TEKBOX
DIGITAL SOLUTIONS

Air Humidity, Temperature and Barometric Pressure Sensor Manual

The TBSHT02 is an air humidity and temperature sensor with SDI-12 interface. The sensor uses a single chip sensor element which measures both temperature and air humidity. An additional MEMS chip measures barometric pressure.

Each sensor chip is individually factory-calibrated.

The RHT sensor chip is protected with a PBT filter cap carrying a PTFE membrane with 1.5μm pore size.

The TBSHT02 Board is conformally coated and fit into an off shelf sensor housing. An additional fine grid nylon mesh provides dust and insect protection. The sensor including bend protection has a length of 115mm and a diameter of 12mm.

The sensor optionally can also be supplied as board, without housing and cables.

With dimensions of only 70mm x 8.5mm, the board can easily be fitted in many standard sensor housings.
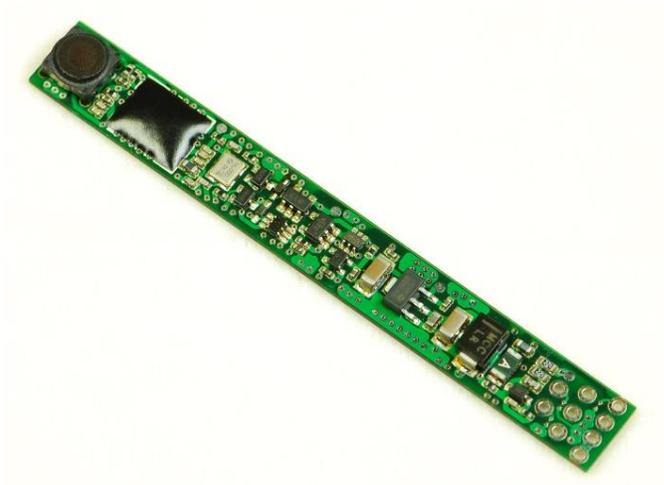
TBSHT02/TBSHTP02 air humidity, air temperature and barometric pressure sensor / sensor

Features

- Air humidity, temperature and barometric pressure sensor
- SDI-12 Interface
- Temperature resolution: 0.01°C
- Temperature accuracy tolerance:
  +5°C to + 60°C: typ. ±0.2°C, max. ±0.4°C
  -40°C to +5°C: max. ±1°C
  +60°C to +85°C: max. ±0.75°C
- Air humidity resolution: 0.04% RH
- Air humidity accuracy tolerance:
  10% to 90%: typ. ±1.8%RH, max. ±2%RH
  0% to 10%: typ. ±3%RH, max. ±4%RH
  90% to 100%: typ. ±3%RH, max. ±4%RH

- SDI-12 Standard V1.3
- Plug and Play
- 6 - 16V supply voltage
- Board: 70 mm x 8.5 mm x 3mm
- Housing: 115 mm, Ø 12 mm
- Operating Temperature Range:
  - 40°C … + 85°C
- Excellent price-performance ratio

Target Applications

- SDI-12 Sensor Networks

Air Humidity, Temperature and Barometric Pressure Sensor Manual

Contents

Air Humidity, Temperature and Barometric Pressure Sensor Manual

Tables

Figures

TBSHT02

Air Humidity, Temperature and Barometric Pressure Sensor Manual

1   Introduction

1.1   Product Features

TBSHT02 is based on a factory calibrated sensor chips, a low power controller and robust SDI-12 interface hardware:

- Measurement of air humidity, air temperature and calculation of dew point
- 5V, 1200 baud SDI-12 data interface with transient protection
- 6 - 17V, 4 mA sensor supply voltage
- Sensor dimensions: 115 mm, Ø 12 mm
- Board dimensions: 70 mmm x 8.5 mm x 3 mm
- Operating temperature range: -40°C … +85°C

1.2   Calibration

Each sensor is individually factory calibrated. No user calibration is required.

1.3   Placement

Don´t expose the sensor to direct sun or precipitation. Install it in a location with permanent shadow and protection from precipitation, inside a radiation shield or in an instrument shelter.

1.4   Installation

The TBSHT02 is compatible with any data logger or remote telemetry unit with SDI-12 interface. Refer to the data logger or RTU manual and to chapter 2 of this datasheet.

1.5   SDI-12

SDI-12 is a standard for interfacing data recorders with microprocessor-based sensors. SDI-12 stands for serial/digital interface at 1200 baud. It can connect multiple sensors with a single data recorder on one cable. It supports up to 60 meter cable between a sensor and a data logger.

Tekbox SDI-12 sensors have been installed in networks with cable lengths up to 200m and with up to 40 connected sensors.

The SDI-12 standard is prepared by

SDI-12 Support Group
(Technical Committee)
165 East 500 South
River Heights, Utah
435-752-4200
435-752-1691 (FAX)
http://www.sdi-12.org

The latest standard is version V1.3 which dates from July 18th, 2005. The standard is available on the website of the SDI-12 Support Group.

