

Datasheet EK-H3

Evaluation Kit with SHT7x Humidity and Temperature Sensors

- Simultaneous data logging of up to 20 sensors
- Simultaneous monitoring of humidity, temperature and dew point
- Easy data handling due to Multi Viewer software
- Includes cables and sensors

Product Summary

The evaluation kit EK-H3 is a data logging equipment suitable for all applications, where precise, easy-to-handle and simultaneous data logging of humidity and temperature is needed. EK-H3 allows for applying 20 humidity and temperature sensors simultaneously and reading out relative humidity, temperature and calculated dew point at the same time.

The application of EK-H3 does not require any software programming, calibration nor does it need additional hardware with the exception of a personal computer.

EK-H3 contains 20 units of SHT75 pin type humidity and temperature sensors. They easily can be exchanged – and as they are provided with internal calibration – without further calibrating them. SHT75 are designed for measurement applications and provide an excellent measurement tolerance: $\pm 1.8\%RH$ and $\pm 0.3^{\circ}C$ at $25^{\circ}C$. For detailed specification please refer to the respective sensor datasheet.

Please be aware that EK-H3 is no stand-alone data logger – it runs only together with a personal computer.

Schematic of Evaluation Kit

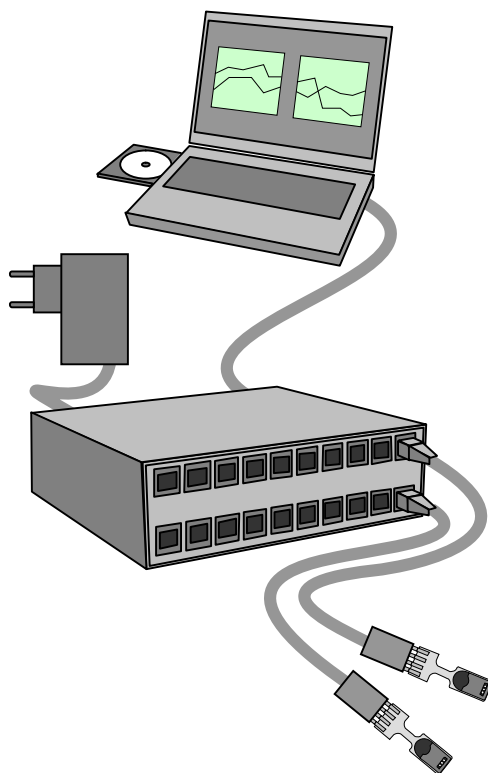


Figure 1: Schematic of Evaluation Kit EK-H3 containing a multiplexer box providing 20 channels for connecting SHT75 on cables and a power plug. Connection is made to a computer with data-logger software for recording and displaying data readings.

Material Contents

EK-H3 contains the following components:

- **1 EK-H3 multiplexer box** with 20 channels for sensor cables, one port for power supply cable and one RS-232 interface for connecting a computer.
- **20 SHT75 humidity and temperature sensors:** Pin type sensor with version 4B sensor chip. Please refer to respective datasheet SHT7x for more details.
- **20 Sensor 3m (20ft) cables** with RJ45 plug for connecting sensors with multiplexer box.
- **1 cable** with RS-232 connector for PC connection.
- **1 Power supply unit** with US adapter.
- **1 Compact disc** with multi viewer software for running EK-H4 as a data-logger.

Properties and Prerequisites

- EK-H3 can read **SHT7x** and **SHT1x** (if connected to pins). SHT2x cannot be read.
- **Supply Voltage** is at 4.5 – 5V.
- **Data-Logging Software Multi Humi-Viewer** is running on Windows operating system only. Minimum requirement is Windows 2000 up to Vista. Multi Humi-Viewer allows for exporting the data to dedicated software such as Excel.
- **Maximum Logging frequency** is 1 Hz.

