HMP228
Moisture and Temperature Transmitter for Oil

USER'S GUIDE

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VAISALA

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Vaisala Oyj
P.O. Box 26
FIN-00421 Helsinki
Finland

Phone : (+358 9) 894 91
Fax: (+358 9) 8949 2227

Visit our Internet pages at http://www.vaisala.com/

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1. PRODUCT DESCRIPTION

1.1 General characteristics

The HMP228 transmitter is a microprocessor based instrument for the measurement of moisture in terms of water activity e.g. in the lubrication of circulation systems or in transformer oil. The transmitter incorporates a capacitive thin film sensor. The operation of the sensor is based on changes in its capacitance as the thin polymer film absorbs water molecules.

The HMP228 transmitter has two analogue outputs and can be connected to a serial bus via the RS 232C interface or through an RS 485/422 serial module or a current loop module.

The transmitter can be configured in many ways. It can have either a blank cover or a cover with a local display and keypad with which the user can operate the transmitter. The power supply voltage can be selected from three alternatives. Two analogue output signals can be scaled and the measurement ranges changed within certain limits. The HMP228 transmitter can be supplied with two, five or ten metre sensor head cable.

The HMP228 also provides for accurate temperature measurement. It is an easy-to-install on-line transmitter which can be calibrated against traceable salt solutions.

Options	
Power supply	24 VDC (standard); (24 VAC: see Chapter 2.3.2), 115/230 VAC
Serial interface	RS 232C (standard), RS 485/422, current loop
Display cover	cover with or without local display & keypad
Alarm output unit	not with 115/230 VAC power supply
Cable length	2, 5 or 10 metres
Cable connectors	for 24 VDC supply, for analogue outputs, for RS 232C line and for RS 485 single loop line; see Appendix 8 for details.

1.2 Typical applications

1.2.1 About the method used for measuring moisture in oil

The HMP228 transmitter measures water in oil in terms of water activity (aw) which can be determined as follows: water activity indicates the amount of oil in the scale of 0 - 1 aw. In this scale, 0 aw is an indication of completely water free oil and 1 aw an indication of oil fully saturated with water. Water is present in free form.

The most important feature which distinguishes the measurement of water activity (aw) from the traditional measurement of absolute water content (in

ppm) is that the saturation point remains stable regardless of the oil type or the aging of oil, additives used etc. As water activity exceeds 0.9 aw in any system, there is a risk for segregation (especially if the temperature decreases). The water activity is used for alarming at the point of >0.9 aw that the risk for free water in the system is obvious. The most important advantages of this system are the fact that water activity is immune to the aging of oil and to additives, and that the HMP228 transmitter can be used for continuous on-line measurements. In addition, the HMP228 can be calibrated against salt solutions and no reference oils are needed.

1.2.2 Lubrication oil in paper machines

Typically, a paper machine contains two or three separate lubrication systems. Usually, one is located at the wet end and the other at the dry end. There is a certain amount of free moisture constantly present which means that there is a risk of this moisture becoming into contact with the machine bearings. The most common reasons for the entrance of water are an inadequate sealing of the housing and cleaning with high pressure. However, accidental leakages from oil coolers and other equipment may also cause damage. In paper machines, the oil should absorb water while lubricating the bearings and then release this water when collected into the reservoir. It is to be noted that bearings should never be exposed to oils that have a high water content; this is especially important during standstill because the risk for corrosion process increases as the oil temperature decreases. It is essential to monitor the water content and keep it on a suitable level.

When measuring the water content of oil in paper machines, it would be useful to measure the water activity before an oil reservoir and from a pressure line flow. This way, the performance of dehumidifiers can be kept under control to ensure that no free water reaches the bearings.

1.2.3 Transformer oil

The determination of moisture in oil is an essential part of a comprehensive transformer maintenance program. Aging and deterioration increase the capacity of oil to absorb water. The primary interest in transformers is to measure the water not in oil but in the cellulosic insulation around the transformer windings. Heating and cooling have a considerable effect on moisture levels in oil. While temperature raises, the paper insulation of transformers tends to loose moisture which is absorbed by the oil surrounding it. Saturation level is thus a true indicator of moisture present. The HMP228 method provides for a reliable detection of the aging of oil and possible leakages. Water activity helps to prevent heavy overloadings and to monitor the transportation of moisture in the transformer.

2. INSTALLATION

2.1 Selecting the place of installation for the probe and the transmitter

Select a place which gives a true picture of the process. Oil should circulate freely around the sensor; a rapid oil flow is recommended. Install the sensor directly into the circulation system and not into the oil reservoir because of deposition.

It is recommended that the sensor head is installed directly in the process through the ball valve assembly. When the ball valve assembly is used, the pipe does not have to be emptied or shut down for installation or removal of the probe. Install the sensor head transversely against the direction of the process flow.

NOTE

Avoid mounting the transmitter housing close to steam sources or directly exposed to rain. 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.

NOTE

Take care not to damage the pipe of the probe. If the pipe is damaged, the probe head is less tight and will not go through the clasp nut. Make sure that the filter is tightly fastened to protect the sensors.

2.2 Mounting

In Figures 2.2.1 and 2.2.2 you can see the dimensions of the HMP228 transmitter and probe:

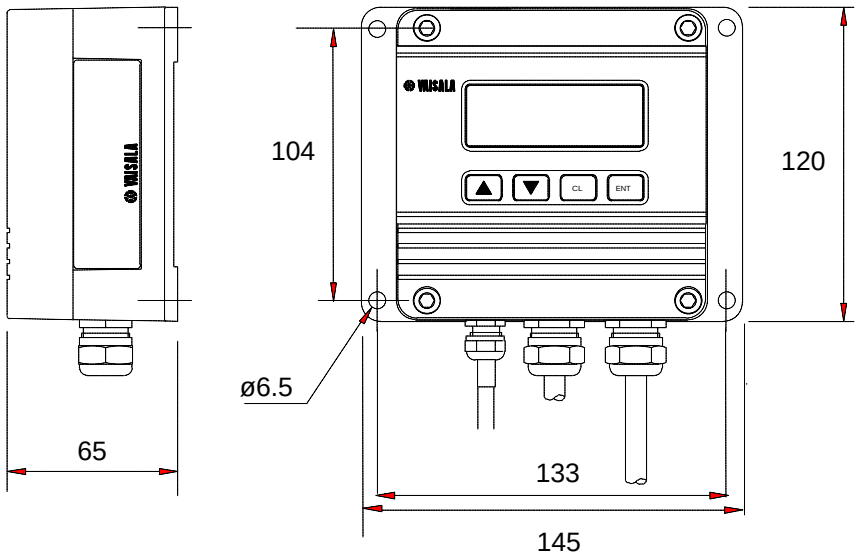


Figure 2.2.1 Dimensions of the HMP228 electronics housing (in mm)

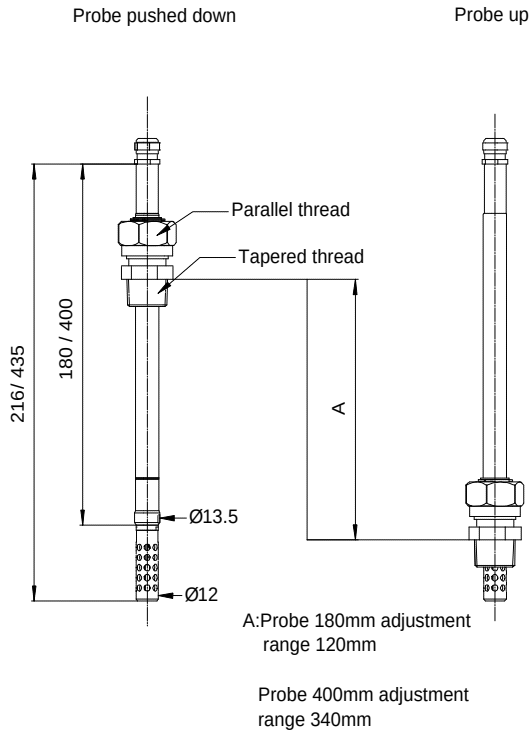


Figure 2.2.2 Probe dimensions (in mm).

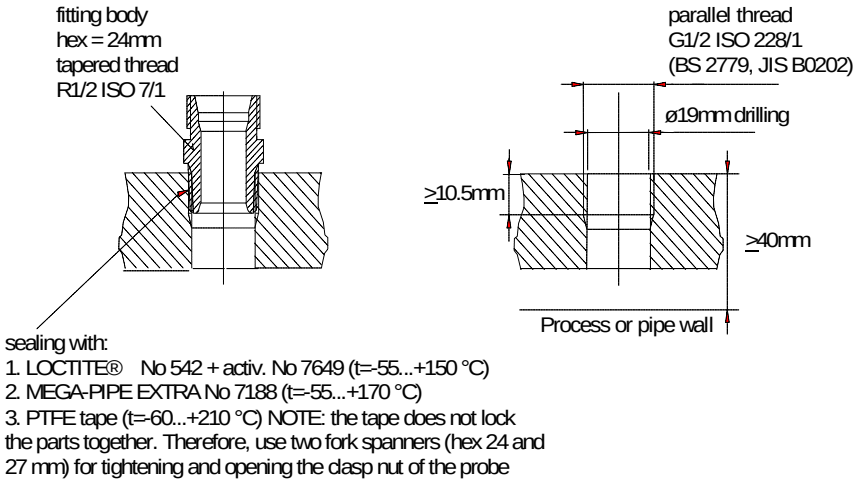


Figure 2.2.3 Sealing and thread cutting for the fitting body

The fitting body can be installed e.g. on standard pipe fittings (G 1/2 ISO 228/1) or on a thread in the process wall. If the wall thickness is less than 10.5 mm, it is recommended to use a welded sleeve (see Figure 2.2.4). Note that the minimum recommended distance of the fitting body and the probe head is 40 mm (see Figure 2.2.3).

Adjust the probe to a suitable distance according to the type of installation and tighten the clasp nut first manually; mark the fitting body and the clasp nut and tighten the clasp nut a further 50 - 60 ° with a fork spanner (see Figure 2.2.4).

Pushing the probe head through the ball valve assembly. Open and close the ball valve assembly with the marking groove always in sight. When the probe has been pressed through, the nut is tightened 50 - 60 ° with a fork spanner (hexacon 27 mm).

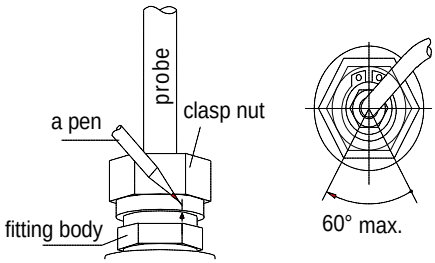


Figure 2.2.4 Tightening the clasp nut

NOTE

Be careful not to tighten the clasp nut more than 60° as this may result in difficulties when trying to pull the probe head up.

2.2.3 Installing the probe through the ball valve assembly

It is recommended that the sensor head is installed in the process through the ball valve assembly. Use a 1/2" ball valve assembly with a hole diameter of 14 mm or more. With this installation, it is not necessary to empty or shut down the process for installing or removing the sensor head. If the sensor head is installed in a process pipe, please note that the nominal size of the pipe must be at least 1 inch. See Figure 2.2.3.1. for detailed instructions.

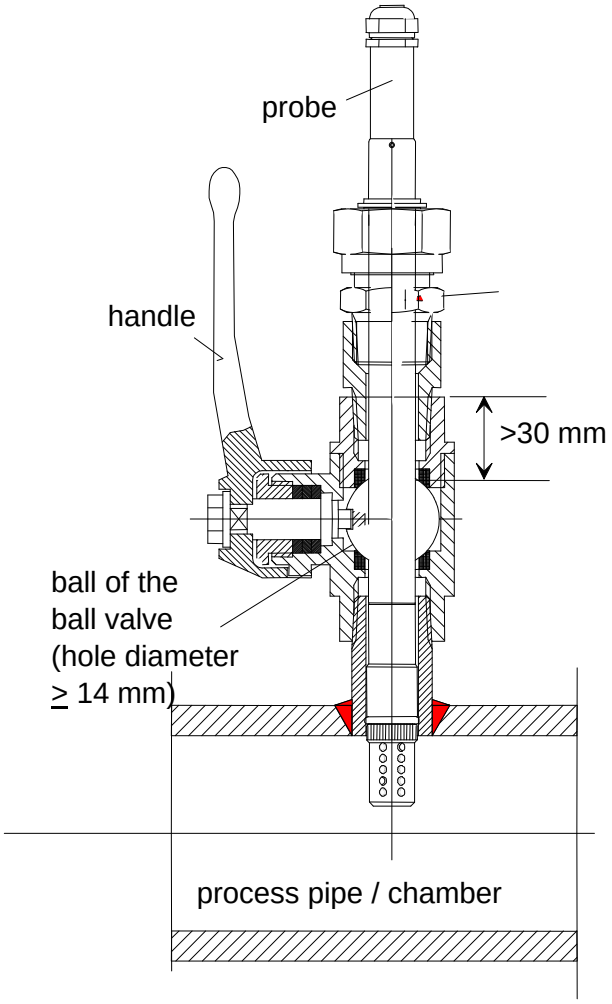


Figure 2.2.3.1 Installing the sensor head through the ball valve assembly

NOTE

The probe can be installed in the process through the ball valve assembly provided that the process pressure is less than 10 bars. This way, the process does not have to be shut down for installing or removing the probe. However, if the process is shut down before removing the probe, the process pressure can be max. 20 bars.

See Figures 2.2.3.2 - 2.2.3.4 for detailed description of installation through the ball valve assembly. Note also that if the sensor head is installed in a process pipe, the nominal size of the pipe must be at least 1 inch.

