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# ***HMP243 TRANSMITTER Operating Manual***

U145en-2.1  
May 1998  
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Yleisjäljennös 05/1998

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5.4.2.2	Stopping the measurement output .....	30
5.4.2.3	Outputting the reading once.....	31
5.4.2.4	Setting the output interval for the RUN mode.....	31
5.4.2.5	Serial bus settings .....	31
5.4.2.6	Selecting the output units .....	32
5.4.2.7	Setting the averaging time .....	32
5.4.2.8	Setting the transmitter address .....	33
5.4.2.9	Setting the calculation mode.....	33
5.4.2.10	Resetting the transmitter.....	33
5.4.3	Operating the transmitter via the serial bus .....	34
5.4.3.1	Setting the serial interface .....	34
5.4.3.2	OPEN & CLOSE .....	35
<b>6.</b>	<b>CALIBRATION .....</b>	<b>36</b>
<b>6.1</b>	<b>Humidity calibration .....</b>	<b>36</b>
6.1.1	One point humidity calibration.....	37
6.1.1.1	With serial commands .....	38
6.1.1.2	With display / keypad commands.....	38
6.1.1.3	With LED commands .....	39
6.1.2	Two point humidity calibration.....	39
6.1.2.1	With serial commands .....	39
6.1.2.2	With display / keypad commands.....	40
6.1.2.3	With LED commands .....	41
6.1.3	Humidity calibration procedure after sensor change .....	42
6.1.3.1	With serial commands .....	42
6.1.3.2	With display / keypad commands.....	42
6.1.3.3	With LED commands .....	43
6.1.4	Humidity calibration table.....	44
<b>6.2</b>	<b>Temperature calibration .....</b>	<b>44</b>
6.2.1	One point offset calibration .....	45
6.2.1.1	With serial commands .....	45
6.2.1.2	With display / keypad commands.....	45
6.2.1.3	With LED commands .....	45
6.2.2	Two point temperature calibration.....	46
6.2.2.1	With serial commands .....	46
6.2.2.2	With display / keypad commands.....	47
6.2.2.3	With LED commands .....	47
<b>6.3</b>	<b>Calibration of analogue outputs .....</b>	<b>48</b>
6.3.1	With serial commands .....	48
6.3.2	With display / keypad commands.....	48
6.3.3	With LED commands .....	49
<b>7.</b>	<b>MAINTENANCE.....</b>	<b>50</b>
<b>7.1</b>	<b>Reference measurements.....</b>	<b>50</b>
<b>7.2</b>	<b>Self-diagnostics .....</b>	<b>50</b>
<b>7.3</b>	<b>Replacing the composite sensor .....</b>	<b>51</b>
<b>7.4</b>	<b>Temperature channel (additional) adjustment with Pt 100 simulators .....</b>	<b>51</b>
7.4.1	With serial commands .....	52
7.4.2	With display commands.....	52
7.4.3	With LED commands .....	52
<b>7.5</b>	<b>Temperature channel adjustment with Pt 100 simulators (composite sensor) .....</b>	<b>53</b>
7.5.1.1	With serial commands .....	54
7.5.1.2	With display commands.....	54

7.5.2	With LED commands.....	54
<b>7.6</b>	<b>Measurement of output currents using test points.....</b>	<b>55</b>
<b>7.7</b>	<b>Adjusting the contrast of the display.....</b>	<b>55</b>
<b>8.</b>	<b>TECHNICAL DATA .....</b>	<b>56</b>
<b>8.1</b>	<b>Dewpoint temperature.....</b>	<b>56</b>
<b>8.2</b>	<b>Temperature (with additional T sensor head).....</b>	<b>57</b>
<b>8.3</b>	<b>Calculated variables.....</b>	<b>57</b>
8.3.1	Relative humidity (with additional T sensor head) .....	57
8.3.2	Accuracy of other calculated variables .....	58
<b>8.4</b>	<b>Outputs .....</b>	<b>59</b>
<b>8.5</b>	<b>Electronics.....</b>	<b>59</b>
<b>8.6</b>	<b>Mechanics.....</b>	<b>60</b>
<b>8.7</b>	<b>Electromagnetic compatibility.....</b>	<b>61</b>
8.7.1	Emissions .....	61
8.7.2	Immunity .....	61
<b>9.</b>	<b>SPARE PARTS AND ACCESSORIES.....</b>	<b>61</b>
<b>APPENDIX 1: SERIAL COMMANDS .....</b>		<b>63</b>
<b>APPENDIX 2: INSTALLING AND USING THE RS 485/422 SERIAL PORT MODULE.....</b>		<b>85</b>
<b>APPENDIX 3: INSTALLING AND USING THE DIGITAL CURRENT LOOP MODULE .....</b>		<b>97</b>
<b>APPENDIX 4: ERROR MESSAGES.....</b>		<b>107</b>
<b>APPENDIX 5: CALCULATION FORMULAS.....</b>		<b>113</b>
<b>APPENDIX 6: WIRING DIAGRAM MK4456.....</b>		<b>115</b>
<b>APPENDIX 7: RE-GAINING.....</b>		<b>117</b>

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## 1. PRODUCT DESCRIPTION

The HMP243 transmitter is a microprocessor based instrument for the measurement of dewpoint temperature especially in high humidities and/or fast changing temperatures. The dewpoint temperature is measured through relative humidity and temperature. The dewpoint temperature, although a calculated variable, is the primary reading obtained with the HMP243. As the probe is equipped with the warming function, the relative humidity reading obtained is not correct as such whereas the dewpoint temperature is. If the temperature is below 0 °C, the user can select whether the transmitter calculates dewpoint or frostpoint reading; as default, the transmitter calculates frostpoint.

The transmitter can be ordered with one or two sensor heads. If the transmitter has only a humidity sensor head, it can output the dewpoint temperature or the mixing ratio. If the transmitter is ordered with an additional temperature head, the user can choose the output from the following readings: dewpoint, relative humidity, ambient temperature, dewpoint difference (= ambient temperature - dewpoint), mixing ratio, absolute humidity, and wet bulb temperature. The configuration that the user completes in the order form determines the available readings. The transmitter has two analogue outputs and can be connected to a serial bus via the RS 232C interface or through an RS 485/422 serial module or a digital current loop module.

There are various possibilities for the configuration of the transmitter. It can have either a blank cover, or a cover with a local display and keypad with which to operate the transmitter. Two analogue output signals are selected from the measured and calculated quantities; the signals can be scaled and the measurement ranges changed. The HMP243 can be supplied with two, five or ten meter sensor head cables.

The dewpoint measurement range is -40...+100 °C. The range depends on the desired accuracy because the dewpoint is calculated through the RH and the T readings (see Chapter 8). The analogue temperature output can be scaled quite freely, for example -20...+60 °C can be set to correspond to 0...10 V. The relative humidity, absolute humidity, dewpoint difference, mixing ratio and wet bulb temperature ranges are also scalable.

In some specific applications, the sensor gain may gradually decrease because of an interference caused by some particular chemicals present in the ambient. These changes can be recovered with an optional re-gaining function.

The transmitter is equipped with a composite humidity and temperature sensor; the operation of the HUMICAP®KC humidity sensor is based on changes in the capacitance of the sensor as its thin polymer film absorbs water molecules.

Options	
Additional T probe	For the measurement of the ambient temperature and for obtaining other quantities in addition to dewpoint temperature and mixing ratio
Calculation variables	dewpoint difference, mixing ratio, absolute humidity, wet bulb temperature
Serial interface	RS 232C (standard), RS 485/422, digital current loop module
Display cover	cover with local display & keypad
Filters	sintered filter, PPS grid with steel netting
Cable lengths	2, 5 or 10 meters
Installation aids	Installation kit for temperatures up to 180 °C
HMP243MIK	Meteorological installation kit

## 2. ADVANTAGES OF A WARMED SENSOR HEAD

In some measurement applications, unwanted dew formation makes humidity measurement difficult or even impossible. At a weather station, for example, high humidity combined with rapidly changing outdoor temperature can condense the water vapour in the air onto the sensor head. Until this dew evaporates or dries, it is impossible to obtain a true reading. Dew formation is also a problem in environmental chambers and in processes involving high humidity, such as meat processing.

In some applications, rapid temperature changes are the source of difficulty. Normally, relative humidity sensors must be at the same temperature as the ambient air or the measurement is incorrect. At +20 °C and 90 %RH a difference of  $\pm 1$  °C causes an error of  $\pm 6$  %RH. This makes reliable humidity measurements difficult in rapidly changing temperatures.

In other applications, the problem is a combination of both the dew formation and rapid changes of temperature; a rapid rise in temperature can cause a corresponding increase of water vapour in the ambient. In these conditions, the temperature of the sensor head rises more slowly, and can remain below the dewpoint of the ambient for a while. Dew then forms on the sensor head, and it may take several hours or in the worst case, several days for the sensor to recover from the condensation.

Vaisala's HMP243 dewpoint transmitter offers a reliable solution for humidity measurement in all these demanding conditions. The humidity sensor head is kept dry by warming it. As the measurement is fully temperature compensated, changes in the process temperature do not delay the measurement. This means that the response time of dewpoint measurement is proportional only to the diffusion time of water molecules inside the sensor head.

The HMP243 has an excellent performance also at normal humidities and in stable environments, but it will mostly be used in applications where very high humidity can take place. In these kinds of applications, the use of traditional transmitters has been restricted.

## **3. INSTALLATION**

### **3.1 Selecting the place of installation**

The transmitter should be installed in a place that gives a true picture of the environment or process and is as clean as possible. Air should circulate freely around the sensor. If necessary, the transmitter can be installed in a place where a hot spot may develop. However, cold spots should be avoided.

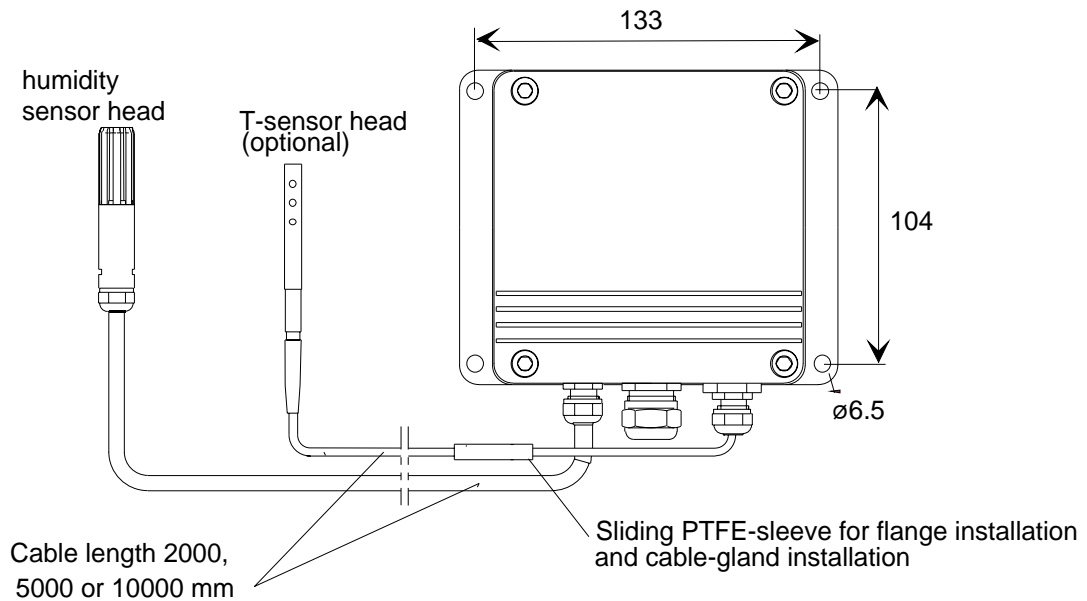
When the sensor head is installed in a duct or a process channel where the temperature is different from the ambient temperature, insulate the point of entry; this is particularly important if the transmitter is installed with the sensor head pointing downwards. Installing the sensor head of the HMP243 vertically is not recommended because in high humidities, the humidity may condense on the sensor head cable and then flow on to the sensor head.

When there is no alternative but to install the sensor head in the process vertically, the point of entry must be carefully insulated. The cable must also be allowed to hang loosely in order to prevent any water that possibly condenses on the cable from running onto the sensor head.

Install the humidity sensor head in the process wherever possible. Avoid sample flows where the gas temperature can drop below dewpoint temperature; this might result in erroneous measurement readings. Install the sensor head transversely against the direction of the process flow. If the process temperature is much higher than that of the environment, the whole sensor head and preferably part of the cable must be inside the process.

In duct or channel installations drill a hole ready for a reference meter. Plug the reference hole tightly (see Figure 3.2).

Install the electronics housing away from possible steams escaping from the process.



