

EE360

High-End Moisture in Oil Sensor

EE360 is dedicated for reliable monitoring of lubrication, hydraulic and insulation oils as well as diesel fuel. In addition to highly accurate measurement of water activity (aw) and temperature (T), EE360 calculates the absolute water content (x) in ppm.

Measurement Performance

The EE360 employs high-end E+E humidity sensing elements manufactured in state-of-the-art thin film technology, which are the prerequisite for outstanding measurement accuracy.

Process Connection

The sensing probe can be employed up to 180 °C (356 °F), 20 bar (290 psi) and is available with either ISO or NPT slide fitting, which allows for variable immersion depth. Using the optional ball valve, the probe can be mounted or removed even without process interruption.

Enclosure

The EE360 features an IP65 / NEMA 4 polycarbonate or stainless steel enclosure which facilitates installation and maintenance. The enclosure can accommodate a 100...240 V AC supply unit or various extension modules.

Display and Outputs

The measured data is available on two analogue outputs, on the RS485 (Modbus RTU) or Ethernet-PoE (Modbus TCP) interface and on the alarm (relay) outputs.

The TFT colour display shows simultaneously up to four measurands and offers extensive setup and diagnosis features. The data logging function saves up to 20 000 measured values for each physical quantity. The logged data can be displayed graphically directly on the device or easily downloaded over the USB interface.

Configurable and Adjustable

The configuration and adjustment of the EE360 can be performed either using the display and the push buttons or with the free EE-PCS Product Configuration Software via the USB interface.



Features

3.5" TFT Colour Display

- » shows up to 4 measurands simultaneously
- » layout and measurands freely selectable
- » data logger for 20 000 values per measurand
- » logged data shown graphically
- » diagnosis functions
- » intuitive device setup with push buttons

Probe

- » oil temperature -40...180 °C (356 °F)
- » pressure tight up to 20 bar (290 psi)
- » ISO or NPT process connection
- » pluggable probe option

Ball valve set

- » probe mounting and removal without process interruption

Enclosure

- » IP65 / NEMA 4 protection class
- » polycarbonate or stainless steel
- » easy mounting and service
- » screws secured in cover

Outputs

- » 2 analogue outputs current / voltage
- » error indication according NAMUR
- » Modbus RTU / Modbus TCP
- » 2 alarm outputs
- » configurable via display or software

USB Service Interface

- » download logged data
- » perform configuration, adjustment and firmware update
- » 4 status LEDs

Inspection certificate
according to DIN EN 10204 – 3.1

Measurement of water activity a_w / water content x

The moisture in oil can be expressed in absolute or relative terms.

- » **Water activity a_w** is the relative measure for moisture in oil. It represents the ratio between the actual amount of dissolved water and the maximum possible amount of dissolved water in the oil at a certain temperature. Independently of the oil type, the water activity shows how close to saturation is the oil at any moment in time.

$a_w = 0$ indicates completely dry oil, while $a_w = 1$ fully saturated oil.
EE360 measures directly the water activity.

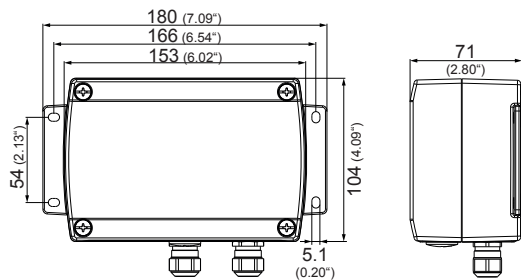
- » The **water content x** is an absolute measure equal to the amount of water in the oil. The water content is measured in ppm (parts per million) and is independent from the oil temperature. For assessing how far is the oil from saturation, x must be regarded together with T .

EE360 calculates x out of the measured a_w and T values. The calculation is oil dependent and requires a set of oil specific parameters.

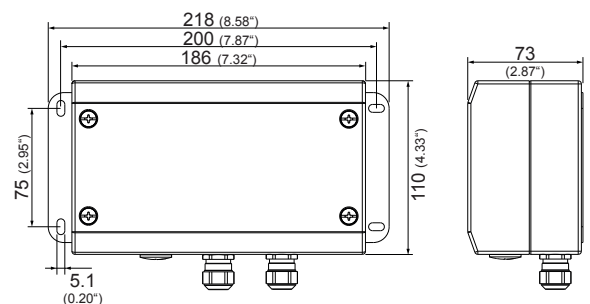
Dimensions in mm (inch)