More information on SDI-12 is presented in chapter 3.
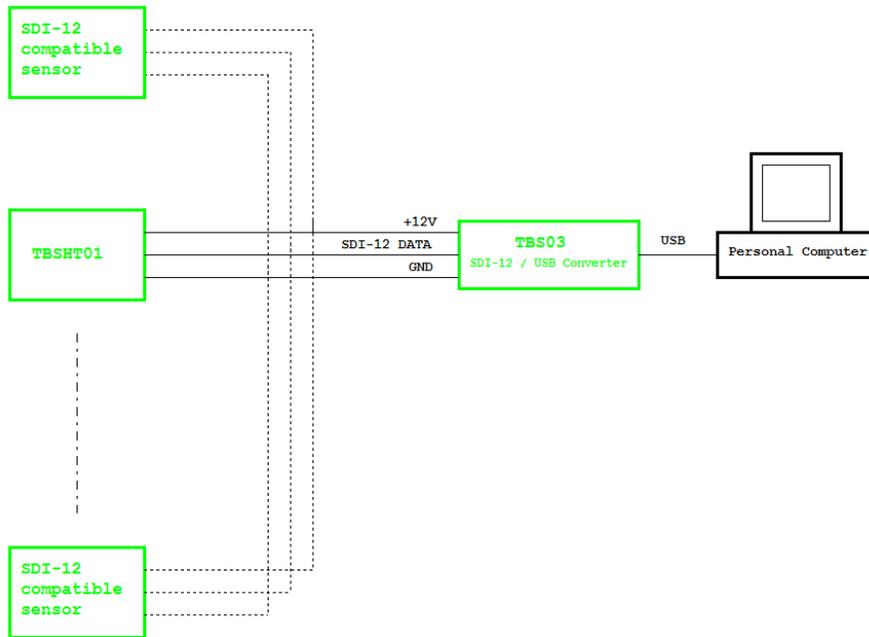
2   Application Examples

Figure 1 – TBSHT02 sensors connected to TBS03 SDI-12 to USB converter, setup for controlling / testing sensors and for PC based data recording
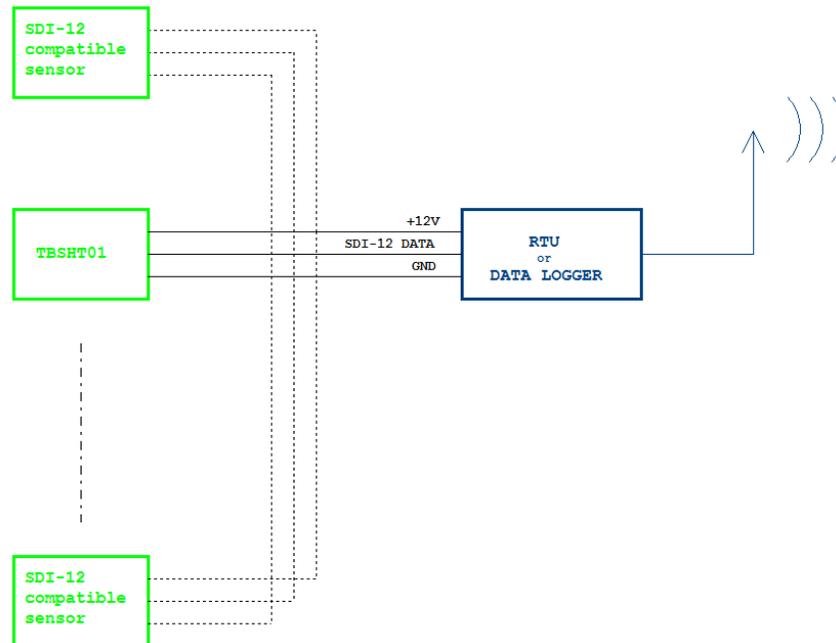

Figure 2 – TBSHT02 sensor(s) connected to Remote Telemetry Unit or Data Recorder

Air Humidity, Temperature and Barometric Pressure Sensor Manual

3   Functional Description

3.1   Overview

The SDI-12 standard defines a set of commands to configure sensors and to initiate measurements. Upon receiving specific commands, the sensor may carry out internal tasks, respond with information on conversion time or send measurement data.

SDI-12 commands are typically ASCII strings which are generated by the data recorder/controller firmware. TBSHT02 can be connected to a TBS03 SDI-12 to USB converter and controlled by a PC application or hyper terminal. TBS03 converts the command strings to the logic levels and baud rate specified by the SDI-12 standard. Furthermore, TBS03 handles breaks, marks and all other details of the SDI-12 protocol.

Upon receiving data or status information originated by TBSHT02, the TBS03 extracts the corresponding ASCII strings and sends them to the USB Virtual COM Port of the PC.

In remote applications, TBSHT02 can be connected to a data logger, a data terminal or a Radio Telemetry Unit with a SDI-12 interface.