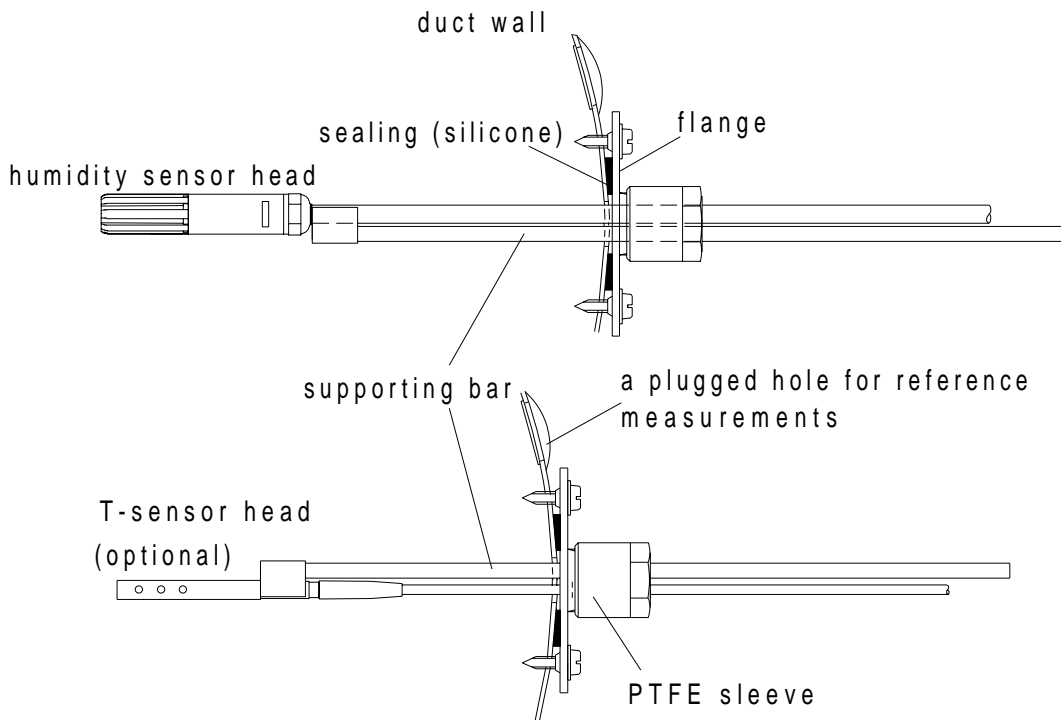
**Figure 3.1 HMP243 transmitter with a humidity sensor head and an additional T sensor head**

When mounted on the side of a duct or channel, the sensor head must be inserted from the side (see Figure 3.2). If this is not possible and the sensor head must be inserted from the top, the point of entry must be carefully insulated.

### NOTE

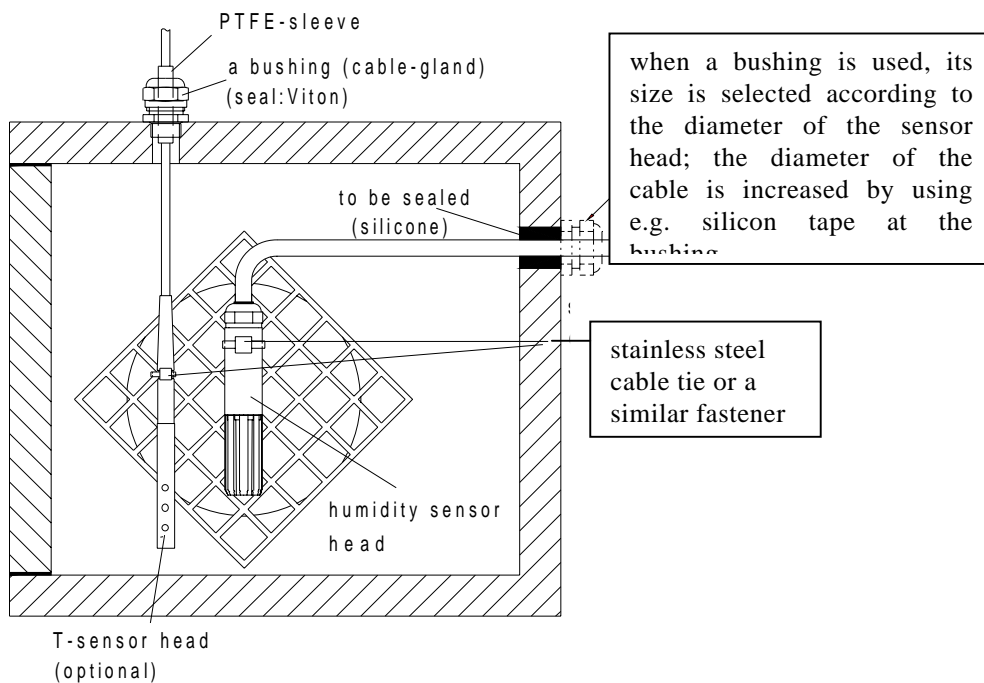
The two sensor heads should be installed so that the humidity sensor head does not warm the T sensor head, i.e. the T sensor head is installed closer to the process flow. When the RH reading is required, always install the T sensor head in the place where you need the reading from.

The HMP243 can be installed in ducts and channels with the help of the installation kit; the kit consists of a flange, a supporting bar for the sensor head cable and screws for attaching the flange to the wall of a duct. With the help of the installation kit the distance between the sensor head and the channel wall can be easily adjusted. The range of adjustment is 100...320 mm; the distance is measured from the tip of the sensor head to the flange.



**Figure 3.2** Installing the sensor heads of the HMP243 in a channel with the help of flanges and supporting bars

The sensor head can also be installed vertically.



**Figure 3.3** Vertical installation of the HMP243 sensor heads

**NOTE**

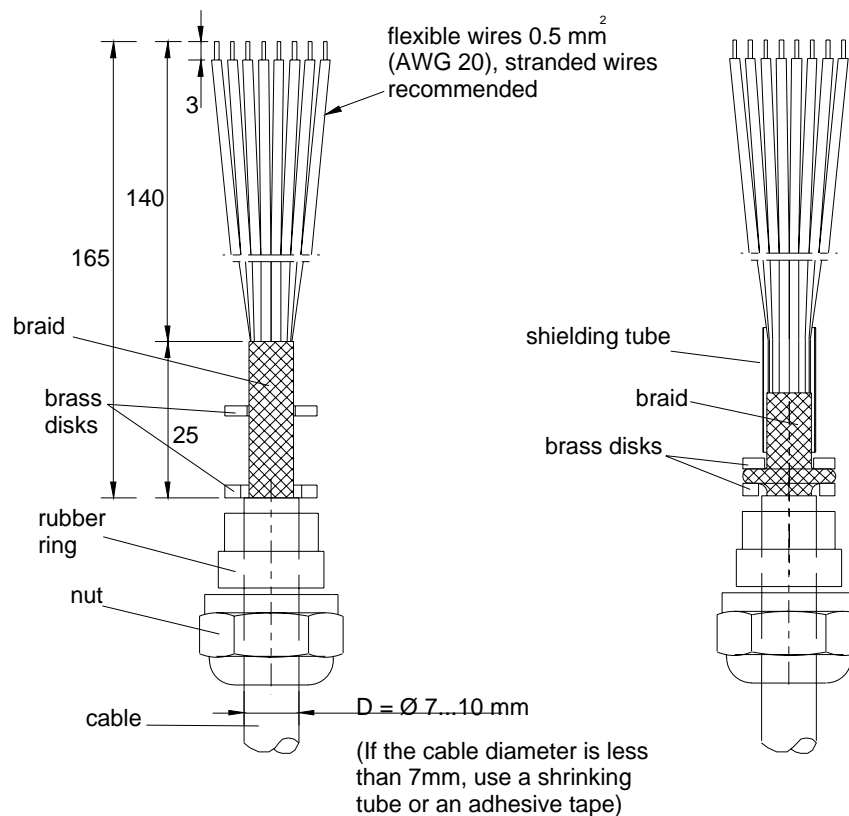
During installation the sensor head must not be unsoldered from and then resoldered to the main printed board of the transmitter. This procedure may interfere with the humidity calibration of the transmitter.

**3.2 Grounding**

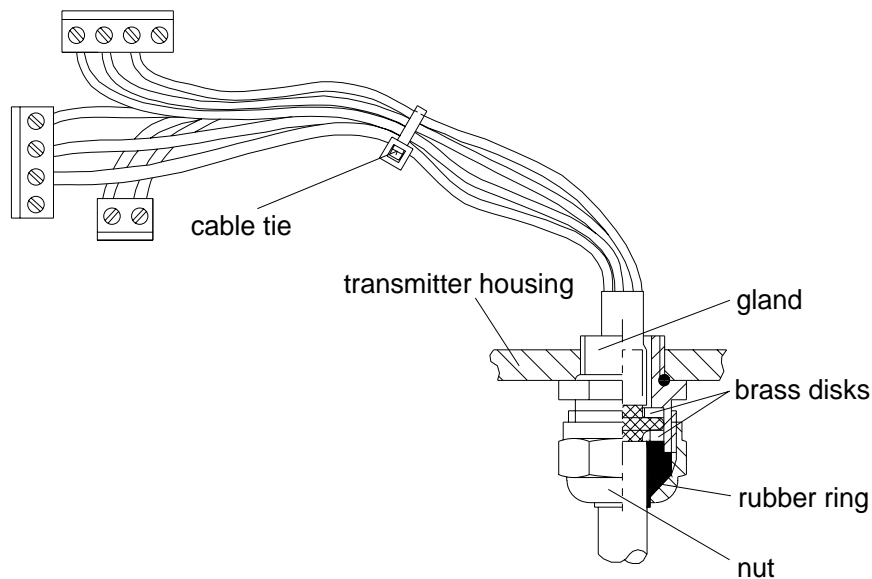
A single electrical cable with a screen and three to ten wires is recommended for power and analogue output/serial bus connections. The cable diameter should be 7...10 mm.

The screen of the electrical cable must be grounded properly to achieve best possible EMC performance. Recommended cable shield is done in the cable gland as shown below.

- remove the brass disks, rubber ring and nut from the transmitter housing
- strip 165 mm of the cable insulation, but leave 25 mm of the braid visible
- slip the nut and rubber ring over the cable insulation
- slip the brass disk that has the bigger hole in it over the braid so that it rests against the cable insulation
- slip the other brass disk over the wires to the middle of the braid



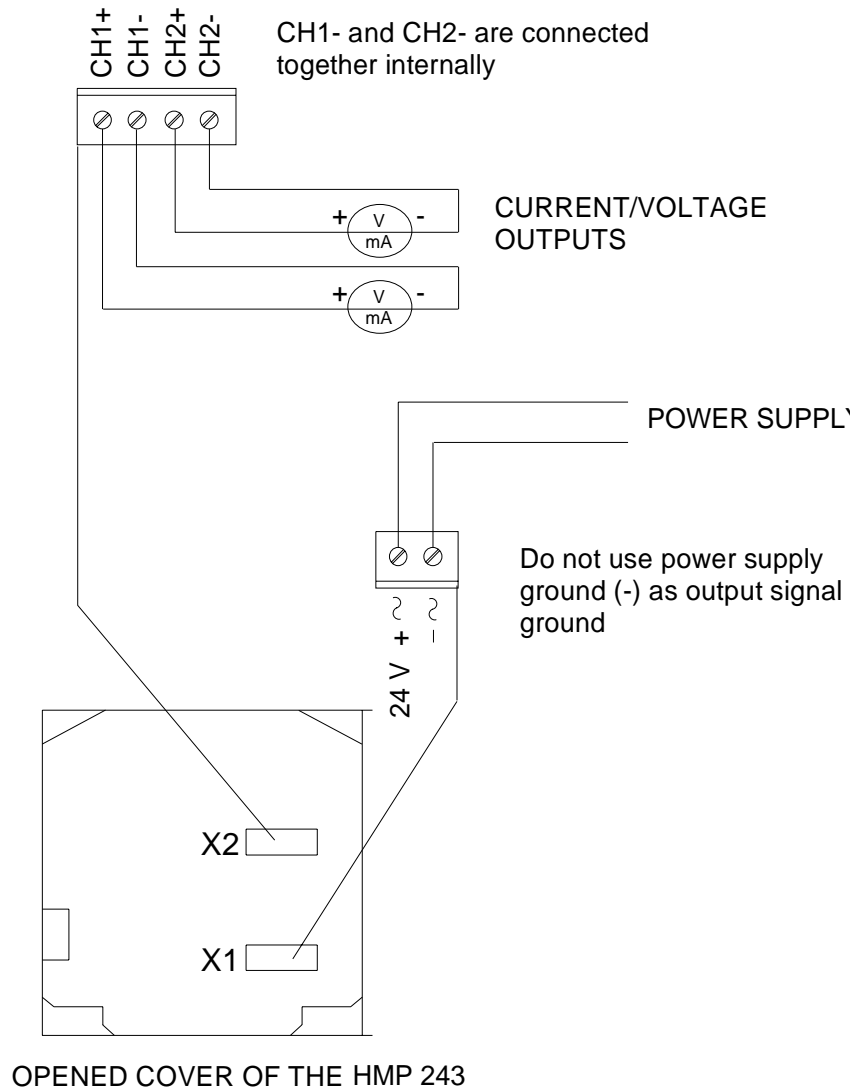
- push back the braid and press it between the two brass disks to achieve a full 360° grounding; the fold between the disks should have the same diameter as the brass disks
- secure the braid with a shielding tube
- insert the wires into the transmitter housing through the gland
- tighten the nut
- connect the wires into the screw terminals and fasten a cable tie around the wires



### NOTE

When the cable is grounded as explained on the previous page, the metallic parts of the sensor head, the shield of its cable, the transmitter housing and the shield of the signal cable to external system are all connected to each other. After this the whole system can be grounded from one point only. If the grounding is made via several points (sensor head, transmitter housing, signal cable), make sure that the different groundings are made to the same grounding potential. Otherwise harmful grounding currents may be generated. If you do the grounding via the transmitter housing, use one serrated lock washer between a mounting screw and the housing; the lock washer breaks the paint on the housing.

