



Ex II 3G Ex ec IIC T4 Gc

Ex II 3D Ex tc IIIB T125°C Dc



RoHS II
COMPLIANT



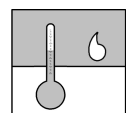
Data sheet

FT90

Humidity and temperature measuring device
PRO-LINE ®

with optional (differential) pressure measurement

09015232 • DB_EN_FT90 • Rev. ST4-B • 08/20



1 Product and functional description

1.1 Performance characteristics

Typical applications

- Humidity and temperature measurement
- Room and cleanroom monitoring
- Air intake/exhaust systems
- Filter monitoring
- Volume flow measurement
- Process monitoring

Main features

- Robust and maintenance-free
- Simple configuration
- Humidity and temperature measurement
 - 0 to 100 %rH
Measurement error of up to 3 %rH
 - -40 to +100 °C
Measurement error of up to 0.4°C
- Optional differential pressure measurement
 - 25 Pa to 25 kPa
 - 1 mbar to 250 mbar
 - Measurement error of up to 0.5%
- Turn down ratio of 4:1
- 4 configurable switch outputs
- Optional analog output signal for each channel
 - Up to 3 analog outputs
 - 0/4 to 20 mA, 0/2 to 10 V, or 1 to 5 V
 - Characteristic curve conversion and adjustment to process
- Multi-line LC display
 - Fully graphic with colour backlighting for the visualisation of the operating modes
 - Multilingual plain text menu
- Digital interfaces
 - USB OTG
 - RS485 Modbus RTU

1.2 Intended use

The FT90 is suitable for the measurement of humidity and temperature in neutral gaseous media. Optionally, the device can be used to measure the pressure, negative pressure, or differential pressure of neutral gaseous media.

Note the specifications in the technical data with regard to media compatibility.

The device may only be used for the purpose stipulated by the manufacturer. The manufacturer will not be liable for damage arising from incorrect or improper use.

1.2.1 Explosion hazard area classification

Devices with the order code **FT90 ## ## ## # 0 # 000 R1 # #** are classified as electrical equipment for use in potentially explosive areas zone 2 (gases and vapours) and/or zone 22 (dusts).

Gas explosion protection

Designation as per Directive 2014/34/EU:

⊕ II 3G Ex ec IIC T4 Gc

Dust explosion protection

Designation as per Directive 2014/34/EU:

⊕ II 3D Ex tc IIIB T125°C Dc

$-20^{\circ}\text{C} \leq T_{\text{amb}} \leq 60^{\circ}\text{C}$

1.3 Function diagram

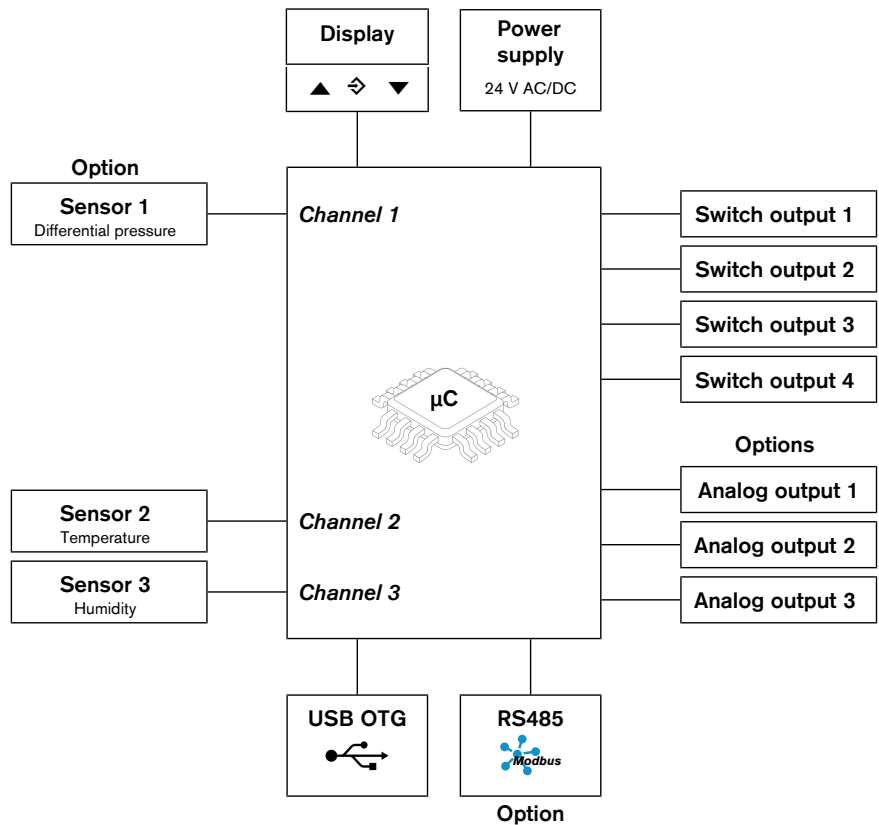


Fig. 1: Function diagram

1.4 Design and mode of operation

Temperature and humidity measurement

The temperature and humidity measurement is based on a sensor chip with a digital I2C bus interface. The analog measurement data is digitally converted and linearised. The transmitted data is evaluated by the integrated electronics and is transformed into a display, analog output, and up to four switch outputs or output via the optional Modbus output.