3.2   SDI-12 Basics

The SDI-12 is a serial data communication standard for interfacing multiple sensors with a data recorder. SDI-12 uses a shared bus with 3 wires: power (+12V), data, ground Data rate: 1200 baud. Each sensor at the bus gets a unique address which is in the range ASCII [0-9, a-z, A-Z]. The default address of every sensor is ASCII[0]. When setting up a SDI-12 sensor network, every sensor needs to be configured with a unique address. This can be done using the Change Address Command. A sensor can typically measure one or more parameters. Sensor manufacturers usually specify '*Extended Commands*' to configure or calibrate sensors. These commands are specified by the manufacturer, but they follow the command structure specified by SDI-12.

A typical recorder/sensor measurement sequence proceeds as follows:

1) The data recorder wakes all sensors on the SDI-12 bus with a break.
2) The recorder transmits a command to a specific, addressed sensor, instructing it to make a measurement.
3) The addressed sensor responds within 15.0 milliseconds, returning the maximum time until the measurement data will be ready and the number of data values it will return.
4) If the measurement is immediately available, the recorder transmits a command to the sensor instructing it to return the measurement result(s). If the measurement is not ready, the data recorder waits for the sensor to send a request to the recorder, which indicates that the data is ready. The recorder then transmits a command to get the data.
5) The sensor responds, returning one or more measurement results.

SDI-12 Command Structure:
Each SDI-12 command is an ASCII string with up to 5 characters, starting with the sensor address and terminated by a "**!**" character.

Example:
Send Identification Command **0I!**
0 is the sensor address (sensor zero). Upon receiving this command, the sensor will send an ASCII string containing sensor address, SDI-12 compatibility number, company name, sensor model number, sensor version number and sensor serial number.

Air Humidity, Temperature and Barometric Pressure Sensor Manual

The standard process to carry out a measurement is to send a measurement request upon which the sensor responds with the time that is required to carry out the measurement and the number of data items being returned. After waiting the time that the sensor requires to carry out the measurement, the data recorder sends a *"Read Command"* to get the measurement results.

Example:
Start Measurement Command **0M1!**
Sensor 0 might respond **00012** which means the measurement will take 1 second and deliver 2 values.
After min. 30 seconds, the data recorder can send the *"Read Data Command"* **0D0!** to which Sensor 0 might reply **0+67.75+17.23**. +67.53+17.23 is the two measurement results which may be 67.75% air humidity level and 17.23°C air temperature.

The response string of a sensor is always in ASCII format and may contain up to 40 or up to 80 characters, depending on the type of command. Out of 40 or 80 characters, the values part of the response string may contain up to 35 or 75 characters.

3.3 Sensor Identification

The air humidity temperature sensor interface will respond with a string of the following format when sending the *"Send Identification"* command **al!**:

allcccccccccmmmmmmmvvvxxxxxxxxxxxxx<CR><LF>

Example: 013TEKBOXVN_TBSHT02_V0.10_000001 <CR><LF>

Where:	0	SDI-12 Sensor address
	13	SDI-12 version number, version 1.3
	TEKBOXVN	Company name
	TBSHT02	Model Name
	V0.10	Firmware version 0.10
	000001	Serial number of TBSHT02

3.4 Sensor Address

Each TBSHT02 is delivered with a default address of "0"
TBSHT02 accepts SDI-12 addresses in the range "0" to "9", "A" to "Z" and "a" to "z". Setting TBSHT02 address can be done using the "*Change Address Command*" **aAb!**.

Note:
- If the new address is invalid, the current address will be kept.
- TBSHT02 will remain unresponsive for approximately 1 second while the new address is saved in the EEPROM memory.
- TBSHT02 interface supports "**?**" as an address only for *"Acknowledge Active"* Command **a!**.

Air Humidity, Temperature and Barometric Pressure Sensor Manual

3.5 Measurement

The TBSHT02 sensor interface accepts the "*Start Measurement*" Command **aM!**, *"Additional Measurement"* Commands **aMn!** and *"Start Concurrent Measurement"* Command **aC!**, "*Additional Concurrent Measurement*" Commands **aCn!** for obtaining calibrated values from the probe.

The TBSHT02 sensor interface will not support the *"Continuous Measurement"* Command **aRn!** and *"Continuous Measurement and Request CRC"* Command **aRCn!**. The TBSHT02 sensor will respond with its address followed by <CR><LF> in response to this command.

The response to *"Start Measurement"* **aM!**, *"Additional Measurement"* Commands **aMn!** and *"Start Concurrent Measurement"* Command **aC!**, the *"Additional Concurrent Measurement"* Command **aCn!** reports how many sensor values   will be sent. In order to receive the desired sensor values, the recorder needs to issue the corresponding *"Send Data"* Command(s) **aDn!**.

Note: The TBSHT02 sensor interface uses a format of "sign" followed by n digits (The n maximum is seven -7), followed by the decimal point, followed by m digits (The m maximum is one - 1) (+n.m) return readings.

3.6 Commands – Quick Reference

Measurement commands:

aM!	aMC!	aC!	aCC!	measure relative humidity [%]
aM1!	aMC1!	aC1!	aCC1!	measure relative humidity [%] / temperature [°C] or [F]
aM2!	aMC2!	aC2!	aCC2!	measure temperature [°C] or [F]
aM3!	aMC3!	aC3!	aCC3!	approximate calculation of dew point / frost point [°C] or [F]
aM4!	aMC4!	aC4!	aCC4!	measure relative Humidity (%) / temperature / dew point (frost point) [°C] or[F]
aM5!	aMC5!	aC5!	aCC5!	approximate calculation of absolute humidity [g/m^3]
aM6!	aMC6!	aC6!	aCC6!	estimate cloud base [m] (estimation; cannot replace a ceilometer measurement)
aM7!	aMC7!	aC7!	aCC7!	rel.humidity/temperature/dew point/frost point/abs. humidity/estd. cloud base

Extended SDI-12 commands:

aXSNnnnnnn!	Set serial number (6 digits)
aXC!	temperature unit Celsius (default factory setting)
aXF!	temperature unit Fahrenheit

3.7 Measurement Examples

aM!, aC!: Measure Relative Humidity [%]

Command	Response	Comment
aM!	a0011<CR><LF>	
aD0!	a+9.25<CR><LF>	
aC!	a00101<CR><LF>	
aD0!	a+9.25<CR><LF>	

The value +9.25 is the relative humidity in [%]. The relative humidity is represented by up to 2 digits before and by two digits after the decimal point. (max. value 99.99)

Air Humidity, Temperature and Barometric Pressure Sensor Manual

aM1!, aC1! Measure Relative Humidity [%] and Air Temperature [°C]

Command	Response	Comment
aM1!	a0012<CR><LF>	
aD0!	a+hh.hh+tt.tt<CR><LF>	The sign will change to – for negative temperatures

Value nn.nn: Relative Humidity   Value mm.mm: Air Temperature value

aM2!, aC2! : Measure Air Temperature [°C]

Command	Response	Comment
aM2!	a0011<CR><LF>	
aD0!	a+tt.tt <CR><LF>	The sign will change to – for negative temperatures

aM3!, aC3! : Measure Dew Point

Command	Response	Comment
aM3!	a0011<CR><LF>	
aD0!	a+dd.dd<CR><LF>	The sign will change to – for negative temperatures

The approximate calculations of dew point (frost point) and absolute humidity are based on the measured values of air temperature and relative humidity and on the Magnus formula:

R_H: relative humidity [%]   T: Temperature [°C] T_K: Temperature in Kelvin [K]

T_D: dew point temperature [°C] P_V: vapour pressure [hPa] P_{Vsat}: saturated vapour pressure [hPa]

C_E: estimated cloud base [m]

Parameters:

a = 7.5, b = 237.3 for T >= 0
a = 7.6, b = 240.7 for T < 0 above water (dew point)
a = 9.5, b = 265.5 for T < 0 above ice (ice point)

$R^* = 8314.3$ J/(kmol*K) (molar gas constant)
$m_w = 18.016$ kg (molecular weight of water vapour)
A_H = absolute humidity in g water vapour per m^3 of air

Formulas:

$P_{Vsat} = 6.1078 * 10^{((a*T)/(b+T))}$

$P_V = (R_H /100) * P_{Vsat}$

$T_D = (b * v)/(a-v)$ where v = log10(P_V / 6.1078)

$T_K = T + 273.15$

$A_H = 10^5 * (m_w / R^*) * (P_V / T_K)$

$C_E = (T-T_D) * 120$

aM4!, aC4! : Measure Relative Humidity [%], Air Temperature [°C] and Dew Point [°C]

Command	Response	Comment
aM4!	a0013<CR><LF>	
aD0!	a+hh.hh+tt.tt+dd.dd<CR><LF>	The sign will change to – for negative temperatures

aM5!, aC5! : approximate calculation of absolute humidity [g/m3]

Air Humidity, Temperature and Barometric Pressure Sensor Manual

Command	Response	Comment
aM5!	a0011<CR><LF>	
aD0!	a+www.ww <CR><LF>	

aM6!, aC6! : estimate cloud base [m] (estimation; cannot replace a ceilometer measurement)

Command	Response	Comment
aM6!	a0011<CR><LF>	
aD0!	a+ccccc <CR><LF>	

aM7!, aC7! : Humidity+Temperature+DewPoint+FrostPoint+absolute humidity+estimate cloud

Command	Response	Comment
aM7!	a0016<CR><LF>	
aD0!	a+hh.hh+tt.tt+dd.dd+ff.ff+www.ww+ccccc<CR><LF>	The sign will change to – for negative temperatures

3.8 Supported SDI-12 Commands

Following commands are supported by TBSHT02:

Command	Description	Response
a!	Acknowledge Active	a<CR><LF>
aI!	Send Identification	allccccccccmmmmmmvvvxxxxxxxxxxxx<CR><LF> Identification information
aAb!	Change Address	b<CR><LF> Changing the probe sensor address
?!	Address Query	a<CR><LF>
aM!	Start Measurement	atttn<CR><LF> Delay (ttt) in seconds and number of values (n) up to 9
aMn!	Additional Measurement	atttn<CR><LF> Delay (ttt) in seconds and number of values (n) up to 9 A response of a0000<CR><LF> is provided indicating the additional measurement are not supported in sensor
aMC!	Start Measurement and Request CRC	a0000<CR><LF> Supported
aMCn!	Additional Measurement and Request CRC	a0000<CR><LF> Supported
aC!	Start Concurrent Measurement	atttnn<CR><LF>

Air Humidity, Temperature and Barometric Pressure Sensor Manual

		Delay (ttt) in seconds and number of values (nn) up to 20
aCn!	Additional Concurrent Measurement	a0000<CR><LF> supported
aCC!	Start Concurrent Measurement and Request CRC	a0000<CR><LF> supported
aCCn!	Additional Concurrent Measurement and Request CRC	a0000<CR><LF> supported
aV!	Start Verification	a0000<CR><LF> Not supported
aRn!	Continuous Measurement	a<CR><LF> Not supported
aRCn!	Continuous Measurement and Request CRC	a<CRC><CR><LF> Not supported

Table 1 – Standard SDI-12 commands

3.9 Supported Extended Commands

Command	Description	Response
aXSNnnnnnn!	Set serial number (6 digits)	aX_OK<CR><LF>
aXC!	temperature unit Celsius (default factory setting)	aX_OK<CR><LF>
aXF!	temperature unit Fahrenheit	aX_OK<CR><LF>

Table 2 – Extended SDI-12 Commands

Air Humidity, Temperature and Barometric Pressure Sensor Manual

4   Application Example

This chapter is a practical guide on how to set up a TBSHT02 , interface it to a PC with a TBS03 SDI-12 to USB converter and carry out measurements.

4.1 Setting up TBSHT02 together with TBS03

4.1.1 Requirements

User Interface

Any hyper terminal (e.g.: Windows Hyper Terminal, Terminal V1.9B, RealTerm) or specific application software (e.g. LabVIEW VI)

Hardware Interface

PC or laptop with USB interface and mini USB-B cable (USB cable supplied with TBS03)

4.1.2 Driver

Silicon Labs CP210x driver must be installed on PC (on CD supplied with TBS03 or download from Silicon Labs)

Do not connect TBS03 to the PC, when starting the CP2102 driver installation process!

1) Start the driver installation executable

2) Follow the installation instructions step by step until the driver installation process is finished

3) The system may need to restart

4) Upon restart after successful driver installation (and not before), connect the TBS03 to the USB interface of the PC

5) Wait until you get the notification, that the new hardware has been installed and is ready to use.

Some terminal programs need manual COM port set up.

Open the hardware manager to check the COM port number assigned to the Silicon Labs USB bridge.

Every TBS03 device is serialized with an individual number. This enables the use of several TBS03's in parallel on a single PC or Laptop.

4.2   Hardware

- Connect the USB / SDI-12 Converter to PC via USB port.
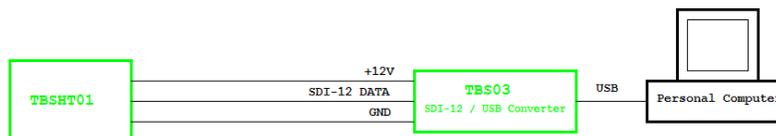- Connect the TBSHT02 SDI-12 interface to the TBS03 SDI-12 data Interface.

Figure 3 – Setup

Air Humidity, Temperature and Barometric Pressure Sensor Manual

4.2.1 Setting up the HyperTerminal application

- Open the hardware manager to check the COM port number assigned to the Silicon Labs USB bridge.
- Start the Windows HyperTerminal application.
- Connect to the COM Port assigned to the SDI-12 USB converter.
- Set the COM speed to 19200, 8 Bits, No Parity, 1 Stop Bit, No Handshake.
- In Settings, click "ASCII Setup" and activate "Send line ends with line feed" and "Echo typed characters locally".

4.3 Operation

4.3.1 SDI-12 / USB converter transfer mode

Every mode of TBS03 needs to be initialized with an ASCII string. Upon reception, the TBS03 will switch into the initialized mode and remain in this mode until the device receives an initialization string for another mode or the device gets disconnected. At the start up time, *"Transfer Mode"* is the default mode.

Transfer Mode initialisation:

In Windows hyper terminal, enter **run sdi recorder** and press the enter key (or <CR><LF>)

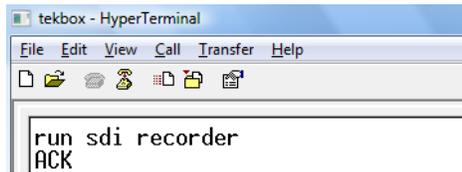The TBS03 will respond with *ACK<CR><LF>*

Figure 4 – TBS03 Transfer mode initialization using Windows Hyper Terminal

The TBS03 is now in transfer mode and ready to transfer commands to the sensor and respond data to the PC.

The following screenshots show how to communicate with the TBSHT02.

