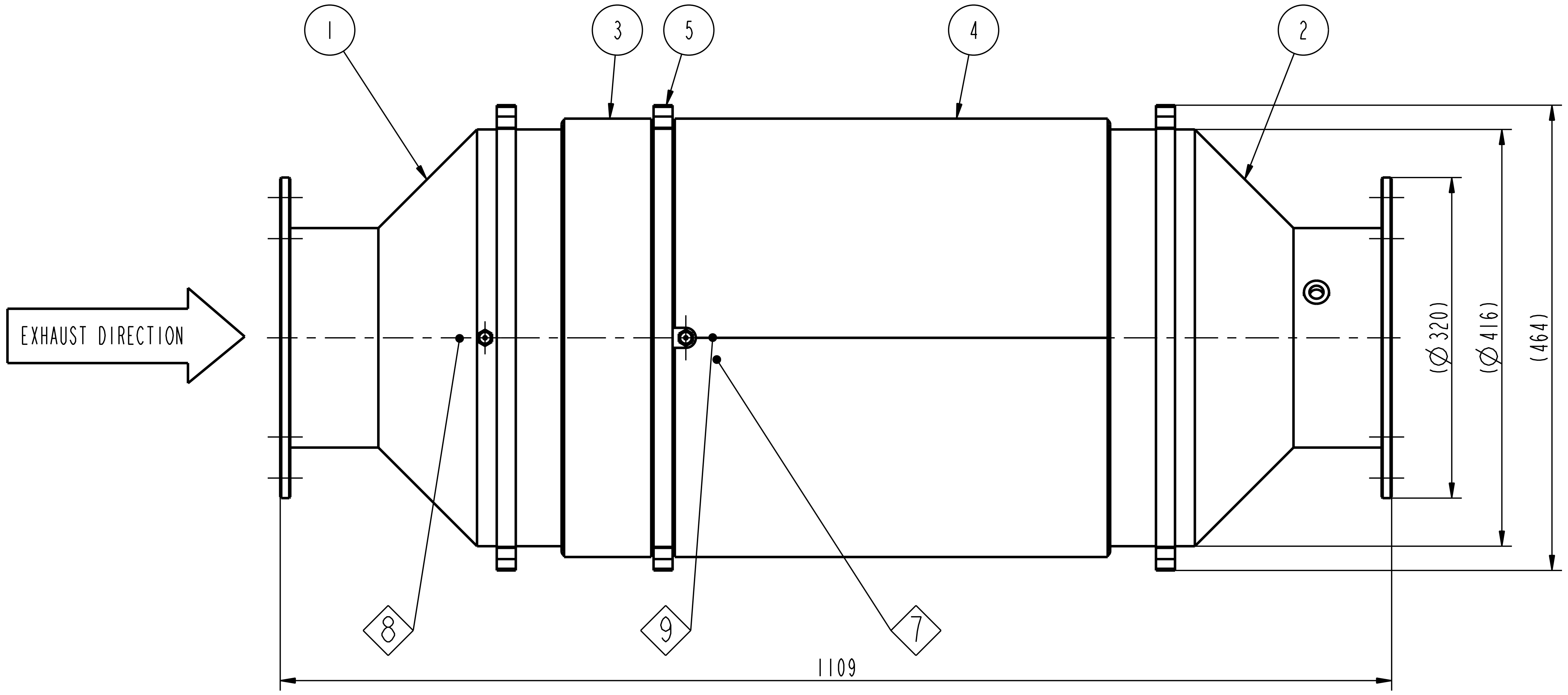
Dwg. no: 108549

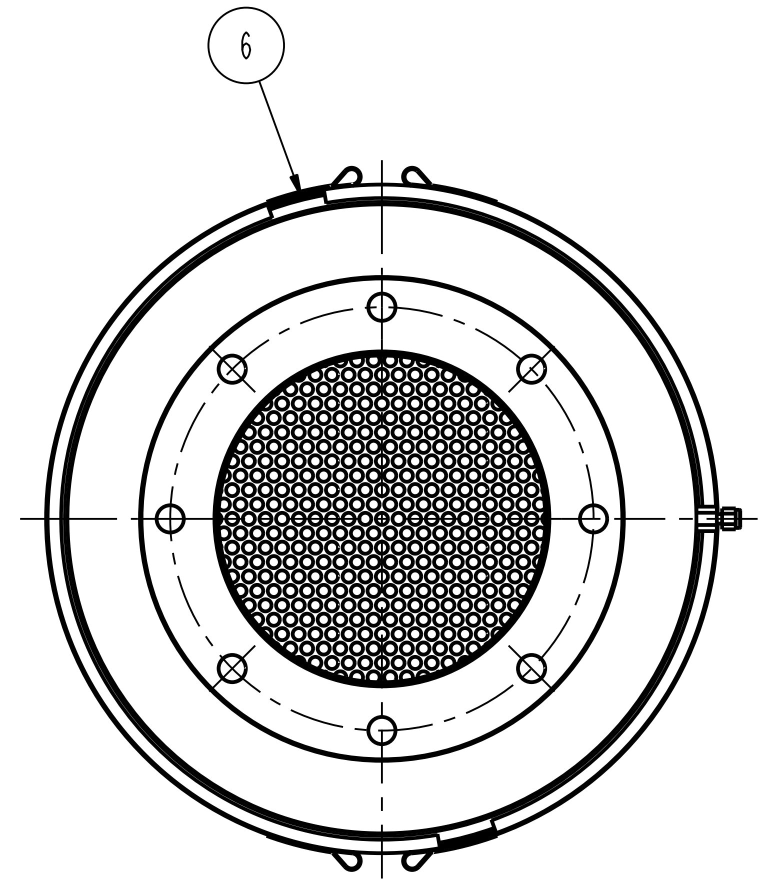
Rev: 01

A2

Rev.	Loc.	Change note a:added, m:mod d:deleted	Date	Sign.







9 MARKED WITH : T_DOC_0

8 MARKED WITH : T_DOC_1

7 MARKED WITH : PART AND SERIAL NUMBER

Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.

General tolerances for dimensions without tolerance indication according to ISO 2768 -m	Surface roughness Ra µm	Projection Method

Designed	Drawn	Copy	Checked	Stand.	Appr.	Scale	Replace.	Replaced by
UE	UE		-		-	1:10		

stt emtec

DPF ASSY 15"
DN200

Filename

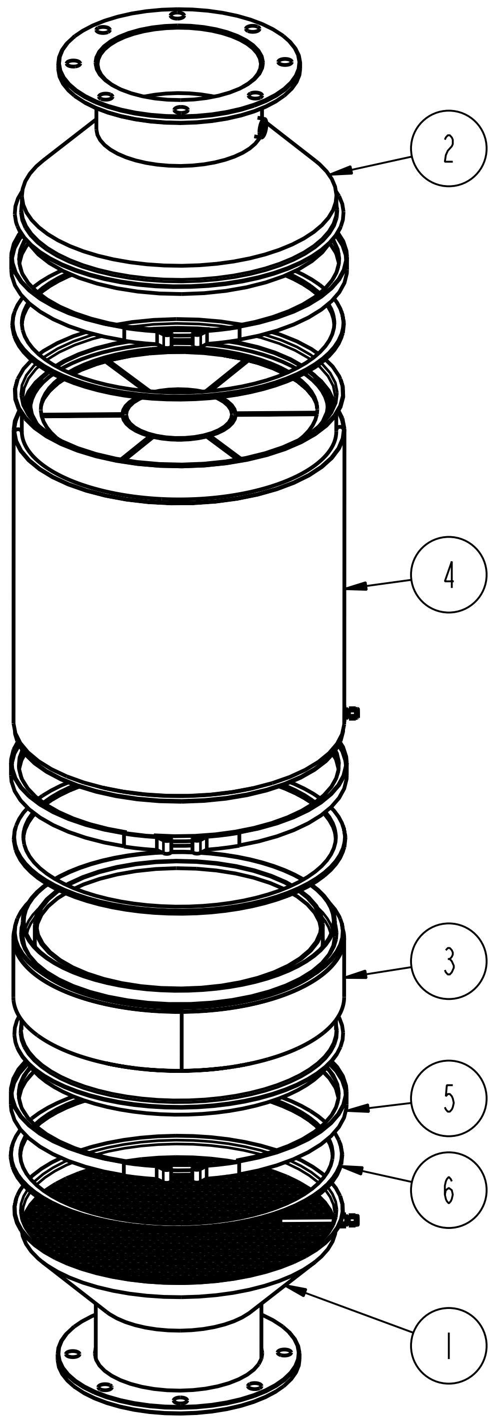
Date 130103

Dwg. no 108559

Rev 00

A2

Rev.	Loc.	Change note a=added, w=was d=deleted	Date	Sign.



Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.

General tolerances for dimensions without tolerance indication according to ISO 2768 -m

Surface roughness Ra µm

Projection Method

Designed	Drawn	Copy	Checked	Stand.	Appr.	Scale	Replace.	Replaced by
PT	UE		-		-	1:10		

stt emtec

DPF ASSY 15"

DN200

Filename

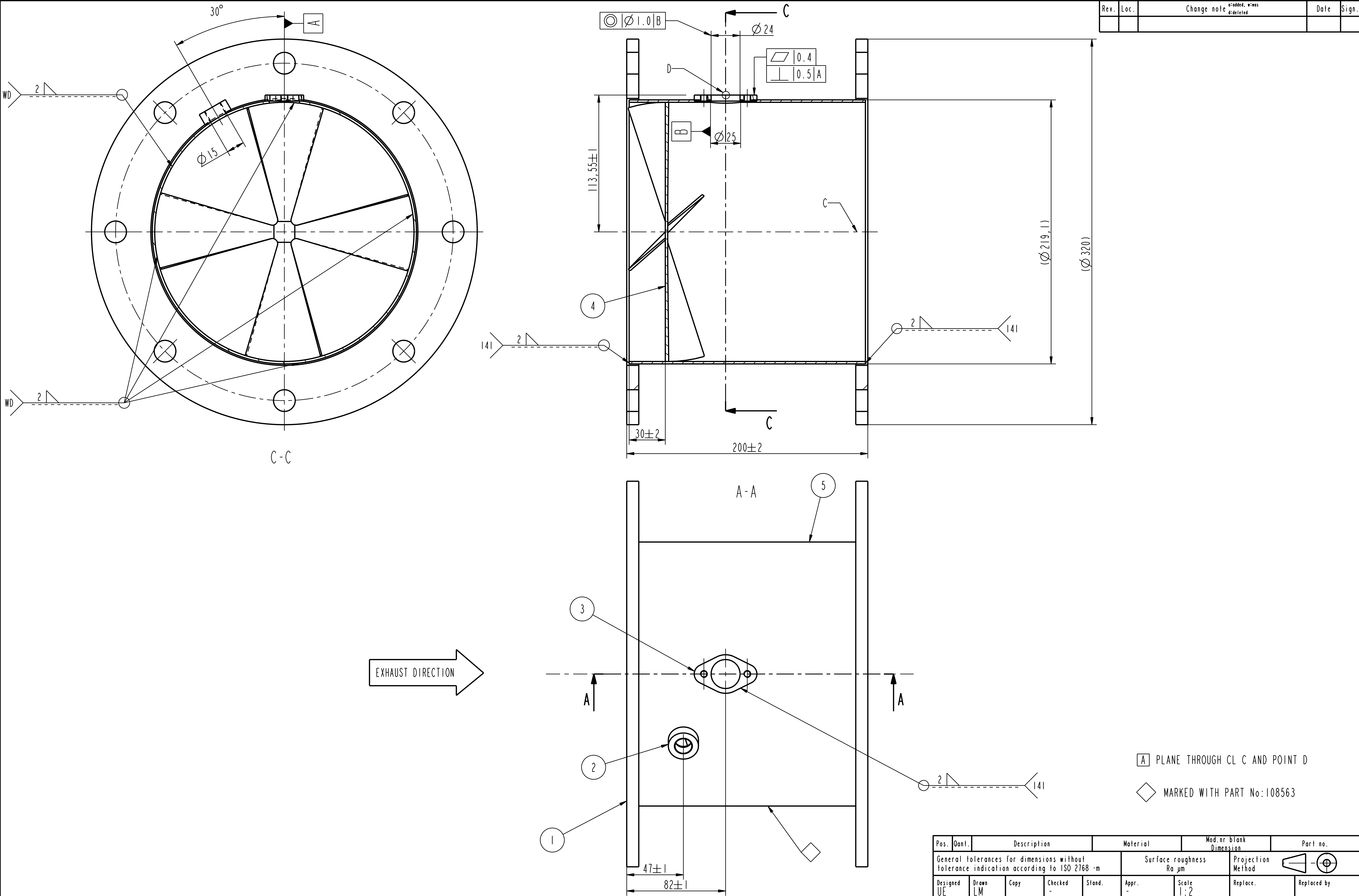
Date 110812

Dwg. no 108559

Rev 00

A3

Product No. Kit	Pos	Product No. Components	Description	Quantity	Sign.
108559-00	00	OP1003	Assembly	1	
	01	108560-00	Can Inlet Assy DN200--15"	1	
	02	108561-00	Can Outl. Assy, DN200--15"	1	
	03	108570-00	Catalyst 15" W. Heat Shield	1	
	04	105309-00	Filter Assy 15"x15" SiC Coated	1	
	05	107691-00	Clamp V-DPF 15"	3	
	06	105666-02	Gasket 15" DPF Assy	3	
	07	106196-00	Marking Plate, Stt logo w pn	1	
	08	106197-00	Marking Plate, T_DOC_I	1	
	09	106198-00	Marking Plate, T_DOC_O	1	



Rev.	Loc.	Change note a:added, w:was d:deleted	Date	Sign.

Pos.	Qant.	Description	Material	Mod.nr blank Dimension	Part no.

General tolerances for dimensions without tolerance indication according to ISO 2768 -m

Surface roughness Ra µm

Projection Method

Designed	Drawn	Copy	Checked	Stand.	Appr.	Scale	Replace.	Replaced by
UE	LM		-		-	1:2		

stt emtec

MIXING UNIT DN200
ASSY

Filename

Date 121214

Dwg. no 108563

Rev 00

A2

Product No. Kit	Pos	Product No. Components	Description	Quantity	Sign.
108563-00	01	108555-00	Flange DN200 PN6 t=10	2	
	02	104345-00	Boss Rp3/8" L10	1	
	03	102203-02	Flange	1	
	04	108569-00	Mixer, Mixing Unit DN200	1	
	05	108564-00	Pipe Ø219,1x2 l=200	1	

Appendix 3 Service and maintenance

*Note: The service interval is indicated in both calendar time and operating hours. The interval should be interpreted as the **shortest** of the two. See also CCTmarine documentation for further maintenance points.*

Component	**See section**	**4 mon 750h**	**6 mon. 1500h**	**12 mon. 2500h**	**24 mon. 5000h**
Control cabinet	**3.1**				**I**
Flange connections	**3.2**		**I**		
Glow plug (optional)	**3.3**		**I**	**R**	
Fuel connection and hoses	**3.4**		**I**		
Fuel filter	**3.5**				**R**
Fuel pressure	**3.6**		**I**		
Injection manifold	**3.7**			**I**	
Injection nozzle	**3.8**	**I (R)**		**R**	
Catalyst	**3.9**			**I**	
Particle filter	**3.10**				**C**
Air compressor filter (optional)	**3.11**			**R**	

I= Inspect (if necessary, clean, adjust or replace), C = Clean, R = Replace.

3.1 Control cabinet
Check and retighten all screws at the terminal blocks

3.2 Flange connections
Regular visual inspection for exhaust/soot leakage.
Check that screws and bolts are securely tightened every 6 month. Replace gaskets if necessary.

3.3 Glow plug
Disconnect the glow plug from the harness, measure the resistance between the igniter body and one wire at the time in the connector, the resistance should be more then 10MΩ. Measure between the pins in the connector, the resistance should be 3±1Ω at 20ºC for a 24VDC glow plug.

3.4 Fuel connection and hoses
Visual inspection on all connections for leakage. Visual inspection for leakage and wear for the entire length of the hoses.

3.5 Fuel filter
The fuel filter shall be replaced every 12 months / 5000h. Detailed instructions are available in the CCT Workshop manual.

3.6 Fuel pressure
The fuel pressure should be within the interval 4400-4900mbar. The fuel pump can be force started and the fuel pressure monitored by the software EmtecDiag.

3.7 Injection manifold
Check for leakage or wear. Check the rubber bobbins for cracks.

3.8 Injection nozzle

Visually inspect the injection nozzle hose for wear or leakage, replace the entire nozzle every 12 mon/3000h or when necessary.
Verify the regeneration temperature every 4mon/750h, replacement is required if regeneration temperature is not reached due to nozzle clogging. Follow this procedure to check regeneration temperature:

1. Start the engine and run under normal conditions to achieve operating temperature in engine and exhaust system
2. Connect ant start the diagnostic tool (EmtecDiag)
3. Initiate a regeneration by pressing the control Injection switch
4. Keep running the engine and monitor the meter Current state: when temperature requirements are met the regeneration will start
5. Keep running the engine and monitor the meter DOC outlet temp: the temperature must exceed 630˚C before the regeneration ends (regeneration takes about 10-15min)

The DOC outlet temperature is allowed to vary both above and below 630˚ but if that temperature is never reached during the regeneration the nozzle is considered clogged and must be replaced.
Depending on application the injection nozzle might need replacement at a shorter interval.
Note that the nozzle is considered a service item and a clogged nozzle will not be covered by warranty.

3.9 Catalyst

All ducts through the catalyst must be open, if a part of them are clogged, it can be an indication that the vehicle's engine is emitting more soot than it should. If there are no clogged ducts, the service interval for the catalyst can be extended to 12months.
Detailed instructions are available in the CCT Workshop manual.

Always use new gaskets and clamps when reassembling the catalyst/particulate filter unit.
Reassembling the catalyst/particulate filter unit requires a special method.

3.10 Particle filter

When the system is working correctly, the particle filter does not need to be cleaned from soot. However, the ash that collects in the filter overtime needs to be removed.
Detailed instructions are available in the CCT Workshop manual.

Always use new gaskets and clamps when reassembling the catalyst/particulate filter unit.
Reassembling the catalyst/particulate filter unit requires a special method. This method is described in a separate service bulletin.

3.11 Air compressor filter

Replace every 12 month, shorten the interval if the compressor is exposed to dusty environments.
Detailed instructions are available in the CCT Workshop manual chapter 11.

3.12 Procedure for DPF service

Diesel Particulate Filters (DPF) included in Active filter- , mCCT- and mDNOx+mCCT- systems require proper sealing between the included parts for desired operation. Therefore the DPF needs to be handled according to the following instruction when service or maintenance is performed.

The DPF consists of four parts, inlet can, catalyst, particulate filter and outlet can, which are assembled together with gaskets and V-clamps and leak tested at delivery.

Always use new gaskets and clamps if the DPF has been dismantled for service or any other reason. For achieving adequate sealing between the DPF parts it is recommended to press them together in a DPF-hydraulic press (picture 42).
When the DPF parts are lined up and pressed together, ensure that the “V-flanges” on the canning meets the gasket prior to assembly of the V-clamps (picture 43). Assemble and tighten the V-clamps and then release the axial pressure.

Figure 42 DPF-hydraulic press

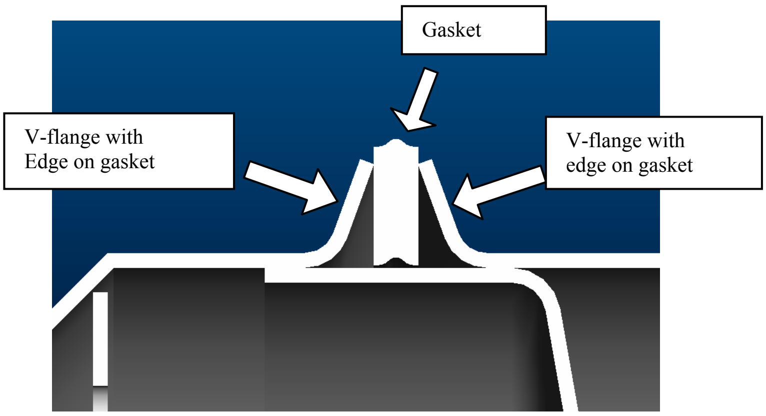


Figure 43 Position for Gasket between the Canning-flanges down straps

Note! Always use new gaskets and clamps when assembling the DPF or leakage may occur!

Appendix 4 Technical specifications

4.1 DPF assembly

Material, canning:	Stainless steel AISI 316/316L, AISI 304/304L
Dimensions module size 3 (W x L):	287 x 860 mm
Weight module size 3:	42 kg
Dimensions module size 2 (W x L):	321 x 940 mm
Weight module size 2:	55 kg
Dimensions module size 1 (W x L):	416 x 1109 mm
Weight module size 1:	73 kg

4.2 Fuel handling system

Material:	Stainless steel, neoprene and copper gaskets
Weight:	3.3 kg
Dimensions (W x L x H):	100 x 170 x 300 mm
Medium:	Diesel (EN590)

4.3 Injection manifold

Material:	Anodized aluminum
Weight:	1.5 kg
Dimension (W x L x H):	42 x 100 x 190 mm
Ambient temperature:	-40 to +85°C
Fuel flow:	22 l/h (max)
Medium:	Diesel (EN590) + compressed air
Regulated air pressure:	4.0±0.5 bar
Air consumption (during regen):	Approx. 20 Nl (+20°C) ????
Cleanliness requirements:	100 µm filter from engine return

4.4 Injection nozzle w hose

Material:	Stainless steel, Teflon
Weight:	0.5 kg
Dimensions (W x L):	13 x 1100 mm (length may be application dependant)
Medium:	Diesel (EN590) + compressed air

4.5 Mixing unit

Material, canning:	Stainless steel AISI 316/316L, AISI 304/304L
Weight:	9.0 kg
Dimensions (W x L):	200 x 555 mm

4.6 Igniter unit

Material, canning:	Stainless steel AISI 316/316L, AISI 304/304L
Weight:	9.5 kg
Dimensions (W x L):	200 x 555 mm

4.7 Air regulator

Material:	Brass, NBR, technopolymer
Temperature:	Operating temperature ±0 to +50°C
Medium:	Compressed air
Operating pressure:	Max 12 bar
Outlet pressure range:	0,5 to 10 bar

4.8 Air compressor (optional)

Material:	Die-cast aluminum, powder coated steel, PTFE, stainless steel, rubber shock-mounts
Dimensions (W x L x H):	102 x 195 x 156
Weight:	2.7 kg
Supply voltage:	24 VDC
Current consumption:	<11 A (max), <60A @ 30ms (peak)

4.9 Control cabinet

Material:	Powder coated steel
Dimension:	380x380x210 mm
Weight:	25 kg
Ambient temperature:	-20 to +60°C
Supply voltage (230VAC):	176 to 264 VAC
Supply voltage (24VDC):	24 – 29 VDC
Current consumption (230VAC):	<1 A
Current comsumption (24VDC):	<5 A
Degree of protection:	IP 65

4.10 Wiring harness

Material, sheath:	Halogen Free Polyolefin Compound
Material, conductor:	Cu (IEC 60228), pair-twisted
Insulation voltage:	1500 V
Ambient temperature:	-20 / +70 ˚C

Appendix Appendix 5 Troubleshooting guide

The troubleshooting guide also includes a description on how to use the diagnose application **EmtecDiag.**

The troubleshooting guide can vary between applications.

About the Marine CCT diagnose application

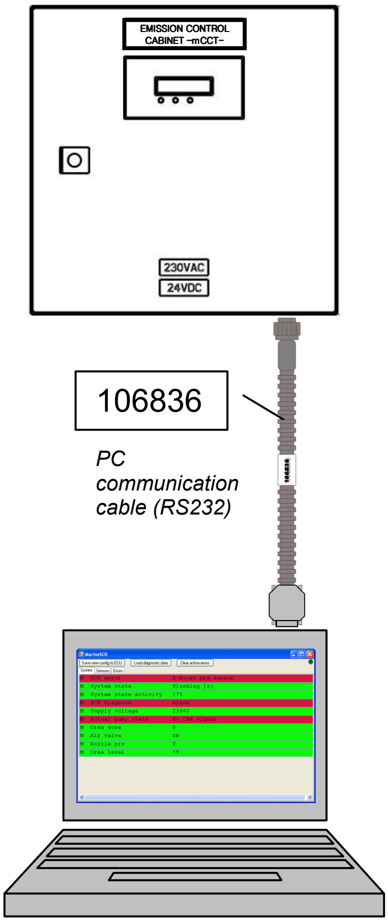
The Marine CCT diagnose application is a PC software designed to support system maintenance and troubleshooting
It is designed to run under Windows XP, Windows Vista and Windows 7 and does not require a hardware lock
Your PC must have at least one available RS232 or USB port

The application installation software comes on a CD labelled *"STT Emtec CCTmarine + DNO$_X$marine Diagnose Application"*
The latest version of the diagnose application can also be downloaded from
http://www.sttemtec.com/

Table of contents

1 Connecting your diagnose equipment

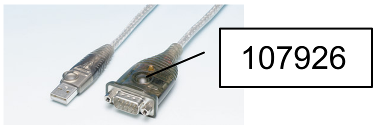
The Marine CCT control cabinet connects to your PC using an RS232 communication cable
(STT part no: 106836)



PC communication cable (RS232)

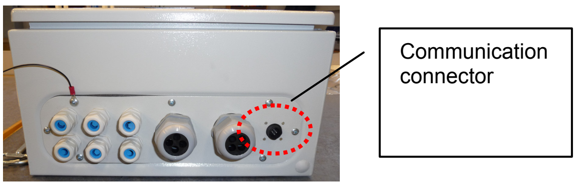
You can use any RS232 or USB port on your PC, the diagnose application will automatically detect where the control system is connected

If your PC does not feature a built-in RS232 connector you should use an additional USB adapter cable
(STT part no: 107926)



USB to RS232 adapter cable

Connect the cable(-s) and make sure that the control cabinet has supply power
Hint: Supply power is on when there is text on the cabinet door display



The connector is located at the bottom right of the Marine CCT control cabinet

2 Overview

EmtecDiag is a monitoring and service tool for STT Emtec ECU's.
It can show runtime data and error codes, download diagnostic data, and update ECU calibration data in the form of complete calibration files.
All files (calibration-, diagnostic data-, and configuration files) are encrypted.

3 Software installation

3.1 *System requirements*

- *1GHz processor or better*
- *512 MB RAM*
- *A Mouse*
- *Windows XP, Windows Vista, Windows 7 or later.*
- *Microsoft .NET Framework 3.51*
- *50 Megabyte free space on the hard disk*
- *RS232 Serial port or USB (on STT's latest ECU's)*

3.2 ECU drivers

STT´s latest generation of ECUs have moved from using a serial port for communication to using USB. This allows for higher communication speeds and better connectivity since many computers are not equipped with serial ports today. To be able to communicate with an ECU using USB, a set of drivers have to be installed. This is done automatically by the EmtecDiag installation program.

3.3 Software setup

Install EmtecDiag and its bundle of drivers and configuration files, by running Setup.exe from the installation CD and following the on-screen instructions.
The setup-program installs EmtecDiag, the drivers for USB-connected ECUs and any configuration files accompanying the setup files. After the setup-program completes, you can start EmtecDiag from the start-menu.
The setup-program will detect if your system already have Microsoft .NET framework 3.5 SP1 installed, and updates your system automatically if needed. The automatic update requires an active internet connection to access Microsoft's servers for downloading the .NET Framework files.
The .NET-framework update is a lengthy task and requires the computer to be restarted, so make sure you plan for it.

4 Program User Guide

When EmtecDiag is started, it automatically performs a scan of all serial ports on the computer. If it gets a response from a STT ECU, it scans any available configuration file for a match, and connects if one is found. The process requires no user input to connect to an ECU other than starting the program.

4.1 User Interface

The program window is named after the configuration file used to access the ECU (in the following examples "Demo.cfg"). At the top of the screen are a row of buttons where the two rightmost are optional and can be hidden depending on the settings in the configuration file.

