V1.0

TBS06-TS

RS232 to SDI-12 converter and bus sniffer

The TBS06-TS (DR) RS232 to SDI-12 Converter is an interface for connecting a PC, data logger or RTU to one or more sensors with SDI-12 interface. The TBS06-TS connects to the RS232 interface and provides a SDI-12 compliant data interface. The TBS06-TS is a versatile tool for everyone who designs sensors and data recorders or who installs, tests or maintains SDI-12 based data acquisition systems. Furthermore it includes a SDI-12 bus sniffer mode.
It is available in a IP67 housing from Fibox or in a Dinrail housing.

TBS06-TS RS232 to SDI-12 Interface – Fibox- and Dinrail

Features

- RS232 toSDI-12 Interface
- Transfer Mode / Monitor Mode
- Plug and play
- No driver required
- Selectable data rate: 4800 - 38400 Baud
- 5V … 12V supply voltage
- Low power mode
- Spring loaded terminal blocks
- IP67 housing or Dinrail housing
- Operating Temperature Range: - 40°C … + 85°C

Target Applications

- SDI-12 Data Recording
- SDI-12 Field Installations
- SDI-12 Interface Debugging
- SDI-12 Sensor Testing

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Contents

1 Introduction

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 and dates from July 18th, 2005. The standard is available on the web site of the SDI-12 Support Group.

TBS06-TS implements all functions for interfacing SDI-12 sensors to a RTU, data logger or PC with RS232 interface.
It is a plug and play solution for controlling or testing of sensors with SDI-12 interface.

1.1 Product Features

- RS232 to SDI-12 Interface based on TBS01 SDI-12 module
- Transfer Mode
- Plug and play
- No driver required
- Selectable data rate: 4800 - 38400 Baud
- 6V … 16V supply voltage
- Current consumption: 6 mA in “always on mode”; less than 250µA in “auto power management mode”
- Fibox IP67 housing variant: Weidmueller spring loaded terminal blocks
- Dinrail housing variant: screw terminal blocks
- