

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 EE-PCS Product Configuration Software.



EE364 with G 1/2" ISO thread



EE364 with 1/2" NPT thread

Features

Outputs

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

Configurable and adjustable

- Service interface
- Free configuration software

Measurement performance

- Water activity (a_w), 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 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 a 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 given temperature. The a_w value indicates how close to saturation is the oil. $a_w = 0$ means dry oil (no water at all), $a_w = 1$ means fully saturated oil. Water activity does not depend on the type of oil.
- **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 .

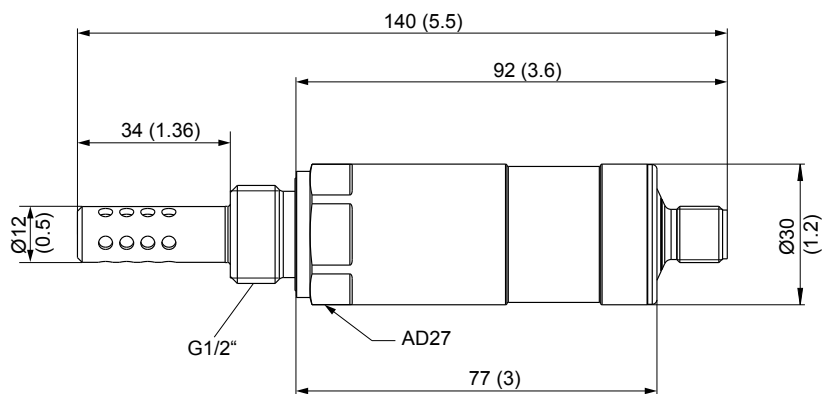
EE364 calculates x based on the measured a_w and T values. The calculation is oil dependent and requires a set of oil specific parameters. E+E offers the service of determining the oil specific parameters, see section "Accessories" below. The parameters can be set upon order or uploaded to EE364 using the EE-PCS Product Configuration Software (available at www.epluse.com/configurator).

Dimensions

Values in mm (inch)

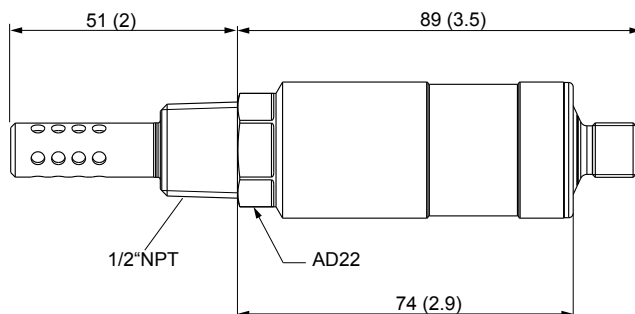
Thread

ISO



Thread

NPT



Technical Data

Measurands

Water Activity (a_w) / Water Content (x)

Measuring range	0...1 a_w 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⁾ @ 20 °C (68 °F)	(0...0.9 a_w) (0.9...1 a_w)	±0.02 a_w ±0.03 a_w
Response time t_{90}, typ. @ 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 (2 x 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, max.	HMI1 HMI2	-40...+80 (-40...+176 °F) -40...+100 °C (-40...+212 °F)
Accuracy¹⁾ @ 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 μ A			




Digital

Digital interface	RS485 (EE364 = 1 unit load)
Protocol Factory settings Supported Baud rates¹⁾ Measured data types	Modbus RTU 9600 Baud, parity even, 1 stop bit, Modbus address 243 9600, 19200 and 38400 FLOAT32

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

Technical Data

General

Power supply class III  USA & Canada: Class 2 supply necessary	10*) - 28V DC *) 10V+0.02*RL RL = load resistance
Power consumption	<20 mA + load current
Electrical connection	M12x1 plug 8 poles
Filter	Material Stainless steel 1.4404 (AISI 316L), perforated
Pressure working range	0...20 bar (0...290 psi)
Temperature working range	Storage -40...+60 °C (-40...+140 °F) Ambience -40...+60 °C (-40...+140 °F) / -40...+80 °C (-40...+176 °F) Oil -40...+80 °C (-40...+176 °F) / -40...+100 °C (-40...+212 °F)
Enclosure	Material 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	 
Configuration software	EE-PCS Product Configuration Software Free download from www.epluse.com/configurator .

