CS INSTRUMENTS GmbH & Co. KG

EN

Operating Instructions

Dew point sensor

FA 510

with 3-wire technology 4…20 mA
and RS 485 Modbus output

I. Foreword

Read these operating instructions carefully and completely before installation, commissioning and maintenance work. Follow the instructions to ensure safe operation and proper functioning.
The operating instructions must always be available at the place of use. It is not permitted to make only individual pages available.

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Impressum
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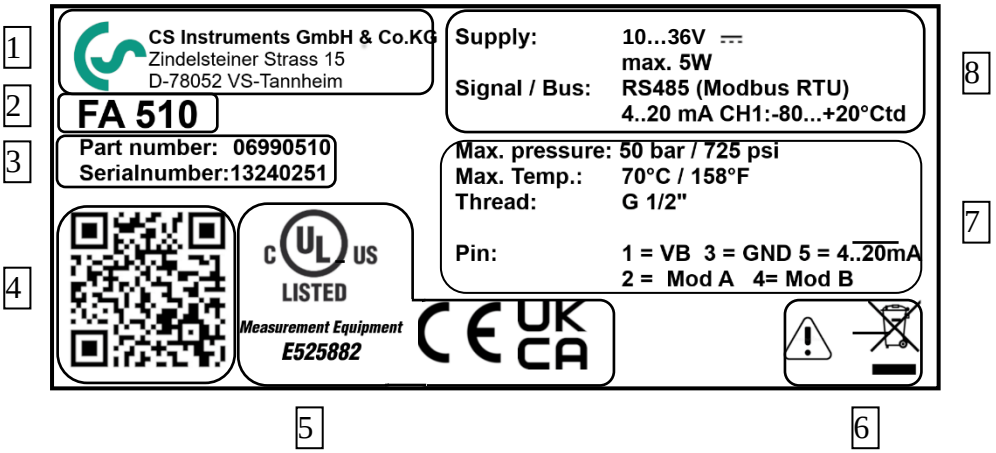
1 Scope of delivery

- Dew point sensor FA510
- Optional measuring chamber
- M12 connector socket, 5-pin, A-coded
- Calibration certificate
- These operating instructions

2 Type plate



1 – Manufacturer info

2 – Sensor name

3 – Part number, serial number, production date

4 – 2D QR code

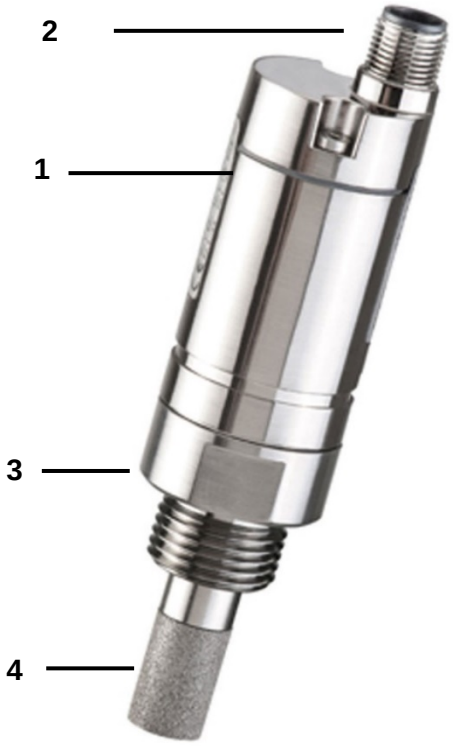
5 – Conformity/certification marking

6 – Warning notice "Operating instructions must be observed".

7 – Pin Assignment, Connection thread etc.

8 – Electrical connection data: e.g. available inputs and outputs, supply voltage

3 Device overview



1. Sensor case
2. M12 Input/Output Connector
3. glass feed-through with G1/2‘ or NPT ½’ screw-in thread
4. humidity sensor element protected by sintered cap-

4 Pictograms and Symbols

4.1 Warning Symbols

General Warning symbol (Danger, Warning, Caution)

General note

Installation- and Instruction manual to consider (on Nameplate)

Installation- and Instruction manual to consider

4.2 Electrical symbols

Symbol	Meaning
	DC Current
	AC Currrent
	DC- abd AC Cusrrent
	Earth connection An earthed terminal that is earthed from the user's point of view via an earthing system..
	Potential equalization connection (PE: Protective earth) Earthing terminals that must be earthed before other connections can be made.

