

Bearing Distance and Temperature Monitoring System BMS3

Distance, Temperature, Water in Oil sensor

Monitoring Unit MPU050x

Sensor Box SBX01030x



Application fields

- 2-stroke diesel engines
- Bearing wear measurement
- Conrod and crosshead splash oil temperature measurement
- Main bearing temperature measurement
- Cylinder liner temperature sensing

Benefits

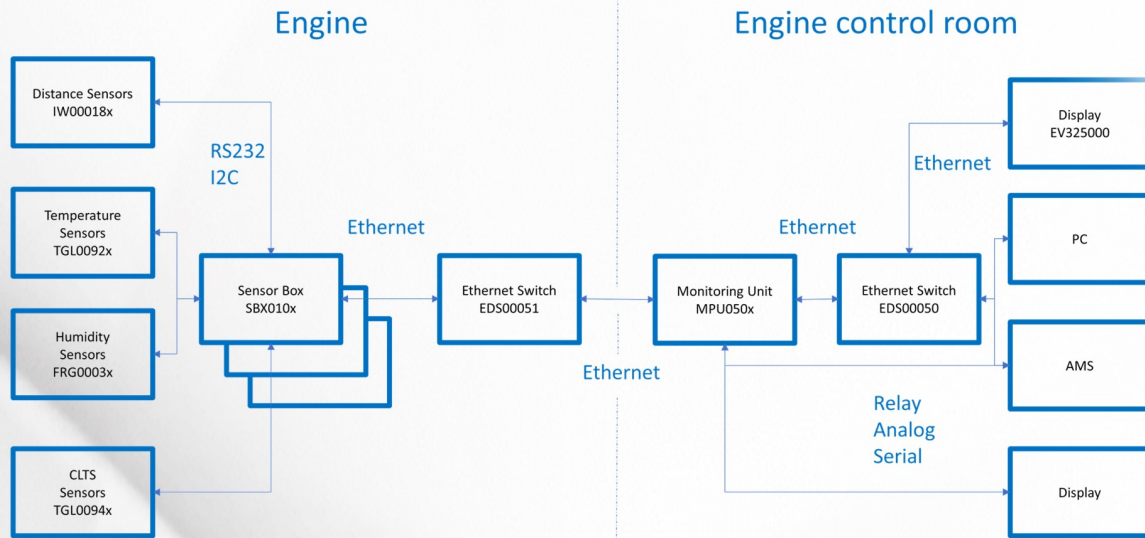
- Fully controlled bearing status
- Up to 72 sensors in different locations for thermal and distance sensing
- Integrated water in oil sensing system
- Trend display for long term information

Overview about Bearing Monitoring System BMS3

The **Bearing Monitoring System** realizes a continuous surveillance of an engine in regard to the distance between sensor and cross head in its lower dead point position, which is a measure of the bearing wear.

Further, it monitors the temperature of the oil in different positions as well as the solved water content in the oil (Water in Oil Sensor). As an option the system offers a precise temperature observation of the cylinder liners.

System overview:



The distance, temperature as well as the water in oil values are read by the **sensor box SBX010x** and are then transferred over ethernet to the **monitoring unit MPU050x**.

The data collection unit (**sensor box SBX010x**) supplies all connected sensors with power and acts as a data transfer unit changing and organizing the signals received from the sensors into an ethernet signal. It tracks the status of each sensor and gives information to the monitoring box in case the sensor status changes.

Usually the **monitoring unit MPU050x** is located in the engine control room. It calculates the measured distances and oil temperatures for each compartment and compares them with defined alarm limits of the engine manufacturers. If necessary, the related alarm is raised, and the relay is activated.

Furthermore, the monitoring unit stores the measured values on the internal memory and on a SD-card for later use.

The BMS3 can be installed as a retrofit into engines already in service. The system is type approved.

The system contains the following components:

Item type	Description	Item type	Description
MPU050x	Monitoring unit	IW00018x	Distance sensor with brackets
SBX01030x	Sensor box for 3 cylinders	TGL00922x	Temperature sensors
SBX01090x	Sensor box for 9 cylinders	FRG00035-I-x	Water in oil sensor type
EDS00051	Electronic data switch with power distribution to SBX01030	TGL00942x	CLTS sensors (cylinder liner temperature)
EDS00050	Electronic data switch without power distribution	EV325000	Data display

Monitoring Unit MPU050x



The heart of the BMS3 is the **main processing unit MPU050x**. It receives all data from the connected sensors. Pre-alarm and load reduction relays are available for selection by the user.

Calculated sensor data are stored on a SD card: The short-term storage allows the view of last 24 hours data in real time. The long-term storage contains maximum, minimum and average values for every 6 running hours. The event log contains alarms, slowdowns and other important information. Storage capacity is about 10 years.