- STEP I: mount the probe with the ball valve assembly closed

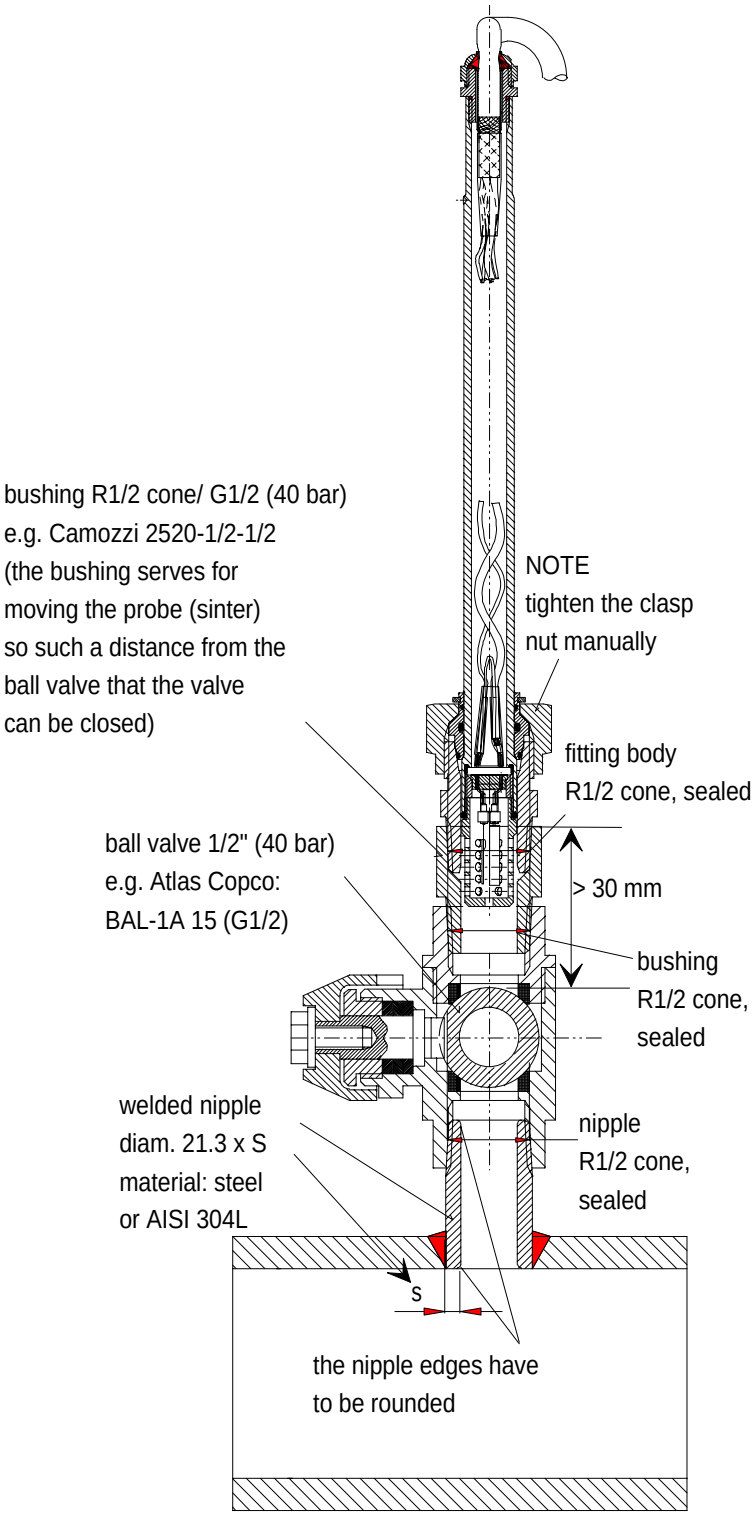


Figure 2.2.3.2 Installing the probe through the ball valve assembly; step 1

- STEP 2: open the ball valve assembly

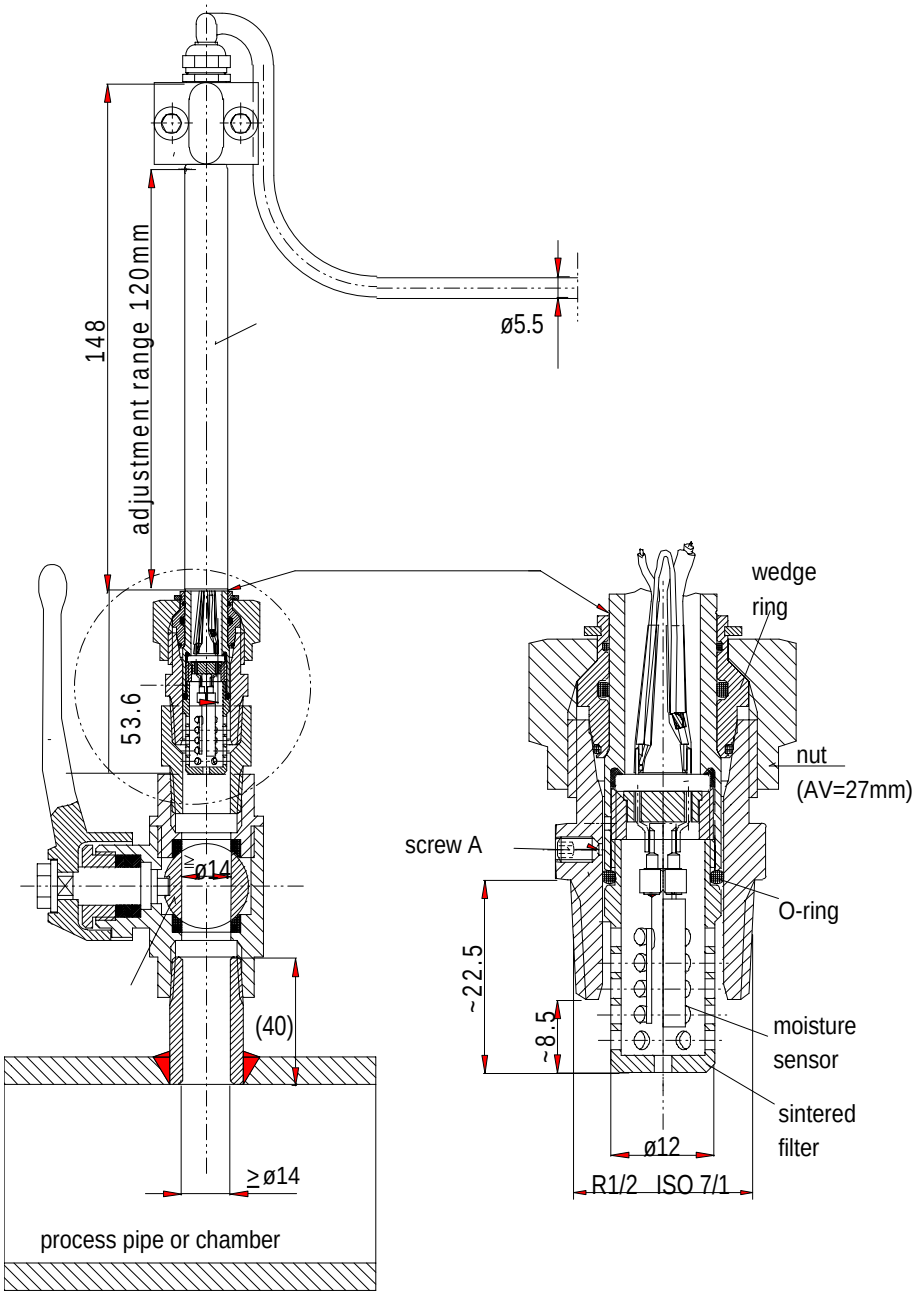


Figure 2.2.3.3 Installing the probe through the ball valve assembly; step 2 (measures in mm)

The clasp nut is tightened manually prior to opening the ball valve assembly.

- STEP 3: push the probe head through the ball valve assembly into the process. Note that the sensor head must be pushed so deep that the filter is completely inside the process flow.

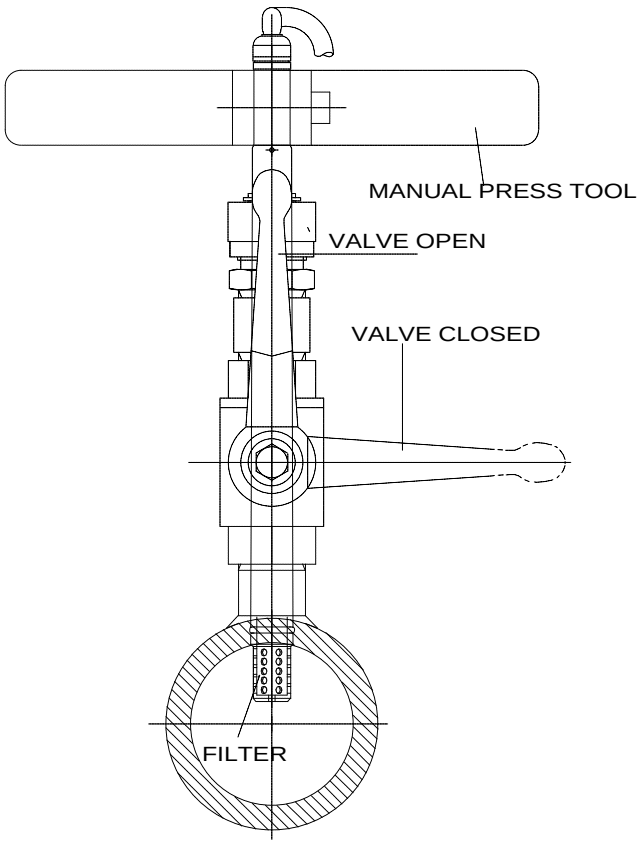


Figure 2.2.3.4 Installing the probe through the ball valve assembly: step 3

2.2.4 Mounting the probe directly in the process pipe

When the probe is installed directly in a process pipe, note that a closing valve is needed on both sides of the installed probe so that the sensor head can be removed from the process for calibration and maintenance.

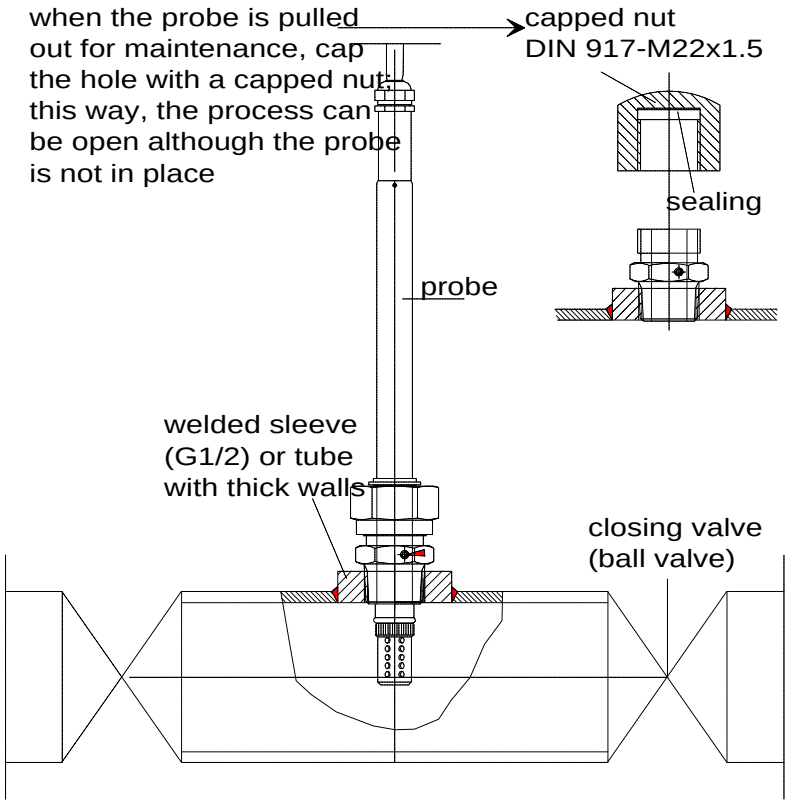


Figure 2.2.4 Installing the sensor head directly in a process pipe

2.3 Signal cabling and grounding

2.3.1 Electrical connections

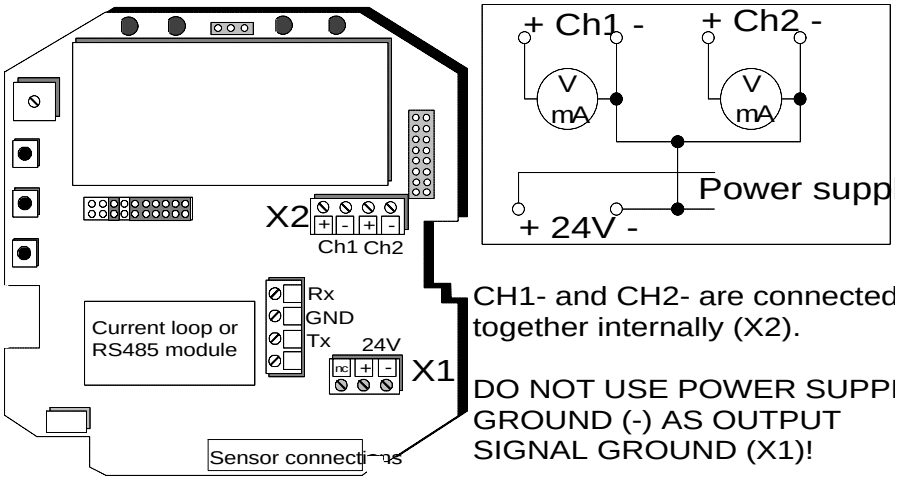


Figure 2.3.1 Electrical connections

Power supply	24 VDC 24 VAC (see Chapter 2.3.2)
with power supply module	115/230 VAC
Output signals	0...20 mA 4...20 mA 0...1 V 0...5 V 0...10 V

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

See Appendix 3 on how to connect the power supply module to the transmitter.

2.3.2 Connection to an AC supply

The HMP228 transmitter can also be connected to an AC supply without an external rectifier. However, when more than one transmitter is connected for example to one 24 VAC transformer, a common loop is formed and there is an increased risk of a short-circuit. To avoid this, always use separate floating supply for each transmitter (see Figure 2.3.2 A). However, if several transmitters have to share one transformer, the phase (~) must always be connected to + connector in each transmitter (see Figure 2.3.2 B).

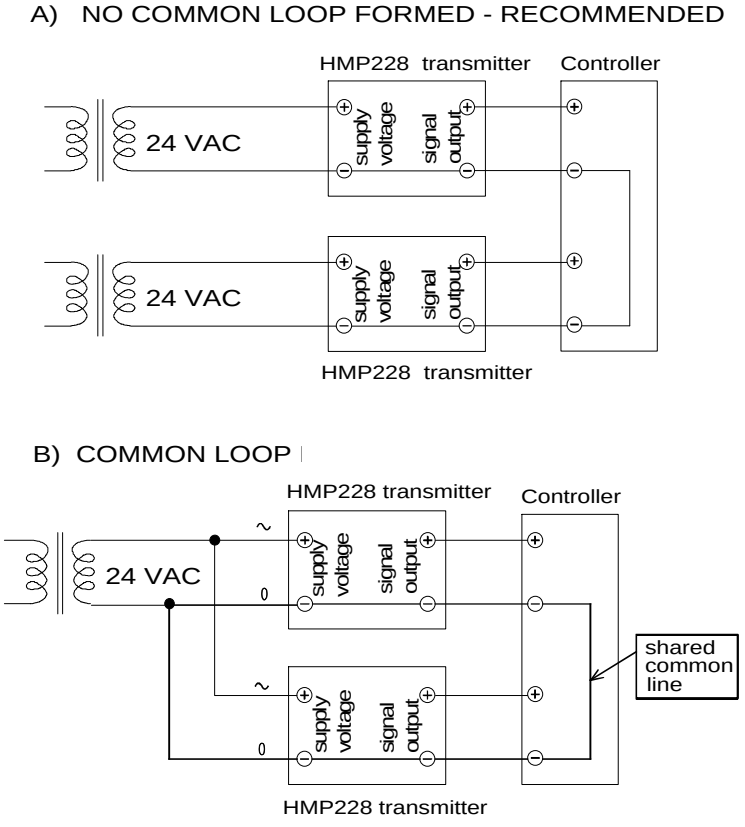


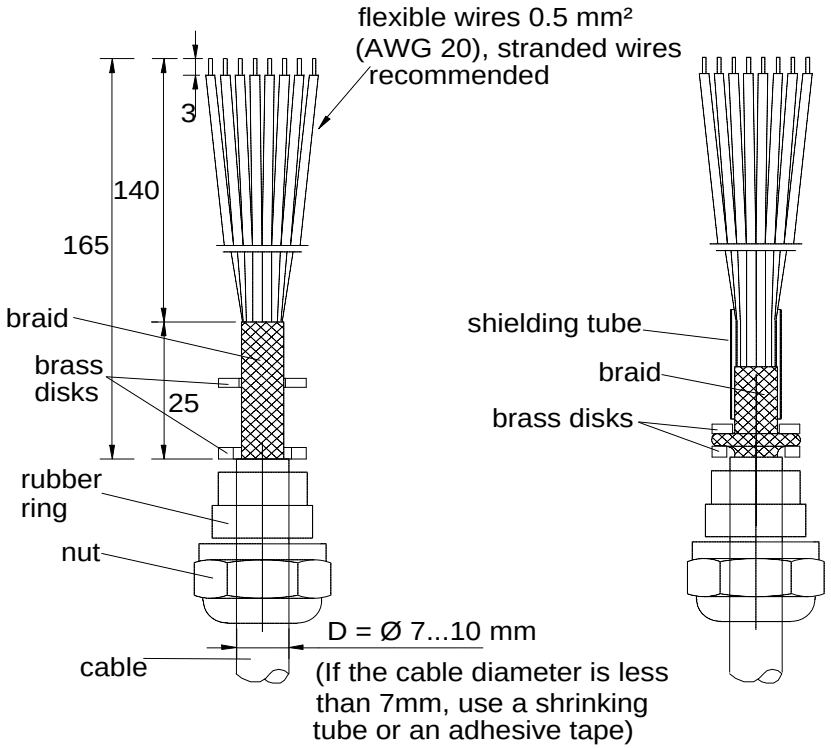
Figure 2.3.2 Connecting the transmitter to an AC supply

2.3.3 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.

