TEKBOX
DIGITAL SOLUTIONS

Air Humidity, Temperature and Barometric Pressure Sensor Manual

The TBSHT(P)06 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, optional MEMS chip measures barometric pressure.
Each sensor chip is individually factory-calibrated.
The TBSHT06/TBSHTP06 PCB assembly is silicon casted inside the sensor housing. A replacable PTFE filter cap with 10μm pore diameter provides dust and insect protection. The sensor has a length of 100mm and a diameter of 16mm.
The sensor can be supplied as air temperature / relative humidity variant with part number TBSHT06 or as temperature / relative air humidity /barometric pressure sensor with part number TBSHTP06.

TBSHT06/TBSHTP06 air humidity, air temperature and barometric pressure sensor

Features

- Air humidity, temperature and barometric pressure sensor
- SDI-12 Interface
- Digital temperature sensor: ±0.2°C
  (range: 0 - 90°C)
- Air humidity sensor tolerance: ±2%RH
  (range: 0 – 100%)
- Barometric pressure sensor tolerance: : ±0.5hPa (range: 300-1250hPa)
- Replaceable PTFE filter cap, 10μm
- SDI-12 Standard V1.3
- 6 - 17V supply voltage
- Power consumption:
  - Active: 8 mA
  - Idle: 24μA

- Operating Temperature Range: - 40°C … + 85°C
- Dimensions: 100 mm x 16 mm

Target Applications

- SDI-12 Sensor Networks

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1   Introduction

Note: this user manual is relevant only to TBSHT06 and TBSHTP06 products which have FW version 16.0.01.04 (TBSHT06) / 17.0.01.04 (TBSHTP06) or above.
For other FW versions, refer to user manual v2.1.

Checking TBSHT06/TBSHTP06 FW version:
- **Send 0I!**
- **Response:**
    - **TBSHT06: 013TBSHT6rvD1234561600104 => TBSHT06 FW version 16.0.01.04**
    - **TBSHTP06: 013TSHTP6rvD1234561700104 => TBSHTP06 FW version 17.0.01.04**

1.1   Product Features

TBSHT06/TBSHTP06 is based on a factory calibrated sensor chips, a low power controller and robust SDI-12 interface hardware:

- Measurement of air humidity, air temperature, barometric pressure (optional) and calculation of absolute air humidity, dew/frost point

- 5V, 1200 baud SDI-12 data interface with transient protection

- Power supply: 6 - 17V, current: 8 mA (active) / 24µA (idle)

- Sensor dimensions: 100 mm, Ø 16 mm

- Operating temperature range: -40°C … +85°C

1.2   Calibration

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

Nevertheless for some specific conditions, additional temperature calibration methods are available. The different options are further described in a [dedicated chapter](#).

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.

The sensor shall not be used in condensing environment nor exposed to salt or other chemicals as it may alter the measurement accuracy or even result in damages to the sensing elements.

1.4   Installation

The TBSHT06/TBSHTP06 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.

The sensor is equipped with a PTFE filter cap with a pore size of 10 micron. It is advised to replace the filter cap every year as it may become clogged by dust or other debris.

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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 standard is available on the website of the SDI-12 Support Group.

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

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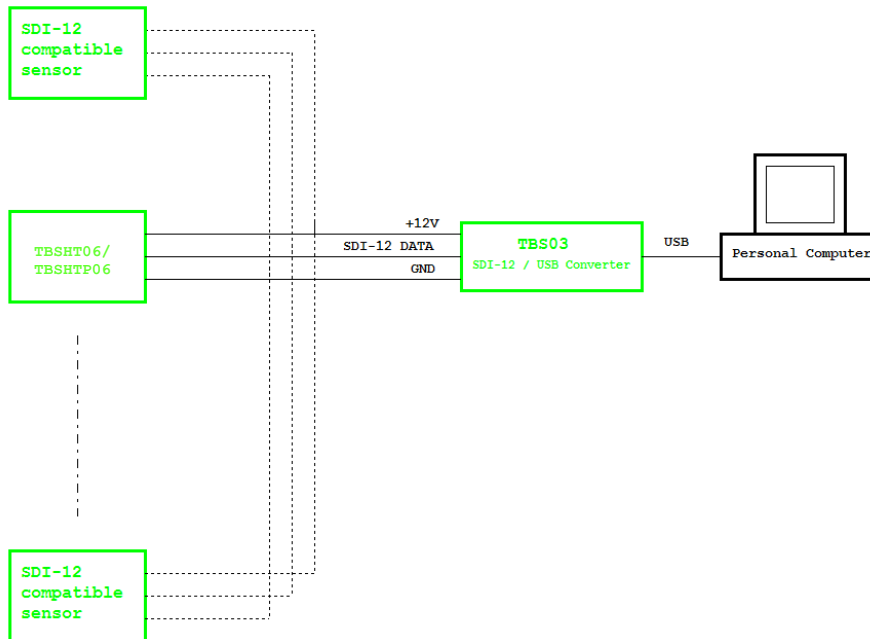## 2 Application Examples

