Committing to the future

2011

Stationary Measurement Technology

Humidity / Differential Pressure / Temperature / Process Displays

°C

%rF

V

mA

Nm/s

Nm^3/h

$°C_{td}$

mbar

inch H_2O

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A1 Overview versions and applications humidity transmitters testo 6621, testo 6651, testo 6681

Testo offers three classes of new transmitters for humidity measurement. The following is a rough presentation of the three classes. After this, each class is described in detail.

The price and performance of the testo 6621 make it ideal for air conditioning applications in buildings. The models testo 6651 and testo 6681, are positioned in the middle to upper performance range. They are designed for the monitoring of critical climate in process engineering and also in compressed air technology. The demanding measurement is realized with the further developed Testo humidity sensor, with its well-known and highly-valued long-term stability. Unmatched state-of-the-art technology in humidity measurement, with solutions for highest accuracy as well as for special applications (high humidity, humidity in H_2O_2, trace humidity etc.) is provided.

Both instrument series present many innovations, including world firsts such as a Profibus interface in the humidity transmitter testo 6681 and an Ethernet interface in the humidity transmitters testo 6681 and testo 6651.

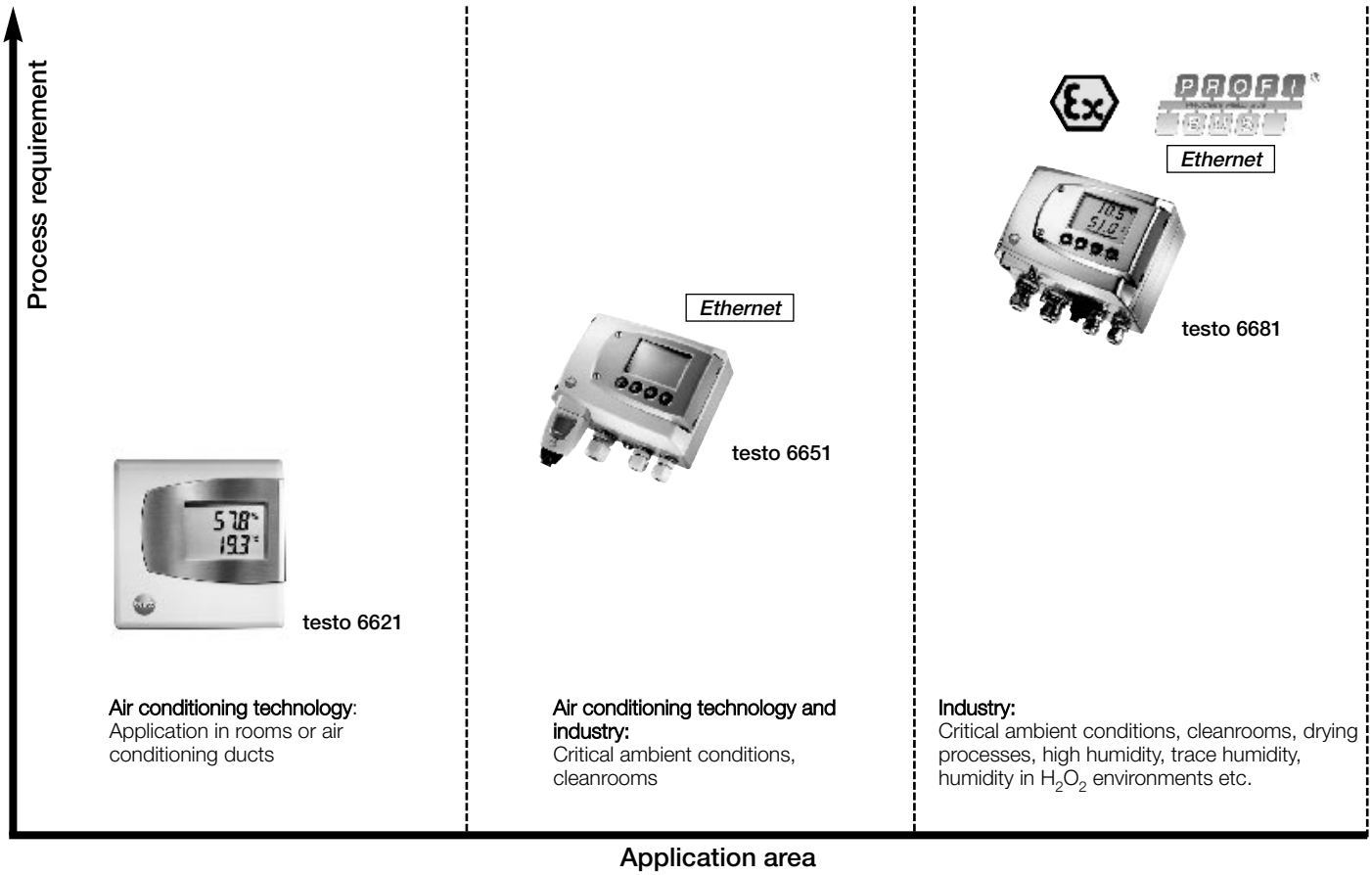
It is a completely newly developed generation of instruments, which in particular offers solutions for safe and service-friendly use, meaning high reliability and operational security for industry:

– exchangeable probes

– early warning reports

– variable possibilites for adjustment

In addition, they also continue to use already existing technology such as the external interface for communication, for example for the parameterization and adjustment software P2A from Testo.



A1 Overview versions and applications humidity transmitters testo 6621, testo 6651, testo 6681

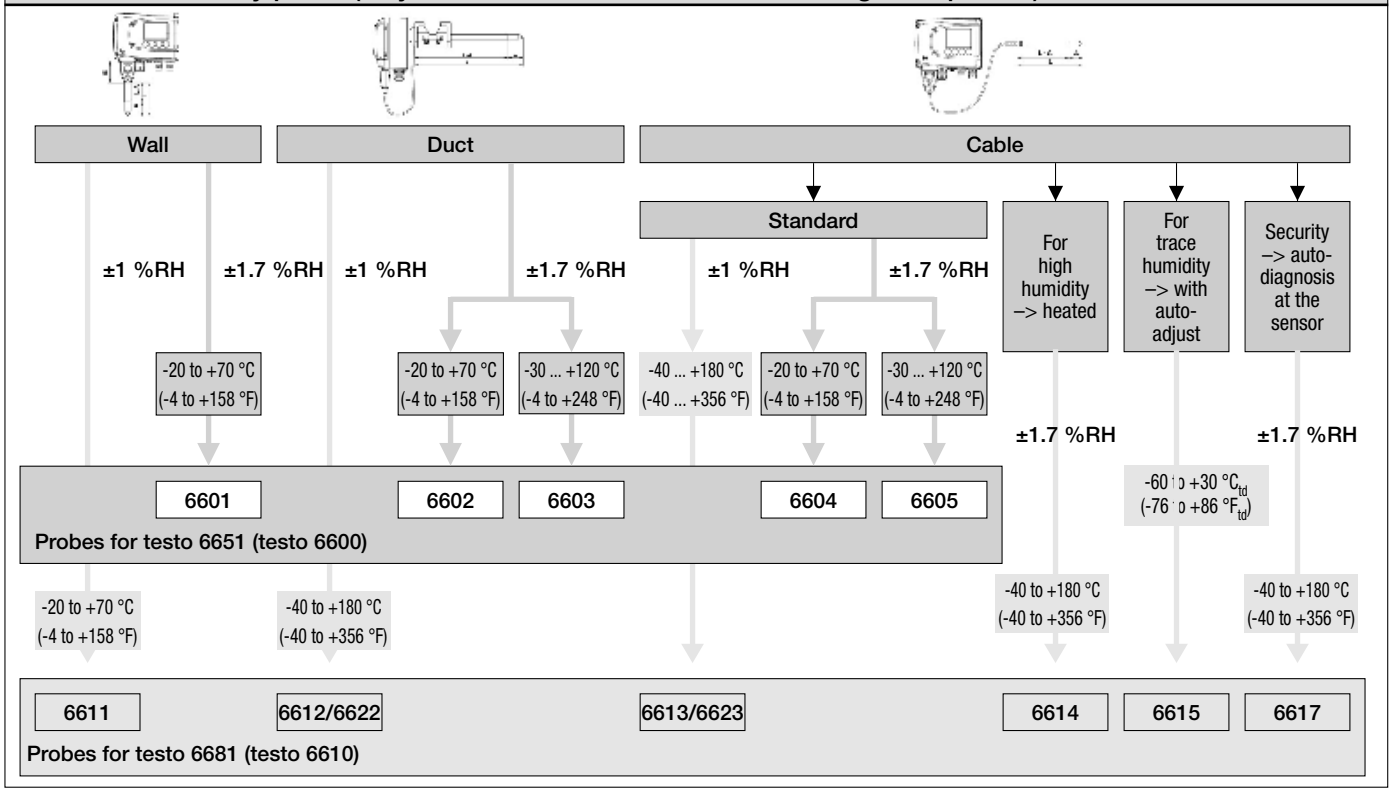
Product selection by instrument

		testo 6621	testo 6651	testo 6681
Measuring range	Humidity	0 to 100 %RH (no high humidity processes)	0 to 100 %RH (no high humidity processes)	0 to 100 %RH
	Temperature (dependent on probe)	0-20 to +120 °C , (not for high humidity processes), duct: -20 to +70 °C (-4 to +158 °F)	-20 to +120 °C (-4 ... +248 °F)	-40 to +180 °C (-40 ... +356 °F)
Accuracy at +25 °C (+77 °F)	Humidity**	±2.0 %RH (0 to 90 %RH) ±4 %RH (90 to 100 %RH)	± (1.7 + 0.007* Mw) %RH (0 to 90%RH) ± (1.9+ 0.007* Mw) %RH (90 to 100%RH)	up to ± (1.0 + 0.007* Mw) %RH (0 to 90%RH) ± (1.4+ 0.007* Mw) %RH (90 to 100%RH), dependent on probe
	Temperature	±0.5 °C / 0.9 °F	Pt1000 Klasse A: ±0,2 °C / 0,38 °F * Pt1000 1/3 Klasse B: ±0,15 °C / 0,27 °F * (testo 6605)	Pt1000 1/3 Class B / Pt 100 1/3 Class B for testo 6615 ±0.15 °C / 0.27 °F *
Measurement parameters		°C, °F, %RH	°C/°F, %rF/%RH, $°C_{td}$/$°F_{td}$	°C/°F, %rF, %RH, $°C_{td}$, $°F_{td}$, g/m³, gr/ft³, g/kg, gr/lb, enthalpy, °Ctw, °Ftw, inch H_2O, ppm(vol), % Vol for H_2O_2-applications: °Ctm/°Ftm
Signal outputs		4 to 20 mA, 2-wire (duct version only) 0 to 1 Volt, 4-wire 0 to 5/10 Volt, 4-wire	4 to 20 mA, 2-wire 0/4 to 20 mA, 4-wire 0 to 1/5/10 Volt, 4-wire	4 to 20 mA, 2-wire (not for testo 6614/6615) 0/4 to 20 mA, 4-wire 0 to 1/5/10 Volt, 4-wire
Mounting variants		Wall or duct installation	Wall probe testo 6601 Duct probe testo 6602/6603 Cable probe testo 6604/6605	Wall probe testo 6611 Duct probe testo 6612 Cable probe testo 6613/6614/6615/6617
max. cable length		–	5 m	10 m
Housing		ABS and nickel-plated ABS	ABS, plastic, IP65	Metal, IP65
Interfaces		digital Testo (for 2PA software or testo 400/650)	digital Testo (for P2A software or testo 400/650) Ethernet (optional intermediary layer)	digital Testo (cf. testo 6651) Profibus (optional intermediary layer) Ethernet(optional intermediary layer)
Special features		External interface, adjustability	4 relays (optional) early warning system (via display or relay collective alarm)	Special probe versions for • Temperature ranges up to +180 °C (+324 °F) • Trace humidity testo 6615 • High humidity testo 6614 • Self-diagnosis testo 6617 4 relays, optional early warning system (via display, relay collective alarm or Profibus)

*Other accuracies apply for the wall probe with 70 mm length in combination with a current output (P07):
Operation: with 2 channels at 12 mA, without display illumination, relay off, additional measurement inaccuracy to above data at +25 °C (+77 °F), humidity ±2.5 %RH, temperature ±1 °C (1.8 °F)

**For more detailed explanation on the determination of the measurement uncertainty according to GUM, see p. 20/25

Product selection by probe (only testo 6651 / testo 6681 with exchangeable probes)



An exact and continuous measurement of temperature and humidity is vital in many industrial processes.

The most important areas of application for the testo 6651/6681 are

- continuous monitoring or regulation of climate (e.g. production air quality or storage)

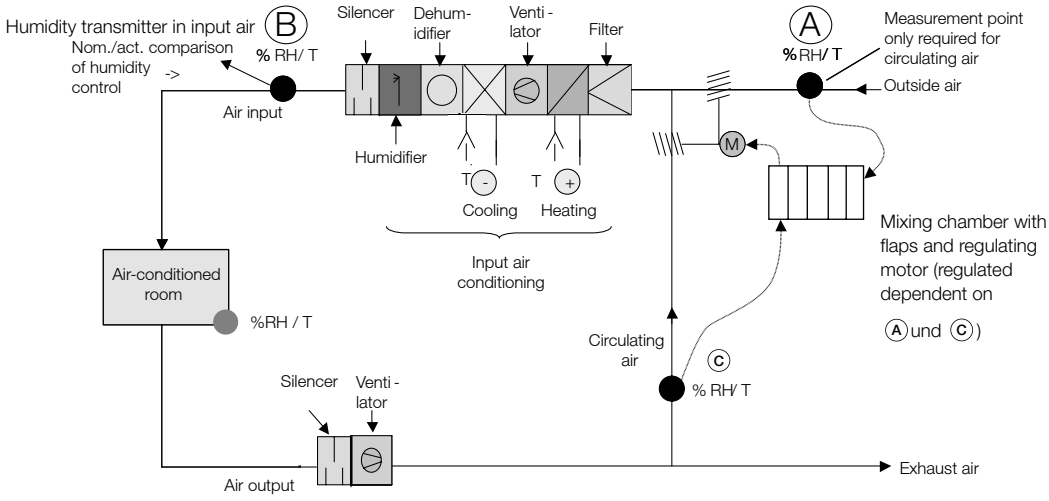
- Drying processes / high humidity processes,
- Humidity measurements in H_2O_2 atmospheres

Depending on the model, the Testo humidity transmitters fulfil the strict, or strictest, demands placed on humidity measurement accuracy and long-term stability.

The following table helps with the allocation of the transmitter models to the applications. (Note: The following table only provides general information - please adapt the selected model and ordering options to the demands of the process yourself. Testo's Sales Department will be happy to assist you with your selection):

Air conditioning applications

Application	Recommendation	Alternative
Semi-conductors (cleanroom) in air ducts	testo 6681 with 6612 / 6613	testo 6651 with 6602 / 66109
Pharmaceuticals (cleanroom) in air ducts	testo 6681 with 6612 / 6613	testo 6651 with 6602 / 6603
Paintshops	testo 6681 with 6612 / 6613 and PTFE protective cap	testo 6651 with 6602 / 6603 with PTFE protective cap
Storage of hygroscopic materials	testo 6651 v 6611/ 6613 or testo 6681 with 6611 / 6613	testo 6651 with 6602 or testo 6681 with 6612
Storage of electronic componenets	testo 6681 v 6613	testo 6651 with 6601 / 6603
Production air quality	testo 6651 v 6611	testo 6681 with 6611



In air conditioning systems, there are three potential measurement points for the transmitters outside air-conditioned rooms. First the condition of the outside air (A) is recorded, after filtration, cooling/heating and, where necessary humidifying/dehumidifying, the condition of the input air is recorded (B). The third measurement point is in the circulating air (C). The data from (B) serve to control the input air conditioning; the data from (A) and (C), on the other hand, decide the position of the flaps in the mixing chamber (mixture of outside and circulating air).

● = Typical installation sites for hygrotest: DHT if hygrotest directly in duct
PHT if hygrotest dislocated from measurement site
● WHT inside air-conditioned rooms/zones

For installation in rooms:
Do not install WHT close to ventilation outlets or on badly isolated outside walls

Drying processes / high humidity processes

For high humidity applications note:

A high humidity application is when the humidity > 90%RH for longer periods!

For high humidity applications with constant temperatures, the testo 6681 with 6613 with a PTFE protective cap + condensation protection is used.

For high humidity applications with changing temperatures, the use of the PTFE protective cap with condensate drip hole (0554 9913) and condensation protection (0554.0166) is recommended.

Application	Recommendation	Alternative
Climate cabinets	testo 6681 with 6613	
Maturing cheese	testo 6681 with 6613 / 6614 incl. PTFE protective cap with drip hole and condensation protection	
Drying pasta	testo 6651 with 6612 or testo 6681 with 6612	
Drying tobacco	testo 6681 with 6613 / 6614 with PTFE protective cap	
Concrete testing chambers	testo 6681 with 6614 with PTFE protective cap with drip hole and condensation protection	
Drying wood	testo 6681 with 6614 with PTFE protective cap	testo 6681 with 6613 with PTFE protective cap (if low reaction speed is sufficient)
Drying ceramics	testo 6681 with 6613 / 6614 and condensation protection	
Bio-research/greenhouses	testo 6681 with 6614 and condensation protection	

A2 Air conditioning humidity transmitter testo 6621

1 Description

For years, Testo has been the first choice when it comes to high-quality humidity measurement transmitters for drying processes and critical ambient conditions. With the testo 6621, this expertise in sensors and electronics has also been made available for classical climate applications - with professional solutions for indoor rooms and ventilation ducts, whose design also appeals to architects.

The measurement transmitter testo 6621 allows the permanent monitoring and regulation of air conditioning systems. Its attractive design makes it adaptable to almost any surroundings. The measurement transmitter versions with a display also allow the person present to record the ambient climatic conditions. Thanks to the combination with the P2A software, furthter transmitters or replacements can be configured by taking over the profiles.

Operators, facility managers, but also plant engineers have recognized that without long-term stability, not only are undesired ambient conditions the result. Operating costs have also been proven to increase if humidity measurement goes out of control. The measurement transmitter testo 6621 offers an easy, low-cost and long-term possiblity of permanently lowering costs.

Übersicht Produktfamilie testo 6621

Wall version with display

Duct version with display

Wall version with external probe

Wall version without display

Duct version without display

Identification code for product and configuration

A01	Wall
A02	Duct
A03	Wall with external probe

2 Application

The air conditioning measurement transmitter testo 6621 was specially designed for use in air conditioning technology. This includes the regulation and monitoring of climate in buildings, e.g. in office buildings, museums, hotels, hospitals, as well as storage and production conditions.

The product is in the lower price range and is equipped with the features important for the application range as well as some new, bonus features:

- an attractive, simple design, ideally suited for use in public view.
- the reliable, tested Testo humidity sensor.
- fast and easy on site adjustment with Testo hand-held instruments (types testo 400 and testo 650).
- easy-to-use software P2A for parameterization or adjustment.

The product is not suited for high humidity drying process (relative air humidity continuously above 90 %). Please see the hygrotest versions for this.

A2 3 Technical data

		testo 6621-A01 and A03 (with ext. probe)-wall versions	testo 6621-A02- duct version
General	Housing	ABS and nickel-plated ABS	ABS and nickel-plated ABS
	Dimensions	81x81x26 mm	81x81x42 mm, probe see illustration
	Weight	80 g	160 g
	Cable screw fittings	None (cable entry through rear wall or break-out opening on underside)	1xM16x1.5
	Protection class	IP 30	IP 65
	EMC	Acc. to EG-guideline 89/336/EEC	
	Application temperature	-20 to +70 °C (-4 to +158 °F); with display: 0 to +50 °C (32 to +122 °F)	
	Storage temperature	-40 to +70 °C (-40 to +158 °F)	
	Measurement parameters	Humidity: %RH; temperature: °C / °F	
	Display	2-line LCD (optional); humidity resolution: 0.1 %RH, temperature resolution: 0.1 °C / 0.1 °F; refresh rate 1/s	
	Measuring medium	Uncontaminated air (filtered air in air conditioning systems and air conditioned rooms); max. 1 bar positive pressure	
	Measuring rate	1/s	
	Reaction time	Reaction time t90: <15s at 2m/s. In calibration / adjustment, note: In static air, the reaction time can be considerably longer.	
Sensor	Humidity	Testo humidity sensor	
	Reaction time w/o protection filter	Diagram	
	Temperature	NTC	
	Replaceability humidity sensor	A01(by Testo service), A02 and A03 (possible by customer, see Replacement Sensor), subsequent 2-point adjustment required	
Measuring range	Humidity	0 to 100 %RH (not for high humidity processes)	
	Temperature	0 to +60 °C (32 to +140 °F)	-20 to +70 °C (-4 to +158 °F)
Measurement inaccuracy	Humidity	±2.0% (0 to 90 %RH), ±4% (90 to100 %RH) Temperature coefficient: 0.05 % / K (Distance from 25 °C)	
	Temperature	±0.5 °C / 0.9 °F	-20 to +70 °C (-4 to+158 °F)
Analog outputs	Current outputs	- 4 to 20 mA (2-wire) only for duct version A02 and wall version A03	
	Voltage outputs	0 to 1 V (4-wire) / 0 to 5 V (4-wire) / 0 to 10 V (4-wire) (not A03)	
	Resolution	<5 µA (4 to 20 mA) / 250 µV (0 to 1 V) / 1.25 mV (0 to 5 V) / 2.5 mV (0 to 10 V)	
	Accuracy current	0.05 mA	
	Accuracy voltage	0 to 1 VDC ±2.5 mV; 0 to 5 VDC ±12.5 mV; 0 to 10 V ±25 mV	
	Digital output	Mini-DIN	
	Voltage supply	At current output: 24 VDC ±10 % / at voltage output: 20 to 30 VDC / VAC	
Current supply	2-wire current 4 to 20 mA	DC 20 V / 20 mA, 24 V / 20 mA, 30 V / 20 mA	
	4-wire voltage, 0 to 10 V	DC 24 V / 7 mA, 30 V / 7 mA, 20 V / 20 mA AC 24 V / 22 mA, 30 V / 28 mA	

A2 4 Electrical connection

4.1 Wiring

Attention! When installing the cable, ensure that the there is a spatial separation between the signal line and any interference from foreign power lines.

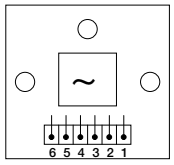
If interference is to be expected, use a shielded and/or twisted cable. The shield must be earthed. Recommended: 8-core cable with close-mesh shield, core cross-section 0.25 to 0.5 mm².

If overloads are to be expected, install overload protection devices.

4.1.1 Wiring 4-wire

A01 wall version

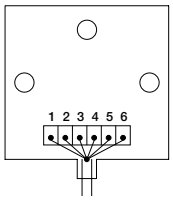
Voltage output (4-wire):
0 to 1 V / 0 to 5 V / 0 to 10 V
U = 20 to 30 VDC/AC



1	+ U
2	- U
3	+ RH
4	- RH
5	+ T
6	- T

A02 duct version

Voltage output (4-wire):
0 to 1 V / 0 to 5 V / 0 to 10 V
U = 20 to 30 VAC/DC

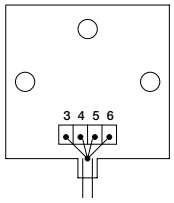


1	+ U
2	- U
3	+ RH
4	- RH
5	+ T
6	- T

4.1.2 Wiring 2-wire

A02 duct version and A03 wall version with external probe

Current output (2-wire): 4 to 20 mA, max. load 500 Ω



3/5	+ U
4/6	- U
3	+ RH
4	- RH
5	+ T
6	- T

4.1.3 Wiring 3-wire technology

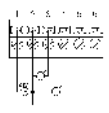
A01 wall version

Connection of 2 channels (temperature and humidity) and current supply.

1	+ U
2	- U
3	+ RH
4	- RH
5	+ T
6	- T

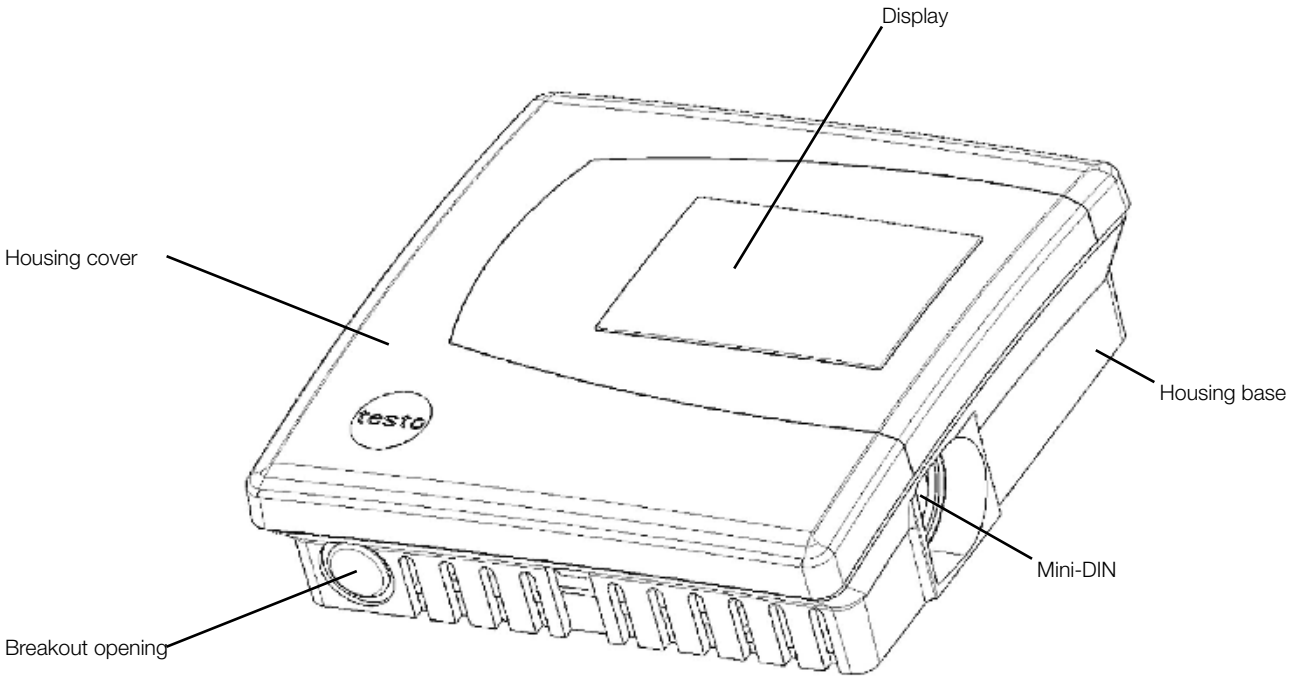
A02 duct version

Connection of 2 channels (temperature and humidity) and current supply.



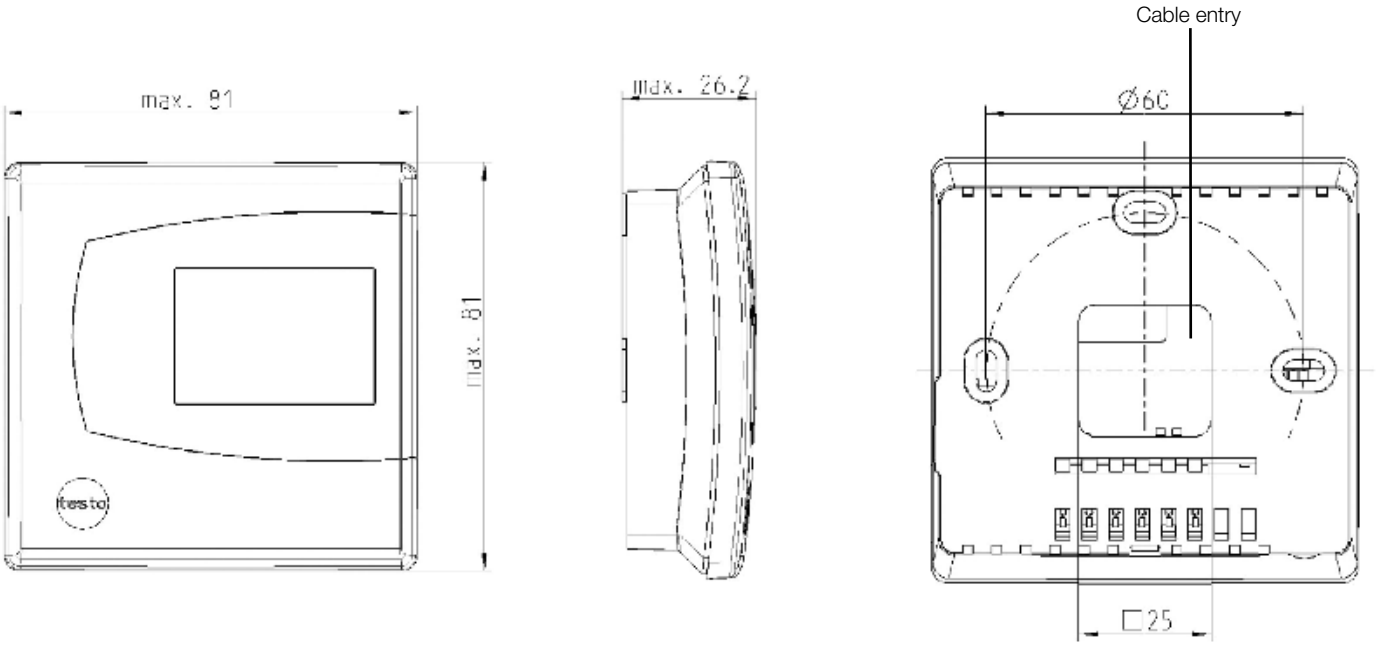
3/5	+ U
4/6	- U
3	+ RH
4	- RH
5	+ T
6	- T

5.1 Wall version A01



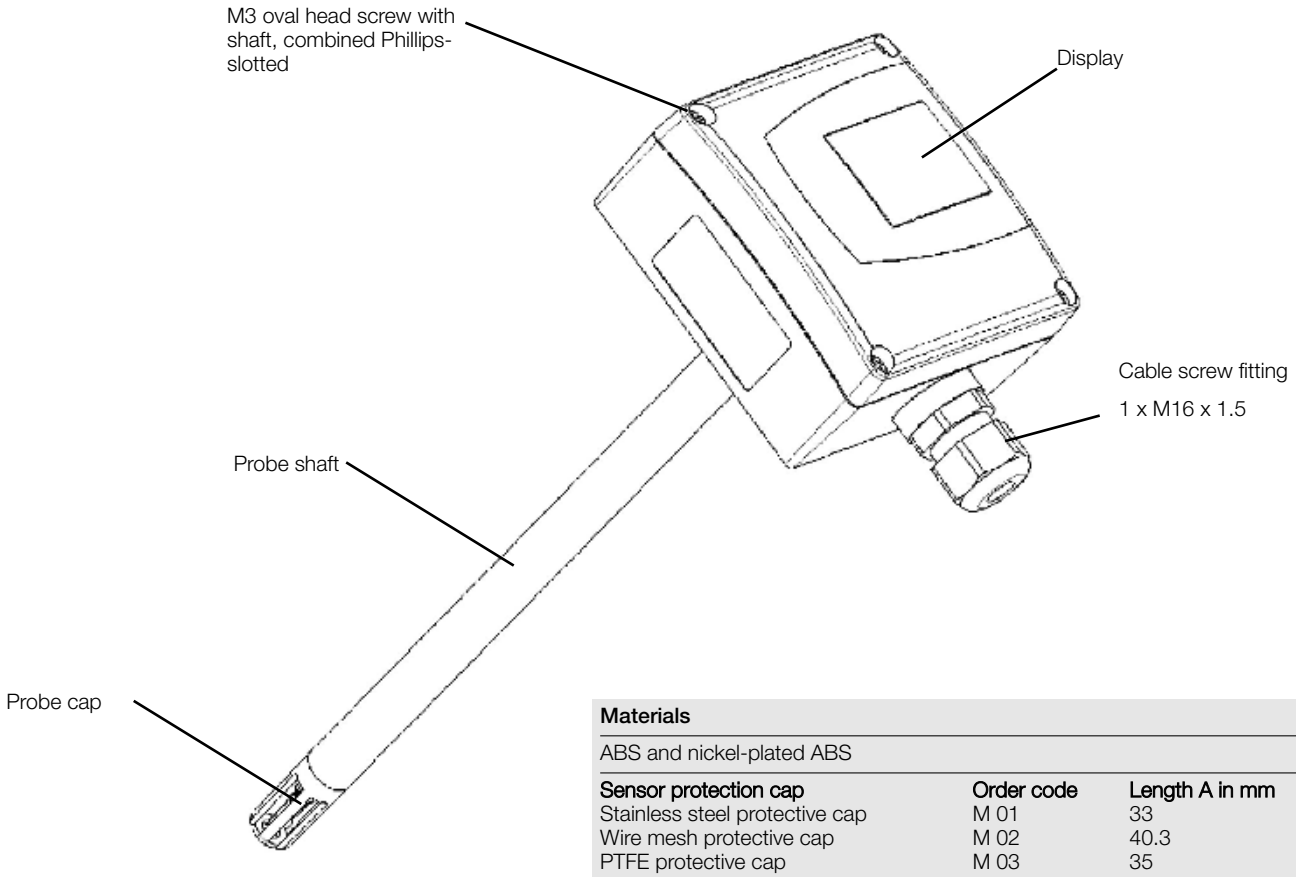
Materials

ABS and nickel-plated ABS



A2 5 Technical drawings

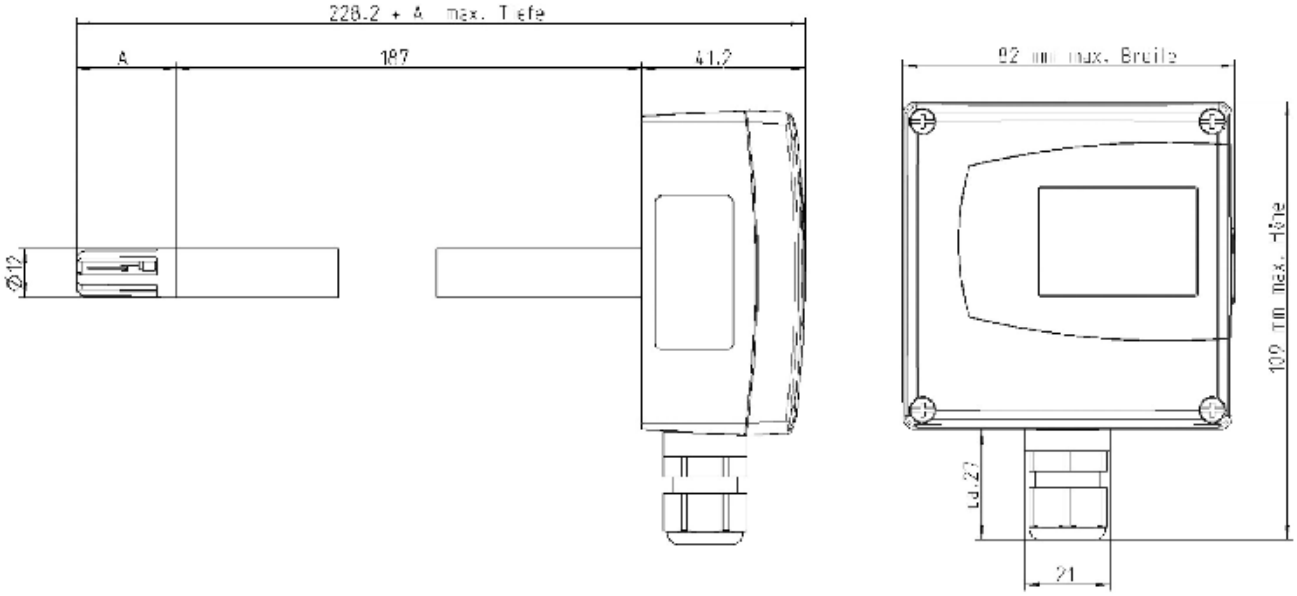
5.2 Duct version A02



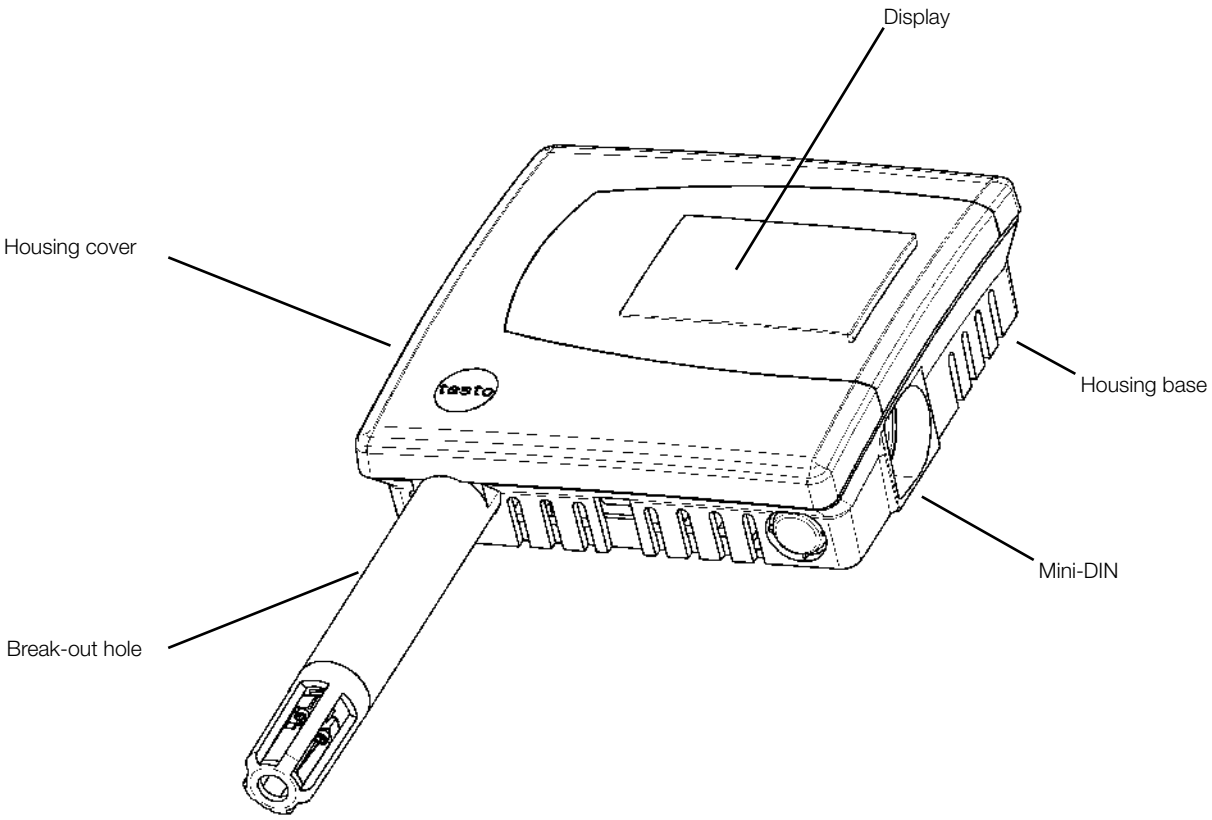
Materials

ABS and nickel-plated ABS

Sensor protection cap	Order code	Length A in mm
Stainless steel protective cap	M 01	33
Wire mesh protective cap	M 02	40.3
PTFE protective cap	M 03	35
Metal protective cap (open)	M 04	35
Plastic protective cap (open)	M 05	25

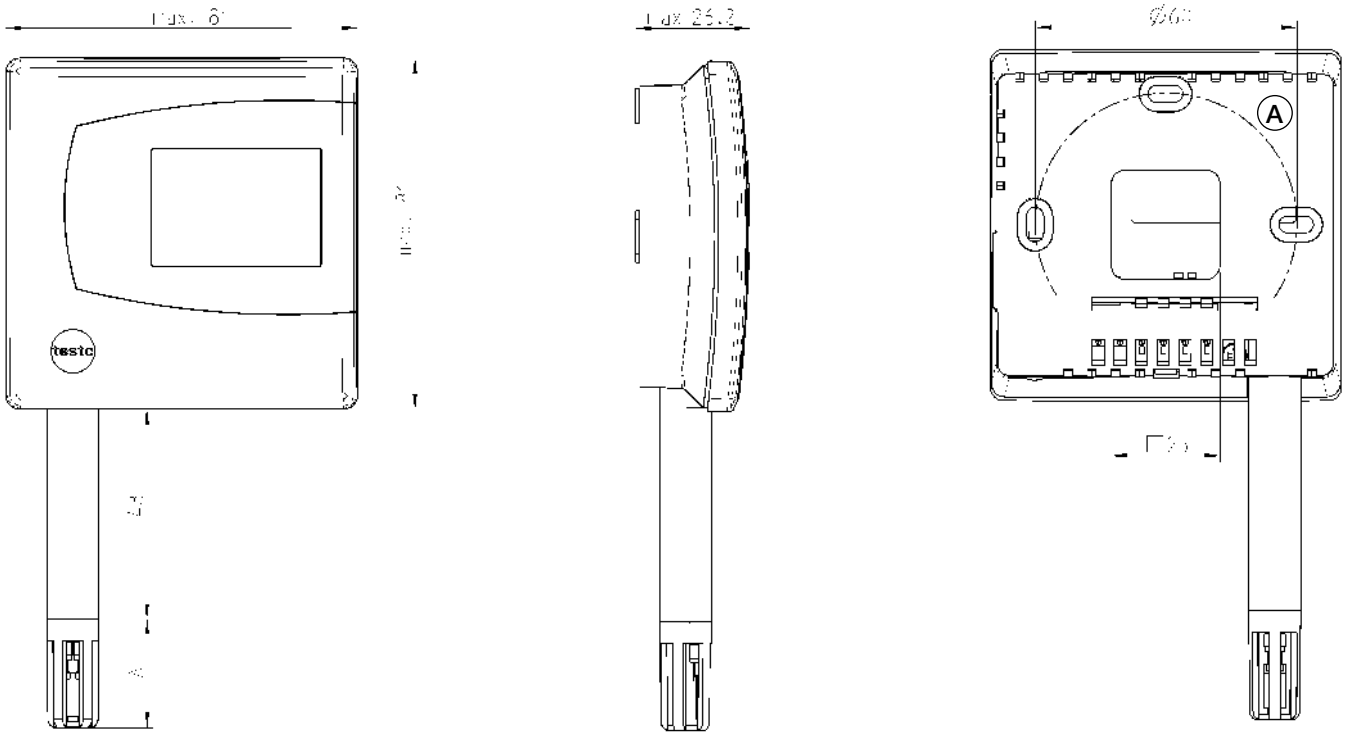


5.3 Wall version A03



Material

Nickel-plated ABS and ABS



A2 6 Installation

6.1 Installation A01 wall version and A03 wall version with external probe

Wall installation A01:

Please note, when installed on poorly insulated outer walls, humidity and temperature values are measured which do not correspond to the mean values in the room. Installation on well insulated outer walls or inner walls is recommended.

