

## SDI-12 PYRANOMETER

The TBSSR1 is based on the popular SP- Lite2 pyranometer of Kipp & Zonen. It contains a SDI-12 interface / data acquisition board inside a cavity in the base of the housing. Consequently the TBSSR1 comes in exactly the same form factor as the original SP- Lite2. The sensor offers a resolution of 0,25W/m2. It is factory calibrated to the individual sensitivity of the SP Lite2.



TBSSR1 SDI-12 Anemometer

### Features

- Spectral range: 400 to 1100nm
- Measurement range: 9 to 1200W/m<sup>2</sup>
- Directional error (up to 80° with 1000W/m<sup>2</sup> beam): < 10W/m<sup>2</sup>
- Field of view: 180°
- Temperature compensated
- Measurement response: 1 sec
- SDI-12 Standard V1.3
- Plug and Play

- 6 - 16V supply voltage
- Less than 40µA idle current
- Operating Temperature Range:  
- 40°C ... + 80°C
- Weight: 0,12kg
- Excellent price-performance ratio

### Target Applications

- SDI-12 Sensor Networks

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## 1 Introduction

The TBSSR1 is a rugged pyranometer with SDI-12 interface. It is based on a Kipp & Zonen pyranometer, model SP-Lite2.

The pyranometer contains a potted data acquisition board with a SDI-12 interface. The board fits into an existing cavity of the SP-Lite2. Consequently the form factor of the SP-Lite2 remains unchanged.

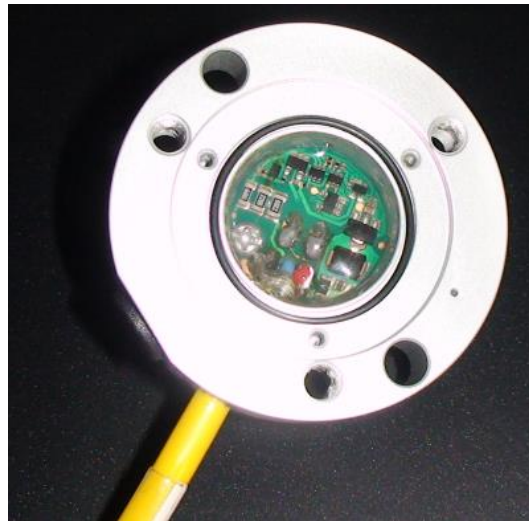


Figure 1 – TBSSR1 data acquisition board inside the SP-Lite2

### 1.1 Measurement

The TBSSR1 outputs the measured solar radiation in  $W/m^2$ :

Supported measurement commands:

<b>aM!</b>	<b>aMC!</b>	<b>aC!</b>	<b>aCC!</b>	<b>solar radiation [<math>W/m^2</math>]</b>
<b>aM1!</b>	<b>aMC1!</b>	<b>aC1!</b>	<b>aCC1!</b>	<b>solar radiation [<math>W/m^2</math>] and sensor temperature [<math>^{\circ}C</math>]</b>
<b>aM2!</b>	<b>aMC2!</b>	<b>aC2!</b>	<b>aCC2!</b>	<b>sensor temperature [<math>^{\circ}C</math>]</b>

The default measurement unit is degree Celsius, however using an extended SDI-12 command, the result can be changed to Fahrenheit

Extended SDI-12 commands:

<b>aXSF,+ff.ff!</b>	<b>set sensitivity (60 to <math>100\mu V/W/m^2</math>)</b>	<b>factory configured</b>
<b>where ff.ff:</b>	<b>sensitivity value</b>	
<b>aXGF!</b>	<b>Query sensitivity</b>	

The sensitivity is an individual parameter provided by K&Z for every sensor. The TBSSR1 comes factory configured with the correct sensitivity value and requires no user setting.

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**aXCT, stt.tt!**                      **temperature calibration**                      **factory calibrated**  
**where s:**                              **sign (+, -)**  
**where tt.tt:**                              **ambient temperature measured with a reference thermometer**

The temperature calibration is carried out in production; in case of a re-calibration, allow the sensor half an hour to settle to room temperature

**aXSTUu!**                      **set temperature unit; u= C for °C; u=F for °F**  
**aXGTU!**                              **query temperature unit**

Use the above command to configure the temperature unit; [°C] is the default setting

### 1.2 Product Specification

- Spectral range: 400 to 1100nm
- Measurement range: 9 to 1200W/m<sup>2</sup>
- Directional error (up to 80° with 1000W/m<sup>2</sup> beam): < 10W/m<sup>2</sup>
- Field of view: 180°
- Resolution: 0,25W/m<sup>2</sup>
- Temperature compensated
- Measurement response: 1 sec
- SDI-12 Standard V1.3
- 6 - 16V supply voltage
- Operating Temperature Range: - 40°C ... + 80°C
- Weight: 0,12kg Current consumption: active 7mA (for 1 second); idle < 40µA
- Standard cable length: 3m; any other length upon requirement

### 1.3 Calibration

The TBSSR1 comes factory calibrated and does not need any user calibration.

