# *HMI38 HUMIDITY DATA PROCESSOR AND HMP35/36/37E PROBES Operating Manual*

**U063en-2.1**
**June 1998**

Yleisjäljennös 06/1998

# Contents

This manual is valid for programme version 2.01.

# 1. PRODUCT DESCRIPTION

The microprocessor based HMI38 Humidity Data Processor is a light, portable instrument with an optional carrying case and built-in rechargeable battery which make it suitable for spot checking measurements or for use as a transfer standard.

The HMI38 is used together with Vaisala's HMP35E, HMP36E or HMP37E humidity and temperature probes to measure relative humidity and temperature quickly and accurately. Two probes can be connected to each HMI38. The HMI38 also calculates dewpoint, mixing ratio, absolute humidity and wet bulb temperature from the relative humidity and temperature it has measured.

The HMI38 has two analogue outputs (0...1V or 0...5 V) which can be selected and scaled freely. The HMI38 also has an RS 232C and an RS 485 interface.

The HMI38 Humidity Data Processor is used through the menu-based display. The user can choose between metric and non-metric units. Output modes are flexible: measured or calculated quantities can be displayed or they can be transferred to a computer or peripheral device using either RS 232C or RS 485 serial bus. Because the HMI38 units are addressable, there can be several units on the same RS 485 line.

The HMI38 can be used as a one point field calibrator for HMP140 series and HMD/W60/70 transmitters with standard or customized settings, as well as for calibrating their predecessors HMD/W20/30 and HMP130Y series. It can also be used as a one or two point calibrator for HMP230 series transmitters. The transmitters are calibrated using an appropriate reference cable between the HMI38 and the calibrated transmitter.

The HMI38 can also be used as a data logger. In continuous data logging, the user selects the interval and the starting time of logging; the HMI38 can store up to 254 readings from both probes in CONTINUOUS mode. In addition, the HMI38 can also be used for manual data logging. The CATCH mode enables the user to store readings manually at any given moment. In this mode, the HMI38 can store 127 readings from both probes. The HMI38 stores the measured relative humidity and temperature values. When the stored data is transferred to a computer or a peripheral through the serial bus, it calculates the other four quantities from them.

The HMI38 is powered with DC voltage, but with an AC adapter it can be powered from the mains. HMI38 has a built-in battery and a charger.

## 2. TO BE NOTED WHEN MEASURING HUMIDITY

It is essential in the measurement of humidity and especially in calibration that temperature equilibrium is reached. Even a small difference in temperature between the measured object and the sensor causes an error. If the temperature is +20 °C (+68 °F) and the relative humidity 50 %RH, a difference of ±1 °C between the measured object and the sensor causes an error of ±3 %RH. When the humidity is 90 %RH, the corresponding error is ±5.4 %RH.

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

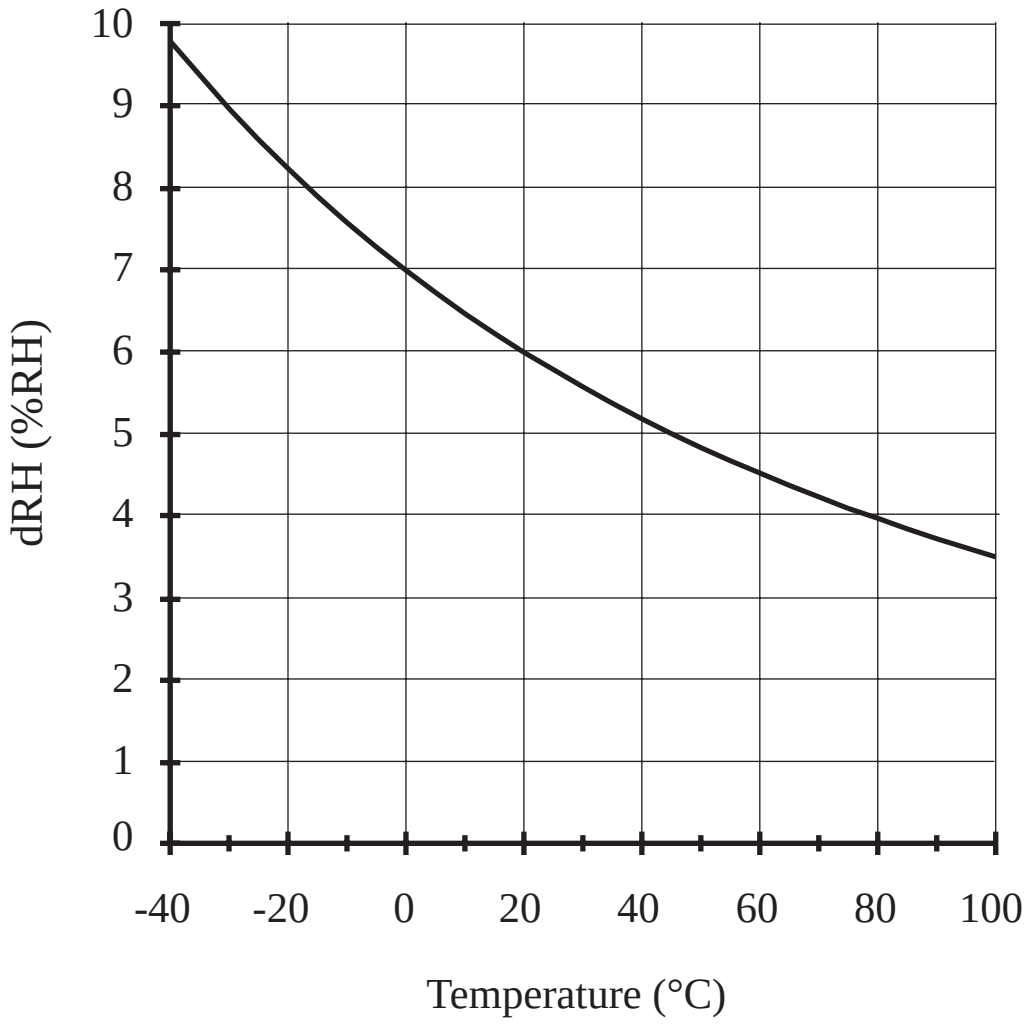



**Figure 2.1 Measurement error at 100 %RH when the difference between the ambient and sensor temperature is 1 °C**

# 3. TAKING THE HMI38 INTO USE

Please, note that when you take the HMI38 into use for the first time, both probe locations have the factory setting for the probe type HMP35E. If this is not the case, the HMI38 displays error message(s) after power up (see appendix 3). Error messages can be cleared by pressing ENT button several times. Should this happen, you must initialize the probe locations. During initialization, the HMI38 gets information on which probe locations have probes connected to them. Initializing is described in Chapter 4.1.

If you use the instrument as a data logger, you must enter the correct date and time; see Chapter 6.

In order to enable the HMI38 to calculate the mixing ratio and wet bulb temperature accurately, enter the ambient air pressure through the keypad or serial bus. This setting is described in Chapter 5.

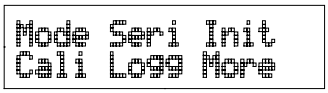
The HMI38 has a rechargeable battery which has not been charged in the factory. Charge the battery overnight. You can use the instrument instantly when you connect it to the mains for charging. To maximize the battery lifetime, completely discharge and recharge the battery about once a month. You can discharge the battery by leaving the HMI38 on without an AC adapter until the low battery voltage switches the HMI38 automatically off.

# 4. COMMISSIONING

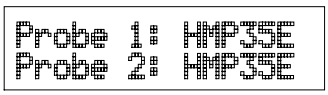
## 4.1. Initializing the probe locations

You can use either keypad or serial bus commands for the initialization of the probe locations. If you use serial commands, see Appendix 1.

If the probe type setting in the HMI38 memory is not correct, some error messages may appear on the display after power up (see Appendix 3). You can clear these messages by pressing ENT button one or several times. When the humidity and temperature readings appear on the display, press CL key to enter the command mode. The first display is the main menu:




Use arrow keys to select *Init* which starts to blink, and then press ENT. The following appears with the indication of **PROBE 1** blinking (in this example, HMP35E):




Use arrow keys to select the correct type for **PROBE 1** (*HMP35E*, *HMP36E*, *HMP37E*, *HMP35BM*, *HMP36BM*) and press ENT. If there is no probe in location 1, select *none* and press ENT. Use arrow keys to select also the type for PROBE 2 and press ENT. The HMI38 returns to the display mode showing the current readings.

## 4.2. Connecting the analogue outputs

Figure 4.1 shows the connections to the analogue output connector. See Chapter 5.1.3 and Chapter 5.1.3.2 for selecting the quantities and for scaling the analogue outputs.

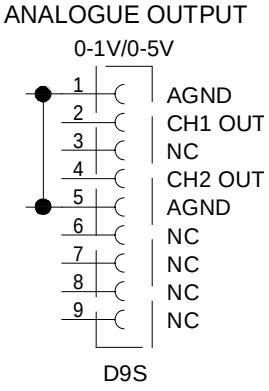



**Figure 4.1 Cable connections to the analogue output connector**

## 4.3. Connecting the RS 232C or RS 485 serial bus

Figure 4.2 shows the pin configuration of the serial line connector and the RS 232C serial line connection of the HMI38 to a peripheral device.

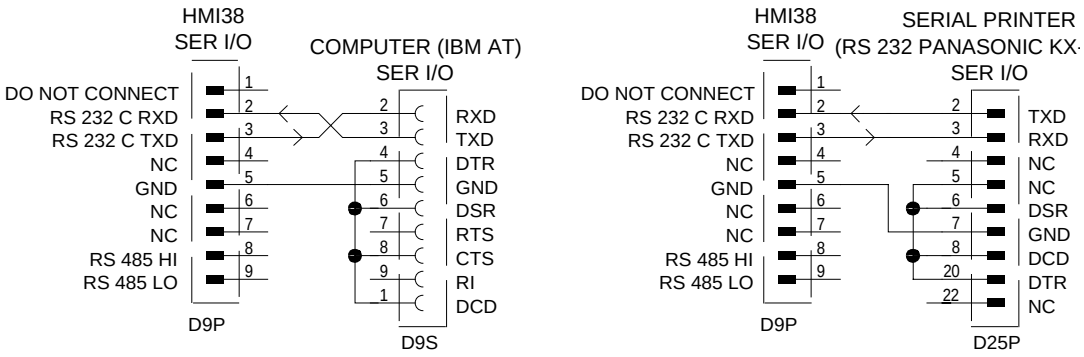



**Figure 4.2 Wiring between the HMI38 and a PC or a serial line printer using RS 232C serial line.**

Connect the serial bus between the PC and the HMI38 and switch the PC on. Use a terminal emulation programme (e.g. Procomm Plus, Datastorm or Windows terminal) when using a PC. The following chapter lists the factory settings for data transfer.

### NOTE

When changing the serial bus settings, switch the instrument off and on again or give the serial line command RESET to activate the new settings.

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

## 4.4. Summary of the factory settings

The factory settings of the HMI38 are the following:

- probe initializations:
  - -probe 1 HMP35E
  - -probe 2 HMP35E
- auto power-off off
- output units metric
- pressure 1013.25 hPa (= mbar)
- analogue outputs:
  - -channel 1 RH1: 0...100 %RH 0...1 V
  - -channel 2 T1: -40...160 °C 0...1 V
- serial line:
  - -bauds, parity, data, stop 4800, even, 7, 1
  - -duplexity FDX
- address 0
- serial mode stop
- echo on
- output interval 0 s
- measurement integration time 16
- filter off

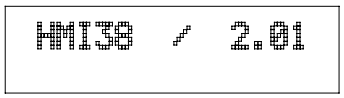
# 5. COMMANDS

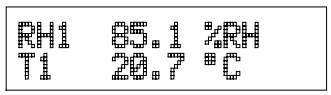
The HMI38 incorporates a microprocessor which allows the configuration to be set according to the user's needs. This is done through commands, either utilizing the menus on the front panel display or giving commands through the serial interface. The commands can be used e.g. to choose the displayed quantities, to select and scale the analogue outputs, to calibrate the temperature channels as well as the analogue outputs and to set the serial interface.

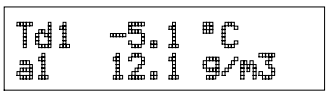
## 5.1. Display/keypad commands

### 5.1.1. Display mode

In the display mode the HMI38 outputs measured and calculated quantities on the display. You can scroll the first line with button ▲ and the second line with button ▼. After reset the instrument shows first the programme type and version and then goes on to the display mode.



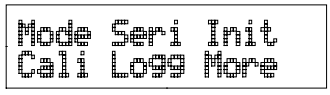




You can scroll different quantities with arrow switches. Acknowledge each selection by pressing ENT; this way, they appear on the display even after power off. The display also shows error messages and alarms if they occur.

### 5.1.2. Command mode

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

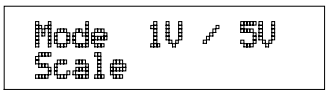



You can scroll the commands with the arrow keys. The currently active command blinks; select the desired command with the ENT key. When a menu is on the display, either the first command or the currently valid setting blinks. The CL key takes the HMI38 back to the display mode.

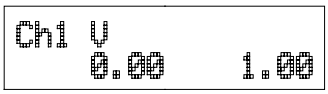
### 5.1.3. Selecting and scaling the analogue outputs

#### 5.1.3.1. Selecting the output

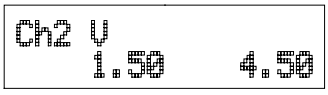
- Select *Mode* in the main menu and *Analog outputs* in the Mode menu:




- Select *Mode 1V / 5V*. The current settings for channel 1 are displayed:




- If the settings are correct, press ENT.
- If you need to change the settings, press CL:
  - the lower limit starts blinking
  - acknowledge the lower limit with ENT or change it with the numeric keys, then press ENT
  - the upper limit starts blinking
  - acknowledge the upper limit with ENT or change it with the numeric keys, then press ENT
- When channel 1 has been set, the programme goes on to channel 2; the procedure is the same as with channel 1.

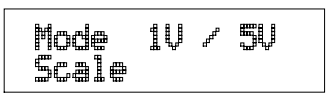



**NOTE**

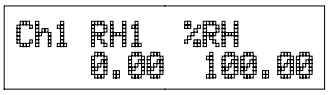
The hardware has two basic voltage ranges: 0...1 V and 0...5 V. When scaling analogue outputs, please note that the relative accuracy of the output may become too low if only a very small part of either range is used to output a quantity with a wide measurement range.

#### 5.1.3.2. Selecting and scaling the analogue output quantities

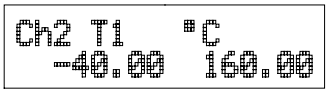
- Select *Mode* in the main menu and *Analog outputs* in the Mode menu:




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



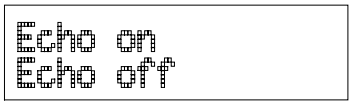
- If the settings are correct, press ENT.
- If you need to change the settings, press CL:
  - the quantity (RHn, Tn, Tdn, xn, an, Twn; n = 1 or 2) starts blinking; change it with the arrow keys and acknowledged with the ENT key
  - the lower limit starts blinking
  - acknowledge the lower limit with ENT or give a new value using the numeric keypad and press ENT
  - the upper limit starts blinking
  - acknowledge the upper limit with ENT or give a new value using the numeric keypad and press ENT
- After channel 1 has been set the settings of channel 2 appear on the display; follow the procedure described above for channel 1.




### 5.1.4. Setting the serial line parameters

#### 5.1.4.1. Turning the serial interface echo ON/OFF

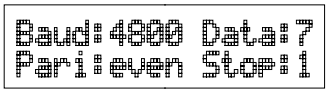
- Select *More* in the main menu, *More* in the More menu and *Echo* in the second More menu.



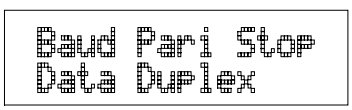

- Use the arrow keys to select the right alternative and press ENT.

#### 5.1.4.2. Serial bus settings

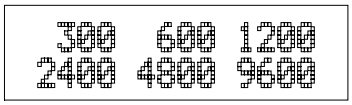
- Select *Seri* in the main menu; the currently valid serial interface settings are displayed:



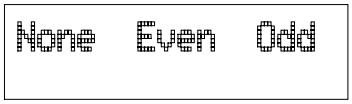

- If the settings are correct, press ENT; the programme returns to the display mode.
- If you need to change the settings, press CL:



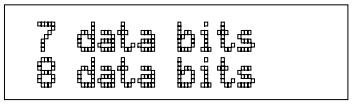
- Select the parameter to be changed with the arrow keys and ENT key.
  - Selecting baud rate:



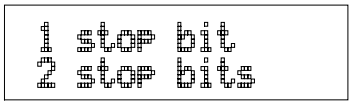

  - Selecting parity:



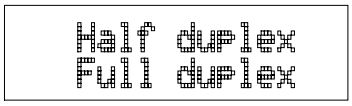

  - Selecting data bits:




  - Selecting stop bits:




  - Full duplex/half duplex:



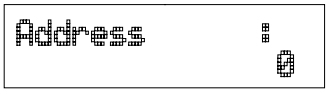

## NOTE

The serial bus settings become effective only after power off/on or the serial line command RESET.

### 5.1.4.3. Setting the instrument address

Address is used when more than one instrument is connected to one serial bus; this enables communication with one instrument at a time.

- Select *More* in the Main menu and then *Addr* in the More menu; the following appears on the display:

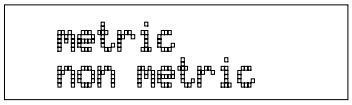



- Change the address by entering a new value and pressing ENT.
- Pressing ENT returns the programme to the More menu.

- Pressing CL returns the programme to display mode and leaves the address unchanged.

#### 5.1.4.4. Selecting the output units

- Select *More* in the Main menu and *Unit* in the More menu:




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

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

### 5.1.5. Setting the output mode

The output modes only affect output through the serial interface: the instrument accepts all display/keypad commands irrespective of which serial output mode it is in. The HMI38 has three serial output modes: RUN, STOP and POLL.

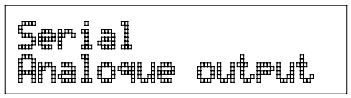
In the RUN mode the instrument outputs measurements automatically through the serial interface to a PC or a peripheral. The only command that can be given through the serial interface is S (stop), which ends the RUN mode.

In the STOP mode serial commands are given to the instrument. Measurements can be output only by giving command SEND.

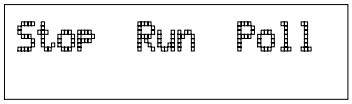
The POLL mode is used when more than one instrument is connected to the same serial bus; a single instrument can be addressed and communicated with. When the connection to one instrument is opened in the POLL mode, this instrument goes into STOP mode and can then accept commands normally. Closing the connection returns the instrument to POLL mode. In POLL mode the instrument outputs measurements only when requested (command SEND aa). If the user has forgotten the address of the instrument, it can be checked using display/keypad commands.

#### 5.1.5.1. Setting the serial interface operation mode

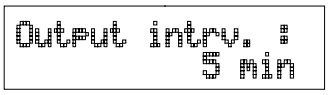
- Select *Mode* in the main menu; the following appears on the display:




- Select *Serial*:




- The currently valid setting blinks. Select the desired mode with the arrow keys and press ENT. After this the programme returns to the previous Menu.
- If you select the *Run* mode, the currently valid output interval appears on the display (with number and unit blinking):




If required, change the output interval setting as follows:

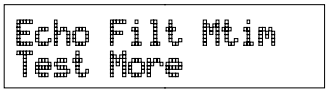
- press CL
- the number starts blinking
- if you need to change the interval, enter the new interval; otherwise press ENT
- the unit (seconds, minutes or hours) starts blinking
- if necessary, change the unit with the arrow keys and acknowledge it with ENT
- after this the programme returns to the previous menu

### 5.1.6. Others

#### 5.1.6.1. Setting the measurement integration time

Lengthening of the measurement integration time filters out any stray changes in the output: the instrument calculates the average of the number of measurement cycles defined by the user.

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

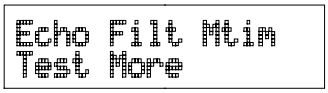


- Pressing ENT returns the programme to the previous menu without changing the integration time.
- If you need to change the integration time, enter the new time (4...255) and press ENT.


#### 5.1.6.2. Setting the measurement integration filter

If the integration filter is set on, the output reading is an average of four last measurements.

- Select *More* in the main menu, *More* in the More menu and *Filt* in the second More menu:

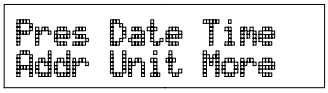



- Choose the correct alternative (Filter on/off) with arrow keys and press ENT.

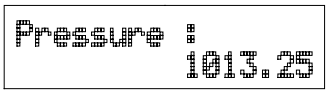
#### 5.1.6.3. Setting the pressure for mixing ratio and wet bulb temperature calculations

The atmospheric pressure has an effect on mixing ratio and on wet bulb temperature. To achieve accurate calculations, the instrument needs to take the ambient pressure into account.

- Select *More* in the main menu:



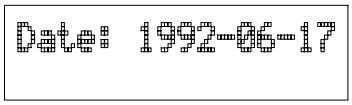

- Select *Pres*:




- Pressing ENT returns the programme to the previous menu without changing the pressure reading.
- If you need to change the pressure, enter the new value and press ENT.

#### 5.1.6.4. Setting the date

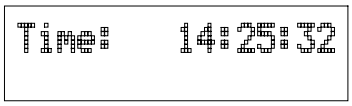
- Select *More* in the main menu; select *Date* in the More menu:




- If the date is correct, acknowledge it by pressing ENT; this takes the programme back to the More menu.
- If you need to change the date, press CL. Enter the new date in the order the digits blink (year-month-day) and press ENT. Press ENT again to return to the previous menu. If there is no need to change the date, press CL.

#### 5.1.6.5. 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 you need to change the time, press CL. Enter the new time in the order the numbers blink and press ENT. Press ENT again to return to the previous menu. If there is no need to change the time, press CL.

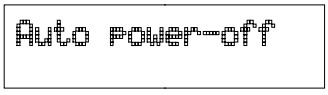
**NOTE**

As the HMI38 does not have a real-time clock with a backup battery, the date and time settings do not stay in the memory during power-off.

#### 5.1.6.6. Setting the automatic shutdown

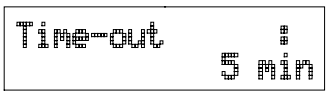
You can set the HMI38 to switch the power off automatically if no button is pressed for a certain time.

- Select *More* in the main menu; select *More* in the first More menu and then again in the second More menu:




- Press ENT and select the correct alternative (*on/off*) for the power-off mode with the arrow keys, then press ENT.


- If you choose *On*, the current power-off time appears. If required, change the time setting as follows:




- press CL
- the number starts blinking
- if you need to change the time, enter the new time; otherwise press ENT
- the unit (seconds, minutes or hours) starts blinking
- if required, change the unit with the arrow keys and acknowledge it with ENT
- after this the programme returns to Main menu

## NOTE

Auto power-off is not operational during data logging and calibration procedures.

## 5.2. Serial commands

Appendix 1 contains more detailed descriptions of the serial commands. The following chapters include only the most commonly used command sequences.

You can interrupt any serial command while giving it by pressing ESC. In the commands <cr> means carriage return.

### 5.2.1. Analogue output commands

#### 5.2.1.1. Setting the analogue outputs

**AMODE a.aaa b.bbb c.ccc d.ddd <cr>**

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

Sets the voltage scale of the analogue outputs on channels 1 and 2 (anything between 0...5 V).

**NOTE**

The hardware has two basic voltage ranges: 0...1 V and 0...5 V. When scaling analogue outputs, please note that the relative accuracy of the output may become too low if only a very small part of either range is used to output a quantity with a wide measurement range.

Examples: Voltage output on channel 1 is set to 0...1 V and that on channel 2 is set to 2...5 V:

```
>AMODE 0 1 2 5 <cr>
Ch1  0.000 ...  1.000 V
Ch2  2.000 ...  5.000 V
```

The current settings are checked by entering AMODE without parameters

```
>AMODE <cr>
Ch1  0.000 ...  1.000 V
Ch2  2.000 ...  5.000 V
```

### 5.2.1.2. Selecting and scaling the analogue output quantities

**ASEL xxx yyy <cr>**

xxx = quantity of channel 1 (RHn, Tn, Tdn, An, Xn or Twn)
yyy = quantity of channel 2 (RHn, Tn, Tdn, An, Xn or Twn)
(n = 1 or 2)

Examples: Relative humidity of probe 1 is output on channel 1 and temperature of probe 2 on channel 2; the temperature range is scaled to be 0...100 °C:

```
>ASEL RH1 T2 <cr>
Ch1  ( RH1 )    lo        0.000 %RH   ? <cr>
Ch1  ( RH1 )    hi        100.000 %RH ? <cr>
Ch2  ( T2 )    lo         -40.000 'C  ? 0 <cr>
Ch2  ( T2 )    hi         160.000 'C  ? 100 <cr>
>
```

After entering ASEL without parameters the instrument outputs its current settings

```
>ASEL <cr>
Ch1  ( RH1 )    lo        0.000 %RH   ? <cr>
Ch1  ( RH1 )    hi        100.000 %RH ? <cr>
Ch2  ( T2 )    lo         0.000 'C    ? <cr>
Ch2  ( T2 )    hi         100.000 'C  ? <cr>
>
```

### 5.2.1.3. Scaling the analogue outputs

**ASCL <cr>**

Scales the outputs selected on channels 1 and 2 (almost the same as ASEL but for scaling only).

Example: Scaling relative humidity on the range of 0...100 %RH and temperature -40...+160 °C

```
>ASCL <cr>
Ch1  ( RH1 )    lo        20.000 %RH  ? 0 <cr>
Ch1  ( RH1 )    hi        90.000 %RH  ? 100 <cr>
Ch2  ( T2 )    lo         0.000 'C    ? -40 <cr>
Ch2  ( T2 )    hi         100.000 'C  ? 160 <cr>
>
```

### 5.2.2. Output via the serial bus

#### 5.2.2.1. Starting the measurement output

**R <cr>**

Starts the measurement outputting of to peripheral devices (RUN mode); the only command that can be used is S (stop).

The output format can be changed with command FORM (see appendix 1).

#### 5.2.2.2. Stopping the measurement output

**S<cr>**

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

#### 5.2.2.3. Outputting the reading once

**SEND <cr>**

in STOP mode or

**SEND aa <cr>**

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

The output format can be changed with command FORM (see appendix 1).

#### 5.2.2.4. Setting the output interval for the RUN state

**INTV xxx yyy <cr>**

xxx = output interval (0...255)
yyy = unit (s, min or h)

Sets the output interval for RUN mode and command R. If the interval is set to zero (s, min or h), the output interval will be determined by the frequency of measurements only.

Example: Changing output interval to 10 minutes

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

### 5.2.2.5. Serial bus settings

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

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

Examples: Giving new settings

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

```
>SERI 600 N 8 2 F <cr>
600 N 8 2 FDX
```
changing all parameters

## NOTE

New settings are effective only after switching the instrument off/on or after the serial command RESET has been given.

If half-duplex setting is used with RS 485 bus, it will automatically turn the echo off. Even then the ECHO command can indicate that echo is on.

### 5.2.2.6. Selecting the output units

**UNIT x <cr>**

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

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

#### 5.2.2.7. Setting the address

**ADDR aa <cr>**

aa = address (0...99)

Example: The HMI38 is given address 99

```
>ADDR <cr>
Address  :    0 ?  99 <cr>
```

#### 5.2.2.8. Resetting the HMI38

**RESET <cr>**

### 5.2.3. Operating the HMI38 via the serial bus

Setting the serial interface mode

**SMODE xxxx<cr>**

xxxx = STOP, RUN or POLL

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

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

In POLL mode: measurements output only with command SEND.

When in POLL mode, the output mode is changed as follows:

**OPEN aa <cr>**

**SMODE xxxx<cr>**

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

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

Example:

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

#### 5.2.3.1. OPEN & CLOSE

**OPEN nn <cr>**

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

**CLOSE <cr>**

In STOP mode: OPEN has no effect, CLOSE sets the serial bus temporarily to the POLL mode

In POLL mode: OPEN sets the serial bus temporarily to STOP mode; CLOSE sets the bus back to POLL mode

The temporary mode changes are not stored in the memory of the transmitter; after reset the bus is in its original mode.

When more than one instrument is connected to the same serial bus, the POLL mode enables communication with an individual instrument.

Example: Transmitter 2 is temperature calibrated (currently in POLL mode)

```
>OPEN 2 <cr>                this line is not visible on the screen
HMI 2 line opened for operator commands
>CT <cr>
...                         calibration procedure
>CLOSE <cr>
line closed
```

# 6. DATA LOGGING

The HMI38 has two data logging modes: the CONTINUOUS mode, i.e. automatic logging which can store up to 254 readings from both probes and the CATCH mode, i.e. manual logging with which the user can store up to 127 readings from both probes. The user can choose the logging interval and starting time of the logging when using the CONTINUOUS mode, and in the CATCH mode he can store readings at any given moment by pushing the button ENT. The HMI38 stores the measured relative humidity and temperature values and when the stored data is transferred to a computer or peripheral through the serial bus, it calculates the other four quantities – dewpoint temperature, mixing ratio, absolute humidity and wet bulb temperature – from them.

## NOTE

The CATCH mode is available only in units that have the software version 2.01 or more. You can easily check the version by reading the sticker on back of the device (SV2 indicates software version 2.01 or more).

Activate logging with either display/keypad or serial line commands. The logged data is output to serial line. In outputting the values for mixing ratio and wet bulb temperature, the currently valid pressure setting is used.

## NOTE 1

To save battery, the analogue outputs cannot be used when data logging is on.

## NOTE 2

When the HMI38 is powered from the battery and the logging memory becomes full, the instrument automatically turns itself off.

## 6.1. Logging using display/keypad commands

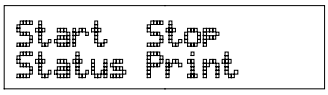
### 6.1.1. Start/stop data logging in the CONTINUOUS mode

**NOTE**

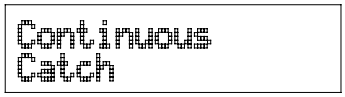
The HMI38 has no battery operated real-time clock. Give current date and time settings manually after power-on (see Chapter 5.1.6.5); this way, correct time and date indications are stored with each reading.

To start data logging:

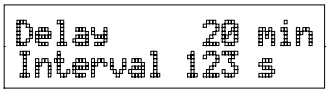
- Select *Logg* in the main menu. The LOGG menu is displayed:




- Select *Start* and in the START menu, select *Continuous*:

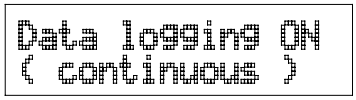



- The current delay (time before logging starts) and interval (time between sequential data storings) settings appear on the display with the current delay blinking:



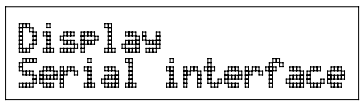

- Press ENT to acknowledge the current delay time setting. To change the setting press CL. Enter the new time and press ENT, then choose the correct time unit (s, min, h) with the arrow keys and press ENT. Acknowledge or change the time interval the same way.

After you have set the time interval, the data logging starts and the logging status appears on the display. The HMI38 displays the logging status and measurements alternately:



## NOTE

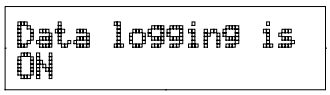
If the HMI38 has not output previous logging data, text *Logged data is not transferred* appears on the display. A new logging starts only after the old data has been transferred. To enable new logging, give command *Print-Display* or *Print-Serial interface*.

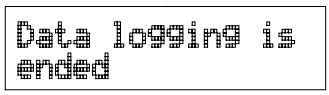


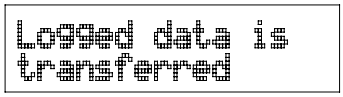

To stop data logging:

- Press CL, select *Logg* in the main menu and then *Stop* in the LOGG menu. Data logging ends.

The current status of the logging can be checked by selecting *Status* in the LOGG menu.



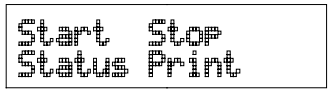

### 6.1.2. Start/stop data logging in the CATCH mode

## NOTE

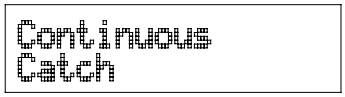
The HMI38 has no battery operated real-time clock. Give current date and time settings manually after power-on (see Chapter 5.1.6.5); this way, correct time and date indications are stored with each reading.