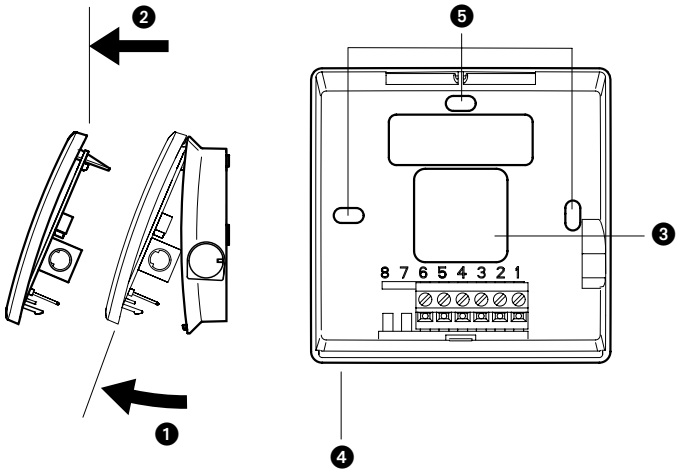
Note: for installation outdoors: protective roof against rain/sunshine!

a. Open housing (ensure there is no plug in the Mini-DIN socket): lift housing cover (1) and remove (2).

b. Insert cable into the housing from behind (3) or from below (4) (remove breakout opening from housing).

c. Depending on the situation on site: attach the housing base using suitable screws (not included in delivery) through the oval holes.

d. After wiring: replace housing cover.

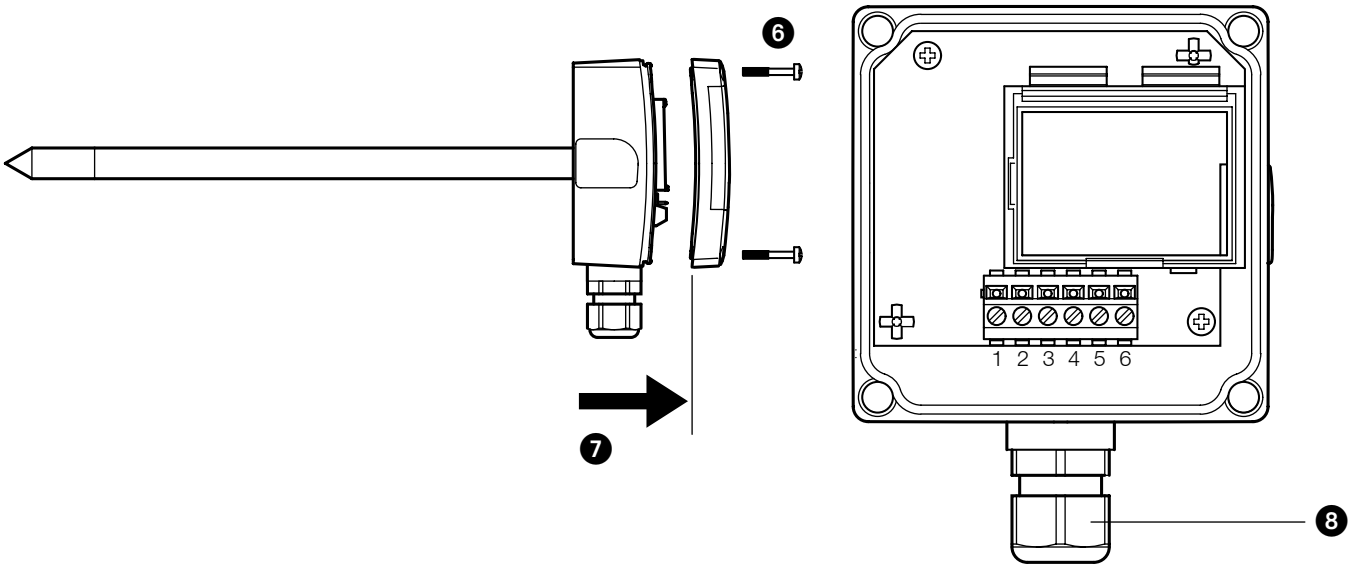


6.2 Installation A02 duct version

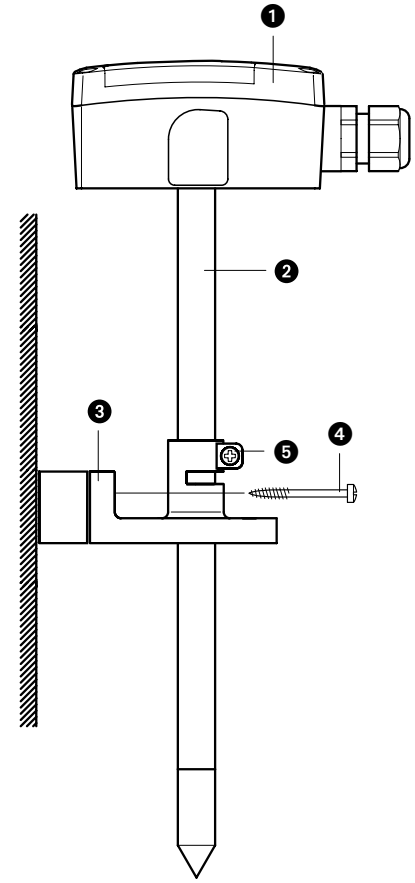
Duct installation A02:

(A) Install instrument according to the situation on site.

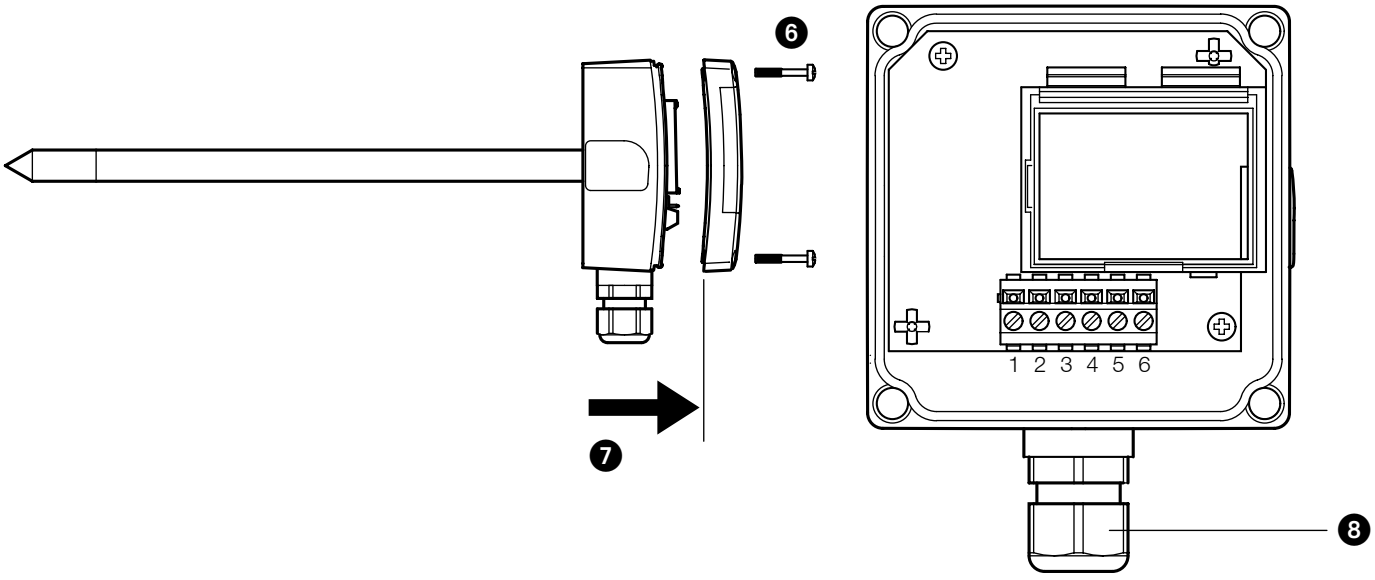
The following illustration shows an example of installationwith the wall/duct holder (accessory 0554 6651) in a ventilation duct:



The following illustration shows an example of installationwith the wall/duct holder (accessory 0554 6651) on a wall:



1. testo 6621-A02 (duct)
2. Probe shaft
3. Wall/duct holder (accessory 0554 6651), for wall mounting with distancing block
4. Installation screws (customer-specific, not include in delivery)
5. Locking screw for fixing the probe shaft.



(B) Open housing: unscrew the four screws in the housing cover (6) and remove the housing cover(7).

(C) Insert cable into the housing base through the cable screw fitting (8).

(D) After wiring (see above): close screw fitting to fix the cable in place (right-hand thread) and replace housing cover.

A2 7 Specifications

6.3 Replacing the humidity sensor

If permanent damage to the sensor has occured due to corrosive media or mechanical influence, it is necessary to replace the humidity sensor of testo 6621. It depends on the instrument type whether this can be carried out by the customer, or whether the instrument must be sent in to Testo Service:

testo 6621 A01	testo 6621 A02 testo 6621 A03
Can be carried out only by Testo Service	Can be carried out by the customer. Order a spare sensor and replace on site (see above, replacement sensors). A 2-point adjustment must then be carried out.

7 Specifications

testo 6621

with a capacitive Testo humidity sensor for continuous humidity measurement, and an NTC sensor for fast and accurate measurement of temperature. In compact design - fully functional without separate analysis software.

Basic versions
A01 Wall version
A02 Duct version
A03 Wall version with external prober

Measuring range: 0 %RH to 100 %RH
A01: 0 to +60 °C (32 to +140 °F)
A02: -20 to +70 °C (-4 to +158 °F)

Additional alternative measurement parameters:
- Humidity, %RH
- Temperature, °C/°F

Application temp.: -20 to +70 °C (-4 to +158 °F)
with display: 0 to +50 °C (32 to +122 °F)

Signal output: Two analog output channels:
0 to 1V ±2.5 mV (4-wire) /
0 to 5V ±12.5 mV (4-wire) /
0 to 10V ±25 mV (4-wire) /
4 to 20 mA ±0.05 mA (2-wire)
Digital output: Mini-DIN

Optimum sensor protection with suitable filters:
- Sintered stainless protective cap
- Wire mesh protective cap
- PTFE protective cap
- Open metal protective cap

Supply:
- 2-wire(4 to 20 mA): 24 VDC±10 %
- 4-wire (0 to 1 V / 0 to 5 V / 0 to 10 V): 20 to30 VAC/VDC

Display functions:
- 2-line LCD (optional);
- Humidity resolution: 0.1 %RH, Temperature resolution: 0.1 °C / 0.1 °F;
- Refresh rate 1/s

Measurement inaccuracy humidity:
±2.0 %RH (0 to 90 %RH), ±4 %RH(>90 to 100 %RH)
Temperature coefficient: 0.05 %/K
(Distance from 25 °C)

Measurement inaccuracy temperature:
Temperature: ±0.5 °C/0.9 °F

Housing materials: ABS and nickle-plated ABS

Cable screw fitting:
6621-A02: 1 x M16 x 1.5

Protection class: Protection class 6621-A01: IP30,
Protection class 6621-A02, Rubber covering IP65

Dimensions: Dimensions 6621-A01: 81 x 81 x 26 mm
Dimensions 6621-A02: 81 x 81 x 42 mm,
Probe see drawing

Interesting accessories:

1) Parameterization, adjustment and analysis software (P2A software incl. adapter cable USB to Mini-DIN)
[Part no. 0554 6020]

2) testo 400, multi-function measuring instrument in cl. readings store up to 500.000 values, VAC module, battery, Li cell and calibration protocol
[Order no. 0563 4001]
Highly accurate reference humidity/temperature probe incl. calibration certificate
[Order no. 0636 9741]
Adjustment adapter for 1-point adjustment with testo 400/650)
[Order no. 0554 6022]

3) Control and adjustment set for 2-point adjustment (11.3 % and 75.3 %RH), only for testo 6621 - A02
[Order no. 0554 0660]

4) Mains unit (desktop appliance), 90 to 264 VAC / 24 VDC (3A)
[Order no. 0554 1748]

5) ISO calibration certificate at 11.3 % and 75.3 %RH
[Order no. 0520 0076]
DKD calibration certificate at 11.3 % and 75.3 %RH
[Order no. 0520 0246]

1 Description

The transmitter testo 6631 was developed specially for monitoring critical ambient conditions in greenhouses, e.g. for research purposes. Precise and reliable humidity measurement is indispensible in these applications, in order to avoid costs caused by failed experiments.

Process security and system availability, among the most important factors in experimental plants, are supported by a number of properties of the testo 6631 greenhouse humidity transmitter:

- Long-term stability and reliability thanks to precise Testo humidity sensor
- Integrated ventilator allows targeted flow impact onto sensor and helps determine mean conditions within the greenhouse cells.
- Time savings in commissioning and maintenance thanks to
  – parameterization, adjustment and analysis software (P2A)
  – Fast and easy ventilator replacement thanks to ventilator drawer assembly and plug-in cable
  – Exchange of the sensor filter thanks to easily accessible service opening.
- Optimum concept for fast implementation of adjustments and calibrations (1, 2-point as well as analog adjustment)
- Optional two-line display

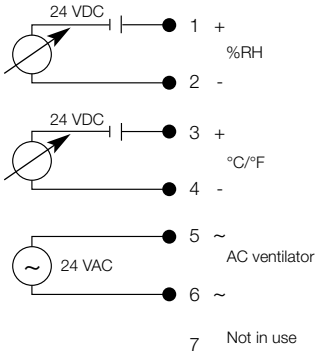
Designed to be practical

- Easily accessible service flap for exchanging and cleaning the filter cap
- Fast ventilator replacement thanks to ventilator drawer assembly
- Protection of electronics and sensor from humidity influences (such as sprinkler irrigation).

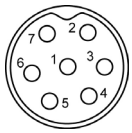
2 Electrical connections

B01
2-wire transmitter
Plug manufacturer Euchner

Pin socket installed ex-works	Cable socket*
Type SD 7K	BS 7K

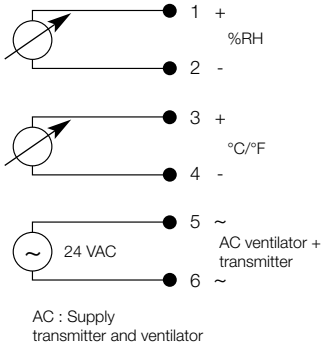


DC: Transmitter supply
AC: Ventilator supply

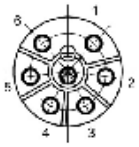


B06
4-wire transmitter
Plug manufacturer Tuchel-Amphenol

Pin socket	Cable socket*
Eco mate Instrument plug	Eco mate cable socket Type no.: C01630D00610010



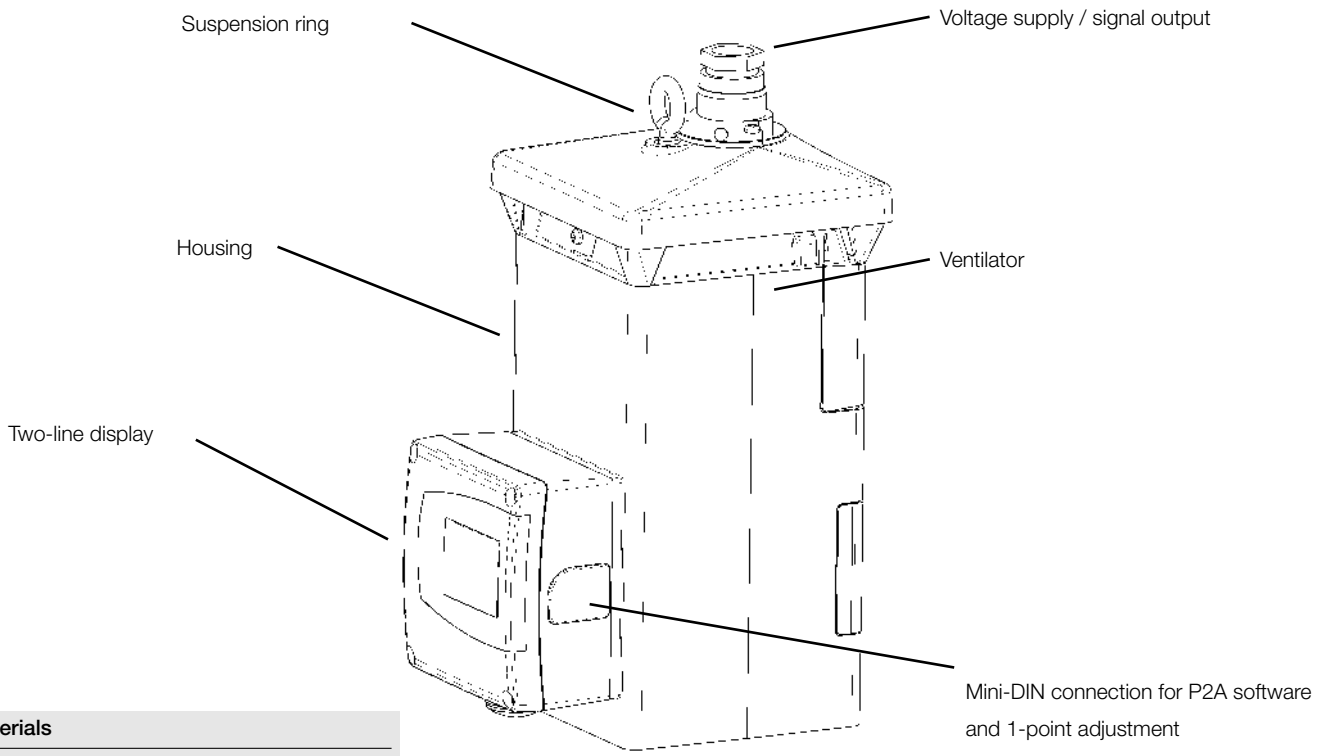
AC : Supply
transmitter and ventilator



* The cable socket is not included in delivery

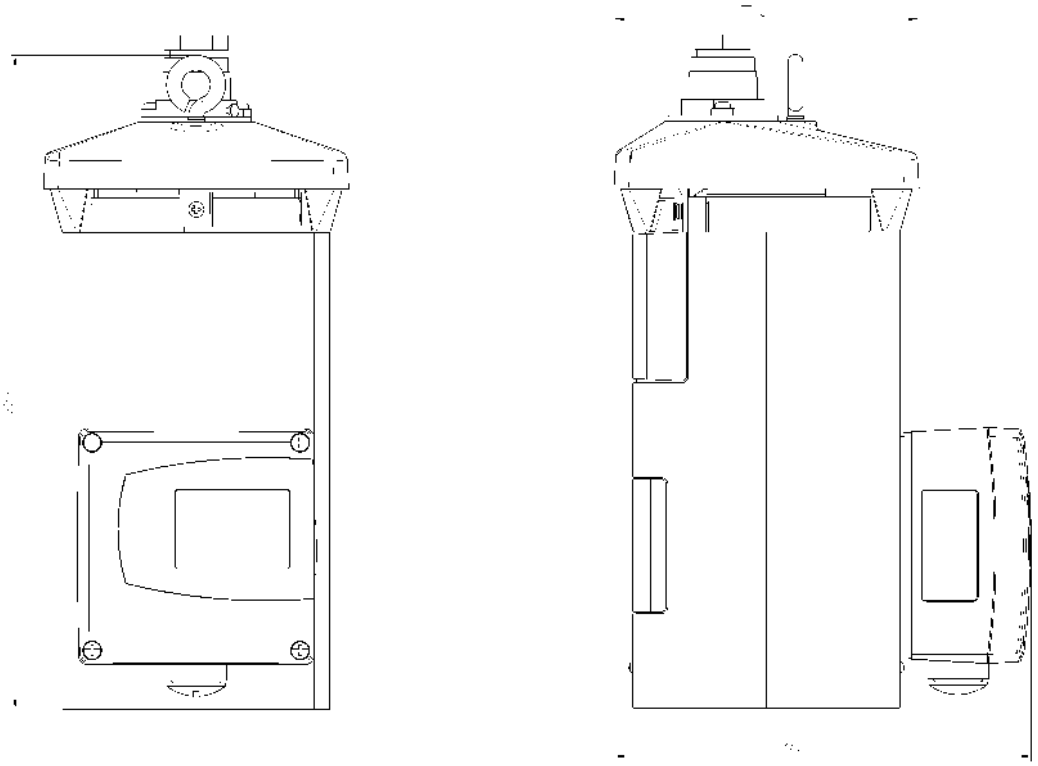
A3 Technical drawings

3 Technical drawings



Materials

ABS and nickel-platedABS



1 Description

The standard humidity transmitter:

- High accuracy and very good long-term stability
- Exchangeable, adjustable probe from the series 6600
- Optimum adjustment possibilities on site
- Early warning reports
- Operation via the parameterization/analysis/adjustment software P2A from Testo or directly via 4 buttons
- Traceability of all settings/reports via internal record
- All common variants of design and signal output can be ordered customer-specifically
- Option for Ethernet interface

2 Exchangeable probes, probe series testo 6600

2.1 Description probe series

Functions and application

The plug-in, adjusted probes from the testo 6600 series are used in conjunction with the humidity measurement transmitter testo 6681

Examples of suitable areas of application for these measuring systems are:
- Process measurement technology
- Test benches
- Production and storage air quality
- Demanding HVAC applications
- Pasta drying.

Digital probes

The probes are adjusted ex-works, and transfer their adjustment data to the internal store of the testo 6651. The synchronization of information between the probe and the measurement transmitter takes place digitally. This means that for adjustment or service purposes, the probes can be separated from the measurement transmitter, which can remain at the measurement site. The measurement transmitter recognizes the probe, and stores in its history which probes have been connected.

In order to guarantee the very high accuracy of the probe series testo 6610, the sensor in the probe cannot be exchanged by the customer.

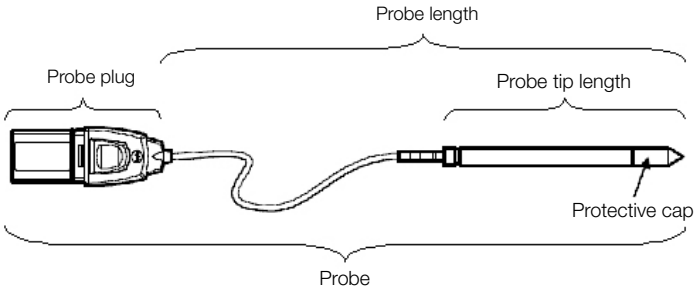
For a change of sensor, please contact Testo customer service.

Self-diagnosis

The probes of the series testo 6600 monitor their function themselves and report the following malfunctions:
- Sensor breakage
- Sensor short circuit
- Condensation
  The condensation report is made at a measurement value of 100 %RH, and deactivated again as soon as the measurement values return to the permitted range.
- Value for relative humidity less than 0:
  The switching threshold is set at -3 %RH. The result of this is that an error is not reported until a clear effect is recognizable.

Included in delivery

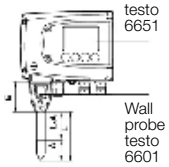
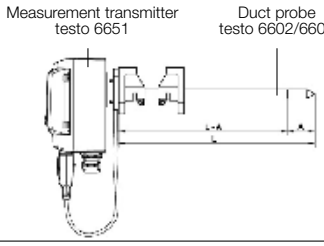
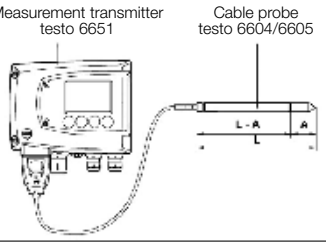
Included in delivery of the probe series 6600:
- Probe plug
- Probe shaft with filter and sensors (%RH and °C/°F)
- Fixing bracket (for duct versions testo 6602 / 6603)
- Probe cable (for duct and cable versions testo 6602 to 6605)



3.1 testo 6651

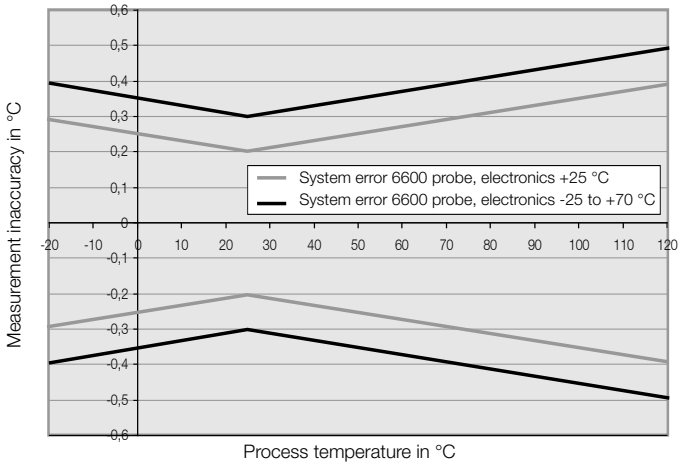
GENERAL						
Housing		Plastic				
Dimensions		122 x 162 x 77 mm (without probe)				
Weight		0.62 kg (without probe)				
Display		2-line LCD with clear-text line (optional) and relay status display. Four operating buttons for operating menu.				
Resolution display		0.1 %RH or 0.01 °C / °F / °C td / °Ftd / °Ctw / °Ftw or 1g / kg / g/m³ / ppm				
Cable screw fitting		M 16 x 1.5 (2x) with inner diameter 4-8 mm for signal/supply cable (for option D01) M 20 x 1.5 (2x) with inner diameter 6-12 mm for relay cable (for options D01 or D03)				
Probe connection		Digital plug-in connection				
Voltage supply		2-wire: 24 VDC (18 to 24 VDC ±10 %) 4-wire: 20 to 30 VAC/DC, 200 mA max. current consumption				
Protection class		IP 65				
EMC		2004/108/EG				
Operating temperature housing		-40 to +70 °C (-40 to +158 °F), with display 0 to +50 °C (+32 to +122 °F), optimal at +15 to 35 °C, (+59 to +95 °F)				
Storage temperature		-40 to +80 °C (-40 to +176 °F)				
Measurement parameters		Temperature in °C / °F Relative humidity %rF / %RH Dewpoint in $°C_{td}$ / $°F_{td}$				
Measurement medium		Air, nitrogen, more on request: applicationsupport@testo.de				
SENSOR (more data see probes)						
Humidity		Testo humid. sensor, cap.				
Reproduceability		better than ±0.2 %RH				
Measurement inaccuracy %RH		cf. probe data				
Probes		6601	6602	6603	6604	6605
Measuring range (Standard scaling)	Humidity	0 to 100 %RH				
	Temperature	-20 to +70 °C (-4 to +158 °F)	-20 to +70 °C (-4 to +158 °F)	-30 to +120 °C (-22 to +248 °F)	-20 to +70 °C (-4 to +158 °F)	-30 to +120 °C (-22 to +248 °F)
	Dewpoint	-60 to +100 $°C_{td}$ or -76 to +212 $°F_{td}$				
Reaction time without protective filter		t 90 max. 10 s				
ANALOG OUTPUT (uniform for all channels, specify when ordering)						
Quantity		2 channels (type analog signal uniform for both channels, specify when ordering)				
Current/accuracy		4 to 20 mA ±0.03 mA (2-wire) 0 to 20 mA ±0.03 mA (4-wire) 4 to 20 mA ±0.03 mA (4-wire) for heated sensor technology				
Voltage/accuracy		0 to 1 V ±1.5 mV (4-wire) 0 to 5 V ±7.5 mV (4-wire) 0 to 10 V ±15 mV (4-wire)				
Galvanic isolation		Galvanic isolation of the output channels (2-wire and 4-wire), isolation of supply from outputs (4-wire)				
Resolution		12 bit				
Maximum load		2-wire 12 VDC: 100 Ohm 24 VDC: 500 Ohm 30 VDC: 625 Ohm 4-wire 500 Ohm				
FURTHER OUTPUTS						
Relays (optional)		4 relays (free allocation to measurement channels or as collective alarm with operating menu/P2A software), up to 250 VAC / 3 A, (NC/C/NO)				
Digital output		Mini DIN for Testo P2A parameterization software and Testo portable instruments 400/650				
Ethernet		Ethernet with Saveris connection or open protocol with XML output. IP address allocation possible via P2A software				

3.2 Probe series testo 6600

Model		testo 6601	testo 6602	testo 6603	testo 6604	testo 6605
						
Type		Wall	Duct	Duct	Cable	Cable
Application		Room climate probe wall mounting	Climate probe duct mounting	Process climate probe duct mounting for higher process temperatures	Climate probe with cable	Stainless steel process probe with cable for higher process temperatures
Measurement parameters		%rF/%RH, °C_{td}/°F_{td}, °C/°F				
Measuring range	Humidity	0 to 100 %RH				
	Temperature	-20 to +70 °C (-4 to +158 °F)		-30 to +120 °C (-22 to +248 °F)	-20 to +70 °C (-4 to +158 °F)	-30 to +120 °C (-22 to +248 °F)
Material	Probe shaft	Plastic ABS				Stainless steel
	Cable	FEP coated				
	Plug	Plastic ABS				
Measurement inaccuracy*	Humidity: (+25 °C)**	± (1.7 + 0.007* Mw) %RH (0 to 90%RH) / ± (1.9+ 0.007* Mw) %RH (90 to 100%RH)				
	Humidity: for deviations from the media temperature ±25 °C	+0.02 %RH/K				
	Temperature: at +25 °C / +77 °F	±0.2 °C / 0.38 °F (PT1000 Class A / PT1000 1/3 Class B)				±0.15 °C / 0.27 °F PT1000 1/3 Class B)
Reproduceablility	Humidity	better than ±0.2 %RH				
Probe dimensions	Diameter	12 mm				
	Probe shaft length L	70/200 mm	280 mm		140/280 mm	200/500 mm
Cable length		–	specially for duct versions		1/2 m	1/2/5 m
Pressure tightness		without	1 bar positive pressure (probe tip) (14.5 psi) no negative pressure			1 to 10 bar (probe tip) (14.5 psi) 1 bar (probe tip) (14.5 psi)
Drawings						

****The determination of measurement uncertainty of the transmitter is carried out according to GUM (Guide to the Expression of Uncertainty in Measurement):**
For the determination of measurement uncertainty, the accuracy of the measuring instrument (hysteresis, linearity, reproduceability), the uncertainty contribution of the test site as well as the uncertainty of the adjustment site (works calibration are taken into account. For this purpose, the value of k=2 of the extension factor, which is usual in measurement technology is used as a basis, which corresponds to a trust level of 95%.

Temperature error dependent on process temperature and electronics temperature



*Other accuracies apply for the wall probe with 70 mm length in combination with a current output (P07):
Operation: with 2 channels at 12 mA, without display illumination, relay off, additional measurement inaccuracy to above data at +25 °C (+77 °F), humidity ±2.5 %RH, temperature ±1 °C (1.8 °F)

1 Description

The industrial humidity measurement transmitter:

- Highest accuracy and very good long-term stability
- Exchangeable, adjusted probes from the testo 6610 series
- Probe versions specially for trace humidity, H_2O_2 and contaminated environments
- Robust metal housing
- Option for interface Profibus DP
- Optimum adjustment possibilities even on site
- Option for Ethernet interface
- Early warning reports/self-diagnosis
- Operation via P2A software Testo or directly via 4 buttons
- Traceability of all settings/reports via internal record
- All common variants of design and signal output can be ordered customer-specifically

2 Exchangeable probes: probe series testo 6610

2.1 Description probe series

Functions and application

The plug-in, adjusted probes from the testo 6610 series are used in conjunction with the humidity measurement transmitter testo 6681.

Examples of suitable areas of application for these measuring systems are:
- Process measurement technology
- Cleanrooms
- Test benches
- Drying processes
- Production and storage air quality
- Demanding HVAC applications

Digital probes

The probes are adjusted ex-works, and transfer their adjustment data to the internal store of the testo 6681. The synchronization of information between the probe and the measurement transmitter takes place digitally. This means that for adjustment or service purposes, the probes can be separated from the measurement transmitter, which can remain at the measurement site. The measurement transmitter recognizes the probe, and stores in its history which probes have been connected.

In order to guarantee the very high accuracy of the probe series testo 6610, the sensor in the probe cannot be exchanged by the customer.

For a change of sensor, please contact Testo customer service.

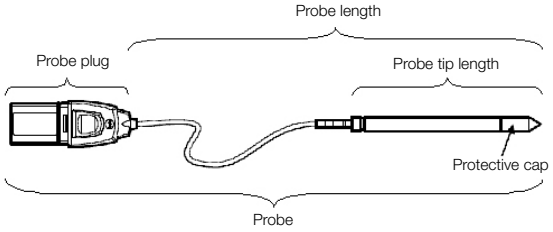
The probes of the series testo 6610 monitor their function themselves and report the following malfunctions:
- Sensor breakage
- Sensor short circuit
- Condensation

The condensation report is made at a measurement value of 100 %RH, and deactivated again as soon as the measurement values return to the permitted range.
- Value for relative humidity less than 0:The switching threshold is set at -3 %RH. The result of this is that an error is not reported until a clear effect is recognizable.
- Early warning of beginning sensor corrosion:

The probe testo 6617 is able to report the first signs of corrosion. This means the probe can be exchanged early without interrupting the availability of the system

Included in delivery

Included in delivery of the probe series 6610:
- Probe plug
- Probe shaft with filter and sensors (%RH and °C/°F)
- Fixing bracket (for duct version testo 6612)
- Probe cable (for duct and cable versions testo 6612 to 6617).



3.1 testo 6681

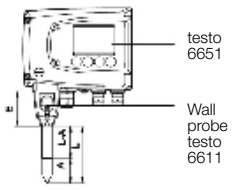
GENERAL								
Housing	Metal							
Dimensions	24122 x 162 x 77 mm (without probe)							
Weight	1.5 kg (without probe), without Profibus/Ethernet module							
Display	2-line LCD with clear-text line (optional) and relay status display. Four operating buttons for operating menu.							
Resolution display	0.1 %RH or 00.1 °C / °F / °C td / °Ftd / °Ctw / °Ftw or 1g / kg / g/m³ / ppm							
Cable screw fitting (Code D01)	M 16 x 1.5 (2x) with inner diameter 4-8 mm for signal/supply cable (for option D01) M 20 x 1.5 (2x) with inner diameter 6-12 mm for relay cable (for options D01 or D03)							
Probe connection	Digital plug-in connection							
Voltage supply	2-wire: 24 VDC (18 to 24 VDC ±10 %) 4-wire: 20 to 30 VAC/DC, 200 mA max. current consumption							
Protection class	IP 65							
EMC	2004/108/EG							
Operating temperature housing	-40 to +70 °C (-40 to +158 °F), with integrated display -40 to +60°C, with display 0 to +50 °C, optimal at +15 to 35 °C, -40 to +60°C with integrated relay							
Storage temperature	-40 to +80 °C							
Measurement parameters	Dependent on probe, altogether are available: Temperature in °C / °F; relative humidity %rF (%RH); dewpoint in °C_{td} (°F_{td}); pressure dewpoint in °C_{td} (°F_{td}); absolute humidity in g/m³ (gr/ft³); degree of humidity in g/kg (gr/lb); enthalpy in kJ/kg (BTU/lb); psychrometer temperature in °Ctw (°Ftw); water vapour partial pressure in hPa / H_2O; water content in ppm vol / % Vol; mixture dewpoint H_2O_2 / in °Ctm / °Ftm							
Measurement medium	Air, nitrogen, more on request: applicationsupport@testo.de							
SENSOR (more data see probes)								
Humidity	Testo humid. sensor, cap.							
Reproduceability	better than ±0.2 %RH							
Measurement inaccuracy %RH	cf. probe data							
Probes	6611	6612	6613	6614	6615	6617		
Measuring range (Standard scaling) Humidity	0 to 100 %RH				-60 to +30 °C_{td}	0 to 100 %RH		
Measuring range (Standard scaling) Temperature	-20 to +70 °C (-4 to +158 °F)	-30 to +150 °C (-22 to +302 °F)	-40 to +180 °C (-40 to +356 °F)	-40 to +180 °C (-40 to +356 °F)	-40 to +120 °C	-40 to +180 °C		
Measuring range (Standard scaling)	%RH	°C_{td}	°F_{td}	g/m³	g/kg	°Cwb	°Fwb	
	0 to 100	-80 to +100	-112 to +212	0 to 600	0 to 9500	-40 to +180	-40 to +356	
Reaction time without protective filter	t 90 max. 10 s							
ANALOG OUTPUT (uniform for all channels, specify when ordering)								
Quantity	2 channels (type analog signal uniform for both channels, specify when ordering) additional 3rd channel (optional)							
Current/accuracy	4 to 20 mA ±0.03 mA (2-wire) 0 to 20 mA ±0.03 mA (4-wire) 4 to 20 mA ±0.03 mA (4-wire) for heated sensor technology							
Voltage/accuracy	0 to 1 V ±1.5 mV (4-wire) 0 to 5 V ±7.5 mV (4-wire) 0 to 10 V ±15 mV (4-wire)							
Galvanic isolation	Galvanic isolation of the output channels (2-wire and 4-wire), isolation of supply from outputs (4-wire)							
Resolution	12 bit							
Maximum load	2-wire 12 VDC: 100 Ohm 24 VDC: 500 Ohm 30 VDC: 625 Ohm 4-wire 500 Ohm							
FURTHER OUTPUTS								
Relays (optional)	4 relays (free allocation to measurement channels or as collective alarm with operating menu/P2A software), up to 250 VAC / 3 A, (NC/C/NO)							
Digital output	Mini DIN for Testo P2A parameterization software and Testo portable instruments 400/650 Profibus-DP (optional as an intermediate layer)							
Ethernet	Ethernet with Saveris connection or open protocol with XML output. IP address allocation possible via P2A software							

A5 3 Technical data

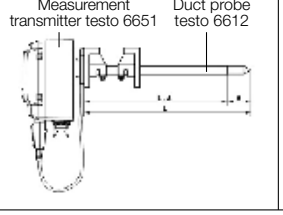
3.2 Probe series testo 6610

Model		testo 6611	testo 6612	testo 6613	testo 6614	testo 6615	testo 6617
							
Type		Wall	Duct	Cable	Heated cable	Cable trace humidity (self-adjustment)	Cable with cover electrode monitoring
Application		Room climate probe wall mounting	Process humidity probe duct mounting	Process humidity probe flexible with cable	Humidity probe for high humidity applications / when risk of condensation	Humiditiy probe for trace humidity / dewpoint (with self-adjustment)	Humidity probe with self-monitoring for sensor-damaging media
Measurement parameters		°C/°F, %rF/%RH, $°C_{td}$/$°F_{td}$, $°C_{td}$/$°F_{td}$, g/m^3/gr/ft^3, g/kg/gr/lb, kJ/kg, BTU/lb, °Ctw/°Ftw, hPa, inch H_2O, ppm vol %, %vol, °Ctm (H_2O_2)/°Ftm (H_2O_2)					
Measuring range	Humidity	0 to 100 %RH				-60 to +30 $°C_{td}$	0 to 100 %RH
	Temperature	-20 to +70 °C (-4 to +158 °F)	-30 to +150 °C (-22 to +302 °F)	-40 to +180 °C (-40 to +356 °F)		-40 to +120 °C (-40 to +356 °F)	0 to +180 °C (32 to +356 °F)
Material	Probe shaft	Stainless steel					
	Cable	FEP coated					
	Plug	Plastic ABS					
Measurement inaccuracy*	Humidity: (+25 °C)**	testo 6611/12/13: ± (1.0 + 0.007* m.v.) %RH (0 to 90%RH) / ± (1.4+ 0.007* m.v.) %RH (90 to 100%RH) testo 6614: ± (1.0 + 0.007* m.v.) %RH (0 to 100%RH) testo 6617: ± (1.2 + 0.007* m.v.) %RH (0 to 90%RH) / ± (1.6 + 0.007* m.v.) %RH (90 to 100%RH)					
	Humidity: for deviations from the media temperature ±25 °C	+0.02 %RH/K					
	Pressure dewpoint					±1 K at 0° C_{tpd} ±2 K at -40° C_{tpd} ±4 K at -50° C_{tpd}	
	Temperature: at +25 °C / +77 °F	±0.15 °C / 0.27 °F (PT1000 1/3 Class B)				±0.15 °C / 0.27 °F PT100 1/3 Klasse B	±0.15 °C / 0.27 °F PT1000 1/3 Klasse B
Reproduceablility	Humidity	better than ±0.2 %RH					
Probe dimensions	Diameter	12 mm					
	Probe shaft length L	80/200 mm	200/300/500/800 mm	120/200/300/500/ 800 mm	200/500 mm		
Cable length		–	specially for duct versions	1/2/5/10 m			
Pressure tightness		1 bar positive pressure (probe tip) no negative pressure		1 to 10 bar (145 psi) (probe tip) 1 bar (43.5 psi) (probe tip)		1 to 16 bar (232 psi) (probe tip)	1 bar (14.5 psi) positive pressure (probe tip)

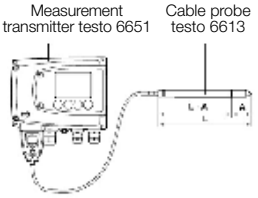
testo 6611



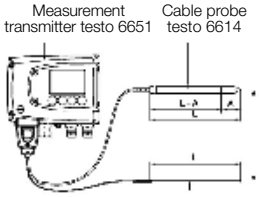
testo 6612/6622



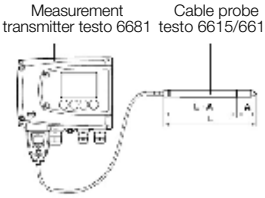
testo 6613/6623



testo 6614

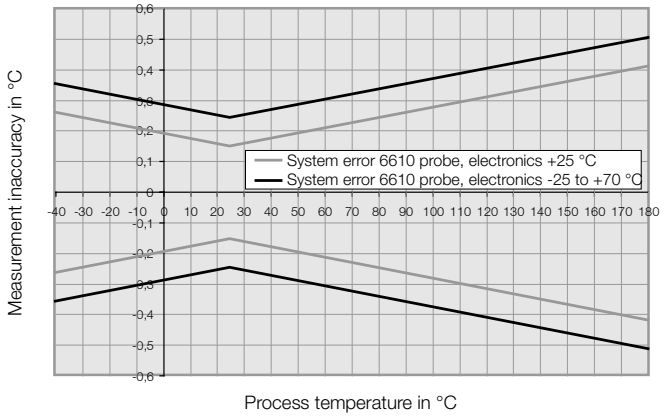


testo 6615/6617



****The determination of measurement uncertainty of the transmitter is carried out according to GUM (Guide to the Expression of Uncertainty in Measurement):**
For the determination of measurement uncertainty, the accuracy of the measuring instrument (hysteresis, linearity, reproduceability), the uncertainty contribution of the test site as well as the uncertainty of the adjustment site (works calibration are taken into account. For this purpose, the value of k=2 of the extension factor, which is usual in measurement technology is used as a basis, which corresponds to a trust level of 95%.

