HMP260 SERIES TRANSMITTERS Operating Manual

HMP260-U017en-1.5
5 January 1996

VAISALA

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Contents

This manual is for programme version HMPS260 1.01

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1. PRODUCT DESCRIPTION

NOTE

Before installing and using the HMP260 transmitter study carefully Appendix 2: SAFETY SUMMARY.

The HMP260 series transmitters are associated electrical apparatuses. This means that the housing of the transmitter is mounted into a safe area and the sensor head and its cable can go to a potentially explosive environment (hazardous area). The transmitters incorporate a protective unit which contains the power limiting components. This unit prevents the entry of any hazardous energies to the potentially explosive area.

The transmitters are microprocessor based instruments which measure relative humidity and temperature; from these variables they can calculate dewpoint temperature, absolute humidity, mixing ratio and wet bulb temperature. The transmitters have 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.

The series consists of three types of transmitter:

- HMP263, installation in tight places; temperatures up to +120 °C
- HMP264, installation in pressure or vacuum chambers
- HMP265, installation in high temperatures up to +180 °C

There are various possibilities for the configuration of the transmitters. They 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 within certain limits. The HMP263, HMP264 and HMP265 can be supplied with two, five, ten or 15 metre probe cable.

The humidity measuring range is 0...100 %RH. The temperature is measured with a Pt 100 sensor. Temperature measurement range depends on the model; the HMP264 and HMP265 have the widest range, -40...+180 °C. The analogue temperature output can be scaled quite freely, for example -20...+60 °C can be set to correspond to 0...10 V. The dewpoint temperature, absolute humidity, mixing ratio and wet bulb temperature ranges are also scalable.

The HMP260 series units incorporate the HUMICAP® sensor, which uses an operating principle based on changes in the capacitance of the sensor as its thin polymer film absorbs water molecules.

Options	
Calculation variables	dewpoint temperature, mixing ratio, absolute humidity, wet bulb temperature
Serial interface	RS 232C (standard), RS 485/422, digital current loop
Display cover	cover with or without local display & keypad
Filters	sintered filter, PPS grid with steel netting, PPS grid
Cable length	2, 5,10 or 15 metres
Installation aids	HMP263: installation kit HMP264: NPT conical pipe threaded fitting body (1/2 - 14 NPT) HMP265: steel and aluminium flanges

2. TO BE NOTED WHEN MEASURING HUMIDITY

In the measurement of humidity and especially in calibration, it is essential that temperature equilibrium is reached. Even a small difference in temperature between the measured object and the sensor causes an error. If the temperature is +20 °C (+68 °F) and the relative humidity 50 %RH, a difference of ±1 °C between the measured object and the sensor causes an error of ±3 %RH. When the humidity is 90 %RH, the corresponding error is ±6 %RH.

The error is at its greatest when the sensor is colder or warmer than the surroundings and the humidity is high. A temperature difference of a few degrees can cause water to condense on the sensor surface. In an unventilated space evaporation may take hours; good ventilation accelerates evaporation. The HUMICAP sensor starts to function normally as soon as the water has evaporated. If the condensed water is contaminated, the life span of the sensor may shorten and calibration may change.

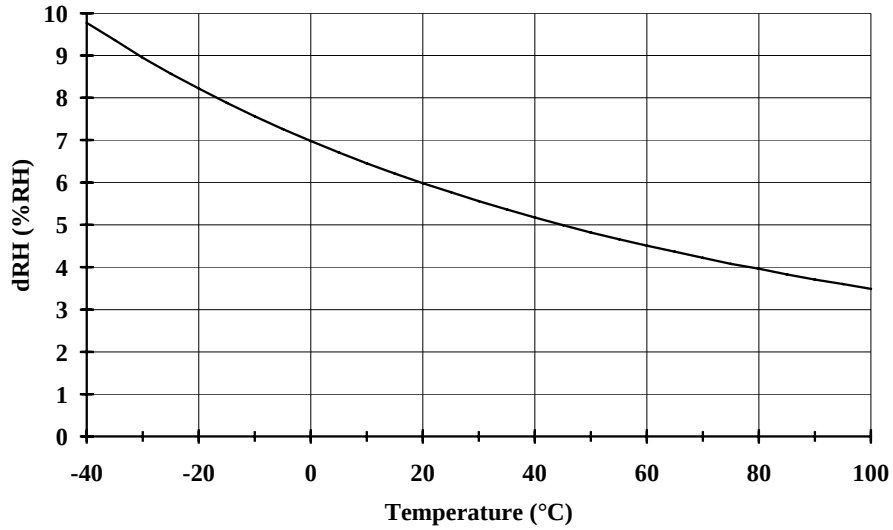


Fig. 2.1 Measurement error at 100 %RH when the difference between the ambient and sensor temperature is 1 °C

3. INSTALLATION

3.1. Selecting the place of installation

The transmitters 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. A rapid air flow is recommended; it ensures that the sensor head and the ambient air are at the same temperature.

Install the transmitter in a place where no cold or hot spot can develop. 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 vertically is not recommended. An uninsulated installation could lead to condensation in the sensor head and even when no condensation occurs, the resultant air flow may change the temperature near the sensor and distort the readings.

Install the sensor head in the process wherever possible; avoid sample flows where the gas temperature can drop below dewpoint temperature. Install the sensor head transversely against the direction of the process flow.

In duct or channel installations drill a hole ready for a reference meter. Plug the reference hole tightly.

The transmitters are associated electrical apparatuses: the electronics housing must be in the **safe area** and only the sensor head and its cable may go into the **hazardous area**.

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

NOTE

To ensure an IP 65 class protection:

1. Always mount the transmitter housing with the cable bushings pointing downwards.

2. Make sure that the connection cable has the right thickness (∅ 7...10 mm) and that the cable bushing is carefully tightened.

3. Pay always special attention to closing the transmitter cover carefully and remember to tighten all four screws.

3.2. Mounting

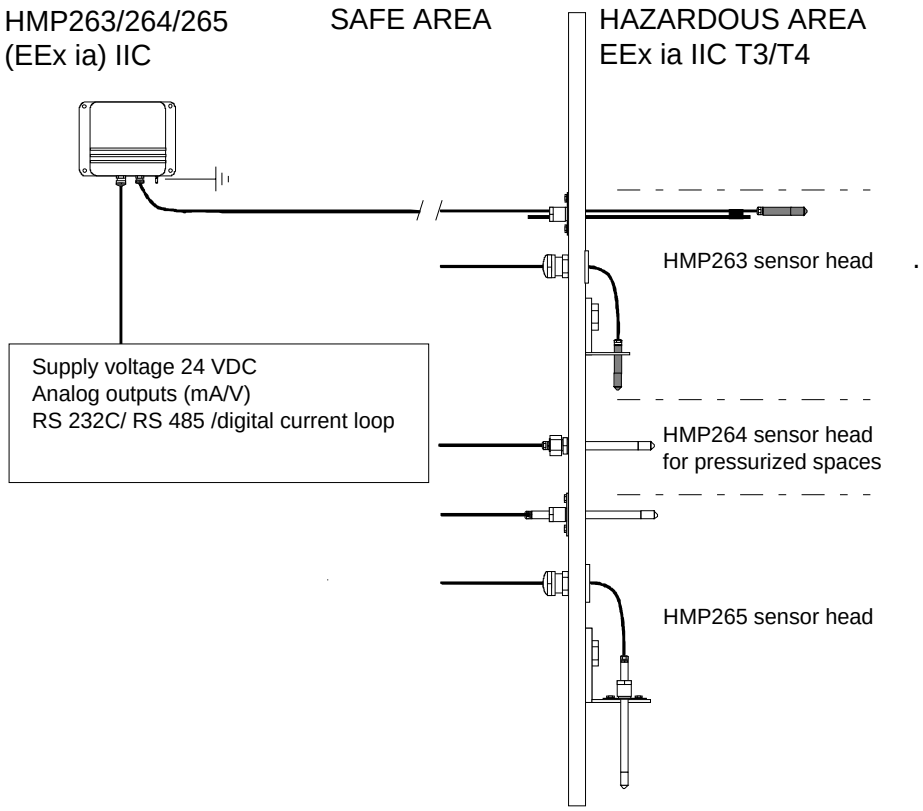


Fig. 3.1 Examples of sensor head mounting

The lead-throughs must be sealed properly to avoid air flowing in or out from the channel. The sealings must fulfil EEx requirements. When using the support bar with the HMP263, the lead-through piece must be sealed e.g. with silicon. See also Appendix 8.

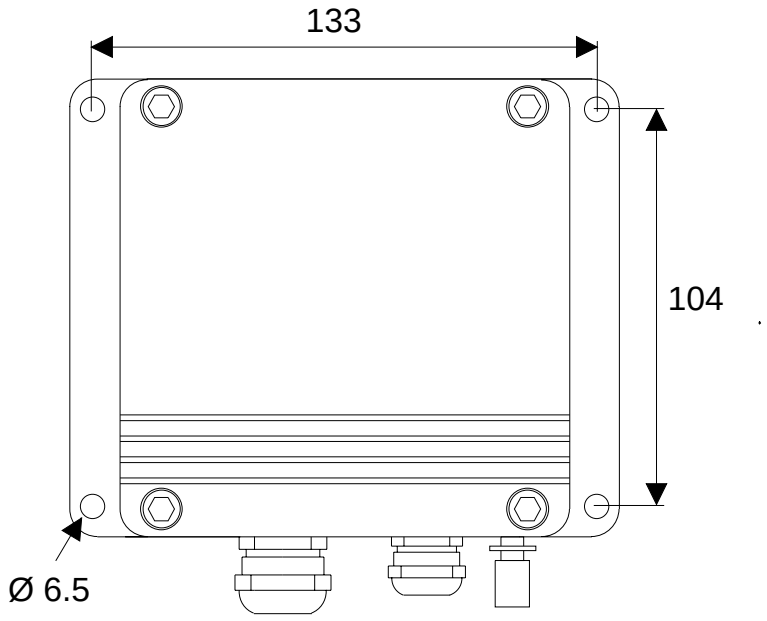


Fig. 3.1 Mounting holes in the HMP260 transmitter housings

The transmitters should be mounted with the sensor head horizontally; this way, any water condensing on the tube cannot flow onto the sensors. 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 as in Figure 3.6; this prevents any condensed water from running onto the sensor head along the cable.

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.

When mounted on the side of a duct or channel, the sensor head must be inserted from the side (see Figure 3.7). If this is not possible and the sensor head must be inserted from the top, the point of entry must be carefully insulated.

NOTE

During installation the protective cover of the protective unit must not be opened and the sensor head must not be unsoldered from and then resoldered to the protective unit of the transmitter. This procedure is not allowed for the user. Vaisala is not responsible for any damages caused by incorrect use.

3.2.1. HMP263 transmitter

The HMP263 can be installed in ducts and channels with the help of the installation kit available; 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.

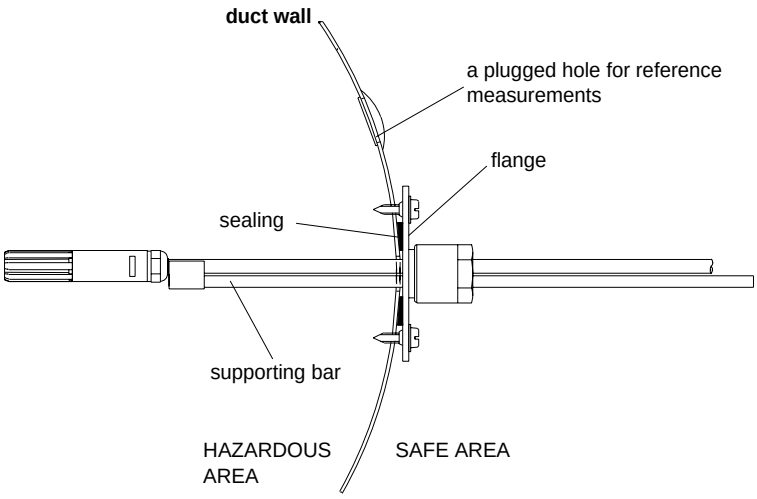


Fig. 3.2 Installing the sensor head of the HMP263 in a channel with the help of flange and supporting bar

NOTE

When using the support bar the lead-through piece and the space between the duct wall and the flange must be sealed e.g. with silicon. The sealings must fulfil EEx requirements.

The sensor head can also be installed vertically.

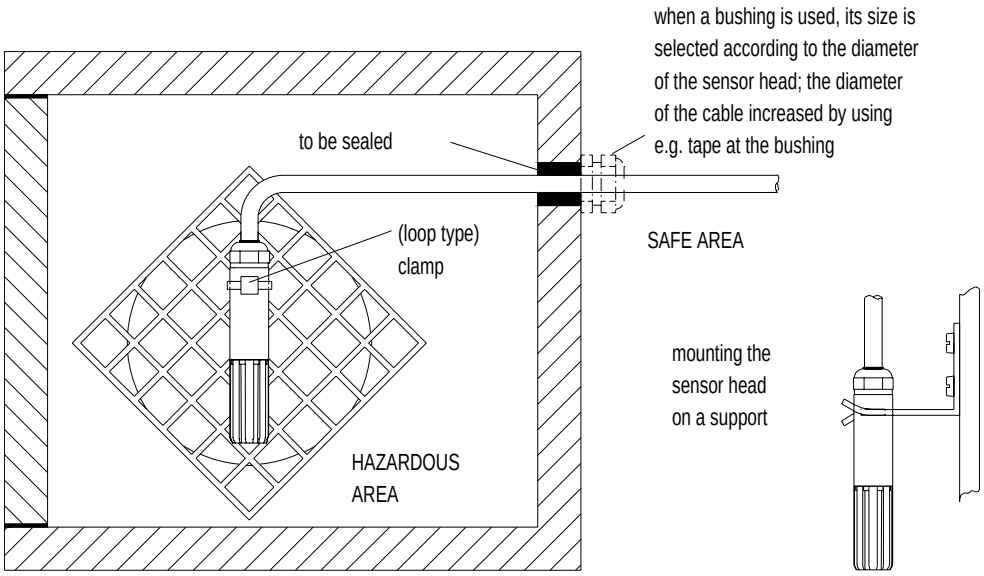


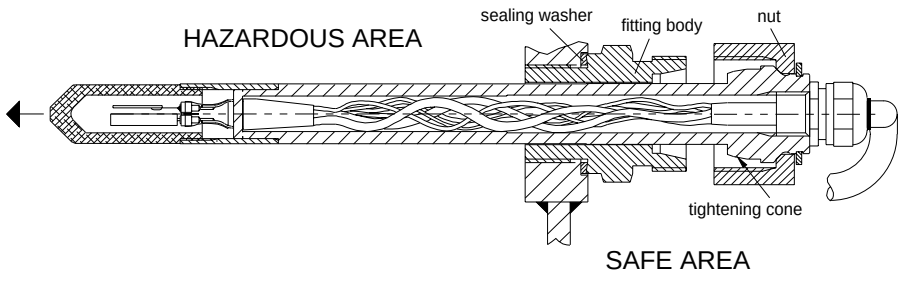
Fig. 3.3 Vertical installation of the HMP263 sensor head

3.2.2. HMP264 transmitter

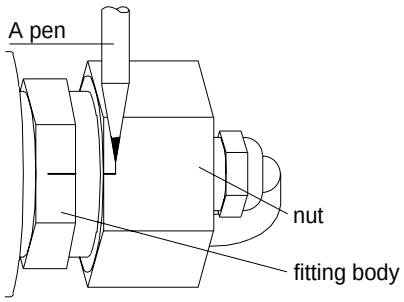
The HMP264 is supplied with a nut, a fitting body and a sealing washer. During handling the fitting body and the nut should remain in place on the body of the sensor head to prevent damage to the highly polished surface.