Getting Started

Hardware

First the components need to be connected as depicted on Figure 1 with respective cables. Sensor ports of the multiplexer box which are not needed may be left open. See Figures 2 and 3 for interface ports on the multiplexer.



Figure 2 Front face of multiplexer box with RJ45 sensor ports.



Figure 3 Rear face of the multiplexer box with RS-232 port to the computer in the middle/left and one port for power supply to the right. The on/off plug is located to the left.

Software

The software for reading humidity and temperature data is installed by running the Multi Humi Viewer setup file. Please make sure that the RS-232 cable of the Multi Sensor Board is plugged into a COM port of the computer before starting the software. After opening the program please select the correct COM port in the *Sensor Settings* section. The software will then automatically probe for all connected sensors. After approximately 15 seconds the buttons of all working sensors in the *Sensor Select* section will turn green. In order to start the measurement, please click on the left-sided *start/stop* switch.

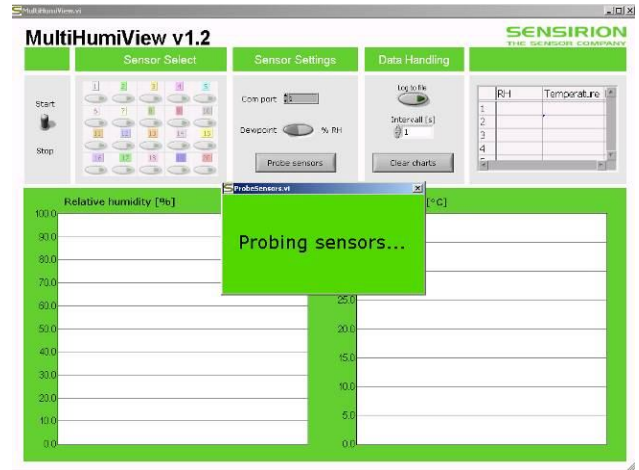


Figure 4: Starting up the Multi-Humi-Viewer software. The software automatically scans all inputs for connected SHTxx humidity and temperature sensors.

After approximately 15 seconds the *Sensor Select* section is updated as follows:

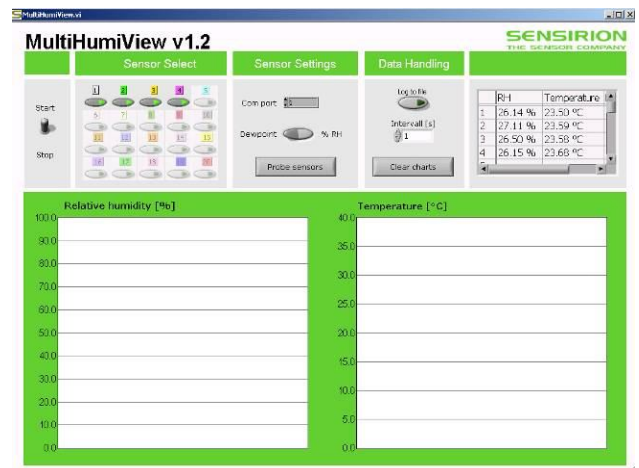


Figure 5: After scanning all ports, the *Sensor Select* panel indicates whether a sensor was detected (in this case sensors were detected on ports 1 through 4).

By clicking onto the buttons in the *Sensor Select* section the sensors are deactivated / activated selectively and the measurement data is visualized accordingly. It is possible to toggle the display between relative humidity and dew point measurement by switching the appropriate button in the *Sensor Setting* section.

Optionally, the acquired data can be written into a text file. This can be done by clicking onto the button *Log to File* in the *Data Handling* section and by giving the file a name. This allows for investigating the data off-line using dedicated software (e.g. Excel).