### 3.3 Electrical connections



**Figure 3.4 Electrical connections**

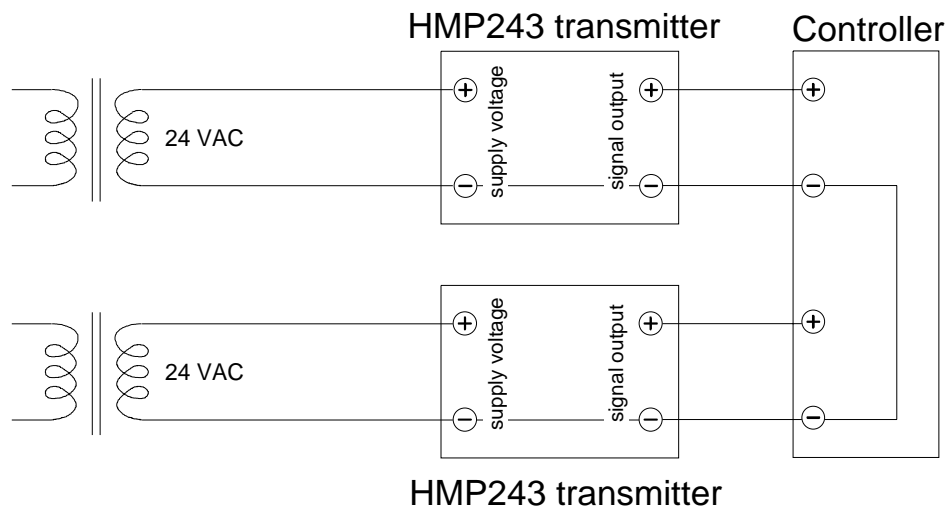
Power supply	24 VDC 24 VAC (see Chapter 3.3.1)
Output signals	0...20 mA 4...20 mA 0...1 V 0...5 V 0...10 V

Power supply ground (-) is connected to the housing with parallel connection of 15 nF capacitor and 300 k $\Omega$  resistor.

### 3.3.1 Connection to a 24 VAC supply

The HMP243 transmitter can also be connected to a 24 VAC supply without an external rectifier. However, when more than one transmitter is connected to one 24 VAC transformer, a common loop is formed and there is an increased risk of a short-circuit. To avoid this, always use separate floating supply for each transmitter (see Figure 3.5 A). However, if several transmitters have to share one transformer, the phase (~) must always be connected to + connector in each transmitter (see Figure Figure 3.5 B).

#### A) NO COMMON LOOP FORMED - RECOMMENDED



#### B) COMMON LOOP FORMED - NOT RECOMMENDED!

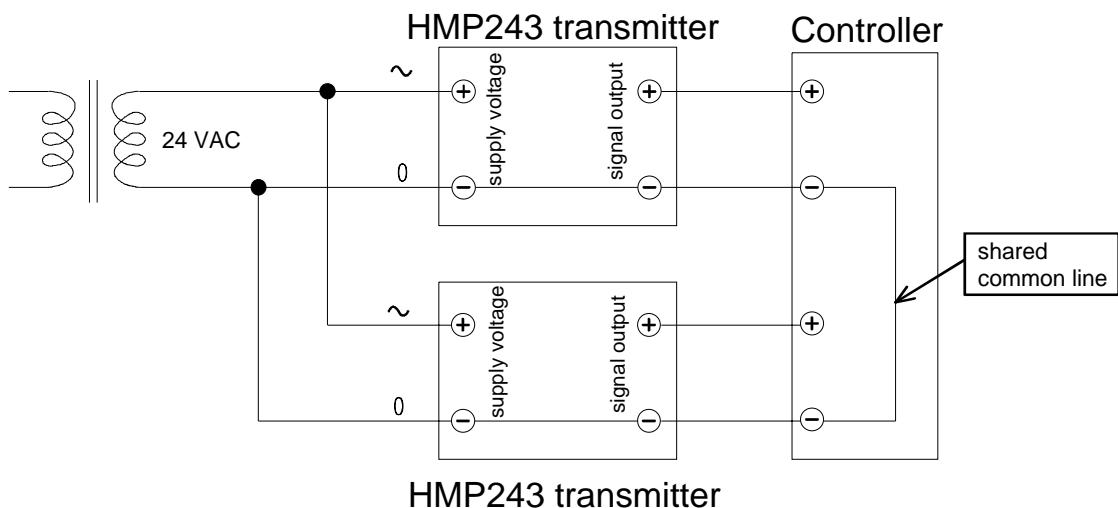


Figure 3.5 Connecting the transmitters to a 24 VAC supply

## 4. COMMISSIONING

When the HMP243 transmitter leaves the factory, its measurement ranges and output signals have already been scaled according to the order form completed by the customer. The unit is calibrated at the factory and ready to operate when the power is turned on. If you take into use active current, voltage or serial bus outputs, make these connections first; appendix 9 describes them in detail.

### NOTE

Make sure that the power is not turned on until cables have been connected to screw terminals!

In transmitters with display, the software version appears for a few seconds when the power is turned on. After this, measurement results appear automatically. Should an error message appear on the display, consult Appendix 6.

If your transmitter has a blank cover and the LED indicator inside the housing lights up, consult Appendix 6 for further information.

Appendix 7 contains information on how to determine the ranges for alarm outputs and alarm controls when an alarm output unit is used.

### 4.1 Changing the parameters

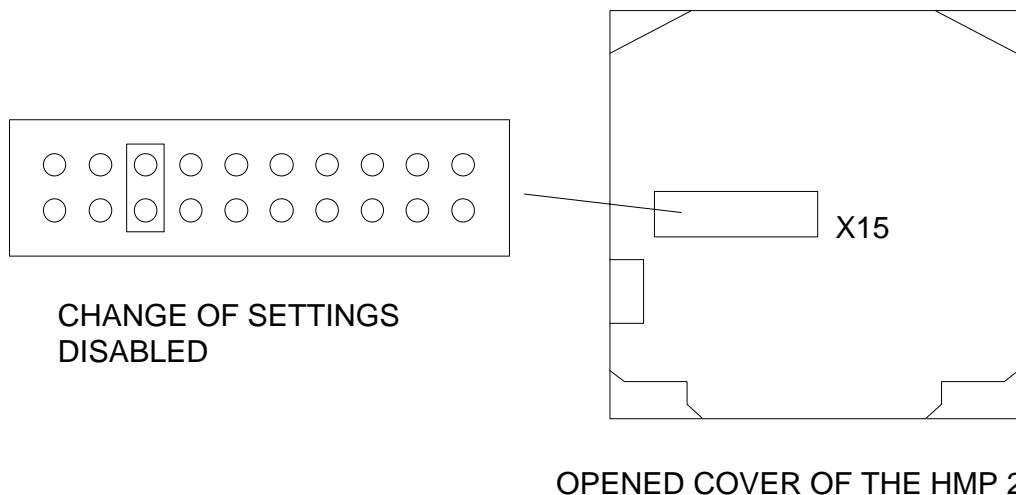
If necessary, the user can subsequently change the measurement units between metric and non-metric and select and scale the output signals with software functions. This is done through commands, either utilizing the menus on the local display or giving commands through the serial interface (see Appendices). Most often the commands are used to change the settings of the two analogue channels.

A limited range of commands can be given with the three press switches (up, down, enter) inside the transmitter housing. There are four LEDs to indicate the commands given with the up and down switches. All HMP243 units incorporate these switches and LED indicators. LED commands can be used to calibrate the transmitters (both humidity and temperature) or to calibrate the analogue outputs.

If you need to change some functions, read the following chapters carefully.

### 4.2 Security lock jumper

Before the settings can be changed, the security lock jumper in connector X15 must be removed (see Figure 4.1). The security lock jumper makes it impossible to change the transmitter settings by mistake.



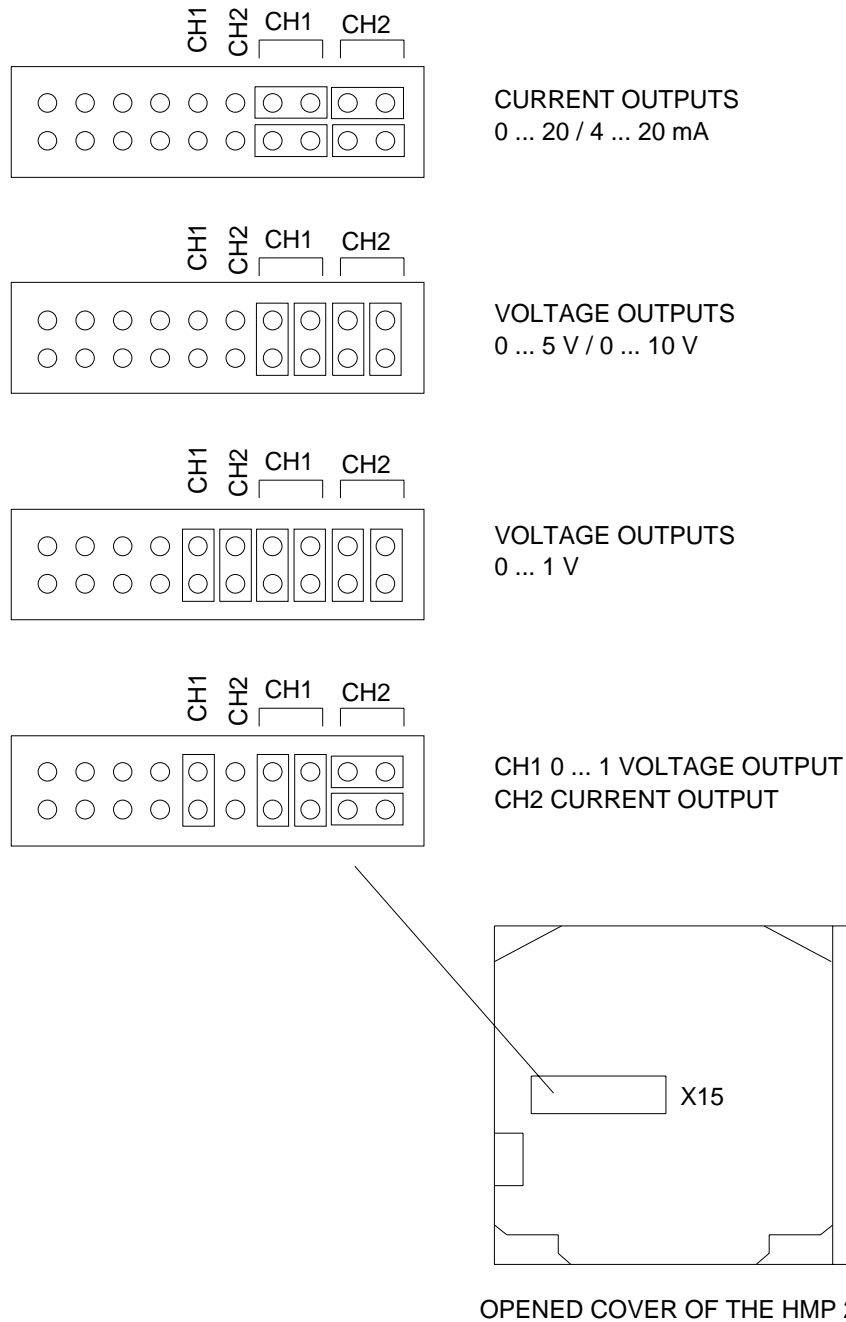
**Figure 4.1 Location of the security lock jumper**

When the security lock jumper is connected, some commands are not available (see Chapter 5).

Should the application require variables that are not included in the configuration of the transmitter, the user is invited to contact Vaisala or a Vaisala representative.

### 4.3 Selecting the analogue outputs

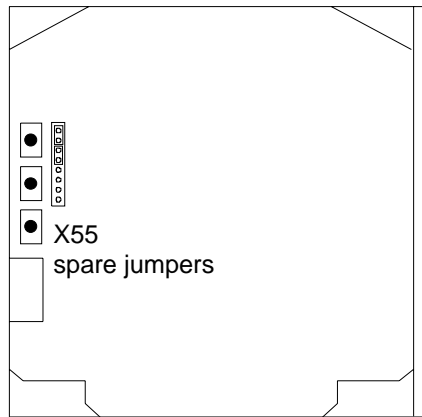
The HMP243 transmitter can be ordered ready with the current or voltage outputs required. If the outputs need to be changed, move the jumpers in connector X15 into positions as shown in Figure 4.2.



**Figure 4.2** Selecting the analogue outputs with jumpers

The software has to be informed which outputs are in use. This is done either through the serial interface or the menus on a local display. The serial command is `AMODE` and the display/keypad command "Mode ⇒ Analog outputs ⇒ Mode" (see Chapter 5). For the scaling of the outputs, see serial command `ASCL` and the display command "Mode ⇒ Analog outputs ⇒ Scale".

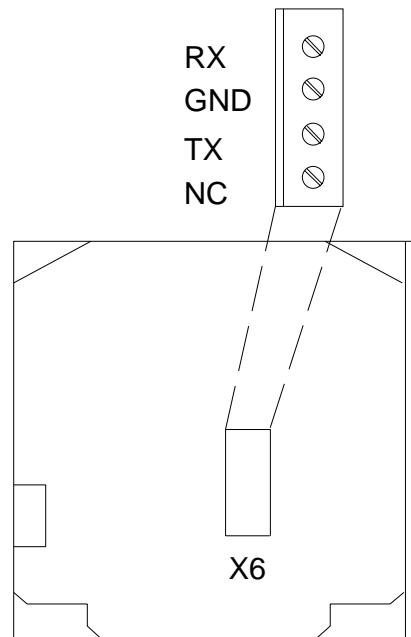
All the jumpers are used only with the 0...1 V outputs. When other outputs are in use, the spare jumpers are kept in connector X55.



