
HMP240 SERIES TRANSMITTERS User's Guide

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1. PRODUCT DESCRIPTION

The HMP240 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 HMP240. 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 HMP240 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 ± 1 °C causes an error of ± 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 HMP240 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 HMP240 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 HMP240 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.

3.2 Mounting

3.2.1 Mounting the HMP243

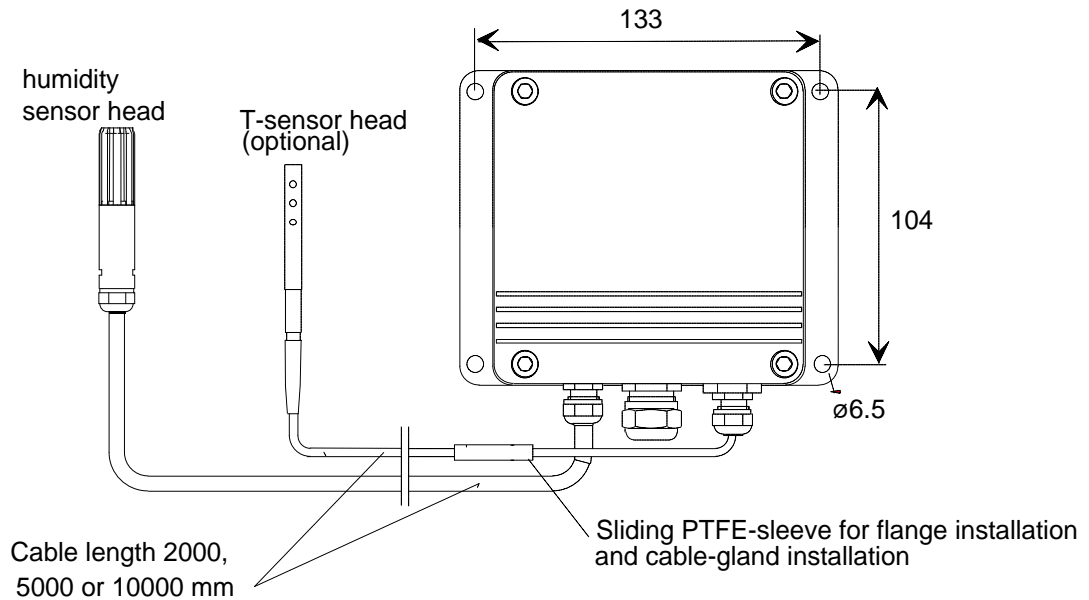


Figure 3.1 HMP243 transmitter with a humidity sensor head and an additional T sensor head

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.

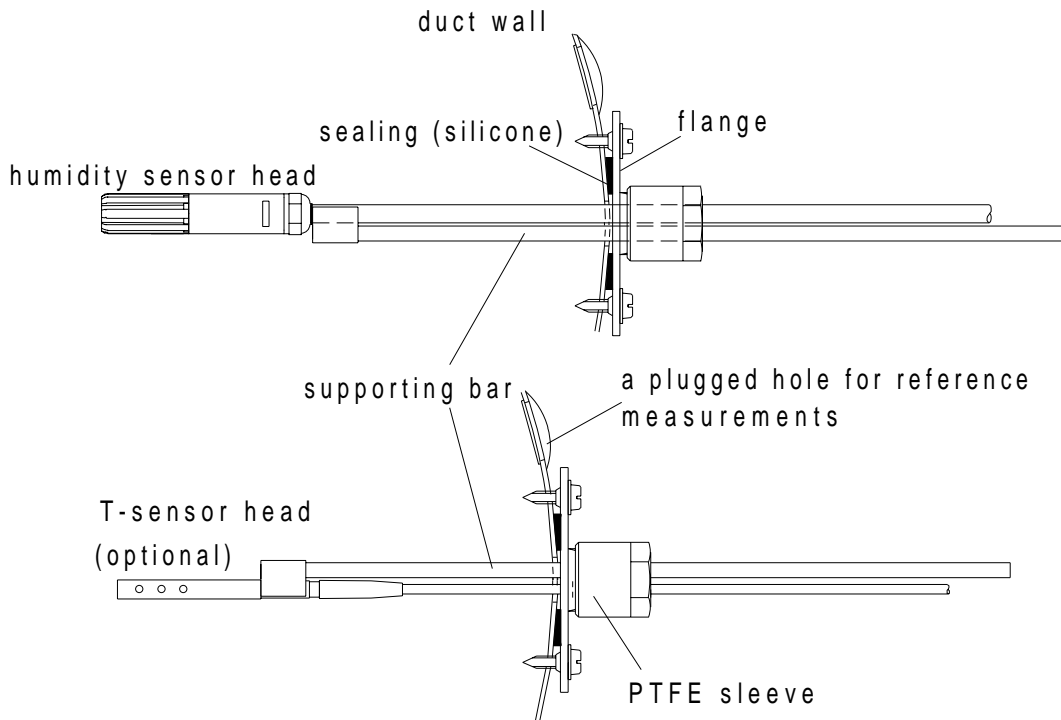


Figure 3.2 Installing the sensor heads of the HMP243 in a channel with the help of flanges and supporting bars

The sensor head can also be installed vertically.

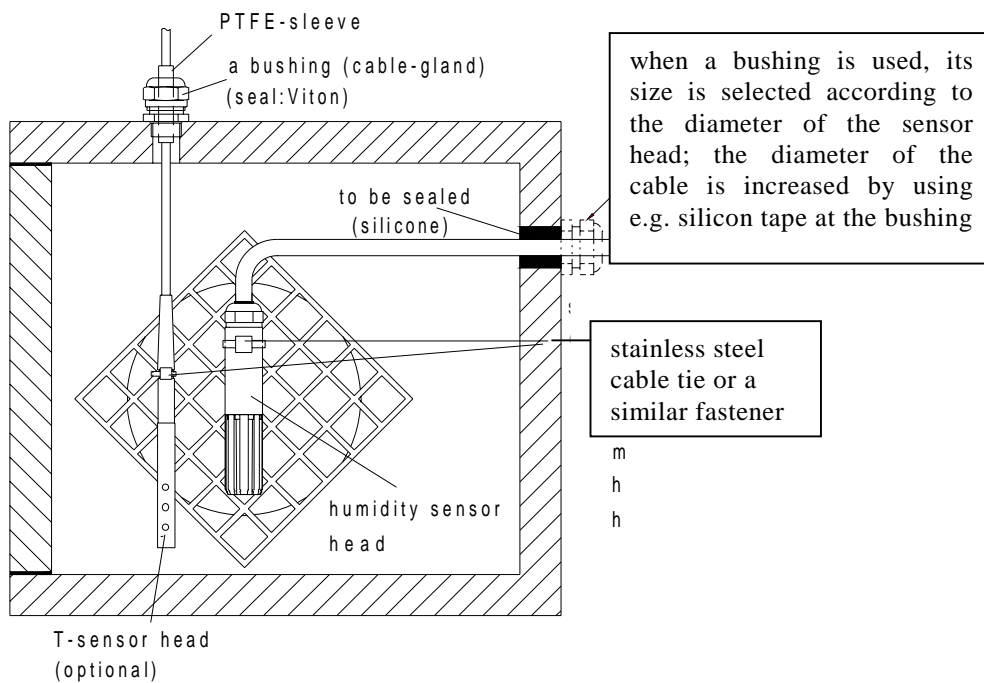


Figure 3.3 Vertical installation of the HMP243 sensor heads

3.2.2 Mounting the HMP247

HMP247 has a small size probe made of stainless steel. The sensor head withstands temperatures $-40...180\text{ }^{\circ}\text{C}$ ($-40...356\text{ }^{\circ}\text{F}$) and pressure up to 10 bar (1MPa, 145 psi). The probe is suitable for applications where a mechanically very durable leak proof probe is needed.

Pressure tight installations

A pressure tight installation can be done by using a probe head installation or cable installation. Vaisala's cable gland HMP247CG is recommended for the humidity probe's cable installation.

The different pressure tight installations of the HMP247 are shown in the following pictures. In cases where the probe shall be positioned horizontally in the measuring chamber (or in duct) a supportive thread bar set HMP247TBS can be ordered from Vaisala (order code: HMP247TBS).

A) Probe head installation

1. Make hole with M20x1.5 thread in the measurement chamber or process wall. The smoothness of the thread circle should be $R=6.3$ microm.

2. Install the cable gland (EN50262, version A, example: AGRO 1160.20.145) on the thread of the process wall.

3. Push the probe through the gland so deep that the backside of the probe is flush with the cable gland nut.

4. Tighten the cable gland nut, the probe will lift up slightly.

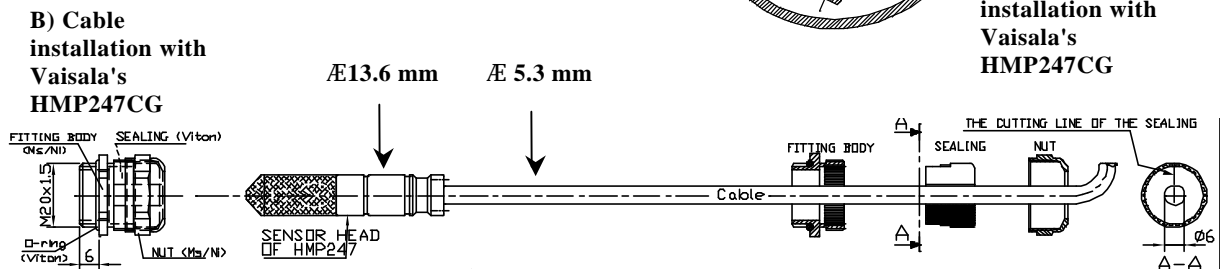
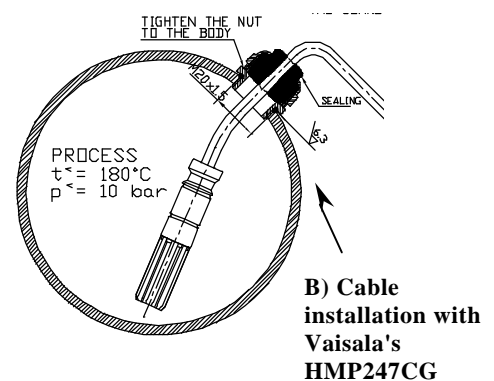
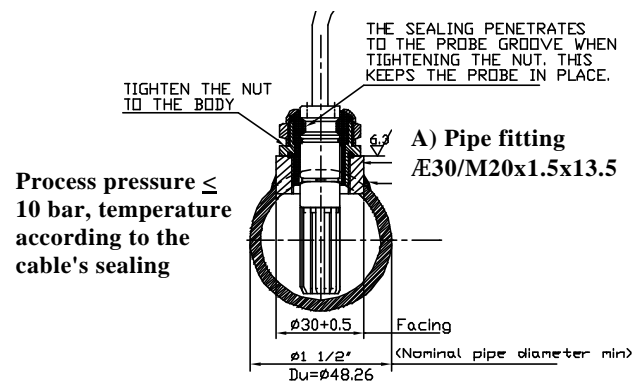
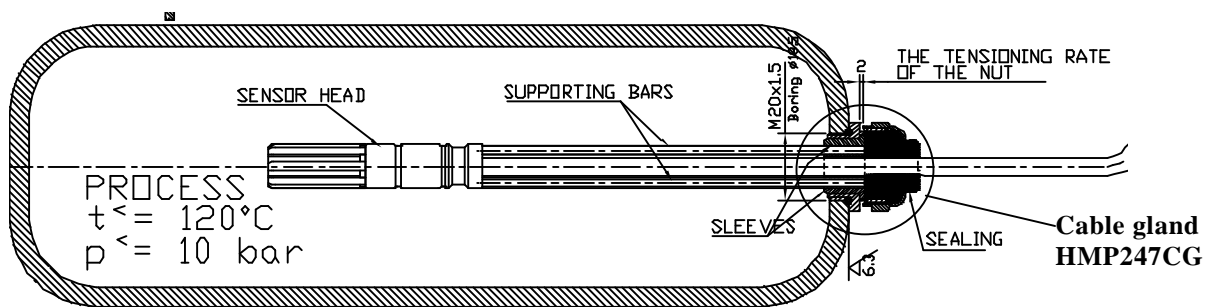


Figure 3.4 HMP247 Pressure tight installations A) Probe head installation B) Cable installation (cable gland: HMP247CG) .

Pressure tight installation with Vaisala's supportive thread bar set HMP247TBS (cable gland HMP247CG included)

1. Make a hole with M20x1.5 to a wall or weld a pipe fitting ($\varnothing 30/M20x1.5x12mm$) to a wall.
2. Install the cable gland's fitting body on the hole in the wall.
3. Thread the sensor head through the nut and press the cable through the cutting line of the sealing.
4. Turn the supporting bars into the sensor head's threaded holes.
5. Turn the sleeve on the opposite end of the supporting bar and trim to the right length.
6. Cut away the overage supporting bar with saw.
7. Press the sleeves together (with cable inside) and install the sensor head to a process through the fitting body.
8. Tighten the cable gland nut.

For processes up to 120°C (248°F). More detailed instructions are included in the set.



Example of pressure tight temperature probe installation (cable gland example: AGRO Nr. 1100.12.91.065, EN50262, version A)

Process pressure < 7 bar,
temperature according to the cable
sealing

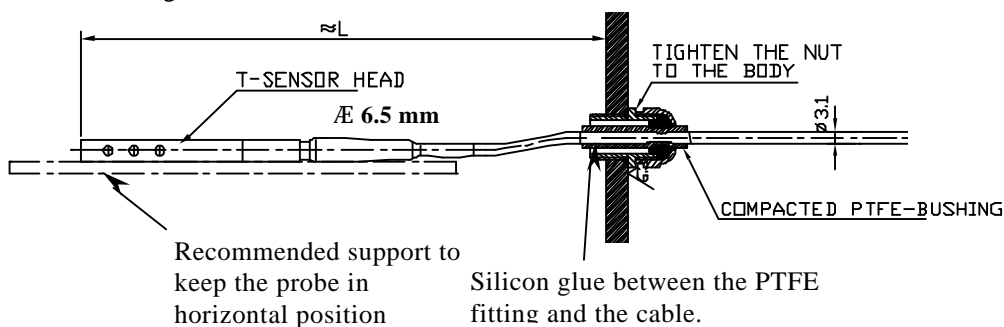


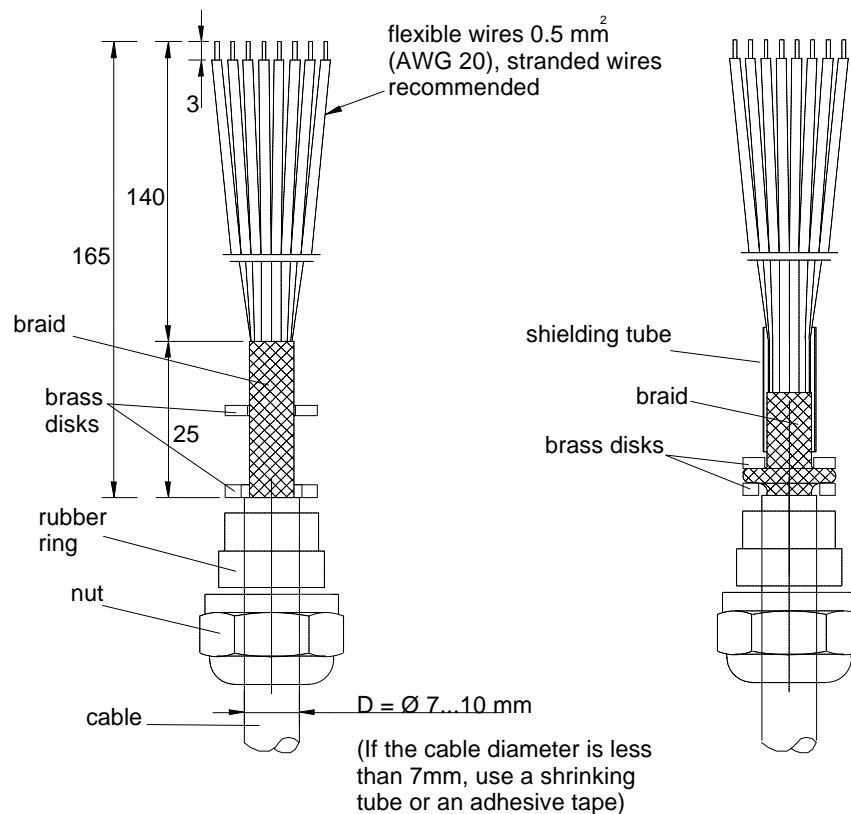
Figure 3.5 HMP247 pressure tight installations with supporting bars.