To start data logging in the CATCH mode:

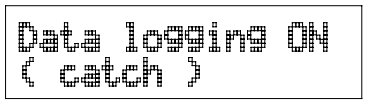
- Select *Logg* in the main menu. The LOGG menu is displayed:



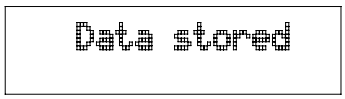

- Select *Start* in the LOGG menu and then *Catch*:




- The measurement readings appear on the display alternately with the following display:




- You can now store readings at any given moment by pressing ENT while the readings are on the display. The text DATA STORED appears to inform you that the readings as well as the time of measurement were correctly stored in the HMI38 memory:

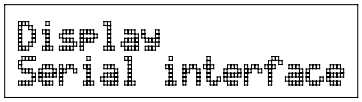



- Press ENT to return to the display showing the measurement readings.

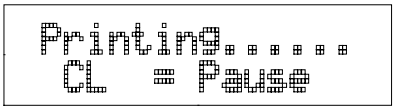
- Note that to save battery life, you can turn the HMI38 off while not storing readings and then turn it on again to continue. However, in this case remember to enter the correct date and time each time you turn the instrument on as it does not have a real-time clock. You can store max. 127 readings from both probes. To stop data logging, select *Logg* in the main menu and then *Stop* in the LOGG menu. Data logging ends.

### 6.1.3. Outputting the logged data to the serial line

- Select *Logg* in the main menu and *Print* in the LOGG menu. Select *Serial interface*:




The following appears:




The HMI38 outputs the logged data to the serial line:

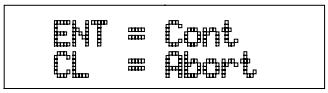
```
>Data logging is ended
 Delay to start :     0 s
 Interval       :    10 min
 First data stored:  1994-10-18 13:45:55
 Number of loggings :      1

 18.1  23.5  -2.1   3.0   3.2  11.3
 15.7  23.0  -4.4   3.2   2.7  10.6
```

The factory format for the data output is:

```
RH1  T1   Td1  a1   x1   Tw1
RH2  T2   Td2  a2   x2   Tw2
```

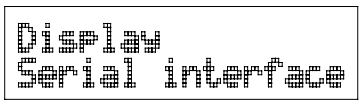
You can change the format with serial line command LFORM and pause the output by pressing CL. If you wish to continue, press ENT; if you wish to stop the outputting completely, press CL:



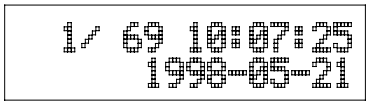

The HMI38 stores the logged data in the memory until a new data logging starts.

### 6.1.4. Outputting the logged data to the display

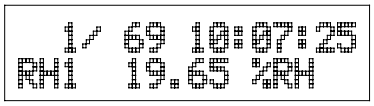
- Select *Logg* in the main menu and *Print* in the LOGG menu. Select *Display*:



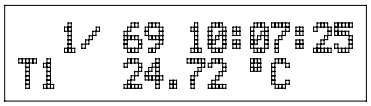

- The first logging point stored appears on the display, e.g.:




- The first number from the left on the first line (in this example, **1**) indicates which logging point is currently being observed. The second number from the left on the first line (in this example, **69**) tells you how many logging points are stored in the HMI38 memory. Other numbers indicate the time and date of the measurement.
- Press ENT and the readings of the first logging point appear on the second line of the display, e.g.:




- The abbreviation of the measurement quantity and the number of the probe appear on the left of the second line. If you wish to see the readings of other measurement quantities or the readings of the second probe (if connected), you can scroll them with buttons ▲ or ▼, for example:




- Press the button CL to move on to the following logging point. When the readings are not on the display, you can select any logging point for observation with buttons ▲ or ▼.
- You can stop outputting the data by pressing twice the button CL.

The HMI38 stores the logged data in the memory until a new data logging starts.

## 6.2. Logging using serial line commands (CONTINUOUS mode)

See Appendix 1 for a description of the format of the serial line commands.

### 6.2.1. Data logging

**LOG xxx aa bbb cc ddd <cr>**

xxx = functional mode: ON, OFF or P(rint)
aa = logging start delay
bbb = delay unit (h, min, s)
cc = logging interval
ddd = interval unit (h, min, s)

Examples:

- start logging and continue with intervals of 10 minutes:

```
>log on 10 min <cr>
Data logging is ON
 Delay to start :     0 s
 Interval       :    10 min
 First data stored:  0000-00-00 00:00:00
 Number of loggings   :     0
```

- start logging after five hours and continue with intervals of 30 minutes:

```
>log on 5 h 30 min <cr>
Waiting for the start of logging
 Delay to start :     5 h
 Interval       :    30 min
 First data stored:  ????-??-?? ??:??:??
 Number of loggings   :     0
```

- end logging:

```
>log off <cr>
Data logging is ended
 Delay to start :     0 s
 Interval       :    10 min
 First data stored:  1994-10-18 13:45:55
 Number of loggings :      1
```

- output the logged data (defined by LFORM command):

```
>log p <cr>
Data logging is ended
 Delay to start :     0 s
 Interval       :    10 min
 First data stored:  1994-10-18 13:45:55
 Number of loggings :      1

  18.1  23.5  -2.1   3.0   3.2  11.3
  15.7  23.0  -4.4   3.2   2.7  10.6
```

#### 6.2.1.1. Setting the output format of the logged data

**LFORM zzz...zzz <cr>**

or

**LFORM <cr>**

**xxx...xxx**

**? zzz...zzz <cr>**

xxx...xxx = old format (blank = factory format)
zzz...zzz = new format

- Select output variables by variable name and the number of the measuring probe:

  RH*n* = relative humidity
  T*n* = temperature
  Td*n* = dewpoint temperature
  A*n* = absolute humidity
  X*n* = mixing ratio
  TW*n* = wet bulb temperature

  where *n* is the number of the probe (1 or 2)

- Give any other text you wish to appear in the output between inverted commas (").

- Give the number format in front of the output variable as:

  <full digits>.<decimal digits>, for example: 3.2 or 2.1 etc. (max. 9.9).

- Give the unit as:

  U*n* where *n* specifies the number of characters (max. 5), e.g. U3.

- other parameters are:

  \n or #n line feed <lf>
  \r or #r carriage return <cr>
  \t or #t horizontal tabulation <ht> or <tab>
  \nnn or #nnn ASCII-code nnn
  TIME current time (HH:MM:SS)
  DATE current date (YYYY-MM-DD)

- If the input line is too short, continue the command parameter entry in the following line as:

  & <cr>.

Some examples:

command: `>LFORM "rh1: " 3.2 RH1 " %RH" \r \n<cr>`
output: `rh1: 29.62 %RH<cr><lf>`

command: `>LFORM "RH: " 2.2 RH1 U1 \r \n<cr>`
output: `RH: 29.62%<cr><lf>`

command: `>LFORM date " " time #t RH1 #t T1 #r #n<cr>`
output: `1994-09-29 10:02:15 <tab> 29.6 <tab> 24.3 <cr><lf>`

command:
```
>LFORM "rh: " 2.2 RH2 " " U3 & <cr>
" t: " 2.2 T2 " " U2 #r #n<cr> (line continued)
```
output: `rh: 29.62 %RH t: 25.35 'C <cr><lf>`

The factory format can be recovered with command:

```
>LFORM * <cr>
```

Please, note that you can use the LFORM command for changing the format of the output of logged data only; otherwise it is functionally similar to the FORM command.

# 7. CALIBRATION

As the HMI38 indicators and their probes have been fully calibrated at the factory, there should be no immediate need for a recalibration. Calibrate them only if you have a reason to believe that the adjustments have changed. The adjustments of the temperature measurement channels and analogue output channels are particularly stable and in normal circumstances, need not be recalibrated. Perform humidity calibration for the probes at least once a year.

## 7.1. Humidity calibration

Perform the humidity calibration of the probes by adjusting the calibration potentiometers in the probe bodies (see Appendices 4, 5 or 6). Perform a two-point calibration with the HMK15 or HMK13B calibrator or send the probe to Vaisala. We recommend recalibration at least once a year. Please, note also that the probe needs recalibration every time the HUMICAP® humidity sensor is changed.

### 7.1.1. Calibration procedure

- Leave the calibrator, the HMI38 and the probe for at least 4 hours in the same space so that their temperatures have time to equalize. Remove the filter cap on the probe.
- Insert the probe into a measurement hole of the LiCl chamber in the calibrator.
- Wait at least 10 minutes, check the humidity reading from the HMI38 and adjust the reading to the correct value using the DRY potentiometer in the probe body.
- Insert the probe into a measurement hole of the NaCl chamber in the calibrator.
- Wait at least 10 minutes and adjust the humidity reading using the WET potentiometer.

**Table 7.1 Greenspan's 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 |
| NaCl | %RH | 75.6 | 75.5 | 75.3 | 75.1 | 74.9 |

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

- As the DRY and WET adjustments may affect each other, check again the humidity reading in the LiCl chamber (wait for 10 minutes after inserting the probe into the measurement hole). If the reading is not

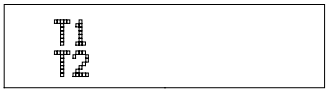
correct, repeat the adjustments in both LiCl and NaCL chambers until the calibration is correct.

## 7.2. Temperature calibration

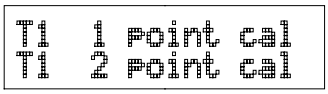
Temperature calibration should be done against an accurate temperature reference. It can be done by using either the serial bus or the display/keypad commands.

### 7.2.1. With display/keypad commands:

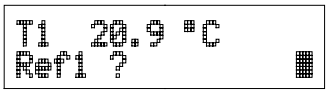
- Leave the reference instrument, the HMI38 and the probe in the same space for at least 4 hours so that their temperatures have time to equalize. Remove the filter before calibration.
- Select *Cali* in the main menu and select the probe:



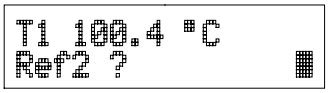

- Select either one-point or two-point calibration:




- After the temperature of the instrument has stabilized, check the first point reading against the reference instrument. Acknowledge the reading by pressing ENT or give the correct reading and press ENT:




- In case of a two-point calibration, change the temperature and allow enough time for temperature stabilization. Then check the transmitter against the reference, give the correct reading and press ENT.




**NOTE**

If you change the factory temperature calibration, the correction data stored in the HMI38 refers to the probe location of the calibrated probe. If you change the probe in this location, revert the measurement channel to its factory settings (see serial command LI in Appendix 1) or perform the calibration again with the new probe.

### 7.2.2. With serial line commands

**CT n <cr>**

n = probe (1 or 2)

With this command, you can calibrate the instrument against an accurate reference, such as a Pt 100 simulator.

Examples: two-point calibration for probe 1:

```
>CT 1 <cr>
T1  :  0.9     Ref1 ?  0 <cr>
Press any key when ready ...
T1 :  119.8 Ref2 ?     120 <cr>
>
```

one-point offset correction for probe 2 (<cr> is given after Ref2):

```
>CT 2 <cr>
T2  :  25.9     Ref1 ? 26 <cr>
Press any key when ready ...
T2  :  25.9     Ref2 ? <cr>
>
```

If you know the corrections at two points, you can also give the command directly as:

**CT n aa.aa bb.bb cc.cc dd.dd <cr>**

where: n = probe location (1 or 2)
aa.aa = first point
bb.bb = first point correction
cc.cc = second point
dd.dd= second point correction

Example: if you know the necessary corrections, perform the calibrations of the previous examples as follows:

```
>CT 1  0.9 -0.9  119.8 0.2 <cr>
>CT 2  25.9 0.1 <cr>
```

You can monitor the progress of the sensor temperature stabilization by entering * <*cr*> at Ref1 or Ref2:

```
>CT 1 <cr>
T1  :  0.80   Ref1 ?   * <cr>
T1  :  0.40   Ref1 ?   0.00 <cr>
Press any key when ready ...
T1  :  56.20  Ref2 ?   55.0 <cr>
>
```

## 7.3. Calibrating the analogue outputs

You can perform the calibration with an accurate voltage meter using serial line command ACAL and make a test with command UTEST (see Appendix 1). Please, note that you should perform this calibration only if there is strong reason to believe that the adjustments of the analogue outputs have changed.

# 8. USING THE HMI38 AS A FIELD CALIBRATOR

You can also use the HMI38 as a field calibrator for HMD/W60/70 and HMP140 series and their predecessors HMD/W20/30 and HMP130Y series, as well as for the HMP230 series transmitters. Perform calibration by connecting an appropriate reference connection cable between the HMI38 and the transmitter to be calibrated (see chapter 11).

## NOTE

The calibration of the HMD/W60/70 and HMP140 series is available only in units that have the software version 2.01 or more. You can easily check the version by reading the sticker on back of the device (SV2 indicates software version 2.01 or more).

## 8.1. HMD/W60/70 and HMP140 series transmitters

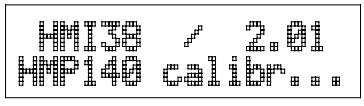
Use probe 1 as a reference measurement probe. Connect the D-connector of the reference connection cable to the connector of probe 2 in the HMI38. Connect the other connector of the cable to the test connector in the transmitter to be calibrated (refer to the transmitter manual for details). The connectors fit in one direction only.

## NOTE

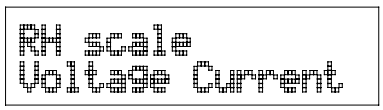
When you calibrate a transmitter with current output, terminate the output loop.

Make sure that the sensors of the transmitter and the reference probe are close to each other. If you are calibrating a duct type transmitter, push the probe through the support piece into the ready-made hole in the duct.

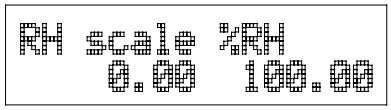
When the power of the HMI38 is off, press and hold down the NUMBER 2 button. Press the ON/OFF button and release it; keep the NUMBER 2 button still pressed. The following appears on the display:



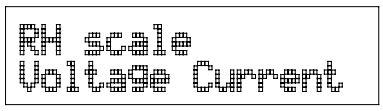

Release the NUMBER 2 button and the following appears on the display:



Select *RH scale* with buttons ▲ or ▼ and press ENT when the text *RH scale* is blinking. The following appears with the lower limit of the RH scale (0.00) blinking:



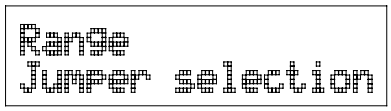

The default scale is 0.00 - 100.00 %RH. Acknowledge the lower limit with button ENT or enter the new value and press ENT. The upper limit (100.00) starts to blink. Acknowledge it with button ENT or enter the new value and press ENT. The display returns to show the following:



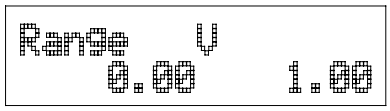

If you are calibrating a transmitter with current outputs, please, refer to Chapter 8.1.2.

### 8.1.1. Calibrating transmitters with voltage outputs

If voltage outputs are used, select *Voltage* with buttons ▲ or ▼ and press ENT when the text *Voltage* is blinking. The following text appears on the display:

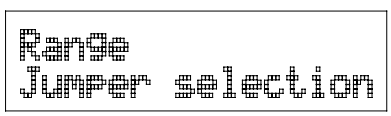



Select *Range* with with buttons ▲ or ▼ and press ENT when the text *Range* is blinking. A text similar to the following appears on the display:

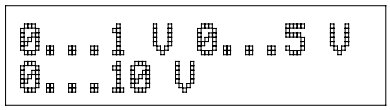



The lower limit (e.g. 0.00) is blinking. Acknowledge it with button ENT or change it by entering the new value and pressing then ENT. The upper limit (e.g. 1.00) starts to blink. Acknowledge it with button ENT or change it by entering the new value and pressing then ENT.