Temperature error dependent on process temperature and electronics temperature



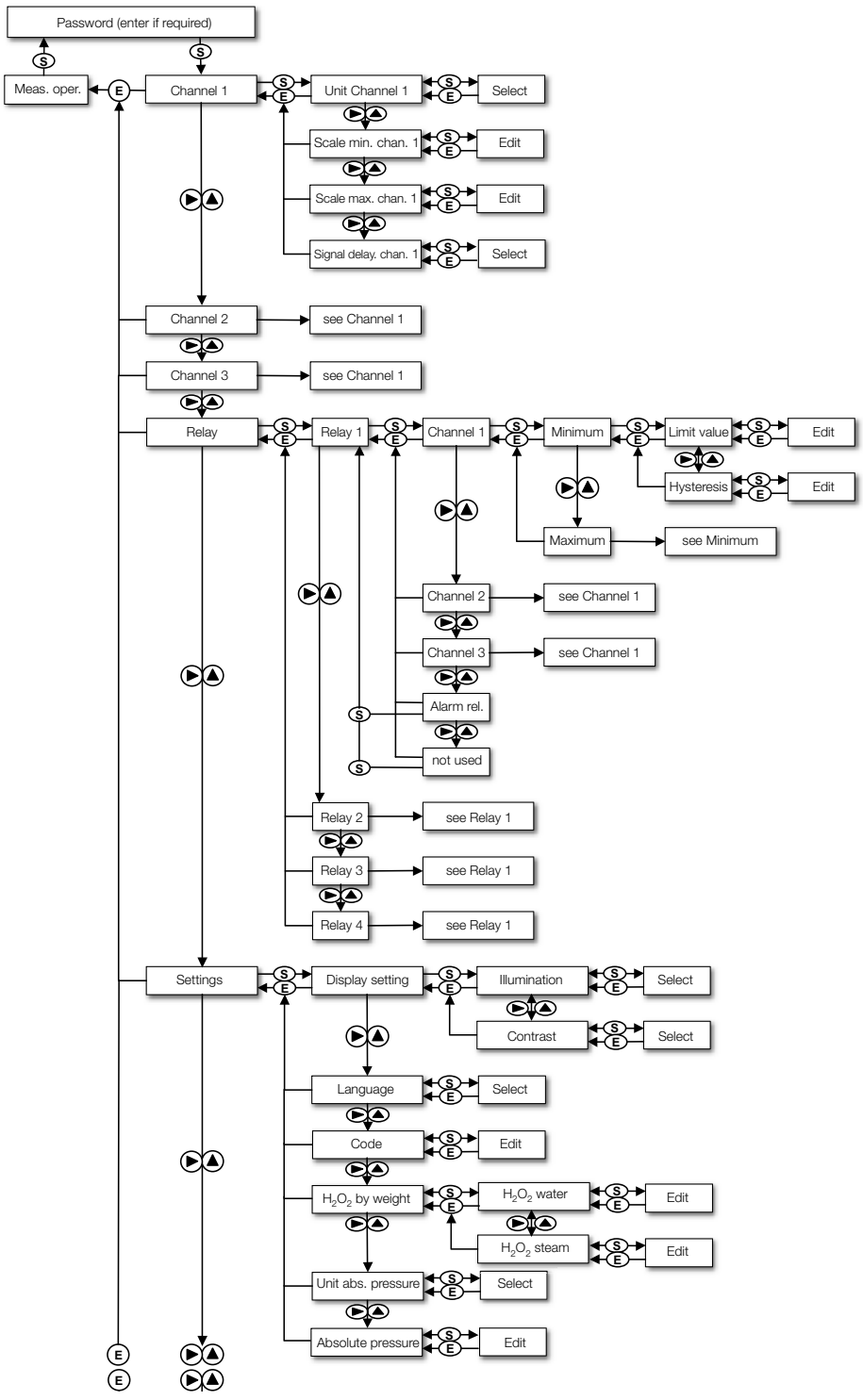
*Other accuracies apply for the wall probe with 70 mm length in combination with a current output (P07):
Operation: with 2 channels at 12 mA, without display illumination, relay off, additional measurement inaccuracy to above data at +25 °C (+77 °F), humidity ±2.5 %RH, temperature ±1 °C (1.8 °F)

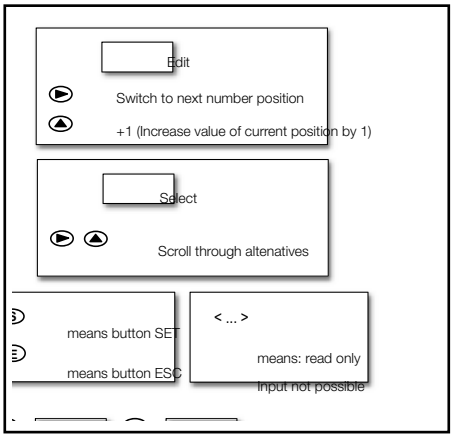
The operation (parameterization, adjustments, display of reports etc.) can be carried out in testo 6681 optionally directly via the 4 operating buttons or via the parameterization software P2A from Testo. The large display (optional) is a great help in operating the measurement transmitter easily and clearly. Almost all menu points are spelt out and not presented as abbreviations.

How to use the operating menu via buttons is shown in the following. The P2A software is described at the end of the chapter.

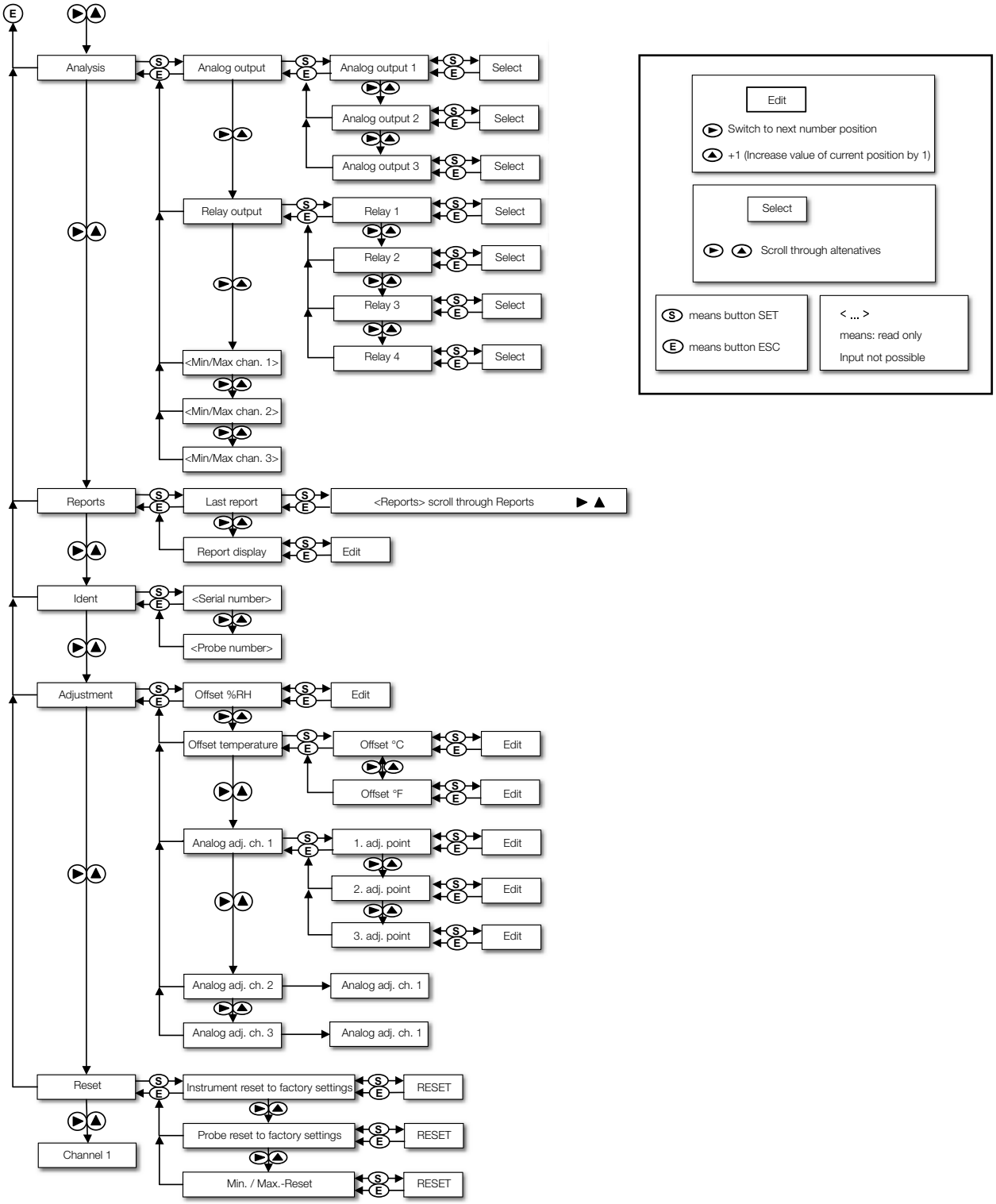
All essential parameterizations and functions can be set using the operating buttons on the measurement transmitter:
- Activation of the password
- Scaling the channels
- Relays: switch thresholds, hysteresis per channel
- Display settings
- Display of all status, warning and error reports
- Adjustments
- Reset

Structure and content of the operating menu of the measurement transmitter:





A6 1 Operating menu



For optimum operational security, the measurement transmitter provides the following reports as standard via the operating menu or the P2A software:

- **Status reports**
- **Warning reports and**
- **Error reports**

They are presented for the measurement transmitter 6681 and the connected probe testo 661x respectively.

The probe 6617 has takes over a particular function. It monitors the functionality of the sensor via the cover electrode. This reports additional wear through corrosion to the sensor, i.e. already at the point when it occurs, and not only when the sensor ceases to function. This mechanism does not prolong the life of the sensor, it merely provides the information early (self-monitoring).

Status reports

Status reports give the current operational status of the measurement transmitter/probe

	Report (display)	Description	Report number
Measurement transmitter	Limit value changed	The limit value was changed or moved	00300
	Scaling changed	The scaling was changed	00301
	Reset executed	The measurement transmitter was reset to factory settings	00500
	Reset MIN/MAX	Resets the stored MIN/MAX values for all channels	0052F
	Reset executed	The measurement transmitter is restarted	00500
	Connection probe	A probe is connected	02506
	Service plug	The Mini DIN socket is connected to the USB adapter for P2A software, the adjustment adapter or the service plug / in not recorded/no number	01D19
	User setting changed	General settings were changed in the measurement transmitter	00307
	Probe disconnected	There is no probe connected	03001
	Analog out adjust	An analog adjustment was carried out	02104
Probe	1-point adjust	A 1-point adjustment is carried out	02101
	2-point adjust 11.3	For a 2-point adjustment, an adjustment at 11.3 %RH is carried out	02102
	2-point adjust 75.3	For a 2-point adjustment, an adjustment at 75.3 %RH is carried out	02103
	Probe reset	The probe is reset	02500

Warning reports

Warning reports represent an early warning or a current malfunction which could negatively influence measurement operation.

	Report (display	Cause	Error correction	Report number
Measurement transmitter	Drift 2point adjust*	Similar corrections occur repeatedly in 2-point adjustment; this can be an indication of sensor drift	Send the probe to Testo service	02101
	Ambient temp high**	The ambient temperature exceeds the permitted temperature for the measurement transmitter	Ensure lower ambient temperature, e.g by cooling or ventilating	00E00
	Ambient temp low**	The ambient temperature is lower than the permitted temperature for the measurement transmitter	Ensure higher ambient temperature, e.g by heating	00E01
	Supply voltage low**		Ensure sufficient voltage supply	00E02
Probe	Process temp high**	The process temperature exceeds the intended temperature for the probe	Remove the probe from the process and if necessary ensure lower process temperature	00E00
	Condensation start*	100 %RH has been reached, condensation occurs	Ensure lower process humidity	02806
	Values below 0 %RH**	The adjustment of the probe is incorrect	Check adjustment (via P2A adjustment history, if required carry out 2-point adjustment). If problem still exists, contact Testo service	02807
	Sensor early warning	Only in probe 6617: the sensor is still functional but the cover electrode is already damaged. The consequence can already be inaccurate measurement values, certainly however a continuous loss of accuracy until complete sensor breakage.	Replace probe and send back to Testo for testing	2809

*Early warning **Current malfunction

A6 3 Wiring / electrical connection

Error reports

Error reports represent a current malfunction

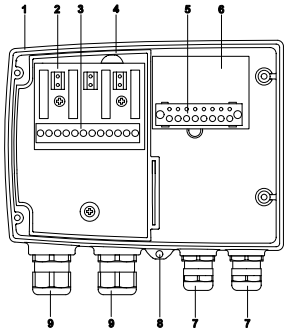
	Report (display)	Cause	Error correction	Report number
Measurement transmitter	No communication	The probe communication is interrupted	- Ensure probe plug is fully pushed into measurement transmitter - If communication can still not be established, contact Testo service	01000
	Wrong probe	The probe connected is not compatible with the measurement transmitter	Use compatible probe. Note: the probes 660x belong to measurement transmitter 665x the probe 661x to the measurement transmitter 668x.	03508
	Watchdog error	Due to a process error, the measurement transmitter carries out an automatic restart	If problem occurs repeatedly, contact Testo service	01505
Probe	%RH short circuit	Short circuit in humidity sensor	Contact Testo service	0300A
	%RH sensor broken	Humidity sensor is damaged (sensor breakage)	Contact Testo service	0300B
	T short circuit	Short circuit in temperature sensor	Contact Testo service	0300C
	T sensor broken	Temperature sensor is damaged (sensor breakage)	Contact Testo service	0300D
	Self-adjustment error	Only in probe testo 6615: the automatic self-adjustment was incorrect	Contact Testo service	03105

Note on alarm reports

For alarm upper and lower limits, single alarmsas well as collective alarms can be specified. If the function collective alarm is activated, an alarm is triggered as soon as an alarm limit or alarm group is exceeded.

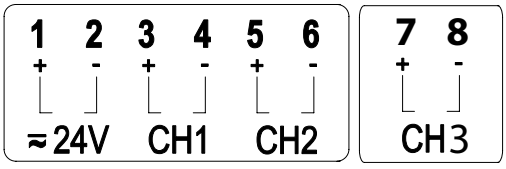
a) Connection overview

1 Housing base
2 Relay board
3 Relay connections
4 Insulation box for relay board
5 Terminal strip for voltage supply and analog outputs
6 Analog board
7 Screw fitting M 16 x 1.5*
8 Eye for measurement site tag
9 Screw fitting M 20 x 1.5*
* alternatively NPT screw fitting or M plug connection



b) Voltage supply

1. Feed cable with voltage supply and analog signal lines through open screw fitting M 16 x 1.5 (pos. (7) in the connection overview).
2. Deinsulate cable ends, pinch on wire terminal caps and connect to voltage terminals
3. Close screw fitting M 16 x 1.5 (pos. (7) in the connection overview).



c) Analog outputs

As analog outputs, the testo 6651 has either

- 2 current outputs (testo 6681 optionally 3) 4 to 20 mA (2-wire) / 0 to 20 mA (4-wire) / 4 to 20 mA (4-wire)

or

- 2 voltage outputs (testo 6681 optionally 3) 0 to 1 V / 0 to 5 V / 0 to 10 V (4-wire).

d) Connection description

In 2-wire operation, channel 1 is used for supply. The two channels are galvanically isolated from each other in 2-wire as well as in 4-wire operation.

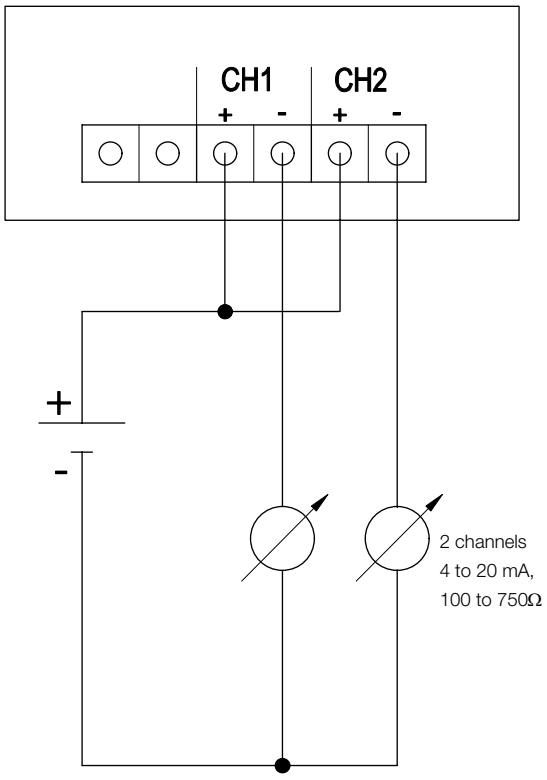
Important information:

The relay option and the display backlighting are available only in 4-wire operation.

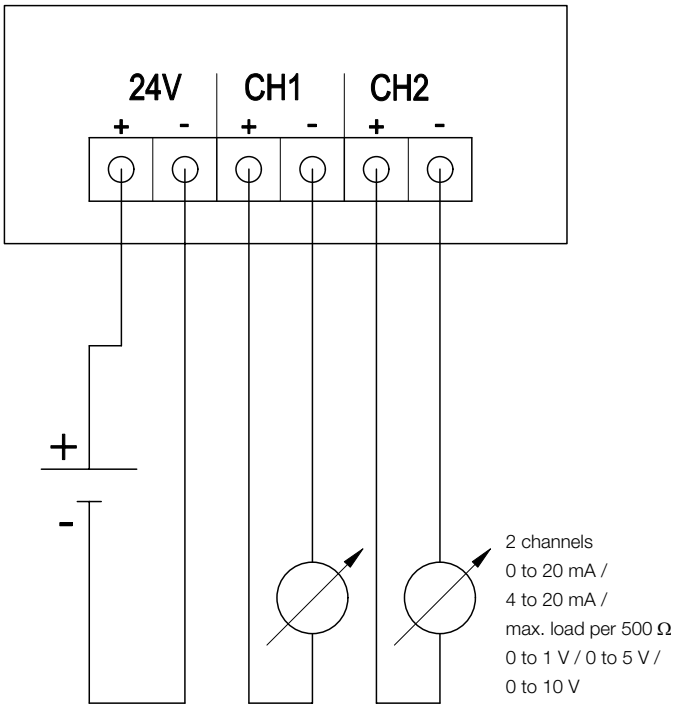
Important information:

If galvanic isolation of the channels is necessary, a separate mains unit for each channel must be used.

Connection diagram 2-wire technology (4 to 20 mA)



Connection diagram 4-wire technology (0 to 20 mA / 4 to 20 mA / 0 to 1 V / 0 to 5 V / 0 to 10 V)



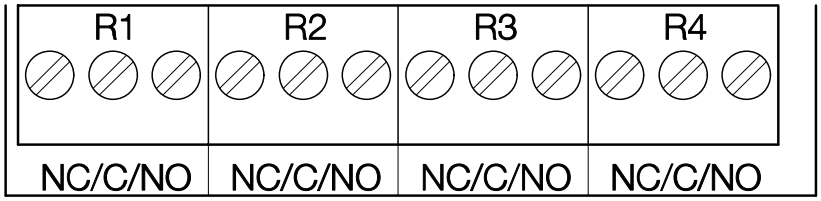
1. Feed connection cables of the two channels through open screw fitting M 16 x 1.5.
2. Deinsulate cable ends, pinch on terminal sleeves and connect to cable connections according to the diagram
3. Close screw fitting M 16 x 1.5.

A6 3 Wiring / electrical connection

e) Relay connection

The relay board has a potential-free switching performance of 250 VAC / 3 A. 12 terminals are available for a total of 4 relays (2 relays per channel).

Switch thresholds and hysteresis can be set via the display or the P2A software

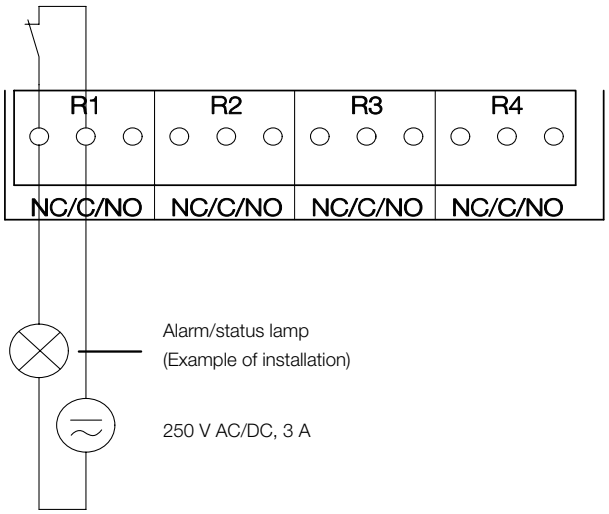


Relay terminal strip

1. Feed connection cables for the relays through open screw fitting M 20 x 1.5.
2. Deinsulate wire ends and pinch on terminal sleeves
3. Connect relay according to the selected function (normally open NO/normally closed NC) - (see following illustrations, relay 1 is shown as an example of connection.)

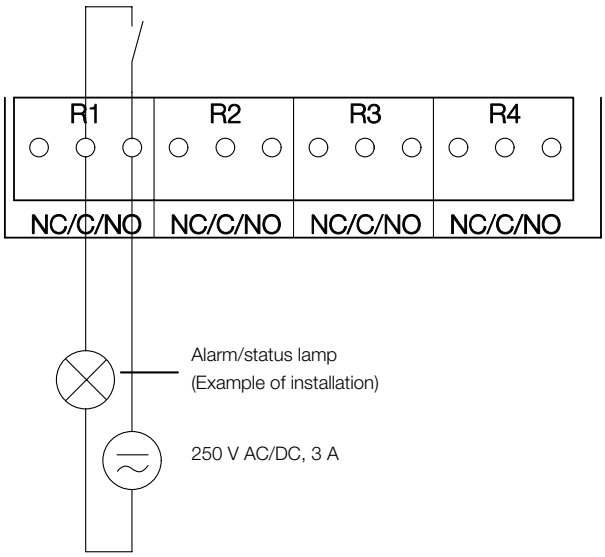
Ther are optionally twelve connection terminals for a total of four relays. The descriptions NC/C/NO (normally closed / pole / normally open) are etched into the surface of the board

Use of the relay as normally closed (NC)



The operating lamp (alarm/status lamp) is continuously lit until the relay opens or the electrical circuit is interrupted. This switch can be used to monitor the functioning of the alarm circuit, as a cable breakage, for example, is indicated if the lamp is no longer lit.

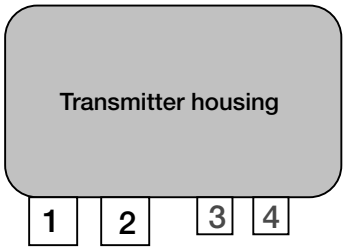
Use of the relay as normally open (NO)



The operating lamp (alarm/status lamp) is lit only when the relay is switched (closed). A monitoring of the function of the alarm circuit is therefore not possible with this switch configuration.

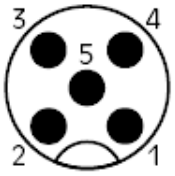
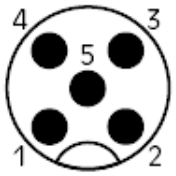
4. Close the screw fitting M 20 x 1.5

f) Optional plug connection

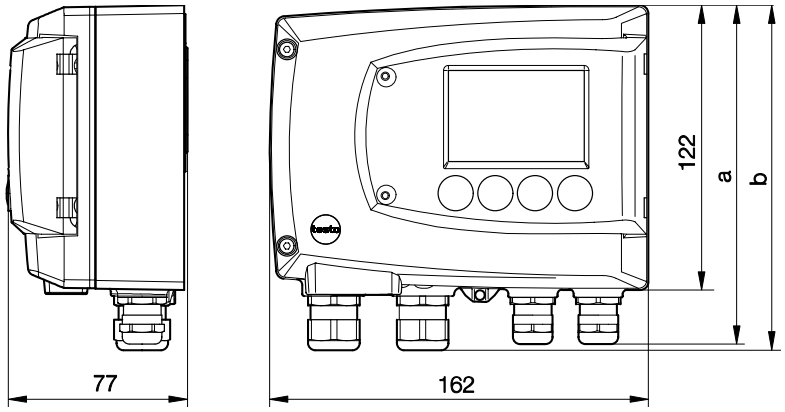


1) and 2) Option plug connection instead of M20 (Relay 1/2 und Relay 3/4) Allocation of plug connection pins mounted on housing:

3) and 4) Option plug connection instead of M16 (current supply and channels) Allocation of plug connection pins mounted on housing:

3 5-pin socket		4 5-pin plug	
			
Pin	Allocation	Pin	Allocation
1	V24 -	1	- Ch 2
2	V24 +	2	+ Ch 2
3	+ Ch 1	3	+ Ch 3
4	- Ch 1	4	- Ch 3
5	PE	5	PE

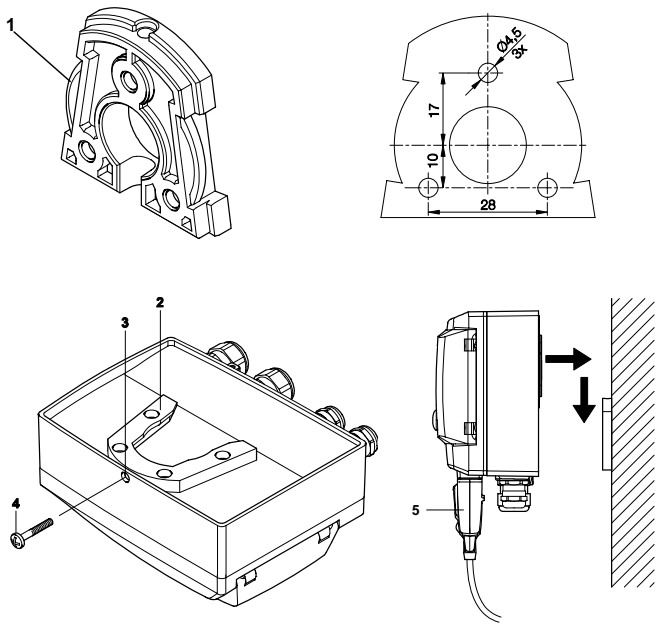
4. Technical drawings



Dimensions in mm	a	b
with cable screw fitting M	144	147
with cable screw fitting NPT	144	144
with plug connection M		

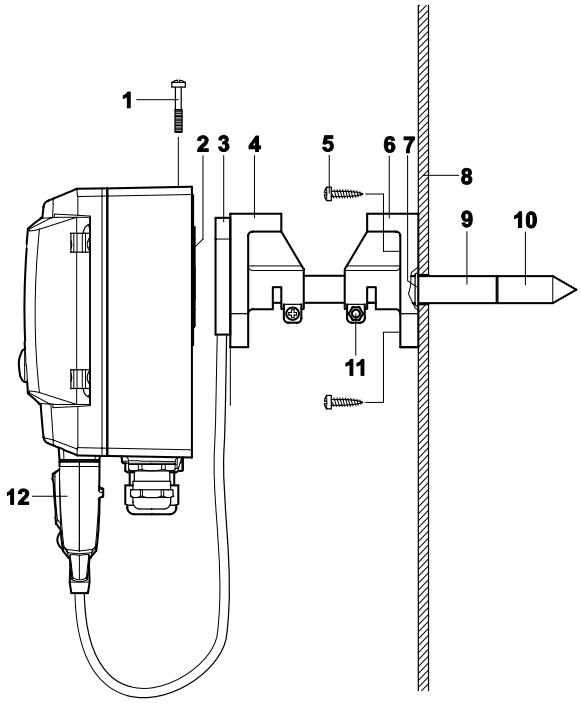
A6 5 Installation

5.1 Wall version



1. Remove safety screw (4), and pull rear wall bracket from plastic fitting (2).
2. Hold rear wall bracket in installation position and mark drilling holes
3. Drill three holes (5 mm) and insert plugs if necessary.
4. Screw on rear wall bracket (with M4 screws /3.5 mm wood screws. Ensure that the fixing clips are facing the wall.
5. Push the plastic fitting (2) on to the rear wall bracket until it clcks into place (see arrows).
6. Push screw (4) through hole (3) and screw tight into the rear wall holder.
7. Push probe plug (5) into socket until it clicks into place.

5.2 Duct version



1. Hold wall/duct bracket (order no. 0554 6651) (6) to duct wall (8) and mark the drilling holes for the wall/duct bracket and the probe shaft.
2. Drill hole for the probe shaft (diameter 13 mm) in the duct wall.
3. Fix wall/duct holder (6) with screws (3.5 mm sheet metal screws (5) to the duct wall.
4. Push probe shaft (9) with filter (10) through the centre hole of the fixing bracket.
5. Fix the correct position of the probe shaft (9) with screw (11), and mark (push probe shaft as far as possible through).
6. Push the plastic fitting (2) on the rear of the measurement transmitter (3, 4) until it clicks into place.
7. Push the screw (1) through the hole on the upper side of the instrument and screw tight on to bracket (3).
8. Push probe plug (12) into socket until it clicks into place.

6.1 testo 6651 and probe series testo 6600

Basic versions:
testo 6651 housing + probe from series 6600

Measuring range: Probe dependent
Humidity: 0 %RH to 100 %RH
Temperature: testo 6601/6602/6604: -20 to +70 °C (-4 to +158 °F)
testo 6603: -30 to +120 °C (-4 to +248 °F)
testo 6605: -30 to +120 °C (-22 to +248 °F)

Additional alternative measurement parameters:
Humidity: %rF / %RH, $°C_{td}$ / $°F_{td}$
Temperature: °C / °F

Operating temperature: housing surroundings
without display: -40 to +70 °C (-40 to +158 °F)
with display: 0 to +50 °C (-32 to +122 °F)
Process (probe): -30 to +120 °C (-22 to +266 °F)

Signal output:
Two analog output signals:
4 to 20 mA ±0.03 mA (2-wire)
0 to 20 mA ±0.03 mA (4-wire)
4 to 20 mA ±0.03 mA (4-wire)
0 to 1 V ±1.5 mV (4-wire)
0 to 5 V ±7.5 mV (4-wire)
0 to 10 V ±15 mV (4-wire)
Digital output:
- Mini-DIN for the P2A software from Testo
- 4 relay outputs
- Ethernet (opt.)

Optimum sensor protection with suitable filters
Stainless steel protective cap
Wire mesh protective cap
PTFE protective cap
Open metal protective cap
Open plastic protective cap
PTFE protective cap with drip hole
Condensation protection

Supply:
2-wire (4 to 20 mA): 24 VDC ±10 %
4-wire (0 to 1 V / 0 to 5 V / 0 to 10 V / 0 to 20 mA / 4 to 20 mA):
20 to 30 VAC/VDC
Current consumption: 200 mA

Display functions:
2-line LCD with information line (optional)
Humidity resolution: 0,1 %RH
Temperature resolution: 0.01 °C / 0.01 °F
Refresh rate: 1/s

Basic measurement inaccuracy humidity:*
± (1.7 + 0.007* m.v.) %RH (0 to 90 %RH)
± (1.9 + 0.007* m.v.) %RH (90 to 100 %RH)
0.02 %RH/K (at discrepancy ±25 °C)

Measurement inaccuracy temperature:
0.2 °C (at +25 °C)
0.38 °F (at +77 °F)

Housing material:
Plastic: ABS

Cable screw fitting:
M 16 x 1.5 (2x) with inner diameter 4-8 mm
M 20 x 1.5 (2x) with inner diameter 6-12 mm

Protection class:
IP65

Dimensions:
122 x 162 x 77 mm
Probe see drawing

Interesting accessories:

1) Parameterization, adjustment and analysis software (P2A software incl.adapter cable USB to Mini-DIN)
[Order no. 0554 6020]

2) testo 400, multifunction measuring instrument incl. measurement value store up to 500.000 readings, VAC module, battery, Li-calle and calibration protocol
[Order no. 0563 4001]
Highly precise reference humidity/temperature probe incl. calibration certificate
[Order no. 0636 9741]
Adjustment adapter (for 1-point adjustment with testo 400/650)
[Order no. 0554 6022]

3) Control and adjustment set for 2-point adjustment (11.3 % and 75.3 %RH)
[Order no. 0554 0660]

4) Mains unit (desktop), 90 to 264 VAC / 24 VDC (3 A)
[Order no. 0554 1748]

5) ISO calibration certificate at 11.3 % and 75.3 %RH
[Order no. 0520 0076]
DKD calibration certificate at 11.3 % and 75.3 %RH
[Order no. 0520 0246]

6) Ethernet intermediary layer

7) Extension and adjustment cable 10m
[Order no. 0554 6610

* For more details on determining measurement uncertainty humidity according to GUM see page 20.

A6 6 Specifications

6.2 testo 6681 and probe series testo 6610

Basic versions:
testo 6681 housing + probe from series 6610

Measuring range: Dependent on probe
Humidity: 0 %RH to 100 %RH
Trace humidity: -60 to +30 °C_{td} (-76 to +86 °F_{td})
Temperatur: 6611: -20 to +70 °C (-4 to +158 °F)
6612: -30 to +150 °C (-22 to +302 °F)
6613: -40 to +180 °C (-40 to +356 °F)
6614: -40 to +180 °C (-40 to +356 °F)
6615: -40 to +120 °C (-40 to +248 °F)
6617: -40 to +180 °C (-40 to +356 °F)

Additional alternative measurement parameters:
Humidity measurement parameters:
°C_{td}/°F_{td}, °C_{td}/°F_{td}, g/m³/gr/ft³, g/kg/gr/lb, kJ/kg/BTU/lb, °Ctw/°Ftw, hPa, inch H_2O, ppm vol%, %vol, °Ctm (H_2O_2)/°Ftm (H_2O_2)

Operating temperature: housing surroundings
without display: -40 to +70 °C (-40 to +158 °F)
with integrated
relay: -40 to + 60 °C
with display: 0 to +50 °C (-32 to +122 °F)
Process (probe): -40 to + 180 °C (-40 to +356 °F)

Signal output:
Two analog output signals (standard), optionally three:
4 to 20 mA ± 0.03 mA (2-wire) not woth relay and probes 6614/6615
0 to 20 mA ± 0.03 mA (4-wire)
4 to 20 mA ± 0.03 mA (4-wire)
0 to 1 V ± 1.5 mV (4-wire)
0 to 5 V ± 7.5 mV (4-wire)
0 to 10 V ± 15 mV (4-wire)
Digital output:
- Mini-DIN for the P2A software from Testo
- 4 relay outputs (opt.)- Profibus-DP (opt.)
- Ethernet (opt.)

Optimum sensor protection with suitable filters
- Stainless steel protective cap
- Wire mesh protective cap
- PTFE protective cap
- Open metal protective cap
- PTFE protective cap with drip hole
- Condensation protection
- H_2O_2 filter

Supply:
- 2-wire (4 to 20 mA): 24 VDC ±10 %
- 4-wire (0 to 1 V / 0 to 5 V / 0 to 10 V / 0 to 20 mA / 4 to 20 mA): 20 to 30 VAC/VDC
- Current consumption: 200 mA

Display functions:
2-line LCD with information line (optional)
Humidity resolution: 0,1 %RH
Temperature resolution: 0.01 °C / 0.01 °F
Refresh-Rate: 1/s

Basic measurement inaccuracy humidity:
testo 6611/12/13: ± (1.0 + 0.007* m.v.) %RH (0 to 90%RH)
± (1.4+ 0.007* m.v.) %RH (90 to 100%RH)
testo 6614: ± (1.0 + 0.007* m.v.) %RH (0 to 100%RH)
testo 6617: ± (1.2 + 0.007* m.v.) %RH (0 to 90%RH)
± (1.6 + 0.007* m.v.) %RH (90 to 100%RH)

Measurement inaccuracy pressure dewpoint for probe testo 6615:
±1 K at 0° Ctpd
±2 K at -40° Ctpd
±4 K at -50° Ctpd

Measurement inaccuracy temperature:
0.15 °C (at +25 °C)
0.27 °F (at +77 °F)

Housing material:
Metal

Cable screw fitting:
M 16 x 1.5 (2x) with inner diameter 4-8 mm
M 20 x 1.5 (2x) with inner diameter 6-12 mm

Protection class:
IP65

Dimensions:
122 x 162 x 77 mm
Probe see drawing

Interesting accessories:

1) Parameterization, adjustment and analysis software (P2A software incl.adapter cable USB to Mini-DIN)
[Order no. 0554 6020]

2) testo 400, multifunction measuring instrument incl. measurement value store up to 500.000 readings, VAC module, battery, Li-calle and calibration protocol
[Order no. 0563 4001]
Highly precise reference humidity/temperature probe incl. calibration certificate
[Order no. 0636 9741]
Adjustment adapter (for 1-point adjustment with testo 400/650)
[Order no. 0554 6022]

3) Extension and dajustment cable, 10m
[Order no. 0554 6610]

4) Control and adjustment set for 2-point adjustment (11.3 % and 75.3 %RH)
[Order no. 0554 0660]

5) Control and adjustment set for 1-point adjustment at 94.5 %RH
[Order no. 0554 0662]

6) Mains unit (desktop), 90 to 264 VAC / 24 VDC (3 A)
[Order no. 0554 1748]

7) ISO calibration certificate at 11.3 % and 75.3 %RH
[Order no. 0520 0076]
DKD calibration certificate at 11.3 % and 75.3 %RH
[Order no. 0520 0246]

8) Profibus intermediary layer
[Order no. 0554 6686]

9) Ethernet intermediary layer
[Order no. 0554 6656]

10) All plug connections

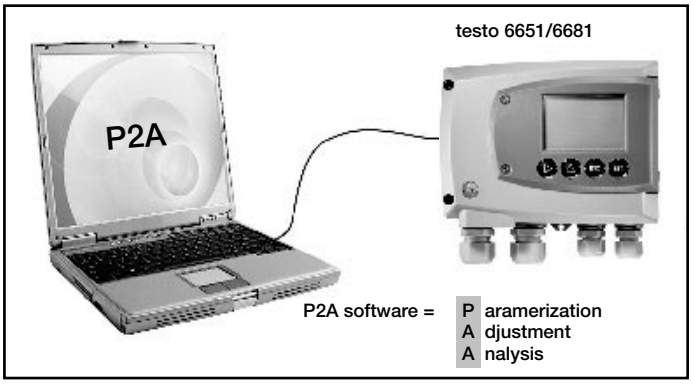
* For more details on determining measurement uncertainty humidity according to GUM see page 20.

B General information on all Testo humidity transmitters

1 P2A software for parameterization, analysis and adjustment (testo 6621, 6651, 6681)

1.1 Overview P2A software

The P2A software is a Testo innovation, as for the first time a software has been developed exclusively for the fast configuration and adjustment of instruments. Existing parameter files can, for example, be easily and quickly copied into instruments of the same type.



System requirements

Operating system
- Windows® 98 Second Edition
- Windows® 2000
- Windows® XP Home / Professional
- Windows® Vista

Computer
- Pentium processor min. 400 MHz or equivalent
- 128 MB RAM
- Graphic resolution min. 1.024x768
- Free hard disk space min. 15 MB
- CD-ROM drive
- USB interface or corresponding adapter
- Min. Internet Explorer 5.0.

Software
The P2A software (order no. 0554 6020) is not included in delivery of the instruments. If you have a new version of the software, the measurement transmitter will be fully supported. Older P2A versions can be updated with the P2A software upgrade.