5 Signalwords according ISO 3864 and ANSI Z 535

Danger!	Imminent danger As a consequence of incorrect handling: serious personal injury or death
Warning!	Possible harzard As a consequence of incorrect handling: possible serious injury or death
Caution!	Imminent hazard As a consequence of incorrect handling: possible personal injury or damage
Note!	Possible harzard As a consequence of incorrect handling: possible personal injury or damage
Important!	Additional notes, information, tips As a consequence of incorrect handling: Disadvantages in operation and maintenance, no danger

6 Intended use

Dew point sensor FA 515 is a measuring probe used to measure the dew point of gaseous fluids (compressed air, nitrogen) in pipes under pressure. The dew point sensor is also used for long-term stable dew point monitoring of corresponding compressed air preparation systems.

The permissible operating pressure for **FA 510** does not exceed **50 bar/725 psig.**. The dew point sensors are designed either for dew point measuring ranges -20...+50 °Ctd/-4...122 °Ftd or -80...+20 °Ctd/-112...68 °Ftd.

Operation is only permitted under the following circumstances:

- The use of the sensor is permitted both indoors and in humid environments.
- In case of installation in pipes, directly after a refrigeration dryer or adsorption dryer or membrane dryer.
- In pipes with non-corrosive, gaseous fluids (compressed air, nitrogen) with clean, dry and oil-free properties.
- According to the technical data and approved ambient conditions.
- With correct calibration

.

7 Use contrary to the intended purpose

Faulty measurement results in the case of impermissible ambient and operating conditions. No condensation is allowed on the sensor element. Condensation or water drops on the sensor element lead to faulty measurement results. Stagnant air leads to long measurement times. Before installation, let compressed air blow off briefly to remove condensate and particles inside the pipe and to prevent contamination of the dew point sensor.

Recommendation: To maintain a reliable pressure dew point temperature, a sample gas temperature of 50 °C/122 °F should not be exceeded. Use a cooling section if necessary.

Misuse when used as a climbing aid! The dew point sensor can be damaged. Danger of slipping. Select the installation location so that the dew point sensor cannot be used as a climbing aid. Never use the dew point sensor as a step or climbing aid.

.

8 Safety provisions

8.1 General safety instructions

Important notes for installation and maintenance personnel

The dew point sensor may only be installed by trained specialists with knowledge and experience in compressed air and electrical engineering.

Electrical connection, commissioning and maintenance are only to be carried out by qualified electricians in accordance with the electrotechnical regulations (DIN EN 50110-1, DIN EN 60204-1 and so on). Prerequisite for the specialist personnel: Technical training and knowledge of technical standards, EU directives and EU regulations.

The applicable national accident prevention regulations and ordinances and general occupational health and safety measures must be observed, including the wearing of suitable and prescribed personal protective equipment (PPE).

Only the manufacturer is permitted to perform repairs and adjustments. Installation and maintenance by trained specialist personnel.

Obligations of the installer and system operator

The dew point sensor must be checked and maintained regularly by a trained and qualified individual

Cleaning and maintenance intervals are to be determined by the system operator in accordance with DIN-ISO certification – frequency depending on ambient conditions and anticipated considerations.

Calibration: As part of the DIN ISO certification, have the dew point sensor calibrated at regular intervals, but at the latest after **two years** (or annually if required by factory regulations). Remove the dew point sensor for calibration and send it to CS Instruments GmbH & Co.KG. Keep an identical replacement sensor ready for use in systems that are essential for operation.

NOTE

▶ Without the consultation and approval of CS Instruments GmbH & Co.KG, the warranty claim is void in case of conversion work which is not listed in these operating instructions. This symbol is located at points in the operating instructions where special attention must be paid to ensure that the guidelines, regulations, instructions and the correct procedure for the work are observed and that damage and destruction are prevented.

Obligations of the installer of the system: The installer of the system is responsible for the safety of the system in which the FA 510 is installed. Pay particular attention to the technical data and ambient conditions (chapter 7) and the information on the electrical connection and prescribed connection cables (chapter 9).

Only use the dew point sensor FA 510 as intended.

Risk of injury and accidents when operating outside the permissible ambient/operating conditions or operating temperatures due to overpressure or faulty installation. Comply with maximum permissible operating pressure. Ensure that the dew point sensor is only operated within the permissible limit values (→ type plate).