To achieve a leak-tight assembly:

1. Remove the fitting body from the nut and the sensor head.
2. Fasten the fitting body to the chamber wall. Tighten the fitting body into the threaded sleeve with a torque spanner. The tightening torque is 150 ±10 Nm.



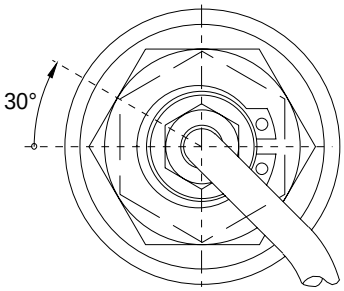
3. Insert the body of the sensor head into the fitting body and screw the nut manually to the fitting body until the connection feels tight.
4. Mark both the fitting body and the nut hex.



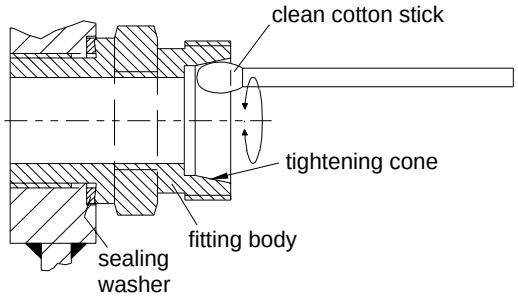
5. Tighten the nut a further 30° (1/12 turn) or if you have a torque spanner tighten it with a torque of 80 ±10 Nm.

NOTE

After detachment the nut must be tightened without increased effort.



6. The tightening cone of the fitting body has to be cleaned and greased after each tenth detachment. Use high-vacuum grease (Down Corning, Europe) or a similar grease.



The sealing washer has to be changed every time the fitting body is detached.

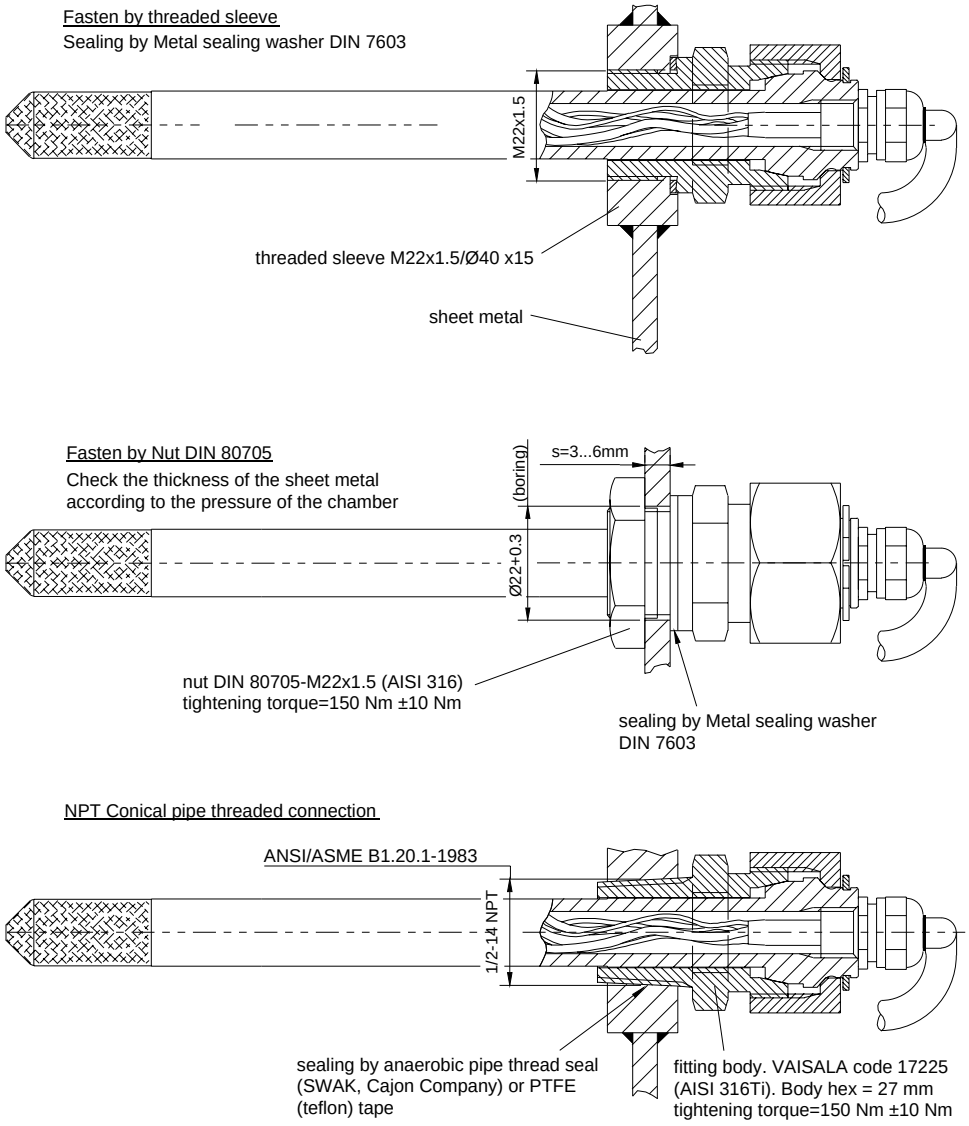


Fig. 3.4 Some examples on the installation of the HMP264 sensor head

3.2.3. HMP265 transmitter

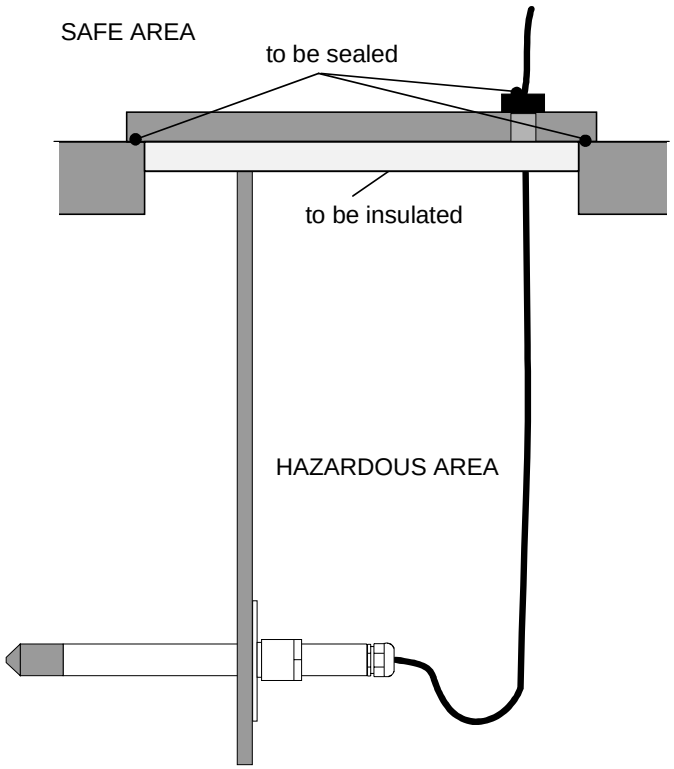


Fig. 3.5 Installing a transmitter in a process with the sensor head horizontally

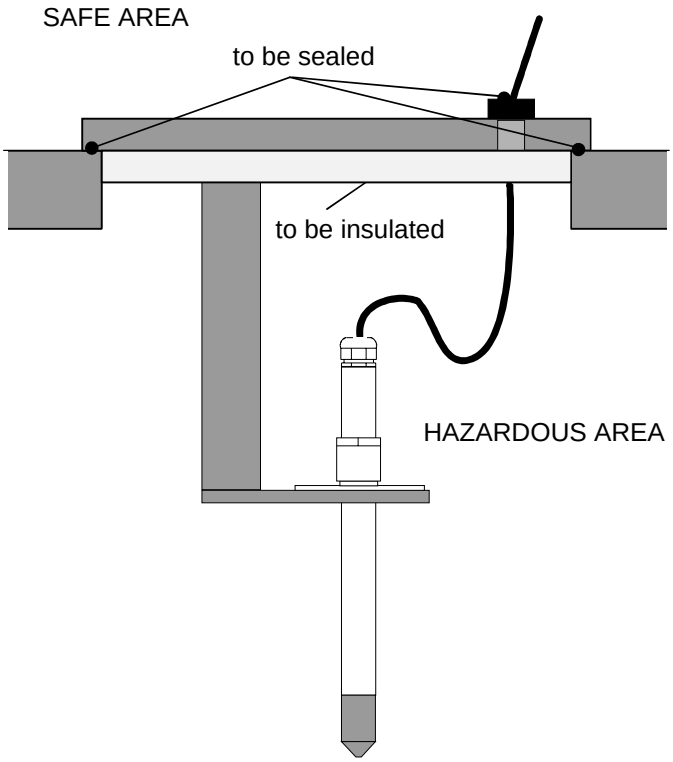


Fig. 3.6 Installing a transmitter in a process with the sensor head downwards (not recommended)

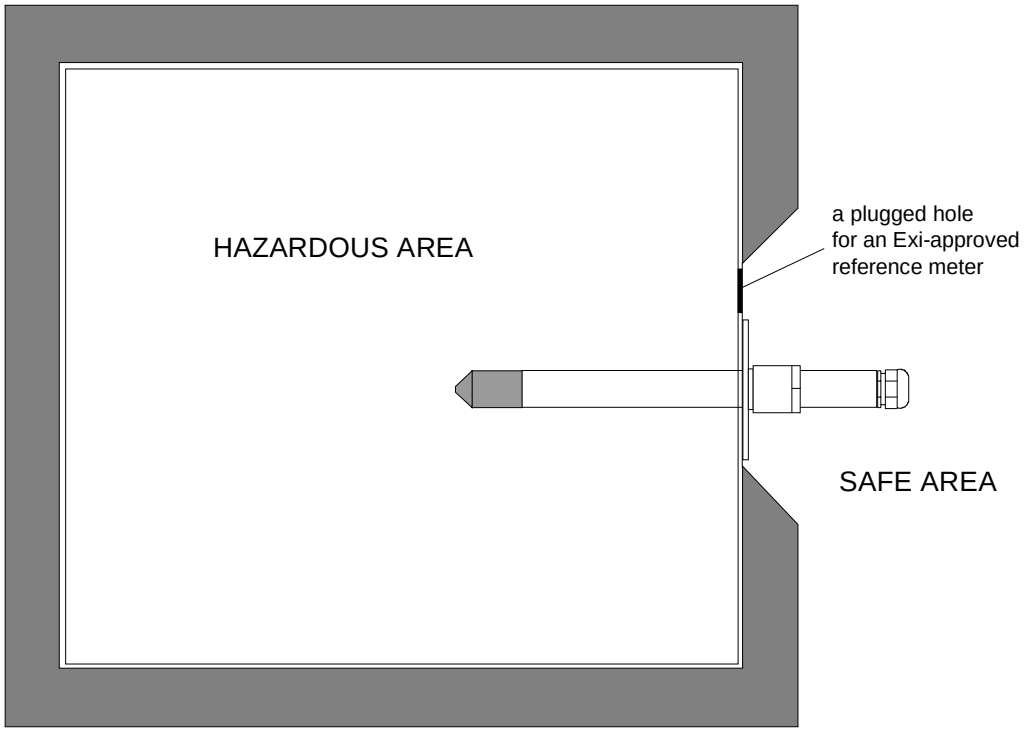


Fig. 3.7 Mounting the sensor head on a duct or channel

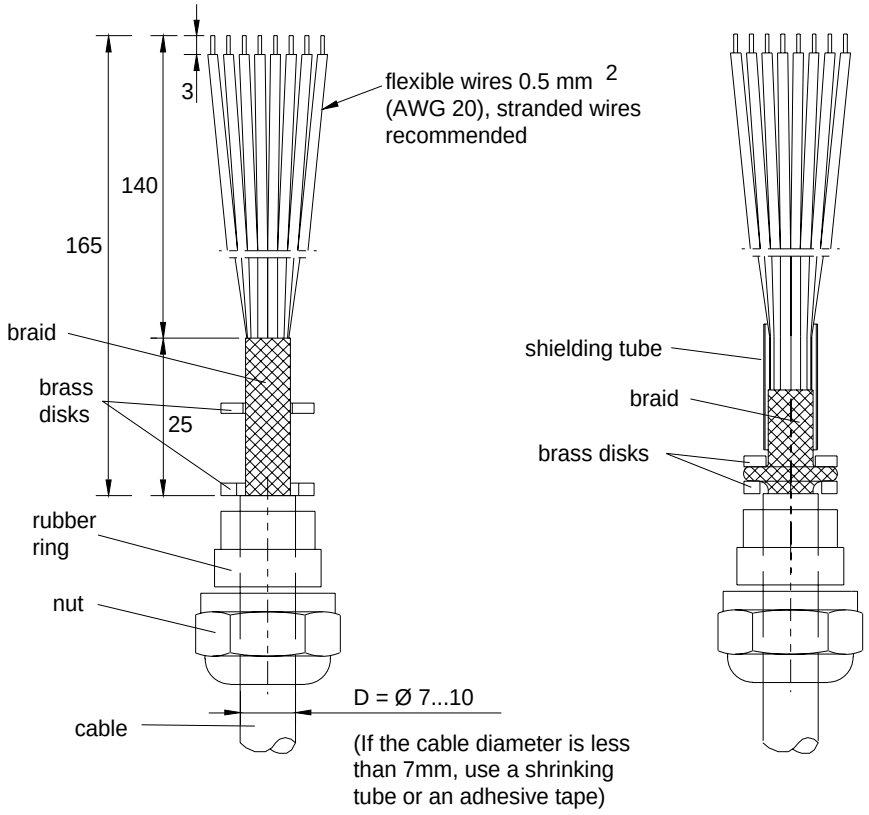
When the sensor head is installed in a duct or a channel, the temperature difference of the air inside and outside the duct must be small as the sensor head conducts heat.