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**Figure 4.3 Spare jumpers**

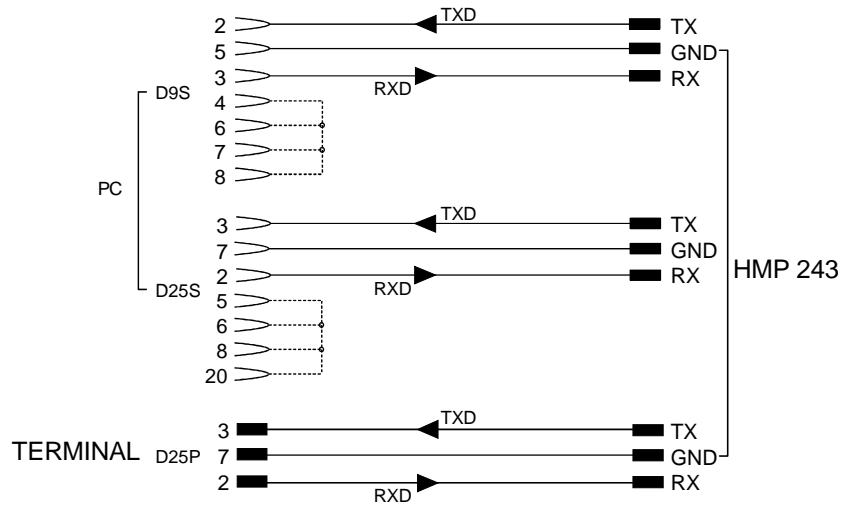
#### 4.4 Connecting the RS 232C serial bus



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**Figure 4.4 Serial bus connections**

To connect a PC to the HMP243 transmitter via the RS 232C serial bus, one of the following cables is required. The type of the cable depends on the terminal and the connector type.



**Figure 4.5 Connection of cables**

When the serial bus has been connected between the PC and the transmitter, the PC is switched on. When using a PC, a terminal emulation programme (e.g. Procomm Plus, Datastorm or Windows terminal) is started.

The factory settings for data transfer are:

- 4800 baud
- even parity
- 7 data bits
- 1 stop bit
- full duplex

## NOTE

When the serial bus settings are changed, the transmitter has to be reset before the new settings become effective.

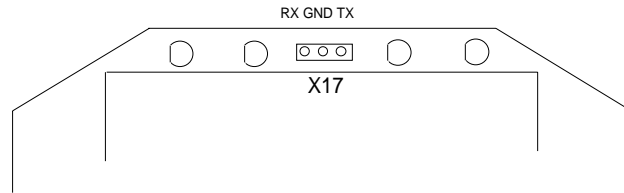
The processor does not allow the following combinations:

- no parity, 7 data bits, 1 stop bit: if this combination is given the HMP243 programme will change the number of stop bits to 2
- even or odd parity, 8 data bits, 2 stop bits: if this combination is given the programme changes the number of stop bits to 1

Refer to the manuals of the PC and the terminal emulation programme when giving serial settings.

The RS 232C screw terminal cannot be used if an RS 485/422 serial module or a current loop module is used. See Appendices 2 and 3 on how to install and operate these modules.

In calibrating or changing the settings of the transmitter it can be more convenient to use the connector X17, if connector X6 is already in use. This connector, however, transfers only RS 232C signals. If an RS 485/422 serial port module or a current loop module has been installed, it has to be removed before communicating through the X17 connector.



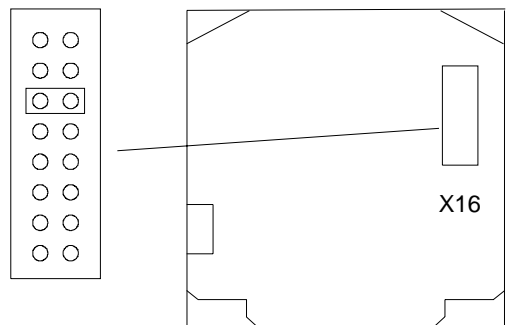
**Figure 4.6** Location and connections of connector X17

**NOTE**

Some PC computers can generate interferences to the measured humidity and temperature values if the transmitter and the PC are connected to different mains outlets. To minimize the possibility of these interferences, always use the same mains outlet (same phase of the mains electricity) for the PC and the power supply of HMP243. This is especially the case when using the serial line connector X17. The serial line connector X6 is more immune to these interferences than connector X17.

**4.4.1 Reverting to factory settings of the serial port**

If the serial port settings are not known, no commands can be given via the serial interface. The settings can be reverted to the factory settings by inserting a jumper in connector X16. The jumper must be inserted when the power is on!



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**Figure 4.7** Forcing the serial port settings back to factory settings

When the jumper is inserted the serial line factory settings become valid, but only temporarily. **The transmitter must be given new settings; otherwise the transmitter uses the old, unknown settings after power-up.** When the new settings have been given, the transmitter must be reset. The jumper must be removed before the transmitter is reset; if the jumper is in place when power is turned on, the transmitter does not work.

After jumper insertion the transmitter is in STOP mode, ready to receive commands.

The same method is used when the transmitter is in POLL mode and the user has forgotten its address.

**CAUTION**

Inserting a jumper in any other place in connector X16 voids the guarantee of the transmitter.

## 5. COMMANDS

As the HMP243 transmitter is a microprocessor based device, its configuration can be set to correspond to the specific needs of the user. This is done through commands, either by utilizing the menus on the local display or by giving commands through the serial interface (see Appendix 1). Most often the commands are used to change the settings of the two analogue channels.

A limited range of commands can be given by using the three press switches - up, down and enter - inside the transmitter housing. Four LEDs indicate the command given with the up and down switches. LED commands can be used to calibrate the transmitter (both humidity and temperature) or to calibrate the analogue outputs.

A full range of commands can be given through the display/keypad or through the RS 232C serial bus. The commands can be used e.g. to select and scale the outputs, to calibrate the humidity and temperature channels as well as the analogue outputs and to set the serial interface.

### 5.1 Commands and security lock jumper

In order to prevent any tampering with the transmitter settings, the transmitter cannot be calibrated, the analogue outputs set or the analogue output quantities selected or scaled unless the security lock jumper has been disconnected. The commands involved are:

- all LED commands
- display/keypad commands:

Cali	⇒	RH	T	Ta	
				Analog outputs	
Mode	⇒	Analog outputs	⇒	Mode	
				Scale	
More	⇒	More	⇒	Frost	
More	⇒	Frost			
- serial commands:  
CRH, CT, CTA, FCRH, ACAL; AMODE, ASEL, ASCL, FROST, FILT

In the following, the description of these functions is preceded with a reminder of the security lock jumper:

**Disconnect the security lock jumper!**

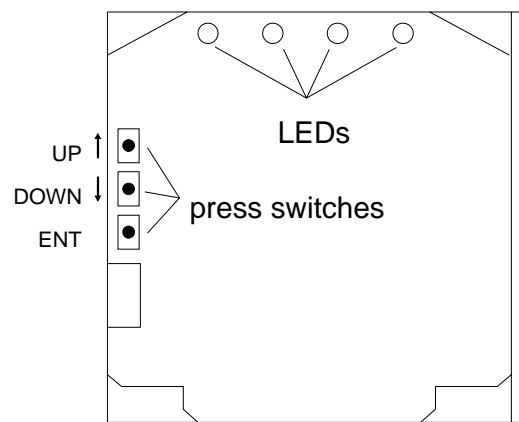
## 5.2 LED commands

### NOTE

If the transmitter has a display/keypad cover, the LED commands cannot be used.

LED commands can be used to operate the transmitter in the field. These commands can be used in humidity and temperature calibration and calibration of the analogue outputs.

Open the housing and press any one of the three press switches. The LEDs will light up for 2 - 3 seconds.



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**Figure 5.1 Location of press switches and LEDs**

Use the up and down switches (marked with arrows on the printed board) to find the desired command code and acknowledge it with the ENT switch. The command codes are (● = lit, ○ = dark):

- |      |     |   |
|------|-----|---|
| ○○○○ | (0) | return to normal state                              |
| ○○○● | (1) | relative humidity calibration                       |
| ○○●○ | (2) | temperature calibration of the humidity sensor head |
| ○●○○ | (3) | temperature calibration of the T sensor head        |
| ○○●● | (4) | calibration of analogue outputs                     |
| ●○○○ | (8) | relative humidity calibration after sensor change   |

## 5.3 Display/keypad commands


### 5.3.1 Display mode

In the display mode the transmitter outputs measurements on the display; different quantities can be scrolled with arrow keys. The first line is scrolled with button  $\sigma$  and the second line with button  $\tau$ ; all selections are stored with ENTER. The selected quantities appear on the display also after power failure. After reset the transmitter is always in the display mode.

The display also shows error messages and alarms if they occur.

### 5.3.2 Command mode

Press the CL key to enter the command mode. The first display is the main menu:



```
Mode Seri Unit
Cali Addr More
```

The commands can be scrolled with the arrow keys. The currently active command flashes; a command is selected with the ENT key. When a menu is displayed, either the first command or the currently valid setting flashes. The CL key takes the transmitter back to the display mode.

### 5.3.3 Entering numbers

When numbers need to be entered into the transmitter programme (e.g. when scaling or setting the analogue outputs, in calibration or when giving the transmitter an address), the field is either empty or the currently valid figure is displayed. Any previously given value is deleted with the CL key.

When the field is empty, a cursor blinks on the right side of the display. Pressing the arrow keys makes either a blank ' ', a comma ',', a dash '-', a full stop '.' or a number from '0' to '9' appear on the display. The right character is selected with ENT; after that the number or numbers move left one step. Entering numbers is ended with selecting a blank ' ' and pressing ENT. The last character entered can be deleted with CL. If CL or ENT key is pressed when the field is empty, the programme returns to the previous display.

With some commands (e.g. calibration) the figures are changed using the arrow keys. When an arrow key is pressed continuously for a while, the numbers start changing at an increasing rate.

### 5.3.4 Analogue output commands

#### 5.3.4.1 Selecting the output (mA/V)

**Disconnect the security lock jumper!**

- Select Mode in the main menu and Analog outputs in the Mode menu:

```
Mode ( mA / V )
Scale
```

- Select Mode ( mA / V ). The current settings for channel 1 are displayed:

```
Ch1 mA      20.00
    0.00
```

- If the settings are correct, press ENT.
- If the settings need to be changed, press CL:
  - the quantity (mA/V) starts flashing; it can be changed with the arrow keys and acknowledged with the ENT key
  - the lower limit starts flashing
  - acknowledge the lower limit with ENT or start changing it by pressing CL; a new lower limit is given one character at a time with the arrow keys
  - the upper limit starts flashing
- acknowledge the upper limit with ENT or start changing it by pressing CL; a new upper limit is given one character at a time with the arrow keys

When channel 1 has been set, the programme goes on to channel 2; the procedure is the same as with channel 1.

```
Ch2 mA      20.00
    4.00
```

### NOTE

The analogue output jumpers must also be set to right places (see Figure 4.2).

### 5.3.4.2 Selecting and scaling the analogue output quantities

**Disconnect the security lock jumper!**

- Select Mode in the main menu and Analog outputs in the Mode menu:

```
Mode ( mA / V )  
Scale
```

- Select Scale. The quantity and scaling for channel 1 are displayed:

```
Ch1 RH %RH  
0.00 100.00
```

- If the settings are correct, press ENT.
- If the settings need to be changed, press CL:
  - the quantity (RH, T, Td, dT, x, a, Tw) starts flashing; it can be changed with the arrow keys and acknowledged with the ENT key
  - the lower limit starts flashing
  - acknowledge the lower limit with ENT or start changing it by pressing CL; a new lower limit is given with the arrow keys
  - the upper limit starts flashing
  - acknowledge the upper limit with ENT or start changing it by pressing CL; a new upper limit is given with the arrow keys
- When channel 1 has been set, the programme goes on to channel 2; the procedure is the same as with channel 1.

```
Ch2 T °C  
-40.00 160.00
```

Please note that the available selections are affected by the choice of output parameters. Also make sure that the temperature measuring ranges are not exceeded.

### 5.3.5 Output via the serial bus

#### 5.3.5.1 Turning the serial interface echo ON/OFF

- Select More in the main menu, select More in the More menu and select Echo in the second More menu.

```
Echo on
Echo off
```

- Use the arrow keys to select the right alternative and press ENT.

#### 5.3.5.2 Serial bus settings

- Select Seri in the main menu; the currently valid serial interface settings are displayed:

```
Baud: 4800 Data: 1
Pari: even Stop: 1
```

- If the settings are correct, press ENT; the programme returns to the display mode.
- If the settings need to be changed, press CL:

```
Baud Pari Stop
Data Duplex
```

- Select the parameter to be changed with the arrow keys and ENT key.  
Selecting baud rate:

```
300 600 1200
2400 4800 9600
```

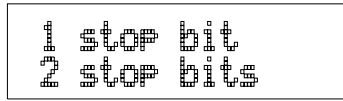
Selecting parity:

```
None Even Odd
```

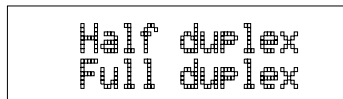
Selecting data bits:

```
? data bits
8 data bits
```

Selecting stop bits:



Full duplex/half duplex:



The processor does not allow the following combinations:

- no parity, 7 data bits, 1 stop bit: if this combination is given the HMP243 programme will change the number of stop bits to 2
- even or odd parity, 8 data bits, 2 stop bits: if this combination is given the programme changes the number of stop bits to 1

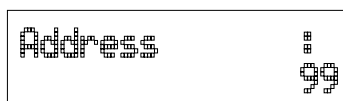
### NOTE

The serial bus settings become effective only after reset.

#### 5.3.5.3 Setting the transmitter address

Address is used when more than one transmitter is connected to one serial bus; this way, it is possible to communicate with one transmitter at a time.

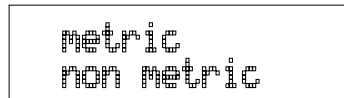
- Select Addr in the main menu; the following is displayed:



- Pressing ENT returns the programme to the main menu.
- Pressing CL deletes the old address; enter the new address with the arrow keys.

