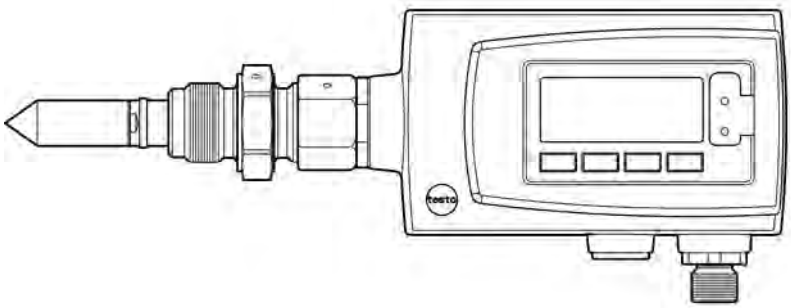
testo 6781 · Transmitter

P2A software · Parameterizing, adjusting and analyzing

Instruction manual



1 Safety and the environment

Avoiding electrical hazards

> Never use the instrument and connected probes to measure on or near live parts!

> Damaged mains cables must only be replaced by authorized personnel.

> Only have the transmitter wired and connected by authorized personnel with the voltage disconnected.

> You must always comply with the regulations applicable in your country for opening and repairing electrical equipment.

Avoiding personal injury and damage to equipment

> Installation, setting and calibration work must only be carried out by qualified and authorized personnel!

> Only open the instrument when this is expressly described in the instruction manual for installation, maintenance or repair purposes.

> Observe the permissible storage, transport and operating temperature.

> Do not store the product together with solvents. Do not use any desiccants.

> Do not use the instrument for control purposes at the same time as operating or servicing the transmitter.

> Only operate the product properly, for its intended purpose and within the parameters specified in the technical data. Do not use any force.

> Carry out only the maintenance and repair work on this instrument that is described in the documentation. Follow the prescribed steps exactly. Use only original spare parts from Testo.

Any additional work must only be carried out by authorized personnel. Otherwise testo will not accept any responsibility for the proper functioning of the instrument after repair and for the validity of certifications.

Protecting the environment

> At the end of its useful life, send the product to the separate collection for electric and electronic devices (observe local regulations) or return the product to Testo for disposal.

2 About this document

Use

> Please read this documentation through carefully and familiarize yourself with the product before putting it to use. Pay particular attention to the safety instructions and warning advice in order to prevent injuries and damage to the products.

> Keep this document to hand so that you can refer to it when necessary.

> Hand this documentation on to any subsequent users of the product.

WARNING	Indicates potential serious injuries
CAUTION	indicates potential minor injuries

Symbols and writing standards

Representation	Explanation
	Note: Basic or further information.
1. ... 2. ...	Action: more steps, the sequence must be followed.
> ...	Action: a step or an optional step.
- ...	Result of an action.
Menu	Elements of the program interface.
[OK]	Buttons of the program interface.
... | ...	Functions/paths within a menu.
"..."	Example entries

3 Contents

4 Transmitter

4.1. Specifications

4.1.1. Functions and use

The testo 6781 transmitter was developed especially for low dewpoint temperatures and is suitable for the following applications, amongst others:

- Compressed air process engineering
- Clean-room technology
- Regulation and monitoring of compressed air driers
- Production and conveyance of gases
- Monitoring of humidity and temperature in medical compressed air or granulate driers

4.1.2. Scope of delivery

The scope of delivery of the testo 6781 transmitter includes the following:

- Assembly accessories
- Operating instructions
- Calibration report
- CD-ROM with operating instructions (PDF) and P2A update (this can only be used in conjunction with the P2A software, which has to be ordered separately).

4.1.3. Accessories

The following accessories are available for the testo 6781 transmitter, amongst others:

- Mains unit
- P2A software (parameterizing, adjusting and analyzing software)
- Assembly accessories

Information about accessories and their order numbers can be found in Accessories and spare parts or on the website at www.testo.com.

4.1.4. Technical data

Parameter

- Dewpoint temperature[1]

Measuring range at 25 °C

- -90 to -20 °C_{td}

Meas. uncertainty[2]

-20 °C_{td} to -40 °C_{td}: +/-1,5 K

-40 °C_{td} to -60 °C_{td}: +/-2 K

-60 °C_{td} to -75 °C_{td}: +/-2,5 K[3]

In case of direct installation of the 6781 in the process the ideal face velocity is between 0.5 and 2 m/s. The measurement uncertainty increases with deviating flow values.

[1] Above 0 °C_{td} the dewpoint temperature is shown and below 0 °C_{td} the frost point temperature is shown. In the instruction manual no differentiation is made and both are referred to as dew point temperature. In rare cases at dewpoint temperatures between -35 °C_{td} and 0 °C_{td} differences between the 6781 and a dew mirror hygrometer may occur.

[2] Expanded basic uncertainty (K = 2) at a process temperature of 25 °C.
Measuring uncertainty according to GUM (Guide to the Expression of Uncertainty in Measurement): ISO guideline for determining the measuring uncertainty in order to render global measurement results comparable.

The following uncertainties are used during the inquiry:

- Hysteresis
- Linearity
- Reproducibility
- Adjustment area/factory calibration
- Test location

An additional uncertainty factor depending on dewpoint temperature and process of ±0.03 K x reading (in °C_{td}) + 0.2 K x (25 °C - process temperature in °C) results from this overall view

Below -75° to -90°Ctd, an assmmetrical measurement uncertainty of +8.5K/ -2.5K applies.

[3] At process temperatures > 25 °C the lower limit of the measuring range increases by 0.5 K/K. The uncertainty values are valid for the respective measuring range.

Response time

t_{63} ≤ 3 s when changing from -75 °C_{td} to -30 °C_{td}

t_{90} ≤ 9 s when changing from -75 °C_{td} to -30 °C_{td}

t_{63} ≤ 300 s when changing from -30 °C_{td} to -75 °C_{td}

t_{90} ≤ 1080 s when changing from -30 °C_{td} to -75 °C_{td}

Resolution

Measuring range	Resolution
0 to 100 % RH	0.001
0.001 to 28 g/kg	0.001
0.01 to 194 gr/lb	0.01
0 to 31 g/m^3	0.001
0.001 to 14 gr/ft^3	0.001
0.1 to 9999.9 ppm (vol)	0.1
-90 to -20 °C_{td}	0.1
-130 to -4 °F_{td}	0.1
-110 to 30 °C_{tdA}	0.1
-165 to 86 °F_{tdA}	0.1
-40 to 70 °C	0.01
-40 to 158 °F	0.01

Meas. cycle

- 1/sec

Interface

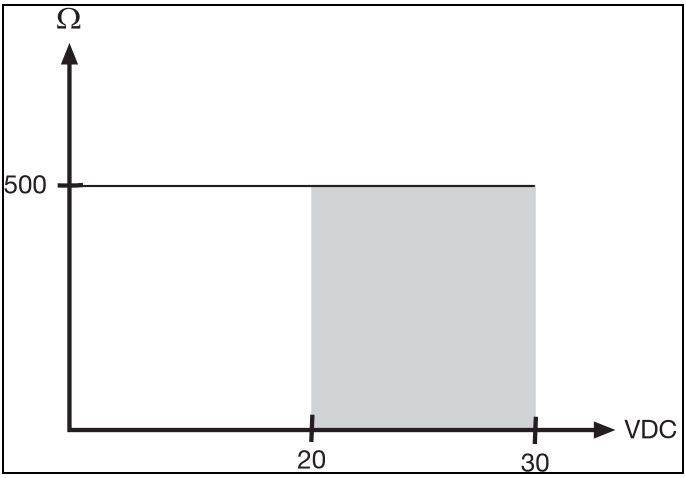
- Mini-DIN for P2A software (adjustment and parameterization software)

Voltage supply

- 4-wire (separate signal and supply lines): 20 to 30 V AC/DC, max. 150 mA power consumption

Maximum load

- 4-wire: 500 Ω (power output)



Minimum load resistance

- 4-wire: 10 kΩ (voltage output)

Analog output

- 0 to 1 V ± 1.5 mV (4-wire) or
- 0 to 5 V ± 7.5 mV (4-wire) or
- 0 to 10 V ± 15 mV (4-wire) or
- 0 to 20 mA ± 0.03 mA (4-wire) or
- 4 to 20 mA ± 0.03 mA (4-wire)

Resolution of analog output

- 12 bit

Display

- 2-line LCD with plain text line (optional)

Operating temperature without display

- -40 to 70 °C

Operating temperature with display

- -20 to 70 °C

Operation humidity

- 0 to 100 % RH

Storage temperature without display

- -40 to 80 °C

Storage temperature with display

- -20 to 80 °C

Process humidity

- 0 to 100 % RH

Process temperature

- -40 to 70 °C

Pressure application range

- 50,000 hPa

Housing, weight

- Metal, 0.5 kg

Process connection

- G 1/2 or
- NPT 1/2"

Protection class

- IP 65 only if the transmitter is wired and/or sealing plugs are inserted

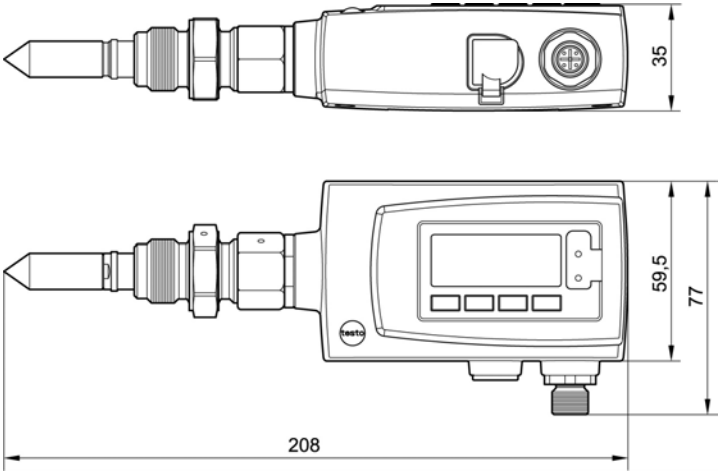
Directives, standards and tests

- EC Directive: 2004/108/EC
- 6781 was manufactured in accordance with EC pressure equipment Directive 97/23/EC, Article 3 Paragraph 3 as per "sound engineering practice", taking the regulations to be observed into account.

Warranty

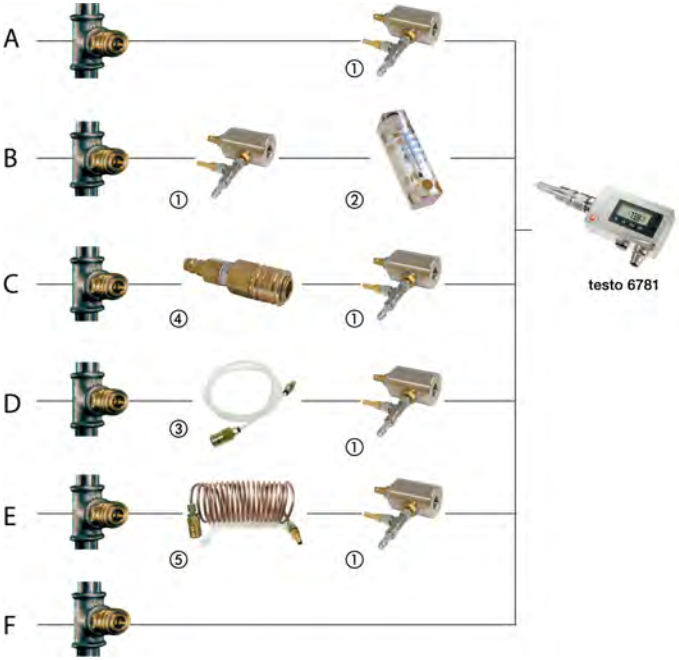
- Duration: 2 years
- Warranty conditions: see website www.testo.com/warranty

4.1.5. Dimensions



4.2. Product description

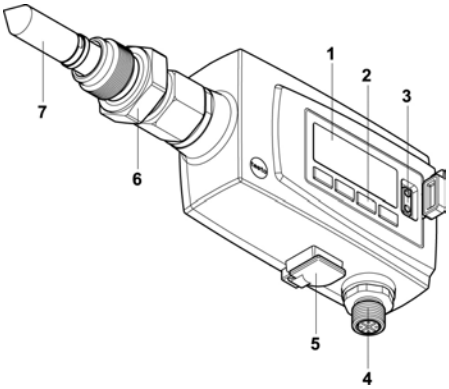
4.2.1. System components



Application		System components
A	With clean air and a process pressure corresponding to the presetting of the measurement chamber (1), a measurement chamber (1) is required for the rapid assembly (without de-pressurizing the installation).	• 1: Measurement chamber • testo 6781 with G1/2 thread
B	With clean air and a process pressure greater than or less than 7000 hPa (1000 to 35,000 hPa) that therefore does not correspond to the presetting of the inflow valve, a measurement chamber (1) with a flow meter (2) is required.	• 1: Measurement chamber • 2: Flow meter • testo 6781 with G1/2 thread

Application		System components
C	For rapid assembly (without de-pressurizing the installation), a measurement chamber (1) is required. Connect a filter (4) upstream for oily media.	• 4: Filter • 1: Measurement chamber • testo 6781 with G1/2 thread
D	With dry air (max. 140 °C), a PTFE tube (3) is used and the valve of the measurement chamber (1) is opened to maximum (suitable up to -60 °C_{td}).	• 3: PTFE tube • 1: Measurement chamber • testo 6781 with G1/2 thread
E	For process temperatures of 50 °C to 200 °C and a process pressure corresponding to the presetting, it is necessary to use a cooling coil (5) and a measurement chamber (1). Connect a filter upstream for oily media.	• Filter, if necessary • 5: Cooling coil • 1: Measurement chamber • testo 6781 with G1/2 thread
F	If A to E are not required. The thread is screwed directly into the process. De-pressurized tube required during installation.	• testo 6781 with G1/2 thread or • testo 6781 with N1/2" thread

4.2.2. At a glance



1 Display (optional)
2 Keys (only with optional display)
3 Test contacts
4 M 16 x 1.5 screw connection, e.g. analog output
5 Service flap with connection for service plug
6 Screw connection with process connection (G 1/2 or NPT 1/2")
7 Sintered cap over sensor unit

4.2.3. Display and keypad

The display option allows operation of the testo 6781 transmitter via the display and four keys.

The LCD display consists of one 7-segment line for displaying readings and units and of an information line (for status messages, for example).

The brightness and contrast of the display and the background lighting (permanent or off) can be changed via the user menu or the P2A software.

4.2.4. Service interface

The parameterizing socket (mini-DIN) is located behind the service flap as an interface to the P2A software.

4.2.5. Analog outputs

As analog outputs, the testo 6781 has either

- 1 current output of 0 to 20 mA (4-wire)/4 to 20 mA (4-wire) or
- 1 voltage output of 0 to 1 V/0 to 5 V/0 to 10 V (4-wire)

4.2.6. Parameters

The following parameters are displayed:

- Relative humidity in % RH (technical)
- Degree of humidity in g/kg and gr/lb
- Absolute humidity in g/m³ and gr/ft³
- Water content in ppm (vol)
- Dewpoint temperature in $°C_{td}$ and $°F_{td}$
- Standardized dewpoint (at atmospheric pressure 1013 hPa) in $°C_{tdA}$ and $°F_{tdA}$
- Temperature °C and °F

4.2.7. Scaling

There are three types of min./max. values:

1 The measuring range: The maximum sensor performance is in this range. Values outside of the measuring range are displayed via messages, for example. Measuring range, see table (below).

2 Standard scaling: The output signals are assigned to this measuring range as standard:

- during delivery if no entries are made in the order code
- after exchanging the unit, the measuring range recorded in the instrument is applied as standard.

The transmitter even retains its scaling with the voltage disconnected.

Measuring range, see table (below).

3 The maximum settings for the manual scaling

- The maximum limits can be calculated as follows:

  X = difference between MIN. and MAX. value of the standard scaling

  (Max. value of standard) + (50 % of X)

  (Min. value of standard) - (50 % of X)

- It is thus possible to scale beyond the measuring range, e.g. for the adjustment of the scaling limits to standard values of a PLC.

  With the alarm definition, however, the physical measuring range limits are decisive.

4.3. Commissioning

4.3.1. Mechanical assembly

- Carefully perform assembly work.
- Take special care with leaktightness. We recommend inserting a metal sealing ring (internal diameter 21 mm).
- Do not use any hygroscopic materials for the sealing.

> Only use force on the union nut.

Depending on the application, there are three different assembly options:

Assembly	**Application**
Without stainless steel measurement chamber and cooling coil	• Process temperatures 0 to 50 °C • Attachment of the sensor directly in the process possible • No fast assembly/dismantling of the testo 6781 required and sufficient inflow of the sensor (1 l/min.) exists
With stainless steel measurement chamber	• Process temperatures 0 to 50 °C • Fast assembly/dismantling of the testo 6781 required and/or • No sufficient inflow of the sensor (1 l/min.) exists
With stainless steel measurement chamber and cooling coil	• Process temperatures 50 to 200 °C

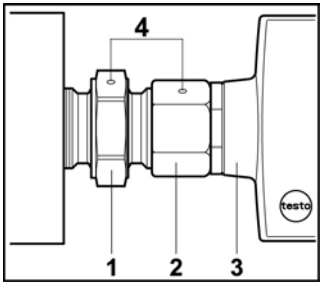
4.3.1.1. Without stainless steel measurement chamber and cooling coil

CAUTION

Compressed air! Danger of injury!

> De-pressurize pipe sections (e.g. compressor off or use of bypass) and vent them before opening.

Clamp ring screw connection is already pre-assembled. Screw connection body (1) and union nut (2) have a point-shaped marking (4).



1. Screw thread in process.
2. Turn housing (3) to desired position without much exertion of energy.
3. Tighten union nut (2) finger-tight.
4. Hold screw connection body (1) with a suitable spanner.
5. Tighten union nut (2) slightly past the marking (4).

An increased resistance can be felt when tightening.

6. Close ventilation of the pipe section and pressurize the pipe section again.

4.3.1.2. With stainless steel measurement chamber (max. 35,000 hPa)

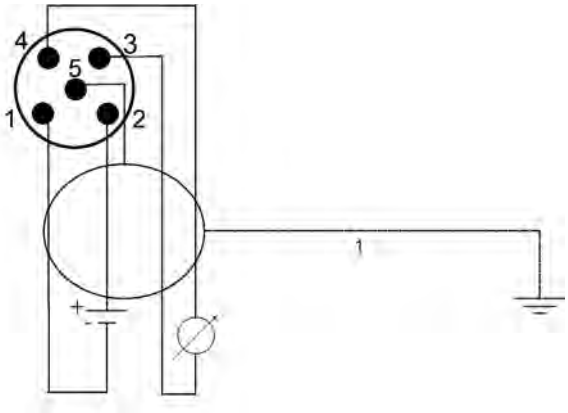
1. Screw process connection (G1/2) of the testo 6781 transmitter into the thread of the measurement chamber.
2. Mount 6781 as described under Without stainless steel measurement chamber and cooling coil page 19.
3. Engage quick-release fastening of the measurement chamber in the standardized socket of the compressed air line.

4.3.1.3. With stainless steel measurement chamber and cooling coil (max. 35,000 hPa)

1. Screw process connection (G1/2) of the testo 6781 transmitter into the thread of the measurement chamber.
2. Mount 6781 as described under Without stainless steel measurement chamber and cooling coil page 19.
3. Engage quick-release fastening of the measurement chamber in quick-release fastening of the cooling coil.
4. Engage second quick-release fastening of the cooling coil in the standardized socket of the compressed air line.

4.3.1.4. Connecting voltage supply and analog outputs

Wiring diagram for 4-wire system (0 … 20 mA / 4 to 20 mA / 0 to 1 V/0 to 5 V/0 to 10 V)



1-channel

0...20 mA / 4...20 mA
max. load per 500 Ω
0...1V / 0...5 V / 0...10 V

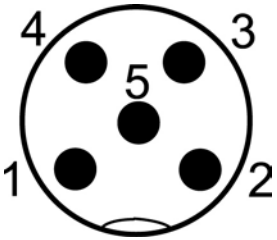
Requirement for the connecting cable of the supply:

- shielded and insulated with cross-section in the range of 0.12-0,5 mm² (depending on cable length).
- the supply lines must be protected against surge current by appropriate means.
- an OFF switch must be installed in an easily accessible position close by and be marked as such.

4.3.1.5. Plug-in connection for power supply and channel

M12 plug-in connection (5-pin) connector

View of the plug-in connection in the installed state from outside



PIN	Assignment
1	-24 V
2	+24 V
3	+ Ch1
4	- Ch1
5	PE

4.3.2. Adjusting the instrument

4.3.2.1. Init. phase during commissioning

In order to achieve the specified high accuracy down to -90°Ctd and quick response times in case of dew point temperature changes, the testo 6781 requires an initialization phase for adjustment.

During this initialization phase any adsorbed moisture, which has deposited in the sensor during transportation/storage and on all surfaces of the compressed air system when opening and screwing in the transmitter, is eliminated. During this time the testo 6781 should be subjected to at least 2 self-adjustment cycles (see Self-adjustment page 22).

In order to achieve an adjustment as quickly as possible, the testo 6781 has an automatic initialization phase, which is configured according to target dew point temperature. The factory setting assumes a dew point range from -20° to -60°Ctd. The following steps are recommended after the mechanical installation of the instrument and a stable state of the compressed air system has been reached.

Residual moisture in the compressed air system has a negative effect on the measuring results. The following times only apply for completely demoisturized compressed air systems. Otherwise longer adjustment times must be expected.

For dew point temperatures from -20 to -60°Ctd:

✓ Instrument in process.

1. Connect the instrument to the electric power supply.

- The instrument automatically passes through the initialization phase and the display shows **Init. phase**.

2. Wait for approx. 4 hours, until the instrument has completed the pre-set 3 self-adjustment cycles.

- After approx. 4 hrs: The reading **Init. phase** disappears from the display, the instrument has reached optimal capacity.

For dew point temperatures from -60 to -90°Ctd:

✓ Instrument in process.

1. Connect the instrument to the electric power supply.

- The instrument automatically passes through the initialization phase and the display shows **Init. phase**.

2. Change the initialization phase to 4 cycles (via operating menu, see Changing the adjustment phase page 34 or via P2A software, see Self-adjustment page 59).

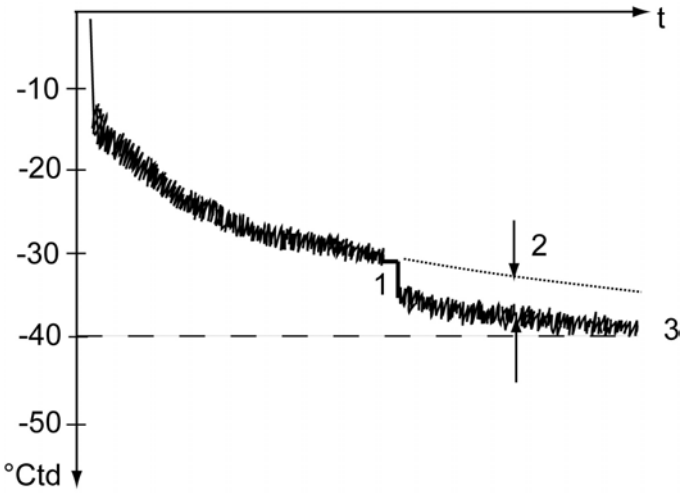
3. Wait for approx. 5 hours, until the instrument has completed 4 self-adjustment cycles.

- After approx. 5 hrs: The reading **Init. phase** disappears from the display, the instrument has reached optimal capacity.

4.3.2.2. Self-adjustment

Conventional residual moisture sensors reveal extremely increasing measurement uncertainties in case of low moisture values, which are mainly caused by hysteresis effects. In case of the residual moisture sensor of the testo 6781 these measurement uncertainties are corrected by an automatic self-adjustment procedure, which is automatically activated periodically over definable cycle times. This means that extremely accurate measuring results are also obtained down to -90 $°C_{td}$.

For this purpose a thermally conductive temperature sensor is attached to the back of the sensor element, which, besides the temperature measurement, is also used as heater. A pair of humidity and temperature values each is taken in both the unheated and heated state. The probe deviation obtained from these pairs of values is automatically corrected.



The graph shows the effect of the self-adjustment, e.g. during the Init. phase.

1 Self-adjustment

2 Correction of measurement value

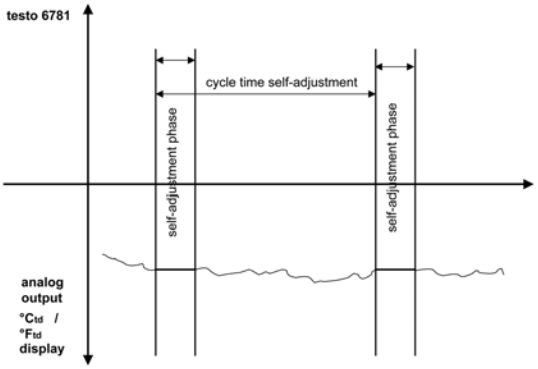
3 Process dew point temperature

For the effectiveness of the self-adjustment the following prerequisites are decisive over the duration of the self-adjustment.

- The process temperature should not vary by more than 0.5K
- The dew point temperature should remain stable, as far as possible
- The process pressure should not vary excessively

If these prerequisites cannot be fulfilled, the values obtained during the last successful self-adjustment will be maintained,

All adjustment processes are saved in the history of the transmitter, see Transmitter history page 69 .



During the self-adjustment phase, the analog outputs, the display value and output value are "frozen". A defined status signal can alternatively be chosen as output value.

The display shows **Self-adjustment active**, until the self-adjustment phase is finished. The self-adjustment time (incl. heating time, calculation time, cooling time) is 30 minutes. The cycle time can be edited via the operating menu or the P2A software, see Setting cycle time of the self-adjustment page 37 and Self-adjustment page 59.

Deactivating the self-adjustment function of the testo 6781 will reduce measuring accuracy and should therefore be restricted to the shortest possible length of time.

The time until the next self-adjustment is displayed in the status bar, in intervals of approx. five seconds.

4.3.2.3. 1-point adjustment by entering a reference value

With the 1-point adjustment you can enter a reference value for a selected work point (e.g. -40 °C_d). With this measure you achieve a minimum deviation between nominal and actual value.

But the further away the measurement is from the working point, the greater the deviation can become. The 1-point adjustment should therefore only be used for a relatively narrow measuring range (working range)

✓ A reference measuring instrument (e.g. chilled mirror dew point hygrometer) is at hand.

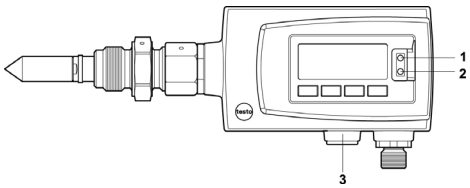
1. Expose the reference measuring instrument and the testo 6781 to the same, constant conditions and wait until the end of the automatic initialization phase.

> Optimal accuracy is achieved if at least two Self-adjustment cycles are executed at dew point temperatures higher than -60 °C_{td}, at dew point temperatures below -60 °C_{td} four Self-alignment cycles are recommended.

2. Measure the reference value and compare it with the measurement value obtained with the testo 6781.
3. If the values deviate: Enter the reference value
   - via the operating menu (see Enter reference value for 1-point adjustment page 37) or
   - via the P2A software (see 1-point adjustment page 66).

4.3.2.4. Analog output adjustment

The purpose of adjusting the analog outputs is to adjust the signal chain from the digital signal (within the transmitter) to the analog outputs. The signal type that was appointed for the transmitter is adjusted respectively for each channel (e.g. 4 to 20 mA or 0 to 1 V, etc.).



1 Contact ch. 1+
2. Contact ch. 1-
3. Service interface

Adjusting the analog output by test contacts

✓ Load of max. 500 Ω is connected to channel 1 (see Plug-in connection for power supply and channel page 21)

✓ A precise multimeter (minimum requirement: resolution 6.5 digits, at least 5-times more accurate than the 6781) is available.

If only a simple multimeter is available, the analog outputs may not be adjusted.

1. Connect the inputs of the multimeter with the contacts (**1**) and (**2**) for channel 1.
2. Transfer the reference analog value measured with the multimeter into the P2A software (see Adjusting the analog output page 68) or enter it via the user menu (see Start self-adjustment page 37).
3. Disconnect connections between the multimeter and the contacts of the testo 6781.

4.4. Operation

4.4.1. Relationship between user menu and mini-DIN socket is active

The testo 6781 can be parameterized using either the user menu or the P2A software (see Parameterizing, adjusting and analyzing software (P2A software) page 47).

The testo 6781 transmitter can only be operated via the display and keypad if the display option is available.

If the testo 6781 is connected to the P2A software, the user menu is blocked for the duration of the communication. The message Service plug is shown in the display of the testo 6781. As soon as the P2A software is disconnected, the user menu is accessible again.

4.4.2. Password protection

The user menu can be protected with a four-digit numerical code (see Calling up Main Menu page 36) so that access to the user menu is denied to unauthorized persons not familiar with this numerical code.

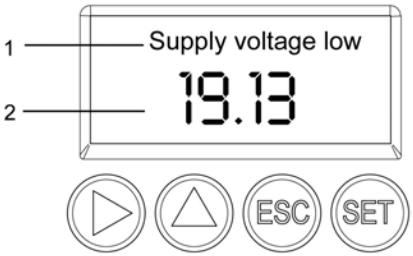
If the password protection is not to be used, the numerical code "0000" must be entered. This is also the status upon delivery.

4.4.3. Structure of user menu

At the main menu level, the user menu comprises the following:

- Main Menu Channel 1
- Main Menu Alarm
- Main Menu Settings
- Main Menu Analysis
- Main Menu Messages
- Main Menu Ident
- Main Menu Adjust
- Main Menu Reset

1 Display for messages
2 Channel 1 display

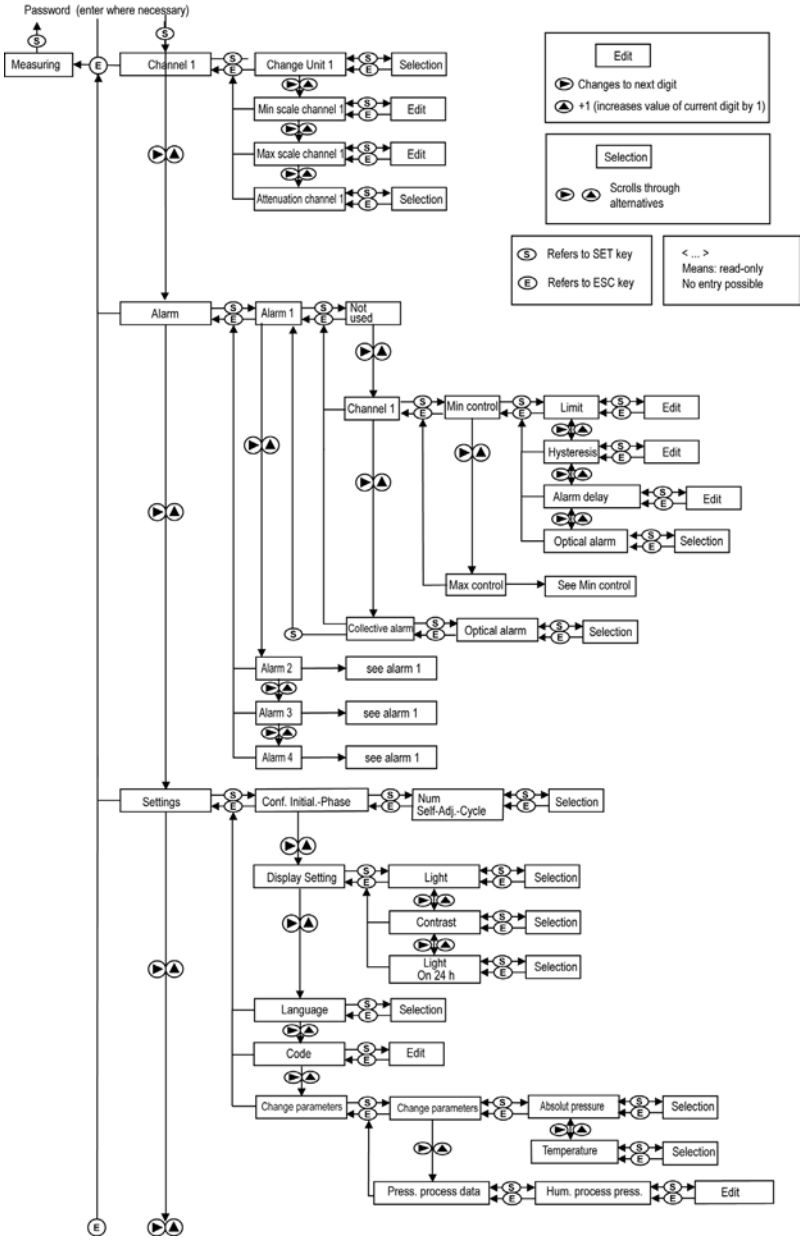


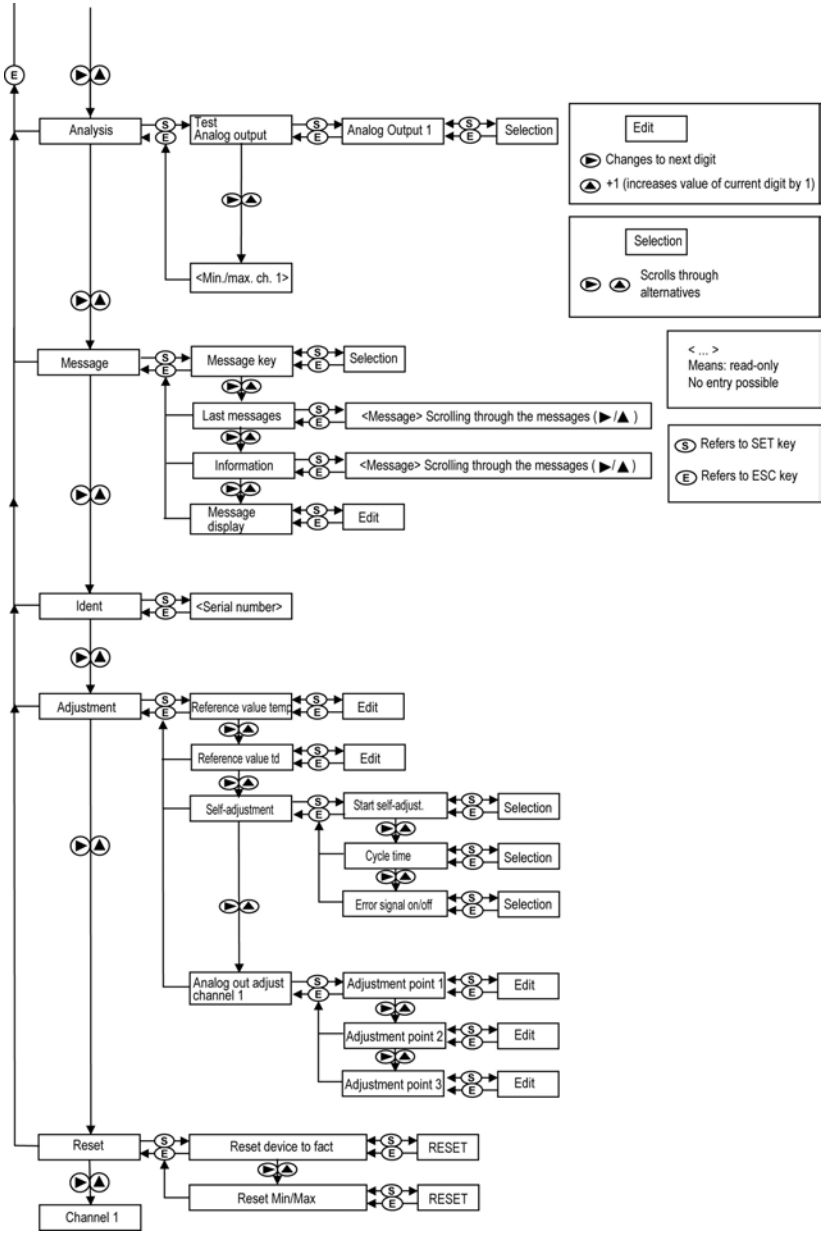
Four keys enable the user to navigate/scroll through the menus and enter/amend values and settings:

Key	Function/description
SET	• In Measuring Mode: changes to parameterization • In Parameterizing Mode: confirms a selection or setting
ESC	• Leaves a menu (without modifying any settings)
▶	• Selecting: scrolls through menus (downwards) or selectable alternatives • Editing: changes to next digit (to the right)

Key	Function/description
▲	• Selecting: scrolls through menus (upwards) or selectable alternatives • Editing: increases the value of the current digit by 1

4.4.4. Overview of the testo 6781 user menu




E
Analysis
S
E
Test
Analog output
Analog Output 1
Selection
<Min./max. ch. 1>
Edit
Changes to next digit
+1 (increases value of current digit by 1)
Selection
Scrolls through
alternatives
Message
Message key
Selection
Last messages
<Message> Scrolling through the messages (▶/▲)
Information
<Message> Scrolling through the messages (▶/▲)
Message
display
Edit
< ... >
Means: read-only
No entry possible
Refers to SET key
Refers to ESC key
Ident
<Serial number>
Adjustment
Reference value temp
Edit
Reference value td
Edit
Self-adjustment
Start self-adjust.
Selection
Cycle time
Selection
Error signal on/off
Selection
Analog out adjust
channel 1
Adjustment point 1
Edit
Adjustment point 2
Edit
Adjustment point 3
Edit
Reset
Reset device to fact
RESET
Reset Min/Max
RESET
Channel 1

4.4.5. The individual main menus

4.4.5.1. Editing main menu of channel 1

An overview is given in Overview of the testo 6781 user menu, page 29).

You can perform basic settings for channel 1.

1. In the Measuring Mode press **SET**, select **Main Menu Channel 1** with ▶ or ▲ and confirm selection with **SET**.

   One of the following parameters can now be selected using ▶ or ▲, after which the selection must be confirmed with **SET**:

- Channel 1 Unit

  The parameter for this channel is selected.

  Edit/select parameter with ▶ or ▲, confirm with **SET** or abort entry with **ESC**.

- Scale minimum for channel 1:

  The lower scale limit is edited; Unit as selected above.

  Editing the value: Scroll one digit to the right using ▶ and increase value of digit by 1 using ▲. Confirm with **SET** or abort entry with **ESC**.

- Scale maximum for channel 1

  The upper scale limit is edited;

  Unit as selected above.

  Editing the value: Scroll one digit to the right using ▶ and increase value of digit by 1 using ▲. Confirm with **SET** or abort entry with **ESC**.

- Signal delay ("Attenuation") for channel 1

  The analog signal can be delayed ("Attenuation"); a time constant is selected for this (1 = no delay; 2-15 = delay in seconds)

  Edit/select parameter with ▶ or ▲, confirm with **SET** or abort entry with **ESC**.

2. Continue to the main menu with ▶ or ▲ or return to Measuring Mode with **ESC**.

4.4.5.2. Editing Main Menu Alarm

The alarm statuses are shown on the display. You can choose whether the alarm is to be used to monitor limit values or as a collective alarm. If an alarm is to be used to monitor limit values, you can choose between monitoring the minimum or maximum value and set a limit value and hysteresis for each alarm.

In addition, every alarm can be linked to a clearly visible visual alarm (display background lighting flashes).

An alarm delay between 0 and 240 seconds can still be assigned to every alarm used for limit value monitoring so that the visual alarm is delayed. If the alarm status goes out within the set alarm delay time, the visual alarm is not triggered. .

With an alarm status present, the visual alarm can be reset by means of acknowledgement. The triggering of a new alarm cannot be enabled until after the alarm status goes out.

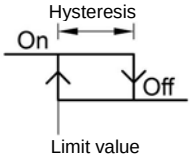
1. In the Measuring Mode press **SET**, select **Main Menu Alarm** with ▶ or ▲ and confirm selection with **SET**.

- Four alarms can be parameterized.

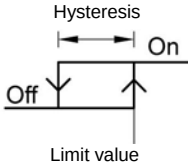
2. Select **Alarm x** with ▶ or ▲ and confirm selection with **SET**.

Using alarm to monitor limit values

Monitoring minimum



Monitoring maximum



3. Select **Channel x** (e.g. "Channel 1") with ▶ or ▲ and confirm selection with **SET**.
4. Select **Max control** or **Min control** with ▶ or ▲ (see graphic).
5. Press **SET** and edit **Limit value** as well as **Hysteresis**: Scroll one digit to the right using ▶ and increase value of digit by 1 using ▲. Confirm with **SET** or abort entry with **ESC**.
6. Select **Visual alarm** with ▶ or ▲. Select **YES** or **NO** with ▶ or ▲. Confirm with **SET** or abort entry with **ESC**.
7. Press **SET** and edit **Alarm delay**: Scroll one digit to the right using ▶ and increase value of digit by 1 using ▲. Confirm with **SET** or abort entry with **ESC**.
8. Return to **Channel x** with **ESC**.

9. Return to **Alarm x** with **ESC**.
10. Change to the other alarms using ▶ or ▲ and perform settings in the same way.

Using alarm as collective alarm or not using it at all

If an alarm is assigned to the collective alarm, the display flashes as soon as (at least) one of the warning or error messages of the testo 6781 transmitter becomes active.

The messages affecting the collective alarm can only be selected in the P2A software, see Using the software page 50

✓ Alarm is selected (see previous steps 1 and 2).

1. Use ▶ or ▲ to determine whether **Alarm x** should be used as a **Collective alarm** or **not used**. Confirm selection with **SET**.
2. If collective alarm is selected: Select **Visual alarm** with ▶ or ▲. Select **YES** or **NO** with ▶ or ▲. Confirm with **SET** and return to **Alarm x**.
3. Change to another alarm using ▶ or ▲ and perform settings in the same way.
4. Return to **Main Menu Alarm** with **ESC**.
5. Continue to **Main Menu Settings** with ▶ or ▲ or return to Measuring Mode with **ESC**.

4.4.5.3. Editing Main Menu Settings

You can edit instrument settings and other settings.

> In measurement mode press **SET**, press ▶ or ▲ to select **Main menu Settings** and confirm the selection with **SET**.

You can edit settings for:

- Init. phase of transmitter
- Display
- Language
- Code
- Unit
  - Absolute pressure
  - Temperature
- Hum. process data

Changing the adjustment phase

You can set the self-adjustment cycles to be executed during the Init. phase.

> Optimal accuracy is achieved, if at least two self-adjustment cycles are executed at dew point temperatures of -60 °C_{td}, at dew point temperatures below -60 °C_{td} four self-adjustment cycles are recommended.

1. Press ▶ or ▲ to select **Conf. Init. Phase** and confirm the selection with **SET**.
2. Press ▶ or ▲ to select the number of self-adjustment cycles (0,1,2,3,4; duration: value+1 hour) and confirm with **SET**.

- During measuring operation the status bar in the display shows the time until the end of the initialization phase in intervals of approx. five seconds.

3. Press **ESC** to return to **Conf. Init. Phase** and press ▶ or ▲ to proceed to the **Display settings**.

4.4.5.4. Editing Main Menu Analysis

You can check the function of analog outputs. In addition, you can read off the minimum and maximum values (since the last voltage supply or reset of the min./max. values).

Testing functionality of analog outputs

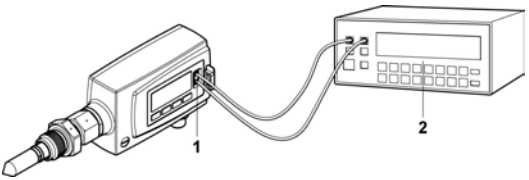
> This function affects the analog outputs directly, not only the test contacts.

1. In the Measuring Mode press **SET**, select **Main Menu Analysis** with ▶ or ▲ and confirm selection with **SET**.

- **Test Analog Output** is shown.

2. Press **SET**, scroll one digit to the right using ▶ and increase value of digit by 1 using ▲. Any analog output value can be predefined, e.g. for an analog output of 4 to 20 mA, the value "6.0 mA". Confirm with **SET** or abort entry with **ESC**.
3. Accept setting by pressing **SET** and test with multimeter (minimum requirement: resolution 6.5 digits, at least 2-times more accurate than the 6781) as follows:

   Analog output 1: Via test contacts under service flap, see diagram.



1 Channel 1 test contacts
2 Multimeter

3. Return to **Test Analog Output** with **ESC** and continue to **Max./min. values** with ▶ or ▲.

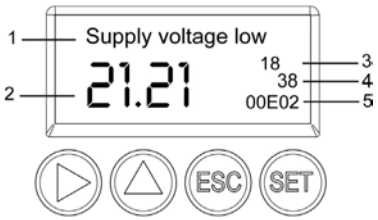
Reading off min./max. values of channels

To reset the max./min. values, see Editing Reset main menu page 39

1. Read off the min./max. values of the channel in succession with ▶ or ▲ and return to the **Main Menu Analysis** with **ESC**.
2. Continue to **Main Menu Message** with ▶ or ▲ or return to Measuring Mode with **ESC**.

4.4.5.5. Editing Message main menu

Messages can be confirmed/acknowledged, the last messages can be called up and the display of the messages can be switched on or off.



1 Message text
2 Additional information on the message
3 Message number (example: "4/7" refers to the fourth of seven messages)
4 Number of messages present (example: "4/7" refers to the fourth of seven messages)
5 Message code (see Status, warning and error messages page 39).

Using the P2A software (see Parameterizing, adjusting and analyzing software (P2A software) page 47) you can predefine whether messages are to be shown in the display.

1. In the Measuring Mode press **SET**, select **Main Menu Message** with ▶ or ▲ and confirm selection with **SET**.

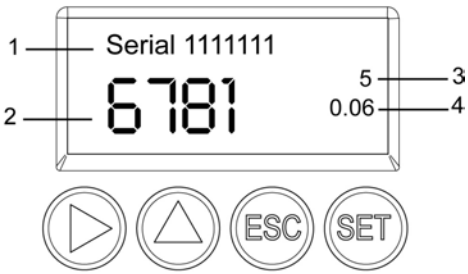
2. Confirm **Confirm message** using **SET**.
3. Select **Last messages** with ▶ or ▲ and confirm with **SET**.
4. Scroll between the warning and error messages recorded so far using ▶ or ▲ and return to **Last messages** using **ESC**.
5. Select **Information** with ▶ or ▲ and confirm with **SET**.
6. Scroll between the status messages recorded so far using ▶ or ▲ and return to **Information** using **ESC**.
7. Continue to **Display of message** with ▶ or ▲.

   ON: Measurements are shown on the display in Measuring Mode.

   OFF: No messages shown on display.
8. Select **ON** or **OFF** with ▶ or ▲ and confirm selection with **SET**.
9. Return to **Main Menu Message** with **ESC**.
10. Continue to **Main Menu Ident** with ▶ or ▲ or return to Measuring Mode with **ESC**.

An overview of the messages can be found in Status, warning and error messages page 39

4.4.5.6. Calling up Main Menu Ident



1. Serial number
2. Instrument type
3. Build number
4. Firmware version

1. In the Measuring Mode press **SET**, select **Main Menu Ident** with ▶ or ▲ and confirm selection with **SET**.

- The type, firmware version, build number and serial number of the transmitter are displayed.

This information is required when servicing.

2. Return to **Main Menu Ident** with **ESC**.

3. Continue to **Main Menu Adjust** with ▶ or ▲ or return to Measuring Mode with **ESC**.

4.4.5.7. Editing Main Menu Adjust

A reference value can be entered for the temperature (°C/°F) and a reference value can be entered for the dewpoint ($°C_{td}$/$°F_{td}$) for the 1-point adjustment. Please refer to the description in Adjusting the analog output page 68.

In addition, the analog outputs can be adjusted. Also see Analog output adjustment page 25 for instructions on how to do this.

Enter reference value for 1-point adjustment

Please also refer to Analog output adjustment page 25.

1. In the Measuring Mode press **SET**, select **Main Menu Adjust** with ▶ or ▲ and confirm selection with **SET**.
2. Select **Reference value temp** or **Reference value Td** with ▶ or ▲.
3. Press **SET**, edit value: Scroll one digit to the right using ▶ and increase value of digit by 1 using ▲. Confirm with **SET** or abort entry with **ESC**.
4. Continue to **Analog Adj. Ch. 1** with ▶ or ▲.
5. Continue with the adjustment of the analog outputs (see below, step 2) or press **ESC** to return to **Main Menu Adjust**.

Start self-adjustment

Please also refer to Self-adjustment Seite 22.

1. In the Measuring Mode press **SET**, select **Main Menu Adjust** with ▶ or ▲ and confirm selection with **SET**.
2. Select **Self-adjust** with ▶ or ▲ and confirm with **SET**.
3. Select **Start Self-adjust** with ▶ or ▲ and confirm with **SET**.

- Self-adjustment starts, the display value and the output value are “frozen”.

4. Continue to **Cycle time** with ▶ or ▲ (see below, step 2) or press **ESC** to return to **Main Menu Adjust**.

Setting cycle time of the self-adjustment

The time span to the next self-adjustment is shown in the status line of the display approx. every 5 seconds.

1. In the Measuring Mode press **SET**, select **Main Menu Adjust** with ▶ or ▲ and confirm selection with **SET**.

2. Select **Self-adjust** with ▶ or ▲ and confirm with **SET**.
3. Select **Cycle time** with ▶ or ▲ and confirm with **SET**.
4. Select the desired value (48h / 24 h / 12 h / 6 h / 1 h / off) with ▶ or ▲, confirm with **SET** and return to **Cycle time**.
5. Continue to **Error signal on/off** with ▶ or ▲ (see below, step 3) or press **ESC** to return to **Main Menu Adjust**.

Setting error signal for the self-adjustment

During the self-adjustment phase, the analog outputs and the last output value are frozen as standard.

When error signal is switched on, a defined error signal is output, see Namur fault conditions Page 44.

1. In the Measuring Mode press **SET**, select **Main Menu Adjust** with ▶ or ▲ and confirm selection with **SET**.
2. Select **Self-adjust** with ▶ or ▲ and confirm with **SET**.
3. Select **Error signal** with ▶ or ▲ and confirm with **SET**.
4. Select the desired value (on / off), confirm with **SET** and return to **Error Signal**.
5. Continue to **First delay** with ▶ or ▲ (see below, step 2) or press **ESC** to return to **Main Menu Adjust**.

Performing analog adjustment

Please refer to Analog output adjustment page 25.

1. In the Measuring Mode press **SET**, select **Main Menu Adjust** with ▶ or ▲ and confirm selection with **SET**.

Each channel is adjusted at three points in the analog range (at 10 %; 50 %; 90°% of the analog scale).

2. Select **Analog Adj. Ch. 1** with ▶ or ▲ and confirm with **SET**.
3. Use ▶ or ▲ to select **Adj. Point 1**.
4. Press **SET**. Read off multimeter display (e.g. 5601 mA) and enter this value in the user menu. Do this by scrolling one digit to the right using ▶ and increasing the value of digit by 1 using ▲. Confirm with **SET** or abort entry with **ESC**.
5. Use ▶ or ▲ to select **Adj. Point 2**.
6. Press **SET**. Read off multimeter display (e.g. 12,001 mA) and enter this value in the user menu. Do this by scrolling one digit to the right using ▶ and increasing the value of digit by 1 using ▲. Confirm with **SET** or abort entry with **ESC**.
7. Use ▶ or ▲ to select **Adj. Point 3**.

8. Press **SET**. Read off multimeter display (e.g. 18,401 mA) and enter this value in the user menu. Do this by scrolling one digit to the right using ▲ and increasing the value of digit by 1 using ▶. Confirm with **SET** or abort entry with **ESC**.
9. Return to **Main Menu Adjust** with **ESC**.
10. Continue to **Main Menu Reset** with ▶ or ▲ or return to Measuring Mode with **ESC**.

4.4.5.8. Editing Reset main menu

You can reset the factory settings for the following:

- Instrument
- Min./max. values

Resetting to the factory settings means resetting to the order specification, i.e. the specific condition at the time of supply to the customer.

1. In the Measuring Mode press **SET**, select **Main Menu Reset** with ▶ or ▲ and confirm selection with **SET**.

- **Reset Device** to factory settings is displayed.

2. Select the setting to be reset using ▶ or ▲ and confirm selection with **SET**.

- **Reset Completed** is displayed.

3. Return to the reset setting with **ESC** or **SET** and return to **Main Menu Reset** with **ESC**.
4. Continue to the **Main Menu Channel 1** with ▶ or ▲ or return to Measuring Mode with **ESC**.

4.5. Status, warning and error messages

To achieve optimum operational reliability (machine availability), the transmitter shows the following via the user menu or the P2A software

- Status messages
- Warning messages
- Error messages

in each case for the testo 6781 transmitter.

All messages are stored in the transmitter with an operating hours stamp. Use the user menu (see Editing Message main menu page 35) or the P2A software (see Transmitter history page 69) to view the message history.

In the transmitter, the last 60 status messages and the last 120 error and warning messages are stored in a ring memory. There is no limit in the P2A software.

4.5.1. Status messages

Status messages show the current operating status of the testo 6781.

Message	Display	Description
02506	Sensor initialization	Message appears while the transmitter is starting up. If the message disappears, the transmitter is ready for operation.
01D19	Service plug	The Mini-DIN socket is connected to: the USB adapter for P2A software, the adjustment adapter or the service plug (is not recorded/no number)
00300	New limit value	The limit value has been changed or shifted
00301	Scaling changed	The scaling has been changed
02104	Analog out adjust	An analog adjustment has been made
00500	Transmitter reset	The transmitter has been restarted.
0052F	Reset Min/Max	Resets all saved Min/Max values for all channels
00503	Reset device to fact	A factory reset of the transmitter was performed
00307	User Setting Change	User Setting Change: General settings were changed for the transmitter

4.5.2. Warning messages

Warning messages show an early warning or a current malfunction which may negatively impact measuring.

Message	Display	Cause	Remedying of fault
00E00	T ambient high**	The ambient temperature exceeds the permissible temperature for the transmitter.	Take necessary measures to lower ambient temperature, e.g. through venting or cooling.
00E01	T ambient low**	The ambient temperature is below the permissible temperature for the transmitter.	Take necessary measures to raise ambient temperature, e.g. through heating.
00E02/00E05	Supply voltage low**	The supply voltage is below the minimum voltage required for the transmitter.	Take measures to ensure sufficient voltage supply.
02822	T process high**	The process temperature exceeds the temperature designated for the probe	Remove the probe from the process and take any necessary measures to lower the process temperature
02821	T process low**	The process temperature is below the temperature designated for the probe	Take necessary measures to raise process temperature
02806	Condensation*	100 % RH has been reached, condensation developing	Take measures to reduce process humidity
02807	Values less than 0 % RH**	The adjustment or sensor is faulty	Check adjustment (via P2A adjustment history). If the problem persists, contact Testo Service
0081C	Alarm 1**	Depending on the parameterization of the alarm.	Depending on the parameterization of the alarm.

Message	Display	Cause	Remedying of fault
0081D	Alarm 2**	Depending on the parameterization of the alarm.	Depending on the parameterization of the alarm.
0081E	Alarm 3**	Depending on the parameterization of the alarm.	Depending on the parameterization of the alarm.
0081F	Alarm 4**	Depending on the parameterization of the alarm.	Depending on the parameterization of the alarm.

* Early warning

** Current malfunction

4.5.3. Transmitter error messages

Error messages show a current malfunction.

Message	Display	Cause	Remedying of fault
01505	Watchdog error	Due to a processor error, the transmitter performs an automatic restart.	If the problem occurs frequently, contact Testo Service.
01115	Low adjustment temperature	The ambient temperature is too low during the pressure adjustment.	Take necessary measures to raise ambient temperature, e.g. through heating.
01116	High adjustment temperature	The ambient temperature is too high during the pressure adjustment.	Take necessary measures to lower ambient temperature, e.g. through venting.
0300A	% RH short-circuit	Short-circuit in humidity sensor	Contact Testo Service
0300B	% RH sensor broken	The humidity sensor is damaged (sensor broken)	Contact Testo Service
0300C	T short-circuit	Short-circuit in temperature sensor	Contact Testo Service
0300D	T sensor broken	The temperature sensor is damaged (sensor broken)	Contact Testo Service

Message	Display	Cause	Remedying of fault
03105	Self-adjustment error	The automatic self-adjustment was faulty	Contact Testo Service
03000	Heat function defective	Heat function defective	Contact Testo Service

4.5.4. Handling alarm messages

Shown on the display[4]	Can be used for collective alarm[5]	Additional message end[6]
New limit value	x	
Scaling changed	x	
Alarm 1		x
Alarm 2		x
Alarm 3		x
Alarm 4		x
Transmitter reset	x	
Analog out adjust	x	
T ambient high	x	x
T ambient low	x	x
Supply voltage low	x	x
Watchdog error	x	
T process high	x	x
T process low	x	x
Condensation	x	x

[4] If multiple messages/alarms are activated at the same time, only the last message/alarm is shown. If this is cancelled, the other messages that are still active are no longer displayed.

[5] The message can be assigned the collective alarm function, which means that the collective alarm is activated as soon as at least one of the messages assigned to it is activated.

[6] The message is shown upon the occurrence of the event causing the message as well as when closing. Two entries appear in the history in the P2A software: Message text_start and Message text_end.

Shown on the display[4]	Can be used for collective alarm[5]	Additional message end[6]
Values less than 0 % RH	x	x
% RH short-circuit	x	x
% RH sensor broken	x	x
T short-circuit	x	x
T sensor broken	x	x
Heat function defective	x	x

Perform the **Confirm message** function (acknowledgement of the alarm via the control keys on the transmitter):

- The message/alarm is no longer shown on the display and the optical alarm goes out, where applicable. If multiple messages/alarms are active at the same time, all are reset simultaneously.
- If at least one message is assigned to the collective alarm, the collective alarm is reset.

4.5.1. Namur fault conditions

If the faults named in the following table occur, the analog outputs output special values that enable a general fault warning in the higher-level control system. The values correspond to the "Namur" industry standard.

Status message in the display	Display value in display	Class	Analog output				
			0 to 20 mA	4 to 20 mA	1 V	5 V	10 V
Values < 0 %RH	uuuuu	Under-range	0 mA	3.8 mA	0 V	0 V	0 V
Condensation	ooooo	Over-range	20.5 mA	20.5 mA	1.1 V	5.5 V	11 V
% RH short-circuit	-----	Error	21 mA	21 mA	1.1 V	5.5 V	11 V
% RH sensor broken	-----	Error	21 mA	21 mA	1.1 V	5.5 V	11 V
T short-circuit	-----	Error	21 mA	21 mA	1.1 V	5.5 V	11 V

Status message in the display	Display value in display	Class	Analog output				
T sensor broken	-----	Error	21 mA	21 mA	1.1 V	5.5 V	11 V
T process low	uuuuu	Under-range	0 mA	3.8 mA	0 V	0 V	0 V
T process high	ooooo	Over-range	20.5 mA	20.5 mA	1.1 V	5.5 V	11 V
Watchdog error	Previous value stops	Error	21 mA	3.8 mA	1.1 V	5.5 V	11 V
Value below min. scale	Reading	Under-range	0 mA	3.8 mA	0 V	0 V	0 V
Value above max. scale	Reading	Over-range	20.5 mA	20.5 mA	1.1 V	5.5 V	11 V
Heat function defective	-----	Error	21 mA	21 mA	1.1 V	5.5 V	11 V
Error signal	Frozen measure-ment value	Error	20,75 mA	20,75 mA	1,05 V	5,25 V	10,5 V

4.6. Maintenance and cleaning

4.6.1. Maintaining the instrument

We recommend that the adjustment and settings of the transmitter be checked at regular intervals using the

- User menu (Operation page 26) or
- P2A software (Parameterizing, adjusting and analyzing software (P2A software) page 47)

4.6.2. Cleaning the instrument

- Only clean the instrument carefully with a moist cloth.
- Do not use aggressive cleaning agents.
- Do not use any solvents.
- Do not touch or damage the sensor.

Protection cap, measurement chamber, cooling coil

If used in process conditions involving oil or dust, the protection cap and, if used, the measurement chamber and cooling coil must be cleaned regularly.

- Unscrew/remove protection cap, measurement chamber and cooling coil and blow out with compressed air or place in an ultrasonic bath.
- Replace a heavily soiled protection cap with the same type of protection cap.

The accuracy is only maintained when the ordered protection cap is replaced by the same type of protection cap.

Sensor cleaning

During sensor cleaning, avoid any contact with the sensor.

Do not mechanically clean the sensor, as otherwise the cover electrode may be damaged.

1. Carefully unscrew protection cap.
2. Carefully rinse with isopropanol and/or distilled water.
3. Allow sensor to dry thoroughly.
4. Screw on protection cap.

5 Parameterizing, adjusting and analyzing software (P2A software)

5.1. Specifications

The P2A software is used for the parameterizing, adjustment and analysis of testo transmitters. The following applies:

- Generally, all newer testo transmitters (as of 2007) are supported.
- Included with every testo transmitter that is bought new is a CD that contains a free upgrade of the software, which includes the device drivers for all transmitters that can be attached at this time.
- This upgrade can be downloaded at any time via the testo homepage "www.testo.com/Download/P2A".

The software must only be bought one time, even for owners of several testo transmitters.

5.1.1. Functions and use

In the P2A software, two different file types are used: The instrument and the parameter file.

Instrument file

The parameters of a particular transmitter are stored in its so-called instrument file. Using this file, the parameters can be edited and the instrument can be tested and adjusted.

Instrument files also contain the respective histories in addition to the parameter data, i.e. "log books" are kept for the previous parameterizations, adjustments and messages (see Transmitter history page 69).

Instrument files are ".cfm" format files.

Parameter file

Parameter files are not tied to a specific individual transmitter and contain only parameter data/no history data.

If you use various instruments of the same type, you can create parameter files once (e.g. by saving the appropriate instrument file as the parameter file) and transmit these onto the other instruments.

Parameter files are ".cfp" format files.

5.1.2. System requirements

Operating system

- Windows® 2000 SP4
- Windows® XP Home/Professional
- Windows® Vista

Computer

- Pentium processor of at least 400 MHz or equivalent
- 128 MB RAM
- Graphics resolution of at least 1024 x 768
- Unused hard drive capacity of at least 15 MB
- CD-ROM drive
- USB interface
- At least Internet Explorer 5.0.

Software

The P2A software must be purchased and installed separately from the transmitter. If it is a new software version, the transmitter is already supported completely. Older P2A software versions can be updated via the P2A software upgrade (cf. product CD included with the transmitter).

5.1.3. Scope of delivery

Included in the scope of delivery are:

- P2A software
- USB driver

When working with the parameterizing, adjusting and analyzing software (P2A software), previous knowledge of Windows® operating systems is assumed. The description in this instruction manual relates to Windows® XP.

5.2. First steps

5.2.1. Installing the software/driver

Administrator rights are required to install programs and drivers under Windows® 2000 SP4, XP and Vista.

5.2.1.1. Installing P2A software

1. Insert CD with P2A software.

✓ If the installation program does not start automatically:

> Open Windows Explorer and start the file **Setup.exe** on the product CD.

2. Follow the directions of the installation wizard.

5.2.1.2. Installing USB driver

Before installing the USB driver, please read the separate documentation that is enclosed with the USB driver CD.

5.2.1.3. P2A software upgrade

1. Insert product CD (supplied with the transmitter).
2. Open Windows® Explorer and start the file **P2A upgrade.exe** on the product CD.
3. Follow the directions of the installation wizard.

5.2.2. Starting the software

5.2.2.1. Starting the program

> Select: **[Start] > All Programs > Testo > P2A Software**.

- The program window is opened (see User interface page 50).