3.3. Grounding

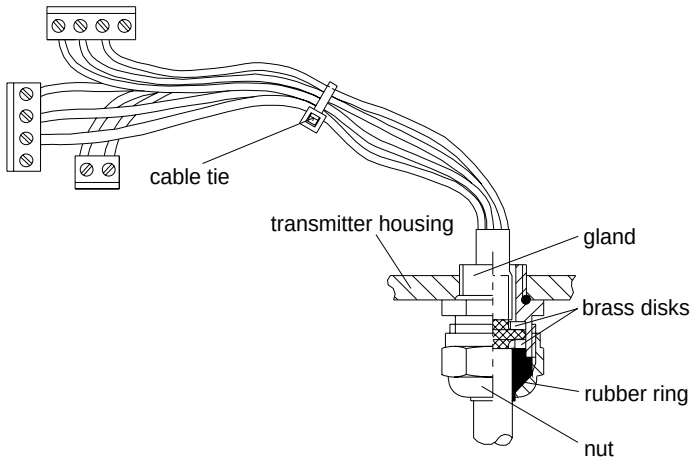
A single electrical cable with a screen and three to ten wires is recommended for power and analogue output/serial bus connections. The cable diameter should be 7...10 mm.

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

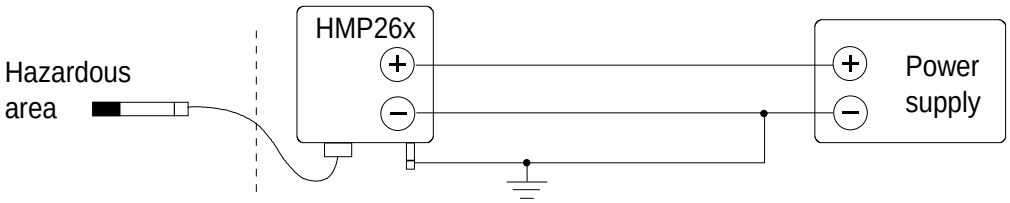


- push back the braid and press it between the two brass disks to achieve a full 360° grounding; the fold between the disks should have the same diameter as the brass disks
- secure the braid with a shielding tube
- insert the wires into the transmitter housing through the gland.
- tighten the nut
-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



NOTE

When the cable is grounded as above, 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. **The transmitter housing must be grounded via the grounding terminal located at the lower right hand corner of the housing. In addition to this the negative terminal of the power supply must be grounded. If these groundings have not been made correctly, the transmitter does not work.**



The electrical safety of the grounding must comply with the EN 50014/13 standard. When compliance with Factory Mutual Standards is required, the grounding must comply with ANSI/ISA RP 12.6 and ANSI/NFPA 70.

WARNING

Always use the grounding terminal to connect the transmitter to safety ground.

3.4. Electrical connections

CAUTION

All the component boards are grounded via the housing frame. Make sure that the fixing screws of the boards are firmly tightened before connecting the cables.

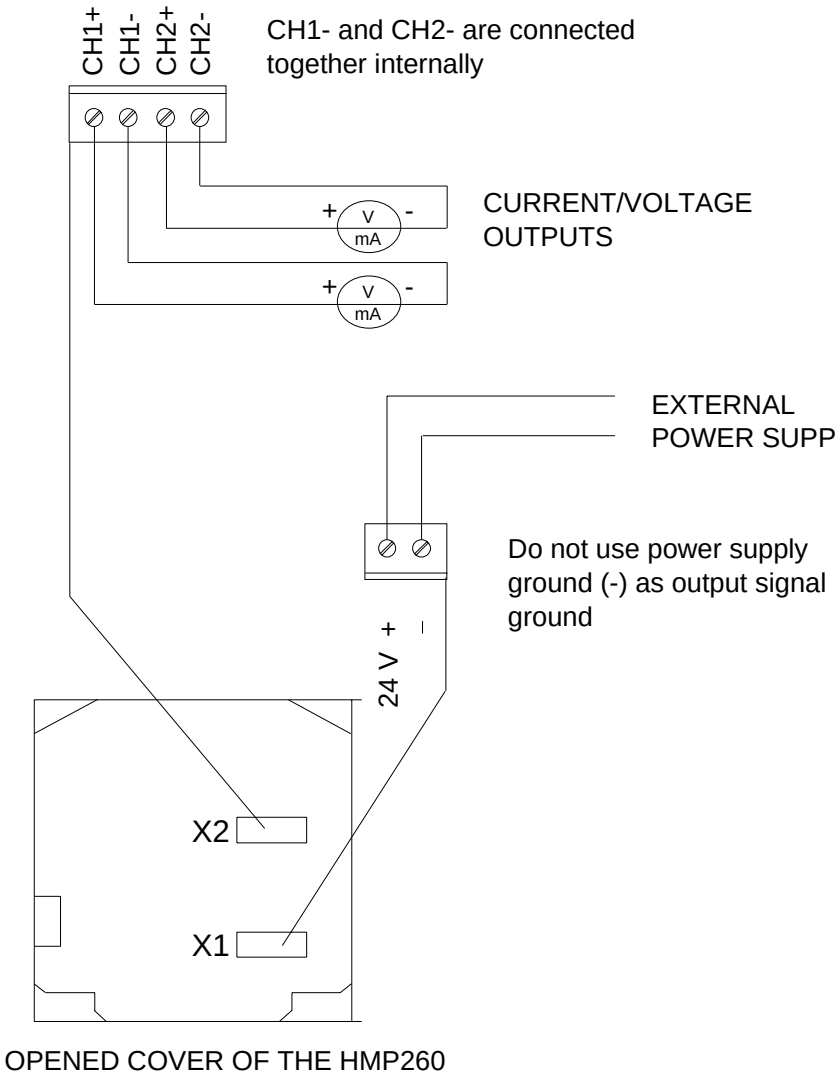


Fig. 3.8 Electrical connections

Power supply	24 VDC
Output signals	0...20 mA 4...20 mA 0...1 V 0...5 V 0...10 V

IF THE CONNECTION INSTRUCTIONS ARE NOT CAREFULLY FOLLOWED OR THE COMPONENTS IN THE PROTECTION UNIT ARE MODIFIED OR TAMPERED WITH, THE DEVICE DOES NOT MEET THE REQUIREMENTS OF EXi CLASSIFICATION. VAISALA IS NOT RESPONSIBLE FOR ANY DAMAGES CAUSED BY INCORRECT USE.

4. COMMISSIONING

When the HMP260 transmitters leave the factory, their measurement ranges and output signals have already been selected. The user can subsequently change the measurement units between metric and non-metric and select and scale the output signals with software functions, see Chapter 5 Commands and Appendix 1.

4.1. Security lock jumper

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

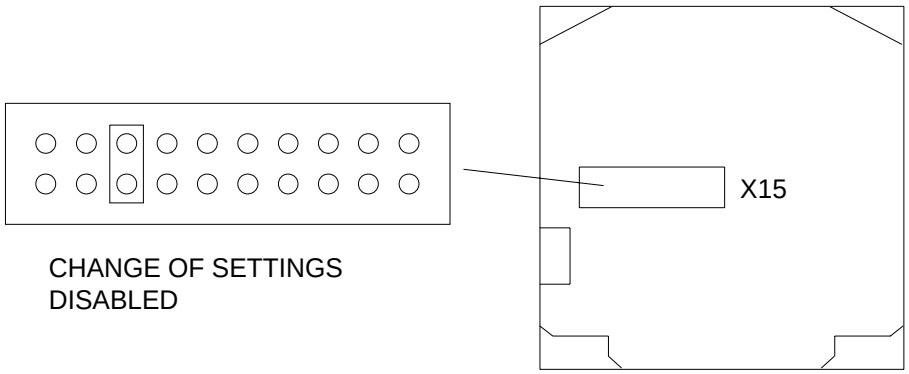


Fig. 4.1 Location of the security lock jumper

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

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.

4.2 Selecting the analogue outputs

The HMP260 transmitters 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 the Figure 4.2.

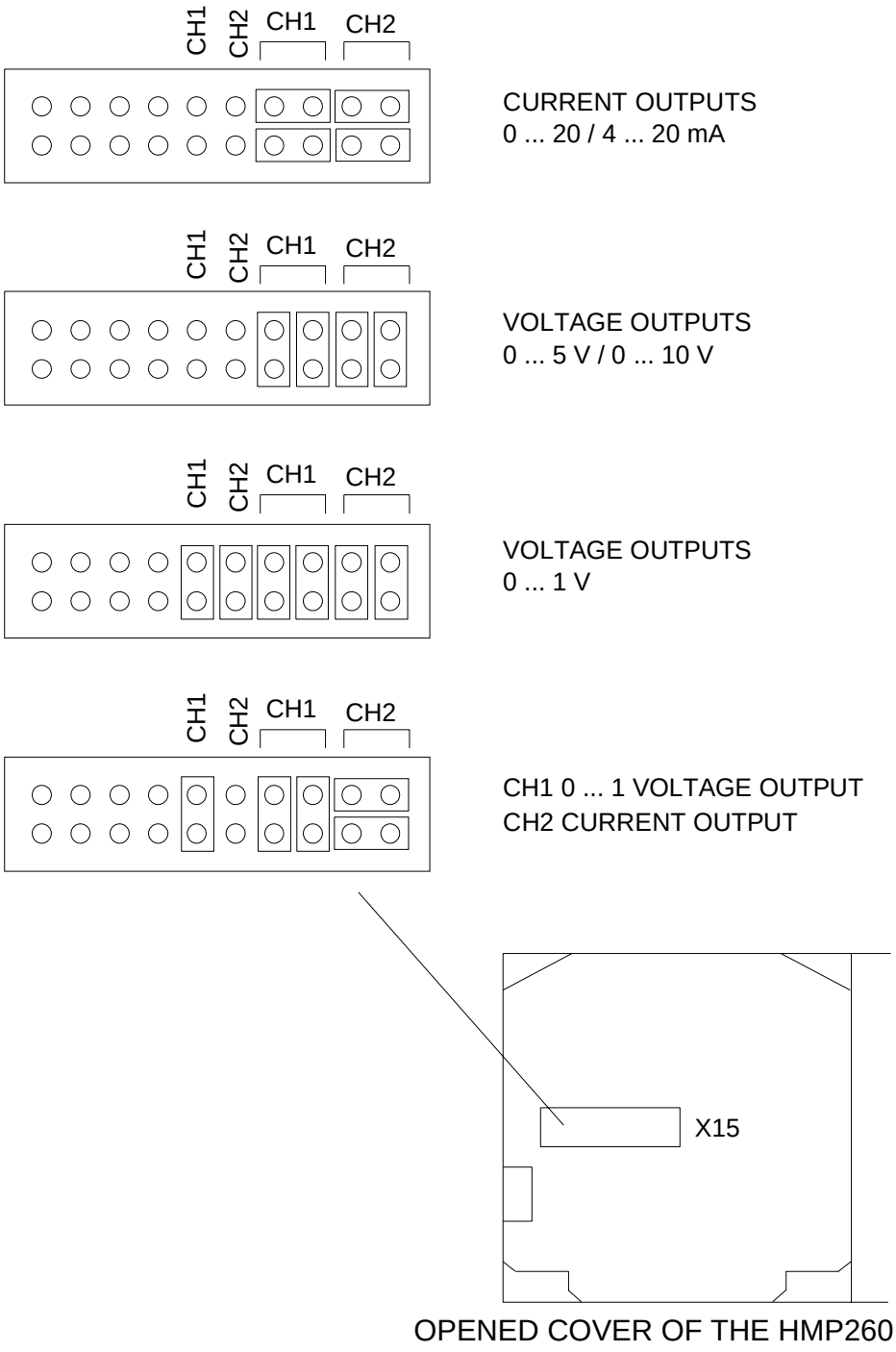


Fig. 4.2 Selecting the analogue outputs with jumpers

The software has to be informed which outputs are in use. This is done either through the serial interface or the menus on local display when one is in use. The serial command is AMODE and the display/keypad command "Mode Analog outputs Mode" (see Chapter 5 Commands). If the outputs need to be scaled, 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.

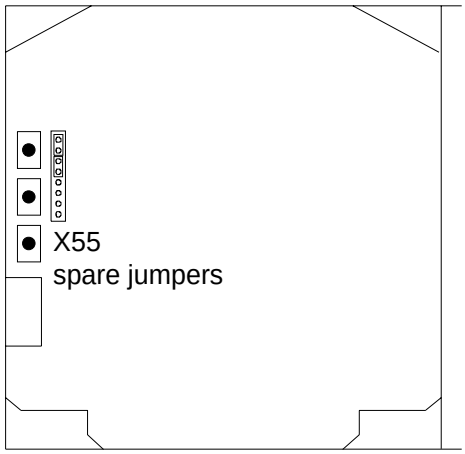


Fig. 4.3 Spare jumpers

4.3 Connecting the RS 232C serial bus

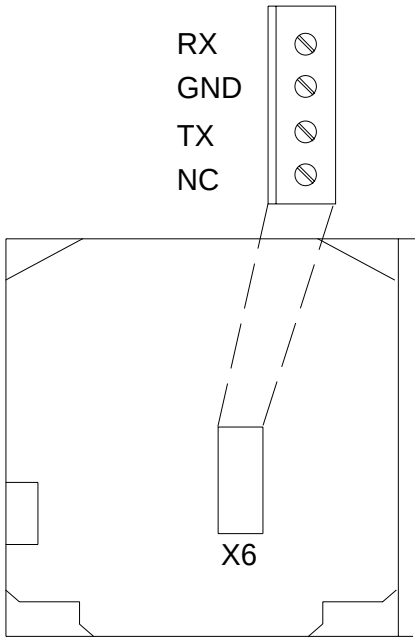


Fig. 4.4 Serial bus connections

To connect a PC to the HMP260 transmitters via the RS 232C serial bus, one of the following cables is required. The type of cable depends on the terminal and the connector type.