Pressure measurement

The pressure measurement is based on a piezo-resistive sensor element that is suitable for measuring overpressure, negative pressure, and differential pressure. The pressures to be compared have a direct effect on a silicon membrane equipped with a measuring bridge.

When the pressure is equal, the measuring membrane is in its idle state. If a pressure difference occurs, the membrane is deflected and a resistance change takes place on the attached measuring bridge. This change is evaluated by the electronics integrated into the device and is transformed into a display, analog output, and up to four switch outputs or is output via the optional Modbus output.

2 Device versions

2.1 Process connection

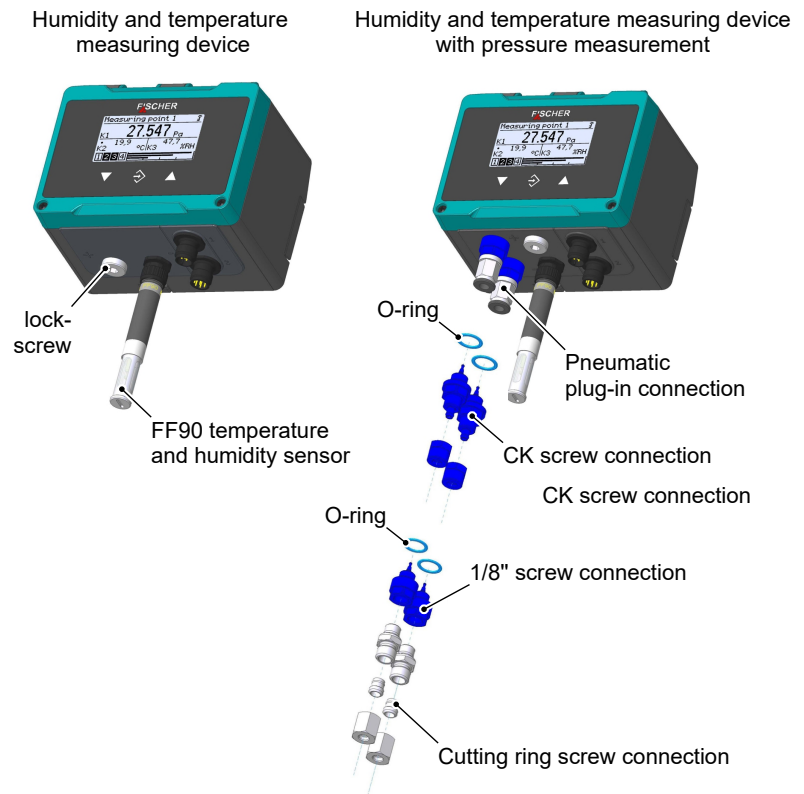


Fig. 2: Process connections

2.2 Electrical connection

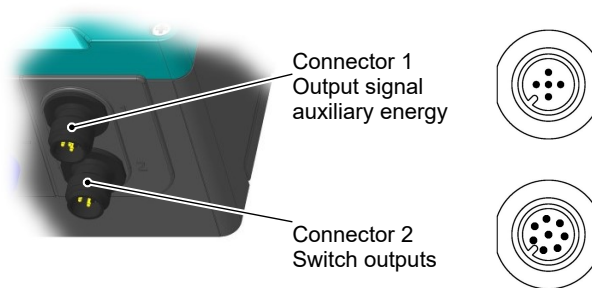


Fig. 3: Electric connections

2.3 ATEX model



Fig. 4: ATEX model

3 Technical data

3.1 General

Type designation	FT90	
Measuring variable	Temperature	
	Humidity	
	Differential pressure	
Measurement principle	Temperature	Band gap
	Humidity	Capacitive
	Print	Piezo-resistive

3.2 Input variables

3.2.1 Temperature and humidity

	Sensor assembly	Temperature measuring range
Possible range	On device	-20 to +70°C
	Offset	-40 to +100°C
		Humidity measuring range
Possible range		0 to +100 %rH

3.2.2 Differential pressure

Asymmetric measuring ranges:

Measuring range		Overload	Bursting pressure	Sensor type
	-20 to +80 Pa	750 mbar	1 bar	A
	0 to 25 Pa	750 mbar	1 bar	A
	0 to 40 Pa	750 mbar	1 bar	A
	0 to 60 Pa	750 mbar	1 bar	A
0 to 1 mbar	0 to 100 Pa	750 mbar	1 bar	A
0 to 1.6 mbar	0 to 160 Pa	750 mbar	1 bar	A
0 to 2.5 mbar	0 to 250 Pa	750 mbar	1 bar	A
0 to 4 mbar	0 to 400 Pa	100 mbar	200 mbar	B
0 to 4 mbar	0 to 400 Pa	750 mbar	1 bar	A *
0 to 6 mbar	0 to 600 Pa	100 mbar	200 mbar	B
0 to 6 mbar	0 to 600 Pa	750 mbar	1 bar	A *
0 to 10 mbar	0 to 1 kPa	100 mbar	200 mbar	B
0 to 10 mbar	0 to 1 kPa	750 mbar	1 bar	A *
0 to 16 mbar	0 to 1.6 kPa	400 mbar	800 mbar	B
0 to 25 mbar	0 to 2.5 kPa	400 mbar	800 mbar	B
0 to 40 mbar	0 to 4 kPa	400 mbar	800 mbar	B
0 to 60 mbar	0 to 6 kPa	1 bar	2 bar	B
0 to 100 mbar	0 to 10 kPa	1 bar	2 bar	B
0 to 160 mbar	0 to 16 kPa	2.5 bar	5 bar	B
0 to 250 mbar	0 to 25 kPa	2.5 bar	5 bar	B

