

## SDI-12 Sub-surface Soil Temperature Sensor

TBSST03 is a soil temperature sensor with SDI-12 interface that can operate over a wide temperature range. The electronic parts are mounted inside an UV resistant resin/glass fiber fabrics reinforced tube and the sensors are based on Swiss made PT1000 with 0.1 °C accuracy. The sensor is typically used to measure the temperature in situations where probing is difficult like in boreholes or soil trenches.



*TBSST03*

### Features

- Soil temperature sensor
- Short response time
- Excellent long term stability
- SDI-12 Standard V1.3
- 6 - 16V supply voltage
- Less than 80µA idle current
- Temperature accuracy: 0.1 °C
- Temperature resolution: 3 digits

- Dimensions: 19x18x4 cm
- Weight: 400 g
- Operating Temperature Range:  
- 40°C ... + 80°C

### Target Applications

- Soil temperature monitoring in boreholes, trenches, etc...

# SDI-12 Sub-surface Soil Temperature Sensor

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# SDI-12 Sub-surface Soil Temperature Sensor

## 1 Introduction

The TBSST03 is a rugged soil temperature probe with SDI-12 interface.

The electronic parts are mounted inside an UV resistant resin/glass fiber fabrics reinforced tubes. The interior of the tube is potted with silicon for enhanced durability.

## 2 Measurement

The TBSST03 outputs the soil temperature.

Supported measurement commands:

**aM! aMC! aC! aCC!** **Temperature**

Extended SDI-12 commands:

**aXSNnnnnnn!** **Set serial number**  
**where nnnnnn: 6 digits serial number**

**aX0!** **Calibration at zero degree**

**aXT,ff.ff!** **Calibration at ambient temperature**  
**where: ff.ff the ambient temperature**

**aXSTUF!** **Set temperature unit to degree Fahrenheit**

**aXSTUC!** **Set temperature unit to degree Celcius**

## 3 Product Specification

- UV resistant resin/glass fiber fabrics reinforced tube
  - 18 mm outer diameter
  - 3.5 mm wall thickness
  - Length: 150 mm
  - Potted with silicon
- SDI-12 Standard V1.3
- 6 - 16V supply voltage
- Operating Temperature Range: - 40°C ... + 80°C
- Temperature accuracy: 0.1 °C
- Temperature resolution: 3 digits
- Weight: 400 g (without cable)

## SDI-12 Sub-surface Soil Temperature Sensor

- Dimensions: 19x18x4 cm
- Current consumption: active 10mA; idle 80µA
- Standard cable length: 3m; any other length upon requirement

### 4 Calibration

TBSST03 is factory calibrated by inserting a 1kΩ resistor in lieu of Pt1000 sensor (which is equivalent to a zero degree Celcius calibration).

However user calibration is also possible by setting the actual temperature based on a reference through aXT,ff,ff! SDI-12 command.

Example:

- aXT,+28.925! => calibrates with temperature +28.925 degrees Celcius

### 5 Installation

TBSST03 is compatible with any data logger or remote telemetry unit with SDI-12 interface (v1.3).

Refer to the data logger or RTU manual for further information.

### 6 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.

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 V1.4 which dates from December 1<sup>st</sup>, 2017. The standard is available on the website of the SDI-12 Support Group.

# SDI-12 Sub-surface Soil Temperature Sensor

## 7 Application Examples

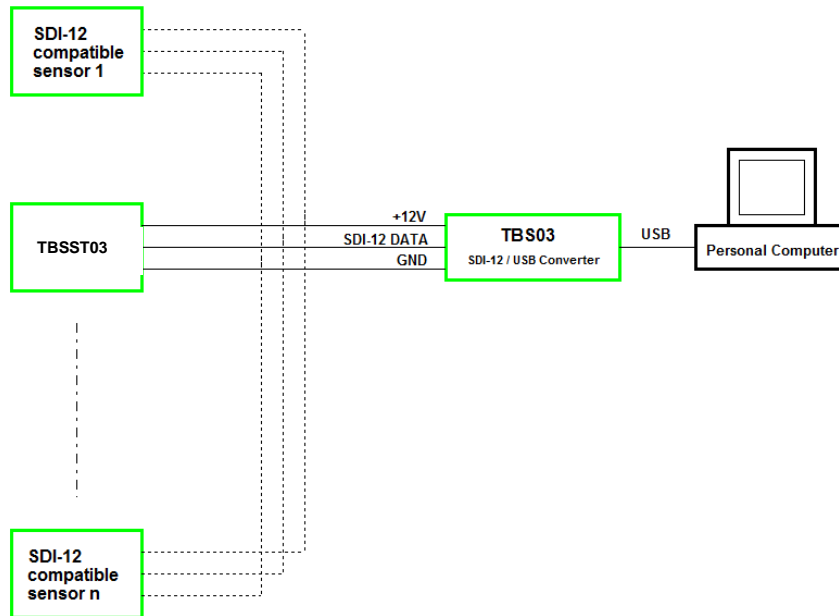


Figure 1 – TBSST03 and other sensors with SDI-12 interface connected to TBS03 SDI-12 to USB converter; setup for controlling / testing sensors and for PC based data recording