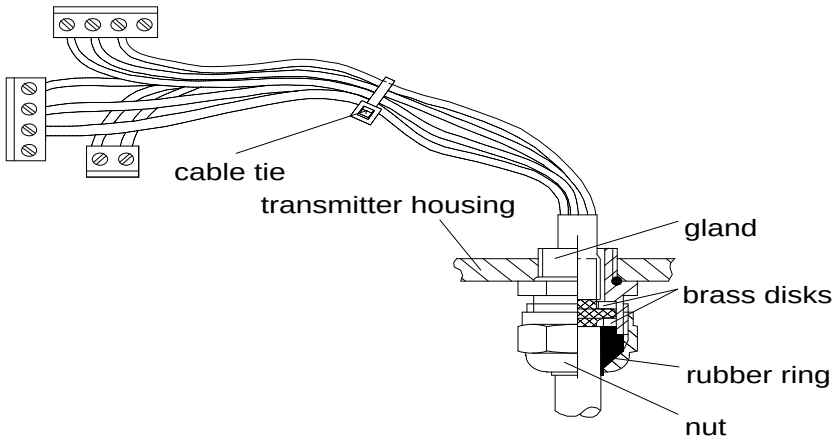
- remove the brass disks, rubber ring and nut from the transmitter housing
- strip 165 mm of the cable insulation, but leave 25 mm of the braid visible
- slip the nut and rubber ring over the cable insulation
- slip the brass disk that has the bigger hole in it over the braid so that it rests against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

Use connectors instead of traditional cabling. See Appendix 8 for connector types available and for detailed instructions.



NOTE

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

When mains power supply is used, ground the housing with a protective ground wire using a grounding screw on the right side of the power supply module (see Appendix 3 for details).

3. COMMISSIONING

When the HMP228 transmitter leaves the factory, its measurement ranges and output signals have already been scaled according to the order form completed by the customer. The unit is calibrated at the factory and ready to operate when the power is turned on. If you take into use active current, voltage or serial bus outputs, make these connections first; appendix 9 describes them in detail.

NOTE

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

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

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

Appendix 7 contains information on how to determine the ranges for alarm outputs and alarm controls when an alarm output unit is used, and Appendix 8 describes the use of connectors.

3.1 Changing the parameters

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

A limited range of commands can be given with the three press switches (up, down, enter) inside the transmitter housing. There are four LEDs to indicate the commands given with the up and down switches. All HMP228 units incorporate these switches and LED indicators. LED commands can be used to calibrate the transmitters (both humidity and temperature) or to calibrate the analogue outputs.

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

3.1.1 Security lock jumper

Before the settings can be changed, the user must first remove the security lock jumper in connector X15 (see Figure 3.1.1). The security lock jumper

makes it impossible to change the transmitter settings by mistake. The jumper should be removed only for changing the settings and for calibration.

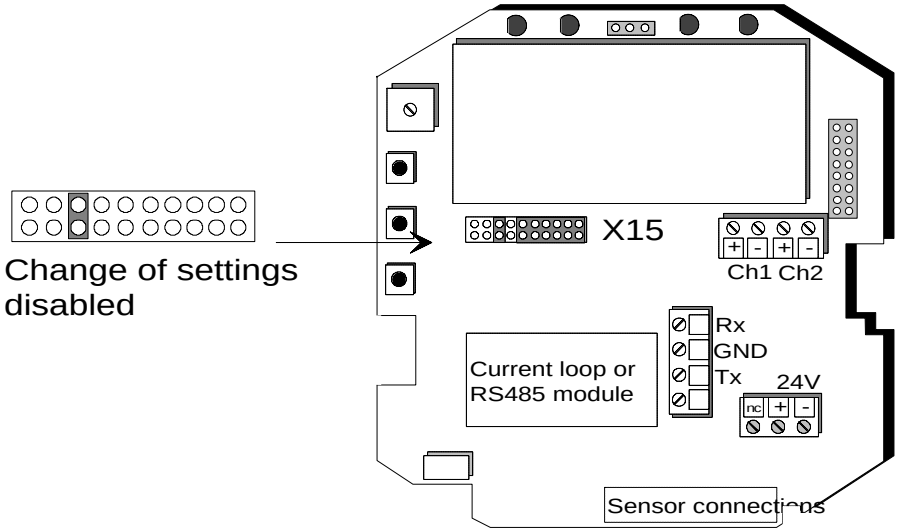


Figure 3.1.1 Location of the security lock jumper

When the security lock jumper is connected, some commands cannot be used, see Chapter 4.

If you wish to take into use variables that are not included in the configuration of your transmitter, contact Vaisala for more information.

3.1.2 Commands and security lock jumper

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

- serial commands: CRH, CT, FCRH, ACAL; AMODE, ASEL, ASCL
- all LED commands
- display/keypad commands:

Cali ⇨ RH T
Analog outputs
Mode ⇨ Analog outputs ⇨ Mode
Scale

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

Disconnect the security lock jumper!

3.2 Using the RS 232C serial bus

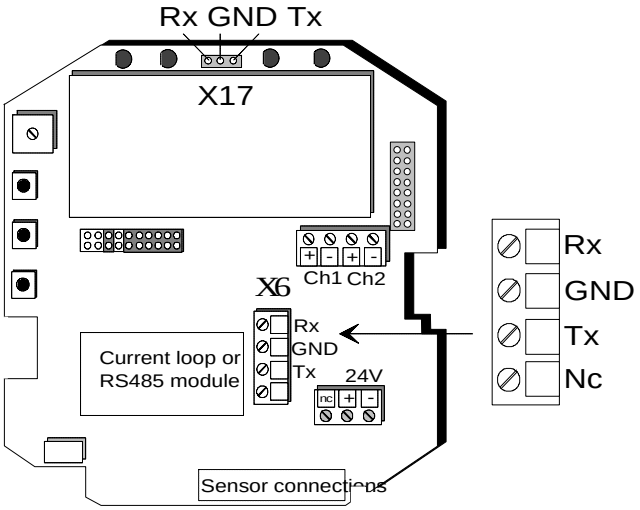


Figure 3.2.1 Serial bus connections

To connect a PC to the HMP228 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.

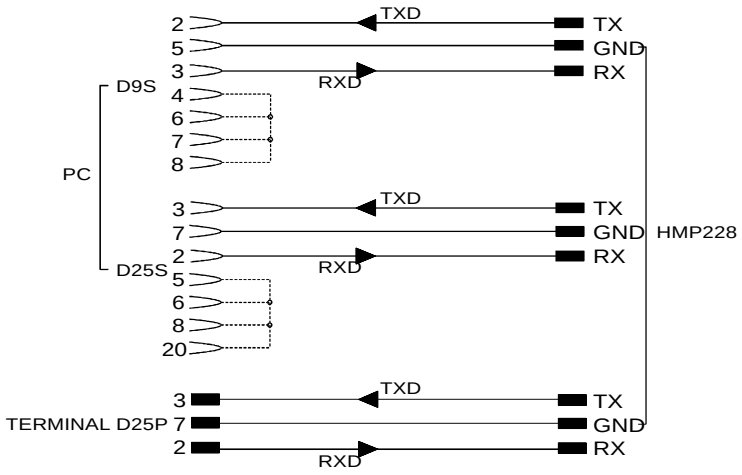


Figure 3.2.2 Connection of cables

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 HMP228 programme will change the number of stop bits to 2
- even or odd parity, 8 data bits, 2 stop bits: if this combination is given the programme changes the number of stop bits to 1

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

The RS 232C screw terminal cannot be used if an RS 485/422 serial module or a current loop module is used. See Appendices 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 232C signals. If an RS 485/422 serial port module or a current loop module has been installed, it has to be removed before communicating through the X17 connector.

NOTE

Some PC computers can generate interferences to the measured humidity and temperature values if the transmitter and the PC are connected to different mains outlets. To minimize the possibility of these interferences, always use the same main outlet (same phase of the main electricity) for the PC and the power supply of HMP228. It is always preferable to use the connector X16 instead of the connector X17 because it is more immune to interferences.

The serial commands are described in Appendix 1.

3.3 Using 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.

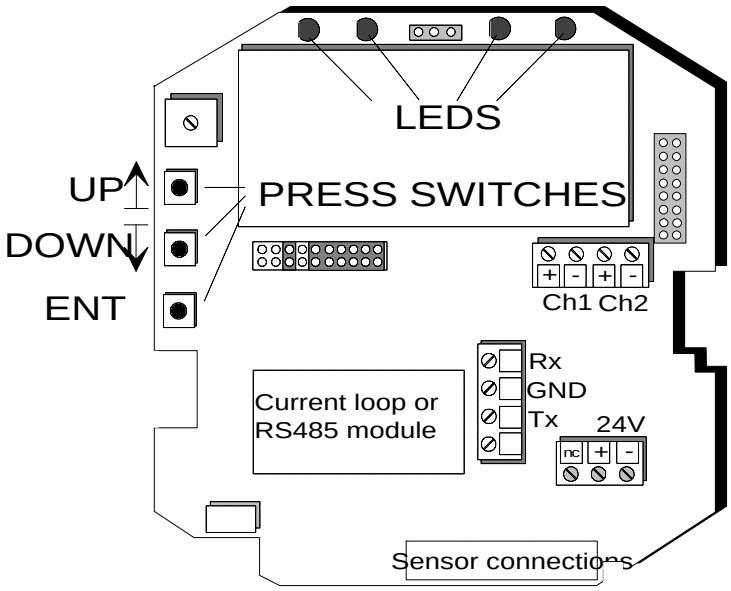


Figure 3.3 Location of press switches and LEDs

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):

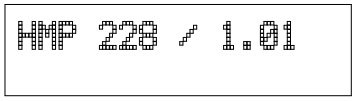
○○○○	(0)	return to normal state
○○○●	(1)	relative humidity calibration
○○●○	(2)	temperature calibration
○○●●	(3)	calibration of analogue outputs
●○○●	(9)	forced auto-calibration (one auto-calibration; the security lock jumper must be connected)

3.4 Using display/keypad commands

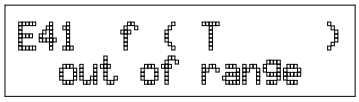
3.4.1 Display mode

In the display mode the transmitters output measurements on the display; different quantities can be scrolled with the arrow keys. The first line is scrolled

with button ▲ and the second line with button ▼; all selections are stored with ENTER. The selected quantities appear on the display also after power failure. After reset the transmitters are always in the display mode.

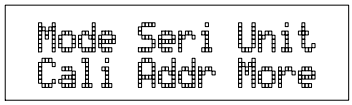


The display also shows error messages and alarms if they occur.



3.4.2 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 command flashes; the desired 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.

3.4.3 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 on 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) 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.

The display commands are described in Appendix 2.

4. MAINTENANCE

4.1 Self-diagnostics

The HMP228 transmitter goes through a self-diagnostics procedure when the power is switched on. If the procedure does not reveal any errors or faults, the transmitter starts operating normally. If errors or faults are found, check first if the moisture and temperature sensors are damaged. If they are intact, send the transmitter to Vaisala for repairs. The error messages 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
>
```

4.2 Reference measurements

Reference measurements are needed to verify whether the transmitter readings are within specifications. This way the user can check if the transmitter needs calibration or service.

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

4.3 Moisture calibration

The HMP228 transmitter has been fully calibrated at the factory so there should be no immediate need for recalibration. The transmitter should be calibrated only if there is reason to believe that the adjustments have changed. The optimal interval for moisture calibrations depends on the process and the recommended interval varies from 3 months to 2 years.

NOTE

The HMP228 transmitter measures water activity in liquid/oil and the calibration is performed as for relative humidity transmitters. In calibration mode the transmitter automatically outputs relative humidity as the calibration parameter. It is essential to clean the sensor surface of oil before calibration; use e.g. instrument air or nitrogen to blow off the oil. Even the smallest amount of oil may destroy the salt solution.

NOTE

As oil performs a membrane over the sensor surface, the sensor's capability of absorbing moisture is slowed down. The stabilization time is thus at least double the time of a clean sensor; pay special attention to controlling the stabilization time.

A two-point calibration can be performed with Vaisala's HMK15 or HMK13B Calibrator or the instrument can be sent to Vaisala. The instrument has to be recalibrated each time the moisture sensor is changed.

A Ø 13.5 adapter must be used when calibrating with the HMK13B Calibrator. The adapters (part no. 16611) can be ordered from Vaisala or Vaisala representatives.

Calibration can be performed by giving the commands using the press switches inside the housing, through the serial bus or through the menus on the local display.

When LED commands are used, relative humidity is output instead of water activity. When the transmitter is 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, perform a calibration according to Chapter 4.4.1.

4.3.1 Two point calibration procedure

A two point calibration should be performed in stable conditions using saturated salt solutions as references.

Disconnect the security lock jumper!

4.3.1.1 Using serial commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter.
- Insert the sensor head into the calibration hole of the LiCl chamber of the humidity calibrator.
- Wait at least 30 minutes.
- Give command CRH <cr>, enter the first point value and press <cr>.

```
>CRH <cr>
RH :  11.9   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...
```

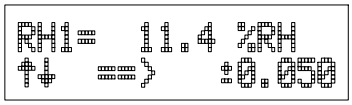
- Insert the sensor head into the calibration hole of the NaCl chamber of the humidity calibrator.
- Wait at least 30 minutes.
- Press any key and enter the second point value; press <cr>.

```
RH  :  75.5   Ref2 ?  yy.y <cr>
```

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

4.3.1.2 Using display/keypad commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter.
- Select Cali in the main menu and then RH cal; select Not changed and then two point calibration RH 2 point cal. Change the first point reading with the arrow keys to correspond to the reference humidity and press ENT; pressing an arrow once changes the reading by 0.05 %RH.



4.3.1.3 Using LED commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter.
- 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 4.4.5) and press ENT switch.
- Insert the sensor head into the calibration hole of the NaCl chamber in the humidity calibrator.
- Wait at least 30 minutes.
- Check that the reading corresponds within the desired accuracy to the value given in the calibration table (Chapter 4.4.5). 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.

4.3.2 One point calibration procedure

A one-point correction can be done manually in the field against an accurate reference but it is always recommended to perform a two point calibration.

Disconnect the security lock jumper!

4.3.2.1 Using serial commands

- Make sure that the sensors of the transmitter and the reference instrument are close to each other. Allow enough time for the sensors to stabilize to the measurement conditions.
- Give command CRH <cr>, enter the humidity value and press <cr>.