TBS03:   Entering *0I!* <CR><LF> will respond with the sensor ID:

TBSHT02 response: 013TEKBOXVN_TBSHT02_V0.10_000001 *<CR><LF>*

Upon sending the ID command **0I!**, the sensor responds with SDI-12 compatibility level, Manufacturer name, Model name, Firmware release number and serial number
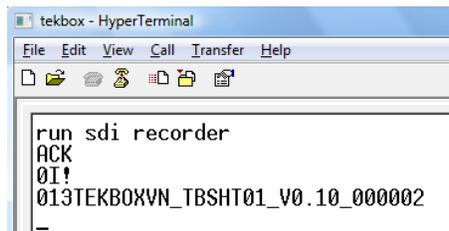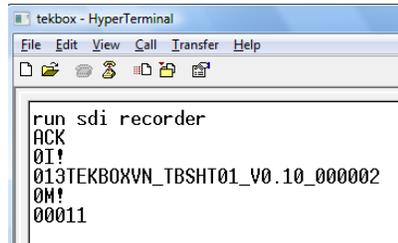

Figure 5 – TBSHT02, sensor response to ID command 0I!

TBS03:   Entering *0M!* <CR><LF> will respond with:

Air Humidity, Temperature and Barometric Pressure Sensor Manual

TBSHT02 response: *00011 <CR><LF>*

which means that the sensor will be able to deliver 1 value after an acquisition time of 1 second
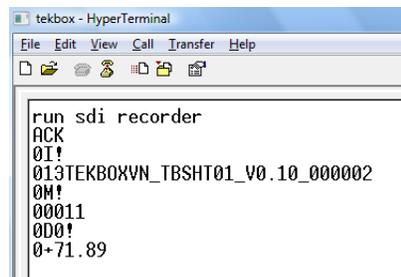

*Figure 6 – TBSHT02 response to Start Measurement command **0M!***

TBS03:   Entering ***0D0!*** <CR><LF> will respond with:

Sensor response: *0+71.89 <CR><LF>*

where 71.89 is the measured air humidity level of 71.89%

*Figure 7 – TBSHT02 response to Send Data command **0D!***

TBS03:   Entering ***0M1!*** <CR><LF> will respond with:
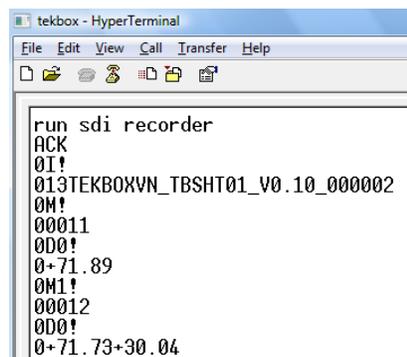
TBSHT02 response: *00012 <CR><LF>*

which means that the sensor will be able to deliver 2 values after an acquisition time of 1 second

TBS03:   Entering ***0D0!*** <CR><LF> will respond with:

Sensor response: *0+71.73+30.04 <CR><LF>*

where 71.73 is the measured air humidity level of 71.73% and 30.04 is the air temperature of 30.04°C

*Figure 8 – TBSHT02 response to commands **0M1!** and **0D!***

Air Humidity, Temperature and Barometric Pressure Sensor Manual

Other SDI commands will work similarly.

4.3.2 Auto-measurement mode

Auto-measurement mode is only available on TBS03 with option OTBS03-1 or option OTBS03-2

Like SDI Transfer commands, this application sends measurement commands which are set up by the user, to the SDI-12 / USB interface. Then, it automatically collects measured data by sending aDn! commands and transfers the data via USB Interface. After that, the next measurement command is started with a user defined time interval inbetween consecutive measurements. The maximum timer value is 4294967295ms. The maximum number of different SDI-12 measurement commands in an auto measurement string is 9. Auto-measurement mode is stopped by sending *stop* <CR><LF>

Syntax: run *auto <measurement command 1> <timer value 1> ... <measurement command n> <timer value n>*

Example of controlling a TBSHT02 in auto measurement mode:

TBS03: Entering ***run auto 0M4!* 10000**<CR><LF> will respond with periodicially measured temperature, humidity and dew point (frost point) values. The time interval between two consecutive measurements is 1000ms:

```
run auto 0M4! 1000
ACK

0M4!: 0+71.96+30.08+24.45
0M4!: 0+71.92+30.09+24.46
0M4!: 0+71.89+30.10+24.46
0M4!: 0+71.86+30.10+24.45
0M4!: 0+71.83+30.11+24.46
0M4!: 0+71.80+30.12+24.46
0M4!: 0+71.76+30.13+24.46
0M4!: 0+71.73+30.15+24.46
0M4!: 0+71.67+30.15+24.45
0M4!: 0+71.67+30.15+24.45
.
.
.
0M4!: 0+71.64+30.16+24.45
0M4!: 0+71.60+30.17+24.45
0M4!: 0+71.60+30.17+24.45
stop
ACK
```

Air Humidity, Temperature and Barometric Pressure Sensor Manual

5   Tools for TBS03

The TBS03 can be controlled using hyper terminals or customized PC application software. National Instruments, for example, offers a LabView SDI-12 API which could be used for designing customized applications for TBS03.