5.2.2.2. Establishing a connection with the instrument

The instrument works with limited functionality, if it is only supplied via the service plug. Some settings, which can be parameterized in the P2A software, will only be executed by the instrument, after it has been connected to the electric power supply.

Multiple instruments can be attached, however only one connection is active at all times.

✓ USB driver is installed (see Installing USB driver page 49).

1. Start the P2A software.
2. Connect adapter (supplied with the P2A software) to the service interface of the instrument (see Service interface page 16).
3. Connect instrument/adapter to the PC via the USB interface.

- The instrument file of the attached instrument is shown in the file list.

5.2.2.3. Activating the connection with the instrument

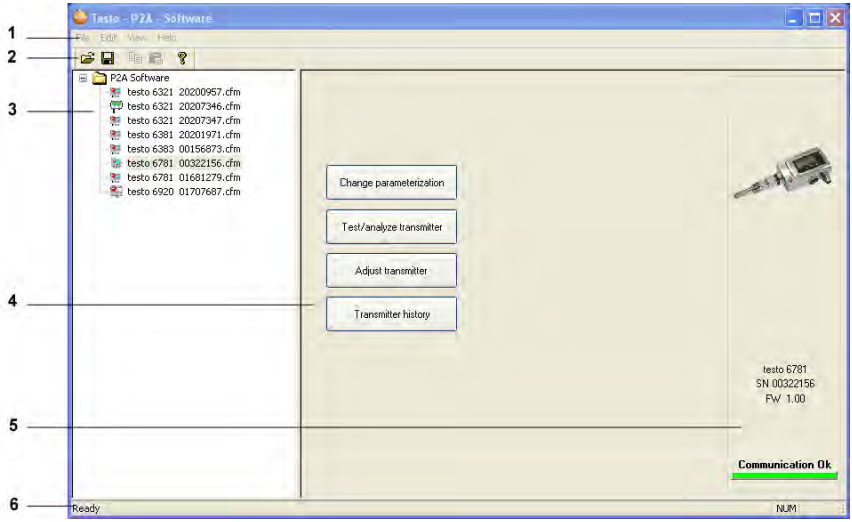
> Click on the desired instrument file.

- The selected file is marked in colour and the connection with the instrument is activated.

If a connection with the instrument is established when the program is started, the corresponding instrument file is marked automatically.

5.3. Using the software

5.3.1. User interface



1 Menu bar:

Menu	Command	Explanation
File	Open	Shows the Windows dialogue for searching and opening files.
	Save as	Saves the parameters of an instrument or parameter file under a new name.
Edit	Copy	Copies the parameters of the marked instrument or parameter file in the cache.
	Paste	Pastes the parameters from the cache in the marked instrument or parameter file.
View	Toolbar Status bar	Activates/deactivates the toolbar or status bar.
?	Check instrument connections	Checks the connections to a connected instrument without the instrument having to be activated.
	Service	A text file with the most important information on the computer and the software is opened via **Display service data**.
	Information	Shows the version number of the P2A software.

2 Toolbar: Shows the Windows-compliant icons for editing.

3 File:

Icon	File	Explanation
 Symbol shows a transmitter	Instrument file	Instrument file Connection to the instrument has been established. **<Type> <Serial number>.cfm** File name should not be changed.

Icon	File	Explanation
 Symbol shows a transmitter with a red minus sign in the upper left corner	Instrument file	Instrument file Connection to the instrument has not been established.
 Symbol shows a transmitter with a white P for parameter file in the upper left corner	Parameter file	**<Type> <Serial number> <Date> <Time>.cfp** File name can be changed. The name can be selected freely, but it is recommended that you retain the reference to the instrument. Parameter files are always marked red; the parameter values they contain are only forwarded to the instrument after being transmitted to the instrument file.

4 Function buttons: Dialogues on editing and testing the instrument are opened by means of the buttons.

[Change parameterization] see Changing instrument/parameter file page 53

[Test/analyze transmitter] see Chapter Analyzing/testing the transmitter page 62

[Adjusting the transmitter] see Chapter Adjusting the transmitter page 66

[Transmitter history] see Transmitter history page 69

5 File information:

Status	Shown in the window
An instrument file is selected	Type, serial number, firmware version of the instrument.
A parameter file is selected	Type, serial number and firmware version of instrument for which the parameter file was created.
Connection status	Green = connection is active Red = connection is inactive

6 Status bar: Shows the current status when editing via the menu bar.

5.3.2. Editing instrument/parameter file

5.3.2.1. Changing instrument/parameter file

✓ The desired instrument/parameter file is marked.

1. Click on **[Change parameterization]**.

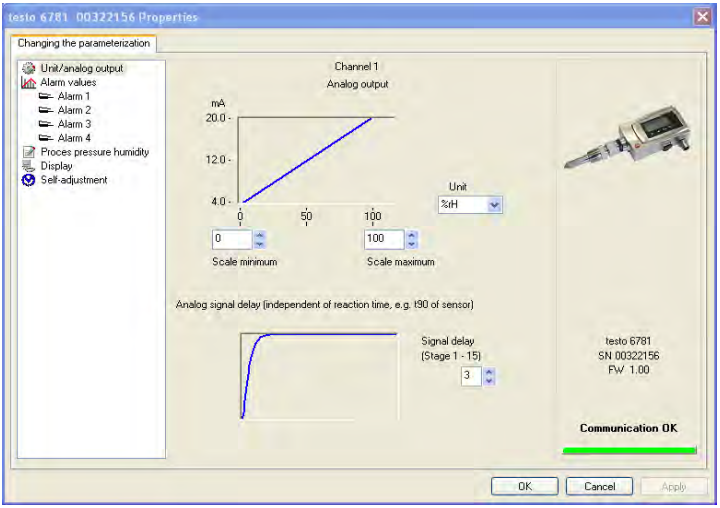
- The **Properties of <Instrument type> <Serial number>** dialogue is opened with the **Change parameterization** register.

If the parameters were transmitted from other parameter files into the instrument file, a message is shown with which you can transmit the new parameters to the connected instrument using **[Yes]**.

> If the parameters should not be transmitted, click on **[No]**.

2. Change or enter parameters in the corresponding fields.

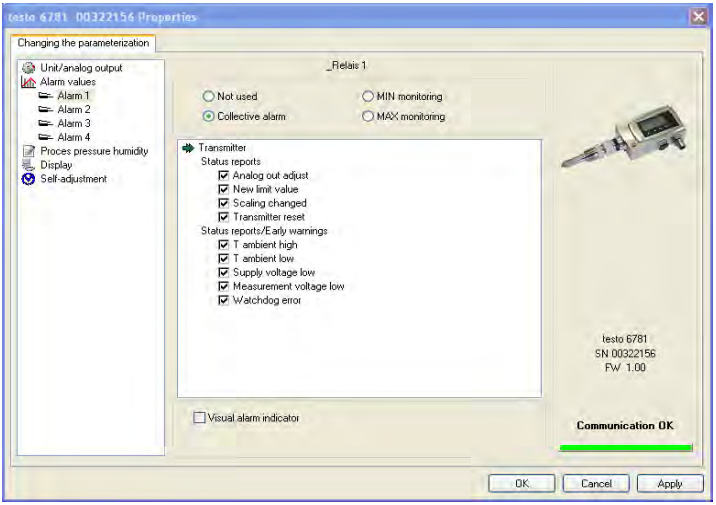
Field	Explanation
Unit/ Analog output	All analog outputs are parameterized in this mask.



Field	Explanation
Unit/analog output (graphic)	Unit: 0 to 1 V/5 V/10 V or 0...20 mA, 4 to 20 mA. Vertical: Current version of the analog output (cannot be changed). Horizontal: Min./max. scale end points of selected unit. The curve changes in accordance with the entered value of scale minimum and maximum.
Scale minimum/ maximum	The endpoints of the scaling can be selected up to the stored scale minimum and maximum. In the process, scaling can take place beyond the measuring range in order to adjust the analog output to the customer system.
Unit	Selection of the physical unit. When changing the unit, standard values are set for scale minimum and maximum.
Signal delay (graphic)	Curve changes according to the set signal delay.
Signal delay	Time interval in stages 1 – 15: 1 = no delay 15 = longest delay. The signal delay is added to the reaction time of the sensor. The signal delay shows averaging over the time interval of the selected stage in seconds: Example Stage 10 = average of the readings from the last 10 seconds.

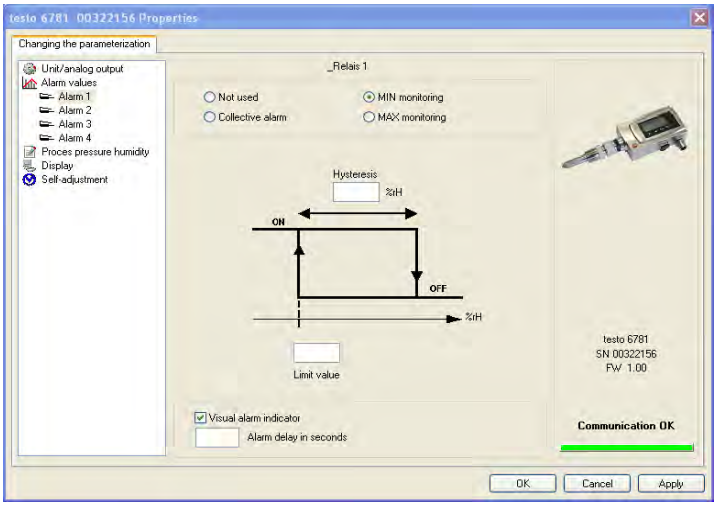
The delay of the signal in relation to the change in the process is also significantly influenced by the selection of the particle filter.

Field	Explanation
Alarm values, alarm 1 to 4	In this mask, the display alarms are parameterized.



Alarm x	Four alarm values are available.
Not used	Alarm is not used. Hysteresis image and input options are hidden.
Collective alarm	If selected messages appear, a collective alarm can be triggered. Selection of the messages (OR linkage) by selecting the checkbox.
Min control	If switched to ON (NO contact) or OFF (NC contact) under the limit value; in the event of a subsequent exceeding of **Limit value** plus **Hysteresis**, it is switched to OFF (NO contact) or ON (NC contact).

Field	Explanation
Max control	If switched to ON (NO contact) or OFF (NC contact) above the limit value; in the event of a subsequent undershooting of **Limit value** minus **Hysteresis**, it is switched to OFF (NO contact) or ON (NC contact).

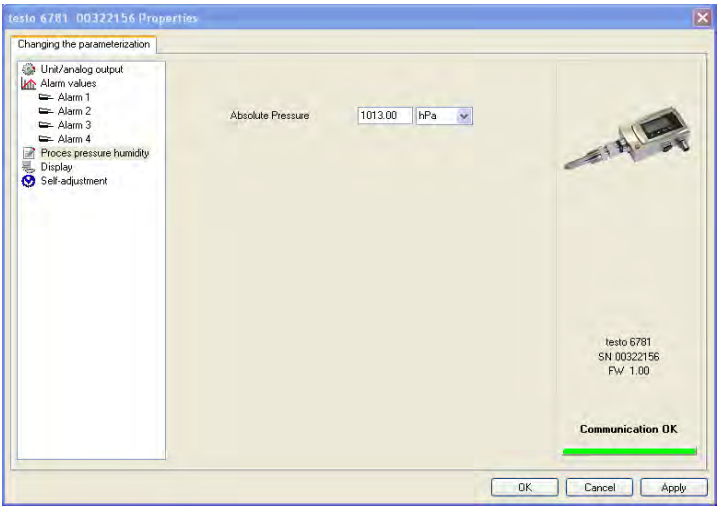


The graphic display in the centre of the screen refers to the relay wiring as a NO contact (ON).

Hysteresis	To avoid switching cycles.
Channel	Selection of the channel that is to be monitored.
Limit value	Values for the limits of the unit selected in **Unit/analog output**; 4 decimal places. When changing the phys. unit, the limit values are set to the default values.
Visual alarm display	Checkbox is activated: Upon the appearance of the selected alarm, the background lighting of the display flashes.

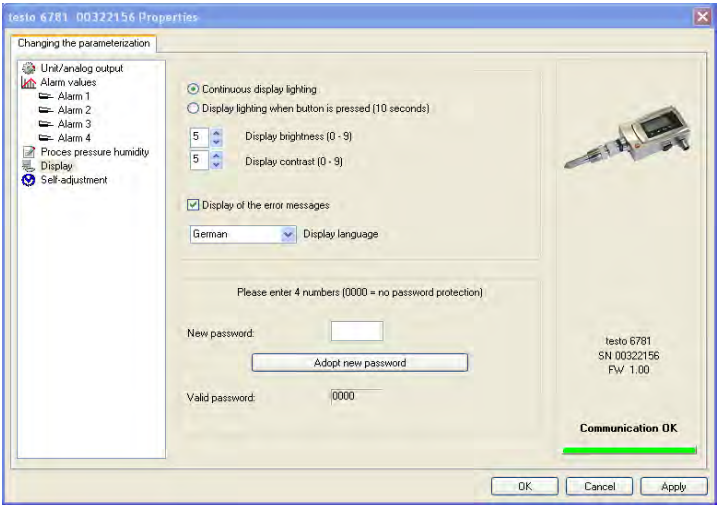
Field	Explanation
Response delay	The desired response delay for the alarms of the min/max control and the visual alarm is entered in the input field (0 to 240 seconds possible). The response delay has no effect on the collective alarms.