The P2A software: easy to use functions for configuration/adjustment

- Output channels: parameterization of unit and scale
- Relay outputs: channel selection, setting of switch thresholds/hysteresis
- Various: creating collective alarms, display settings
- Analysis: analog/relay output test, query of min/max values, reset to factory setting
- Adjustment (1-point, 2-point, analog adjustment), see below
- Parameterization and adjustment history (all events in the P2A software are registered in the PC)
- Serial number and Firmware version can be called up

New is the adjustment across the entire signal chain — from the Testo humidity sensor to the analog output. The 1- or 2-point adjustment and the additional analog adjustment in the example shown below contribute to the long-term stability throughout the entire measurement stretch

1.2 Operation

The measurement transmitter is connected to the software installed on the PC using a USB-Mini-DIN cable (the USB driver must previously be installed for a particular USB port -> please use this USB port for the USB-Mini-DIN cable!). The measurement transmitter is automatically recognized, and identified and processed via the serial number. Non-wired instruments, i.e. those without an external power supply, can also be connected to a PC, as they are supplied with power via the USB interface. The display shows **ON** for the duration of the connection.

If the measurement transmitter is connected to the PC, and the software has recognized the measurement transmitter, an instrument file is created in the file list in the left-hand area of the window, when the transmitter is parameterized for the first time. This instrument file is given the serial number of the connected instrument as a file name (details see below).

On the right-hand side, in the **instrument information**, the type of instrument from the selected instrument file is displayed as an image. A bar also shows the status of the connection with the instrument via the USB interface:

green: the measurement transmitter is connected via the USB and has been recognized -> communication is active

red: the measurement transmitter is not connected or has not yet been recognized

As long as the measurement transmitter is connected to the PC (-> communication is active), the parameter data entered in the software are automatically transferred to the measurement transmitter, parameter files which have already been created can be conveniently copied into the measurement ransmitter. Conversely, the entire parameter range can be read out of the measurement transmitter and stored in a separate parameter file.

The file list differentiates between **instrument files** and **parameter files**

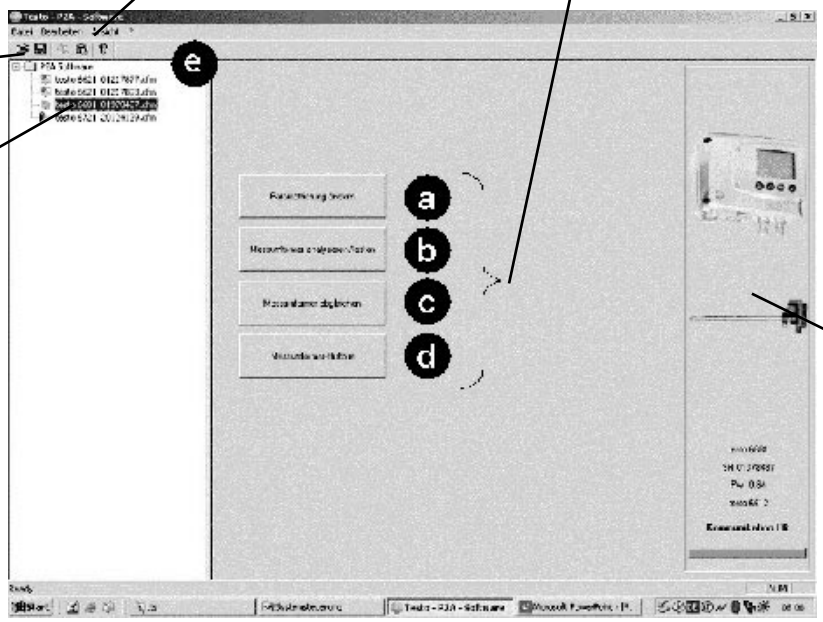
- An **instrument file** contains all parameter data for a certain instrument and is stored under its serial number. This name cannot be altered. An instrument file is automatically created when connecting a measurement transmitter for the first time, and is permanent. When the instrument is re-connected, the file is automatically allocated to it, and the status “Communication active” is marked via a symbol in the instrument file, on the left-hand side of the file list.

- A **parameter file** contains parameter data which do not relate to an instrument. These can be freely copied into another parameter file or the instrument file of any instrument of the same type from the data list. This means that several instruments of the same type can be quickly and easily parameterized identically.

B 1 General information on all Testo humidity transmitters

1.3 Operating menu (in the P2A software)

Main screen view



In the following, the implementation of the individual main menu items (main functions) is briefly described:

a Changing instrument and parameter files

The desired instrument file is selected.

a. Click on **Change parameterization**.

b. If parameters were transferred to the instrument file from other parameter files, an information window is shown, in which you can transfer the new parameters to the instrument with **Yes**.
If the parameters are not to be transferred, click on **No.**

c. Enter or change parameter in the corresponding space.

b Testing / analyzing instrument:

The desired instrument file is selected.

a. Click on the button **Analyze / test measurement transmitter.**

b. Carry out tasks:

- Carry out factory reset: Reset parameter unit, scaling limits and hysteresis to factory settings.
- Test analog output: Test channel 1 / 2 / optionally 3
- Test switch outputs: Switch relays 1 to 4 to manual for testing
- Min./max. values: The minimum and maximum value measured since the last reset is displayed.

c. To close the dialog click on **OK** or **Cancel**.

c Adjusting measurement transmitter:
Detailed example see below chapter 4.7.4

d Measurement transmitter history: View of the parameterization and adjustment histories. These can be printed out, but neither deleted nor altered.

- Parameterization history
- Adjustment histories
  - 1-point adjustments
  - 2-point adjustments
  - Analog adjustments
- Error/status reports

e Parameter file management via the menu bar / toolbar:

Storing parameter file:

Parameters can be stored in new parameter files.

a. Mark instrument parameter file.

b. Click on **File>Save as** in the menu bar.

c. Select storage location and enter file name.

d. Click on **Store**.

The new parameter file is shown in the file list

Only the parameters from an instrument file are stored, the history files are not taken over.

Opening parameter file:

All parameter files stored in the standard directory path are automatically shown in the file list when the software is started.

You can also open parameter files which are stored in other directories.

a. Click on **File>Open** in the menu bar.

b. Select storage location and click on desired file.

c. Click on **Open**.

Copying and pasting parameter files:

The parameter data of an instrument / parameter file can be transferred to another instrument / parameter file of the same instrument type. History data from instrument files are not transferred

a. Select the file whose parameter data are to be copied.

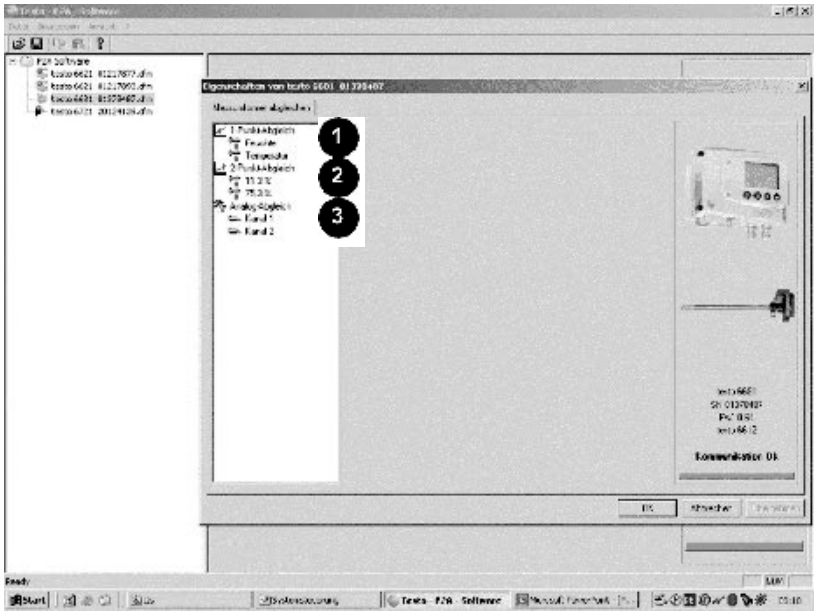
b. Click on **Edit > Copy** in the menu bar.

c. Select the file which is to be changed.

d. Click on **Edit > Paste** in the menu bar.

1.4 Carrying out adjustments via the P2A software

The following view appears by clicking on the button **Adjust measurement transmitter**. Here you have the possibility of adjusting the measurement transmitter using different methods.



1 **1-point adjustment (Offset)**

A testo 400/600 with a precision probe is recommended as a reference instrument

a. Click on button **Adjust measurement transmitter**.

b. Select channel under **1-point adjustment**.

c. Subject reference measuring instrunment and instrument to be adjusted, to the same, constant conditions, and observe assimilation time.

d. Enter reference value and and carry out adjustment by clicking on **1-point adjustment**. To reset an offset value, click on **Zero offset**.

e. To close the dialog, click on **OK** or **Cancel**.

2 **Carrying out 2-point adjustment::**

a. Subject reference measuring instrunment and instrument to be adjusted, to the same, constant conditions, and observe assimilation time.

b. Mark instrument file of connected instrument

c. Click on **Adjust measurement transmitter**.

d. Mark 11.3 %, enter reference value of lower adjustment point and click on **Lower adjustment point.**
The adjustment is carried out.

e. Mark 75.3 %, enter reference value of upper adjustment point and click on **Upper adjustment point**.

f. To close the dialog, click on **OK** or **Cancel**.

3 **Carrying out an anlog adjustment:**

a. Connect precision multimeter

b. Mark instrument file of connected instrument

c. Click on **[Adjust measurement transmitter]**.

d. Click on **[Start Wizard]** and follow the instructions of the assistent.

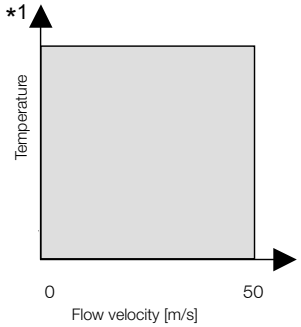
The adjustment is carried out when the assistent is ended.

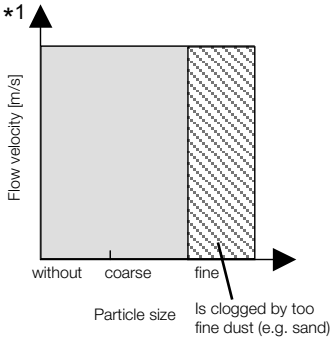
B 2 Protective caps

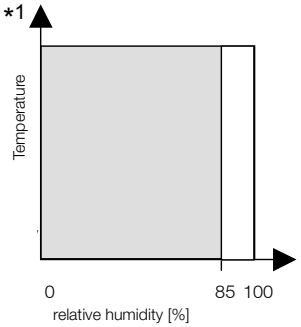
Code M01 (0554 0647): Stainless steel protective cap (sintered) pore size 100µm

Sensor protection in dusty atmospheres or higher flow velocities

- mechanically robust
- good sensor protection
- easy to clean



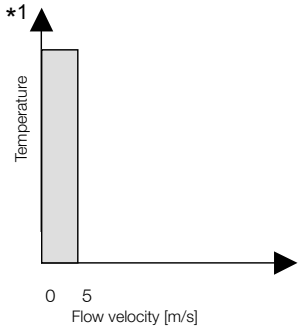


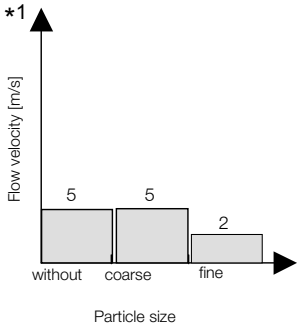


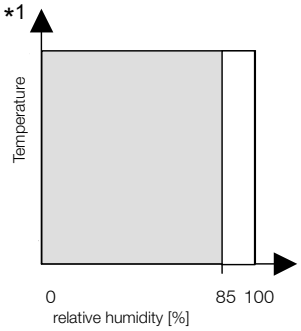
Code M02 (0554 0757): Wire mesh filter protective cap

Special features

- faster reaction than G1
- limited protection in dusty processes
- pore size 70 µm

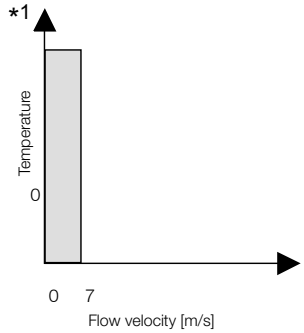


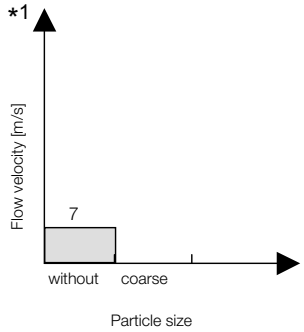


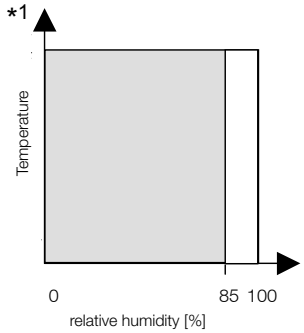


Code M04 (0554 0755): Metal protective cap (open)

- Fast reaction time, at flow velocities ‹7m/s (not suitable for dusty or high humidity atmospheres)
- Especially suited to cleanrooms





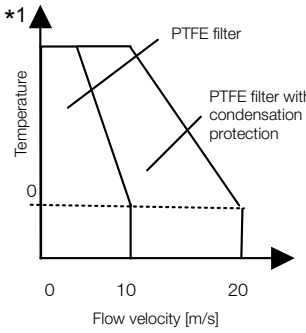


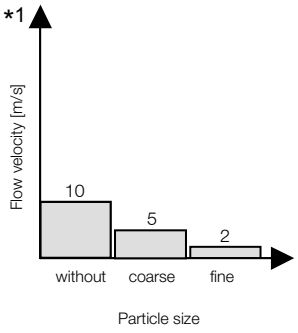
Code M08 (0699 5867/1):
The special protective cap M08 is designed for use in an H_2O_2 environment. Particularly advantageous is the fact that, no reduction is caused by the filtration, so that saturation of the filter cannot occur. The protective function is permanently guaranteed. Owing to an innovative concept, the mixture dewpoint can be determined.

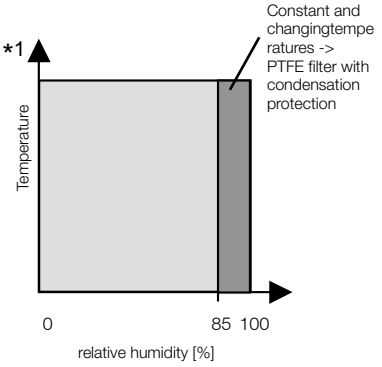
- pore size 100 µm
- pore size < M01 + M02

Code M03 (0554 0758): PTFE protective cap

- Pore size 100 µm, sensor protectionin high humidity and aggressive atmospheres, especially suited to changing temperatures in continuous high humidity.
- Pore density < M01 + M02
- Use in dust-free atmospheres

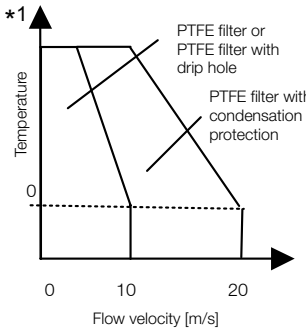


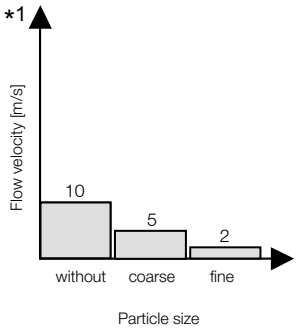


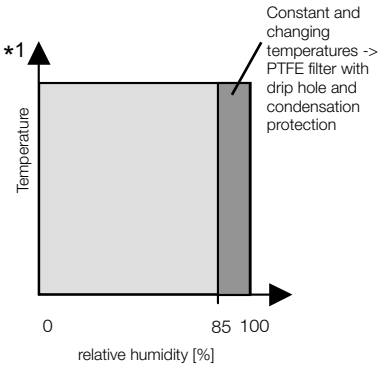


Code M06 PTFE (0554 9913)

- PTFE protective cap with condensate drip hole 1.5 mm
- Pore size 100 µm
- Pore density < M01 + M02
- Use in dust-free atmospheres

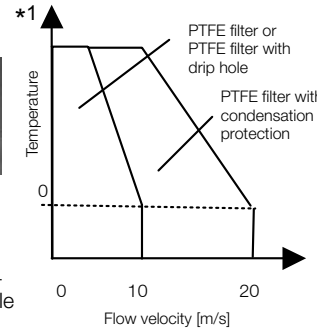


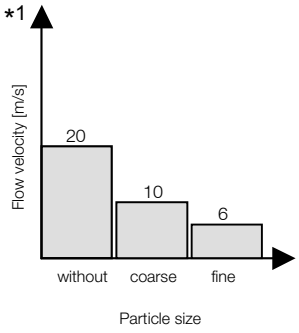


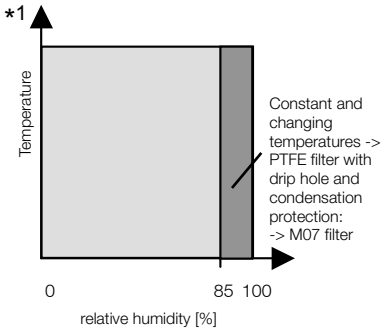


Code M07 / PTFE

- PTFE protective cap with condensation protection (0554 0166) and condensate drip hole 1.5 mm
- Pore size 100 µm
- Use in dust-free atmospheres







*1 Temperature data are not exactly specifiable, and are based maionly on the measuring range of the probe used. Between -20 to +70 °C, experience provides values which are used here as a basis.

B 3 Adjustment/calibration and calibration certificates

3.1 Adjustment/calibration for testo 6621, testo 6651 and testo 6681

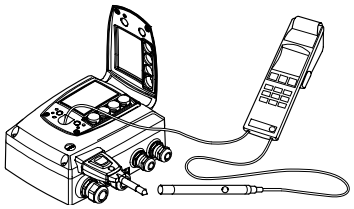
The Testo adjustment concept allows the entire signal chain from the sensor signal (probe) via the digital signal (measurement transmitter internal) to the analog signal (measurement transmitter output signal) to be adjusted. For the adjustment of the signal chain sensor signal to digital signal, a 1-point adjustment (offset correction) or a 2-point adjustment (gradient correction) are available.

The measurement transmitters testo 6651 and 6681 have digital probes whose adjustment information is stired in the internal store of the probe. For this reason, both 1-point and 2-point adjustments can be carried out on any housing (testo 6651 or 6681), e.g. in a calibration laboratory. Only the respective probe is calibrated.

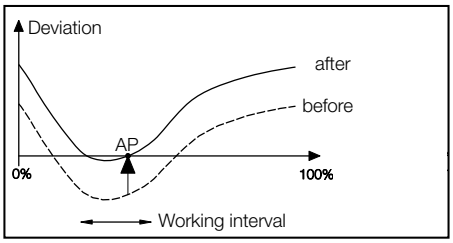
The adjustment of the analog outputs, however, refers to the housing of the measurement transmitter (testo 6651 and 6681) and is independent of the connected probe.

Carrying out adjustment and Testo accessories:

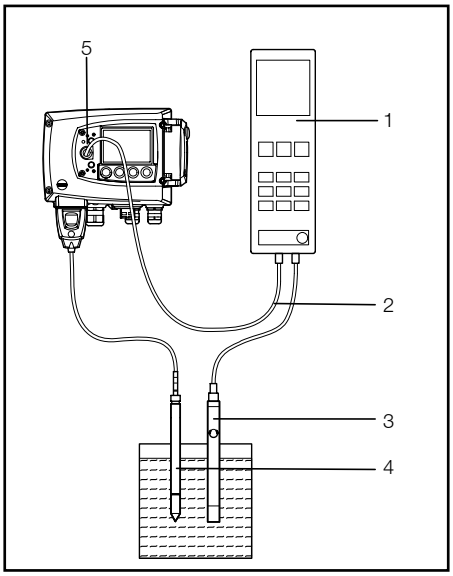
1-point adjustment



Adjustment via
- testo 400/650 with adjustment adapter
- P2A software
- Operating menu

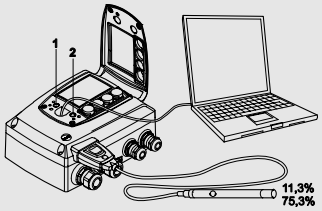


Offset shift with 1-point adjustment

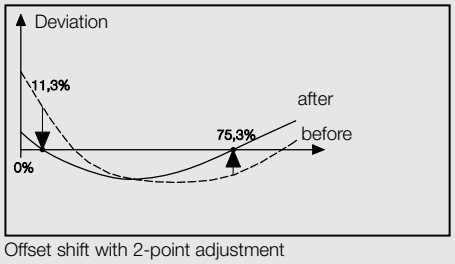


1-point adjustment: the most time is saved by adjustment on site with a Testo portable instrument

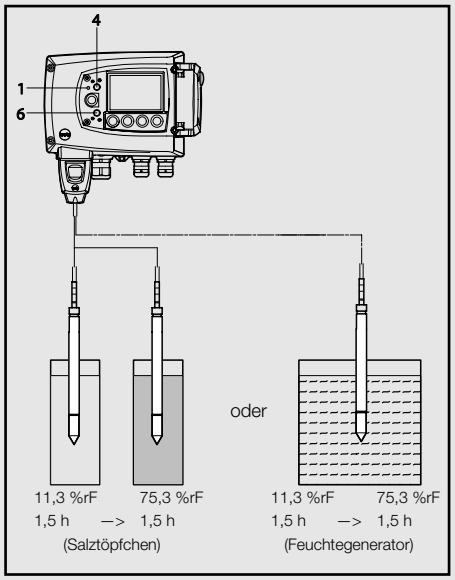
2-point adjustment



Adjustment via
- Djustment buttons (1, 2)
- P2A software

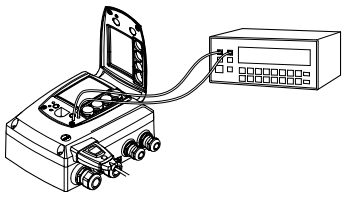


Offset shift with 2-point adjustment



2-point adjustment with the reference options saline pots (Testo accessory) or a humidity generator

Analog adjustment

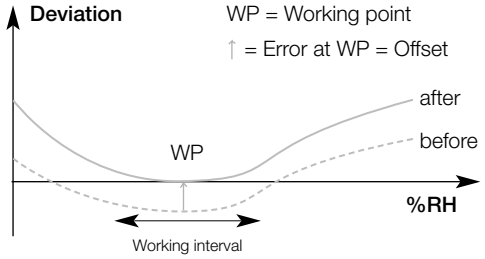


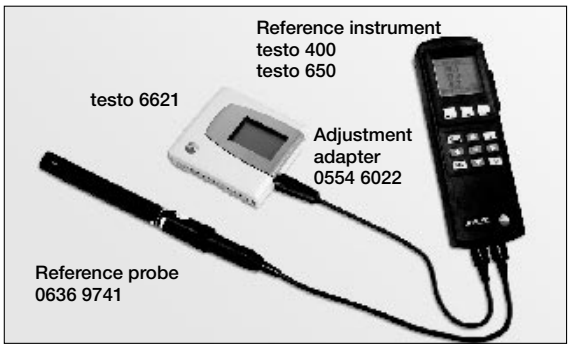
Adjustment using precise multimeter and transfer of analog reference value to
- P2A software or
- Operating menu

3.1.1 1-point adjustment

In 1-point adjustment, the measurement value at the working point is adjusted to the reference value by shifting the entire curve by the offset value. There is therefore no deviation, at least at the working point.

The advantage of a 1-point adjustment is the good measurement result in the working interval. However, the deviation can be all the greater, the further the measurement is from the working point. For this reason, the 1-point adjustment should only be used for a narrow measuring range (e.g. cleanroom application, storage conditions etc.). The deviation of the measurement signal from the reference value dependent on the measurement parameter is shown in this diagramm. Since the Testo transmitter has two output channels, an offset can be carried out for each channel. This 1-point adjustment can be carried out with the reference measuring instruments testo 400 or 650, even without the need for software.





Ill. 1-point adjustment on site, directly with the Testo reference measuring instrument, without P2A software.

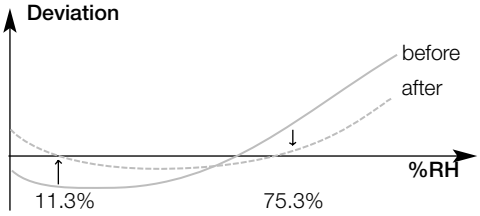
Ill. 1-point adjustment with the reference measuring instrument and the P2A software.

3.1.2 2-point adjustment

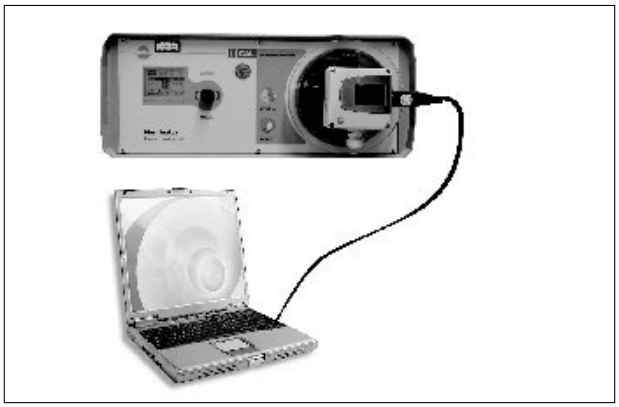
The measurement parameter is adjusted to the reference value at the two standard adjustment points 11.3 %RH and 75.3 %RH

In 2-point adjustment, the error is minimized over the entire humidity range. 2-point adjustment is therefore recommended for large working intervals, e.g. in drying processes.

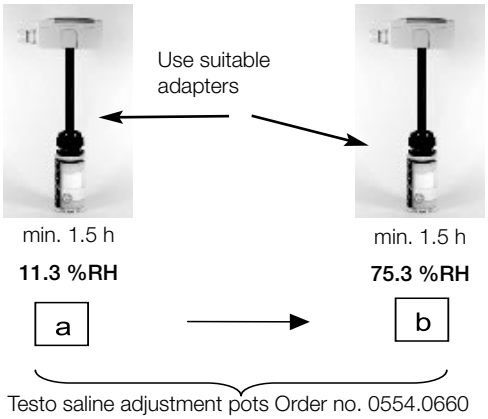
The reusable Testo saline solutions 11.3 % and 75.3 %RH (0554 0660) are very suitable for 2-point adjustment, alternatively, a humidity generator can be used for humidity adjustment



The deviation of the measurement signal from the reference value dependent on the air humidity is shown in this diagramm



Ill. 1- or 2-point adjustment with the Testo Huminator (humidity generator) and the P2A software.



Testo saline adjustment pots Order no. 0554.0660

3.2 Calibration certificates

3.2.1 Certificates

Testo offers calibration in accredited testo laboratories.

If requirements from the field of quality assurance are in the foreground (ISO 9001, QS9000, GMP, FDA, HACCP,...), ISO calibration (laboratory accredited according to ISO 17025) offers the ideal solution. If highest reliability is required, for instance in production norms, for assessors, official bodies and critical applications, DKD calibration is recommended

If the measuring instrument has a DKD certificate, you are entitled to carry out internal ISO calibrations in the works with this DKD calibrated reference instrument. The testo 6651 and testo 6681(with DKD certificate and 1%RH measurement inaccuracy), for example, are thus suitable for an internal works calibration laboratory.

testo 6651 and testo 6681 are delivered with a factory adjustment certificate confirmation of the test on delivery). for higher certification requirements, ISO and DKD certificates are also available.

ISO certificate

DKD certificate

For ISO/DKD certificates, the difference is made between (see also table below)

- Standard certification:
  prescribed calibration points

- Selective certification:
  freely selectable calibration points

- Individual certification:
  freely selectable calibration points and repair service

	Pre-determined calibration points	Freely selectable calibration points	Pre-determined certificate layout	Individual certificate layout	Pre-determined calibration label	Individual calibration label	Transport service	Express service	Instrument loan service	Repair after accepted quote	Repair without quote
ISO standard	●		●		●		○	○	○	●	
ISO selective	◎		◎		◎		○	○	○	●	
ISO individual	◎		◎		◎		○	○	○	◎	
DKD standard	●		●		●		○	○	○	●	
DKD selective	◎		●		●		○	○	○	●	
DKD individual	◎		●		●		○	○	○	◎	

● fixed component ○ additionally selectable (by customer) when ordering ◎ alternatively selectable (by customer) when ordering

3.2.2 Temperature calibration

The calibration takes place as a comparative measurement in suitable thermostats/temperature cabinets instead of with highly accurate resistance thermometers or thermocouples.

Calibration point/range		Order no.
DKD	Selective -30 to +120°C	0520.0281
	Standard -20/0/+60°C	0520.0261
ISO	Selective -40 to +180°C	0520.0141
	Standard -18/0/+60°C	0520.0151
	Standard -8/0/+40°C	0520.0171
	Standard -18/0°C	0520.0441
	Standard 0/+60°C	0520.0442
	Standard -18/+60°C	0520.0443
	Standard -18°C	0520.0461
	Standard 0°C	0520.0462
	Standard +60°C	0520.0463

3.2.3 Humidity calibration

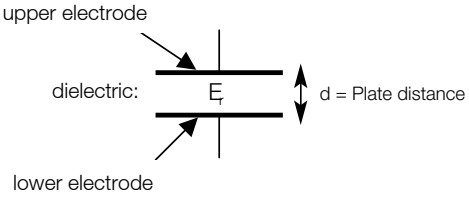
The calibration takes place in a two-pressure temperature-humidity generator or in a temperature cabinet/huminator as a comparative measurement with a highly accurate dewpoint mirror/humidity probe

	Calibration point/range	Order no.
DKD	Selective 5 to 95 %RH at +25 °C	0520.0236
	Selective 5 to 95 %RH at -18 to +70 °C	0520.0236
	Selective 5 to 95 %RH at +70 to +90 °C	0520.0236
	Standard 11.3/75.3 %RH at 25 °C	0520.0246
	Standard 11.3/50.0/75.3 %RH at 25 °C	0520.0276
ISO	Selective 5 to 95 %RH at +15 to +35 °C	0520.0066
	Selective 5 to 95 %RH at -20 to +15 and +35 °C to +80 °C	0520.0066
	Standard 11.3/75.3 %RH at 25 °C	0520.0076
	Standard 11.3/50.0/75.3 %RH at 25 °C	0520.0176

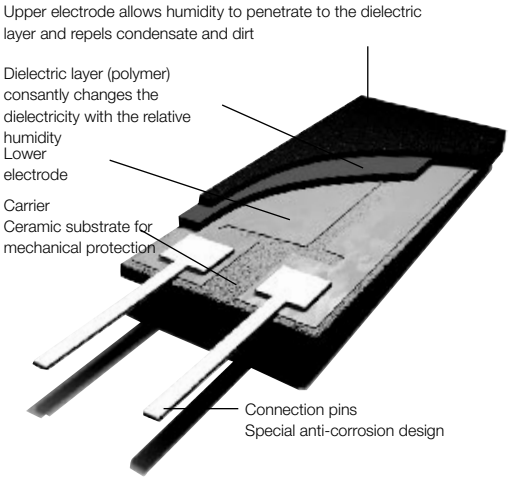
4.1 Capacitive Testo humidity sensor

The Testo humidity sensor has been used successfully, and continually improved, for over 15 years, and from the very beginning, the focus was on the two accuracy parameters measurement inaccuracy and long-term stability.

The capacitive Testo humidity sensor is in principle a plate capacitor. A plate capacitor consists of two electically conductive plates (electrodes), which are positioned parallel to each other.

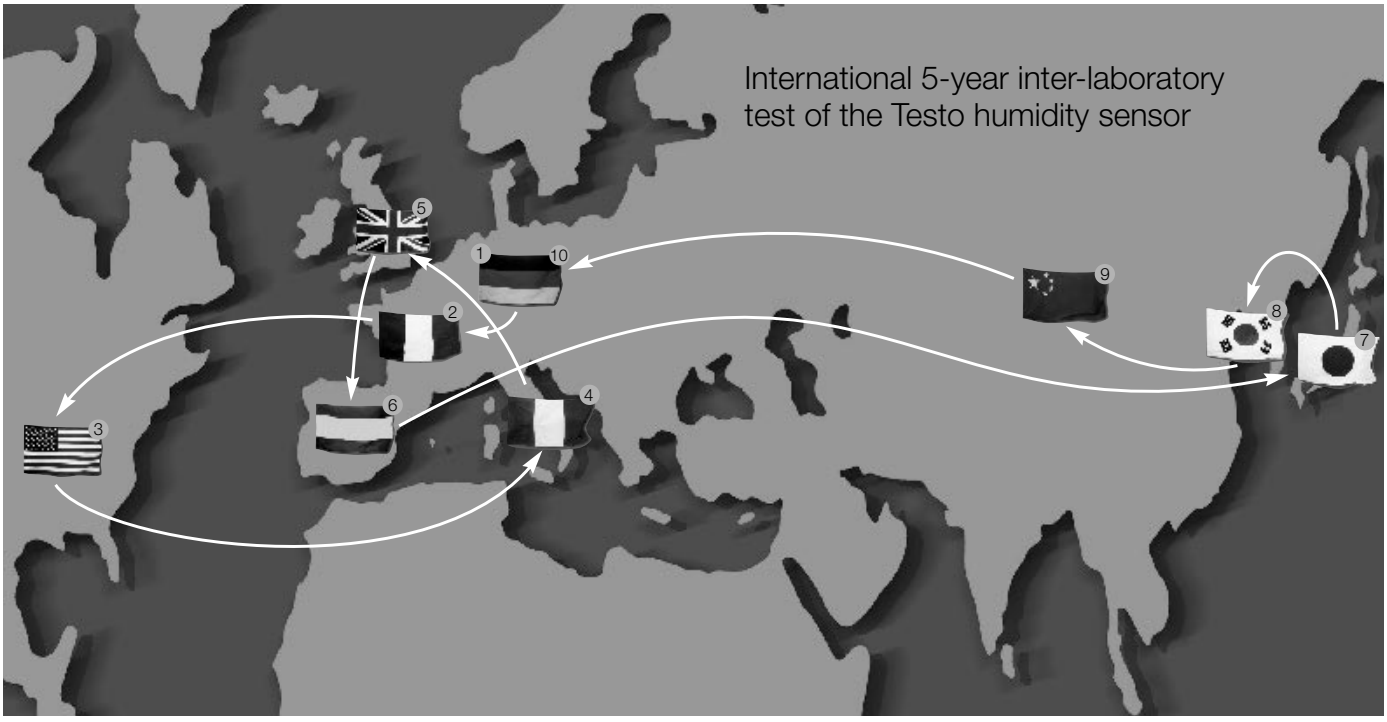


They are separated by an isolating layer called a dielectric. (In the dielectric of a charged capacitor, energy is stored which can then be released again.)



In the Testo humidity sensor, a humidity-sensitive polymer serves as the dielectric between the capacitor electrodes. The extraordinary feature is the perfect adaptation of the individual layers to each other. This is seen especially in the upper electrode, which has to fulfil two functions which at first glance appear contradictory: It must be completely permeable for the water vapour which must penetrate through to the polymer dielectric. At the same time, however, it must be impermeable, smooth and resistant as regards condensate, oil and dirt, in order to protect the sensor. In the Testo humidity sensor, this combination has been achieved perfectly with the help of extensive research.

Because of this design and the high level of process stability in Testo's production, it is possible to guarantee a measurement inaccuracy of +/-2 %RH, optionally even +/-1 %RH. In addition to this, the Testo humidity sensor excels above all through its well-known long-term stability. This was impressively proven, for example, in an inter-laboratory test in which several Testo humidity sensors were put through a number of international calibration laboratories (PTB, NIST etc., cf. illustration), where in the course of 5 years the +/-1 %RH limit was not exceeded, without the need for readjustment



Country	1 Germany	2 France	3 USA	4 Italy	5 England	6 Spain	7 Japan	8 Korea	9 China	10 Germany
Institute	PTB	CETIAT	NIST	IMGC	NPL	INTA	JQA	KRISS	NRCCRM	PTB
Arrival	04/96	10/96	12/96	07/97	09/98	10/98	03/99	05/00	10/00	03/01
Departure	08/96	10/96	05/97	10/97	09/98	10/98	04/00	09/00	12/00	08/01

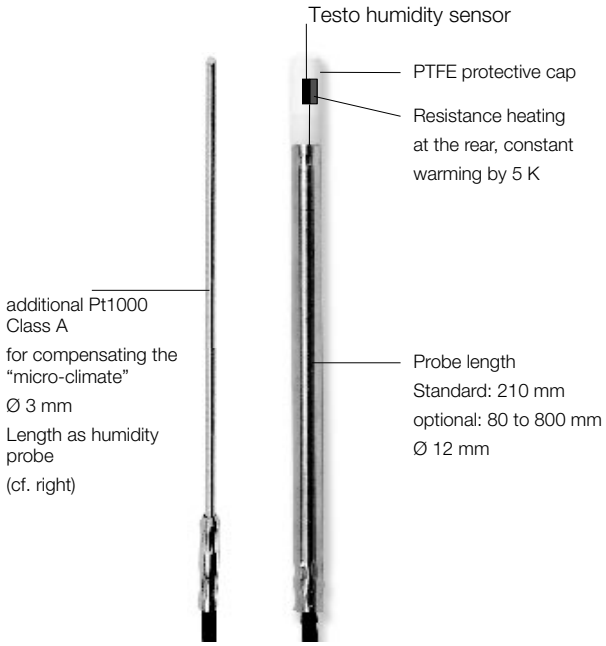
4.2 Functionality of the testo 6681 with probe testo 6614 (heated sensor for high humidity applications)

High humidity processes place highest demands

High moisture conditions prevail in many industrial processes, i.e. the relative humidity is close to the 100% limit at which the air can no longer hold the water and condensation is precipitated. A critical point in the regulation chain is moisture measurement. High quality measurement transmitters are today able to measure accurately even in the high moisture range, however their reaction capability is severely reduced if the probe works close to the dewpoint limit over hours and days.

hygrotest 650 HP -20/120

2 analog outputs
(0 to 20 mA, 4 to 20 mA,
0 to 1 V, 0 to 10 V), all 4-wire

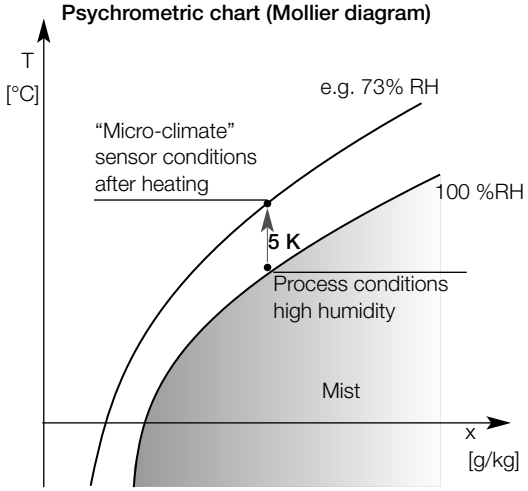


The innovative Testo solution to the high humidity problem

In the testo 6681 and 6614, the testo humidity probe is heated at the rear, so that a micro-climate is created around the probe (inside the PTFE protective cap), which is constantly 5 Kelvin warmer than the actual process conditions. As the psychrometric chart shows, this causes the relative humidity at the moisture probe to sink from a range close to 100 %RH to a lower value, e.g. of 73%. In this range, the reaction speed is on the one hand noticeably better than in the condensation range, and on the other hand there is less risk of corrosion for the probe.

The actual process temperature is recorded by a separate, highly accurate temperature probe Pt1000 class A. On this basis, the micro-processor built into the measurement transmitter computes the actual humidity conditions in the process. In addition to 4...20 mA (4-wire), the versions 0 to 20 mA and 0 to 1/0 to 10 V are available as analog outputs.

Psychrometric chart (Mollier diagram)



4.3 Temperature sensor (NTC = Negative Temperature Coefficient)

The **testo 6681 und 6614** uses an NTC thermistor for temperature measurement. Thermistors (NTC) are semi-conductor resistances which are temperature-dependent. They conduct better at high temperatures than at low temperatures, because the resistance is lower at higher temperatures. They have a negative temperature coefficient and are thus referred to as “Negative Temperature Coefficient” resistances. They are particularly suited for use in humidity measurement transmitters, as they combine good accuracy with a fast reaction time.

4.4 Temperature sensor (Pt 1000 Class A)

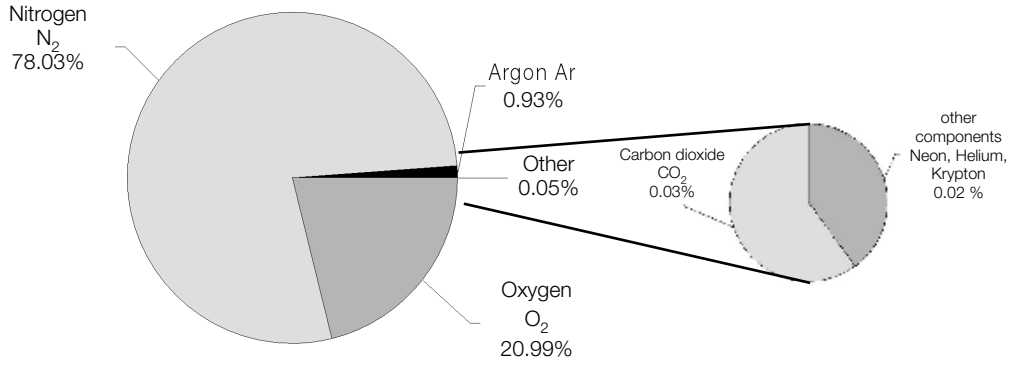
The **testo 6681** uses a platinum resistance Pt 1000 for temperature measurement. Resistance sensors are resistances which are temperature-dependent. They conduct worse at higher temperatures, because the resistance is higher at higher temperatures. They have a positive temperature coefficient. They are particularly suited for use in humidity measurement transmitters, as they combine good accuracy with a fast reaction time and a wide temperature range. As they are clearly normed, they are also exchangeable.