The display returns to show the following:

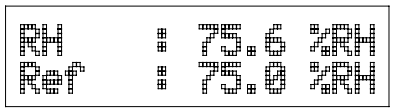



Select *Jumper selection* with with buttons ▲ or ▼ and press ENT when the text *Jumper selection* is blinking. A text similar to the following appears on the display:




The voltage range and the jumper selection are normally the same, but if the transmitter has customized ranges, these selections may differ from one another. Select the range according to the transmitter with buttons ▲ or ▼ and press ENT. You can return to voltage range and jumper selections by pressing the button CL. If you wish to return to the normal display mode, turn the HMI38 OFF and then ON again.

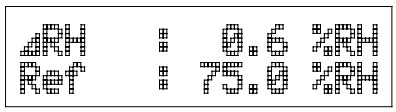
When you have acknowledged the jumper selection with ENT, the display changes to show a text similar to the following:




Numbers on the first line indicate the relative humidity measured by the transmitter, and numbers on the second line indicate the RH measured by the HMI38 reference probe. If you wish, you can now adjust the transmitter:

- Wait until the readings have stabilized and adjust the calibration potentiometers until the readings on the first and the second line are the same. It is recommended to use the offset potentiometer if the RH is <65 %RH and the gain potentiometer if the RH is ≥65 %RH.
- After having completed the calibration, turn the HMI38 off (disconnect the cable).

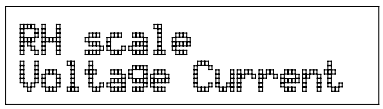
If you press the ENT button in the first RH calibration mode, you will go on to the second RH calibration mode which is an alternative for the first one. A text similar to the following is displayed:



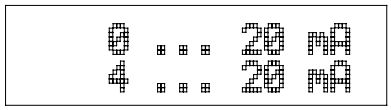

Numbers on the first line indicate how much the RH measured by the transmitter differs from that measured by the HMI38 reference probe. Numbers on the second line indicate the relative humidity measured by the reference probe. If you wish, you can now adjust the transmitter:

- Wait until the readings have stabilized and adjust the calibration potentiometers until the numbers on the first line are at zero. It is recommended to use the offset potentiometer if the RH is <65 %RH and the gain potentiometer if the RH is ≥65 %RH.
- After having completed the calibration, turn the HMI38 off (disconnect the cable).

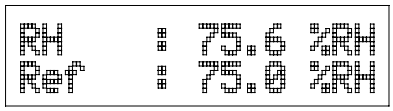
### 8.1.2. Calibrating transmitters with current outputs




If current outputs are used, select *Current* with buttons ▲ or ▼ and press ENT when the text *Current* is blinking. A text similar to the following appears on the display:



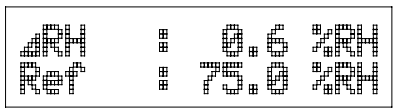

Select the current range used with buttons ▲ or ▼ and press ENT. The display changes to show a text similar to the following:




Numbers on the first line indicate the relative humidity measured by the transmitter, and numbers on the second line indicate the RH measured by the HMI38 reference probe. If you wish, you can now adjust the transmitter:

- Wait until the readings have stabilized and adjust the calibration potentiometers until the readings on the first and the second line are the same. It is recommended to use the offset potentiometer if the RH is <65 %RH and the gain potentiometer if the RH is ≥65 %RH.
- After having completed the calibration, turn the HMI38 off (disconnect the cable).

If you press the ENT button in the first RH calibration mode, you will go on to the second RH calibration mode which is an alternative for the first one. A text similar to the following is displayed:




Numbers on the first line indicate how much the RH measured by the transmitter differs from that measured by the HMI38 reference probe. Numbers on the second line indicate the relative humidity measured by the reference probe. If you wish, you can now adjust the transmitter:

- Wait until the readings have stabilized and adjust the calibration potentiometers until the numbers on the first line are at zero. It is recommended to use the offset potentiometer if the RH is <65 %RH and the gain potentiometer if the RH is ≥65 %RH.
- After having completed the calibration, turn the HMI38 off (disconnect the cable).

## 8.2. HMP230 series transmitters

Use probe 1 as a reference measurement probe. Open the cover of the HMP230 to be calibrated. Connect the D-connector of the reference connection cable to the serial I/O connector of the HMI38 and the other connector of the cable to the connector X5 of the HMP230 (see Figure 8.1). This connector is also the other mounting connector for RS 485/422 serial port module and current loop module; if a module is mounted, it must first be removed.

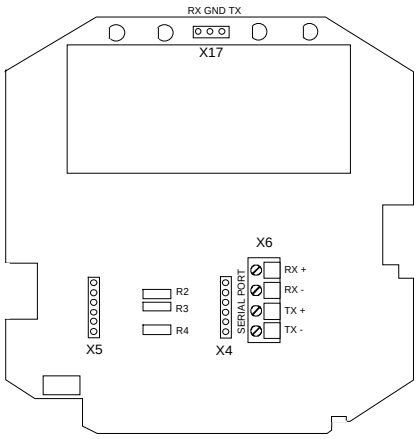
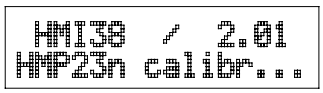
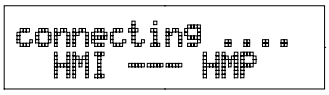



**Figure 8.1 Connector X5 on the main board of the HMP230**

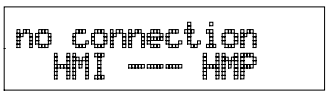
Make sure that the sensors of the transmitter and the reference probe are close to each other.

When the power of the HMI38 is off, press and hold down the NUMBER 0 button. Press and release the ON/OFF button; keep the NUMBER 0 button still pressed. When the programme type and version appear on the display, release the NUMBER 0 button. The following appears on the display:




If the connection fails, the following text appears:

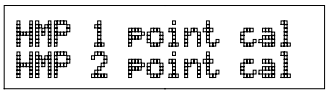



Should this happen, check that the HMP230 is powered and that the reference cable is properly connected.

### NOTE

The HMP230 must not be in the POLL mode and the serial line settings must be 4800, e, 7, 1 (factory settings, which can be restored using the factory settings jumper; see the HMP230 Operating Manual).

When connection has been formed, select either one or two point calibration with the arrow keys and press ENT:

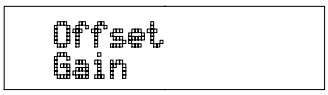



## NOTE

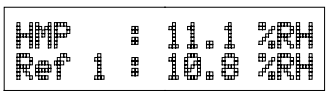
If the programme version of the HMP230 is 1.06 or earlier (version is printed on the CPU hybrid), start the HMI38 as described above without connecting the reference connection cable. After the text *'no connection'* appears on the screen, connect the cable. This procedure is necessary for avoiding a possible overflow in the serial line buffer of the HMP230.

### 8.2.1. One point calibration

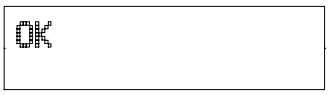
- Select either offset or gain calibration using arrow keys and press ENT. If the reference humidity is above 50 %RH, gain calibration is preferred. If the reference humidity is below 50 %RH, the HMP230 accepts only offset calibration .



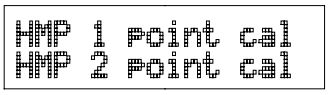

- The humidity readings of the HMP230 and the reference probe appear on the display:




- Wait until the readings have been stabilized and press ENT:




The correction factor is now stored to the memory of the HMP230 and the new readings of both the transmitter and the reference appear again on the display. In case of any drift in either of the readings, repeat the calibration by pressing the ENT button again. End the calibration procedure by pressing the CL button twice. This brings the following text on the display:

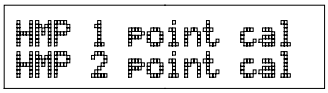



You have now completed the calibration; switch off the HMI38.

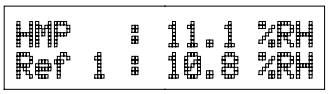
If the calibration fails (e.g. after an attempt of gain calibration below 50 %RH), an error message appears and no correction factor is stored into the HMP230:


### 8.2.2. Two point calibration

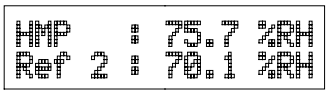
The HMI38 displays:



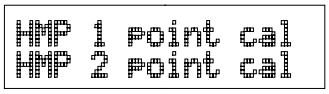

- Select two-point calibration using arrow keys and press ENT. The readings at the first humidity point appear on the display, e.g.:




- Wait until the readings have stabilized and press ENT. The instrument stores the correction at the first point and readings at the second humidity point appear:




- Wait again until the readings have stabilized and press ENT. The instrument stores the correction at the second point. End the calibration procedure by pressing the CL button twice. This brings the following text on the display:




- Switch off the HMI38.

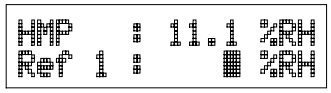
If the calibration fails, an error message appears on the display and no correction factors are stored to the HMP230.


Two point calibration fails e.g. if the reference humidities at the first and the second point differ less than 50 %RH of each other.

#### 8.2.2.1. Two point calibration with reference salts

You can also give the reference humidities of the two point calibration manually (using the HMI38 as a display only). Insert the probe of the HMP230 into the low humidity bath. Follow the procedure of the two point calibration.

- When the humidities at the first calibration point appear on the display, press CL:




- Enter the reference humidity with numeric keys and press ENT.
- Insert the probe into the high humidity bath and repeat the procedure. The correction factors are now stored to the HMP230. End the calibration procedure by pressing the CL button twice. Switch off the HMI38.

### 8.3. HMD/W 20/30 and HMP130Y series transmitters

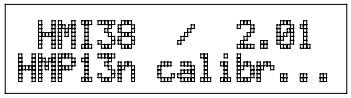
Use probe 1 as a reference measurement probe. Connect the D-connector of the reference connection cable to the connector of probe 2 in the HMI38. Connect the other connector of the cable to the test connector in the transmitter to be calibrated (refer to the transmitter manual for details). The connectors fit in one direction only.

**NOTE**

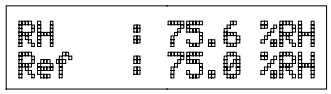
When you calibrate a transmitter with current output, terminate the output loop.

Make sure that the sensors of the transmitter and the reference probe are close to each other. If you are calibrating a duct type transmitter, push the probe through the support piece into the ready-made hole in the duct.

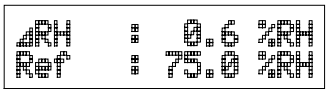
When the power of the HMI38 is off, press and hold down the NUMBER 1 button. Press the ON/OFF button and release it; keep the NUMBER 1 button still pressed. When the programme type and version appear on the display, release also the NUMBER 1 button. The following appears on the display:




The humidity readings of the transmitter and the reference probe appear on the display:



You can change the display to show the difference between the transmitter and reference reading by pressing ENT; the reference reading appears on the second line:




You can change the display mode between these two modes by pressing the ENT button. You can make adjustments adjustment in all display modes. The potentiometer used for adjusting the transmitter varies depending on the transmitter type and the humidity level in which you perform the calibration (see the transmitter manual).

HMW20/30 UB/YB (wall mount transmitters):

- use the "DRY" or one-point calibration trimmer potentiometer (see the sticker inside the transmitter cover)

HMD20/30 UB/YB (duct mount transmitters):

- if the reference humidity is below 65 %RH use the "DRY" trimmer potentiometer
- if the reference humidity is above 65 %RH use the "WET" trimmer potentiometer

HMP130Y series:

- if the reference humidity is below 65 %RH use the trimmer potentiometer R5 (offset)
- if the reference humidity is above 65 %RH use the trimmer potentiometer R18

Wait until the readings stabilize and adjust the transmitter reading to correspond to the reference reading or adjust the difference reading to zero. Turn the power of the HMI38 off and on again to return to normal operation.

# 9. MAINTENANCE

## 9.1. Reference measurements

Reference measurements help to verify whether the instrument readings are within specifications. This way the user can check if the probe or the indicator needs calibration or service.

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

Whatever technique is used, make sure that the reference instrument and the instrument to be checked are at the same temperature in order to avoid errors caused by temperature differences. The reference measurements are most accurate when made in laboratories where the conditions are stable. Make the reference measurement as close to the sensor to be checked as possible and read the readings simultaneously, when possible.

## 9.2. Self-diagnostics

The HMI38 goes through a self-diagnostics procedure when the power is switched on. If the procedure does not reveal any errors or faults, the instrument the normal operation. If the procedure finds errors or faults, check first that the probes are connected, the initialization of the probes is correct and the humidity and temperature sensors are not damaged. If errors still appear, follow the troubleshooting instructions in Appendix 3 to find out whether the fault is in a probe or the HMI38. Send the faulty instrument to Vaisala or a Vaisala representative for repairs.

If any errors occur during operation, the error messages appear on the LCD display if the instrument displays measurements; if the menus are in use, error messages do not appear. During operation, however, the error messages will not output automatically through the serial interface. If there is any reason to doubt that there is something wrong with the instrument, use command ERRS:

**ERRS <cr>**

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

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

When errors have occurred, the instrument outputs the error code (see Appendix 3 for all error messages):

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

### 9.3. Adjusting the contrast of the display

Adjust the contrast of the display with the trimmer R9 "CONTRAST". Release the six screws at the bottom of the HMI38 and remove the top cover of the indicator body. The trimmer is located at the front end of the main board.

## 10. TECHNICAL DATA

### 10.1. Relative humidity

| | |
|---|---|
| Measuring range | 0...100 %RH |
| Accuracy (at +20°C) | 0.1 %RH (for overall system accuracy see probe specifications in Appendix 4, 5 or 6) |
| Resolution | 0.1 %RH |
| Temperature dependence over the entire operating temperature range | ±0.2 %RH |

### 10.2. Temperature

| | |
|---|---|
| Measuring range | -40...+120 °C (depending on the probe used, see Appendices 4, 5 and 6) |
| Accuracy (error caused by HMI38 at +20°C) | ±0.1°C |
| Resolution | 0.1°C |
| Typical temperature dependence of electronics | 0.004 °C/°C |

### 10.3. Calculated quantities

| | | |
|---|---|---|
| Widest ranges (depending on the probe used) | dewpoint temperature | -40...+100 °C |
| | mixing ratio | 0...500 g/kg dry air |
| | absolute humidity | 0...600 g/m$^3$ |
| | wet bulb temperature | 0...+100 °C |

Accuracies of the calculated quantities depend on the accuracies of the measured quantities; see Appendices 4, 5 or 6 for more details.

## 10.4. Data logging

| | |
|---|---|
| Storage capacity: | |
| continuous mode | 254 measurements per probe |
| catch mode | 127 measurements per probe |
| Logging interval | from 10 s to 99 h |

## 10.5. Analogue outputs

| | |
|---|---|
| Two analogue outputs | |
| ranges | 0...1 V and 0...5 V (freely adjustable between 0...5 V) |
| Typical accuracy of analogue output at +20 °C | ±0.05 % full scale |
| Typical temperature dependence of analogue output | 0.005 %/°C full scale |

## 10.6. Serial interface

| | |
|---|---|
| Serial port types (only one usable at a time) | RS 232C and RS 485 |
| Communication parameters | |
| bauds | 300, 600, 1200, 2400, 4800, 9600 |
| data bits | 7 or 8 |
| stop bits | 1 or 2 |
| parity | even, odd or none |
| mode | full or half duplex |
| Connector | D-type female D9S |
| Data format | ASCII characters |

## 10.7. Electronics

| | |
|---|---|
| Display | 2 x 16 character alphanumeric high-contrast, wide view angle LCD |
| character height | 3.85 mm (0.15") |
| Keyboard | 4 x 4 tactile membrane switches |
| Probes (max. 2) | HMP35E, HMP36E or HMP37E (with some modifications also HMP35B or HMP36B - type changes into BM) |

| | |
|---|---|
| Rechargeable battery pack | 8 NiCd 1.2 V cells, standard 'AA' cell size |
| Battery operating time in | |
| continuous use | 8 hours |
| data-logging mode | 24 hours |
| charging time | 6 hours |
| Supply voltage | 12 VDC (11...16 VDC), 0.2 A |
| Power consumption during charge | 3 W maximum |
| Recommended external load for 0...1 V voltage output | >2 kΩ (to ground) |
| Recommended external load for 0...5 V voltage output | >10 kΩ (to ground) |
| Operating temperature (electronics) | 0...+50 °C |
| Storage temperature range | -20...+70 °C |
| Operating humidity range | 95 %RH maximum, non-condensing |
| Storage humidity range | 90 %RH maximum |

## NOTE

The operating humidity range is higher than the storage humidity range because the air in a warm instrument has a lower relative humidity than the ambient air.