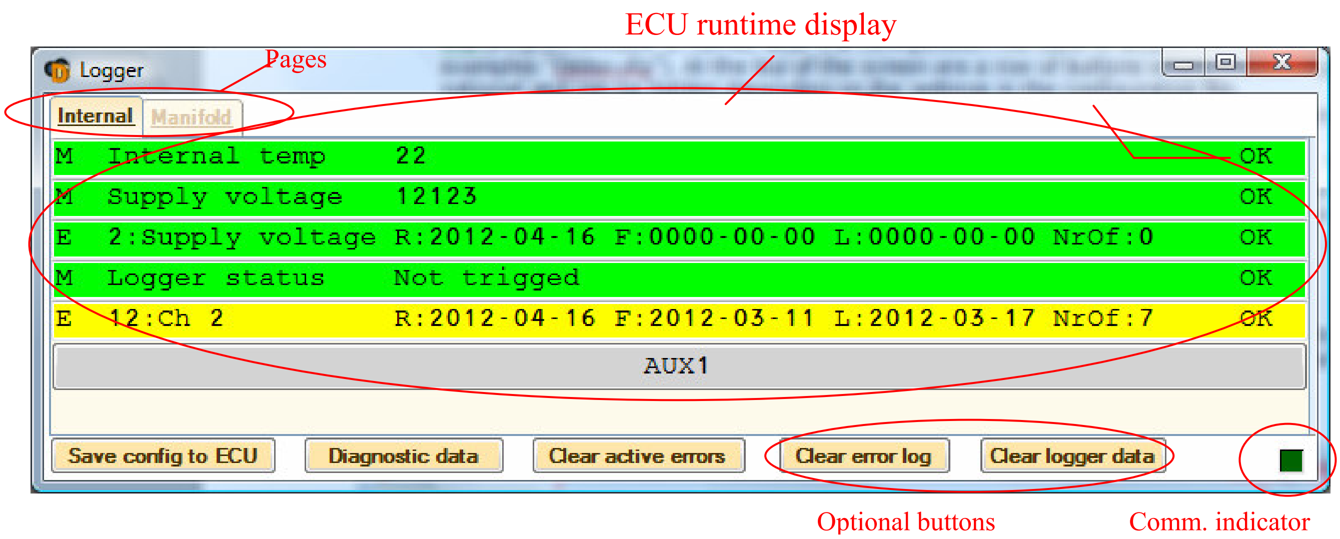
On the same level as the buttons, but on the far right of the screen is the communication-indicator which blinks when EmtecDiag is communicating with an ECU.

The runtime information is grouped into pages of Meters, Errors and Control-buttons. The number of pages, their names and content is decided by the configuration file. In these examples, there are two pages ("Engine sensors" and "ECU-info"). Switch between pages by clicking on the desired tab with your mouse.

4.2 Runtime display

The ECU runtime display is composed of Meters, Error information and Control-buttons and its data is updated as long as the ECU is connected (and the Communication Indicator is flashing).

Each line in the runtime display is a different Meter, Error or Control-button.

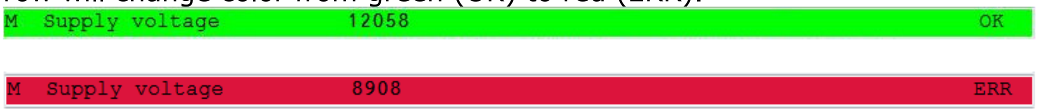


4.3 Display components

There are three different objects that can be found on the runtime display… Meters which typically show sensor readings, Errors which show registered fault-conditions and Control-buttons which can be pushed using the mouse to send commands to the ECU.

Meters

are identified by the "**M**" designator at the far left of its row.
After the designator comes the Meter name and –value. To the far right is its current status, which is determined by preset min- and max values (in the configuration-file). The status can be "OK" or "ERR" and the entire row will change color from green (OK) to red (ERR).

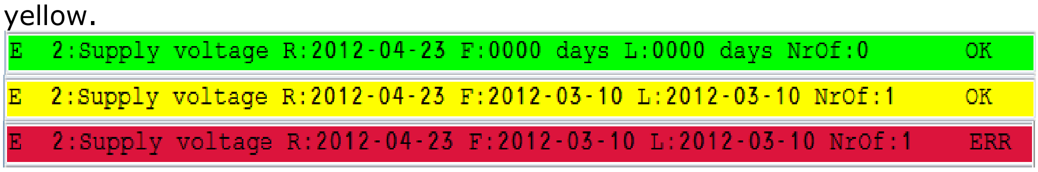


Errors

are identified by the "**E**" designator at the far left of its row. After the designator comes the Error name and a group of other information.

- **R:2011-10-24** – Reset date, is when the error code was last reset by a user.
- **F:0000 days** - First error, is the no. of days after reset the first error occurred.
- **L:0000 days** - Last error, is the no. of days after reset the latest error occurred.
- **NrOf:0** - Error count, is the total no. of recorded errors since reset.

To the far right is the current status of the Error which can be "**OK**" or "**ERR**".
When the Error is currently active, the row turns from green (OK) to red (ERR).
An error that is not currently active, but has stored errors is shown in yellow.

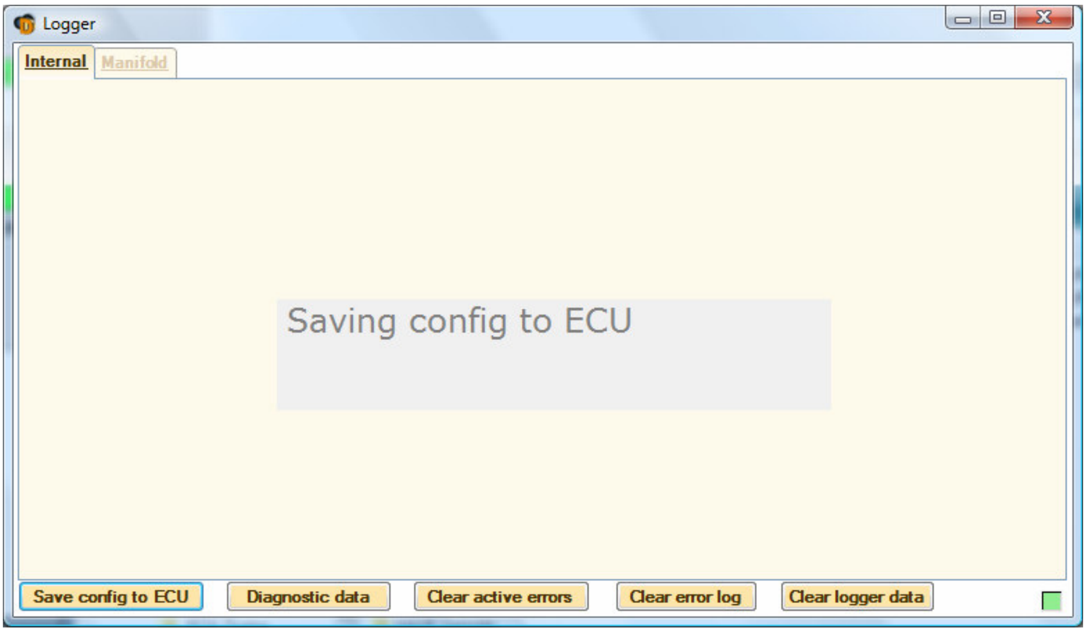


Control buttons

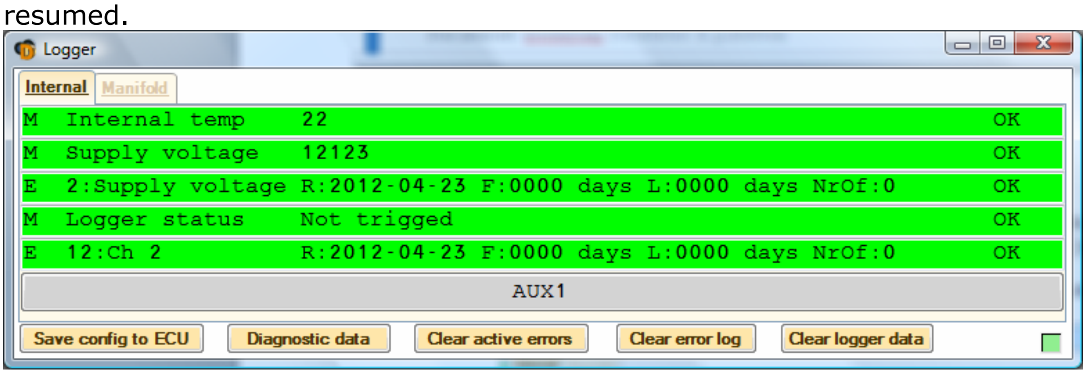
are used to send simple on/off-type instructions to the ECU. Activate the Control button by pressing it with your mouse. Each Control button is labeled with its function.

4.4 Buttons

Use this button to update the dataset in the ECU. A file-selection window pops up when the button is pressed. Navigate to the new dataset-file (extension .mml), select it and press the OK-button.
The text "Saving config to ECU" is shown while the update is in progress.

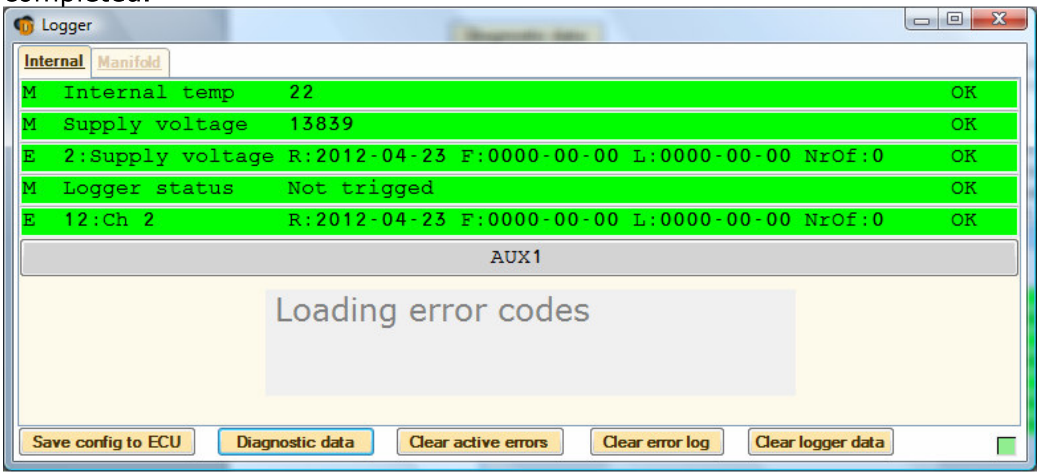


After the dataset has been updated, the runtime communication is resumed.

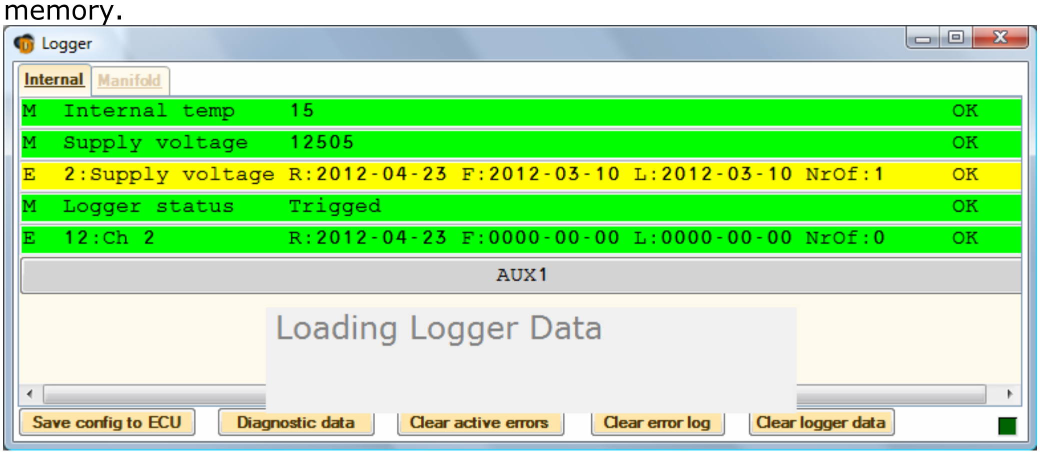


Diagnostic data

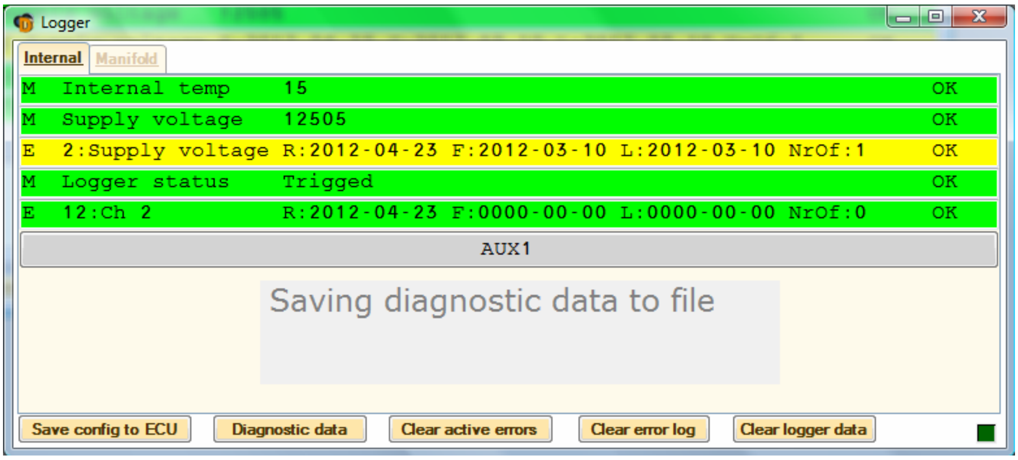
Downloads all stored error codes in the ECU to a file. Depending on the settings in the configuration file, logger data may be included in the download. If this is the case, the download will take longer to complete. You will be asked for a file name when the button is pressed. An automatically generated file name will be presented as a suggestion, but the user is free to change it. The download will start when the Save-button is pressed. If the configuration file allows it, the logger data is shown to the user as a graph. Normal operation is resumed after the download is completed.



Logger data being downloaded. This is a long task if the ECU has a large memory.



After download of the logger data, it is saved to the diagnostic data file. This can take some time if there is a lot of data. The downloaded diagnostic data file is in binary form and not in readable text. The ECU configuration tool "EmtecMapper V" is used to extract readable data from the file.



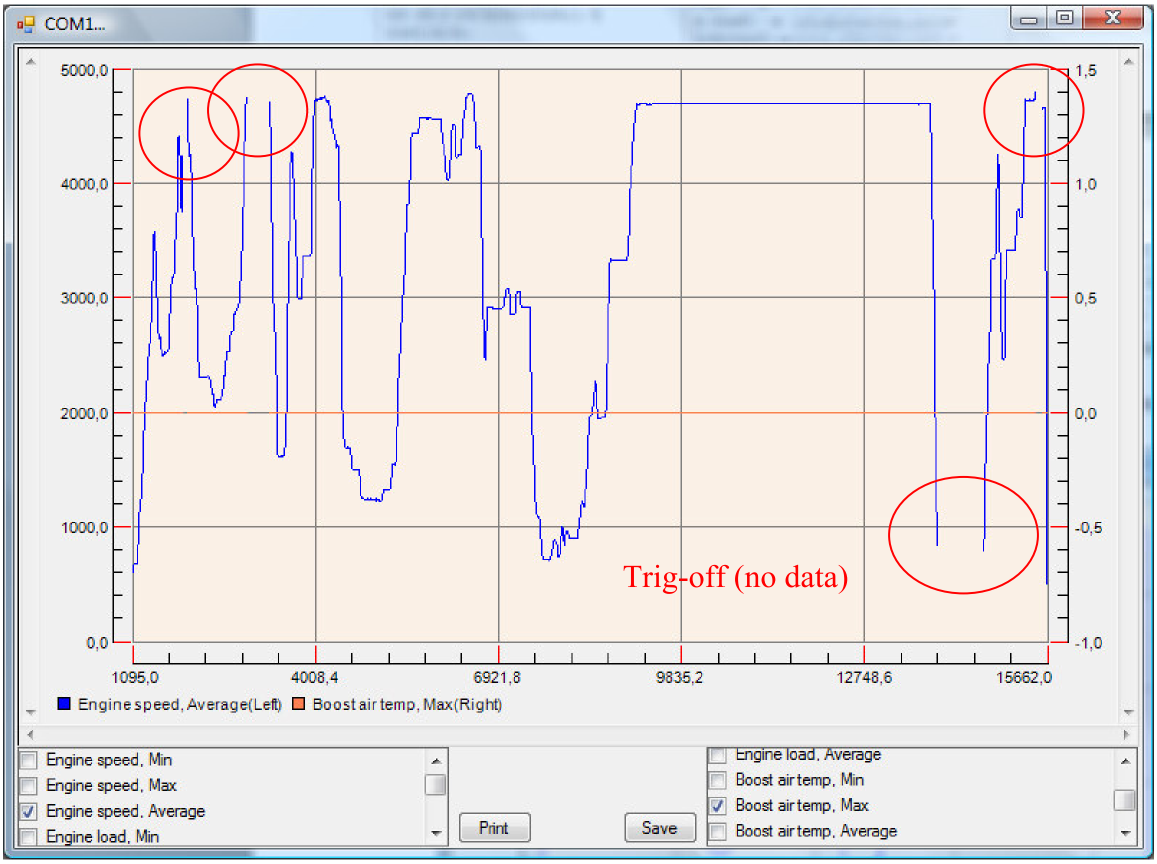
Resets currently active error codes in the ECU. On ECU's with support for this function, the current error-states of all Errors are set to "OK" while the ECU re-evaluates them all. On ECU's lacking this function, all error counters will be reset, and the reset date will read 1970-01-01.

This button is optional, and may not be shown for all installations. Resets all error counters in the ECU and sets the reset time to the current date.

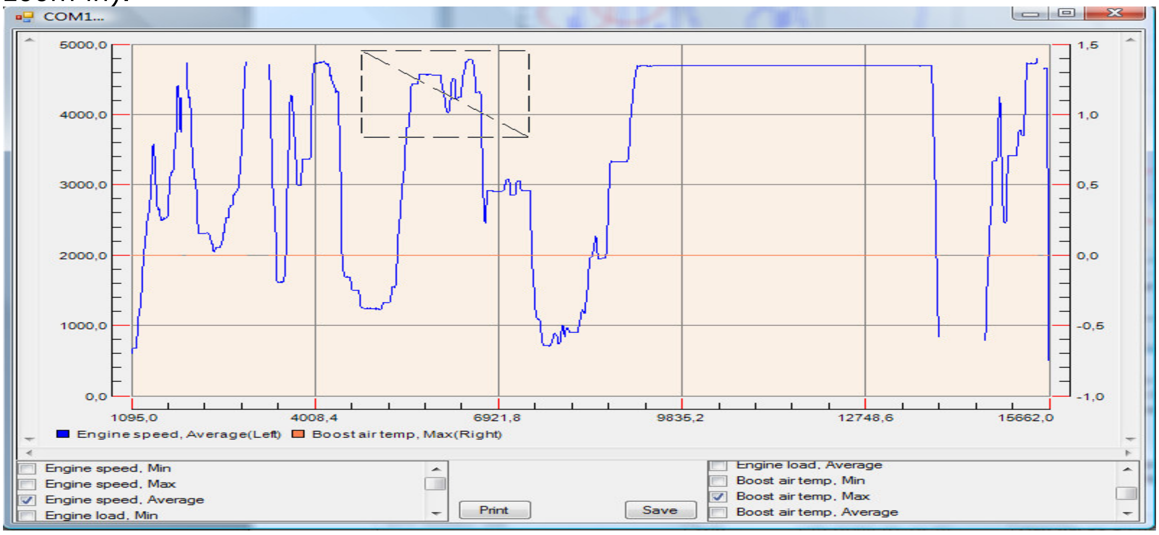
This button is optional, and may not be shown for all installations. Clears all logged data in the ECU along with any stored Alarms.

4.5 Logdata graph

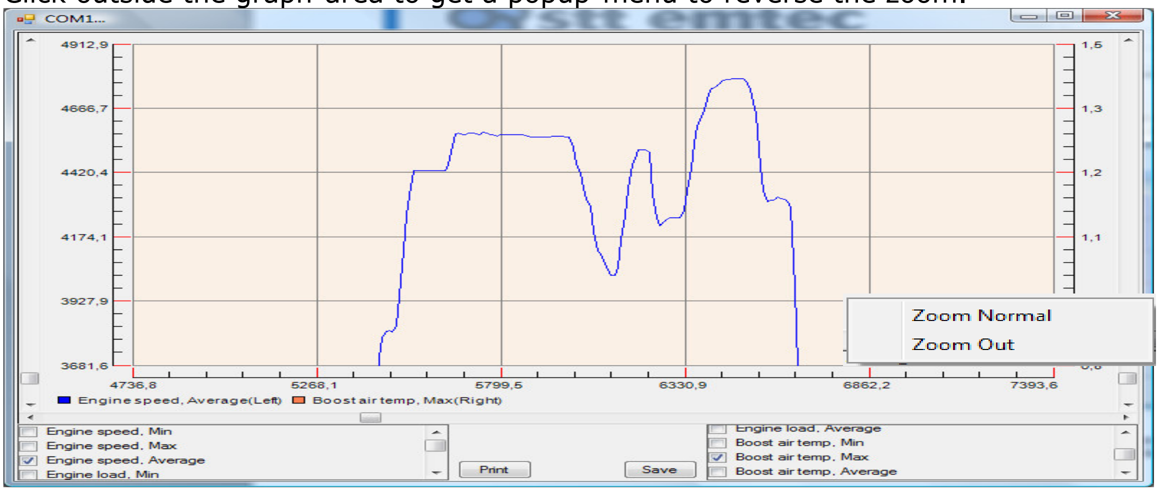
If the settings in the configuration file allow it, some- or all of the data is presented in graph form. The logdata-viewer can plot data on both the left- and right axis of the graph. Use the checkboxes to select on which axis to plot the data. The selected traces are plotted, each in a different color and a legend with information on which axis they belong to is shown below the graph area. If the trace is broken, the logger has been trigged-off during that time.



Zooming
Zoom in to view details by selecting an area with your mouse (press-and-hold the left mouse button in the graph area and drag the mouse. Release the mouse to zoom in).



After zoom… When zoomed in, use the scroll bars to pan around in the graph area.
Click outside the graph-area to get a popup-menu to reverse the zoom.

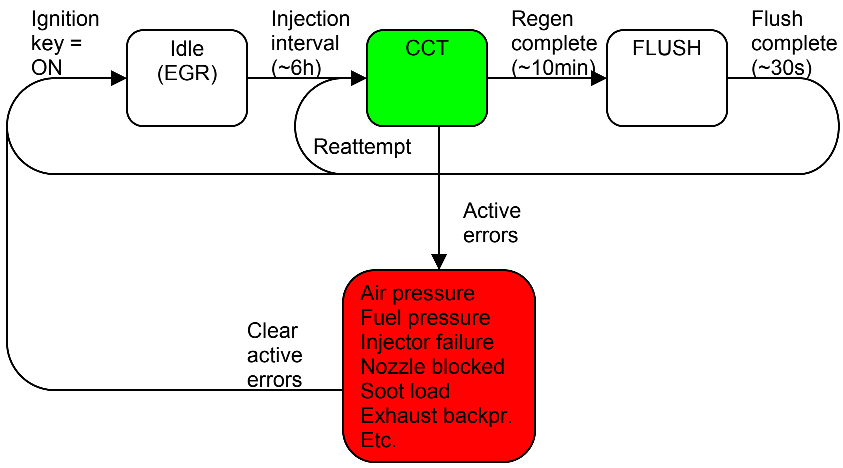


The **Print**-button will print the current graph, as seen on the screen
The **Save**-button saves the current view (selected traces only, and only the time span shown on screen, i.e. the zoomed in data only) to a TAB-separated text file for easy import into a spreadsheet.

5 System state

The control system operates in three states according to the figure below. During DPF cleaning (CCT) and FLUSH states EGR is disabled. Most fault condition will force the system to EGR state. Depending on the fault code EGR may also be disabled.

Note: some fault codes must be manually cleared using Clear active errors **before full operation is restored.**



Note: EGR is an option only active when the CCT*marine* is combined with a **DNO$_X$*marine*** control system. When a **DNO$_X$*marine*** is not fitted all references to 'EGR' may be ignored.

Info tab

This in the main diagnose tab. It gives an overview of the system operation.

Name	Meaning	Default (Ok) value	Red background
Errors	Will scroll thru any active trouble codes at a 2s rate Codes are presented in plain text, see *DTC tab* for more information *Note: trouble codes may show on Errors before they appear in the DTC tab*	N/A	Any trouble code
Current state	For monitoring system operation **System not ready**: Automatic installation failed or was not completed **EGR**: EGR enabled, all valves closed on CCT manifold **CCT**: DPF cleaning in progress, air valve open and injector active, EGR disabled **FLUSH**: System actuators flushed with compressed air after DPF cleaning, Flush valve is open intermittently, EGR disabled	N/A	System not ready
State info	For monitoring system operation, provides additional information to Current state **No info**: System in idle state **Complete: Time duration**: **Complete: Temp integral**: The DPF cleaning was successfully completed **Abort: Activation switch** **Abort: Disabled switch** **Abort: DOC inlet temp under time** **Abort: DOC outlet temp under time**	N/A	N/A

Name	Meaning	Default (Ok) value	Red b.g.
State info (continued)	**Abort: DOC inlet under temp** **Abort: DOC outlet over temp** **Abort: Speed under time** **Abort: EGR error** **Abort: INJ error** **Abort: Air pressure error** **Abort: Fuel pressure error** DPF cleaning was initiated but aborted due to this condition **Waiting: Disable switch** **Waiting: DOC inlet temp** **Waiting: HC smoke temp** **Waiting: H2O smoke temp** **Waiting: Start switch** **Waiting: System errors** **Waiting: Activation switch** **Waiting: Installation** DPF cleaning is requested but cannot start until this requirement is fulfilled	N/A	N/A
State activity	For monitoring system operation, provides additional information to State info Will show remaining time or temperature in above state. Ex: Current state= CCT, State info= Waiting: DOC inlet temp, State activity= 36 means that the DOC inlet temperature must raise 36˚C more before the DPF cleaning can start	N/A	N/A
Air pressure [mbar]	Backpressure measured in the injection manifold (Absolute reading = reads 1013mbar at atmosphere) Monitors the air/fuel flow thru the injection nozzle	Idle: 900-1100 mbar DPF cleaning: 1400-1900mbar	N/A

Name	Meaning	Default (Ok) value	Red b.g.
Air pressure [mbar] (continued)	The pressure is a result of diesel and compressed air being forced thru a tight nozzle to form a uniform spray over the DOC A low pressure indicate lack of air pressure or a damaged hose or nozzle A high pressure indicate a clogged nozzle Both high and low nozzle pressure will disabled DPF cleaning	Idle: 900-1100 mbar DPF cleaning: 1400-1900mbar	N/A
Fuel pressure [mbar]	Pressure generated by the fuel pump (Absolute reading = reads 1013mbar at atmosphere) Monitors the operation of the fuel pump and fuel flow thru the injection nozzle A low pressure indicate leakage or fuel pump malfunction A high pressure indicate problem with the fuel pressure regulator or an abnormally high supply voltage Both high and low nozzle pressure will disabled DPF cleaning	Idle: 900-1100mbar DPF cleaning: 4000-5000mbar	N/A
DOC inlet temp [˚C]	Inlet temperature in the DOC For controlling fuel injection during DPF cleaning DPF cleaning will only start if above ~250˚C	Engine specific	N/A
DOC outlet temp [˚C]	Outlet temp of the DOC For monitoring fuel injection during DPF cleaning Cleaning will abcort when below ~200˚C or above ~800˚C	Idle: Follows DOC inlet temp w delay DPF cleaning: ~650˚C	N/A
IGN outlet temp [˚C]	Outlet temp of the igniter module (option) For monitoring fuel injection during DPF cleaning	Idle: Follows DOC inlet temp DPF cleaning: varies up to ~650˚C	N/A
INJ [0-255]	Fuel injector opening rate **0**: injector closed **255**: injector fully open	Idle: 0 DPF cleaning: 0-255	N/A

Name	Meaning	Default (Ok) value	Red b.g.
Exhaust pressure [mbar]	Exhaust gas back pressure before DOC (Gauge reading = reads 0mbar at atmosphere) For monitoring soot load in the DPF A high exhaust pressure indicate a high soot load in the DPF	Engine specific Should typically not exceed 250mbar	N/A
LP EGR actual	Actual EGR rate should equal target EGR rate +/- 10 units **0**: EGR damper closed, AIR damper open **400**: EGR damper open, AIR damper open **800**: EGR damper open, AIR damper closed	EGR: 0-800 DPF cleaning: 0 Flush: 0	
LP EGR servo temperature	Internal temperature of EGR servo motor. The servo is cooled by the inlet air.	<65˚C typical <105˚C intermittent	

Test tab

This tab is useful for testing the components on the injection manifold and the EGR valve. The Fuel relay activates the fuel pump and optionally the air compressor. The Air-/Flush valves engage the corresponding solenoid on the injection manifold. The EGR valve controls the mix between intake air and recirculated exhaust gas.

