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technology.



# Datasheet EE364

Moisture in Oil Sensor



# EE364

## Moisture in Oil Sensor

The compact moisture in oil sensor is designed for reliable online monitoring of the moisture in transformer, engine, lubrication or hydraulic oil as well as in diesel fuel. Besides the accurate measurement of water activity ( $a_w$ ) and temperature ( $T$ ), the EE364 calculates the absolute water content ( $x$ ) of the oil in ppm.

### Outstanding Measurement Performance

The sensor employs high end E+E humidity sensing elements which feature outstanding long term stability and high resistance to pollution.

### Functional Design

The small size and robust stainless steel enclosure, together with the choice of process connections allow easy and space-saving installation.

### Analogue and Digital Outputs

The  $a_w$ ,  $T$  and  $x$  measured data is available on two freely configurable 4 - 20 mA analogue outputs and on the RS485 interface with Modbus RTU protocol. The wide scaling range of the analogue output facilitates the EE364 implementation in existing monitoring and control systems.

### Configurable and Adjustable

The setup and adjustment of the EE364 can be easily performed with an optional configuration adapter and the free PCS10 Product Configuration Software.



EE364 with G 1/2" ISO thread



EE364 with 1/2" NPT thread

# Features

## Outputs

- 2x 4 - 20 mA output, wide scaling range
- Modbus RTU
- Industrial M12x1 connector

## Configurable and adjustable

- Service interface
- Free configuration software

## Measurement performance

- Water activity (aw), water content (x), temperature (T)
- Oil temperature -40...+100 °C (-40...+212 °F)
- Suitable for transformer, lubrication and hydraulic oil, as well as for diesel fuel



## Mechanical construction

- Stainless steel enclosure and filter cap
- Pressure tight up to 20 bar (290 psi)
- Process connection with ISO or NPT thread
- IP65 / NEMA 4X

## Inspection certificate

According to DIN EN 10204-3.1

# Features

## Measurement Water activity $a_w$ / Water content $x$

**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. The  $a_w$  value indicates the degree of saturation of the oil.  $a_w = 0$  indicates completely dry oil,  $a_w = 1$  indicates fully saturated oil. The water activity is independent of the type of oil and shows how close to saturation is the oil at any moment in time.

**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. To assess the degree of saturation,  $x$  must be considered together with  $T$ .

EE364 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 "Accessories" below. The parameters can be set upon order or uploaded to EE364 using the PCS10 Product Configuration Software (available at [www.epluse.com/pcs10](http://www.epluse.com/pcs10)).

## Sensor Leads Protection

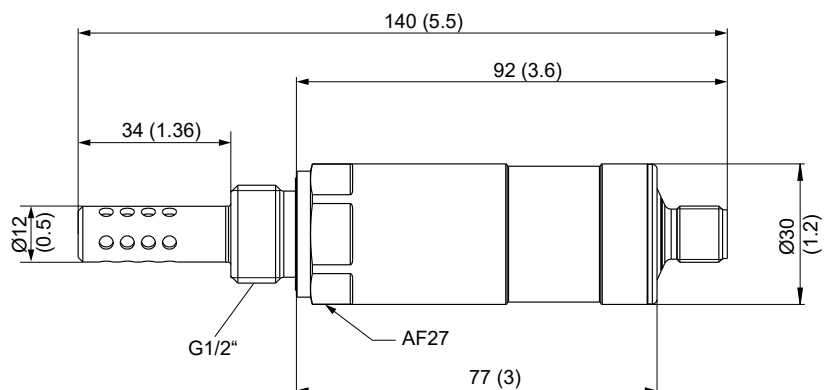
In certain applications, the oil can become corrosive over time, for example due to continuous contamination of lubricating oils by salt water in the maritime environment. In such demanding applications, the E+E proprietary protection of the sensing element leads can significantly extend the service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

# Dimensions

Values in mm (inch)

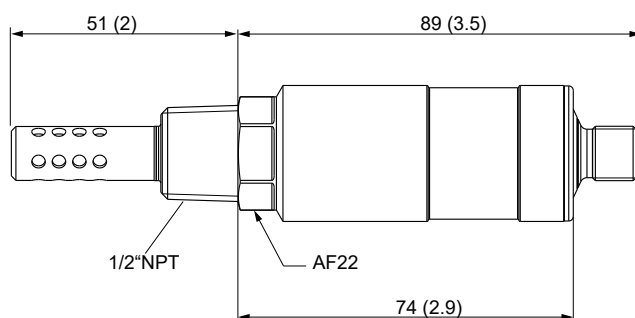
## Thread

ISO



## Thread

NPT



# Technical Data

## Measurands

### Water Activity (aw) / Water Content (x)

<b>Measuring range</b>		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))
<b>Accuracy<sup>1)</sup></b> @ 20 °C (68 °F)	<b>(0...0.9 aw)</b>	±0.02 aw
	<b>(0.9...1 aw)</b>	±0.03 aw
<b>Response time t<sub>90</sub>, typ.</b> @ 20 °C (68 °F) in still oil		10 min.

