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in sensor
technology.

# Datasheet MOP301

## Digital Moisture in Oil Immersion Probe up to 120 °C (248 °F)

Modbus

www.epluse.com

# MOP301

## Digital Moisture in Oil Immersion Probe up to 120 °C (248 °F)

The MOP301 reliably measures the moisture in transformer, lubrication or hydraulic oil as well as in diesel fuel. It is ideal for the preventive maintenance of equipment and machinery. Besides the accurate measurement of water activity (aw) and temperature (T), the MOP301 calculates the absolute water content of the oil (x) in ppm. The dynamic calculation is based on oil-specific solubility parameters.

### Measurement Performance

The probe employs high end E+E humidity sensing elements with outstanding long term stability and high resistance to pollution.

### Versatility

Various cable and probe lengths, together with the sliding fitting facilitate the MOP301 installation. Using the optional ball valve, the probe can be mounted or removed without process interruption.

### RS485 Interface

The measured data is available on the RS485 interface with Modbus RTU protocol. The oil resistant cable with moulded M12 connector assures reliable data transmission even in harsh and aggressive environment.

### Configurable and Adjustable

The free PCS10 Product Configuration Software and the optional adapter facilitate the setup and adjustment of the MOP301.

MOP301 with ball valve G 1/2" ISO

MOP301 pressure tight probe with sliding fitting

# Features

**Measurement Performance**

- High mesurement accuracy:
  - Water activity aw
  - Temperature T
- Suitable for transformer, lubrication and hydraulic oil
- Calculation of water content x [ppm]
- Temperature range: -40...+120 °C (-40...+248 °F)
- Temperature compensation

**Interface and Connection**

- RS485 with Modbus RTU
- Oil resistant cable
- Moulded M12x1 connector

**Mechanical Construction**

- Stainless steel enclosure and filter cap
- Pressure tight up to 20 bar
- Process connection with ISO or NPT sliding fitting
- IP66 rating

**Inspection certificate**

According to DIN EN 10204-3.1

# Features

## Measurement of water activity aw / water content x

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

- **Water activity aw** 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 the oil is at any moment in time. aw = 0 indicates completely dry oil, while aw = 1 fully saturated oil. MOP301 measures the water activity directly.
- The **water content x** is an absolute measure for the amount of water in the oil (dissolved, emulsified or separated). The water content is usually expressed in ppm or mg water/kg oil and it is independent from the oil temperature. For assessing the degree of saturation, x must be regarded together with T. MOP301 calculates x based on the measured aw and T values. The calculation is oil dependent and requires a set of oil specific parameters. E+E offers the service of determining the oil specific parameters, see section “Ordering Guide” below. The parameters can be set upon order or uploaded to MOP301 using the PCS10 Product Configuration Software.

## 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.

## E+E Modular Sensor Platform

The MOP301 is compatible with the Sigma 05 host device of the E+E Modular Sensor Platform. Together they become a versatile, plug-and-play aw / x modular sensor with analogue outputs and optional display. Besides MOP301, Sigma 05 accommodates also other E+E intelligent sensing probes. See www.epluse.com/sigma05 for further details.