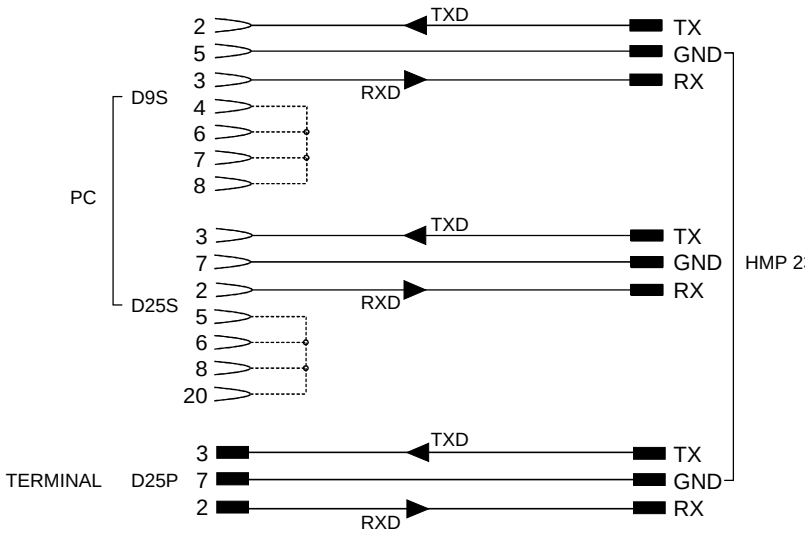


Fig. 4.5 Connection of cables

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 HMP260 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 digital current loop module is used. See appendices 3 and 4 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 232 signals. If an RS 485/422 serial port module or a digital current loop module has been installed, it has to be removed before communicating through the X17 connector.

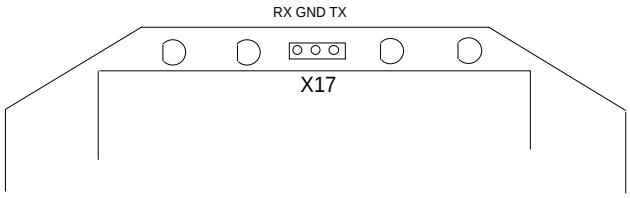


Fig. 4.6 Location and connections of connector X17

4.3.1 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!**

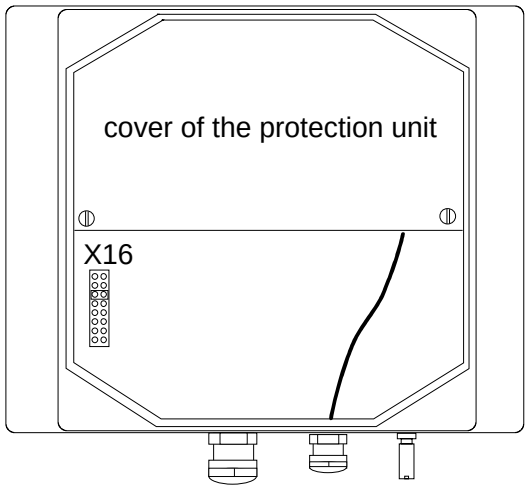


Fig. 4.7 Forcing the serial port settings back to factory settings

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. Note that 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.

NOTE

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

5. COMMANDS

As the HMP260 transmitters are microprocessor based devices, their configuration can be set to correspond to the specific needs of the user. This is done through commands, either 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. The switches and LEDs are in all HMP260 transmitters. LED commands can be used to calibrate the transmitters (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 transmitters can not 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 cal	T cal	
	Analog outputs		
Mode	Analog outputs		Mode
			Scale

- serial commands:

  CRH, CT, FCRH, ACAL; AMODE, ASEL, ASCL

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 transmitters 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.

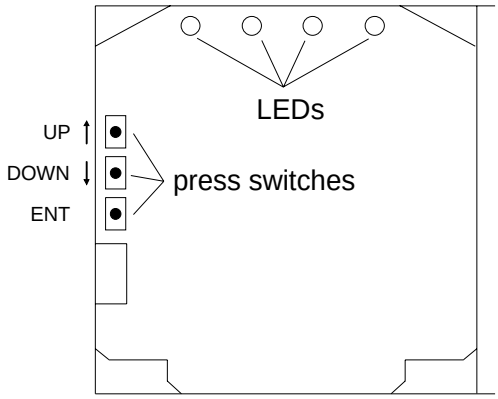


Fig. 5.1 Location of press switches and LEDs

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

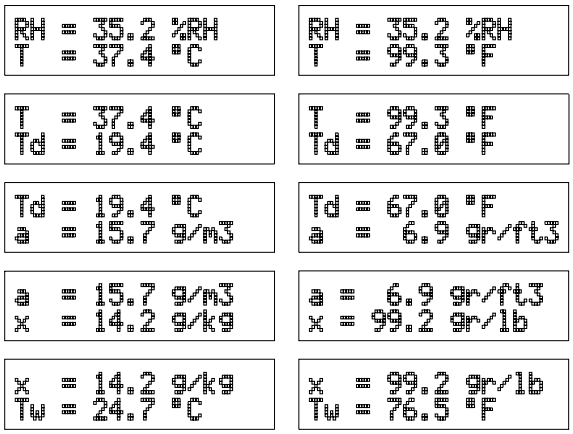
○○●● (3) calibration of analogue outputs

●○○○ (8) relative humidity calibration after sensor change

5.3 Display/keypad commands

5.3.1 Display mode

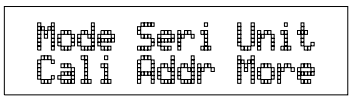
In the display mode the transmitters output measurements on the display; different quantities can be scrolled with the arrow keys according to the variables selected when ordering the transmitter. After reset the transmitters are always in the display mode.



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:



The commands can be scrolled with the arrow keys. The currently active commands 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 the transmitter needs numbers to be entered into the 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 at the right side of the display. Pressing the arrow keys brings either a blank ' ', a comma ',', a dash '-', a full stop '.' or a number from '0' to '9' 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.

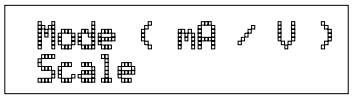
With some commands (e.g. calibration) the figures are changed using the arrow keys. When an arrow key is pressed continuously for a while, the numbers start changing at an increasing rate.

5.3.4 Analogue output commands

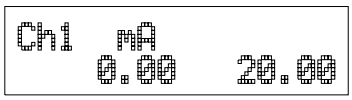
5.3.4.1 Selecting the output (mA/V)

Disconnect the security lock jumper!

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

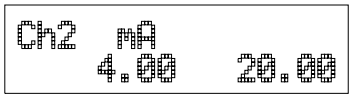


- Select Mode (mA / V). The current settings for channel 1 are displayed:



- 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.



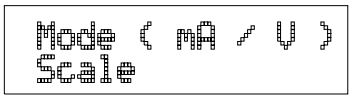
NOTE

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

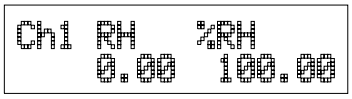
5.3.4.2 Selecting and scaling the analogue output quantities

Disconnect the security lock jumper!

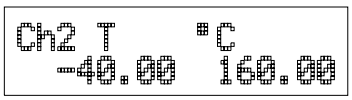
- Select Mode in the main menu and Analog outputs in the Mode menu:



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



- If the settings are correct, press ENT.
- If the settings need to be changed, press CL:
  - the quantity (RH, T, Td, 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.

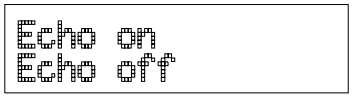


Please note that the selections that are possible are affected by the choice of output parameters. Also make sure that the temperature measuring ranges are not exceeded, e.g. the HMP263 can not be used in temperatures above +120 °C.

5.3.5 Output via the serial bus

5.3.5.1 Turning the serial interface echo ON/OFF

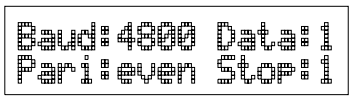
- Select More in the main menu, select More in the More menu and select Echo in the second More menu.



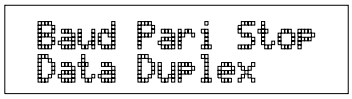
- Use the arrow keys to select the right alternative and press ENT.

5.3.5.2 Serial bus settings

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

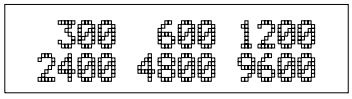


- If the settings are correct, press ENT; the programme returns to the display mode.
- If the settings need to be changed, press CL:

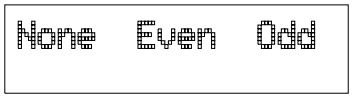


- Select the parameter to be changed with the arrow keys and ENT key.

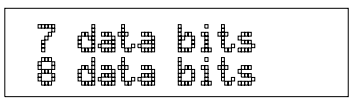
  Selecting baud rate:



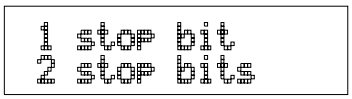
  Selecting parity:



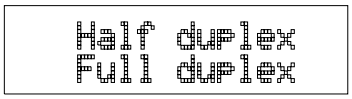
  Selecting data bits:



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 HMP260 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

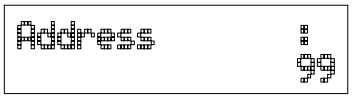
NOTE

The serial bus settings become effective only after reset.

5.3.5.3 Setting the transmitter address

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

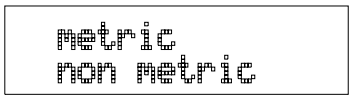
- Select Addr in the main menu; the following is displayed:



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

5.3.5.4 Selecting the output units

- Select Unit in the main menu:



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

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

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 HMP260 transmitters have three serial output modes: RUN, STOP and POLL.

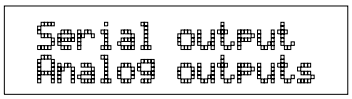
In the RUN mode the transmitter outputs measurements automatically through the serial interface to a PC or a peripheral. The only command that can be given through the serial interface is S (stop), which ends the RUN mode.

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

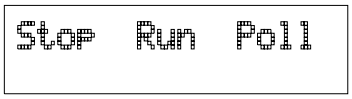
The POLL mode is used when more than one transmitter is connected to the same serial bus; a single transmitter can be addressed and communicated with. When the connection to a given transmitter is opened in the POLL mode, the transmitter goes into STOP mode and can then receive commands normally. Closing 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 4.3.1). If the transmitter has a display, the settings can be checked through it.

5.3.6.1 Setting the serial interface operation mode

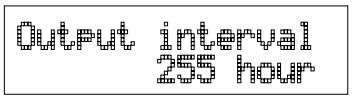
- Select Mode in the main menu; the following is displayed:



- Select Serial output:



- 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:

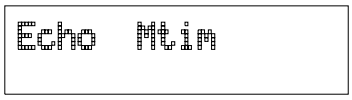
- press CL
- the number starts flashing
- if the interval needs to be changed, press CL again and enter the new interval; otherwise press ENT
- the unit (seconds or hours) starts flashing
- the unit can be changed with the arrow keys and acknowledged with ENT
- after this the programme returns to Mode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

5.3.7 Others

5.3.7.1 Setting the measurement integration time

By lengthening the measurement integration time any stray changes in the output can be filtered out: the transmitter calculates the average of a number of measurement cycles defined by the user.

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

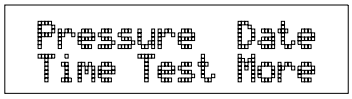


- Pressing ENT returns the programme to the main menu without changing the integration time.
- If the integration time needs to be changed, press CL; enter the new integration time with the arrow keys (4...255)

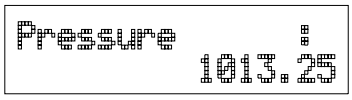
5.3.7.2 Setting the pressure for mixing ratio and wet bulb calculations

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:



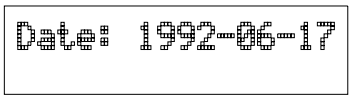
- Select Pressure:



- 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

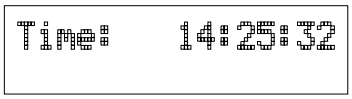
- Select More in the main menu; select Date in the More menu:



- 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:



- 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

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

5.4 Serial commands

More detailed descriptions of the serial commands can be found in Appendix 1. Here only the most commonly used command sequences are described. The instructions on how to connect the HMP260 transmitters to serial bus are given in Chapter 4.3.

