Mounting and operating instructions

FluidIX LUB-VDT

Inline Condition Monitoring Sensor

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Inhaltsverzeichnis

1. general information

- Read the safety instructions and keep the manual
- Installation, commissioning, electrical connection and repairs may only be carried out by qualified personnel
- The specified degree of protection is only guaranteed if the unit is installed in the correct position and the cables are inserted and screwed in properly
- Operate the unit only at the specified voltage
- Modification and conversion of the device is not permitted and releases ZILA GmbH from any warranty and liability

Read these assembly instructions carefully before using the unit. Follow the instructions. Keep these assembly instructions in a safe place for future use.

1.1. Safety instructions

Safe operation is only provided if the instructions and warnings in these operating instructions are observed.

- Assembly and electrical connection only permitted by qualified personnel.
- Read these operating instructions carefully before commissioning.
- Only operate the unit with the voltage and frequency specified on the label.
- Do not make any changes to the unit.
- Never operate the appliance without the electronics cover.

Seals and Labels:
Opening or removing seals or labels, e.g. with serial numbers or similar, will result in the immediate loss of warranty claims.

ATTENTION

1.2. Intended use

The manufacturer is not liable for damage resulting from improper use or use not in accordance with the intended purpose.

Before operating the unit, please compare the supply voltage with the specifications on the label.

If it becomes obvious that safe operation is no longer possible (e.g. in the case of visible damage), please take the unit out of operation immediately and secure it against unintentional operation.

In case of improper use or use not in accordance with the intended purpose, dangers may arise from the unit, which is why we refer to consistent observance of the safety instructions.

1.3. Assembly, commissioning & installation personnel

Assembly, electrical installation, commissioning and maintenance of the unit may only be carried out by trained specialist personnel who have been authorised to do so by the system operator.

The qualified personnel must have read and understood these operating instructions and follow their statements.

The unit may only be operated by persons who have been authorised and instructed by the system operator. The instructions in this operating manual must be followed.

Ensure that the unit is correctly connected according to the electrical connections.

1.4. Repairs

Repairs can only be carried out by trained customer service personnel.

In this case, please contact ZILA GmbH.

1.5. Technical progress

The manufacturer reserves the right to adapt technical data to technical development progress without special notice. For information on the activities and possible extensions of these operating instructions, please contact ZILA GmbH.

2. product description

The FluidIX LUB-VDT is a compact sensor for monitoring mechanical fluid characteristics such as viscosity and mass density based on a low-frequency resonance sensor element. The excellent performance of the LUB-VDT is achieved by combining a patented resonator evaluation technology with a robust and reliable quartz crystal tuning fork resonator. The sensor offers high sensitivity and long-term stability, making it particularly suitable for oil condition monitoring in predictive maintenance programmes. Due to the high measuring rate, excellent data quality can be achieved even under unstable environmental conditions (pressure, temperature, flow). The FluidIX LUB-VDT offers digital and configurable analogue interfaces for easy and cost-effective integration into existing environments.

Avoid damage:
Never bend the sensor cable, otherwise the internal air tube for atmospheric pressure compensation of the height sensor may be damaged.

ATTENTION

Note: When installing, ensure that there is sufficient space above and below the unit for cable routing and operation.
We recommend at least 100 mm.

2.1. Technical data

2.1.1. General specifications

Dimensions	30x93,4mm
Weight	150g
Protection class	IP68
Material	Stainless steel
Power consumption	1 W (without analogue outputs)
Supply voltage	9…35 V (24V)
Screw connection	G 3/8"
Tightening torque	31…39 Nm
Elec. Connection	M12-8 A-Coding
Partikelgröße	250 μm
Oil pressure	50 bar
Ambient temperature	-40…105 °C
Medientemperatur	-40…125 °C
Analogue outputs	2x 4…20mA ±1 %FS
Digital output	ModbusRTU
CE conformity	EN 61000-6-1/2/3/4