```
>CRH <cr>
RH :  11.9   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:

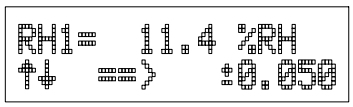
```
RH : 11.9  Ref1  ? c <cr>
RH : 11.5  Ref1  ? c <cr>
RH : 11.5  Ref1  ? 11.3 <cr>
Press any key when ready...
```

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

```
RH  :  75.5   Ref2 ?  yy.y <cr>
```

4.3.2.2 Using display/keypad commands

- Make sure that the sensors of the transmitter and the reference instrument are close to each other. Allow enough time for the sensors to stabilize to the measurement conditions.
- Select Cali in the main menu and then RH cal; select Not changed and then one point offset calibration RH 1 point cal. Change the humidity reading with the arrow keys to correspond the reference humidity and press ENT; pressing an arrow once changes the reading by 0.05 %RH.



4.3.2.3 Using LED commands

- Make sure that the sensors of the transmitter and the reference instrument are close to each other. Allow enough time for the sensors to stabilize to the measurement conditions.
- Connect an ammeter/voltmeter to the analogue outputs (connector X2). If the outputs are already connected to e.g. 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 the mother board).Give command ○○○●. 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 the left starts flashing; press ENT again.

4.4 Changing the moisture sensor

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 moisture calibration must be performed according to the instructions in section 4.4.1.

4.4.1 Calibration procedure after sensor change

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

Disconnect the security lock jumper!

4.4.1.1 Using serial commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter.
- Insert the sensor head into the calibration hole of the LiCl chamber of the humidity calibrator.
- Wait for 30 minutes.
- Give command FCRH <cr>, enter the first point value and press <cr>:

```
>FCRH <cr>
RH: 11.9 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...
```

- Insert the sensor head into the calibration hole of the NaCl chamber of the humidity calibrator.
- Wait for 30 minutes.
- Press any key, enter the second point value and press <cr>:

```
RH: 75.5 Ref2 ? yy.y  <cr>
```

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

4.4.1.2 Using display/keypad commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter.
- Insert the sensor head into the calibration hole of the LiCl chamber of the humidity calibrator.
- Wait for 30 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.
- Insert the sensor head into the calibration hole of the NaCl chamber of the humidity calibrator.
- Wait at least 30 minutes.
- If necessary, change the second point reading with the arrow keys and press ENT.

4.4.1.3 Using LED commands

- Leave the calibrator and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the transmitter. '
- Insert the sensor head into the calibration hole of the LiCl chamber of the humidity calibrator.
- Wait for 30 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 4.4.5) and press ENT switch.
- Insert the sensor head into the calibration hole of the NaCl chamber in the humidity calibrator.
- Wait at least 30 minutes.
- Check that the reading corresponds within the desired accuracy to the value given in the calibration table (Chapter 4.4.5). 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.

4.4.5 Humidity calibration table

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

Table 1 Greenspan's calibration table

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

4.6 Temperature calibration

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

Temperature calibration should be performed 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 offset correction or a two point calibration is possible.

Disconnect the security lock jumper!

4.6.1 One point offset correction

4.6.1.1 Using serial commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.
- Check the transmitter against the reference.
- Give command CT <cr>, enter the first point value and press <cr>:

```
>CT <cr>
T  :  0.90   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 then <cr>.

4.6.1.2 Using display/keypad commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.
- Check the transmitter against the reference.
- Select Cali in the main menu and then T cal; select one-point calibration T 1 point cal.
- Change the reading with the arrow keys to correspond to the reference and press ENT.

4.6.1.3 Using LED commands

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

4.6.2 Two point temperature calibration

Disconnect the security lock jumper!

4.6.2.1 Using serial commands

- Leave the reference instrument and the transmitter for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap prior to calibration.
- Check the transmitter against the reference.
- Give command CT <cr>, enter the first point value and press <cr>:

```
>CT <cr>
T  :  0.90   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 again check the transmitter against the reference.
- Check that the reading corresponds with the reading of the reference instrument. If not, adjust the second point.
- Press any key, enter the second point value and press <cr>.

```
T  :  20.0   Ref2 ?  yy.y <cr>
```

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

4.6.2.2 Using display/keypad commands

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

4.6.2.3 Using LED commands

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

- Check that the reading corresponds with 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.

4.6.3 Temperature channel adjustment with Pt 100 simulators

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

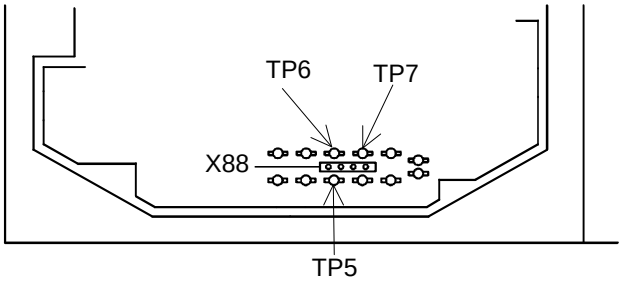


Figure 4.6.3.1 Location of solder lugs TP5, TP6 and TP7 and connector X88

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

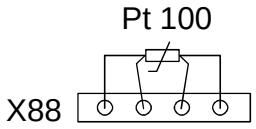


Figure 4.6.3.2 Connecting the Pt 100 simulator to connector X88

Switch the power on. Follow the one or two point calibration instructions in Chapters 4.6.1 - 4.6.2.

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

The correct connections according to the wire colours are:

TP5	TP6	TP7	TP8
blue	green	yellow	black

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

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

where

D0 = -243.5673014
D1 = 2.278542701
D2 = 0.002050681
D3 = -6.15025E-06
D4 = 1.34949E-08

4.7 Analogue output channels

4.7.1 Setting the analogue outputs

The HMP228 transmitters can be ordered with the required current or voltage outputs already selected. If the outputs need to be changed, move the jumpers in connector X15 into positions as shown in Figure 4.7.1.2.

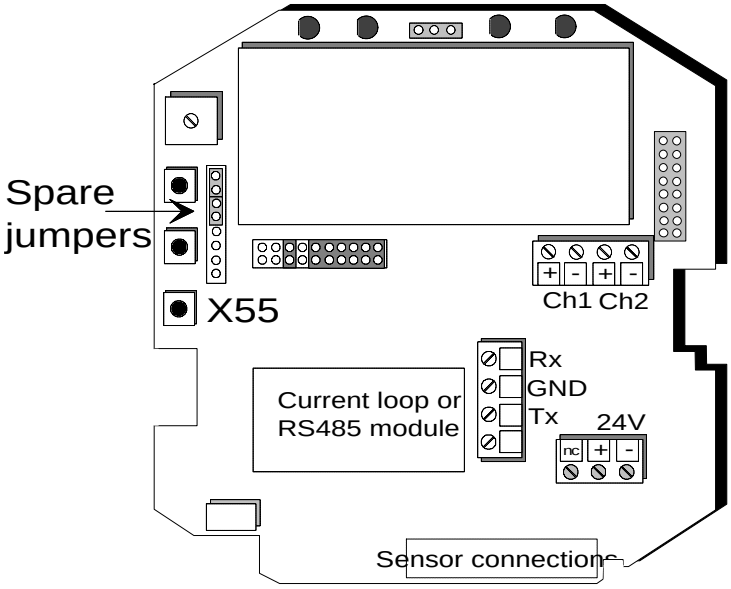


Figure 4.7.1.1 Spare jumpers

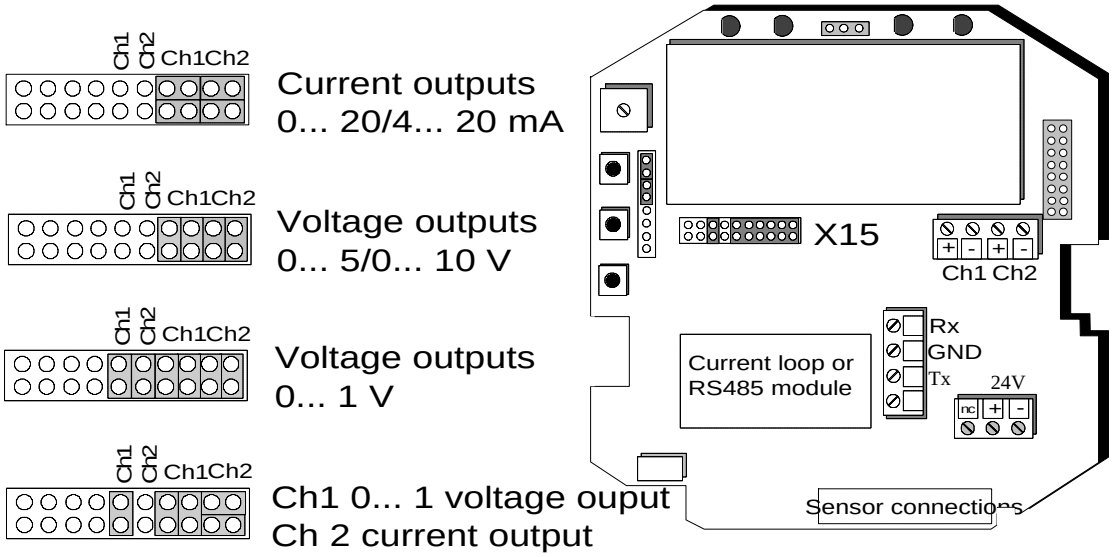


Figure 4.7.1.2 Selecting the analogue outputs with jumpers

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

4.7.1.1 Using serial output

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.

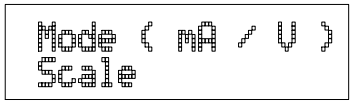
Example: lower limit of channel 1 is 0 V and upper limit 1 V (U 0 1)
lower limit of channel 2 is 2 V and upper limit 10 V (U 2 10)

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

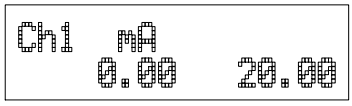
4.7.1.2 Using display/keypad commands

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 key and acknowledged with ENT

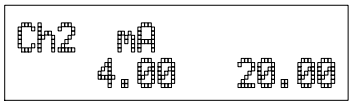
- the lower limit starts flashing

- 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.



4.7.2 Selecting and scaling the analogue output quantities

Disconnect the security lock jumper!

4.7.2.1 Using serial output

ASEL xxx yyy <cr>

xxx = channel 1's quantity
yyy = channel 2's quantity (Aw, T)

Example: water activity is selected on channel 1 and temperature on channel 2

```
>ASEL aw T <cr>
Ch1  (aw) lo      0.000 aw   ? <cr>
Ch1  (aw) hi      1.000 aw   ? <cr>
Ch2  (T ) lo    -40.000 'C   ? <cr>
Ch2  (T ) hi   +160.000 'C   ? <cr>
```

ASCL <cr>

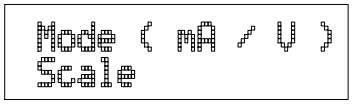
Example: water activity is scaled on the range of 0...1 Aw and temperature 0...+100 °C

```
>ASCL <cr>
Ch1  (Aw) lo   0.000 Aw ? <cr>
Ch1  (Aw) hi   1.000 Aw ? <cr>
Ch2  (T  )     lo   -40.000 'C    ?  0 <cr>
Ch2  (T  )     hi   160.000 'C    ?  100 <cr>
```

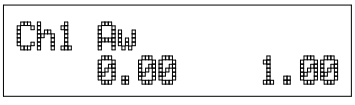
4.7.2.2 Using display/keypad commands

Disconnect the security lock jumper!

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

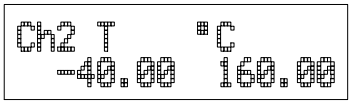


- Select Scale. The quantity and scaling for channel 1 are displayed:



- If the settings are correct, press ENT.

- If the settings need to be changed, press CL:
  - the quantity (aw, T) 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.



4.8 Checking and calibrating the analogue outputs

The operation of analoque outputs can be tested by forcing the outputs to given values. See on appendix n. ITEST command.

4.8.1 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.

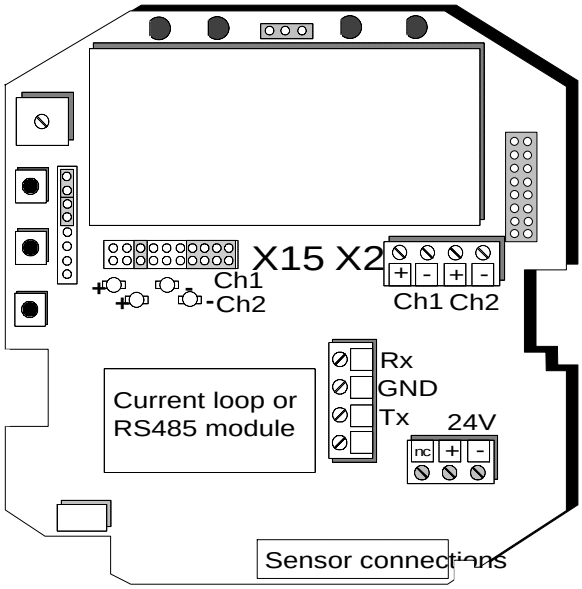


Figure 4.8.1.1 Location of the CH1 and CH2 test points

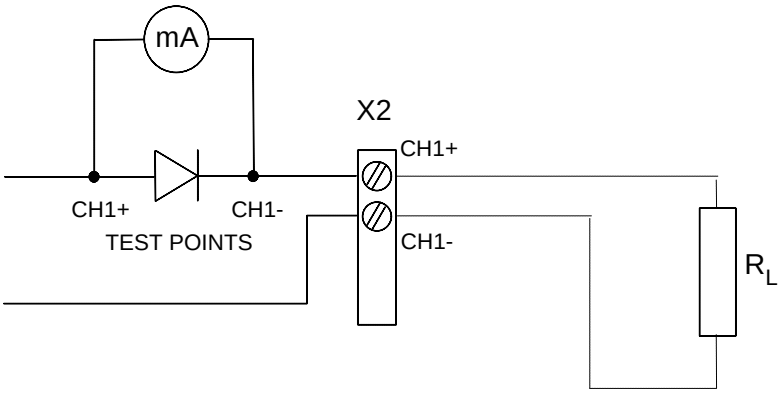


Figure 4.8.1.2 Circuit diagram of the analogue output current test points.

4.8.1 Calibration of the 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.

Disconnect the security lock jumper!

4.8.1.1 Using serial commands

ACAL <cr>

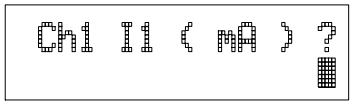
The outputs on channels 1 and 2 are measured and the measured values (mA or V) entered as calibration coefficients.

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

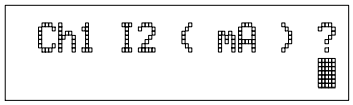
```
>ACAL <cr>
Ch1  U1 ( V  ) ? 0.123 <cr>
Ch1  U2 ( V  ) ? 9.980 <cr>
Ch2  U1 ( V  ) ? 0.120 <cr>
Ch2  U2 ( V  ) ? 9.980 <cr>
```

4.8.1.2 Using display/keypad commands

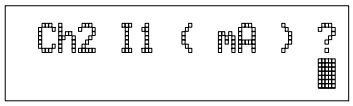
- Connect an ammeter/voltmeter to the output of channel 1, select Cali in the main menu and Analog outputs in the Cali menu. The following is displayed (the quantity can be either mA or V):



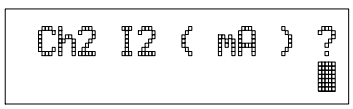
- Enter the measured lower end current/voltage on channel 1.