Name	Meaning	Default (Ok) value	Red background
Fuel pressure [mbar]	Pressure generated by the fuel pump (Absolute reading = reads 1013mbar at atmosphere) Monitors the operation of the fuel pump and fuel flow thru the injection nozzle A low pressure indicate leakage or fuel pump malfunction	Idle: 900-1100mbar DPF cleaning: 4000-5000mbar	N/A

Name	Meaning	Default (Ok) value	Red b.g.
Fuel	Actual state of the fuel pump control relay. Fuel is not injected until the injector is activated. **OFF**: pump is idle **ON**: pump is running May also start the (optional) air compressor	Idle: OFF DPF cleaning: ON Flush: ON	N/A
Fuel relay	Overrides the fuel relay (and optionally air compressor) output Output is active for 5 sec when the control is pressed. Repeatedly pressing the control gives 5 more seconds up to max 1 minute.	N/A	N/A
Air pressure [mbar]	Injection nozzle backpressure measured in the injection manifold (Absolute reading = reads 1013mbar at atmosphere) Monitors the air/fuel flow thru the injection nozzle The pressure is a result of diesel and compressed air being forced thru a tight nozzle to form a uniform spray over the DOC A low pressure indicate lack of air pressure or a damaged hose or nozzle A high pressure may indicate a clogged nozzle	Idle: 900-1100 mbar DPF cleaning: 1400-1900mbar	N/A
Air	Actual state of the fuel solenoid valve on the injection manifold **OFF**: Valve is closed **ON**: Valve is open	Idle: OFF DPF cleaning: ON Flush: OFF	N/A
Air valve	Overrides the air valve solenoid control output. Air flows thru the outer mantle of the coaxial injection nozzle hose. Valve opens when the control is pressed and closes when the control is released. The override is active for 5 seconds; repeatedly pressing the control gives 5 more seconds up to max 1 minute. If the system is equipped with a separate air compressor you must also activate the Fuel relay to obtain proper Air pressure when actuating this valve	N/A	N/A

Name	Meaning	Default (Ok) value	Red b.g.
FLUSH	Actual state of the flush solenoid valve on the injection manifold **OFF**: Valve is closed **ON**: Valve is open	Idle: OFF DPF cleaning: OFF Flush: ON	N/A
Flush valve	Overrides the flush valve solenoid control output. Air flows thru the inner tube of the coaxial injection nozzle hose (fuel line). Valve opens when the control is pressed and closes when the control is released. The override is active for 5 seconds; repeatedly pressing the control gives 5 more seconds up to max 1 minute. If the system is equipped with a separate air compressor you must also activate the Fuel relay to obtain proper Air pressure when actuating this valve	N/A	N/A
LP EGR actual	Actual state of the EGR valve servo **0**: EGR damper closed, AIR damper open **400**: EGR damper open, AIR damper open **800**: EGR damper open, AIR damper closed	EGR: 0-800 DPF cleaning: 0 Flush: 0	N/A
LP EGR valve	Overrides the LP EGR servo. EGR target is 800 when the control is pressed and 0 when the control is released. The override is active for 5 seconds; repeatedly pressing the control gives 5 more seconds up to max 1 minute.	N/A	N/A

Engine tab

This tab show the readings of the engine mounted sensors. They typically are received via an on-board SAE-J1939 CAN databus.

Name	Meaning	Default (Ok) value	Red background
Engine load [%]	For calculating Engine Air to Fuel ratio and Exhaust massflow. For calculating EGR rate in EGR state Full load is 100% Engine idling is typically around 10% Typically CAN (J1939) data from engine	Engine specific	N/A
Engine speed [rpm]	For calculating air mass flow and required fuel injection during DPF cleaning For calculating EGR rate in EGR state Typically CAN (J1939) data from engine	Engine specific	N/A
Boost pressure [mbar]	Air pressure in the inlet manifold [mbar] (Gauge reading = reads 0mbar at atmosphere) For calculating air mass flow and required fuel injection during DPF cleaning For calculating EGR rate in EGR state Typically CAN (J1939) data from engine	Engine specific	N/A
Boost air temp [˚C]	Temperature in the inlet manifold For calculating air mass flow and required fuel injection during DPF cleaning For calculating EGR rate in EGR state Typically CAN (J1939) data from engine	Engine specific	N/A
Air temp [˚C]	For calculating EGR rate in EGR state. To prevent condensate formation EGR is disabled at lower temperatures. Typically CAN (J1939) data from engine	>10˚C	N/A

Name	Meaning	Default (Ok) value	Red b.g.
Water temp [˚C]	For calculating EGR rate in EGR state. EGR is only active when engine is at working temperature. Typically CAN (J1939) data from engine	65-95˚C	N/A
Inlet pressure [mbar]	For calculating EGR rate in EGR state. EGR is disabled if pressure drops. Typically CAN (J1939) data from engine	< -50mbar	N/A
Activation switch	Enables the entire injection system Triggers offset sampling of Gauge emulated sensors Stores volatile data (regeneration timers, operating time etc) into permanent memory **OFF**: System disabled **ON**: System enabled Typically a digital (0V or 12V) signal from the ignition switch or engine activation/shutdown relay	Engine running: ON Engine stopped: OFF	N/A

DTC tab

This tab contains a list of all stored and active trouble codes. Active codes are presented in red in sttDiag.
Note: DTC's with a red marking in the last column will inhibit DPF cleaning and must be immediately attended in order not to damage the DPF. If the box also contains an 'L' the code will not self-restore and must be manually cleared!

Name	Trouble condition	Possible fault	Action	E
Speed sensor	CAN (J1939) sensor not transmitting or Analog sensor reading 0.0V or 5.0V	Damaged sensor Cable break Cable short circuit	Check wiring Replace sensor	
Boost temp sensor				
Boost sensor				
Air temp sensor				
Water temp sensor				

Name	Trouble condition	Possible fault	Action	E
DOC inlet temp sensor	Sensor reading <-100C or >2000C	Damaged sensor Cable break Cable short circuit	Check wiring Replace sensor	
DOC outlet temp sensor				
Exhaust prs sensor	Sensor reading 0.0V or 5.0V			
Air pressure sensor				
Fuel pressure sensor				
Fuel temp sensor				
IGN temp sensor				
CAN communication	Control system cannot communicate with engine J1939 databus			
Exhaust hose blow-off	Sensor reading “frozen” (not changing over time) but within electrical limits	Damaged sensor Hose broken, leaking or plugged	Replace sensor Replace hose	
Boost hose blow-off				
Inlet hose blow-off				
Activation switch	Activation switch = OFF while engine appears to be running (Air massflow > 0)	Cable break Cable short circuit	Check wiring to Activation switch Check sensors relating to Air mass flow; Engine speed, Boost pressure and Boost temp	
Supply voltage	DC supply voltage out of range 12V system: < 11V or > 32V 24V system: <16V or > 32V	Damaged alternator or battery Short circuit in wire or sensor	Check wiring Check battery and alternator	
Air pressure	Nozzle backpressure is out of limit Idle: ~900-1100mbar	Compressed air pressure to low, correct supply pressure is ~4000mbar	Check air compressor fuse and relay (if compressor fitted)	

Name	Trouble condition	Possible fault	Action	E
Air pressure (continued)	DPF cleaning: ~1200-2000mbar Flush: ~1200-2000mbar	Injection nozzle blocked Leakage in nozzle assembly Cable break Cable short circuit	Check air pressure sensor on injection manifold Check wiring	
Fuel pressure	Fuel pressure in injection manifold is out of limit Idle: ~900-100mbar DPF cleaning: ~4000-5000mbar Flush: ~4000-5000mbar	Fuel pump not operating correct Fuel pressure regulator on injection manifold damaged Cable break Cable short circuit	Check fuel pump fuse and rely Check fuel pressure regulator Check fuel pressure sensor on injection manifold Check wiring	
INJ control	The control actuator for the fuel injector solenoid in the injection manifold is measuring a faulty voltage The injector is pulse modulated and the voltage feedback should toggle rapidly between 0 and 12 or 24V	Damaged injector Cable break Cable short circuit *Note: This DTC does not detect a blocked injector or fuel path*	Check injector (resistance ≈ 15Ω) Check wiring	
IGN control	The control actuator for the igniter module is measuring a faulty voltage The injector is pulse modulated and the voltage feedback should toggle rapidly between 0 and 12 or 24V	Damaged igniter module Cable break Cable short circuit	Check igniter (resistance ≈ 1Ω at 25˚C) Check wiring	

Name	Trouble condition	Possible fault	Action	E
EGR control	The servo actuator for the EGR valve cannot assume target position	Mechanical throttle damper failure Throttle return spring broken Damaged EGR servo module Cable break Cable short circuit	Check and clean throttle valve from soot Run EGR valve test procedure (see Post installation inspection procedure) Check wiring and fuses	
Inlet overpressure	Pressure drop over the inlet filter system exceeds ~50mbar EGR is disabled	Engine inlet filter clogged Inlet sensor hose clogged Inlet pressure sensor broken	Check/replace inlet filter Clean hose to pressure sensor Check inlet pressure sensor	
DOC outlet overtemp	Temperature downstream the DOC is above ~850˚C Indicates that too much fuel is injected during DPF cleaning	Sensor failure; DOC inlet temperature, DOC outlet temperature, Engine speed, Boost pressure, Boost temp TC lube oil leakage into exhaust stream, Major exhaust pipe leakage upstream DOC	Check DOC and DPF for damage from overtemperature Check exhaust piping Check turbocharger Check sensors	L
Exhaust pressure warning	Exhaust backpressure before the DPF is to high The limit is application specific but should typically not exceed ~250mbar May also set the soot level warning/alarm Typically follows upon any regeneration error	Soot build-up in DPF or DOC See Soot level warning/alarm	Check and clean DPF and DOC Check injection nozzle Check Igniter	
Exhaust pressure alarm				L

Name	Trouble condition	Possible fault	Action	E
Soot level warning	The soot load of the DPF is to high for the cleaning process to start. Attempting to clean the DPF at high soot load may damage the filter. May also set the Exhaust pressure warning/alarm	Soot build-up in DPF or DOC due to repeated regeneration failure, inspect trouble code list for root cause failure(-s) e.g; Partially blocked injection nozzle Damaged DOC Damaged Igniter	Check DPF and DOC Check injection nozzle Check Igniter **Note: If the warning is left unattended there is a great risk that the fault code will progress into alarm where the DPF must be removed and manually cleaned!**	
Soot level alarm			Manually clean DPF and DOC Check injection nozzle	**L**
Soot low level alarm	The measure backpressure before the DPF is too low. The limit is application specific but should always be above 0mbar when engine is running	Exhaust leakage in DPF, DOC or piping Exhaust pressure sensor failure	Check DOC and DPF assembly Check Exhaust pressure sensor	**L**
Regeneration frequency warning	The DPF cleaning process is activated too frequently	Ash build-up in DPF Rapid soot build-up in DPF (abnormal engine smoke level is abnormally high)	Check/clean DPF and DOC Check engine (TC, injectors)	
Regeneration frequency alarm				**L**
Regeneration interval warning	The DPF cleaning process has not been successfully completed within a given interval. The interval is application specific but is typically around	Engine running at to low load (for the DPF cleaning process to start or complete) over an extended period	Operate engine at higher load Check/replace injection nozzle	
Regeneration interval alarm				**L**

Issuer: Leif Högberg
Tel: + 46 60 142073
Fax: + 46 60 142065
E-mail: leif.hogberg @STTEmtec.com

Name	Trouble condition	Possible fault	Action	E
Regeneration interval alarm (continued)	16-24h of engine operation See also Soot regeneration restarts	DPF cleaning repeatedly aborted by engine shutoff Damaged injection nozzle		
Regeneration interval warning				
Catalyst conversion	Target exhaust temperature downstream DOC is not reached during DPF cleaning May also set the Regeneration interval warning/alarm	Injection nozzle blocked DOC damaged	Check/replace injection nozzle	**L**
Soot regeneration restarts	The DPF cleaning process has been aborted too often. DPF cleaning require ~15 min of engine running (above idling) to complete. If rpm drops to idling for a longer period or if the engine is shut off the cleaning process will abort. See also Regeneration interval warning/alarm DPF cleaning keeps trying regardless of this alarm	Changed engine/vessel operating cycle Damaged DOC temperature sensors Activation switch circuit failure Damaged wiring harness (regarding DOC temperature sensors and Activation switch)	Verify operating cycle Check DOC temperature sensors Check Activation switch function	
Internal temp	ECU internal failure	N/A	Replace control unit	
Program failure				
Mapdata failure				

Appendix 6 Commissioning prerequisites

In order to achive a successful commissioning of the SCRmarine system the following conditions must be met

6.1. System installation completed, checklist below

6.1.1. Exhaust system
6.1.2. DPF catalyst/filter assembly installed
6.1.3. Exhaust system without leakage
6.1.4. Insulation of exhaust system completed

6.1.5. Diesel dosing system
6.1.6. Injection manifold assembly installed
6.1.7. Injection nozzle installed
6.1.8. Fuel pump/catch tank assembly installed on engine fuel return
6.1.9. Diesel pipes or hoses between catch tank and injection manifold installed and air tight
6.1.10. Hoses for exhaust backpressure pressure sensor assembly installed and air tight with a continuous downward slope
6.1.11. Pipe or hose for compressed air installed

6.1.12. Electrical system
6.1.13. CCT control cabinet installed
6.1.14. Sensors and cables installed according to Appendix 4
6.1.15. Supply voltage installed according to Appendix 4 (24VDC or 230VAC)
6.1.16. CAN (J1939) cable connected to engine management system, the following signals must be available:

- Engine speed
  - PGN 0xF004: EEC1 – EngineSpeed
- Boost pressure
  - PGN 0xFEF6: InletExhaustCond – BoostPressure
- Boost temperature
  - PGN 0xFEF6: InletExhaustCond – IntakeManifoldTemp or
  - PGN 0xFEF5: AmbientConditions – AirInletTemperature

6.1.17. RUN (Engine running) cable connected to engine management system contact closing when engine is running

6.2. Optional system

6.2.1. CCT system alarm relay output in CCT control cabinet connected to vessel monitoring sum alarm or equivalent system
6.2.2. LCD display installed on bridge and connected to CCT control cabinet
6.2.3. DPF cleaning start switch installed on bridge and connected to CCT control cabinet

6.3. Compressed air available

- 4 bar, 25 l/min continuous per system (70l/min free air)

6.4. Supply voltage available at control cabinet

- 24VDC/10A or 230VAC depending on installation (See Appendix 4)

6.5. Engine able to run under normal load conditions

- 15 min 25% continuous load
- 15 min 50% continuous load
- 15 min 75% continuous load
- 15 min 100% continuous load

NOTE: Engine operation with CCT system deactivated

After the DPF assembly is installed engine operation must be extremely restricted until the CCT system is operational. Engine malfunction and severe damage to the DPF may otherwise occur due to excessive soot build-up.
Max 2 hours total running time before commissioning after DPF installation is allowed.

Appendix 7 Post installation and inspection

After an installation is completed it is important that the system is checked from a complete list of inspection points and adjustments before the system is and handed over to the operator.

The inspection includes testing alarms, fault codes and its intended default position. The list of inspection points can vary between engines and applications and are therefore presented in an appendix to this document.

This protocol must be followed and completed in order to enable the product warranty and is a part of the documentation package handed over to the system operator.

Group	Power supply
Sub system / actuator/sensor	CCT Control cabinet

System status during test

Item	**Status**
Compressed air	Off
Main switch electrical central for CCT control cabinet	On
Power switch inside the control cabinet	On (enabled)
Service tool connected to the control cabinet	Not required
Engine	Off

Tests and result

Step	Test	Approved interval	Result	Signature
1	Make sure that the 230VAC main supply, (terminal group A) is properly grounded to the frame	<1.0 Ohm		
2	Measure voltage on terminal group A (230 VAC) in the control cabinet. Measure between terminal connectors N and L	200-250 VAC		
3	Measure voltage on terminal group B in the control cabinet. Measure between any terminal in group C and any terminal in group B.	23-25 volt		
4	Measure voltage on terminal group E in the control cabinet. Measure between any terminal in group D and any terminal in group E.	4,5-5,5 volt		

Group	Control system
Sub system / actuator/sensor	System wiring

System status during test

Item	**Status**
Compressed air	On
Main switch electrical central for CCR control cabinet	On
Power switch inside the control cabinet	On (enabled)
Service tool connected to the control cabinet	EmtecDiag conected
Engine	Off

Tests and result

Step	Test	Approved interval	Result	Signature
1	Connect EmtecDiag service tool to the control cabinet. Establish online connection and upload .XML file (map file). Make sure that the correct .XML file and correct. HEX file (firmware) are used.	File names according to system spec. sheet		
2	Clear all errors by using EmtecDiag			
3	Check if any active errors occur. If any active error occurs, consult error code list, appendix 8 for corrective actions. **Note.** If CAN J1939 is used for obtaining engine signals, errors for engine signals can occur if engine control system is deactivated.			

Group	Sensors
Sub system / actuator/sensor	Type K thermocouples

System status during test

Item	**Status**
Compressed air	On
Main switch electrical central for CCT control cabinet	On
Power switch inside the control cabinet	On (enabled)
Service tool connected to the control cabinet	EmtecDiag conected
Engine	Off

Description

The exhaust temperature sensors are used to meter fuel during DPF regeneration and also to monitor engine and CCT*marine* system operation. The TDO sensor (DOC outlet temp) is always located at the DPF assembly, downstream the DOC. If an Igniter unit is fitted the TDI sensor (DOC inlet temp) is located on that unit and the TIO sensor (IGN outlet temp) is placed at the DPF assembly upstream the DOC. Without an Igniter module the TDI sensor is placed at the DPF assembly upstream of the DOC.

Tests and result

Step	Test	Approved interval	Result	Signature
1	Check temperature readings on Emtec mapper meters DOC inlet temp , DOC outlet temp and IGN outlet temp (when applicable). Check if the value is reasonable according to current conditions.	± 5°C to ambient temperature		
2	Unplug the connector at TDI (DOC inlet temp) and check that EmtecDiag identifies the correct sensor by changing temperature meter colour from green to red. And that the corresponding fault code becomes active (standard default is 0°C). Reconnect the sensors and check that the fault code becomes inactive and that the reading resume the original value Repeat the procedure with TDO (DOC outlet temp) and TIO (IGN outlet temp) when applicable			

Group	Sensors
Sub system / actuator/sensor	Exhaust pressure sensor

System status during test

Item	**Status**
Compressed air	On
Main switch electrical central for CCT control cabinet	On
Power switch inside the control cabinet	On (enabled)
Service tool connected to the control cabinet	EmtecDiag conected
Engine	Off

Description

The exhaust pressure sensor is used to monitor soot loading of the DPF and to detect high exhaust back pressure.
The exhaust pressure is normally located at the bracket for the Fuel handling and Injection manifold units and is marked with “EBP”.
Exhaust pressure reads gauge (≈0mbar at atmosphere).

Tests and result

Step	Test	Approved interval	Result	Signature
1	Check that the value on the meter “Exhaust pressure” (gauge) in Emtec mapper corresponds to 0 mbar.	0 mbar ± 10 mbar max.		
2	Disconnect the pressure hose to the sensor and apply a known pressure to the sensor. Note: max pressure 1000 mbar.	± 10 mbar max difference to the applied pressure.		

Group	Sensors
Sub system / actuator/sensor	Engine sensors

System status during test

Item	**Status**
Compressed air	On
Main switch electrical central for CCT control cabinet	On
Disable switch inside the control cabinet	On (enabled)
Service tool connected to the control cabinet	EmtecDiag conected
Engine	On

Description

Run the engine on idle and check all engine related signals. The signals are checked by comparing the readings on the relevant meters in the service tool to the corresponding standard engine instrumentation.
The engine signals can be supplied to the CCT control system via the engines CAN (SAE J1939) system or from external digital and or analogue sensors. The inspection procedure is the same.

Note that some engines does not broadcast CAN signals if the engine is not running. If so, the CCT system can display active error codes for these signals when the engine is stopped. The errors will clear as son as the engines is started.

Boost pressure reads gauge (≈0mbar at atmosphere).

Tests and result

Step	Test	Approved interval	Result	Signature
1	Engine load - eng off - Eng idle	within ± 5% of standard instrumentation		
2	Engine speed – eng off - eng idle	within ± 5% of standard instrumentation		
3	Boost pressure – eng off (gauge) - eng idle	within ± 5% of standard instrumentation		
4	Boost air temperature – eng off - eng idle	within ± 5% of standard instrumentation		

NOTE: absolute vs guage tryck

Group	Air and fuel lines
Sub system / actuator/sensor	Air and fuel valves

System status during test

Item	**Status**
Compressed air	On
Main switch electrical central for CCT control cabinet	On
Power switch on inside the control cabinet	On (enabled)
Service tool connected to the control cabinet	EmtecDiag conected
Engine	Off

Description

The compressed air is connected to the Injection manifold via a regulator. See the installation guideline for more information about the air regulator. The regulator is typically located at the bracket for the Fuel handling and Injection manifold units.
When the compressor is running and either of the Air- or Flush valves on the Injection manifold are open air will flow thru the Injection nozzle and create a backpressure in the nozzle tip. This pressure is measured as "Air pressure" in the control system. The control Air valve flow air thru the outer mantle of the nozzle hose whereas the Flush vale flow air thru the inner hose (the fuel line). When a 24V compressor is used the Control Fuel relay need to be activated in order for the compressor to start.
Air pressure and Fuel pressure reads absolute (≈1000mbar at atmosphere).

Tests and result

Step	Test	Approved interval	Result	Signature
1	In the service tool make sure that the meters FUEL , AIR and FLUSH all show OFF. Verify that both Air pressure (absolute) and Fuel pressure (absolute) is around atmosphere pressure. ***!Note!**: If FUEL has recently been active it may take a few minutes before the Fuel pressure drops to atmosphere.*	1000 ±100mbar		
2	In the service tool press the control Fuel relay repeatedly until Time > 30s. Verify that the Fuel pressure is within the approved interval	4100-4900 mbar		
3	*Without 24V compressor* In the service tool press the control Air valve repeatedly until Time > 30s. Adjust the air regulator so that the meter "Air	1600mbar ±100mbar		

	pressure” reads 1800±200mbar. Verify that the air pressure at the manometer of the regulator show ~4 bar and that regulator cap is in the locked position (pushed down).	4,0bar ±0.5bar		
	With 24V compressor In the service tool press the controls Fuel relay and Air valve repeatedly until Time > 30s on both. Verify that the Air pressure is within the approved interval	1400mbar ±200mbar.		
4	*Without 24V compressor* In EmtecDiag press the control Flush valve repeatedly until Time > 30s. Verify that the Air pressure is within the approved interval	2400mbar ±100mbar		
	With 24V compressor In EmtecDiag press the controls Fuel relay and Flush valve repeatedly until Time > 30s on both. Verify that the Air pressure is within the approved interval	1400mbar ±200mbar.		

Group	Air and fuel lines
Sub system / actuator/sensor	Regeneration temperature

System status during test

Item	**Status**
Compressed air	On
Main switch electrical central for CCT control cabinet	On
Power switch inside the control cabinet	On (enabled)
Service tool connected to the control cabinet	EmtecDiag conected
Engine	On

Description

Start the engine and press the Injection control in the service tool. This will trigger a DPF regeneration. Make sure there are no trouble codes active. If so; consult the appropriate appendix to troubleshoot the system before the regeneration can start. If the engine is cold the meter State info will show Waiting DOC inlet temp/Waiting HC smoke temp/Waiting H2O smoke temp. Run the engine at load until the temperature conditions are met. The regeneration will only start when the DOC has reached a temperature of 250-300˚C (the exact temperature is system dependant). When the engine (and exhaust gas) is warm enough the meter System state will shift from EGR to CCT indicating that the regeneration process has started. In the next few minutes the meter DOC outlet temperature should rise swiftly to ~650˚C while the meter DOC inlet temperature reflect the engine out exhaust temperature. The regeneration process takes about 10-15min to complete. During regeneration; note the approximate average of the DOC outlet temperature. After the regeneration is completed the meter System state will shift from CCT to FLUSH. Flushing takes about 60s to complete and during this time only compressed air is forced thru the Injection manifold and nozzle.

Tests and result

Step	Test	Approved interval	Result	Signature
1	Visual inspection of fuel connections and lines between the main fuel tank and the CCT*marine* catch tank. (see Fuel handling system in the Installation guide)	No leakage		
2	Visual inspection of fuel connections and lines between the fuel catch tank and the Injection manifold (see Injection manifold in the Installation guide)	No leakage		
3	Visual inspection of air connections from main regulator to the Injection manifold. Use of leak spray recommended. (see Air supply in Installation	No leakage		

	guide)			
4	Visual inspection of Injection nozzle hose. Use of leak spray recommended (see Injection nozzle in Installation guide)	No leakage		
5	Check if any trouble codes occur during engine heating up or regeneration. If any; consult appendix containing the error code list for corrective actions.	No trouble codes		
6	Average temperature after saturation > 600˚C	600-700˚C		

After finalization of the post installation inspection checks, clear the error code list and disconnect the service tool.

Make sure that all connectors and hoses are reinstalled properly and leave the disable switch inside the control cabinet on (enabled) and the compressed air valve open.

Appendix 8 Installing analogue sensors

This document contains general information regarding sensor installation on engines without CAN bus protocol (J1939).

Position of sensors, cabling, threading, welding of adapters and so on differs between applications and has to be developed for each installation.

8.1 Engine load sensor (Throttle position sensor)

This chapter is only for engines without engine load signal at the CAN bus (J1939).

Bag 104103 contains mounting details for the load sensor.

Remove screw and nut in the centre of the injection pump axle. Mount a spacer nut on injection pump axle. Mount support washer on the injection pump axle, use tapered head screw. Before tightening the tapered head screw, adjust the support washer so that the two M4 holes are in a parallel line with the injection pump lever arm.

Mount position indicator on support washer with the two allen head M4 screw.

Mount load sensor bracket. It is possible that the sensor bracket needs to be modified to fit at the injection pump.

The height of the position sensor should be approximately 2mm lower than the height of the load sensor bracket. If the distance is bigger use washers between the spacer nut and support washer to adjust. Mount the load sensor on the load sensor bracket.

8.2 Engine speed sensor

This chapter is only for engines without engine speed signal at the CAN bus (J1939).

Option 1: OEM RPM sensor
Locate the OEM RPM sensor and the RPM signal wire. Strip off a section of insulation (do not cut) this wire approximately 30mm from the sensor. Solder the STT Emtec wire marked RPM and the OEM RPM wire together and insulate with shrink hose or similar to ensure that the seal is completely tight.

Option 2: RPM signal from the generator, marked W
Route the engine speed wire from the SCR control cabinet to the generator and the connector marked “W”.

Option 3: STT Emtec RPM sensor
Mount the alternator RPM sensor (included in the bag with STT P/N 107938) using a bracket (not included). Turn the alternator so that one of the alternator fan blades is directly under the RPM sensor. Adjust the bracket so that the distance between the RPM

sensor and the fan blade is approximately 2mm. Turn the alternator around and make sure that all fan blades passes the sensor with the same distance. Figure below shows an example of an RPM sensor installed at the generator. Wire the harness from the sensor to the SCR control cabinet. Secure the harness with cable ties. Cut the open wire side to the right length and make proper connections in the cabinet (see the wiring layout document in appendix 2).

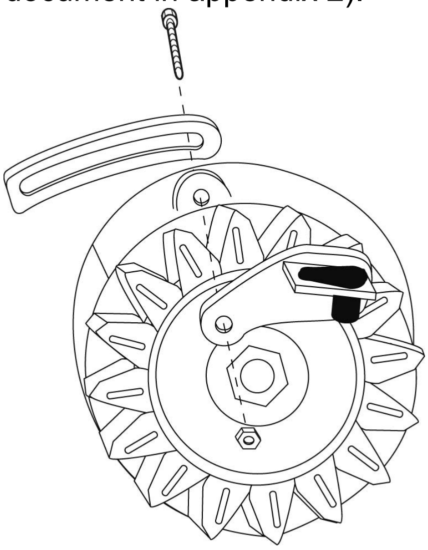


Figure 44
RPM sensor at the generator (example only)

8.3 Boost pressure (MAP) sensor

This chapter is only for engines without the boost pressure signal from the CAN bus (J1939)

Bag STT P/N 107938 contains the sensor and the wiring harness for the boost pressure sensor installation. Locate the air inlet pipe. Mount a boss at the air inlet pipe. The figure below shows an example of the mounting position of the boss. Mount the sensor near to the air inlet pipe. Connect a hose between the MAP sensor and the boss at the air inlet pipe using clamps.

Note! Ensure the MAP sensor hose is routed uphill from the air inlet pipe to the sensor!

Secure hose with cable ties.

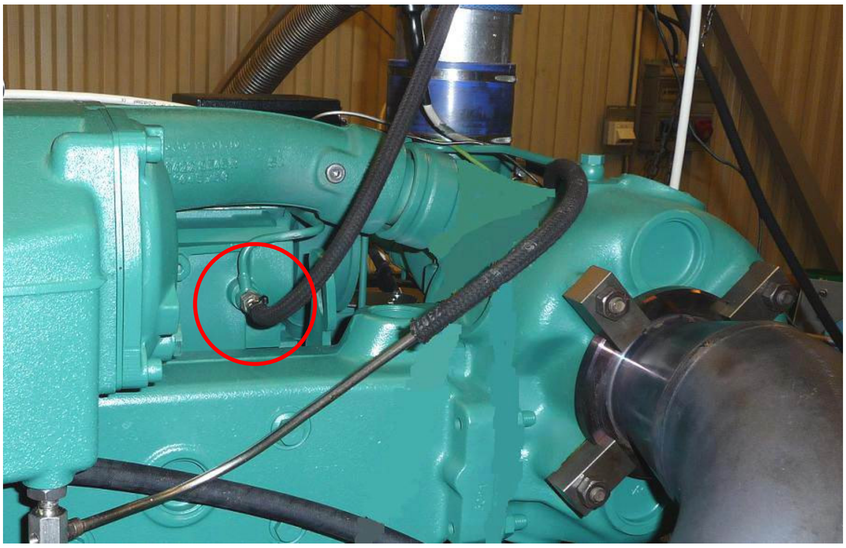


Figure 45. *Mounting position of the boss for the MAP sensor. Example only!*

Wire the harness from the sensor to the SCR control cabinet. Secure the harness with cable ties. Cut the open wire side to the right length and make proper connections in the cabinet (see the wiring layout document in appendix 2).