### 5.3.5.4 Selecting the output units

- Select Unit in the main menu:



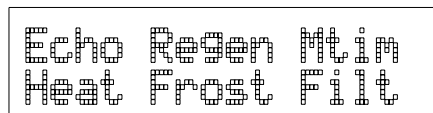
- Use the arrow keys to select the right alternative and press ENT.

	metric	non- metric
RH	%RH	%RH
T	°C	°F
Td	°C	°F
dT	°C	°F
a	g/m <sup>3</sup>	gr/ft <sup>3</sup>
x	g/kg	gr/lb
Tw	°C	°F

### 5.3.5.5 Selecting the calculation mode

**Disconnect the security lock jumper!**

- Select More and then again More in the second menu:



- Select Frost and then the desired alternative with the arrow keys; FROST ON (default) for frostpoint and FROST OFF for dewpoint calculation at dewpoint temperatures below 0 °C.

### 5.3.6 Output modes

The output modes only affect output through the serial interface: the transmitter accepts all display and LED commands irrespective of which serial output mode it is in. The HMP243 transmitter has three serial output modes: RUN, STOP and POLL.

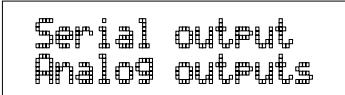
In the RUN mode the transmitter outputs measurements automatically through the serial interface to a PC or a peripheral. The only command that can be given through the serial interface is S (stop), which ends the RUN mode.

In the STOP mode serial commands are given to the transmitter. Measurements are then output only by entering command SEND.

The POLL mode is used when more than one transmitter is connected to the same serial bus; a single transmitter can be addressed and communicated with. When the connection to a given transmitter is opened in the POLL mode, the transmitter goes into STOP mode and can then receive commands normally. Closing the connection returns the transmitter to POLL mode. In POLL mode, the transmitter outputs measurement only when requested (command SEND aa). If the user has forgotten the address of the transmitter and the transmitter does not have a display, the transmitter has to be reverted to the factory settings (see Chapter 4.4.1). If the transmitter has a display, the settings can be checked through it.

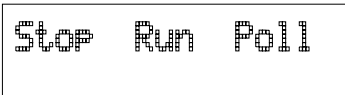
### 5.3.6.1 Setting the serial interface operation mode

- Select Mode in the main menu; the following is displayed:



```
Serial output
Analog outputs
```

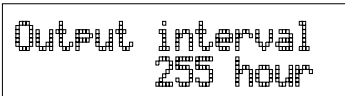
- Select Serial output:



```
Stop  Run  Poll
```

- The currently valid setting flashes. Select the desired mode with the arrow keys and press ENT. After this the programme returns to the Mode Menu.
- When Run mode is selected, the currently valid output interval is displayed:

The output interval setting can be changed as follows:



```
Output interval
255 hour
```

- press CL
- the number starts flashing
- if the interval needs to be changed, press CL again and enter the new interval; otherwise press ENT
- the unit (seconds or hours) starts flashing
- the unit can be changed with the arrow keys and acknowledged with ENT
- after this the programme returns to Mode menu

### 5.3.7 Others

#### 5.3.7.1 Setting the averaging time

**Disconnect the security lock jumper!**

With command FILT the transmitter can be given the averaging time during which the individual measurement samples are integrated to get an averaged reading. The time can be set in seconds within the range of 0 - 1024 (0 = no averaging time).

- Select More in the main menu, select More in the More menu and select Filtr in the second More menu:

```
Echo Regen Mtim
Heat Frost Filtr
```

- Pressing ENT returns the programme to the main menu without changing the filtration time.
- If the filtration time needs to be changed, press CL; enter the new filtration time with the arrow keys.

```
Filter ( s ) :
                100
```

#### 5.3.7.2 Setting the pressure for mixing ratio and wet bulb calculations

The atmospheric pressure has an effect on mixing ratio and wet bulb. Accurate calculations can be achieved only when the ambient pressure is taken into consideration.

- Select More in the main menu:

```
Pressure Date
Time Test More
```

- Select Pressure:

```
Pressure :
                1013.25
```

- Pressing ENT returns the programme to the main menu without changing the pressure reading.
- If the pressure needs to be changed, press CL; enter the new pressure with the arrow keys

### 5.3.7.3 Setting the date

- Select More in the main menu; select Date in the More menu:



Date: 1992-06-17

- If the date is correct, acknowledge it by pressing ENT; this takes the programme back to the More menu.
- If the date needs to be changed, press CL.
  - first the centuries (19) start flashing; use the arrow keys to change them and press ENT
  - the years (92) start flashing; use the arrow keys to change them and press ENT
  - the months (06) start flashing; use the arrow keys to change them and press ENT
  - the days (17) start flashing; use the arrow keys to change them and press ENT

### 5.3.7.4 Setting the time

- Select More in the main menu; select Time in the More menu:



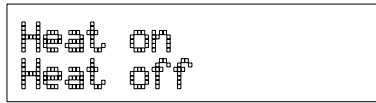
Time: 14:25:32

- If the time is correct, acknowledge it by pressing ENT; this takes the programme back to the More menu.
- If the time needs to be changed, press CL.
  - first the hours (14) start flashing; use the arrow keys to change them and press ENT
  - the minutes (25) start flashing; use the arrow keys to change them and press ENT
  - the seconds (32) start flashing; use the arrow keys to change them and press ENT

### NOTE

The transmitter does not have a real-time clock with backup battery. This means that the date and time settings are not permanent.

### 5.3.7.5 Heat on / heat off command



The status of this command should always be HEAT ON, and it should not be altered. It is meant for service purposes only.

## 5.4 Serial commands

All available serial commands are described in more detail in Appendix 1. The following chapters include only the most commonly used command sequences. See Chapter 4.4 for connecting the HMP243 transmitter to a serial bus.

Pressing ESC always interrupts any serial command being given. In the commands <cr> stands for carriage return.

### 5.4.1 Analogue output commands

#### 5.4.1.1 Setting the analogue outputs

**Disconnect the security lock jumper!**

**AMODE a bb.bbb cc.ccc d ee.eee ff.fff <cr>**

a = channel 1: U = voltage output  
                  I = current output  
bb.bbb = lower limit of channel 1  
cc.ccc = upper limit of channel 1  
d = channel 2: U = voltage output  
                  I = current output  
ee.eee = lower limit of channel 2  
ff.fff = upper limit of channel 2

The bb.bbb, cc.ccc, ee.eee and ff.fff parameters are entered in volts or milliamperes.

Example: lower limit of channel 1 is 0 V and upper limit 1 V (U 0 1)  
          lower limit of channel 2 is 2 V and upper limit 10 V (U 2 10)

```
>AMODE U 0 1 U 2 10 <cr>
Ch1 : 0.000 ... 1.000 V
Ch2 : 2.000 ... 10.000 V
```

### 5.4.1.2 Selecting and scaling the analogue output quantities

**Disconnect the security lock jumper!**

**ASEL xxx yyy <cr>**

xxx = channel 1's quantity  
yyy = channel 2's quantity (RH, T, Td, dT, Abs, Mix or Tw)

Example: RH selected on channel 1 and temperature on channel 2

```
>ASEL RH T <cr>
Ch1 (RH) lo 0.000 %RH? <cr>
Ch1 (RH) hi 100.000 %RH ? <cr>
Ch2 (T ) lo -40.000 'C ? <cr>
Ch2 (T ) hi +160.000 'C ? <cr>
```

### 5.4.1.3 Scaling the analogue outputs

**Disconnect the security lock jumper!**

**ASCL <cr>**

Example: relative humidity is scaled in the range 0...100 %RH and temperature in the range -40...+160 °C

```
>ASCL <cr>
Ch1 (RH) lo 0.000 %RH? <cr>
Ch1 (RH) hi 100.000 %RH ? <cr>
Ch2 (T ) lo 0.000 'C ? -40 <cr>
Ch2 (T ) hi 100.000 'C ? 160 <cr>
```

## 5.4.2 Output via the serial bus

### 5.4.2.1 Starting the measurement output

**R <cr>**

Starts output of measurements to the peripheral devices (RUN mode); the only command that can be used is S (stop). The output mode can be changed with command FORM (see Appendix 1).

### 5.4.2.2 Stopping the measurement output

**S <cr>**

Ends the RUN mode; after this command all other commands are available.

### 5.4.2.3 Outputting the reading once

**SEND <cr> in STOP mode**

or

**SEND aa <cr> in POLL mode**

aa = address of the transmitter when more than one transmitter is connected to a serial bus (0..99)

The output format depends on which parameters the transmitter can output.

Output types:

```
"Td=999.9 'C", <cr><lf>
"RH=999.9 %RH T=999.9 'C Td=9999.9 'C", <cr><lf>
"Td=999.9 x=999.9 g/kg", <cr><lf>
"RH=999.9 %RH T=999.9 'C Td=9999.9 'C a=9999.9 g/m3
x=9999.9 g/kg Tw=999.9 'C", <cr><lf>
```

The output mode can be changed with command FORM (see Appendix 1).

### 5.4.2.4 Setting the output interval for the RUN mode

**INTV xxx yyy <cr>**

xxx = output interval (0..255)  
(0 = no pause between outputs)  
yyy = unit (s, min or h)

Example: output interval is changed into 10 minutes

```
>INTV 10 min <cr>
Output intrv. : 10 min
```

### 5.4.2.5 Serial bus settings

**SERI b p d s x <cr>**

b = bauds (300, 600, 1200, 2400, 4800, 9600)  
p = parity (n = none, e = even, o = odd)  
d = data bits (7 or 8)  
s = stop bits (1 or 2)  
x = duplex (H = half, F = full)

The settings can be changed one parameter at a time or all parameters at once:



nnn = averaging time (0 - 1024 seconds)

This command is used to set and inspect the averaging time during which the individual measurement samples are integrated to get an averaged reading. The time can be set in seconds within the range of 0 - 1024 (0 = no averaging time).

For example:

```
>FILT
Filter (S): 0 ? 1024
>

>FILT 100 <cr>
Filter (S): 100
>
```

#### 5.4.2.8 Setting the transmitter address

**ADDR aa <cr>**

aa = address (0...99)

Example: transmitter is given address 99

```
>ADDR <cr>
Address : 2 ? 99 <cr>
```

#### 5.4.2.9 Setting the calculation mode

**Disconnect the security lock jumper!**

**FROST ON/OFF <cr>**

This command is used to select whether the transmitter calculates the frostpoint (default) or the dewpoint reading at dewpoint temperatures below 0 °C. Select FROST ON for frostpoint and FROST OFF for dewpoint calculations. For example:

```
>Frost <cr>
Frost : ON
>Frost off
Frost : OFF
>Frost on
Frost : on
>
```

#### 5.4.2.10 Resetting the transmitter

**RESET <cr>**

### 5.4.3 Operating the transmitter via the serial bus

#### 5.4.3.1 Setting the serial interface

```
SMODE xxxx<cr>
```

xxxx = STOP, RUN or POLL

In STOP mode: measurements output only by command, all commands can be used

In RUN mode: outputting automatically, only command S can be used

In POLL mode: measurements output only with command SEND. When in POLL mode, the output mode is changed as follows:

```
OPEN aa <cr>  
SMODE xxxx<cr>
```

aa = address of the transmitter

xxxx = STOP, RUN or POLL

The OPEN command sets the bus temporarily in STOP mode so that the SMODE command can be given.

Example:

```
>SMODE STOP <cr>          setting STOP mode  
Serial mode      : STOP
```

### 5.4.3.2 OPEN & CLOSE

**OPEN nn <cr>**

nn = address of the transmitter (0...99)

**CLOSE <cr>**

In STOP mode: command OPEN has no effect, CLOSE sets the transmitter in POLL mode

In POLL mode: command OPEN sets the transmitter temporarily in STOP mode, command CLOSE returns the instrument to POLL mode

Example: relative humidity calibration is performed at transmitter 2 which is in POLL mode

```
>OPEN 2 <cr>      opens the line to transmitter 2
>CRH <cr>         calibration started
...
>CLOSE <cr>       line closed
```

## 6. CALIBRATION

The HMP243 transmitter has been fully calibrated at the factory so there should be no immediate need for recalibration. The transmitter should be calibrated only if there is reason to believe that the adjustments of the transmitter have changed. The adjustments of the temperature measurement channel and the analogue outputs are particularly stable; in normal circumstances there is no need to recalibrate them. Humidity calibration should be performed at least once a year.

### NOTE

During the calibration procedure, the HMP243 is like any standard RH transmitter and is therefore calibrated against known RH values. The warming function is not active and corrective calculations are not made. It is therefore essential that the sensor head is allowed enough time to stabilize to the ambient conditions in order to ensure the highest possible accuracy in calibration.

Either a one-point or a two-point calibration is possible. The security lock jumper has to be disconnected at the moment of taking the transmitter to the calibration room in order to make sure that the temperature of the sensor head stabilizes correctly and the warming function does not interfere with the stabilization. The stabilization of the humidity sensor head can be monitored by the RH reading or by the T reading: the T reading is actually that of the humidity sensor head stabilizing to the ambient temperature.

When the security lock jumper is disconnected, the serial port and analogue outputs show the RH reading and T reading measured directly from the humidity sensor head (instead of the calculated values). This means that the readings (RH, T, a, x, dT or Tw) are erroneous until the humidity sensor head has stabilized to the ambient temperature; the Td reading is correct also during stabilization. It is recommended that the transmitter is disconnected from the process during the calibration.

### 6.1 Humidity calibration

The calibration of the HMP243 transmitter can be checked with a calibrated Vaisala humidity meter, e.g. the HM34. The HMI38 humidity data processor with an appropriate reference connection cable can be used as a field calibrator. A two-point calibration can be done with the HMK15 or the HMK13B calibrator, or the instrument can be sent to Vaisala. We recommend recalibration at least once a year. The instruments must be recalibrated every time the HUMICAP<sup>®</sup>HC sensor is changed.

