

Translation of the original operating instructions

EN

FO 510

| HUMIDITY |



The completeness and accuracy of this documentation have been carefully checked. We reserve the right to make technical changes at any time. These changes may result in deviations from the information provided in this documentation.

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1 General information

For the sake of simplicity, this documentation refers to the product "FO 510" simply as the **product**.

1.1 Documentation

This documentation provides important warnings, safety precautions, and instructions for the safe and proper operation of the product.

- ▷ Before operating the product, read this documentation carefully and ensure that you fully understand its contents.
- ▷ Always keep this documentation readily available for reference purposes.

1.2 Symbols and labels used

The following markings and symbols are used in this documentation:







Labeling/symbol	Usage
Text	Important text passages are highlighted
 2 Security	Cross-reference to text passage, figure or chapter
•	Enumeration, list element
▷	Call to action as part of an instruction. Can also be numbered.
✓	Final or intermediate result of an instruction
✗	Final or intermediate result of an instruction that has not been achieved
! (in circle)	Note on an intermediate result

Table 1: Symbols and labels used

1.3 Safety instructions and notes

	DANGER Indicates an imminent danger. Death or very serious injuries may result.
	WARNING Indicates a potentially dangerous situation. Death or serious injury may result.
	CAUTION Indicates a potentially dangerous situation. Slight or minor injuries may result.
	NOTICE Indicates a potentially dangerous situation. Material or environmental damage may result.
	NOTE Indicates important information, application tips, and useful information for proper working.



2 Security

The product has been designed, manufactured, and functionally tested in accordance with applicable safety regulations.

To ensure operational safety, please observe the following:

- Chapter "Intended use"
- Chapter "Organizational measures to be taken by the operator"
- Chapter "Residual hazards"

Regardless of the instructions provided in this manual, all applicable country-specific occupational health and safety regulations must be observed.

2.1 Intended use

The operational safety of the product supplied is only guaranteed if it is used as intended.

This product enables the measurement of moisture content in industrial oils.

The product is considered to be used as intended, in particular, if

- the product is correctly connected,
- the product is protected from direct sunlight and harmful environmental and moisture influences,
- the measured medium is clean and free of contaminants,
- the technical specifications and permissible environmental conditions are observed,
- calibration and maintenance are performed regularly by qualified personnel.

Use outside these conditions, particularly if the permissible temperature is exceeded or if contaminants or hazardous substances are introduced, is considered improper and may result in malfunctions or irreversible damage.

Any use beyond or deviating from this is considered improper use. The manufacturer accepts no liability for any resulting damage.

Intended use also includes:

- Adherence to the supplied documentation
- Compliance with all inspection and maintenance requirements specified by the manufacturer

Reasonably foreseeable misuse or improper handling are:

- Overheating of the product
- Contact with unsuitable media, e.g., aggressive, corrosive, or contaminated media
- Use as a climbing aid
- Operation outside the technical specifications
- Tampering with the product in any way that does not comply with the intended and described procedures
- Continuous outdoor operation in wet conditions or direct exposure to the weather
- Use in potentially explosive atmospheres

2.2 Organizational measures of the operator

The product may only be used if it is in perfect technical condition. It may no longer be used if it has been technically modified or damaged.

Instructions

The information on commissioning, operation, and maintenance provided in these instructions must be followed. These instructions should always be kept accessible with the product.

Personnel

People working on the product must read these instructions, particularly the chapter entitled " 2 Security", before starting work. This also applies to people who only work occasionally.

2.3 Residual risks



DANGER

Risk of injury due to insufficiently qualified personnel

Improper handling of the product can lead to serious personal injury and damage to property. All work described in these instructions may only be carried out by qualified specialists.

Qualified personnel are persons with appropriate training and in-depth knowledge of measurement, control, regulation and compressed air technology. They must also be familiar with the applicable national regulations, standards and directives and be able to assess risks independently.



DANGER

Injury or death from touching live parts

When carrying out installation and maintenance work, you may encounter parts that carry dangerous voltages during operation. Touching live parts can lead to death.

- ▷ Work on electrical systems or equipment may only be carried out by qualified electricians or by instructed persons under the direction and supervision of a qualified electrician in accordance with electrotechnical regulations.