The unit is suitable for use with the following liquids:

- mineral oils
- Synthetic oils
- Other permissible liquids on request

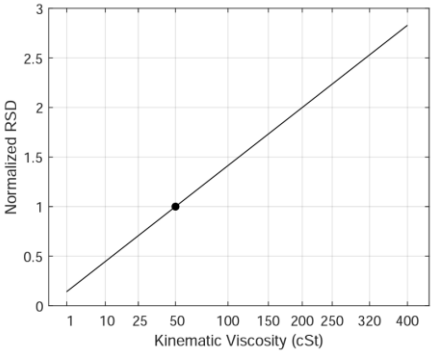
2.1.2. Measurement specifications

Specifications at 24°C ambient temperature in reference fluid. Cannon Instruments N140 viscosity standard at 40°C unless otherwise stated..

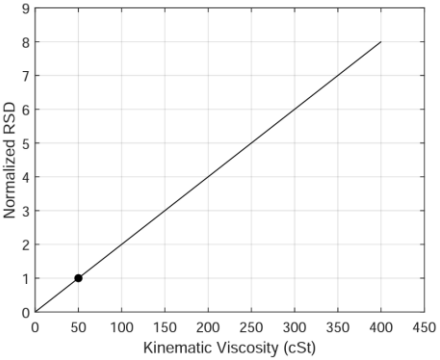
Resonator frequency	20…25 kHz
Kinematic viscosity	1…400 cSt (=mm²/s)
Density	0,5…1,5 g/m³
Temperature	-40…125°C
Sampling rate	1/s

Measuring accuracy according to ISO 5725-1 for Newtonian fluids:

Viscosity v ≤ 200cSt v >200cSt	±0.1cSt ± 1 ± 5%
Density	
Temperature	±0.1 °C



Normalised relative standard deviation (RSD) of viscosity as a function of viscosity.



Normalised relative standard deviation (RSD) of density as a function of viscosity

Activated fuse:
A blown fuse must not be repaired by the customer, as these are special specimens for ATEX-approved units.

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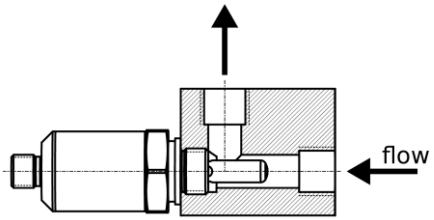
2.2. Mounting instructions

The sensing element of the LUB-VDT is a quartz crystal tuning fork resonator. To protect this resonator from mechanical shocks, the LUB-VDT has a permanent protective cap. Liquid can enter this cap through an opening at the tip and exit through openings at the sides. It is recommended to mount the sensor in a T-piece (inlet opposite the sensor and outlet on the side) or similar arrangement. For sealing, we recommend a bonded sealing washer; the required torque for these washers is usually in the range of 31-39Nm



The sensor element of the LUB-VDT is practically insensitive to installation position, flow direction or pressure. Despite this, we recommend paying attention to a few details for optimum performance:

Note: Air bubbles change the mechanical properties of a liquid and thus influence the measurement. Ensure that no air bubbles can be trapped at the sensor and potential bubbles are carried away from the sensor by flow or uplift. Avoid feeding oil with air pockets to the sensor and note that dissolved gases in the oil can form bubbles when the pressure is reduced.

Note: If the sensor is placed in a reservoir or sump, the flow rate may be very low. This can lead to an extremely slow response of the sensor as well as measurement-affecting residues or even clogging of the sensor.

Note: Although the sensing element itself is virtually insensitive to pressure, the viscosity of the oil is a function of pressure. The effects of pressure variations on measurements are generally more noticeable at higher pressures.

Note: Consider the heat transfer from the liquid to the sensor housing when working at high liquid temperature.

