

# 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 slide 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 assure 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.



## Features

### Measurement Performance

- » High aw/T measurement accuracy
- » Suitable for transformer, lubrication and hydraulic oil
- » Calculation of water content x [ppm]
- » T 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 slide fitting
- » IP66 rating



Inspection certificate  
according 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 the oil is at any moment in time.  
 $a_w = 0$  indicates completely dry oil, while  $a_w = 1$  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  $a_w$  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 special applications, the oil can become corrosive in 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 moisture in oil and temperature sensor with interchangeable probe, analogue outputs and optional display. Besides MOP301, Sigma 05 accommodates also other E+E intelligent sensing probes.  
See [www.epluse.com/sigma05](http://www.epluse.com/sigma05) for further details.



## 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))

Response time  $t_{90}$ , typ. @ 20 °C (68 °F) 10 min. in still oil

Accuracy<sup>1)</sup>  
Including hysteresis, non-linearity and repeatability

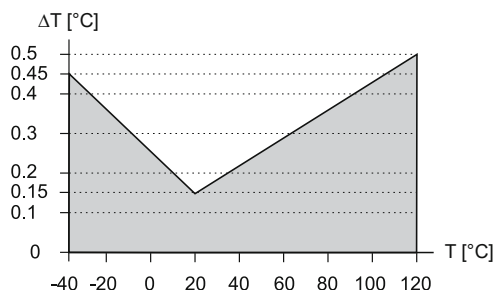
0...40 °C (32...104 °F)	(0...0.9 aw)	±0.02 aw
	(0.9...1 aw)	±0.025 aw
-40...120 °C (-40...356 °F)	(0...1 aw)	±0.03 aw

Resolution 0.0001 aw

#### Temperature (T)

Measuring range -40...120 °C (-40...248 °F)

Accuracy<sup>1)</sup>





Resolution 0.01 °C

### Output

Digital interface	RS485 (MOP301 = 1 unit load)
Protocol	Modbus RTU
Factory settings	9600 Baud, parity even, 1 stop bit, Modbus address 70
Supported baud rates	9600, 19200, 38400, 57600, 76800 and 115200
Data types for measured values	FLOAT 32 bit and INTEGER 16 bit registers

### General

Power supply class III  (EU) / class 2 (NA)	8 - 35 V DC <sup>2)</sup>
Power consumption, typ.	40 mW (without termination resistor)
Electrical connection	M12x1, 4 poles
Protection rating	IP66/NEMA 4
Pressure rating	20 bar (300 psi)
Probe material	Stainless steel 1.4404
Cable jacket <sup>3)</sup>	HFS 125XL, black, oil and fuel resistant
Temperature working range	Sensing element + filter cap: -40...125 °C (-40...257 °F) Probe: -40...120 °C (-40...248 °F) Cable: -40...120 °C (-40...248 °F) M12 connector: -25...90 °C (-13...194 °F)
Storage conditions	-40...80 °C (-40...176 °F) 0...95 %RH, non-condensing
Electromagnetic compatibility	EN 61326-1 EN 61326-2-3 ICES-003 ClassA Industrial Environment FCC Part15 ClassA 
Shock and vibration	Tested acc. to EN 60068-2-6 and EN 60068-2-27
Configuration and adjustment	PCS10 Product Configuration Software (free download) and configuration adapter

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).

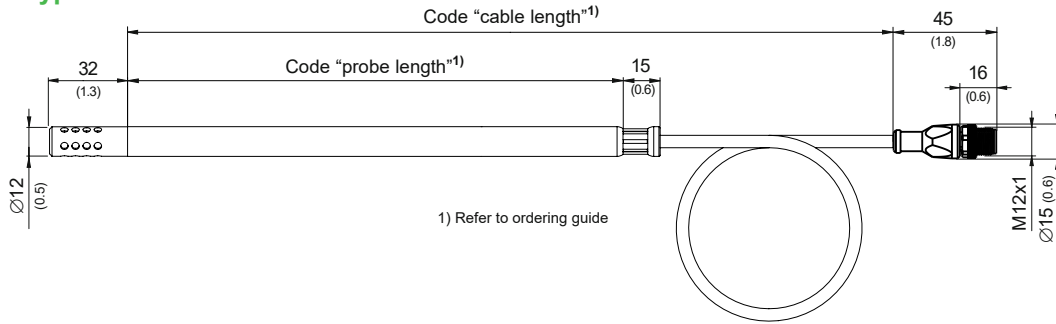
2) USA & Canada class 2 supply required, max. supply voltage 30 V DC.