3.3 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.

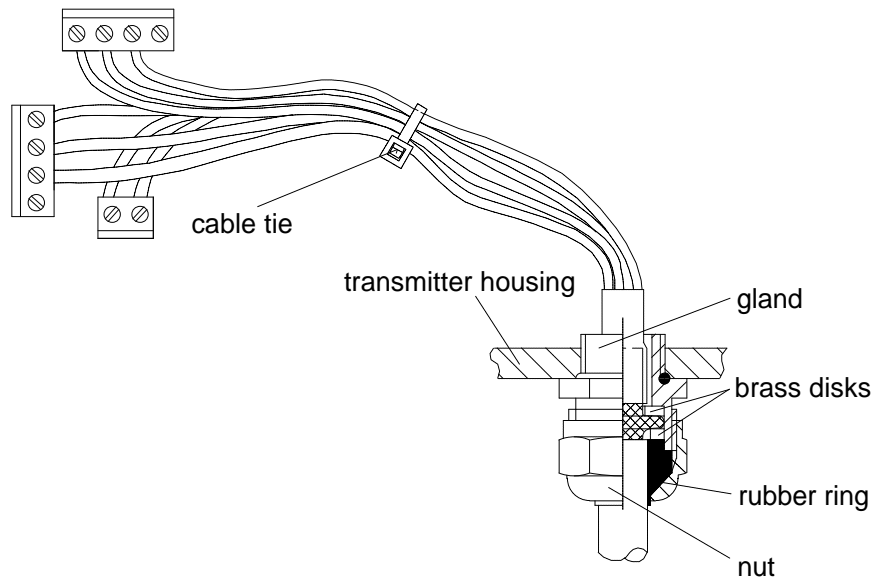
The screen of the electrical cable must be grounded properly to achieve best possible EMC performance. Recommended cable shield is done in the cable gland as shown below.

- 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.

3.4 Electrical connections

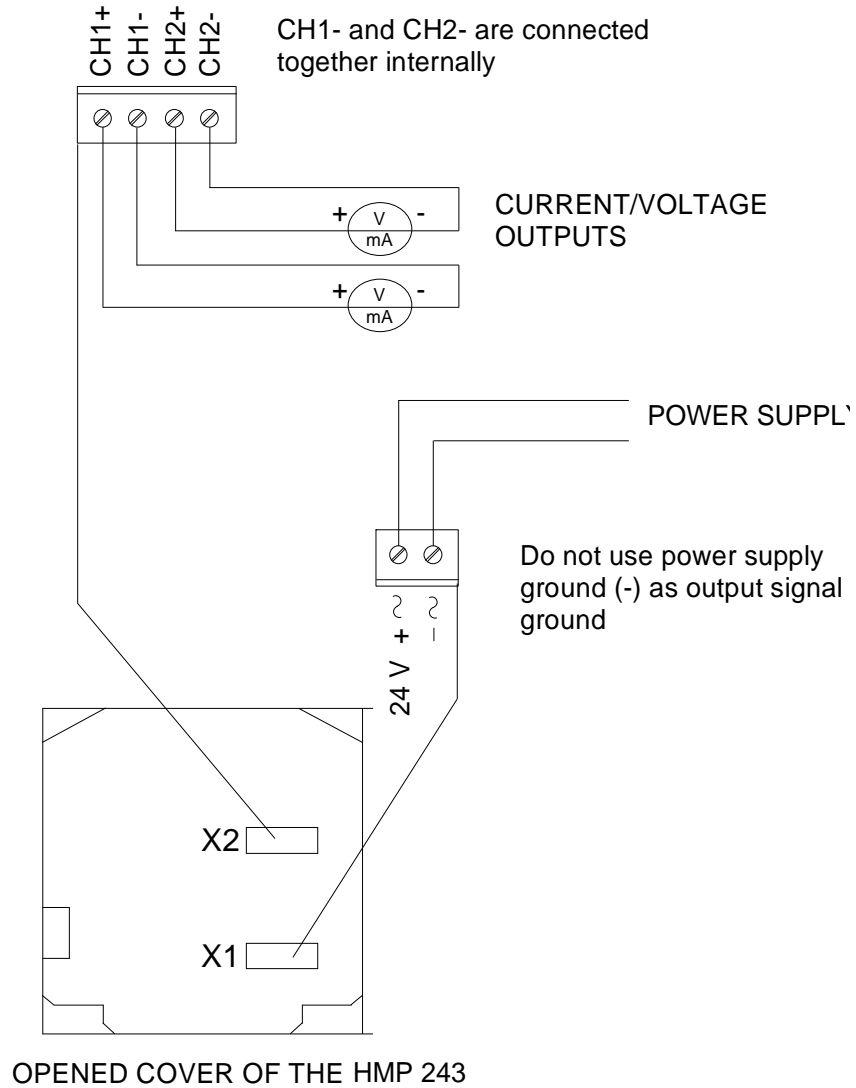


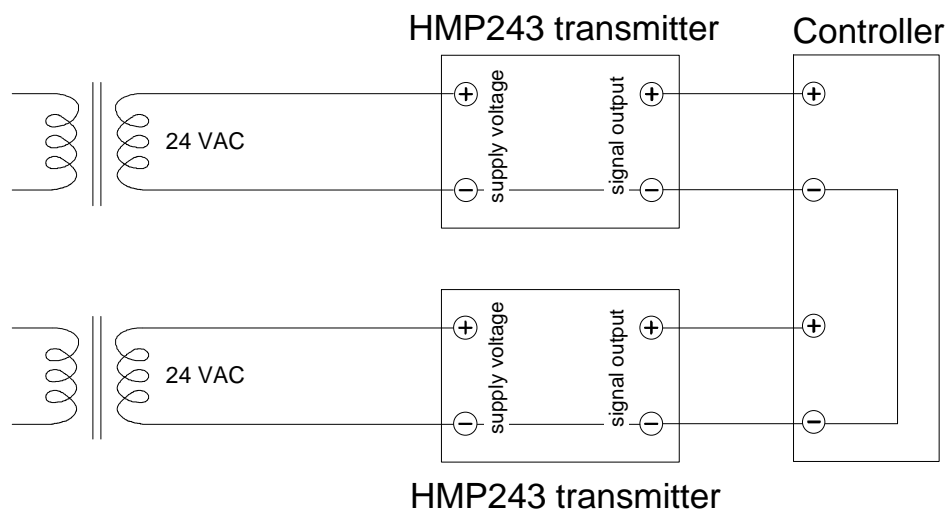
Figure 3.6 Electrical connections

Power supply	24 VDC 24 VAC (see Chapter 3.4.1)
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 Ω resistor.	

3.4.1 Connection to a 24 VAC supply

The HMP240 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 3.7 A). However, if several transmitters have to share one transformer, the phase (~) must always be connected to + connector in each transmitter (see Figure Figure 3.7 B).

A) NO COMMON LOOP FORMED - RECOMMENDED



B) COMMON LOOP FORMED - NOT RECOMMENDED!

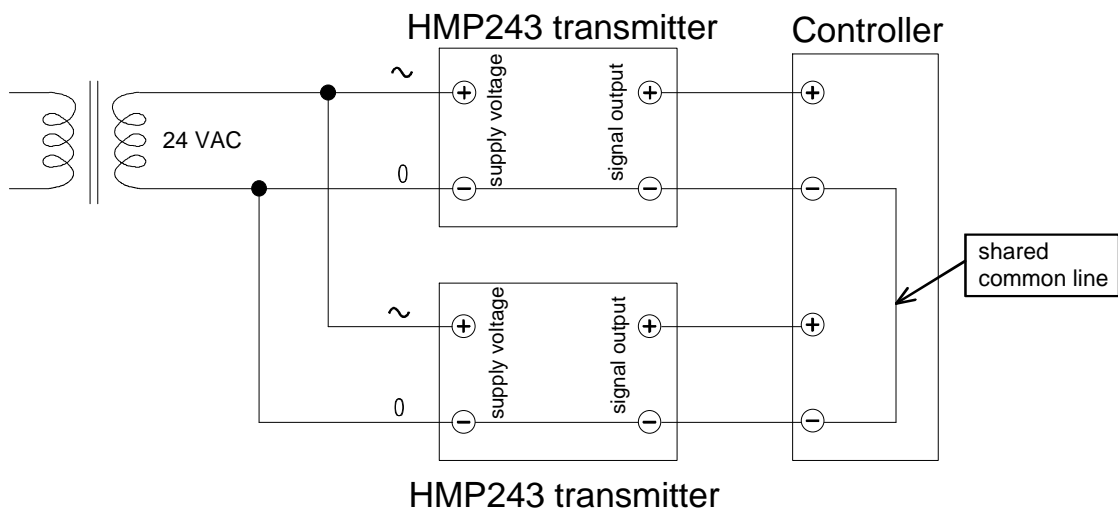


Figure 3.7 Connecting the transmitters to a 24 VAC supply (valid also for the HMP247 transmitter).

4. COMMISSIONING

When the HMP240 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 6 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 4.

If your transmitter has a blank cover and the LED indicator inside the housing lights up, consult Appendix 4 for further information.

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 HMP240 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.

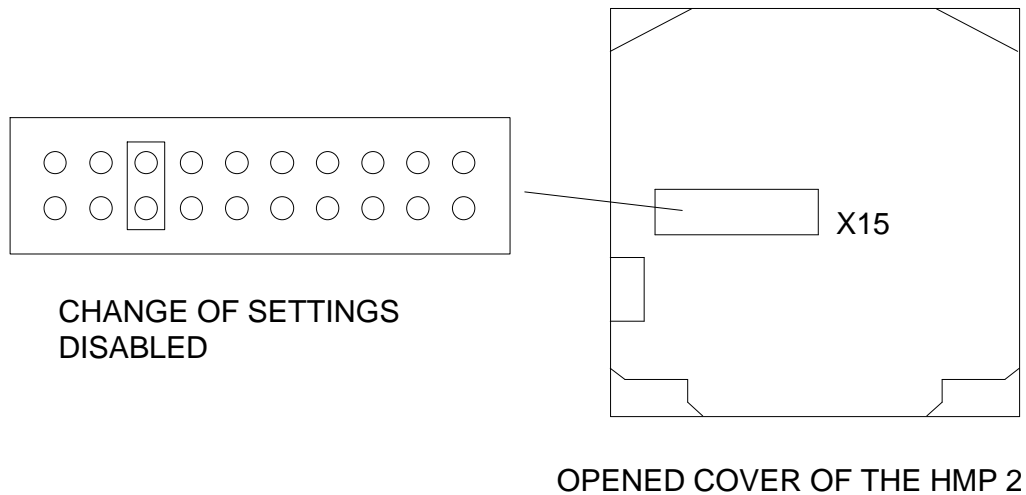


Figure 4.1 Location of the security lock jumper

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 HMP240 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.

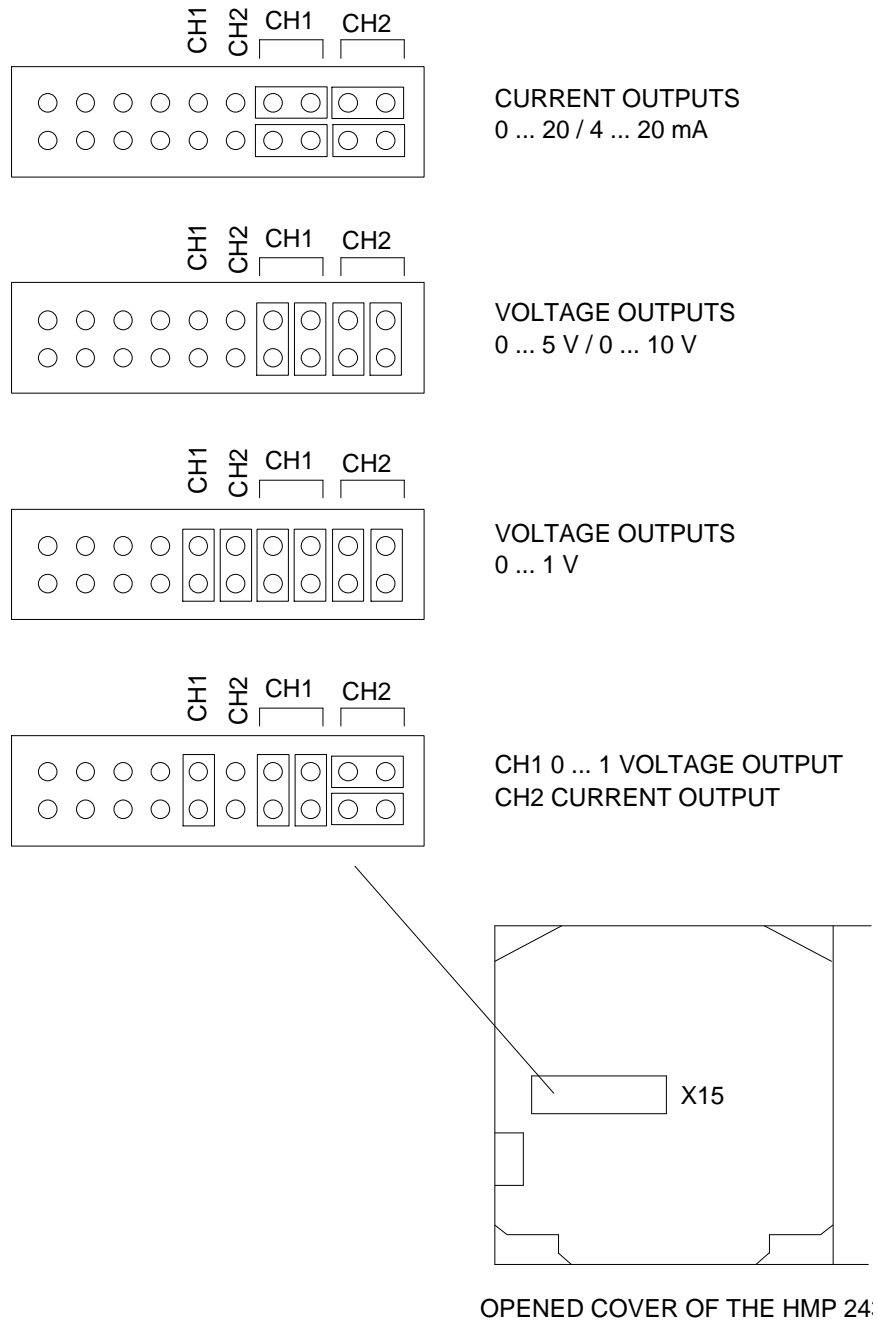
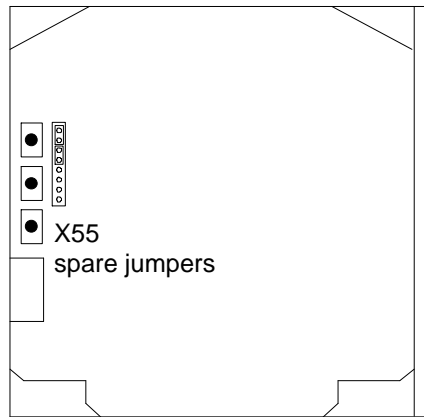


Figure 4.2 Selecting the analogue outputs with jumpers

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".

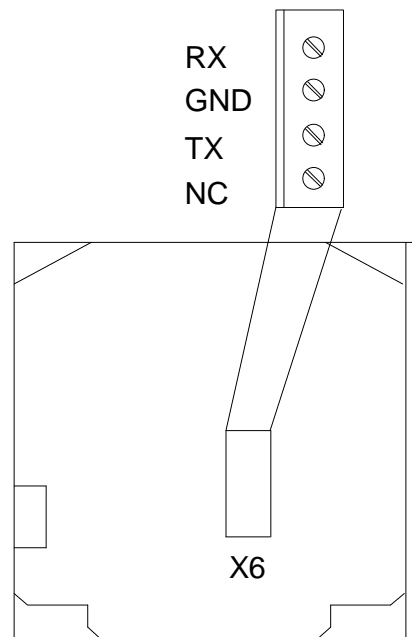
All the jumpers are used only with the 0...1 V outputs. When other outputs are in use, the spare jumpers are kept in connector X55.