For the purpose of presentation to surveyors from classification societies, before open-up a main bearing data can be exported, analyzed – and therefore an open-up most probably avoided.

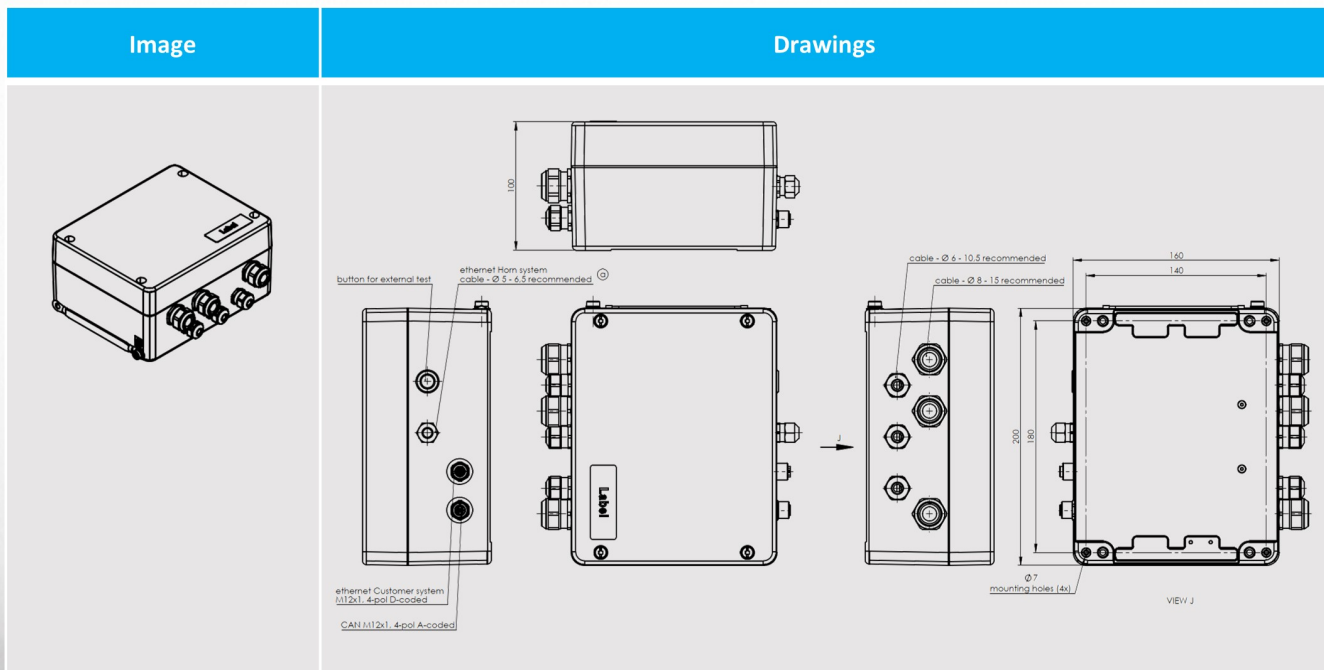
The customer can connect devices via ethernet connection. A web interface is accessible via public ethernet port with HTTP protocol means no additional software for communication is required. A FTP server is provided for easy data download via the ethernet port.

The web interface provides diagrams for the crew, superintendents, classification surveyors and service specialists. The wear record and tracked values can easily be downloaded for further investigations by our service team. The MPU050x provides different outputs:

- Analog outputs (2x) are provided whereas the max. distance, the max. temperature or the water in oil content can be transferred.
- RS422 serial data output is available, which will output all incoming data with their alarm level and temperature.
- Modbus is available either via RS485 or via TCP (in parallel)
- A galvanic isolated CAN interface is available for integration to data communication systems.