A  $\varnothing$  13.5 mm adapter must be used when calibrating with the HMK13B calibrator. The adapter (part no. 16611) can be ordered from Vaisala or Vaisala representatives.

Calibration can be performed by giving the commands with the press switches inside the housing (see Chapter 5.2), through the serial bus (see Chapter 5.4) or through the menus on the local display (see Chapter 5.3).

When LED commands are used and when the two analogue channels do not output either relative humidity and/or temperature, relative humidity is calibrated on channel 1 and temperature is calibrated on channel 2. The calibration ranges are 0...100 %RH and -20...+80 °C. When the transmitters are calibrated at two points, the points must be either 50 %RH or 50 °C apart from each other.

### NOTE

If the transmitter includes the re-gaining option, the sensor re-gaining must always be done before humidity calibration. Before starting the calibration make sure that the temperature of the composite sensor has come down to ambient temperature (see Appendix 7).

#### 6.1.1 One point humidity calibration

The HMI38 humidity data processor can be used as a one-point field calibrator. A two-point calibration with the HMI38 can also be done, provided that two separate humidity points with a difference of more than 50%RH between them are available. The HMI38 is connected to an HMP243 transmitter using an appropriate reference connection cable. The necessary correction factors are automatically stored in the HMP243 memory. Detailed calibration instructions are given in the HMI38 operating manual.

A manual one-point correction can also be done in the field against an accurate reference.

### NOTE

If the sensor has been changed, the calibration has to be done according to the instructions in Chapter 6.1.3.

### 6.1.1.1 With serial commands

- Make sure that the sensors of the transmitter and the reference instrument are close to each other. Allow enough time for the sensor heads to stabilize to the measurement conditions

**Disconnect the security lock jumper!**

- Give command CRH <cr>, enter the humidity value and press <cr>.

```
>CRH <cr>  
RH : xx.x Ref1 ? yy.y <cr>  
Press any key when ready...
```

- If you want to see how the sensor stabilizes to the reference humidity, enter c <cr> instead of the first reference:

```
RH : 11.9 Ref1 ? c <cr>  
RH : 11.5 Ref1 ? c <cr>  
RH : 11.5 Ref1 ? 11.3 <cr>  
Press any key when ready...
```

- Press any key and <cr> when the transmitter requests the second point value.

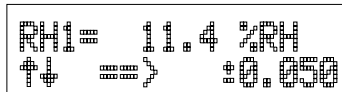
```
RH : yy.y Ref2 ? <cr>
```

### 6.1.1.2 With display / keypad commands

- Make sure that the sensors of the transmitter and the reference instrument are close to each other. Allow enough time for the sensor heads to stabilize to the measurement conditions

**Disconnect the security lock jumper!**

- Select Cali in the main menu and then RH cal; select Not changed and then one-point offset correction RH 1 point cal. Change the humidity reading with the arrow keys to correspond to the reference value and acknowledge it with ENT; pressing an arrow once changes the reading by 0.05 %RH.



```
RH= 11.4 %RH  
↑ ==> 0.050
```

### 6.1.1.3 With LED commands

- Make sure that the sensors of the transmitter and the reference instrument are close to each other. Allow enough time for the sensor heads to stabilize to the measurement conditions

**Disconnect the security lock jumper!**

- Connect an ammeter/voltmeter to the analogue outputs (connector X2); if the outputs are already connected e.g. to a process computer and you do not want to disconnect them, the current output can be measured at separate test points located next to connector X15 (see Chapter 7.1). Give command ○○○● (see Chapter 5.2). At the first calibration point the LED on the left flashes; adjust the humidity point (offset) with the arrow switches to the reference value. One push of a switch changes the output by 0.05 %RH; the change of the output voltage or current depends on the output scaling. Press ENT switch. The second LED from left starts flashing; press ENT again.

#### NOTE

If neither channel normally outputs the RH reading, during the calibration channel 1 outputs the RH reading 0...100%RH, corresponding to the current/voltage scale selected for this channel.

### 6.1.2 Two point humidity calibration

A two-point humidity calibration should be performed in stable conditions using saturated salt solutions as a reference. Read also the calibrator manual.

#### NOTE

If the sensor has been changed, the calibration has to be done according to the instructions in Chapter 6.1.3.

#### 6.1.2.1 With serial commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter.

**Disconnect the security lock jumper!**

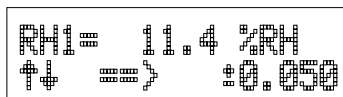
- Insert the sensor head into the measurement hole of the LiCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Give command CRH <cr>, enter the first point value and press <cr>.  
>CRH <cr>  
RH : xx.x Ref1 ? yy.y <cr>  
Press any key when ready...
- If you want to see how the sensor stabilizes to the humidity in the calibrator, enter c <cr>:  
RH : 11.9 Ref1 ? c <cr>  
RH : 11.5 Ref1 ? c <cr>  
RH : 11.5 Ref1 ? 11.3 <cr>  
Press any key when ready...
- Insert the sensor head into the measurement hole of the NaCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Press any key, enter the second point value and press <cr>.  
RH : xx.x Ref2 ? yy.y <cr>
- The stabilization of the sensor can be monitored by entering c<cr>.

### 6.1.2.2 With display / keypad commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter.

**Disconnect the security lock jumper!**

- Insert the sensor head into the measurement hole of the LiCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Select Cali in the main menu and then RH cal; select Not changed and then two-point calibration RH 2 point cal. Change the first point reading with the arrow keys to correspond to the reference humidity and press ENT; pressing an arrow once changes the reading by 0.05 %RH.



RH = 11.4 %RH  
→ 0.050

- Insert the sensor head into the measurement hole of the NaCl chamber.

- Wait at least 10 minutes for the reading to stabilize.
- If necessary, change the second point reading with arrow keys and press ENT.

### 6.1.2.3 With LED commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter.

**Disconnect the security lock jumper!**

- Insert the sensor head into the measurement hole of the LiCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Connect an ammeter/voltmeter to the analogue outputs (connector X2). Give command ○○○●. At the first calibration point the LED on the left flashes; adjust the first point (offset) with the arrow switches to the value given in the calibration table (Chapter 6.1.4) and press ENT switch.
- Insert the sensor head into the measurement hole of the NaCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Check that the reading corresponds within the desired accuracy to the reading in the calibration table (Chapter 6.1.4). If not, adjust the second point with the arrow switches to the correct value and press ENT. At the second calibration point the second LED from the left flashes.

### NOTE

If neither channel normally outputs the RH reading, during the calibration channel 1 outputs the RH reading 0...100 RH%, corresponding to the current/voltage scale selected.

### 6.1.3 Humidity calibration procedure after sensor change

Humidity calibration should be performed in stable conditions using saturated salt solutions as a reference. If the transmitter has the re-gaining option, the re-gaining has to be done manually before starting the calibration.

#### 6.1.3.1 With serial commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the sensor head.

**Disconnect the security lock jumper!**

- Insert the sensor head into the measurement hole of the LiCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Give command FCRH <cr>, enter the first point value and press <cr>:  

```
>FCRH <cr>
RH : xx.x Ref1 ? yy.y <cr>
Press any key when ready...
```
- The stabilization of the sensor to the reference humidity can be monitored by entering c <cr>:  

```
RH : 11.9 Ref1 ? c <cr>
RH : 11.5 Ref1 ? c <cr>
RH : 11.5 Ref1 ? 11.3 <cr>
Press any key when ready...
```
- Insert the sensor head into the measurement hole of the NaCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Press any key, enter the second point value and press <cr>.  

```
RH : xx.x Ref2 ? yy.y <cr>
```
- The stabilization of the sensor can be monitored by entering c <cr>.

#### 6.1.3.2 With display / keypad commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the sensor head.

**Disconnect the security lock jumper!**

- Insert the sensor head into the measurement hole of the LiCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Select Cali in the main menu and then RH cal; select Sensor changed. Change the first point reading with the arrow keys and press ENT.
- Insert the sensor head into the measurement hole of the NaCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- If necessary, change the second point reading with arrow keys and press ENT.

### 6.1.3.3 With LED commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the sensor head.

**Disconnect the security lock jumper!**

- Insert the sensor head into the measurement hole of the LiCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Connect an ammeter/voltmeter to the analogue outputs (connector X2). Give command ●○○○. At the first calibration point the LED on the left flashes; adjust the first point with the arrow switches to the value given in the calibration table (Chapter 6.1.4) and press ENT switch.
- Insert the sensor head into the measurement hole of the NaCl chamber.
- Wait at least 10 minutes for the reading to stabilize.
- Check that the reading corresponds within the desired accuracy to the reading of the calibration table (Chapter 6.1.4). If not, adjust the second point with the arrow switches to the correct value and press ENT. At the second calibration point the second LED from the left flashes.

### NOTE

If neither channel normally outputs the RH reading, during the calibration channel 1 outputs the RH reading 0...100%RH, corresponding to the current/voltage scale selected for this channel.

The basic capacitance of the new sensor may differ considerably from that of the previous one. Therefore the corresponding humidity reading of the transmitter may be below 0 %RH at the low or above 100 %RH at the high calibration point. However, the current/voltage reading of the analogue output shows only the minimum or maximum value of the selected current/voltage scale and the output value may not change even though the arrow switches are pressed several times. If this happens, press the up or down arrow switch continuously to bring the output back into the selected scale; this may take as long as half a minute.

### 6.1.4 Humidity calibration table

Temperature	°C	15	20	25	30	35
	°F	59	68	77	86	95
LiCl	%RH	*)	11.3	11.3	11.3	11.3
4...20 mA			5.81	5.81	5.81	5.81
0...20 mA			2.26	2.26	2.26	2.26
0...1 V			0.113	0.113	0.113	0.113
0...5 V			0.565	0.565	0.565	0.565
0...10 V			1.13	1.13	1.13	1.13
NaCl	%RH	75.6	75.5	75.3	75.1	74.9
4...20 mA		16.10	16.08	16.05	16.02	15.98
0...20 mA		15.12	15.10	15.06	15.02	14.98
0...1 V		0.756	0.755	0.753	0.751	0.749
0...5 V		3.780	3.775	3.765	3.755	3.745
0...10 V		7.56	7.55	7.53	7.51	7.49

**Table 1 Greenspan's calibration table**

\*) If the LiCl solution is used or stored at temperatures below +18 °C (+64 °F), its equilibrium humidity changes permanently.

## 6.2 Temperature calibration

The temperature channel has been calibrated at the factory and since it is very stable, calibration should be performed only when there is strong reason to believe that the adjustments have changed.

Temperature calibration should be done against some accurate temperature reference. It can be done either by using the press switches inside the housing, through the serial bus or the menus on the local display. Either a one-point offset correction or a two-point calibration are possible.

### NOTE

If neither channel normally outputs the T reading, during the calibration channel 2 outputs the T reading -20...+80°C, corresponding to the current/voltage scale selected for this channel.

## 6.2.1 One point offset calibration

### 6.2.1.1 With serial commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.

**Disconnect the security lock jumper!**

- Check the transmitter against the reference.
- After giving the correct temperature value (Ref1) and pressing <cr>, press any key and then <cr>.

### 6.2.1.2 With display / keypad commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.

**Disconnect the security lock jumper!**

- Check the transmitter against the reference.
- Select T 1 point cal (or Ta 1 point cal), change the reading to correspond to the reference and press ENT.

### 6.2.1.3 With LED commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.

**Disconnect the security lock jumper!**

- Check the transmitter against the reference.
- After adjusting the offset point and pressing ENT, the second LED from left flashes. Press ENT without changing the output value.

## 6.2.2 Two point temperature calibration

### 6.2.2.1 With serial commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.

**Disconnect the security lock jumper!**

- Check the transmitter against the reference.
- For the humidity sensor head: give command CT <cr>, enter the first point value and press <cr>:

```
>CT <cr>
T : xx.x Ref1 ? yy.y <cr>
Press any key when ready
```

- If you want to see how the sensor stabilizes to the reference temperature, enter c <cr> instead of the first reference:

```
T : 0.90 Ref1 ? c <cr>
T : 0.55 Ref1 ? c <cr>
T : 0.55 Ref1 ? 0.0 <cr>
Press any key when ready...
```

- For the additional temperature sensor head: give command CTA <cr>, enter the first point value and press <cr>:

```
>CTA<cr>
Ta: -20.07 Ref1 ? -20.08
Press any key when ready...
```

- Change the temperature and check the transmitter again against the reference.
- Check that the reading corresponds to the reading of the reference instrument. If not, adjust the second point.
- Press any key, enter the second point value and press <cr>.

```
T (or Ta) : xx.x Ref2 ? yy.y <cr>
```

- The stabilization of the sensor can be monitored by entering c <cr> instead of the reference value.

### 6.2.2.2 With display / keypad commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.

**Disconnect the security lock jumper!**

- Check the transmitter against the reference.
- Select Cali in the main menu and then T (Ta for the additional T sensor head); select two-point calibration T (or Ta) 2 point cal. Change the first point reading with the arrow keys and press ENT.
- Change the temperature and check the transmitter again against the reference.
- Check that the reading corresponds to the reading of the reference instrument. If not, adjust the second point.
- If necessary, change the second point reading with the arrow keys and press ENT.

### 6.2.2.3 With LED commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.

**Disconnect the security lock jumper!**

- Check the transmitter against the reference.
- Connect an ammeter/voltmeter to the analogue outputs (connector X2). Give command ○○●○ (or ○●○○ for the T sensor head). At the first calibration point the LED on the left flashes; adjust the first point (offset) with the arrow switches to the same reading with the reference and press ENT switch.
- Change the temperature and check the transmitter again against the reference.
- Check that the reading corresponds to the reading of the reference instrument. If not, adjust the second point.
- If necessary, adjust with the arrow switches to the correct value and press ENT. At the second calibration point the second LED from the left flashes.