*) Measuring range with increased overload and bursting pressure capability (see 'Order codes/Special aspects')

Symmetric measuring ranges:

Measuring range	Overload	Bursting pressure	Sensor	
-25 to +25 Pa	750 mbar	1 bar	A	
-40 to +40 Pa	750 mbar	1 bar	A	
-60 to +60 Pa	750 mbar	1 bar	A	
-1 to +1 mbar	-100 to +100 Pa	750 mbar	1 bar	A
-1.6 to +1.6 mbar	-160 to +160 Pa	750 mbar	1 bar	A
-2.5 to +2.5 mbar	-250 to +250 Pa	100 mbar	200 mbar	B
-2.5 to +2.5 mbar	-250 to +250 Pa	750 mbar	1 bar	A *
-4 to +4 mbar	-400 to +400 Pa	100 mbar	200 mbar	B
-4 to +4 mbar	-400 to +400 Pa	750 mbar	1 bar	A *
-6 to +6 mbar	-600 to +600 Pa	100 mbar	200 mbar	B
-6 to +6 mbar	-600 to +600 Pa	750 mbar	1 bar	A *
-10 to +10 mbar	-1 to +1 kPa	100 mbar	200 mbar	B
-10 to +10 mbar	-1 to +1 kPa	750 mbar	1 bar	A *
-16 to +16 mbar	-1.6 to +1.6 kPa	400 mbar	800 mbar	B
-25 to +25 mbar	-2.5 to +2.5 kPa	400 mbar	800 mbar	B
-40 to +40 mbar	-4 to +4 kPa	400 mbar	800 mbar	B
-60 to +60 mbar	-6 to +6 kPa	1 bar	2 bar	B
-100 to +100 mbar	-10 to +10 kPa	1 bar	2 bar	B
-160 to +160 mbar	-16 to +16 kPa	2.5 bar	5 bar	B
-250 to +250 mbar	-25 to +25 kPa	2.5 bar	5 bar	B

*) Measuring range with increased overload and bursting pressure capability (see 'Order codes/Special aspects')

3.3 Output sizes**Analog outputs**

The number of analogue outputs depends on the device version.

Device version	Temperature Humidity	Temperature Humidity Differential pres- sure
Number of analog outputs	2	3

The output signal can be set in the configuration. Upon delivery, all of the analog outputs are set to the same signal (see the type plate).

Output signal	0 to 20 mA 4 to 20 mA	0 to 10 V 2 to 10 V 1 to 5 V
Signal range	0.0 to 21.5 mA	0.0 to 10.5 V
Load impedance R_L	$\leq 600 \Omega$	$\geq 2 k\Omega$
Turn down	4:1	4:1

Switch outputs

The assignment of the switch outputs to the channels can be configured freely.

Number of switch outputs	4
Type	Potential-free semiconductor switch (MOS-FET)
Progr. switching function	1-pole open contact (NO) 1-pole break contact (NC)
Max. switching voltage	3 to 32 V AC/DC
Max. switching current	0.25 A
Max. switching output	8 W / 8 VA $R_{ON} \leq 4 \Omega$

3.4 Measuring accuracy

3.4.1 Humidity

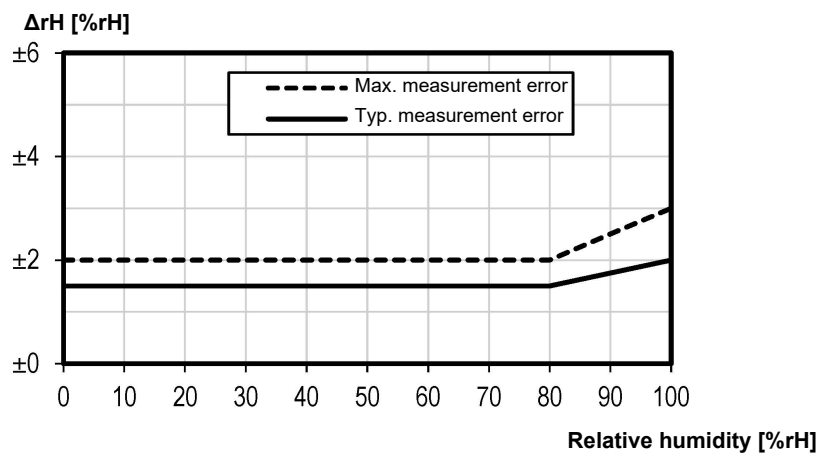


Fig. 5: Relative humidity measurement error in relation to relative humidity

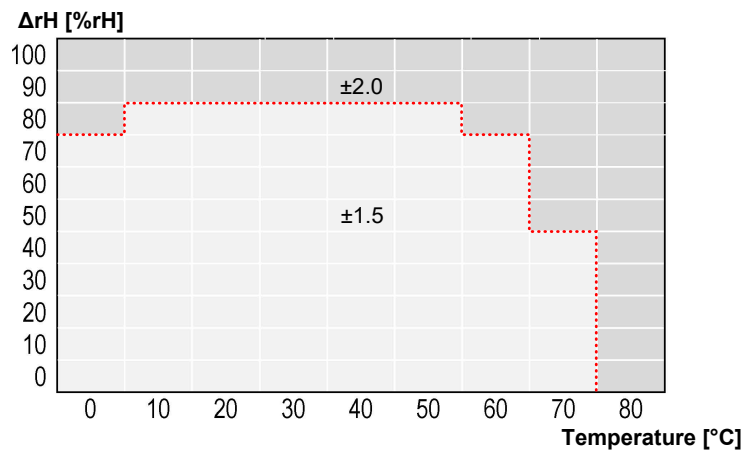


Fig. 6: Relative humidity measurement error in relation to temperature

Typical measurement error	1.5 to 2%rH
Maximum measurement error	2 to 3%rH

If the sensor is operated continuously with a humidity of over 80%rH, the measurement error can exceed the specified maximum value after a certain period of time.