When using Hyper Terminal programs, take care that the representation of <CR><LF> may be different for different programs.

Windows Hyper Terminal requires activatation of "Send line ends with line feed" in ASCII setup and thereafter pressing the ENTER-key results in <CR><LF>

Many Hyper Terminal programs require \n at the end of each SDI-12 string – e.g. *0M!\n or run sdi recorder\n*

Terminal v1.9b – 20080315β – by Br@y ++ requires adding $0D$0A for <CR><LF>. This tool offers user defined macros for frequently used commands - a convenient feature when working with TBS03.
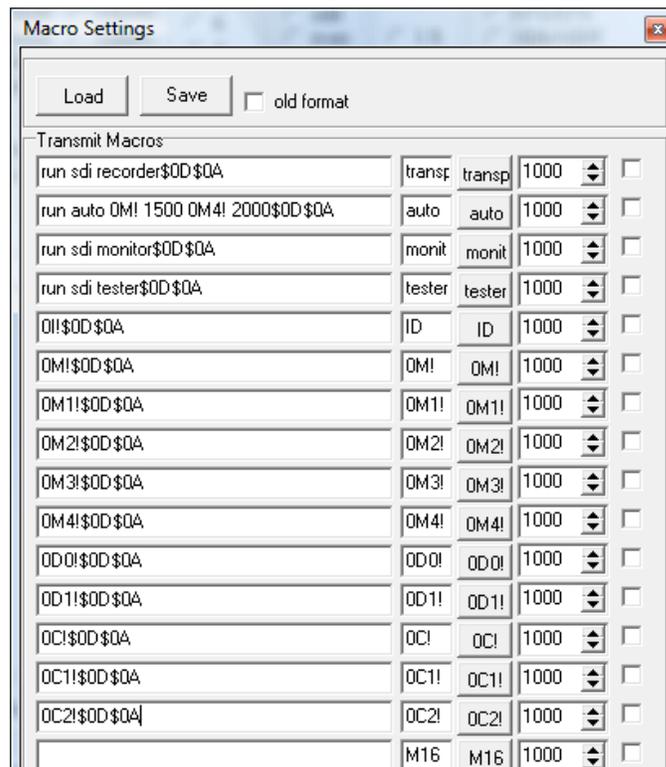

Figure 9 – Terminal v1.9b, defining Macros for mode initialization and SDI-12 commands

Air Humidity, Temperature and Barometric Pressure Sensor Manual

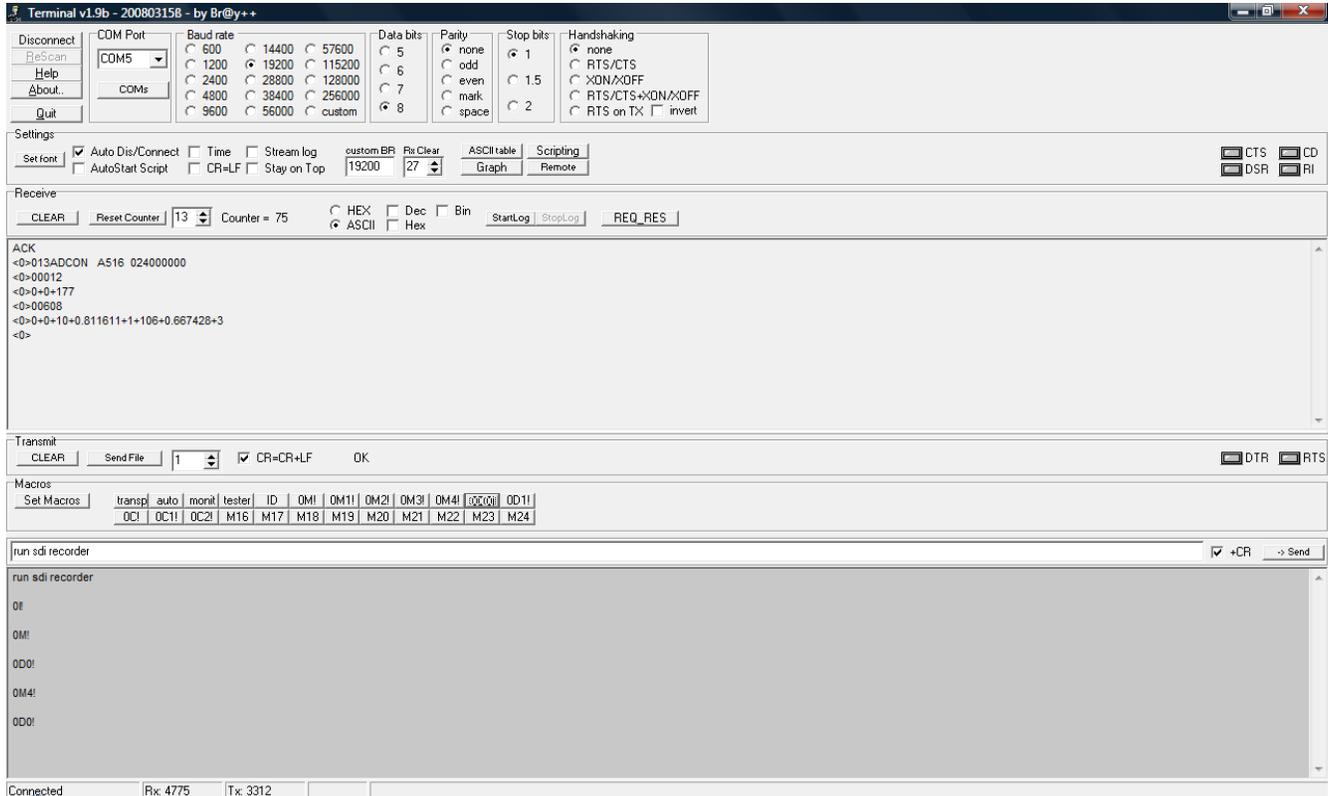When manually entering commands in Terminal v1.9b, tick the CR=CR+LF and +CR box.