Figure 1 – TBSHT06/TBSHTP06 sensors connected to TBS03 SDI-12 to USB converter, setup for controlling / testing sensors and for PC based data recording
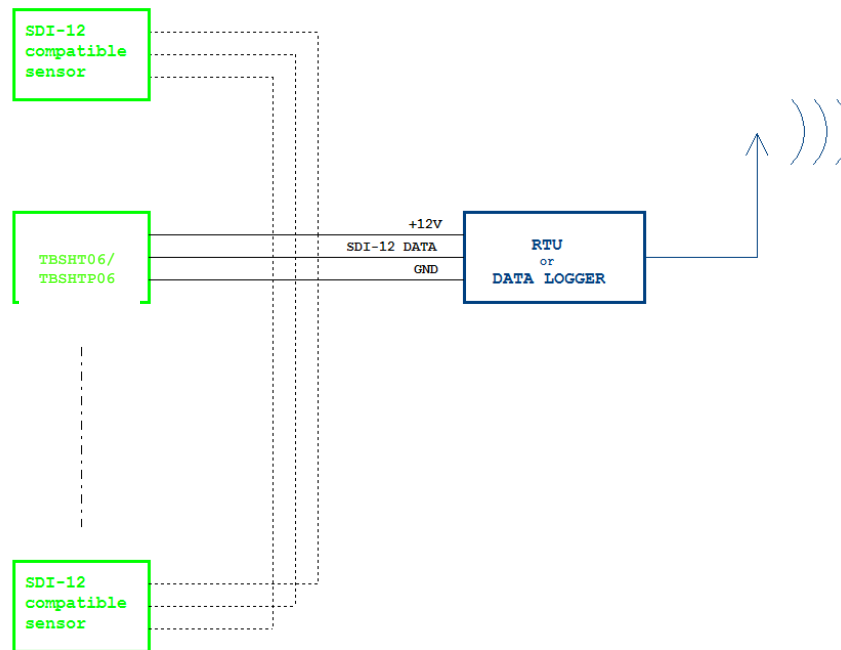

Figure 2 – TBSHT06/TBSHTP06 sensor(s) connected to Remote Telemetry Unit or Data Recorder

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. The TBSHT06/TBSHTP06 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 the TBSHT06/TBSHTP06, the TBS03 extracts the corresponding ASCII strings and sends them to the USB Virtual COM Port of the PC.

In remote applications, the TBSHT06/TBSHTP06 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.

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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 **0M!**
Sensor 0 may respond **00053** which means the sensor will take 5 second to deliver 3 measurement values.
After min. 5 seconds, the data recorder can send the *"Read Data Command"* **0D0!** to which Sensor 0 replies **0+68.83+25.29+19.1626**. +68.83+25.29+19.1626 are the three measurement results corresponding to air humidity (68.83), air temperature (25.29) and dew point (19.1626).

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 **aI!**:

allccccccccmmmmmmvvvxxxxxxxxxxxxx<CR><LF>

Example: 013TEKBOXVNTSHTP6rvD1234561700104<CR><LF>

Where:	0	SDI-12 Sensor address
	13	SDI-12 version number, version 1.3
	TEKBOXVN	Company name
	TSHTP6	Model Name
	rvD	HW version
	123456	Serial number
	1700104	FW version

Remark about the model name field *mmmmmm*:
- For TBSHTP06:   *mmmmmm* is TSHTP6
- For TBSHT06:   *mmmmmm* is TBSHT6

3.4   Sensor Address

Each TBSHT06/TBSHTP06 is delivered with a default address of "0"
The TBSHT06/TBSHTP06 accepts SDI-12 addresses in the range "0" to "9", "A" to "Z" and "a" to "z". Setting the TBSHT06/TBSHTP06 address can be done using the "*Change Address Command*" **aAb!**.

