

+ Datasheet EE360

High-End Moisture in Oil Sensor



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 4X 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 up to four measurands simultaneously 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 via 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 E+E PCS10 Product Configuration Software via the USB interface.



EE360 with stainless steel enclosure



EE360 with polycarbonate enclosure

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

Enclosure

- IP65 / NEMA 4X protection rating
- Polycarbonate or stainless steel
- Easy mounting and service
- Screws secured in cover

USB service interface

- Download logged data
- Perform configuration, adjustment and firmware update
- 4 status LEDs

Outputs

- 2 analogue outputs current / voltage
- Error indication according NAMUR
- Modbus RTU / Modbus TCP
- 2 alarm outputs
- Configurable via display or software

Ball valve set

- Probe mounting and removal without process interruption

Probe

- Oil temperature -40...+180 °C (-40...+356 °F)
- Pressure tight up to 20 bar (290 psi)
- ISO or NPT process connection
- Pluggable probe option

Inspection certificate

According to DIN EN 10204-3.1

Features

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
- $a_w = 1$ indicates fully saturated oil

EE360 measures directly the water activity.

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.

Sensor Leads Protection

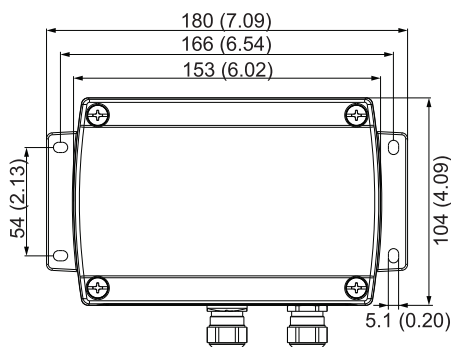
In certain applications, the oil can become corrosive over time, for example due to continuous contamination of lubricating oils by salt water in the maritime environment. In such demanding applications, the E+E proprietary protection of the sensing element leads can significantly extend the service life of the sensor.

Dimensions

Values in mm (inch)

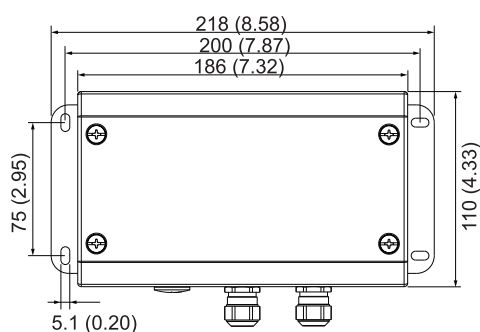
Enclosure

Polycarbonate



Enclosure

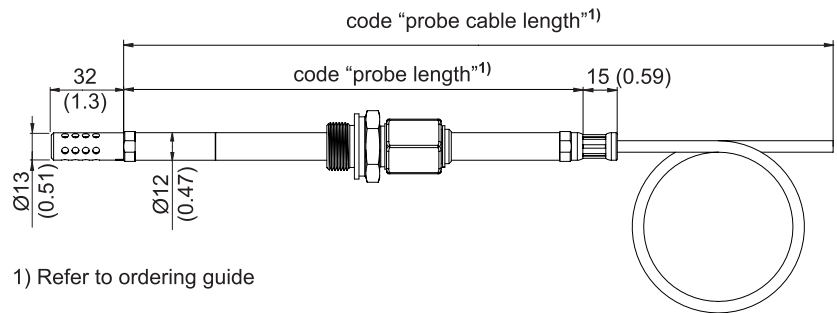
Stainless steel



Dimensions

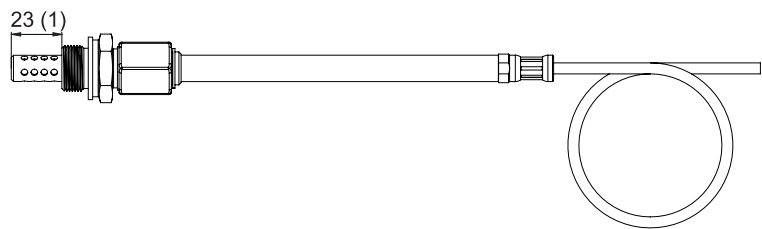
Values in mm (inch)

