Operating Instructions

for

Industrial Oil Moisture Sensor

Model: AFO

1. Contents

1. Contents....2
2. Note....3
3. Instrument Inspection....3
4. Regulation Use....3
5. Operating Principle....4
6. Safety Instructions....5
7. Electrical Connection....6
8. Installation instructions....7
9. Modbus....8
   9.1 Register Mapping measuring values:....8
   9.2 Register device settings....9
   9.3 Analog Scaling Settings (2007…2011)....9
10. Calibration/Adjustment....10
11. Technical Information....10
12. Order Codes....10
13. Dimensions....10
14. Disposal....11
15. EU Declaration of Conformance....12

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2. Note

Please read these operating instructions before unpacking and putting the unit into operation. Follow the instructions precisely as described herein.
The instruction manuals on our website www.kobold.com are always for currently manufactured version of our products. Due to technical changes, the instruction manuals available online may not always correspond to the product version you have purchased. If you need an instruction manual that corresponds to the purchased product version, you can request it from us free of charge by email (info.de@kobold.com) in PDF format, specifying the relevant invoice number and serial number. If you wish, the operating instructions can also be sent to you by post in paper form against an applicable postage fee.

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

The devices are only to be used, maintained and serviced by persons familiar with these operating instructions and in accordance with local regulations applying to Health & Safety and prevention of accidents.

When used in machines, the measuring unit should be used only when the machines fulfil the EC machinery directive.

3. Instrument Inspection

Instruments are inspected before shipping and sent out in perfect condition.
Should damage to a device be visible, we recommend a thorough inspection of the delivery packaging. In case of damage, please inform your parcel service / forwarding agent immediately, since they are responsible for damages during transit.

Scope of delivery:
The standard delivery includes:

- Industrial Oil Moisture Sensor model: AFO

4. Regulation Use

Any use of the device, which exceeds the manufacturer's specification, may invalidate its warranty. Therefore, any resulting damage is not the responsibility of the manufacturer. The user assumes all risk for such usage.

5. Operating Principle

The AFO humidity and temperature transmitter is a reliable measuring device that can be used in various applications.

It is a microprocessor-controlled device that enables moisture measurement in the form of water activity or relative humidity. This is particularly useful in areas such as the lubrication of circulation systems or in oil transformers.

The analog interfaces with two current outputs can be freely configured, while a digital output (RS-485) is also available.

Connection options (ISO and NPT 1/2).

In addition, the AFO enables precise temperature measurement and is designed as an easy-to-install online probe.

Special advantages of the AFO oil sensor

- Measured variables: Water activity (a_w), temperature (t) and water content in PPM (x) (for transformer oils)
- Fast Response time
- Two freely configurable analog outputs as well as Modbus-RTU (RS 485) interface available)

The AFO is used to measure the moisture content in oil using water activity (a_W) and relative humidity (% rh). Using internal calculations on specific oil parameters, the AFO can also measure oil moisture in ppm (supported as standard for mineral transformer oil).

The water activity is measured on a scale from 0 to 1 a_W, where 0 a_W stands for completely water-free oil and 1 a_W indicates that the oil is completely saturated with water. The relative humidity indicates the water content on a scale from 0 to 100% rH, where 0% rH stands for completely water-free oil and 100% rH indicates that the oil is completely saturated with water.

If the water activity exceeds 0.9 aw or the relative saturation exceeds 90 % rH, there is a risk of segregation in the system, especially at falling temperatures.

The water activity and relative humidity serve as critical parameters to indicate risks of free water in the system, especially when they reach values of >0.9 a_w / >90 % rH.

The key advantages of this measuring system are that water activity and relative saturation are independent of oil ageing and immune to additives.

The AFO transmitter enables continuous online measurements and can also be calibrated with salt solutions without the need for reference oils.

Programming by software.
With the Service Software incl. USB / Modbus adapter settings like Modbus settings can be changed, analog output can be rescaled, and measured values can be assigned to adapt these oil specific parameters for different oil types.

6. Safety Instructions

Before installing the AFO, read these operating instructions carefully. Failure to follow the instructions in this manual, in particular the safety instructions, may result in danger to personnel, equipment and installations.

- The product may only be used and applied in accordance with its intended use.
- Installation of the oil moisture sensor (oil humidity sensor) and maintenance work may only be carried out by trained personnel.
- Installation and service work must be carried out in a de-energized state.
- The applicable safety regulations must be observed!
- Attention: max. pressure range 300 bar must not be exceeded.
- Observe the measuring ranges of the sensor! Overheating will destroy the sensors.
- Observe the permissible storage and transport temperature as well as the permissible operating temperature (e.g. protect the measuring device from direct sunlight).
- Opening the device, improper handling or use of force will void the warranty!

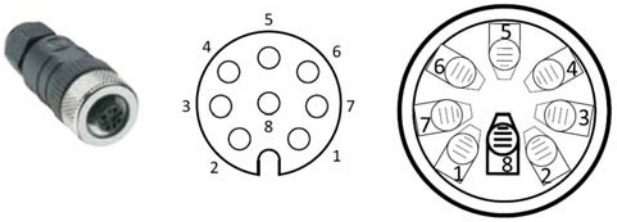
7. Electrical Connection

Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
NC	RS485 (B)	RS485 (A)	+I output	+I output	-VB	NC	+VB

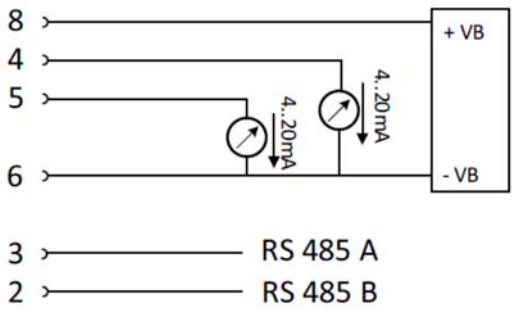
+VB	Positive supply voltage 24VDC (10...30 VDC) smoothed
RS485 (A)	Modbus A (+)
-VB	Negative supply voltage
RS 485 (B)	Modbus B (-)
+I	Positive 4...20 mA Signal **
NC	not connected

** Measuring value assignment for 4-20mA signal selectable

M12 Connector



Connection diagram



Remark: The sensor must only be connected in a de-energised state.