Note:
- If the new address is invalid, the current address will be kept.
- The TBSHT06/TBSHTP06 will remain unresponsive for approximately 1 second while the new address is saved in the EEPROM memory.
- The TBSHT06/TBSHTP06 interface supports "**?**" as an address only for *"Acknowledge Active"* Command **a!**.

3.5   Measurement

The TBSHT06/TBSHTP06 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 TBSHT06/TBSHTP06 sensor interface will not support the *"Continuous Measurement"* Command **aRn!** and *"Continuous Measurement and Request CRC"* Command **aRCn!**. The TBSHT06/TBSHTP06 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 TBSHT06/TBSHTP06 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:

Commands	Parameters	Units	Example: measurements returned by 0D0! (TBSHTP06)
aM! aMC! aC! aCC!	Relative humidity, Air temperature, Dew/Frost point, Barometric pressure[(*)]	% °C / °F °C / °F hPa	0+68.83+25.29+19.1626+1006.53
aM1! aMC1! aC1! aCC1!	Absolute humidity, Cloud base, Altitude[(*)]	g/m^3 m m	0+16.14+748.433+58.2094

[(*)]: TBSHTP06 only

Extended SDI-12 commands:

aXC!	Set temperature unit to Celsius (default factory setting)
aXF!	Set temperature unit to Fahrenheit
aXM*<m>*!	Select the measurement mode
aXLS*<pid><rid><mid><coeff>*!	Set the custom calibration parameters and coefficients
aXLG*<pid><rid><mid>*!	Get the custom calibration parameters and coefficients
aXG!	Get previous extended SDI-12 command execution status

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3.7 Parameters
3.7.1 Measured parameters

Only 3 parameters are actually measured while others are calculated from these values.

Parameter	Sensor	Operating range
Temperature	Digital IC	-40 ℃ to +85 ℃
Relative humidity	Digital IC	0 – 100%
Barometric pressure	Digital IC (TBSHTP06)	300 – 1250 hPa

Refer to the technical specification for further details.

3.7.2 Calculated parameters

Given the below measured parameters:
- R_H: relative humidity [%]
- T: temperature [°C] (T_K: temperature in Kelvin [K])
- P_B: barometric pressure [hPa]

The following parameters are estimated:
- T_D: dew point temperature [°C]
- P_V: vapour pressure [hPa]
- P_{Vsat}: saturated vapour pressure [hPa]
- C_E: estimated cloud base [m]
- A_H = absolute humidity in g water vapour per m^3 of air
- h_E: estimated altitude [m]

Using following formulas (these are given for reference only as there are many different implementations available depending on the environment and expected tolerance):

Saturated vapour pressure
It is calculated based on Tetens formula for temperature equal or above zero degree Celcius:

$P_{VSat} = 6.1078 * e^{17.27T/(T+237.3)}$

And the Murray's variant is applied for negative temperatures:

$P_{VSat} = 6.1078 * e^{21.87T/(T+265.5)}$

Vapour pressure

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

Dew point (Temperature ≥ 0) / frost point (Temperature < 0)

$T_D = (b * \alpha(T, R_H)) / (a - \alpha(T, R_H))$

Where:

$\alpha(T, R_H) = \ln(R_H/100) + aT/(b+T)$

a=17.625 and b=243.04 are the Magnus coefficients values as recommended by Alduchov and Eskrige.