Technical data Monitoring Unit MPU050x

Property	Value	Property	Value
Power supply	18...32 VDC, max. permissible ripple ≤ 5 % (protected by automatic fuse) 2 power supply inputs (redundancy)	Connection to PE	Copper mesh band
Power consumption	< 10 W	Cable glands	M16 for sensor M16 for serial M16 for analog/binary inputs Cable size M16: ø6...10.5mm M20 for power supply M20 for relay Cable size M20: ø8...15mm
Polarity protection	Yes	Connectors	Ethernet: 1x M12x1, 4 pin D-coded (output), 4 pin connector (internal system) CAN: 1x M12x1, 4 pin A-coded
Operating temperature	-25...+85°C	Sensor interface	Ethernet
Storage temperature	-25...+85°C	Sensor interface (additional)	I ² C (Variant A) RS422 (Variant B, BMS2 upgrade)
Relative humidity	< 90 %, non-condensing	Cable length sensor inputs	Max. 100 m
Protection degree	IP65	Additional inputs	2x Binary input (+24 VDC with own supply) 2x Analog input (4-20 mA, others on request)
Dimensions	See drawings	Output	6x PhotoMOS Relay (Alarm) 2x Analog output 1x PhotoMOS Relay (Ready) 1x Serial output 1x Mechanical Relay (Alarm) 1x Ethernet output 1x CAN (120 Ω resistor via switch)
Weight	< 2.5 kg	Relays	Photo-MOS output: < 60 VDC, 500 mA (Short Circuit Protected SCP)
EMC-standard	DIN EN 55016-2, safety rules acc. EN 61000-4, rules for type approval test accord. DNVGL-CG-0339	Analog output	Current output or voltage output (details configurable: 4-20 mA, 0-20 mA, 0-24 mA or 0-5V, 0-10V VDC), galvanic isolated, user selectable
Environmental standard	DIN EN 60068-2 rules for type approval test accord. DNVGL-CG-0339	Serial output	RS422 / RS485, 9600, 19200, 38400, 57600 or 115200 baud, data printout, Modbus
Current output load	max. 1200 Ω	Cable lengths	CAN: Usual CAN connection scheme applies Ethernet: 100 m Serial output: 50 m Analog output: 30 m Relay: 30 m
Ethernet	Transmission rate max. 100 Mbit/s, galvanic isolated, IP-Address adjustable	Configuration	Web page
CAN	Transmission rate 20 kBaud...1 Mbaud, galvanic isolated, Node ID adjustable 1...127	Display	Web page, Modbus TCP
Data access	Web page over ethernet, FTP	RTC setup	Web page, NTP
RTC battery	Lithium-thionyl chloride (Li-SOCl ₂), 1/2 AA, 3,6V		



Further details on request.

Sensor Box SBX01030x (compact version)

Single sensors are connected to the **sensor box SBX01030x**. An interface for sensors with RS232C or I²C interface is available. Each sensor port has a LED for easy check of the sensor status. The received data are transferred to the main controller unit MPU050x using ethernet technology.

The SBX01030x is connected via ethernet switch EDS00051 which handles the communication as well as the power supply. The power supply is internally galvanic isolated.

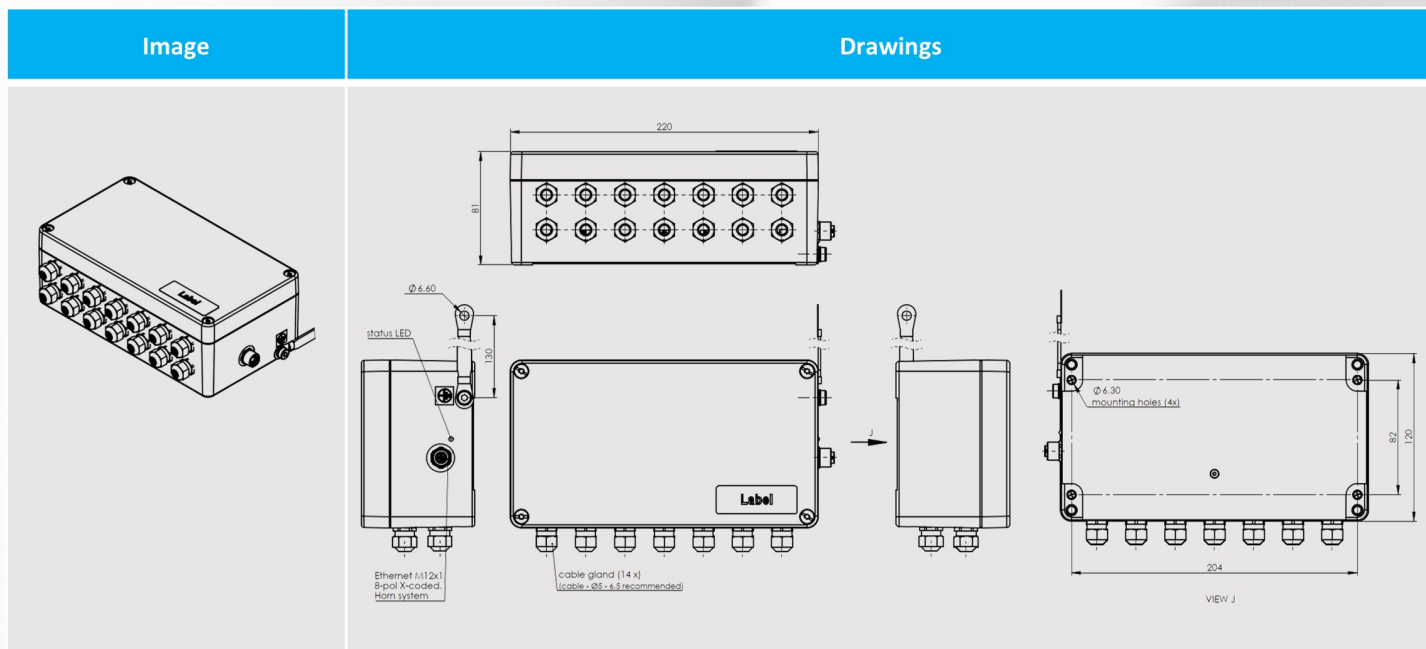
In addition an analog output can be used to directly provide sensor information to external systems in the area of the SBX01030x (e.g. analog water in oil data).