8. Installation instructions

- **The direct installation of the sensor is only allowed in the unpressurized state of the system.**
- **The sensor must be tightened with a torque of 25 - 30 Nm.**
- **Tightness of the connection must be checked and ensured.**
- **It is not permitted to use a sealing ring with a NPT 1/2“.**
- **Instead, use a suitable PTFE sealing tape or sealant.**

Screw the sensor with the G 1/2" thread pressure- tight into the line to be measured via a connecting piece.
Place the sensor tip (hole cap) as deep as possible in the oil (> 40% of the sensor tip length).
To obtain the shortest possible response time, there should be a continuous flow of oil.

9. Modbus

The oil moisture sensor AFO comes with a Modbus RTU Interface. Before commissioning of the sensor, the communication parameters

Modbus ID, Baudrate, Parity und Stop bit

must be set in order to ensure the communication with the Modbus master.
The adjustment can be done either with the PC service software.

Modbus communication default values:

- Modbus ID : 1 (1 -247)
- Baudrate: 19200 bps (1200,2400, 4800, 9600, 19200, 38400 bp
- Parity: even (none, even, odd)
- Stoppbit: 1 1,2)

Supported are following function codes:

- function codes 03: Read Holding Register
- function codes 16: Write multiple Register

9.1 Register Mapping measuring values:

Modbus Register	Modbus Adress	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
1001	1000	4	Float	Temperature		R	[°C]
1003	1002	4	Float	Temperature		R	[°F]
1005	1004	4	Float	Water Activity aw		R	
1007	1006	4	Float	xs PPM		R	
1009	1008	4	Float	xs PPM static temperature		R	
1011	1010	4	Float	relative Humidity		R	

9.2 Register device settings

Modbus Settings (2001…2006)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
2001	2000	2	UInt16	Modbus ID	1	R/W	Modbus ID 1…247
2002	2001	2	UInt16	Baudrate	4	R/W	0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38400
2003	2002	2	UInt16	Parity	1	R/W	0 = none 1 = even 2 = odd
2004	2003	2	UInt16	Number of Stopbits		R/W	0 = 1 Stop Bit 1 = 2 Stop Bit
2005	2004	2	UInt16	Word Order	0xABCD	R/W	0xABCD = Big Endian 0xCDAB = Middle Endian
2006	2005	2	UInt16	Modbus Enabled	FA510: 1 FA515: 0	R/W	0 = Modbus disabled 1 = Modbus Enabled

9.3 Analog Scaling Settings (2007…2011)

Modbus Register	Modbus Address	No.of Byte	Data Type	Description	Default Setting	Read Write	Unit /Comment
2007	2006	4	UInt32	Output Value	4	R/W	0 = 4-20mA disabled 1 = Temperature [°C] 2 = Temperature [°F]
2009	2008	4	float	4 mA Scale Low	-80	R/W	
2011	2010	4	float	20 mA Scale High	20	R/W	

10. Calibration/Adjustment

Within the scope of DIN ISO certification, we recommend having the measuring instruments calibrated and, if necessary, adjusted by the manufacturer at regular intervals. The calibration cycles should be based on your internal specifications. Within the scope of DIN ISO certification, we recommend a calibration cycle of one year for the AFO.

11. Technical Information

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

12. Order Codes

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

13. Dimensions

Operating instructions, data sheet, approvals and further information via the QR code on the device or via www.kobold.com

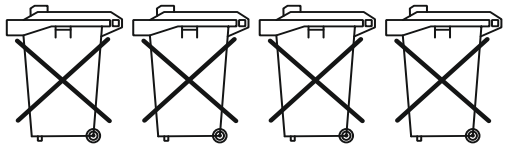
14. Disposal

Note!

- Avoid environmental damage caused by media-contaminated parts
- Dispose of the device and packaging in an environmentally friendly manner
- Comply with applicable national and international disposal regulations and environmental regulations.

Batteries

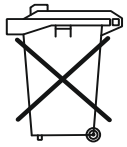
Batteries containing pollutants are marked with a sign consisting of a crossed-out garbage can and the chemical symbol (Cd, Hg, Li or Pb) of the heavy metal that is decisive for the classification as containing pollutants:



Cd[1] Hg[2] Pb[3] Li[4]

1. „Cd" stands for cadmium
2. „Hg" stands for mercury
3. „Pb" stands for lead
4. „Li" stands for lithium

Electrical and electronic equipment



15. EU Declaration of Conformance

We, KOBOLD Messring GmbH, Nordring 22-24, 65719 Hofheim, Germany, declare under our sole responsibility that the product:

Industrial Oil Moisture Sensor **Model: AFO**

to which this declaration relates is in conformity with the following EU directives stated below:

2014/30/EU **EMC Directive**
2011/65/EU **RoHS** (category 9)

Also, the following standards are fulfilled:

EN 55011: 55011:2016 + A1:2017 + A11:2020 + A2:2021
Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement

EN IEC 61326-1:2021
Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

Hofheim, 08 Jan. 2024

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