Absolute humidity

Temperature in Kelvin: $T_K = T + 273.15$

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

Where:

- $R^* = 8314.3$ J/(kmol*K) (molar gas constant)
- $m_w = 18.016$ kg (molecular weight of water vapour)

Estimated cloud base

$C_E = (T-T_D) * 122$

Estimated altitude

From the barometric pressure formula, the estimated altitude is

$h_E = - \frac{R*T}{g*M} * \ln(\frac{P}{P0})$

Where:

- $P_0 = 1013.25$ hPa (pressure at sea level)
- $R = 8.31432$ N.m/(mol.K) (universal gas constant)
- $M = 0.0289644$ kg/mol (air molar mass)
- $g = 9.81$ m/s^2 (acceleration due to gravity)
- P: pressure [hPa]
- T_K: temperature [K]

3.8   Temperature and humidity calibration

Both temperature and humidity measurements can be calibrated using various kind of compensation methods described below.

Refer to the technical specification and the extended commands description for further details.

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3.8.1 Temperature calibration

TBSHT(P)06 uses a digital IC sensing element to measure the temperature, which ensures a typical tolerance of ±0.2°C over 0°C to 90°C.

However the use of a protective PTFE filter cap impacts the actual temperature measurement tolerance depending on ambient conditions.

TBSHT(P)06 has then been finely tuned to achieve the following tolerance: ±0.50 °C when temperature is between -20 °C to 60 °C and temperature changing no more than 1 °C/10 minutes (calibration mode 2 – cf below).

These are the default factory settings that are applied.

The external command **XM** allows switching between different measurement modes:
- Raw values: in that mode, no calibration is applied to the temperature measurements
  - Command: **XM0!**
- Custom calibration: in this mode, it is possible to define a custom calibration to be applied on top of temperature raw measurements by using extended command **XLS**
  - Command: **XM1!**
- Factory calibration: this is the default embedded temperature calibration described above.
  - Command: **XM2!**

When the custom calibration is enabled with **XM1!**, a 2 levels custom calibration for temperature measurement can be configured by using **XLS** extended command and selecting the right index(however it's also possible to apply just one calibration method – cf below for details).

Given T_{raw} the raw temperature measured by the digital IC, the following 2 levels calibration is performed so T_{final} is returned by SDI-12 measurement command:
- First calibration level (**XLS0**): $T_{Cal\_lvl1} = T_{raw} + M_{lvl1}(T_{raw})$
- Second calibration level (**XLS1**): $T_{final} = T_{Cal\_lvl1} + M_{lvl2}(T_{Cal\_lvl1})$

Where M_{lvl1} and M_{lvl2} are one of the 4 available calibration methods.

4 different calibration methods are available on top of temperature raw values over the [T_{Min} ; T_{Max}] operating range:

- Method (O) - Offset: $T_{Meas} = T_{raw} + Offset$
- Method (L) – Linear: $T_{Meas} = aT_{raw} + b$
- Method (P) – Polynomial: $T_{Meas} = aT^3_{raw} + bT^2_{raw} + cT_{raw} + d$
- Method (R) – Multi ranges polynomials: same as above but up to 3 polynomials can be applied to 3 different and consecutive temperature ranges covering the whole operating range.

Notes:

- If only the first level is required, then the second level shall be configured with **XLS10O***min,max,*0!

Example:

TBSHT06 is deployed in an area where the actual temperature ranges from -10 °C to +25 °C.

The first method applied is multi polynomials calibration (method R) over 3 temperature ranges:

- Range **0**: -10 °C to 0 °C – Polynomial P_1 with coefficients a_1, b_1, c_1, d_1
  - 0XLS0**0**R-10,0, a_1, b_1, c_1, d_1!
- Range **1**: 0 °C to 10 °C – Polynomial P_2 with coefficients a_2, b_2, c_2, d_2
  - 0XLS0**1**R0,10, a_2, b_2, c_2, d_2!
- Range **2**: 10 °C to 25 °C – Polynomial P_3 with coefficients a_3, b_3, c_3, d_3
  - 0XLS0**2**R10,25, a_3, b_3, c_3, d_3!

The second method applied is an offset compensation (method *O)* on top of the multi polynomials calibration:

- Offset applied: -0.03 °C
  - 0XLS10O-10,25,-0.03!
  - The range index is set to zero as this parameter is relevenant only to multi polynomials calibration
  - The method applies to the whole operating range (-10 °C to 25 °C)

The calibration coefficients can be retrieved by using commands **XLG/XG**, for instance in the case of a polynomial calibration:

```
0XLS20P0,100,0.00009,-0.0129,0.6216,-6.784!
0Receive_OK
0XLG20P!
0Receive_OK
0XG!
0P+0,+100,+0.00009,-0.0129,+0.62159,-6.78399
```

3.8.2 Humidity calibration

TBSHT(P)06 measures the air humidity level through a digital IC and does not apply any compensation of this measurement.