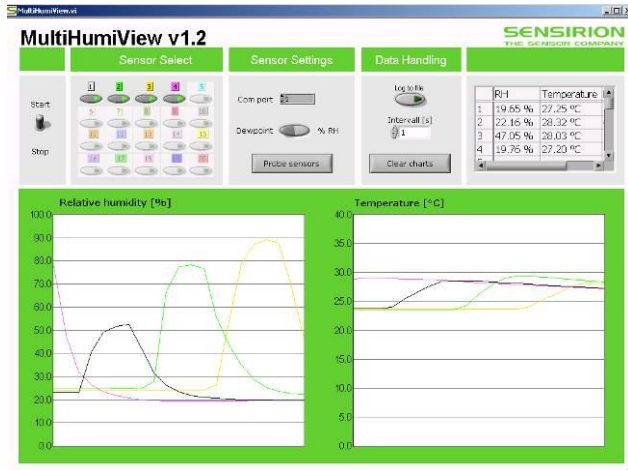


Figure 6: Data of all detected sensors are visualized on the graph

Furthermore, the logging interval can be selected in the *Data Handling* section. To avoid self-heating of the sensors an interval of at least 2 seconds should be chosen.

To change the scaling of the display axis the desired range can be entered directly by clicking on the y-axis values.

Sample Code

This Chapter describes the communication between a personal computer and the EK-H3. It shall help to integrate the EK-H3 to an experimental environment or driving EK-H3 from a hyper terminal or palm.

This document refers to each sensor either as "sensor" or as "chip". For sensor functionality please refer to the respective SHT7x datasheet.

General remarks

The EK-H3 contains a controller board, which is equipped with two microcontroller units (MCU, uP in some cases). The address of the board is set to "1". The two MCUs are named "A" and "B". The front panel connectors labeled 1 – 10 are wired to the MCU A, while the connectors 11 – 20 are wired to the MCU B.

After each power on of the EK-H3 the MCUs memories are reset. Therefore, in order to communicate with the connected sensors, the following sequence of commands needs to be carried out:

- Chip (sensor) selection: Selection of the sensor(s), which shall be addressed
- Chip testing: Tests whether or not the selected sensors are connected and working properly
- Chip power: Switches the sensors ON and OFF

The RS232 port has to be configured as following:

Baud rate	19200 Baud
Data bits	8
Parity	no
Stop bits	1
Flow control	no

An acknowledgement (referred to as „OK“) will be sent from EK-H3 to PC after each command. A "NOT OK" means, the MCU on the EK-H3 did not recognize the command or is not (yet) able to process the command.

The commands are sent in ASCII format.

Description of Commands

TestConnectUP tests whether or not the MCUs are able to communicate with the master device (personal computer, palm, etc.) and whether or not their power consumption is in the normal range. Parameter is the address of the MCU.

ChipSelectOne selects one sensor for communication. Parameter is the MCU address and the number of the sensor.

ChipSelectList selects a list of sensors for communication. Parameter is the MCU address and a list containing their numbers.

ChipSelectAll selects all sensors (10) for communication. Parameter is the MCU address.

TestConnectChip tests, whether or not the sensors selected with *ChipSelect* are connected and working properly. This function has to be called after each power on of the EK-H3. Otherwise, further communication with the sensors is not possible. Parameter is the MCU address.

SetChipPower switches the sensors, which were selected with *ChipSelect* on or off. Parameter is the MCU address and the status "ON" or "OFF"

Measure starts a measurement. Depending on the state of the status register of the sensors, the calibration data from the sensors' OTP memory may or may not be restored into the sensors' volatile memory (see SHT7x datasheet). Parameter is the MCU address. *Measure* returns "OK" to acknowledge the measurement has been started. It does NOT mean the measurement has been successful!

REMARK: *Measure* only starts a measurement. It does not return data. The data will be returned after the function *GetData* (see below), not after *Measure*.

RealMeasure also starts a measurement. But unlike *Measure* it assures that the sensors restore the calibration data from the OTP memory (see data sheet and application note status register). Parameter is the MCU address. *RealMeasure* returns "OK" to acknowledge the

measurement has been started. It does NOT mean the measurement has been successful!