ENCLOSURE

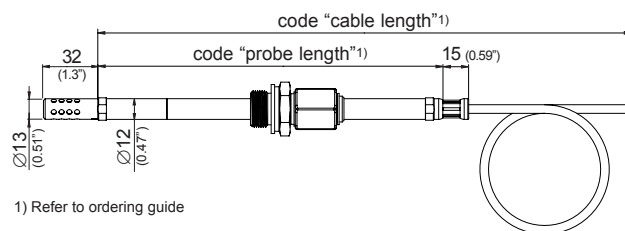
Polycarbonate



Stainless steel

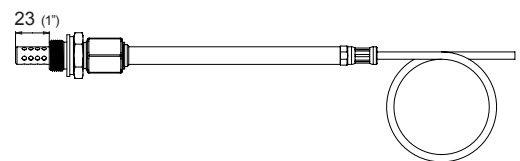


PROBE



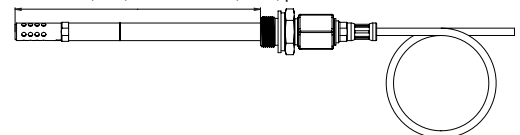
1) Refer to ordering guide

Minimum insertion depth

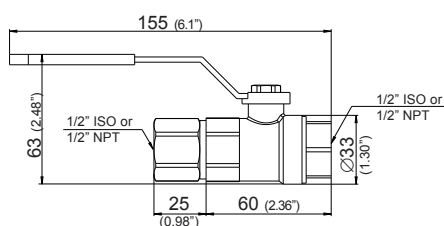


Maximum insertion depth

64 mm (2.5") for 100 mm (3.94") probe
164 mm (6.5") for 200 mm (7.87") probe
364 mm (14.3") for 400 mm (15.75") probe



Ball valve set 1/2" ISO or NPT



Technical data

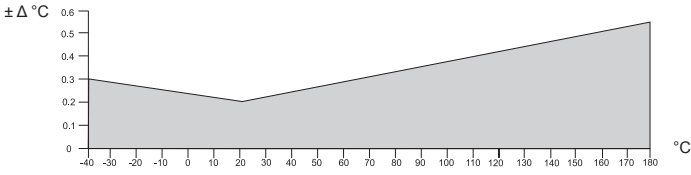
Measurands

Water activity (a_w) / Water content (x) ¹⁾

Measuring range	0...1 a_w / 0...100,000 ppm	
Accuracy ²⁾		
-15...40 °C (5...104 °F)	$\leq 0.9 a_w$	$\pm (0.013 + 0.3\% \cdot mv) a_w$
-15...40 °C (5...104 °F)	$> 0.9 a_w$	$\pm 0.023 a_w$
-25...70 °C (-13...158 °F)		$\pm (0.014 + 1\% \cdot mv) a_w$
-40...180 °C (-40...356 °F)		$\pm (0.015 + 1.5\% \cdot mv) a_w$
Temperature dependence of electronics, typ.	$\pm 0.0001 [1/^\circ\text{C}]$ (typ. $\pm 5.6 \cdot 10^{-5} [1/^\circ\text{F}]$)	
Temperature dependence of sensing probe, typ.	$\pm (0.00002 + 0.0002 \times a_w) \times \Delta T [^\circ\text{C}]$	$\Delta T = T - 20 \text{ }^\circ\text{C}$
Response time at 20 °C (68 °F) / t_{90} , typ.	10 min in still oil	

mv = measured value

Temperature (T)

Working range sensing probe	-40...180 °C (-40...356 °F)	
Accuracy ²⁾		
Temperature dependence of electronics, typ.	$\pm 0.005^\circ\text{C}/^\circ\text{C}$	

Outputs

Two analogue outputs freely selectable and scalable	0 - 1 / 5 / 10 V	-1 mA $< I_L < 1$ mA
	4 - 20 mA 3-wire	$R_L < 500$ Ohm
	0 - 20 mA 3-wire	$R_L < 500$ Ohm
Digital interface / protocol	RS485 / Modbus RTU, max. 32 unit load devices on one bus (EE360 = 1 unit load; factory settings: 9600 bps, parity even, stop bit 1 / slave-ID 231)	
	Ethernet-PoE with Modbus TCP	

General

Power supply class III \diamond (EU) / class 2 (NA)	8...35 V DC	12...30 V AC
	100...240 V AC, 50/60 Hz	
Current consumption at 24 V DC/AC, typ.	15 mA / 40 mA _{rms} for 2 voltage outputs 35 mA / 100 mA _{rms} for 2 current outputs 50 mA / 150 mA _{rms} additional for display 30 mA / 90 mA _{rms} additional for Ethernet	
Pressure range for pressure tight probe	0.01...20 bar (0.15...300 psi)	
Probe material	stainless steel 1.4404 / AISI 316L	
Enclosure material	polycarbonate, UL94-V0 approved stainless steel 1.4404 / AISI 316 L	
Protection class	IP65 / NEMA 4	
Cable glands	for polycarbonate enclosure for metal enclosure	
	M16 x 1.5, for cable \varnothing 3 - 7 mm (0.12 - 0.28") M16 x 1.5, for cable \varnothing 4.5 - 10 mm (0.18 - 0.39")	
Electrical connection	screw terminals max. 1.5 mm ² (AWG 16)	
Working and storage temperature range of electronics	-40...60 °C (-40...140 °F) without display -20...50 °C (-4...122 °F) with display	
Electromagnetic compatibility	EN61326-1 Industrial Environment	EN61326-2-3 ICES-003 ClassA FCC Part15 ClassA
Two alarm outputs ³⁾	changeover contact 250 V AC / 6 A 28 V DC / 6 A	
System requirements for EE-PCS software	Windows XP or higher; USB port	