Would there be a need to adjust the measured humidity, the commands **XLS** can still be used but with the calibration index set to 2 or 3:

- **XLS2… to configure the first calibration level**
- **XLS3… to configure the second calibration level**

Besides the specific calibration indexes used for humidity calibration, XLS command shall be used exactly as described in previous chapter.

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3.9 Supported SDI-12 Commands

Following commands are supported by the TBSHT06/TBSHTP06:

Command	Description	Response
a!	Acknowledge Active	a<CR><LF>

aI!	Send Identification	Identification information
		a13TEKBOXVN<mmmmmm>rv<h><nnnnnn><fffffff><CR><LF>
		With:
		   o <a>: SDI-12 address
		   o <mmmmmm>: model name
		        o TBSHT06: *TBSHT6*
		        o TBSHTP06: *TSHTP6*
		   o <h>: HW revision (one letter)
		   o <nnnnnn>: serial number (6 digits)
		   o <fffffff>: firmware version (7 digits)
		Example:
		013TEKBOXVNTSHTP6rvD1234561700100<CR><LF>

aAb!	Change Address	b<CR><LF> Changing the probe sensor address
?!	Address Query	a<CR><LF>

aM!	Start Measurement
	
	Measures:
	  o relative humidity [%]
	  o air temperature [°C or °F]
	  o dew/frost point [°C or °F]
	  o barometric pressure(*) [hPa]
		TBSHT06:
		a0053<CR><LF>
		Delay (5) seconds and number of values (3)
		
		TBSHTP06:
		a0054<CR><LF>
		Delay (5) seconds and number of values (4)

aM1!	Additional Measurement
	
	Measures:
	  o absolute humidity [g/m^3]
	  o cloud base [m]
	  o altitude(*) [m]
		TBSHT06:
		a0052<CR><LF>
		Delay (5) seconds and number of values (2)
		
		TBSHTP06:
		a0053<CR><LF>
		Delay (5) seconds and number of values (3)

aMC!	Start Measurement and Request CRC	**TBSHT06:** a0053<CR><LF> Delay (5) seconds and number of values (3)

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	Measures: - relative humidity [%] - air temperature [°C or °F] - dew/frost point [°C or °F] - barometric pressure(*) [hPa]	**TBSHTP06:** a0054\<CR>\<LF> Delay (5) seconds and number of values (4)
aMC1!	Additional Measurement and Request CRC Measures: - absolute humidity [g/m³] - cloud base [m] - altitude(*) [m]	**TBSHT06:** a0052\<CR>\<LF> Delay (5) seconds and number of values (2) **TBSHTP06:** a0053\<CR>\<LF> Delay (5) seconds and number of values (3)
aC!	Start Concurrent Measurement Measures: - relative humidity [%] - air temperature [°C or °F] - dew/frost point [°C or °F] - barometric pressure(*) [hPa]	**TBSHT06:** a00503\<CR>\<LF> Delay (5) seconds and number of values (3) **TBSHTP06:** a00504\<CR>\<LF> Delay (5) seconds and number of values (4)
aC1!	Additional Concurrent Measurement Measures: - absolute humidity [g/m³] - cloud base [m] - altitude(*) [m]	**TBSHT06:** a00502\<CR>\<LF> Delay (5) seconds and number of values (2) **TBSHTP06:** a00503\<CR>\<LF> Delay (5) seconds and number of values (3)
aCC!	Start Concurrent Measurement and Request CRC Measures: - relative humidity [%] - air temperature [°C or °F] - dew/frost point [°C or °F] - barometric pressure(*) [hPa]	**TBSHT06:** a00503\<CR>\<LF> Delay (5) seconds and number of values (3) **TBSHTP06:** a00504\<CR>\<LF> Delay (5) seconds and number of values (4)

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aCC1!	Additional Concurrent Measurement and Request CRC
	
