TEKBOX
DIGITAL SOLUTIONS

SDI-12 ULTRASONIC LEVEL SENSORS

The TBSLS05 and TBSLS10 are ultrasonic level sensors with SDI-12 interface. The TBSLS05 is designed for a measurement range of 30cm to 5m and the TBSLS10 covers a range of 50cm to 10m. The TBSLS05S is a variant which is also capable of snow depth measurement. Stable, reliable range readings and excellent noise rejection make the sensor easy to use. The sensor automatically handles acoustic noise and provides a typical accuracy of 1% or better.

TBSLS10/05/05S ultrasonic level sensor with SDI-12 interface

Features

- TBSLS05 measurement range: 0.3 – 5m
- TBSLS10 measurement range: 0.5 – 10m
- Resolution: 5mm / 10mm
- Accuracy: typically 1% or better
- Acoustic noise suppression
- Internal temperature compensation
- IP67 rated
- Operating voltage: 6V … 16V
- Operating current: 8mA
- Operating Temperature Range: -40°C … 65°C

Application

Water level measurement

Tank level measurement

Corn level measurement

Snow depth measurement (TBSLS05S)

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Contents

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1   Introduction

The TBSLS series are ultrasonic level sensors with SDI-12 interface. Depending on the model, they offer a measurement range up to 10m with mm resolution.

1.1   Product Features

- SDI-12 interface

- Command for level (distance) and temperature measurement

- TSBLS10: 50 cm – 10m range, 10 mm resolution

- TBSLS05: 30 cm – 5m, 5 mm resolution

- Factory matched accuracy, typ. 1%

- Reading to reading stability from measurement to measurement: typ. 1mm

- Internal temperature compensation

- Excellent clutter rejection

- Supply voltage range: 7V to 16V

- 0.1°C resolution

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

1.2   Calibration

The TBSLS10/05/05S come factory calibrated, with a matched accuracy of typically 1% or better. Each time the sensor takes a range reading, it calibrates itself. The sensor then uses this data to range objects. If the temperature, changes during sensor operation, the sensor will continue to function normally over the rated temperature range while applying compensation for changes caused by temperature.

1.3   Interface

The TBSLS series level sensors are 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 currently implemented SDI-12 standard is version 1.3

1.4   Target size compensation

The TBSLS series level sensors compensate for target size differences. This means that, provided an object is large enough to be detected, the sensor will report the same distance, typically within 1%, regardless of target size.
Smaller targets can have additional detection noise that may limit this feature. In addition, targets with small or rounded surfaces may have an apparent distance that is slightly farther, where the distance reported may be a composite of the sensed object(s).

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1.5   Sensor dead zone

For the TBSLS10, targets closer than 500 mm will typically range as 500 mm. For the TBSLS05, targets closer than 300 mm will typically range as 300mm. The reference plane for the measurement is the bottom surface of the Fibox housing, not the opening of the cone.

1.6   Condensation, debris or sludge

Given the properties of the ultrasonic range measurement, it is obvious that condensation, buildup of ice, debris or sludge on the transducer surface will create unwanted reflections and erroneous readings. Though the cone offers considerable protection, install the sensor in a way, to avoid the risk of getting it contaminated.