- 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.

4.8.1.3 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)
- 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 that outputs are correctly scaled: 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 cannot 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

4.9 Other functions

4.9.1 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.

4.9.2 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!

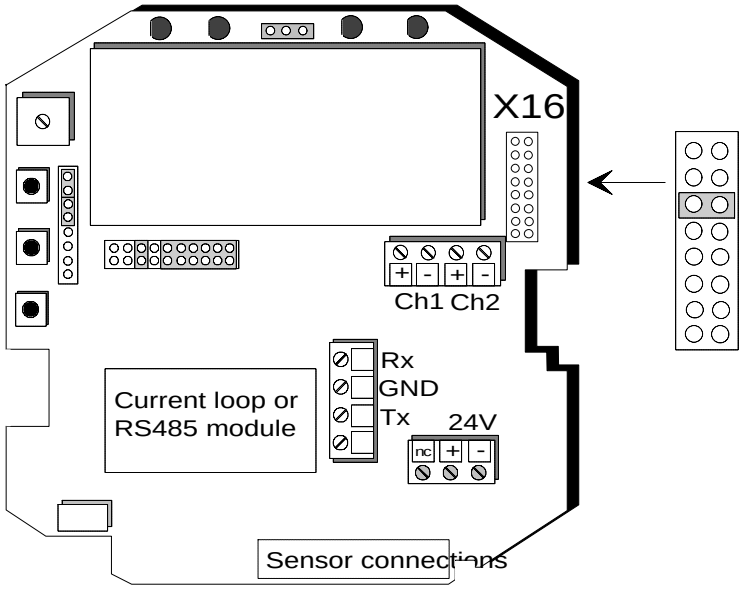


Figure 4.9.2 Forcing the serial port settings back to factory settings

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

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

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

CAUTION

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

5. TECHNICAL DATA

5.1 Water activity

Measuring range of water activity	0...1
Accuracy (including nonlinearity and repeatability)	
maximum achievable accuracy when calibrated against high quality, when calibrated against salt solutions (ASTM E104-85):	±0.02 (0...0.9) ±0.03 (0.9...1.0)
maximum achievable accuracy when calibrated against high-quality, certified humidity standards:	±0.01 (0...0.9) ±0.02 (0.9...1.0)
Response time (90 %) at +20 °C in still oil (stainless steel filter)	10 min
Sensor	HUMICAP® thin film polymer sensor (part no. 19525HM)

5.2 Temperature

Measuring range	-40...+180 °C
Typical accuracy of electronics at +20 °C (+68 °F)	± 0.1 °C
Typical temperature dependence of electronics	± 0.005 °C/°C
Temperature sensor	Pt 100 IEC 751 1/3 class B (part no. 10429)

5.4 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	
Serial output	RS232C	

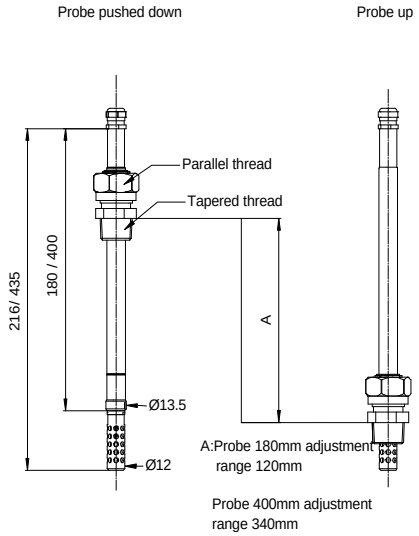
5.5 Electronics

User interface	3 keys and 4 LEDs inside the housing or local display keypad
Display	2 x 16 character alphanumeric high-contrast, wide view angle LCD
character height	3.85 mm (0.15")
Keyboard	1 x 4 keypad
Connections	screw terminals, 0.5 mm^2 wires (AWG 20), stranded wires recommended
Operating voltage	24 VDC / isolated 24 VAC (20...28 V)
option	115/230 VAC with power supply module
Power consumption	100 mA maximum (24 VDC)
of the alarm relays	55 mA max (24 VDC)
Recommended external load for current outputs	<500 Ω
0...1 V voltage output	>2 kΩ (to ground)
0...5 and 0...10 V voltage outputs	>10 kΩ (to ground)
Operating temperature (electronics)	-40...+60 °C
with display cover	0...+50 °C
with power supply module	-40...+45 °C
with alarm outputs up to 8A	-40...+45 °C
with alarm outputs up to 6A	-40...+60 °C
Storage temperature	-40...+70 °C
Pressure range of the HMP228 sensor head	0...40 bar

5.6 Mechanics

Housing material	G-AlSi12 (DIN 1725)
Housing classification	IP 65 (NEMA 4)

Bushing	for 7...10 mm diameter cable (8 x 0.5 mm^2 shielded cable)
Sensor protection	Stainless steel filter (part no. HM46999)
Housing dimensions	145 x 120 x 65 mm
Sensor head dimensions (see Figure)	length 170 mm, Ø 13.5 mm:



Cable diameter	5.5 mm

Weight (without display cover and power supply module):

With 2 m cable	1300 g
With 5 m cable	1600 g
With 10 m cable	2100 g
Weight of display cover	420 g
Weight of power supply module	240 g

5.7 Electromagnetic compatibility

The emission and immunity tests have been performed according to thestandard EN61326-1:1997+Am1:1998; Industrial environment.

5.7.1 Emissions

Test:	**Setup according to:**
Radiated emissions	EN 55022/CISPR 22 (class B)
With power supply unit (HMP230PW):	
Conducted emissions	EN 55022/CISPR 22 (class B)
Harmonic currents	EN/ IEC 61000-3-2
Voltage fluctuations	EN/ IEC 61000-3-3

5.7.2 Immunity

Test:	**Setup according to:**
Electrostatic discharge	EN/ IEC 61000-4-2
Electrical fast transients	EN/ IEC 61000-4-4
Radiated immunity	EN/ IEC 61000-4-3
Conducted immunity	EN/ IEC 61000-4-6

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

CE

6. OPTIONS

Power supply module	
Operating voltage	115 VAC (93...127 V) 230 VAC (187...253 V)
Serial interface	RS485/422 module HMP230RS current loop module HMP230CL
Cable length	2, 5 or 10 metres
Display cover	cover with or without local display & keypad
Connectors for supply, signal, RS232C and RS485 lines	see Appendix 8 for details
Ball valve set	DMP248BVS
Alarm output unit	DMP240ALSP;2 pcs 8A/230 V CPCO (single pole change over) for adjustable low and high alarm

7. SPARE PARTS

Order code	Description
19525HM	Moisture sensor
HM46999	Stainless steel filter, outer thread
HM47453	Stainless steel filter, inner thread
5237	Fuse 160 mA T 5x20 mm for power supply module
17143	Fuse 8A for alarm output unit
16611	Calibration adapter for the HMK15 Calibrator

APPENDIX 1: SERIAL COMMANDS

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

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

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: 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 (aw, T)

For example, water activity 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  (aw) lo     0.000       ? <cr>
Ch1  (aw) hi     1.000       ? <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  (aw) lo      0.000
Ch1  (aw) hi      1.000
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 water activity on the range of 0...1.00 and temperature -40...+160 °C:

```
>ASCL <cr>
Ch1  (aw) lo     0.000       ? <cr>
Ch1  (aw) hi     1.000       ? <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, water activity is scaled to 0...1.00 on channel 1 and temperature to -40...+100 °C on channel 2:

```
>ASCL 0  1  -40  100 <cr>
Ch1  (aw) lo     0.000
Ch1  (aw) hi     1.000
Ch2  (T ) lo   -40.000 'C
Ch2  (T ) hi   100.000 'C
```

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 moisture 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>

Using 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  ) ?  9.980 <cr>
Ch2  U1   (V  ) ?  0.120 <cr>
Ch2  U2   (V  ) ?  9.980 <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
Tsoffset       : 0.000
Ts   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>
Ts   offset    : 0.000  ? <cr>
Ts   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.

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 which variables are in use. The order, however, is always the same: water activity and temperature temperature. An example:

```
aw= 0.43.0 T= 21.0 'C <cr><lf>
```

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

The output mode can be changed with command FORM.

S Stopping the measurement output

S<cr>

Ends the RUN state; after this command all other commands can be used.

SEND Outputting a reading once

SEND <cr> in STOP state

or

SEND aa <cr> in POLL state

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:

```
"aw= .999 T=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 0.144    60.3'C
   5 0.150    63.2'C
  10 0.122    62.0'C
  33 0.135    61.1'C
>
```

ERRS Outputting error messages

ERRS <cr>

During operation 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, 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 state

INTV xxx yyy <cr>

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

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

For example, the currently valid settings are output with:

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

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

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

The unit is changed into seconds with:

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

The change can also be done with one command:

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

FORM Setting the output format

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

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

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

\aa..aa\	water activity
\TT..TT\	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
\a.aaa \ \+TT.TT\\r             0.123 +99.99 <cr>
\TTT.T\ \uu\\r\n                15.2 'C <cr><lf>
\a.aaa\ \+DD.D\ \uu\\r          0.123 +10.8 'C <cr>
```

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

```
aw: \a.aaa\ T: \+TT.TT\\r       aw: 0.54 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"
?\a.aaa\\t\TTT.T\\r\n <cr>
```

The output is then:

```
0.474<tab> 22.4 <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 aw= 0.195 T= 26.0 'C
09:31:18 aw= 0.195 T= 26.0 'C
09:31:23 aw= 0.195 T= 26.0 'C
09:31:28 aw= 0.195 T= 26.0 'C
09:31:33 aw= 0.195 T= 26.0 'C
09:31:38 aw= 0.195 T= 26.0 'C
...
```

Inactivating the time output

```
>ftime off
Form. time    :  OFF
>r
aw= 0.196 T= 26.1 'C
aw= 0.196 T= 26.1 'C
aw= 0.196 T= 26.1 'C
aw= 0.196 T= 26.1 'C
aw= 0.196 T= 26.1 'C
aw= 0.196 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 aw= 0.206 T= 26.0 'C
1995-03-10 aw= 0.206 T= 26.0 'C
1995-03-10 aw= 0.206 T= 26.0 'C
1995-03-10 aw= 0.206 T= 26.0 'C
1995-03-10 aw= 0.206 T= 26.0 'C
...
```

Inactivating the date output

```
>fdate off
Form. date    :  OFF
>r
aw= 0.202 T= 26.0 'C
aw= 0.202 T= 26.0 'C
aw= 0.202 T= 26.0 'C
aw= 0.202 T= 26.0 'C
aw= 0.202 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 HMP228 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	non-metric
aw	(aw)	(aw)
T	°C	°F

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

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

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

ADDR Setting the transmitter address

ADDR aa <cr>

aa = address (0...99)

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

For example, transmitter is given address 99

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

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

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

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.

Operation modes

SMODE Setting the serial interface

SMODE xxxx<cr>

xxxx = STOP, RUN or POLL

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

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

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

OPEN aa <cr>
SMODE xxxx<cr>

aa = address of the transmitter
xxxx = STOP, RUN or POLL

The OPEN command sets the bus temporarily in STOP MODE so that the SMODE command can be given. For example:

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

OPEN & CLOSE

OPEN nn <cr>

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

CLOSE <cr>

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

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

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

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

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 calculations

PRES pppp.pp <cr>

pppp.pp = pressure (hPa)

The atmospheric pressure has an effect on mixing ratio. Therefore accurate mixing ratio 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 calculations temporarily

XPRES pppp.pp <cr>

pppp.pp = pressure (hPa)

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

DATE Setting the date

DATE <cr>

For example, to enter a new date:

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

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

TIME Setting the time

TIME <cr>

For example, to enter a new time:

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

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

VERS Name and version of the programme

VERS <cr>

For example:

```
>VERS <cr>
HMP 228 / x.yy
```

where x.yy is the programme version.

? Outputting the transmitter settings

? <cr>

For example:

```
>? <cr>
HMP 228 / 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  ( aw )  lo     0.000
 Ch1  ( aw )  hi     1.000
 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.

FILT Setting the averaging time

FILT nnnn <cr>

This command is used to set and inspect the avaeraging time during which the individual measurement samples are integrated to get an averaged reading. The time can be set in seconds within the range of 0...1000 (0 = no averaging time).

For example:

```
>FILT nnnn<cr
Filter ( S )  :        5 <cr>
>


>FILT <cr>
Filter...     ...? 10 <cr>
>
```

APPENDIX 2: DISPLAY COMMANDS

1. DISPLAY COMMANDS 67

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1. DISPLAY COMMANDS

The HMP228 transmitter uses a microprocessor; therefore its configuration can be set according to the user's needs. This is done through commands. Most often the commands are used to change the settings of the two analogue channels.

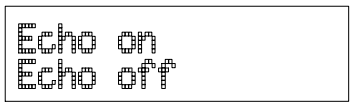
A full range of commands can be given through the display/keypad. The commands can be used e.g. to select and scale the outputs, to calibrate the humidity and temperature channels as well as the analogue outputs and to set the serial interface.

1.1 Display/keypad commands

1.1.1 Output via the serial bus

1.1.1.1 Turning the serial interface echo ON/OFF

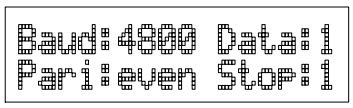
- Select More in the main menu, select More in the More menu, then again More and then Echo.



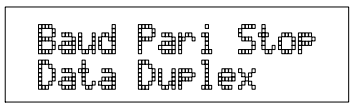
- Use the arrow keys to select the right alternative and press ENT.

1.1.1.2 Serial bus settings

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

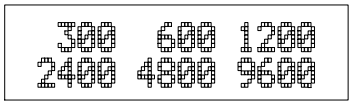


- If the settings are correct, press ENT; the programme returns to the display mode.
- If the settings need to be changed, press CL:

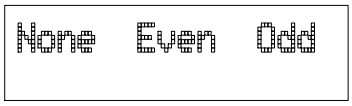


- Select the parameter to be changed with the arrow keys and ENT key.

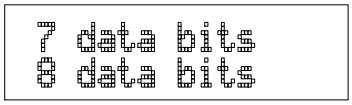
  Selecting baud rate:



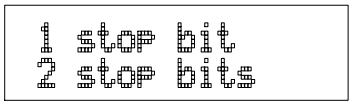
Selecting parity:



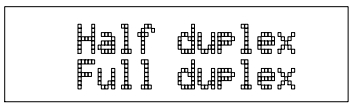
Selecting data bits:



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 HMP228 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.

1.1.1.3 Setting the transmitter address

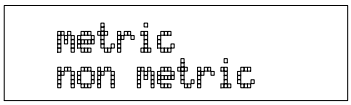
Address is used when more than one transmitter is connected to one serial bus; it makes it possible to communicate with one transmitter at a time.

- Select More in the main menu and Addr in the More 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.

1.1.1.4 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
aw	(aw)	(aw)
T	°C	°F

1.1.2 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 HMP228 transmitter has three serial output modes: RUN, STOP and POLL.