### 6.3 Calibration of analogue outputs

The analogue outputs have been calibrated at the factory and since they are very stable, calibration should be performed only when there is reason to believe that their adjustments have changed.

#### 6.3.1 With serial commands

**Disconnect the security lock jumper!**

**ACAL <cr>**

The outputs on channels 1 and 2 are measured and the measured values (mA or V) entered as calibration coefficients.

Example: both channels have 0...10 V outputs (set with AMODE command); enter the voltages measured at the analogue outputs:

```
>ACAL <cr>
Ch1 U1 ( V ) ? 0.123 <cr>
Ch1 U2 ( V ) ? 9.98 <cr>
Ch2 U1 ( V ) ? 0.120 <cr>
Ch2 U2 ( V ) ? 9.98 <cr>
```

#### 6.3.2 With display / keypad commands

**Disconnect the security lock jumper!**

- Connect an ammeter/voltmeter to the output of channel 1, select Cali in the main menu and Analog outputs in the Cali menu. The following is displayed (the quantity can be either mA or V):

Ch1 I1 ( mA ) ?

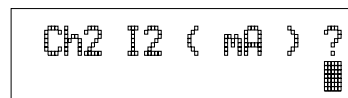
- Enter the measured lower end current/voltage on channel 1:

Ch1 I2 ( mA ) ?

- Enter the measured upper end current/voltage on channel 1:

Ch2 I1 ( mA ) ?

- Connect the meter to the output of channel 2 and enter the measured lower end current/voltage on channel 2:



- Enter the measured upper end current/voltage on channel 2.

### 6.3.3 With LED commands

If both the analogue outputs and humidity/temperature channels are calibrated, the analogue outputs should be calibrated first. This applies only when the calibrations are done with LED commands!

- connect an ammeter/voltmeter to the analogue outputs (connector X2)

**Disconnect the security lock jumper!**

- Give command ○○●●.
- the LED on the left flashes; set the low end of channel 1 with the arrow keys and press ENT
- the second LED from the left flashes; set the high end of channel 1 with the arrow keys and press ENT
- the LED on the left flashes; set the low end of channel 2 with the arrow keys and press ENT
- the second LED from the left flashes; set the high end of channel 2 with the arrow keys and press ENT

The analogue outputs are calibrated to ensure the correct scaling: for example, when the output is scaled to 4...20 mA, the low end of the scale is 4 mA and high end 20 mA exactly. However, when 0... 20 mA output is used, the output can not be adjusted to exactly 0 mA, but to 50  $\mu$ A. When 0...1 V, 0...5 V or 0...10 V output is in use, the output is adjusted to 50 mV. The following table summarizes the correct output values.

#### Summary of the correct output values:

	Output scale:				
	0...20 mA	4...20 mA	0...1 V	0...5 V	0...10 V
low end:	50 $\mu$ A	4 mA	50 mV	50 mV	50 mV
high end:	20 mA	20 mA	1 V	5 V	10 V

## 7. MAINTENANCE

### 7.1 Reference measurements

Reference measurements are necessary for the verification of whether the transmitter readings are within specifications. This way the user can check if the transmitter needs calibration or service. If the transmitter can be taken out of the process or the control system, perform the reference measurement in a laboratory with stable conditions.

The reference meter should preferably use the same technology as the instrument checked, i.e. transmitters as HMP243 which use a capacitive RH sensor, should be checked with instruments that also use capacitive RH sensors. This minimizes the risk of errors caused by different measurement techniques.

Whatever technique is used, make sure that the reference instrument is at the same ambient conditions as the checked instrument in order to avoid errors caused by temperature differences. The reference measurement should be made as close to the checked sensor as possible and the readings should be read at the same time, when possible.

When an RH reference meter is used, disconnect the security lock jumper and wait until the temperature of the probe has stabilized to the same temperature with the reference meter. When the security lock jumper is disconnected, the HMP243 is like any other RH transmitter outputting the RH and T values (for further details, see Chapter 6).

### 7.2 Self-diagnostics

The HMP243 transmitter goes through a self-diagnostics procedure when the power is switched on. If the procedure does not reveal any errors or faults, the transmitter starts operating normally. If errors or faults are found, first check whether the humidity and temperature sensors are damaged. If they are intact, send the transmitter to Vaisala or a Vaisala representative for repairs. The error messages the transmitter outputs are listed in Appendix 4.

If any errors occur during operation, the error messages are output on the local display if the transmitter displays measurements; if the menus are used, error messages are not output. The LEDs indicate errors at all times. During operation, however, the error messages are not output automatically through the serial interface. If there is any reason to doubt that there is something wrong with the transmitter, use command ERRS:

**ERRS <cr>**

If there are no error messages, only a prompt is displayed:

```
>ERRS <cr>  
>
```

When errors have occurred, the transmitter outputs an error code (see Appendix 4 for all error messages):

```
>ERRS <cr>
E40 f ( all ) out of range
>
```

### 7.3 Replacing the composite sensor

The humidity and temperature sensors (HUMICAP® H-sensor and Pt100) have been glued together. If one or both sensors are damaged, the whole composite sensor must be changed.

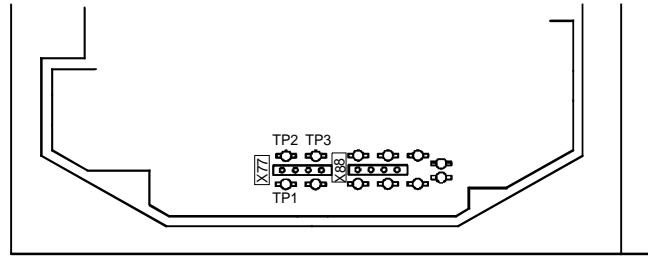
- Cut the pins of the Pt100 sensor at the top.
- Lift the humidity sensor gently.
- Loosen the pins of the Pt100 sensor by soldering.
- Remove the old tin from the connectors.
- Put a new humidity sensor in place.
- Bend the pins of the Pt100 sensor carefully into the connectors.
- Fasten the pins by soldering them with Multicore 96S-Flux 381.
- Make sure the solder joints are good and check that the pins are not short-circuited.
- Remove possible splashes from the solder joint with distilled water, but take care not to damage the humidity sensor.

After sensor change the humidity calibration must be done according to the instructions in Chapter 6.1.3.

Replace a dirty membrane or sintered filter to ensure a maximum lifetime for the sensor. Do not try to clean the filter. The sensor can be cleaned with distilled water; if this does not work, replace the sensor.

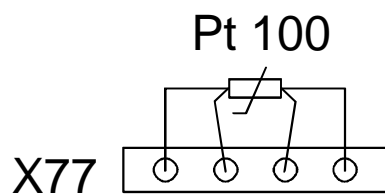
### 7.4 Temperature channel (additional) adjustment with Pt 100 simulators

Switch the power off and disconnect the wires to the Pt 100 sensor from solder lugs TP1, TP2 and TP3.



**Figure 7.1** Location of solder lugs TP1, TP2 and TP3 and connector X77

Connect a Pt 100 simulator to connector X77 and set it at the lowest temperature to be calibrated.



**Figure 7.2** Connecting the Pt 100 simulator to connector X77

Switch the power on.

#### 7.4.1 With serial commands

Give command CTA, enter the first point value and press <cr>:

```
>CTA <cr>
Ta : xx.x Ref1 ? yy.y <cr>
Press any key when ready
```

Set the Pt 100 simulator at the highest temperature to be calibrated and press any key. Enter the second point (gain) reference reading.

#### 7.4.2 With display commands

Select Cali in the main menu and then Ta; select two-point calibration Ta 2 point cal. Change the first point reading with the arrow keys and press ENT.

Set the Pt 100 simulator at the highest temperature to be calibrated and adjust the second point (gain) to the reference reading.

#### 7.4.3 With LED commands

Connect an ammeter/voltmeter to the analogue outputs (connector X2). Give command ○●○○ and adjust the first point (offset) with the arrow switches to the same reading with the reference; press ENT switch.

Set the Pt 100 simulator at the highest temperature to be calibrated and adjust the second point (gain) to the reference reading.

Disconnect the Pt 100 simulator and reconnect the Pt 100 wires to solder lugs TP1, TP2 and TP3.

The correct connections according to wire colours are:

TP1	TP2	TP3
blue	white	red

If a Pt 100 simulator is not available, the adjustment can be made with two resistors of 84  $\Omega$  and 154  $\Omega$  with precisely known resistance. Measure resistors with a resistance meter. Look up the corresponding temperature value from a Pt 100 conversion table or calculate it according to the following equation:

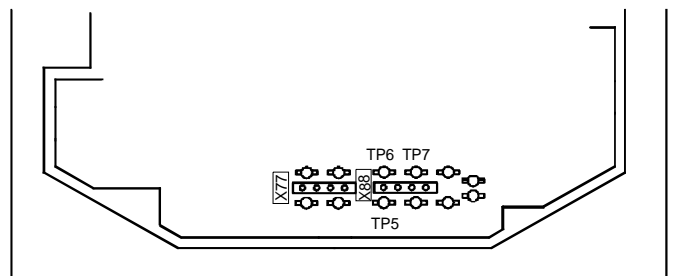
$$T = D0 + R \times \{D1 + R \times [D2 + R \times (D3 + R \times D4)]\}$$

where

$$\begin{aligned} D0 &= -243.5673014 \\ D1 &= 2.278542701 \\ D2 &= 0.002050681 \\ D3 &= -6.15025E-06 \\ D4 &= 1.34949E-08 \end{aligned}$$

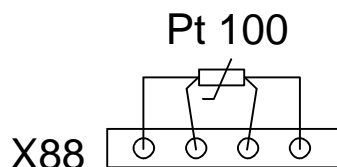
### 7.5 Temperature channel adjustment with Pt 100 simulators (composite sensor)

Switch the power off and disconnect the wires to the Pt 100 sensor from solder lugs TP5, TP6 and TP7.



**Figure 7.3** Location of solder lugs TP5, TP6 and TP7 and connector X88

Connect a Pt 100 simulator to connector X88 and set it at the lowest temperature to be calibrated.



**Figure 7.4 Connecting the Pt 100 simulator to connector X88**

Switch the power on.

### 7.5.1.1 With serial commands

Give command CT, enter the first point value and press <cr>:

```
>CT <cr>
C : xx.x Refl ? yy.y <cr>
Press any key when ready
```

Set the Pt 100 simulator at the highest temperature to be calibrated and press any key. Enter the second point (gain) reference reading.

### 7.5.1.2 With display commands

Select Cali in the main menu and then T; select two-point calibration T 2 point cal. Change the first point reading with arrow keys and press ENT.

Set the Pt 100 simulator at the highest temperature to be calibrated and adjust the second point (gain) to the reference reading.

## 7.5.2 With LED commands

Connect an ammeter/voltmeter to the analogue outputs (connector X2). Give command ○○●○ and adjust the first point (offset) with arrow switches to the same reading with the reference and press ENT switch.

Set the Pt 100 simulator at the highest temperature to be calibrated and adjust the second point (gain) to the reference reading.

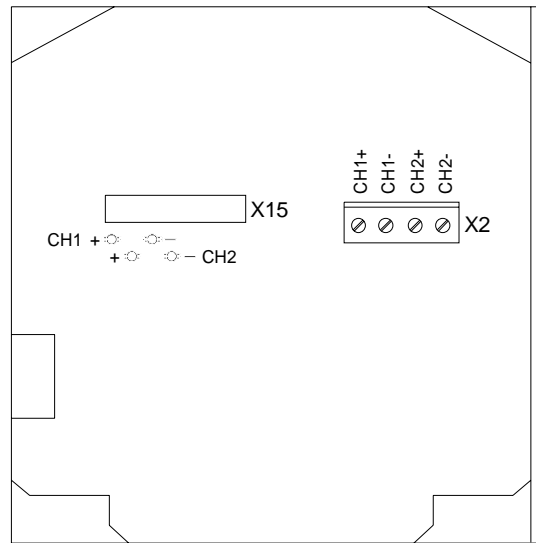
Disconnect the Pt 100 simulator and reconnect the Pt 100 wires to solder lugs TP5, TP6 and TP7.

The correct connections according to wire colours are:

	TP5	TP6	TP7
HMP243	blue	green	yellow

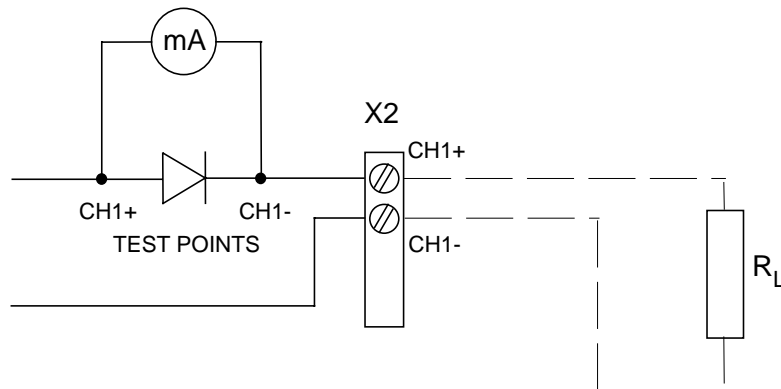
### 7.6 Measurement of output currents using test points

If a current output has been connected e.g. to a process computer, the output current cannot be measured at the output connector X2 without disconnecting the external load. The output current can, however, be measured at test points CH1+/CH1- and CH2+/CH2- without disconnecting the output wires. These test points can therefore be used in one point offset correction against an accurate reference or in checking the current output without disconnecting the analogue output from the process.