1) The accuracy statement includes the uncertainty of the factory calibration with an enhancement factor k=2 (2x 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

## Measurands

### Temperature (T)

Measuring range, max.	-40...+100 °C (-40...+212 °F)
Accuracy <sup>1)</sup> @ 20 °C (68 °F) in oil	±0.2 °C (±0.36 °F)
Resolution	0.01 °C (0.18 °F)

1) 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 scalable outputs	2x 4 - 20 mA	3-wire	$R_L < 500 \Omega$	$R_L$ = load resistance
Resolution	2 $\mu$ A			

### Digital

Digital interface	RS485 (EE364 = 1 unit load)
Protocol	Modbus RTU
Factory settings	9600 Baud, parity even, 1 stop bit, Modbus address 243
Supported Baud rates <sup>1)</sup>	9600, 19200 and 38400
Measured data types	FLOAT32

1) Find more details about communication settings in the User Manual and the Modbus Application Note AN0103 at [www.epluse.com/ee364](http://www.epluse.com/ee364).

## General

<b>Power supply</b> class III  USA & Canada: Class 2 supply necessary	10 <sup>1)</sup> - 28V DC                      *) 10V+0.02*R <sub>L</sub> R <sub>L</sub> = load resistance		
<b>Power consumption</b>	<20 mA + load current		
<b>Electrical connection</b>	M12x1 plug 8 poles		
<b>Filter</b>	<b>Material</b>	Stainless steel 1.4404 (AISI 316L), perforated	
<b>Pressure working range</b>	0...20 bar (0...290 psi)		
<b>Temperature working range</b>	<b>Storage</b> <b>Ambience</b> <b>Oil</b>	-40...+60 °C (-40...+140 °F) -40...+60 °C (-40...+140 °F) / -40...+80 °C (-40...+176 °F) -40...+80 °C (-40...+176 °F) / -40...+100 °C (-40...+212 °F)	
<b>Enclosure</b>	<b>Material</b> <b>Protection rating</b>	Stainless steel 1.4404 (AISI 316L) IP65/NEMA 4X	
<b>Electromagnetic compatibility</b>	EN 61326-1 FCC Part15 Class A	EN 61326-2-3 ICES-003 Class A	Industrial environment
<b>Conformity</b>	 		
<b>Configuration software</b>	PCS10 Product Configuration Software Free download from <a href="http://www.epluse.com/pcs10">www.epluse.com/pcs10</a> .		

# Ordering Guide

## Positon 1: Sensor

Feature	Description	Code
Hardware Configuration		<b>EE364-</b>
	Process connection	G 1/2" ISO thread 1/2" NPT thread
	Fluid temperature	-40...+100 °C (-40...+212 °F)
	Sensing element protection	Without Sensor leads protection
	Filter	Stainless steel, for flow <1 m/s (<3.28 ft/s) Stainless steel, for flow >1 m/s (>3.28 ft/s)
	Accessories	Without M12x1 cable socket, for self assembly
Software Setup - Analogue Outputs	Output 1 measurand	Water activity aw [1] Water content x [ppm] Temperature T [°C] Temperature T [°F]
	Output 1 scaling low	0 Value
	Output 1 scaling high	1 Value
	Output 2 measurand	Temperature T [°C] Temperature T [°F] Water activity aw [1] Water content x [ppm]
	Output 2 scaling low	-20 Value
	Output 2 scaling high	80 Value
	Units (Modbus RTU)	Metric (SI) Non-metric (US/GB)
	Oil parameterization for water content calculation	Mineral transformer oil Customer specific oil

## 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.	<b>Oil-ppmcal</b>
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.	<b>Oil-calc</b>

