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+ 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).

Sensor Leads Protection

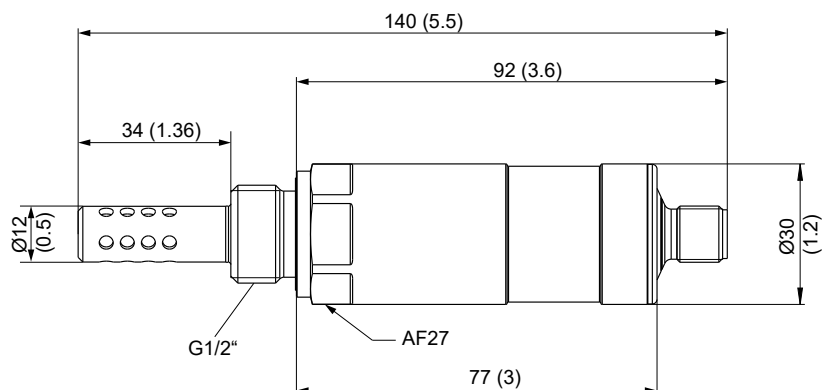
In certain applications, the oil can become corrosive over time, for example due to continuous contamination of lubricating oils by salt water in the maritime environment. In such demanding applications, the E+E proprietary protection of the sensing element leads can significantly extend the service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

Dimensions

Values in mm (inch)

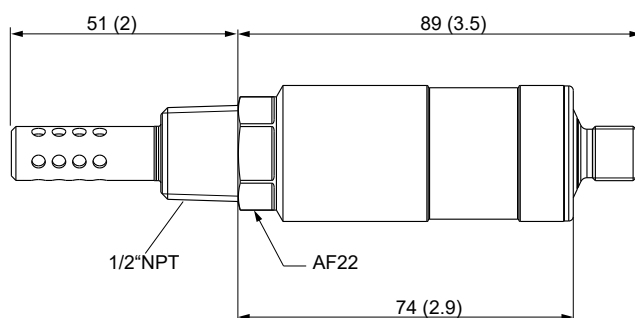
Thread

ISO



Thread

NPT



Technical Data

Measurands

Water Activity (aw) / Water Content (x)

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))	
Accuracy¹⁾ @ 20 °C (68 °F)	(0...0.9 aw) (0.9...1 aw)	±0.02 aw ±0.03 aw
Response time t₉₀ , 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 (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 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	$R_L < 500 \Omega$	$R_L = \text{load resistance}$
Resolution	2 µA			

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 ¹⁾	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.

General

Power supply class III  USA & Canada: Class 2 supply necessary	10 ¹⁾ - 28V DC	*) 10V+0.02*R _L	$R_L = \text{load resistance}$
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 FCC Part15 Class A	EN 61326-2-3 ICES-003 Class A	Industrial environment
Conformity	 		
Configuration software	PCS10 Product Configuration Software Free download from www.epluse.com/pcs10 .		

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 [1]	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 aw [1]	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-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: www.epluse.com/pcs10)	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



Company Headquarters &
Production Site

E+E Elektronik Ges.m.b.H.
Langwiesen 7
4209 Engerwitzdorf | Austria
T +43 7235 605-0
F +43 7235 605-8
info@epluse.com
www.epluse.com

Subsidiaries

E+E Sensor Technology (Shanghai) Co., Ltd.
T +86 21 6117 6129
info@epluse.cn

E+E Elektronik France SARL
T +33 4 74 72 35 82
info.fr@epluse.com

E+E Elektronik Deutschland GmbH
T +49 6171 69411-0
info.de@epluse.com

E+E Elektronik India Private Limited
T +91 990 440 5400
info.in@epluse.com

E+E Elektronik Italia S.r.l.
T +39 02 2707 86 36
info.it@epluse.com

E+E Elektronik Korea Ltd.
T +82 31 732 6050
info.kr@epluse.com

E+E Elektronik Corporation
T +1 847 490 0520
info.us@epluse.com



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