Risk of injury due to unauthorized unit modifications, incorrect installation or damaged components. The operating licence expires in these cases. **Operation is only permitted with original components.** Only operate the dew point sensor when it is completely assembled. Do not operate a damaged sensor, and prevent further use of the sensor until it is repaired. The sensor must be checked and maintained regularly by trained and qualified individuals. Device modifications are not permitted and release the manufacturer from any warranty and liability.

Dirt particles in the compressed air will cause measurement errors. Dirt particles and liquids can contaminate the sensor element and lead to malfunction or failure. The system operator must ensure the prescribed purity of the fluids approved for the application as well as appropriate cleaning and maintenance intervals. The manufacturer provides no warranty and accepts no liability of any kind with regard to misuse.

Explosion hazard in potentially Ex-protective zones due to ignition of explosives when sparks are generated. The dew point sensor does not have Ex approval! Do not use the dew point sensor in Ex-protective zones.

Ensure clean compressed air without harmful components. Harmful components include explosive or chemically unstable gases and vapours, acid or base-forming substances such as ammonia, chlorine or hydrogen sulphide and condensates or oils and oil vapours.

Danger of burns from hot sensor. Hot air/gas/gas mixtures in the pipe can warm up or heat the dew point sensor. Only touch the sensor when it has cooled down. If applicable, use protective gloves.

Danger to life from escaping compressed air if it is directed at people, especially at high pressure. For assembly, maintenance and calibration work, depressurise the system and check the depressurised state. Alternatively, use a quick coupling for FA 510 with measuring chamber. For **FA 510 without measuring chamber,** install a shut-off valve or ball valve in the compressed air line before and after the dew point sensor so that the dew point sensor can be removed quickly and easily for maintenance and calibration purposes. **Ensure proper installation.**

Danger if the applicable regulations for electrical installations are not observed. For electrical installation, observe the applicable regulations, e.g. DIN EN 50110-1. In Germany observe in particular VDE 0100 in the relevant parts. Observe local regulations. Before working on the electrical installation, switch off all supply circuits, switch off the mains fuse and secure against being switched on again. Ensure voltage-free status. Operate the dew point sensor only with permissible connection cables for the mains supply and bus connection → technical data. Establish the electrical connection according to the wiring diagram (→ chapter 9).

Exercise due care when handling packaging materials. Comply with applicable safety and accident prevention regulations. Keep packaging material out of reach of children (choking hazard if foil or small parts are swallowed).

Seals/sealants: As a suitable sealant for the screw connections, sealing rings made of copper or aluminium, elastomer sealing rings with metal backing, sealing tape/sealing cord or other equivalent sealants that meet the demands of the required, necessary compressed air quality can be used.

8.1 Environmental protection

The dew point sensor as well as the packaging contain recyclable materials that should not be disposed of in the residual waste. At the end of use, dispose of the packaging materials and dew point sensor in an environmentally friendly manner in accordance with the regulations in your country.

The operating materials and auxiliary materials consumed and any parts that are replaced during operation of the dew point sensor must be disposed of in accordance with environmental protection regulations.

Germany: Disposal code according to the Waste Catalogue Ordinance (AVV) **16 02 14**, electrical and electronic devices and their components.

9 Product informationen

9.1 Sensor types

- **FA 510** for pressure ranges up to 50 bar/725 psig and for dew point measuring ranges of -20...+50 °Ctd/-4...122 °Ftd..
  Recommendation: after refrigeration dryers, for example.

- **FA 510** for pressure ranges up to 50 bar/725 psig and for dew point measuring ranges of -80…+20 °Ctd/-112…68 °Ftd.
  Recommendation: after adsorption dryers, for example

9.2 Product features

- Dew point measurement down to -80° Ctd
- High accuracy (± 2 °Ctd/3.6 °Ftd) at different ambient temperatures
- Long-term stable and reliable measurements through internal auto-calibration
- Sensor element is condensation-resistant (stainless steel sintered cap protects against direct contact with dirt particles)
- Very fast response and adjustment time
- Units can be selected as required: °Ctd, °Ftd, % RH, °C, °F, hPa, mbar, bar, psi, g/m³, mg/m³, g/kg, ppm
- 1x analogue output 4...20 mA, adjustable for the pressure dew point, temperature or absolute humidity parameters
- Modbus of RTU interface (RS-485)
- IP 66 housing
- Sensor version **with** measuring chamber for use in quick coupling (simple assembly/disassembly)

9.3 Function

Dew point sensor FA 510 continuously measures the pressure dew point of the gaseous fluid (compressed air, nitrogen) in the pipes (under pressure).