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**Figure 7.5** Location of the CH1 and CH2 test points



**Figure 7.6** Circuit diagram of the analogue output current test points

### 7.7 Adjusting the contrast of the display

The contrast of the display can be adjusted using the trimmer "LCD display contrast" located next to press switches.

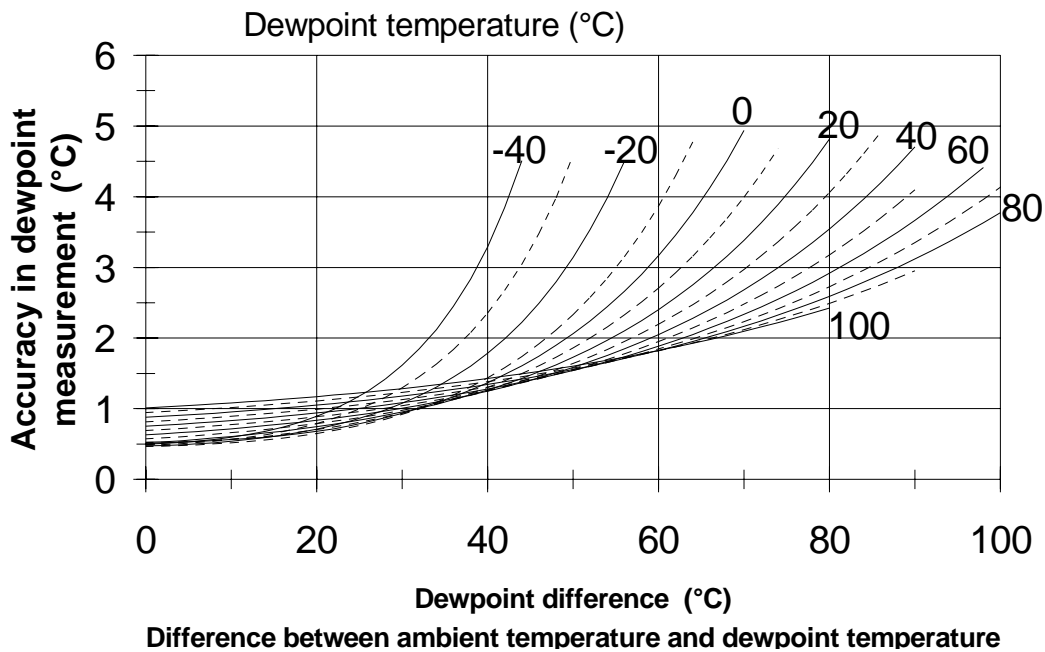
## 8. TECHNICAL DATA

Sensor	RH & T composite sensor HUMICAP®KC(part no. 18258HM)
T sensor in the humidity sensor head	Pt 100 IEC 751 class 1/3 B
Voltage proof, AC: DC supply (+ or -) to housing 250 VAC, 1 minute (300 kΩ and 15 nF parallel)	

### 8.1 Dewpoint temperature

typical range of dewpoint temperature -40...+100 °C

Response time (90 %) at +20 °C in still air (with sintered filter) 15 s



**Figure 8.1 Accuracy in dewpoint measurement as a function of depression and dewpoint (NOTE: dewpoint < 0 °C = calculation of frostpoint)**

## 8.2 Temperature (with additional T sensor head)

Measurement range	-40...+180 °C
Typical accuracy at +20 °C (+68 °F)	±0.1 °C
Typical temperature dependence of electronics	0.005 °C/°C
Temperature sensor	Pt 100 RTD DIN IEC 751, class 1/4 B

## 8.3 Calculated variables

Without the additional temperature head only dewpoint temperature and mixing ratio are available.

Typical ranges

relative humidity	0...100 %RH
dewpoint difference	0...+50 °C
mixing ratio	0...500 g/kg dry air
absolute humidity	0...600 g/m <sup>3</sup>
wet bulb temperature	0...+100 °C

Response time (90 %) at +20 °C in still air (with sintered filter) 15 s

Accuracies of the calculated quantities depend on the accuracies of the measured quantities: relative humidity and temperature. In the dewpoint accuracy graph and accuracy tables for x, a and Tw the accuracies of relative humidity and temperature are assumed to be ±(0.5 + 2.5 % of the reading) %RH for humidity and 0.1°C for temperature (at 25°C). Note that the user can select whether the HMP243 calculates the frostpoint (default) or the dewpoint when the dewpoint is < 0 °C. In addition, the HMP243 also calculates the dewpoint difference, i.e. the difference between the ambient temperature and the dewpoint (= dT).

### 8.3.1 Relative humidity (with additional T sensor head)

Accuracy (including nonlinearity and repeatability)

maximum achievable accuracy when calibrated against high quality, certified humidity standards: ±(0.5 + 2.5 % of the reading) % RH  
for example, accuracy at:

0 % RH	±0.5 % RH
60 % RH	±2.0 % RH

Response time (90 %) at +20 °C in still air (with sintered filter) 15 s

### 8.3.2 Accuracy of other calculated variables

<b>Accuracy of mixing ratio (g/kg) when ambient pressure is 1013 mbar</b>										
	<b>Relative humidity</b>									
<b>Temp.</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>	<b>100</b>
<b>-40</b>	0.001	0.002	0.002	0.002	0.003	0.003	-	-	-	-
<b>-20</b>	0.007	0.010	0.012	0.014	0.017	0.019	0.021	0.024	-	-
<b>0</b>	0.033	0.043	0.053	0.063	0.074	0.084	0.094	0.104	0.115	0.125
<b>20</b>	0.12	0.15	0.19	0.23	0.26	0.30	0.33	0.37	0.41	0.45
<b>40</b>	0.37	0.49	0.61	0.74	0.87	1.00	1.14	1.28	1.42	1.57
<b>60</b>	1.03	1.41	1.82	2.26	2.73	3.25	3.82	4.43	5.10	5.84
<b>80</b>	2.60	3.79	5.23	6.99	9.16	11.85	15.25	19.57	25.17	32.54
<b>100</b>	6.24	10.49	17.10	27.98	47.20	84.96	172.5	446.0	-	-
<b>120</b>	15.45	36.25	100.4	464.4	-	-	-	-	-	-
<b>140</b>	44.97	326.3	-	-	-	-	-	-	-	-
<b>160</b>	228.7	-	-	-	-	-	-	-	-	-

<b>Accuracy of absolute humidity (g/m<sup>3</sup>)</b>										
	<b>Relative humidity</b>									
<b>Temp.</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>	<b>100</b>
<b>-40</b>	0.002	0.003	0.003	0.004	0.005	0.005	-	-	-	-
<b>-20</b>	0.011	0.014	0.018	0.022	0.026	0.030	0.034	0.037	-	-
<b>0</b>	0.045	0.060	0.075	0.090	0.105	0.120	0.13	0.15	0.16	0.18
<b>20</b>	0.15	0.20	0.24	0.29	0.34	0.38	0.43	0.48	0.53	0.57
<b>40</b>	0.43	0.57	0.71	0.85	0.99	1.12	1.26	1.40	1.54	1.68
<b>60</b>	1.09	1.45	1.81	2.17	2.53	2.88	3.24	3.60	3.96	4.32
<b>80</b>	2.43	3.24	4.06	4.88	5.69	6.51	7.33	8.15	8.96	9.78
<b>100</b>	4.89	6.56	8.23	9.90	11.57	13.25	14.92	16.59	18.26	19.93
<b>120</b>	9.06	12.19	15.33	18.46	21.59	-	-	-	-	-
<b>140</b>	15.66	21.12	-	-	-	-	-	-	-	-
<b>160</b>	25.53	-	-	-	-	-	-	-	-	-

<b>Accuracy of wet bulb temperature (°C)</b>										
	<b>Relative humidity</b>									
<b>Temp.</b>	<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>	<b>100</b>
<b>-40</b>	0.18	0.18	0.18	0.18	0.19	0.19	-	-	-	-
<b>-20</b>	0.15	0.16	0.17	0.18	0.19	0.19	0.2	0.21	-	-
<b>0</b>	0.15	0.17	0.2	0.22	0.24	0.26	0.28	0.3	0.31	0.33
<b>20</b>	0.21	0.25	0.29	0.32	0.35	0.38	0.4	0.43	0.45	0.47
<b>40</b>	0.37	0.43	0.48	0.52	0.55	0.57	0.6	0.61	0.63	0.64
<b>60</b>	0.63	0.68	0.71	0.74	0.76	0.77	0.79	0.8	0.81	0.82
<b>80</b>	0.96	0.94	0.94	0.94	0.94	0.95	0.95	0.96	0.97	0.98
<b>100</b>	1.3	1.18	1.13	1.12	1.11	1.11	1.11	1.12	1.12	1.13
<b>120</b>	1.62	1.39	1.31	1.28	1.27	-	-	-	-	-
<b>140</b>	1.9	1.58	-	-	-	-	-	-	-	-
<b>160</b>	2.17	-	-	-	-	-	-	-	-	-

The formulas used in calculation of dewpoint/frostpoint, mixing ratio and absolute humidity are presented in Appendix 5.

**8.4 Outputs**

Two analogue outputs selectable	0...20 mA 0...1 V 0...10 V	4...20 mA 0...5 V
Typical accuracy of an analogue output at +20 °C	±0.05 % full scale	
Typical temperature dependence of an analogue output	0.005 %/°C full scale	
Serial output available	RS 232C	

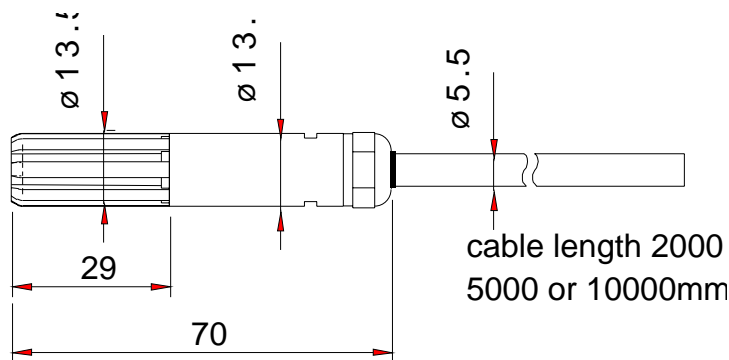
**8.5 Electronics**

User interface	3 keys and 4 LEDs inside the housing or local display keypad	
Display	2 x 16 character alphanumeric high-contrast, wide view angle LCD	
character height	3.85 mm (0.15")	
Keyboard	1 x 4 keypad	
Connections	screw terminals, 0.5 mm <sup>2</sup> wires (AWG 20), stranded wires recommended	
Operating voltage	24 VDC 24 VAC (see Chapter 3.3.1) (20...28 V)	
Power consumption	200 mA maximum (24 VDC)	
during re-gaining	270 mA maximum (24 VDC)	
Recommended external load for:		
current outputs	<500 Ω	
0...1 V voltage output	>2 kΩ (to ground)	
0...5 and 0...10 V voltage outputs	>10 kΩ (to ground)	
Operating temperature (electronics)	-40...+60 °C	
with display cover	0...+50 °C	
Storage temperature	-40...+70 °C	

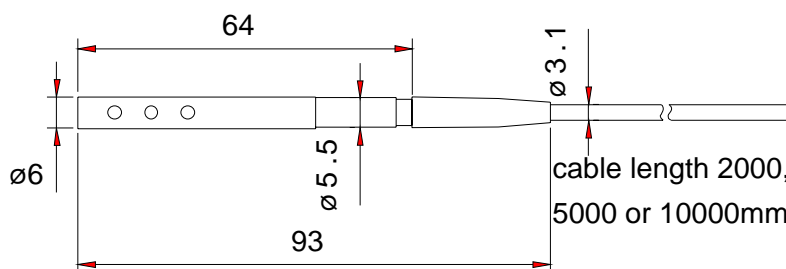
## 8.6 Mechanics

Housing material	G-AISI12 (DIN 1725)
Housing classification	IP 65 (NEMA 4)
Bushing	for 7...10 mm diameter cable (8 x 0.5 mm <sup>2</sup> shielded cable)
Sensor protection	stainless steel sintered filter (part no. 16452) PPS grid with stainless steel netting (part no. 16720)
Housing dimensions	145 x 120 x 65 mm

Sensor head dimensions:



**Figure 8.2 HMP243 RH sensor head dimensions**



**Figure 8.3 HMP243 T sensor head dimensions**

Weight with	2 m cable	5 m cable	10 m cable
HMP243 (duct mounting, max 180°C, without T probe)	1100 g	1300 g	1500 g
T probe for HMP243	80 g	150 g	250 g
HMP243FA (duct installation kit for HMP243; 180°C)	140 g		
2 x HMP243FA	280 g		

Weight of display cover 420 g

**8.7 Electromagnetic compatibility****8.7.1 Emissions**

<b>Test:</b>	<b>Setup according to:</b>	
Radiated interference	EN55022	(class B)

**8.7.2 Immunity**

<b>Test:</b>	<b>Setup according to:</b>	<b>Performance:</b>
Electrostatic discharge	EN61000-4-2:1995	criteria B
Electrical fast transients	EN61000-4-4:1995	criteria B
GSM-field immunity	ENV50204:1995	criteria A
RF-radiated fields	ENV50140:1993	criteria A
RF-conducted fields	ENV50141:1993	criteria A

**9. SPARE PARTS AND ACCESSORIES**

Order code	Description
HMP243FA	Mounting kit for HMP243, +180 °C cable
16452	Sintered filter, stainless steel
16720	PPS grid with stainless steel netting
HUMICAP®KC	Composite humidity and temperature sensor
16611	Calibration adapter for the HMK13B Calibrator
HMP243RS	RS 485/422 serial module
HMP243CL	Current loop module