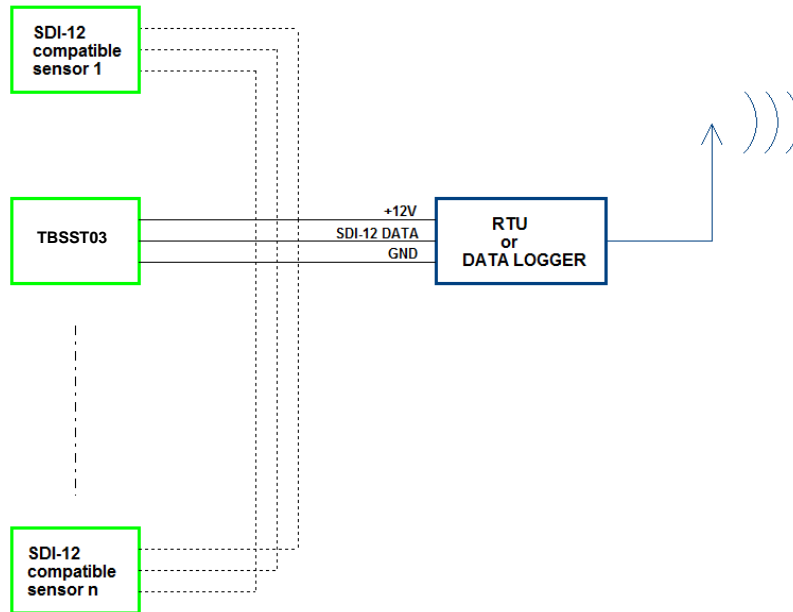


Figure 2 – TBSST03 and other sensors with SDI-12 interface connected to Remote Telemetry Unit or Data Recorder

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## 8 Functional description

Below is an example of SDI-12 communication between a SDI-12 Recorder and TBSST03 to retrieve the measured temperature:

*Measuring the temperature*

<b>SDI-12 Recorder</b>	<b>TBSST03</b>
OM!	00011
OD0!	0+23.876

User can choose to report the temperature in degree Celcius or Fahrenheit by using extended SDI-12 commands aXSTUC!/aXSTUF!.

## 9 Supported SDI-12 v1.3 Commands

Following commands are supported by the TBSST03:

Command	Description	Response
<b>a!</b>	Acknowledge Active	a<CR><LF>
<b>al!</b>	Send Identification	013TEKBOXVNTBSST3v.vnnnnnn<CR><LF> With nnnnnn representing the serial number and v.v representing the firmware version
<b>aAb!</b>	Change Address	b<CR><LF> Changing the sensor address from a to b
<b>?!</b>	Address Query	a<CR><LF>
<b>aM!</b>	Start Measurement Measures temperature	a0011<CR><LF> Delay: (1) seconds and number of values (1)
<b>aMC!</b>	Start Measurement and request CRC Measures temperature and calculates CRC	a0011<CR><LF> Delay: (1) second, number of values (1)
<b>aC!</b>	Start Concurrent Measurement Measures temperature	a00101<CR><LF> Delay: (1) second and number of values (01)
<b>aCC!</b>	Start Concurrent Measurement and request CRC Measures temperature and calculate CRC	a00101<CR><LF> Delay: (1) second, number of values (1)
<b>aD0!</b>	Get Measurement Result(s)	Upon issuing the aD0! Command, TBSST03 will send the measurement results.
<b>aV!</b>	Start Verification	a0000<CR><LF> Not supported
<b>aRn! aRCn!</b>	Continuous Measurement Continuous Measurement + CRC	a<CR><LF> Not supported

# SDI-12 Sub-surface Soil Temperature Sensor

Table 1 – Standard SDI-12 v1.3 commands

## 10 Supported Extended Commands

Command	Description	Response
<b>aXSNnnnnnn!</b>	Set 6 digits serial number nnnnnn	aX_OK<CR><LF>
<b>aX0!</b>	Temperature calibration at zero degree Celcius. Used for factory calibration using a 1kΩ resistor.	aX_OK<CR><LF>
<b>aXT,ff.ff!</b>	Temperature calibration (user settings) where: ff.ff: is the temperature in floating format (9 digits maximum including sign and decimal point)	aX_OK<CR><LF>
<b>aXSTUF!</b>	Set temperature unit to degree Fahrenheit	aX_OK<CR><LF>
<b>aXSTUC!</b>	Set temperature unit to degree Celcius	aX_OK<CR><LF>

Table 2 – Extended SDI-12 Commands

## 11 Mechanical Dimensions

- UV resistant resin/glass fiber fabrics reinforced tube
  - 18 mm outer diameter
  - 3.5 mm wall thickness
- Length: 150 mm

## 12 Cable Connection

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

Table 3 – Cable Connection

## 13 Ordering Information

Part Number	Description

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TBSST03	SDI-12 sub-surface soil temperature sensor
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Please mention in your order, if you require a different cable length

*Table 4 – Ordering Information*

### 14 History

Version	Date	Author	Changes
V1.0	24.12.2019	Philippe Hervieu	Creation of the document
V1.1	17.01.2020	Philippe Hervieu	Add pictures + dimensions
V1.2	13.02.2020	Philippe Hervieu	Temperature accuracy/resolution added
V1.3	17.02.2020	Philippe Hervieu	Update dimensions and weight
V1.4	16.03.2020	Philippe Hervieu	Update MC/CC responses
V1.5	22.06.2020	Hoa Hoang	Correction: 12 Cable Connection

*Table 5 – History*