### 10.8. Mechanics

| | |
|---|---|
| Housing material | ABS plastic |
| Housing dimensions (h x w x l) | 90 x 200 x 295 mm |
| Accessories | optional carrying case |
| Weight | 1090 g |

## 10.9. Electromagnetic compatibility

### 10.9.1. Emissions

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

### 10.9.2. Immunity

| Test: | Setup according to: | Performance: |
|---|---|---|
| Electrostatic discharge | EN61000-4-3:1995 | criteria B |
| Electrical fast transients | IEC 801-4:1988 | criteria B |
| RF-radiated fields | IEC 801-3:1984 | criteria A |
| * GSM field immunity<br>* (additional test) | ENV50204:1995 | criteria A |

Vibration IEC 68-2-6 Fc (0.15 mm/10...500 Hz/2 g/20 sweep cycles)

CE

# 11. ACCESSORIES AND SPARE PARTS

| Order code | Description |
|---|---|
| 18326 | Carrying case |
| 17371 | AC adapter for 230 VAC with EURO plug |
| 18100ZZ | Connection cable for the calibration of HMD/W20/30 and HMP130Y series transmitters |
| 18200ZZ | Connection cable for the calibration of HMP230 transmitters |
| 18300ZZ | Connection cable for the calibration of HMD/W60/70 and HMP140 series transmitters |
| 0606 | Rechargeable 1.2 V NiCd battery<br>must be ordered in batches of 8 pcs |
| HMP35E | Humidity and temperature probe for general measurement |
| HMP36E | Humidity and temperature probe for measurement of granulates and concrete |
| HMP37E | Humidity and temperature probe for tight or remote places or high temperatures (5 m cable) |

# Appendix 1: Serial commands

# 1. GENERAL

After start up, the instrument outputs the name and version of the programme if it is in STOP mode:

```
HMI38 / 1.01
>
```

Before the output above some error messages may also appear on the display. The error messages appear in all operational modes.

```
E00 internal ram error
E01 external ram error
E02 CPU timer 0 error
E03 CPU timer 1 error
E04 CPU timer 2 error
E05 CPU PCA ...
...
```

The commands function as described when the serial interface is in full-duplex mode and echo is on. When entering commands note that:

- you can use both capital and small letters
- number format is free:
  - zeros in front of a number are allowed (00001234)
  - zero before decimal point is not necessary (.12345, -.678)
  - exponential format can be used (-.345E-3, 1000.23456e0007)
- <ESC>
  - in command line interrupts the command entry
  - in parameter entry line usually interrupts the command execution (with some exceptions)
- <CR>
  - ends the command line
  - in parameter entry line keeps the old parameter value valid
- <LF>
  - has no effect

# 2. ANALOGUE OUTPUT COMMANDS

## 2.1. AMODE Setting the analogue outputs

**AMODE a.aaa b.bbb c.ccc d.ddd <cr>**

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

Sets the voltage scale of the analogue outputs on channels 1 and 2 to any value between 0...5 V.

Example: Voltage output on channel 1 is set to 0...1 V and on channel 2 to 2...5 V:

```
>AMODE 0 1 2 5 <cr>
Ch1  0.000 ...    1.000 V
Ch2  2.000 ...    5.000 V
```

The current settings can be checked by entering AMODE without parameters

```
>AMODE <cr>
Ch1  0.000 ...    1.000 V
Ch2  2.000 ...    5.000 V
```

## 2.2. ASEL Selecting and scaling the analogue output quantities

**ASEL xxx yyy <cr>**

| | | |
|---|---|---|
| xxx | = | quantity of channel 1 (RHn, Tn, Tdn, An, Xn or Twn) |
| yyy | = | quantity of channel 2 (RHn, Tn, Tdn, An, Xn or Twn) (n = 1 or 2) |

Example: Relative humidity of probe 1 is to be output on channel 1 and temperature of probe 2 on channel 2; the temperature range is scaled to be 0...100 °C:

```
>ASEL RH1 T2 <cr>
Ch1      ( RH1 )    lo        0.000 %RH   ? <cr>
Ch1      ( RH1 )    hi        100.000 %RH ? <cr>
Ch2      ( T2 )     lo        -40.000 'C  ? 0 <cr>
Ch2      ( T2 )     hi        160.000 'C  ? 100 <cr>
>
```

If ASEL is entered without parameters the instrument outputs its current settings:

```
>ASEL <cr>
Ch1      ( RH1 )    lo        0.000 %RH   ? <cr>
Ch1      ( RH1 )    hi        100.000 %RH ? <cr>
Ch2      ( T2 )     lo        0.000 'C    ? <cr>
Ch2      ( T2 )     hi        100.000 'C  ? <cr>
>
```

The outputs and their scales can also be given directly in the command line

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

| | | |
|---|---|---|
| xxx | = | quantity of channel 1 |
| yyy | = | quantity of channel 2 |
| 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 |

Example:

```
>ASEL RH1 T2 0 100 -40 160 <cr>
Ch1      ( RH1)    lo          0.000 %RH
Ch1      ( RH1)    hi          100.000 %RH
Ch2      ( T2 )    lo          -40.000 'C
Ch2      ( T2 )    hi          160.000 'C
>
```

## 2.3. ASCL Scaling the analogue outputs

**ASCL <cr>**

Scales the outputs selected on channels 1 and 2 (almost the same as ASEL but for scaling only).

Example: Scaling relative humidity on the range of 0...100 %RH and temperature -40...+160 °C

```
>ASCL <cr>
Ch1      ( RH1 )   lo          20.000 %RH  ? 0 <cr>
Ch1      ( RH1 )   hi          90.000 %RH  ? 100 <cr>
Ch2      ( T2 )    lo          0.000 'C    ? -40 <cr>
Ch2      ( T2 )     hi         100.000 'C  ? 160 <cr>
>
```

The output scales can also be given directly in the command line:

**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 |

Example: Relative humidity is scaled to 0...100 %RH on channel 1 and temperature to -40...+100 °C on channel 2

```
>ASCL 0 100 -40 100 <cr>
Ch1      ( RH1 )  lo       0.000 %RH
Ch1      ( RH1 )  hi     100.000 %RH
Ch2      ( T2 )   lo     -40.000 'C
Ch2      ( T2 )   hi     100.000 'C
>
```

# 3. CALIBRATION COMMANDS

## 3.1. CT Linear temperature calibration

With this command the instrument can be calibrated against an accurate reference, such as a Pt 100 simulator.

**CT n <cr>**

n = probe (1 or 2)

If the necessary corrections in two points are known the command can also be given as:

**CT n aa.aa bb.bb cc.cc dd.dd <cr>**

where: n = probe (1 or 2)
aa.aa = first point
bb.bb = first point correction
cc.cc = second point
dd.dd = second point correction

Examples: Two-point calibration for probe 1:

```
>CT 1 <cr>
T1  :  0.9    Ref1 ?        0 <cr>
Press any key when ready ...
T1 :  119.8   Ref2 ?        120 <cr>
>
```

One-point offset correction for probe 2 (<cr> is given after Ref2):

```
>CT 2 <cr>
T2  :  25.9    Ref1 ?       26 <cr>
Press any key when ready ...
T2  :  25.9    Ref2 ?       <cr>
>
```

When the required corrections are known, the calibration can be done as follows:

```
>CT 1  0.9 -0.9  119.8 0.2 <cr>

>CT 2  25.9 0.1 <cr>
```

The progress of the sensor temperature stabilization can be followed by entering * <*cr*> at Ref1 or Ref2.

```
>CT 1 <cr>
T1  :  0.80    Ref1 ?       * <cr>
T1  :  0.40    Ref1 ?       0.00 <cr>
Press any key when ready ...
T1  :  56.20   Ref2 ?       55.0 <cr>
>
```

## 3.2. ACAL Calibrating the analogue outputs

**ACAL <cr>**

Calibrates the outputs selected on channels 1 and 2. Both channels are calibrated at the same time. The output is measured using a voltage meter and the measured voltage value is entered as a calibration coefficient.

Example: Calibrating the outputs (0...1 V signal selected on both channels using AMODE )

```
>ACAL <cr>
Ch1 U1 ( V ) ? 0.123 <cr>
Ch1 U2 ( V ) ? 0.998 <cr>
Ch2 U1 ( V ) ? 0.120 <cr>
Ch2 U2 ( V ) ? 0.998 <cr>
>
```

Calibration can be tested with UTEST.

## 3.3. L Outputting linear correction coefficients

**L <cr>**

With the L command the user can check the linear correction coefficients of the temperature output.

```
>L <cr>
T1 offset:    0.000
T1 gain  :    1.000
T2 offset:    0.000
T2 gain  :    1.000
>
```

## 3.4. LI Entering linear correction coefficients

**LI <cr>**

The LI command is one way to calibrate the temperature measurement.

Example:

```
>LI <cr>
T1 offset: 0.000  ? <cr>
T1 gain  : 1.000  ?  .8 <cr>
T2 offset: 0.000  ? <cr>
T2 gain  : 1.000  ?  1.1 <cr>
>
```

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

# 4. OUTPUT VIA THE SERIAL BUS

## 4.1. R Starting the measurement output

**R <cr>**

Starts outputting the measurements to peripheral devices (PC display or printer).

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 format can be changed with command FORM and the output interval with command INTV.

### 4.1.1.1. S Stopping the measurement output

**S<cr>**

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

### 4.1.1.2. SEND Outputting a reading once

**SEND <cr>**

in STOP mode

or

**SEND aa <cr>**

in POLL mode

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

Outputs the current measurement readings of probe 1 (first line) and probe 2 (second line) with variables in the order of RH, T, $T_d$, a, x and $T_w$ (factory setting).

The output format can be changed with command FORM.

## 4.2. ERRS Outputting error messages

**ERRS <cr>**

During operation error messages are not output automatically. If there is any doubt of an error in the instrument operation, possible error messages can be output with ERRS command.

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
>
```

## 4.3. ECHO Setting serial line echo ON/OFF

**ECHO xxx <cr>**

xxx = ON or OFF

When the echo is off neither the commands given to the serial bus nor the prompt > are visible on the display.

When the serial line is **in half-duplex mode, the echo is always off**, even though the ECHO command would indicate that echo is on.

## 4.4. INTV Setting the output interval for RUN mode

**INTV xxx yyy <cr>**

xxx = output interval (0...255)
yyy = unit (s, min or h)

Sets the output interval for RUN mode and command R. If the interval is set to zero (s, min or h) the output interval will be determined only by the frequency of measurements.

Examples: Outputting the currently valid settings

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

Changing interval to 10 minutes

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

Changing unit to seconds

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

Changing both value and unit at the same time (e.g. to 1 hour)

```
>INTV 1 H <cr>
Output intrv. :  1 h
```

## 4.5. FORM Setting the output format

**FORM zzz...zzz <cr>**

or

**FORM <cr>**

**xxx...xxx**

**? zzz...zzz <cr>**

xxx...xxx = old format (blank = factory format)
zzz...zzz = new format

The FORM command sets the format of the outputs generated in RUN mode and after the SEND command. Output variables are selected by variable name and the number of the measuring probe.

| | |
|---|---|
| RH*n* | relative humidity |
| T*n* | temperature |
| Td*n* | dewpoint temperature |
| A*n* | absolute humidity |
| X*n* | mixing ratio |
| Tw*n* | wet bulb temperature |

where *n* is the number of the probe (RH1 = relative humidity of probe 1, T2 = temperature of probe 2 etc.)

Other texts to appear in the output are given between inverted commas ("). In front of the output variable the number format is given by

```
<full digits>.<decimal digits>
```

for example 3.2, 2.1 etc. (max. 9.9).

Unit is given by

```
Un
```

where n specifies the number of characters (max. 5), e.g. U3.

Other parameters are:

| | |
|---|---|
| \n or #n | line feed <lf> |
| \r or #r | carriage return <cr> |
| \t or #t | horizontal tabulation <ht> or <tab> |
| \nnn or #nnn | ASCII-code nnn |
| TIME | current time (HH:MM:SS) |
| DATE | current date (YYYY-MM-DD) |

If the input line is too short the command parameter entry can be continued in the following line by entering:

```
&  <cr>.
```

Some examples:

command: `>FORM  "rh1: " 3.2  RH1  "  %RH" \r \n<cr>`
output: rh1:  29.62 %RH<cr><lf>

command: >FORM "RH: " 2.2 RH1 U1 \r \n<cr>
output: RH: 29.62%<cr><lf>

command: >FORM date " " time #t RH1 #t T1 #r #n<cr>
output: 1994-09-29 10:02:15 <tab> 29.6 <tab> 24.3 <cr><lf>

command: FORM "rh: " 2.2 RH2 " " U3 & <cr> (line continued in the following line)
" t: " 2.2 T2 " " U2 #r #n<cr>
output: rh: 29.62 %RH t: 25.35 °C <cr><lf>

The factory format can be recovered by:

```
>FORM * <cr>
```

## 4.6. LFORM Setting the output format for data logging

**LFORM zzz...zzz <cr>**

or

**LFORM <cr>**

**xxx...xxx**

**? zzz...zzz <cr>**

xxx...xxx = old format (blank = factory format)
zzz...zzz = new format

Functionally similar to the FORM command except that this format is effective only for the output of the logged data. The factory format can be recovered by: `>LFORM * <cr>`

## 4.7. LOG Data logging

**LOG xxx aa bb cc dd <cr>**

xxx = functional mode (ON, OFF or P)
aa = logging start delay
bb = delay unit (h, min, s)
cc = logging interval
dd = interval unit (h, min, s)

Examples: Start logging and continue with intervals of 10 min

```
>log on 10 min <cr>
Data logging is ON
      Delay to start :     0 s
      Interval       :    10 min
      First data stored:  0000-00-00 00:00:00
      Number of loggings   :     0
```

Start logging after five hours and continue with intervals of 30 min

```
>log on 5 h 30 min <cr>
Waiting for the start of logging
      Delay to start :     5 h
      Interval       :    10 min
      First data stored:  ????-??-?? ??:??:??
      Number of loggings   :     0
```

End logging

```
>log off <cr>
Data logging is ended
      Delay to start :     0 s
      Interval       :    10 min
      First data stored:  1994-10-18 13:45:55
      Number of loggings :      1
```

Output the logged data (defined by LFORM command)

```
>log p <cr>
Data logging is ended
      Delay to start :     0 s
      Interval       :    10 min
      First data stored:  1994-10-18 13:45:55
      Number of loggings :      1

      18.1  23.5  -2.1   3.0   3.2  11.3
      15.7  23.0  -4.4   3.2   2.7  10.6
```

## 4.8. 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)

New settings are effective only after reset.

Examples: Outputting the current settings

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

Giving new settings

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

>SERI 600 N 8 2 F <cr>        changing all parameters
600 N 8 2 FDX
```

The processor does not allow the following combinations:

- no parity, 7 data bits, 1 stop bit: if this combination is given the HMI38 programme changes 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

If half-duplex setting is used with the RS 485 bus, it will automatically turn the echo off. Even then the ECHO command can indicate that echo is on.

## 4.9. UNIT Selecting the output units

**UNIT x <cr>**

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

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

Example: Outputting the current setting

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

Setting the non-metric units

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

## 4.10. ADDR Setting the address

**ADDR aa <cr>**

aa = address (0...99)

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

Example Transmitter is given an address 99

```
>ADDR <cr>
Address  :    0 ?  99 <cr>
```

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

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

## 4.11. RESET Resetting the instrument

**RESET <cr>**

All settings that have been changed stay in the memory even after reset or power failure. There are some exceptions which are pointed out in the corresponding command description.

## 4.12. Operation modes

### 4.12.1. SMODE Setting the serial interface

**SMODE xxxx<cr>**

xxxx = STOP, RUN or POLL

In STOP mode: data is output only after commands R or SEND, all commands are functional, '>' prompt is output if ECHO is ON

In RUN mode: outputting is automatic after RESET, only command S is functional

In POLL mode: data is output only after command SEND, exiting POLL mode is made by

>OPEN aa <cr>
>SMODE xxx<cr>

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

The OPEN command sets the bus temporarily to STOP mode and a new SMODE command can be given.