In addition to the pressure dew point, the atmospheric dew point (if the fluid would be expanded to ambient pressure) or the pressure dew point at reduced pressure can also be calculated/measured.

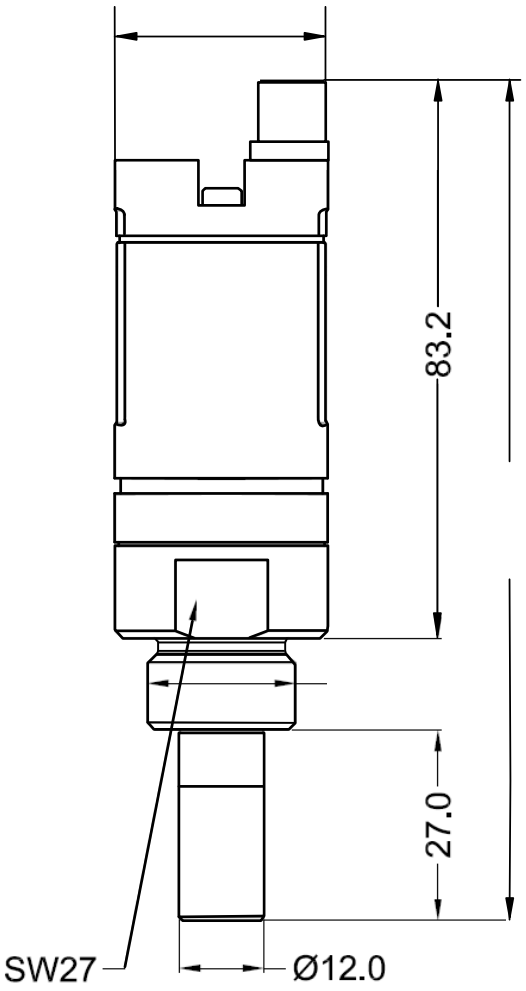
The measured values for pressure dew point and temperature can be transmitted to a PLC via a bus system (RS485) or as an analog output 4..20mA.

10 Technical data and ambient conditions

Parameters	Pressure dew point, temperature (optional pressure)
Sensor principle	Dew point measurement
Measuring range 0699.0510 0699.0512	-80…+20 °Ctd/-112…68 °Ftd -20…+50 °Ctd/-4…122 °Ftd
Accuracy	±1 °C/1.8 °F at +50...-20 °Ctd/122...-4 °Ftd ±2 °C/3.6 °F at -20...-50 °Ctd/-4...-58 °Ftd ±3 °C/5.4 °F at -50...-80 °Ctd/-58...-112 °Ftd
Pressure range/operating pressure (dew point measurement)	FA 510 up to 50 bar/725 psig (Special version up to 350 bar / 5075 psig)
Temperature range	-20...+70 °C / -4…158 °F
Temperature Accuracy	± 1.5°C / 2.7°F (-10…+50 °C / 14...122 °F)
Medium temperature	-20…70 °C / 32…158 °F (ideal 0…50°C / 32…122°F
Ambient temperature	-20...70 °C / -4…158 °F
Storage temperature	-40...80 °C/-40…176 °F
Pollution level	2
Relative humidity (transport, storage, operation)	0% to 90% (non-condensing)
Operating height, storage height	0…4000m (0…13123 ft)
Compressed air requirements min.	ISO 8573-1 (Particle-Moisture-Oil) 5-6-4
Relative humidity of measured medium	< 95% RH, no condensation allowed on the sensor element
Mounting thread (for variants without quick coupling)	G ½" or NPT ½"
Power supply	10 to 36 VDC via SELV supply, 5W). Fuse protection in supply unit T2.5L 125V If used at an altitude above 2000m, the power supply unit must also be approved for this altitude.
Power consumption	Max. 5 W
Signal output	Modbus-RTU (RS-485)** 1 AO 4..20 mA Dew point, temperature, pressure or absolute humidity Optional: IO-Link
Load for analogue output:	< 500 Ohm
Measured values with Modbus-	Pressure dew point (°Ctd, °Ftd) Temperature (°C, °F) Pressure (hPa, mbar, bar, psi,...) Absolute humidity (g/m³, mg/m³)
Electrical connection	1 x M12 flush-type connector, 5-pin (A-coded)
Protection class	IP 66