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

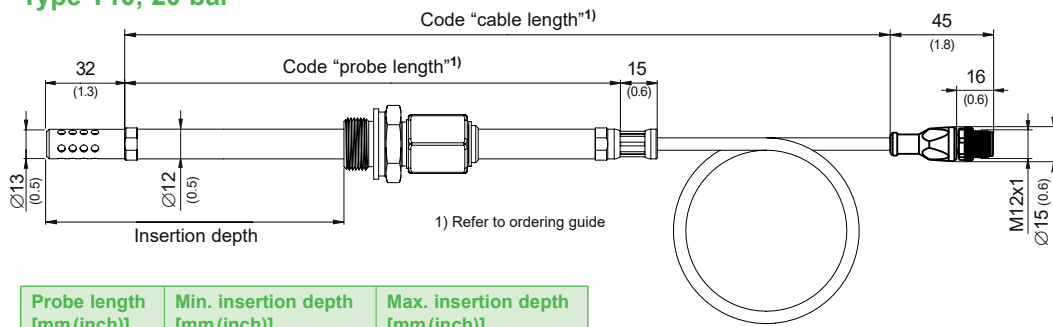
## Dimensions

Values in mm (inch)

### Type T4

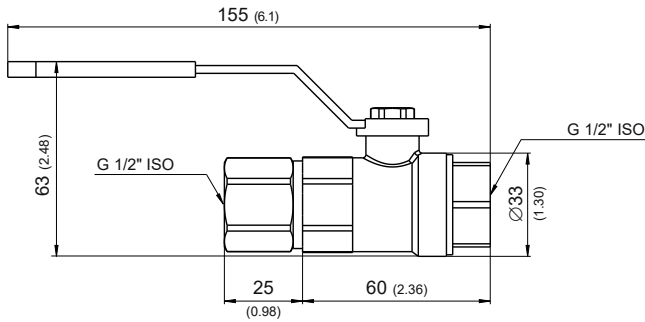


### Type T10, 20 bar

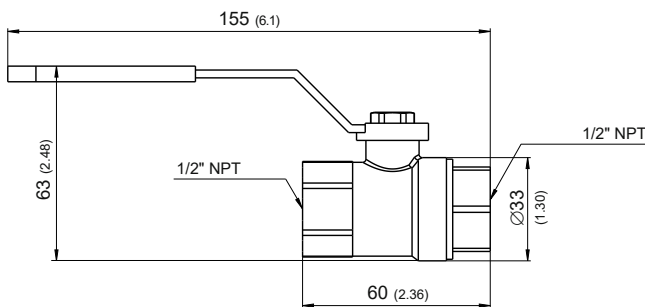


Probe length [mm (inch)]	Min. insertion depth [mm (inch)]	Max. insertion depth [mm (inch)]
200 (7.9)	23 (0.9)	164 (6.5)
400 (15.7)	23 (0.9)	364 (14.3)

### Ball valve G 1/2" ISO



### Ball valve 1/2" NPT



## Ordering Guide

### Position 1: Probe

			MOP301-	
Configuration	Type	Probe up to 120 °C (248 °F) Probe, pressure tight up to 20 bar (300 psi) and 120 °C (248 °F)	T4	T10
	Filter	Stainless steel, for flow < 1 m/s Stainless steel, for flow > 1 m/s	F13	F18
	Cable length	2 m (6.6 ft) 5 m (16.4 ft) 10 m (32.8 ft)	K2	K5 K10
	Probe length	200 mm (7.9") 400 mm (15.7")	L200	L400
	Process connection	1/2" ISO thread 1/2" NPT thread		PA23 PA25
	Sensing element protection	Without Casted sensor leads	C0	C2
	Oil parameterization for ppm calculation	Mineral transformer oil Customer specific oil	no code	PPMxxx <sup>1)</sup>

### <sup>1)</sup> Position 2: Procedure for customer specific oil

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

## Ordering Examples

### Position 1: MOP301-T10F13K2L200PA23C0

Type:	Probe, pressure tight up to 20 bar (300 psi) and 120 °C (248 °F)
Filter:	Stainless steel, for flow < 1 m/s
Cable length:	2 m (6.6 ft)
Probe length:	200 mm (7.9")
Process connection:	1/2" ISO thread
Sensing element protection:	Without
Oil type :	Mineral transformer oil

### Position 1: MOP301-T10F13K2L200PA23C0PPMxxx

Type:	Probe, pressure tight up to 20 bar (300 psi) and 120 °C (248 °F)
Filter:	Stainless steel, for flow < 1 m/s
Cable length:	2 m
Probe length:	200 mm
Process connection:	1/2" ISO thread
Sensing element protection:	Without
Oil type :	Customer specific oil, oil parameters unknown

### Position 2: Oil-ppmcal

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

## Accessories

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

Modbus configuration adapter	HA011018
E+E Product Configuration Software (Free download: <a href="http://www.epluse.com/pcs10">www.epluse.com/pcs10</a> )	PCS10
T coupler M12 - M12	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