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, Abs, Mix or Tw)

Example:
relative humidity 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 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>
```

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 available command 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> **i**n 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:

"RH=999.9 %RH T=999.9 *C",<cr><lf>

"RH=999.9 %RH T=999.9 *C Td=9999.9 *C",<cr><lf>

"RH=999.9 %RH T=999.9 *C a=9999.9 g/m3 x=9999.9 g/kg Tw=999.9*C",<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 processor does not allow the following combinations:

- no parity, 7 data bits, 1 stop bit: if this combination is given the HMP260 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.

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

```
SERI O <cr>                    changing parity only
4800 O 7 1 HDX
SERI 600 N 8 1 F <cr>          changing all parameters
600 N 8 1 FDX
```

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
a	g/m^3	gr/ft^3
x	g/kg	gr/lb
Tw	°C	°F

5.4.2.7 Setting the transmitter address

ADDR aa <cr>

aa = address (0...99)

Example:
transmitter is given address 99

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

5.4.2.8 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 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.

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 HMP260 transmitters have been fully calibrated at the factory and there should be no immediate need for recalibration. The transmitters should be calibrated only if there is reason to believe that the adjustments of the transmitters have changed. The adjustments of the temperature measurement channel and the analogue outputs are particularly stable and in normal circumstances there is no need to recalibrate them. Humidity calibration should be performed at least once a year.

6.1 Humidity calibration

A two-point calibration can be done with the HMK11 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 humidity sensor is changed.

The covers of the calibration jars of the HMK11 and HMK13B Calibrator do not have a hole for the Ø 13.5 mm sensor heads of the HMP260 transmitters; therefore an adapter must be used when calibrating with the HMK11 or HMK13B Calibrator. The adapters (part no. 16612 or 16611 respectively) can be ordered from Vaisala or Vaisala representatives.

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

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

6.1.1. One point calibration procedure

6.1.1.1 Using serial commands

Disconnect the security lock jumper!

- 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
- Give command CRH <cr> and 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 press <cr> when the transmitter requests the second point value.

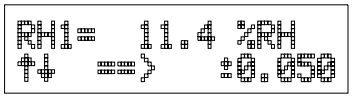
```
RH  :  yy.y   Ref2 ?  <cr>
```

6.1.1.2 Using display/keypad commands

Disconnect the security lock jumper!

- 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

- 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.



6.1.1.3 Using LED commands

Disconnect the security lock jumper!

- 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
- 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 7.5). 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.

6.1.2 Two point calibration procedure

A two-point humidity calibration should be performed in stable conditions using saturated salt solutions a reference.

NOTE.

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

6.1.2.1 Using serial commands

Disconnect the security lock jumper!

- 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.
- Place the sensor head into the calibration hole of the LiCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- Give command CRH <cr> and 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> 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...

- Place the sensor head into the calibration hole of the NaCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- Press any key and 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> instead of the reference value.

6.1.2.2 Using display/keypad commands

Disconnect the security lock jumper!

- 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.
- Place the sensor head into the calibration hole of the LiCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- 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 and press ENT.
- Place the sensor head into the calibration hole of the NaCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- If necessary, change the second point reading with the arrow keys and press ENT.

6.1.2.3 Using LED commands

Disconnect the security lock jumper!

- 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.
- Place the sensor head into the calibration hole of the LiCl bottle in the humidity calibrator.

- Wait for 10 minutes.
- 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.
- Place the sensor head into the calibration hole of the NaCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- Check that the reading corresponds within the desired accuracy to the reading given 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.

6.1.3 Calibration procedure after sensor change

Humidity calibration should be performed in stable conditions using saturated salt solutions as a reference.

6.1.3.1 Using serial commands

Disconnect the security lock jumper!

- 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.
- Place the sensor head into the calibration hole of the LiCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- Give command FCRH <cr> and 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 giving 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...
```

- Place the sensor head into the calibration hole of the NaCl bottle in the humidity calibrator.
- Wait for 10 minutes.

- Press any key and 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> instead of the reference value.

6.1.3.2 Using display commands

Disconnect the security lock jumper!

- 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.
- Place the sensor head into the calibration hole of the LiCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- 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.
- Place the sensor head into the calibration hole of the NaCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- If necessary, change the second point reading with the arrow keys and press ENT.

6.1.3.3 Using LED commands

Disconnect the security lock jumper!

- 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.
- Place the sensor head into the calibration hole of the LiCl bottle in the humidity calibrator.
- Wait for 10 minutes.
- 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.
- Place the sensor head into the calibration hole of the NaCl bottle in the humidity calibrator.
- Wait for 10 minutes.

- Check that the reading corresponds within the desired accuracy to the reading in the calibration table. 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.

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

*) LiCl solution must not be used or stored in temperature below +18 °C, otherwise the equilibrium humidity of the salt solution 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 made against some accurate temperature reference. It can be done either using the press switches inside the housing, through the serial bus or the menus on the local display. Either a one point or a two point calibration can be done.

6.2.1 One point offset correction

6.2.1.1 Using serial commands

Disconnect the security lock jumper!

- 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.
- Check the transmitter against the reference.
- Give command CT <cr> and 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...
```

- After giving the correct temperature value (Ref1) and pressing <cr> press any key and press <cr>.

6.2.1.2 Using display/keypad commands

Disconnect the security lock jumper!

- 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.
- Check the transmitter against the reference.
- Select Cali in the main menu and then T cal; select two-point calibration T 2 point cal. Change the first point reading with the arrow keys and press ENT.
- Select T 1 point cal, change the reading to correspond to the reference and press ENT.

6.2.1.3 Using LED commands

Disconnect the security lock jumper!

- 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.
- Check the transmitter against the reference.
- 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 same reading with the reference and press ENT switch.
- 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 Using serial commands

Disconnect the security lock jumper!

- 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.
- Check the transmitter against the reference.
- Give command CT <cr> and 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...
```

- 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  :  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 Using display/keypad commands

Disconnect the security lock jumper!

- 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.
- Check the transmitter against the reference.
- Select Cali in the main menu and then T cal; select two-point calibration T 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 Using LED commands

Disconnect the security lock jumper!

- 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.
- Check the transmitter against the reference.
- 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 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 of the outputs should be performed only when there is reason to believe that their adjustments have changed.

6.3.1 Using 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.

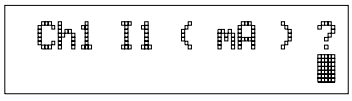
Example: both channels have 0...10 V outputs (set with AMODE command); enter the voltages measured at the analogue outputs:

```
>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>
```

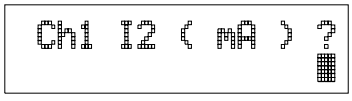
6.3.2 Using display/keypad commands

Disconnect the security lock jumper!

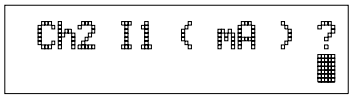
- Connect an ammeter/voltmeter to the output of channel 1, select Cali in the main menu and Analog outputs in the Cali menu. The following is displayed (the quantity can be either mA or V):



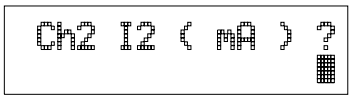
- Enter the measured lower end current/voltage on channel 1.



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



- 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.

6.3.4 Using 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 made using the 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 µA. 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 µA	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.

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

Whatever technique is used, make sure the reference instrument is at the same temperature as the checked instrument in order to avoid errors caused by temperature differences. If the sensor head is installed in a potentially explosive area, the reference instrument must have the same Exi-classification. The reference measurement should be done as close to the checked sensor as possible and the readings should be read at the same time, when possible.

The best reference measurements are done in laboratories. If it is possible to take the transmitter out of process or control system, perform the reference measurement in a laboratory where the conditions are stable.

7.2 Self-diagnostics

The HMP260 transmitters go 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 3.

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 the error code (see Appendix 3 for all error messages):

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

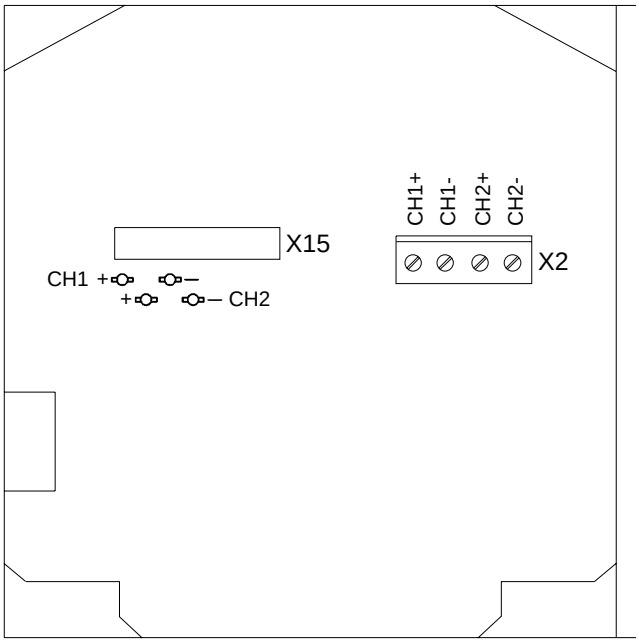
7.3 Changing the HUMICAP® sensor and the filter

Remove the damaged sensor and insert a new one. Handle the sensor by the plastic socket. DO NOT TOUCH THE SENSOR PLATE. 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 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.



OPENED COVER OF THE HMP260

Fig. 7.3 Location of the CH1 and CH2 test points

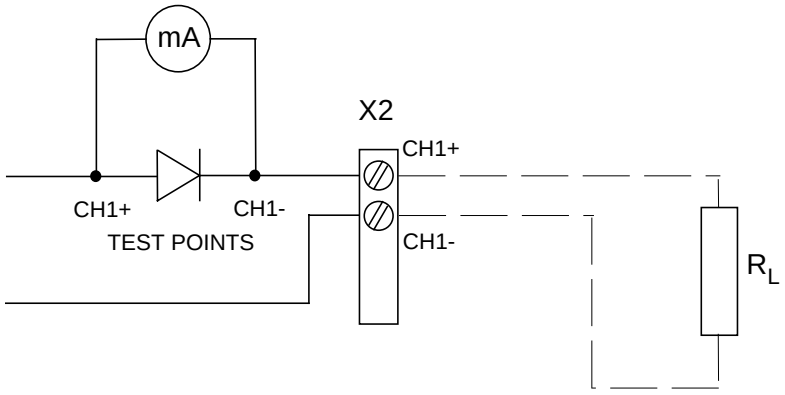


Fig. 7.4 Circuit diagram of the analogue output current test points

7.5 Adjusting the contrast of the display

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

8. TECHNICAL DATA

Specifications of the protection unit, see Appendix 9.

8.1 Relative humidity

Measuring range	0...100 %RH
Accuracy (including nonlinearity and repeatability)	
maximum achievable accuracy when calibrated against high quality, certified humidity standards:	
	±1 %RH (0...90 %RH) ±2 %RH (90...100 %RH)
when calibrated against salt solutions (ASTM E104-85):	
	±2 %RH (0...90 %RH) ±3 %RH (90...100 %RH)
Response time (90 %) at +20 °C in still air (with sintered filter)	15 s
Sensor	HUMICAP® H-sensor (part no. 16663)

8.2 Temperature

Measuring range	
HMP263	-40...+120 °C
HMP264	-40 ...+180 °C
HMP265	-40...+180 °C
Typical accuracy of electronics at +20 °C (+68 °F)	±0.1 °C
Typical temperature dependence of electronics	0.005 °C/°C
Sensor	Pt 100 RTD 1/3 DIN 43760B

8.3 Calculated variables

Typical ranges	
dewpoint temperature	-40...+100 °C
mixing ratio	0...500 g/kg dry air
absolute humidity	0...600 g/m^3
wet bulb temperature	0...+100 °C

Accuracies of the calculated quantities depend on the accuracies of the measured quantities: relative humidity and temperature. In the tables below their accuracies are ±2 %RH and ±0.2 °C.

Accuracy of dewpoint temperature (°C)

	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	1.86	1.03	0.76	0.63	0.55	0.50	0.46	0.43	-	-
-20	2.18	1.19	0.88	0.72	0.62	0.56	0.51	0.48	-	-
0	2.51	1.37	1.00	0.81	0.70	0.63	0.57	0.53	0.50	0.48
20	2.87	1.56	1.13	0.92	0.79	0.70	0.64	0.59	0.55	0.53
40	3.24	1.76	1.27	1.03	0.88	0.78	0.71	0.65	0.61	0.58
60	3.60	1.96	1.42	1.14	0.97	0.86	0.78	0.72	0.67	0.64
80	4.01	2.18	1.58	1.27	1.08	0.95	0.86	0.79	0.74	0.70
100	4.42	2.41	1.74	1.40	1.19	1.05	0.95	0.87	0.81	0.76
120	4.86	2.66	1.92	1.54	1.31	1.16	1.04	0.96	0.89	0.84
140	5.31	2.91	2.10	1.69	1.44	1.26	1.14	1.05	0.97	0.91
160	5.80	3.18	2.30	1.85	1.57	1.38	1.24	1.14	1.06	0.99

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	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	-	-
-20	0.017	0.018	0.019	0.021	0.022	0.023	0.025	0.026	-	-
0	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.13	0.13
20	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49
40	0.97	1.03	1.10	1.17	1.24	1.31	1.38	1.46	1.54	1.62
60	2.68	2.91	3.16	3.43	3.72	4.04	4.38	4.75	5.15	5.58
80	6.73	7.73	8.92	10.34	12.05	14.14	16.71	19.92	24.01	29.29
100	16.26	21.34	28.89	40.75	60.86	98.85	183.66	438.56	-	-
120	40.83	74.66	172.36	-	-	-	-	-	-	-

Accuracy of absolute humidity (g/m^3)

	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	0.004	0.004	0.005	0.005	0.005	0.006	0.006	0.006	-	-
-20	0.023	0.025	0.027	0.029	0.031	0.032	0.034	0.036	-	-
0	0.10	0.11	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17
20	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55
40	1.08	1.13	1.18	1.24	1.29	1.34	1.39	1.44	1.49	1.54
60	2.73	2.84	2.95	3.07	3.18	3.29	3.40	3.52	3.63	3.74
80	6.08	6.30	6.51	6.73	6.95	7.17	7.39	7.61	7.83	8.05
100	12.2	12.6	13.0	13.4	13.8	14.2	14.6	15.0	15.3	15.7
120	22.6	23.3	23.9	24.6	25.2	25.8	26.5	27.1	27.8	28.4
140	39.1	40.0	41.0	42.0	43.0	44.0	45.0	45.9	46.9	47.9
160	63.5	64.9	66.4	67.8	69.2	70.7	72.1	73.5	74.9	76.4

Accuracy of wet bulb temperature (°C)										
	Relative humidity									
Temp.	10	20	30	40	50	60	70	80	90	100
-40	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	-	-
-20	0.21	0.21	0.22	0.22	0.22	0.22	0.23	0.23	-	-
0	0.27	0.28	0.28	0.29	0.29	0.29	0.30	0.30	0.31	0.31
20	0.45	0.45	0.45	0.44	0.44	0.44	0.43	0.43	0.42	0.42
40	0.84	0.77	0.72	0.67	0.64	0.61	0.58	0.56	0.54	0.52
60	1.45	1.20	1.03	0.91	0.83	0.76	0.71	0.67	0.63	0.60
80	2.23	1.64	1.32	1.13	0.99	0.89	0.82	0.76	0.72	0.68
100	3.06	2.04	1.58	1.31	1.14	1.01	0.92	0.85	0.80	0.75
120	3.85	2.40	1.81	1.48	1.28	1.13	1.03	0.95	0.88	0.83
140	4.57	2.73	2.03	1.65	1.41	1.25	1.13	1.04	0.97	0.91
160	5.25	3.06	2.25	1.82	1.55	1.37	1.24	1.13	1.05	0.99

The formulas used in calculation of dewpoint, mixing ratio and absolute humidity are presented in Appendix 6. However, when measuring in a high ambient pressure using HMP264 some corrections are needed in the calculations. These corrections can be made according to the instructions in Appendix 6.