Technical data Sensor Box SBX01030x for 3 cylinders

Property	Value	Property	Value
Power supply	18...32 VDC, max. permissible ripple ≤ 5 % (protected by automatic fuse)	Connection to PE	Copper mesh band
Power consumption	< 5 W	Cable glands	M12 for sensor Cable size M12: $\phi 5...6.5\text{mm}$
Polarity protection	Yes	Ethernet connector	1x M12x1, 8 pin X-coded (output, with power supply input)
Operating temperature	-25...+85°C	Sensor interface	6xRS232, with 24 VDC sensor power supply, short circuit protected 8x1°C, with 5 VDC sensor power supply, short circuit protected
Storage temperature	-25...+85°C	Cable length sensor inputs	Max. 15 m (others on request)
Relative humidity	< 90 %, non-condensing	Analog output	Current output or voltage output (details configurable: 4-20 mA, 0-20 mA, 0-24 mA or 0-5V, 0-10V VDC), galvanic isolated, user selectable
Protection degree	IP65	Current output load	max. 1200 Ω
Dimensions	See drawing	Cable length ethernet	Max. 100 m
Weight	< 2 kg	Cable length analog output	Max. 30 m
EMC-standard	DIN EN 55016-2, safety rules acc. EN 61000-4, rules for type approval test accord. DNVGL-CG-0339	Ethernet	Transmission rate max. 100 Mbit/s, galvanic isolated, IP-Address adjustable
Environmental standard	DIN EN 60068-2 rules for type approval test accord. DNVGL-CG-0339		

Drawing SBX01030x



Further details on request.

Electronic Data Switch EDS00051

The **EDS00051** is used as **ethernet switch** for routing data packages from connected SBX010x to the MPU050x and back. Four ports provide the power supply for SBX01030x.

Communication between EDS and MPU runs via ethernet without additional power supply.

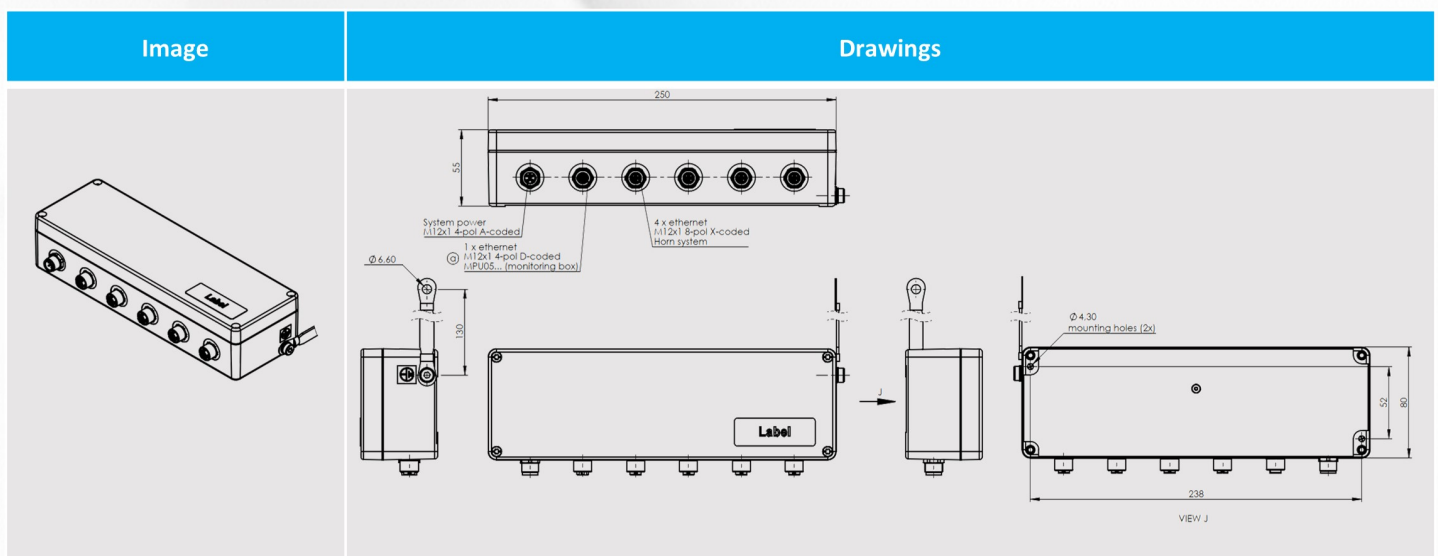
Each ethernet port has link and transfer indication LEDs to provide a quick connection status indication.