DANGER

Hazard due to media flow in the system

Contact with the medium and unsecured system components can result in serious injury or death.

- ▷ Perform installation and maintenance work only when the system is de-energized and depressurized.
- ▷ Use only suitable and pressure-resistant installation materials as well as suitable and undamaged tools.
- ▷ Inspect all system components and tighten all screw connections.
- ▷ Open valves and shut-off devices in a controlled manner to prevent sudden changes in pressure or flow.
- ▷ Pipe or secure lines properly.
- ▷ Ensure that persons and objects do not come into contact with the medium.
- ▷ Avoid transmitting vibrations, oscillations and shocks to the product.
- ▷ Perform a leak test on the system before commissioning.



WARNING

Danger during operation outside the specified limit values

Exceeding or falling below the permissible operating, storage or transportation limits can endanger people and property. There is a risk of malfunctions and operating faults as well as falsified measurement results.

- ▷ Only operate the product within the limit values specified on the rating plate and in the technical data.
- ▷ Observe the permissible storage and transportation conditions.



WARNING

Risk of injury due to unauthorized modifications

Unauthorized device modifications can cause injuries and lead to the loss of the operating permit. Operation is only permitted with original components.

- ▷ Unauthorized modifications are not permitted and lead to the exclusion of any warranty and liability by the manufacturer (CS INSTRUMENTS).



CAUTION

Danger due to malfunction of the product

Incorrect installation or inadequate maintenance can lead to malfunctions that impair the function of the product and can lead to dangerous misinterpretations.

- ▷ Observe all applicable national regulations and safety regulations during installation and operation.



NOTICE

Measurement errors caused by contaminants in the measurement medium

Contaminants can lead to malfunctions or disruptions.

- ▷ The plant operator must ensure that the measuring medium meets the required purity standards and that appropriate cleaning and maintenance intervals are observed.
- ▷ The manufacturer (CS INSTRUMENTS) accepts no warranty or liability for incorrect use.

3 FO 510

3.1 Product overview

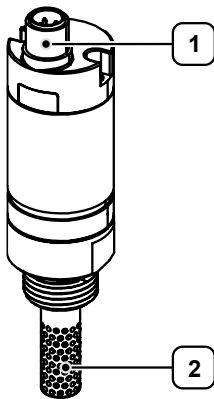


Figure 1: FO 510 (Example)

- | | |
|-----------------|-------------|
| 1 M12 connector | 2 Probe tip |
|-----------------|-------------|

3.2 Product description

This product is a measuring device designed to determine the relative humidity and temperature in industrial oils. It is used for the continuous monitoring of humidity levels in industrial applications.

The product measures humidity based on water activity (a_w) or relative humidity (% rH). Water activity is measured in the range of 0...1 a_w , where 0 a_w corresponds to an anhydrous oil and 1 a_w to an oil completely saturated with water. Relative humidity is measured in the range of 0...100 % RH, where 0 % RH corresponds to an anhydrous oil and 100 % RH to an oil completely saturated with water.

High values of water activity or relative humidity can indicate a risk of free water or phase separation in the system, particularly as temperatures drop. Continuous monitoring of these parameters enables the early detection of critical operating conditions caused by moisture or free water.

3.3 Type plate

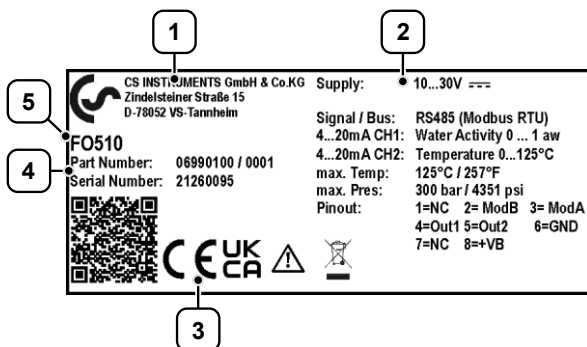


Figure 2: Type plate (example)

- | | |
|------------------------------------|--------------------------|
| 1 Manufacturer information | 4 Material/serial number |
| 2 Technical specifications | 5 Product name |
| 3 Conformity/certification marking | |

3.4 Scope of delivery

Depending on the version ordered, the package includes the following components:

- FO 510
- M12 connector
- Calibration certificate
- Translation of the original operating instructions



3.5 Applicable documents

This Translation of the original operating instructions contains information on the operation of the product "FO 510". This essentially includes information such as

- Installation and commissioning
- Maintenance and servicing

**NOTE**

Configuration, parameterization, data retrieval, and data transfer are not covered in this documentation.