**** Remark:** Parallel use of analogue 4…20mA and RS 485 Modbus output is possible

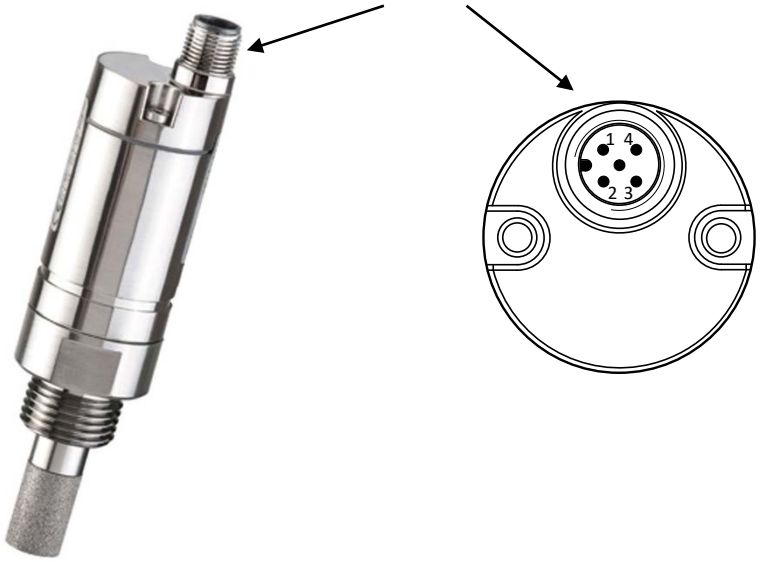
11 Dimensions



12 Electrical connection

Work on the electrical system may only be carried out by qualified electricians or other competent persons. For electrical installation, observe the applicable regulations, e.g. DIN EN 50110-1. In Germany observe in particular VDE 0100 in the relevant parts or other national regulations accordingly.

M12 Connector plug



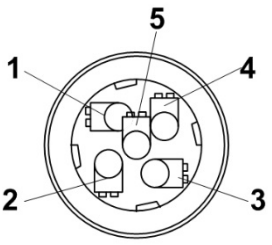
		Pin 1	Pin 2	Pin 3	Pin 4	Pin 5
Standard	**Standard**	+VB	RS485 A	-VB	RS485 B	+I Current output
	IO-Link	+VB	RS485 (A)	-VB	IO-Link	RS485 (B)
	Connection cable 0554.0104 (5 m) 0554.0105 (10 m)	brown	white	blue	black	grey

+VB	Positive supply voltage 24VDC (10...36 VDC) smoothed
RS485 A	Modbus A (+)
-VB	Negative supply voltage
RS485 B	Modbus B (-)
+I	Positive 4...20 mA signal **

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

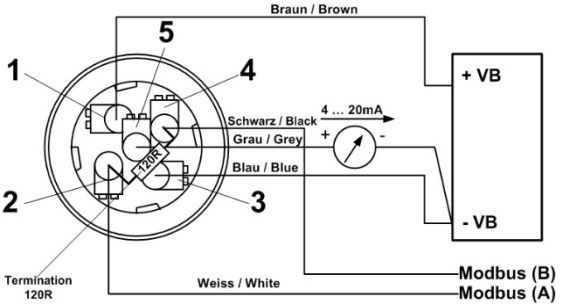
If no connection cable (0553.0104, 0553.0105) is ordered, the sensor will be supplied with a M12 connector plug. The user can connect the supply and signal cables as indicated in the connection diagram.