Field	Explanation
Basic settings	Setting the absolute pressure.



Absolute pressure	The absolute pressure is included in the calculation of the following units: • $°C_{td}$ or $°F_{td}$ • g/kg or gr/lb • ppm (vol)

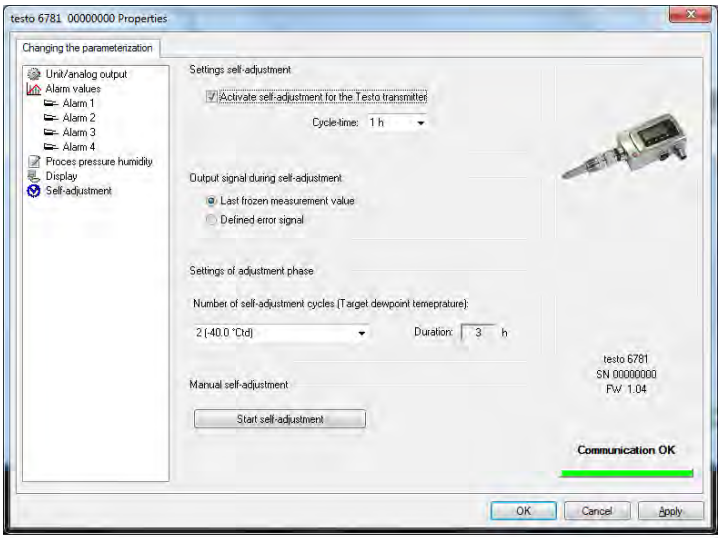
Field	Explanation
Display	Setting the display functions (if a display is available on the transmitter).



Continuous display lighting	Display lighting is permanently switched on.
Display lighting when button is pressed (10 seconds)	When a particular button on the instrument is pressed, the display lights up for 10 seconds.
Display brightness (0 to 9)	Setting the brightness between 0 and 9: 0 = dark 9 = light
Display contrast (0 to 9)	Setting the contrast between 0 and 9: 0 = low contrast 9 = high contrast
Display of the error messages	Selection of whether the error messages should be shown in the display.
Display language	Selection of the language.
New password	The password consists of four numbers, each of which must be between 1 and 9. If the password protection is not to be used, the numerical code "0000" must be entered.

Field	Explanation
[Adopt new password]	Button for confirming the new password.
Valid password	Display of the current password.

Field	Explanation
Self-adjustment	Setting the self-adjustment



Activation of self-adjustment for transmitter	• Control box activated: The self-adjustment is executed in a set cycle. • Control box not activated: The self-adjustment is not executed.

Field	Explanation
Cycle time	Set the cycles at which the self-adjustment is to be executed: • 1 hour • 6 hours • 12 hours • 24 hours (default setting) • 48 hours • deactivated In order to obtain reliable measurement values during the calibration or adjustment time for the transmitter, Testo recommends the shortest possible cycle time. In continuous operation a longer cycle time may be set.
Output signal during the self-adjustment	Selection of whether the latest frozen measurement value, or a defined status signal is to be emitted as an output signal during the self-adjustment.
Settings during the Init. phase	Possibility to match the pre-set Init. phase in dependence on the process temperature. Optimal accuracy is achieved, if at least two self-adjustment cycles are executed at dew point temperatures of -60 °C_{td}, at dew point temperatures below -60 °C_{td} four self-adjustment cycles are recommended.
[Start self-adjustment]	Start the self-adjustment manually at a defined time outside the cycle time.

5.3.2.2. Creating a new instrument file

It is possible to create an instrument file without restarting the P2A software.

✓ Transmitter must be connected.

1. Click on **File > New connection** in the menu bar.

- Connection to the transmitter is established.

5.3.2.3. Saving parameters

Parameters can be saved in new parameter files.

1. Mark instrument/parameter file.
2. Click on **File > Save as** in the menu bar.
3. Select storage location and enter the file name.
4. Click on **[Save]**.

- The new parameter file is shown in the file list.

Only the parameters are saved from an instrument file; the history data are not adopted.

The original name (Instrument type, Serial number) is suggested with the current date/time as standard, e.g. "testo 6781 01234578 061120 1403.cfp".

For a standard installation, the files are saved under "C:\Documents and Settings\All Users\Shared Documents\P2A Software". The path can differ depending on the version of the operating system.

5.3.2.4. Opening the parameter file

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

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

1. Click on **File > Open** in the menu bar.
2. Select the storage location and click on the requisite file.
3. Click on **[Open]**.

- The selected file is opened. This can be changed and saved (see Editing instrument/parameter file page 53).

5.3.2.5. Copying and pasting parameters

The parameters of a parameter file can be transmitted to an instrument file or another parameter file from the same instrument type.

1. Select file from which parameters are to be copied.
2. Click on **Edit > Copy** in the menu bar.
3. Select the file which is to be modified.
4. Click on **Edit > Paste** in the menu bar.

- The parameters are transmitted to the file.

> You can also use the common keyboard shortcuts for copying (CTRL+C) and pasting (CTRL+V).
>
> Parameters can also be transmitted using drag & drop, where you drag the icon of the parameter file onto the icon of the target instrument file.

5. Connect and select corresponding instrument.
6. Click on **[Change parameterization]**.
7. Confirm confirmation request.

- Parameter data are transferred to the instrument.

5.3.2.6. Deleting instrument/parameter file

Instrument/parameter files can be deleted from the file list.

1. Click on the file that is to be deleted with the right mouse button.
2. Select the command **Delete** in the context menu.

- The instrument or parameter file is deleted from the list.

5.3.3. Analyzing/testing the transmitter

In this section, you can test the outputs of the connected instrument, read off the limit values and reset the parameters to the factory settings.

The function is only available for instrument files.

5.3.3.1. Analyzing/testing the instrument

✓ The required instrument file is marked.

1. Click on **[Test/analyze transmitter]**.

- The **Properties of <Instrument type> <Serial number>** dialogue is opened with the **Test/analyze transmitter** register.

2. Perform action:

Action	Explanation
Carrying out factory reset	Reset the unit, limit value and hysteresis parameters to factory settings (see below).
Testing analog output	Test channel 1 (see Testing analog output page 63).
Display min./max. values	Overview of the minimum and maximum values measured since the last reset of the transmitter (see Displaying min./max. values page 65).

3. Click on **[OK]** or **[Cancel]** to close the dialogue.

5.3.3.2. Carrying out factory reset

✓ The required instrument file is marked.

1. Click on **[Test/analyze transmitter]**.

- The **Properties of <Instrument type> <Serial number>** dialogue is opened with the **Test/analyze transmitter** register.

2. Mark transmitter test.

- Current operating hours are shown.

3. Confirm control query to perform the reset.

- The values are reset to the customer-specific factory settings.

4. Click on **[OK]** or **[Cancel]** to close the dialogue.

5.3.3.3. Testing analog output

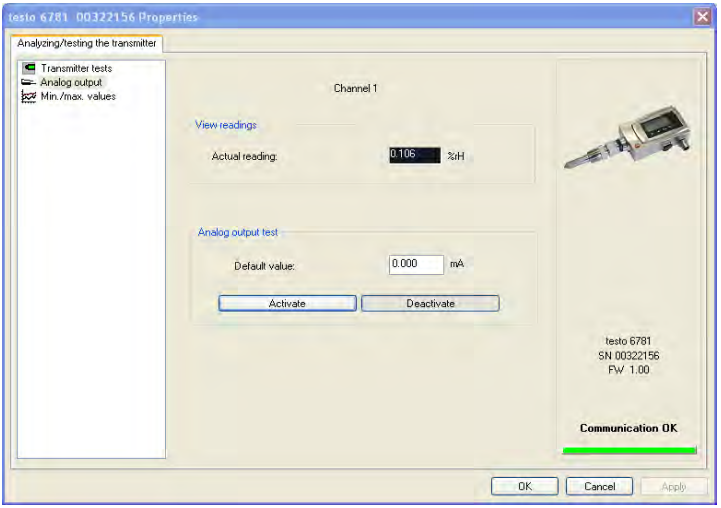
✓ The required instrument file is marked.

1. Click on **[Test/analyze transmitter]**.

- The **Properties of <Instrument type> <Serial number>** dialogue is opened with the **Test/analyze transmitter** register.

2. Mark channel and test values.

Field/button	Explanation
	Check the analog outputs (see Testing functionality of analog outputs page 34).



Current reading	Readings are updated every second.
Unit	Unit according to the type of analog output.
Default value	Freely definable output value for the respective type of analog output (V or mA), 1 decimal place.
[Activate]	The entered default value is forwarded to the corresponding analog output and to the test contacts by clicking. A warning informs that the value is being transmitted to the connected instrument in the event of existing cabling. Now check the analog output using a precise multimeter.
[Deactivate]	Finish entering the electrical variables at the analog output. The analog output returns to the current reading again.

3. Click on **[OK]** or **[Cancel]** to close the dialogue.

- The analog output returns to Measuring Mode again.

5.3.3.4. Displaying min./max. values

The transmitter saves the minimum or maximum value for each channel (measured since the last voltage supply or since the last manual reset).

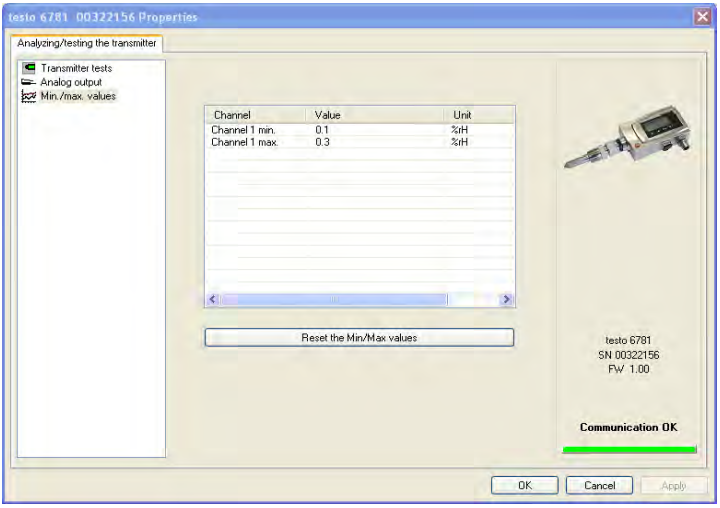
✓ The required instrument file is marked.

1. Click on [Test/analyze transmitter].

- The **Properties of <Instrument type> <Serial number>** dialogue is opened with the **Test/analyze transmitter** register.

2. Mark **Min./max. values**.

Field/button	Explanation
Min./max. values	View the min./max. values of each channel. Only the values within the measuring range are shown.



Channel	Channel 1 min./max.
Value	Min. or max. value, 1 decimal place.
Unit	Unit selected in **Unit/analog output**.

3. Reset **Min./max. values**.
4. Click on **[Reset min./max. values]**.

5. Confirm control query to perform the reset.
- The values are reset to the factory settings.
6. Click on **[OK]** or **[Cancel]** to close the dialogue.

5.3.4. Adjusting the transmitter

This function is used to adjust an attached instrument. The following adjustments may be carried out using the software:

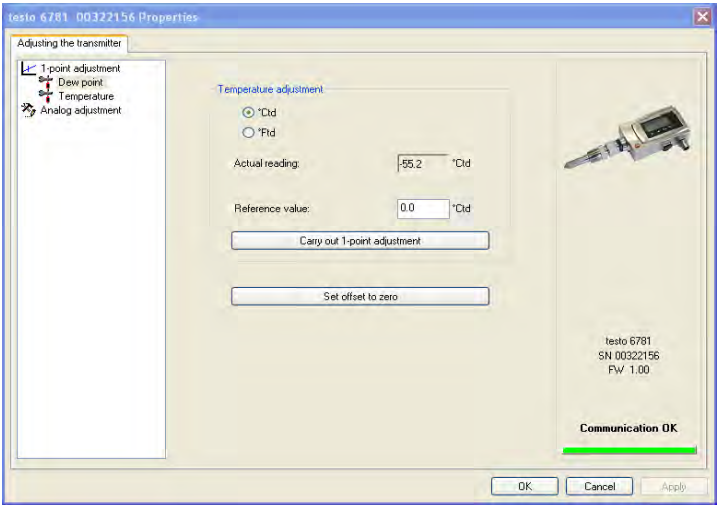
- 1-point adjustment (offset)
- Analog adjustment (entry via assistant/wizard)

Also see Adjusting the instrument page 21

5.3.4.1. 1-point adjustment

A dew mirror hygrometer is recommended as the reference measuring instrument for the 1-point adjustment (offset).