5 Physical principles

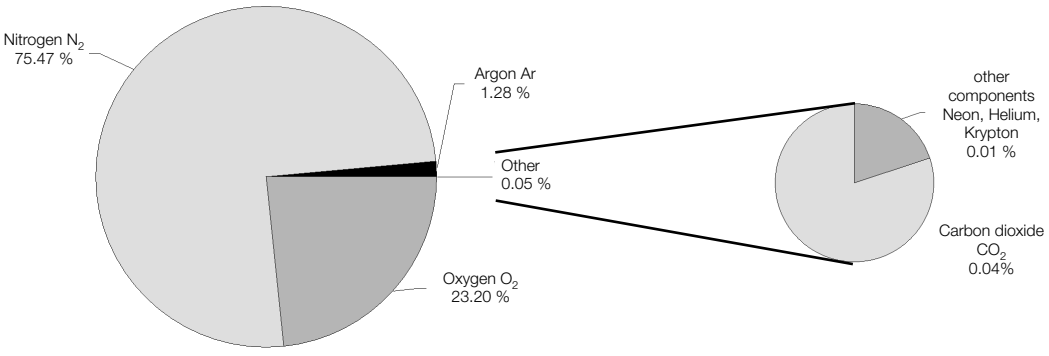
5.1 Water vapour partial pressure

Air is a mixture of different gases. **Dry** air is composed as follows:

Proportional volume in %



Proportional weight in %



Humid air of course, contains water vapour as a further important component; this is decisive. Water vapour is only present in small quantities in ambient air. The weight proportion of the water vapour is approximately 0.1% to 2%. 0,1% bis 2%. In spite of this small quantity of water present in the air, the well-being of humans and the quality of many technical processes are in great measure dependent on the humidity content.

Dalton's law (law of partial pressures) states that the sum of all partial pressures p_i is equal to the total pressure of the gas mixture P_{total}

$$p_{total} = p_{N2} + p_{O2} + p_W + \ldots$$

p_{total}	= Total pressure [mbar]
p_{N2}	= Nitrogen partial pressure [mbar]
p_{O2}	= Oxygen partial pressure [mbar]
p_W	= Water vapour partial pressure

Since all components are distributed evenly over the available space:

$$p_i = r_i \bullet p_{total}$$

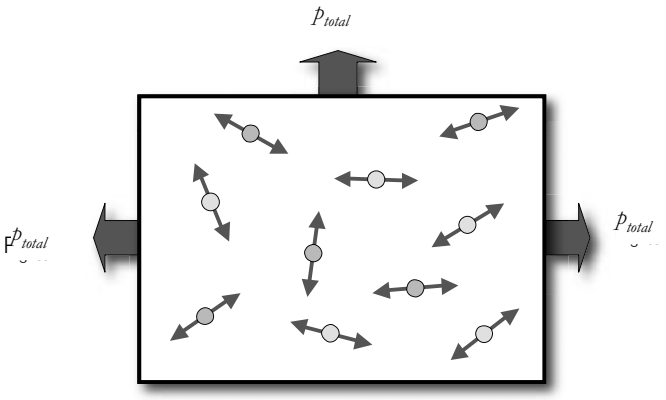
p_{total}	= Total pressure [mbar]
ri	= Proprtional space/volume of the partial gas
p_i	= Partial pressure [mbar]

The proportional volume is therefore decisive, not the proportional weight of a gas. For example, the partial pressure of nitrogen (with 78% proportional volume) at a total pressure of 1013 mbar, is 790 mbar.

Humid air is composed of dry air and water vapour. This results in:

$$p_{total} = p_t + p_W$$

p_{total}	= Total pressure [mbar]
p_t	= Pressure of the dry air [mbar]
p_W	= Water vapour partial pressure [mbar]



$$p_{total} = p_{air} + p_{water}$$

= Water vapour partial pressure

The water vapour partial pressure describes the actual (momentary) water vapour pressure in the humid air.

$$p_w = c_1 \cdot e^{\frac{c_2 \cdot Td}{c_3 + Td}}$$

$$p_w = p_w \bullet \frac{U}{100\%}$$

p_W	= Water vapour partial pressure [mbar]
Td	= Dewpoint temperature [°C]
U	= Relative humidity [%rF]
p_S	= Saturated vapour pressure temperature-dependent, not pressure-dependent = [mbar] C1, C2, C3 see chapter A3 13.2

Note: in compliance with the VDI/VDE GMA, vapour pressure will in future be denoted with the formula symbol e.

5.2 Saturated vapour pressure

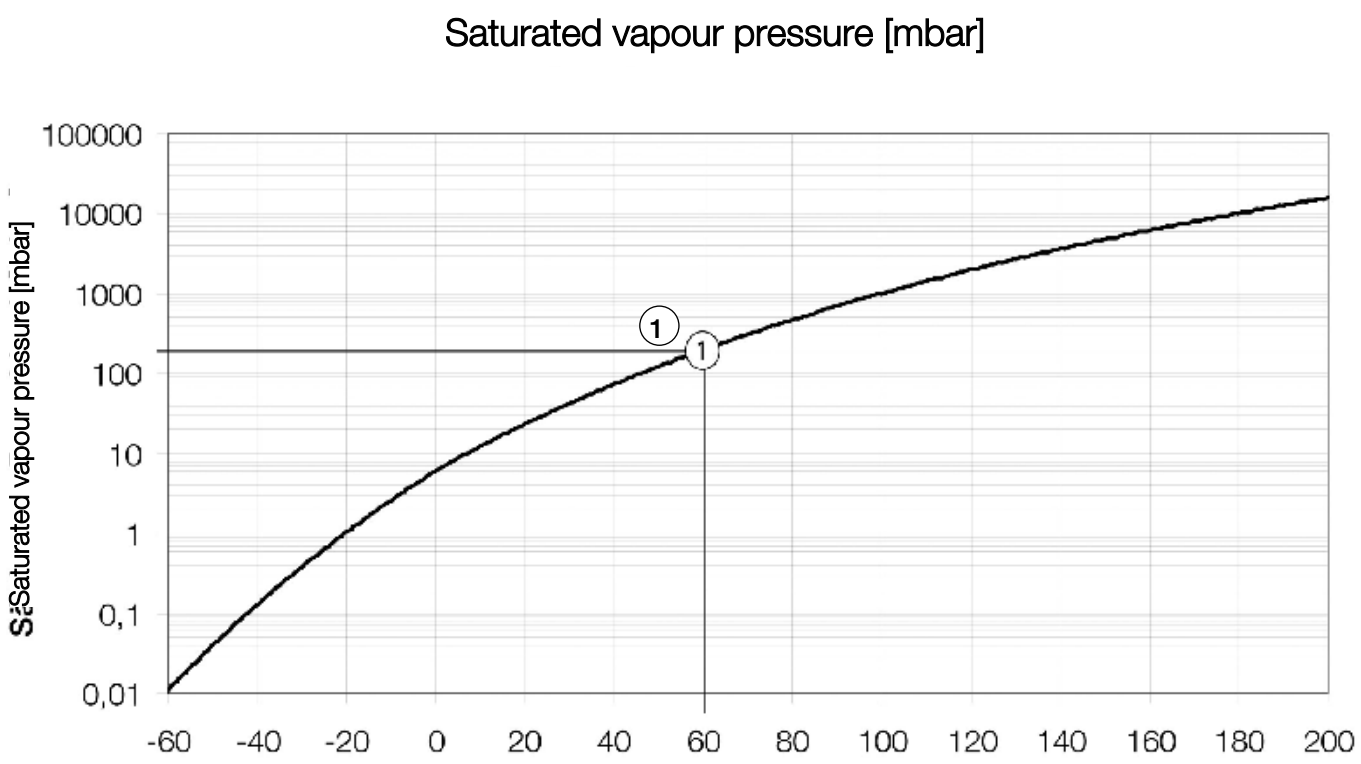
The saturated vapour pressure p_s [mbar; hPa] describes the maximum vapour pressure/vapour concentration/water vapour partial pressure at a certain temperature. If a higher water vapour pressure (or lower temperature) were present, condensation would be formed.

$$p_s = c_1 \cdot e^{\frac{c_2 \cdot T}{c_3 + T}}$$

p_s = Saturated vapour pressure [mbar]
T = Temperature [°C]
C1, C2, C3 see table

Coeffecients according to Magnus (DIN 50010)

Phase	Process temperature T [°C]	C1 [mbar]	C2 [ ]	C3 [°C]
Ice	-50.9 to 0	6.10714	22.44294	272.44
Water	-50.9 to 0	6.10780	17.84362	245.425
Water	0.0 to 100	6.10780	17.08085	234.175



(1) The example shows a saturated vapour pressure of 199 mbar at 60 °C.

5.3 Relative humidity

Relative humidity [%RH] is defined as the partial pressure ratio between the existing water vapour partial pressure p_w and the vapour saturated pressure p_s at the same air pressure and the same temperature, expressed in percent. Relative humidity thus shows how many percent of the maximum possible water vapour quantity is present in the air at the moment.

Relative humidity is expressed as a percentual value. According to this definition, saturation is thus 100% relative humidity.

$$U = \frac{p_w}{p_s} \cdot 100\ [\%RH]$$

Application: Air conditioning technology, especially indoor climate

5.4 Dewpoint temperature

The dewpoint temperature [°Ctd] is the temperature at which water begins to condense out of the air, i.e. the existing water vapour pressure p is then the same as the water vapour saturated pressure p_w. As the temperature falls, the ability of the air to hold water decreases.

Application: In the dry range [trace humidity] (better resolution than %RH scale), as well as for monitoring the avoidance of condensation (process temperature remains above the dewpoint).

5.5 Absolute humidity [g/m³]

Absolute humidity [g/m³] is the water quantity present in a closed volume of 1 m³.

$$Absolute\ humidity = \frac{Water\ weight}{Air\ volume} \quad [g/m^3]$$

Application: In drying processes as a unit for dehumidification .

5.6 Degree of humidity X or mix ratio

The degree of humidity X [g/kg] is defined as the ratio of the mass of the water present in the air to the mass of the dry air.

$$Degree\ of\ humidity\ X = \frac{Mass\ water\ vapour}{Mass\ dry\ air} \quad [g/kg]$$

Application: In air conditioning systems, e.g. optimum mixture of partial air flows.

5.7 Wet bulb temperature

Wet bulb temperature is still a widely used humidity parameter. For this reason, it is made available in the hygrotest 650 as a calculated parameter.

Wet bulb temperature [°C;°F] is usually recorded with the help of a psychrometer. This also measures the dry bulb temperature (= process temperature).

Classical design (psychrometer):
The measurement tip of the wet bulb thermometer is covered with a textile (e.g. felt) and moistened with distilled water. Both thermometers are situated in an air flow and are protected from radiated heat. Because of the air flow, water evaporates, the temperature drops. This wet bulb temperature, together with the dry temperature, is a unit for air humidity. The air humidity can be determined with the help of a psychrometric table. (see table)

Example: The dry bulb thermometer measures 22 °C, at the same time the wet bulb termometer measures 19 °C. It therefore follows that the psychrometric difference is 3 K, and the relative humidity thus amounts to 75 %RH.

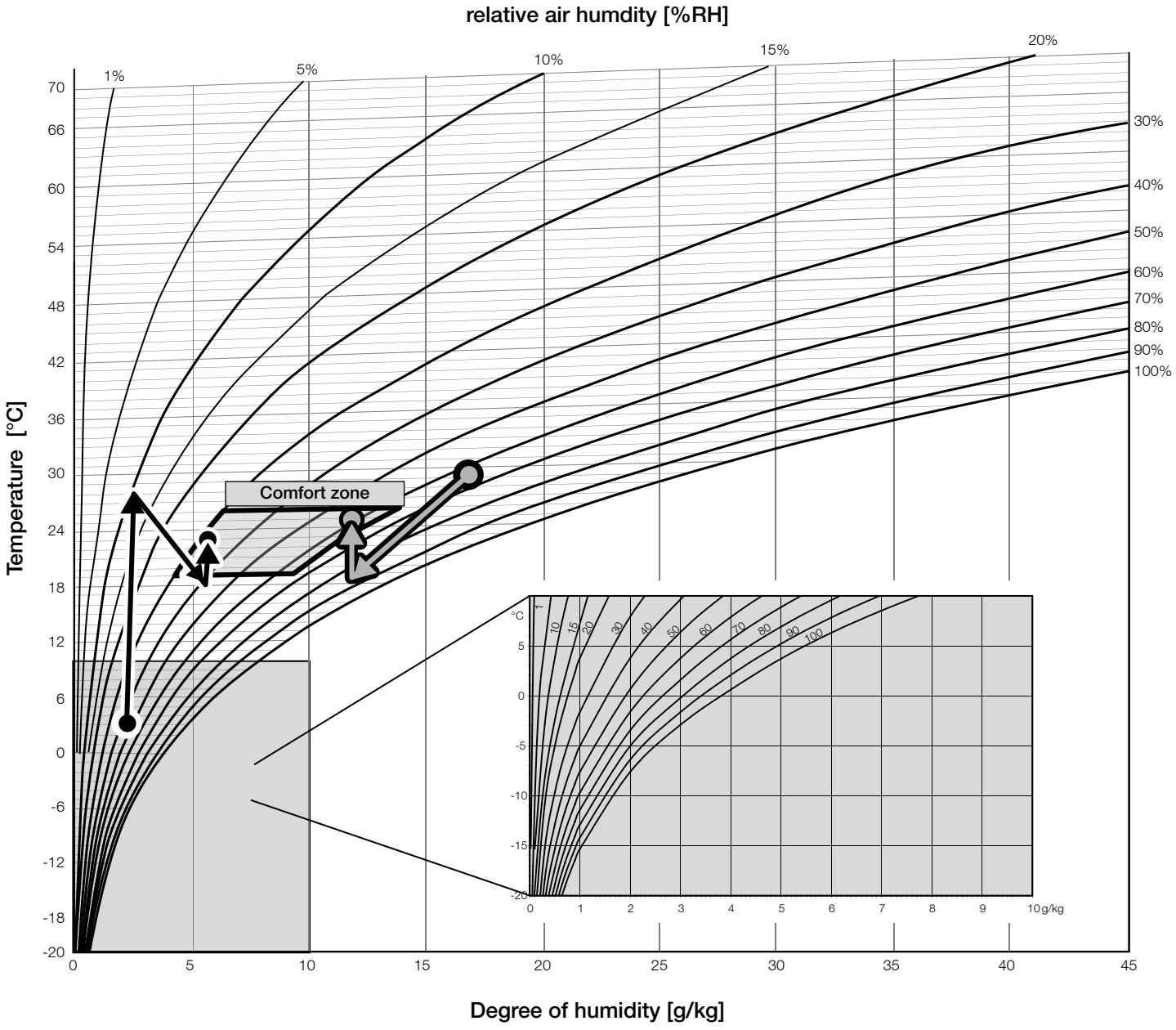
Psychrometric table
relative air humidity in %

Dry thermo-meter °C	Psychrometric difference in K													
	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
-9	85	71												
-8	87	73	59	45										
-7	87	74	62	49	36	24								
-6	88	75	64	52	40	28								
-5	88	77	66	54	43	32								
-4	89	78	67	57	46	36								
-3	89	79	69	59	49	39	29	19						
-2	90	80	70	61	52	42	33	23						
-1	91	81	72	63	54	45	36	27						
0	91	82	73	64	56	47	39	31						
1	91	83	75	66	58	50	42	34	26	18				
2	92	84	76	68	60	52	45	37	30	22				
3	92	84	77	69	62	54	47	40	33	25				
4	92	85	78	70	63	56	49	42	36	29				
5	93	86	79	72	65	58	51	45	38	32	26	19		
6	93	86	79	73	66	60	53	47	41	35	29	23		
7	93	87	80	75	67	61	55	49	43	37	31	26	20	14
8	94	87	81	75	69	62	57	51	45	40	34	29	23	18
9	94	88	82	76	70	64	58	53	47	42	36	31	26	21
10	94	88	82	77	71	65	60	55	49	44	39	34	29	24
11	94	88	83	77	72	66	61	56	51	46	41	36	31	26
12	94	89	83	78	73	68	62	57	53	48	43	38	33	29
13	95	89	84	79	74	69	64	59	54	49	45	40	36	31
14	95	90	84	79	74	70	65	60	56	51	46	42	38	33
15	95	90	85	80	75	71	66	61	57	53	48	44	40	36
16	95	90	85	81	76	71	67	62	58	54	50	46	42	37
17	95	90	86	81	77	72	68	63	59	55	51	47	43	39
18	95	91	86	82	77	73	69	65	61	56	53	4,9	45	41
19	95	91	86	82	78	74	70	65	62	58	54	50	46	43
20	96	91	87	83	78	74	70	66	63	59	55	51	48	44
21	96	91	87	83	79	75	71	67	64	60	56	52	49	45
22	96	92	88	83	80	75	72	68	64	61	57	54	50	47
23	96	92	88	84	80	76	72	69	65	62	58	55	51	48
24	96	92	88	84	80	77	73	70	66	62	59	56	53	49
25	96	92	88	85	81	77	74	70	67	63	60	57	54	51
26	96	92	88	85	81	78	74	71	67	64	61	58	55	51
27	96	93	89	85	81	78	75	71	68	65	62	59	55	53
28	96	93	89	86	82	79	75	72	68	65	62	59	56	53
29	96	93	89	86	82	79	76	72	69	66	63	60	57	54
30	96	93	89	86	83	79	76	73	70	67	64	61	58	55

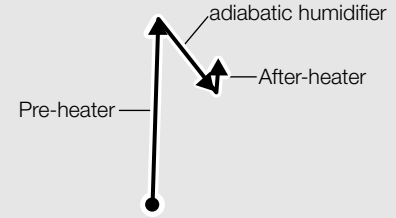
Application: In air-conditioned chambers/cabinets and in conventional measurement technology.

5.8 Psychrometric chart for air conditioning applications

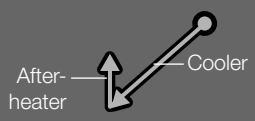
Psychrometric charts are compact presentations of air conditions and apply to one pressure level respectively, usually at atmospheric pressure (use in the field of air conditioning technology).
The psychrometric chart shown here allows different humidity parameters (relative humidity [%RH] and degree of humidity [g/kg]), as well as temperature [°C] to be placed in relationship to each other. (Pressure-dependent psychrometric chart see Stationary Measurement Technology, Compressed Air)



Winter operation (example)



Summer operation (example)



On page 111 you will find an empty psychrometric chart for your calculations.

Example:
Use of the psychrometric charts - example winter case/sommer case
The comfort zone (humans feel comfortable in this temperature and air humidity range) is between 20 and 26 °C and between 30 and 65 %RH. (for details. DIN 1946 and ASHRAE-Fundamentals (American Society of Heating, Refrigerating and Air-Conditioning Engineers))

Winter case (example)
In order for the winter air, which is too cold and too dry, to be adapted to the comfort zone, in winter operation the air must first be heated, then the relative humidity is raised with the help of an adiabatic humidifier, for example, and the air simultaneously cooled. The air is then re-heated in an after-heater and is thus within the comfort zone (see psychrometric chart, black arrows).

Summer case (example)
In order for the summer air, which is too warm and too moist, to be adapted to the comfort zone, in summer operation the air temperature must first be lowered with the help of a cooler. In doing so, the air humidity also drops, as water condenses. The air is then re-heated with the help of a after-heater. The air is now within the comfort zone (see psychrometric chart, grey arrows).

5.9 Temperature- and pressure-dependency of the humidity parameters

Humidity parameter	Pressure-dependent	Temperature-dependent
Water content/proportional volume Atmospheric dewpoint Degree of humidity	NO	NO
Saturated vapour pressure	NO	YES
Pressure dewpoint	YES	NO
Water vapour partial pressure Relative humidity Absolute humidity	YES	YES

For the pressure-dependency of humidity parameters cf. “Stationary Measurement Technology, Compressed Air”, Chapter A3 12

Notes

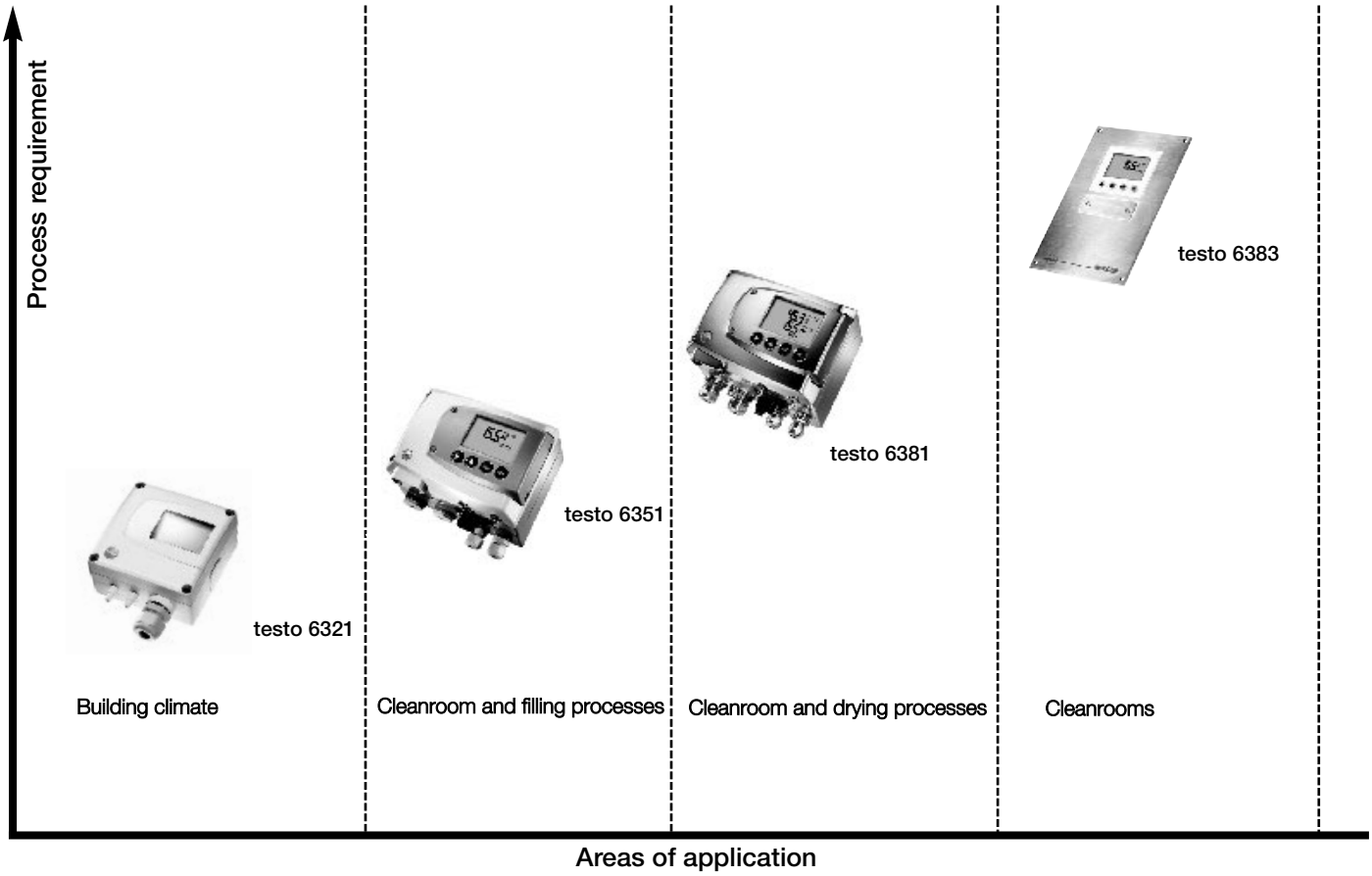
C1 Overview of versions and applications

Testo offers four transmitters for the stationary measurement of differential pressure. The following is a rough allocation of the transmitters to segments. Each transmitter is then decribed in detail.

The transmitters are designed for demanding applications in cleanrooms, in drying processes and in building climate.

As a rule, pressure sensors are subject to a temperature and time-dependent drift, which can have a negative effect on the measurement results, and thus also on the processes. In order to avoid this drift, the new Testo transmitters for differential pressure carry out a cyclic automatic zero-point adjustment. This guarantees high precision and long-term stability. Testo also offers the cleanroom-conform panel version testo 6383 and the industrial version testo 6381as special models, both of which can additionally measure temperature and humidity.

The following overview shows the Testo-developed differential pressure transmitters:



C1 Differential pressure transmitters

	testo 6321	testo 6351	testo 6381	testo 6383
				
Parameter	Differential pressure	Differential pressure, flow velocity, volume flow	Differential pressure, humidity/pressure (optional), flow velocity, volume flow	Differential pressure, humidity/temperature
Meas. range selectable between...	100 Pa to 2000 hPa	50 Pa to 2000 hPa	10 Pa to 1000 hPa	10 Pa to10 hPa
Housing	Plastic housing	Plastic housing	Metal housing	Flat stainless steel housing (panel design)
Networking via Ethernet	——	Integration of transmitter in existing system. Integration of transmitter in measurement data monitoring system, such as testo Saveris	Integration of transmitter in existing system. Integration of transmitter in measurement data monitoring system, such as testo Saveris	Integration of transmitter in existing system.
Area of application	**Building climate:** Industrial and commercial buildings, e. g. in production and storage Office and adminstrative buildings salesrooms and exhibition halls, museums and libraries, schools, hotels, hospitals etc.	Differential pressure monitoring in filling processes Critical air conditioning technology (VAC systems)	Differential pressure monitoring in filling processes, spray-painting plants Differential pressure monitoring between cleanrooms (optional: simultaneous measurement of temperature and humidity)	Differential pressure monitoring in cleanrooms (optional: simultaneous measurement of temperature and humidity
Usual installation site in cleanroom	Not for use in cleanrooms	Normal zone or outside zone	Normal zone or outside zone	Critical zone: Flush installation in cleanroom wall

2 Differential pressure transmitter in cleanroom-conform panel design

1 Description

The differential pressure transmitter testo 6383 was developed specially for monitoring low differential pressures in the measuring range from 10 Pa to 10 hPa. In cleanroom technology, the maintenance of positive pressure prevents the entry of contaminated air in critical zones. Thanks to an optional internal or external probe from the probe series 6610, the additional recording of humidity and temperature with one instrument is also possible.

The testo 6383 is particularly outstanding thanks to the automatioc zero-point adjustment which ensures high accuracy and long-term stability.

The integrated self-monitoring and early warning function also guarantees the operator high system availability.

Areas of application:

- Monitoring positive and negative pressure in cleanrooms, operating theatres and isolation rooms
- Optional monitoring of humidity and temperature in cleanrooms

- Measurement of differential pressure; optional: humidity and temperature
- Automatic zero-point adjustment guarantees high, temperature-independent accuracy and long-term stability
- Low measurement range up to 10 Pa ensures highest precision at lowest pressures
- Flat housing allows flush surface integration in the cleanroom wall
- Display with multi-language operating menu and optical alarm display
- Ethernet, relay and analog outputs allow optimum integration into individual automation systems
- Self-monitoring of the transmitter and early warning function guarantee high system availablity
- The P2A software for parameterization, adjustment and analysis saves time and costs in commissioning and maintenance
- Scalability of ±50 percent of the measuring range final value and free scalability within the measuring range
- Configurable alarm management with adjustable response delay and alarm acknowledgement

C2 2 Technical data

2 Technical data

Parameters

Differential pressure		
Measuring range	0 to 10 Pa 0 to 50 Pa 0 to 100 Pa 0 to 500 Pa 0 to 10 hPa	-10 to +10 Pa -50 to +50 Pa -100 to +100 Pa -500 to +500 Pa -10 to +10 hPa
Measurement uncertainty*	±0,3% of measurement range final value ±0.3 Pa Temperature gain drift: 0.02% of measuring range per Kelvin deviaton from nominal temperature 22 °C Zero point drift: 0% (thanks to cyclic zero-point adjustment)	
Selectable units	Differential pressure in Pa, hPa, kPa, mbar, bar, mmH_2O, kg/cm^2, PSI, inch HG, inch H_2O	
Sensor	Piezoresistive sensor	
Autom. Zero-point adjustment	via magnetic valve Frequency adjustable: 15 sec, 30 sec, 1 min, 5 min, 10 min	
Overload	**Measuring range** 0 to 10 Pa 0 to 50 Pa 0 to 100 Pa 0 to 500 Pa 0 to 10 hPa -10 to 10 Pa -50 to 50 Pa -100 to 100 Pa -500 to 500 Pa -10 to 10 hPa	**Overload** 20000 Pa 20000 Pa 20000 Pa 20000 Pa 200 hPa 20000 Pa 20000 Pa 20000 Pa 20000 Pa 200 hPa

Parameters

	Humidity/temperature optional					
Probe	Integrated probe	testo 6612	testo 6613	testo 6614	testo 6615	testo 6617
Type		Channel	Channel	Duct heated	Cable trace humidity	Cable with cover electrode monitoring
Parameters	%RH / °C/°F / $°C_{td}$ / $°F_{td}$ / g/kg / gr/lb / g/m3 / gr/ft³ / ppmV / °Cwb / °Fwb / kJ/kg / mbar / inch H_2O / °Ctm (H_2O_2)/°Ftm (H_2O_2) / % Vol					
Meas. range						
Humidity / trace humidity	0 to 100 %RH				-60 to +30 °C td	0 to 100 %RH
Temperature	-20 to +70 °C -4 to +158 °F	-30 to +150 °C -22 to +302 °F	-40 to +180 °C -40 to +356 °F		-40 to +120 °C -40 to +248 °F	-40 to +180 °C -40 to +356 °F
Measurement uncertainty*						
Humidity	Integrated probe	testo 6612	testo 6613	testo 6614	testo 6615	testo 6617
	± (1.0 + 0.007* m.v.) %RH (0 to 90%RH) ± (1.4+ 0.007* m.v.) %RH (90 to 100%RH)			± (1.0 + 0.007* m.v.) %RH (0 to 100%RH)		± (1.2 + 0.007* m.v.) %RH (0...90%RH) ± (1.6 + 0.007* m.v.) %RH (90 to 100%RH)
	for deviations from media temp. ±25 °C:±0.02 %RH/K					
Dewpoint					±1 K at 0 $°C_{td}$ ±2 K at -40°C_{td} ±4 K at -50 $°C_{td}$	
Temp. at +25°C / +77°F	±0.15 °C / 32.2 °F Pt1000 1/3 Class B				±0.15 °C/ 32.2 °F Pt1000 1/3 Class B	±0.15 °C/ 32.2 °F Pt1000 1/3 Class B

Subject to change without notice.

Inputs/outputs

Analog outputs		
Quantity	Standard: 1; with optional humidity probe: 3	
Output type	0/4 to 20 mA (4-wire) (24 VAC/DC) 0 to 1/5 to 10 V (4-wire) (24 VAC/DC)	
Scaling	Differential pressure: scalable ±50% of measuring range final value; freely scalable within measuring range	
Meas. cycle	1/sec	
Resolution	12 bit	
Max. load	max. 500 Ω	
Other outputs		
Ethernet	Optional	
Relay	Optional: 4 relays (free allocation to measurement channels or as collective alarm in operating menu/P2A), up to 250 VAC/3A (NO or NC)	
Digital	Mini-DIN for P2A software	
Supply		
Voltage supply	20 to 30 VAC/DC, 300 mA current consumption, galvanically separate signal and supply line	

General technical data

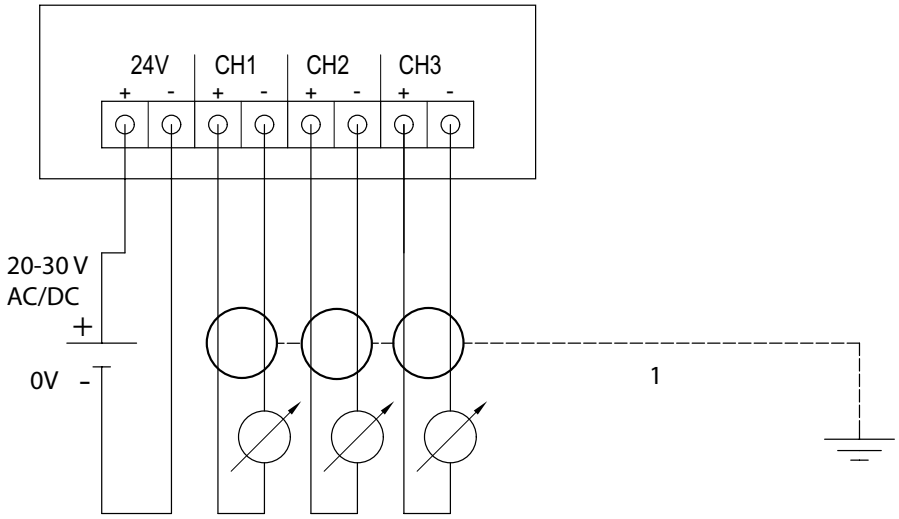
Model		
Material	Front plate stainless steel, housing plastic	
Dimensions	without humidity/temperature: 246 x 161 x 47 mm with humidity/temperature: 396 x 161 x 78 mm	
Weight	Version without humidity: 0.9 kg; Version with integrated humidity probe:1.35 kg; version with preparation for external humidity probe: 1.26 kg	
Display		
Display	optional: 3-line LCD with multi-language operating menu	
Resolution		
Differential pressure	**Measuring range** 0 to 10 Pa 0 to 50 Pa 0 to 100 Pa 0 to 500 Pa 0 to 10 hPa -10 to 10 Pa -50 to 50 Pa -100 to 100 Pa -500 to 500 Pa -10 to 10 hPa	**Resolution** 0,1 Pa 0,1 Pa 0,1 Pa 0,1 Pa 0,01 hPa 0,1 Pa 0,1 Pa 0,1 Pa 0,1 Pa 0,01 hPa
Humidity	0,1 %RH	
Temperature	0,01 °C / 0,01 °F	
Miscellaneous		
Protection class	IP 65	
Connection nipple	Ø 6 mm, fits hoses 4 + 4.8 mm	

Operating conditions

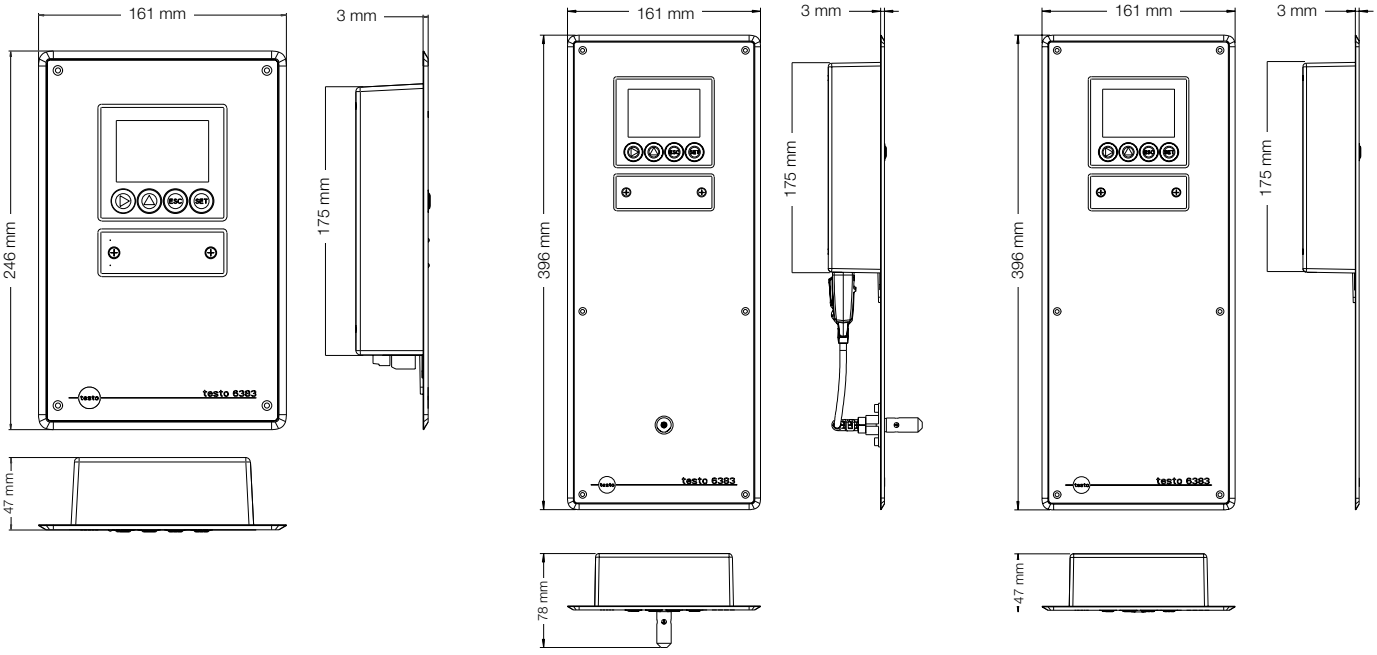
With / without display	Operation temperature	-5 to +50 °C / +23 to +122 °F
	Storage temperature	-20 to +60 °C / -4 to +140 °F
	Process temperature	-20 to +65 °C / -4 to +149 °F

The determination of measurement uncertainty of the transmitter is carried out according to GUM (Guide to the Expression of Uncertainty in Measurement):
For the determination of measurement uncertainty, the accuracy of the measuring instrument (hysteresis, linearity, reproduceability), the uncertainty contribution of the test site as well as the uncertainty of the adjustment site (works calibration are taken into account. For this purpose, the value of k=2 of the extension factor, which is usual in measurement technology is used as a basis, which corresponds to a trust level of 95%.
Measurement uncertainty differential pressure: ±0.5% of measuring range final value ±0.3Pa

3 Connection plan



4 Technical drawings



Notes

1 Description

The differential pressure transmitter testo 6381 was developed specially for monitoring differential pressure in the measuring range from 10 Pa to 1000 hPa. In cleanroom technology, the maintenance of positive pressure prevents the entry of contaminated air. In order to keep the cleanroom conditions constant, the transmitter additionally calculates the parameters volume flow and flow velocity from the measured differential pressure. Thanks to an optional probe from the probe series 6610, the additional recording of humidity and temperature with one instrument is also possible.

The testo 6381 is particularly outstanding thanks to the automatioc zero-point adjustment which ensures high accuracy and long-term stability.

The integrated self-monitoring and early warning function also guarantees the operator high system availability.

Areas of application:

- Differential pressure monitoring between cleanrooms; optional: simultaneous measurement of ambient temperature and humidity
- Monitoring drying processes
- Differential pressure measurement in filling processes and spray-painting systems

- Measurement of differential pressure, flow velocity, volume flow; optional: humidity and temperature
- Automatic zero-point adjustment guarantees high, temperature-independent accuracy and long-term stability
- Low measurement range up to 10 Pa ensures very high precision at lowest pressures
- The robust metal housing protects from tough ambient conditions
- Display with multi-language operating menu and optical alarm display
- Ethernet, relay and analog outputs allow optimum integration into individual automation systems
- Self-monitoring of the transmitter and early warning function guarantee high system availablity
- The P2A software for parameterization, adjustment and analysis saves time and costs in commissioning and maintenance
- Scalability of ±50 percent of the measuring range final value and free scalability within the measuring range
- Configurable alarm management with adjustable response delay and alarm acknowledgement

C3 Technical data

2 Technical data

Parameters			
Differential pressure			
Measuring range	0 to 10 Pa 0 to 50 Pa 0 to 100 Pa 0 to 500 Pa 0 to 10 hPa 0 to 50 hPa 0 to 100 hPa 0 to 500 hPa 0 to 1000 hPa	-10 to 10 Pa -50 to 50 Pa -100 to 100 Pa -500 to 500 Pa -10 to 10 hPa -50 to 50 hPa -100 to 100 hPa -500 to 500 hPa -1000 to 1000 hPa	
Measurement uncertainty*	±0,5% of measurement range final value ±0.3 Pa Temperature gain drift: 0.02% of measuring range per Kelvin deviaton from nominal temperature 22 °C Zero-point: 0% (thanks to cyclic zero-point adjustment)		
Selectable units	Differential pressure in Pa, hPa, kPa, mbar, bar, mmH_2O, kg/cm^2, PSI, inch HG, inch H_2O calculated parameters: volume flow in m^3/h, l/min, Nm^3/h, Nl/min Flow velocity in m/s, ft/min		
Sensor	Piezoresistive sensor		
Autom. Zero-point adjustment	via magnetic valve Frequency adjustable: 15 sec, 30 sec, 1 min, 5 min, 10 min		
Overload	**Measuring range**	**Overload**	
	0 ... 10 Pa	0,1 Pa	
	0 ... 50 Pa	0,1 Pa	
	0 ... 100 Pa	0,1 Pa	
	0 ... 500 Pa	0,1 Pa	
	0 ... 10 hPa	0,01 hPa	
	0 ... 50 hPa	0,01 hPa	
	0 ... 100 hPa	0,1 hPa	
	0 ... 500 hPa	0,1 hPa	
	0 ... 1000 hPa	1 hPa	
	-10 ... 10 Pa	0,1 Pa	
	-50 ... 50 Pa	0,1 Pa	
	-100 ... 100 Pa	0,1 Pa	
	-500 ... 500 Pa	0,1 Pa	
	-10 ... 10 hPa	0,01 hPa	
	-50 ... 50 hPa	0,01 hPa	
	-100 ... 100 hPa	0,1 hPa	
	-500 ... 500 hPa	0,1 hPa	
	-1000 ... 1000 hPa	1 hPa	

***The determination of measurement uncertainty of the transmitter is carried out according to GUM (Guide to the Expression of Uncertainty in Measurement):**
For the determination of measurement uncertainty, the accuracy of the measuring instrument (hysteresis, linearity, reproduceability), the uncertainty contribution of the test site as well as the uncertainty of the adjustment site (works calibration are taken into account. For this purpose, the value of k=2 of the extension factor, which is usual in measurement technology is used as a basis, which corresponds to a trust level of 95%.