OPENED COVER OF THE HMP 243

Figure 4.3 Spare jumpers

4.4 Connecting the RS 232C serial bus



OPENED COVER OF THE HMF

Figure 4.4 Serial bus connections

To connect a PC to the HMP240 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.

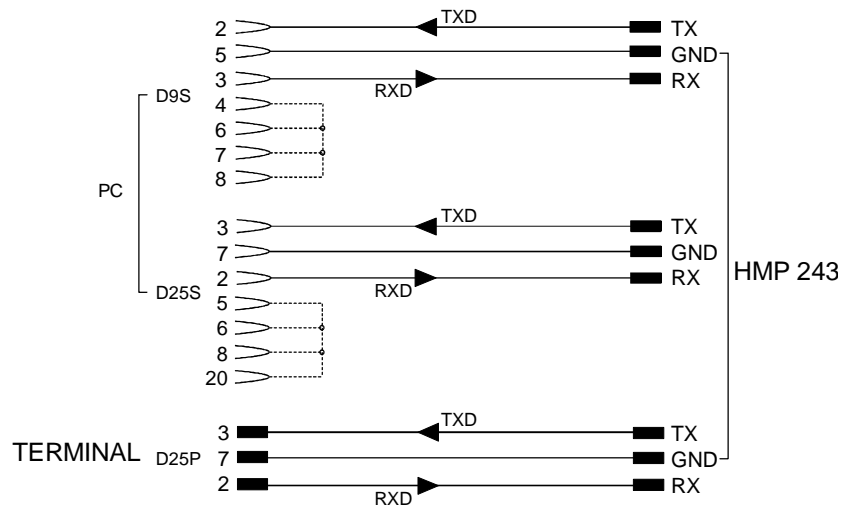


Figure 4.5 Connection of cables

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 HMP240 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.

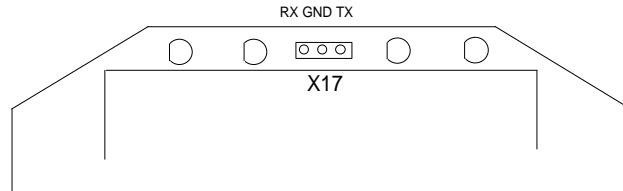


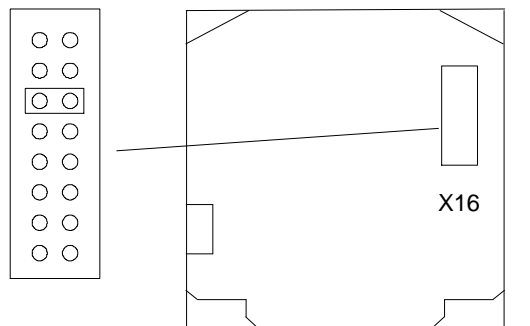
Figure 4.6 Location and connections of connector X17

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 HMP240. 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!



OPENED COVER OF THE HMP 243

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 HMP240 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!

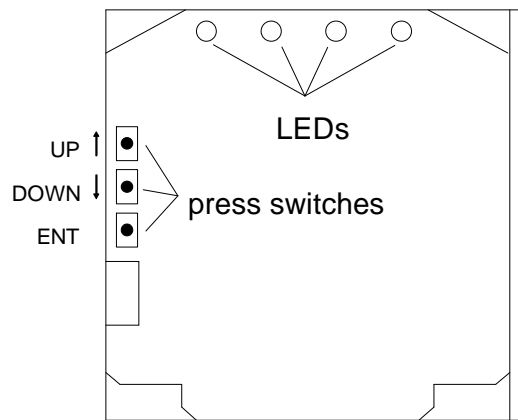
5.2 LED commands

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.



OPENED COVER OF THE HMP 240

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 σ and the second line with button τ ; 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
```

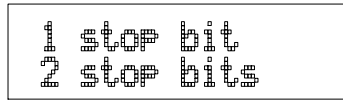
Selecting parity:

```
None Even Odd
```

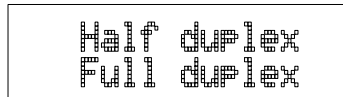
Selecting data bits:

```
7 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 HMP240 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

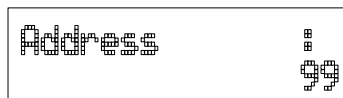
NOTE

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:

```
metric
non metric
```

- 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 ³	gr/ft ³
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:

```
Echo Regen Ht in
Heat Frost Fil t
```

- 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 HMP240 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.

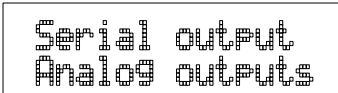
In the STOP mode serial commands are given to the transmitter. Measurements are then output only by entering command SEND.

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.

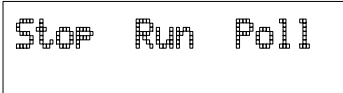
5.3.6.1 Setting the serial interface operation mode

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



```
Serial output
Analog outputs
```

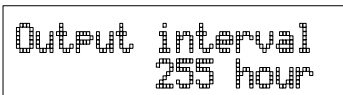
- Select Serial output:



```
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 Mtin
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:



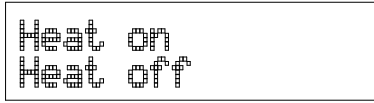
Time: 14:25:32

- 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 HMP240 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:

```
>SERI 0 <cr>           changing parity only
4800 0 7 1 HDX

>SERI 600 N 8 1 F <cr>  changing all parameters
600 N 8 1 FDX
```

The processor does not allow the following combinations:

- no parity, 7 data bits, 1 stop bit: if this combination is given the HMP240 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.

When the half-duplex mode is set, it will automatically turn the echo off. Even then the ECHO command can indicate that echo is on.

5.4.2.6 Selecting the output units

UNIT x <cr>

x = m(etric units)
 n(on-metric units)

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

5.4.2.7 Setting the averaging time

Disconnect the security lock jumper!

FILT nnnn <cr>

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 HMP240 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 HMP240 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 HMP240 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[®]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 HMP240 transmitter using an appropriate reference connection cable. The necessary correction factors are automatically stored in the HMP240 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.

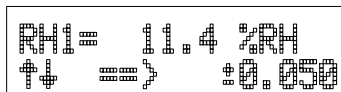
```
RH : yy.y Ref2 ? <cr>
```

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 20 minutes for the reading to stabilize.
- Press any key, enter the second point value and press <cr>.

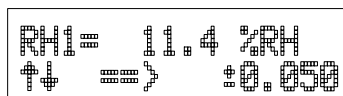
```
RH : xx.x Ref2 ? yy.y <cr>
```
- The stabilization of the sensor can be monitored by entering c<cr>.

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 20 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.



```
RH1 = 11.4 %RH  
↑↓ ==> +0.050
```


- Insert the sensor head into the measurement hole of the NaCl chamber.
- Wait at least 20 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 20 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 20 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 20 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 20 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 20 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 20 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 20 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) ?

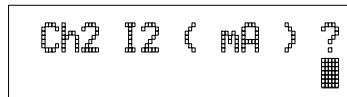
- Enter the measured lower end current/voltage on channel 1:

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 μ 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 μ 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 HMP240 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 HMP240 is like any other RH transmitter outputting the RH and T values (for further details, see Chapter 6).

7.2 Self-diagnostics

The HMP240 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.

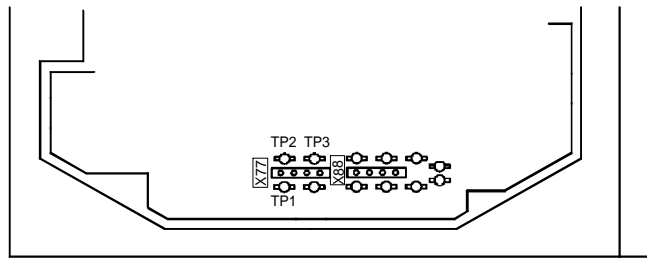


Figure 7.1 Location of solder lugs TP1, TP2 and TP3 and connector X77

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

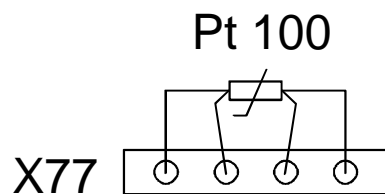


Figure 7.2 Connecting the Pt 100 simulator to connector X77

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 Ω and 154 Ω 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.

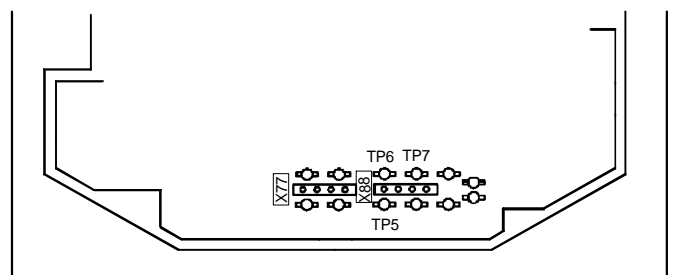


Figure 7.3 Location of solder lugs TP5, TP6 and TP7 and connector X88

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

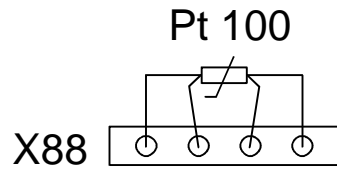


Figure 7.4 Connecting the Pt 100 simulator to connector X88

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.

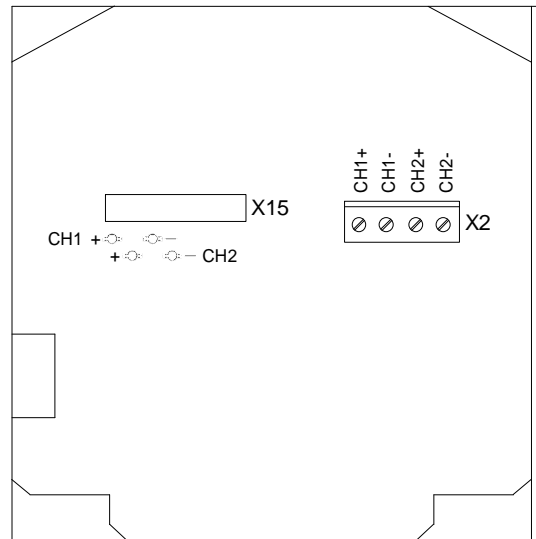
The correct connections according to wire colours are:

	TP5	TP6	TP7
HMP240	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

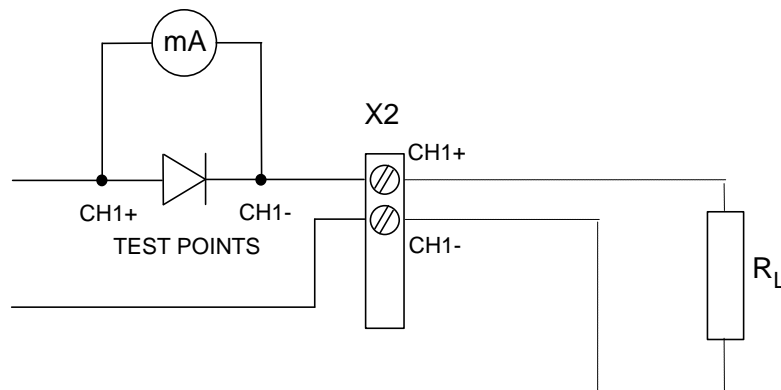


Figure 7.6 Circuit diagram of the analogue output current test points

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

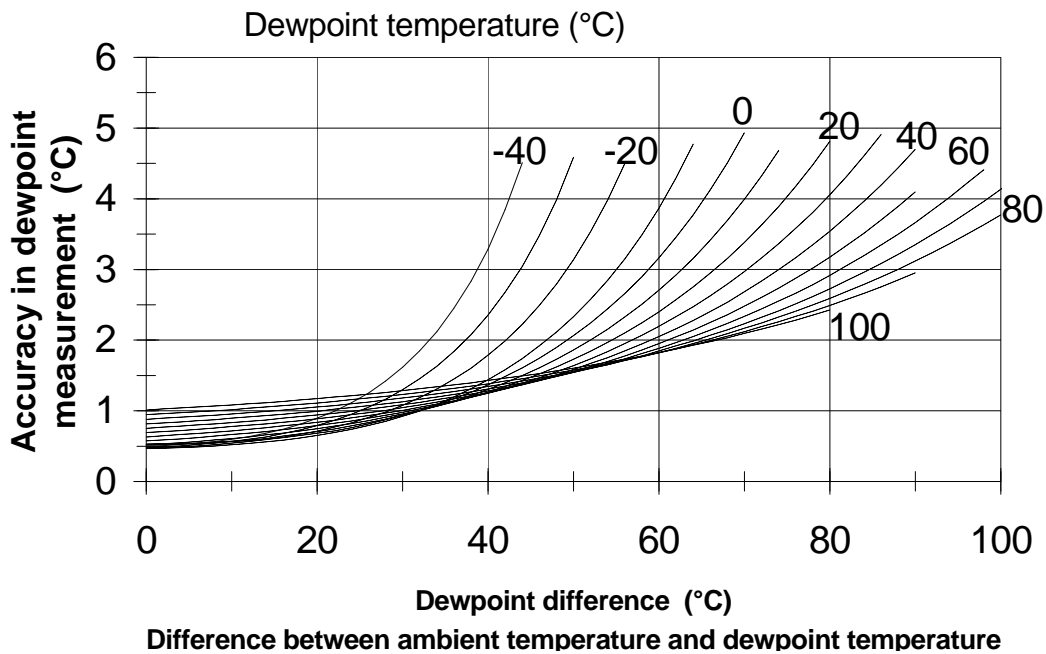


Figure 8.1 Accuracy in dewpoint measurement as a function of depression and dewpoint (NOTE: dewpoint < 0 °C = calculation of frostpoint)

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 ³
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 T_w the accuracies of relative humidity and temperature are assumed to be $\pm(0.5 + 2.5 \%$ of the reading) %RH for humidity and 0.1°C for temperature (at 25°C). Note that the user can select whether the HMP240 calculates the frostpoint (default) or the dewpoint when the dewpoint is < 0 °C. In addition, the HMP240 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: $\pm(0.5 + 2.5 \%$ 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

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

Accuracy of absolute humidity (g/m³)										
	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	0.002	0.003	0.003	0.004	0.005	0.005	-	-	-	-
-20	0.011	0.014	0.018	0.022	0.026	0.030	0.034	0.037	-	-
0	0.045	0.060	0.075	0.090	0.105	0.120	0.13	0.15	0.16	0.18
20	0.15	0.20	0.24	0.29	0.34	0.38	0.43	0.48	0.53	0.57
40	0.43	0.57	0.71	0.85	0.99	1.12	1.26	1.40	1.54	1.68
60	1.09	1.45	1.81	2.17	2.53	2.88	3.24	3.60	3.96	4.32
80	2.43	3.24	4.06	4.88	5.69	6.51	7.33	8.15	8.96	9.78
100	4.89	6.56	8.23	9.90	11.57	13.25	14.92	16.59	18.26	19.93
120	9.06	12.19	15.33	18.46	21.59	-	-	-	-	-
140	15.66	21.12	-	-	-	-	-	-	-	-
160	25.53	-	-	-	-	-	-	-	-	-

Accuracy of wet bulb temperature (°C)										
	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	0.18	0.18	0.18	0.18	0.19	0.19	-	-	-	-
-20	0.15	0.16	0.17	0.18	0.19	0.19	0.2	0.21	-	-
0	0.15	0.17	0.2	0.22	0.24	0.26	0.28	0.3	0.31	0.33
20	0.21	0.25	0.29	0.32	0.35	0.38	0.4	0.43	0.45	0.47
40	0.37	0.43	0.48	0.52	0.55	0.57	0.6	0.61	0.63	0.64
60	0.63	0.68	0.71	0.74	0.76	0.77	0.79	0.8	0.81	0.82
80	0.96	0.94	0.94	0.94	0.94	0.95	0.95	0.96	0.97	0.98
100	1.3	1.18	1.13	1.12	1.11	1.11	1.11	1.12	1.12	1.13
120	1.62	1.39	1.31	1.28	1.27	-	-	-	-	-
140	1.9	1.58	-	-	-	-	-	-	-	-
160	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 ² wires (AWG 20), stranded wires recommended	
Operating voltage	24 VDC 24 VAC (see Chapter 3.4.1) (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)	
Pressure range for the probe HMP247		
for humidity probe	0...1 MPa	
(The entire sensor head in pressurized space)	(0...10 bar, 0...145 psi)	
for temperature probe	0...0.7 MPa	
(the entire sensor head in pressurized space)	(0...7 bar, 0...100 psi)	

Operating temperature (electronics) with display cover	-40...+60 °C 0...+50 °C
Storage temperature	-40...+70 °C

8.6 Mechanics

Housing material	G-AlSi12 (DIN 1725)
Housing classification	IP 65 (NEMA 4)
Bushing	for 7...10 mm diameter cable (8 x 0.5 mm ² 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:

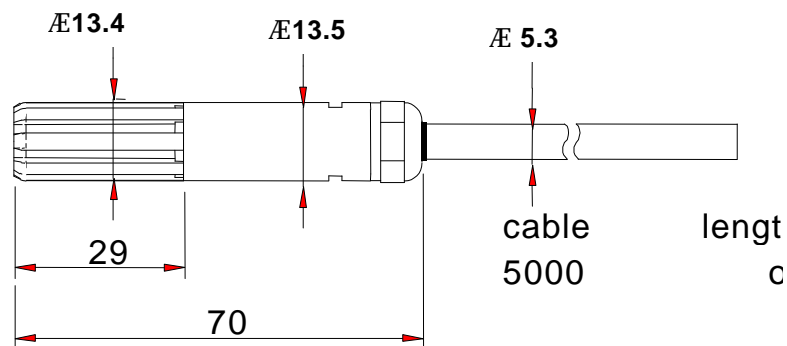


Figure 8.2 HMP243 RH sensor head dimensions

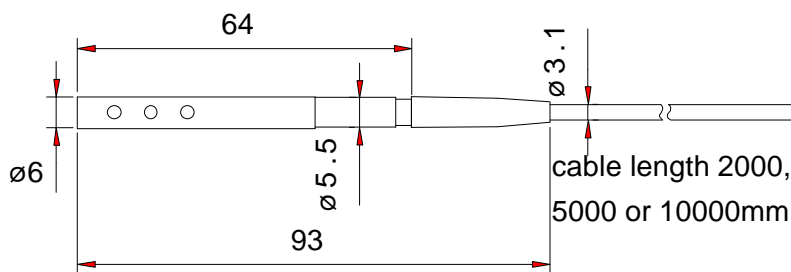


Figure 8.3 HMP243 T sensor head dimensions

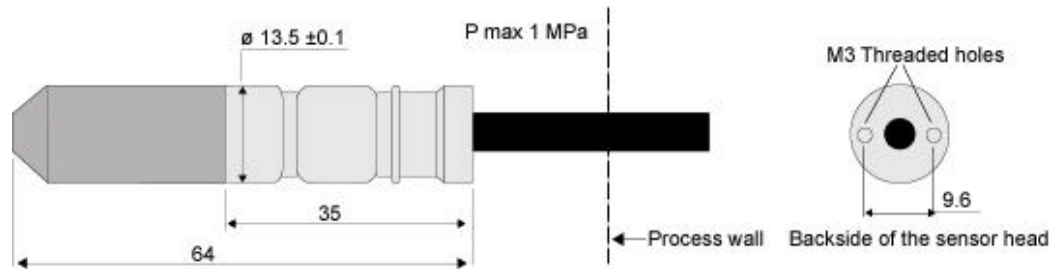


Figure 8.4 HMP247 sensor head information

Weight with	2 m cable	5 m cable	10 m cable
HMP240 (duct mounting, max 180°C, without T probe)	1100 g	1300 g	1500 g
T probe for HMP240	80 g	150 g	250 g
HMP243FA (duct installation kit for HMP240; 180°C)	140 g		
2 x HMP243FA	280 g		

Weight of display cover 420 g

8.7 Electromagnetic compatibility

Complies with the following standard:

EN 61326-1:1997 + Am 1:1998, Electrical equipment for measurement, control and laboratory use - EMC requirements, Industrial environment.

Filters of the sensor: PPS grid & stainless steel netting filter (16720) and sintered steel filter (16452).

Test methods

Emission

Radiated emissions	CISPR16 class B (CISPR22 Class B)
Harmonic currents to AC mains	EN/IEC 61000-3-2
Voltage fluctuations	EN/IEC 61000-3-3

Immunity

Electrostatic discharge (ESD)	EN/IEC 61000-4-2
Radiated immunity	EN/IEC 61000-4-3 Industrial environment: 10 V/m,
EFT Burst	EN/IEC 61000-4-4
Surge	EN/IEC 61000-4-5
Conducted immunity	EN/IEC 61000-4-6



9. SPARE PARTS AND ACCESSORIES

Order code	Description
HMP243FA	Mounting kit for HMP240, +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
HMP240RS	RS 485/422 serial module
HMP247CG	Cable gland for HMP243 and HMP247
HMP247TBS	Thread bar set for HMP247
HMP240CL	Current loop module

APPENDIX 1: SERIAL COMMANDS

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The commands function as described when the serial interface is in full-duplex mode and echo is on. All commands except FORM can be given in either capital or small letters.

In the commands <cr> means carriage return, <lf> line feed and <ht> horizontal tabulation.

1. ANALOGUE OUTPUT COMMANDS

AMODE 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.

Sets the analogue outputs on channels 1 and 2. An example of this is when the voltage output on channel 1 is set to be 0...1 V and channel 2 set to 2...10 V:

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

The current settings can be checked by giving the command without any parameters:

```
>AMODE <cr>  
Ch1 : 0.000 ... 20.000 mA  
Ch2 : 0.000 ... 20.000 mA
```

ASEL Selecting the 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)

For example, relative humidity is selected to be output on channel 1 and temperature on channel 2; the temperature range is scaled to 0...100 °C:

```
>ASEL RH T <cr>
Ch1 (RH)    lo   0.000 %RH   ? <cr>
Ch1 (RH)    hi  100.000 %RH  ? <cr>
Ch2 (T )    lo  -40.000 'C   ?  0 <cr>
Ch2 (T )    hi  +160.000 'C  ?  100 <cr>
```

When the ASEL command is given on its own, the transmitter outputs its current settings:

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

The outputs and their scales can also be given directly with the ASEL command.

ASEL xxx yyy aaa.a bbb.b ccc.c ddd.d <cr>

xxx = channel 1's quantity
 yyy = channel 2's quantity
 aaa.a = lower limit of channel 1
 bbb.b = upper limit of channel 1
 ccc.c = lower limit of channel 2
 ddd.d = upper limit of channel 2

ASCL Scaling the analogue outputs

Disconnect the security lock jumper!

ASCL <cr>

Scales the outputs selected on channels 1 and 2.

For example, scaling relative humidity on the range of 0...100 %RH and temperature -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>
```

The output scales can also be given directly with the ASCL command.

```
ASCL aaa.a bbb.b ccc.c ddd.d <cr>
```

aaa.a = lower limit of channel 1
bbb.b = upper limit of channel 1
ccc.c = lower limit of channel 2
ddd.d = upper limit of channel 2

For example, when relative humidity is scaled to 0...100 %RH on channel 1 and temperature to -40...+100 °C on channel 2:

```
>ASCL 0 100 -40 100 <cr>  
Ch1 (RH) lo 0.000 %RH  
Ch1 (RH) hi 100.000 %RH  
Ch2 (T ) lo -40.000 'C  
Ch2 (T ) hi 100.000 'C
```

2. CALIBRATION COMMANDS

CRH Relative humidity calibration

Disconnect the security lock jumper!

CRH <cr>

With this command the transmitter can be calibrated against a reference. A one-point calibration can be done against an accurate transfer standard in the field and a two-point calibration using saturated salt solutions in controlled conditions. A two-point calibration is performed as follows:

```
>CRH <cr>
RH : 12.00 Ref1 ? 11.3 <cr>
Press any key when ready ...
RH : 76.00 Ref2 ? 75.5 <cr>
```

In one-point offset correction, the Ref2 prompt is acknowledged with <cr>:

```
>CRH <cr>
RH : 12.80 Ref1 ? 11.3 <cr>
Press any key when ready ...
RH : 75.50 Ref2 ? <cr>
```

If the stabilization of the sensor to the humidity in the calibrator needs to be monitored, the measurement output can be repeated by giving command c<cr> at Ref1 and Ref2:

```
>CRH <cr>
RH : 12.00 Ref1 ? c <cr>
RH : 11.70 Ref1 ? c <cr>
RH : 11.50 Ref1 ? 11.3 <cr>
Press any key when ready ...
RH : 76.00 Ref2 ? 75.5 <cr>
```

FCRH Relative humidity calibration after sensor change

Disconnect the security lock jumper!

FCRH <cr>

After humidity sensor change the transmitter must be calibrated using this command and the calibration must be done at two reference points. The calibration is performed as follows:

```
>FCRH <cr>
RH : 1.90 Ref1 ? 11.3 <cr>
Press any key when ready ...
RH : 76.30 Ref2 ? 74.9 <cr>
```

The command can also be divided into two commands, so the computer can be used for other purposes while waiting for the sensor to stabilize to the higher humidity.

```
>FCRH 1 <cr>
RH : 1.90          Ref1 ?  11.3 <cr>

FCRH 2 <cr> ...
RH : 76.30 Ref2 ?  74.9 <cr>
```

If the stabilization of the sensor to the humidity in the calibrator needs to be monitored, the measurement output can be repeated by giving command c<cr> at Ref1 and Ref2:

```
>FCRH <cr>
RH : 12.00 Ref1 ?  c <cr>
RH : 11.70 Ref1 ?  c <cr>
RH : 11.50 Ref1 ?  11.3 <cr>
Press any key when ready ...
RH : 76.00 Ref2 ?  75.5 <cr>
```

CT Temperature calibration of the humidity sensor head

Disconnect the security lock jumper!

CT <cr>

With this command the humidity sensor head can be calibrated against an accurate reference, such as a Pt 100 simulator. A two-point calibration is performed as follows:

```
>CT <cr>
T : 0.80 Ref1 ?  0.0 <cr>
Press any key when ready ...
T : 56.20 Ref2 ?  55.0 <cr>
```

In one-point offset correction, the Ref2 prompt is acknowledged with <cr>:

```
>CT <cr>
T : 0.80 Ref1 ?  0.0 <cr>
Press any key when ready ...
T : 75.50 Ref2 ?  <cr>
```

If the stabilization of the sensor to the temperature of the calibrator or the reference needs to be monitored, the measurement output can be repeated by giving command c<cr> at Ref1 and Ref2:

```
>CT <cr>
T : 0.80 Ref1 ?  c <cr>
T : 0.40 Ref1 ?  0.00 <cr>
Press any key when ready ...
T : 56.20 Ref2 ?  55.0 <cr>
```

CTA Temperature calibration of the optional T sensor head**Disconnect the security lock jumper!****CTA <cr>**

With this command the optional temperature sensor head can be calibrated against an accurate reference, such as a Pt 100 simulator. A two-point calibration is performed as follows:

```
>CTA <cr>
Ta : 0.80  Ref1 ?  0.0 <cr>
Press any key when ready ...
Ta : 56.20 Ref2 ?  55.0 <cr>
```

In one-point offset correction, the Ref2 prompt is acknowledged with <cr>:

```
>CTA <cr>
Ta : 0.80  Ref1 ?  0.0 <cr>
Press any key when ready ...
Ta : 75.50 Ref2 ?  <cr>
```

If the stabilization of the sensor to the temperature of the calibrator or the reference needs to be monitored, the measurement output can be repeated by giving command c<cr> at Ref1 and Ref2:

```
>CTA <cr>
Ta : 0.80  Ref1 ?  c <cr>
Ta : 0.40  Ref1 ?  0.00 <cr>
Press any key when ready ...
Ta : 56.20 Ref2 ?  55.0 <cr>
```

ACAL Calibrating the analogue outputs**Disconnect the security lock jumper!****ACAL <cr>**

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

For example, calibrating the outputs when 0...10 V signal has been selected on both channels (set with AMODE command)

```
>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>
```

L Outputting linear correction coefficients

L <cr>

With the help of command L the user can check how the transmitter has been adjusted after it has been calibrated at the factory.

```
>L <cr>
RH  offset   : 0.000
RH  gain     : 1.000
Ts  offset   : 0.000
Ts  gain     : 1.000
Ta  offset   : 0.000
Ta  gain     : 1.000
```

where: Ts = temperature of the humidity sensor head

Ta = temperature of the temperature sensor head

LI Entering linear correction coefficients

Disconnect the security lock jumper!

LI <cr>

The LI command is one way of calibrating the transmitter.

```
>LI <cr>
RH  offset   : 0.000 ? 0.1 <cr>
RH  gain     : 1.000 ? <cr>
Ts  offset   : 0.000 ? <cr>
Ts  gain     : 1.000 ?
Ta  offset   : 0.000 ? -0.05
Ta  gain     : 1.000 ?
```

where: Ts = temperature of the humidity sensor head

Ta = temperature of the temperature sensor head

The factory settings are offset 0 and gain 1. The transmitter can be returned to its factory calibration by giving these values .

NOTE

The temperature unit in offset correction is always degrees Centigrade, even if the transmitter is using non-metric units (Fahrenheit) in its measurement output.

3. OUTPUT VIA THE SERIAL BUS

R Starting the measurement output

R <cr>

Starts output of measurements to the peripheral devices (PC display or printer); output interval is set with command INTV. The output format depends on the transmitter configuration and variables used. The sequence, however, is always the same: relative humidity, temperature, dewpoint temperature, absolute humidity, mixing ratio, wet bulb temperature and dewpoint difference. An example:

```
RH= 43.0 %RH T= 21.0 'C Tdp= 8.0 'C x= 6.7 g/kg Tw=
13.7 'C <cr><lf>
```

When the transmitter sends out the readings, the serial interface does not echo any commands; the only command that can be used is S (stop).

The output mode can be changed with command FORM.

S Stopping the measurement output

S<cr>

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

SEND Outputting a 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; set with command ADDR)

Outputs the current measurement readings via the serial line. The output format depends on which parameters the transmitter can output. Output types are:

```
"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.

DSEND Outputting readings of all connected transmitters once

DSEND <cr>

All transmitters connected to the serial bus send their addresses and current measurement readings in a sequence defined by their addresses. After receiving DSEND command a transmitter sets a delay time according to its address value and sends the data after this delay. DSEND works also in POLL mode. With this command the user can, for example, easily find out the addresses of the transmitters.

The output when four transmitters with addresses 4, 5, 10, 33 have been connected to the serial bus:

```
>dsend <cr>
  4 14.43 %RH
  5 22.7 'C
 10 14.99 %RH
 33 22.3 'C
>
```

ERRS Outputting error messages

ERRS <cr>

During operation, error messages are not automatically output through the serial interface. If there is any reason to doubt that there is something wrong with the transmitter, possible error messages can be output with command ERRS.

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

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

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

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


ECHO Turning the serial interface echo ON/OFF

```
ECHO xxx <cr>
```

xxx = ON or OFF

When the echo is off, the commands given through the serial interface or the prompt > cannot be seen on the display.

When the serial interface is in half-duplex mode, the echo is always off. Even then the ECHO command can indicate that echo is on.

INTV 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)

Sets the output interval when the transmitter outputs measurement readings to a peripheral device.

For example, the currently valid settings are output with:

```
>INTV <cr>  
Output intrv. : 0 min
```

When this is changed into 10 minutes, the command is:

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

The unit is changed into seconds with:

```
>INTV S <cr>  
Output intrv. : 10 s
```

The change can also be done with one command:

```
>INTV 10 S <cr>  
Output intrv. : 10 s
```

FORM Setting the output format

```
FORM <cr>
"xxx...xxx"
? zzz...zzz <cr>
```

```
xxx...xxx = old format
zzz...zzz = new format
```

The FORM command sets the format of the outputs generated in RUN state and by SEND command. Please note that **capital and small letters have different meanings.**

```
\UU..UU\ relative humidity
\TT..TT\ temperature
\DD..DD\ dewpoint temperature
\AA..AA\ absolute humidity
\XX..XX\ mixing ratio
\WW..WW\ wet bulb temperature
\dd..d\ dewpoint difference
\uu..uu\ unit according to the preceding variable
\n line feed <lf>
\r carriage return <cr>
\t horizontal tabulation <ht> or <tab>
\\ \
```

For example:

format	output
\UUU.UU\ \+TT.TT\r	100.00 +99.99 <cr>
\TTT.T\ \uu\r\n	15.2 'C <cr><lf>
\UUU.U\ \uuu\+DD.D\ \uu\r	46.9 %RH +10.8 'C <cr>

Any text can be written in the command and it appears in the output. For example:

```
RH: \UUU.U\ T: \+TT.TT\r          RH: 54.0 T: +25 <cr>
```

The format can be deleted by giving \ as a parameter:

```
>FORM \<cr>          Note, only one space before \ and none
after
```

or

```
>FORM <cr>
"xxx...xxx"
?\<cr>
```

An example of a format suitable for use in Microsoft Excel spreadsheets:

```
>FORM <cr>
"xxx...xxx"
```

```
?\UUU.U\\t\TTT.T\\t\DDD.D\\t\AAA.A\\t\XXX.X\\t\WWW.W\\
r\n <cr>
```

The output is then:

```
47.4<tab> 22.4 <tab> 10.6 <tab> 9.4 <tab> 8.0 <tab>
15.4 <cr><lf>
```

FTIME Adding time to output

FTIME xxx <cr>

xxx = ON or OFF

When FTIME is activated, the current time is output at the beginning of the output line. The time is set with command TIME. After RESET or power on the current time is 00:00:00.

Activating the time output

```
>ftime on
Form. time      : ON
>intv 5 s
Output intrv.   :      5 s
>r
09:31:13 RH= 19.4 %RH T= 26.0 'C
09:31:18 RH= 19.4 %RH T= 26.0 'C
09:31:23 RH= 19.8 %RH T= 26.0 'C
09:31:28 RH= 19.6 %RH T= 26.0 'C
09:31:33 RH= 19.5 %RH T= 26.0 'C
09:31:38 RH= 19.5 %RH T= 26.0 'C
...
```

Inactivating the time output

```
>ftime off
Form. time      : OFF
>r
RH= 19.4 %RH T= 26.1 'C
RH= 19.8 %RH T= 26.1 'C
RH= 20.6 %RH T= 26.1 'C
RH= 20.5 %RH T= 26.1 'C
RH= 19.9 %RH T= 26.1 'C
RH= 19.6 %RH T= 26.1 'C
...
```

FDATE Adding date to output

FDATE xxx <cr>

xxx = ON or OFF

When FDATE is activated, the current date is output at the beginning of the output line. The time is set with command DATE. After RESET or power on the current date is 1991-01-01.

Activating the date output

```
>fdate on
Form. date      :   ON
>r
1995-03-10 RH= 21.1 %RH T= 26.0 'C
1995-03-10 RH= 21.3 %RH T= 26.0 'C
1995-03-10 RH= 23.1 %RH T= 26.0 'C
1995-03-10 RH= 22.2 %RH T= 26.0 'C
1995-03-10 RH= 20.6 %RH T= 26.0 'C
...
```

Inactivating the date output

```
>fdate off
Form. date      :   OFF
>r
RH= 20.2 %RH T= 26.0 'C
RH= 19.9 %RH T= 26.0 'C
RH= 19.8 %RH T= 26.0 'C
RH= 19.7 %RH T= 26.0 'C
RH= 19.7 %RH T= 26.0 'C
...
```

SERI 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)

Giving the command on its own outputs the current settings:

```
>SERI <cr>
4800 E 7 1 FDX
```

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

```
>SERI O H <cr>          changing parity and duplex
4800 O 7 1 HDX
```

```
>SERI 600 N 8 1 F <cr>  changing all parameters
600 N 8 1 FDX
```

NOTE

The serial bus settings become effective only after reset.

The processor does not allow the following combinations:

- no parity, 7 data bits, 1 stop bit: if this combination is given the HMP240 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

When the half-duplex mode is set, it will automatically turn the echo off. Even then the ECHO command can indicate that echo is on.

UNIT Selecting the output units

UNIT x <cr>

x = m(etric units) n(on-metric units)

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

For example, the command for setting the non-metric units is:

```
>UNIT N <cr>
Output units : non metric
```

When the command is given with no parameters, the transmitter outputs the currently valid setting.

ADDR Setting the transmitter address

ADDR aa <cr>

aa = address (0...99)

The address is used when more than one transmitter is connected to one serial bus. The ADDR command makes it possible to communicate with one transmitter at a time in POLL state.

For example, transmitter is given address 99

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

When asking the current address, no address number is given:

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

FROST 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  
>
```

RESET Resetting the transmitter

RESET <cr>

Resets the transmitter. All settings that have been changed remain in the memory even after reset or power failure.

3.1 Operation modes

SMODE 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 state 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. For example:

```
>SMODE <cr>                which mode is in use at the moment
Serial mode      : STOP
>SMODE STOP <cr>          setting STOP mode
Serial mode      : STOP
```

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

When more than one transmitter is connected to the same serial bus, the POLL mode makes it possible to communicate with the transmitters. For example, a relative humidity calibration is performed at transmitter 2 (<bel> = ASCII 7):

```
>OPEN 2 <cr>
<cr><lf> 'HMP nn line opened for operator commands'
<cr><lf><lf><bel>
>CRH <cr>
...
>CLOSE <cr>
<cr><lf> 'line closed' <cr><lf>
```

4. OTHERS

ITEST Testing the analogue outputs

ITEST <cr>

or

ITEST a b <cr>

- a = current/voltage of channel 1
- b = current/voltage of channel 2

The operation of the analogue outputs can be tested by forcing the outputs to given values which can then be measured with a current/voltage meter from the analogue outputs. The response to ITEST command gives six outputs/parameters. Only the first two are relevant; they show the channel current or voltage in mA or V. The other four figures contain information for service purposes only.

Examples:

- reading the channel outputs and parameters

```
>itest <cr>  
1.9438 2.3483 1.00694 10.64634 1.97374 2.17665  
>
```

- forcing outputs 0.5 V and 4 V to channels 1 and 2

```
>itest 0.5 4 <cr>  
0.5000 4.0000 1.00694 10.62970 1.23336 3.01722  
>
```

- releasing the forced control and reading the outputs

```
>itest <cr>  
1.9427 2.3392 1.00731 10.62428 1.97157 2.16978  
>
```

FILT Setting the averaging time

Disconnect the security lock jumper!

FILT nnnn <cr>

- nnnn = 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 <cr>
Filter (S):  0 ?  1024
>

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

PRES **Setting the pressure for mixing ratio and wet bulb temperature calculations**

PRES pppp.pp <cr>

pppp.pp = pressure (hPa)

The atmospheric pressure has an effect on mixing ratio and wet bulb temperature. Therefore, accurate calculations can be achieved only when the ambient pressure is taken into consideration. The pressure is used for pressure compensation of the HUMICAP[®] sensor in order to ensure the best possible measurement accuracy.

When the command is given, the transmitter first gives the currently used pressure; after this a new value can be entered or the old one acknowledged.

```
>PRES <cr>
Pressure            :  1013.25 ?  1000.00 <cr>
```

When the currently used pressure is known, a new pressure can also be entered directly:

```
>PRES 1010 <cr>
Pressure            :  1010
```

NOTE

If the pressure setting is frequently adjusted, e.g. by using an external barometer as a pressure input source, the command XPRES is recommended.

XPRES Setting the pressure for mixing ratio and wet bulb temperature calculations temporarily

XPRES pppp.pp <cr>

pppp.pp = pressure (hPa)

The function and format of XPRES are the same as those of the PRES command except that by using XPRES the setting is valid only until a reset is given or power is turned off or pressure is set to zero using XPRES. After this the pressure stored using command PRES is valid again.

CDATE Entering calibration date

CDATE xxxxxx <cr>

xxxxxx = calibration date (000101...991231)

When the latest calibration date has to be kept in memory, it is entered as follows:

```
>CDATE 940506 <cr>
```

If the command is given without the date, the transmitter outputs the latest calibration already in memory.

```
>CDATE <cr>  
940420
```

The date can be given in any format; however, the maximum number of digits is six.

DATE Setting the date

DATE <cr>

For example, to enter a new date:

```
>DATE <cr>  
Current date is 1993-01-30  
Enter new date (yyyy-mm-dd) : 1993-06-12 <cr>
```

When the current date is asked, the new date is passed with <cr>.

TIME Setting the time

TIME <cr>

For example, to enter a new time:

```
>TIME <cr>
Current time is 01:35:54
Enter new time (hh:mm:ss) : 13:25:56 <cr>
```

When the current time is asked, the new time is passed with <cr>.

VERS Name and version of the programme**VERS <cr>**

For example:

```
>VERS <cr>
HMP 240 / x.yy
```

where x.yy is the programme version.

? Outputting the transmitter settings**? <cr>**

For example:

```
>? <cr>
HMP 240 / 1.02
CPU serial nr : 0
Keyboard type : 0
Address : 7
Output units : metric
Baud P D S : 4800 E 7 1 FDX
Serial mode : STOP
Output intrv. : 0 min
Mtim : 32
Pressure : 1013.25
Analog outputs
Ch1 0.00 ... 10.00 V
Ch2 0.00 ... 10.00 V
Ch1 ( RH ) lo 0.000 %RH
Ch1 ( RH ) hi 100.000 %RH
Ch2 ( T ) lo -20.000 'C
Ch2 ( T ) hi 180.000 'C
Transducer :
PRB serial nr : 0
Calibr. date : 0
```

?? Outputting the transmitter settings also in POLL mode

?? <cr>

Command ?? outputs the same information as command ? but it works also when the transmitter has been set to POLL mode. However, if there are more than one addressed transmitters connected to the serial bus, they all will respond at the same time and the output on the screen will be chaotic.

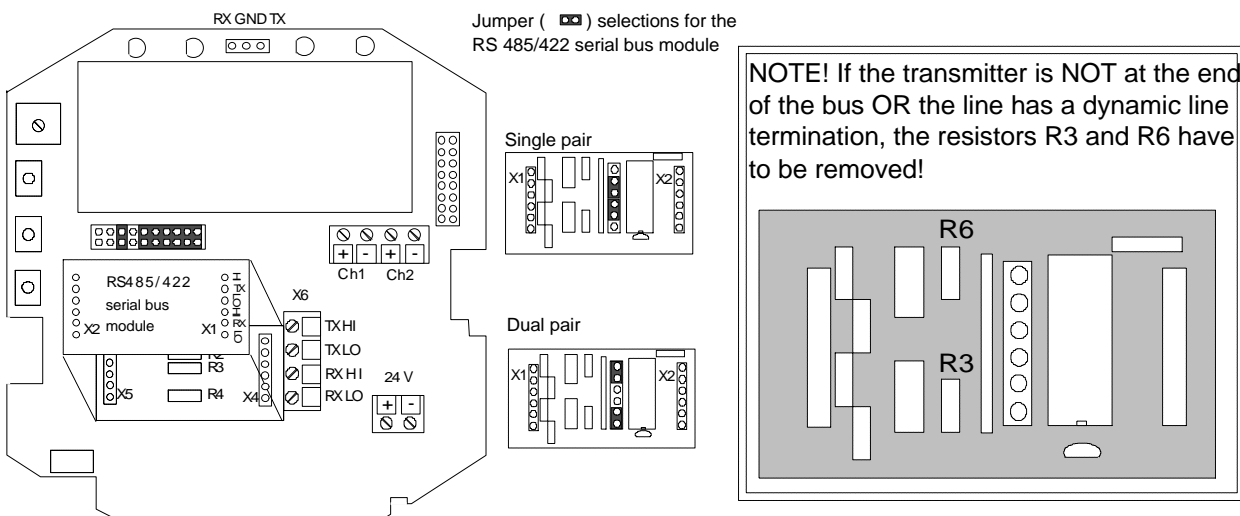
APPENDIX 2: INSTALLING AND USING THE RS 485/422 SERIAL PORT MODULE

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1. INSTALLATION

Switch the transmitter off.

Resistors R2, R3 and R4 between connectors X4 and X5 in the component board in the cover of the transmitter are removed with side-cutting pliers. The module is plugged in connectors X4 and X5 on the main board of the HMP240 transmitter; connector X1 on the module board to connector X4 and connector X2 to connector X5.



Cut off the resistors R2, R3 and R4 on the main board.
 New signal names for X6 screw terminal are on the module.
 Follow the instructions on the module:
 X1 to X4 and
 X2 to X5 on the mother board

Connect the data wires to screw terminal X6 on the main board. Switch the power on.

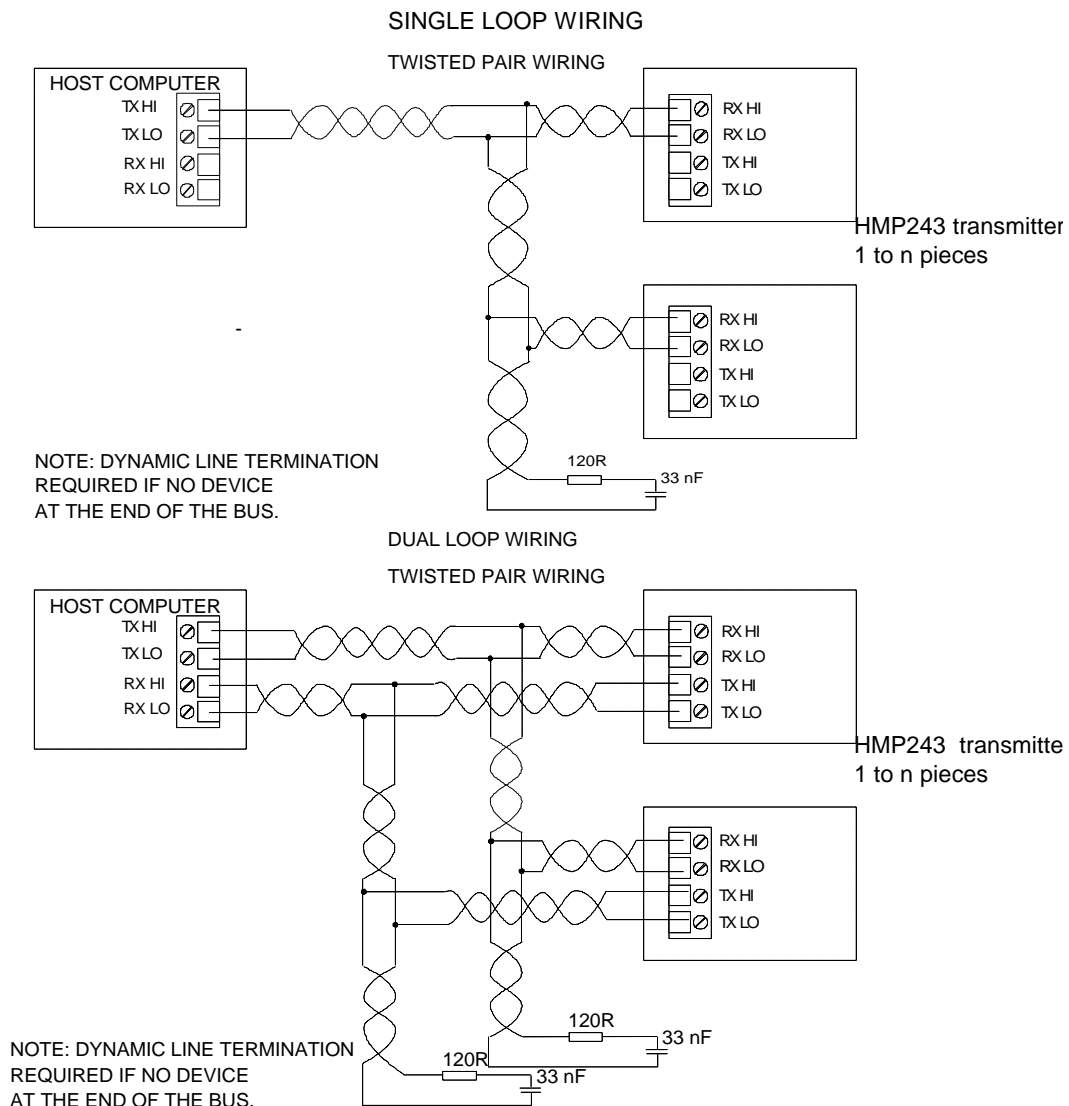
2. OPERATION

The HMP240 transmitter can either be given an address or operated without an address. Both single and dual loop wiring with half duplex connection can be used. No address is needed when only one HMP240 transmitter is used; when several transmitters are connected to the same line, each transmitter must be given an address in the initial configuration.

A single transmitter can get its operating voltage from the master or it can have its own (floating) power supply.