REMARK: *RealMeasure* only starts a measurement. It does not return data. The data will be returned after the function *GetData* (see below), not after *RealMeasure*.

GetData returns the data after *Measure* and *RealMeasure*. Parameter is "OK" and the list of data, or a "NOT OK". The data of the sensors, which do not work properly, are replaced in the list with "NOT OK". The *GetData* command returns first temperature values of all sensors, which were selected with *ChipSelect*. Secondly, the *GetData* command returns all relative humidity values.

StatusWrite allows for writing into the status register of each sensor. This may be used to turn the heater on and off. Parameter is the MCU address and the data for the status register.

ATTENTION: Do only use ONE heated sensor at a time!

StatusRead reads the status register of the sensors (chips).

ChipReset resets the sensors (chips), which were selected with *ChipSelect*.

Command	Parameter	Output or Answer
TestConnectUP	MCU address;	Ok / not ok / -
ChipSelectOne	MCU address; chip	Ok / not ok
ChipSelectList	MCU address; chip1, chip2...	Ok / not ok
ChipSelectAll	MCU address;	Ok / not ok
TestConnectChip	MCU address;	Ok; list of non working sensors / not ok
SetChipPower	MCU address; power status	Ok; list of non working sensors / not ok
Measure	MCU address;	Ok / not ok
RealMeasure	MCU address;	Ok / not ok
GetData	MCU address;	Ok; data (list) / not ok
StatusWrite	MCU address; status register	Ok; list of sensors which cannot be written / not ok
StatusRead	MCU address;	Ok; status register (list) / not ok
ChipReset	MCU address;	Ok; list of sensors which cannot be reset / not ok

Overview table of EK-H3 commands

Command Format

The Command-Strings are the following:

CommandX = MCU address; parameter1, parameter2 ... \r

To simplify the command recognition in the MCU each command consists of a three-letter string. Each command

is terminated with a carriage return. The following table shows the command strings:

Command	Command String	Response String
TestConnectUP	TCU=<upadr>;\r	<ok/nok/->\r
ChipSelectOne	CSO=<upadr>;<chip>;\r	<ok/nok>\r
ChipSelectList	CSL=<upadr>;<chip1>;<chip2> .. <chipn>;\r	<ok/nok>\r
ChipSelectAll	CSA=<upadr>;\r	<ok/nok>\r
TestConnectChip	TCC=<upadr>;\r	<ok/nok>;<chipx>... \r
SetChipPower	SCP=<upadr>;<on/off>;\r	<ok/nok>;<chipx>... \r
Measure	MEA=<upadr>;\r	<ok/nok>\r
RealMeasure	RME=<upadr>;\r	<ok/nok>\r
GetData	GDA=<upadr>;\r	<ok/nok>;<temp1>;... <tempn>;<hum1>; ...<humn>\r
StatusWrite	STW=<upadr>;<stat1>;... <statn>;\r	<ok/nok>;<chipx>... \r
StatusRead	STR=<upadr>;\r	<ok/nok>;<stat1>;...<statn>\r
Chipreset	CRS=<upadr>;\r	<ok/nok>;<chipx>... \r

The abbreviations used above can adopt the following values:

- <upadr>: <upboard><up>
<upboard>: 1 - 99, integer, ASCII coded
<up>: A (MCU on top side) or B (MCU on bottom side), ASCII coded
- <ok/->: 1 (ok) or - (no answer -> timeout), integer, ASCII coded
- <chip>: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, integers, ASCII coded
- <ok/nok>: 1 (ok) or -1 (nok), integer, ASCII coded
- <on/off>: 1 (on) or 0 (off), integer, ASCII coded
- <temp>: 0 - 65535, integers, ASCII coded
- <hum>: 0 - 65535, integers, ASCII coded
- <stat>: 0 - 255, integers, ASCII coded

Data Interpretation

The output readings are ASCII-coded numbers between and including 0 and 65535. 0 represents the minimum humidity or temperature, 65535 (2¹⁶ - 1) represents the maximum humidity or temperature. In order to convert the readings into physical values they first must be divided by 4 for temperature, by 16 for humidity. Then apply the conversion formulas given in the SHTxx data sheet using the high resolution coefficients.