For further information on this topic, please refer to the "Operating Instructions - service software."

**NOTE**

In addition to the basic registers, the device provides further registers.

Further information on this can be found in the "Operating instructions - Modbus installation".



4 Transportation and storage



NOTE

Improper transportation, storage and commissioning are accident-prone and can cause damage or malfunctions to the delivered product, for which the manufacturer (CS INSTRUMENTS) does not grant any liability or warranty.

4.1 Delivery

Transport damage

- ▷ Check the delivered components for any visible transportation damage.
- ▷ Report any transportation damage to the following parties immediately:
 - the carrier
 - the manufacturer's customer service (CS INSTRUMENTS)
- ▷ Ensure that the product is handled properly during transportation.

Packaging

- ▷ Keep the original packaging for any future transportation or storage.

4.2 Storage

To avoid damage due to environmental influences, the product must be stored properly when not in use.

- ▷ If possible, store the product in its original packaging.
- ▷ Store the product in dry, dust-free rooms.
- ▷ Keep the product away from direct sunlight, heat sources, and corrosive or aggressive chemicals.



5 Installation and commissioning



DANGER

Risk of injury from flying parts, escaping medium or electric current

Death or serious injury due to electric shock or mechanical impact.

- ▷ Only carry out the installation in a depressurized and de-energized state.
- ▷ Avoid improper installation.



CAUTION

Danger from commissioning a damaged product

If a damaged product is installed or put into operation, it may result in functional failures, electrical hazards, or mechanical risks.

- ▷ Before each commissioning, inspect the product, accessories, and all supply lines for visible damage, loose parts, or missing components.
- ▷ Immediately take any defective product out of operation immediately.

5.1 Set up measuring point

Setting up the measuring point

To ensure precise measurement results, the measuring point must be set up correctly.

Prerequisite

- The system is depressurized.
- ▷ Select a suitable installation location for the measuring point.
- ▷ Set up the measuring point correctly.
 - ⓘ Installation is only permitted when the system is depressurized.
- ▷ Check the installation for leaks and a secure fit.

5.2 Assemble product

Install the sensor

Prerequisite

- The system is depressurized.
- ▷ Apply a suitable sealing material compatible with the process medium to the mounting thread.
 - ⓘ Note for NPT versions: The use of a sealing ring is not approved. Instead, use a suitable PTFE sealing tape or a suitable sealant.
- ▷ Screw the sensor (SW 27) into the point of measurement so that it is pressure-tight.
 - ⓘ Position the measuring tip so that sufficient flow of the medium is ensured. A continuous flow of the medium is recommended for a short response time.
- ▷ Tighten the sensor.
 - ⓘ Tightening torque: 25–30 Nm

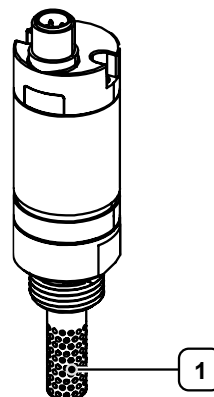


Figure 3: Installing the sensor (example)

1 Measuring tip

5.3 Complete the installation work

Check installation

- ▷ After installation, check the system for leaks and ensure that it is securely fastened.
- ▷ Ensure that the product can be operated as intended.
- ▷ After installation, ensure that the system is clean and free of contaminants.

5.4 Connect product



DANGER

Danger to life due to electrical voltage

During installation, maintenance or in the event of an error, touchable conductive parts can carry dangerous voltages. Contact with uninsulated parts or mains voltage can lead to serious injury or death.

- ▷ Do not operate the product if power supply cables are damaged or housing parts are defective or removed.
- ▷ Strictly observe all locally applicable regulations and safety regulations.
- ▷ Only carry out work on electrical connections when the power supply is switched off. Secure the product against unintentional restarting.
- ▷ Check all electrical connections before commissioning and regularly during operation.