	Measures:
	  o absolute humidity [g/m^3]
	  o cloud base [m]
	  o altitude$^{(*)}$ [m]
		TBSHT06:
		a00502<CR><LF>
		Delay (5) seconds and number of values (2)
		
		TBSHTP06:
		a00503<CR><LF>
		Delay (5) seconds and number of values (3)

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

(*): TBSHTP06 only

Table 1 – Standard SDI-12 commands

3.10 Supported Extended Commands

Command	Description	Response
aXC!	Temperature unit Celsius (default factory setting)	aReceive_OK<CR><LF>
aXF!	Temperature unit Fahrenheit	aReceive_OK<CR><LF>

aXM<*m*>!	Temperature measurement mode: temperature is reported
	
	<*m*>: calibration method
	  o 0: as raw values
	  o 1: with custom calibration
	  o 2: with factory calibration (default)
		aReceive_OK<CR><LF>

aXLS<*pid*><*rid*><*mid*> <*coeff*>!	Sets custom calibration parameters – **aXM1! must be sent beforehand**.
	
	<*pid*>: parameter calibration index
	  o 0: 1^{rst} calibration method applied to temperature
	  o 1: 2nd calibration method applied to temperature
	  o 2: 1^{rst} calibration method applied to humidity
	  o 3: 2nd calibration method applied to humidity
	
	<*rid*>: range index (0 – 2) when multi-polynomial method is used (*mid*=R). Set to zero otherwise.
		aReceive_OK<CR><LF>

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	<mid>: calibration method index
	
	     o O: Offset
	     o L: Linear
	     o P: Polynomial
	     o R: multi-ranges polynomials
	
	 <coeff>: coefficients list, depends on *<mid>* setting
	
	     o O: *min,max,offset*
	     o L: *min,max,a,b*
	     o P: *min,max,a,b,c,d*
	     o R: *min,max,a,b,c,d*
	     o Where:
	           o *min/max/offset/a/b/c/d* are float numbers
	           o *a/b/c/d* are polynomial coefficients (maximum of 5 decimal digits)
	           o *min/max*: whole temperature or humidity operating range. In case the multi-range polynomial method is used, it defines the boundaries of each range (selected by *rid*).	

aXLG*<pid><rid><mid>*!	Select custom calibration coefficients to be retrieved depending on calibration index *pid* and calibration method *mid.* If *mid=R* then *rid* can hold indexes 0, 1 or 2, otherwise this parameter must be set to zero. The values can then be retrieved using **aXG!** Command.	aReceive_OK<CR><LF>
aXG!	Get the status of previously executed extended SDI-12 command. If **aXLG** command has been previously executed, it will return the calibration coefficients Returned coefficients have the same format than SDI-12 data command aDx! response	aX_OK<CR><LF> or aX_FAIL<CR><LF> or a*<coeff>*<CR><LF> Where: *<coeff>*: coefficients list, depends on *<mid>* setting

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			o	O: min,max,offset
			o	L: min,max,a,b
			o	P: min,max,a,b,c,d
			o	R: min,max,a,b,c,d

Table 2 – Extended SDI-12 Commands

4 Technical specification

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Electrical characteristics						
Is	Supply current	Active mode		8		mA
Is	Supply current	Sleep mode		24		µA
Vs	Supply voltage		6	12	17	V
Temperature sensor						
T_{Tol}	Accuracy tolerance	Typ, 0°C to +90°C		±0.2	see Figure 3	°C
$t_{0.63}$	Response time			>2		s
T_{res}	Temperature resolution	Typ.		0.01		°C
T_{range}	Temperature measurement range		-40		+85	°C
T_{drift}	Long term drift				<0.03	°C/yr
T_{rep}	Repeatability	At constant ambient conditions	0.15	0.08	0.04	°C
Humidity sensor						
RH_{range}	Relative humidity measurement range		0		100	%RH
RH_{res}	Relative humidity resolution			0.01		%RH
RH_{tol}	Relative humidity accuracy tolerance			±2	see Figure 4	%RH
RH_h	Relative humidity hysteresis	At 25 °C		±0.8		%RH
RH_{rep}	Relative humidity repeatability	Medium		±0.15		%RH