8.4 Manifold inlet temperature (MIT) sensor

This chapter is only for engines without the manifold inlet temperature signal at the CAN bus (J1939).

Bag 107938 contains the sensor and the wiring harness for the boost pressure sensor installation. Locate the air inlet pipe. Mount the sensor at the air inlet pipe using a boss or direct into the inlet pipe. Make sure that the sensor element is in touch with the gas stream. Figure below shows the temperature sensor delivered by STT. The thread is M10x1.5.

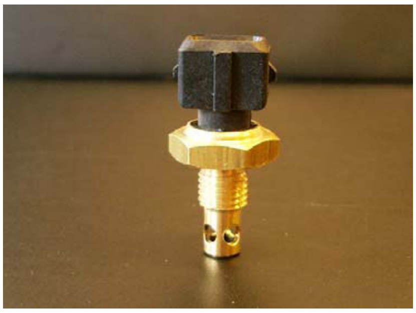
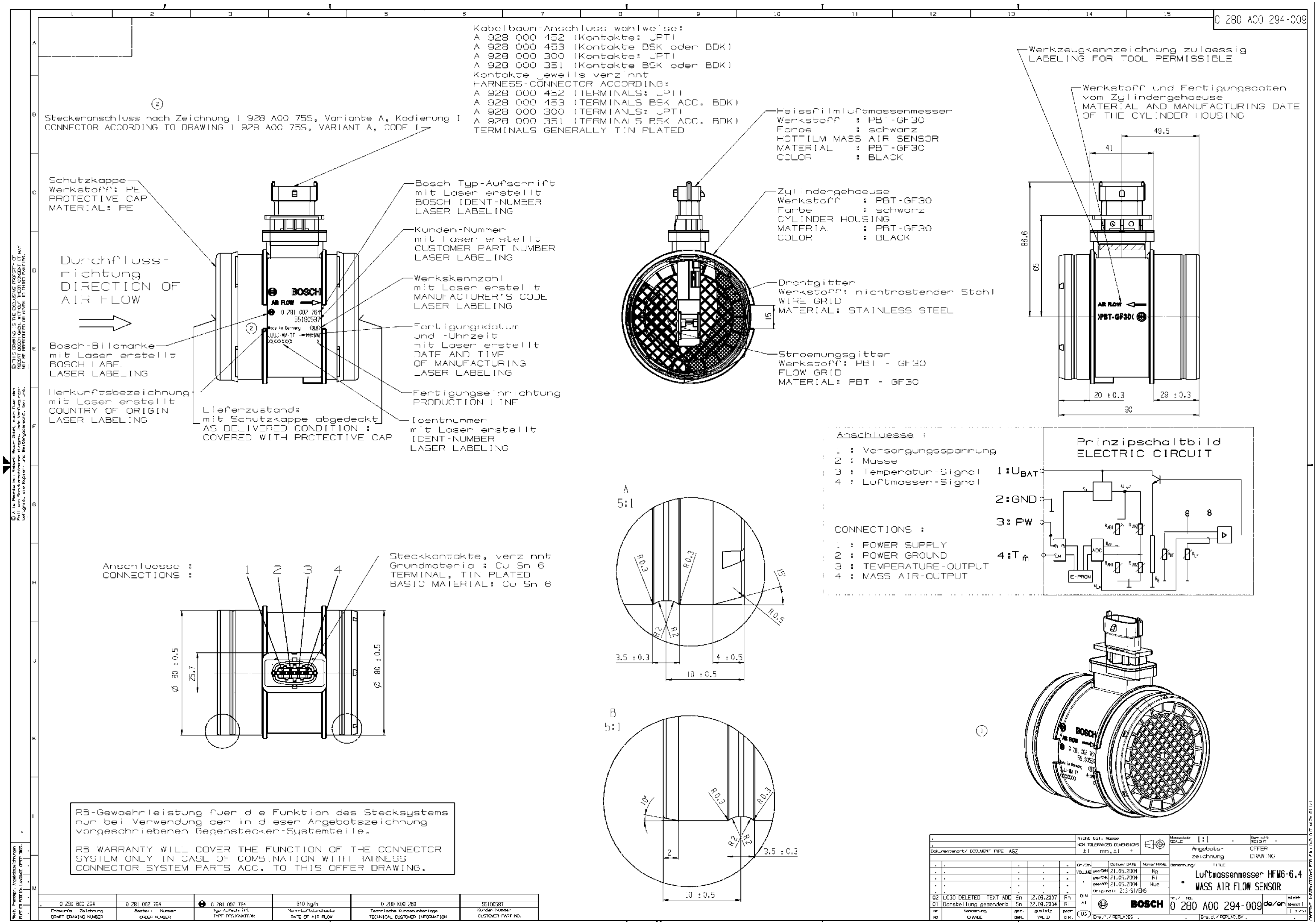


Figure 46. *Manifold inlet temperature sensor.*

Wire the harness from the sensor to the SCR control cabinet. Secure the harness with cable ties. Cut the open wire side to the right length and make proper connections in the cabinet (see the wiring layout document in appendix 2).

Appendix 9 Sensor datasheets

For each applicable sensor read the datasheet carefully to make sure that the installation follows the sensor requirements.


0 280 A00 294-009
Kabelbaum-Anschluss wahlweise:
A 928 000 452 (Kontakte: JPT)
A 928 000 453 (Kontakte BSK oder BDK)
A 928 000 300 (Kontakte: JPT)
A 928 000 351 (Kontakte BSK oder BDK)
HARNESS-CONNECTOR ACCORDING:
A 928 000 452 (TERMINALS: JPT)
A 928 000 453 (TERMINALS BSK ACC. BDK)
A 928 000 300 (TERMINALS: JPT)
A 928 000 351 (TERMINALS BSK ACC. BDK)
TERMINALS GENERALLY TIN PLATED
Steckeranschluss nach Zeichnung 1 928 A00 755, Variante A, Kodierung I
CONNECTOR ACCORDING TO DRAWING 1 928 A00 755, VARIANT A, CODE I
Schutzkappe
Werkstoff: PE
PROTECTIVE CAP
MATERIAL: PE
Durchfluss-richtung
DIRECTION OF AIR FLOW
Bosch-Bildmarke mit Laser erstellt
BOSCH LABEL LASER LABELING
Herkunftsbezeichnung mit Laser erstellt
COUNTRY OF ORIGIN LASER LABELING
Lieferzustand: mit Schutzkappe abgedeckt
AS DELIVERED CONDITION : COVERED WITH PROTECTIVE CAP
Bosch Typ-Aufschrift mit Laser erstellt
BOSCH IDENT-NUMBER LASER LABELING
Kunden-Nummer mit Laser erstellt
CUSTOMER PART NUMBER LASER LABELING
Werkskennzahl mit Laser erstellt
MANUFACTURER'S CODE LASER LABELING
Fertigungsdatum und -Uhrzeit mit Laser erstellt
DATE AND TIME OF MANUFACTURING LASER LABELING
Fertigungseinrichtung
PRODUCTION LINE
Identnummer mit Laser erstellt
IDENT-NUMBER LASER LABELING
Heissfilmluftmassenmesser
Werkstoff : PBT-GF30
Farbe : schwarz
HOTFILM MASS AIR SENSOR
MATERIAL : PBT-GF30
COLOR : BLACK
Zylindergehaeuse
Werkstoff : PBT-GF30
Farbe : schwarz
CYLINDER HOUSING
MATERIAL : PBT-GF30
COLOR : BLACK
Drahtgitter
Werkstoff: nichtrostender Stahl
WIRE GRID
MATERIAL: STAINLESS STEEL
Stroemungsgitter
Werkstoff: PBT - GF30
FLOW GRID
MATERIAL: PBT - GF30
Werkzeugkennzeichnung zulaessig
LABELING FOR TOOL PERMISSIBLE
Werkstoff und Fertigungsdaten vom Zylindergehaeuse
MATERIAL AND MANUFACTURING DATE OF THE CYLINDER HOUSING
49.5
41
86.6
65
20 ±0.3
29 ±0.3
90
Anschluesse :
1 : Versorgungsspannung
2 : Masse
3 : Temperatur-Signal
4 : Luftmasser-Signal
CONNECTIONS :
1 : POWER SUPPLY
2 : POWER GROUND
3 : TEMPERATURE-OUTPUT
4 : MASS AIR-OUTPUT
Prinzipschaltbild
ELECTRIC CIRCUIT
1:UBAT
2:GND
3:PW
4:Tm
Anschluesse :
CONNECTIONS :
1 2 3 4
Steckkontakte, verzinnt
Grundmaterial : Cu Sn 6
TERMINAL, TIN PLATED
BASIC MATERIAL: Cu Sn 6
Ø 80 ±0.5
25.7
A 5:1
3.5 ±0.3
4 ±0.5
10 ±0.5
B 5:1
3.5 ±0.3
10 ±0.5
RB-Gewaehrleistung fuer die Funktion des Stecksystems nur bei Verwendung der in dieser Angebotszeichnung vorgeschriebenen Gegenstecker-Systemteile.
RB WARRANTY WILL COVER THE FUNCTION OF THE CONNECTOR SYSTEM ONLY IN CASE OF COMBINATION WITH HARNESS CONNECTOR SYSTEM PARTS ACC. TO THIS OFFER DRAWING.
0 280 B00 254 Entwurfs Zeichnung DRAFT DRAWING NUMBER
0 281 002 764 Bestell Nummer ORDER NUMBER
0 281 002 764 Typ-Aufschrift TYPE DESIGNATION
640 kg/h Nenn-Luftdurchsatz RATE OF AIR FLOW
0 280 K00 269 Technische Kundenunterlage TECHNICAL CUSTOMER INFORMATION
55190597 Kunden-Nummer CUSTOMER-PART-NO.
Angebots-zeichnung OFFER DRAWING
Luftmassenmesser HFM6-6.4
MASS AIR FLOW SENSOR
0 280 A00 294-009
02 LC30 DELETED TEXT ADD 12.06.2007
01 Darstellung geaendert 22.09.2004
21.05.2004
BOSCH

Produkt / Product: **Heißfilmluftmassenmesser**
Mass Air Flow Sensor

Typ / Type: **HFM6 – 6.4 ID**

Bestellnummer / Part Number: 0 281 002 763/764

Angebotszeichnung / Offer Drawing: 0 280 A00 294-009

Prüfmethoden-TKU / Test Method-TCI: 0 280 K00 002

Schnittstellen-TKU / Interface-TCI:: 0 280 K00 004

Handhabung-TKU / Handling-TCI: 0 280 K00 003

Applikationshinweis / Application Information:
Gasoline Systems: 0 280 K00 038
Diesel Systems: 0 281 YE0 002

Applikations-Checkliste / Application Checklist :
Gasoline Systems: Y 280 A20 707
Diesel Systems: Y 281 E22 045

Kennlinie / Characteristic Curve
Luftmasse / Mass air: 0 280 K00 082 (Anhang A/ Appendix A)
Lufttemperatur/ Air Temperature
- Signal/Signal HFM-Sensorchip 0 280 K00 103 (Anhang B/ Appendix B)

Bemerkung / Comment:

Nr. Index	Seite Page	Änderung Revision	Datum Date	GS-SI/ENS5 (gz/dr)	GS-SI/ENS5 (gp/ch)	GS-SI/ENS (gs/appr.)	DS/EDS1 (gs/appr.)	DS/SGF (gs/appr.)
—	—	**Erstausgabe / First Edition**	18.05.05	Schwaben.	Konzelmann 23.05.05	i.V. Konzelmann 23.05.05	Brückner 01.06.05	Hillmann 03.08.05

In case of doubt, the German version of this standard must be applied.

Contents

1. General

1.1 General information

HFM6-ID is a mass air flow sensor of the 6th generation with an air flow duct with 2 paths for air flow. Air with water and particles is separated from clean air with centrifugal forces. In one path the reference mass air will pass across the sensor element, and in the other path the air with water and particles is directed out of the sensor.
The temperature of the intake air can be measured depending on the dynamic requirements with a signal from a temperature sensor located directly on the mass air sensor element.

In this cover sheet additional information of the mentioned documents can be found, e.g. application note, interface TCI and handling TCI.

1.2 Application in vehicle

The mass air flow sensor (HFM) is designed as a sensor for metering the mass air and temperature of the intake air for an engine application.
The HFM is designed for diesel and gasoline applications.
The design of the HFM allows for reverse air flow measurement. Pulsations in the air flow can potentially create reverse air flow conditions. Thus, the mean mass air flow can correctly be determined if there are pulsations.

1.3 Design and function

1.3.1 Basic design

The HFM consists of a plug-in sensor and cylinder housing (figure 1).

The electronic module, with the evaluation circuit (hybrid) and the sensor element, is located in the plug-in sensor (figure 2).
The sensor element is positioned on the electronic module and extends into the metering duct (bypass channel) of the connector housing.

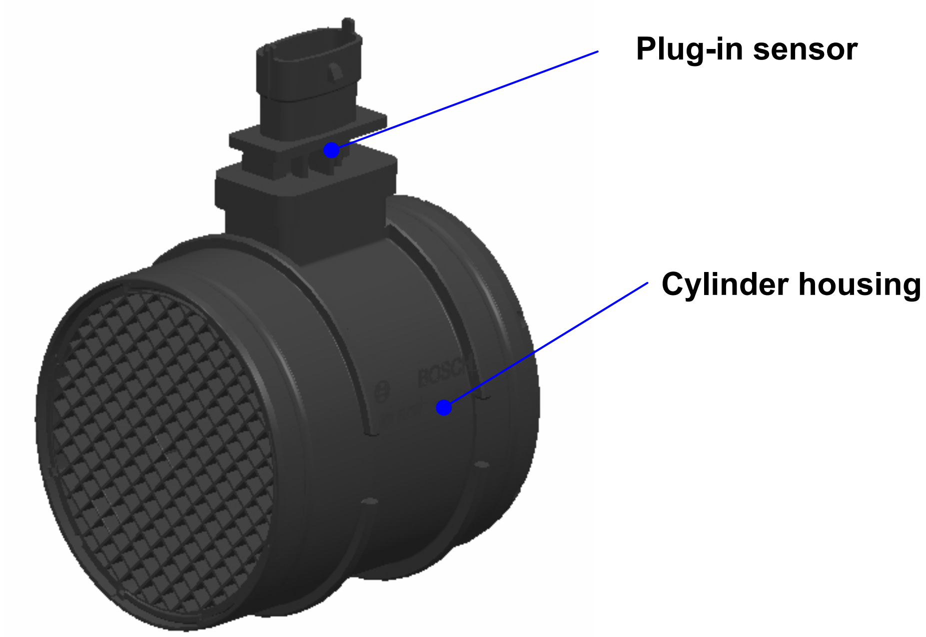


Figure 1:
General view HFM 6.4ID

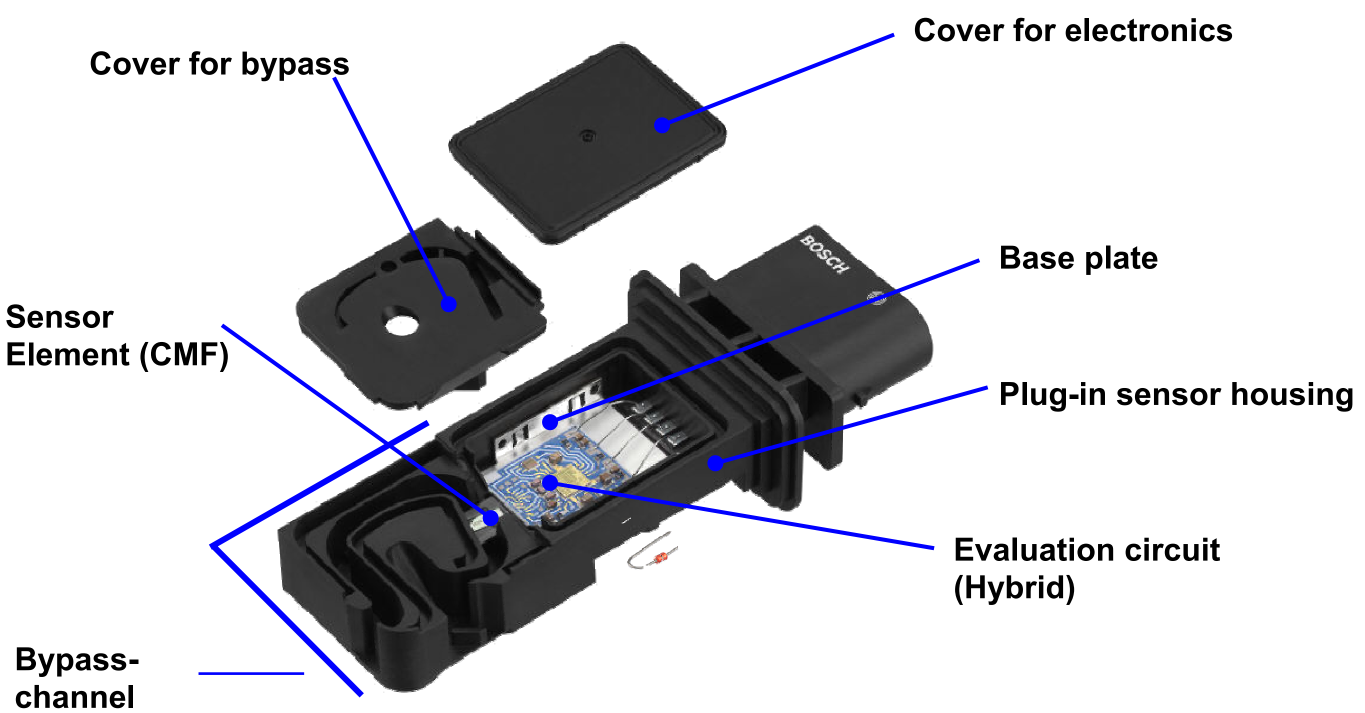


Figure 2:
HFM6-ID Plug-in sensor

1.3.2 Functional description

The HFM6 hot-film mass air flow sensor is a thermal flowmeter.

From the intake air flow within the cylinder housing, a portion of the total mass air flow will pass across the sensor element in the bypass channel. This portion of the mass air flow is then calibrated to the total mass air flow in the cylinder housing.

A diaphragm is located on the sensor element. In the center of the diaphragm is a heating zone with symmetrically placed temperature sensors (figure 3).

The heating zone is controlled to a certain temperature. Without air flow, the temperature from the heating zone to the edges of the diaphragm decreases linearly (figure 3: red curve), and the temperature sensors up- and downstream of the heating zone will have the same value. With air flow, the sensor diaphragm area upstream will be cooled by the heat transfer in the boundary layer. The downstream temperature sensor will keep its temperature because the air is heated as it passes over the heating zone. The difference between the signals of the temperature sensors is evaluated in a bridge circuit and corresponds to a mass air flow value and direction. Temperature compensation and standardized characteristics are achieved by digital processing of the bridge voltage and of the intake air temperature sensor signal.

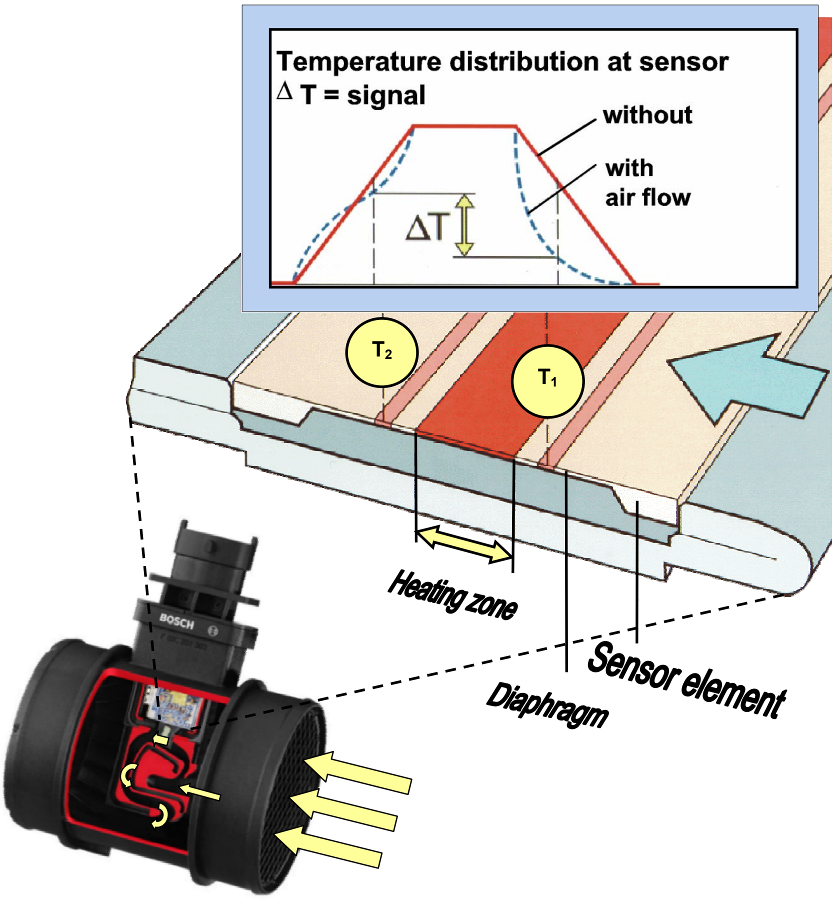


Figure 3
HFM6-Operating principle

2. Characteristic data

2.1 Pneumatic characteristic data

2.1.1 Nominal mass air flow

$$\dot{m}_{nom.} = 640\ kg/h$$

2.1.2 Pressure drop at $\dot{m}_{nom.}$

$$\Delta p_{HFM} \leq 18\ hPa$$

2.1.3 Characteristic curve range

The mass air signal is coded in the period length of the M-output (M= output mass air flow signal).

In terms of characteristic curve range and dynamics, the HFM6 is designed so that reverse flow resulting from dynamic intake pipe pulsations can be detected and both the amplitude as well as flow direction are measured.

Taking into account the intake pipe pulsations, the acquisition range of the mass air flow amounts to:

$\dot{m}_{nom.}$ [kg/h]	Acquisition range of the mass air flow [kg/h]
640	-60 bis 800

2.1.4 Mass air flow signal characteristic curve

The characteristic curve of the mass air flow signal is related to the **AMP** (absolute measuring test bench) at the ROBERT BOSCH production plant in Eisenach. The programming occurs after the plug-in sensor is assembled into the cylinder housing, which is connected to the AMP via appropriate adapters.

The characteristic curve of the HFM6 is shown in table form (see appendix A)

In the case of backflow pulsations, the specified backflow range of the characteristic curve (acc. appendix A, mass air flow characteristic curve) can be determined only by a specified dynamic test bench in a qualitative way (e.g. ROBERT BOSCH GmbH). A static measurement of the back flow characteristic is not possible and therefore not included in the tolerance.

2.1.5 Characteristic curve tolerance of new parts

The tolerance of the characteristic curve depends on the size of the HFM6 and the appropriate air flow (see appendix A).

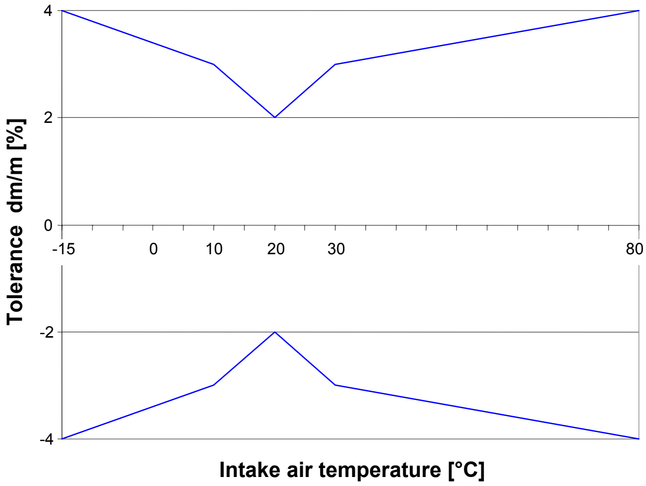
SIZE 6.4 $\dot{m}_{nom}$	640 kg/h
m [kg/h]	dm/m [%]
10	**+/-3**
15	**+/-2**
75	**+/-2**
160	**+/-2**
310	**+/-2**
640	**+/-2**
800	**+/-3**

Test conditions: T_{intake} = 20 °C ± 1 °C

U_{bat} = 14 V ± 0.1 V

2.1.6 Permissible total mass air flow error across the intake air temperature range

With changing intake air temperature a **total tolerance for the output characteristic** at the mass air flow points with a ±2 % tolerance from section 2.1.5 is shown in the following graph.



Temperature [°C]	Tolerance dm/m [%]
-15	±4
10	±3
20	±2
30	±3
80	±4

2.1.7 Power-on behavior

Time span t_e after power on until the output signal is within ± 5% of the final value.

$$t_e \leq 0.1 \text{ s}$$

2.1.8 Dynamic mass air flow (pulsations)

Characteristic curve tolerance $\Delta\dot{m}/\dot{m}$ -2% ... +8% referring to the individual characteristic.

Values apply under the assumption that:

- Plug-in sensor is in the cylinder housing
- Specific to the RB-dynamic test bench

  (mean mass air flow 90 kg/h; frequency 58 Hz, pulsation amplitude 1.2; back flow at amplitude >1)

The pulsation behavior of the mass air flow depends upon the engine. The back-flow characteristic of the HFM6 is selected so as to comply with the upper tolerance in the normal engine operating range. The pulsation behavior of the engine is to be checked directly on the applicable engine. Special measures are to be agreed upon in exceptional cases, e.g. suitable back-flow characteristic.

2.1.9 Sudden changes in mass air flow

With sudden changes of the intake mass air flow the following time constants apply:

$$10 \text{ kg/h} \rightarrow 310 \text{ kg/h} : \tau_{63} \leq 10 \text{ ms} ; \Delta\dot{m}/\dot{m} < \pm 5\% \text{ after } \leq 30 \text{ ms}$$

2.2 Characteristic data of the temperature signal

2.2.1 Using the air temperature sensor on the HFM sensor element

2.2.1.1 Characteristic curve range

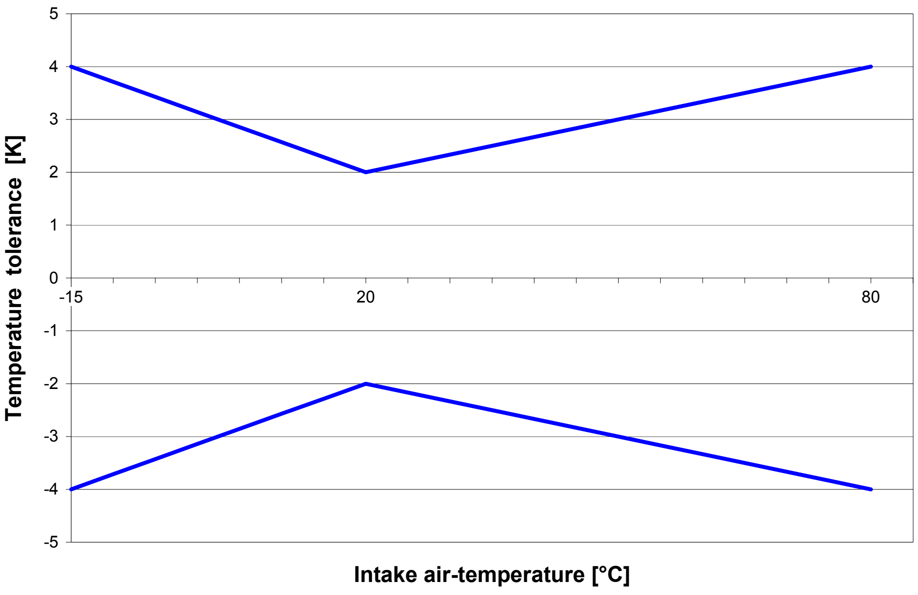
The temperature signal is encoded in the pulse width. The range is between -40 …+130°C.

2.2.1.2 Characteristic temperature signal

The characteristic curve is defined by a straight line and shown in table form
(see appendix B).

2.2.1.3 Characteristic curve tolerance for new parts

The permissible tolerance of the temperature signal is shown in the following graph. Acquisition of constant air flow (see appendix C):



Temperature [°C]	Temperature tolerance [K]
-15	±4
20	±2
80	±4

2.2.1.4 Sudden temperature changes

In the case of sudden changes of the intake air temperature as well as when powering on the component, the following time constants are apply (check points):

Mass air point $\dot{m}/\dot{m}_{nom.}$	Time constant τ_{63} [s]
$\dot{m}/\dot{m}_{nom.} = 0.2$	30
$\dot{m}/\dot{m}_{nom.} = 1$	10

This data applies for a temperature level change from 20°C to 60°C

For higher requirements regarding temperature sensor dynamics a separate NTC may be used.