DANGER

Injury or death from touching live parts

When carrying out installation and maintenance work, you may encounter parts that carry dangerous voltages during operation. Touching live parts can lead to death.


- ▷ Work on electrical systems or equipment may only be carried out by qualified electricians or by instructed persons under the direction and supervision of a qualified electrician in accordance with electrotechnical regulations.



NOTICE

Permissible loads and voltages

The permissible loads and voltages must be observed when connecting. Failure to do so may result in damage to the connection or malfunctions.

- ▷ Observe the permissible loads and voltages when connecting.
- ▷ Further information can be found in chapter " 8.1 Technical data".

Connect the product to a power source

- ▷ Connect all necessary electrical connections to the product.
 - ⓘ If no connecting cable was ordered, the sensor is supplied with an M12 connector.
- ▷ Observe the country-specific electrical safety regulations.



Designation	Pin assignment	Wiring diagram
M12 connector (8-pin, A-coded)	Pin 1 (not connected)	
	Pin 2 (Modbus (B))	
	Pin 3 (Modbus (A))	
	Pin 4 (I+ (analogue Output 1)) ¹	
	Pin 5 (I+ (analogue output 2))	
	Pin 6 (VB- (negative power supply))	
	Pin 7 (not connected)	
	Pin 8 (VB+ (positive power supply))	

Table 2: Pin assignment

5.5 Initial commissioning

Putting the product into operation

- ▷ Connect the product to the power supply.

5.6 Switching on and off

Turn on

- ▷ Connect the product to the power supply.

Turn off

- ▷ Disconnect the product from the power supply.
 - ✓ The device will turn off.

¹ Measured value assignment of the 4–20 mA outputs is configurable.

6 Maintenance and servicing



CAUTION

Safety instructions

- ▷ The product may only be serviced by a qualified electrician.
- ▷ Work on the electrical equipment of the product may only be carried out by qualified electricians or by instructed persons under the direction and supervision of a qualified electrician in accordance with the electrotechnical regulations.
- ▷ Spare parts must comply with the technical requirements specified by the manufacturer (CS INSTRUMENTS). This is always guaranteed with original spare parts.



NOTICE

Measurement errors caused by contaminants in the measurement medium

Contaminants can lead to malfunctions or disruptions.

- ▷ The plant operator must ensure that the measuring medium meets the required purity standards and that appropriate cleaning and maintenance intervals are observed.
- ▷ The manufacturer (CS INSTRUMENTS) accepts no warranty or liability for incorrect use.



NOTE

Unless expressly described otherwise, only begin maintenance and servicing work after

- the product has been disconnected from the power supply,
- the product has been switched off and secured against being switched on again.

6.1 Clean product

Cleaning the housing

If the housing becomes dirty, clean it with solvent-free cleaning agents.

- ▷ Use a slightly damp, lint-free cloth to clean the housing regularly.
- ▷ Inspect the product for damage and corrosion.

6.2 Check cables



DANGER

Danger to life due to electrical voltage

During installation, maintenance or in the event of an error, touchable conductive parts can carry dangerous voltages. Contact with uninsulated parts or mains voltage can lead to serious injury or death.

- ▷ Do not operate the product if power supply cables are damaged or housing parts are defective or removed.
- ▷ Strictly observe all locally applicable regulations and safety regulations.
- ▷ Only carry out work on electrical connections when the power supply is switched off. Secure the product against unintentional restarting.
- ▷ Check all electrical connections before commissioning and regularly during operation.

**CAUTION****Danger from commissioning a damaged product**

If a damaged product is installed or put into operation, it may result in functional failures, electrical hazards, or mechanical risks.

- ▷ Before each commissioning, inspect the product, accessories, and all supply lines for visible damage, loose parts, or missing components.
- ▷ Immediately take any defective product out of operation immediately.

Check cables**Prerequisite**

- The product is de-energized and freely accessible.

The electrical cables of the product must be checked regularly by a qualified person.

The user is responsible for determining suitable maintenance intervals.

- ▷ Check the electrical cables for damage.

6.3 Perform calibration

Observe calibration intervals

It is the operator's responsibility to determine appropriate intervals.