Figure 10 – Example set up of Terminal v1.9b

The above mentioned Hyper Terminal Programes are just examples to highlight that using such tools requires to take care of their way to handle <CR><LF>.

Air Humidity, Temperature and Barometric Pressure Sensor Manual

6   Technical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Is	Supply current	Active mode	3.8	4	4.2	mA
Is	Supply current	Sleep mode	25	30	35	µA
Vs	Supply voltage		6	12	17	V
tm	Measurement Time	Time in active mode per measurement			700	ms
RH_{range}	Relative humidity measurement range		0		100	%RH
RH_{res}	Relative humidity resolution			0.04		%RH
RH_{tol}	Relative humidity accuracy tolerance			±1.8	see fig. 13	%RH
RH_h	Relative humidity hysteresis			±1		%RH
RH_{rep}	Relative humidity repeatability			±0.1		%RH
RH_{drift}	Relative humidity long term drift			<0.5		%RH / year
T_{range}	Temperature measurement range		-40		+85	°C
T_{res}	Temperature resolution			0.01		°C
T_{tol}	Temperature accuracy tolerance			±0.2	see fig.14	°C
T_{res}	Temperature long term drift			<0.04		°C / year

Table 3 – Technical Specifications RHT sensor
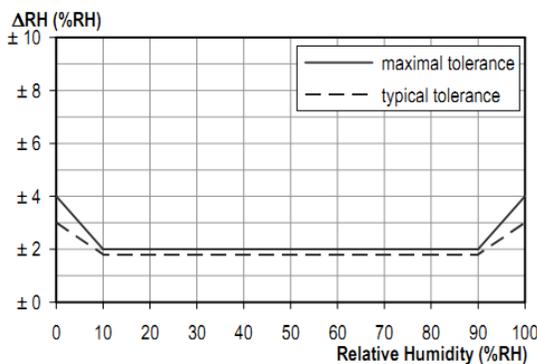

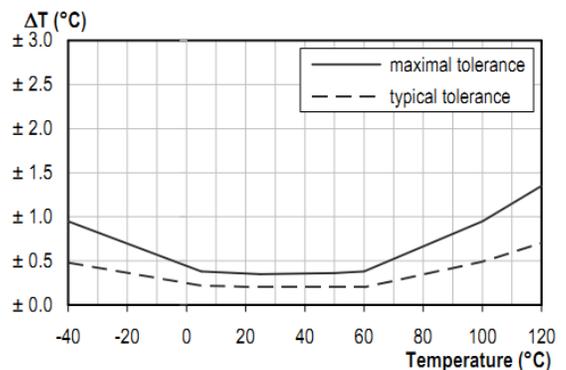*Figure 11 – RH, typical and maximum tolerance at 25℃*

Figure 12 –maximum tolerance for temperature sensor

Air Humidity, Temperature and Barometric Pressure Sensor Manual

7 Environmental Specifications

Symbol	Parameter	Conditions	Min	Max	Unit
T_A	Operating Ambient Temperature Range		-40	+85	°C
T_{STG}	Storage Temperature Range		-50	+90	°C
	humidity level		0	100	%

Table 4 - Environmental Specifications

8 Cable Connection

Cable Colour	Signal Assignment
Red	SDI-12 Power
Yellow	SDI-12 Data
Brown	GND
Black	Shield (GND)

Table 5 – Cable Connection

9 Ordering Information

Part Number	Description
TBSHT02	Air Humidity, Temperature, SDI-12 Interface, Hygrosens housing 4-wire cable (SDI-12 Power, SDI-12 Data, GND, Shield), cable length: 5m

Table 6 – Ordering Information

10 History

Version	Date	Author	Changes
V1.0	16.05.2013	Mayerhofer	Creation of the document

Air Humidity, Temperature and Barometric Pressure Sensor Manual

Table 7 – History