2.2.1.5 Power-on behavior

Powering on of the sensor may cause a max. deviation of 11 K too low of the temperature signal.
This deviation will be reduced with the time constant of the temperature change.

2.2.1.6 Behavior with air dynamics

With sudden mass air flow changes a deviation of the temperature may occur.

Mass air flow step $\dot{m}$ **[kg/h]**	**Deviation max.** **[K]**	**Time constant** τ_{63} **[s]**
10 → 310	15	15
310 → 10	6	10

2.3 Electrical characteristic data

2.3.1 Connector

RB-connector plug system

RB guarantees the functioning of the connector system only when used with the mating connector as specified in the project drawing.

2.3.2 Pin assignments in the connector

Corresponding to the applicable project drawing.

2.3.3 Nominal voltage

$U_{nom.} = 14$ V

2.3.4 Measurement range as a function of operating voltage

Given the operational voltage of

$7.5\text{ V} \leq U_{bat} < 17.0\text{ V}$

the output tolerance range per section 2.1.5 will be met.

U_{bat} measured at HFM; other measurement conditions see item 2.1.5.

2.3.5 Current consumption

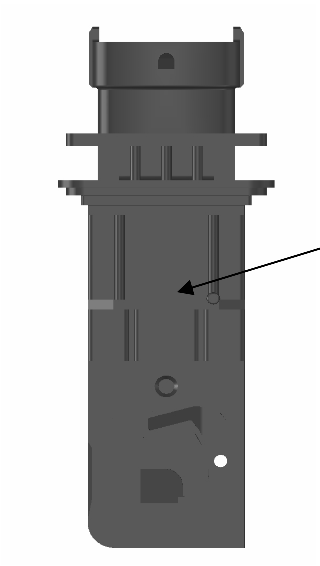
Typical current consumption	I_{typ} < 0.06 A	at U_{bat}	7.5 - 17 V.
Maximum current consumption	I_{max} < 0.1 A	at U_{bat}	7.5 - 17 V.

2.3.6 Immunity to radiant interferences

The resistance of the HFM6 is tested in an absorber hall as part of the release testing of the complete vehicle. Engine operation must be assured.

2.4 Max. permissible temperature exposure

Temperature range (A = intake air, S = sensor)



ϑ_S: Measurement point on the HFM6

measuring point ϑ_S

ϑ_A: Measuring point on the grid

Measuring point ϑ_A right in front of the center of the flow grid

$\Rightarrow$
Direction of flow

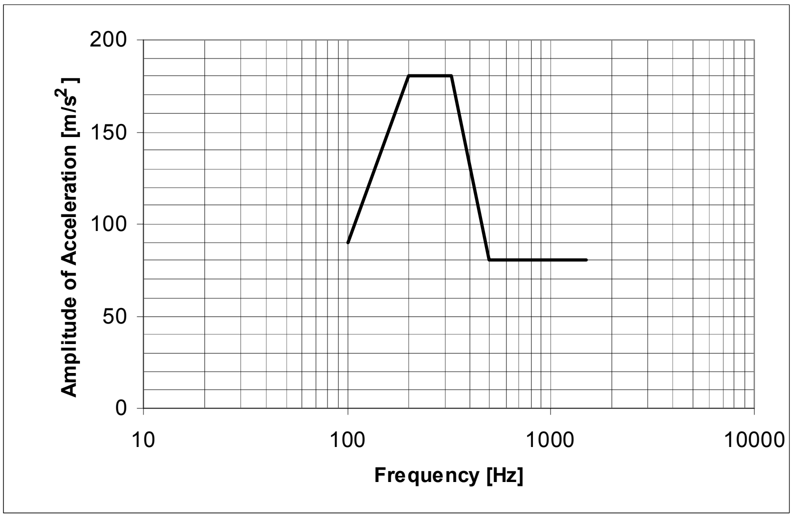
Continuous operation:	$-40\ °C \leq \vartheta_S \leq +120\ °C$	at $\vartheta_A \leq 100\ °C$
		$U_{bat} = 14\ V$
Short-term operation:	max. +130 °C	at $\vartheta_A \leq 130\ °C$
		$U_{bat} = 14\ V$

The evaluation and release of the temperature measurement will be performed by ROBERT BOSCH GmbH.

<u>Important:</u> Short-term operation not longer than 3 min. and not more than 2% of entire service life (4000 h).

2.5 Standard values for permissible vibration acceleration

Peak excitation values of the first and higher order corresponding to the following sine-wave profile (measured on measuring point 1; measuring point 2 has to be documented and is used for complete acquisition of the mounting conditions).

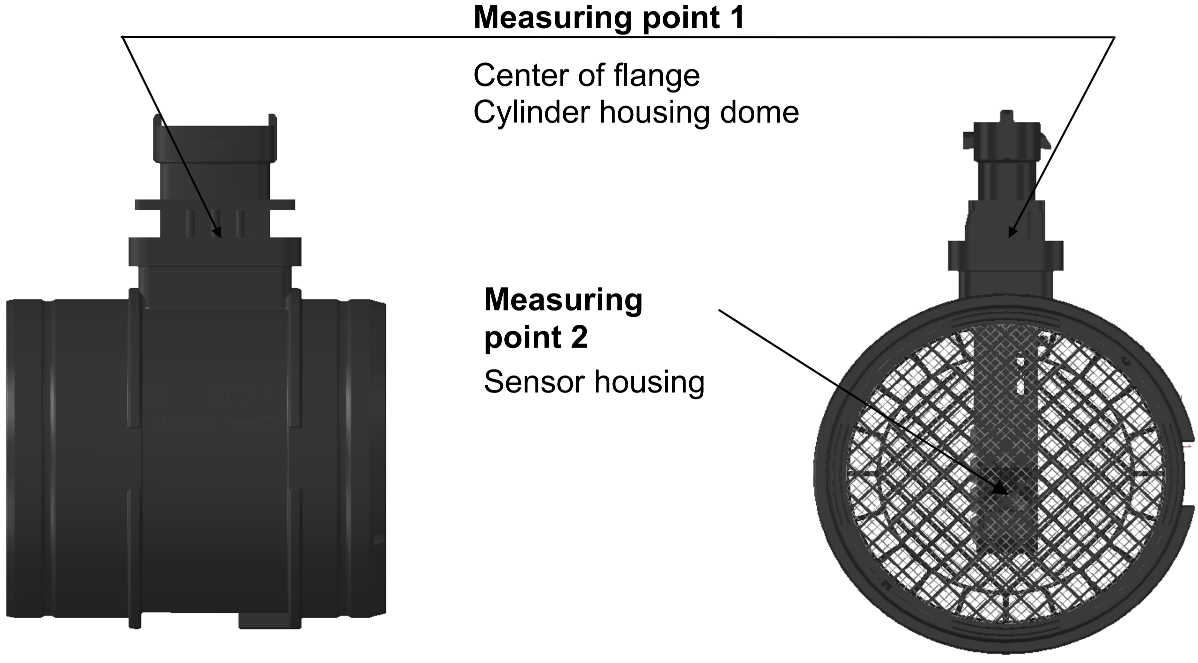


Frequency [Hz]	Amplitude of Acceleratio [m/s²]
100	90
200	180
325	180
500	80
1500	80

Ambient temperatureT_{amb} = 20 °C ±10 K

Measurements are carried out during vehicle operation. Measuring points on the HFM6 are illustrated below. In some special cases, supplementary measurements may be required for frequencies specific to the mounting location. Evaluation and release of the vibration acceleration measurements are performed by ROBERT BOSCH GmbH.

Different connector configurations are to be tested separately for the above demands.



Acceleration sensor e.g. Birchall A 32
Weight ≤ 8 g

3. Continuous operation (Service life requirements)

An additional expansion of the characteristic curve tolerance, by ± 3 % compared to item 2.1.5 or 2.1.6 above, is permitted for the cleaned sensor due to the load across the service life. Within this range, the sensor is evaluated as free of fault.

This tolerance value applies when taking into account the permissible operational limits, the application note according to item 5 below, and with a total filtration efficiency for a dry air filter of > 99% within the entire service life (ISO 5011 test dust SAE fine). The maximum allowable particle size downstream of the air filter is 20 µm.

A characteristic deviation as a result of contamination can only be determined after investigation of production parts that have been operated under actual field conditions. Until these production parts are available, parts from special or general vehicle testing are used for release evaluation.

The product functionality in the full system must be assured by the customer through an appropriate vehicle test under realistic conditions of use.

The evaluation and release is performed by ROBERT BOSCH GmbH.

4. Recommendation for handling

For information regarding logistics, storage and installation refer to the handling recommendation for the hot film mass air flow sensor (see cover sheet).

5. Application note

The HFM6 application and the checklist for HFM-application are applicable (see cover sheet).

5.1 Installation and installed position

See application notice HFM6 0 280 K00 038 E section 6.1.1 "Minimum requirements" and section 6.1.2 "Favorable installation conditions" and application notice HFM6 0 281 YE0 002 E section 5.1.1 “Minimum requirements” and section 5.1.2 “Favorable installation conditions”.

5.2 Cable fixing

See application notice HFM6 0 280 K00 038 E section 6.6 "Harness fastening" and application notice HFM6 0 281 YE0 002 E section 5.5 "Harness fastening".

Appendix A: Mass air flow signal measuring points

Size 6.4, mass air characteristic 0 280 K00 082

Mass air flow characteristic curve at ambient temperature:

Luftmasse m/ Mass air m	Kennlinie T_m / Characteristic T_m	Toleranz gemäß Punkt 2.1.5 der TKU / Tolerance according to TCI item 2.1.5		
[kg/h]	[µs]	Δm/m [%]	$T_{m,min}$ [µs]	$T_{m,max}$ [µs]
10	504,27	±3	503,03	505,53
15	484,34	±2	483,22	485,47
75	365,46	±2	363,75	367,20
160	295,19	±2	293,19	297,22
310	223,01	±2	220,66	225,41
640	127,68	±2	124,81	130,59
800	94,07	±3	89,49	98,75

Mass air flow charcteristic curve at 80°C

Luftmasse m/ Mass air m	Kennlinie T_m / Characteristic T_m	Toleranz gemäß Punkt 2.1.6 der TKU / Tolerance according to TCI item 2.1.6		
[kg/h]	[µs]	Δm/m [%]	$T_{m,min}$ [µs]	$T_{m,max}$ [µs]
10	504,27	±5	502,20	506,36
75	365,46	±4	362,07	368,07
160	295,19	±4	291,22	299,28
310	223,01	±4	218,33	227,83

Appendix B: Temperature signal measuring points

Size 4.7, Characteristic Temperature 0 280 K00 103

Temperature charateristic at ambient temperature:

Luftmasse m/ Mass air m	Kennlinie PW_ϑ / Characteristic PW_ϑ	Toleranz gemäß Punkt 2.2.3 der TKU / Tolerance according to TCI item 2.2.3		
kg/h	%	$\Delta\vartheta$ in K	$PW_{\vartheta,min}$ in %	$PW_{\vartheta,max}$ in %
310	38	±2	37.2	38.8

Temperature characteristic at 80 °C

Luftmasse m/ Mass air m	Kennlinie PW_ϑ / Characteristic PW_ϑ	Toleranz gemäß Punkt 2.2.3 der TKU / Tolerance according to TCI item 2.2.3		
kg/h	%	$\Delta\vartheta$ in K	$PW_{\vartheta,min}$ in %	$PW_{\vartheta,max}$ in %
310	62	±4	60.4	63.6

Solid State Sensors
Hall Effect Gear Tooth Sensors

GT1 Series

TYPICAL APPLICATIONS

Automotive and Heavy Duty Vehicles:
- Camshaft and crankshaft speed/ position
- Transmission speed
- Tachometers
- Anti-skid/traction control

Industrial:
- Sprocket speed
- Chain link conveyor speed and distance
- Stop motion detector
- High speed low cost proximity
- Tachometers, Counters

GT1 ORDER GUIDE

Catalog Listing	Description
1GT101DC	Gear Tooth Sensor

FEATURES

- Senses ferrous metal targets
- Digital current sinking output (open collector)
- Better signal-to-noise ratio than variable reluctance sensors, excellent low speed performance, output amplitude not dependent on RPM
- Sensor electronically *self-adjusts* to slight variations in runout and variations in temperature, simplifying installation and maintenance
- Fast operating speed – over 100 kHz
- EMI resistant
- Reverse polarity protection and transient protection (integrated into Hall I.C.)
- Wide continuous operating temperature range (–40° to 150°C), short term to 160°C

GENERAL INFORMATION

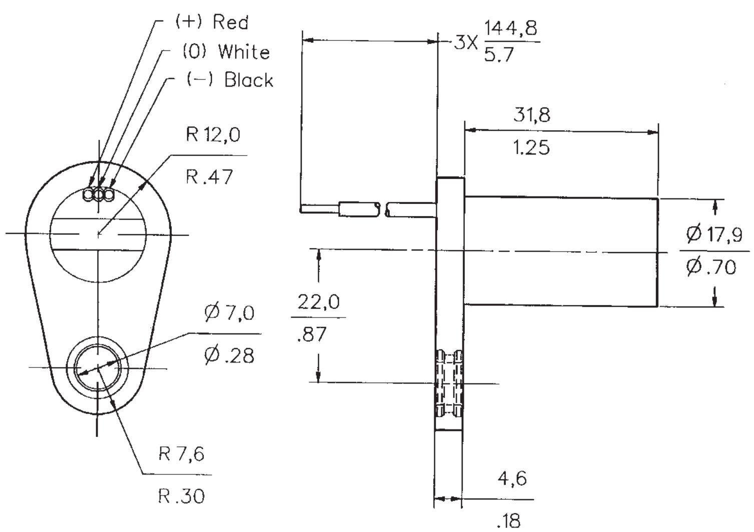
1GT1 Series Gear Tooth Sensors use a magnetically biased Hall effect integrated circuit to accurately sense movement of ferrous metal targets. This specially designed I.C., with discrete capacitor and bias magnet, is sealed in a probe type package for physical protection and cost effective installation.

Units will function from a 4.5 to 24 VDC power supply. Output is digital, current sinking (open collector). Reverse polarity protection is standard. If power is inadvertently wired backwards, the sensor will not be damaged. Built-in protection against pulsed transients to +60V, –40V is also included.

Optimum sensor performance is dependent on the following variables which must be considered in combination:

- Target material, geometry, and speed
- Sensor/target gap
- Ambient temperature
- Magnetic material in close proximity

MOUNTING DIMENSIONS (For reference only)



Solid State Sensors

Hall Effect Gear Tooth Sensors

SENSOR SPECIFICATIONS

All values were measured using 1 K pull-up resistor.

Electrical Characteristics	Supply Voltage	4.5 to 24 VDC
	Supply Current	10 mA typ., 20 mA max.
	Output Voltage (output low)	0.4 V max.
	Output Current (output high)	10 µA max. leakage into sensor
	Switching Time Rise (10 to 90%)	15 µsec. max.
	Fall (90 to 10%)	1.0 µsec. max.
Absolute Maximum Ratings*	Supply Voltage (Vs)	±30 VDC continuous
	Voltage Externally Applied To Output (output high)	−0.5 to +30 V
	Output Current	40 mA sinking
	Temperature Range Storage	−40 to 150° (−40 to 302°F)
	Operating	−40 to 150° C (−40 to 302°F)
Switching Characteristics**	Operate Point	3.7±1.25° (3,28±1,13 mm)
	Release Point	4.7±2.50° (4,16±2,21 mm)
	Differential Travel	8.4±3.70° (7,45±3,34 mm)

* As with all solid state components, sensor performance can be expected to deteriorate as rating limits are approached; however, sensors will not be damaged unless the limits are exceeded.
** See Reference Target table.

TARGET GUIDELINES

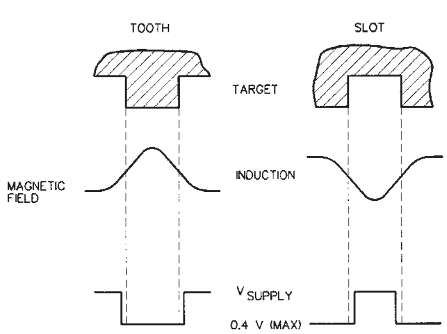
The Target Guidelines table provides basic parameters when an application is not restricted to a specific target.

Any target wheel that exceeds the following minimum specifications can be sensed over the entire temperature range of −40° to 150°C with any sensing gap up to .080 in. (2,0 mm). This data is based on a 4 in. (102 mm) diameter wheel, **rotating 10 to 3600 RPM.**

Reference Target Dimensions

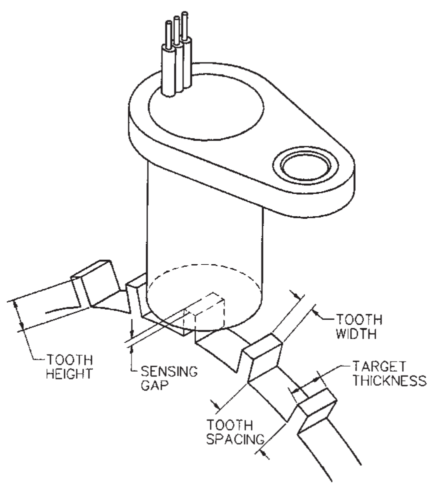
Tooth Height:	.200 in. (5,06 mm) min.
Tooth Width:	.100 in. (2,54 mm) min.
Tooth Spacing:	.400 in. (10,16 mm) min.
Target Thickness:	.250 in. (6,35 mm)

Sensor Output (with pull-up resistor added to output circuit)



REFERENCE TARGET/CONDITIONS

Characteristics will vary due to target size, geometry, location, and material. Sensor specifications were derived using a cold-rolled steel reference target. See table, right, for reference target configuration and evaluation conditions.



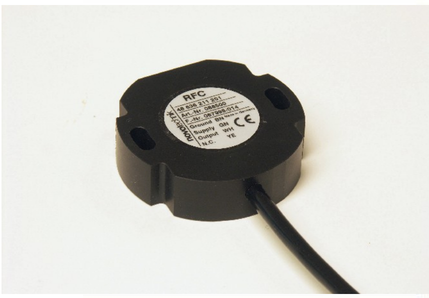
Target	
Diameter:	4 in. (101,6 mm)
Tooth Width:	.350 in. (8,89 mm)
Thickness:	.250 in. (6,35 mm)

Test Conditions	
Air Gap:	.040 to .080 in. (1,02 to 2,03 mm)
V Supply:	4.5 to 24 V
RPM:	10 min., 3600 max.

novotechnik
Siedle Group

Angle Sensor non-contacting

Series RFC4800



The sensor utilizes the orientation of a magnetic field for the determination of the measurement angle. Therefore, a magnet is attached to the sensor shaft, the magnetic field orientation is captured with an integrated circuit. An analogue output signal represents the calculated angle.

The housing is made of a special high grade temperature-resistant plastic material. Fixings are in the form of elongated slots which allow simplicity in mounting together with ease of mechanical adjustment.
The sensor is totally sealed and therefore, is not sensitive to dust.

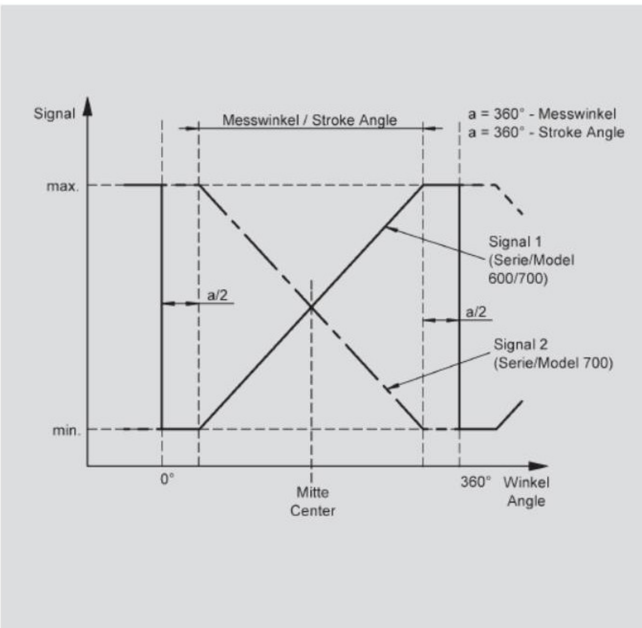
The two-part design of the sensor Series RFC and its position marker offers the customer maximal freedom when mounting or installing the sensor, even retroactively. The absence of shaft or a bearing simplifies the adjustment for customer application bearing tolerances.
Measurements can be made through various (non-magnetic) materials.

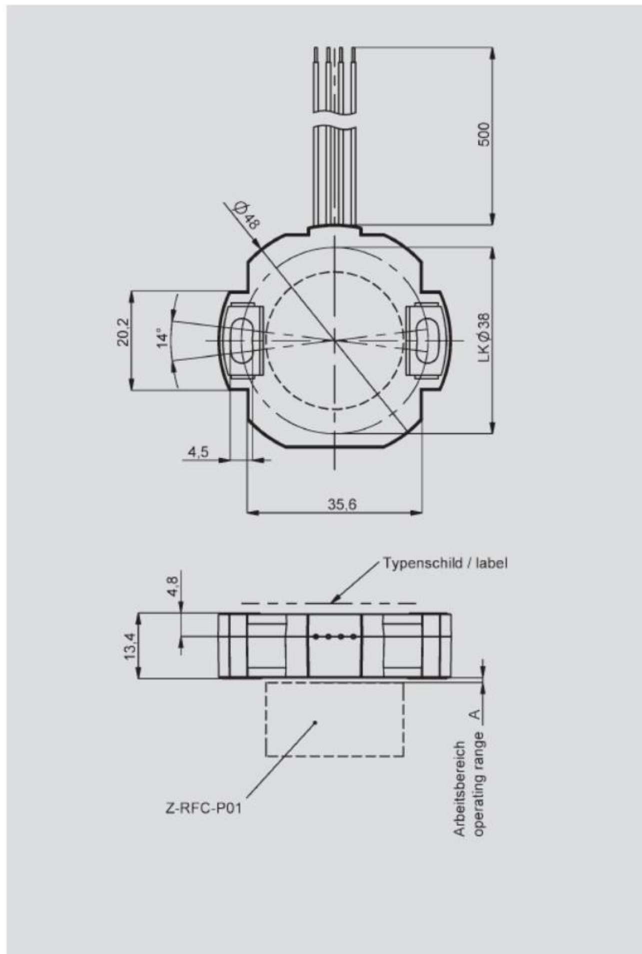
Electrical connection is made via a shielded cable (alternative lead wires) which is sealed into the housing.

Special features

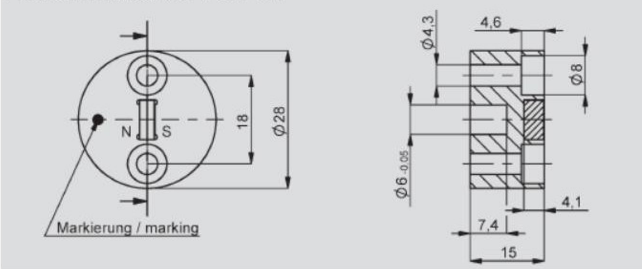
- non-contacting, magnetic
- electrical range 30° up to 360°, in 10°-steps programmable
- simple mounting
- protection class IP67
- mechanical unlimited lifetime
- resolution 12 Bit
- independent linearity ±0,5 %

Description	
Housing	high grade, temperature resistant plastic
Electrical connections	shielded cable AWG 26 (0.14 mm^2) alternative lead wires AWG 22 (0.35 mm^2)

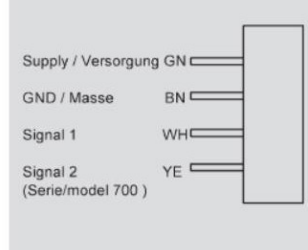




Position marker Z-RFC-P01



When the shaft marking is pointing to cable, the sensor is located in an electrical center position.



Mechanical Data		
Dimensions	see dimension drawing	
Mounting	2 M4 fillister-head screws and washer	
Starting torque of mounting clamps at housing flange	200	Ncm
Mechanical travel	360 continuous	°
Maximum operational speed	unlimited	min^{-1}
Weight	ca. 50	g

Electrical Data		
Supply voltage Ub	5 ±0.5 8 ... 34	VDC VDC
No-load supply current	15 typical (model 600) 40 typical (model 700)	mA mA
Reverse voltage	yes, only feeder	
Short circuit protection	yes	
Measuring range	0 ... 30, 0 ... 360	°
Repeatability	≤ 0.03 of signal range	%
Independent linearity	±0.5 of signal range	%
Output signal	ratiometric (supply voltage 5V ±0.5V) load ≥1 kΩ 0.25 ... 4,75 V (supply voltage 8 ...34 V) load ≥1 kΩ	
TC of output signal	typical 100	ppm/K
Insulation resistance (500 VDC, 1 bar, 2s)	≥ 10	MΩ
Cable length, bare, tinned	ca. 500	mm
Cable diameter	ca. 0.14 / 0.35	mm^2

Environmental Data		
Working distance A to position marker Z-RFC-P01	1 ... 4	mm
Temperature range	-40...+125	°C
Vibration (IEC 68T2-6)	5...2000 A_{max} = 0.75 a_{max} = 20	Hz mm g
Shock (IEC 68T2-27)	100 (11 ms)	g
Life	mechanical unlimited	
Protection class (DIN 40050 / IEC 529)	IP67	
CE-conformable	ESD EN 6100-4-2 HF-Feld EN 61000-4-3 BURST EN 61000-4-4 Conducted disturbances EN 61000-4-6 Emission test EN 55011	

Novotechnik U.S., Inc.
155 Northboro Road
Southborough, MA 01772

Telephone 508-485-2244
FAX 508-485-2430

Email: info@novotechnik.com
Web: www.novotechnik.com

Art. Nr: 062 717a
Printed in USA

Ordering specifications

R F C | 4 8 0 1 | 6 3 6 | 2 1 1 | 3 0 1

Series

Mechanical version
4801 Standard

Model
6 Optional: model 600
7 Optional: model 700 redundant

Electrical angle model 600 and model 700
36 Standard: Electrical angle 30° ... 360°

Electrical Interface
2 Standard: Analogue interface, supply voltage VDC (4.5 VDC ... 5.5 VDC)
3 Optional: Analogue interface, supply voltage 12/24 VDC (18.0 VDC ... 35.0 VDC)

Output signal analogue 5 VDC interface 2XX
1 Standard: 5 % ... 95 % of supply voltage
2 Optional: 10 % ... 90 % of supply voltage

Output signal analogue 12/24 VDC-interface 3XX
4 Alternative: 0.5 VDC ... 4.5 VDC
5 Standard: 0.25 VDC ... 4.75 VDC

Analogue interface 2XX and 3XX
1 Standard: positive gradient CW
3 Standard: Redundant positve gradient CW and CCW (model 700)

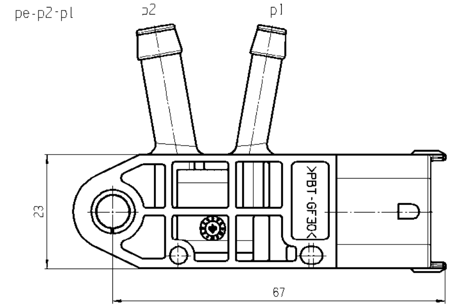
Electrical connection
301 Standard: NT standard cable 6-pol. 0.5 m
401 Optional: NT standard lead wires 3 x 0.5 m (5 VDC)
411 Optional: NT standard lead wires 4 x 0.5 m (24 VDC; 12/24

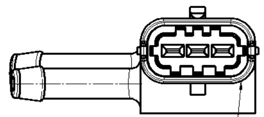
Required accessories

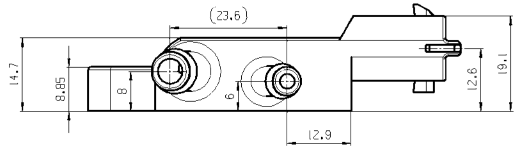
Position marker Z-RFC-P01,
Art.No. 005660

Preliminary datasheet.
Subject to change.

0 261 A04 024-000







Am Sensor: RB-Kompaktstecker 1.1 nach RB-Zeichnung
D 928 002 69A vom 15.02.1999, 3-polig, Kodierung I, Kontakte verzinnt.
AT SENSOR: RB-KOMPAKT CONNECTOR 1.1 ACCORDING TO RB-DRAWING
D 928 002 69A FROM 15.02.1999, 3 PINS, CODING I, TERMINALS TIN PLATED.