Hence it is not recommended to use the calibration related extended SDI-12 commands unless there is a requirement for re-calibration.

The TBSSR1 automatically compensates for the inherent temperature drift of the SP-Lite2 sensor (-0,1%/°C)

### 1.4 Installation

The TBSSR1 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 and 3 of this datasheet. Chapter 2 refers to the electrical installation; chapter 3 refers to the mechanical drawings.

The TBSSR1 shall be mounted at least 1,5 meters above cut grass.

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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.

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 18<sup>th</sup>, 2005. 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

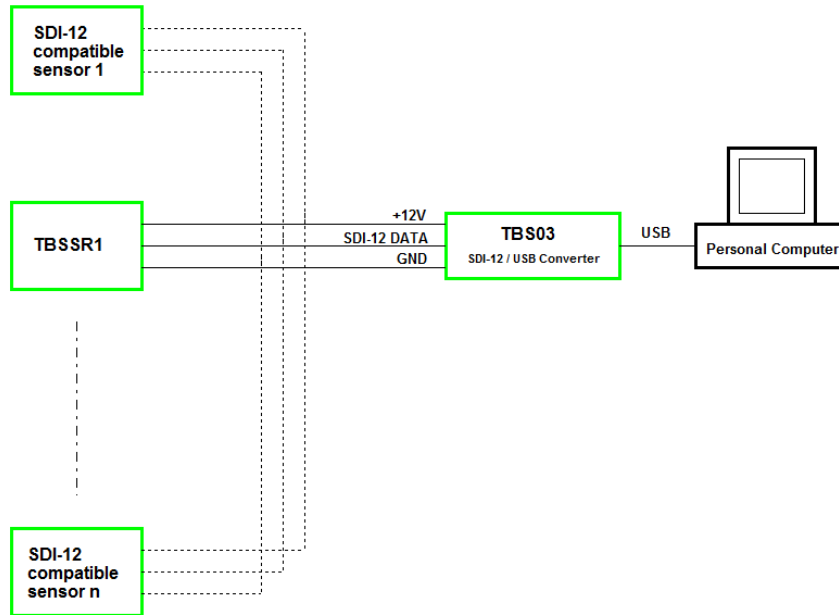


Figure 2 – TBSSR1 and other sensors with SDI-12 interface connected to TBS03 SDI-12 to USB converter; setup for controlling / testing sensors and for PC based data recording

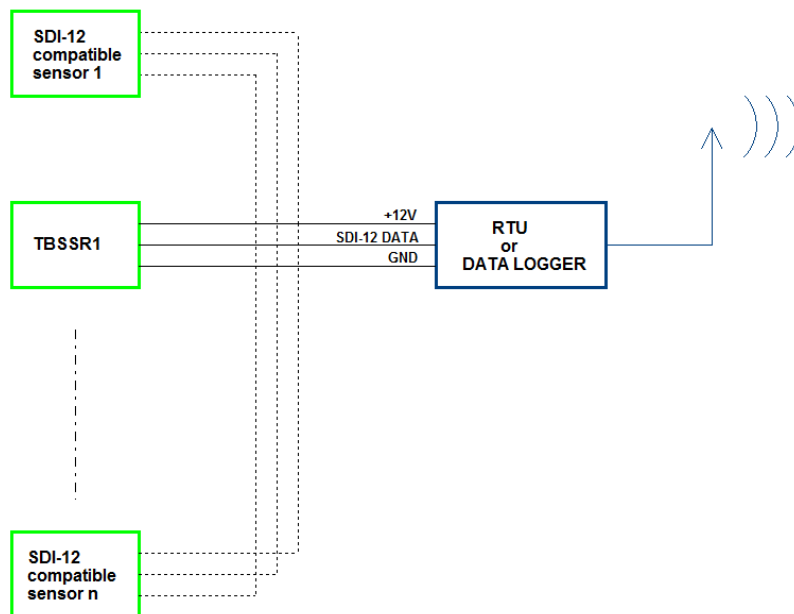


Figure 3 – TBSSR1 and other sensors with SDI-12 interface connected to Remote Telemetry Unit or Data Recorder

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### 3 Mechanical Dimensions

Refer to <http://www.kippzonen.com/Product/9/SP-Lite2-Pyranometer> with respect to the mechanical drawings.