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Symbol	Parameter	Conditions	Min	Typ	Max	Unit
RH_{drift}	Relative humidity long term drift			<0.25		%RH / year
Pressure sensor						
P	Barometric pressure range	With temperature between -40 °C and +85 °C (full accuracy: 0°C and +65 °C)	300	-	1250	hPa
A_{rel}	Relative pressure accuracy	700 . . . 1100 hPa +25 °C to +40 °C 10kPa steps		±0.03		hPa
A^{P}_{full}		900 hPa +25 °C		±0.33		hPa
A^{P}_{full}		300 . . . 1100 hPa 0 . . . +65 °C		±0.50		hPa
A^{P}_{ext}	Absolute pressure accuracy	900 . . . 1100 hPa +25 °C . . . +40 °C		±0.40		hPa
A^{P}		1100 . . . 1250 hPa 0 °C . . . +65 °C		±0.50		hPa
A^{P}		300 . . . 1100 hPa -20 °C		±0.50		hPa
TCO	Temperature coefficient offset	900 hPa, +25 °C to +40 °C		±0.6		Pa/K
ΔP_{Stab}	Long term stability	12 months		±0.16		hPa

Table 3 – Technical specification

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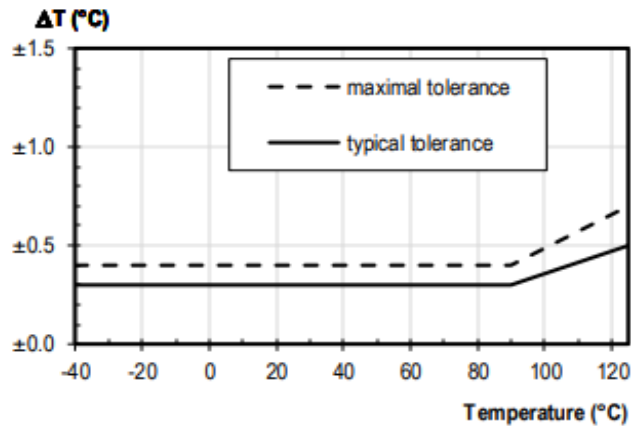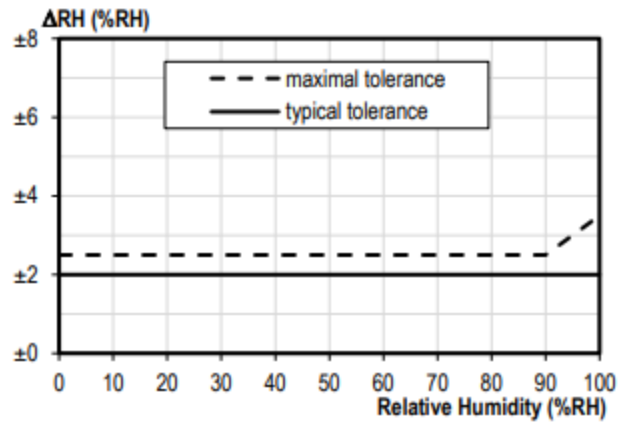

Figure 3 – Temperature accuracy

Figure 4 – RH, typical and maximum tolerance at 25°C

5   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

6   Cable Connection

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

Table 5 – Cable Connection

7   Ordering Information

Part Number	Description
TBSHT06	Air Humidity, Temperature, SDI-12 Interface
TBSHTP06	Air Humidity, Temperature, Barometric Pressure sensor, SDI-12 Interface
ATRH_FIL	Replacement filter cap, PTFE, 10µm pore diameter

Table 6 – Ordering Information

8   History

Version	Date	Author	Changes
V1.0	17.07.2018	Mayerhofer	Creation of the document
V1.1	16.01.2020	Mayerhofer	Table 4 Update
V1.2	18.03.2020	Mayerhofer	Update from TBSHT(P)04 to new version TBSHT(P)06
V1.3	07.07.2021	Philippe Hervieu	Warm up time information
V2.0	03.01.2024	Philippe Hervieu	Update SDI-12 commands description following FW upgrade and pressure sensor change (BMP390)
V2.1	24.01.2024	Philippe Hervieu	Update SDI-12 identification string
V2.2	11.10.2024	Philippe Hervieu	Modify extended commands related to calibration / Update chapter 3.7 (calibration)

Table 7 – History