M12 connector plug



Connector plug

Wiring diagram



Remark: The sensor must be connected in strain less state only

12.1 Interface IO-Link

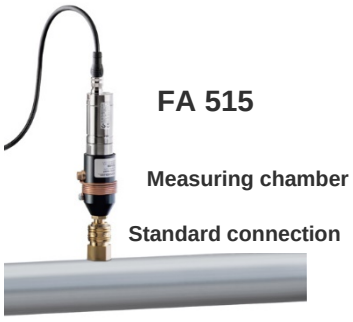
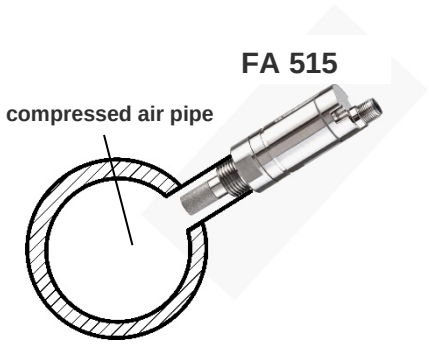
Transmission type:	COM 2 (38.4 kBaud)
IO-Link Revision:	1.1
SDCI standard:	IEC 61131-9 CDV
IO-Link Device ID:	01 d / 01 h
Profiles:	Identification and Diagnosis (0x4000)
SIO mode:	Nein
Required master port class:	A
Analog process data:	7
Process data binary:	--
Min process cycle time:	20,4 ms

13 Installation

- 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“ thread. Appropriate PTFE sealing tape or sealant should be used instead

Please note: CS recommends the indirect installation with measuring chamber

Advantage: Easy mounting and dismounting of the probe without interruption of the line. Quick response time due to quick coupling. Optimum sensor protection.

	**Indirectly in the compressed air system** Connect probe with measuring chamber to the compressed air pipe by means of a quick coupling. In case of compressed air containing oil and dirt particles a pre-filter should be installed in front of the measuring chamber. Compressed air flows continuously (at 7 bar approx. 1 l/min expanded) in the capillary pipe of the measuring chamber. The reaction times for the humidity reading are shorter than in case of a direct mounting.
	**Directly in the compressed air system** Screw in probe with G 1/2" thread pressure-tight in the center or at the top of the compressed air pipe. Take care that measurement is effected close to the compressed air flow. U-bend pipes or non-flowing compressed air, result in very slow reaction times for the moisture reading.
	Measurable gases In general, humidity can be measured in all non-corrosive gases. In case of measurements in corrosive gases please consult CS Instruments GmbH.

14 Modbus

The dew point sensor FA 510 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 with the CS Instruments PC service software.

Modbus communication default values:

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

Supported are following functioncodes:

- Function code 03: Read Holding Register
- Function code 16: Write multiple Register

14.1 Register Mapping der Werte-Register:

Modbus Register	Modbus Adresse	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	Relative Humidity		R	[%]
1007	1006	4	Float	Dew Point		R	[°Ctd]
1009	1008	4	Float	Dew Point		R	[°Ftd]
1011	1010	4	Float	Absolute Humidity		R	[g/m³]
1013	1012	4	Float	Absolute Humidity		R	[mg/m³]
1015	1014	4	Float	Humidity Grade		R	[g/kg]
1017	1016	4	Float	Vapor Ratio (Volume)		R	[ppm]
1019	1018	4	Float	SaturationVapor Pressure		R	[hPa]
1021	1020	4	Float	Partial Vapor Pressure		R	[hPa]
1023	1022	4	Float	Atmospheric DewPoint		R	[°Ctd]
1025	1024	4	Float	Atmospheric DewPoint		R	[°Ftd]
1027	1026	4	Float	Pressure absolut		R	[hPa]
1029	1028	4	Float	Pressure absolut		R	[bar]
1031	1030	4	Float	Pressure absolut		R	[psi]
1033	1032	4	Float	Pressure relative		R	[hPa]
1035	1034	4	Float	Pressure relative		R	[bar]
1037	1036	4	Float	Pressure relative		R	[psi]

Remark for DS400 / DS 500 / Handheld devices - Modbus Sensor Datatyp:

„Data Typ R4-32“ match with „Data Type Float“

14.2 Register of device settings

14.2.1 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

14.2.2 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] 3 = relative Humidity [%] 4 = DewPoint [°C] 5 = DewPoint [°F] 6 = Absolute Humidity [g/m3] 7 = Absolute Humidity [mg/m3] 8 = Humidity Grade [g/kg] 9 = Vapor Ratio [ppm] 10 = SaturationVapor Pressure[hPa] 11 = Partial Vapor Pressure [hPa] 12 = Atmospheric DewPoint [°C] 13 = Atmospheric DewPoint [°F]
2009	2008	4	float	4mA Scale Low	-80	R/W	
2011	2010	4	float	20mA Scale High	20	R/W	

Modbus installation, Modbus settings and further information refer to the manual CS Instruments **"Modbus Installation and Operating Instructions FA 5xx sensors"**

15 Maintenance

15.1 Removal

NOTE
▶ The dew point sensor may only be removed by trained specialist personnel. Observe the safety instructions.