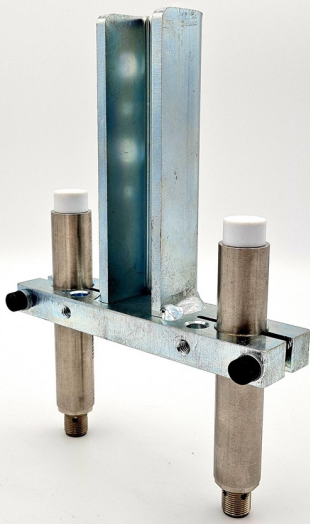
Technical data Electronic Data Switch EDS00051 with power output

Property	Value	Property	Value
Power supply	18...32 VDC, max. permissible ripple $\leq 5\%$ (protected by automatic fuse) 2 power supply inputs (redundancy)	EMC-standard	DIN EN 55016-2, safety rules acc. EN 61000-4, rules for type approval test accord. DNVGL-CG-0339
Power consumption	< 5 W	Environmental standard	DIN EN 60068-2 rules for type approval test accord. DNVGL-CG-0339
Polarity protection	Yes	Connection to PE	Copper mesh band
Operating temperature	-25...+85°C	Connectors	Ethernet: 4x M12x1, 8 pin X-coded (input from SBX01030x, with power supply output) 1x M12x1, 4 pin D-coded (output to MPU050x) Power supply: 1x M12x1 4 pin A-coded
Storage temperature	-25...+85°C	Cable length ethernet	Max. 100 m
Relative humidity	< 90 %, non-condensing	Ethernet	Max. 100 m
Protection degree	IP65	Dimensions	See drawing
Weight	< 1 kg		

Drawing EDS00051



Further details on request.



The **distance sensor IW000184** with electrical short circuit protection is an intelligent high-speed dual sensor inside the BMS. It is able to measure the distance in a range between 2.0...6.0 mm with a high resolution of 0.01 mm.

Additionally it measures the splash oil temperature in the area around the sensor within the range of 0...+70 °C at a tolerance of ± 2 °C.

The sensor detects the crosshead within its position range and calculates the lowest air gap distance in mm. The values are stored in an internal buffer and updated constantly at every revolution. Sensor Box collects the data from buffer via serial link and compares them with the defined limits.

The sensors fastening in the engine is arranged by clamping in specific brackets.

For correct installation on the SBX010x the sensor is marked with a special ID allowing the installer to identify the sensor to ensure that the FWD- and AFT-sensors per cylinder are connected correctly to the network.

Additionally, the sensor is equipped with a LED light indicating correct power supply.

For connection to the outside through the cable glands in the engine wall the sensor is delivered with a connector and 15m oil resistant PUR cable. By this connection an easy exchange is possible in case an exchange should become necessary.

The sensor is provided in a long (132 mm) and short (122 mm) version.

Technical data Distance sensor IW000184

Property	Value	Property	Value
Power supply	15...32 VDC, max. permissible ripple $\leq 5\%$	Dimensions	See drawing
Power consumption	< 1 W	Weight	Approx. 0.12 Kg
Polarity protection	Yes	EMC-standard	DIN EN 55016-2, safety rules acc. EN 61000-4, rules for type approval test accord. DNVGL-CG-0339
Operating temperature	-25...+70°C	Environmental standard	DIN EN 60068-2 rules for type approval test accord. DNVGL-CG-0339
Storage temperature	-25...+85°C	Data interface	RS232
Relative humidity	< 90 %, non-condensing	Connector	1x M12x1 4 pin A-coded, RS232 with 24 VDC power supply, short circuit protected
Protection degree	IP67	Cable length	Max. 15 m

Drawing IW000184

Image	Drawings

Further details on request.

Water in Oil Sensor FRG00035

The **water in oil sensor FRG00035x** is based on using a capacitor to measure the absorption of water in lube oil. The physical measured value is the so called "water activity" (AW). This sensor is installed in the pressure line or near to the pressure outlet of the lube oil filter.

Oil has the ability to hold a certain amount of dissolved water. The maximum water amount oil can hold is called "saturation point". Above the saturation point free water will fall out which can cause corrosion inside the engine.

The context between humidity and AW is $x AW * 100 = x \% \text{ humidity}$. The PAV (pre alarm value) of 0.5 AW means 50 % of humidity, while the MAV (main alarm value) of 0.9 AW means 90 % of humidity.

If the system shows main alarm, the saturation value is higher than 90%. The alarm levels of PAV and MAV are adjustable via web interface of the device.