The serial line structure is a parallel interfaced chain (daisy chain). At the end of the serial line there must be an HMP240 transmitter, dynamic line adapter (120 ohm resistor in series with a 33 nF capacitor) or line master. If a branch line is made with a junction box, the branch should be shorter than 3 meters.

When connecting the device, follow the instructions given in the figure in Chapter 1.



The RS 485/422 module has separate lines for transmitting and receiving, but they can be connected together with jumpers. Dual loop connection is the factory setting; when a single loop connection is used, the positions of jumpers in connector X4 on the module must be changed.

The HI of the receiving line is approx. 0.6 V and its LO is approx. 0 V in order to reduce noise on the lines when no data is transferred (idling). Both lines are terminated with a 120 ohm resistor in series with a 33 nF capacitor. When operating the transmitter through a single pair, only one line terminal impedance is in use. The line must not be terminated with a resistor alone, as the power consumption increases too much.

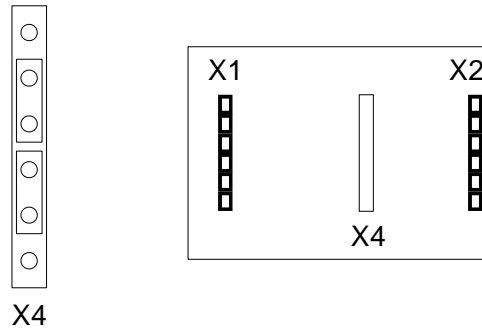
The data lines can withstand short circuit to ground and to each other. They do not survive connection of supply voltage to the data lines.

The module must be mounted on the main board in the right direction. If mounted in the wrong direction or to the wrong pins, the module will not break but it does not work.

3. NETWORK CONFIGURATION

3.1 Single loop operation

Bi-directional data on one pair is one of the great advantages of the RS 485 line. Set jumpers in connector X4 on the module board as shown in the figure below.



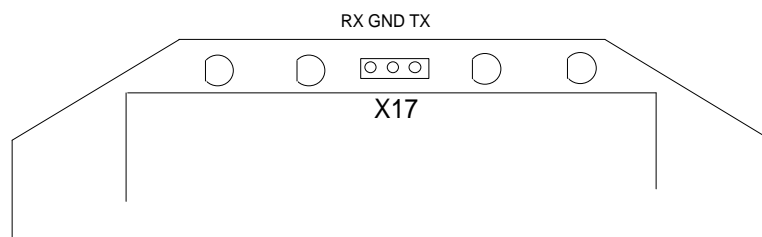
This jumper setting connects RX HI to TX HI and RX LO to TX LO and selects only one common line termination. The HI and LO terminals of the RX pair can now be used for operation.

Supplying power from the same end to the whole network prevents common mode voltages from rising too high (over 7 V).

- Connect wires to the transmitter's serial connector.
- Check the wiring.

The following procedure must be repeated with all transmitters.

- Open the transmitter cover.
- Pull out the RS 485/422 serial port module, if it is already mounted.
- Set the serial port of the terminal to 4800 baud, even parity, seven data bits and one stop bit, full duplex (4800 E 7 1 FDX).



- The serial settings of the transmitter must also be 4800 E 7 1 FDX and the transmitter must be in STOP mode. If these factory settings have been changed, they must be returned. Connect the RS 232C port of the terminal to connector X17 on the top of the main board and switch the power on.

- Set the address of the transmitter; you can choose any number between 1 and 99. In this example the address is 22:

```
>addr 22
Address      :      22
```

- Set the serial bus settings according to your network specifications. This setting will become valid after next RESET or power off:

```
>seri 2400 e 7 1 h
2400 E 7 1 HDX
```

- Set the transmitter in POLL mode:

```
>smode poll
Serial mode  : POLL
```

NOTE 1

The SMODE command must be given last.

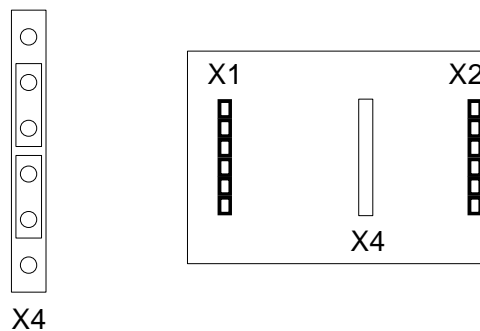
NOTE 2

The transmitter outputs no prompt (>) after the SMODE POLL command and it only reacts to commands which include its address.

- Check that the transmitter responds to its address:

```
>send 22
RH= 24.4 %RH T= 29.1 'C
```

- Disconnect the terminal.
- Check that the jumpers in connector X4 are in the right places.



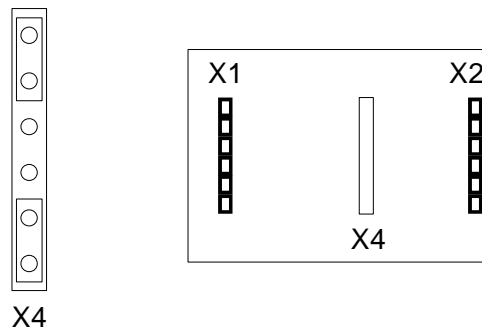
- Remount the RS 485/422 serial module.
- Close the cover.
- When all transmitters on the network have been configured, switch them off.

3.2 Dual loop operation

The following procedure must be repeated with all transmitters.

- Open the transmitter cover.
- Pull out the RS 485/422 serial port module, if it is already mounted.
- Set the serial port of the terminal to 4800 baud, even parity, seven data bits and one stop bit, full duplex (4800 E 7 1 FDX).
- The serial settings of the transmitter must also be 4800 E 7 1 FDX and the transmitter must be in STOP mode. If these factory settings have been changed, they must be returned. Connect the RS 232C port of the terminal to connector X17 on the top of the main board and switch the power on.

When dual loop is used, the jumpers in connector X4 on the module board must be as shown below.



- Set the address of the transmitter; you can choose any number between 1 and 99. In this example the address is 22:

```
>addr 22
Address : 22
```

- Set the serial bus settings according to your system. This setting will become valid after next RESET or power off:

```
>seri 2400 e 7 1 f
2400 E 7 1 FDX
```

- Switch echo on:

```
>echo on
ECHO : ON
>
```

- Change the serial output mode into POLL:

```
>smode poll
Serial mode : POLL
```

NOTE 1

The SMODE command must be given last.

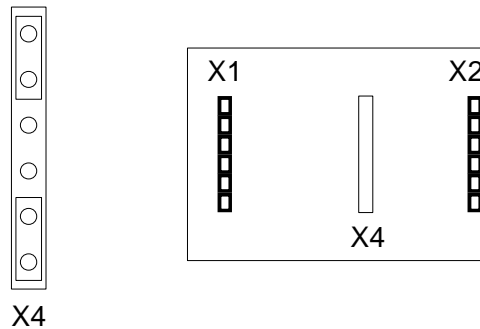
NOTE 2

The transmitter outputs no prompt (>) after the SMODE POLL command and it only reacts to commands which include its address.

- Check that the transmitter responds to its address:

```
>send 22  
RH= 24.4 %RH T= 29.1 'C
```

- Disconnect the terminal.
- Check that the jumpers in connector X4 are in the right place



- Remount the RS 485/422 serial module.
- Close the cover.
- Repeat this setting procedure with each transmitter.
- When all transmitters on the network have been configured, switch them off.

4. CHECKING THE SERIAL PORT NETWORK OPERATION

Measurement readings are normally asked with the transmitter in POLL mode; the command must include the address of the transmitter. If the settings of the transmitter need to be changed, the transmitter is switched to STOP mode with command OPEN; commands can then be given without address. When the line to the transmitter is closed, it returns to POLL mode.

4.1 STOP mode

Open the line to the transmitter:

```
open 22<cr>
HMP 22 line opened for operator commands
```

Transmitter no. 22 is now temporarily set to STOP mode; it accepts commands sent without address until CLOSE command is given. Individual settings can now be easily modified. Do not open more than one line at a time.

Use command ? to find out the settings of the active transmitter:

```
? <cr>
HMP 240 / 1.02
CPU serial nr : 0
Keyboard type : 0
Address : 7
Output units : metric
Baud P D S : 4800 E 7 1 FDX
Serial mode : STOP
Output intrv. : 0 min
Mtim : 32
Pressure : 1013.25
Analog outputs
Ch1 0.00 ... 10.00 V
Ch2 0.00 ... 10.00 V
Ch1 ( RH ) lo 0.000 %RH
Ch1 ( RH ) hi 100.000 %RH
Ch2 ( T ) lo -20.000 'C
Ch2 ( T ) hi 180.000 'C
Transducer :
PRB serial nr : 0
Calibr. date : 0
```

When the necessary settings have been given, close the line to transmitters (the command closes all open lines):

```
>close
line closed
```

CLOSE command is always given without address. If no line is open, there will be no response to the CLOSE commands.

4.2 POLL mode

If a transmitter has been set to POLL mode, it will respond only to commands sent with its address:

```
send 22  
RH= 24.4 %RH T= 29.1 'C
```

Addresses from 1 to 99 can be used. According to the RS 485/422 standard a maximum of 32 devices can be connected on same bus, but the number can be increased if the line length and/or baud rate is reduced.

More than one baud rate can be used on an RS 485 line. E.g. the host of the line can use different baud rates with different devices (this makes it possible to use the same address for several devices).

The line terminations must be dynamic; e.g. an RC circuit is used instead of a simple resistor termination. Each RS 485 module has a dynamic line termination so it can be used at the end of a line.

4.3 RS 485 network settings

HMP240 settings	Single pair	Dual pair
Full duplex/half duplex	HDX	FDX
Echo on/off	OFF	ON

Terminal settings	Single pair	Dual pair
Line feed after carriage re- turn	yes	no
HDX/FDX	FDX	FDX

When terminal is set to general <lf> (line feed) after <cr> (carriage return), the listings will have two line feeds where also the HMP240 transmitters send line feed.

5. SPECIFICATIONS

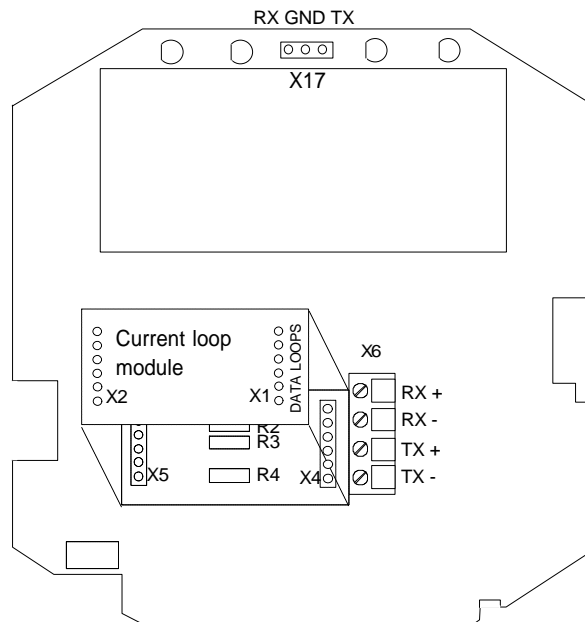
Connections on the main board	Berg sockets screw terminals 0.5 mm ² wires, stranded wires recommended
Assembly	plug-in module
Board dimensions	40 x 28 mm
Operating mode (single or dual pair wiring)	half duplex
Network:	
network type	daisy chain
cable type	twisted pair
line length max.	1000 m (3000 ft)
number of devices	32 devices on line
data speed	9600 baud max. for HMP240 transmitters
operating mode	polling mode
common mode voltage range	±7 V
Operating temperature	-40...+60 °C
Storage temperature	-40...+70 °C

APPENDIX 3: INSTALLING AND USING THE DIGITAL CURRENT LOOP MODULE

INSTALLATION

Switch the transmitter off.

Resistors R2, R3 and R4 between connectors X4 and X5 in the component board in the cover of the transmitter are removed with side-cutting pliers. The module is plugged in connectors X4 and X5 on the main board of the HMP240 transmitter; connector X1 on the module board to connector X4 and connector X2 to connector X5.



Connect the data wires to screw terminal X6 on the main board. Switch the power on.

OPERATION

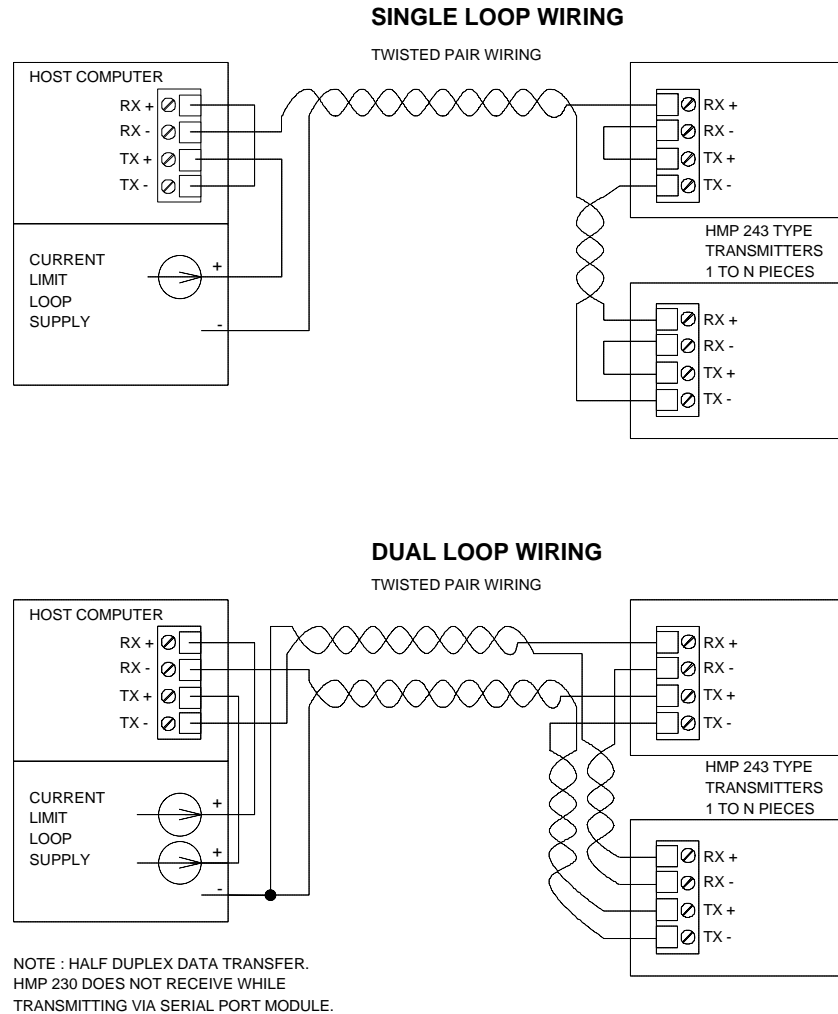
The HMP240 transmitter can either be given an address or operated without an address. Both single and dual loop wiring with half duplex connection can be used. No address is needed when only one HMP240 transmitter is used; when several transmitters are connected to the same line, each transmitter must be given an address in the initial configuration.

A current loop must get its operating voltage from the master or it can have its own (floating) power supply capable of supplying 15...40 V and 20...30 mA.

Unregulated AC/DC adapter can be used, if the current is limited to 20 mA at least by a serial resistor.

Note. The host computer can restrict the loop supply voltage that can be used; see computer specifications.

The serial line structure is a serial interfaced chain (daisy chain). At one end of the serial line there must be a HMP240 transmitter and at the other end a line master. A branch line can be made with a junction box.



The digital current loop module has separate lines for transmitting and receiving. Both single loop wiring and dual loop wiring can be used (see figure). With dual loop connection it is possible to have a few more transmitters on the same loop pair. The wiring of single loop connection is more simple. Data transmission is achieved by switching the loop current on and off.

Normally current flows through the loop(s) even when the HMP240 transmitter is not on, so switching one transmitter off does not affect the other transmitters on the loop.

When the wires have been connected correctly, the voltage drop from RX+ to RX- is below 2 V. If the wires RX+ and RX- or TX+ and TX- are connected

incorrectly, the voltage drop from RX+ to RX- or from TX+ to TX- is below 1 V and the transmitter does not work. Even then the current goes through the loop and the other transmitters can be operated normally.

When the loop supply is current limited, the data lines can withstand short circuit to ground and to each other. They do not survive connection of supply voltage to the data lines.