ATTENTION: Always use the high resolution coefficients (14bit temperature, 12bit relative humidity), even if a low resolution measurement has been carried out!

Examples

1) Read sensor data: Note that all commands, which are sent from the PC are denoted with "<" while all answers, which come from the microcontroller are denoted with ">". Every command sent from the PC is terminated by a carriage return. The "-1"s in the GDA-response string indicate, that there are non-connected or defect sensors.

```
< TCU=1A;          TestConnectUP
> 1
< CSL=1A; 1, 2, 3, 4, 5, 6, 7, 8;
   ChipSelectList
> 1
< TCC=1A;          TestConnectChip
> 1
< SCP=1A;1;        SetChipPower
> 1;5,8
< RME=1A;          RealMeasure
> 1
< GDA=1A;          GetData
> 1; 24629, 24633, 24629, 24645, -1,
   24637, 24657, -1; 14371, 14339,
   14339, 14307, -1, 14339, 14307, -1
< SCP=1A; 0;       SetChipPower
> 1
```

Conversion of sensor data: The first data set of the above communication example is 24629, 14371. These values may be transformed into temperature and humidity as follows (compare also the latest version of datasheet SHT7x):

$$T = [d_1 + d_2 * (24629 / 4)] °C = 21.57 °C$$

where $d_1 = -40.1$ and $d_2 = 0.01$

$$RH_{linear} = [c_1 + c_2 * (14371 / 16) + c_3 * (14371 / 16)^2] \%RH = 30.12 \%RH$$

where $c_1 = -2.0468$, $c_2 = 0.0367$ and $c_3 = -1.5955 * 10^{-6}$

$$RH_{true} = [RH_{linear} + (T - 25) * (t_1 + t_2 * (14371 / 16))] \%RH = 29.84 \%RH$$

where $t_1 = 0.01$ and $t_2 = 8 * 10^{-5}$

2) Turn heater on/off: Once more: as the sensors connected to the EK-H3 are powered by the pins of the microcontroller in the micro-control unit, it is not permitted to turn on more than one heater at the same time!

```
< CSL=1A;1;        ChipSelectList
> 1
< TCC=1A;          TestConnectChip
> 1
< SCP=1A;1;        SetChipPower
> 1;
< STW=1A;4;        StatusWrite (turns
   heater on)
> 1
< STW=1A;0;        StatusWrite (turns
   heater off)
> 1
< SCP=1A;0;        SetChipPower
> 1
```

Revision History

Date	Version	Page(s)	Changes
04 Oct 2006	2.4		Sensirion Inc. address added
28 May 2008	3.0	1 – 6	New release, cosmetics
10 March 2010	3.1	1 – 6	New format, Chapter "Sample Code" added

Important Notices

Warning, Personal Injury

Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury. Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product, please consult the data sheet and application notes. Failure to comply with these instructions could result in death or serious injury.

If the Buyer shall purchase or use SENSIRION products for any unintended or unauthorized application, Buyer shall defend, indemnify and hold harmless SENSIRION and its officers, employees, subsidiaries, affiliates and distributors against all claims, costs, damages and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if SENSIRION shall be allegedly negligent with respect to the design or the manufacture of the product.

ESD Precautions

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take customary and statutory ESD precautions when handling this product.

See application note "ESD, Latch-Up and EMC" for more information.

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- such defects shall be found, to SENSIRION's reasonable satisfaction, to have arisen from SENSIRION's faulty design, material, or workmanship;
- the defective product shall be returned to SENSIRION's factory at the Buyer's expense; and
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