1. Expose the reference measuring instrument and the instrument to be adjusted to the same constant conditions and wait for equalization period to lapse.
2. Mark the instrument file of the connected instrument.
3. Click on **[Adjusting the transmitter]**.
- The **Properties of <Instrument type> <Serial number>** dialogue is opened with the **Adjusting the transmitter** register.
4. Enter reference value and click on **[Carry out 1-point adjustment]**.
5. Confirm confirmation request.
- The adjustment is carried out.

Field	Explanation
	
$°C_{td}$/$°F_{td}$	Selection of the unit; only for dewpoint adjustment.
°C/°F	Selection of the unit; only for temperature adjustment.
Current reading	Reading in the selected unit $°C_{td}$/$°F_{td}$ or °C/°F. Readings are updated every second.
Reference value	Entry of the read-off value from the reference measuring instrument. Permissible entries: • max. 10 $°C_{td}$ deviation (sum of all 1-point adjustments) • max. 2 K (°C) deviation (sum of all 1-point adjustments)

> Click on **[Set offset to zero]** to reset a transmitted reference value.

\- The current reading is used again.

6. Click on **[OK]** or **[Cancel]** to close the dialogue.

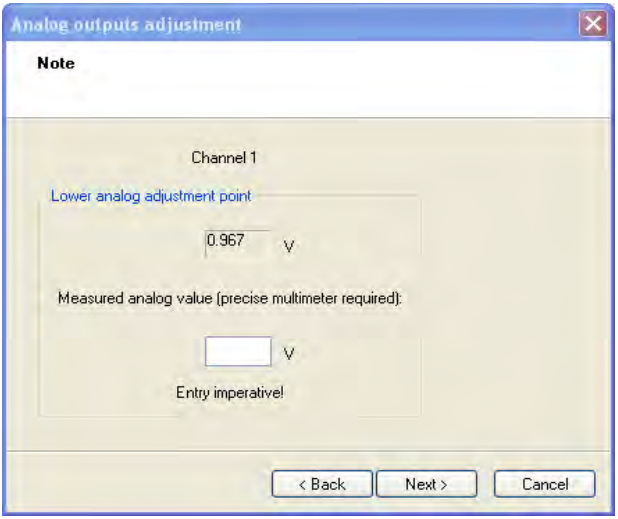
5.3.4.2. Adjusting the analog output

1. Connect precision multimeter (see Analog output adjustment page 25).
2. Mark the instrument file of the connected instrument.
3. Click on **[Adjusting the transmitter]**.

- The **Properties of <Instrument type> <Serial number>** dialogue is opened with the **Adjusting the transmitter** register.

4. Click on **[Start wizard ...]** and follow the instructions of the wizard.

- The adjustment is performed when the wizard is closed.

Field	Explanation
	
Default value	The analog output value from the last performed adjustment is given at the output. Value of the factory adjustment: • Lower adjustment point: approx. 10 % of the max. value • Centre adjustment point: approx. 50 % of the max. value • Upper adjustment point: approx. 90 % of the max. value
Measured analog value	Required field: Entry of the value read off at the multimeter.

5.3.5. Transmitter history

Parameterizations, adjustment processes and messages that have occurred are registered in the transmitter with an operating hours stamp.

In the history overviews (explained later in more detail), past processes and events can be made visible.

For parameter changes or adjustments that are performed directly at the instrument (via the user menu), "Transmitter" is entered in the User field and only the operating hour is entered in the Date/time field instead of operating hour/date/time.

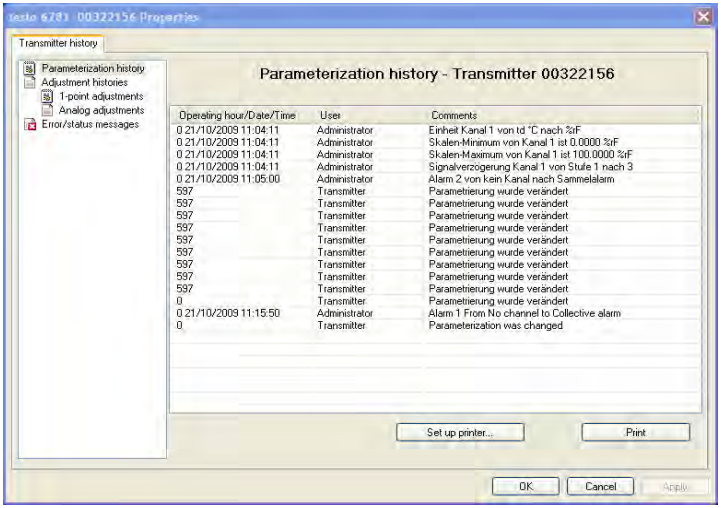
For entries that are performed using the P2A software, the name of the user logged into Windows appears in the User field, while the date/time and operating hour are shown in the Date/time field.

1. Mark the instrument file of the connected instrument.
2. Click on the **[Transmitter history]** button.

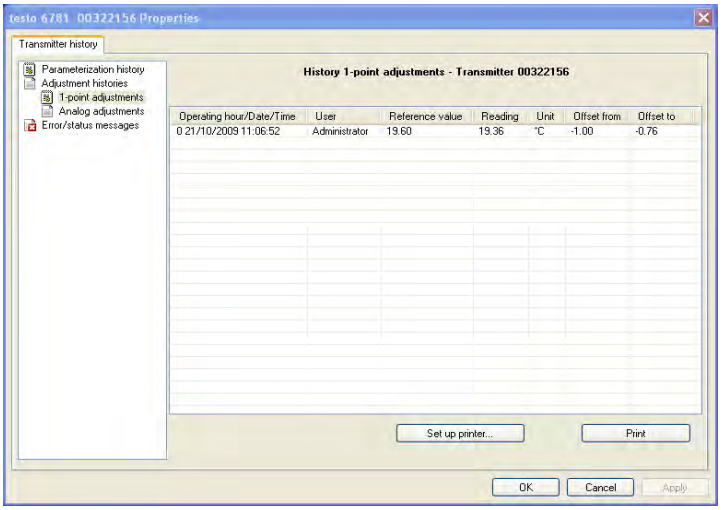
- The **Properties of <Instrument type> <Serial number>** dialogue is opened with the **Transmitter history** register.

3. Click on the required entry in the list to change the display.

Field	Explanation



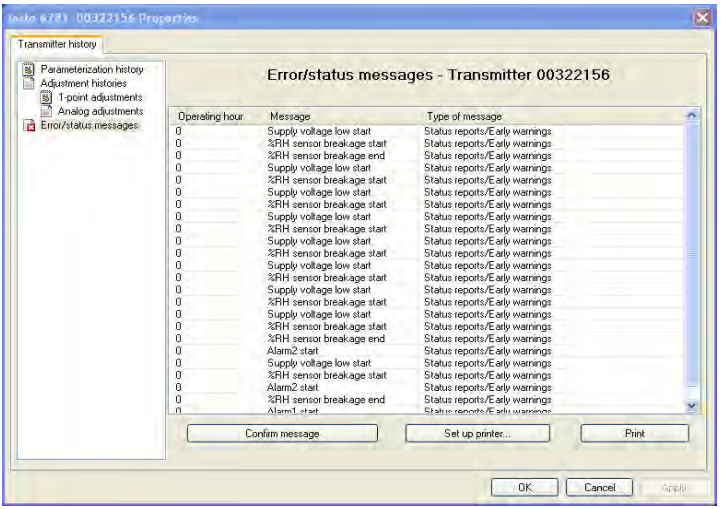
Field	Explanation
Operating hours / date/time	Operating hour/time stamp at which the change at the instrument was performed.
User	Name with which the user is logged into the operating system. "Transmitter" entry if the change was performed at the instrument.
Comments	Type of parameter change, e.g. "Unit of channel 1 from % RH to Ctpd".



Selection of adjustment histories: **1-point adjustments** / **Analog adjustments**.

Operating hours / date/time	Operating hour/time stamp at which the change at the instrument was performed.
User	Name with which the user is logged into the operating system. "Transmitter" entry if the change was performed at the instrument.
Reference value	Value read off at reference instrument.
Unit	Unit during the adjustment.
Actual value before adjustment	1-point adjustment: Reading of the transmitter. If no changes were performed, no value is displayed.

Field	Explanation
Offset from	1-point adjustment: Value before the adjustment.
Offset to	1-point adjustment: Value after the adjustment.
Channel	Analog adjustment: Channel 1.
Specification	Analog adjustment: Actual value.
Reading	Analog adjustment: Entered reference value.
Offset	Analog adjustment: Deviation at time of adjustment.



The table is shown only for error and status messages that were generated in the transmitter and were transferred and saved there via the connection to the P2A software.

Operating hours	Operating hour at which the message appeared in the instrument.
Serial number	Serial number of the instrument to which the message is assigned
Message	e.g. "Scaling changed". The scaling was changed.
Type of message	e.g. early warning, status message.

> To print out the history data, click on **[Print]**.

	The printing job is automatically sent to the default printer for the operating system. With **[Set up printer …]** a different printer can be selected or the printout can be edited.

4. Click on **[OK]** or **[Cancel]** to close the dialogue.

6 Tips and assistance

6.1. Questions and answers

Question	Possible causes/solution
Connection to instrument cannot be established	Check connection cable/plug contacts
Reading is too high or too low	• There is still no equilibrium condition in the system. • Clean sensor or sintered cap, see Maintenance and cleaning page 45
A message appears on the display	See Status, warning and error messages page 39
Malfunction (with and without display)	Analysis using the P2A software, see Analyzing/testing the transmitter page 62
Undo adjustment	A 1-point temperature/humidity adjustment can be reset to the current readings using **[Set offset to zero]** The actual values before the adjustment can be read out from the corresponding history table.

If we could not answer your question, please contact your dealer or Testo Customer Service. For contact details see the rear side of this document or the web page www.testo.com/service-contact

6.2. Accessories and spare parts

Description	Article no.
Measurement chamber and cooling coil	
Precision measurement chamber up to 35,000 hPa with adjustable inflow	0554 3312
Cooling coil for process temperatures above 50 °C (up to 200 °C), only with measurement chamber	0554 3304
Preliminary filter	0554 3311
Flow indicator	0554 3313
Interface and software	
P2A software (parameterizing, adjusting, analyzing) incl. USB adapter	0554 6020
Plug-in connections	
M12 plug-in connection (socket) for power and signal lines	0554 6689
Supply	
Mains unit (desktop, wall-mounted)	0554 1748
Mains unit (top-hat rail mounting)	0554 1749
Hose	
PTFE tube with compressed air connections, 2 m, up to 140 °C and max. 9000 hPa	0699 2824/4
External display	
Process display for testo 54-2 AC....	5400 7553
Process display for testo 54-7 AC....	5400 7555
Calibration	
Standard ISO calibration certificate for dewpoint (-40 °C_{td} to 0 °C_{td} at 6000 hPa), freely selectable points	0520 0116
Standard DKD calibration certificate for dewpoint at -10 °C_{td} and -40 °C_{td}	0520 0136

For a complete list of all accessories and spare parts, please refer to the product catalogues and brochures or look up our website at: www.testo.com

6.2.1. Ordering options for testo 6781 transmitter (0555 6781)

Order code	Characteristic
Axx Process connection	
A01	Process connection G1/2
A02	Process connection NPT 1/2"
Bxx Analog output/supply	
B02	0 to 1 V (4-wire, 24 V AC/DC)
B03	0 to 5 V (4-wire, 24 V AC/DC)
B04	0 to 10 V (4-wire, 24 V AC/DC)
B05	0 to 20 mA (4-wire, 24 V AC/DC)
B06	4 to 20 mA (4-wire, 24 V AC/DC)
Cxx Display	
C00	Without display
C02	With display/English
C03	With display/German
C04	With display/French
C05	With display/Spanish
C06	With display/Italian
C07	With display/Japanese
C08	With display/Swedish
Fxx Humidity variable	
F01	°C_{td}/Min/Max
F02	°F_{td}/Min/Max
F03	% RH/Min/Max
F04	% RH/Min/Max
F05	°C_{tdA}/Min/Max
F06	°F_{tdA}/Min/Max
F07	ppm (vol)/Min/Max
F08	g/m^3 /Min/Max

Order code	Characteristic
F09	gr/ft^3 /Min/Max
F10	g/kg /Min/Max
F11	gr/lb /Min/Max
Kxx Languages of instruction manual	
K01	German/English instruction manual
K02	French/English instruction manual
K03	Spanish/English instruction manual
K04	Italian/English instruction manual
K05	Dutch/English instruction manual
K06	Japanese/English instruction manual
K07	Chinese/English instruction manual
K08	Swedish/English instruction manual
Mxx Protection cap[7]	
M01	Protection cap made of stainless steel
M03	Protection cap made of PTFE

[7] The accuracy is only maintained when the ordered protection cap is replaced by the same type of protection cap in the event of heavy soiling.