Measurement uncertainty differential pressure: ±0.8% of measuring range final value ±0.3Pa

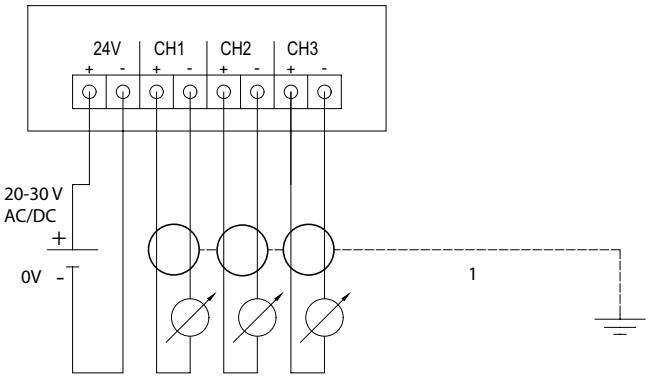
Parameters						
	Humidity/temperature optional					
Probe	testo 6611	testo 6612	testo 6613	testo 6614	testo 6615	testo 6617
Type	Wall	Channel	Channel	Duct heated	Cable trace humidity	Cable with cover electrode monitoring
Parameters	%RH / °C/°F / °C_{td} / °F_{td} / g/kg / gr/lb / g/m3 / gr/ft³ / ppmV / °Cwb / °Fwb / kJ/kg / mbar / inch H_2O / °Ctm (H_2O_2)/°Ftm (H_2O_2) / % Vol					
Meas. range						
Humidity / trace humidity	0 to 100 %RH				-60 to +30 °C td	0 to 100 %RH
Temperature	-20 to +70 °C -4 to +158 °F	-30 to +150 °C -22 to +302 °F	-40 to +180 °C -40 to +356 °F		-40 to +120 °C -40 to +248 °F	-40 to +180 °C -40 to +356 °F
Measurement uncertainty*						
Humidity	testo 6611	testo 6612	testo 6613	testo 6614	testo 6615	testo 6617
	± (1.0 + 0.007* m.v.) %RH (0 to 90%RH) ± (1.4+ 0.007* m.v.) %RH (90 to 100%RH)			± (1.0 + 0.007* m.v.) %RH (0 to 100%RH)		± (1.2 + 0.007* m.v.) %RH (0...90%RH) ± (1.6 + 0.007* m.v.) %RH (90 to 100%RH)
	for deviations from media temp. ±25 °C:±0.02 %RH/K					
Dewpoint					±1 K at 0 °C td ±2 K at -40 °C td ±4 K at -50 °C td	
Temp. at +25°C / +77°F	±0,15 °C/ 32,2 °F Pt1000 1/3 Class B				±0.15 °C/ 32.2 °F Pt100 1/3 Class B	±0,15 °C/ 32,2 °F Pt1000 1/3 Class B

Inputs/outputs	
Analog outputs	
Quantity	Standard: 1; with optional humidity probe: 3
Output type	0/4 to 20 mA (4-wire) (24 VAC/DC) 0 to 1/5 to 10 V (4-wire) (24 VAC/DC)
Scaling	Differential pressure: scalable ±50% of measuring range final value; freely scalable within measuring range
Meas. cycle	1/sec
Resolution	12 bit
Max. load	max. 500 Ω
Other outputs	
Ethernet	Optional
Relay	Optional: 4 relays (free allocation to measurement channels or as collective alarm in operating menu/P2A), up to 250 VAC/3A (NO or NC)
Digital	Mini-DIN for P2A software
Supply	
Voltage supply	20 to 30 VAC/DC, 300 mA current consumption, galvanically separate signal and supply line

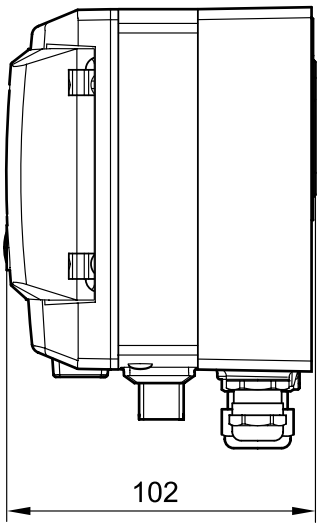
3 General technical data / connection plan

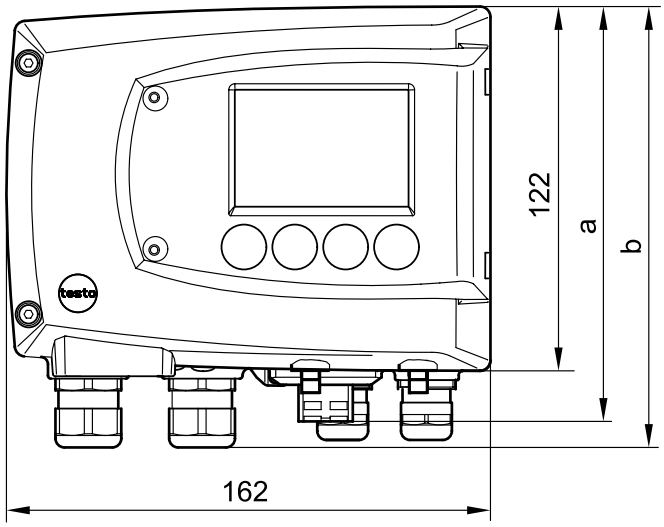
General technical data			
	Model		
	Material	Metal housing	
	Dimensions	162 x 122 x 77 mm	
	Weight	1.96 kg; optional: Ethernet intermediary layer 0.61 kg	
	Display		
	Display	optional: 3-line LCD with multi-language operating menu	
	Resolution		
	Differential pressure	**Measuring range**	**Resolution**
		0 to 10 Pa	0,1 Pa
		0 to 50 Pa	0,1 Pa
		0 to 100 Pa	0,1 Pa
		0 to 500 Pa	0,1 Pa
		0 to 10 hPa	0,01 hPa
		0 to 50 hPa	0,01 hPa
		0 to 100 hPa	0,1 hPa
		0 to 500 hPa	0,1 hPa
		0 to 1000 hPa	1 hPa
		-10 to 10 Pa	0,1 Pa
		-50 to 50 Pa	0,1 Pa
		-100 to 100 Pa	0,1 Pa
		-500 to 500 Pa	0,1 Pa
		-10 to 10 hPa	0,01 hPa
		-50 to 50 hPa	0,01 hPa
		-100 to 100 hPa	0,1 hPa
		-500 to 500 hPa	0,1 hPa
		-1000 to 1000 hPa	1 hPa
	Humidity	0,1 %RH	
	Temperature	0,01 °C / 0,01 °F	
	Miscellaneous		
	Protection class	IP 65	
	EMC	EU guideline 2004/108/EC	
	Connection nipple	Ø 6 mm, fits hoses 4 + 4.8 mm	

Operating conditions		
With / without display	Operation temperature	-5 to 50 °C / 23 to 122 °F
	Storage temperature	-20 to 60 °C / -4 to 140 °F
	Process temperature	-20 to +65 °C / -4 to +149 °F



4 Technical drawings





Notes

1 Description

Areas of application:

- Differential pressure monitoring between cleanrooms
- Differential pressure monitoring in filling processes
- Monitoring differential pressure, volume flow and flow velocity in critical air conditioning technology (VAC systems)

The differential pressure transmitter testo 6351 was developed specially for monitoring differential pressure in the measuring range from 50 Pa to 2000 hPa. In cleanroom technology, the maintenance of positive pressure prevents the entry of contaminated air. In order to keep the cleanroom conditions constant, the transmitter additionally calculates the parameters volume flow and flow velocity from the measured differential pressure.

The testo 6351 is particularly outstanding thanks to the automatioc zero-point adjustment which ensures high accuracy and long-term stability.

The integrated self-monitoring and early warning function also guarantees the operator high system availability.

- Measurement of differential pressure, flow velocity and volume flow
- Automatic zero-point adjustment guarantees high, temperature-independent accuracy and long-term stability
- Plastic housing
- Display with multi-language operating menu and optical alarm display
- Ethernet, relay and analog outputs allow optimum integration into individual automation systems
- Self-monitoring of the transmitter and early warning function guarantee high system availablity
- The P2A software for parameterization, adjustment and analysis saves time and costs in commissioning and maintenance
- Scalability of ±50 percent of the measuring range final value and free scalability within the measuring range
- Configurable alarm management with adjustable response delay and alarm acknowledgement

2 Technical data

Parameters

Differential pressure

Measuring range	0 to 50 Pa 0 to 100 Pa 0 to 500 Pa 0 to 10 hPa 0 to 50 hPa 0 to 100 hPa 0 to 500 hPa 0 to 1000 hPa 0 to 2000 hPa	-50 to 50 Pa -100 to 100 Pa -500 to 500 Pa -10 to 10 hPa -50 to 50 hPa -100 to 100 hPa -500 to 500 hPa -1000 to 1000 hPa -2000 to 2000 hPa
Measurement uncertainty*	±0,8% of measurement range final value ±0.3 Pa Temperature gain drift: 0.02% of measuring range per Kelvin deviaton from nominal temperature 22 °C Zero point drift: 0% (thanks to cyclic zero-point adjustment)	
Selectable units	Differential pressure in Pa, hPa, kPa, mbar, bar, mmH_2O, kg/cm^2, PSI, inch HG, inch H_2O Calculated variables: Volume flow in m^3/h, l/min, Nm^3/h, Nl/min Flow velocity in m/s, ft/min	
Sensor	Piezoresistive sensor	
Autom. Zero-point adjustment	via magnetic valve Frequency adjustable: 15 sec, 30 sec, 1 min, 5 min, 10 min	

Overload capacity

Measuring range	Overload
0 to 50 Pa	20000 Pa
0 to 100 Pa	20000 Pa
0 to. 500 Pa	20000 Pa
0 to 10 hPa	200 hPa
0 to 50 hPa	750 hPa
0 to 100 hPa	750 hPa
0 to 500 hPa	2500 hPa
0 to 1000 hPa	2500 hPa
0 to 2000 hPa	2500 hPa
-50 to 50 Pa	20000 Pa
-100 to 100 Pa	20000 Pa
-500 to 500 Pa	20000 Pa
-10 to. 10 hPa	200 hPa
-50 to 50 hPa	750 hPa
-100 to 100 hPa	750 hPa
-500 to 500 hPa	2500 hPa
-1000 to 1000 hPa	2500 hPa
-2000 to 2000 hPa	2500 hPa

The determination of measurement uncertainty of the transmitter is carried out according to GUM (Guide to the Expression of Uncertainty in Measurement):
For the determination of measurement uncertainty, the accuracy of the measuring instrument (hysteresis, linearity, reproduceability), the uncertainty contribution of the test site as well as the uncertainty of the adjustment site (works calibration are taken into account. For this purpose, the value of k=2 of the extension factor, which is usual in measurement technology is used as a basis, which corresponds to a trust level of 95%.

Measurement uncertainty differential pressure: ±0.8% of measuring range final value ±0.3Pa

Inputs/outputs

Analog outputs

Quantity	1
Output type	0/4 to 20 mA (4-wire) (24 VAC/DC) 0 to 1/5 to 10 V (4-wire) (24 VAC/DC)
Scaling	Differential pressure: scalable ±50% of measuring range final value; freely scalable within measuring range
Meas. cycle	1/sec
Resolution	12 bit
Max. load	max. 500 Ω

Other outputs

Ethernet	Optional with Ethernet module
Relay	Optional: 4 relays (free allocation to measurement channel or as collective alarm in operating menu/P2A), up to 250 VAC/3A (NO or NC)
Digital	Mini-DIN for P2A software

Supply

Voltage supply	20 to 30 VAC/DC, 300 mA current consumption, galvanically separate signal and supply line

General technical data

Model

Material	Plastic housing
Dimensions	162 x 122 x 77 mm
Weight	0.7 kg; optional: Ethernet intermediary layer 0.6 kg

Display

Display	Optional: 3-line LCD with multi-language operating menu

Resolution

Measuring range	Resolution
0 to 50 Pa	0,1 Pa
0 to 100 Pa	0,1 Pa
0 to 500 Pa	0,1 Pa
0 to 10 hPa	0,01 hPa
0 to 50 hPa	0,01 hPa
0 to 100 hPa	0,1 hPa
0 to 500 hPa	0,1 hPa
0 to 1000 hPa	1 hPa
0 to 2000 hPa	1 hPa
-50 to 50 Pa	0,1 Pa
-100 to 100 Pa	0,1 Pa
-500 to 500 Pa	0,1 Pa
-10 to 10 hPa	0,01 hPa
-50 to 50 hPa	0,01 hPa
-100 to 100 hPa	0,1 hPa
-500 to 500 hPa	0,1 hPa
-1000 to 1000 hPa	1 hPa
-2000 to 2000 hPa	1 hPa

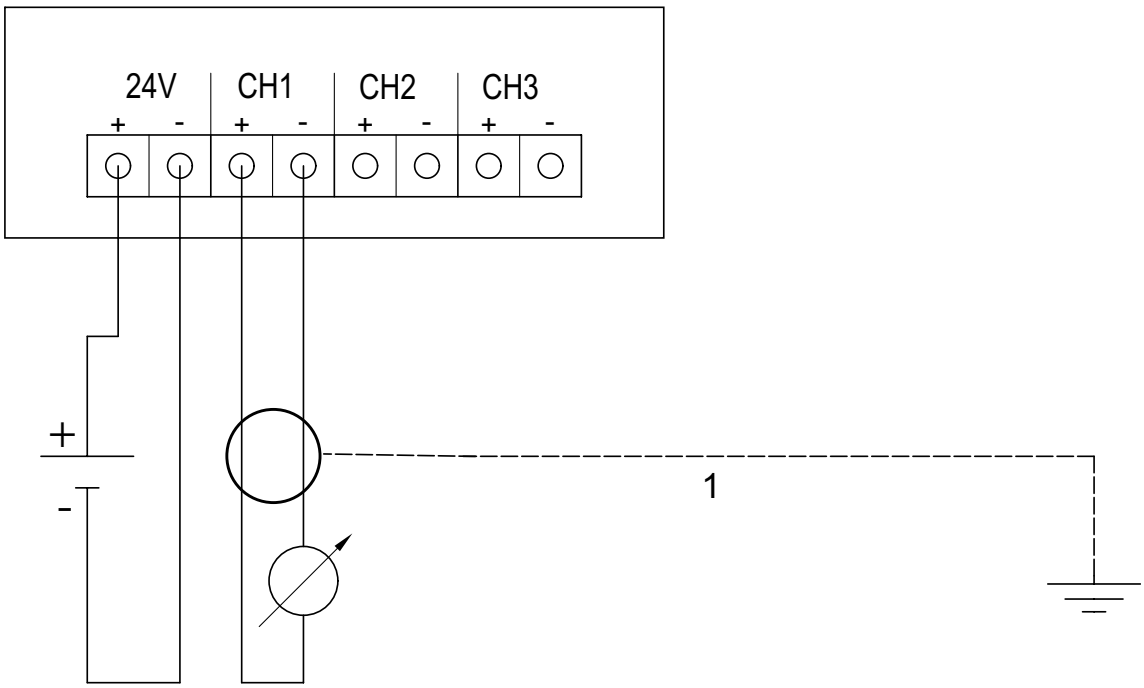
Miscellaneous

Protection class	IP 65
EMC	EU guideline 2004/108/EC

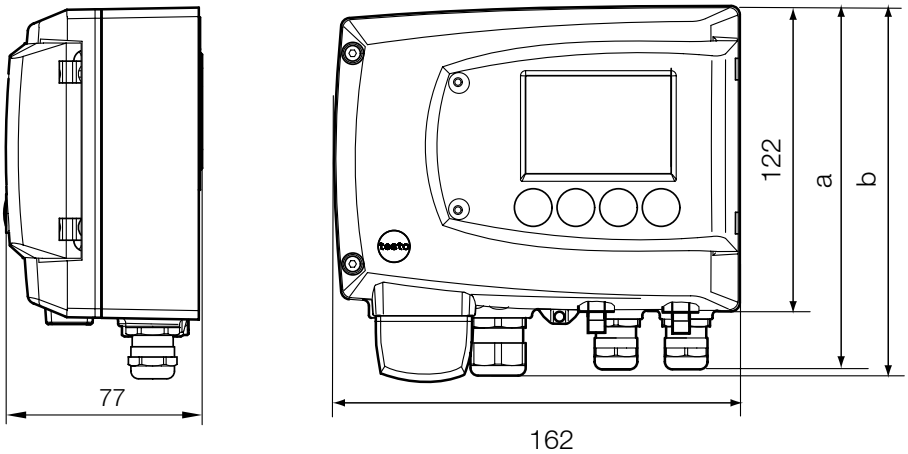
Operating conditions

With / without display	Operating temperature	-5 to +50 °C / +23 to +122 °F
	Storage temperature	-20 to +60 °C / -4 to +140 °F
	Process temperature	-20 to +65 °C / -4 to +149 °F

3 Connection plan



4 Technical drawings



Notes

C5 Differential pressure transmitter for building climate

1 Description

A differential pressure transmitter with a good price/performance ratio for applications in air conditioning and ventilation technology. The automated building services must always be monitored precisely, whereby the requirements placed on the measuring technology are increased. **testo 6321** fulfills these requirements by ensuring the best possible system function, optimization of the climatic conditions and energy savings by means of highly accurate measurement, stable over the long-term, of the differential pressure.

Areas of application:

- Industrial and commercial buildings, e.g. in production and storage
- Offices and administrational buildings
- Sales areas and exhibition halls
- Museums and libraries
- School buildings, hotels, clinics etc.

- Piezoresistive measuring cells in the measuring range of 100 Pa to 2 bar
- Freely scalable: ±50% of measuring range final value
- Magnetic valve for automatic zero-point adjustment
- External interface for parameterization, adjustment and analysis (P2A)
- Accuracy ±1.2 % of measuring range + intrinsic error of 0.3 Pa – valid for zeroing cycle of 60 sec/nominal temperature +22 °C
- Diverse analog outputs and measuring ranges
- Display optional
- Freely scalable within measuring ranges

2 Technical data

Parameters

Differential pressure		
Meas. range	0 to 100 Pa 0 to 10 hPa 0 to 20 hPa 0 to 50 hPa 0 to 100 hPa 0 to 500 hPa 0 to 1000 hPa 0 to 2000 hPa	-100 to 100 Pa -10 to 10 hPa -20 to 20 hPa -50 to 50 hPa -100 to 100 hPa -500 to 500 hPa -1000 to 1000 hPa -2000 to 2000 hPa
Measurement inaccuracy*	±1.2% of measuring range final value ±0.3 Pa Temperature gain drift: 0.05% of measuring range per Kelvin deviation from nominal temperature 22 °C Zero-point drift: 0% (due to cyclic zero-point adjustment)	
Sensor	Piezoresistive sensor	
Autom. zero-point adjustment	via magnetic valve	
Overload capacity	**Meas. range** 0 to 100 Pa 0 to 10 hPa 0 to 20 hPa 0 to 50 hPa 0 to 100 hPa 0 to 500 hPa 0 to 1000 hPa 0 to 2000 hPa -100 to 100 Pa -10 to 10 hPa -20 to 20 hPa -50 to 50 hPa -100 to 100 hPa -500 to 500 hPa -1000 to 1000 hPa -2000 to 2000 hPa	**Overload** 20,000 Pa 200 hPa 200 hPa 750 hPa 750 hPa 2500 hPa 2500 hPa 2500 hPa 20,000 Pa 200 hPa 200 hPa 750 hPa 750 hPa 2500 hPa 2500 hPa 2500 hPa

Inputs and outputs

Analog outputs	
Output type	0 to 1/5/10 V (4-wire) 4 to 20 mA (4-wire)
Meas. cycle	1/sec
Resolution	12 bit
Accuracy of analog outputs	0 to 1 V ±2,5 mV 0 to 5 V ±12.5 mV 0 to 10 V ±25 mV 4 to 20 mA ±0.05 mA
Max. load	500 Ω
Additional outputs	
Other analog outputs	Mini-DIN for P2A software (adjustment and parameterization software)
Supply	
Voltage supply	20 to 30 V AC/DC
Current consumption	300 mA

Operating conditions

Humidity (sensors)	0 to 90% RH
Temperature (sensors)	-5 to +50 °C
Storage temperature	-40 to +80 °C

The determination of measurement uncertainty of the transmitter is carried out according to GUM (Guide to the Expression of Uncertainty in Measurement):
For the determination of measurement uncertainty, the accuracy of the measuring instrument (hysteresis, linearity, reproduceability), the uncertainty contribution of the test site as well as the uncertainty of the adjustment site (works calibration are taken into account. For this purpose, the value of k=2 of the extension factor, which is usual in measurement technology is used as a basis, which corresponds to a trust level of 95%.

General

Housing		
Material/ colour	ABS/ pure white (RAL 9010) or light grey	
Weight	approx. 160 g	
Display		
Display	1-line LCD (optional)	
Resolution	**Meas. range** 0 to 100 Pa 0 to 10 hPa 0 to 20 hPa 0 to 50 hPa 0 to 100 hPa 0 to 500 hPa 0 to 1000 hPa 0 to 2000 hPa -100 to 100 Pa -10 to 10 hPa -20 to 20 hPa -50 to 50 hPa -100 to 100 hPa -500 to 500 hPa -1000 to 1000 hPa -2000 to 2000 hPa	**Resolution** 0.1 0.01 0.01 0.01 0.1 0.1 1 1 0.1 0.01 0.01 0.01 0.1 0.1 1 1
Miscellaneous		
Protection class	IP 65 only if the transmitter is wired and/or sealing plugs are inserted	
EMC	EC Directive: 2004/108/EC	
Automatic zero-point adjustment	Every 60 seconds in the factory setting	

1.1 Calibration certificates

Testo offers calibration in accredited Testo laboratories.

If requirements from the field of quality assurance are in the foreground (ISO9001, QS9000, GMP, FDA, HACCP,...), ISO calibration (laboratory accredited according to ISO 17025) offers the ideal solution. If highest reliability is required, for instance in production norms, for assessors, official bodies and critical applications, DKD calibration is recommended.

If the measuring instrument has a DKD certificate, you are entitled to carry out internal ISO calibration in the works with this DKD calibrated reference instrument. The 6340 (with DKD certificate), for example, is thus suitable for an internal works calibration laboratory.

Each testo 6340 is delivered with a works calibration certificate (confirmation of tests at the point of delivery). For higher certificate requirements, ISO and DKD certificates are offered.


Kalibrier-Zertifikat
Calibration Certificate


DEUTSCHER KALIBRIERDIENST DKD

The customer can also additionally choose between a standard certification (pre-set calibration points) or selective certification (freely selectable calibration points) or individual certification (freely selectable calibration points and repair service).(cf. table below)

	Pre-determined calibration points	Freely selectable calibration points	Pre-determined certificate layout	Individual certificate layout	Pre-determined calibration label	Individual calibration label	Transport service	Express service	Instrument loan service	Repair after accepted quote	Repair without quote
ISO standard	●		●		●		○	○	○	●	
ISO selective	◎		◎		◎		○	○	○	●	
ISO individual	◎		◎		◎		○	○	○	◎	
DKD standard	●		●		●		○	○	○	●	
DKD selective	◎		●		●		○	○	○	●	
DKD individual	◎		●		●		○	○	○	◎	

● **fixed component** ○ **additionally selectable (by customer) when ordering** ◎ **alternatively selectable (by customer) when ordering**

Differential pressures are produced in the Testo pressure laboratory using highly accurate piston-type pressure gauges and precision weights. Alternatively, reference measuring instruments with electronic pressure sensors are also used.

DKD calibration is available on request for all calibration ranges.

DKD/ ISO	Accuracy	Calibration points/range		Order no.
DKD	Standard <=0.03	11 cal. points	0.2 mbar to 1 bar	0520.0295
	Standard <0.1	11 cal. points	0.2 mbar to 1 bar	0520.0205
	Standard 0.1 to 0.6	11 cal. points	0.2 mbar to 1 bar	0520.0215
	Standard >0.6	6 cal. points	0.2 mbar to 1 bar	0520.0225
ISO	Selective <0.1		0 to 1 bar	0520.0155
	Selective 0.1 to 0.6		0 to 1 bar	0520.0145
	Selective >0.6		0 to 1 bar	0520 0105
	Standard <0.1	3 cal. points	0 to 1 bar	0520.0075
	Standard 0.1 to 0.6	3 cal. points	0 to 1 bar	0520.0085
	Standard >0.6	3 cal. points	0 to 1 bar	0520.0095
	Standard <0.1	5 cal. points	0 to 1 bar	0520.0035
	Standard 0.1 to 0.6	5 cal. points	0 to 1 bar	0520.0025
	Standard >0.6	5 cal. points	0 to 1 bar	0520.0005
	Standard > 0.1		0/5/10/15/20/25 Pa	0520.0405

C6 2 Physical principles

2.1 Definition of pressure

Pressure P is the quotient of a force F acting on an area A.

The derived unit for pressure in the SI system is Pascal: 1 Pa = 1 N/m², whereas 1 bar = 100.000 Pa.

$$Pressure(P) = \frac{Force(F)}{Area(A)}$$

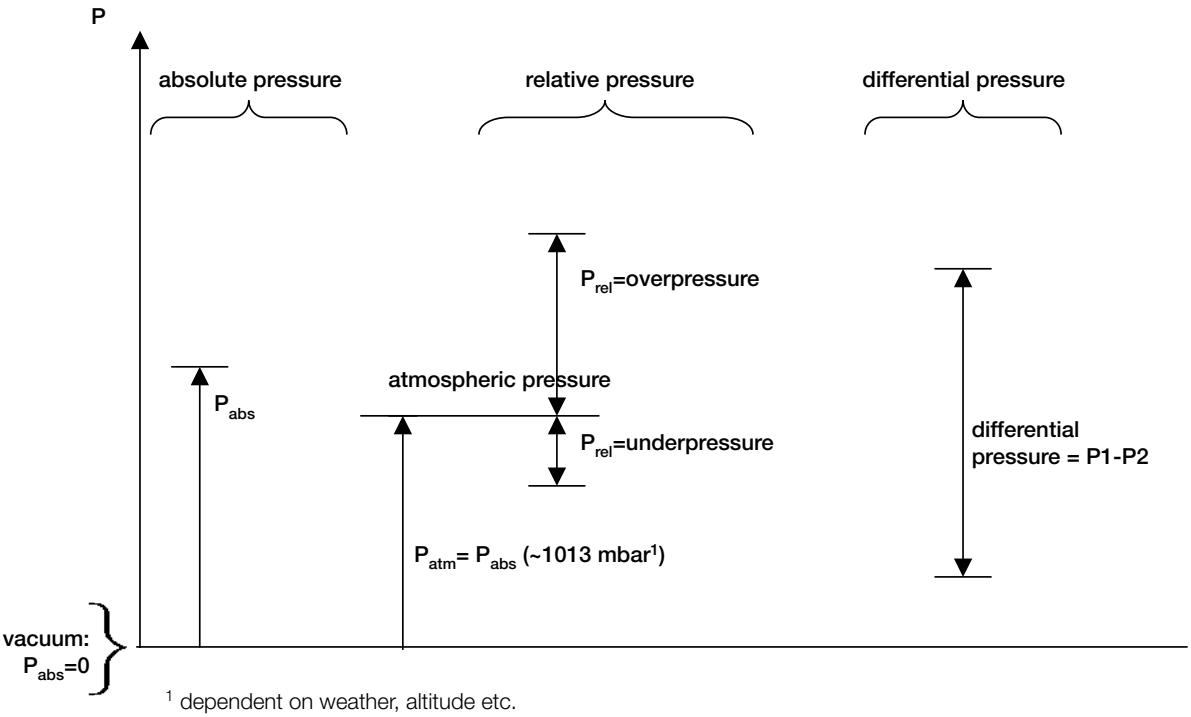
P = pressure [Pa]
F = vertical force on area [N]
A = area [m²], on which the force acts vertically

Example: 1000 Pa correspond to 10 mbar

Pressure unit	Values						Symbol
Pascal	1	10	50	1,000	10,000	100,000	Pa
Hectopascal	0.01	0.1	0.5	10	100	1,000	hPa
Millibar	0.01	0.1	0.5	10	100	1,000	mbar
Bar	0.00001	0.0001	0.0005	0.01	0.1	1	bar
Inch of water	0.004	0.04	0.2	4	40	400	in H2O
kg/cm²	0.00001	0.0001	0.0005	0.01	0.1	1	kg/cm²

2.2 Overview of pressures

With the help of testo 6340
1. **differential pressure**
2. **relative pressure** (one pressure connection remains open)
   can be measured.



[1] dependent on weather, altitude etc.

2.3 Atmospheric air pressure (P_{atm})

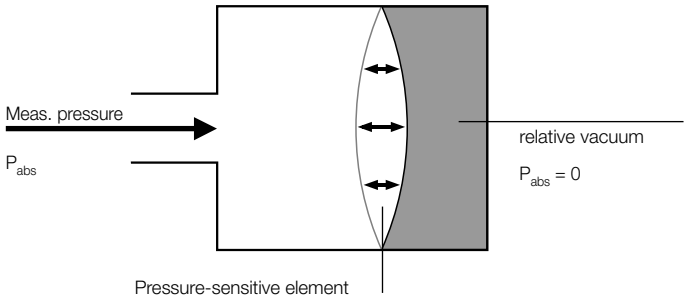
Atmospheric pressure (=ambient pressure) is the most important pressure for life on earth. It is created by the weight of the air surrounding the earth. The air cover reaches to an altitude of approx. 500 km. The air pressure constantly decreases up to this height (absolute pressure in space P_{abs} = zero). The atmospheric air pressure is additionally influenced by climatic fluctuations. The mean P_{atm} at sea level is 1013.25 hectopascal (hPa) or millibar (mbar). It can vary up to +/- 5% in high or low pressure weather zones.

2.4 Absolute pressure (P_{abs})

The pressure relating to the air-free space of the universe (pressure zero) or to an (artificially) created vacuum, is described as absolute pressure.

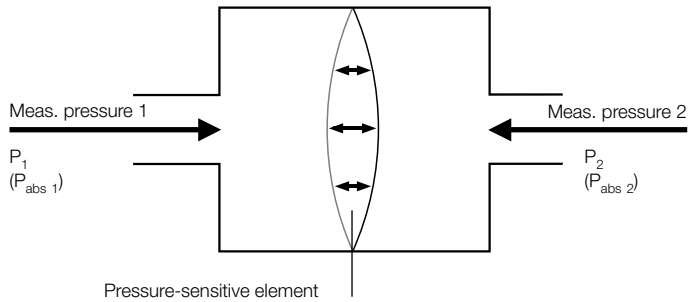
Absolute pressure is denoted with the index “abs”.

This measurement cannot be made with the testo 6340.



2.5 Differential pressure (ΔP)

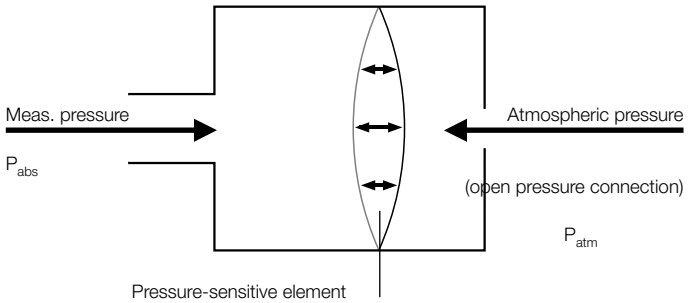
The difference between two pressures p1 and p2 is referred to as differential pressure (Δp= p1-p2).



2.6 Relative pressure (P_{rel})

The relative pressure describes by which amount an absolute pressure (P_{abs}) is higher or lower than the atmospheric pressure (P_{atm}); $P_{rel} = P_{abs} - P_{atm}$. A positive relative pressure is an overpressure and a negative relative pressure is an underpressure.

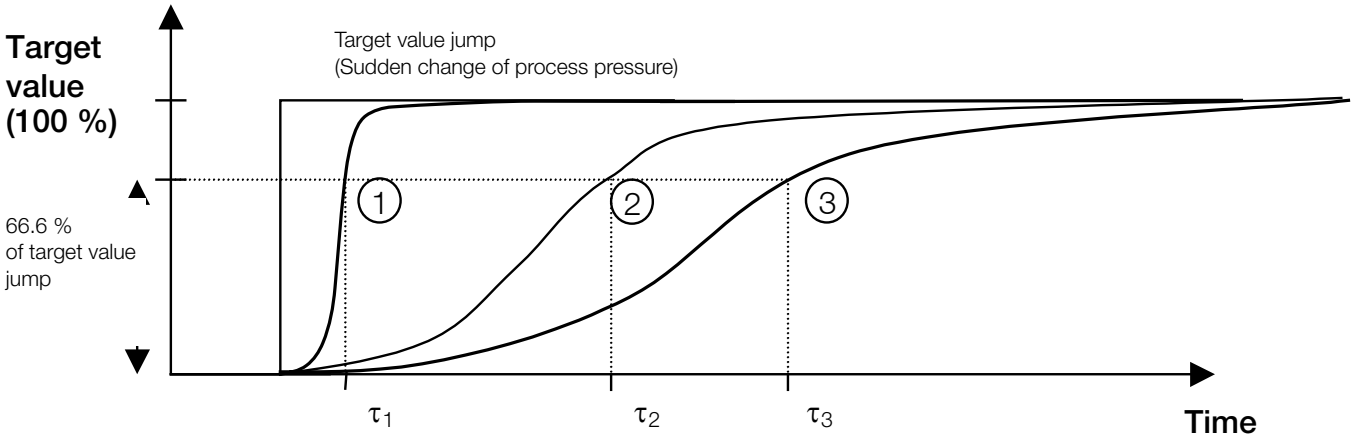
Relative pressure can be measured with the testo 6340 by connecting the positive pressure connection to the process and leaving the negative pressure connection open (i.e. opened to atmospheric pressure).



C6 2 Physical principles

2.7 Signal delay/damping

The testo 6340 has a reaction time in the millisecond range. This enables an optimum reaction/control in many applications. Some applications, however, require a slower signal reaction (e.g. individual pressure peaks should not trigger an alarm in a cleanroom). For this reason, the reaction time is increased (damped) by increasing the time constant "τ ".



① Jump reaction of testo 6340 without damping

② Jump reaction of testo 6340 with weak damping

③ Jump reaction of testo 6340 with strong damping

testo 6341/43: The damping value (time constant) can be set in the instrument (twist potentiometer (S1)).
The standard time constant is 2.5 sec. This can be altered to 1/5/10/20/30 or 40 seconds by the user if required.

testo 6342/44: A specified damping value (time constant) can be set. The standard time consant is 2 sec.. On request, this can be increased to 1/2/5 or 10 seconds in the factory - alteration on site not possible !

Note: To enhance stability in small measurement values, small measurement ranges are given a higher damping (minimal fluctuations are blanked out).

1 Description

The testo 6920 is a cost-effective temperature transmitter that is appealing thanks to its functionality and design. If desired, it can be equipped with a display and/or an interface for adjustment. A set-point adjuster is available as an option for set-point setting. If equipped with an interface, the transmitter can be calibrated/adjusted using the P2A software. The testo 6920 transmitter is available as a wall and a duct version.

Areas of application:

- Industrial and commercial buildings, e.g. in production and storage
- Offices and administrational buildings
- Sales areas and exhibition halls
- Museums and libraries
- School buildings, hotels, clinics etc.

- Optional external interface for parameterization, analysis and adjustment using the P2A software
- 2 housing versions for application as a wall or duct version
- Optional display
- Optional set-point adjuster with adjusting range 10 to 32 °C/50 to 90 °F or - … 0 … +
- Temperature available as an analog or passive output

D Technical data

2 Technical data

	testo 6920 - A01 (wall version)	testo 6920 - A02 (duct version)
Parameters		
Temperature		
Meas. range	0 to +70 °C/ +32 to +158 °F	-20 to +70 °C/ -4 to +158 °F
Accuracy	±0.5 °C/0.9 °F	
Selectable units	°C/°F	
Sensor	5 kΩ NTC (active) Pt 100 class A looped through (passive) Pt 100 class B looped through (passive) Pt 1000 class B looped through (passive) Nl 1000 looped through (passive) 5 kΩ NTC looped through (passive) 10 kΩ NTC looped through (passive)	
Inputs and outputs		
Analog outputs		
Number of channels	2 channels (temperature)	
Output type	4 to 20 mA (2-wire) 0 to 1/5/10 V (4-wire)	
Meas. cycle	1/sec	
Accuracy of analog outputs	4 to 20 mA ±0.05 mA 0 to 1 V ±2.5 mV 0 to 5 V ±12.5 mV 0 to 10 V ±25 mV Resistance value of the temperature sensor (passive)	
Supply		
Voltage supply	20 to 30 V DC/V AC 24 V DC ±10 %	
Current consumption		
Output	Supply voltage [V]	Current consumption [mA]
2-wire current 4 to 20 mA	20	20
	24	20
	30	20
4-wire voltage 0 to 10 V	24	7
	30	7
	20	20
	24	22
	30	28
Operating conditions		
Electronics temperature (housing) (with/without display)	Without display: 0 to +70 °C/ +32 to +158 °F (A01) With display: 0 to +50 °C/+32 to +122 °F (A01) Without display: -20 to +70 °C/ -4 to +158 °F With display: 0 to +50 °C/ +32 to +122 °F	
Storage temperature	-40 to +80 °C/-40 to +176 °F	
Measuring medium	Air in air-conditioning systems or air-conditioned rooms	

	testo 6920 - A01 (wall version)	testo 6920 - A02 (duct version)
General		
Housing		
Material/colour	ABS, pure white (RAL 9010)	
Dimensions	81 x 81 x 26 mm/3.19 x 3.19 x 1.03”	81 x 81 x 42 mm/3.19 x 3.19 x 1.66”, without probe shaft
Weight	80 g	160 g
Display		
Display	1-line, 7-segment	
Resolution	0.1 °C/0.1 °F	
Operation		
Nominal value adjusting range	10 to 32 °C/50 to 90 °F / - ... 0 ... + or via the keys (C01 with W01 or W02) or via P2A (optionally via external interface)	
Assembly		
Cable screw connection	None (cable routed through rear wall opening or break-out opening on bottom)	1 x M16 x 1.5
Miscellaneous		
Protection class	IP 30	IP 65
EMC	According to EC Directive 89/336 EEC, EN 60730-1	

3 Connection plan

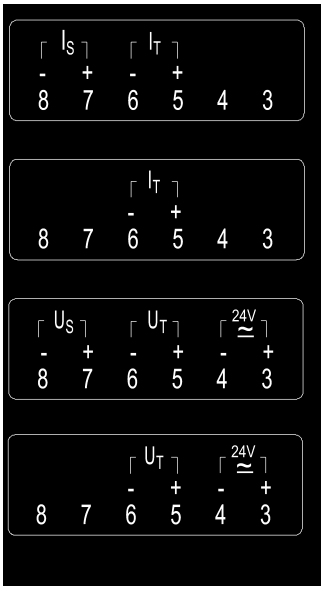
Wall version active

Current with adjuster

Current without adjuster

Voltage with adjuster

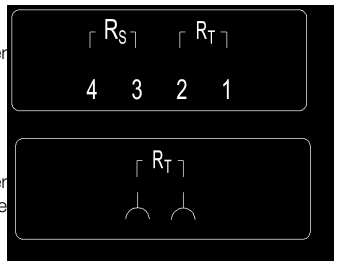
Current without adjuster



Wall version passive

With adjuster

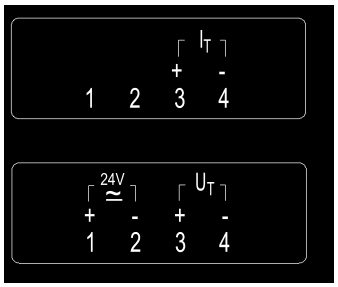
Without adjuster
Duct version passive



Duct version active

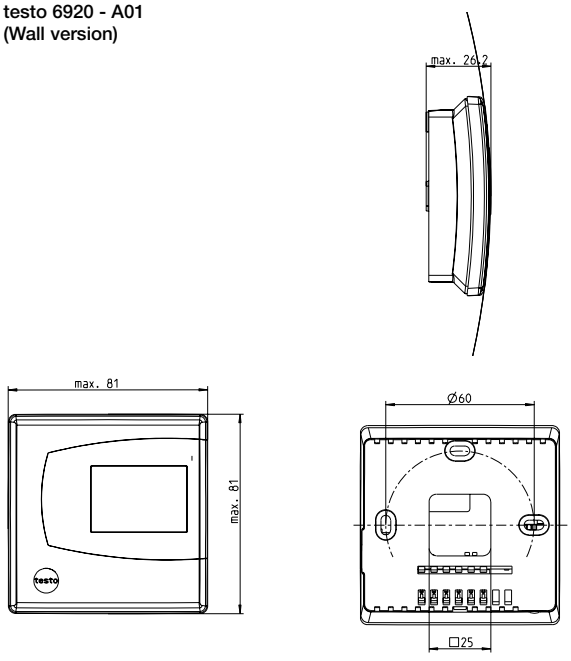
Current

Voltage

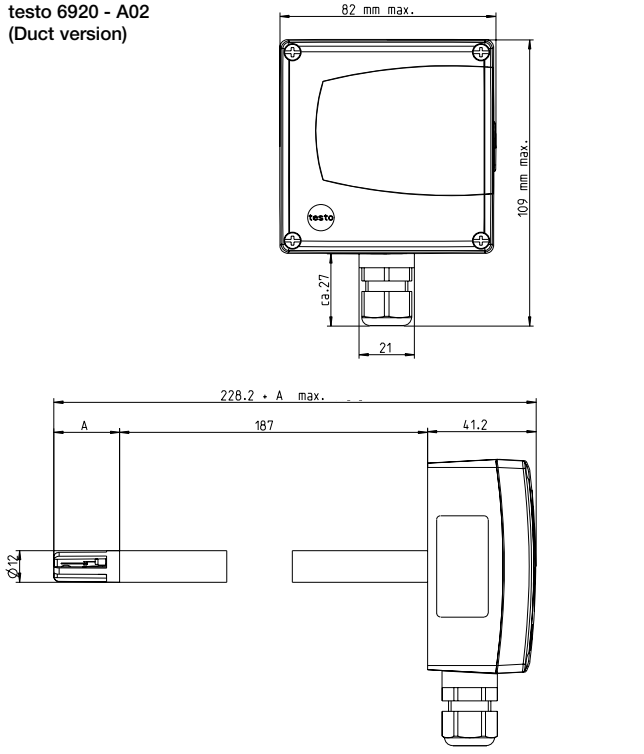


Technical drawings

testo 6920 - A01
(Wall version)



testo 6920 - A02
(Duct version)



Notes

1 Description

The process displays testo 54 fit optimally into the front of a switch cabinet or into a wall housing (accessory). In testo 54-1/-2/-3/-7/-8, a removable terminal strip is integrated for convenient cable connection. Depending on the type (cf. table Chapter 1.2), the process displays testo 54 can be used for switching, as displays, for networking, alarming, MIN./MAX. storage, totaliser function, for supplying measurement transmitters with an auxilliary energy output (24 VDC), as well as for online monitoring. Resistance thermometers (Pt100 and others), as well as thermocouples (Type K, J, T, S and others) can be directly connected. Further types serve to display analog signals (4 to 20 mA or 0 to 10 VDC and others). The input type is simply selected in the easy-to-follow menu, and the value is immediately shown in the clearly legible display.