8.4 Pressure

Pressure range of the HMP264 sensor head	0...10 MPa (0...100 bar)

8.5 Analogue outputs

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

8.6 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 (20...28 V)
Power consumption	120 mA maximum (24 VDC)
Recommended external load for current outputs	<500 Ω
Recommended external load for 0...1 V voltage output	>2 kΩ (to ground)
Recommended external load for 0...5 and 0...10 V voltage outputs	>10 kΩ (to ground)
Operating temperature (electronics) with display	-40...+60 °C 0...+50 °C
Storage temperature	-40...+70 °C

8.7 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) PPS grid (part no. 16562)
Housing dimensions	145 x 120 x 65 mm
Sensor head dimensions	see figures 8.1...8.3)
Cable diameter	5.5 mm

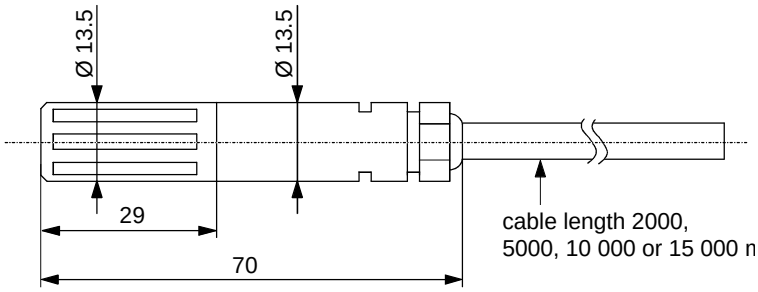


Fig. 8.1 HMP263 sensor head dimensions

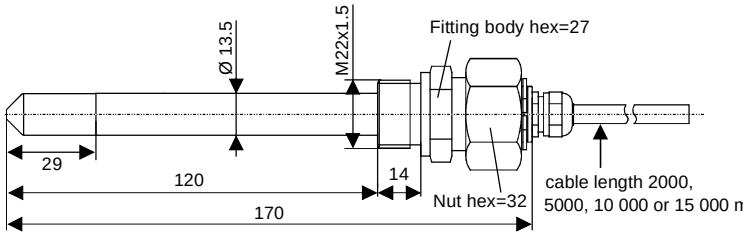


Fig. 8.2 HMP264 sensor head dimensions

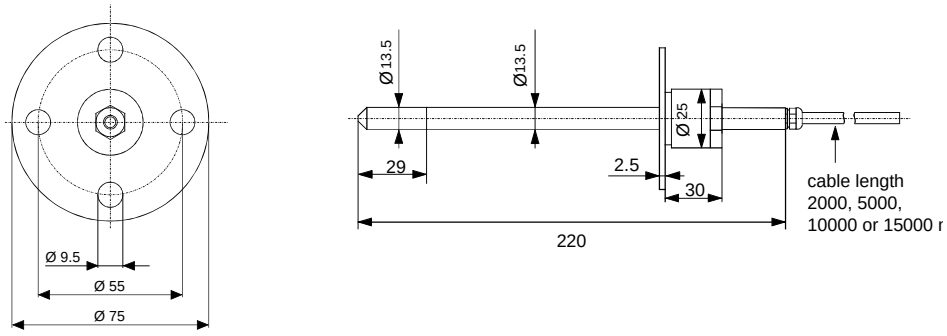


Fig. 8.3 HMP265 sensor head and flange dimensions

Weight (without display cover):

with	2 m cable	5 m cable	10 m cable	15 m cable
HMP263 (+ 120°C cable)	1260 g	1500 g	2000 g	2500 g
HMP264 (+ 180°C cable)	1400 g	1700 g	2200 g	2700 g
HMP265 (+ 180°C cable)	1600 g	1900 g	2400 g	2900 g

Weight of display cover 420 g

8.8 Electromagnetic compatibility

The emission and immunity tests have been performed according to standards EN50081-1 and EN50082-2.

NOTE

These tests are valid with specified sensor protections only.

Type:	Sensor protection/notes:
HMP263	PPS grid & stainless steel netting (part no. 16720)
HMP264	sintered filter (part no. 16452)
HMP265	sintered filter (part no. 16452), PPS grid & stainless steel netting (part no. 16720)

8.8.1 Emissions

Test:	Setup according to:
Radiated interference	EN55022 (class B)

8.8.2 Immunity

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

Voltage proof, AC: DC supply (+ or -) to housing 250 VAC, 1 minute (300 kΩ and 15 nF parallel)

CE

9. OPTIONS

Mounting flanges for HMP265	aluminium stainless steel for harsh conditions
Installation kit for HMP263	aluminium flange
Cable length	2, 5, 10 or 15 metres

10. SPARE PARTS

Order code	Description
HMP235FS	Mounting flange for HMP265, stainless steel
HMP235FA	Mounting flange for HMP265, aluminium
HMP233FAH	Mounting kit for HMP263
16452	Sintered filter, stainless steel
16720	PPS grid with stainless steel netting
16562	PPS grid
16663	HUMICAP humidity sensor (-40...+180 °C)
16612	Calibration adapter for the HMK11 Calibrator
HMP230RS	RS 485/422 serial module
HMP230CL	Digital current loop module
17223	Fitting body for HMP264 (standard)
17225	NTP conical pipe threaded fitting body for HMP264 (1/2 - 14 NPT)

GUARANTEE

Vaisala issues a guarantee for the material and workmanship of this product under normal operating condition for one (1) year from the date of delivery. Exceptional operating conditions, damage due to careless handling and misapplication will void the guarantee.

SERIAL COMMANDS

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, 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 transmitters 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

Disconnect the security lock jumper!

CT <cr>

With this command the transmitters 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>
```

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
T    offset     : 0.000
T    gain  : 1.000
```

LI Entering linear correction coefficients

Disconnect the security lock jumper!

LI <cr>

The LI command is one way of calibrating the transmitters.

```
LI <cr>
RH   offset     : 0.000  ?  -.6 <cr>
RH   gain  : 1.000  ? <cr>
T    offset     : 0.000  ? <cr>
T    gain  : 1.000  ?  .4 <cr>
```

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 the variables in use. The order, however, is always the same: relative humidity, temperature, dewpoint temperature, absolute humidity, mixing ratio and wet bulb temperature. 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 mode; 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:

```
"RH=999.9 %RH T=999.9 'C",<cr><lf>
"RH=999.9 %RH T=999.9 'C Td=9999.9 'C",<cr><lf>
"RH=999.9 %RH T=999.9 'C a=9999.9 g/m3 x=9999.9 g/kg Tw=999.9 'C",<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 an order 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 5 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 mode 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
\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                                   setting the output interval
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
```

The processor does not allow the following combinations:

- no parity, 7 data bits, 1 stop bit: if this combination is given the HMP260 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.

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
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 mode.

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>
```

RESET Resetting the transmitter

RESET <cr>

Resets the transmitter. All settings that have been changed stay 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 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. For example:

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

MTIM Setting the measurement integration time

MTIM nnn <cr>

nnn = number of cycles measured (4...255)

By lengthening the measurement integration time any stray changes in the output can be filtered out: the transmitter calculates the average of a number of measurement cycles defined by the user. The command can be given in two ways:

```
MTIM <cr>
Mtim       :     4  ?  5 <cr>
```

or

```
MTIM 5 <cr>
Mtim :     5
```

PRES Setting the pressure for mixing ratio and wet bulb calculations

PRES pppp.pp <cr>

pppp.pp = pressure (hPa)

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.

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 calculations temporarily

XPRES pppp.pp <cr>

pppp.pp = pressure (hPa)

The function and format of XPRES are the same as that 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 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 numbers 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>
HMPS 260 / x.yy
```

where x.yy is the programme version.