# Order Example

## Position 1: EE364-PA1HM2F13AC2U1

Feature	Code	Description
Process connection	PA1	G 1/2" ISO thread
Fluid temperature	HM2	-40...+100 °C (-40...+212 °F)
Sensing element protection	No code	Without
Filter	F13	Stainless steel, for flow <1 m/s (<3.28 ft/s)
Accessories	AC2	M12x1 cable socket, for self assembly
Output 1 measurand	No code	Water activity aw [1]
Output 1 scaling low	No code	0
Output 1 scaling high	No code	1
Output 2 measurand	No code	Temperature T [°C]
Output 2 scaling low	No code	-20
Output 2 scaling high	No code	80
Units (Modbus RTU)	U1	Metric (SI)

## Positon 2: Oil-ppmcal

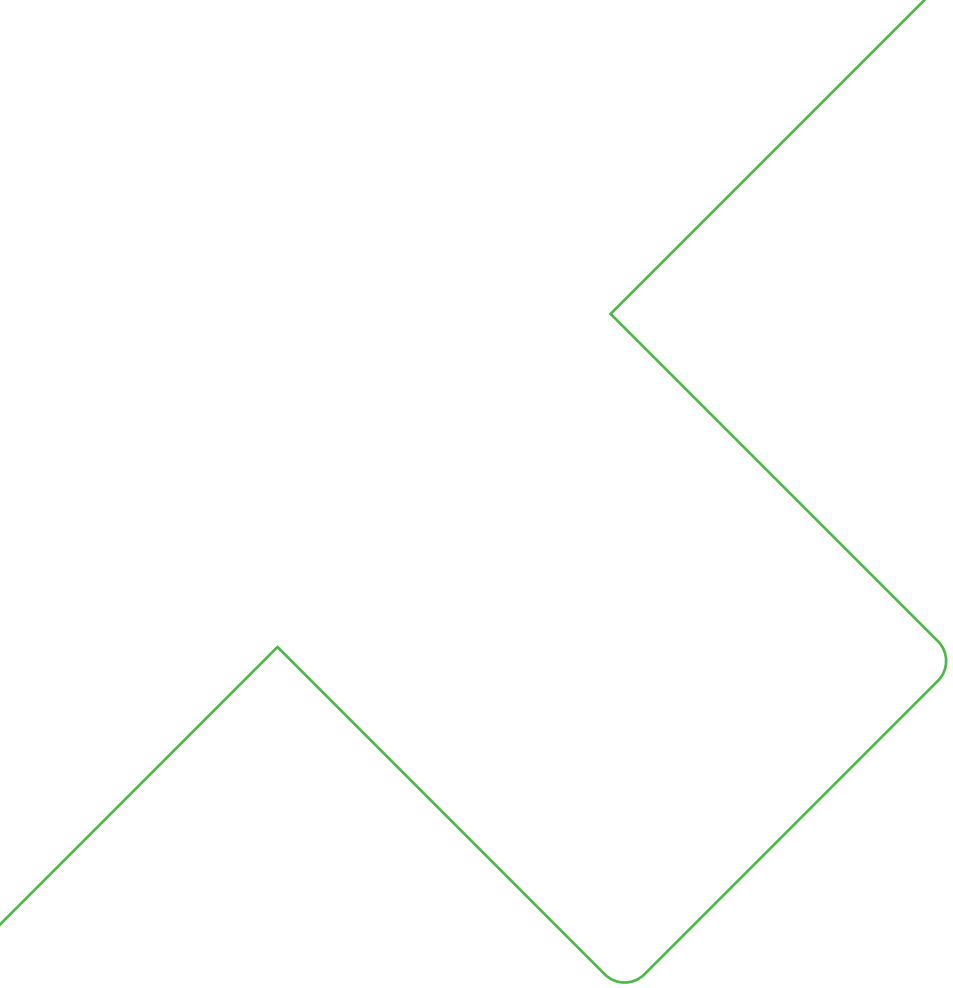
Contact and provide E+E HQ the datasheet of the oil before sending us 2 litres of oil.

# Accessories

For further information please refer to the [Accessories](#) datasheet.

Description	Code
Modbus configuration adapter	HA011013
PCS10 Product configuration software (Free download: <a href="http://www.epluse.com/pcs10">www.epluse.com/pcs10</a> )	PCS10
M12x1 8 pole cable socket for self assembly	HA010704
M12x1 8 pole shielded connection cable, socket/flying leads	
1.5 m (4.9 ft)	HA010322
5 m (9.8 ft)	HA010324
10 m (16.4 ft)	HA010325
Sampling cell with shut-off function, PN40, DN25	HA050109





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