E+E

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in sensor
technology.

Datasheet
EE364

Moisture in Oil Sensor

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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 (aw) 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 aw, 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 (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 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. The aw value indicates the degree of saturation of the oil. aw = 0 indicates completely dry oil, aw = 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. For assessing the degree of saturation, x must be regarded together with T.
EE364 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 parametrs, 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).
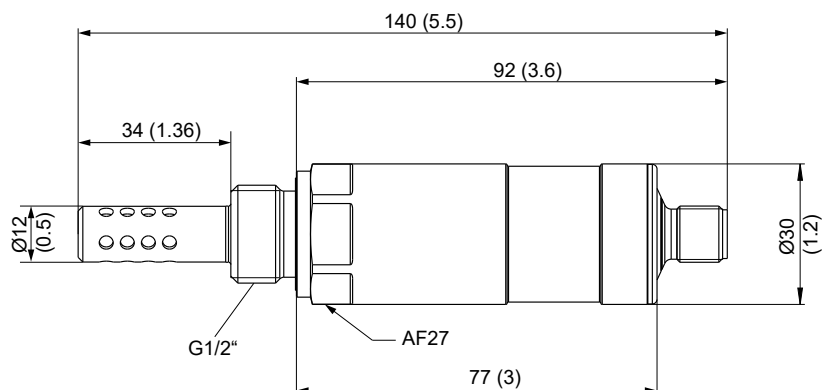
Sensor Leads Protection

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.
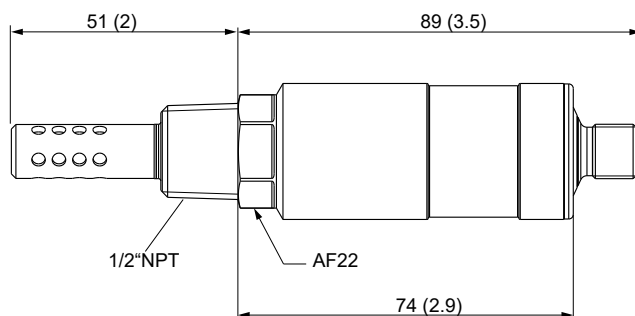
Dimensions

Values in mm (inch)

Thread

ISO

140 (5.5)

92 (3.6)

34 (1.36)

Ø12 (0.5)

Ø30 (1.2)

G1/2"

AF27

77 (3)

Thread

NPT

51 (2)

89 (3.5)

1/2"NPT

AF22

74 (2.9)

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]) @ 20 °C (68 °F)	**(0...0.9 aw)**	±0.02 aw
	(0.9...1 aw)	±0.03 aw
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).

Technical Data

Measurands

Temperature (T)

Measuring range, max.	-40...+100 °C (-40...+212 °F)
Accuracy[1] @ 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 Ω	R_L = load resistance
Resolution	2 µA			

Digital

Digital interface	RS485 (EE364 = 1 unit load)
Protocol **Factory settings** **Supported Baud rates**[1] **Measured data types**	Modbus RTU 9 600 Baud, parity even, 1 stop bit, Modbus address 243 9 600, 19 200 and 38 400 FLOAT32

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

General

Power supply class III ⬦ USA & Canada: Class 2 supply necessary	$10^{*)}$ - 28V DC *) $10V+0.02*R_L$ R_L = 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
      Ambience
         Oil
	
	-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)

Enclosure **Material** **Protection rating**	 Stainless steel 1.4404 (AISI 316L) IP65 / NEMA 4X
Electromagnetic compatibility	EN 61326-1 EN 61326-2-3 Industrial environment FCC Part15 Class A ICES-003 Class A
Conformity	CE UKCA
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...+100 °C (-40...+212 °F)	**HM2**
	Sensing element protection	Without	**No code**
		Sensor leads protection	**C2**
	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 aw [ ]	**No code**
		Water content x [ppm]	**MA70**
		Temperature T [°C]	**MA1**
		Temperature T [°F]	**MA2**
	Output 1 scaling low	0	**No code**
		Value	**SAL**Value
	Output 1 scaling high	1	**No code**
		Value	**SAH**Value
	Output 2 measurand	Temperature T [°C]	**No code**
		Temperature T [°F]	**MB2**
		Water activity aw [ ]	**MB67**
		Water content x [ppm]	**MB70**
	Output 2 scaling low	-20	**No code**
		Value	**SBL**Value
	Output 2 scaling high	80	**No code**
		Value	**SBH**Value
	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	**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: EE364-PA1HM2F13AC2U1

Feature	Code	Description
Process connection	PA1	G 1/2" ISO thread
Fluid temperature	HM2	-40...+100 °C (-40...+212 °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)

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.

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) 5 m (9.8 ft) 10 m (16.4 ft)	HA010322 HA010324 HA010325
Sampling cell with shut-off function, PN40, DN25	HA050109

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