? Outputting the transmitter settings

? <cr>

For example:

```
? <cr>
HMPS 260 / 1.01
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.

SAFETY SUMMARY

In this summary the following symbols are used:

WARNING

A WARNING denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result in injury or death to personnel.

CAUTION

A CAUTION denotes a hazard. It calls attention to a procedure, practice, condition or the like, which, if not correctly performed or adhered to, could result damage to or destruction of part or all of the product.

The personnel must understand the following general safety precautions completely in order to be able to apply them to the use and maintenance of the HMP260 series transmitters. Some of these warnings and cautions also appear in other places in this operating manual but are repeated here for emphasis.

WARNING

Only the sensor head must be used in an explosive atmosphere. Do not use the equipment in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

CAUTION

Do not modify the instrument in any way or change any of its parts. Do not install unsuitable parts in the instrument as this may give rise to additional hazards. Contact Vaisala or its authorized representative for repairs to ensure that safety is maintained.

CAUTION

Only fuses with the required current rating and of the specified type may be used. Do not use a substitute for the right fuse and never short-circuit the fuse holder.

WARNING

Always use the grounding terminal to connect the transmitter to safety ground.

CAUTION

All the component boards are grounded via the housing frame. Make sure that the fixing screws of the boards are firmly tightened before cables are connected.

CAUTION

This equipment contains parts and assemblies sensitive to damage by electrostatic discharge (ESD). Use ESD precautionary procedures when touching, removing or inserting any objects inside the housing.

CAUTION

There are surface mounted components located on some boards. Avoid contact between these components when removing and mounting the board.

WARNING

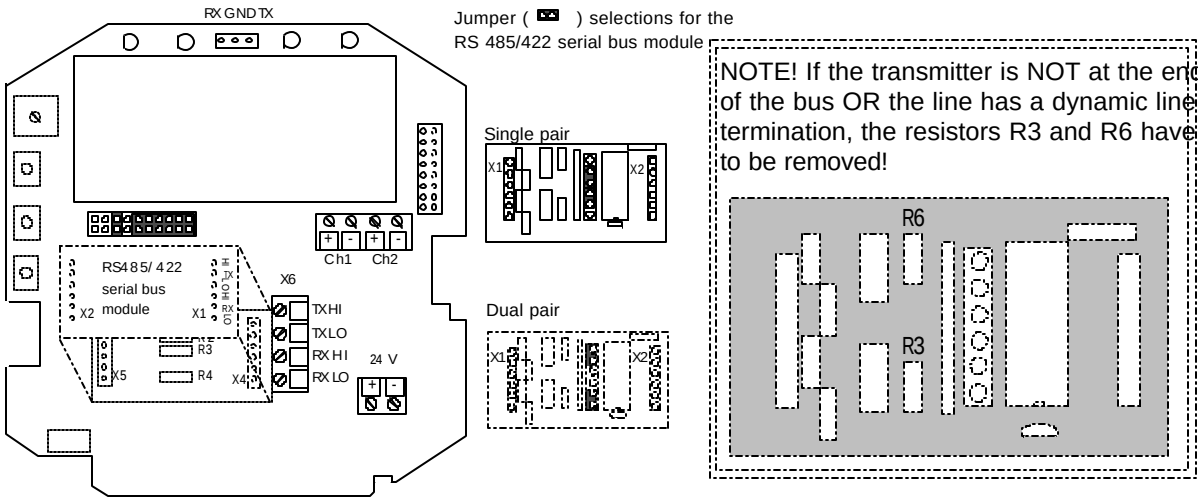
Protect the liquid crystal display (LCD) from bending and shock. If the LCD is leaking, wash exposed items (hands, clothes, etc.) thoroughly with water.

INSTALLING AND USING THE RS 485/422 SERIAL PORT MODULE

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 HMP260 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.

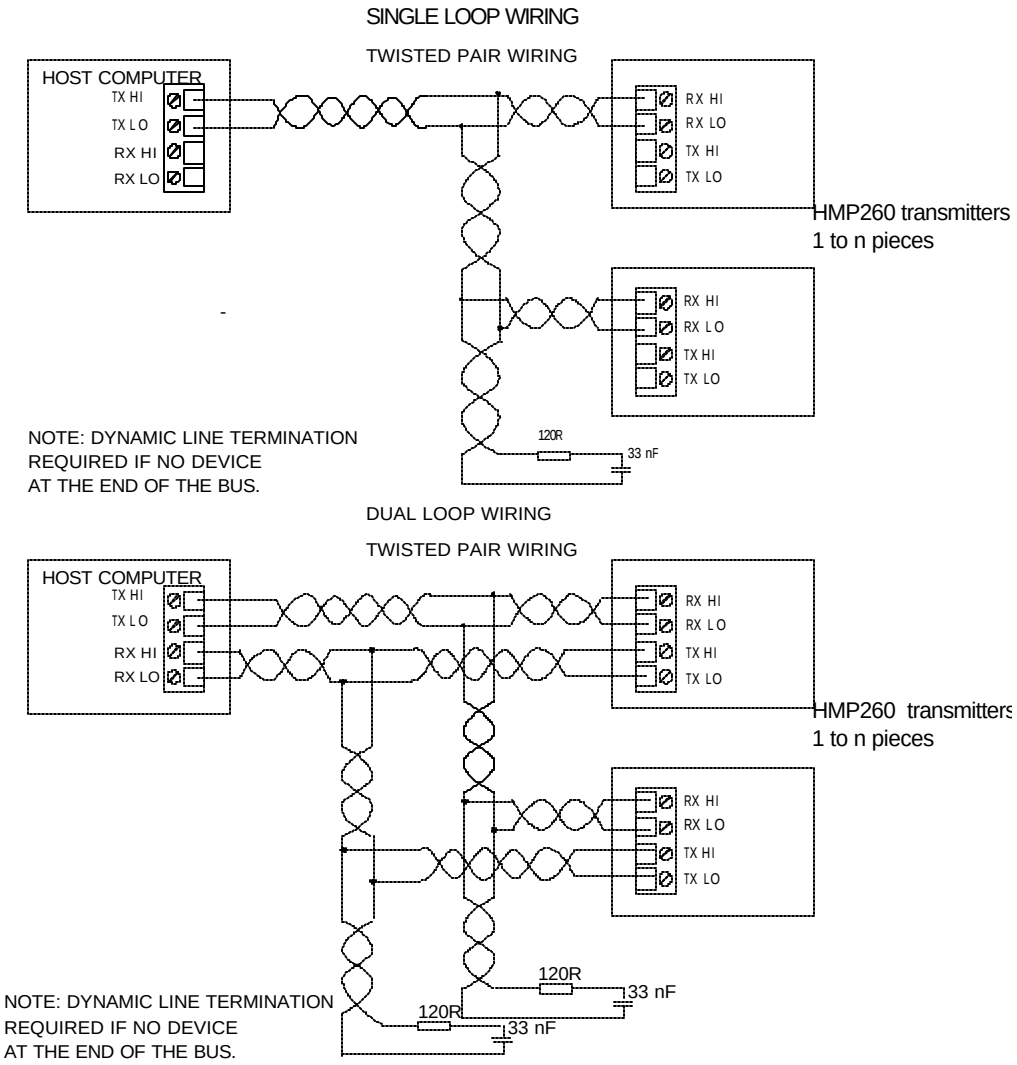
2 OPERATION

The HMP260 transmitters 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 HMP260 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 or it has the power supply module in use.

The serial line structure is a parallel interfaced chain (daisy chain). At the ends of the serial line there must be a HMP260 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, naturally only one line terminal impedance is in use. The line must not be terminated with a resistor alone, as then the power consumption increases too much.

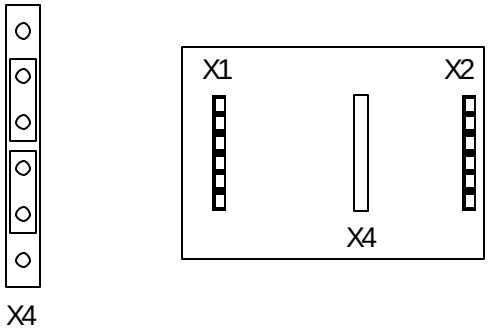
The data lines can withstand short circuit to ground and to each other. They do not survive connection of supply voltage to the data lines.

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

3 NETWORK CONFIGURATION

Single loop operation

Bidirectional 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.



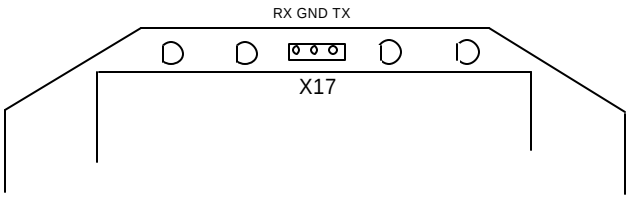
This jumper setting connects RX HI to TX HI and RX LO to TX LO and selects only one common line termination. The HI and LO terminals of the RX pair can now be used for operation.

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 changed back. 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; it can be 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.

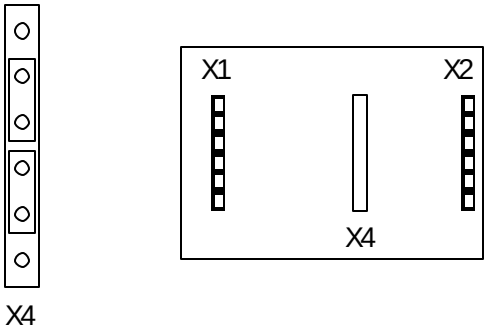
NOTE 2

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.



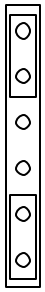
- Remount the RS 485/422 serial module.
- Close the cover.
- When all transmitters on the network have been configured, switch them off.

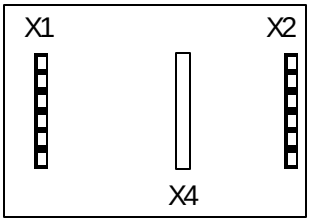
Dual loop operation

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 changed back. 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, it can be 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.

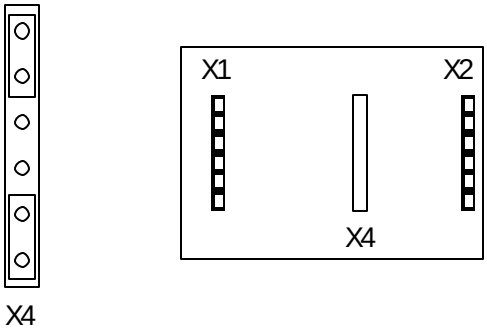
NOTE 2

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

Normally measurement readings are asked when the transmitter is in POLL mode; the command must then 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 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>
HMPS 260 / 1.01
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 made, 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 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. 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.

RS 485 network settings

HMP260 settings	single pair	dual pair
Full duplex/half duplex	HDX	FDX
Echo on/off	OFF	ON
Terminal settings		
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 HMP260 transmitters send line feed.

5 SPECIFICATIONS

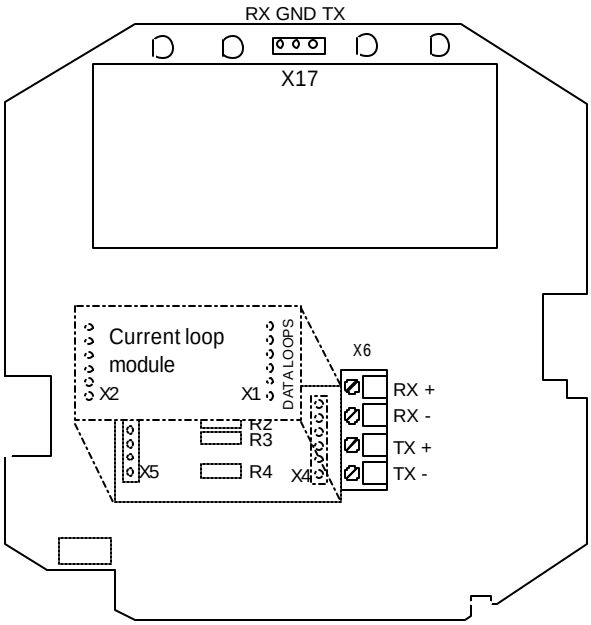
Connections	Berg sockets
on the main board	screw terminals 0.5 mm² wires, stranded wires recommended
Assembly	plug-in module
Board dimensions	40 x 28 mm
Operating mode (single or dual pair wiring)	half duplex
Network:	
network type	daisy chain
cable type	twisted pair
line length max.	1000 m (3000 ft)
number of devices	32 devices on line
data speed	9600 baud max. for HMP260 transmitters
operating mode	polling mode
common mode voltage range	±7 V
Operating temperature	-40...+60 °C
Storage temperature	-40...+70 °C

INSTALLING AND USING THE DIGITAL CURRENT LOOP MODULE

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 HMP 260 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.

2 OPERATION

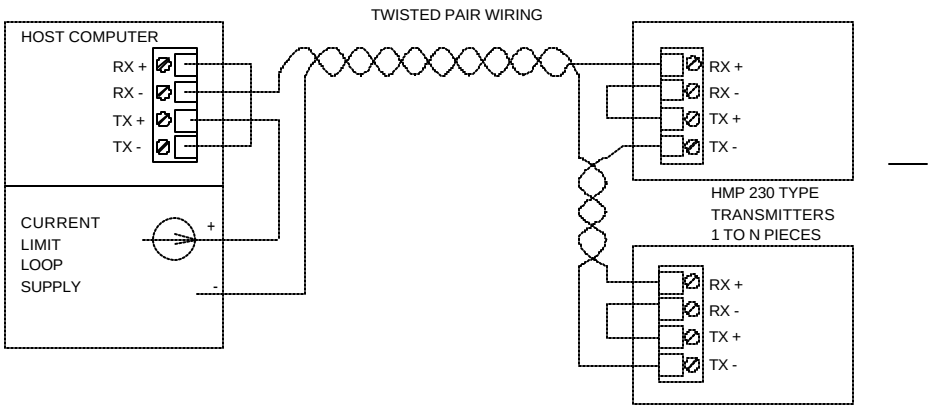
The HMP260 transmitters can either be given an address or operated without an address. Both single and dual loop wiring with half duplex connection can be used. No address is needed when only one HMP260 transmitter is used; when several transmitters are connected to the same line, each transmitter must 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.

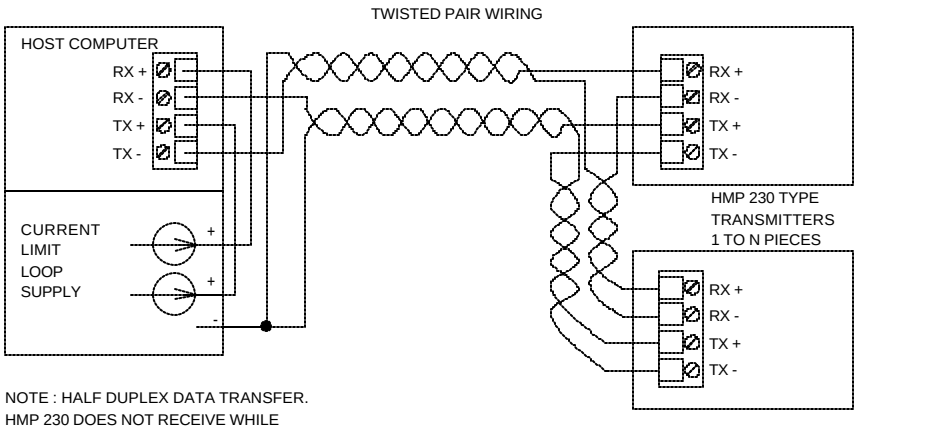
Note. The host computer can restrict the loop supply voltage that can be used; see computer specifications.

The serial line structure is a serial interfaced chain (daisy chain). At one end of the serial line there must be a HMP260 transmitter and at the other end a line master. A branch line can be made with a junction box.

SINGLE LOOP WIRING



DUAL LOOP WIRING



NOTE : HALF DUPLEX DATA TRANSFER.
HMP 230 DOES NOT RECEIVE WHILE
TRANSMITTING VIA SERIAL PORT MODULE.

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). Dual loop connection makes it possible to have a few more transmitters on the same loop pair. A single loop connection has simpler wiring. Data transmission is achieved by switching the loop current on and off.

Normally current flows through the loop(s) even when the HMP260 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. The module will not break if it is mounted in the wrong direction or to wrong pins, but it does not work. Reverse wiring of RX+ and RX- or TX+ and TX- does not affect the module.

3 NETWORK CONFIGURATION

Single loop operation

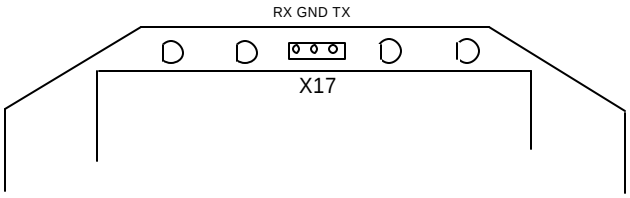
Bidirectional data on one pair and galvanic isolation are the advantages of the current loop. Single pair/dual pair use is configured through wiring (see figure on page 3).

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 changed back. 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; it can be 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
```

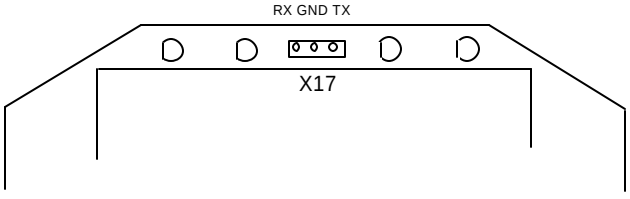
- Disconnect the terminal.
- Remount the digital current loop module.
- Close the cover.
- When all transmitters on the network have been configured, switch them off.

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 changed back. 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, it can be 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.

4 CHECKING THE SERIAL PORT NETWORK OPERATION

Normally measurement readings are asked when the transmitter is in POLL mode; the command must then 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; the 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>
HMPS260 / 1.01
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 made, close the line to transmitters (the command closes all open lines):

```
>close
line closed
```

CLOSE command is always given without address. If there was no line 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 raised to 9 by using dual loop wiring.

Current loop settings

HMP260 settings	single pair	dual pair
Full duplex/half duplex	HDX	FDX
Echo on/off	OFF	ON
Terminal settings		
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 HMP260 transmitters send line feed.

5 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 mm² 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

ERROR MESSAGES

The HMP260 transmitters go through a self-diagnostics procedure when the power is switched on. When the procedure does not reveal any errors or faults, the transmitter starts operating normally. If errors or faults are found, the transmitter outputs an error message. 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

Errors after reset

Display	Serial bus
E11 CPU EEPROM ackn. error	E11 CPU EEPROM ackn. error
E12 CPU EEPROM csum error	E12 CPU EEPROM csum error
E21 PRB EEPROM ackn. error	E21 PRB EEPROM ackn. error
E22 PRB EEPROM csum error	E22 PRB EEPROM csum error

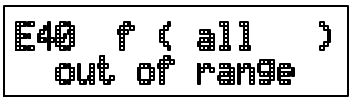
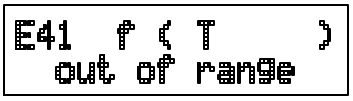
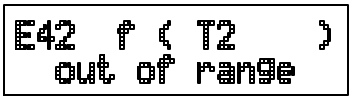
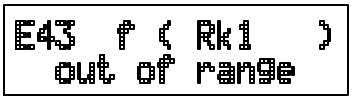
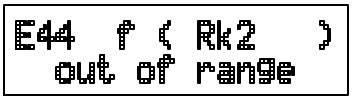
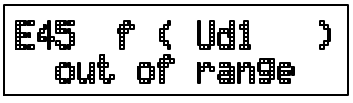
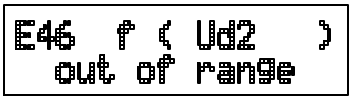
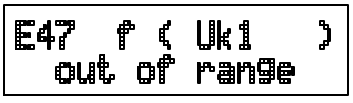
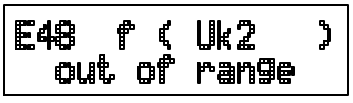
ackn. error = EEPROM is faulty
csum error = check sum is erroneous

The LEDs indicate these errors as follows:

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

Errors during operation

There are two types of errors that may occur during the operation of the transmitters. The first type indicates that no frequency comes from the converter.