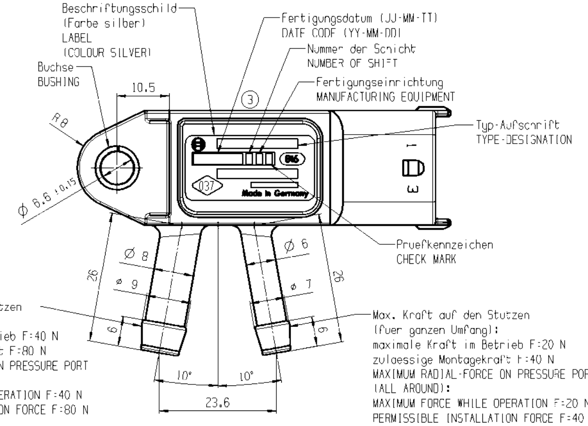
Kabelbaumstecker: RB-Kompaktstecker 1.1a nach RB-Zeichnung
A 928 000 453 vom 07.08.2000, 3-polig, Kodierung I, Kontakte verzinnt.

WIRE HARNESS CONNECTOR: RB-KOMPAKT CONNECTOR
1.1a ACCORDING TO RB-DRAWING A 928 000 453 FROM 07.08.2000,
3 PINS, CODING I, TERMINALS TIN PLATED.

Zu beachten:
Der Sensor ist durch aufgesteckten Gegenstecker
vor Eindringen von Wasser zu schuetzen.
ATTENTION:
USE HARNESS CONNECTION FOR PROTECTION AGAINST
WATER INGRESS.

Steckerbelegung
CONNECTOR DETAIL

1 Spannungsversorgung 5 Volt	SOURCE 5 VOLT
2 Masse	GROUND
3 Ausgangssignal	OUTPUT SIGNAL



Max. Kraft auf den Stutzen
(fuer ganzen Umfang):
maximale Kraft im Betrieb F:40 N
zulaessige Montagekraft F:80 N
MAXIMUM RADIAL-FORCE ON PRESSURE PORT
(ALL AROUND):
MAXIMUM FORCE WHILE OPERATION F:40 N
PERMISSIBLE INSTALLATION FORCE F:80 N

Max. Kraft auf den Stutzen
(fuer ganzen Umfang):
maximale Kraft im Betrieb F:20 N
zulaessige Montagekraft F:40 N
MAXIMUM RADIAL-FORCE ON PRESSURE PORT
(ALL AROUND):
MAXIMUM FORCE WHILE OPERATION F:20 N
PERMISSIBLE INSTALLATION FORCE F:40 N

Maximale axiale Kraft auf jeden Stutzen: F:280 N
MAXIMUM AXIAL FORCE ON EACH PRESSURE PORT: F:280 N

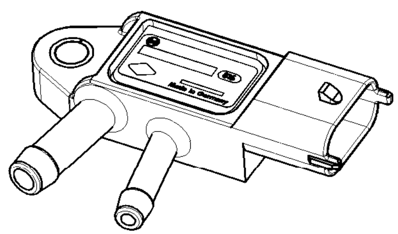
RB-Gewaehrleistung fuer die Funktion des Stecksystems nur bei Verwendung der in dieser Angebotszeichnung vorgeschriebenen Gegenstecker-Systemteile.
RB WARRANTY WILL COVER THE FUNCTION OF THE CONNECTOR SYSTEM ONLY IN CASE OF COMBINATION WITH HARNESS CONNECTOR SYSTEM PARTS ACCORDING TO THIS OFFER DRAWING.

Erste Abstuetzstelle des Kabels muss auf dem Sensortraeger liegen, max. 250 mm (gestreckte Kabellaenge) nach der Steckverbindung.
FIRST CABLE MOUNTING POINT MUST BE LOCATED ON THE SENSOR CARRIER, MAX. 250 MM (STRAIGHT CABLE LENGTH) AFTER THE PLUG.

Abwinkelung des Kabels (Abweichung von der geraden Linie) zwischen Kabelabgang am Sensor und erster Abstuetzstelle: 20...90°.
ANGLE OF BENDING THE CABLE (DEVIATION FROM STRAIGHT LINE) BETWEEN CABLE EXIT AT SENSOR AND FIRST MOUNTING POINT: 20...90°.

Zulaessiger Biegeradius des Kabels bis zur ersten Abstuetzstelle: R >50 mm.
ADMISSIBLE BENDING RADIUS OF THE CABLE UP TO THE FIRST CABLE MOUNTING POINT: R >50 MM.

3D-Ansicht
PERSPECTIVE VIEW

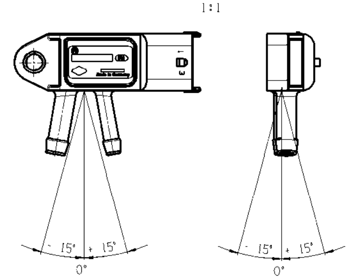


Einbaulage im Fahrzeug:
INSTALLATION POSITION IN THE VEHICLE:

Druckanschluesse senkrecht nach unten gerichtet:
0...±15° in allen Richtungen zur Senkrechten.

PRESSURE PORTS DIRECTED VERTICAL DOWNWARDS:
0...±15° IN ALL DIRECTIONS FROM VERTICAL.

1:1



Anbaustelle
MOUNTING POSITION

Maximaler Durchmesser der Befestigungsschraube innerhalb des Befestigungslochs: 6 mm
MAXIMUM DIAMETER OF THE SCREW IN THE INTERIOR OF MOUNTING HOLE: 6 MM

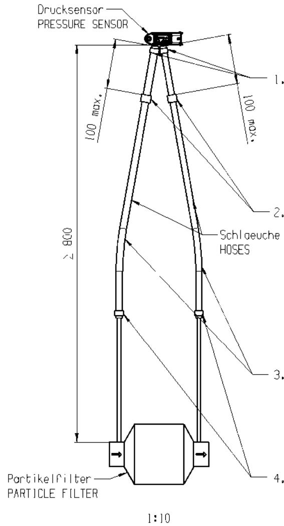
Unterlegscheibe mit mind. ⌀10 mm oder entsprechenden Schraubenkopfdurchmesser verwenden.
USE WASHER ⌀ 10 MM MINIMUM OR ADEQUATE SCREW HEAD DIAMETER.

Maximal zulaessige Montagespannkraft der Befestigungsschraube 4,5 kN.
MAXIMUM PERMISSIBLE MOUNTING TIGHTENING FORCE FOR FIXING SCREWS 4,5 KN.

Beispiel: Mit Schraube M5 (DIN 84, 912, 931 und 933), verzinkt, leicht geoelt und Scheibe, verzinkt, ergibt sich ein max. zulaessiges Anschraubmoment von 3,3 Nm.
EXAMPLE: SCREW M5 (DIN 84, 912, 931 AND 933), ZN COATED, LIGHTLY OILED AND WASHER, ZN COATED, RESULTS IN A MAXIMUM PERMISSIBLE TIGHTENING TORQUE OF 3,3 NM.

Anbaustelle geschuetzt gegen Fahrtwind. Bei tiefen Temperaturen (<0° C) Gefahr des Ausfrierens von Abgaskondensat (Verstopfung des Sensors moeglich)
INSTALLATION LOCATION PROTECTED AGAINST THE HEADWIND. FOR LOW TEMPERATURES (<0° C) DANGER OF FROZEN EXHAUST-GAS CONDENSATE IN THE SENSOR

Die Funktionsfaehigkeit des Sensors in der Fahrzeugapplikation ist mit Fahrzeugversuchen durch den Kunden sicherzustellen.
THE FUNCTIONALITY OF THE SENSOR IN THE VEHICLE APPLICATION SHALL BE PROVED WITH VEHICLE TESTS BY THE CUSTOMER.



Anschluss des Sensors an das Abgassystem
CONNECTION TO THE EXHAUST GAS SYSTEM

Die Verantwortung fuer die Verbindungsleitungen liegt beim Kunden.
THE RESPONSIBILITY FOR THE CONNECTING HOSES AND PIPES IS BY THE CUSTOMER.

1. Gute Sicherung gegen Abrutschen (auch bei warmen Schlaeuchen) erforderlich, um das Ausstroemen von heissem Abgas zu verhindern und einen sicheren Betrieb zu gewaehrleisten. Innendurchmesser der Schlaeuche: 6..8 mm und 4..6 mm fuer 8 mm- bzw. 6 mm-Stutzen, mit mindestens 20 mm Laenge ueber die Stutzen schieben.
HOSES SECURED ON THE PRESSURE PORTS AGAINST SLIDING OFF (EVEN FOR WARM HOSES) TO PREVENT ESCAPE OF HOT EXHAUST GAS AND TO ENSURE A SAFE OPERATION. INNER DIAMETER OF THE HOSES: 6..8 mm AND 4..6 mm FOR THE 8 mm AND 6 mm PRESSURE PORT, RESPECTIVELY. HOSES PUT ON PRESSURE PORTS WITH A LENGTH OF AT LEAST 20 mm.

2. Schlaeuche auf dem Sensortraeger (keine Relativbewegung) moeglichst dicht hinter Anschlussstutzen fixiert. Vibrationen mit frei schwingenden Schlaeuchen koennen zur Ueberschreitung der zulaessigen Kraft auf die Anschlussstutzen fuehren (Gewicht und Resonanzen der Schlaeuche, evtl. Verhaertung bei tiefer Temperatur). Durch Fahrzeugtests muss abgesichert werden, dass die Fixierung der Schlaeuche ausreicht.
HOSES ARE FIXED ON THE SAME CARRIER AS THE SENSOR (NO RELATIVE MOVEMENT) AS CLOSE AS POSSIBLE TO THE PRESSURE PORTS. VIBRATIONS WITH FREELY SWINGING HOSES CAN EXCEED THE MAXIMUM PERMISSIBLE FORCES AT THE PRESSURE PORTS (MASS AND RESONANCE OF THE HOSES, POTENTIAL HARDENING AT LOW TEMPERATURES). IT HAS TO BE PROVED BY VEHICLE TESTS BY THE CUSTOMER THAT THE FIXATION OF THE HOSES IS SUFFICIENT.

3. Gesamtlaenge der Schlauch/Rohrleitungen mindestens 800 mm. Verlegung zum Sensor hin stetig steigend und gegen kalten Fahrtwind geschuetzt, sonst Gefahr der Vereisung von Abgaskondensat. Engstellen vermeiden.
THE TOTAL LENGTH OF THE HOSES AND PIPES MUST BE AT LEAST 800 MM. THE HOSES ARE RISING ALL THE WAY TO THE SENSOR AND ARE PROTECTED AGAINST COLD HEADWIND TO PREVENT FREEZING OF EXHAUST-GAS CONDENSATE. CONSTRICTIONS SHALL BE AVOIDED.

4. Metallrohrleitungen direkt am Abgasrohr unter Beachtung der Temperaturfestigkeit der Schlaeuche. Gute Sicherung (siehe oben).
METAL PIPES CONNECTED DIRECTLY AT THE EXHAUST-GAS SYSTEM UNDER CONSIDERATION OF THE TEMPERATURE STABILITY OF THE HOSES. HOSES SECURED (SEE ABOVE)

Der Applikationshinweis Y 281 E22 043 ist unbedingt zu beachten.
THE APPLICATION INSTRUCTION Y 281 E22 043 MUST BE STRICTLY REGARDED.

DS-D2

0 261 B04 024	0 281 002 772	0 281 002 772	0...100	0,5...4,5	Y 261 K26 098
Entwurfs-Nummer / DRAFT NUMBER	Bestell-Nummer / ORDER NUMBER	Typ-Aufschrift / TYPE-DESIGNATION	Druckbereich p2-p1 in kPa / PRESSURE RANGE p2-p1 IN kPa	Spannungsbereich in Volt / VOLTAGE RANGE	Technische Kundenunterlage / TECHNICAL CUSTOMER INFO

Nicht tol. Masse / NON TOLERANCED DIMENSIONS ±1 mm, ±5°
Massstab / SCALE 2:1 1:1
Gewicht / WEIGHT ca. 21g
Angebotszeichnung / OFFER DRAWING
Dokumentenart / DOCUMENT TYPE AGZ

Datum/DATE	Name/NAME
gez./DRN 31.01.2005	A1
gepr./CHK 31.01.2005	Ku
gen./APP 01.02.2005	Am
Original: 213/EZ5	

Benennung/TITLE
Differenzdrucksensor
DIFF. PRESSURE SENSOR

BOSCH
Nr./NO. 0 261 A04 024-000 de/en
Blatt SHEET 1 1 Bl/SH

Ers.f./REPLACES
Ers.d./REPLAC.BY

Ausfuellanleitung N12A D11/1 beachten!

Produkt / Product:	**Differential Pressure Sensor for Diesel Particulate Filters**
Typ / Type:	**DS-D2** **0 to 100 kPa**
Bestellnummer / Part Number:	0 281 002 617 0 281 002 589 0 281 002 772
Angebotszeichnung / Offer Drawing:	A 261 260 330 - . . . A 261 260 335 - . . . 0 261 A04 024 - . . .
Applikationshinweis / Application Guidelines:	Y 281 E22 043
Kenndaten / Characteristic Data:	Seite/Page 3 bis/to 7
Prüfmethoden / Test Method:	Seite/Page 8 bis/to 11
Prüfdaten / Test Data:	Seite/Page - bis/to -
Gültig ab / Valid from:	Start of production
Bemerkung / Comment:	

Nr. Index	Seite Page	Änderung Revision	Datum Date	GS-SI/ENS1 (dr)	GS-SI/ENS1 (ck)	GS-SI/ENS (app)	GS-SI/MKT	DS/EDS
—	—	**Erstausgabe / First Edition**	20.01.00	11.02.00 Kuhnt	11.02.00 Mast	14.02.00 Lembke	23.02.00 Fischbach	02.03.00 Berger
[1]	all	Complete revision	16.07.01	16.07.01 Kuhnt	-	-	-	-
[2]	3, 4, 5, 9	Revision, replaces provisional TKU	10.05.02	24.06.02 Kuhnt	24.06.02 Mast	27.06.02 Lembke	-	21.06.02 Berger
[3]	3, 4	Completion of 1.2 and 1.3	03.12.02	03.12.02 Kuhnt	03.12.02 Mast	06.12.02 Lembke	-	04.12.02 Berger
[4]	1	New type	20.07.04	-	-	-	-	-

Contents:

1. Description

1.1 Application

The sensor described in this data sheet serves to measure the differential pressure $p_e = p_2 - p_1$ between the pressure ports shown in the offer drawing. The sensor can be used for measurement of the differential pressure at the Diesel particulate filter.

1.2 Technical principle

The piezo-resistive pressure sensor element and a suitable circuitry for signal amplification and temperature compensation are integrated on a silicon chip. The pressure p_1 operates to the back side of the silicon diaphragm, which is resistant to corrosive media. The pressure p_2 operates from above to the active side of the silicon diaphragm. The upper chip side is protected against corrosion by a protection gel. [3] Because of its strong chemical resistance there is so far no solvent, which is capable of removing the gel for analysis without damaging the sensor chip itself. Therefore the analysis of customer complaints is only possible with restrictions.

1.3 Installation instructions

The pressure sensor is designed for attachment to the bodywork in the engine compartment of motor vehicles. By suitably fitting the sensor in the vehicle (sensor as high as possible, pressure ports directed downwards, hose/pipe continuously decreasing, recommended hose length/distance to exhaust system/particulate filter > 80 cm by an inner hose diameter of 5 to 8 mm), it must be ensured that no soot/condensate will accumulate in the sensor or that it can drain off. If a shorter hose length is used, safety of function has to be demonstrated by vehicle tests.

The firm seat of the hose connection has to be proven by vehicle endurance tests, because in case of escaping exhaust gas high temperatures can occur. Sensor and [3] hose should be protected from headwind in order to avoid icing of condensate at low temperatures.

The details of the offer drawing as well as of the application guidelines are to be [3] regarded, therein especially the check list in chapter 5. The safety of function in the vehicle application shall be proven by vehicle tests at the customer.

In the interest of good continuity on the connectors, it is essential that not only the connector on the component side is according to specification, but that the material quality and exact fit of the cable harness connector are also guaranteed. The cable harness connector should therefore be according to the BOSCH offer drawing specification.

1.4 Assembly instructions

In order to avoid deterioration or pre-damage of the sensor at the user the following points have to be absolutely noticed:

a) The sensor must not be mounted with striking tools (e.g. hammer).
b) When the assembly unit is exposed to a leakage test, don't exceed maximum overpressure.
c) At immersion test plug connector and pressure port for protection against water ingress.
d) Avoid reverse voltage and overvoltage when electrical tests are applied to the sensor.

If the installation of the sensor takes place at the supplier e.g. of an assembly unit, the supplier has to be instructed accordingly.

1.5 Signal evaluation

The pressure sensor supplies an analogue output signal, which is ratiometric to the supply voltage. An RC low-pass filter is recommended as an input circuitry for the following electronics in order to suppress possibly disturbing harmonic vibrations. The filter time constant should be at least two times as long as the sampling period. In case of measuring the differential pressure at the particulate filter, for a sampling period of 20 ms it is recommended to use a low pass with τ = 47 ms (R_{TP}= 10 kΩ, C_{TP}= 4.7 µF), see figure 1.

1.6 Signal range check

The electric output of the sensor is designed in such a way, that failures in function by cable breaks or short circuits can be detected by a suitable input circuitry of the following electronics. For the signal range check the diagnosis ranges beyond the output clamps are provided. We recommend a pull-up resistor of 680 kΩ connected to an auxiliary voltage of 5.5 V to 16 V. Example of circuitry for detection of all kinds of failures by signal out of output clamps:

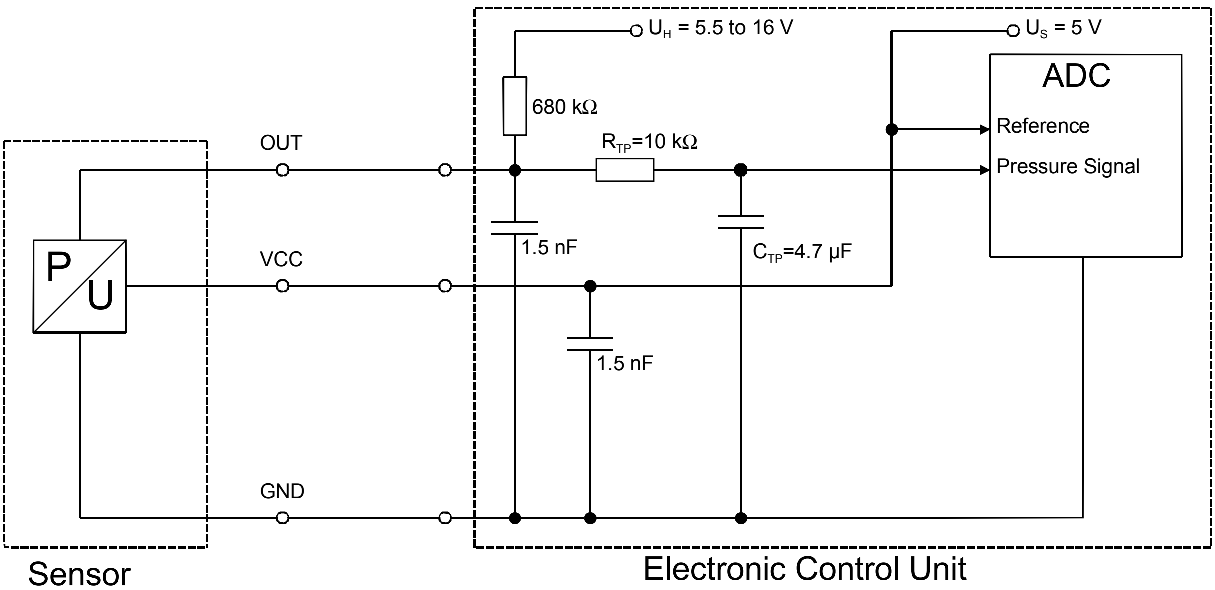


Figure 1. Signal evaluation with load resistor to U_H= 5.5 to 16 V

2. Data

2.1 Maximum ratings

Parameter	Symbol	Value	Unit
Supply voltage	$U_{S,max.}$	16	V
Absolute pressure p_1 Absolute pressure p_2	$p_{1,max.}$ $p_{2,max.}$	500 500	kPa kPa
Differential pressure p_e	$p_{e,max.}$	± 350	kPa
Storage temperature	t	-40/+130	°C

The output is resistant against short circuit to 0 V or 5 V, respectively. The sensor is resistant against reverse voltage for 5 min at room temperature, as the maximum current is limited to 0.3 A.

2.2 Operating characteristics

Parameter	Symbol	Value			Unit
		min.	typ.	max.	
Pressure range	$p_e = p_2 - p_1$	0		100	kPa
Temperature range	t	-40		130	°C
Supply voltage	U_S	4.75	5.0	5.25	V
Supply current at U_S = 5 V	I_S	6.0	9.0	12.5	mA
Output load current	I_L	-1.0		0.5	mA
Load resistance to U_S or to ground	$R_{pull\text{-}up}$ $R_{pull\text{-}down}$	5 10			kΩ kΩ
Load capacitance	C_L			12	nF
Response time	$T_{10/90}$			1.0	ms
Lower output clamp at U_S = 5 V	$U_{out,min.}$	0.25	0.3	0.35	V
Upper output clamp at U_S = 5 V	$U_{out,max.}$	4.75	4.8	4.85	V
Output resistance [1] to ground, U_S open	R_{lo}	2.4	4.7	8.2	kΩ
Output resistance [1] to U_S, ground open	R_{hi}	3.4	5.3	8.2	kΩ

1) valid only for measuring voltage < 0.5 V

2.3 Transfer function

$$U_{out} = (c_1 \cdot p_e + c_0) \cdot U_S$$

where U_{out} = signal output voltage in V
U_S = supply voltage in V
p_e = differential pressure in kPa
c_0 = 0.1
c_1 = 0.008 kPa^{-1}

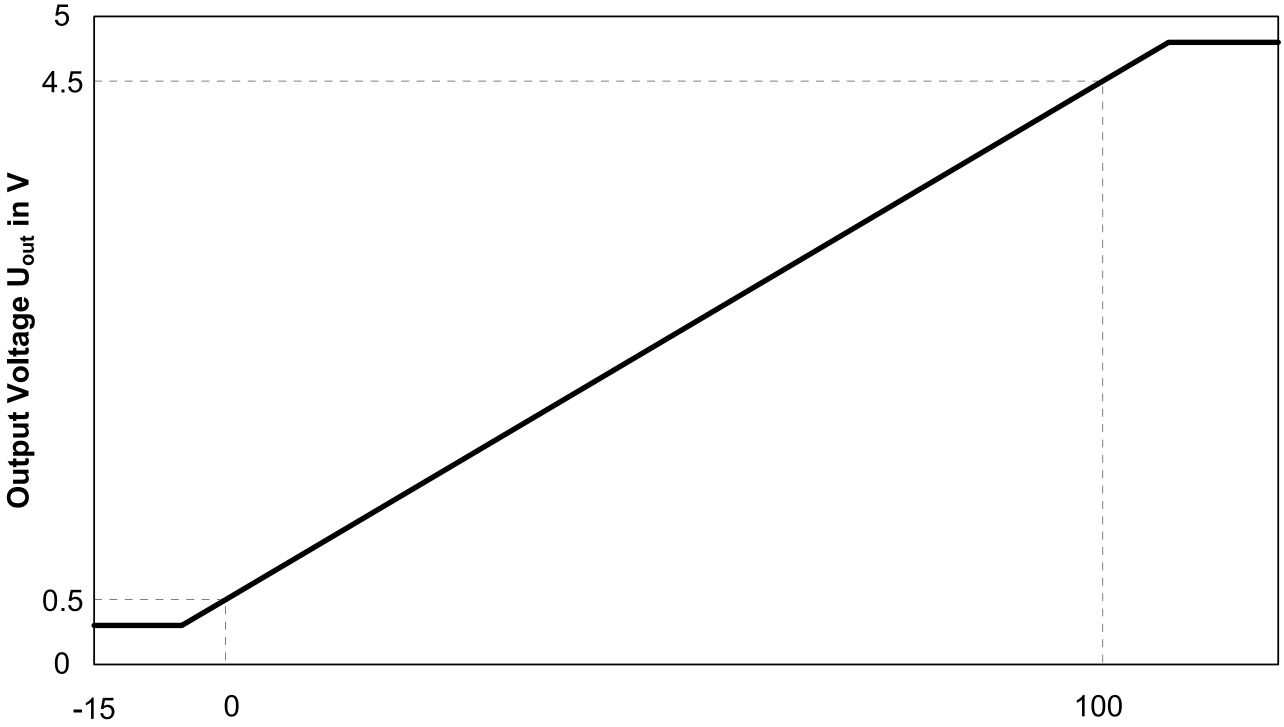


Figure 2. Characteristic at U_S= 5.000 V

2.4 Accuracy

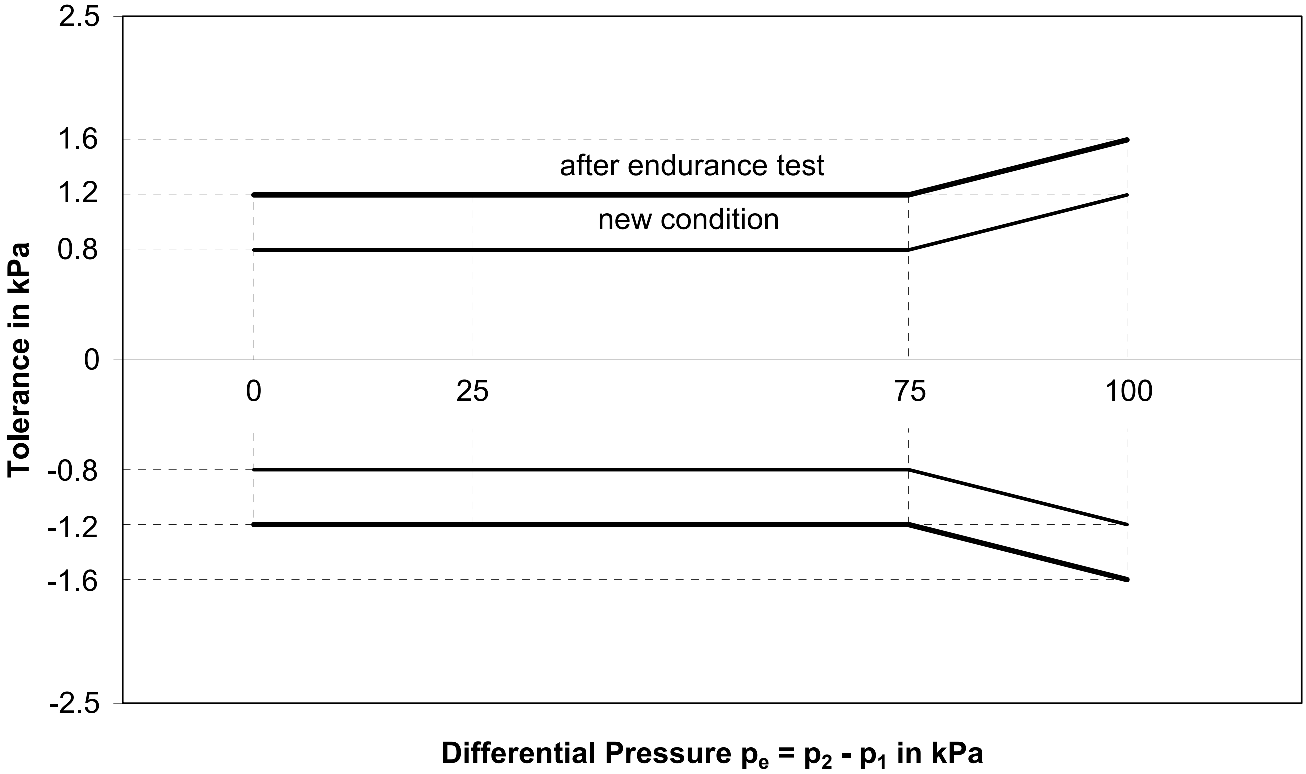


Figure 3. Characteristic tolerance

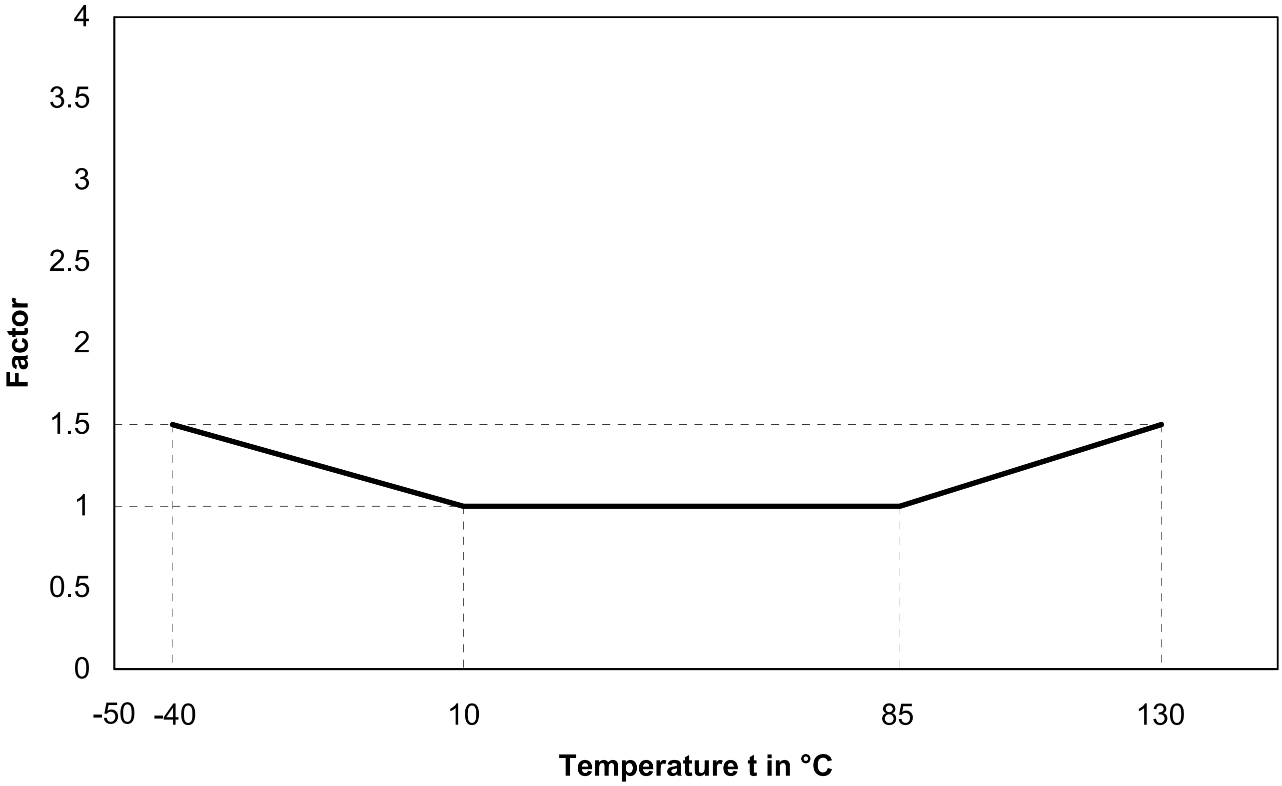


Figure 4. Tolerance broadening as a function of temperature

3. Functional test

Ambient temperature: (23 ± 5) °C

Supply voltage: U_S= (5.000 ± 0.250) V
If the supply voltage U_S differs from the nominal value 5.000 V, the measured output voltage U_{out} must be converted to the nominal value with factor 5.000 V/U_S.