Examples:

```
>SMODE <cr>                 asking for the current mode
Serial mode     : STOP

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

### 4.12.2. OPEN & CLOSE

**OPEN nn <cr>**

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

**CLOSE <cr>**

In STOP mode: OPEN has no effect, CLOSE sets the serial bus temporarily to the POLL mode (mode is not stored into the memory, after reset bus is again in STOP mode)

In POLL mode: OPEN sets the serial bus temporarily to STOP mode, CLOSE sets the bus back to POLL mode

The temporary mode changes are not stored in the memory of the transmitter; after reset the bus is in its original mode.

When more than one instrument is connected to the same serial bus, the POLL mode enables communication with an individual instrument.

Example: Transmitter 2 is temperature calibrated (currently in POLL mode)

```
>OPEN 2 <cr>            this line is not visible on the screen
HMI 2 line opened for operator commands
     >CT <cr>
     ...                calibration procedure
>CLOSE <cr>
line closed
```

# 5. OTHERS

## 5.1. UTEST Testing the analogue outputs

**UTEST <cr>**

or

**UTEST a.aaa b.bbb <cr>**

a.aaa = voltage of channel 1
b.bbb = 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 from the analogue outputs using a voltage meter. The UTEST command gives six output parameters of which the first two show the voltage of channels 1 and 2 in V. The other four contain information for service purposes only.

Examples: Reading the channel outputs and parameters

```
>utest <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

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

Releasing the forced control and reading the outputs

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

## 5.2. INIT Setting the probe types

**INIT xxxxx yyyyy <cr>**

xxxxx = type of probe 1 (HMP35E, HMP36E, HMP37E,
yyyyy = type of probe 2 HMP35BM, HMP36BM, NONE)

Examples: Probe 1 HMP35E, probe 2 not connected

```
>init hmp35e none <cr>
      PRB 1: HMP35E
          2: None
```

Outputting the current settings

```
>init <cr>
      PRB 1: HMP35E
          2: None
```

## 5.3. MTIM Setting the measurement integration time

**MTIM nnn <cr>**

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

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

Examples: Outputting the current integration time

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

Setting a new time

```
>MTIM <cr>
Mtim          :    4 ? 16 <cr>
>
```

or alternatively

```
>MTIM 16 <cr>
Mtim          :    16
>
```

## 5.4. FILT Setting the filtering mode

**FILT xxx <cr>**

xxx = ON or OFF

The FILT command is used to set an additional numerical filtering mode. If the FILT mode is on an average of the four last measurements is output.

Examples: Outputting the current mode

```
>FILT <cr>
filter   :    OFF
>
```

Changing the mode

```
>FILT ON <cr>
filter   :    ON
>
```

## 5.5. PRES Setting the pressure value

**PRES pppp.p <cr>**

pppp.p = pressure (hPa)

The atmospheric pressure has an effect on mixing ratio and wet bulb temperature calculations. Therefore accurate values can be achieved only when the ambient pressure is taken into account.

Examples: Outputting the current value and giving a new one

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

Entering new value in the command line

```
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.

## 5.6. XPRES Setting the pressure value temporarily

**XPRES pppp.pp <cr>**

pppp.pp = pressure (hPa)

The function and format of XPRES are the same as those of the PRES command. However, using XPRES the setting is valid only until a RESET is given, power is turned off or pressure is set to zero using XPRES. After these the pressure stored using PRES command is valid again.

## 5.7. CDATE Storing calibration date

**CDATE xxxxxxx <cr>**

xxxxxxx = calibration date (max. 7 digits or a character A...Z + max. 6 digits)

CDATE enables storage of the last calibration date (given by the user). The date can be entered in any format (e.g. yymmdd).

Examples: Outputting the previous calibration date

```
>CDATE <cr>
Cal. date     : 940420
```

Entering new calibration date

```
>CDATE 941018 <cr>
Cal. date     : 941018
```

## 5.8. DATE Setting the date

**DATE <cr>**

Example: entering a new date

```
>DATE <cr>
Current date is 1993-01-30
Enter new date (yyyy-mm-dd) : 1994-06-12 <cr>
>
```

By entering only <cr> the current date remains valid. After reset the current date is "1994-01-01".

## 5.9. TIME Setting the time

**TIME <cr>**

Example: entering a new time

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

By typing only <cr> the current time remains valid. After reset the current time is "00:00:00".

## 5.10. VERS Name and version of the programme

**VERS <cr>**

Example:

```
>VERS <cr>
HMI38 / 1.01
```

1.01 is the programme version

## 5.11. ? Outputting the instrument settings

**? <cr>**

Example:

```
>? <cr>
HMI38 / 1.01
CPU serial nr :  N4220089
Address       :  7
Output units  :  metric
Baud P D S        :  4800 E 7 1 FDX
Serial mode       :  STOP
Output intrv. :  0 s
Mtim              :  16
Pressure      :  1013.25
Analog outputs
 Ch1   0.00 ...  1.00 V
 Ch2   0.00 ...  1.00 V
 Ch1  ( RH1 ) lo 0.000 %RH
 Ch1  ( RH1 ) hi 100.000 %RH
 Ch2  ( T1  ) lo -20.000 'C
 Ch2  ( T1  ) hi 60.000 'C

Analog input hybrid :
Serial no.        :  9442
Calibr. date  :   941018
```

## 5.12. ?? Outputting the instrument settings also in POLL mode

**?? <cr>**

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

## 5.13. AOFF Automatic shutdown

**AOFF xxx nnn <cr>**

where xxx = time (0...255) or OFF
nnn = unit (s, min or h)

This command sets the time after which the instrument turns the power off if no command has been given by the user (minimum time 60 s).

### NOTE

Automatic shutdown is not effective during e.g. data logging and calibration.

Examples: Asking for the current setting

```
>aoff <cr>
Auto shut off :   OFF
```

Setting a new time

```
>aoff 10 min <cr>
Auto shut off :   10 min
```

Switching off the automatic shutdown