Sigma 05 with MOP301



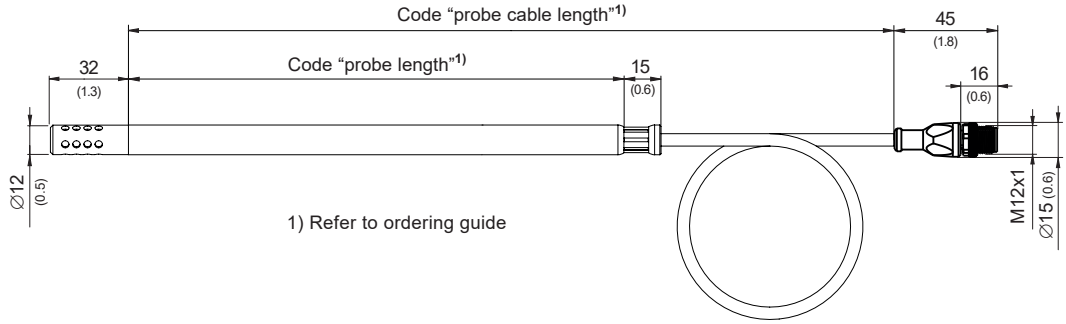
 

# Dimensions

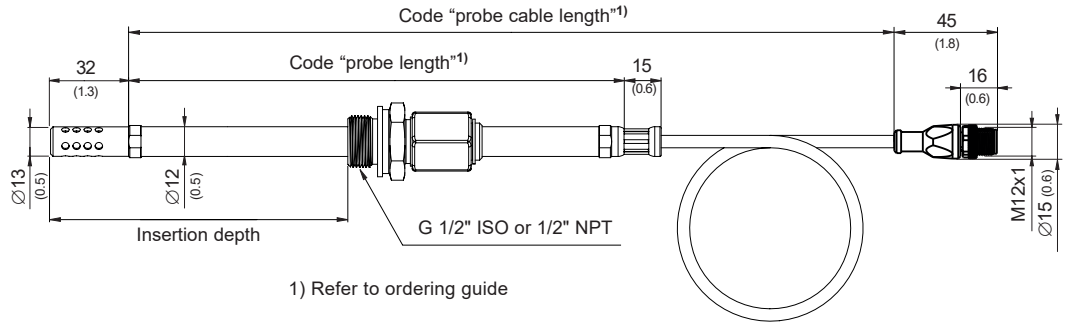
Values in mm (inch)

**Types**

Type T4



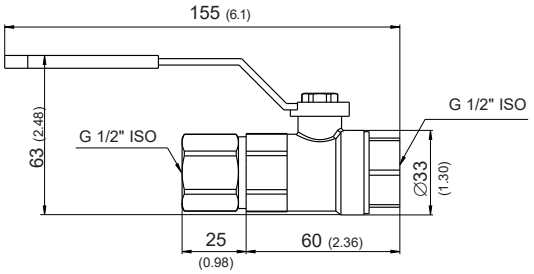

Type T10, 20 bar



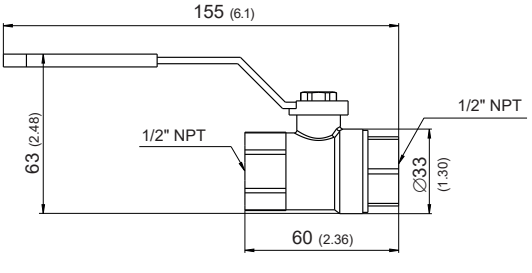

| Probe length [mm (inch)] | Min.insertion depth [mm (inch)] | Max. insertion depth [mm (inch)] |
|---|---|---|
| 200 (7.9) | 23 (0.9) | 167 (6.6) |
| 400 (15.7) | 23 (0.9) | 367 (14.4) |

**Ball valve**

G 1/2" ISO




1/2" NPT



# Technical Data

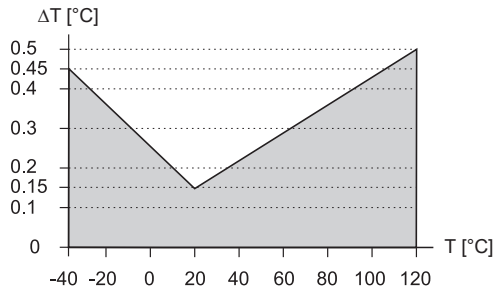
## Measurands

### Water activity (aw) / water content (x)

| | |
|---|---|
| **Measuring range** | 0...1 aw<br>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)) |
| **Accuracy1**[1)]<br>including hysteresis, non-linearity and repeatability<br>**0...40 °C (32...104 °F) (0...0.9 aw)**<br>**(0.9...1 aw)**<br>**-40...+120 °C (-40...+356 °F) (0...1 aw)** | <br><br>±0.02 aw<br>±0.025 aw<br>±0.03 aw |
| **Response time $t_{90}$**, typ.<br>@ 20 °C (68 °F) in still oil | 10 min. |
| **Resolution** | 0.0001 aw |

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).

### Temperature (T)

| | |
|---|---|
| **Measuring range** | -40...+120 °C |
| **Accuracy**[1)] |  |
| **Resolution** | 0.01 °C |

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).

# Technical Data

## Output

### Digital

| | |
|---|---|
| **Digital interface** | RS485 (MOP301 = 1 unit load) |
| **Protocol**<br>**Factory settings**<br>**Supported Baud rates**<br>**Measured data types** | Modbus RTU<br>9600 Baud, parity even, 1 stop bit, Modbus address 70<br>9600, 19200, 38400, 57600, 76800 und 115200<br>FLOAT32 and INT16 |