The module must be mounted on the main board in the right direction. If mounted in the wrong direction or to the wrong pins, the module will not break but it does not work. Reverse wiring of RX+ and RX- or TX+ and TX- does not affect the module.

NETWORK CONFIGURATION

Single loop operation

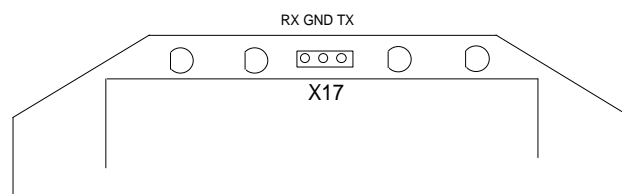
Bi-directional data on one pair and galvanic isolation are the advantages of the current loop. Single pair/dual pair use is configured through wiring (see figure on previous page).

Supplying power from the same end to the loops prevents crossover voltages.

- Connect wires to the transmitter's serial connector.
- Check the wiring.

The following procedure must be repeated with all transmitters.

- Open the transmitter cover.
- Pull out the digital current loop module, if it is already mounted.
- Set the serial port of the terminal to 4800 baud, even parity, seven data bits and one stop bit, full duplex (4800 E 7 1 FDX).
- The serial settings of the transmitter must also be 4800 E 7 1 FDX and the transmitter must be in STOP mode. If these factory settings have been changed, they must be returned. Connect the RS 232C port of the terminal to connector X17 on the top of the main board and switch the power on.



Single loop wiring

- Set the address of the transmitter; you can choose any number between 1 and 99. In this example the address is 22:

```
>addr 22
Address      :      22
```

- Set the serial bus settings according to your network specifications. This setting will become valid after next RESET or power off:

```
>seri 2400 e 7 1 h
2400 E 7 1 HDX
```

- Set the transmitter in POLL mode:

```
>smode poll
Serial mode  : POLL
```

NOTE 1

The SMODE command must be given last.

NOTE 2

The transmitter outputs no prompt (>) after the SMODE POLL command and it only reacts to commands which include its address.

- Check that the transmitter responds to its address:

```
send 22
RH= 24.4 %RH T= 29.1 'C
```

- Disconnect the terminal.
- Remount the digital current loop module.
- Close the cover.
- When all transmitters on the network have been configured, switch them off.

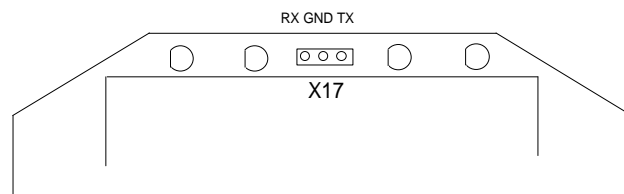
Dual loop operation

Single pair/dual pair use is configured through wiring (see figure on page 2).

The following procedure must be repeated with all transmitters.

- Open the transmitter cover.
- Pull out the digital current loop module, if it is already mounted.

- Set the serial port of the terminal to 4800 baud, even parity, seven data bits and one stop bit, full duplex (4800 E 7 1 FDX).
- The serial settings of the transmitter must also be 4800 E 7 1 FDX and the transmitter must be in STOP mode. If these factory settings have been changed, they must be returned. Connect the RS 232C port of the terminal to connector X17 on the top of the main board and switch the power on.



Dual loop wiring

- Set the address of the transmitter; you can choose any number between 1 and 99. In this example the address is 22:

```
>addr 22
Address          :    22
```

- Set the serial bus settings according to your system. This setting will become valid after next RESET or power off:

```
>seri 2400 e 7 1 f
2400 E 7 1 FDX
```

- Switch echo on:

```
>echo on
ECHO          :    ON
>
```

- Change the serial output mode into POLL:

```
>smode poll
Serial mode   :    POLL
```

NOTE 1

The SMODE command must be given last.

NOTE 2

The transmitter outputs no prompt (>) after the SMODE POLL command and it only reacts to commands which include its address.

- Check that the transmitter responds to its address:

```
>send 22
RH= 24.4 %RH T= 29.1 'C
```

- Disconnect the terminal.
- Remount the digital current loop module.
- Close the cover.
- Repeat this setting procedure with each transmitter
- When all transmitters on the network have been configured, switch them off.

CHECKING THE SERIAL PORT NETWORK OPERATION

Measurement readings are normally asked with the transmitter in POLL mode; the command must include the address of the transmitter. If the settings of the transmitter need to be changed, the transmitter is switched to STOP mode with command OPEN; commands can then be given without address. When the line to the transmitter is closed, it returns to POLL mode.

STOP mode

Open the line to the transmitter:

```
open 22<cr>
HMP 22 line opened for operator commands
```

Transmitter no. 22 is now temporarily set to STOP mode; it accepts commands without address until CLOSE command is given. Individual settings can now be easily modified. Do not open more than one line at a time.

Use command ? to find out the settings of the active transmitter:

```
? <cr>
HMP 240 / 1.02
CPU serial nr : 0
Keyboard type : 0
Address : 7
Output units : metric
Baud P D S : 4800 E 7 1 FDX
Serial mode : STOP
Output intrv. : 0 min
Mtim : 32
Pressure : 1013.25
Analog outputs
Ch1 0.00 ... 10.00 V
Ch2 0.00 ... 10.00 V
Ch1 ( RH ) lo 0.000 %RH
Ch1 ( RH ) hi 100.000 %RH
Ch2 ( T ) lo -20.000 'C
```

```
Ch2 ( T ) hi 180.000 'C  
Transducer   :  
PRB serial nr : 0  
Calibr. date  : 0
```

When the necessary settings have been given, close the line to transmitters (the command closes all open lines):

```
>close  
line closed
```

CLOSE command is always given without address. If no line is open, there will be no response to the CLOSE commands.

POLL mode

If a transmitter has been set to POLL mode, it will respond only to commands sent with its address:

```
send 22  
RH= 24.4 %RH T= 29.1 'C
```

Addresses from 1 to 99 can be used. According to the 20 mA current loop standard current flows with no transmission on line. A maximum of 6 devices can be connected on same single loop line, but the number can be increased to 9 by using dual loop wiring.

More than one baud rate can be used on a current loop line. E.g. the host of the line can use different baud rates with different devices (this makes it possible to use the same address for several devices).

Current loop settings

HMP240 settings	Single pair	Dual pair
Full duplex/half duplex	HDX	FDX
Echo on/off	OFF	ON

Terminal settings	Single pair	Dual pair
Line feed after carriage return	yes	no
HDX/FDX	FDX	FDX

When terminal is set to general <lf> (line feed) after <cr> (carriage return), the listings will have two line feeds where also the HMP240 transmitters send line feed.

Specifications

Galvanic isolation	1500 VAC/DC max. (1 min)
Loop supply voltage	40 V max.
Loop supply current must be current limited	20 mA nominal
Operating loop voltage requirement	4 V/each transmitter (TX+/TX-) on the loop 2 V/each receiver (RX+/RX-) on the loop
Loop current	12...30 mA (space) 0...2 mA (mark) 30 mA max.
Connections on the main board	Berg sockets screw terminals 0.5 mm ² wires, stranded wires recommended
Assembly	plug-in module
Board dimensions	40 x 28 mm
Operating mode (single or dual pair wiring)	half duplex
Network:	
network type	serial daisy chain
cable type	twisted pair
line length max.	1000 m (3000 ft)
number of devices	6 devices on line (single loop) 9 devices on line (dual loop)
data speed	4800 baud max.
operating mode	polling mode
isolation voltage proof	250 VAC (1 min)
Operating temperature	-40...+60 °C
Storage temperature	-40...+70 °C

APPENDIX 4: ERROR MESSAGES

1.1	Errors after reset	112
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1. ERROR TYPES

The HMP240 transmitter goes through a self-diagnostics procedure when the power is switched on. When the procedure does not reveal any errors or faults, the transmitter starts its normal operation. If errors or faults are found, the transmitter outputs an error message. Possible error message can also be checked with command ERRS (see Appendix 1). Note also that if the analogue current output is selected to be 4 - 20 mA, in case of error the signal drops to 0 mA.

The error messages can be divided into two groups: error messages after reset and error messages during operation.

LED symbols:

○	LED dark
⊠	LED blinking
●	LED lit

1.1 Errors after reset

Display

Serial bus

```
E11 CPU EEPROM
ackn. error
```

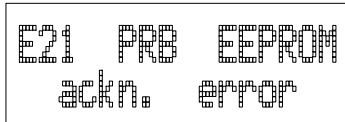
E11 CPU EEPROM ackn. error

- the CPU hybrid is probably damaged. Send the transmitter to Vaisala for repair.

```
E12 CPU EEPROM
csun error
```

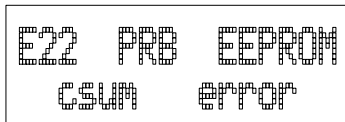
E12 CPU EEPROM checksum error

- possibly due to an electrical disturbance an erroneous parameter value or an incorrect checksum has been stored in the EEPROM. Change any parameter value (e.g. with command INTV) and give command RESET, or turn the power off and then on again. If the error message no longer appears, the transmitter is in order. Should the message re-appear repeatedly, send the transmitter to Vaisala for repair.



E21 PRB EEPROM ackn. error

- no connection to the EEPROM including calibration information can be formed. Send the transmitter to Vaisala for repair.



E22 PRB EEPROM checksum error

ackn. error = EEPROM is faulty
 checksum error = check sum is erroneous

- possibly due to an electrical disturbance an erroneous calibration parameter value or an incorrect checksum has been stored in the EEPROM including the calibration information. Change any parameter value, e.g. RH offset: check the value with command L, write it down and then change it with command LI. Return the previous value with command LI and give command RESET, or turn the power off and then on again. If the error message no longer appears, check the transmitter reading and if it seems to be in order, the transmitter can be taken into use again. Should the message re-appear repeatedly, send the transmitter to Vaisala for repair.

The LEDs display these error types as follows:

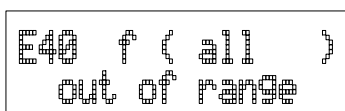
○●○○	CPU EEPROM error
●○○○	input hybrid error

1.2 Errors during operation

Two types of errors are possible during operation of the transmitters. The first type indicates that no frequency comes from the converter.

Display:

Serial bus:



E40 f (all) out of range

- the measurement hybrid is probably damaged. Send the transmitter to Vaisala for repair.

```

E41 f ( T )
out of range

```

E41 f (T) out of range

- the temperature measurement cannot be completed. Check the temperature sensor when only a humidity probe is used, and both temperature sensors if also an additional temperature probe is used. Check also the temperature measurement wires and their solderings on the component board (TP5,TP6,TP7 and TP8 for the humidity probe and TP1, TP3 and TP4 for the additional temperature probe). If you cannot find any faults, send the transmitter to Vaisala for repair.

```

E42 f ( T2 )
out of range

```

E42 f (T2) out of range

- the temperature measurement cannot be completed. Check the temperature sensor and its solderings. Check the temperature measurement wires and their solderings on the component board (TP5,TP6,TP7 and TP8). If you cannot find any faults, send the transmitter to Vaisala for repair.

```

E43 f ( Rk1 )
out of range

```

E43 f (Rk1) out of range

- the temperature measurement cannot be completed. Check the temperature sensor and its solderings. Check the temperature measurement wires and their solderings on the component board (TP5,TP6,TP7 and TP8). If you cannot find any faults, send the transmitter to Vaisala for repair.

```

E44 f ( Rk2 )
out of range

```

E44 f (Rk2) out of range

- the temperature measurement cannot be completed. Check the temperature sensor and its solderings. Check the temperature measurement wires and their solderings on the component board (TP5,TP6,TP7 and TP8). If you cannot find any faults, send the transmitter to Vaisala for repair.

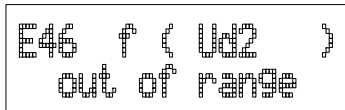
```

E45 f ( Ud1 )
out of range

```

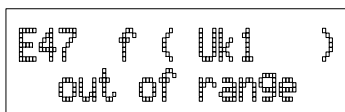
E45 f (Ud1) out of range

- the humidity measurement cannot be completed. Check the HUMICAP sensor and humidity measurement wires and their solderings on the component board (TP9,TP10 and TP11/15). If you cannot find any faults, send the transmitter to Vaisala for repair.



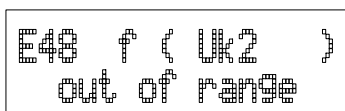
E46 f (Ud2) out of range

- the measurement hybrid is probably damaged. Send the transmitter to Vaisala for repair.



E47 f (Uk1) out of range

- the measurement hybrid is probably damaged. Send the transmitter to Vaisala for repair.



E48 f (Uk2) out of range

- the measurement hybrid is probably damaged. Send the transmitter to Vaisala for repair.

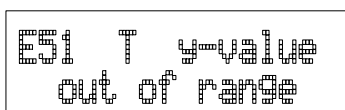
The LEDs display these error types as follows:

○ ○ ✕ ✕	no frequency at all
○ ○ ✕ ○	a frequency missing from the RH channel
○ ○ ○ ✕	a frequency missing from the T channel

The second error type indicates erroneous y-values (used in internal calculations):

Display:

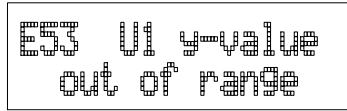
Serial bus:



E51 T y-value out of range

- the temperature measurement cannot be completed. Check the temperature sensor when only a humidity probe is used, and both temperature sensors if also an additional temperature probe is used. Check also the temperature measurement wires and their solderings on the component board

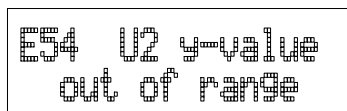
(TP5,TP6,TP7 and TP8 for the humidity probe and TP1, TP3 and TP4 for the additional temperature probe). If you cannot find any faults, send the transmitter to Vaisala for repair.



E53 U1 y-value
out of range

E53 U1 y-value out of range

- the humidity measurement cannot be completed. Check the HUMICAP sensor and humidity measurement wires and their solderings on the component board (TP9,TP10 and TP11/15). If you cannot find any faults, send the transmitter to Vaisala for repair.



E54 U2 y-value
out of range

E54 U2 y-value out of range

- the measurement hybrid is probably damaged. Send the transmitter to Vaisala for repair.