```
>aoff off <cr>
Auto shut off :   OFF
```

# APPENDIX 2: ERROR MESSAGES

# 1. TROUBLE SHOOTING

The HMI38 goes through a self-diagnostics procedure when the power is switched on. When the procedure does not reveal any errors or faults, the instrument starts operating normally. If errors or faults are found, the instrument outputs an error message.

## 1.1. Error messages E41...E4B:

- check the initialization of the probe locations; error messages can be cleared by pressing the ENT button (several times)

## 1.2. Error messages E21, E22, E24:

- if these messages appear repeatedly, send the HMI38 unit to service

## 1.3. Error messages E41...E49:

- a possible fault in temperature channel in either the probe or the HMI38 unit
- if possible, check the operation of the temperature measurement by connecting another probe to the same HMI38 probe location; if the error messages continue to appear the HMI38 unit needs service, if not the fault is in the probe

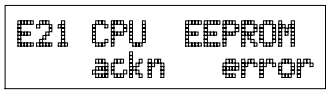
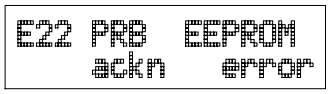
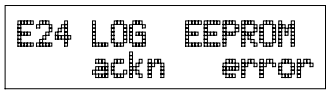
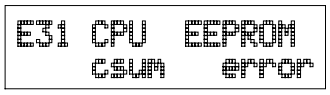
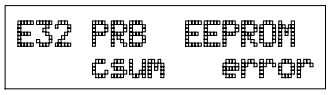
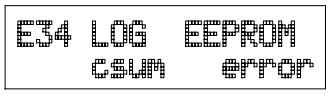
## 1.4. Error messages E4A, E4B, E54, E55:

- a possible fault in humidity channel in either the probe or the HMI38 unit
- if possible, check the operation of the humidity measurement as described above for temperature measurement in order to locate the fault into either the probe or the HMI38 unit

# 2. LIST OF ERROR MESSAGES

A list of the error messages of HMI38 is given in the following. The error messages can be divided into two groups: error messages after reset and error messages during operation.

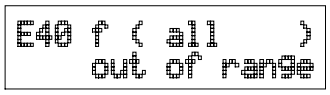
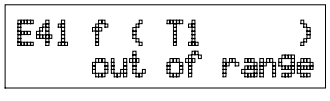
## 2.1. Errors after reset

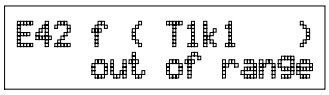
| Display: | Serial bus: |
|---|---|
|  | E21 CPU EEPROM ackn. error |
|  | E22 PRB EEPROM ackn. error |
|  | E24 LOG EEPROM ackn. error |
|  | E31 CPU EEPROM csum error |
|  | E32 PRB EEPROM csum error |
|  | E34 LOG EEPROM csum error |

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

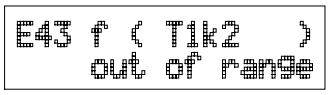
## 2.2. Errors during operation

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

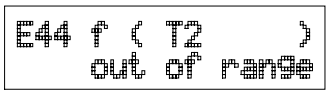
| Display: | Serial bus: |
|---|---|
|  | E40 f ( all ) out of range |
|  | E41 f ( T1 ) out of range |



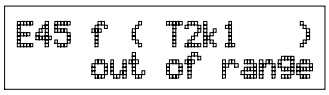

E42 f ( T1k1 ) out of range



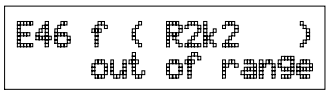

E43 f ( T1k2 ) out of range



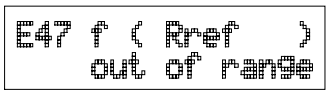

E44 f ( T2 ) out of range



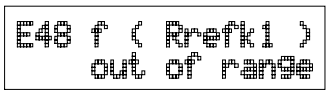

E45 f ( T2k1 ) out of range



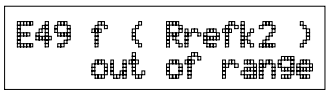

E46 f ( R2k2 ) out of range



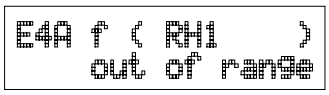

E47 f ( Rref ) out of range



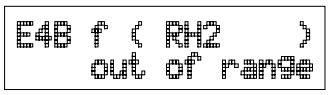

E48 f ( Rrefk1 ) out of range



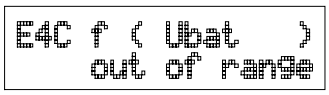

E49 f ( Rrefk2 ) out of range



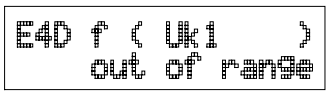

E4A f ( RH1 ) out of range



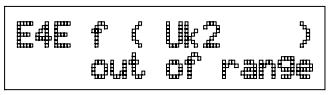

E4B f ( RH2 ) out of range




E4C f ( Ubat ) out of range

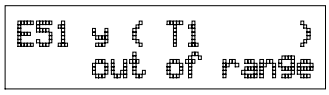
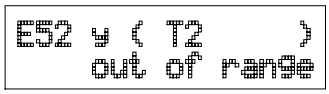
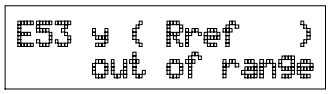
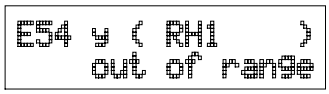
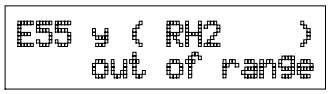
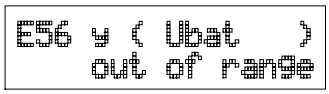



E4D f ( Uk1 ) out of range




E4E f ( Uk2 ) out of range

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

| Display: | Serial bus: |
|---|---|
|  | E51 T1 y-value out of range |
|  | E52 T2 y-value out of range |
|  | E53 Rref y-value out of range |
|  | E54 RH1 y-value out of range |
|  | E55 RH2 y-value out of range |
|  | E56 Ubat y-value out of range |

# Appendix 3: HMP35E probe

# 1. GENERAL

The HMP35E probe is designed for the measurement of relative humidity and temperature. The probe can be used with Vaisala's HMI38 humidity data processor. The probe comes equipped with a connector which can be inserted in the connector on the back panel of the HMI38.

# 2. CALIBRATION AND MAINTENANCE

Check and calibrate the HMP35E probe at regular intervals which depend on the operating conditions and accuracy desired, but at least once a year. You can perform a one point calibration for the probe. If the humidity during calibration is below 65 %RH, make the adjustment using potentiometer "DRY"; if the humidity is above 65 %RH, make the adjustment using potentiometer "WET". Use Vaisala's calibrated humidity meters as a reference.

If a more accurate two-point calibration is required, use the HMK15 or the HMK13B Humidity Calibrator and saturated lithium chloride and sodium chloride salt solutions (LiCl, NaCl). Ajdust the probe first at the dry end and then at the wet end with trimmer potentiometers DRY and WET which are located under a snap-off cover in the probe handle. See calibrator manuals for more detailed calibration.

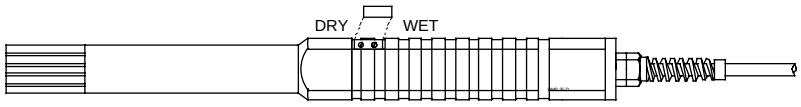



**Figure 2.1 Calibration potentiometers**

## 2.1. Changing the HUMICAP® sensor

Remove the damaged sensor and mount a new one in its place. Handle the sensor with care. Calibrate the probe using a two-point calibration procedure.

## 2.2. Chemical tolerances of the HUMICAP®K-sensor

Long-term exposure of the HUMICAP® sensor to certain chemicals and gases may affect the characteristics of the sensor and shorten its life. The following table gives the recommended maximum ambient concentrations of some chemicals:

| | ppm (typ.) |
|---|---|
| Organic solvents | 1000...10 000 |
| Aggressive chemicals (e.g. strong acids such as $SO_2$, $H_2SO_4$, $H_2S$, HCl, $Cl_2$, etc.) | 1...10 |
| Weak acids | 100...1000 |
| Bases | 10 000...100 000 |

Detailed information on allowed concentrations can be requested from Vaisala representatives.

# 3. SPARE PARTS AND ACCESSORIES

| part no. | |
|---|---|
| HUMICAP®K | Humidity sensor |
| 10429 | Temperature sensor Pt 100 (1/3 DIN 43760B) |
| 15795 | Metallized grid |
| 16126HM | Membrane filter 0.2 µm |
| 6685 | Sintered filter 37 µm |
| 6686 | Sintered filter 216 µm |
| HMK15 | Humidity Calibrator |
| HMK13B | Humidity Calibrator |

# 4. TECHNICAL DATA

## 4.1. Relative humidity

Measurement range 0...100 %RH

Output signal 0.002...1 VDC (equals 0.2...100 %RH)

Accuracy (at +20 °C, unlinearity and repeatability included)

| | |
|---|---|
| best accuracy when compared to high-quality humidity standards | ±1 %RH |
| when calibrated with salt solutions | ±2 %RH (0...90 %RH)<br>±3 %RH (90...100 %RH) |

Temperature dependance of electronics (humidity sensor is temperature compensated by software) ±0.04 %RH /°C

Typical long-term stability better than 1 %RH per year

Response time (+20 °C, 90 % response) 5 s with metallized grid
15 s with membrane filter

| | |
|---|---|
| Humidity sensor | HUMICAP®K-sensor |

## 4.2. Temperature

| | |
|---|---|
| Measurement range | |
| continuous measurement | -40...+60 °C |
| short-term measurement | -40...+80 °C |
| Temperature sensor | Pt 100 (IEC 751 1/3 Class B), four wire connection |

## 4.3. Calculated quantities

Dewpoint temperature, mixing ratio, absolute humidity and wet bulb temperature can be calculated from measured humidity and temperature values. The accuracy of the calculated quantities depends on the calibration of the probe and on how correctly the measurement is performed.

The following tables give accuracies of the calculated quantities with measurement accuracies for relative humidity ±2 %RH and for temperature ±0.2 °C (values in tables are also ± values).

**Accuracy of calculated dewpoint temperature (°C)**

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -20 | 2.18 | 1.19 | 0.88 | 0.72 | 0.62 | 0.56 | 0.51 | 0.48 | - | - |
| 0 | 2.51 | 1.37 | 1.00 | 0.81 | 0.70 | 0.63 | 0.57 | 0.53 | 0.50 | 0.48 |
| 20 | 2.87 | 1.56 | 1.13 | 0.92 | 0.79 | 0.70 | 0.64 | 0.59 | 0.55 | 0.53 |
| 40 | 3.24 | 1.76 | 1.27 | 1.03 | 0.88 | 0.78 | 0.71 | 0.65 | 0.61 | 0.58 |
| 60 | 3.60 | 1.96 | 1.42 | 1.14 | 0.97 | 0.86 | 0.78 | 0.72 | 0.67 | 0.64 |

**Accuracy of calculated mixing ratio (g/kg)**

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -20 | 0.017 | 0.018 | 0.019 | 0.021 | 0.022 | 0.023 | 0.025 | 0.026 | - | - |
| 0 | 0.08 | 0.09 | 0.09 | 0.10 | 0.10 | 0.11 | 0.11 | 0.12 | 0.13 | 0.13 |
| 20 | 0.31 | 0.33 | 0.35 | 0.37 | 0.39 | 0.41 | 0.43 | 0.45 | 0.47 | 0.49 |
| 40 | 0.97 | 1.03 | 1.10 | 1.17 | 1.24 | 1.31 | 1.38 | 1.46 | 1.54 | 1.62 |
| 60 | 2.68 | 2.91 | 3.16 | 3.43 | 3.72 | 4.04 | 4.38 | 4.75 | 5.15 | 5.58 |

**Accuracy of calculated absolute humidity (g/m$^3$)**

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -20 | 0.023 | 0.025 | 0.027 | 0.029 | 0.031 | 0.032 | 0.034 | 0.036 | - | - |
| 0 | 0.10 | 0.11 | 0.12 | 0.13 | 0.13 | 0.14 | 0.15 | 0.15 | 0.16 | 0.17 |
| 20 | 0.37 | 0.39 | 0.41 | 0.43 | 0.45 | 0.47 | 0.49 | 0.51 | 0.53 | 0.55 |
| 40 | 1.08 | 1.13 | 1.18 | 1.24 | 1.29 | 1.34 | 1.39 | 1.44 | 1.49 | 1.54 |
| 60 | 2.73 | 2.84 | 2.95 | 3.07 | 3.18 | 3.29 | 3.40 | 3.52 | 3.63 | 3.74 |

**Accuracy of calculated wet bulb temperature (°C)**

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -20 | 0.21 | 0.21 | 0.22 | 0.22 | 0.22 | 0.22 | 0.23 | 0.23 | - | - |
| 0 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 |
| 20 | 0.45 | 0.45 | 0.45 | 0.44 | 0.44 | 0.44 | 0.43 | 0.43 | 0.42 | 0.42 |
| 40 | 0.84 | 0.77 | 0.72 | 0.67 | 0.64 | 0.61 | 0.58 | 0.56 | 0.54 | 0.52 |
| 60 | 1.45 | 1.20 | 1.03 | 0.91 | 0.83 | 0.76 | 0.71 | 0.67 | 0.63 | 0.60 |

## 4.4. General

| | |
|---|---|
| Supply voltage | 7...35 VDC |
| Current consumption | $\leq$ 4 mA |
| Operating temperature range | -40...+60 °C |
| Sensor protection | |
| standard | chromium plated membrane filter (part no. 16126HM) |
| option | sintered filter 37 µm (part no. 6685)<br>sintered filter 216 µm (part no. 6686) |
| Housing classification | IP 55 (NEMA 3S) |
| Housing material | chromium plated ABS plastic |
| Connector | D-type male D9P |
| Cable length | 1500 mm |
| Weight | 180 g |

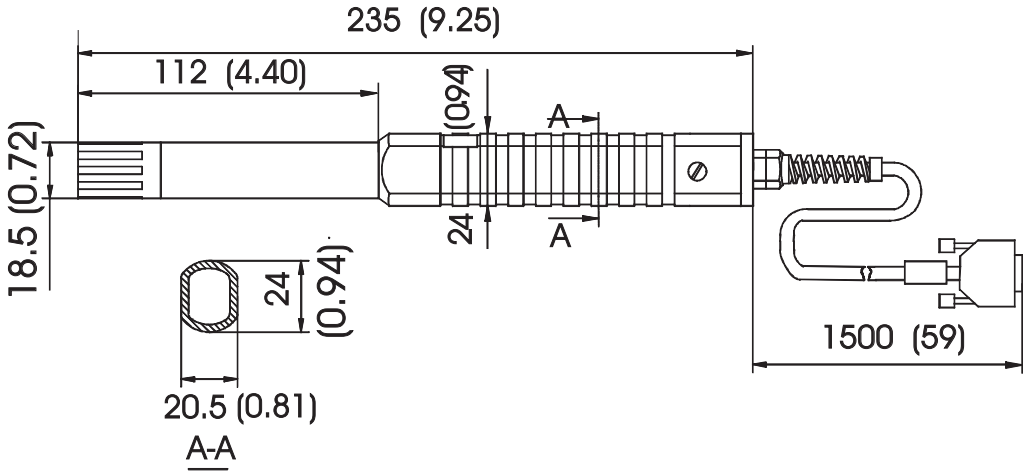



**Figure 4.1 Dimensions (in mm)**

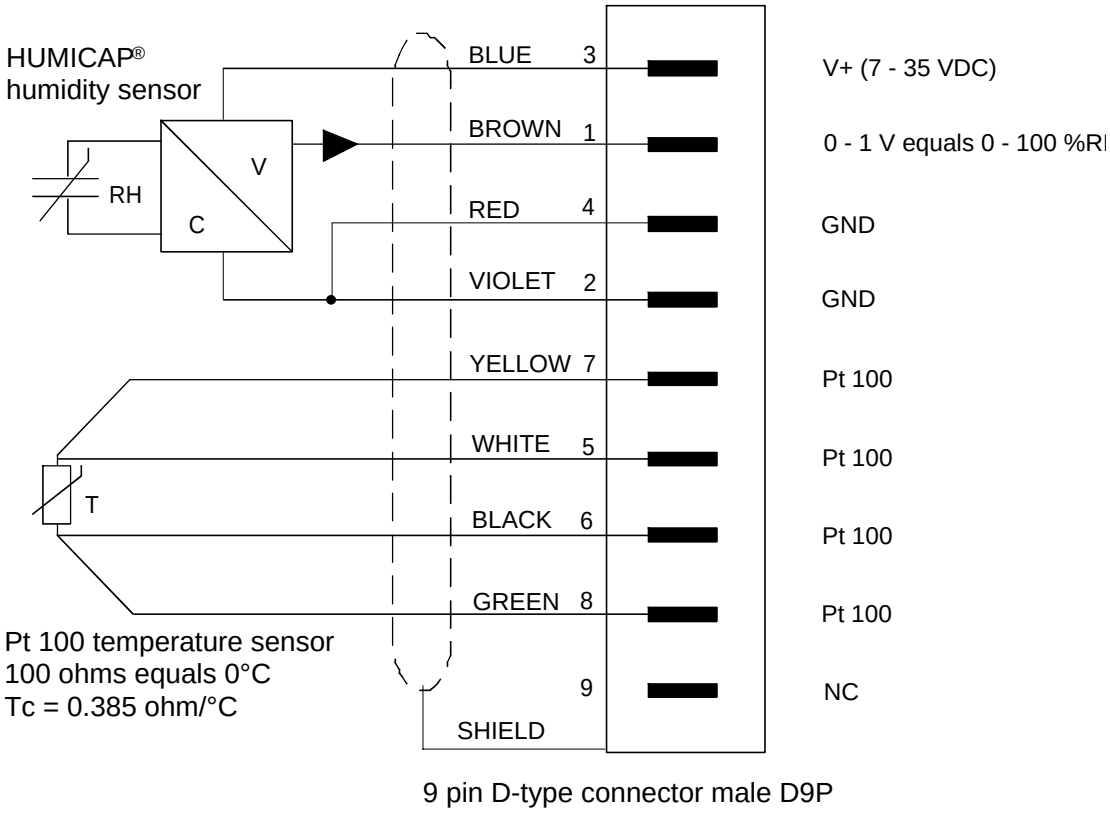



**Figure 4.2 Electrical connections**

# Appendix 4: HMP36E probe

# 1. GENERAL

The HMP36E humidity and temperature probe is meant to be used with the HMI38 humidity data processor. The HMP36E has a D-type male connector which is connected directly to the HMI38.

# 2. CALIBRATION AND MAINTENANCE

Check and calibrate the HMP36E probe at regular intervals which depend on the operating conditions and accuracy desired, but at least once a year. You can perform a one point calibration for the probe. If the humidity during calibration is below 65 %RH, make the adjustment using potentiometer "DRY"; if the humidity is above 65 %RH, make the adjustment using potentiometer "WET". Use Vaisala's calibrated humidity meters as a reference.

If a more accurate two-point calibration is required, use a Vaisala HMK15 or HMK13B (with adapter, part no. 0305) humidity meter calibrator and saturated salt solutions as described in the calibrator manuals. Perform the calibration first for the dry end and then for the wet end by adjusting trimmer potentiometers marked "DRY" and "WET", respectively. The adjustments are to be found under a protective plug in the probe handle.

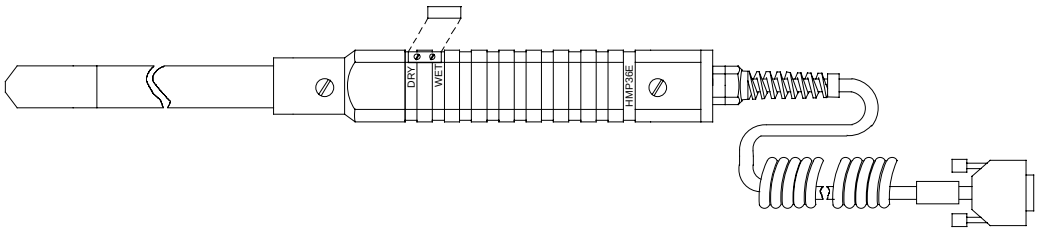