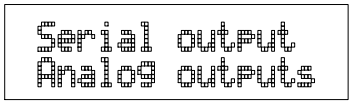
In the RUN state the transmitter outputs measurements automatically through the serial interface to a PC or a peripheral. The only command that can be given through the serial interface is S (stop) which ends the RUN state.

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

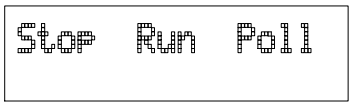
The POLL state is used when more than one transmitter is connected to the same serial bus; a single transmitter can be addressed and communicated with. When the connection to the one transmitter is opened in the POLL state, the transmitter goes into STOP state and can then receive commands normally.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

1.1.2.1 Setting the serial interface operation mode

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

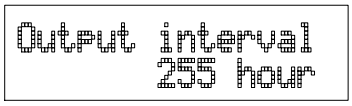


- Select Serial output:



- 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:



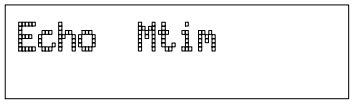
- press CL
- the number starts flashing
- if the interval needs to be changed, press CL again and enter the new interval; otherwise press ENT
- the unit (s, min, h) starts flashing
- the unit can be changed with the arrow keys and acknowledged with ENT
- after this the programme returns to Mode menu

1.1.3 Others

1.1.3.1 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:

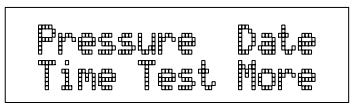


- Pressing ENT returns the programme to the main menu without changing the integration time.
- If the integration time needs to be changed, press CL; enter the new integration time with the arrow keys (4...255)

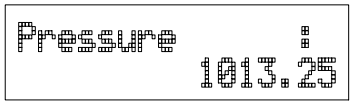
1.1.3.2 Setting the pressure for mixing ratio calculations

The atmospheric pressure has an effect on mixing ratio. Therefore accurate calculations can be achieved only when the ambient pressure is taken into consideration.

- Select More in the main menu:



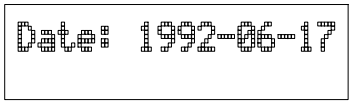
- Select Pressure:



- 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

1.1.3.3 Setting the date

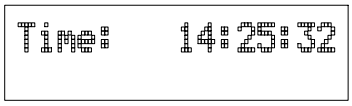
- Select More in the main menu; select Date in the More menu:



- 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

1.1.3.4 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

NOTE

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

APPENDIX 3: POWER SUPPLY MODULE

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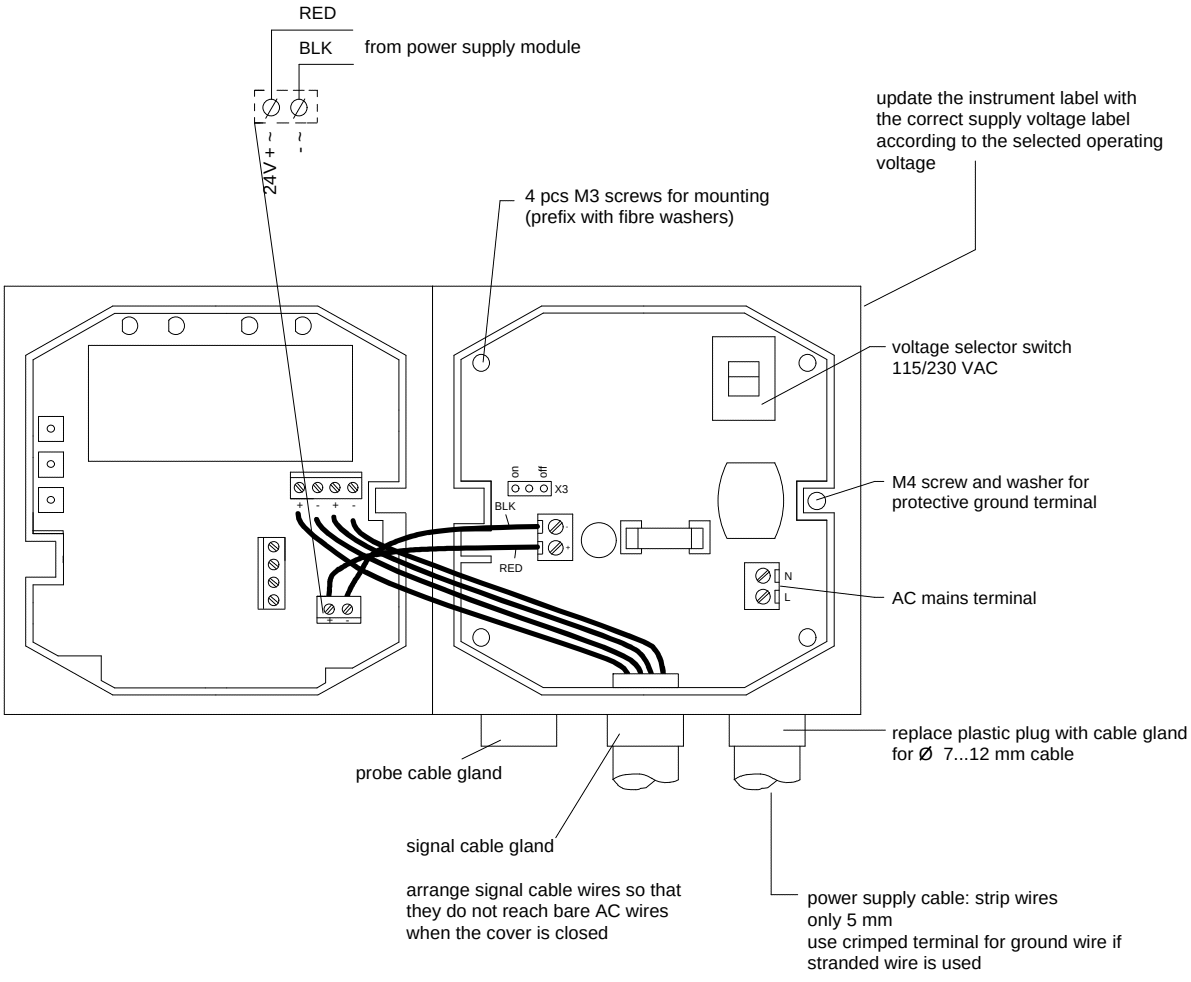
2. INSTALLING THE POWER SUPPLY MODULE

The mains power connection may be connected to the power supply module only by an authorized electrician. A readily accessible disconnect device shall be incorporated in the fixed wiring (IEC 950).

1. Remove the plastic plug in the transmitter housing and replace it with the cable gland.
2. Fasten the power supply module to the bottom of the housing with four screws
3. Select the correct mains voltage with voltage selector switch (115/230).
4. Attach the grounding wire screw (M4) and washer to the protective ground terminal on the right-hand side of the module.
5. Attach the wires from the power supply module to the power terminal on the main board of the transmitter (see figure below).

When the power supply module is on, the power on LED is lit.

NOTE The jumper in connector X3 has to be in position ON; otherwise no power is supplied to the transmitter.



Peel the correct power supply voltage from the sticker enclosed in the power supply module package and attach it on the instrument label to indicate that the supply voltage has been changed.

NOTE	The power supply module cannot be used if the re-gaining option has been activated.

WARNING	Do not detach the power supply module from the transmitter when the power is on. Do not connect the power supply to mains when it is not installed in the transmitter.

WARNING	Always connect protective ground terminal !

3. TECHNICAL SPECIFICATIONS

Operating voltage	115 VAC (93...127 V) 230 VAC (187...253 V)
Connections	
input screw terminals	1.5 mm^2 wire (AWG 16)
output screw terminals	2.5 mm^2 wire (AWG 20)
Bushing	for 7...12 mm diameter cable
Indicator	PWR ON LED on power supply module board
Operating temperature range	-40...+45 °C
Storage temperature range	-40...+70 °C

NOTE

The power supply module cannot be used if the re-gaining option has been activated.

APPENDIX 4: INSTALLING AND USING THE RS 485/422 SERIAL PORT MODULE

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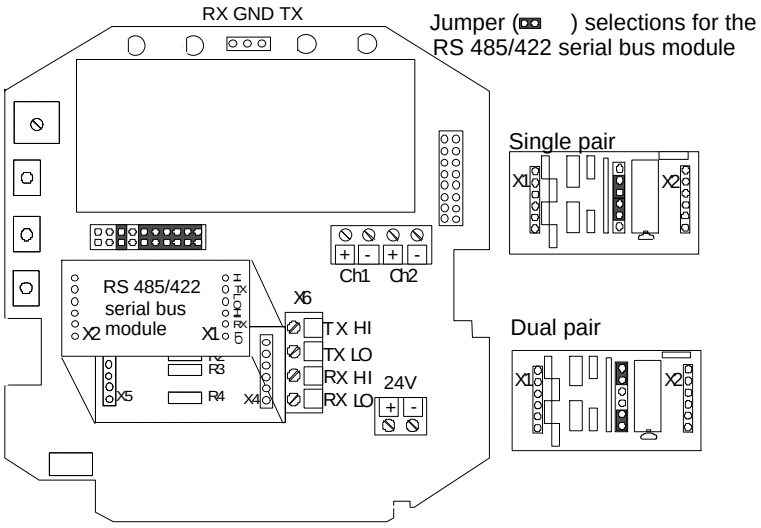
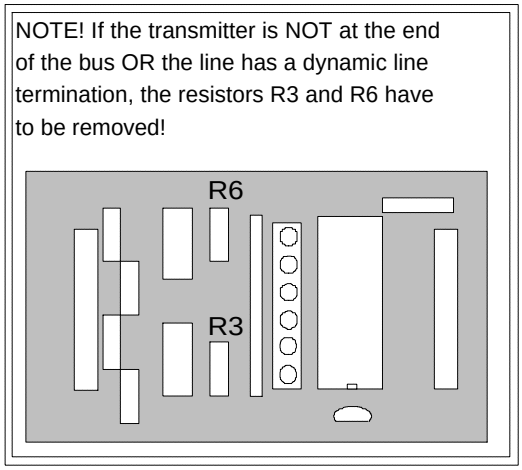
1. INSTALLATION

Switch the transmitter off.

Resistors R2, R3 and R4 between connectors X4 and X5 in the component board in the cover of the transmitter are removed with side-cutting pliers. The module is plugged in connectors X4 and X5 on the main board of the HMP228 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.

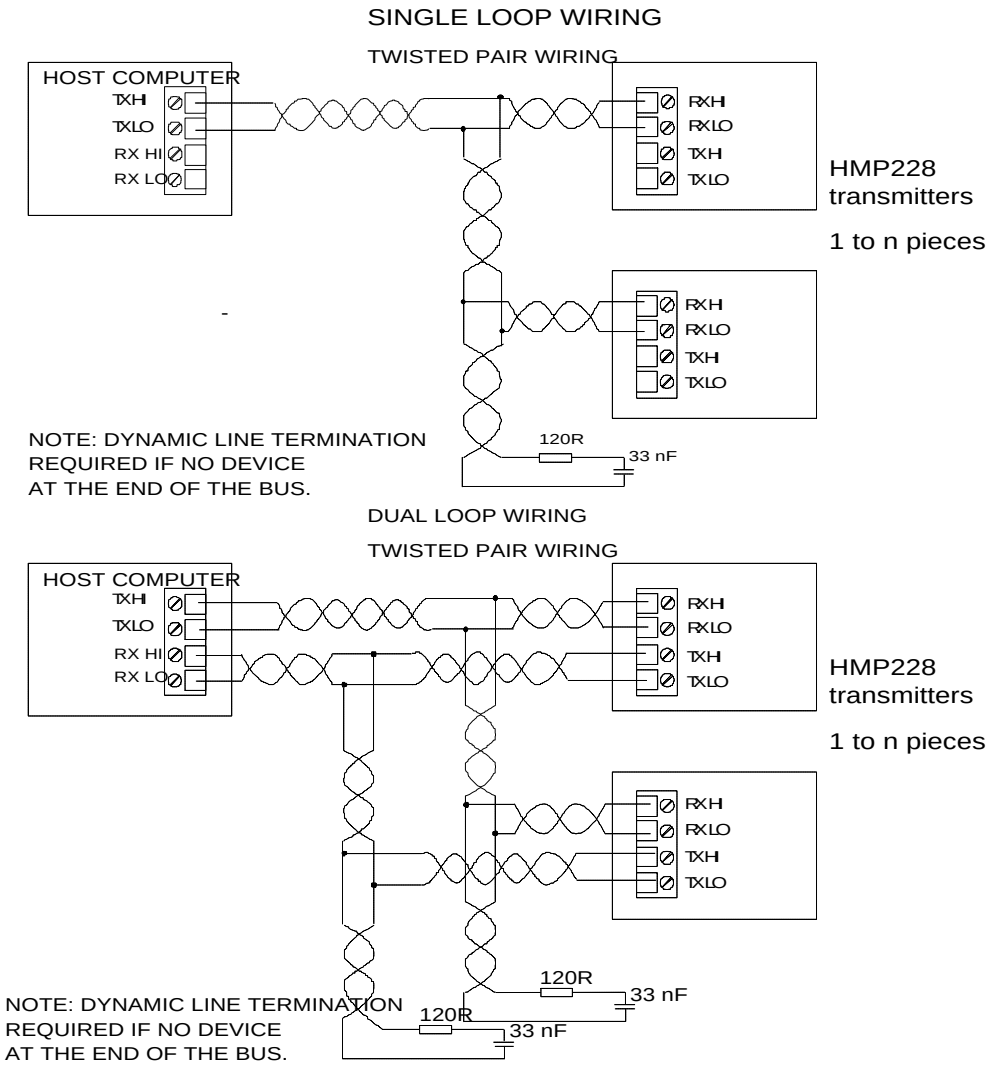
2. OPERATION

The HMP228 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 HMP228 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 HMP228 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.

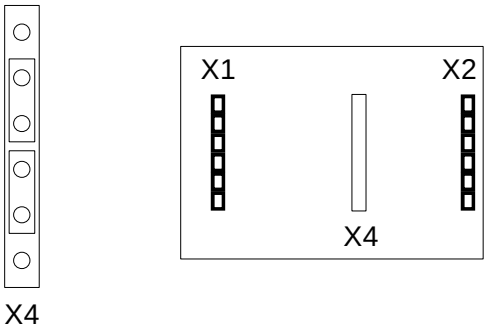
The data lines can withstand short circuit to ground and to each other. They do not survive connection of supply voltage to the data lines.

The module must be mounted on the main board in the right direction. It can be mounted in the wrong direction or to the wrong pins without breaking the module; it simply does not work then.

3. NETWORK CONFIGURATION

Single loop operation

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



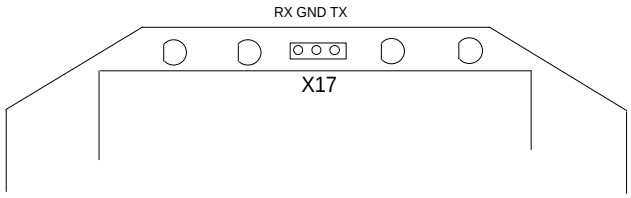
This jumper setting connects RX HI to TX HI and RX LO to TX LO and selects only one common line termination. The HI and LO terminals of the RX pair can now be used for operation.

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

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

The following procedure must be repeated with all transmitters.

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



- The serial settings of the transmitter must also be 4800 E 7 1 FDX and the transmitter must be in STOP mode. If these factory settings have been changed, they must be 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.