Probe



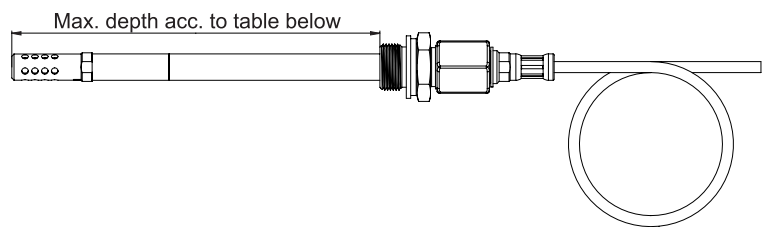
Probe

Minimum insertion depth



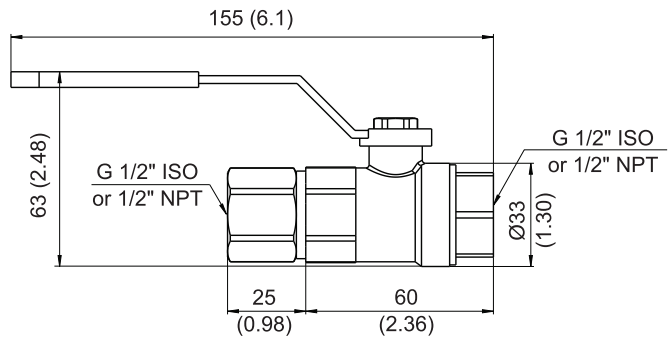
Probe

Maximum insertion depth



Ball valve set G 1/2" ISO or NPT

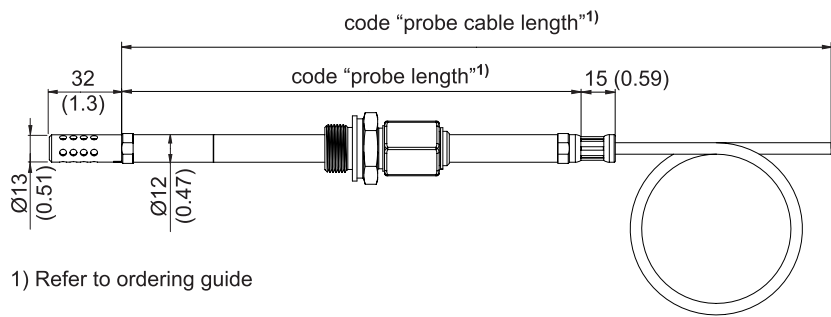
| Probe length [mm (inch)] | Max. insertion depth [mm (inch)] |
|-----------------------------|-------------------------------------|
| 100 (2.5) | 64 (3.9) |
| 200 (6.5) | 164 (7.9) |
| 400 (14.3) | 364 (15.8) |
| 600 (22.2) | 564 (23.6) |
| 800 (30.1) | 764 (31.59) |
| 1000 (38.0) | 964 (39.4) |



Dimensions

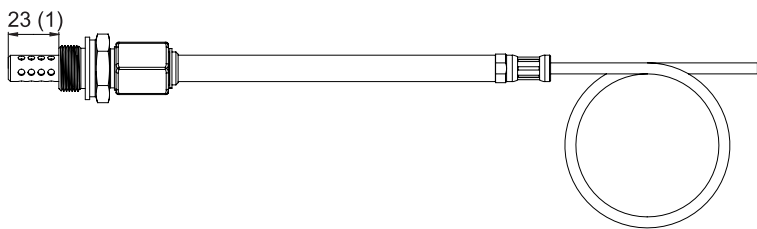
Values in mm (inch)