Once the relative humidity drops below 80%rH, the sensor returns to its initial state and the measurement error is again within the specified limits.

3.4.2 Temperature

The limit values apply for plastic and all sensors mounted at an offset.

To ensure that the specified measurement error is upheld for stainless steel sensors mounted directly on the device, an air flow of at least 0.1 m/s must be guaranteed.

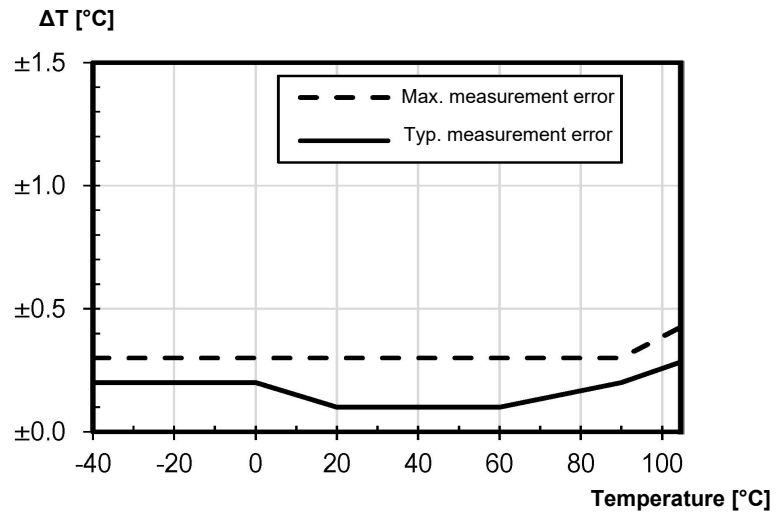


Fig. 7: Temperature measurement error in relation to temperature

Typical measurement error	0.1 to 0.3°C
Maximum measurement error	0.3 to 0.4°C

3.4.3 Differential pressure

- The specifications for the measurement error include linearity and hysteresis.
- All specifications relate to the basic measuring range (see the type plate) and a compensation range of -20 to +70°C.

Sensor type A

Measuring range	Measurement error [%]	Tc-zero [%/10K]		Tc span [%/10K]			
		Typ.	Max.	Typ.	Max.		
-20 to +80 Pa	0.5 / 1.0	0.3	0.6	0.2	0.4		
0 to 25 Pa	1.5 / 2.5	0.5	1.0	0.3	0.6		
0 to 40 Pa	1.0 / 2.0	0.5	1.0	0.2	0.4		
0 to 60 Pa	0.75 / 1.5	0.3	0.6	0.2	0.4		
0 to 1 mbar	0 to 100 Pa	0.5	1.0	0.3	0.6	0.2	0.4
0 to 1.6 mbar	0 to 160 Pa	0.5	1.0	0.3	0.6	0.2	0.4
0 to 2.5 mbar	0 to 250 Pa	0.5	1.0	0.3	0.6	0.2	0.4
0 to 4 mbar	0 to 400 Pa	0.5	1.0	0.15	0.3	0.05	0.1
0 to 6 mbar	0 to 600 Pa	0.5	0.75	0.15	0.25	0.05	0.1
0 to 10 mbar	0 to 1 kPa	0.25	0.5	0.1	0.2	0.05	0.1
-25 to +25 Pa	1.0 / 2.0	0.4	0.8	0.2	0.4		
-40 to +40 Pa	0.75 / 1.5	0.3	0.6	0.2	0.4		
-60 to +60 Pa	0.5 / 1.0	0.3	0.6	0.2	0.4		
-1 to +1 mbar	-100 to +100 Pa	0.5	1.0	0.3	0.6	0.2	0.4
-1.6 to +1.6 mbar	-160 to +160 Pa	0.5	1.0	0.3	0.6	0.2	0.4
-2.5 to +2.5 mbar	-250 to +250 Pa	0.5	1.0	0.15	0.3	0.05	0.1

Measuring range		Measurement error [%]		Tc-zero [%/10K]		Tc span [%/10K]	
		Typ.	Max.	Typ.	Max.	Typ.	Max.
-4 to +4 mbar	-400 to +400 Pa	0.5	1.0	0.1	0.2	0.05	0.1
-6 to +6 mbar	-600 to +600 Pa	0.5	0.75	0.1	0.15	0.05	0.1
-10 to +10 mbar	-1 to +1 kPa	0.25	0.5	0.05	0.1	0.05	0.1