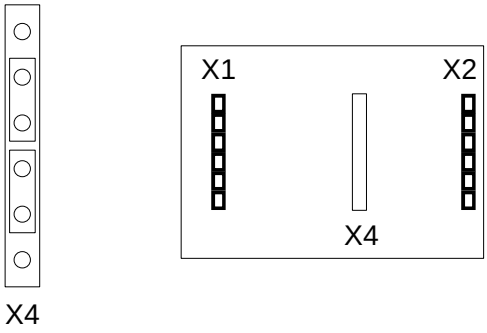
NOTE 2

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
aw= 0.244 aw T= 29.1 'C
```

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



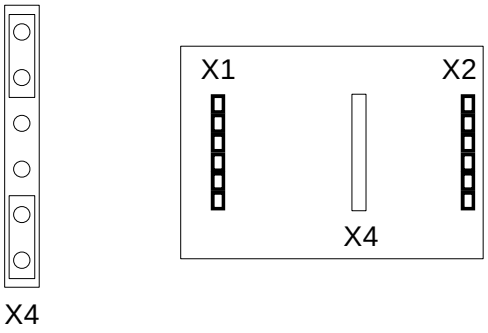
- Remount the RS 485/422 serial module.
- Close the cover.
- When all transmitters on the network have been configured, switch them off.

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.

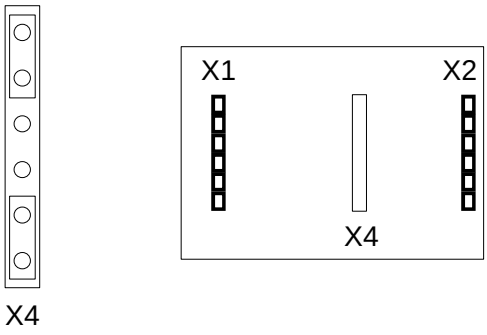
NOTE 2

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
aw= 0.244 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.
- 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; then the command must include the address of the transmitter. If the settings of the transmitter need to be changed, the transmitter is switched to STOP mode with command OPEN; commands can then be given without address. When the line to the transmitter is closed, it returns to POLL mode.

STOP mode

Open the line to the transmitter:

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

Transmitter no. 22 is now temporarily set to STOP mode; it accepts commands 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>
HMP228 / 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  ( aw )   lo     0.000
Ch1  ( aw )   hi     1.000
Ch2  ( T  )   lo   -20.000 'C
Ch2  ( T  )   hi   180.000 'C
Transducer    :
PRB serial nr :  0
Calibr. date  :  0
```

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

```
>close
line closed
```

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

POLL mode

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

```
send 22
aw= 0.244 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.

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

RS 485 network settings

HMP228 settings	single pair	dual pair
Full duplex/half duplex	HDX	FDX
Echo on/off	OFF	ON

Terminal settings	single pair	dual pair
Line feed after carriage return	yes	no
HDX/FDX	FDX	FDX

When terminal is set to general <lf> (line feed) after <cr> (carriage return), the listings will have two line feeds when also the HMP228 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 HMP228 transmitters
operating mode	polling mode
common mode voltage range	±7 V
Operating temperature	-40...+60 °C
Storage temperature	-40...+70 °C

APPENDIX 5: INSTALLING AND USING THE DIGITAL CURRENT LOOP MODULE

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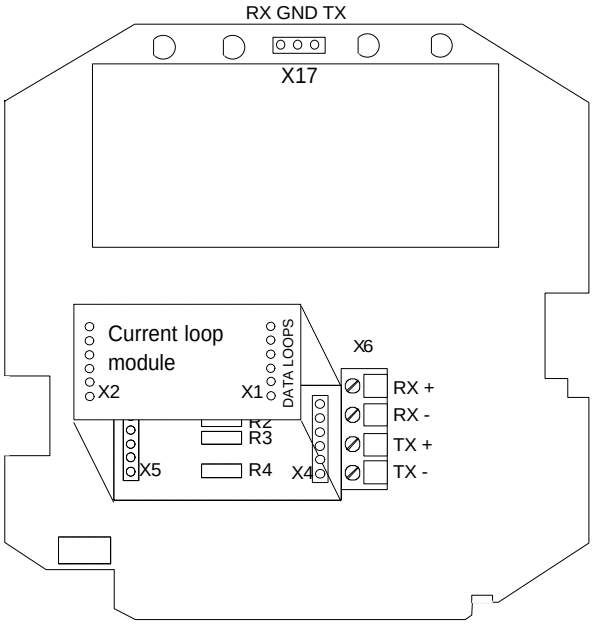
5. SPECIFICATIONS 97

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 HMP228 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.

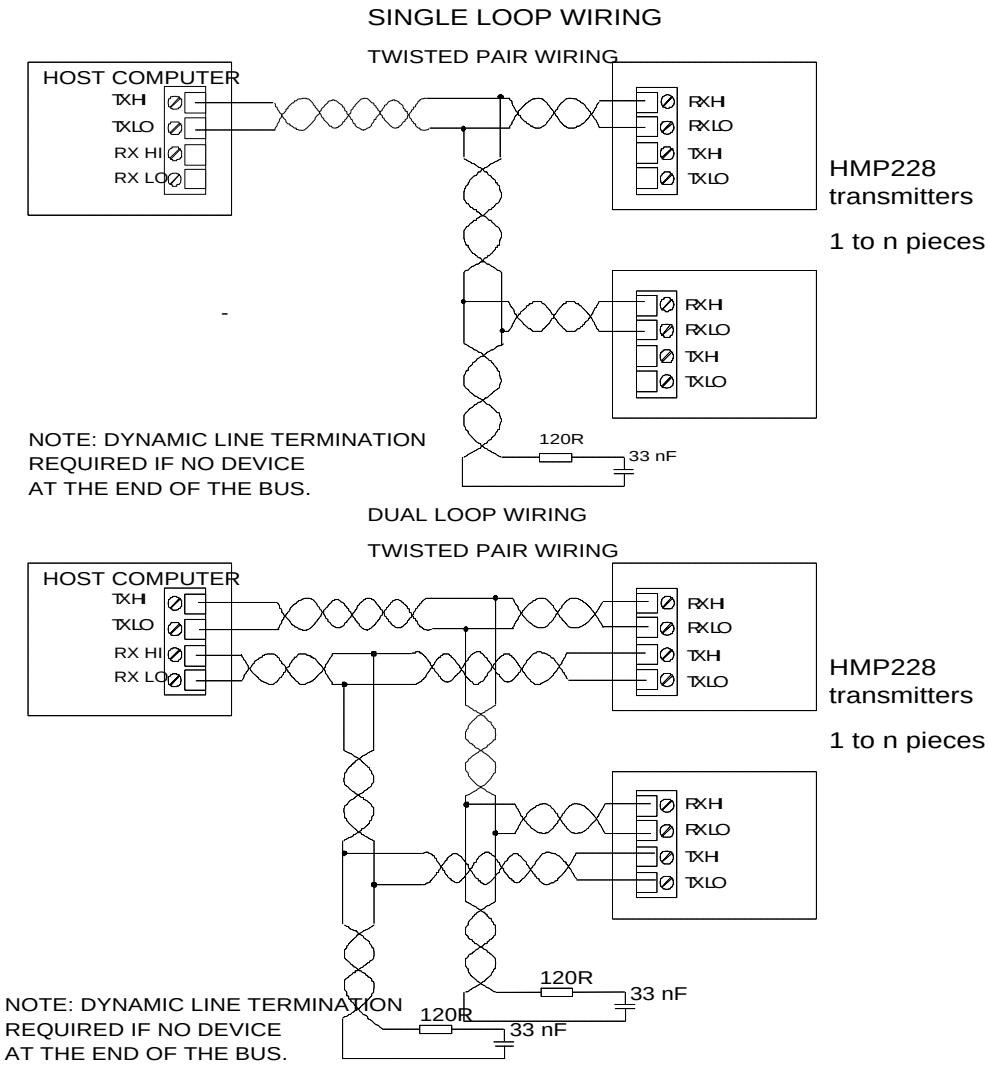
2. OPERATION

The HMP228 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 HMP228 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 HMP228 transmitter and at the other end a line master. A branch line can be made with a junction box.



The digital current loop module has separate lines for transmitting and receiving. Both single loop wiring and dual loop wiring can be used (see figure). 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 HMP228 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. It can be mounted in the wrong direction or to the wrong pins without breaking the module; it simply does not work then. Reverse wiring of RX+ and RX- or TX+ and TX- does not affect the module.

3. NETWORK CONFIGURATION

Single loop operation

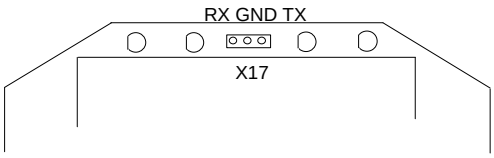
Bi-directional data on one pair and galvanic isolation are the advantages of the current loop. Single pair/dual pair use is configured through wiring (see figure).

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
aw= 0.244 T= 29.1 'C
```

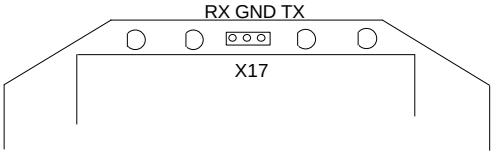
- Disconnect the terminal.
- Remount the digital current loop module.
- Close the cover.
- When all transmitters on the network have been configured, switch them off.

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
aw= 0.244 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; then the command must include the address of the transmitter. If the settings of the transmitter need to be changed, the transmitter is switched to STOP mode with command OPEN; commands can then be given without address. When the line to the transmitter is closed, it returns to POLL mode.

STOP mode

Open the line to the transmitter:

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

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

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

```
? <cr>
HMP228 /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  ( aw )   lo     0.000
Ch1  ( aw )   hi     1.000
Ch2  ( T  )   lo   -20.000 'C
Ch2  ( T  )   hi   180.000 'C
Transducer    :
PRB serial nr :  0
Calibr. date  :  0
```

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

```
>close
line closed
```

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

POLL mode

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

```
send 22
aw= 0.244 T= 29.1 'C
```

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

Current loop settings

HMP228 settings	single pair	dual pair
Full duplex/half duplex	HDX	FDX
Echo on/off	OFF	ON

Terminal settings	single pair	dual pair
Line feed after carriage return	yes	no
HDX/FDX	FDX	FDX

When terminal is set to general <lf> (line feed) after <cr> (carriage return), the listings will have two line feeds when also the HMP228 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

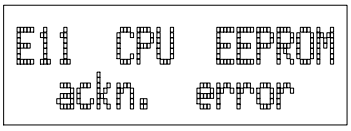
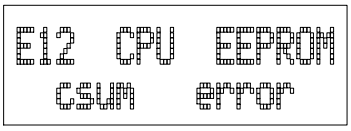
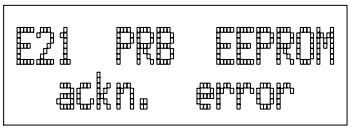
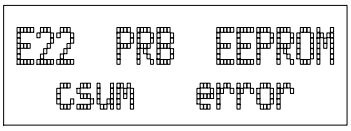
APPENDIX 6: ERROR MESSAGES

The HMP228 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
	E12 CPU EEPROM csum error
	E21 PRB EEPROM ackn. error
	E22 PRB EEPROM csum error

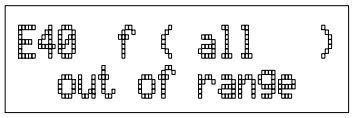
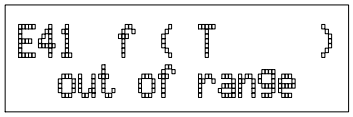
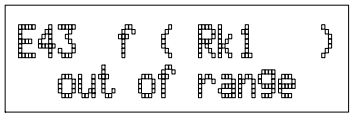
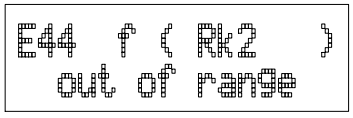
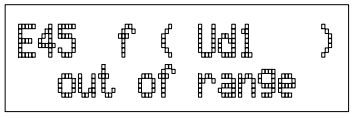
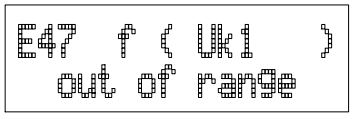
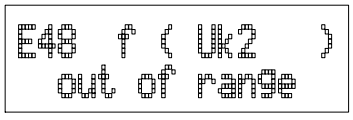
ackn. error = EEPROM is faulty
csum error = check sum is erroneous

The LEDs display these error types as follows:

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

Errors during operation

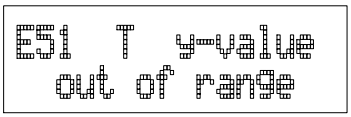
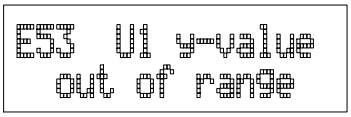
Two types of errors are possible during operation of the transmitters. The first type indicates that no frequency comes from the converter.

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

The LEDs display these error types as follows:

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

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

Display:	Serial bus:
	E51 T y-value out of range
	E53 U1 y-value out of range

The LEDs display these error types as follows:

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

ALARM OUTPUT UNIT

The alarm output unit consists of two alarm relays and two opto-isolated outputs (see Figure 1). The relay output 1 is available at screw terminal X1 and the relay output 2 at screw terminal X2. The opto-outputs are activated simultaneously with the corresponding relays and available at screw terminal X5.

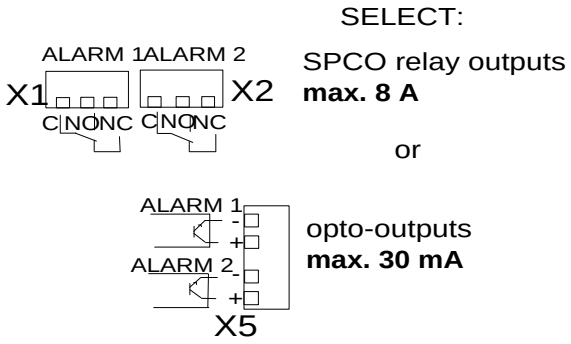


Figure 1 Relay and opto-outputs

When the relay is not activated, the C and NC outputs of the screw terminal are closed. When the relay is activated, these outputs are opened and the C and NO outputs are closed. If required, the relays can be activated by inserting a jumper to the test connector X4. By inserting the jumper to two pins on the left, relay 1 is activated and by inserting the jumper to two pins on the right, relay 2 is activated.

The alarm output unit is delivered with the alarm outputs in OFF mode (not in use). Therefore, the customer needs to set and take into use the desired outputs.

If the mains power is in use, only an authorized electrician may connect the alarm unit. A readily accessible disconnect device shall be incorporated in the fixed wiring (IEC 950).