3.1 Characteristic

Output voltage at:	p_e =	0.0 kPa:	U_{out} = (0.500 ± 0.032) V
	p_e =	75.0 kPa:	U_{out} = (3.500 ± 0.032) V

3.2 Leakage

Test pressure: Δp = (25.0 ± 5.0) kPa
Leakage rate: < 20 ml/min

3.3 Electromagnetic compatibility

a. Interference pick-up in accordance with ISO 11452-5:
Test specimen with electrical connection, hereof 1.5 m cable under the stripline.
Voltage supply and output signal are led through filters.
Effective field strength in the frequency range 1 to 400 MHz: 100 V/m
Maximum deviation by the interference pick-up: ± 0.150 V

b. Test pulses a) -60 V and b) 40 V in accordance with ISO 7637-3:
Input of the control unit simulated by RC network (21.5 kΩ, 100 nF).
Maximum deviation by pulse test: ± 0.150 V

c. Electrostatic discharge in accordance with ISO TF 10605, level 4, class A
10 single discharges via 330 pF and 2 kΩ in each case.
Time duration between successive single discharges: 5 s
Contact discharge to open pins: ± 8 kV
Air discharge to housing surface: ± 15 kV
After contact discharge as well as during and after air discharge the function may not be affected beyond normal tolerance.

4. Endurance tests

The tests will depend upon the mechanical and climatic stresses applicable to the engine compartment. Experience has shown that these cover the requirements expected during the vehicles life cycle. For critical requirements the conditions have to be investigated by vehicle measurements.

New parts must be used for each test.

Assessment:
After the tests have been conducted, the characteristic of the pressure sensor must be in the following tolerance band:

Output voltage at:	p_e =	0.0 kPa:	$U_{out} = (0.500 \pm 0.048)$ V
	p_e =	75.0 kPa:	$U_{out} = (3.500 \pm 0.048)$ V

4.1 Temperature cycling

500 temperature shocks between -40°C and +130°C.
Dwell time at the final temperatures 1 h in each case.
No electrical operation.

4.2 High-temperature storage

100 h of storage at 130°C.
No electrical operation.

4.3 Functional endurance run

Electrical operation.
Pressure cycles with frequency of 0.5 Hz between differential pressure of 0 kPa and 100 kPa:

- $p_1 = p_{amb}$ (atmospheric pressure 100 kPa)
- p_2: pressure cycles between 100 kPa and 200 kPa (absolute pressure)

Superposed temperature profile:

- 0.5 h dwell time at -40°C
- 2 h increase temp. to 90°C
- 2 h dwell time at 90°C
- 1 h increase temp. to 130°C
- 1 h dwell time at 130°C
- 2 h decrease temp. to -40°C

Duration: $2 \cdot 10^6$ pressure cycles

4.4 Wideband random vibration

Carrying out with intended connector and cable harness, fastened approximately 20 cm from the sensor. Wideband random vibration according to ISO CD 16750-3 of 10.01.2001, item 4.1.3.1.5.2:

- power spectral density at 10 Hz: 20.00 $(m/s^2)^2/Hz$
- power spectral density at 55 Hz: 6.50 $(m/s^2)^2/Hz$
- power spectral density at 180 Hz: 0.25 $(m/s^2)^2/Hz$
- power spectral density at 300 Hz: 0.25 $(m/s^2)^2/Hz$
- power spectral density at 360 Hz: 0.14 $(m/s^2)^2/Hz$
- power spectral density at 1000 Hz: 0.14 $(m/s^2)^2/Hz$

RMS acceleration value: 27.8 m/s^2
Duration of stressing per principle axis: 8 h
Total duration in 3 axis: 24 h

4.5 Humidity cycle

Pressure ports open.
Fit the connector to standard electrical interface.
Electrical operation under daytime tropical conditions.
Humidity cycling test: 21 cycles in accordance with FW24 DIN 50 016

4.6 Salt spray

Test specimens mounted on carrier as in the vehicle.
Close off the pressure ports.
Fit the connector to standard electrical interface.
No electrical operation.
Salt spray test: 144 h in accordance with DIN 50 021 - SS
Assessment: Characteristic, see above; surface may not become cracked.

4.7 Resistance to vehicle climate

Follow-up test with the same test specimens:

1. Pressure ports open.
   No electrical operation.
   Test specimens approximately 200 mm away from the fuel surface in the heatable test tank. Test fuel: unleaded premium-grade gasoline.
   Test cycle: Heating in 3 h from room temperature to (70 ± 3) °C
   Test 5 h at (70 ± 3) °C
   Cooling in 16 h (70 ± 3) °C to room temperature
   Duration: 4 cycles
2. Close off the pressure ports.
   Fit the connector to standard electrical interface.
   No electrical operation.
   Test cycle: wet with diesel fuel for 5 s, 24 h storage at +80°C
   Duration: 4 cycles
3. Test cycle: wet with engine oil (SAE10W40) for 5 s, 24 h storage at +80°C
   Duration: 4 cycles
4. Test cycle: 1 h storage at +80°C, wet for 5 s with cold cleaning agent (P3 of Henkel)
   Duration: 4 cycles
5. Splashwater test in accordance with DIN 40 050, part 9
   Degree of protection IP X4K

Assessment: Characteristic, see above; surface may not become cracked.

5. Evaluation of field returns

Field returns are examined for their mechanical and electrical capability. For the characteristic curve the test thresholds according to endurance tests apply.

A 261 260 607

1. Fehlende Masse der Schnittstelle am Sensor: RB-Kompaktstecker 1.1 nach RB-Zeichnung D 928 002 69A, vom 15.02.1999, 3-polig, Kodierung 1, Kontakte verzinnt.

2. Kabelbaumstecker: RB-Kompaktstecker 1.1a nach RB-Zeichnung A 928 000 453, vom 07.08.2000, 3-polig, Kodierung 1, Kontakte verzinnt.

3. RB-Gewaehrleistung fuer die Funktion des Stecksystems nur bei Verwendung der in dieser Angebotszeichnung vorgeschriebenen Gegenstecker-Systemteile.

4. Erste Abstuetzstelle des Kabels muss auf dem Sensortraeger liegen, max. 250 mm (gestrecke Kabellaenge) nach der Steckverbindung.

5. Abwinkelung des Kabels (Abweichung von der geraden Linie) zwischen Kabelabgang am Sensor und erster Abstuetzstelle: 20...90° .

6. Zulaessiger Biegeradius des Kabels bis zur ersten Abstuetzstelle: R >50 mm.

7. Der Sensor ist durch aufgesteckten Gegenstecker vor Eindringen von Wasser zu schuetzen.

8. Maximaler Durchmesser der Befestigungsschraube innerhalb des Befestigungslochs: 6 mm.
Unterlegscheibe mit mind. Ø 10 mm oder entsprechenden Schraubenkopfdurchmesser verwenden. Maximal zulaessige Montagespannkraft der Befestigungsschraube 4,5 kN. Beispiel: Mit Schraube M5 (DIN 84, 912, 931 und 933), verzinkt, leicht geoelt und Scheibe, verzinkt, ergibt sich ein max. zulaessiges Anschraubmoment von 3,3 Nm.

9. Der Applikationshinweis 0 281 YE0 001 ist unbedingt zu beachten.

1. MISSING DIMENSIONS OF CONNECTOR INTERFACE AT SENSOR: RB-KOMPAKT CONNECTOR 1.1 ACCORDING TO RB-DRAWING D 928 002 69A, FROM 15.02.1999, 3 PINS, CODING 1, TERMINALS TIN PLATED.

2. WIRE HARNESS CONNECTOR: RB-KOMPAKT CONNECTOR 1.1a ACCORDING TO RB-DRAWING A 928 000 453, FROM 07.08.2000, 3 PINS, CODING 1, TERMINALS TIN PLATED.

3. RB WARRANTY WILL COVER THE FUNCTION OF THE CONNECTOR SYSTEM ONLY IN CASE OF COMBINATION WITH HARNESS CONNECTOR SYSTEM PARTS ACCORDING TO THIS OFFER DRAWING.

4. FIRST CABLE MOUNTING POINT MUST BE LOCATED ON THE SENSOR CARRIER, MAX. 250 mm (STRAIGHT CABLE LENGTH) AFTER THE PLUG.

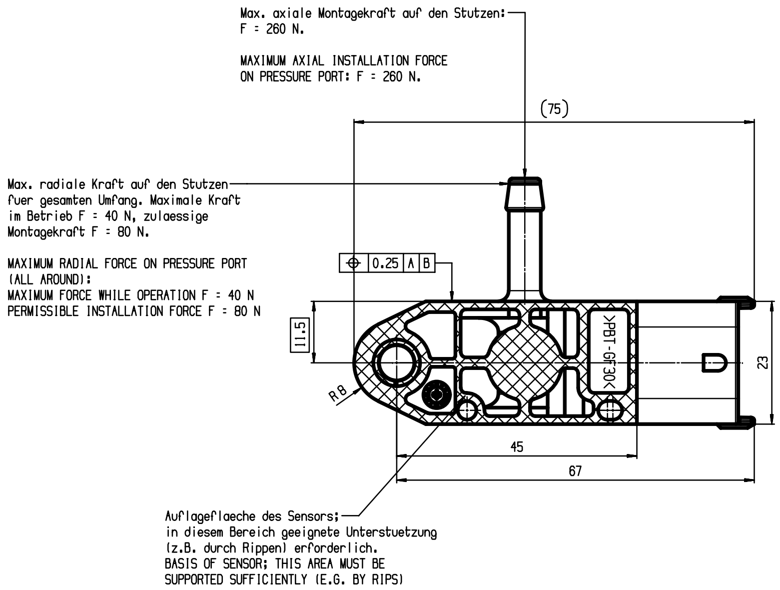
5. ANGLE OF BENDING THE CABLE (DEVIATION FROM STAIGHT LINE) BETWEEN CABLE EXIT AT SENSOR AND FIRST MOUNTING POINT: 20...90° .

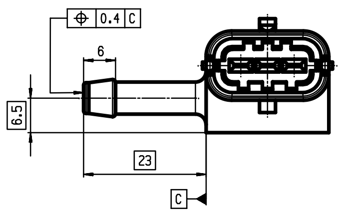
6. ADMISSIBLE BENDING RADIUS OF THE CABLE UP TO THE FIRST CABLE MOUNTING POINT: R >50 mm.

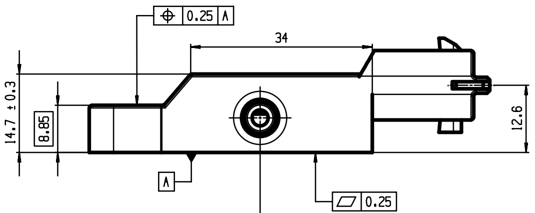
7. USE CABLE HARNESS CONNECTOR FOR PROTECTION AGAINST WATER INGRESS!

8. MAXIMUM DIAMETER OF THE SCREW IN THE INTERIOR OF MOUNTING HOLE: 6 mm. USE WASHER Ø 10 mm OR ADEQUATE SCREW HEAD DIAMETER. MAXIMUM PERMISSIBLE MOUNTING TIGHTENING FORCE FOR FIXING SCREWS 4.5 kN. EXAMPLE: SCREW M5 (DIN 84, 912, 931 AND 933), Zn COATED, LIGHTLY OILED AND WASHER, Zn COATED, RESULTS IN A MAXIMUM PERMISSIBLE TIGHTENING TORQUE OF 3,3 Nm.

9. THE APPLICATION INSTRUCTIONS 0 281 YE0 001 MUST BE STRICTLY REGARDED.





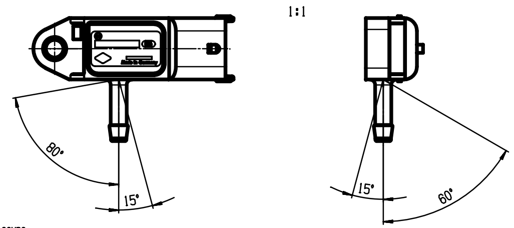


Einbaulage im Fahrzeug:

Druckanschluesse senkrecht nach unten gerichtet.

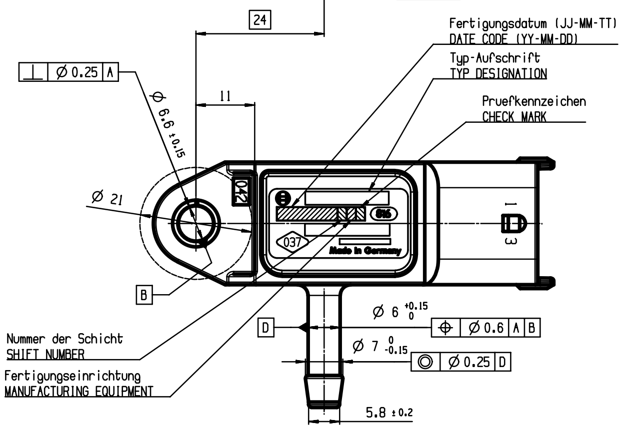
INSTALLATION POSITION IN THE VEHICLE:

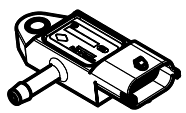
PRESSURE PORTS DIRECTED VERTICAL DOWNWARDS.



Steckerbelegung
CONNECTOR DETAILS

1 Spannungsversorgung 5 Volt	SOURCE 5 VOLT
2 Masse	GROUND
3 Ausgangssignal	OUTPUT SIGNAL





3-D Ansicht
PERSPECTIVE VIEW
M 1:1

B 261 260 607	0 281 002 593	0 281 002 593	20 ... 250	.	Y 261 K26 134
Entwurfs - Nummer DRAFT NUMBER	Bestell - Nummer ORDER NUMBER	Typ - Aufschrift TYPE - DESIGNATION	Druckbereich in kPa PRESSURE RANGE IN kPa	Bestellnr. des Kunden CUSTOMER'S ORDER NUMBER	Technische Kundenunterlage TECHNICAL CUSTOMER INFO

DS-LDF6 (DS-S2)

Dokumentenart/ DOCUMENT TYPE	AGZ
Nicht tol. Masse / NON TOLERANCED DIMENSIONS	±1 mm, ±5 °
ISO E	
Massstab / SCALE	2:1 (1:1)
Gewicht / WEIGHT	ca. 20g
	Angebots-zeichnung / OFFER DRAWING
gez/DWN	12.11.2003 Ga
gep/CHK	12.11.2003 Hi
gen/APP	12.11.2003 Ku
Original:	GS-SE/ENG
DIN	A1
Benennung/ TITLE	Drucksensor PRESSURE SENSOR
Nr./ NO.	A 261 260 607
	de/en
Blatt / SHEET	1
	1 Bl/SH
Ers.f./ REPLACES	.
Ers.d./ REPLAC.BY	.

Nr / NO	Aenderung / CHANGE	gez. / DWN.	gueltig / VALID	gepr / CHK.
.	.	.	.	.

BOSCH

Ausfuellanleitung N12A D11/1 beachten!

OBSERVE INSTRUCTIONS FOR FILLING OUT N12A D11/1

Weit. fremdspr. Angebotszeichnungen / FURTHER FOREIGN LANGUAGE OFFER DWGS.

01/AST11 (05.2000) A A1

Produkt / Product:	**Manifold Absolute Pressure Sensor for attachment to the bodywork**
Typ / Type:	**DS-S2 (DS-LDF6)** **20 – 250 kPa**
Bestellnummer / Part Number:	0 281 002 593
Angebotszeichnung / Offer Drawing:	A 261 260 607 - . . .

Kenndaten / Characteristic Data:	-	Seite/Page	3	bis/to	7
Prüfmethoden / Test Method:	-	Seite/Page	8	bis/to	11
Prüfdaten / Test Data:	-	Seite/Page	-	bis/to	-
Gültig ab / Valid from:	Start of production				

Bemerkung / Comment:

Nr. Index	Seite Page	Änderung Revision	Datum Date	GS/EZS2 (dr)	GS/EZS2 (ck)	GS/EZS (app)	GS/VSA Kunzmann	DS/ESK1
—	—	**Erstausgabe / First Edition**	07.02.02					

Contents:

1. Description

1.1 Application

The sensor described in this data sheet serves to measure the absolute intake-manifold pressure up to 250 kPa of the intake air stream of internal-combustion engines operated with leaded or unleaded regular-grade or premium-grade gasoline, M15, E22 or diesel fuel.

1.2 Technical principle

The piezo-resistive pressure sensor element and a suitable circuitry for signal amplification and temperature compensation are integrated on a silicon chip. The measured pressure operates from above to the active side of the silicon diaphragm. Between the backside and a glass socket a reference vacuum is enclosed. By a suitable coating process the pressure sensor is resistant against vapours and fluids existing in the intake-manifold.

1.3 Installation instructions

The pressure sensor is designed for attachment to the bodywork in the engine compartment of motor vehicles. It is connected to the intake-manifold by means of a suitable hose.
By suitable fitting the pressure sensor in the vehicle (tapping the pressure at the intake-manifold, laying the pressure hose, pressure sensor fitted as high as possible, pressure port pointing downwards etc.), it must be ensured that no fluids (fuel, water, condensate etc.) can penetrate the pressure sensor cell.
The connection to the pressure port (material, shape) must be designed so as to guarantee a long-term, leak-proof seat at the port and to guarantee resistance to the measured medium (gas mixture in the intake-manifold).
In the interest of good continuity on the connectors, it is essential that not only the connector on the component side is according to specification, but that the material quality and exact fit of the cable harness connector are also guaranteed. The cable harness connector should therefore be according to the BOSCH offer drawing specification.

1.4 Assembly instructions

In order to avoid deterioration or pre-damage of the sensor at the user the following points have to be absolutely noticed:
a) The sensor must not be mounted with striking tools (e.g. hammer).
b) When the assembly unit is exposed to a leakage test, don’t exceed maximum overpressure.
c) At immersion test plug connector and pressure port for protection against water ingress.
d) Avoid reverse voltage and overvoltage when electrical tests are applied to the sensor.
If the installation of the sensor takes place at the supplier e.g. of an assembly unit, the supplier has to be instructed accordingly.

1.5 Signal evaluation

The pressure sensor supplies an analogue output signal, which is ratiometric to the supply voltage. An RC low-pass filter with for instance τ = 2 ms is recommended as an input circuitry for the following electronics in order to suppress possibly disturbing harmonic vibrations.

1.6 Signal range check

The electric output of the sensor is designed in such a way, that failures in function by cable breaks or short circuits can be detected by a suitable input circuitry of the following electronics. For the signal range check the diagnosis ranges beyond the characteristic limits are provided. Example of circuitry for detection of all kinds of failures by signal out of characteristic limits:

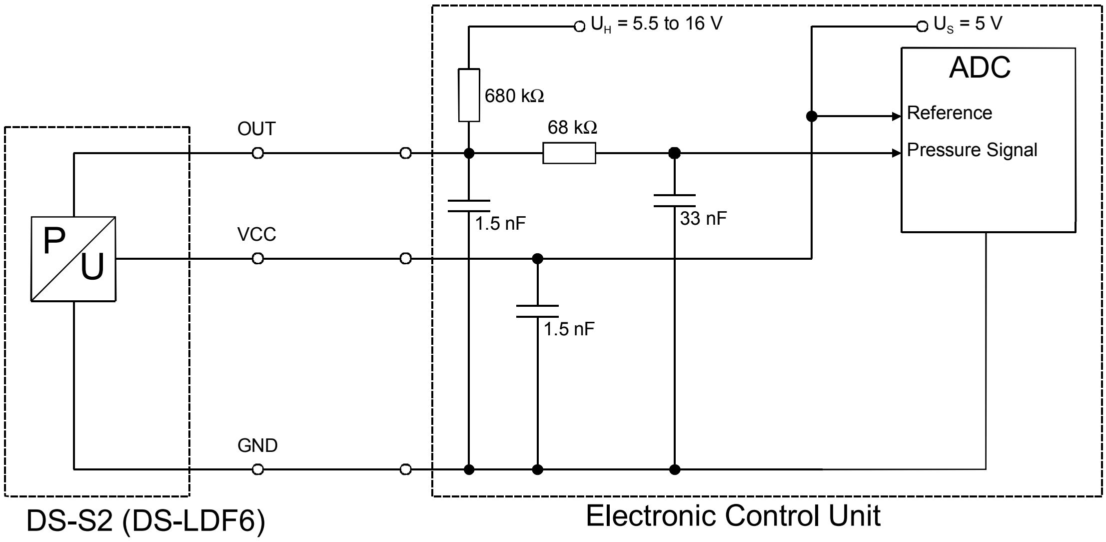


Figure 1a. Signal evaluation with load resistor to U_H= 5.5 to 16 V

Further possibility of circuitry for detection of failures (signal below characteristic limit or above plausible characteristic range):

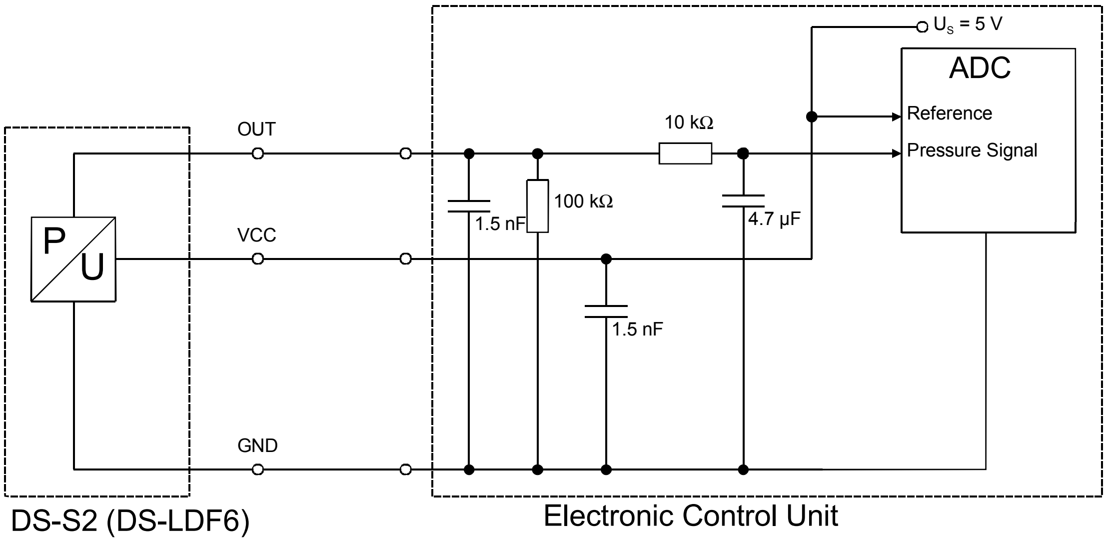


Figure 1b. Signal evaluation with load resistor to ground

2. Data

2.1 Maximum ratings

Parameter	Symbol	Value	Unit
Supply voltage	$U_{S,max.}$	16	V
Pressure	$p_{abs,max.}$	500	kPa
Storage temperature	t	-40/+130	°C

The output is resistant against short circuit to 0 V respectively 5 V. The sensor is resistant against reverse voltage for 5 min at room temperature, as the maximum current is limited to 0.3 A.

