

SDI-12 SOIL TEMPERATURE SENSOR

The TBSST02 is a sensor for monitoring soil temperature values in precision farming and environmental monitoring applications.

The TBSST02 has been designed to work in any type of soil. It has a low current consumption and an SDI-12 interface. It is ideally suited for battery or solar powered remote applications. The TBSST02 has short measurement time and fast response to any changes in the soil temperature. It is easy to install and easy to calibrate. The TBSST02 is a rugged, hermetically sealed design, equipped with a polyurethane protected cable.



Features

- Accurate soil temperature measurement
- PT1000 $\pm 0.15^{\circ}\text{C}$ accuracy
- 0.01°C resolution
- Suitable for any soil type
- SDI-12 Interface
- Low Power Consumption
- Simple installation
- Small size
- Rugged design
- Hermetically sealed
- Cable with PU jacket
- Operating Temperature Range:
-40°C - +85°C

Target Applications

- Agricultural monitoring
- Soil hydrology monitoring
- Erosion monitoring

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1 Introduction

The TBSST02 is a PT1000 based soil temperature sensor with SDI-12 interface. It offers a resolution of 0.01°C and $\pm 0.15^\circ\text{C}$ accuracy.



Figure 1 – TBSST02 Soil Temperature Sensor

2 Measurement

The TBSST02 outputs soil temperature

SDI-12 Measurement Commands:

aM!	Read soil temperature [$^\circ\text{C}$], [$^\circ\text{F}$]
aMC!	Read soil temperature [$^\circ\text{C}$], [$^\circ\text{F}$] – measurement with cyclic redundancy check
aC!	Read soil temperature [$^\circ\text{C}$], [$^\circ\text{F}$]
aCC!	Read soil temperature [$^\circ\text{C}$], [$^\circ\text{F}$] – measurement with cyclic redundancy check

Extended SDI-12 Commands:

aXC!	set temperature unit to Celsius ($^\circ\text{C}$)
aXF!	set temperature unit to Fahrenheit ($^\circ\text{F}$)
aXSTO,f,!f!	set temperature offset, example: 0XSTO,+00.03! -> add 0.03 degree offset;

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3 Product Specification

- SDI-12 Interface
- Supply voltage: 12V nominal; working range 6V17V
- Supply current: 8mA during measurement (1 sec); 80 μ A in sleep mode
- $\pm 0.15^{\circ}\text{C}$ accuracy
- 0.01 $^{\circ}\text{C}$ resolution
- Operating temperature range: -40 ... +85 $^{\circ}\text{C}$
- Dimensions: 140 x 29 x 9 mm

4 Calibration

The TBSST02 comes factory calibrated and does not require any user calibration. However, an extended SDI-12 command enables offset calibration, if required.

5 Installation

The TBSST02 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.

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

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7 Application Examples

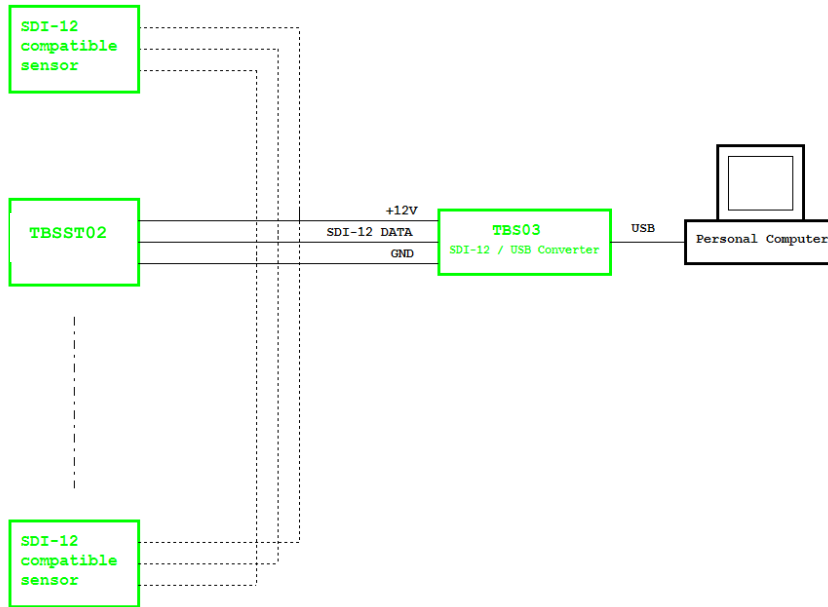


Figure 2 – TBSST02 sensor connected to TBS03 SDI-12 to USB converter; setup for controlling / testing sensors and for PC based data recording