Sensor data are transferred via I²C to the SBX010x.



Technical data Water in Oil sensor FRG00035-I

Property	Value	Property	Value
Power supply	5 VDC, max. permissible ripple ≤ 5 %	Weight	Approx. 0.25 kg
Power consumption	< 0.25 W	EMC-standard	DIN EN 55016-2, safety rules acc. EN 61000-4, rules for type approval test accord. DNVGL-CG-0339
Polarity protection	Yes	Environmental standard	DIN EN 60068-2 rules for type approval test accord. DNVGL-CG-0339
Operating temperature	-25...+125°C	Data interface	I ² C
Storage temperature	-25...+125°C	Connector	1x M12x1 4 pin A-coded, I ² C with 5 VDC power supply, short circuit protected
Relative humidity	< 90 %, non-condensing	Cable length	Max. 15 m (others on request)
Protection degree	IP67	Accuracy of humidity measurement	±3 % within -25...+85°C
Dimensions	See drawing	Pressure resistance against medium	10 bar

Drawing FRG00035-I-x

Image	Drawings

Temperature Sensor TGL00922x



The **temperature sensor type TGL00922x**, with electrical short circuit protection is used for main bearing and conrod splash oil measurement. The minimized flat design allows mounting the sensor at the main bearing support close to the bearing shell. Versions with different sensor housing to fit for alternative bearing support are available.


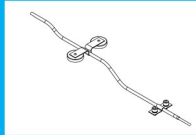
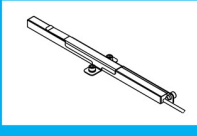
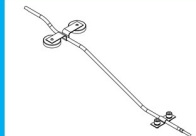
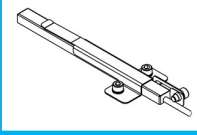
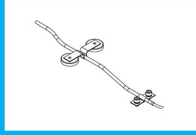
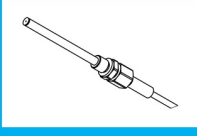
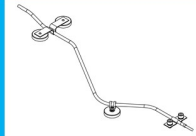
The temperature sensor can easily be placed with strong internal magnets. After positioning it has to be secured by oil resistant glue. Versions fixed by screws are also in our portfolio.

The temperature data are measured within a tolerance of $\pm 0.5^{\circ}\text{C}$ and transferred via the I²C bus to the Sensor Box SBX010x. The maximum operating temperature is 125°C.

Technical data Temperature Sensor TGL00922x

Property	Value	Property	Value
Power supply	5 VDC, max. permissible ripple $\leq 5\%$	Dimensions	See drawing
Power consumption	< 0.1 W	Weight	Approx. 0.1 kg
Polarity protection	Yes	EMC-standard	DIN EN 55016-2, safety rules acc. EN 61000-4, rules for type approval test accord. DNVGL-CG-0339
Operating temperature	-40...+125°C (sensor) -25...+85°C (cable)	Environmental standard	DIN EN 60068-2 rules for type approval test accord. DNVGL-CG-0339
Storage temperature	-25...+85°C	Data interface	I ² C
Relative humidity	< 90 %, non-condensing	Cable length	Max. 15 m (others on request)
Protection degree	IP67	Accuracy of temperature measurement	$\pm 0.5^{\circ}\text{C}$ (typical from -20°C to 100°C)

TGL00922x Temperature Sensor (different applications)

Version	Characteristics	Version	Characteristics
	TGL00922-1 Splash oil temperature sensor		TGL00922-5 Main bearing temperature sensor
	TGL00922-2 Main bearing temperature sensor		TGL00922-6 Main bearing temperature sensor
	TGL00922-3 Thrust bearing temperature sensor		TGL00922-7 Main bearing temperature sensor
	TGL00922-4 Splash oil temperature sensor		TGL00922-8 Main bearing temperature sensor

Cylinder liner temperature Sensor TGL00942x

Cylinder liner temperature sensors continuously observe the temperature level of each liner. The aim is to detect defects at an early stage and to protect the cylinder liner from irreparable damage.

Each liner will be equipped with a pair of sensors, both installed in opposite direction. This supports to determine the worst case temperature level no matter installation tolerances and air gaps inside the liner.