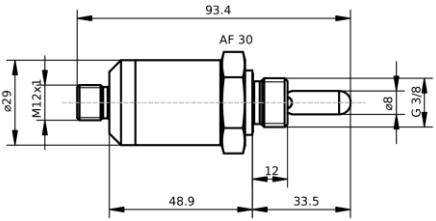
If cleaning of the sensor is necessary, use suitable solvents (e.g. benzine or alcohol).

Do not use compressed air, as this can permanently damage the resonator due to the high flow velocity.

ATTENTION

Do not puncture the protective cap with any objects (e.g. needles or wires).

ATTENTION



2.3. Pin assignment

Power supply and signals share an M12-8 connector with A-coding according to DIN EN 61076-2-101. Install only with shielded cables.

The internal 120Ω resistor for RS485 bus termination is activated by connecting pin 3 to the RS485 A line (pin 4). To deactivate the termination, either connect pin 3 to the RS485 B line (pin 5) or leave it unconnected. Any connection should be made as close as possible to the sensor.

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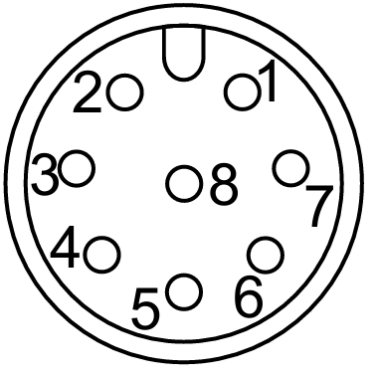

PIN	Signal	Anmerkung
1	OUT 1	4-20mA output
2	CFG reset	Connect to Ground
3	Terminator	Connect to pin 4 for termination
4	RS485 A	Modbus RTU
5	RS485 B	Modbus RTU
6	OUT 2	4-20mA output
7	+24V	Supply
8	0V	Ground

3. data filter

The raw data rate of the sensor is approximately one measurement per second. To provide reliable, low-noise results in applications with lower data rate requirements, the FluidIX LUB-VDT provides a moving average filter for all measured parameters. The length of the filter is configurable via a Modbus register from 1 to 256 seconds, with the default set to 60s. Incorrect measurements (such as out-of-range) are also stored in the filter, but discarded when averaging. Therefore, the output of the filter provides valid results as long as valid data is present in the filter.

4. Modbus Interface

Modbus RTU via RS-485 can be used to retrieve measurement results and status information as well as to configure filter settings, analogue outputs and the Modbus interface itself. All data is organised in 16-bit registers with signed or unsigned integer values. If necessary, two registers are combined (MSB first) to represent a 32-bit integer.

The supported Modbus functions are:

- 3: read holding registers
- 6: write single holding register
- 16: write multiple holding registers

4.1. Default Configuration

The default configuration is 19200 baud and device address 1. A timeout value of at least 2s should be used when communicating with the device. Please note that all changes to the configuration (with the exception of the Modbus interface) are accepted immediately, but are not permanently saved until a 1 (0x0001) is written to the command register. In the event of a misconfiguration, the sensor can be reset to the factory settings using the following procedure:

- Make sure that the sensor is properly supplied with power.
- Connect pin 2 to the supply voltage (nominal +24VDC, pin 7) for at least 10 seconds.
- Disconnect the sensor from the power supply.
- Connect pin 2 to ground and switch the sensor on again.
- After the restart, the configuration (especially the baud rate and the unit address) is reset to the factory settings.

4.2. Register Map

General Purpose	This is an unused register that can be used freely. The content of this register can be changed when it is reset.
HW Revision ID	Hardware version of the sensor
Serial Number	Serial number of the sensor
Firmware Date	UNIX timestamp for the sensor firmware