Sensor type B

Measuring range		Measurement error [%]		Tc-zero [%/10K]		Tc span [%/10K]	
		Typ.	Max.	Typ.	Max.	Typ.	Max.
0 to 4 mbar	0 to 400 Pa	0.5	1.0	0.15	0.3	0.05	0.1
0 to 6 mbar	0 to 600 Pa	0.5	0.75	0.15	0.25	0.05	0.1
0 to 10 mbar	0 to 1 kPa	0.25	0.5	0.1	0.2	0.05	0.1
0 to 16 mbar	0 to 1.6 kPa	0.25	0.5	0.15	0.3	0.05	0.1
0 to 25 mbar	0 to 2.5 kPa	0.25	0.5	0.15	0.25	0.05	0.1
0 to 40 mbar	0 to 4 kPa	0.25	0.5	0.1	0.2	0.05	0.1
0 to 60 mbar	0 to 6 kPa	0.25	0.5	0.1	0.2	0.05	0.1
0 to 100 mbar	0 to 10 kPa	0.25	0.5	0.1	0.15	0.05	0.1
0 to 160 mbar	0 to 16 kPa	0.25	0.5	0.05	0.1	0.05	0.1
0 to 250 mbar	0 to 25 kPa	0.25	0.5	0.05	0.1	0.05	0.1
-2.5 to +2.5 mbar	-250 to +250 Pa	0.5	1.0	0.15	0.3	0.05	0.1
-4 to +4 mbar	-400 to +400 Pa	0.5	1.0	0.1	0.2	0.05	0.1
-6 to +6 mbar	-600 to +600 Pa	0.5	0.75	0.1	0.15	0.05	0.1
-10 to +10 mbar	-1 to +1 kPa	0.25	0.5	0.05	0.1	0.05	0.1
-16 to +16 mbar	-1.6 to +1.6 kPa	0.25	0.5	0.1	0.2	0.05	0.1
-25 to +25 mbar	-2.5 to +2.5 kPa	0.25	0.5	0.1	0.15	0.05	0.1
-40 to +40 mbar	-4 to +4 kPa	0.25	0.5	0.05	0.1	0.05	0.1
-60 to +60 mbar	-6 to +6 kPa	0.25	0.5	0.05	0.1	0.05	0.1
-100 to +100 mbar	-10 to +10 kPa	0.25	0.5	0.05	0.1	0.05	0.1
-160 to +160 mbar	-16 to +16 kPa	0.25	0.5	0.05	0.1	0.05	0.1
-250 to +250 mbar	-25 to +25 kPa	0.25	0.5	0.05	0.1	0.05	0.1

3.5 Digital interfaces

USB interface

USB On The Go	2.0
Data rate	12 Mbit/s (Full Speed)
Port	Micro USB type B
Communication	Host/Device mode

Modbus RTU interface

interface	RS 485
Report	Modbus RTU
Modbus specification	Application Protocol Specification V1.1b3 (April 26, 2012)
Address	1 ... 247
Baud rate	2400 ... 115200 Baud
Parity	Even, uneven, parity
Stopbits	1...2

3.6 Auxiliary energy

NOTICE! Only a CE-compliant mains adapter with a slow 200 mA fuse may be used in the power supply circuit for ATEX devices.

Nominal voltage	24 V AC/DC
Admissible operating voltage U_b	19.2 to 28.8 V AC/DC
Power consumption	Typ. 2W (VA) Max. 3W (VA)

3.7 Operating conditions

	Standard	ATEX
Ambient temperature range	-20 to +70 °C	-20 to +60 °C
Medium temperature range	-20 to +70 °C	-20 to +60 °C
Storage temperature range	-20 to +70 °C	-20 to +70 °C
Ingress Protection Code	IP65	IP65
EMC	EN 61326-1:2013 EN 61326-2-3:2013	
ATEX	EN IEC 60079-0:2018 EN 60079-15:2010 EN 60079-31	
RoHS	EN IEC 63000:2018	

CAUTION! Avoid contact between the temperature/humidity sensor and the following chemicals and substances:

- Contaminated air/air that is not oil-free (e.g. jets of air from an air gun)
- Volatile chemicals such as solvents and organic (carbonated) compounds
- Ketene, acetone, ethanol, isopropyl alcohol, toluene and so on are known for causing a drift in the measured humidity value. In most cases, this is not reversible. Please note that these chemicals are integral parts of epoxides, adhesives, glues etc. and can degas during baking/curing.
- Acids and bases such as HCl, H₂SO₄, HNO₃, and NH₃ can affect the sensor irreversibly, and should be avoided. Ozone in high concentrations or H₂O₂ has the same effect and should also be avoided.
- The sensor must not be allowed to come into contact with cleaning agents (e.g. alcohol and detergents). The application of cleaning agents to the sensor can cause the measured value to drift or the sensor to fail completely.

3.8 Display

Display	Full graphic LC display
Resolution	128 x 64 Pixel
Backlight	RGB
Measured value display	6 digits

3.9 Construction design

Process connection		Outer Ø	Inner Ø
CK screw connections made of aluminium	Hose	6 mm	4 mm
	Hose	8 mm	6 mm
Pneumatic connector socket in nickel-plated brass	Hose	6 mm	4 mm
	Hose	8 mm	6 mm
Cutting ring connection in stainless steel	Pipe	6 mm	
	Pipe	8 mm	

Electrical connection	
<i>Devices with analog and switch outputs</i>	
Connector 1 : Auxiliary energy, output	5-pin male
Connector 2 : Switch outputs	8-pin male
Connector 3: Temperature/humidity sensor	4-pin female
<i>Device with Modbus</i>	
Connector 1: Modbus IN	5-pin male
Connector 2: Modbus OUT	5-pin female
Connector 3: Temperature/humidity sensor	4-pin female