Probe



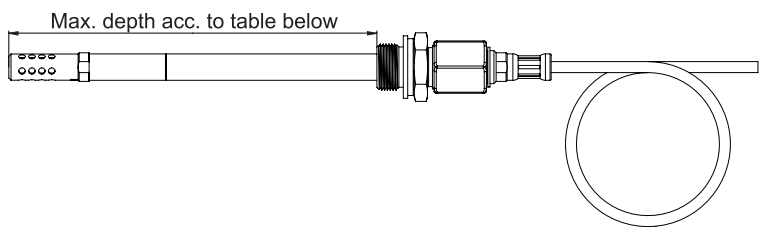
Probe

Minimum insertion depth



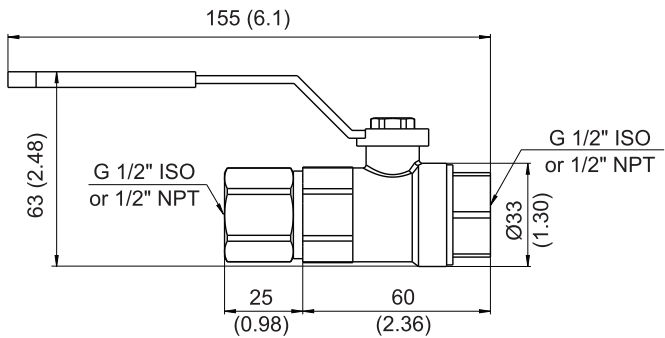
Probe

Maximum insertion depth



Ball valve set G 1/2" ISO or NPT

| Probe length [mm (inch)] | Max. insertion depth [mm (inch)] |
|-----------------------------|-------------------------------------|
| 100 (2.5) | 64 (3.9) |
| 200 (6.5) | 164 (7.9) |
| 400 (14.3) | 364 (15.8) |
| 600 (22.2) | 564 (23.6) |
| 800 (30.1) | 764 (31.59) |
| 1000 (38.0) | 964 (39.4) |



Technical Data

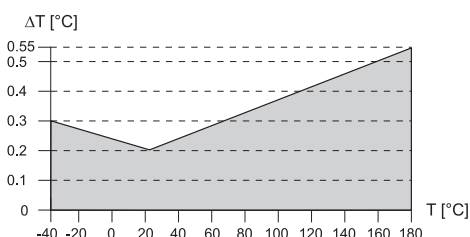
Measurands

Water Activity (aw) / Water Content (x)

| | |
|---|---|
| Measuring range | 0...1 aw 0...100 000 ppm; actual range depends on the oil type, for non-mineral transformer oil, specific solubility parameters are needed (ppm output is valid in the range 0...100 °C (32...212 °F)) |
| Accuracy ¹⁾ -15...+40 °C (5...+104 °F) (0...0.9 aw) -15...+40 °C (5...+104 °F) (0.9...1 aw) -25...+70 °C (-13...+158 °F) -40...+180 °C (-40...+356 °F) | ±(0.013 + 0.3%*mv) aw ±0.023 aw ±(0.014 + 1%*mv) aw ±(0.015 + 1.5%*mv) aw mv = measured value |
| Temperature dependency of electronics, typ. | ±0.0001 aw/°C (±5.6 * 10 ⁻⁵ aw/°F) |
| Response time t ₉₀ , typ. @ 20 °C (68 °F) in still oil | 10 min. |

1) 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).

Temperature (T)

| | |
|---|---|
| Probe measuring range | -40...+180 °C (-40...+356 °F) |
| Accuracy ¹⁾ |  |
| Temperature dependency of electronics, typ. | ±0.005 °C/°C (±0.016 °F/°F) |

1) Traceable to international 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).