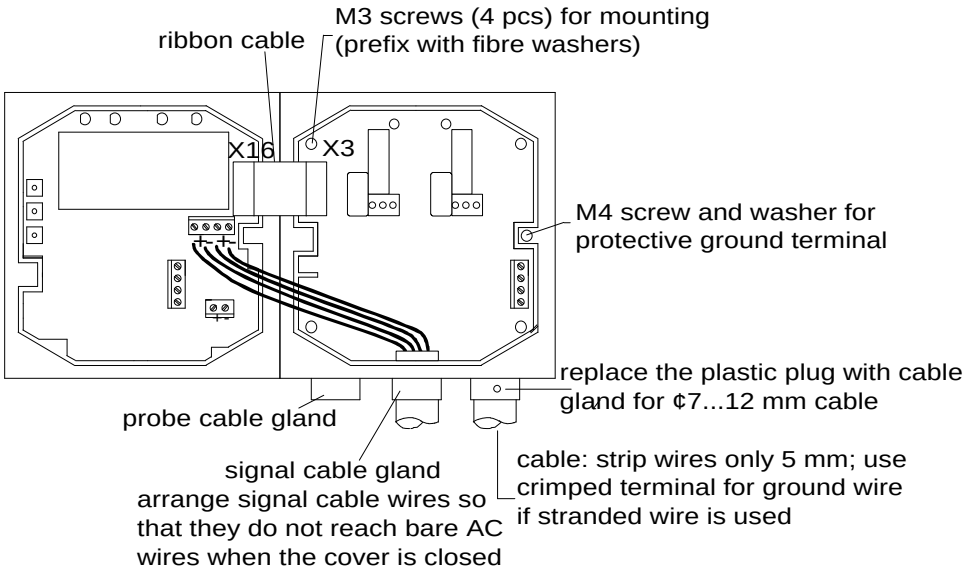
For alarm output cabling, remove the plastic plug in the transmitter housing and replace it with the cable gland. Fasten the alarm unit to the bottom of the housing with four screws.

Attach the grounding wire with the screw and washer to the grounding terminal on the right-hand side of the module if the mains power is in use. Attach the ribbon cable from X3 of the alarm unit to the X16 on the main board of the transmitter.

NOTE

NO jumper in connector X4 during normal operation.

When one alarm unit relay is on, the corresponding LED is lit.



Prefix the fastening screws with fiber washers for mounting the unit to the box.

NOTE

The alarm unit cannot be used with the power supply unit HMP230PW.

WARNING

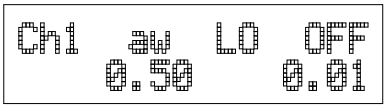
Do not detach the alarm unit from the transmitter when the power is on.

WARNING

Do not connect the mains power to alarm unit without grounding the transmitter.

Setting and activating the outputs with menu commands

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



- If the settings need to be changed, press CL:

  - the quantity starts blinking; it can be changed with arrow switches, and acknowledged with ENT.

- the third parameter (in this example HI ON) starts blinking. This parameter determines whether the alarm output is in use or not, and when it is activated. The selection is acknowledged with ENT.

The options are the following:

- HI ON (the alarm is activated by exceeding the setpoint, the output is in use)
- LO ON (the alarm is activated if the value goes below the setpoint, the output is in use)
- HI OFF (the alarm is activated by exceeding the setpoint, the output is not in use)
- LO OFF (the alarm is activated if the value goes below the setpoint, the output is not in use)

- the setpoint starts blinking (in this example, -20.00); if you wish to change it, press CL and enter the new setpoint

- the hysteresis value starts blinking (in this example, 5.00); if you wish to change it, press CL and enter the new value

NOTE

The options HI OFF and LO OFF are used to deactivate the relay outputs e.g. for service purposes.

The settings of the channel 2 are changed in the same way.

Setting and activating the outputs using an RS line

ALARM <cr>

or

ALARM n ON <cr>

where n = channel number (1 or 2)

The currently valid settings of the alarm output unit can be checked with command ALARM:

```
>alarm<cr>
Ch1  aw   LO   OFF    0.000  0.000
Ch2  T    LO   OFF    0.000  0.000'C
>
```

This is an example of the factory setting (both alarm outputs are in OFF mode, i.e. not in use). The settings can be changed with command ALARM:

```
>alarm   1    aw   HI   .9   .1
Ch1  aw   HI   OFF  0.900    0.100
>
```

When giving this command, first enter the channel number i.e. the number of the alarm output you wish to use (1 or 2). Then select the quantity you wish to have on that channel (aw or T). The third parameter (HI/LO) determines whether the alarm is activated when the setpoint value is exceeded (HI) or not reached (LO). The fourth parameter is the actual setpoint value which activates the alarm. The last parameter is the hysteresis value; it indicates how much the measured value has to exceed or go below the setpoint before the alarm is deactivated. If the third parameter is HI, the alarm is deactivated when the measured value goes below the setpoint with the chosen hysteresis value; if the parameter is LO, the alarm is deactivated when the measured value exceeds the setpoint with the chosen hysteresis value.

When the alarm outputs have been set, you can activate the outputs with commands ALARM 1 ON (channel 1) or ALARM 2 ON (channel 2). Note that you can also activate the outputs when giving other parameters with command ALARM.

Examples of activating the outputs:

with command ALARM:

```
>alarm   2    T    HI   25   5    ON
Ch2  T    HI   ON   25.000    5.00 'C
>
```

with commands ALARM 1 ON and ALARM 2 ON:

```
>alarm   1    ON
Ch1  aw   HI   ON     0.900   0.100 'C
>
>alarm   2    ON
Ch2  T    HI   ON    25.000   5.000 'C
>
```

APPENDIX 8: CONNECTORS

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1.2 Analogue outputs 106
1.3 Serial connections 107
1.4 Instructions for connecting and mounting the counter pieces 108

1.1 Connector options

The HMP228 moisture transmitter can be ordered with various connector configurations meaning that the sleeve or plug of the standard transmitter has been replaced with a connector. In the following, various options and signals.

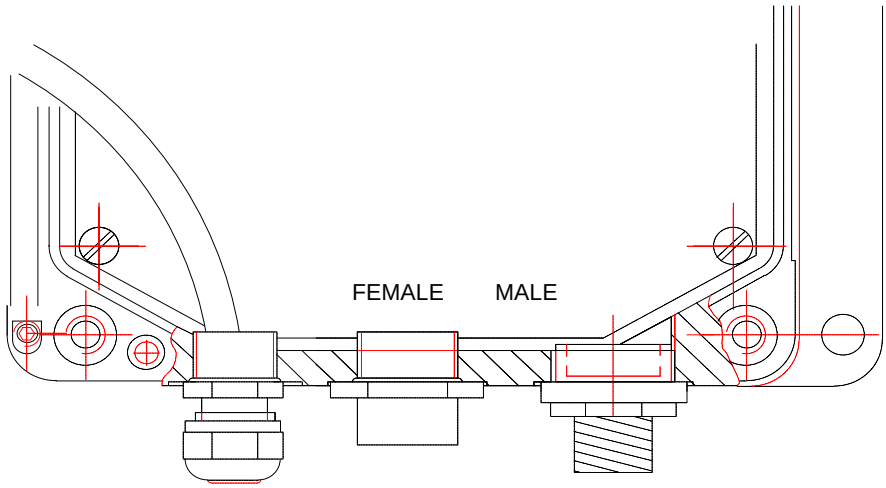


Figure 1 Connector location

1.2 Analogue outputs

Analogue outputs are selected when ordering the transmitter (order form has options for 0... 20 mA, 4... 20 mA, 0... 1V, 0.... 5V and 0... 10V). They can be connected to a connector. If the transmitter is used the HMP230PW power supply module, only analogue outputs are connected to the connector. If the transmitter is operated with 24 VAC/VDC, also the power supply is connected to the same connector.

Part #	Connection 1	Connection 2
19372	24 VAC/VDC	HMP230PW
1	X1/24V+	X1/NC
2	X2/Ch1+	X2/Ch1+
3	X1/24V-	X2/Ch1-
4	X2/Ch2+	X2/Ch2+
5	X2/Ch2-	X2/Ch2-

The female connector (part no. 19372) is situated at the centre of the transmitter. The counter piece incorporating screw terminals (no. 19369) is delivered with each connector.

1.3 Serial connections

Also an RS232C serial bus can be connected to the connector; in this case, the connector is used mainly for maintenance and calibration purposes. Alternatively, a two wire RS 485 net can be built through the connector; in this case, also the power supply (24 VDC) is chained through transmitters.

RS232C connection

Part #	Connection
19371	
1	X6/Rx
2	X6/Tx
3	X6/GND-
4	X1/NC
5	X1/NC

The male connector (part n. 19371) is located on the right hand side of the transmitter. It is mounted with a sleeve socket Pg11/Pg9 (part no. 19813). The counter piece incorporating screw terminals (part no. 19370) is delivered with each connector.

RS485 single loop wiring

Part #	Connection	Part #	Connection
19372		19371	
1	X1/24V+	1	X1/24V+
2	X6/RxHi	2	X6/RxHi
3	X1/24V-	3	X1/24V-
4	X6RxLo	4	X6RxLo
5	X1/NC	5	X1/NC

The female connector (part no. 19372) is located at the centre of the transmitter. The male connector (part no. 19371) is located at the right hand side of the transmitter. It is mounted with with a sleeve socket Pg11/Pg9 (part no. 19813). Counter pieces (parts no. 19369 and 19370) are delivered with each connector. If the transmitter is removed for maintenance, the counter pieces can be connected to each in order not to break the RS485 loop.

1.4 Instructions for connecting and mounting the counter pieces

The counter piece has to be grounded as shown in Figure 1.4 in order to maintain a complete EMC protection. The recommended cable is a shielded cable with an outer diameter of 4 - 6 mm, e.g. PFSK 6 x 0.22 mm.

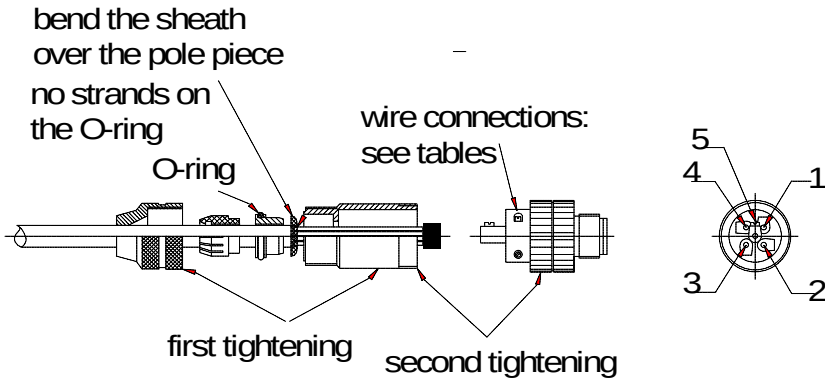
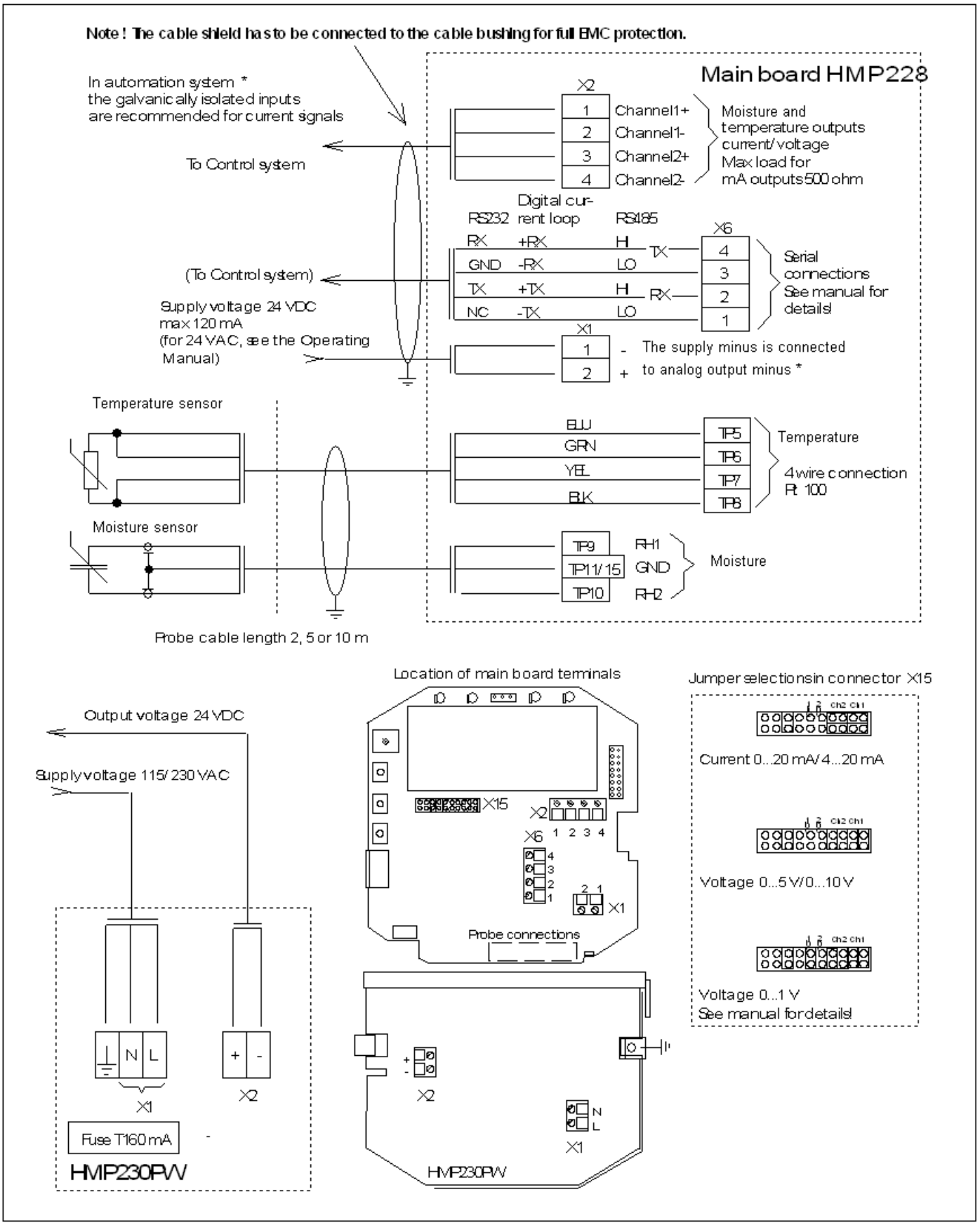


Figure 1.4 Connecting and grounding the connector

APPENDIX 9


Note ! The cable shield has to be connected to the cable bushing for full EMC protection.
Main board HMP228
In automation system *
the galvanically isolated inputs
are recommended for current signals
To Control system
(To Control system)
Supply voltage 24 VDC
max 120 mA
(for 24 VAC, see the Operating Manual)
X2
1 Channel1+
2 Channel1-
3 Channel2+
4 Channel2-
Moisture and temperature outputs current/voltage
Max load for mA outputs 500 ohm
Digital current loop
RS232
RS485
RX +RX
GND -RX
TX +TX
NC -TX
H
LO
H
LO
TX
RX
X6
4
3
2
1
Serial connections
See manual for details!
X1
1 -
2 +
The supply minus is connected to analog output minus *
Temperature sensor
BLU
GRN
YEL
BLK
TP5
TP6
TP7
TP8
Temperature
4 wire connection
Pt 100
Moisture sensor
TP9
TP11/15
TP10
RH1
GND
RH2
Moisture
Probe cable length 2, 5 or 10 m
Location of main board terminals
X15
X2
X6
1 2 3 4
4
3
2
1
2 1
X1
Probe connections
Output voltage 24 VDC
Supply voltage 115/230 VAC
N L
X1
+ -
X2
Fuse T160 mA
HMP230P/V
X2
N
L
X1
HMP230P/V
Jumper selections in connector X15
Ch2 Ch1
Current 0...20 mA/4...20 mA
Ch2 Ch1
Voltage 0...5 V/0...10 V
Ch2 Ch1
Voltage 0...1 V
See manual for details!