**NOTICE****Manufacturer's recommendation**

To prevent potential errors early on, calibration should be performed every 12 months.

- ▷ Perform an initial recalibration of the product no later than 12 months after delivery—regardless of operating conditions.

Increased maintenance or calibration requirements may be necessary, particularly under the following conditions:

- Extreme ambient temperatures (especially low temperatures)
 - Exposure to moisture or condensate outside of the intended use
 - Mechanical stress, e.g., due to impact or overload
 - Interventions for maintenance or repair purposes
- ▷ Follow the guidelines of the quality management system as specified in the QM manual.
 - ⓘ The calibration interval must be determined dynamically, preferably via a procedure established within the quality management system. In the absence of specific guidelines, the interval is determined on a risk-based basis, taking economic factors into account.
 - ⓘ Rare recalibration: increased risk of inaccurate measurement results
 - ⓘ Frequent recalibration: higher operating costs
 - ▷ Always have the product calibrated after exposure to special operating conditions.
 - ▷ Further information can be found in the attached factory calibration certificate.

Have factory calibration performed

- ▷ Send the product to the manufacturer (CS INSTRUMENTS).
 - ⓘ For use in mission-critical systems, a replacement product of the same design should be kept on hand.

**NOTE**

The product can also be calibrated using humidity reference cells.

For more information, please refer to the "Operating Instructions - Humidity Reference Cells."



6.4 Customer service

For rapid processing by customer service

Prerequisite

- Material number (product rating plate)
- Serial number (product rating plate)
- ▷ Describe the problem as precisely as possible.
- ▷ Make a note of any error messages displayed.
- ▷ Inform customer service about:
 - When does the problem occur?
 - How often does it occur?
 - What changes were last made to the product, the configuration, or the environment?



7 Decommissioning and disposal

Decommissioning

Decommissioning is defined as an extended period of non-use of the components. The components must then be protected from external influences.

- ▷ If necessary, disconnect the components from the power supply.
- ▷ Properly package the components if they will not be used for an extended period.
- ▷ Store the components in a manner that prevents exposure to significant temperature fluctuations. Resulting condensation can lead to moisture buildup and cause corrosion.

Disposal

Parts and components that have reached the end of their service life, e.g. due to wear, corrosion and mechanical stress, must be properly disposed of after disassembly, in accordance with national regulations.

The product and packaging contain recyclable materials that must not be disposed of with residual waste.

- ▷ Separate the components after recycling.
 - ⓘ Disposal code according to the European Waste Catalog (EWC) 16 02 14, electrical and electronic devices and their components.
- ▷ Dispose of the components in an environmentally responsible manner, in accordance with local regulations or through a certified disposal company.



NOTE

Information on environmentally responsible disposal can be obtained from local authorities, or certified disposal companies.

- ▷ Alternatively, you can return the product to the manufacturer (CS INSTRUMENTS) at the end of its service life.

8 Appendix

8.1 Technical data

Parameters	Specification	Unit
Weight	~ 0.2	kg
Power supply	24 (10...36 V DC via SELV) Optional: Power over Ethernet according to IEEE 802.3af, Class 2 (3.84...6.49 W)	V DC
Electrical connection	Via connector (M12, 8-pin, A-coding)	
Humidity measuring range	0...1	a _w
Measurement precision for humidity	<ul style="list-style-type: none"> 0...0.9 a_w: ±0.02 at +23 °C 0.9...1.0 a_w: ±0.03 at +23 °C 	a _w
Temperature measuring range	0...+125	°C
Temperature measurement precision	±0.2	°C
Measured variables	<ul style="list-style-type: none"> Relative humidity Absolute humidity Temperature 	
Mounting thread	Depending on the version: <ul style="list-style-type: none"> G ½" NPT ½" 	
Pressure range	0...300	bar
Digital output	RS485 (Modbus RTU), in accordance with EIA/TIA-485 standard	
Analogue output	2 x 4...20 mA active (not galvanically isolated), R _L < 500 Ω	
Application	Indoor and outdoor use	
Pollution degree	2	
Ambient temperature	-20...+70	°C
Storage temperature	-40...+80	°C
Humidity	Max. 90% relative humidity, non-condensing	
Altitude rating	Up to 2000 m above sea level	
Protection class	IP66	