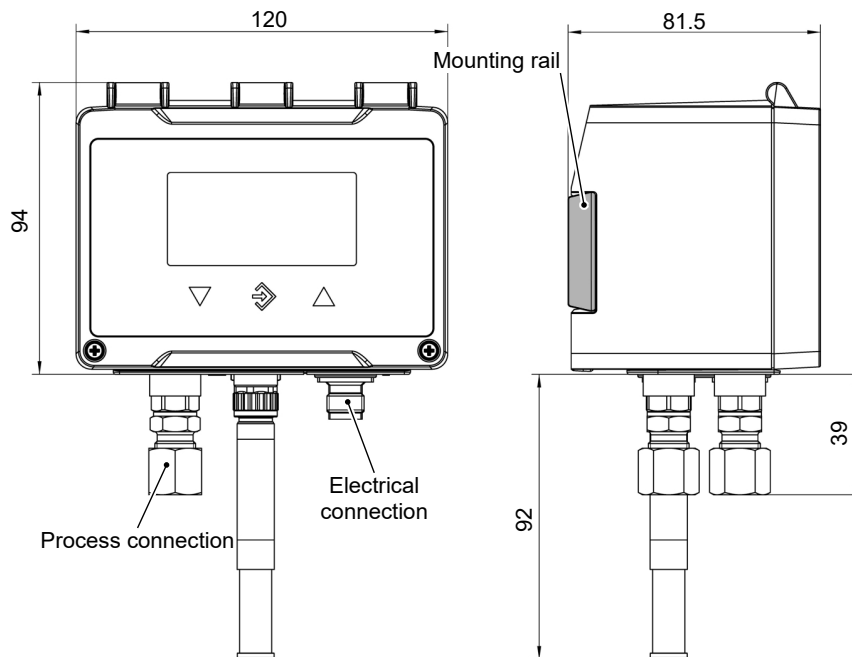
Installation position	User-defined
Dimensions (without connections)	120 x 81.5 x 95 mm
Weight	Max. 380 g

3.9.1 Materials

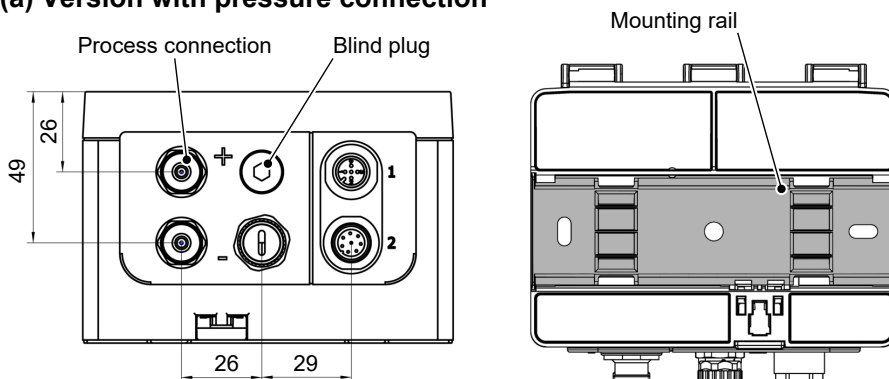
Materials of the parts that come into contact with the medium	
Pressure sensor	Silicon, PVC, FKM, aluminium, brass, stainless steel
Temperature and humidity sensor FF90FK	FR4, polyoxymethylene, solder resist, silicon, tin, copper, nickel, silver, ceramic
Humidity and temperature sensor FF90FV	FR4, stainless steel, solder resist, silicon, tin, copper, nickel, silver, ceramic
Materials of the parts that come into contact with the surroundings	
All versions	Polyester, PET, polyamide 6.6, aluminium, nickel-plated brass, stainless steel
Humidity and temperature sensor FF90FK	Polyoxymethylene
Humidity and temperature sensor FF90FV	Stainless steel