Outputs

Analogue




| | | | |
|---|--|---|---|
| Two analogue outputs freely selectable and scalable | 0 - 1 / 5 / 10 V 4 - 20 mA 3-wire 0 - 20 mA 3-wire | -1 mA < I _L < 1 mA R _L < 500 Ohm R _L < 500 Ohm | I _L = load current R _L = load resistance |
|---|--|---|---|

Digital

| | |
|---|---|
| Digital interface | RS485 (EE360 = 1 unit load) |
| Protocol Factory settings Supported Baud rates Measured data types | Option J3 Modbus RTU 9600 Baud, parity even, 1 stop bit, Modbus address 231 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 76800 FLOAT32 and INT16 |
| Protocol | Option J4 Ethernet-PoE Modbus TCP |

Technical Data

General

| | |
|--|---|
| Power supply class III  USA & Canada: Class 2 supply necessary, max. voltage 30 V DC | 8 - 35 V DC 12 - 30 V AC 100 - 240 V AC, 50/60 Hz with Option AM3 ¹⁾ |
| Current consumption , typ. @ 24 V DC/AC for 2 voltage outputs for 2 current outputs additional for display additional for Ethernet | 15 mA and 40 mA _{rms} 35 mA and 100 mA _{rms} 50 mA and 150 mA _{rms} 30 mA and 90 mA _{rms} |
| Electrical connection | Screw terminals max. 1.5 mm ² (AWG 16) |
| Cable glands for polycarbonate enclosure for metal enclosure | M16x1.5, for cable Ø3 - 7 mm (0.12 - 0.28") M16x1.5, for cable Ø4.5 - 10 mm (0.18 - 0.39") |
| Pressure working range with pressure-tight probe | 0.01...20 bar (0.15...300 psi) |
| Temperature range Operation Storage | -40...+60 °C (-40...+140 °F) without display -20...+50 °C (-4...+122 °F) with display |
| Material Probe Enclosure | Stainless steel 1.4404 (AISI 316L) PC (Polycarbonate), UL94-V0 approved Stainless steel 1.4404 (AISI 316L) |
| Protection rating | IP65/NEMA 4X |
| Electromagnetic compatibility | EN 61326-1 EN 61326-2-3 Industrial environment FCC Part15 Class A ICES-003 Class A |
| Conformity |   |
| Two alarm outputs, with option AM2¹⁾ | Changeover contact 250 V AC / 6 A 28 V DC / 6 A |
| Configuration software | E+E PCS10 Product Configuration Software Free download from www.epluse.com/pcs10 |

1) Degree of pollution 2, overvoltage category II, altitude up to 3000 m (9843 ft).

Ordering Guide

| Feature | Description | Code |
|--------------------------|---|--|
| Hardware Configuration | | EE360- |
| | Enclosure material | PC (Polycarbonate) Stainless steel |
| | | No code HS2 |
| | Filter | Stainless steel, for flow <1 m/s (<3.3 ft/s) Stainless steel, for flow >1 m/s (>3.3 ft/s) |
| | | No code F18 |
| | Probe Cable Length (incl. probe length) | 2 m (6.6 ft) 5 m (16.4 ft) 10 m (32.8 ft) 20 m (65.6 ft) |
| | | No code K5 K10 K20 |
| | Probe length | 100 mm (3.94") 200 mm (7.87") 400 mm (15.75") 600 mm (23.62") 800 mm (31.50") 1000 mm (39.37") |
| | | L100 No code L400 L600 L800 L1000 |
| | Process connection | G 1/2" ISO - slide fitting, Ø13 mm (0.51") 1/2" NPT - slide fitting, Ø13 mm (0.51") |
| | | No code PA25 |
| | Electrical connection | Cable glands 1 x plug for power supply and outputs 1 x cable gland and 1 plug for Modbus RTU (requires option J3) 2 x plugs for power supply + outputs and Modbus RTU (requires option J3) 3 x plugs for power supply + outputs and Modbus RTU (requires option J3) ¹⁾ |
| | | No code E4 E5 E6 E12 |
| | Optional features | 3.5" TFT display with integrated data logger RS485 module - Modbus RTU Ethernet module - Modbus TCP ¹⁾²⁾ Pluggable probe ¹⁾ Sensing element protection (Sensor leads protection) Alarm outputs (Relay module with cable glands) ²⁾ Integrated power supply (100 - 240 V AC, 50/60 Hz), with connector ²⁾³⁾ |
| | | D2 J3 J4 PC4 C2 AM2 AM3 |
| Setup (Analogue) Outputs | Output 1 measurand | Water activity aw [1] Water content x [ppm] Temperature T [°C] Temperature T [°F] |
| | | No code MA70 MA1 MA2 |
| | Output signal 1⁴⁾ | 0 - 1 V 0 - 5 V 0 - 10 V 0 - 20 mA 4 - 20 mA |
| | | GA1 GA2 GA3 GA5 GA6 |
| | Output 1 scaling low | 0 Value |
| | | No code SALValue |
| | Output 1 scaling high | 1 Value |
| | | No code SAHValue |
| | Output 2 measurand | Temperature T [°C] Temperature T [°F] Water activity aw [1] Water content x [ppm] |
| | | No code MB2 MB67 MB70 |
| | Output signal 2⁴⁾ | 0 - 1 V 0 - 5 V 0 - 10 V 0 - 20 mA 4 - 20 mA |
| | | GB1 GB2 GB3 GB5 GB6 |
| | Output 2 scaling low | Value |
| | | SBLValue |
| | Output 2 scaling high | Value |
| | | SBHValue |
| | Oil parameterization for water content calculation | Mineral transformer oil Customer specific oil |
| | | No code PPMxxx ⁵⁾ |