2 Ordering options

	Overview of types		Inputs		Supply	Store	Totaliser (Sum function)	Outputs			
	Types	Part no.	Thermocouple Type B/E/J/K/N/R/S/T Resistance thermometer 0 to 400 / 0 to 4000 Ohm Millivolt input 0 to100/-100 to +100 mV	4 to 20 mA 0 to 20 mA 0 to 10 V -10 to +10 V +2 to +10 V	Voltage	Min./ Max. value store	ideal for flow-through applications	2 relay * outputs	24 VDC/ 50 mA ** auxilliary energy output	RS485-output for online monitoring, cf Chap. 2	
	54-3DC	5400 6554	√	–	①	√	–	√	–	–	
	54-3AC	5400 7554	√	–	②	√	–	√	√	–	
	54-7DC	5400 6555	–	√	①	√	√	√	–	√	
	54-7AC	5400 7555	–	√	②	√	√	√	√	√	
	54-8DC	5400 6556	√	–	①	√	–	√	–	√	
	54-8AC	5400 7556	√	–	②	√	–	√	√	√	

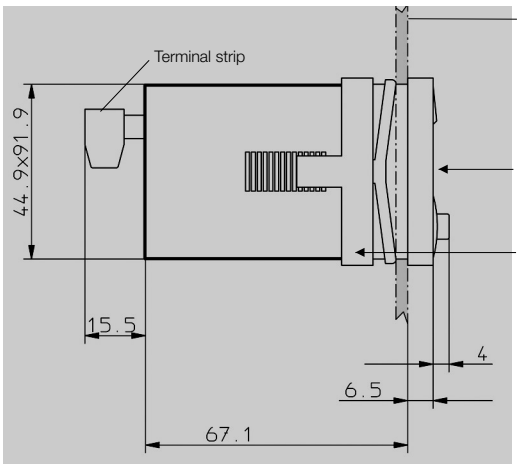
① 20 to 30 VDC
② 100 to 250 VAC, 50/60 Hz

Properties:

- Optimum illumination, even in dark surroundings (engine rooms etc.)
- * Relay outputs (54-3, 54-7, 54-8) directly switchable with 90 to 250 VAC/300 VDC, max. 3 A, min. 30 mA
- ** Auxilliary energy output 24 VDC: Replaces the mains unit (4 to 20 mA) in two-wire transmitters or supplies an alarm lamp, for example.
- Data storage 10 years (EEPROM): scaling limits, input type and other parameters securely stored
- IP 65 from the front (when installed)
- Key-locking possible
- Easy installation (cf. drawing below)
- Load 225 Ω
- 5-figure 7-segment display

Front view (Example testo 54-3AC)

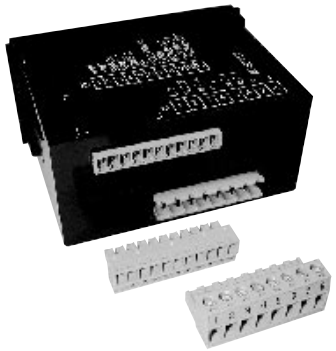
Easy installation (e.g. in switching cabinets)
(Dimensions for testo 54-3, -7, -8)



Switching cabinet front (cut-out dimensions 92x45 mm)

1. Push in testo 54 from the front (Front dimensions 96x48 mm incl. installation frame; cut-out 92x54 mm)
2. Push on installation frame from the rear

Rear view (Example testo 54-3AC)



E testo 54-3 with relay outputs

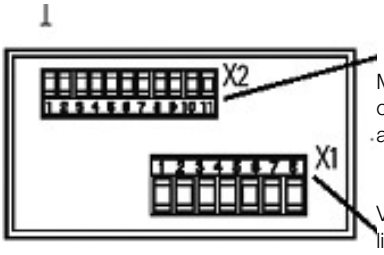
3 testo 54-3 with relay outputs

testo 54-3

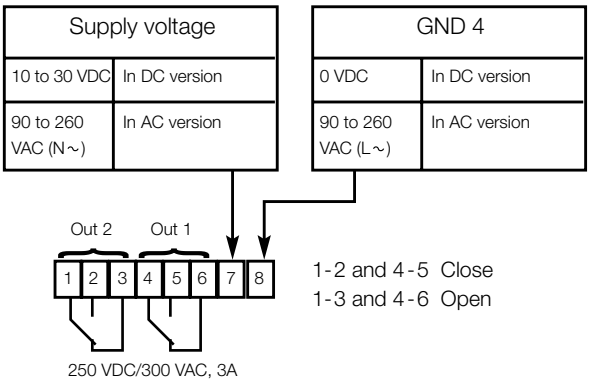
The testo 54-3 has a connection for thermocouples, measurement resistances, resistance thermometers and sensors in the mV range.

This type has two relay outputs, which are switchable up to 250 VAC/300 VDC (3 A). Use as an opener or closer is freely selectable. The version testo 54-3AC additionally offers an auxilliary energy output (24 VDC/50 mA), with which, for example, a measurement transmitter or an alarm lamp can be supplied. The min./max. values can also be read from the display.

3.1 Electrical connections for testo 54-3



Terminal strip X1 (testo 54-3)



Terminal strip X2 in testo 54-3
(Measurement input: PT 100 or TC)

1	Measurement inputs for thermocouples,
2	resistance measurement (Pt100/Pt1000/
3	0 to 400 Ohm/0 to 4000 Ohm) or voltage
4	measurement (0 to 100 mV/-100 to +100 mV)
5	see instruction manual testo 54-3
7	GND2 (KEY/MPI) (4 to 30 VDC/min. 5 ms)
8	MP-Input Reset-Limit value-Latch/Display-Hold*
9	GND3 (for Uout)
10	Uout +10 V/30mA
11	Uout +24 V/50mA
	Only when supplied with 90 to 260 VAC

* Display is frozen as long as terminals 7-8 are connected to a voltage of 4 to 30 VDC (Calculation of MIN./MAX. values continues in the background). Release of Latch input when signal level drops below 2 VDC.

4 Temperature/analog value process displays (external displays) testo 54-7/-8 with relay outputs and RS485-output as well as min./max. value store

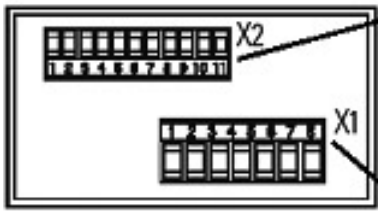
testo 54-7/-8

The testo 54-7 has a connection for signal inputs of 4 to 20 mA/0 to 10V and an additional integrated totaliser (the current values are cumulated at a sampling rate of 1 second).

The testo 54-8 has a connection for thermocouples, measurement resistances, resistance thermometers and sensors in the mV range.

Both types also have two relay outputs each, which can be switched up to 250 VAC/300 VDC (3 A), as well as an RS485-output for online monitoring (cf. chapter 2) and a min./max. value store. The versions testo 54-7AC and testo 54-8AC also offer an auxilliary energy output (24 VDC/50 mA), with which, for example, a measurement transmitter or an alarm lamp can be supplied.

4.1 Electrical connections for testo 54-7/-8

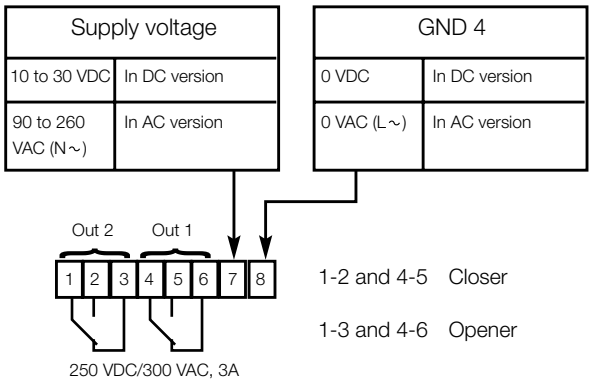


Measurement and control signals as well as auxilliary signals

Voltage supply and limit value outputs

RS485 interface

Terminal strip X1 (in testo 54-7 or testo 54-8)



Terminal strip X2 in testo 54-7 (with measurement input: 4 to 20mA/0 to 10V)

1	Current input (I)0 to 20 mA/4 to 20 mA
2	GND1 (Analog)
3	Voltage input (U)0 to 10 V, 2 to 10 V, -10…+10 V
4	Not used
5	Not used
6	Keylock "Key" (4 to 30 VDC/min. 5 ms)
7	GND2 (KEY/MPI)
8	MP-Input Reset-Limit value-Latch/Display-Hold/Reset Totaliser
9	GND3 (for Uout)
10	Uout +10 V/30mA
11	Uout +24 V/50mA Only when supplied with 90 to 260 VAC

Terminal strip X2 in testo 54-8 (with measurement input: Pt100 or TC)

1	Measurement inputs for thermocouples,
2	resistance measurement (Pt100/Pt1000/
3	0 to 400 Ohm/0 to 4000 Ohm) or voltage
4	measurement (0 to 100mV/-100 to+100mV
5	see instruction manual testo 54-8
6	Keylock "Key" (4 to 30 VDC/min. 5 ms)
7	GND2 (KEY/MPI)
8	MP-Input Reset-Limit value-Latch/Display-Hold
9	GND3 (for Uout)
10	Uout +10 V/30mA
11	Uout +24 V/50mA Only when supplied with 90 to 260 VAC

Terminal strip X3 (in testo 54-7 or testo 54-8)

1	Not used
2	DO+/RI+ (RS485)
3	DO-/RI- (RS485)
4	Not used
5	Not used

* Display is frozen as long as terminals 7-8 are connected to a voltage of 4 to 30 VDC (Calculation of MIN./MAX. values continues in the background). Release of Latch input when signal level drops below 2 VDC. (cf. Chapter 1.9.1.3)

5 Accessories for process display testo 54

Wall housing for the process displays testo 54

With the wall housing, the process displays testo 54 can be installed directly adjacent to the measurement location or in other suitable places. The wall housing is made of polycarbonate and has three cable inputs M20x1.5.

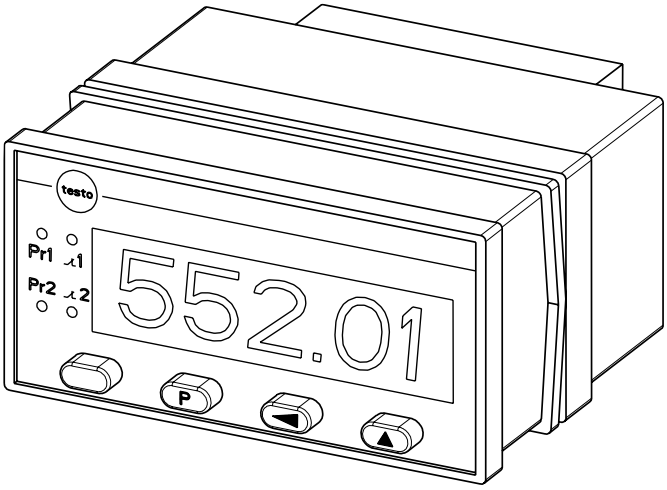
Wall housing
ID-No. 0699 5809

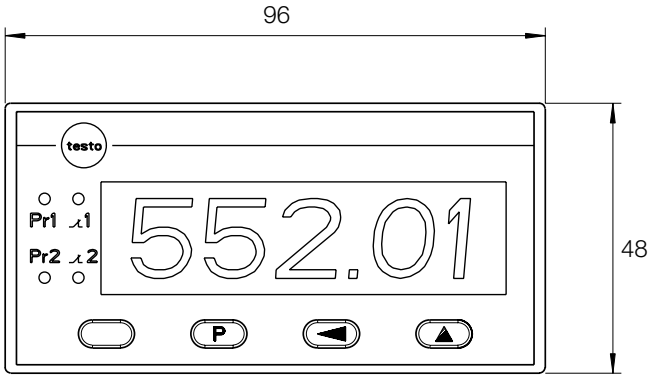
Alarm column for the process displays testo 54

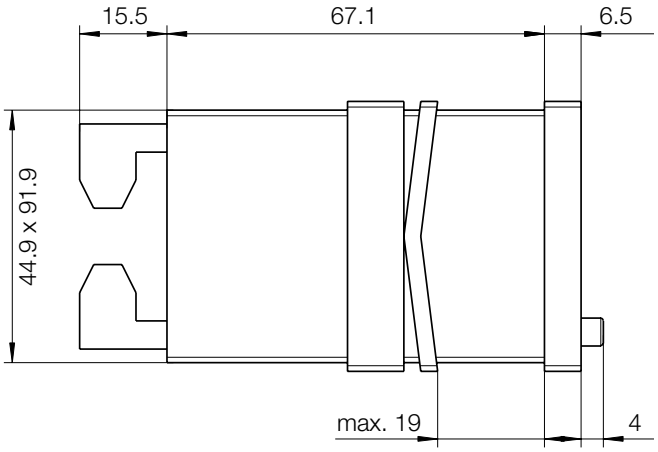
Alarm column

With the alarm column, the process displays testo 54 can be installed directly adjacent to the measurement location or in other suitable places. The alarm column is made of polycarbonate and has three cable inputs M20x1.5. The alarm column is delivered fully wired, incl.5 m of cable for the sensor and 3 m of mains cable. An optical signal serves as a pre-alarm, an audible signal as a main alarm. Both alarm levels can be acknowledged using the buttons. The alarm column also has a terminal block for the alarm reports.

6.1 Technical drawing testo 54-3/-7/-8

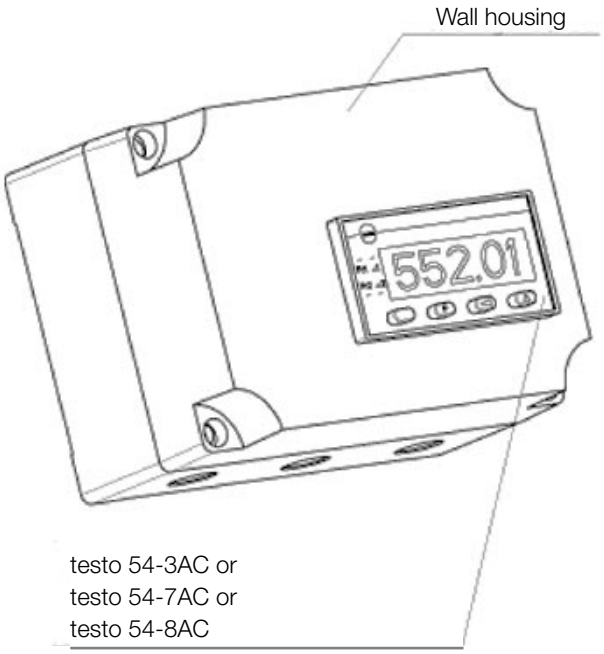


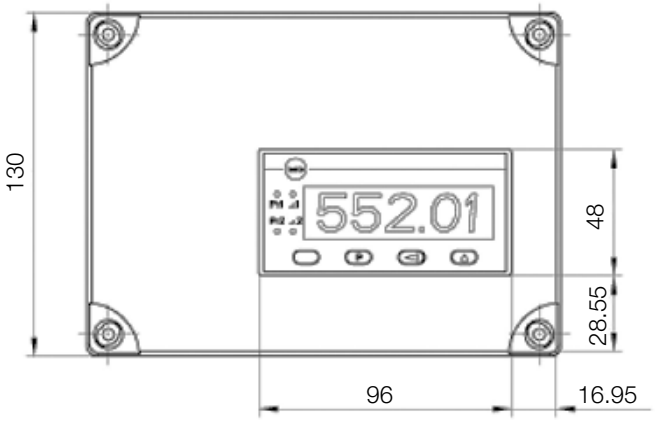


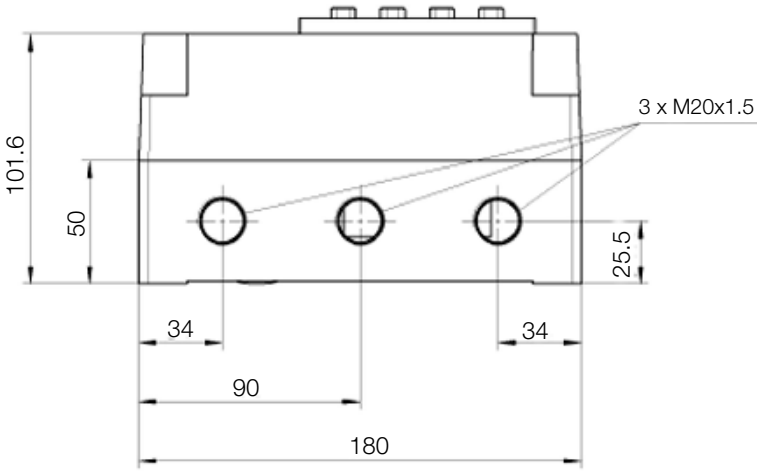


E Technical drawings

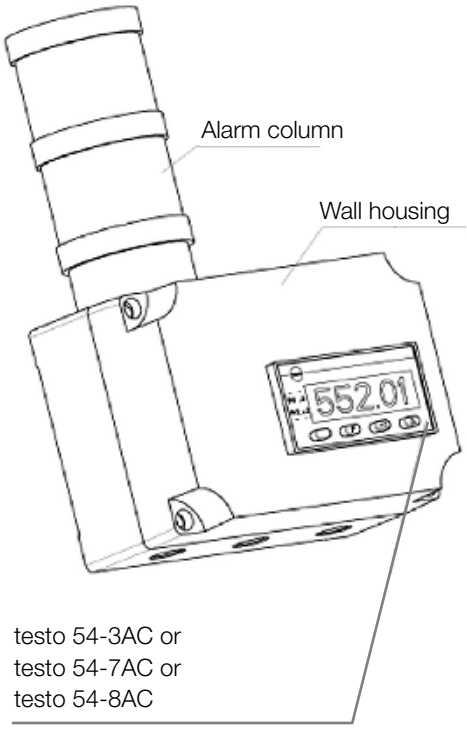
6.2 Technical drawings wall housing

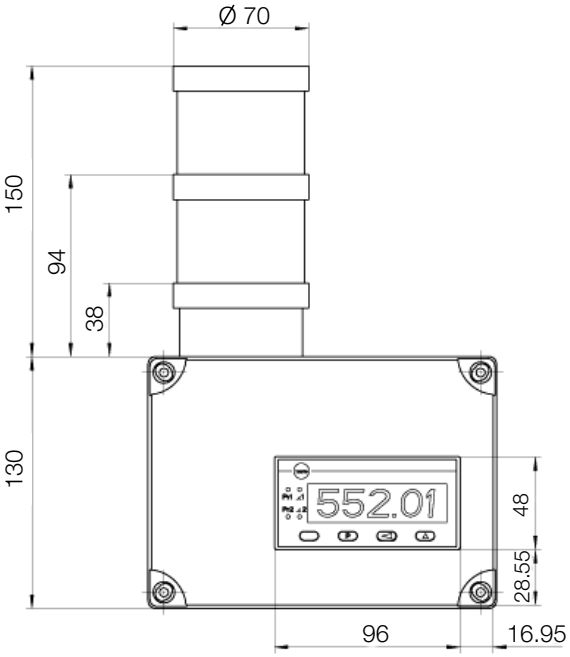


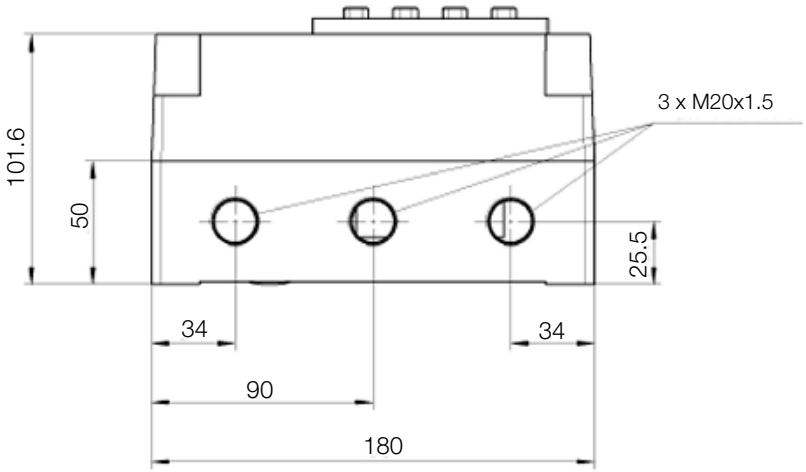




6.3 Technical drawings alarm column







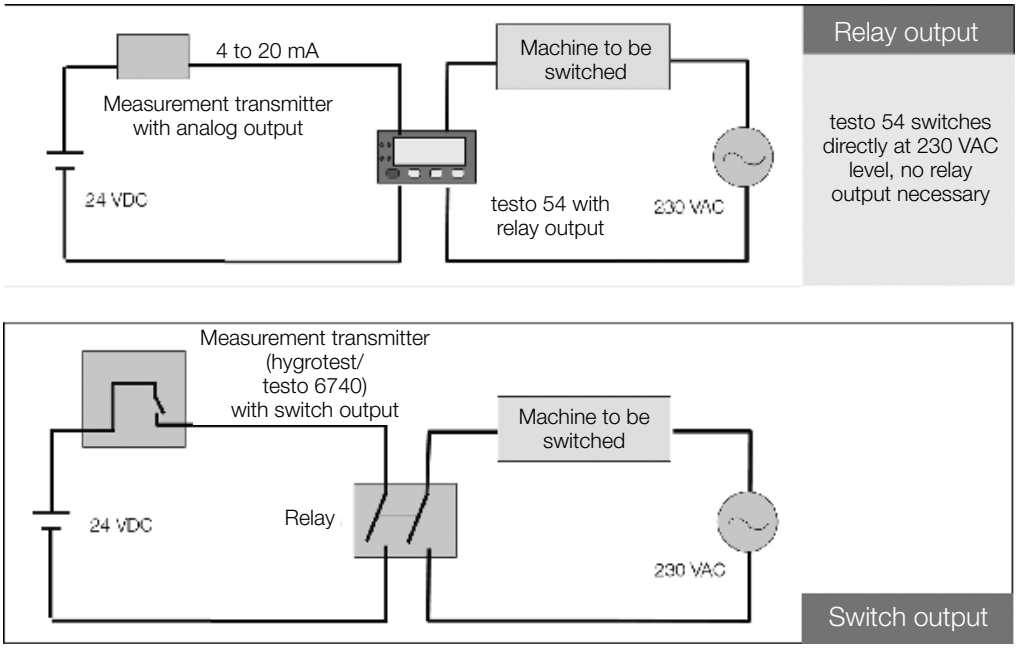
7 Process display testo 54 - the basics

7.1 Limit value settings

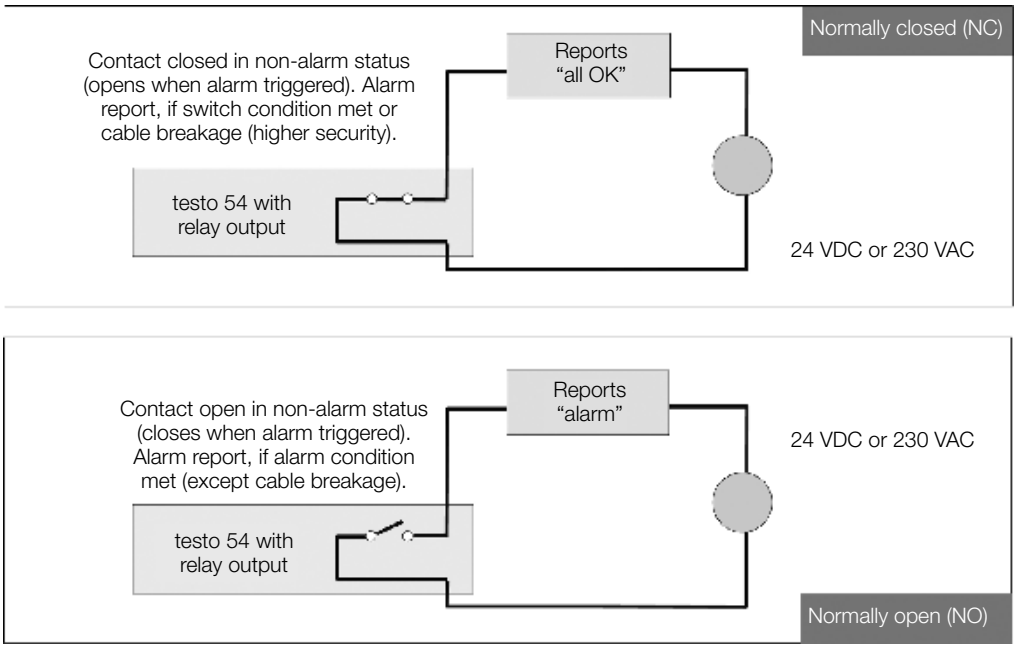
7.1.1 Difference between relay output and switch output

A relay output can be directly integrated into a cicuit with 230 VC for switching a machine.

A switch output, however, is used in a circuit with 24 VDC. In order to switch a machine situated in a 230 VAC circuit, a relay output must be interposed here.



7.1.2 Relay outputs can be wired in NC or NO mode



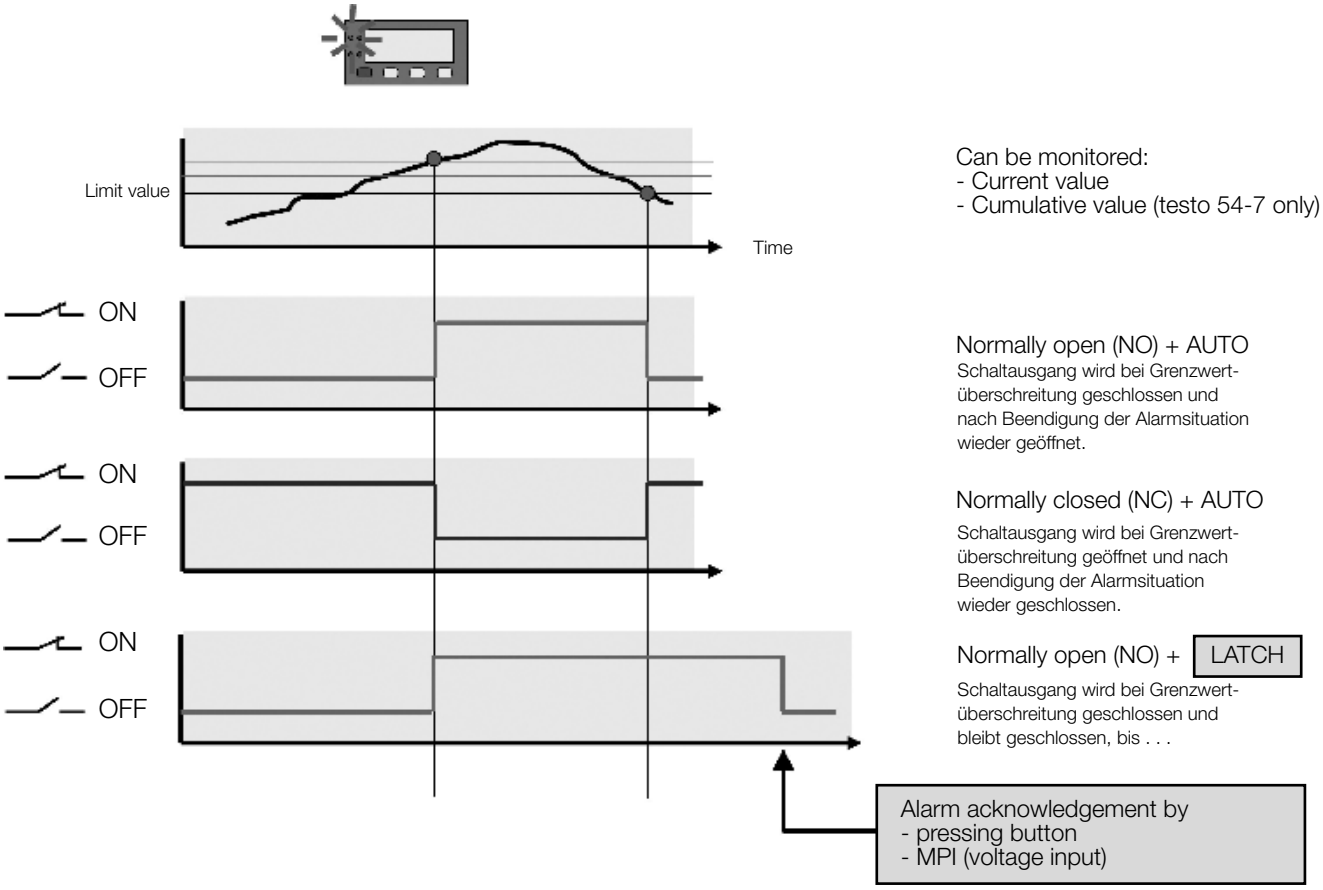
7.1.3 Limit value settings (AUTO or LATCH signal) in testo 54-3/-7/-8

The testo 54 offers the following setting possibilities for the versions with two limit value outputs (testo 54-3/-7/-8):

- Opener/closer selectable, cf. graphic chap. 1.9.1.1 /1.9.1.2
- 2 limit values settable (conveniently via operating menu)
- 2 hysteresis values freely settable
- Alarm termination when alarm situation over (AUTO) or when acknowledged (LATCH), cf. graphic below.
- Alarm acknowledged (LATCH) when key pressed or MPI (auxilliary voltage input)

The LATCH function in testo 54-3/-7/-8 causes the signal (current value) to be locked and held (“frozen”), if a limit value is exceeded. The calculation of MIN./MAX. values continues in the background.

In LATCH mode, the signal can only be acknowledged manually (red button) or electrically MPI-input, cf. electrical connection). In AUTO function, however, the signal is automatically acknowledged when a limit value is exceeded.

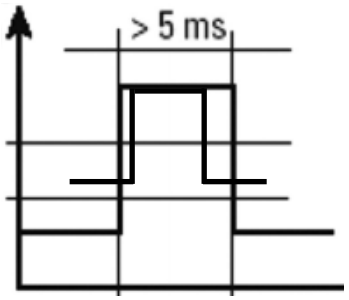


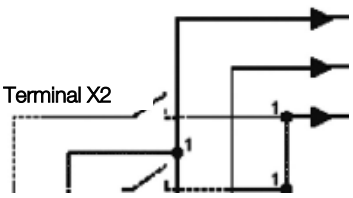
E Process display testo 54 - the basics

7.2 Keylock "Key" in testo 54-3/-7/-8

The keylock “Key” is only active, when a voltage (4 to 30 VDC, min. 5 ms), a so-called high level, is connected to terminal 6 of terminal strip X2, and terminal 7 of terminal strip X2 is earthed (see adjacent illustration below)

When the keylock “Key” is active, you cannot alter the limit values in display mode, you can still however, display all values, reset the MIN./MAX. values or the totaliser and acknowledge alarms with the red button.

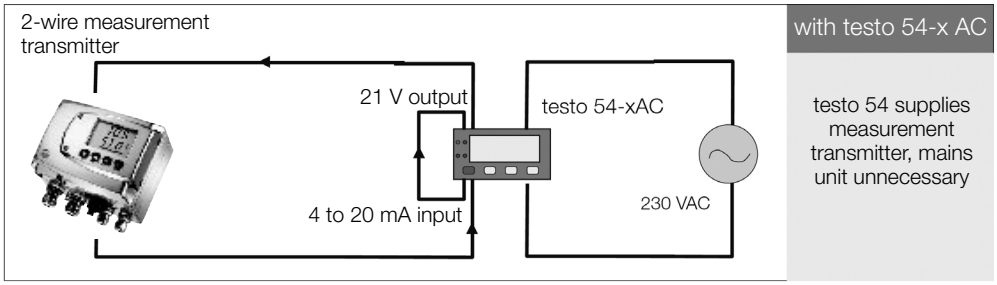


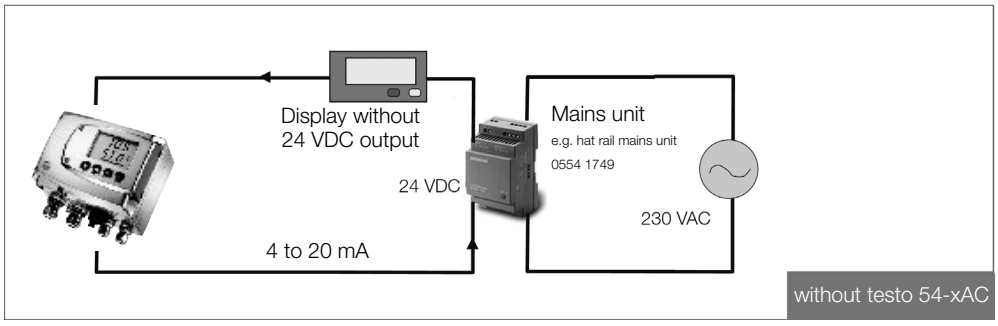


Terminal strip X2	
9	GND3 (for Uout)
10	Uout +10 V / 30 mA
11	Uout +24 V / 50 mA only when supplied with 90 to 260 V AC
8	MPI* „Reset-Limit value-Latch/Display-Hold/Reset Totaliser“
7	GND2 (KEY/MPI)
6	Keylock „KEY“

7.3 Using the auxilliary energy output

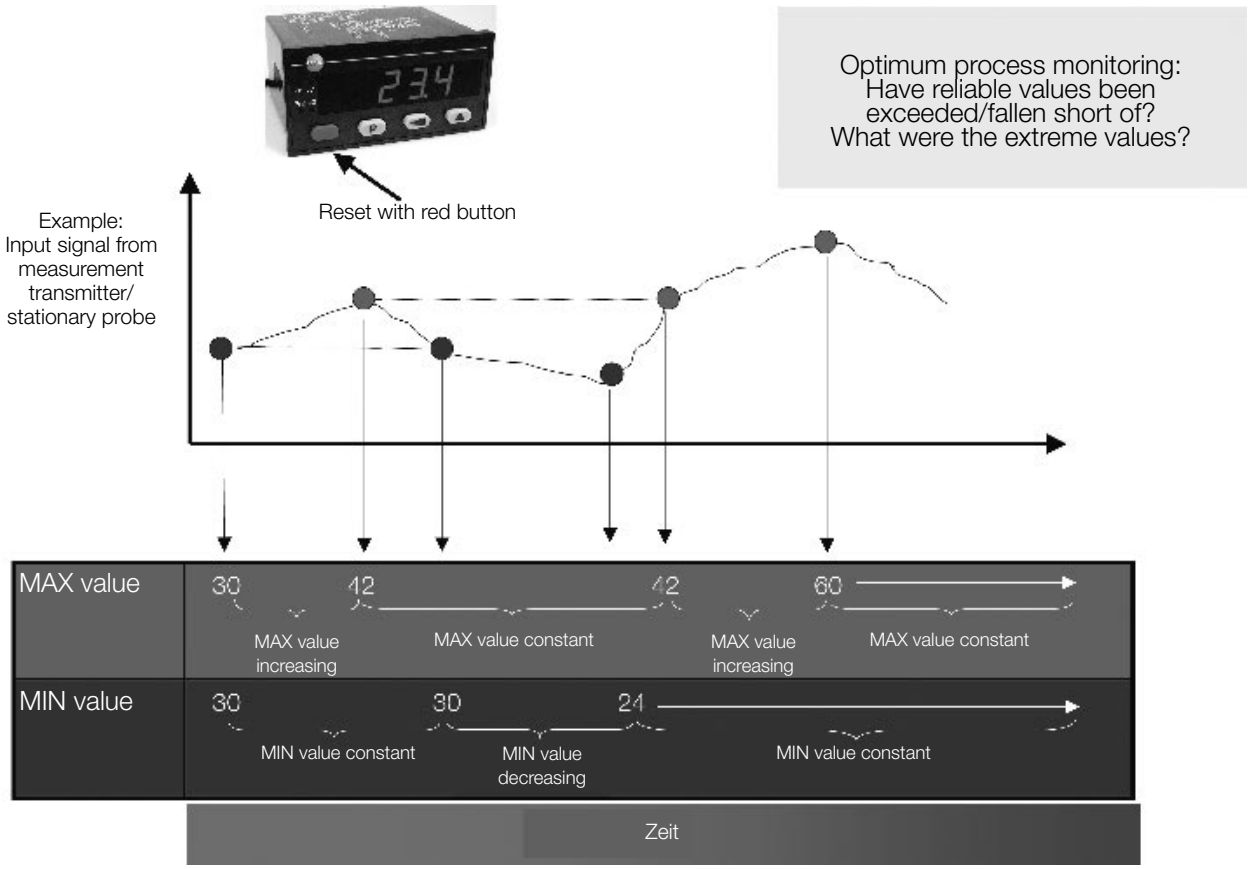
In the testo 54-x AC, an auxilliary energy output (24 VDC/50 mA) for supplying a measurement transmitter or, for example, an alarm lamp, is integrated. This makes an additional mains unit for supplying the 2-wire measurement transmitter unnecessary. All testo 54-x AC and the testo 54-3/-7/-8 DC also provide a 10 VDC/30 mA auxilliary energy output.





7.4 MIN/MAX value store

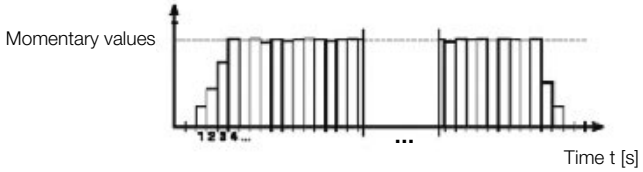
In the testo 54-6/-7/-8, storage of minimum and maximum values is integrated. These values can be conveniently called up via the operating menu.

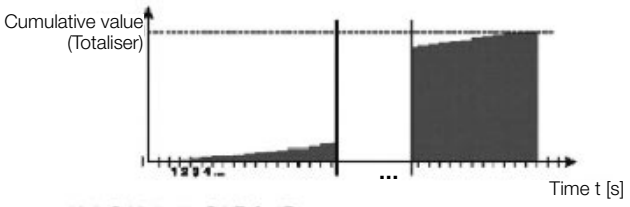


7.5 Totaliser

7.5.1 Totaliser function

In the testo 54-7, the totaliser function is integrated, i.e. the totaliser adds the momentary values at a sampling rate of 1 second (see illustration)





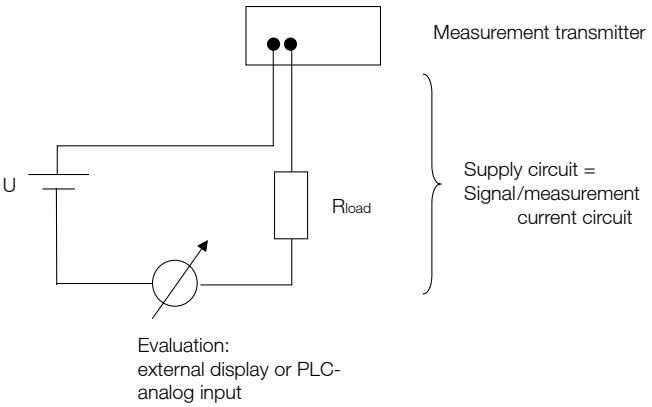
F Information relevant for all measurement transmitters

1 Avoiding errors in wiring

1.1 2-wire technology (4 to 20 mA)

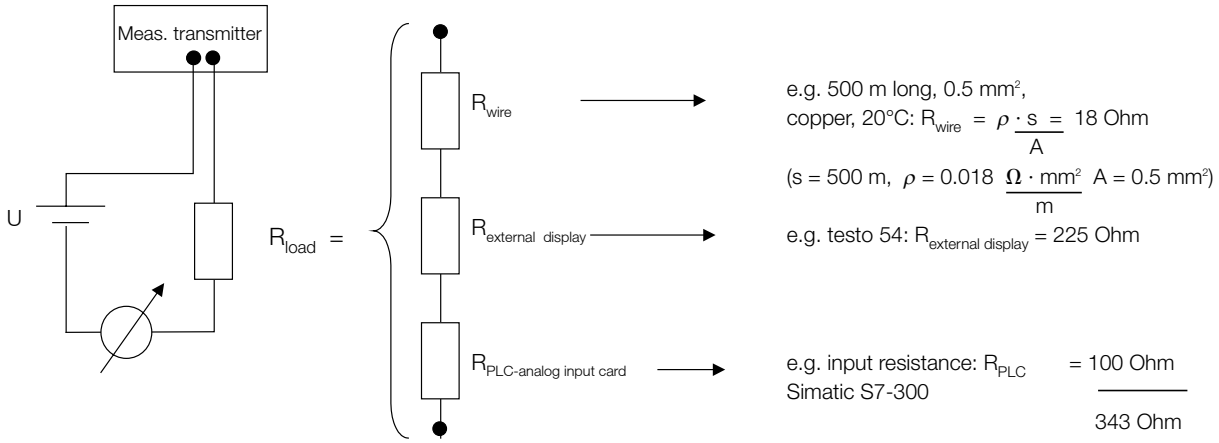
Two-wire measurement transmitters serve to convert non-electrical parameters, e.g. temperature, pressure, relative humidity etc. into a uniform electrical signal of 4 to 20 mA. The measurement transmitters are connected to a DC voltage source via 2 wires. The current consumption of the measurement transmitters changes in the range of 4 to 20 mA, dependent on the parameter to be measured. Supply circuit and signal cicuit are thus identical (see illustration.)