**Figure 2.1 Calibration potentiometers**

## 2.1. Changing the HUMICAP® sensor

Remove the damaged sensor and mount a new one in its place. Handle the sensor with care. Calibrate the probe using a two-point calibration procedure.

## 2.2. Chemical tolerances of the HUMICAP®K-sensor

Long-term exposure of the sensor to certain chemicals and gases may shorten sensor life and affect its properties. The following list gives suggested maximum ambient concentrations for some typical chemicals:

| | ppm (typ.) |
|---|---|
| Organic solvents | 1000...10 000 |
| Aggressive chemicals (e.g. strong acids such as $SO_2$, $H_2SO_4$, $H_2S$, HCl, $Cl_2$, etc.) | 1...10 |
| Weak acids | 100...1000 |
| Bases | 10 000...100 000 |

Detailed information on allowed concentrations is available on request from your Vaisala representative.

# 3. SPARE PARTS AND ACCESSORIES

| part no. | Description |
|---|---|
| HUMICAP®K | Humidity sensor |
| 0195 | Sintered filter 133 µm |
| 10159 | Membrane filter |
| HMK15 | Humidity Calibrator |
| HMK13B | Humidity calibrator |

# 4. TECHNICAL DATA

## 4.1. Humidity

| | |
|---|---|
| Measurement range | 0...100 %RH |
| Output signal | 0.002...1 VDC (equals 0.2...100 %RH) |
| Accuracy (at +20 °C) (including nonlinearity and hysteresis) | |
| against factory references | ±1 %RH |
| against field references | ±2 %RH (0...90 %RH)<br>±3 %RH (90...100 %RH) |
| Temperature dependence of electronics (humidity sensor is temperature compensated by software) | ±0.04 %RH/°C |
| Typical long-term stability | better than 1 %RH per year |
| Response time (at +20 °C, 90 % response) | 15 s |
| Humidity sensor | HUMICAP®K-sensor |

## 4.2. Temperature

| | |
|---|---|
| Measurement range | |
| continuous measurement | -40...+80 °C |
| short-term measurement | -40...+160 °C |
| Temperature sensor | Pt 100 (IEC 751 1/3 Class B), four-wire connection |

## 4.3. Calculated quantities

Dewpoint temperature, mixing ratio, absolute humidity and wet bulb temperature can be calculated from measured humidity and temperature values. The accuracy of the calculated quantities depends on the calibration of the probe and on how correctly the measurement is performed.

The following tables give accuracies of the calculated quantities with measurement accuracies for relative humidity ±2 %RH and for temperature ±0.2 °C (values in tables are also ± values).

**Accuracy of calculated dewpoint temperature (°C)**

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -20 | 2.18 | 1.19 | 0.88 | 0.72 | 0.62 | 0.56 | 0.51 | 0.48 | - | - |
| 0 | 2.51 | 1.37 | 1.00 | 0.81 | 0.70 | 0.63 | 0.57 | 0.53 | 0.50 | 0.48 |
| 20 | 2.87 | 1.56 | 1.13 | 0.92 | 0.79 | 0.70 | 0.64 | 0.59 | 0.55 | 0.53 |
| 40 | 3.24 | 1.76 | 1.27 | 1.03 | 0.88 | 0.78 | 0.71 | 0.65 | 0.61 | 0.58 |
| 60 | 3.60 | 1.96 | 1.42 | 1.14 | 0.97 | 0.86 | 0.78 | 0.72 | 0.67 | 0.64 |
| 80 | 4.01 | 2.18 | 1.58 | 1.27 | 1.08 | 0.95 | 0.86 | 0.79 | 0.74 | 0.70 |
| 100 | 4.42 | 2.41 | 1.74 | 1.40 | 1.19 | 1.05 | 0.95 | 0.87 | 0.81 | 0.76 |
| 120 | 4.86 | 2.66 | 1.92 | 1.54 | 1.31 | 1.16 | 1.04 | 0.96 | 0.89 | 0.84 |

**Accuracy of calculated mixing ratio (g/kg)** (at ambient pressure 1013 hPa)

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -20 | 0.017 | 0.018 | 0.019 | 0.021 | 0.022 | 0.023 | 0.025 | 0.026 | - | - |
| 0 | 0.08 | 0.09 | 0.09 | 0.10 | 0.10 | 0.11 | 0.11 | 0.12 | 0.13 | 0.13 |
| 20 | 0.31 | 0.33 | 0.35 | 0.37 | 0.39 | 0.41 | 0.43 | 0.45 | 0.47 | 0.49 |
| 40 | 0.97 | 1.03 | 1.10 | 1.17 | 1.24 | 1.31 | 1.38 | 1.46 | 1.54 | 1.62 |
| 60 | 2.68 | 2.91 | 3.16 | 3.43 | 3.72 | 4.04 | 4.38 | 4.75 | 5.15 | 5.58 |
| 80 | 6.73 | 7.73 | 8.92 | 10.34 | 12.05 | 14.14 | 16.71 | 19.92 | 24.01 | 29.29 |
| 100 | 16.26 | 21.34 | 28.89 | 40.75 | 60.86 | 98.85 | 183.7 | 438.6 | - | - |
| 120 | 40.83 | 74.66 | 172.4 | - | - | - | - | - | - | - |

**Accuracy of calculated absolute humidity (g/m$^3$)**

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -20 | 0.023 | 0.025 | 0.027 | 0.029 | 0.031 | 0.032 | 0.034 | 0.036 | - | - |
| 0 | 0.10 | 0.11 | 0.12 | 0.13 | 0.13 | 0.14 | 0.15 | 0.15 | 0.16 | 0.17 |
| 20 | 0.37 | 0.39 | 0.41 | 0.43 | 0.45 | 0.47 | 0.49 | 0.51 | 0.53 | 0.55 |
| 40 | 1.08 | 1.13 | 1.18 | 1.24 | 1.29 | 1.34 | 1.39 | 1.44 | 1.49 | 1.54 |
| 60 | 2.73 | 2.84 | 2.95 | 3.07 | 3.18 | 3.29 | 3.40 | 3.52 | 3.63 | 3.74 |
| 80 | 6.08 | 6.30 | 6.51 | 6.73 | 6.95 | 7.17 | 7.39 | 7.61 | 7.83 | 8.05 |
| 100 | 12.2 | 12.6 | 13.0 | 13.4 | 13.8 | 14.2 | 14.6 | 15.0 | 15.3 | 15.7 |
| 120 | 22.6 | 23.3 | 23.9 | 24.6 | 25.2 | 25.8 | 26.5 | 27.1 | 27.8 | 28.4 |

**Accuracy of calculated wet bulb temperature (°C)**

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -20 | 0.21 | 0.21 | 0.22 | 0.22 | 0.22 | 0.22 | 0.23 | 0.23 | - | - |
| 0 | 0.27 | 0.28 | 0.28 | 0.29 | 0.29 | 0.29 | 0.30 | 0.30 | 0.31 | 0.31 |
| 20 | 0.45 | 0.45 | 0.45 | 0.44 | 0.44 | 0.44 | 0.43 | 0.43 | 0.42 | 0.42 |
| 40 | 0.84 | 0.77 | 0.72 | 0.67 | 0.64 | 0.61 | 0.58 | 0.56 | 0.54 | 0.52 |
| 60 | 1.45 | 1.20 | 1.03 | 0.91 | 0.83 | 0.76 | 0.71 | 0.67 | 0.63 | 0.60 |
| 80 | 2.23 | 1.64 | 1.32 | 1.13 | 0.99 | 0.89 | 0.82 | 0.76 | 0.72 | 0.68 |
| 100 | 3.06 | 2.04 | 1.58 | 1.31 | 1.14 | 1.01 | 0.92 | 0.85 | 0.80 | 0.75 |
| 120 | 3.85 | 2.40 | 1.81 | 1.48 | 1.28 | 1.13 | 1.03 | 0.95 | 0.88 | 0.83 |

## 4.4. General

| | |
|---|---|
| Supply voltage | 7...35 VDC |
| Current consumption | ≤ 4 mA |
| Operating temperature | |
| sensor head | -40...+80 °C |
| electronics | -20...+60 °C |
| Sensor protection | |
| standard | sintered filter 133 µm (part no. 0195) |
| option | membrane filter (part no. 10159HM) |
| Protection class | IP55 (NEMA 3S) |
| Housing material | ABS plastic |
| Connector | D-type male D9P |
| Cable length | spiral cable: 1150 mm / 3000 mm |
| Weight | 400 g |

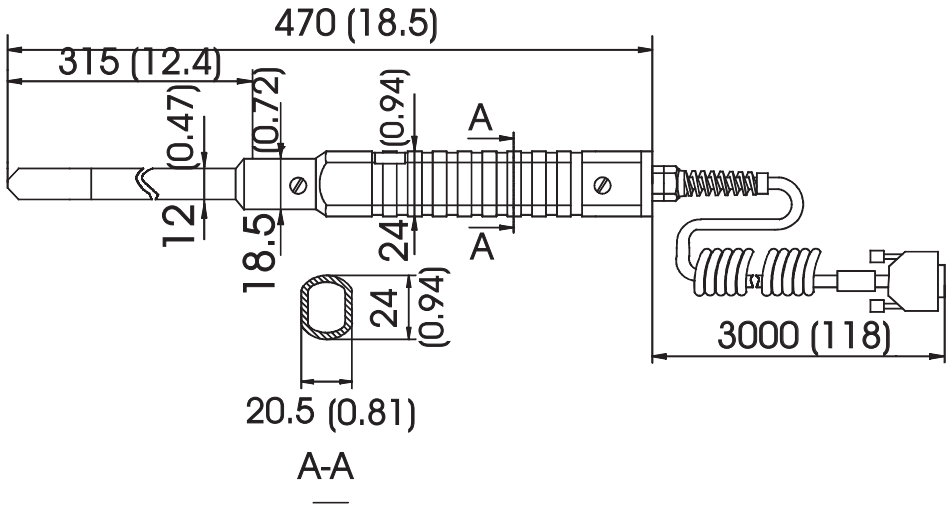



**Figure 4.1 Dimensions of the HMP36E**

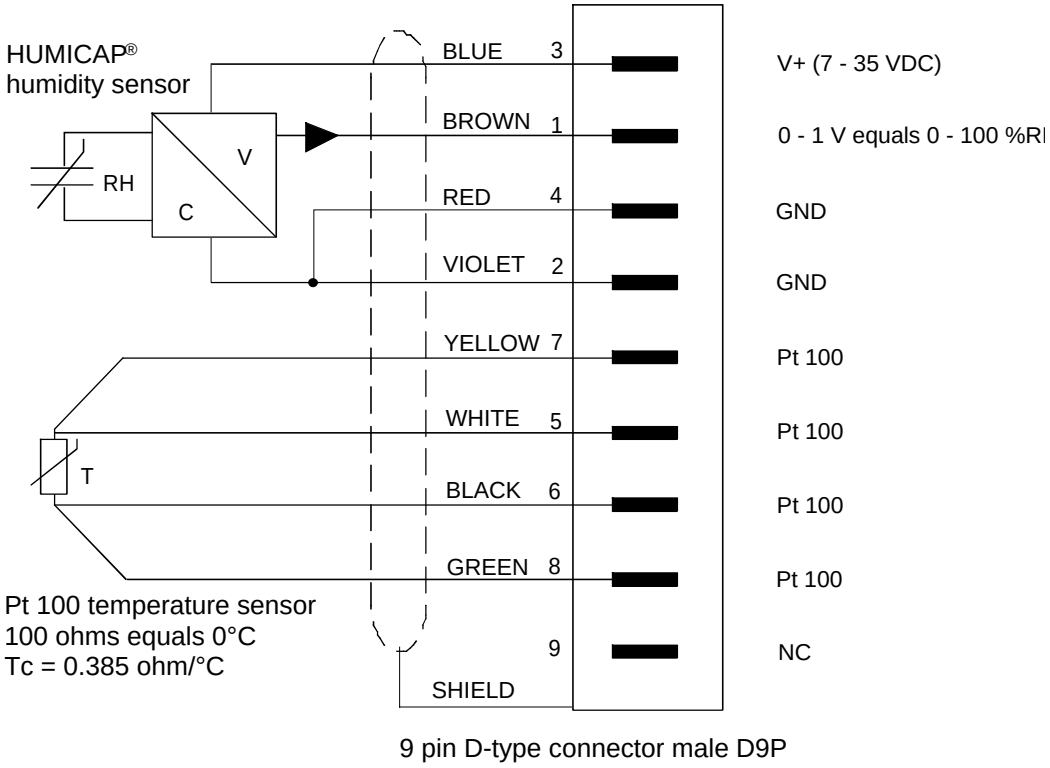



**Figure 4.2 Electrical connections**

# Appendix 5: HMP37E probe

# 1. GENERAL

The HMP37E humidity and temperature probe is meant to be used with the HMI38 humidity data processor. The HMP37E has a D-type male connector which is connected directly to the HMI38.

# 2. CALIBRATION AND MAINTENANCE

Check and calibrate the HMP37E probe at regular intervals which depend on the operating conditions and accuracy desired, but at least once a year. You can perform a one point calibration for the probe. If the humidity during calibration is below 65 %RH, make the adjustment using potentiometer "DRY"; if the humidity is above 65 %RH, make the adjustment using potentiometer "WET". Use Vaisala's calibrated humidity meters as a reference.

If a more accurate two-point calibration is required, use a Vaisala HMK15 (with adapter, part no. 16612) or HMK13B (with adapter, part no. 16611) humidity meter calibrator and saturated salt solutions as described in the calibrator manual. Perform the calibration first for the dry end and then for the wet end by adjusting trimmer potentiometers marked "DRY" and "WET", respectively. The adjustments are to be found under a protective plug in the probe handle.

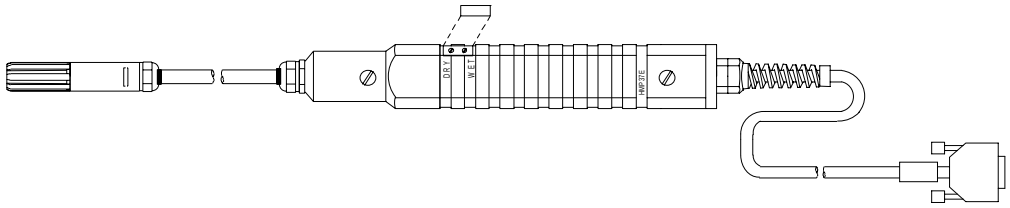



**Figure 2.1 Calibration potentiometers**

## 2.1. Changing the HUMICAP® sensor

Remove the damaged sensor and mount a new one in its place. Handle the sensor with care. Calibrate the probe using the two-point calibration procedure.

## 2.2. Chemical tolerances of the HUMICAP®K-sensor

Long-term exposure of the sensor to certain chemicals and gases may shorten sensor life and affect its properties. The following list gives suggested maximum ambient concentrations for some typical chemicals:

| | ppm (typ.) |
|---|---|
| Organic solvents | 1000...10 000 |
| Aggressive chemicals (e.g. strong acids such as $SO_2$, $H_2SO_4$, $H_2S$, HCl, $Cl_2$, etc.) | 1...10 |
| Weak acids | 100...1000 |
| Bases | 10 000...100 000 |

Detailed information on allowed concentrations is available on request from your Vaisala representative.

# 3. SPARE PARTS AND ACCESSORIES

| part no. | |
|---|---|
| HUMICAP®K | Humidity sensor |
| 16720HM | PPS grid with stainless steel netting |
| HMK15 | Humidity Calibrator |
| HMK13B | Humidity Calibrator |

# 4. TECHNICAL DATA

## 4.1. Humidity

| | |
|---|---|
| Measurement range | 0...100 %RH |
| Output signal | 0.002...1 VDC (equals 0.2...100 %RH) |
| Accuracy (at +20 °C) (including nonlinearity and hysteresis) | |
| against factory references | ±1 %RH |
| against field references | ±2 %RH (0...90 %RH) |
| | ±3 %RH (90...100 %RH) |
| Temperature dependence of electronics (humidity sensor is temperature compensated by software) | ±0.04 %RH/°C |
| Typical long-term stability | better than 1 %RH per year |
| Response time (at +20 °C, 90 % response) | 15 s |
| Humidity sensor | HUMICAP®K-sensor |

## 4.2. Temperature

| | |
|---|---|
| Temperature sensor | Pt 100 (IEC 751 1/3 Class B), four-wire connection |

## 4.3. Calculated quantities

Dewpoint temperature, mixing ratio, absolute humidity and wet bulb temperature can be calculated from measured humidity and temperature values. The accuracy of the calculated quantities depends on the calibration of the probe and on how correctly the measurement is performed.

The following tables give accuracies of the calculated quantities with measurement accuracies for relative humidity ±2 %RH and for temperature ±0.2 °C (values in tables are also ± values).

**Accuracy of calculated dewpoint temperature (°C)**

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

**Accuracy of calculated mixing ratio (g/kg)** (at ambient pressure 1013 hPa)

| | Humidity (%RH) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Temperature (°C) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| -40 | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 | 0.004 | - | - |
| -20 | 0.017 | 0.018 | 0.019 | 0.021 | 0.022 | 0.023 | 0.025 | 0.026 | - | - |
| 0 | 0.08 | 0.09 | 0.09 | 0.10 | 0.10 | 0.11 | 0.11 | 0.12 | 0.13 | 0.13 |
| 20 | 0.31 | 0.33 | 0.35 | 0.37 | 0.39 | 0.41 | 0.43 | 0.45 | 0.47 | 0.49 |
| 40 | 0.97 | 1.03 | 1.10 | 1.17 | 1.24 | 1.31 | 1.38 | 1.46 | 1.54 | 1.62 |
| 60 | 2.68 | 2.91 | 3.16 | 3.43 | 3.72 | 4.04 | 4.38 | 4.75 | 5.15 | 5.58 |
| 80 | 6.73 | 7.73 | 8.92 | 10.34 | 12.05 | 14.14 | 16.71 | 19.92 | 24.01 | 29.29 |
| 100 | 16.26 | 21.34 | 28.89 | 40.75 | 60.86 | 98.85 | 183.7 | 438.6 | - | - |
| 120 | 40.83 | 74.66 | 172.4 | - | - | - | - | - | - | - |

### Accuracy of calculated absolute humidity (g/m$^3$)

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

### Accuracy of calculated wet bulb temperature (°C)

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

## 4.4. General

| | |
|---|---|
| Supply voltage | 7...35 VDC |
| Current consumption | $\underline{<}$ 4 mA |
| Operating temperature | |
| sensor head | -40...+120 °C (+180 °C short term) |
| electronics | -40...+60 °C |
| Sensor protection | |
| standard | PPS grid with stainless steel netting (part no. 16720HM) |
| option | PPS grid, stainless steel sintered filter |
| Protection class | IP55 (NEMA 3S) |

| | |
|---|---|
| Housing material | ABS plastic |
| Connector | D-type male D9P |
| Cable length | 5 m between sensor head and electronics, 1.5 m between electronics and D-connector |
| Weight | 500 g |

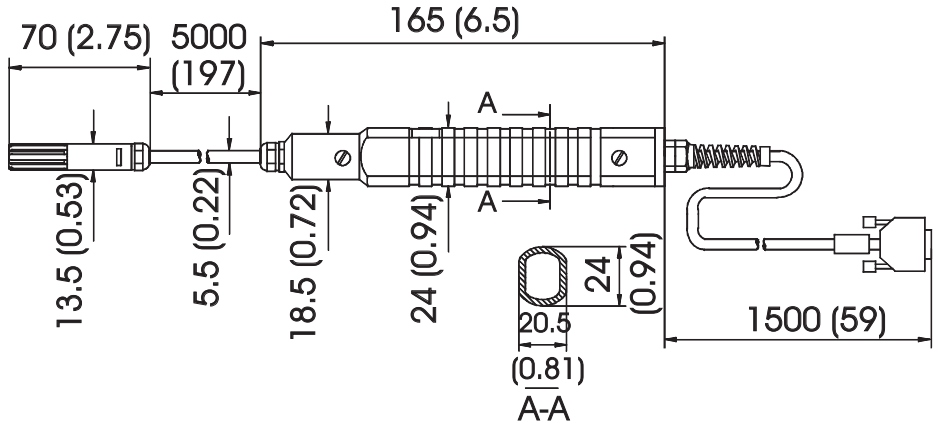



**Figure 4.1 Dimensions of the HMP37E**

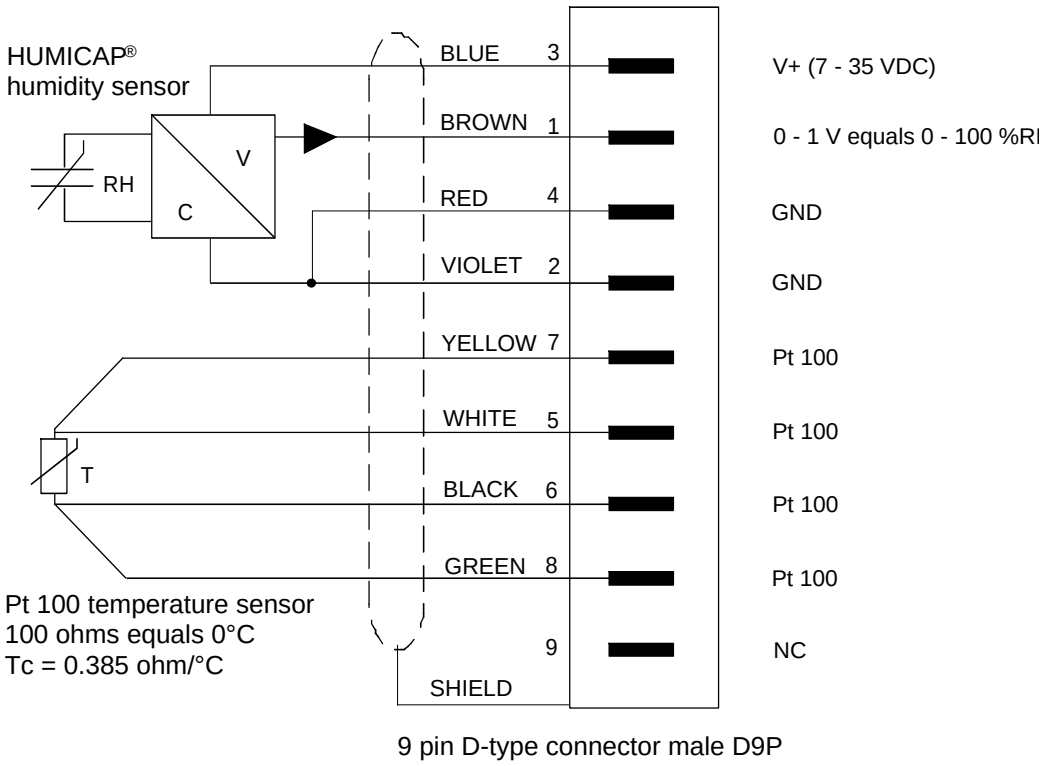



**Figure 4.2 Electrical connections**