### 4 Cable Connection

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

Table 1 – Cable Connection

### 5 Supported SDI-12 Commands

Following commands are supported by the TBSSR1:

Command	Description	Response
<b>a!</b>	Acknowledge Active	a<CR><LF>
<b>al!</b>	Send Identification	013TEKBOXVNTBSAB21.0000005xxxxx<CR><LF> With xxxxx representing the serial number
<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 solar radiation	att1<CR><LF> Delay (ttt = 001) in seconds and number of values (1)
<b>aM1!</b>	Additional Measurement Measures solar radiation and board temperature	att1<CR><LF> Delay (ttt = 001) in seconds and number of values (1)
<b>aMC!</b>	Start Measurement and request CRC Measures solar radiation and calculates CRC	att1<CR><LF> Delay (ttt = 001) in seconds and number of values (1)
<b>aMC1!</b>	Additional Measurement and request CRC	att1<CR><LF> Delay (ttt = 001) in seconds and number of values (1)

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	Measures solar radiation and board temperature and calculates CRC	
<b>aC!</b>	Start Concurrent Measurement Measures solar radiation	att1<CR><LF> Delay (ttt) in seconds and number of values (4)
<b>aC1!</b>	Start Concurrent Measurement Measures solar radiation and board temperature	att1<CR><LF> Delay (ttt) in seconds and number of values (4)
<b>aCC!</b>	Start Concurrent Measurement and request CRC Measures solar radiation and calculates CRC	att1<CR><LF> Delay (ttt) in seconds and number of values (4)
<b>aCC1!</b>	Start Concurrent Measurement and request CRC Measures solar radiation and board temperature and calculates CRC	att1<CR><LF> Delay (ttt) in seconds and number of values (4)
<b>aD0!</b>	Get Measurement Result(s)	Upon issuing the aD0! Command, the TBSSR1 will send the measurement results. The response format depends on the measurement command issued before.
<b>aV!</b>	Start Verification	a0000<CR><LF> Not supported
<b>aRn!</b> <b>aRCn!</b>	Continuous Measurement Continuous Measurement + CRC	a<CR><LF> Not supported

Table 2 – Standard SDI-12 commands

### 5.1 Supported Extended Commands

Command	Description	Response
<b>aXSF,+ff.ff!</b>	Set sensitivity The sensitivity is the parameter [ $\mu\text{V}/\text{W}/\text{m}^2$ ] which is used to convert the output voltage of the sensor element into solar radiation [ $\text{W}/\text{m}^2$ ]. +ff.ff = 60 ... 100 $\mu\text{V}/\text{W}/\text{m}^2$ The sensitivity is an individual parameter provided by K&Z for every sensor. The TBSSR1 comes factory configured with the correct sensitivity value and requires no user setting.	aX_ok<CR><LF>
<b>aXGF!</b>	Query sensitivity	a+a.aaa <CR ><LF>
<b>aXCT,slt.tt</b>	Temperature calibration s: sign (+,-) tt.tt: ambient temperature measured with a reference thermometer	aX_ok<CR><LF>
<b>aXSTUu!</b>	Set temperature unit u = c for [ $^{\circ}\text{C}$ ], u = f for [ $^{\circ}\text{F}$ ]	aX_ok<CR><LF>
<b>aXGTU!</b>	Query temperature unit	au<CR><LF>

Table 3 – Extended SDI-12 Commands



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### 6 Ordering Information

Part Number	Description
TBSSR1	TBSSR1, Pyranometer with 3m cable

Please mention in your order, if you require a different cable length

*Table 4 – Ordering Information*

### 7 History

Version	Date	Author	Changes
V1.0	13.04.2014	Mayerhofer	Creation of the document
V1.1	23.06.2014	Thin	Updated extended cmd
V1.2	17.10.2014	Mayerhofer	Temperature calibration command: sign added
V1.3	18.02.2015	Mayerhofer	Type error correction
V1.4	28.02.2016	Mayerhofer	Table 3 corrected

*Table 5 – History*