3.9.2 Dimensional drawings

All dimensions in mm unless otherwise stated



(a) Version with pressure connection



(b) Version without pressure connection

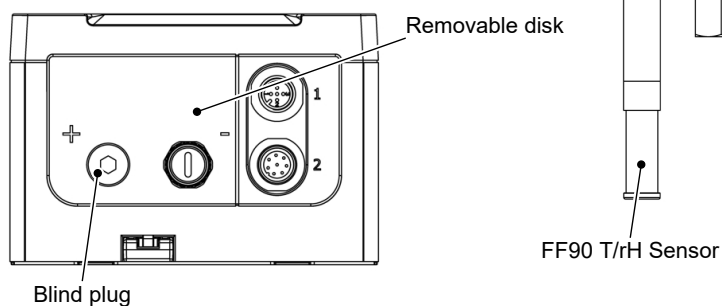


Fig. 8: Dimensional drawing

Mounting rail

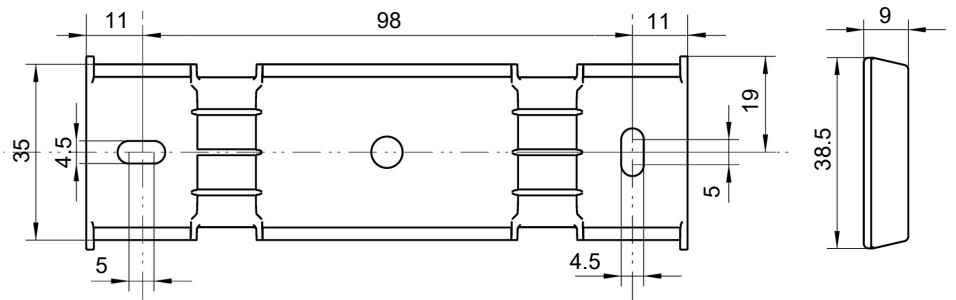


Fig. 9: Mounting rail

Process connection

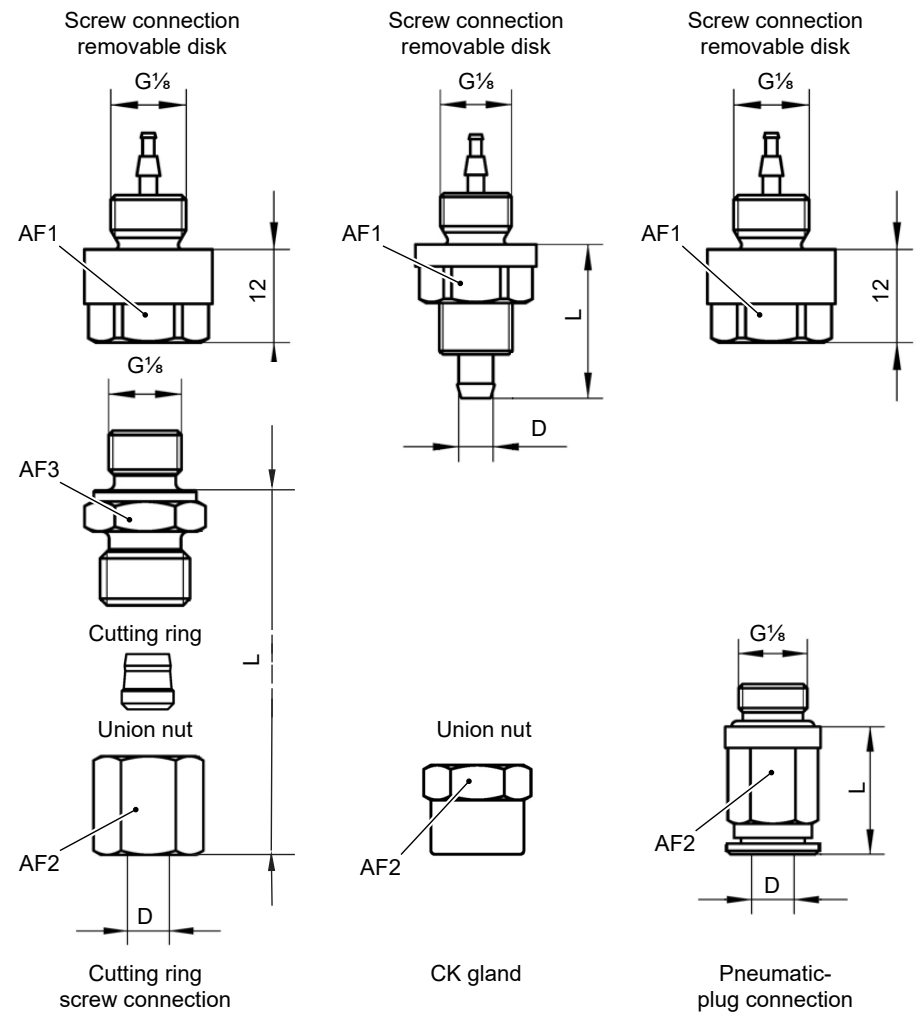
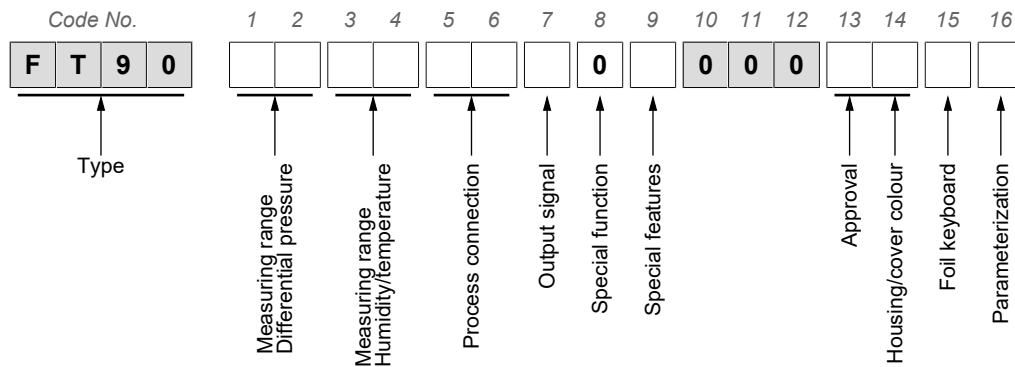


Fig. 10: Options for the process connection

Process connection		D	d	L	SW1	SW2	SW3
Cutting ring screw connection	Pipe	6	---	23.5	14	14	14
		8	---	24.5	14	17	14
CK screw connection	Hose	6	4	21	14	12	---
		8	6	21	14	14	---
Pneumatic plug-in connection	Pneumatic hose	6	4	18	14	11	---
		8	6	20.5	14	13	---

D: Outer diameter; d: Inner diameter

4 Order code



Differential pressure measuring range:

[1,2]	[1,2]	[1,2]		
00	Without differential pressure measuring			
	L0	-20 ... +80 Pa		
	D1	0 ... 25 Pa		
	D2	0 ... 40 Pa		
	D3	0 ... 60 Pa		
51	D4	0 ... 100 Pa		
97	D5	0 ... 160 Pa		
98	D6	0 ... 250 Pa		
52	D7	0 ... 400 Pa		
53	D8	0 ... 600 Pa		
54	N1	0 ... 1 kPa	D9	0 ... 1000 Pa
55	N2	0 ... 1,6 kPa	E1	0 ... 1600 Pa
56	N3	0 ... 2,5 kPa	E2	0 ... 2500 Pa
57	N4	0 ... 4 kPa	E3	0 ... 4000 Pa
58	N5	0 ... 6 kPa	E4	0 ... 6000 Pa
59	E5	0 ... 10 kPa		
60	E6	0 ... 16 kPa		
82	E7	0 ... 25 kPa		
	L5	-25 ... +25 Pa		
	R6	-40 ... +40 Pa		
	2L	-60 ... +60 Pa		
A4	L7	-100 ... +100 Pa		
A5	R7	-160 ... +160 Pa		
A6	L6	-250 ... +250 Pa		
A7	R1	-400 ... +400 Pa		
A8	R2	-600 ... +600 Pa		
A9	L8	-1 ... +1 kPa		
B1	L9	-1,6 ... +1,6 kPa		
B2	M6	-2,5 ... +2,5 kPa		
C5	M7	-4 ... +4 kPa		
B3	M8	-6 ... +6 kPa		
B4	R8	-10 ... +10 kPa		
R5	R9	-16 ... +16 kPa		
B6	T1	-25 ... +25 kPa		

Humidity and temperature measuring range:

[3,4]	Measuring range	Sensor material
10	Humidity 0 to 100% rH Temperature -40 to 100°C	Plastic (POM)
20	Humidity 0 to 100% rH Temperature -40 to 100°C	Stainless steel

Process connection:

[5,6]	
40	Aluminium CK screw connection for 6/4 mm hose
41	Aluminium CK screw connection for 8/6 mm hose
P6	Nickel-plated brass pneumatic plug-in connector for 6/4 mm hose
P8	Nickel-plated brass pneumatic plug-in connector for 8/6 mm hose
24	Stainless steel cutting ring connection for 6 mm pipe
25	Stainless steel cutting ring connection for 8 mm pipe

Output signal:

[7]	
0	without
<i>Switchable, factory pre-set:</i>	
C	0 ... 10 V
A	0 ... 20 mA
P	4 ... 20 mA
<i>Digital interface:</i>	
M	RS485 Modbus RTU

Special functions:

[8]	
0	None

Special aspects:

[9]			
0	None		
1	Sensor with increased overload and bursting pressure strength of 1 bar only for the following pressure ranges:		
52	0 to 4 mbar	D7	0 to 400 Pa
53	0 to 6 mbar	D8	0 to 600 Pa
54	0 to 10 mbar	N1	0 to 1 kPa
A6	-2.5 to +2.5 mbar	L6	-250 to +250 Pa
A7	-4 to +4 mbar	R1	-400 to +400 Pa
A8	-6 to +6 mbar	R2	-600 to +600 Pa
A9	-10 to +10 mbar	L8	-1 to +1 kPa

Approval and housing/lid colour:

[13,14]	Approval	Housing colour	Lid colour
00	None	Anthracite	Green
R1	ATEX zones 2 and 22	Black (conductive housing)	Black

Membrane keypad:

[15]	
0	FISCHER
1	Neutral

Configuration:

[16] Preset at the factory ^{*)}	
0	'Standard' configuration
Z	'Customer-specific' configuration

^{*)} The configuration can be changed on the device at any time. The delivery state is defined by the order code. For details, see the operating instructions.

4.1 Accessories**M12 connection cables**

Designation	No. of poles	Length	Order no.
PUR connection cable with M12 coupling, A-coded	4 poles	2 m	06401993
		5 m	06401994
		7 m	06401563
		10 m	06401572
	5 poles	2 m	06401995
		5 m	06401996
		7 m	06401564
		10 m	06401573
	8 poles	2 m	09001844
		5 m	09011146
		10 m	09011016

Connection cables for FF90 humidity and temperature sensor

Designation	No. of poles	Length	Order no.
M12 coupling/M12 straight connector, A-coded	4 poles	2 m	09011363
		5 m	09011364
		7 m	09011365
		10 m	09011366
Mounting flange for temperature sensor			06402713

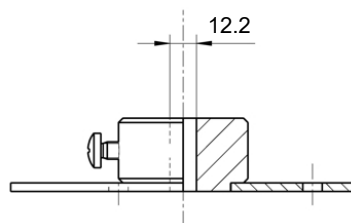


Fig. 11: Mounting flange for FF90 humidity and temperature sensor

Spare parts

FF90 humidity and temperature sensor	Order no.
Smooth sensor made from plastic	FF90 FK
Smooth sensor made from stainless steel	FF90 FV

USB interface

Designation		Order no.
Connection cable, USB-A on USB micro-B connector	2 m	09007340
Stick USB 2.0, USB-A/micro-B connector	16 GB	09007316

Modbus

Designation		Order no.
Modbus terminating resistor	120 ohm socket	06411280
	120 ohm connector	06411279

Software

The configuration software inTouch is available at fischermesstechnik.de as a download.



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