Ordering Guide

Positon 1: Sensor

	Feature	Description	Code
Hardware Configuration			EE364-
	Process connection	G 1/2" ISO thread	PA1
		1/2" NPT thread	PA2
	Fluid temperature	-40...+80 °C (-40...+176 °F)	HM1
		-40...+100 °C (-40...+212 °F)	HM2
	Filter	Stainless steel, for flow <1 m/s (<3.28 ft/s)	F13
Stainless steel, for flow >1 m/s (>3.28 ft/s)		F18	
Accessories	Without	AC0	
	M12x1 cable socket, for self assembly	AC2	
Software Setup - Analogue Outputs	Output 1 measurand	Water activity a_w []	No code
		Water content x [ppm]	MA70
		Temperature T [°C]	MA1
		Temperature T [°F]	MA2
	Output 1 scaling low	0	No code
		Value	SALValue
	Output 1 scaling high	1	No code
		Value	SAHValue
	Output 2 measurand	Temperature T [°C]	No code
		Temperature T [°F]	MB2
		Water activity a_w []	MB67
		Water content x [ppm]	MB70
	Output 2 scaling low	-20	No code
		Value	SBLValue
	Output 2 scaling high	80	No code
		Value	SBHValue
Units (Modbus RTU)	Metric (SI)	U1	
	Non-metric (US/GB)	U2	
Oil parameterization for water content calculation	Mineral transformer oil	No code	
	Customer specific oil	PPMxxx¹⁾	

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: EE364-PA1HM1F13AC2U1

Feature	Code	Description
Process connection	PA1	G 1/2" ISO thread
Fluid temperature	HM1	-40...+80 °C (-40...+176 °F)
Filter	F13	Stainless steel, for flow <1 m/s (<3.28 ft/s)
Accessory	AC2	M12x1 cable socket, for self assembly
Units (Modbus RTU)	U1	Metric (SI)

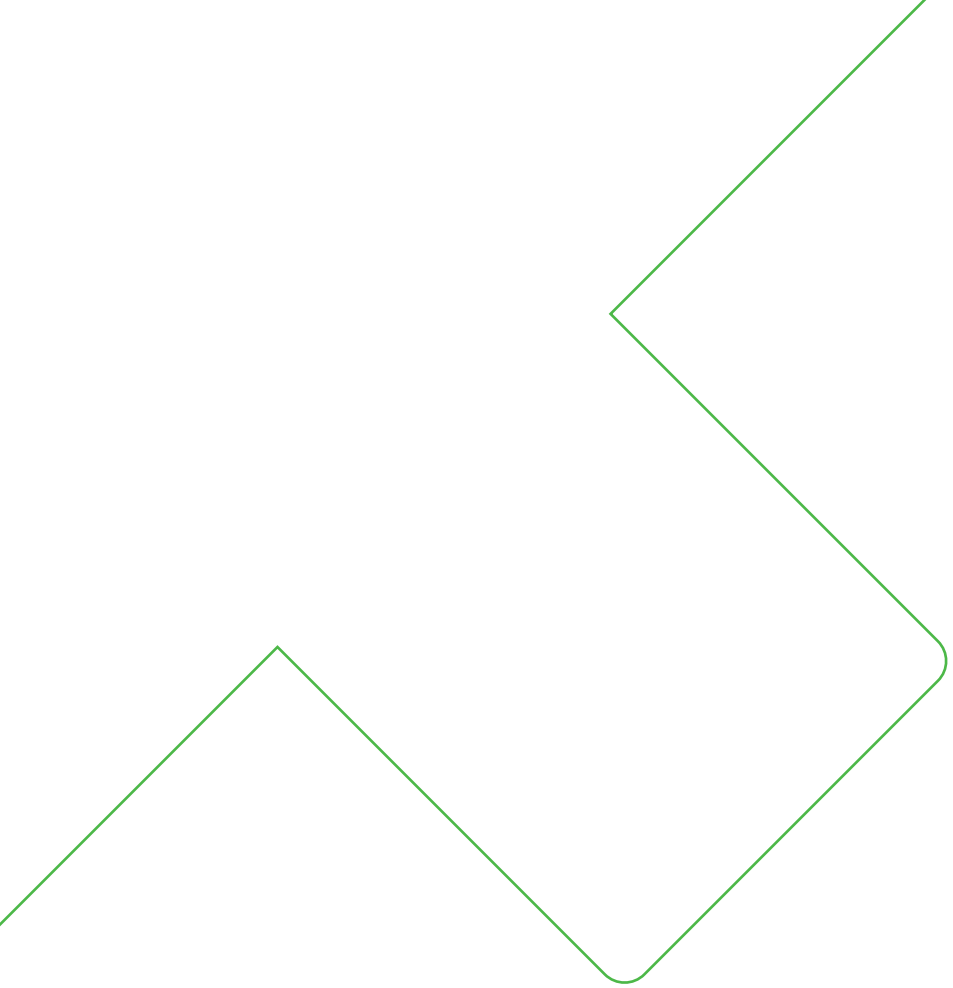
Position 2: Oil-ppmcal

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](#).

Description	Code
Modbus configuration adapter	HA011013
EE-PCS Product configuration software (Free download: www.epluse.com/configurator)	EE-PCS
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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