The LEDs display these error types as follows:

⊠ ○ ○ ○	RH channel y-value out of range
○ ⊠ ○ ○	T channel y-value out of range

APPENDIX 5: CALCULATION FORMULAS

The HMP240 transmitter measures relative humidity and temperature. From these values dewpoint, mixing ratio and absolute humidity are calculated using the following equations:

$$\text{dewpoint:} \quad T_d = \frac{T_n}{\frac{m}{\log \left(P_{ws} \cdot \frac{RH}{100 \cdot A} \right) - 1}} \quad (1)$$

$$\text{mixing ratio:} \quad x = 621.98 \cdot RH \cdot \frac{P_{ws}}{(100 \cdot p - RH \cdot P_{ws})} \quad (2)$$

$$\text{absolute humidity:} \quad a = 216.68 \cdot RH \cdot \frac{P_{ws}}{100 \cdot (t + 273.2)} \quad (3)$$

where

- T_d = dewpoint temperature (°C)
- P_{ws} = partial pressure of saturated water vapour (mbar)
- RH = relative humidity (%)
- x = mixing ratio (g/kg)
- p = atmospheric pressure (mbar)
- a = absolute humidity (g/m³)
- t = temperature (°C)

The partial pressure of water P_{ws} is calculated using equation:

$$\Theta = T - \sum_{i=0}^3 C_i T^i \quad (4)$$

where:

- T = temperature in K
- C_i = coefficients
- C_0 = 0.4931358
- C_1 = -0.46094296 * 10⁻²
- C_2 = 0.13746454 * 10⁻⁴
- C_3 = -0.12743214 * 10⁻⁷

The vapour pressure (in Pascals) is calculated using equation:

$$\ln P_{ws} = \sum_{i=-1}^3 b_i \Theta^i + b_4 \ln \Theta$$

where: b_i = coefficients

$$b_{-1} = -0.58002206 * 10^4$$

$$b_0 = 0.13914993 * 10^1$$

$$b_1 = -0.48640239 * 10^{-1}$$

$$b_2 = 0.41764768 * 10^{-4}$$

$$b_3 = -0.14452093 * 10^{-7}$$

$$b_4 = 6.5459673$$

The parameters A , m , and T_n depend on temperature according to the following table:

t	A	m	T_n
0 ... 50 °C	6.1078	7.5000	237.3
50 ... 100 °C	5.9987	7.3313	229.1
100 ... 150 °C	5.8493	7.2756	225.0
150 ... 180 °C	6.2301	7.3033	230.0

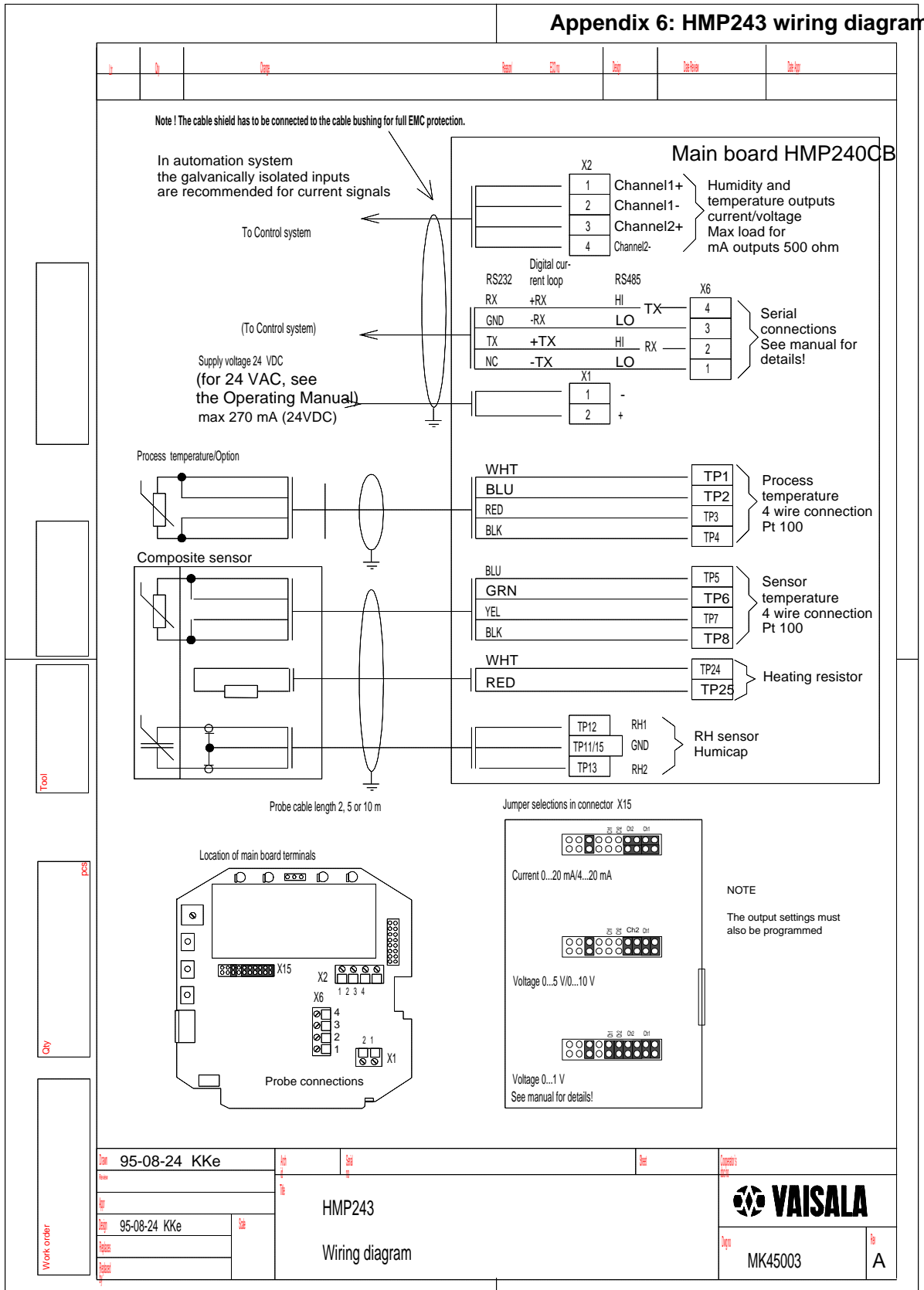
When $T_d < 0$ and the transmitter is set to dewpoint calculation mode (FROST OFF), the parameters are as follows:

$$A = 6.119866 \quad m = 7.926104 \quad T_n = 250.4138$$

When $T_d < 0$ and the transmitter is set to frostpoint calculation mode (FROST ON), the parameters are as follows:

$$A = 6.1134 \quad m = 9.7911 \quad T_n = 273.47$$

APPENDIX 6: HMP240 WIRING DIAGRAM



APPENDIX 7: RE-GAINING

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1. GENERAL

In some specific applications the sensor gain may decrease gradually due to an interference caused by some particular chemical present in the ambient (see figure 1). The sensor polymer absorbs the interfering chemical; this reduces the polymer's ability to absorb water molecules and so decreases the sensor gain.

In re-gaining the interfering chemical is evaporated by heating the humidity sensor. Automatic re-gaining (if active) takes place repeatedly with time intervals defined by the user. Re-gaining can also be started manually using either LED, display/keypad or serial commands.

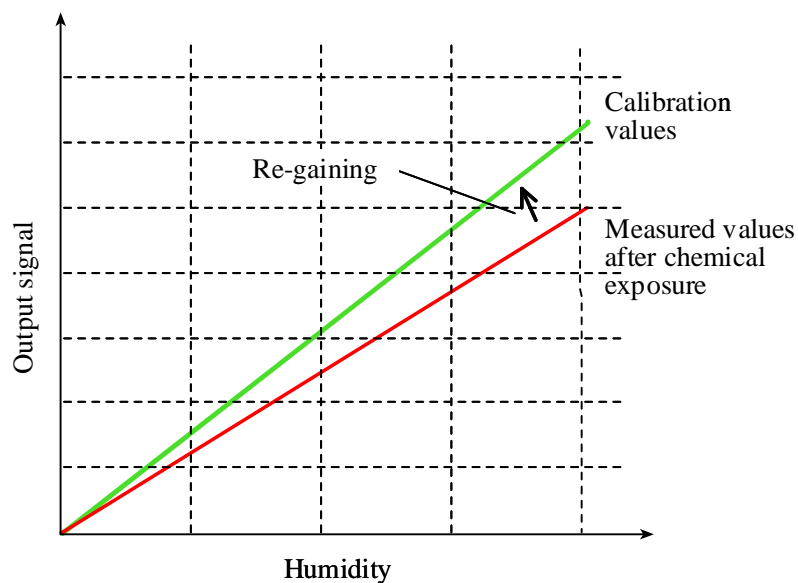


Figure 1.1 Decrease of the sensor gain due to an interfering chemical and the effect of the re-gaining process.

Re-gaining option requires that the sensor is protected either with a PPS grid with stainless steel netting (part no. 16720HM) or with a stainless steel sintered filter (part no. 16452).

2. TO BE NOTED IN RE-GAINING

Re-gaining cannot be started automatically or manually unless the security lock jumper is on. This prevents automatic re-gaining during a sensor calibration (when the security lock jumper must be removed). Furthermore, re-gaining can be started only if the sensor temperature is below 100 °C. At higher temperatures the chemicals evaporate spontaneously from the sensor, and the re-gaining is not necessary. The power consumption during re-gaining is 270 mA maximum (24 VDC).

NOTE

The possible re-gaining must always take place before a humidity calibration of the transmitter and not after. Make sure that the temperature of the composite sensor has come down to normal temperature before starting a calibration.

Re-gaining can be automatic or it can be started manually. For automatic re-gaining, five parameters are stored in the transmitter memory: the re-gaining interval, the duration of the sensor heating, the settling - cooling - time, the difference between the current sensor temperature and the ambient temperature measured before re-gaining and the k parameter (the power level the sensor is heated at). The parameter values can be changed by the user; however, please note that it is necessary to remove the security lock jumper first. The factory settings are:

Interval	min	:	720
Duration	s	:	120
Temp diff		:	0.50
Settl time	s	:	240
k	%	:	95.00

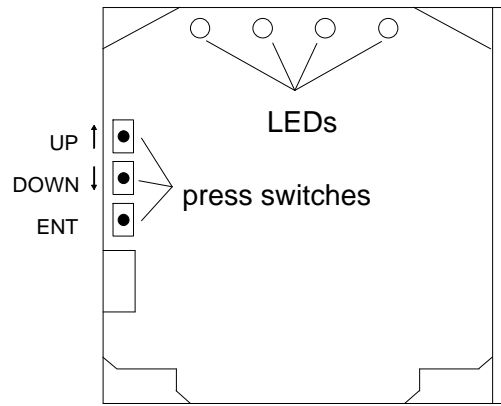
The time interval between subsequent re-gainings starts at the end of the settling time.

During heating and settling periods both the analogue and serial outputs as well as the local display are locked to the values measured before re-gaining started. The outputs are released again when the sensor has cooled within the temperature difference setting or when the settling period is completed irrespectively of whether the sensor has cooled within the temperature difference or not.

The k parameter should not be changed from 95%. The recommended duration of heating is 120 s and it should not be altered. The cooling time needed for the sensor to stabilize to the ambient temperature is strongly dependent on process conditions, especially on the speed of the air flow around the sensor head. After the re-gaining has been completed, wait for a few seconds before you start the measurement.

3. LED COMMANDS

Re-gaining can be started manually using the LED command ●●○○ (● = lit, ○ = dark). Use the up and down press switches (marked with arrows in the printed board) to find the command code and acknowledge it with the ENT switch. The re-gaining parameters stored in the transmitter memory are used. When re-gaining is over the LEDs are dark again.



OPENED COVER OF THE HMP

Location of the press switches and LEDs

4. DISPLAY/KEYPAD COMMANDS

Disconnect the security lock jumper!

Press the CL key to enter the command mode. Select MORE from the first menu using the arrow keys and press ENT key. Select again MORE from the second menu and press ENT. The following menu is displayed

```
Echo Regen Mtin  
Heat Frost Fil
```

Select Regen and press ENT.

```
Regen. settings  
Regeneration
```

To change or inspect the re-gaining parameter settings select Regen. settings and press ENT. To start re-gaining manually select Regeneration and press ENT.

4.1. Re-gaining parameters

The re-gaining parameters are displayed in a sequence of

- status of the automatic re-gaining
- re-gaining interval
- duration of heating
- temperature difference
- settling time
- k parameter

Each setting can be changed by entering a new parameter value using the arrow keys. After the parameter sequence the menu Regen. settings/Regeneration is displayed again. If you want to leave the parameters for the main menu, press CL once or several times. This leaves the rest of the parameters unchanged.

NOTE

To activate the new parameter settings immediately, the transmitter must be switched off/on. Otherwise the transmitter starts re-gaining with new parameters only when the old re-gaining interval is completed.

```
Regen      OFF
```

```
Regen      ON
```

Use arrow keys to change the status of the automatic re-gaining and press ENT.

```
Interval  min :  
          720
```

Acknowledge the current setting by pressing ENT. To change the interval press CL. Select the new time interval digit by digit with the arrow keys and acknowledge each digit with ENT key. With CL key you can correct the entry by deleting the digits one by one. When you have entered the whole time interval, press ENT for the second time.

```
Duration   s :  
          120
```

```
Settl time s :  
          240
```

```
Temp diff  % :  
          0.50
```

```
k          % :  
          95.00
```

Other re-gaining parameters are acknowledged or changed the same way. When all the parameters have been changed or acknowledged, the menu Regen. settings/Regeneration is displayed again.

4.2. Starting re-gaining manually

To start re-gaining manually select Regeneration and press ENT. The following is displayed

```
Regeneration ...  
any key to abort
```

When the heating is completed or it has been aborted, the settling period begins and the transmitter returns to the display mode outputting the measured or calculated values. However, during the settling time or until the temperature difference is small enough, the display is locked to the values measured before re-gaining was started. A new re-gaining cannot be started during the settling period.

5. SERIAL COMMANDS

1.2.1 REG Re-gaining settings

REG <cr>

REG nnn <cr>

nnn = ON or OFF

Command REG is used to check the re-gaining parameter settings and to activate or inactivate the automatic re-gaining.

Examples: checking the current settings

```
>reg
REG OFF                                automatic re-gaining is inactive
Interval min :          720
Duration s :          120
Temp diff :          0.50
Settl time s :          240
k % :          95.00
>
```

activating the automatic re-gaining

```
>reg on
REG ON
>
```

deactivating the automatic re-gaining

```
>reg off
REG OFF
>
```

1.2.2 CR Re-gaining parameters

CR <cr>

Command CR can be used to check the values of re-gaining parameters.

Example:

```
>cr
Interval min :          720
Duration s :          120
Temp diff :          0.50
Settl time s :          240
k % :          95.00
>
```

1.2.3 CRI Changing re-gaining parameters

CRI <cr>

With command CRI the values of the re-gaining parameters can be changed.

Example: changing the re-gaining interval to 480 min and the settling time after sensor heating to 360 s

```
>cri
Interval min :      720 ? 480
Duration s :      120 ?
Temp diff :      0.50 ?
Settl time s :      240 ? 360
k % :      95.00 ?
>
```

NOTE

To activate new parameter settings immediately, command RESET must be given. Otherwise the transmitter starts the re-gaining with new parameters only when the old re-gaining interval is completed.

1.2.4 FST Displaying re-gaining status

FST nnn <cr>

nnn = ON or OFF

With FST ON the status of the re-gaining is output at the beginning of the output line.

Example: activating status display

```

>fst on
Form. status : ON
>r
N 0 RH= 20.8 %RH T= 25.6 'C
N 0 RH= 20.7 %RH T= 25.6 'C
N 0 RH= 20.7 %RH T= 25.6 'C
N 0 RH= 20.8 %RH T= 25.6 'C
H 163 RH= 20.8 %RH T= 25.6 'C
H 163 RH= 20.8 %RH T= 25.6 'C
H 163 RH= 20.8 %RH T= 25.6 'C
H 163 RH= 20.8 %RH T= 25.6 'C
S 163 RH= 20.8 %RH T= 25.6 'C
S 163 RH= 20.8 %RH T= 25.6 'C
S 163 RH= 20.8 %RH T= 25.6 'C
S 163 RH= 20.8 %RH T= 25.6 'C
N 163 RH= 20.8 %RH T= 25.6 'C
N 163 RH= 15.0 %RH T= 31.5 'C
N 163 RH= 16.7 %RH T= 30.0 'C
N 163 RH= 17.4 %RH T= 29.1 'C
H 160 RH= 17.7 %RH T= 28.6 'C
H 160 RH= 17.7 %RH T= 28.6 'C

```

N = re-gaining off

H = heating on, 163 describes the heating power

S = settling period on

H = new heating (new power)

deactivating status display

```

>fst off
Form. status : OFF
>r
RH= 20.1 %RH T= 26.4 'C
RH= 20.2 %RH T= 26.4 'C
RH= 20.1 %RH T= 26.4 'C
RH= 20.2 %RH T= 26.4 'C

```

1.2.5 REGEN Starting re-gaining manually**REGEN <cr>**

Re-gaining can also be started manually with command REGEN. The current re-gaining parameters (duration and settling times stored with command CRI) are used.

Example: starting re-gaining

```

>regen
Regeneration started, press any key to abort
>

```

The prompt '>' appears when the heating period is over. However, the transmitter outputs are locked to values measured before re-gaining until the settling time is over.

Example:

```
>regen
  Regeneration started, press any key to abort
>r
  S 162 RH= 20.0 %RH T= 26.5 'C      heating is finished,
  S 162 RH= 20.0 %RH T= 26.5 'C      settling time is on and
  S 162 RH= 20.0 %RH T= 26.5 'C      outputs are locked
  ...
  N 162 RH= 18.4 %RH T= 27.7 'C      settling time is over and
  N 162 RH= 18.5 %RH T= 27.6 'C      outputs are released
  N 162 RH= 18.8 %RH T= 27.5 'C
```

Re-gaining can not be started if automatic re-gaining (heating/cooling) is on, the temperature of the sensor exceeds 100 °C or the security lock jumper is off. In these cases the 'Regeneration started...' text is not output by the transmitter but the prompt '>' appears immediately.

Example:

```
>regen
>r
  H 162 RH= 19.7 %RH T= 26.4 'C      forced re-gaining failed
  H 162 RH= 19.7 %RH T= 26.4 'C      as automatic re-gaining
  H 162 RH= 19.7 %RH T= 26.4 'C      (heating) is going on
```