WARNING
Risk of injury from pressurised components in case of overpressure/bursting.
▶ Remove the dew point sensor without quick coupling only in a depressurised state. Check and ensure a depressurised state.

1. Ensure depressurised state in the area of the dew point sensor. Close the ball valves on both sides of the dew point sensor or depressurise the system. Exception: When using a quick coupling.
2. Remove the dew point sensor.

15.2 Maintenance

NOTE
Measurement errors can be caused by dirt particles in the compressed air. A contaminated sensor element may lead to malfunctions or disturbances. The repair of the dew point sensor may only be carried out by the manufacturer.

15.3 Cleaning

1. unscrew the sintered cap
2. do not touch the sensor element
3. clean the sintered cap with isopropanol and blow out with compressed air
4. wash the sensor element with isopropanol (without touching)

5. allow all parts to dry for 4 hours after cleaning
6. carefully reassemble all parts

16 Calibration

From the manufacturer

According to DIN ISO certification of the measuring instruments we recommend regular calibration and, if necessary, adjustment of the instrument by the manufacturer. The calibration cycles should fit your internal scheme.

17 Order details

Order no.	*Description*
0699.0510	FA 510 dew point sensor (-80…20 °Ctd)
0699.0512	FA 510 dew point sensor (-20…50 °Ctd)
0553.0104	Connection cable, length: 5 m
0553.0105	Connection cable, length:10 m
0699.3390	Standard measuring chamber for compressed air up to 16 bar
0699.3590	High-pressure measuring chamber up to 350 bar *
0699.3690	Measuring chamber for atmospheric dew point
0699.3790	Measuring chamber for respiratory air bottles up to 350 bar *
0699.4004	Special scaling, output in g/kg, % RH, mg/m³, ppm (V/V), g/m³
0699.3396	Precision calibration at -40 °Ctd or 3° Ctd incl. ISO certificate
3200.0003	Precision calibration at 0 °Ctd and 10 °Ctd incl. ISO certificate
	CS Service Software for FA/VA sensors incl. PC connection set, USB connection and interface adapter to the sensor

17.1 FA 510 Order code

Beispiel-Bestellcode FA 51x: 0699 0510_B1_C1_D1_E1_F1_G1_I1_Y1

Signal outputs
B1 RS 485 (Modbus RTU), 4...20 mA (3-Wire)
B2 2...10 V, RS 485 (Modbus RTU)
B3 I/O Link, RS 485 (Modbus RTU)

Scaling analogue output
C1 Standard-scaling
C2 Special scaling 4…20 mA = 0…x °Ctd, g/m3, ppm, g/kg…

Sensor protection cap
D1 Stainless steel sintered cap(~50 µm)
D2 perforated stainless steel cap

Connection thread
E1 G1/2“
E2 UNF 5/8“
E3 NPT 1/2“
E4 NPT 3/8“

Maximum pressure
F1 50 bar
F2 350 bar
F3 500 bar
F4 16 bar only with Y2)

Surface condition
G1 Standard version
G2 special cleaning - oil and grease free (e.g. for oxygen applications and so on)
G3 Silicone-free version including special cleaning oil- and grease-free

Connector plug
I1 M12 plug (straight)
I2 M12 plug 90° angled

Pressure measurement
Y1 without pressure sensor
Y2 With integrated pressure sensor 0…16 bar(g), output only via digital interfaces (only with F4, not with E2 and E4)

KONFORMITÄTSERKLÄRUNG

DECLARATION OF CONFORMITY

Wir / We: CS Instruments GmbH & Co.KG
Gewerbehof 14, 24955 Harrislee

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

Feuchtesensoren FA510 / FA515
Dew point sensors FA510 / FA515

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/EUG 2014/30/EC
RoHS (Restriction of certain Hazardous Substances)	2011/65/EC

Angewandte harmonisierte Normen:
Harmonised standards applied:

EMV-Anforderungen EMC requirements	**EN 55011:2016 + A1:2017 + A11:2020 + A2:2021** **EN IEC 61326-1: 2021**

Anbringungssjahr der CE Kennzeichnung: 15
Year of first marking with CE Label: 15

Das Produkt ist mit dem abgebildeten Zeichen gekennzeichnet.
The product is labelled with the indicated mark.

CE

Harrislee, den 14.12.2023

Wolfgang Blessing Geschäftsführer