1.7   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.
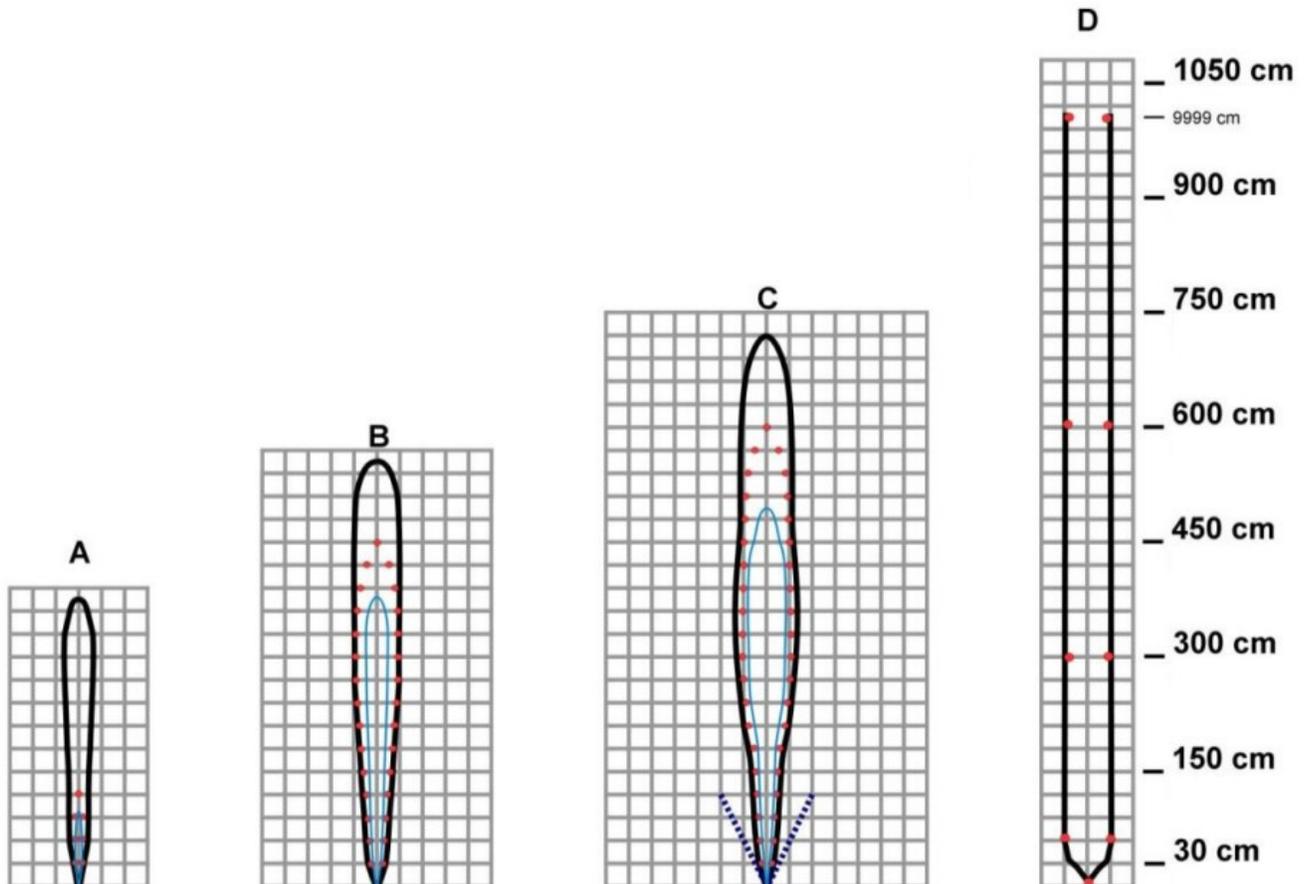
More information on SDI-12 is presented in chapter 3.

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2 Mounting

2.1 Radiation pattern of TBSLS10

- Refer to black line only; detection of objects happens within the black curve; sample results for measured beam pattern are drawn on a 30cm grid.
- The detection pattern is shown for dowels of varying diameter that are placed in front of the sensor
- **A**: 6 mm dowel
- **B**: 25 mm dowel
- **C**: 9 cm dowel
- **D**: 30cm wide board moved from left to right with the board parallel to the sensors face