Error Count	Counter for measurement error incl. out-of-range: Value is zero at switch-on
Measurement Results	Each measurement is assigned a sequential number that is reset to 0 at power-up and can be read from the Modbus registers. The measurement results are scaled and encoded in signed / unsigned 16-bit integers. Invalid results are indicated by a value of 0xFFFF.
Status Code	This register is used to report measurement and error/warning conditions. Each bit that is set to 1 indicates a specific condition
LOCK Register	Registers of the Config Data Block are prevented from accidental write access by the LOCK register. To enable write mode for the Config Data Block (including the Command register) write 44252 (0xACDC) to the LOCK register. After the configuration is finished set the LOCK register 0 to prevent accidental damage to the configuration.
Command Register	To permanently save changes write 1 (0x0001) to the Command register. Please note that this operation may take about 1 s. When writing 255 (0x00FF) to the Command register the device is restarted.
Baud Rate	Baud rate of the Modbus interface. Accepted values are 9600, 19200, and 115200 baud. Default value: 19200 baud. Changes are activated after a restart.
Address	Device address of the sensor. Default value: 1. Changes are activated after a restart.
Filter Length	Length of the moving average data filter in the range of 1 to 256. Default value: 60.
OUTx_select	Selection of parameter that is mapped to analog output x, where x is 1 or 2.
OUTx_min	Value that is mapped to 4mA output current. This value must be scaled and encoded in the same way as the selected measurement parameter (see section 5.2). If the measurement result is lower than this limit, the output remains at 4mA as long as the result is valid (saturation).
OUTx_max	Value that is mapped to 20mA output current. This value must be scaled and encoded in the same way as the selected measurement parameter (see section 5.2). If the measurement result is higher than this limit, the output remains at 20mA as long as the result is valid (saturation).

Note: By default, analogue output 1 is configured for temperature (-40 .. 125◦C) and analogue output 2 for viscosity (0 .. 400cSt). An invalid measurement result is represented by an output current of 1mA.

4.3. Overview Status Codes

Bit	Description	Causes
0	No resonance detected	Resonance search is still in progress, liquid outside measuring range, sensor damaged or dirty
1	Out of range	At least one parameter is out of range
2	Frequency Controller error	Viscosity or density out of range
3	Noise error	Electromagnetic interference; Very high flow velocity.
4	Invalid configuration	Missing or incorrect configuration
5	Resonator error	Resonator damaged
6	Temperature sensor error	Temperature sensor damaged
7	Hardware error	Sensor electronics damaged
8-15	reserved	

4.4. Modbus Register

Address DEC	Address HEX	Description	Unit	size words	datatype	r/w
0	0x0000	General Purpose		1	uint16	rw
1	0x0001	HW Revision ID		1	uint16	r
2	0x0002	Serial Number		2	uint32	r
4	0x0004	Firmware Date		2	ulnt32	r
6	0x0006	reserved		1		
7	0x0007	reserved		1		
8	0x0008	Error Count		2	ulnt32	r
Measurement Results						
16	0x0010	Measurement #		2	ulnt32	r
18	0x0012	Viscosity	0.01 cSt	1	ulnt16	r
19	0x0013	Density	0.1 g/l	1	ulnt16	r
20	0x0014	reserved		1		
21	0x0015	reserved		1		
22	0x0016	Temperature	0.01 °C	1	slnt16	r
23	0x0017	Status Code		1	ulnt16	r
Config Data Block						
32	0x0020	LOCK Register		1	ulnt16	rw
33	0x0021	Command		1	ulnt16	r(w)
34	0x0022	Baud Rate		2	ulnt32	r(w)
36	0x0024	Address		1	ulnt16	r(w)
37	0x0025	reserved		1		
38	0x0026	Filter Length		1	ulnt16	r(w)
39	0x0027	reserved		1		
40	0x0028	OUT1_select		1	ulnt16	r(w)
41	0x0029	OUT1_min		1	u/slnt16	r(w)
42	0x002A	OUT1_max		1	u/slnt16	r(w)
43	0x002B	reserved		1		
44	0x002C	OUT2_select		1	uint16	r(w)
45	0x002D	OUT2_min		1	u/slnt16	r(w)
46	0x002E	OUT2_max		1	u/slnt16	r(w)
47	0x002F	reserved		1		