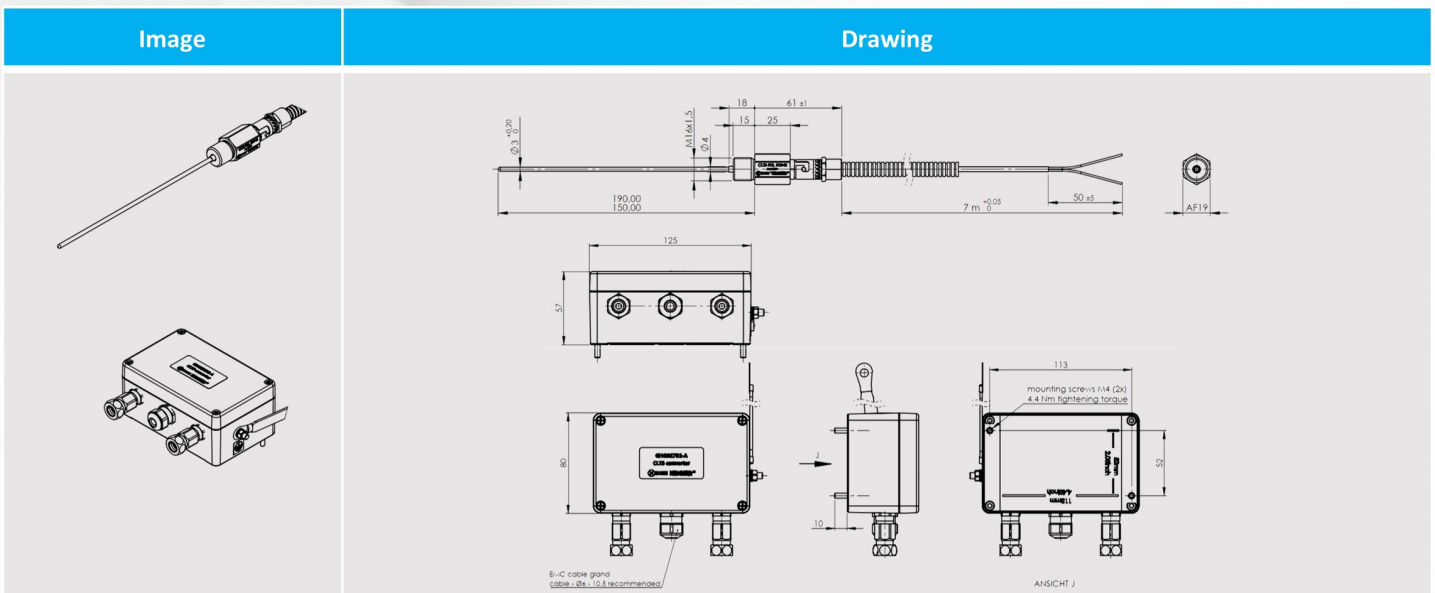
The sensors show a highly robust design: Sensor tip can withstand and detect temperatures up to 800°C whereas materials in use are of stainless steel. Inside the sensors there is a flexible mechanism which allows the sensor tip to move – and therefore to guarantee the constant mechanical contact between sensing element and cylinder liner. This will provide excellent thermal response and short reaction times in case of overheating.



Technical data Cylinder liner temperature sensor TGL00942x

Property	Value
Element type	Type K, NiCr-NiAl
Operating temperature	max. 250°C sensor / -20°C...85°C signal converter box
Max. temperature sensor tip	800°C
Accuracy of temp. measurement	±2.5°C or 0.007*t (t = measuring value)
Weight	approx. 1 kg (unit)
Protection degree	IP65 (sensor and box)
Standards (converter box)	EMC accord. EN61000-4, vibration accord. DIN EN 60068-2

Drawings Sensor TGL00942x and Signal converter box GHG02731-A



Internal spring force pushes the sensor tip to the surface of the bearing to be controlled.



Data Display EV325000

The **data display EV325000** is a 10" touch panel and visualizes data of the web interface of the system. An on-screen-keyboard is used to interact with the device.