2.2 Operating characteristics

Parameter	Symbol	Value			Unit
		min.	typ.	max.	
Pressure range	p_{abs}	20		250	kPa
Temperature range	t	-40		130	°C
Supply voltage	U_S	4.75	5.0	5.25	V
Supply current at U_S = 5 V	I_S	6.0	9.0	12.5	mA
Output load current	I_L	-1.0		0.5	mA
Load resistance to U_S or to ground	$R_{pull-up}$ $R_{pull-down}$	5.0 10.0			kΩ kΩ
Load capacitance	C_L			12	nF
Response time	$T_{10/90}$			1.0	ms
Lower limit at U_S = 5 V	$U_{out,min.}$	0.25	0.3	0.35	V
Upper limit at U_S = 5 V	$U_{out,max.}$	4.75	4.8	4.85	V
Output resistance [1)] to ground, U_S open	R_{lo}	2.4	4.7	8.2	kΩ
Output resistance [1)] to U_S, ground open	R_{hi}	3.4	5.3	8.2	kΩ

1) valid only for measuring voltage < 0.5 V

2.3 Transfer function

$$U_{out} = (c_1 \cdot p_{abs} + c_0) \cdot U_S$$

where U_{out} = signal output voltage in V
U_S = supply voltage in V
p_{abs} = absolute pressure in kPa
c_0 = 1.4/230
c_1 = 0.85/230 kPa^{-1}

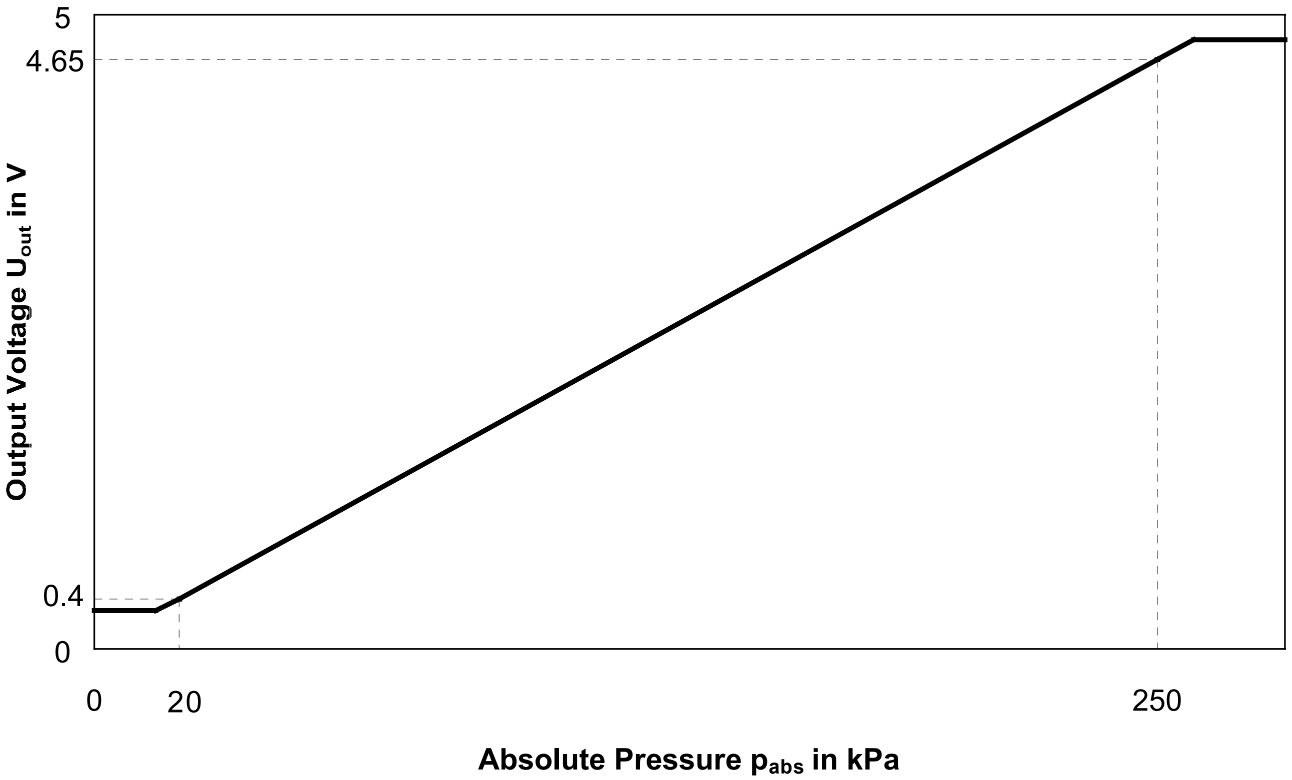


Figure 2. Characteristic at U_S= 5.000 V

2.4 Accuracy

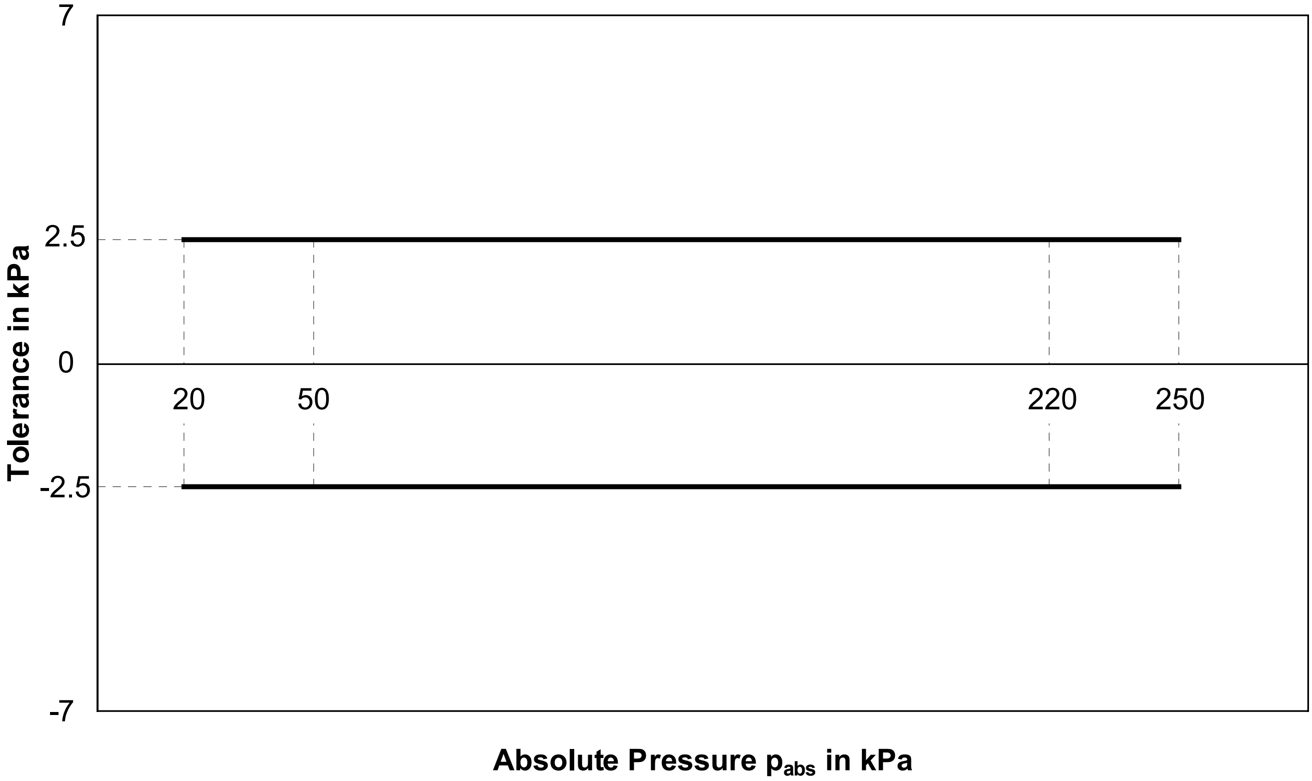


Figure 3. Characteristic tolerance

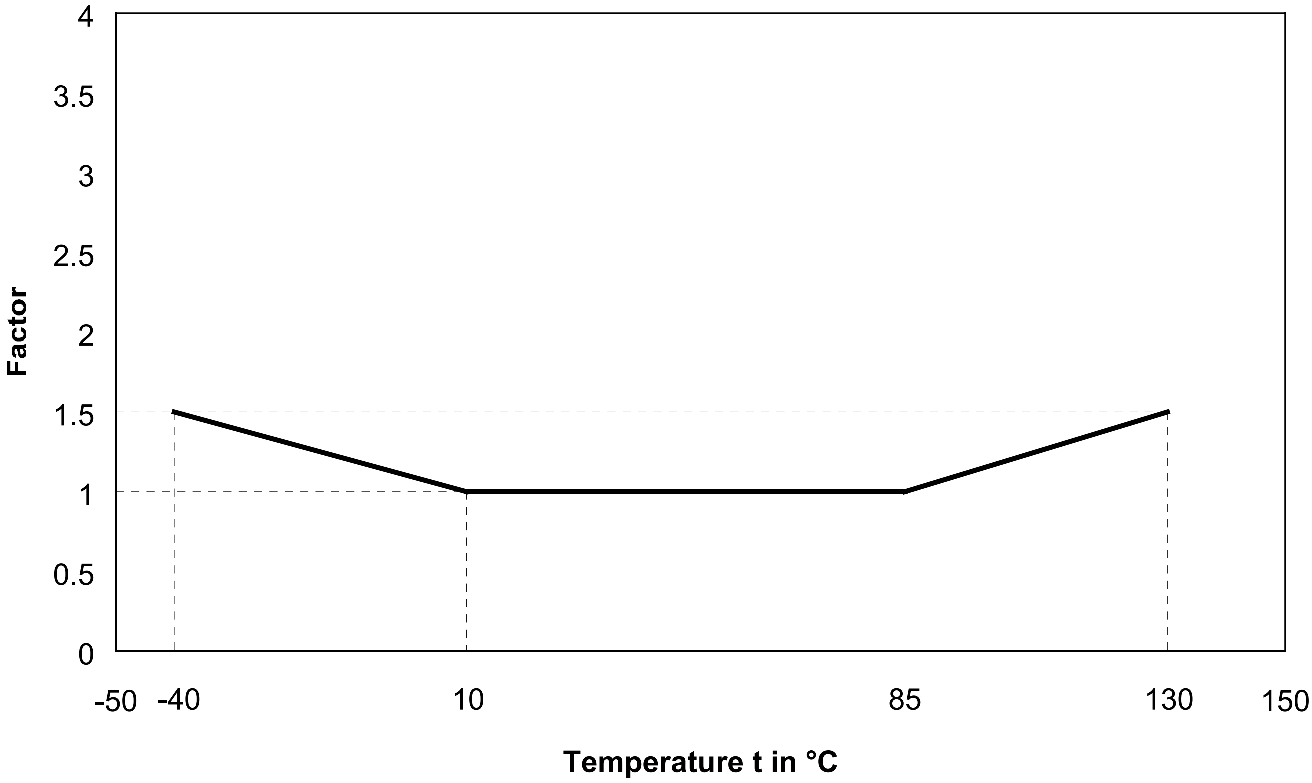


Figure 4. Tolerance broadening as a function of temperature

3. Functional test

Ambient temperature: (23 ± 5) °C

Supply voltage: U_S= (5.000 ± 0.250) V
If the supply voltage U_S differs from the nominal value 5.000 V, the measured output voltage U_{out} must be converted to the nominal value with factor 5.000 V/U_S.

3.1 Characteristic

Output voltage at:	p_{abs} =	50.0 kPa:	U_{out} = (0.954 ± 0.046) V
	p_{abs} =	220.0 kPa:	U_{out} = (4.096 ± 0.046) V

3.2 Leakage

Test pressure: Δp = (25.0 ± 5.0) kPa
Leakage rate: < 20 ml/min

3.3 Electromagnetic compatibility

a. Interference pick-up in accordance with ISO 11452-5:
Test specimen with electrical connection, hereof 1.5 m cable under the stripline.
Voltage supply and output signal are led through filters.
Effective field strength in the frequency range 1 to 400 MHz: 100 V/m
Maximum deviation by the interference pick-up: ± 0.150 V

b. Test pulses a) -60 V and b) 40 V in accordance with ISO 7637-3:
Input of the control unit simulated by RC network (21.5 kΩ, 100 nF).
Maximum deviation by pulse test: ± 0.150 V

4. Endurance tests

The tests will depend upon the mechanical and climatic stresses applicable to the engine compartment. Experience has shown that these cover the requirements expected during the vehicles life cycle. For critical requirements the conditions have to be investigated by vehicle measurements.

New parts must be used for each test.

Assessment:
After the tests have been conducted, the output voltage must be within the limits given in section 3.1.

4.1 Temperature cycling

500 temperature shocks between -40°C and +130°C.
Dwell time at the final temperatures 1 h in each case.
No electrical operation.

4.2 High-temperature storage

100 h of storage at 130°C.
No electrical operation.

4.3 Functional endurance run

Electrical operation.
Ambient temperature: (110 ± 5) °C
Pressure cycling: $p_{min.}$ = 20 kPa to $p_{max.}$ = 250 kPa, frequency approx. 0.5 Hz
Duration: $2 \cdot 10^6$ pressure cycles

4.4 Wideband Random Vibration

Performed with scheduled connector and harness, fixed approx. 20 cm away from the sensor.
Test in accordance with DIN 40046, part 22 resp. IEC 68-2-34
Wideband random vibration spectrum:
spectral acceleration density at 10 Hz: 9.68 $(m/s^2)^2/Hz$ ± 3 dB
spectral acceleration density at 300 Hz: 0.326 $(m/s^2)^2/Hz$ ± 3 dB
spectral acceleration density at 1000 Hz: 0.0296 $(m/s^2)^2/Hz$ ± 3 dB
Effective acceleration a_{rms}(10 – 1000 Hz): 20 m/s^2
Duration of stressing per principal axis: 3 h
Ambient temperature: 85°C

4.5 Humidity cycle

Pressure port open.
Fit the connector to standard electrical interface.
Electrical operation under daytime tropical conditions.
Humidity cycling test: 21 cycles in accordance with FW24 DIN 50 016

4.6 Salt spray

Test specimens mounted on carrier as in the vehicle.
Close off the pressure port.
Fit the connector to standard electrical interface.
No electrical operation.
Salt spray test: 144 h in accordance with DIN 50 021 - SS
Assessment: Characteristic, see above; surface may not become cracked.

4.7 Resistance to vehicle climate

Follow-up test with the same test specimens:

1. Pressure port open.
   No electrical operation.
   Test specimens approximately 200 mm away from the fuel surface in the heatable test tank. Test fuel: unleaded premium-grade gasoline.
   Test cycle: Heating in 3 h from room temperatur to (70 ± 3) °C
   Test 5 h at (70 ± 3) °C
   Cooling in 16 h (70 ± 3) °C to room temperature
   Duration: 4 cycles
2. Close off the pressure port.
   Fit the connector to standard electrical interface.
   No electrical operation.
   Test cycle: wet with diesel fuel for 5 s, 24 h storage at +80°C
   Duration: 4 cycles
3. Test cycle: wet with engine oil (SAE10W40) for 5 s, 24 h storage at +80°C
   Duration: 4 cycles
4. Test cycle: 1 h storage at +80°C, wet for 5 s with cold cleaning agent (P3 of Henkel)
   Duration: 4 cycles
5. Splashwater test in accordance with DIN 40 050, part 9
   Degree of protection IP X4K

Assessment: Characteristic, see above; surface may not become cracked.

5. Evaluation of field returns

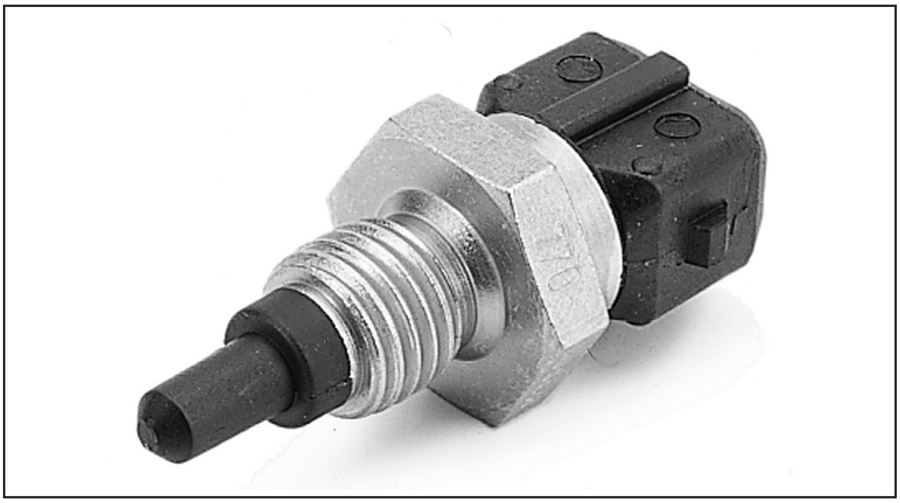
Field returns are examined for their mechanical and electrical capability. For the characteristic curve the test thresholds according to endurance tests apply.

NTC temperature sensors: -40°C to 130° C

Measurement of air temperatures

Output quantity: R

- Measurement with temperature-sensitive resistors.
- Broad temperature range.



NTC temperature sensor
Plastic-sheathed NTC thermistor

Design and operation
NTC thermistors have a negative temperature coefficient, i.e. their conductivity increases with increasing temperature: Their resistance decreases. The conductive element of the temperature sensor consists of semi-conducting heavy metal oxides and oxidized mixed crystals pressed or sintered into wafers or beads with the aid of binding agents and provided with a protective casing. In combination with a suitable evaluation circuit, such resistors permit precise temperature determination. Depending on the housing design, the sensors are suitable for measuring temperatures in liquids and gases. In motor vehicles they are used to measure the temperature of the intake air, i.e. in the range -40...130 °C.

Note
For a 2-pin connector, 1 connector housing, 2 contact pins and 2 individual seals are required.
Genuine Tyco crimping tools must be used for motor vehicle applications.

Explanation of characteristic quantities
R Resistance ϑ Temperature

Installation instructions
The sensor is installed such that the front section with the sensing element is directly exposed to the air flow.

Robert Bosch GmbH
Automotive Aftermarket
Postfach 410960
76225 Karlsruhe
Germany

www.bosch-sensoren.de

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Invented for life

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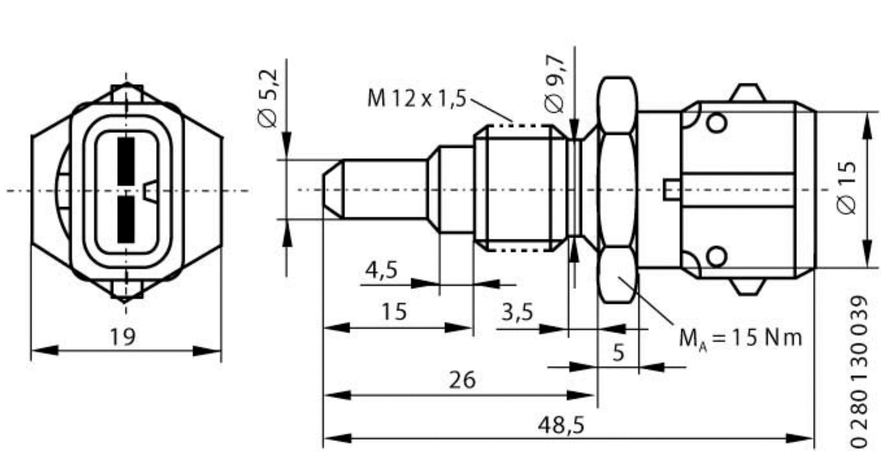
Part number 0 280 130 039

Technical data

Perm. temperature max.	°C	130
Rated resistance at 20 °C	kΩ	2,5 ± 5 %
Resistance at -10 °C	kΩ	8,325 ... 10,572
Resistance at +20 °C	kΩ	2,280 ... 2,736
Resistance at +80 °C	kΩ	0,288 ... 0,359
Nominal voltage	V	5 ± 0,15
Max. measurement current	mA	1
Self-heating with max. perm. power loss of P = 2 mW and still air (23 °C)	K	≤ 2
Temperature/time constant τ_{63}[1])	s	≤ 38
Approximate value for permissible vibration acceleration a_{sin} (sinusoidal vibration)	m/s²	300
Corrosion-tested as per		DIN 50 018

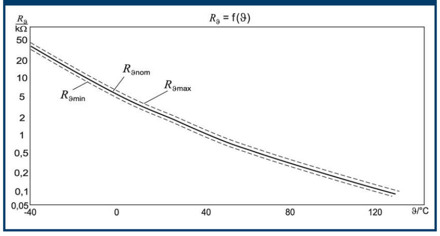
Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required. [1])Available from Tyco Electronics.

Dimensional drawing

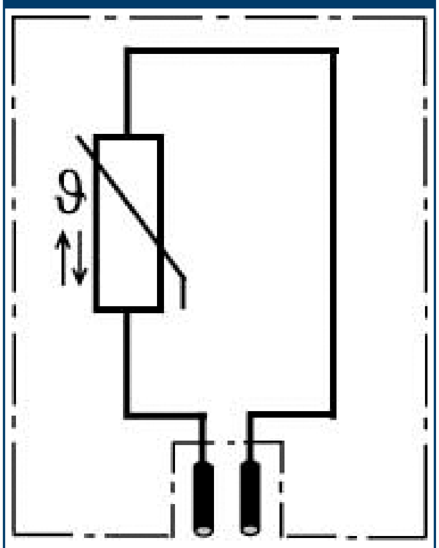


g_{rms} Tightening torque

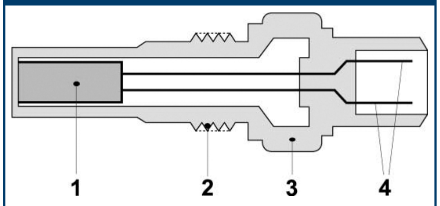
Resistance profile of temperature sensor



Circuit diagram



Temperature sensor (block diagram)



1 NTC thermistor
2 Screw-in thread
3 Housing
4 Electrical connection

Accessories

Accessories			Part number
Jetronic connector		2-pin	1 928 402 078
Protective cap		Temperature-resistant; Contents: 1 x	1 280 703 031
Contact pins	For Ø 0.5...1.0 mm^2	Tyco number	929 939-3[1])
Contact pins	For Ø 1.5...2.5 mm^2	Tyco number	929 937-3[1])
Individual seal		For Ø 0.5...1.0 mm^2; Contents: 50 x	1 987 280 106
Individual seal		For Ø 1.5...2.5 mm^2; Contents: 20 x	1 987 280 107

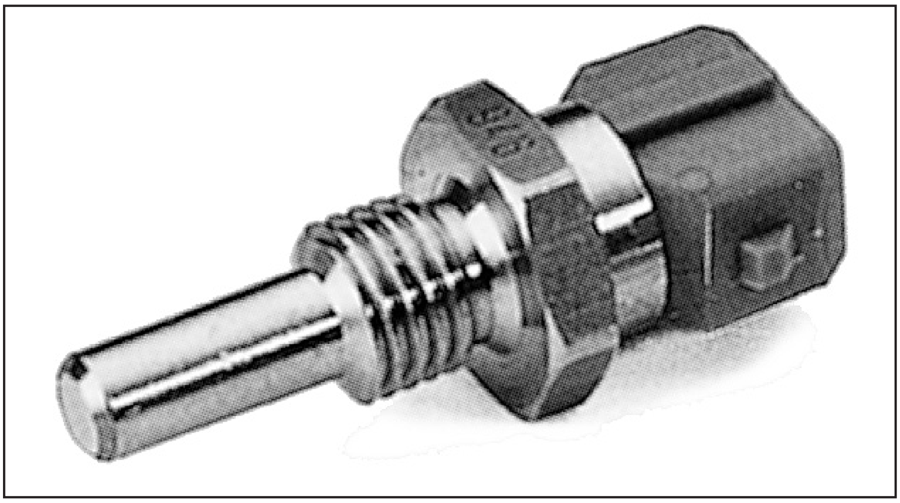
Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required. [1]) Available from Tyco Electronics.

NTC temperature sensors: -40°C to 130° C

Measurement of liquid temperatures

Input quantity: ϑ
Output quantity: R

- Wide range of liquid temperature measurements with temperature-sensitive resistors.



NTC temperature sensor

NTC thermistor in brass housing.

Design and operation

NTC thermistors have a negative temperature coefficient, i.e. their conductivity increases with increasing temperature: Their resistance decreases. The conductive element of the temperature sensor consists of semi-conducting heavy metal oxides and oxidized mixed crystals pressed or sintered into wafers or beads with the aid of binding agents and provided with a protective casing. In combination with a suitable evaluation circuit, such resistors permit precise temperature determination. Depending on the housing design, the sensors are suitable for measuring temperatures in liquids and gases.
In motor vehicles they are used to measure the temperature of engine oil, coolant and fuel, i.e. in the range -40...130 °C.

Note

For a 2-pin connector, 1 connector housing, 2 contact pins and 2 individual seals are required.
Genuine AMP crimping tools must be used for motor vehicle applications.

Explanation of characteristic quantities

R Resistance
ϑ Temperature

Robert Bosch GmbH
Automotive Aftermarket
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76225 Karlsruhe
Germany

www.bosch-sensoren.de

BOSCH
Invented for life

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Invented for life

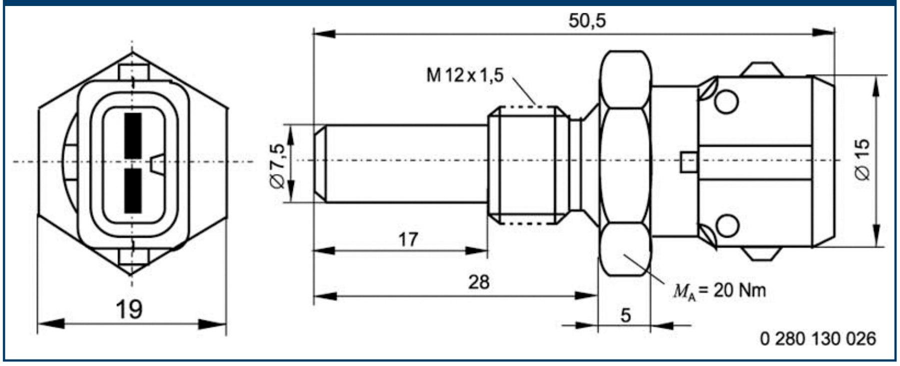
Part number 0 280 130 026

Technical data

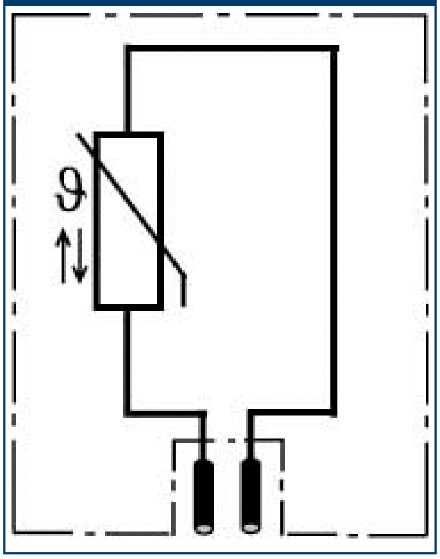
Application/medium		Oil/water
Measuring range	°C	- 40 ...+ 130
Rated resistance at 100 °C	kΩ	2,5 ± 5 %
Resistance at -10 °C	kΩ	8,325 ... 10,572
Resistance at +20 °C	kΩ	2,280 ... 2,736
Resistance at +80 °C	kΩ	0,288 ... 0,359
Temperature/time constant τ_{63} [1])	s	≤ 15
Approximate value for permissible vibration acceleration a_{sin} (sinusoidal vibration)	m/s²	300
Degree of protection [1])		IP 5K9K
Thread		M 12 x 1,5
Corrosion-tested as per		DIN 50 021
Connector		Jetronic, tinned pins
Tightening torque	Nm	20
Rated voltage	V	5 ± 0,15
Max. measurement current	mA	1

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.
[1]) Available from Tyco Electronics.

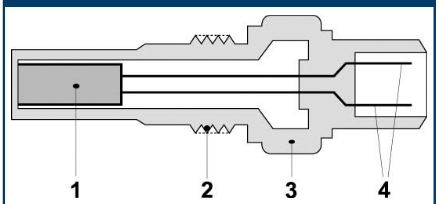
Dimensional drawing



Circuit diagram

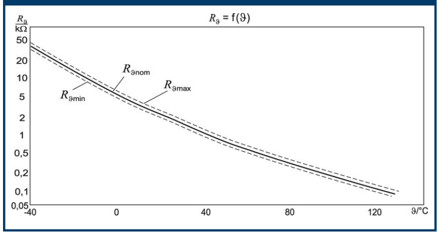


Temperature sensor (block diagram)



1 NTC thermistor
2 Screw-in thread
3 Housing
4 Electrical connection

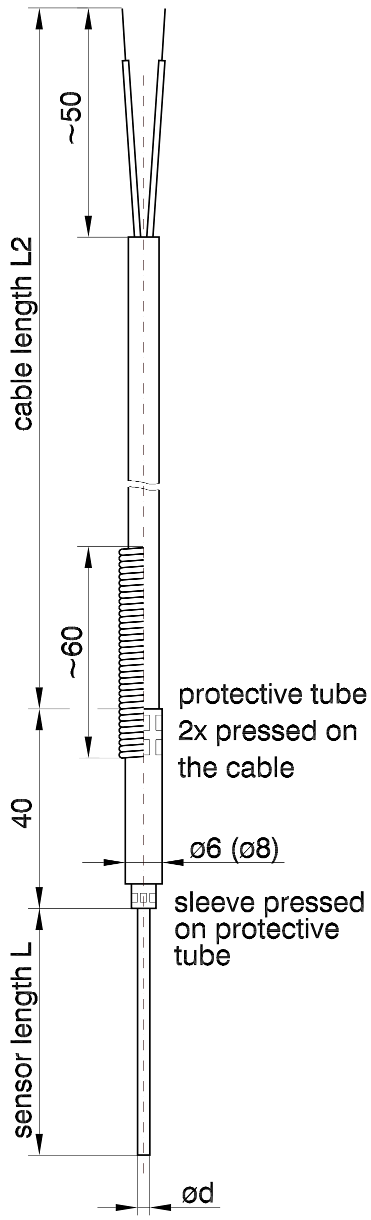
Resistance profile of temperature sensor



Accessories			Part number
Jetronic connector		2-pin	1 928 402 078
Protective cap		Temperature-resistant; Contents: 1 x	1 280 703 031
Contact pins	For Ø 0.5...1.0 mm^2	Tyco number	929 939-3[1])
Contact pins	For Ø 1.5...2.5 mm^2	Tyco number	929 937-3[1])
Single-wire seal		For Ø 0.5...1.0 mm^2; Contents: 50 x	1 928 498 106
Single-wire seal		For Ø 1.5...2.5 mm^2; Contents: 20 x	1 987 280 107

Accessories are not included in the scope of delivery of the sensor and are therefore to be ordered separately as required.
[1]) Available from Tyco Electronics.

Thermocouples
Sheathed Thermocouple
Series 294



Sheathed Thermocouple with connecting sleeve and thermo-compensating-lead

Bending radius of the sheath material ≥ 5x⌀ d

Application temperature

-200 to +1000°C

Thermo junction

J (Fe-CuNi) DIN EN 60584
K (NiCr-Ni) DIN EN 60584
on inquiry

Number of Thermo junction

1 thermocouple
2 thermocouples

Sheath diameter

0.5 mm
1,0 mm
1.5 mm
2,0 mm
3,0 mm
4,5 mm
6,0 mm
on inquiry

Sheath material

1.4541
1.4571
1.4841
2.4816
on inquiry

Measuring point design

insulated of sheat
welded in sheat
disconnected bead at 2 thermocouples
connected bead at 2 thermocouples

Sensor length L

on inquiry min 10 mm

Issue of 03/2012 *Subject to change without notice*

electrotherm Gesellschaft für Sensorik
und thermische Meßtechnik mbH
Gewerbepark 6, D-98716 Geraberg

Tel.: +49 (0) 3677 7956 0
Fax: +49 (0) 3677 7956 25
eMail: info@electrotherm.de

Series 294

Compensating cable length L_2

on inquiry

Type of compensating cable

on inquiry

Bend protection

without
with spiral spring

Connector

free ends
connector on inquiry

electrotherm Gesellschaft für Sensorik
und thermische Meßtechnik mbH
Gewerbepark 6, D-98716 Geraberg

Tel.: +49 (0) 3677 7956 0
Fax: +49 (0) 3677 7956 25
eMail: info@electrotherm.de