1) ppm output is valid in the range 0...100 °C (32...212 °F)

2) Including hysteresis, non-linearity and repeatability, traceable to intern. standards, administrated by NIST, PTB, BEV...

The accuracy statement includes the uncertainty of the factory calibration with an enhancement factor k=2 (2-times standard deviation).

The accuracy was calculated in accordance with EA-4/02 and with regard to GUM (Guide to the Expression of Uncertainty in Measurement).

3) Appropriate for outdoor use, wet location, degree of pollution 2, overvoltage category II, altitude up to 3000 m (9843 ft).



Ordering Guide

		EE360-	
Hardware Configuration	Enclosure	polycarbonate stainless steel	no code HS2
	Cable length (incl. probe length)	2 m (6.6 ft)	no code
		5 m (16.4 ft)	K5
		10 m (32.8 ft)	K10
	Probe length	100 mm (3.94")	L100
		200 mm (7.87")	no code L400
		400 mm (15.75")	
Process connection	1/2" ISO thread	no code	
	1/2" NPT thread	PA25	
Electrical connection	cable glands	no code	
	1 plug for power supply and outputs	E4	
	1 cable gland / 1 plug for Modbus RTU (requires option J3)	E5	
	2 plugs for power supply / outputs and for Modbus RTU (requires option J3)	E6	
Optional features	3 plugs for power supply / outputs and Modbus RTU (requires option J3) ¹⁾	E12	
	3.5" TFT display with integrated data logger	D2	
	RS485 module - Modbus RTU	J3	
	Ethernet module - Modbus TCP ^{1) 2)}	J4	
	pluggable probe ¹⁾	PC4	
	alarm outputs with cable glands ²⁾	AM2	
integrated power supply 100...240 V AC, 50/60 Hz ^{2) 3)}	AM3		
Setup - Analogue outputs	Output 1	water activity a _w []	no code
		other measurand (xx see measurand code below)	MAxx
	Output signal 1 ⁴⁾	0-1 V	GA1
		0-5 V	GA2
		0-10 V	GA3
		0-20 mA	GA5
		4-20 mA	GA6
	Scaling 1 low	0	no code
		value	SALvalue
	Scaling 1 high	1	no code
		value	SAHvalue
Output 2	temperature T [°C]	no code	
	other measurand (xx see measurand code below)	MBxx	
Output signal 2 ⁴⁾	0-1 V	GB1	
	0-5 V	GB2	
	0-10 V	GB3	
	0-20 mA	GB5	
	4-20 mA	GB6	
Scaling 2 low	value	SBLvalue	
Scaling 2 high	value	SBHvalue	

1) Only with polycarbonate enclosure.

3) Integrated power supply includes 2 plugs for power supply and outputs, other plug options are not possible.

2) No combination of alarm output (AM2), Ethernet module (J4) and integrated power supply (AM3) is possible.

4) Both analogue outputs shall be either voltage or current.

Measurand Code for output 1 and 2 in the ordering guide

		Mx
Temperature	°C	1
	°F	2
Water activity	aw	67
Water content x in mineral transformer oil	ppm	70
Water content x in customer specific oil	ppm	70PPMxxx

Order Example

EE360-D2J3GA3GB3SBL-40SBH180

Enclosure:	no code	polycarbonate	Output 1:	no code	water activity
Cable length:	no code	2 m (6.6 ft)	Output signal 1:	GA3	0-10 V
Probe length:	no code	200 mm (7.87")	Scaling 1 low:	no code	0
Process connection:	no code	1/2" ISO thread	Scaling 1 high:	no code	1
Electrical connection:	no code	cable glands	Output 2:	no code	temperature °C
Optional features:	D2	3.5" TFT display with	Output signal 2:	GB3	0-10 V
		integrated data logger	Scaling 2 low:	SBL-40	-40
		J3	RS485 module - Modbus RTU	Scaling 2 high:	SBH180

Accessories (for further information, see data sheet "Accessories")

Bracket for installation onto mounting rails	HA010203 (Two pieces for each EE360; for polycarbonate enclosure only)
Determination of oil specific parameters	ppm-cal
Humidity calibration kit	refer to data sheet „Humidity calibration kit“
Ball valve set 1/2" ISO	HA050101
Ball valve set 1/2" NPT	HA050104