The advantages of two-wire system are for one the extremely small installation costs and the unproblematic connection. The length of the wire has no influence on the measurement signal. A further advantage is the so-called “live-zero” signal, i.e. the scale minimum corresponds to a current of 4 mA. This means that this value is clearly transferred and cannot, for example, be mistaken for a system which is switched off. In many cases, installing a separate network wire to the measurement location is complicated. By carrying the supply and the measurement signal in one wire, the two-wire measurement transmitter can be used to great advantage here.



The maximum load shows how high the permitted total resistance of the instruments connected in the circuit (without the measurement transmitter), and the installed wiring, can be. The sum of the resistances may not be higher than the maximum load.
If the load resistance consists of a wire (500 m, 0.5 mm², copper with a specific resistance $\rho = \frac{0.018\ \Omega}{m} \cdot mm^2$ at 20°C), a process display testo 54 and a Simatic-300 analog input card, the resistance is still 157 Ohms below the maximum load limit of 500 Ohms, i.e. a further instrument could be integrated into the measurement circuit, or the wire length could be increased or the cross-section area reduced, provided that an additional maximum of 157 Ohms result (see illustration).

Load example (2-wire)



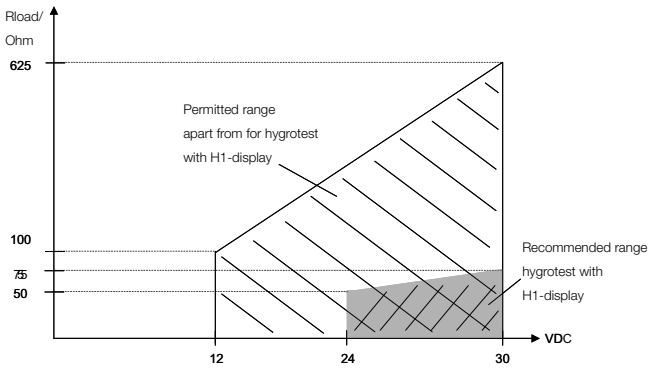
Max. wire length:

- The maximum signal wire length for 4 to 20 mA should be smaller than 1000 m (theoretically max. 3500 m according to the conductivity formula with 99% pure copper, 0.25 mm² cross-section and at 500 Ohms load resistance).
- A greater core cross-section (e.g. 0.5 mm² instead of 0.25 mm²) increases the permitted wire length.
- Screened wires should generally be used.

Load field 2-wire technology
The maximum permitted load in 2-wire technology is dependent on the connected input voltage i.e. the higher the connected voltage, the higher the permitted maximum load.
In the exemplary load field in the adjacent illustration, this means that with a minimum voltage input of 12 V the maximum load 100 Ohms, and with a maximum voltage input of 30 V the maximum load 625 Ohms may not be exceeded.

This means that, with a maximum load resistance of 500 Ohms, a maximum additional load of 157 Ohms (500 Ohms - 343 Ohms) can be placed on the measurement circuit.

Load field 2-wire technology

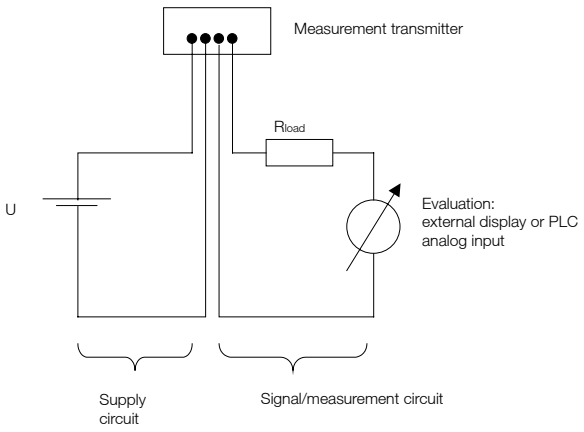


1.2 4-wire technology (0 to 20 mA, 4 to 20 mA, 0 to 1 V, 0 to 10 V)

In 4-wire technology, the measurement transmitter has a supply circuit and a separete (active) measurement circuit

The 4-wire technology is still widely in use, despite the advantages of the 2-wire technology.

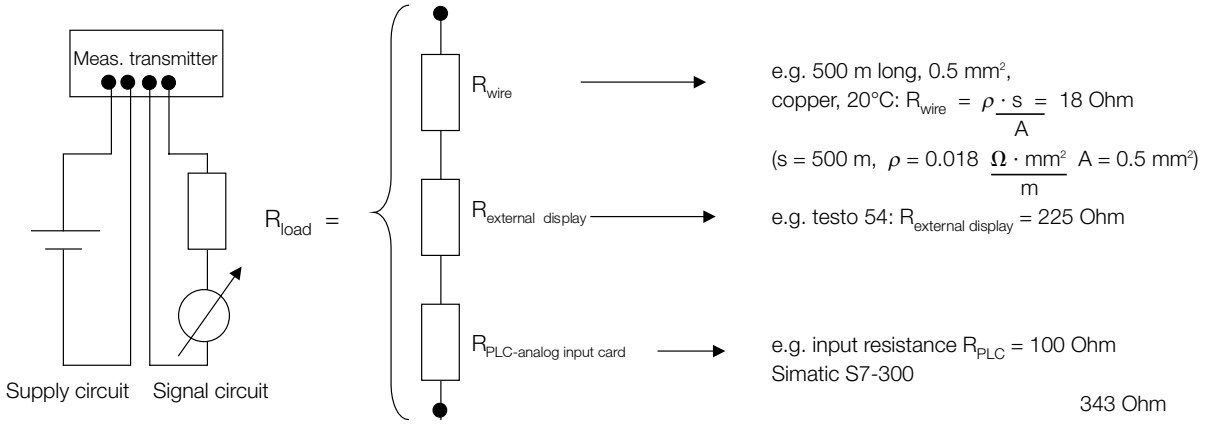
The 4-wire technology furthermore provides a supply of measurement transmitters with a higher current consumption (e.g. for testo 6341/6343 because of the automatic zero point calibration).



The maximum load shows how high the permitted total resistance of the instruments connected in the circuit (without the measurement transmitter), and the installed wiring, can be. The sum of the resistances may not be higher than the maximum load.

If the load resistance consists of a wire (500 m, 0.5 mm^2, copper, 20°C), a process display testo 54 and a Simatic-300 analog input card, the resistance is still 157 Ohms below the maximum load limit of 500 Ohms, i.e. a further instrument could be integrated into the measurement circuit, or the wire length could be increased or the cross-section area reduced, provided that an additional maximum of 157 Ohms result (see illustration).

Load example (4-wire)



Max. wire length:

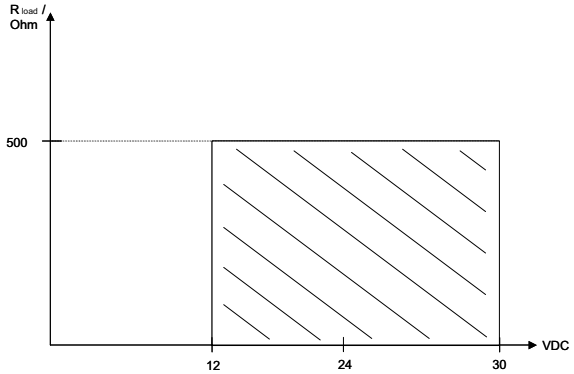
The maximum signal wire length for voltage signals (0 to 1 V and 0 to 10 V) should be smaller than 50 m (note: in the example above, a current signal is being measured), as otherwise the original signal decreases along the length of the wire and is thus falsified. Current outputs (e.g. 0 to 20 mA), however, compensate the load resistances up to a certain length (full utilization of the “max. load”, see above), here wire lengths of several 100 m can be achieved.

This means that, with a maximum load resistance of 500 Ohms, a maximum additional load of 157 Ohms (500 Ohms - 343 Ohms) can be placed on the measurement circuit.

Load field 4-wire technology

In contrast to 2-wire technology, in 4-wire technology the load field is constant because of the separate voltage supply, i.e. the permitted load is independent of the connected input voltege (cf. illustration). In the example on the right, the supply voltage may not amount to less than 12 VDC or more than 30 VDC.

Load field 4-wire technology



F Avoiding errors in wiring

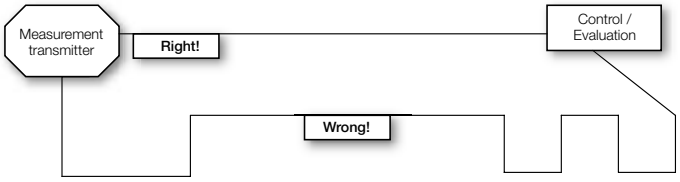
1.3 Wiring guide

Measurement transmitters can be exposed to interference in industrial use. Directly adjacent to the measurement transmitter or its signal wires, for instance, motors can start, which can lead to signal interference. Or metal measurement transmitters are brought into contact with voltage potentials of their mountings. Here are a few tips to help you avoid interference.

Preliminary note:
PE (Protection Earth) wires, insulation colour green-yellow, help to avoid a potential (voltage) difference in equipment assemblies. These potential differences lead to undesired currents and to falsified signals, and in extreme cases to damaged electronic components.

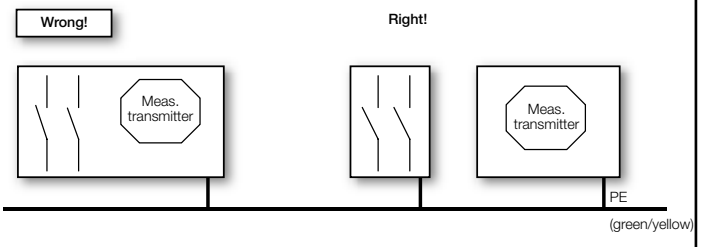
1. Install wires and cables always as short as possible

- This applies primarily to signal wires, but also to supply cables and earthing wires (PE).
- The maximum signal wire length for 0 to 1 V and 0 to10 V should be less than 50 m.
- The maximum signal wire length for 4 to 20 mA should be less than 1000 m (theoretically max. 3500 m according to the conductivity formula with 99% pure copper, 0.25 mm² cross-section and at 500 Ohms load resistance).



2. Measurement transmitters and measurement displays may not be installed directly adjacent to guards, mains switches, motors, frequency converters and similar

- Separating the housings is recommended.
- Separate earth wires (PE) are also recommended.

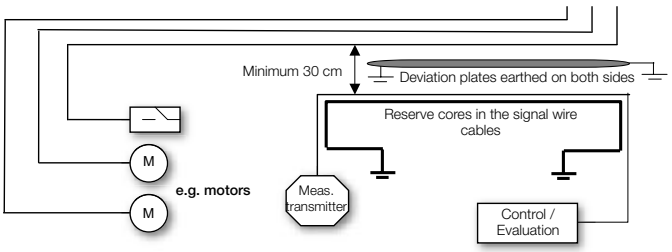


3. Screening units should always be used on guards and other switching equipment

- Switching processes lead to abrupt changes which can cause field effects on neighbouring wires and equipment assemblies.
- Interference effects can often already be prevented with the use of screening units (e.g. toroidal chokes).

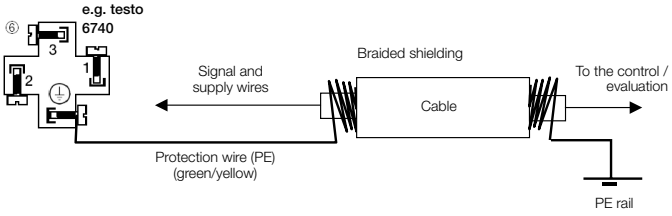
4. Never install measurement transmitter wires parallel to live wires. These should always be located separately.

- The greatest causers of interference are supply cables which are connected to motors, guards, frequency converters and similar.
- A minimum distance of approx. 30 cm should be kept between signal wires and their supply cables.
- Different types of wires should be arranged according to signal groups (current inputs, analog wires, digital wires etc.).
- So-called deviation plates are also to be recommended (applies primarily to supply ≥ 230 VAC). These plates must be earthed on both sides!
- Reserve cores in the signal wire cables can also be earthed on both sides as a screen.



5. Use shielded wires as far as possible

- Shielding reduces external interference effects (e.g. through large switches, frequency converters, motors etc.).
- The use of a cable with braided shielding is recommended, foil shields have a five times worse shielding effect.
- The shield must be connected to a PE on both sides of the cable.



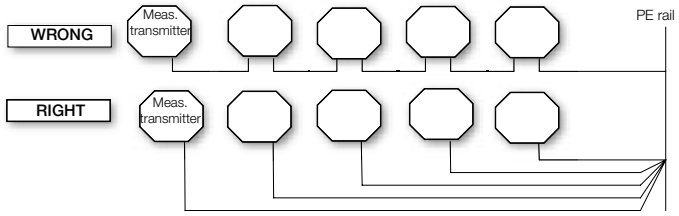
6. Connect PE (protection wire) with low impedance (low resistance)

- Use as thick wires as possible, with many individual cores. These should be kept a short as possible (see point 1).

Recommended: min. 0.5 mm² cross-section for PE wires

7. Do not loop the protection wire through from one instrument to the next.

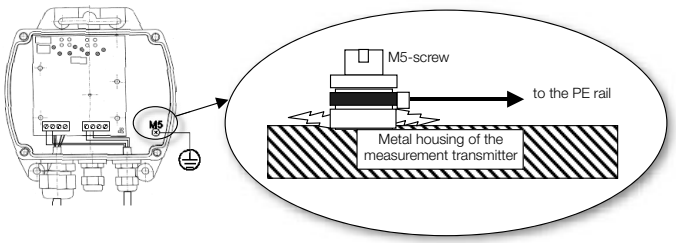
- The protection wire should always be laid in a star-shaped pattern to a fixed point (best is the shortest way to the PE rail)



8. When connecting the protection wire to (metal) measurement transmitters, ensure that the transition resistances are as low as possible

- Remove paint and grease deposits, and any other contamination thoroughly.
- The use of washers and lock washers is recommended!

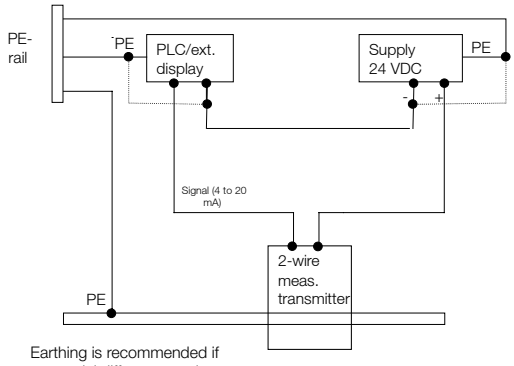
Example hygrotest 650 (metal housing):



9. Mutual zero potential is recommended if potential differences exist between measurement location (e.g. container wall) and voltage supply/external display/PLC.

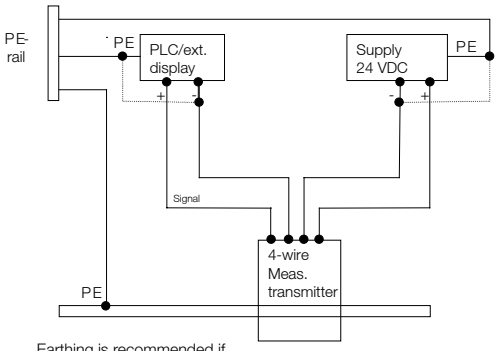
The following PE wiring measures are only relevant if metal housings or metal probes are in conductive connection with process partitions

PE connection in 2-wire technology



Earthing is recommended if potential differences exist between measurement location (e.g. container wall) and voltage supply/external display/PLC

PE connection in 4-wire technology



Earthing is recommended if potential differences exist between measurement location (e.g. container wall) and voltage supply/external display/PLC

With testo 6340 only the supply voltage is earthed, as it is electrically isolated

F Selection assistance for voltage supply

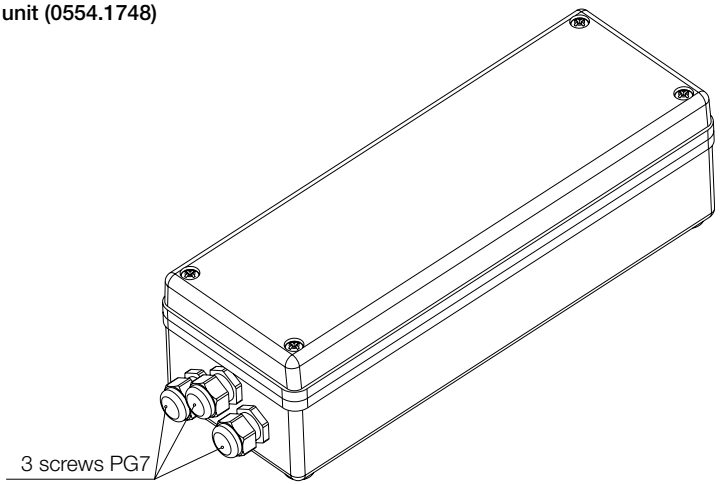
2 Selection assistance for voltage supply

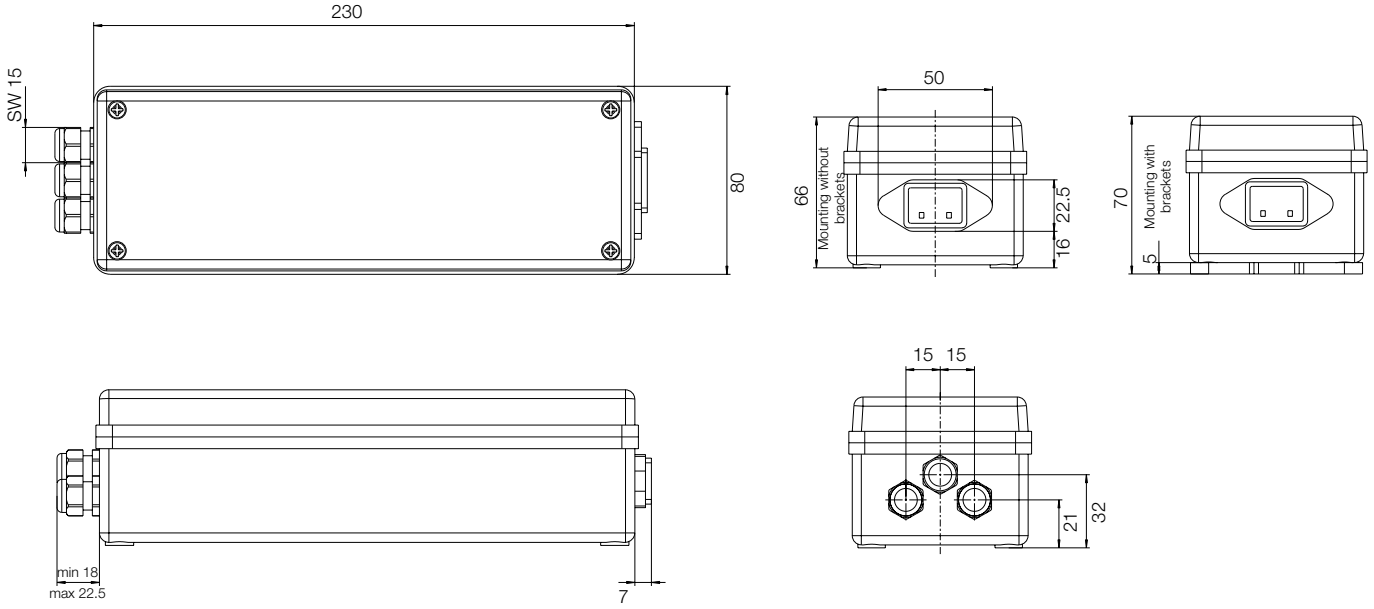
2.1 Description of the voltage supply possibilities

	A Desktop mains unit 0554.1748	B Hat rail mains unit 0554.1749	C Voltage output of the process displays testo 54-2AC/-7AC	D PLC analog input card. Simatic S7-300
Sketch/dimensions/ drawing/ connection image				
Input voltage	110 to 240 VAC 50/60 Hz	9 to 264 VAC 47 to 63 Hz	90 to 260 VAC 50/60 Hz	230 VAC
Output voltage	24 VDC +/- 5 %	24 VDC adjustment by customer possible (22.2 to 26.4 VDC)	24 VDC +/- 15%	24 VDC
Output current	350 mA, short-circuit-proof, max. 1200 mA	2.5 A, short-circuit-proof, max. 3.4 A	50 mA, max.1 channel	150 mA, max.1 channel

2.2. Dimensional drawings of voltage supplies

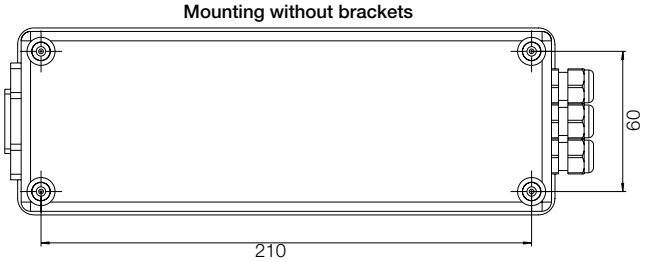
2.2.1 Desktop mains unit (0554.1748)



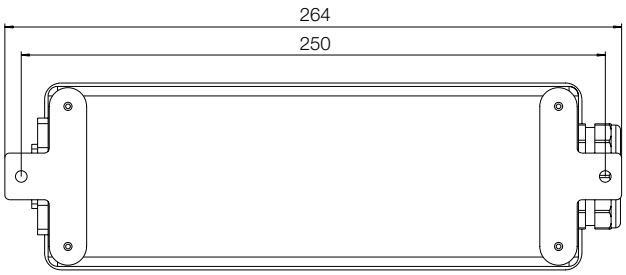


View from below:

Mounting without brackets

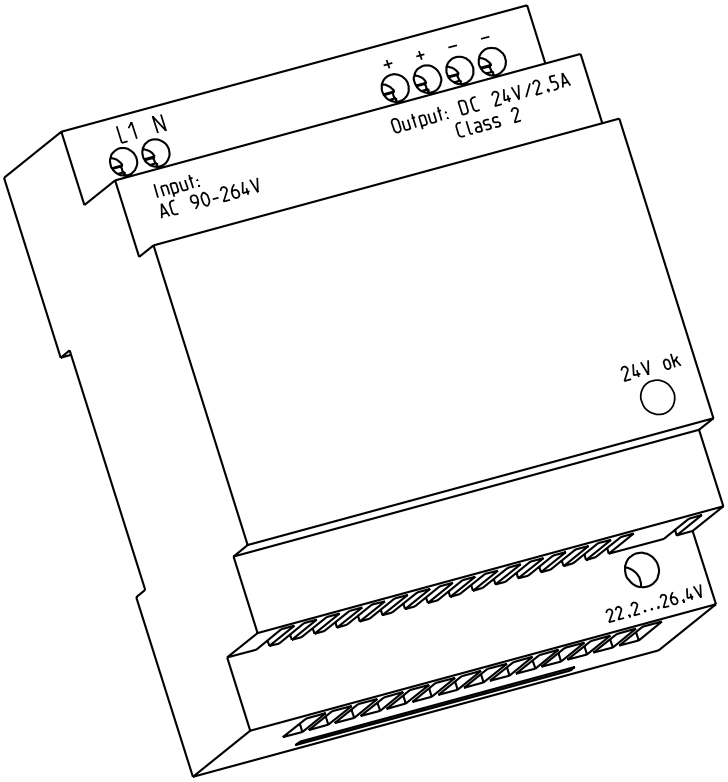


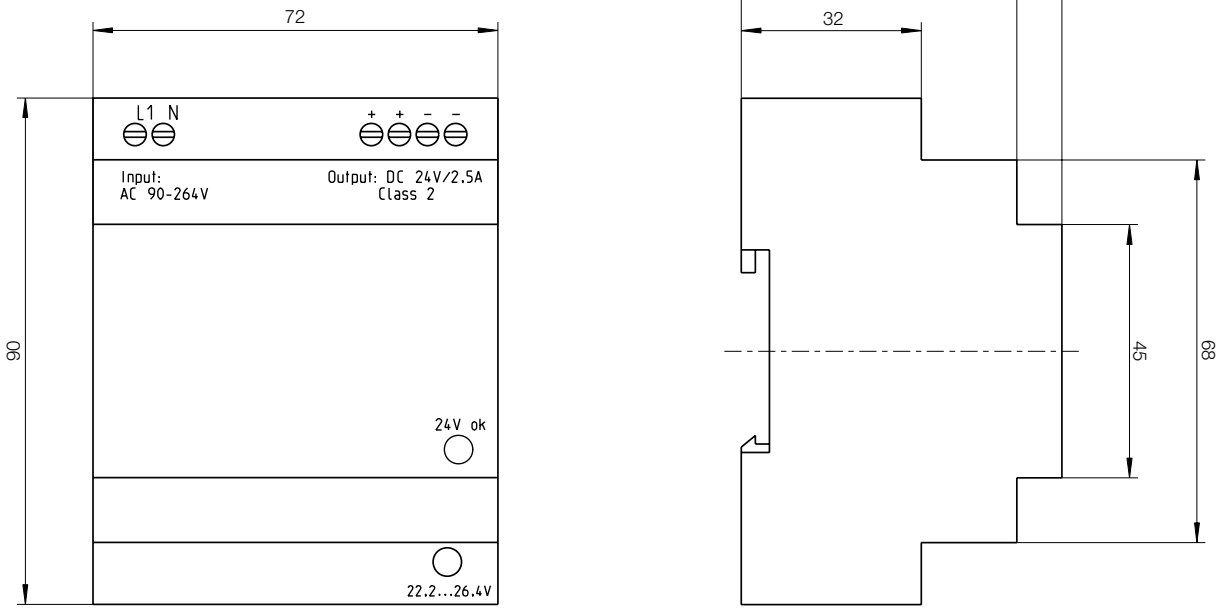
Mounting with brackets



F Selection assistance for voltage supply

2.2.2 Hat rail mains unit (0554.1749)





3 Calibration and adjustment

Testo offers calibration in accredited testo laboratories.

If requirements from the field of quality assurance are in the foreground (ISO 9001, QS9000, GMP, FDA, HACCP,...), **ISO calibration** (laboratory accredited according to ISO 17025) offers the ideal solution. If highest reliability is required, for instance in production norms, for assessors, official bodies and critical applications, **DKD calibration** is recommended

If the measuring instrument has a DKD certificate, you are entitled to carry out internal ISO calibrations in the works with this DKD calibrated reference instrument. The hygrotest 650 (with DKD certificate), for example, is thus suitable for an internal works calibration laboratory.

Definition of terms:

A **calibration** is the comparison between the actual value and the nominal value, and its documentation.

An **adjustment** is the alignment of the actual value to the nominal value.

4 Influence of the measurement inaccuracy of the reference instrument

When carrying out an adjustment with the help of a reference instrument, it must be taken into account that not only the measuring instrument has a measurement inaccuracy, but also the refrence instrument.

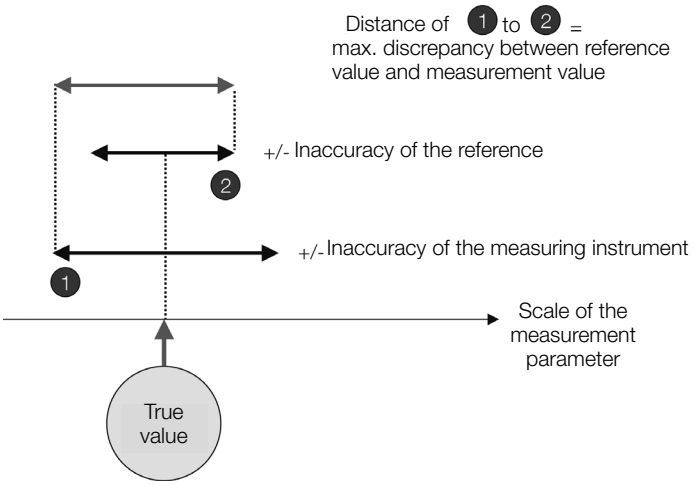
A the illustration shows, the measuring instrument ❶ has a greater measurement inaccuracy than the reference instrument ❷

In the worst case, point 1 and point 2 move as far apart as possible, as shown in the graphic.

It thus follows that the measurement inaccuracy of a measuring instrument is within the tolerance range, if the distance between the measurement value and the true value is not greater than the sum of the two measurement inaccuracies.

Example:
- Measurement inaccuracy measuring instrument: +/- 2 %RH
- Measurement inaccuracy reference instrument: +/- 1 %RH

→ The measuring instrument is within the tolerance as long as the discrepancy is less than +/- 3 %RH.



F Scaling and resolution

5 Scaling and resolution

Digital measurement transmitters convert the signal coming from the sensor into an analog signal. Digital signals consist only of the two signal stati “0” and “1”, to which different current or voltage stati can be allocated. In digital-analog conversion, this creates a step pattern of the signal, i.e. analog signals can only be emitted at a certain grid distance and in a certain voltage or current range.
The grid distance is dependent on the quantisation (Bit resolution) as well as on the absolute value of the measurement range. By scaling the measurement range as tightly as possible, the resulting error of the analog signal can be reduced through the quantisation.

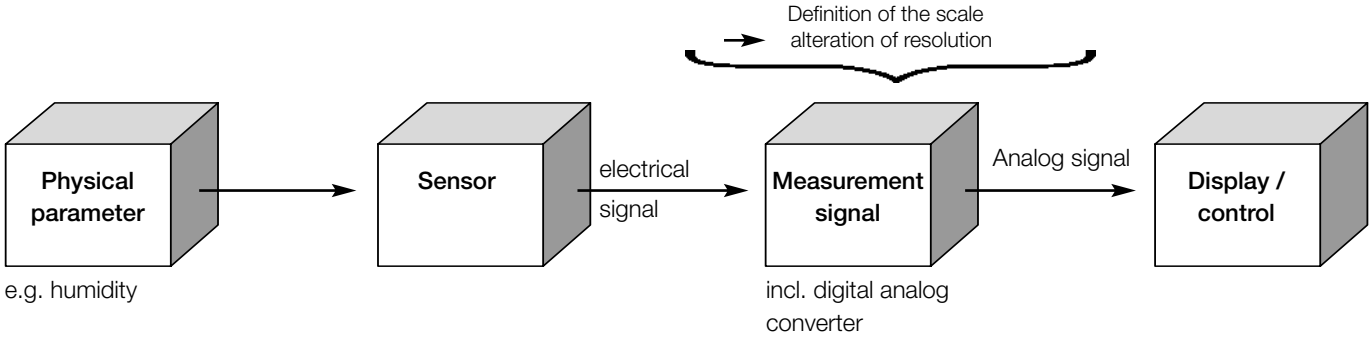
→ Calculation of the measurement range resolution:

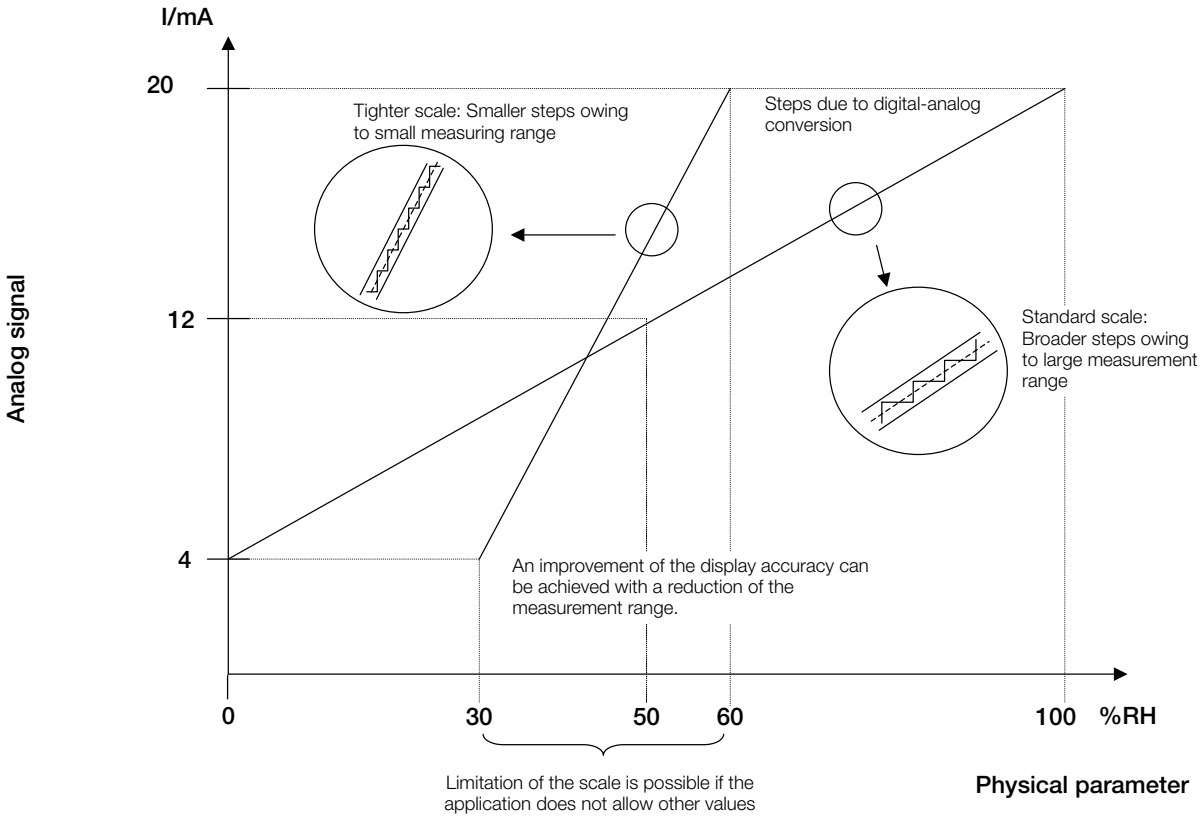
$$\frac{|\text{Meas. range}|}{\text{Bit resolution}} = \frac{|\text{Meas. range}|}{2^X} = \text{Measurement value resolution}$$

Example: Measurement range --> 0.25 to 75 Nm³/h; 12-Bit resolution

$$\text{Meas. value res.} = \frac{|\text{Meas. value}|}{\text{Bit resolution}} = \frac{|74.75|\ \text{Nm}^3/\text{h}}{2^{1.}} = 0{,}01825\ \text{Nm}^3/\text{h}$$

A step pattern of the signal is created (in digital-analog conversion). This so-called “resolution” can be improved by scaling as tightly as possible.

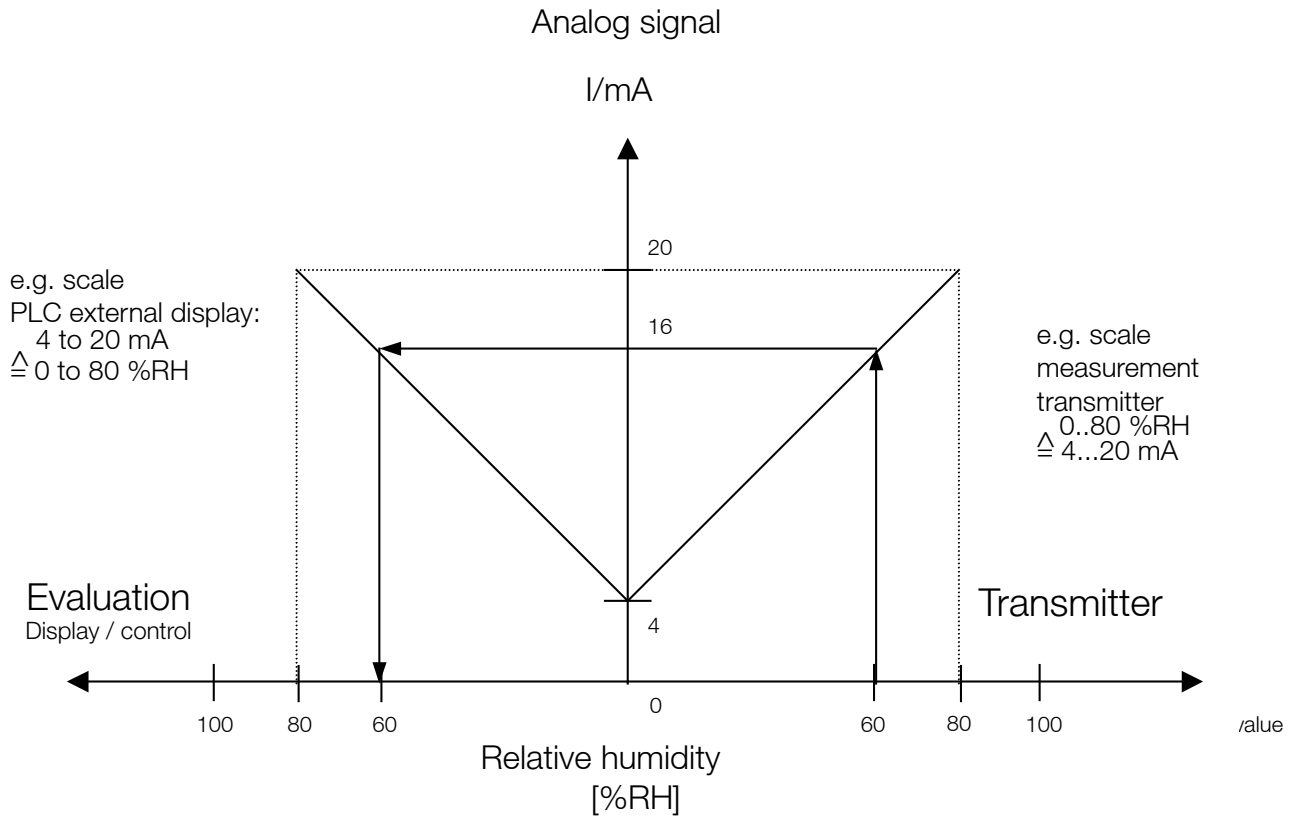




The diagram shows two different measurement transmitter scales, 0 to 100 %RH and 30 to 60 %RH. The resolution of the current signal remains constant (the number of steps), which is why the steps are compressed when the scale is reduced horizontally.

The measurement range should be set as small as possible for this reason (dependent on the process - all expected measurement values must be within the scale!), as this improves the accuracy of the display and the signal through smaller steps.

In scaling, one should generally ensure that the scale of the measurement transmitter and that of the control/external display are laterally reversed/identical (see following illustration).



6 Housing protection according to IP (International Protection)

6.1 Tightness according to IP-norm

The IP regulation VDE 0470-1 (previously: DIN40050) is a system for the classification of the housings of electrical appliances according to the following aspects:

- Protection of persons from dangerous components inside the housing
- Protection of assemblies inside the housing from ingress of solid foreign bodies
- Protection of assemblies inside the housing from ingress of water

F Housing protection according to IP (International Protection)

First digit of the IP-protection class: Protection from solid bodies

The first code number refers to the accessibility of the dangerous component for a person or solid foreign body.

0	No protection
1	Protection from solid bodies to 50 mm, e.g. unintentional hand contact
2	Protection from solid bodies to 12 mm, e.g. fingers
3	Protection from solid bodies over 2.5 mm, e.g. tools and small wires
4	Protection from solid bodies over 1 mm, e.g. small wires
5	Limited protection from dust ingress (no harmful deposits)
6*	Complete protection from dust

* Example IP 65 (testo hygrotest)

First digit of the IP-protection class: Protection from water

The second code number refers to the damage caused by water ingress. The conditions described go from vertically dripping water via water spray and water jets to constant immersion.

0	No protection
1	Protection from vertically dripping water (e.g. condensation)
2	Protection from direct water spray to 15° from vertical direction
3	Protection from direct water spray to 60° from vertical direction
4	Protection from water spray from all directions, limited ingress permitted
5*	Protection from low-pressure water jet from all directions, limited ingress permitted
6	Protection from powerful water jet e.g. for use on ship's decks, limited ingress permitted
7	Protection from immersion in water up to a depth between 15 cm and 1m
8	Protection from immersion in water under pressure for longer periods

6.2 Watertightness test at Testo (based on DIN VDE 0470-1/ EN 60529 / ICE 529)

The Testo measuring instruments are tested under the following conditions (as long as no other instrument specifications are defined):

temperature: 15 to 35°C,

relative humidity: 25 to 75%RH

air pressure: 860 to 1060 mbar

test medium: water (+/- 5 K to test object)

Passing condition:
No damaging quantities of water may have entered the product at the end of the test.

The following table shows the tests for the most common protection classes:

IP 42	Test object is placed under water dripping vertically or at an angle of up to 15°. Protection from dripping water
IP 54	Water is sprayed at the test object from different sides (approx. 60°) at a distance of 200 mm using a hand shower and a water quantity of aprox. 0.07l/min. Protection from water spray.
IP 65	Water is sprayed at the test object from a jet in a quantity of approx. 12l/min. Protection from water jet.
IP 67	Test object is immersed in a tank 0.15 m from top edge up to approx.1m from bottom edge for 30 mins. Protection from temporary immersion.
IP 68	Test object is immersed in a water tank according to its specifications and previously set times. The test must be recorded in a product norm (stricter than IP 67 i.e. deeper than 1 m / longer than 30 min). Protection from immersion.

Always at your service!

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