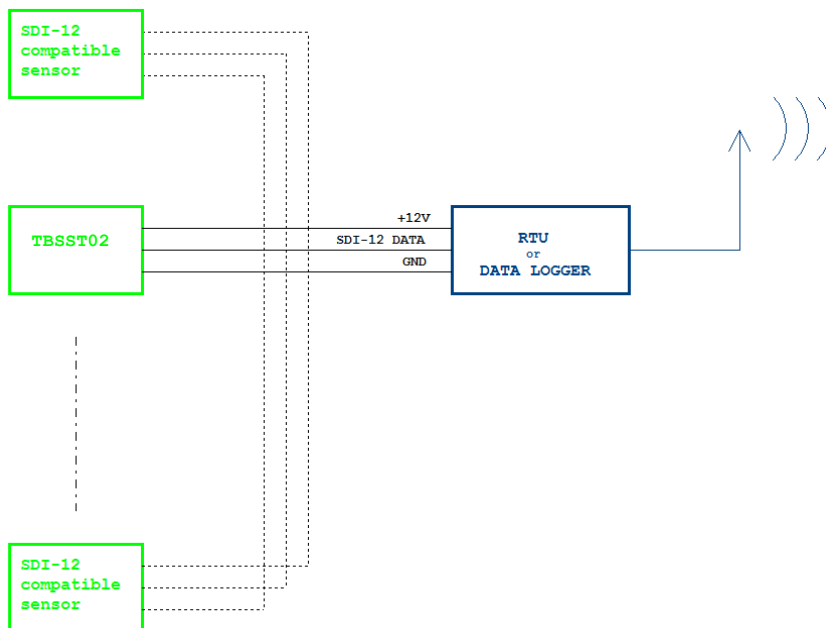


Figure 3 – TBSST02 sensors connected to Remote Telemetry Unit or Data Recorder

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8 Supported SDI-12 Commands

Command	Description	Response
a!	Acknowledge Active	a<CR><LF>
al!	Send Identification	013TEKBOXVN_TBSST02_V0.10_XXXXX <CR><LF> With XXXXX representing the serial number
aAb!	Change Address	b<CR><LF> Changing the sensor address from a to b
?!	Address Query	a<CR><LF>
aM!	Start Measurement Measures soil temperature	att1<CR><LF> Delay (ttt = 001) in seconds and number of values (1)
aMC!	Start Measurement and request CRC Measures soil temperature and calculates CRC	att1<CR><LF> Delay (ttt = 001) in seconds and number of values (1)
aC!	Start Concurrent Measurement Measures soil temperature	att1<CR><LF> Delay (ttt) in seconds and number of values (1)
aCC!	Start Concurrent Measurement and request CRC Measures soil temperature and calculates CRC	att1<CR><LF> Delay (ttt) in seconds and number of values (1)
aD0!	Get Measurement Result(s)	Upon issuing the aD0! Command, the TBSST02 will send the measurement results.
aV!	Start Verification	a0000<CR><LF> Not supported
aRn! aRCn!	Continuous Measurement Continuous Measurement + CRC	a<CR><LF> Not supported

Table 1 – Standard SDI-12 commands supported by the TBSST02

9 Supported Extended Commands

Command	Description	Response
aXC!	set temperature unit to Celsius (°C)	aX_ok<CR><LF>
aXF!	set temperature unit to Fahrenheit (°F)	aX_ok<CR><LF>
aXSTO,f,f	Set temperature offset example: 0XSTO,+00.03! -> add 0.03 degree offset	aX_ok<CR><LF>

Table 2 – Extended SDI-12 Commands

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10 Technical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _s	Supply current	Active mode (during measurement)		8		mA
I _s	Supply current	Sleep mode		80		μA
V _s	Supply voltage		6	12	17	V
t _m	Measurement Time	Time in active mode upon receiving a measurement command		1		s
t _r	Thermal response time	Based on the measurement of a 10° temperature step		30		s/°C
TR	Temperature measurement range		-40		+85	°C

Table 3 – Technical Specifications

11 Cable Connection

Cable Color	Signal Assignment
Red	SDI-12 Power
White	SDI-12 Data
Blue	GND
Black	Shield

Table 4 – Cable Connection

12 Environmental Specifications

Symbol	Parameter	Conditions	Min	Max	Unit
T _A	Operating Ambient Temperature Range		-40	+85	°C
T _{STG}	Storage Temperature Range		-40	+85	°C
	Moisture level		-	100	%

Table 5 - Environmental Specifications

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13 Ordering Information

Part Number	Description
TBSST02	TBSST02, Soil Temperature Sensor with 5m PU cable *)

*) any other cable length is available upon order

Table 6 – Ordering Information

14 History

Version	Date	Author	Changes
V1.0	11.7.2015	Mayerhofer	Creation of the document

Table 7 – History