## General

| | |
|---|---|
| **Power supply** class III<br>USA & Canada: Class 2 supply necessary, max. voltage 30 V DC | 8 - 35 V DC |
| **Power consumption**, typ.<br>without termination resistor | 40 mW |
| **Electrical connection** | M12x1, 4 poles |
| **Pressure rating** | 20 bar (290 psi) |
| **Temperature working range**<br>**Sensing element + filter cap**<br>**Probe**<br>**Cable**<br>**M12 connector** | <br>-40...+125 °C (-40...+257 °F)<br>-40...+120 °C (-40...+248 °F)<br>-40...+120 °C (-40...+248 °F)<br>-25...+90 °C (-13...+194 °F) |
| **Storage conditions** | -40...+80 °C (-40...+176 °F)<br>0...95 %RH, non-condensing |
| **Material**<br>**Cable jacket**[1)]<br>**Probe** | <br>HFS 125XL, black, oil and fuel resistant<br>Stainless steel 1.4404 |
| **Protection rating** | IP66 / NEMA 4X |
| **Electromagnetic compatibility** | EN 61326-1 EN 61326-2-3 Industrial Environment<br>FCC Part15 Class B ICES-003 Class B |
| **Shock and vibration** | Tested acc. to EN 60068-2-6 and EN 60068-2-27 |
| **Conformity** | CE UKCA |
| **Configuration and adjustment** | PCS10 Product Configuration Software (free download) and configuration adapter |

1) Please mind the mounting and installing instructions included in the user manual.

# Ordering Guide

## Positon 1: Probe

| | Feature | Description | Code | |
|---|---|---|---|---|
| | | | MOP301- | |
| Configuration | Type | Probe up to 120 °C (248 °F) | T4 | |
| | | Remote probe with sliding fitting, pressure tight up to 20 bar (290 psi) and 120 °C (248°F) | | T10 |
| | Filter | Stainless steel, for flow <1 m/s (3.3 ft/s) | F13 | |
| | | Stainless steel, for flow >1 m/s (3.3 ft/s) | F18 | |
| | Probe Cable Length | 2 m (6.6 ft) | K2 | |
| | | 5 m (16.4 ft) | K5 | |
| | | 10 m (32.8 ft) | K10 | |
| | Probe length | 200 mm (7.87") | L200 | |
| | | 400 mm (15.75") | L400 | |
| | Process connection | G 1/2" ISO - sliding fitting, Ø13 mm (0.51") | | PA23 |
| | | 1/2" NPT - sliding fitting, Ø13 mm (0.51") | | PA25 |
| | Sensing element protectiom | Without | C0 | |
| | | Sensor leads protection | C2 | |
| | Oil parameterization for water content calculation | Mineral transformer oil | No code | |
| | | Customer specific oil | PPMxxx[1)] | |

## 1) Positon 2: 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

## Position 1: MOP301-T10F13K2L200PA23C0

| Feature | Code | Description |
|---|---|---|
| Type | T10 | Remote probe with sliding fitting, pressure tight up to 20 bar (290 psi) and 120 °C (248°F) |
| Filter | F13 | Stainless steel, for flow <1 m/s |
| Cable length | K2 | 2 m (6.6 ft) |
| Probe length | L200 | 200 mm (7.9") |
| Process connection | PA23 | G 1/2" ISO - sliding fitting, Ø13 mm (0.51") |
| Sensing element protection | C0 | Without coating |
| Oil parameterization | No code | Mineral transformer oil |

# Order Example

### Positon 1: MOP301-T10F13K2L200PA23C0PPMxxx

| Feature | Code | Description |
|---|---|---|
| **Type** | **T10** | Remote probe with sliding fitting, pressure tight up to 20 bar (290 psi) and 120 °C (248°F) |
| **Filter** | **F13** | Stainless steel, for flow < 1 m/s |
| **Probe cable length** | **K2** | 2 m (6.6 ft) |
| **Probe length** | **L200** | 200 mm (7.9") |
| **Process connection** | **PA23** | G 1/2" ISO - sliding fitting, Ø13 mm (0.51") |
| **Sensing element protection** | **C0** | Without |
| **Oil parameterization** | **PPMxxx** | Customer specific oil, oil parameters unknown |

### Positon 2: 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.

| Accessories | Code |
|---|---|
| **Modbus configuration adapter** | **HA011018** |
| **E+E Product Configuration Software**<br>(Free download: www.epluse.com/pcs10) | **PCS10** |
| **M12 Y adaptor** | **HA030204** |
| **Protection cap M12 socket** | **HA010781** |
| **Protection cap M12 plug** | **HA010782** |
| **Ball valve G 1/2" ISO** | **HA050101** |
| **Ball valve 1/2" NPT** | **HA050104** |
| **Sampling cell with shut-off function, PN40, DN25** | **HA050109** |



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