1) Only with polycarbonate enclosure.

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

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

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

5) Procedure for customer specific oil (see table below).

Ordering Guide

5) Procedure for customer specific oil

| Option | Description | Code |
|---|--|-------------------|
| Oil number is known | Replace the xxx by the corresponding number | |
| Obtaining new oil parameters via oil analysis | Contact and provide E+E HQ the datasheet of the oil before sending us 2 litres of oil. After determination of the oil specific parameters, the corresponding oil number is available, insert this in place of the xxx . | Oil-ppmcal |
| Obtaining new oil parameters via saturation curve | Contact and provide E+E HQ the datasheet of the oil together with the saturation curve. After calculation of the oil specific parameters, the corresponding oil number is available, insert this in place of the xxx . | Oil-calc |

Order Example

EE360-D2J3GA3GB3SBL-40SBH180

| Feature | Code | Description |
|-----------------------|------------------|---|
| Enclosure material | No code | PC (Polycarbonate) |
| Filter | No code | Stainless steel, for flow <1 m/s (<3.3 ft/s) |
| Probe cable length | No code | 2 m (6.6 ft) |
| Probe length | No code | 200 mm (7.87") |
| Process connection | No code | G 1/2" ISO - slide fitting, Ø13 mm (0.51") |
| Electrical connection | No code | Cable glands |
| Optional features | D2 J3 | 3.5" TFT display with integrated data logger RS485 module - Modbus RTU |
| Output 1 measurand | No code | Water activity aw [1] |
| Output 1 signal | GA3 | 0 - 10 V |
| Output 1 scaling low | No code | 0 |
| Output 1 scaling high | No code | 1 |
| Output 2 measurand | No code | Temperature T [°C] |
| Output 2 signal | GB3 | 0 - 10 V |
| Output 2 scaling low | SBL-40 | -40 |
| Output 2 scaling high | SBH180 | 180 |

Oil-ppmcal

Contact and provide E+E HQ the datasheet of the oil before sending us 2 litres of oil.

Accessories

For further information see datasheet [Accessories](#).

| Description | Code |
|--|---|
| PCS10 Product Configuration Software (Free download: www.epluse.com/pcs10) | PCS10 |
| USB-C to USB-A configuration cable | HA010327 |
| Bracket for installation onto mounting rails ¹⁾ | HA010203 |
| Determination of oil specific parameters | ppm-cal |
| Humidity calibration kit | see data sheet Humidity calibration kit |
| Ball valve set G 1/2" ISO | HA050101 |
| Ball valve set 1/2" NPT | HA050104 |

1) For polycarbonate enclosure only. Two pieces are necessary for each EE360.