Display:	Serial bus:
	E40 f (all) out of range
	E41 f (T) out of range
	E42 f (T2) out of range
	E43 f (Rk1) out of range
	E44 f (Rk2) out of range
	E45 f (Ud1) out of range
	E46 f (Ud2) out of range
	E47 f (Uk1) out of range
	E48 f (Uk2) out of range

The LEDs indicate these errors 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	E51 T y-value out of range
E53 U1 y-value out of range	E53 U1 y-value out of range
E54 U2 y-value out of range	E54 U2 y-value out of range

The LEDs indicate these errors as follows:

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

1 CALCULATION

The HMP260 series transmitters measure relative humidity and temperature. From these values dewpoint, mixing ratio and absolute humidity are calculated using the following equations

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

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

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

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/m^3)
t = temperature (°C)

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

$$P_{ws} = A \cdot 10^{\left(\frac{m \cdot t}{t + T_n}\right)}. \quad (4)$$

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

t	A	m	T_n
-40 ... 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

2 CORRECTIONS AT HIGH PRESSURE

The saturation pressure of water vapour calculated with equation (4) is accurate only in vacuum where water vapour is the only gas present. In presence of other gases the real saturation pressure of water vapour P_{ws} will rise. At pressure levels up to the normal atmospheric pressure this effect causes only a minimal error in the calculated variables and can therefore be ignored. However, at ambient pressures significantly above normal atmospheric pressure corrections should be made. The pressure correction of P_{ws} is not included in the software of HMP260 series and therefore it must be made separately.

When using the HMP264 at ambient pressures significantly above normal atmospheric pressure, an enhancement factor f can be used to correct P_{ws}. The enhancement factors listed in the table below have been proposed for CO_2-free air[1)] at different temperatures and pressures. The corrected partial pressure of saturated water vapour is then

$$P_{ws,corrected} = f \cdot P_{ws} \qquad (5)$$

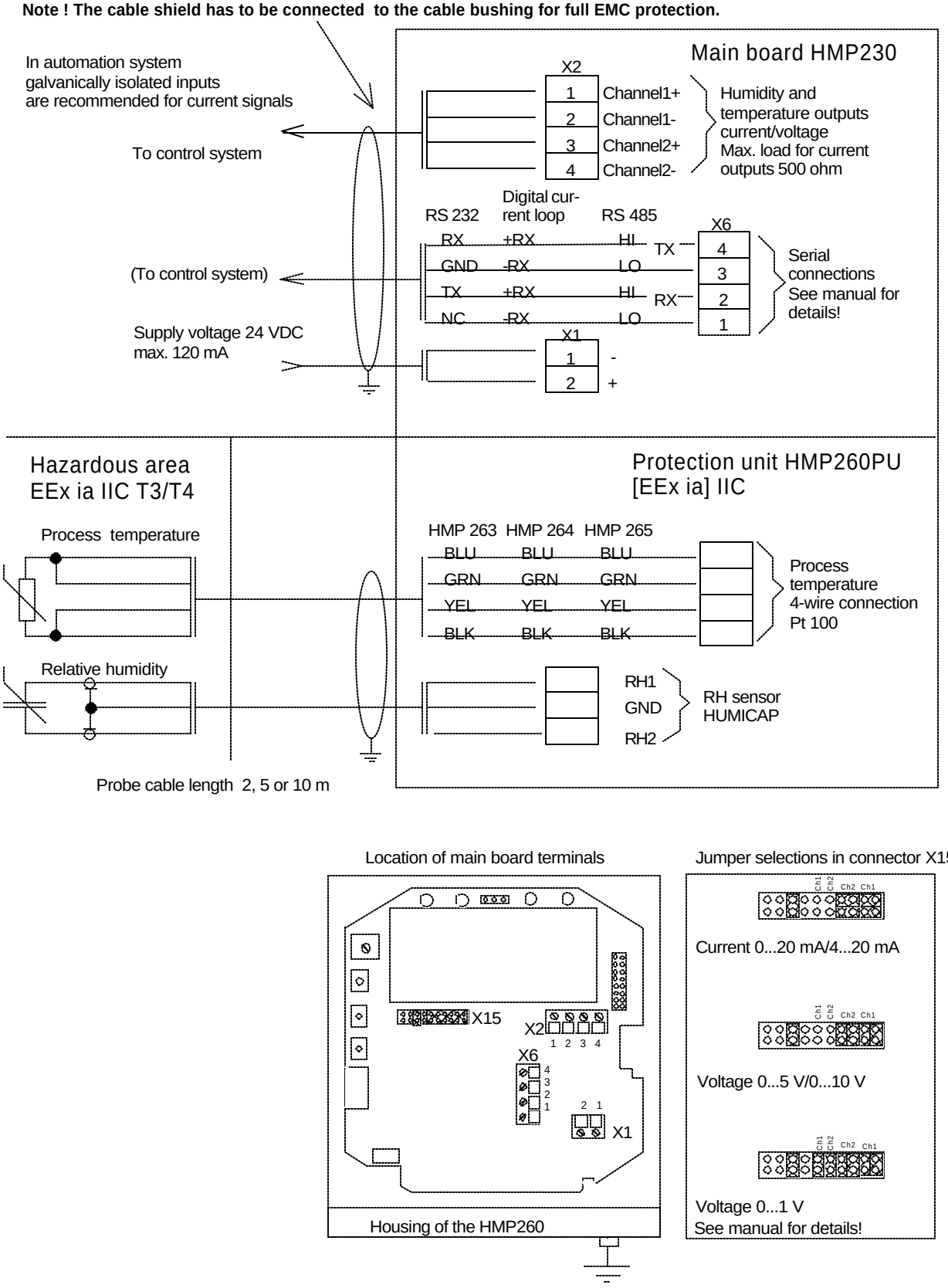
With the help of the corrected water vapour pressure more accurate calculatios of the dewpoint temperature, mixing ratio and absolute humidity are possible.

Enhancement factors f [1)]							
Total press.	t (°C)						
(bar)	-40	-20	0	20	40	60	80
0.25	1.0013	1.0012	1.00131	1.00173	1.00223	1.00111	
1.00	1.0052	1.0044	1.0039	1.00400	1.00467	1.00571	1.00564
2.00	1.0104	1.0086	1.0074	1.0069	1.00728	1.00839	1.00968
3.00	1.0156	1.0129	1.0108	1.0099	1.0098	1.0108	1.01234
4.00	1.0209	1.0172	1.0144	1.0128	1.0124	1.0130	1.0146
5.00	1.0262	1.0215	1.0179	1.0158	1.0149	1.0153	1.0168
10.00	1.0533	1.0435	1.0356	1.0308	1.0277	1.0265	1.0271
20.00	1.110	1.089	1.072	1.0615	1.0539	1.0493	1.0474
30.00	1.171	1.138	1.111	1.093	1.081	1.073	1.0680
40.00	1.237	1.189	1.151	1.126	1.109	1.096	1.0890
50.00	1.307	1.243	1.193	1.161	1.137	1.121	1.111
60.00	1.38	1.300	1.237	1.196	1.167	1.146	1.133
70.00	1.46	1.360	1.282	1.233	1.197	1.172	1.155
80.00	1.55	1.42	1.330	1.271	1.228	1.198	1.178
90.00	1.64	1.49	1.381	1.311	1.261	1.226	1.202
100.00	1.75	1.56	1.43	1.352	1.294	1.254	1.226

1) Hyland R.W., Journal of Research of the NBS, Vol. 80A, No. 4 (1975) pp. 551-559

Ltr	Qty	Change	Reason/ ECO no	Design	Date Review	Date Appr

Note ! The cable shield has to be connected to the cable bushing for full EMC protection.



Location of main board terminals

Housing of the HMP260

Jumper selections in connector X15

Current 0...20 mA/4...20 mA

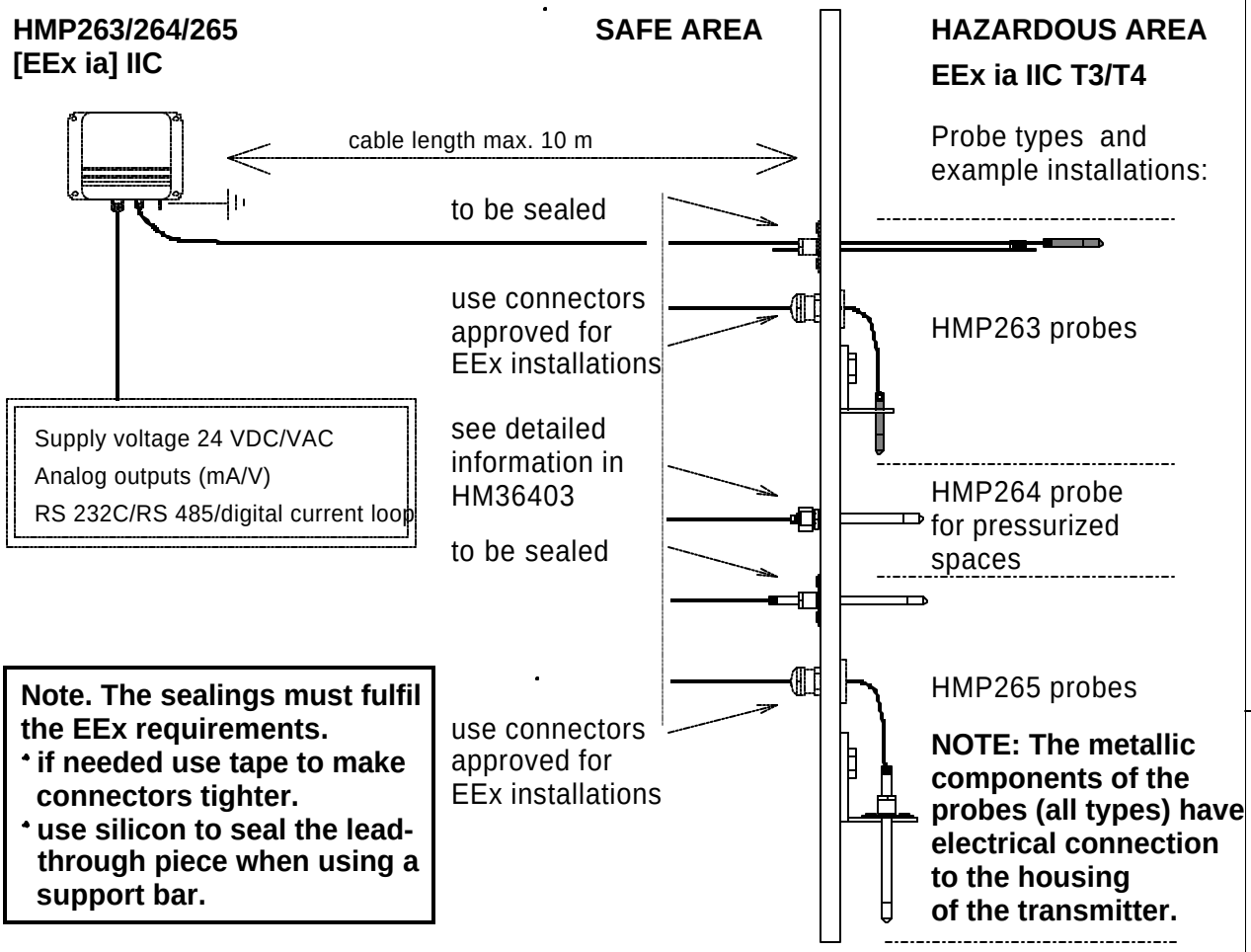
Voltage 0...5 V/0...10 V

Voltage 0...1 V
See manual for details!

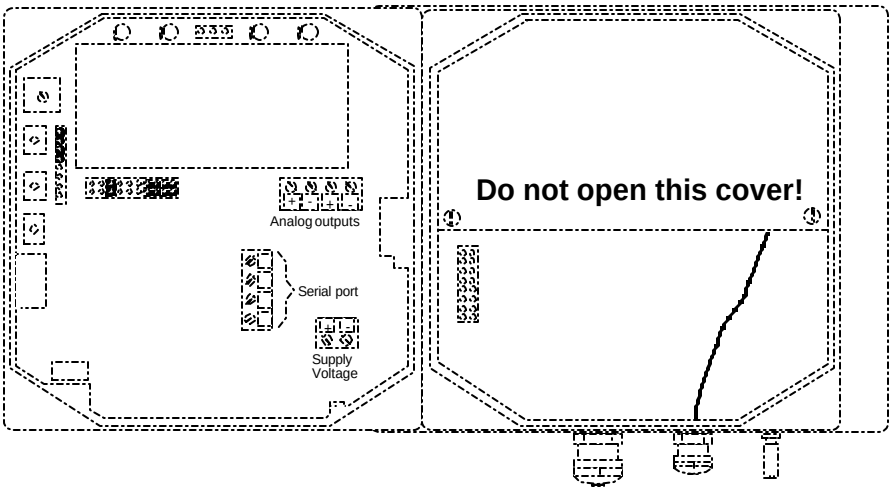
Drawn 94-02-16 KKe	Arch id	Serial no	Sheet	Cooperator`s doc no	
Review	Title				
Appr	HMP263, HMP264 AND HMP265 WIRING DIAGRAM				
Design KKe	Scale				
Replaces				Dwg no MK4462	Rev A

Ltr	Qty	Change	Reason/ ECO no	Design	Date Review	Date Appr

Installation examples of intrinsically safe operation for transmitter types HMP263/264/265.



Note. The sealings must fulfil the EEx requirements.
- **if needed use tape to make connectors tighter.**
- **use silicon to seal the lead-through piece when using a support bar.**



See MK4462 for more details on wiring!

Drawn 94-07-04 KKe	Arch id	Serial no	Sheet	Cooperator`s doc no	
Review					
Appr					
Design KKe	Scale	Title: HMP263, HMP264 AND HMP265 INSTALLATION			
Replaces				Dwg no MK4461	Rev B

APPROVALS AND SPECIFICATIONS OF THE PROTECTION UNIT

The transmitter conforms to the European Standards EN 50014 and EN 50020 and meets the requirements with the following marking of the type and protection: transmitter [EEx ia] IIC and sensor heads EEx ia IIC T3/T4.

Protection Unit HMP 260PU

Operating temperature with display cover	-40...+60 °C 0...+50 °C
Operating humidity	0...100 %RH non-condensing
Voltage protection VAC/VDC	Hazardous to Non-hazardous Side 250
Safe maximum values (CENELEC)	U_m= 250 V, $U_o \leq 7$ V, $I_o \leq 55$ mA, $C_o \leq 15$ µF, $L_o \leq 14$ mH
Marking (CENELEC)	[EEx ia] IIC
Location	non-hazardous area
Certification	VTT No. Ex-94.C.016X DEMKO No. 94C.115330X

Sensor heads

Safe maximum values (CENELEC)	$U_i \leq 7$ V, $I_i \leq 55$ mA, $C_i \leq 0.1$ µF, $L_i \approx 0$ mH
Marking (CENELEC)	EEx ia IIC T3/T4
Location	hazardous area
Certification	VTT No. Ex-94.C.018X DEMKO No. 94C.115330X

See attached certificates for further details.