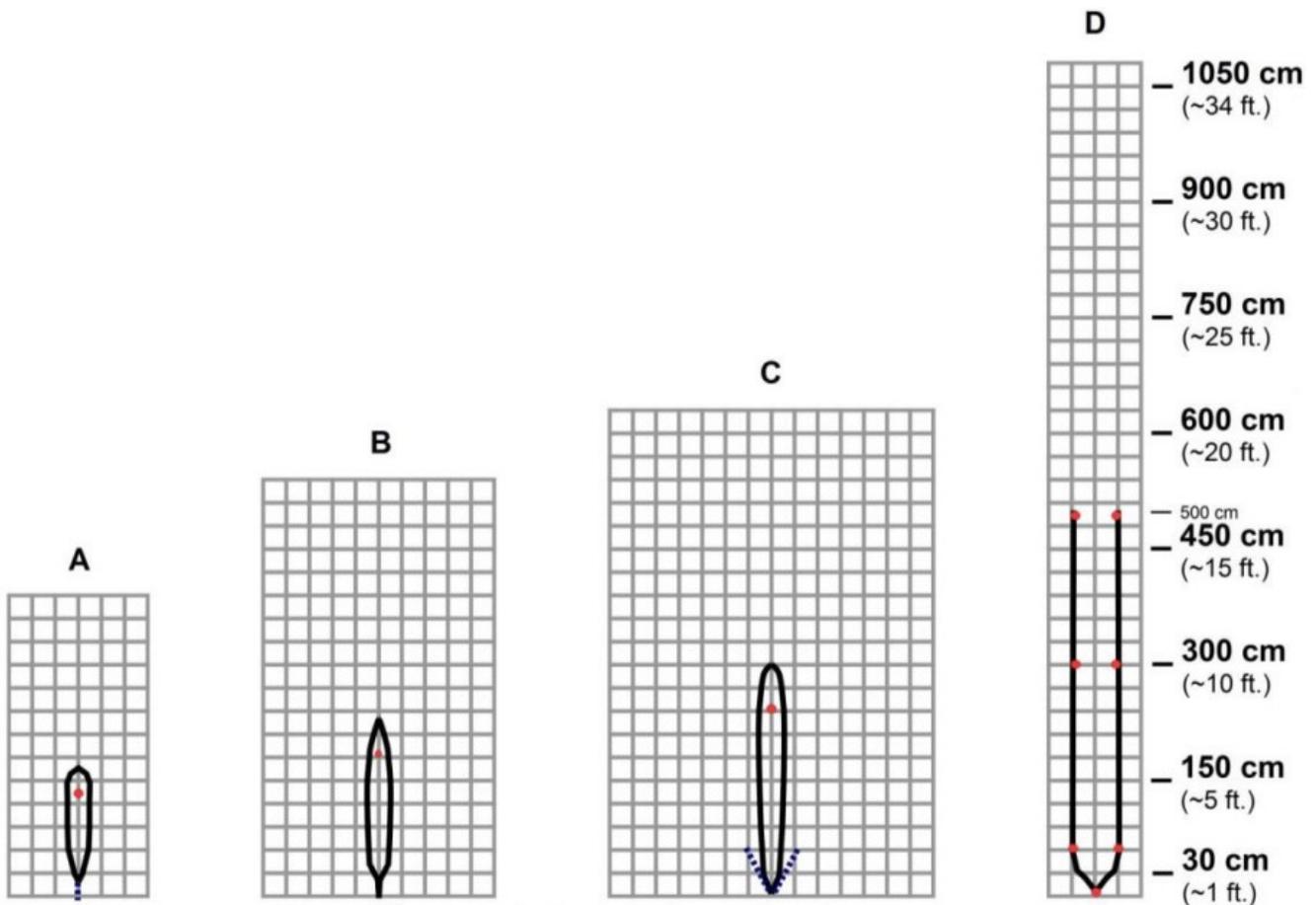# SDI-12 ULTRASONIC LEVEL SENSORS

2.2 Radiation pattern of TBSLS05

▪ Refer to black line only; detection of objects happens within the black curve; sample results for measured beam pattern are drawn on a 30cm grid.

▪ The detection pattern is shown for dowels of varying diameter that are placed in front of the sensor

▪ **A**: 6 mm dowel

▪ **B**: 25 mm dowel

▪ **C**: 9 cm dowel

▪ **D**: 30cm wide board moved from left to right with the board parallel to the sensors face

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3 Measurement Commands

3.1 Supported SDI-12 Commands

Following commands are supported by the TBSLS sensors:

Command	Description	Response
a!	Acknowledge Active	a<CR><LF>
aI!	Send Identification	013TEKBOXVNTBSAB21.0000005xxxxx<CR><LF> With xxxxx representing the serial number
aAb!	Change Address	b<CR><LF> Changing the probe sensor address
?!	Address Query	a<CR><LF>
aM!	Start Measurement Measures distance (level) [mm]	attt1<CR><LF> Delay (ttt) in seconds and number of values (1)
aMC!	Start Measurement and request CRC Measures distance (level) [mm] and calculates CRC	attt1<CR><LF> Delay (ttt) in seconds and number of values (1)
aM1!	Start Measurement Measures distance (level) [mm] with height reference	attt1<CR><LF> Delay (ttt) in seconds and number of values (1)
aMC1!	Start Concurrent Measurement and request CRC Measures distance (level) [mm] with height reference and calculates CRC	attt1<CR><LF> Delay (ttt) in seconds and number of values (1)
aM2!	Start Measurement Measures temperature [C] [F]	attt1<CR><LF> Delay (ttt) in seconds and number of values (1)
aMC2!	Start Concurrent Measurement and request CRC Measures temperature [C] [F] and calculates CRC	attt1<CR><LF> Delay (ttt) in seconds and number of values (1)
aD0!	Get Measurement Result(s)	Upon issuing the aD0! Command, the TBSLS will send the measurement result.
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

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3.2 Supported Extended Commands

Command	Description	Response
aXSHR,h!	set height reference to measure level h: from 500 (mm) to 10000 (10 m , default) output data = h - measurement data example: 0XSHR,5000! h = 5000 mm measurement data = 1800 mm so, the level = 5000 – 1800 = 3200 mm	aX_OK<CR><LF>
aXGHR!	Query height reference [mm]	A+h <CR><LF>
saXTUx!	set temperature unit to Celsius (C) or Fahrenheit (F) example: 0XTUC! set temperature unit to Celsius example: 0XTUF! set temperature unit to Fahrenheit	aX_OK<CR><LF>
aXCT,+aa.bb!	set temperature calibration, aa.bb is the ambient temperature measured with a reference temperature sensor and used to align the result of the on chip temperature sensor of the microcontroller. example: 0XCT,+25.12! : align temperature to 25.12 °C	aX_OK<CR><LF>

Table 2 – Extended SDI-12 Commands

3.3 Measurement Examples

aM! Measure distance

Command	Response	Comment
aM!	a0011<CR><LF>	Means: 1 measurement value will be available after 1second
aD0!	a+1200<CR><LF>	The measured 1200 mm

[a] represents the SDI-12 bus address of the TBSLS

aM1! Measure level

Command	Response	Comment
aM2!	a0011<CR><LF>	Means: 1 measurement value will be available after 1second

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aD0!	a+3800<CR><LF>	The measured 3800 mm with height reference = 5000 mm

[a] represents the SDI-12 bus address of the TBSLS

aM2! Measure temperature

Command	Response	Comment
aM2!	a0011<CR><LF>	Means: 1 measurement value will be available after 1second
aD0!	a+25.37<CR><LF>	The measured temperature is 25.37°C

[a] represents the SDI-12 bus address of the TBSLS

4   Technical Specifications

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Vs	Supply voltage		7	12	16	V
Is	Supply current	@ 12V supply voltage	6	7	8	mA
tm	Measurement Time	Time upon receiving a measurement result		1		s
TR	Temperature measurement range	This measures on chip temperature inside the housing and cannot substitute a dedicated air temperature sensor	-40		+85	°C
Tc	Temperature measurement accuracy at 20°C	@ +22 °C	-1		+1	°C
Tl	Temperature measurement linearity	From -40 to +80 °C	-3.5		+3.5	°C

Table 3 – Technical Specifications

5   Cable Connection

The cable has to be fed through a grommet at the side of the FIBOX enclosure. A Weidmueller terminal block provides connectivity for Shield / GND, SDI-12 data and SDI-12 supply voltage.

Follow the silkscreen on the PCB with respect to the pin assignment of the internal Weidmueller spring loaded terminal block.

6   Environmental Specifications

Symbol	Parameter	Conditions	Min	Max	Unit

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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	closed housing, no condensation, no icing	-	100	%

Table 4 - Environmental Specifications

7   Ordering Information

Part Number	Description
TBSLS10	Ultrasonic level sensor, SDI-12 Interface, 10 m range
TBSLS05	Ultrasonic level sensor, SDI-12 Interface, 5 m range
TBSLS05S	Ultrasonic level sensor, SDI-12 Interface, 5 m range, optimized

Table 5 – Ordering Information

8   History

Version	Date	Author	Changes
V1.0	5.4.2019	Mayerhofer	Creation of the document
V1.1	3.20.2020	NPTHINH	Update new commands

Table 6 – History