E+E

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in sensor
technology.

Datasheet EE364

Moisture in Oil Sensor



Modbus

www.epluse.com

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 (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 PCS10 Product Configuration Software.



EE364 with G 1/2" ISO thread



EE364 with 1/2" NPT thread

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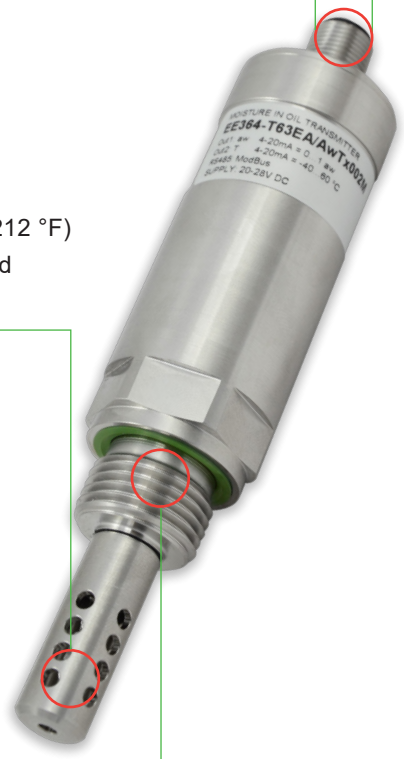
Features

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

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Features

Measurement Water activity aw / Water content x

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. To assess the degree of saturation, x must be considered 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 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.

Accredited Traceable Calibration Certificate



Internationally recognised certificates for the calibration of measuring instruments from accredited laboratories document the traceability of the measurements to the International System of Units (SI). The E+E Elektronik calibration laboratory offers two levels of traceable calibrations.

- As a Designated Institute (DI) of the Republic of Austria, the E+E calibration laboratory maintains Austria’s national measurement standards for humidity, dew point temperature, air velocity and CO_2. This authorises the E+E calibration laboratory to issue calibration certificates at the level of a National Metrological Institute (NMI).
- The E+E calibration laboratory is accredited by Akkreditierung Austria in accordance with DIN EN ISO/IEC 17025 with the identification number 0608. This allows the laboratory to issue ISO 17025 certificates for the measurands humidity, temperature, dew point temperature, air velocity, flow, pressure and CO_2.

Visit www.epluse.com for detailed information on calibration and to enquire a certificate of accredited traceable calibration for the EE364 from the Designated Institute / E+E Elektronik calibration laboratory.

ISO 9001 Calibration Certificate

An ISO 9001 calibration certificate documents the comparative measurement of a device against high quality reference equipment (factory level standard). The comparison is performed in accordance with internal procedures that comply with ISO 9001 and provides information on the specimen’s measuring accuracy. The reference equipment is traceable to national standards, however, the calibration process is not accredited. Therefore, an ISO 9001 calibration is neither traceable nor internationally comparable.

Visit www.epluse.com/iso9001cal for detailed information on calibration and to enquire an ISO 9001 calibration certificate.

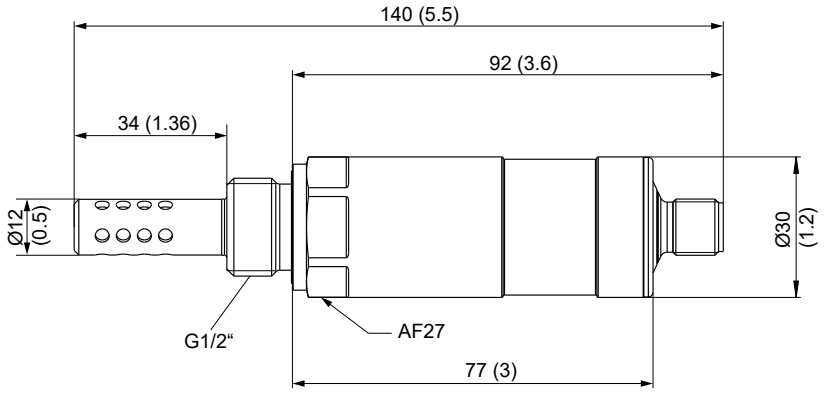
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Dimensions

Values in mm (inch)

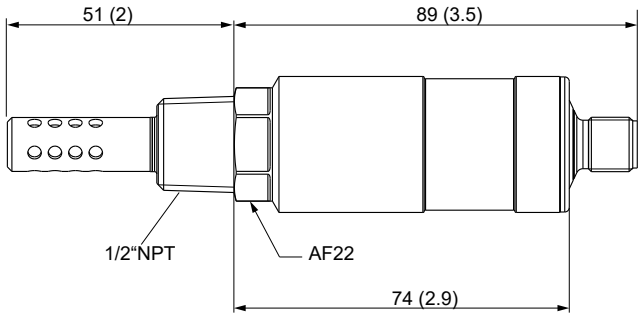
Thread

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

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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 coverage 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 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.

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 FCC Part15 Class B	EN 61326-2-3 ICES-003 Class B	Industrial environment	
Conformity	CE UKCA			
Configuration software	PCS10 Product Configuration Software Free download from www.epluse.com/pcs10.			

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Ordering Guide

Positon 1: Sensor

	Feature	Description	Code
			EE364-
Hardware Configuration	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	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 [1]	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)]
	Accredited Traceable Calibration Certificate in accordance with DIN EN ISO/IEC 17025		see www.eplusecal.com
	ISO 9001 Calibration Certificate		see www.epluse.com/iso9001cal

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

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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, M12 ←→ USB	**HA011013**
PCS10 Product configuration software (Free download: www.epluse.com/pcs10)	**PCS10**
Connector, M12x1 socket, 8 poles, for self assembly	**HA010704**
Sensor connection cable, **M12x1 socket ←→ free ends, 8 poles, shielded** **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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