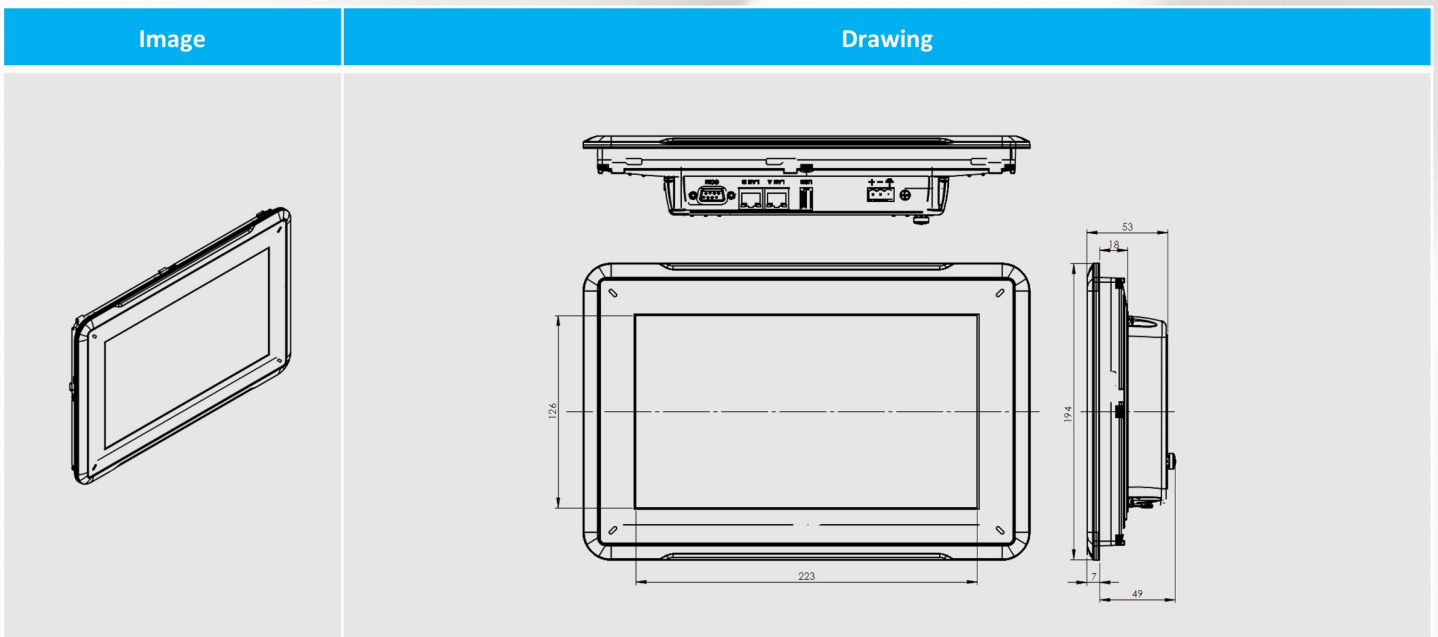
In addition users can connect their personal computer in order to use it as an own display. No additional software required.



Technical data Data Display EV325000

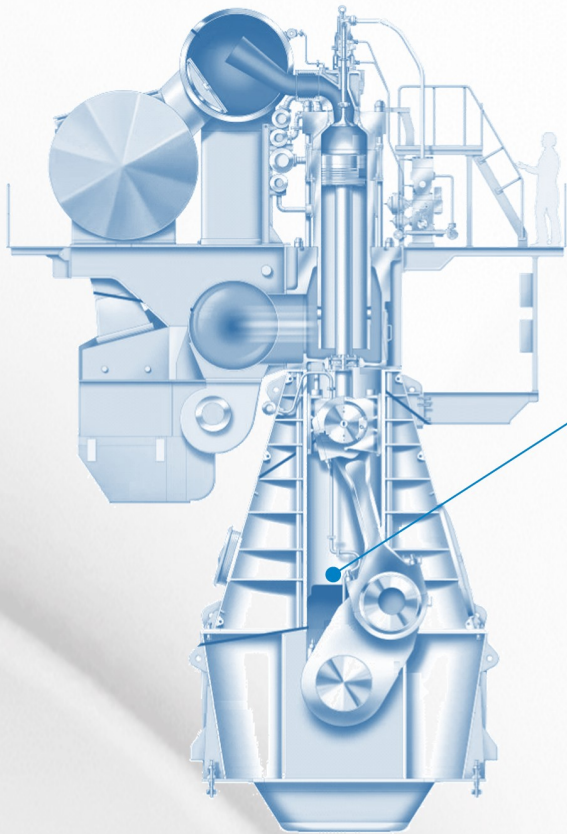
Property	Value
Power supply	+24 V DC (18 to 32 V DC)
Power consumption	< 21.6 W
Operating temperature	-10°C to +60°C
Dimensions	See drawing
Weight	1.65 kg
Data interface	Ethernet

Drawing EV325000



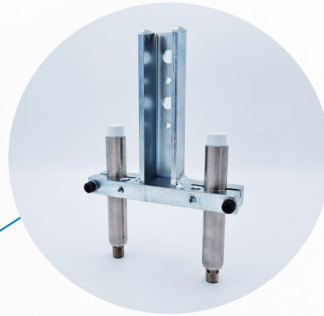
Further details on request.

General working principle of BMS system



Source: MAN

Crosshead position control in lower dead end. Double sensor alignment for monitoring straight movement of crosshead. Each sensor with detection range of 4mm.



Signal conditioning and evaluation. Alerts when reaching faulty orientation of crosshead. Collects data of up to 72 sensors: position, temperature, water in oil.



Touch screen 10" for easy data access. Event memory, datalog, trend analysis and real-time monitoring.

Dr. E. Horn – Your global partner

As a mid-sized enterprise located in south Germany we are serving on global scale. With our own service team and our strong partners all over the globe we grant a direct and personal support.

We offer retrofit actions as well as maintenance operations and digital services.

Please contact us for further information.



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DK 100004 Rev: 0 2022-04-21