Table 3: Technical specifications | FO 510

Parameters	Specification	Unit
Measuring medium	Technical oils	
Materials in contact with the medium	<ul style="list-style-type: none"> Process connection: Stainless steel 1.4404 Sensor protection: Stainless steel 1.4301 	
Medium temperature	-20...+125	°C

Table 4: Technical data | Measuring medium

8.2 Dimensions

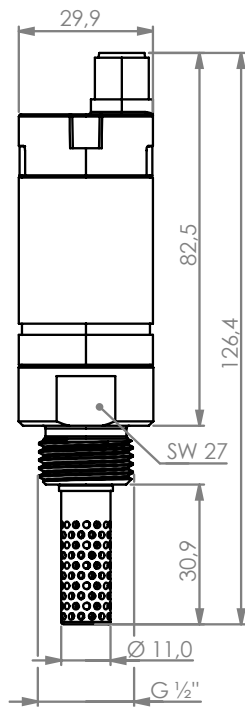


Figure 4: Dimensions

8.3 Register assignment

Index	Address	Number of bytes	Data type	Description	Default	Access	Unit/Note
2001	2000	2	uint16	Modbus ID	1	Read-Write	Modbus ID 1...247
2002	2001	2	uint16	baud rate	4	Read-Write	0 = 1200 1 = 2400 2 = 4800 3 = 9600 4 = 19200 5 = 38,400 6 = 115,200
2003	2002	2	uint16	Parity	1	Read-Write	0 = none 1 = even 2 = odd
2004	2003	2	uint16	Number of stop bits		Read-Write	0 = 1 stop bit 1 = 2 stop bits
2005	2004	2	uint16	Word Order	0xABCD	Read-Write	0xABCD = Big Endian 0xCDAB = Middle Endian
2006	2005	2	uint16	Modbus Enabled	1	Read-Write	0 = Modbus disabled 1 = Modbus enabled

Table 5: Value Register | Modbus

Index	Address	Number of bytes	Data type	Description	Default	Access	Unit/Note
2007	2006	4	uint32	Output Value	4	Read-Write	0 = 4–20 mA disabled



Index	Address	Number of bytes	Data type	Description	Default	Access	Unit/Note
							1 = Temperature [°C] 2 = Temperature [°F]
2009	2008	4	float	4 mA Scale Low	-80	Read-Write	
2011	2010	4	float	20 mA Scale High	20	Read-Write	

Table 6: Value Register | Analogue Output Scaling

Index	Address	Number of bytes	Data type	Description	Access	Unit
1001	1000	4	float	Temperature	Read-Only	[°C]
1003	1002	4	float	Temperature	Read-Only	[°F]
1005	1004	4	float	Water Activity aw	Read-Only	
1007	1006	4	float	xs PPM	Read-Only	
1009	1008	4	float	xs PPM static temperature	Read-Only	
1011	1010	4	float	Relative Humidity	Read-Only	

Table 7: Value Register



8.4 Declaration of conformity



KONFORMITÄTSERKLÄRUNG

DECLARATION OF CONFORMITY

Wir CS INSTRUMENTS GmbH & Co.KG
We Zindelsteiner Straße 15, 78052 VS-Tannheim

Erklären in alleiniger Verantwortung, dass das Produkt
Declare under our sole responsibility that the product

Industrieller Ölfeuchte Sensor FO 510
Industrial oil moisture sensor FO 510

den Anforderungen folgender Richtlinien entsprechen:
We hereby declare that above mentioned components comply with requirements of the following EU directives:

Elektromagnetische Verträglichkeit Electromagnetic compatibility	2014/30/EU
RoHS (Restriction of certain Hazardous Substances)	2011/65/EU & (EU) 2015/863

Angewandte harmonisierte Normen:


Harmonised standards applied:

EMV-Anforderungen EMC requirements	EN 55011:2016 + A1:2017 +A11:2020 EN 61326-1: 2013 EN 61000-3-2:2014 EN 61000-3-3:2013
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Das Produkt ist mit dem abgebildeten Zeichen gekennzeichnet.
The product is labelled with the indicated mark.



Villingen-Schwenningen, den 03.06.2026


Wolfgang Blessing Geschäftsführer



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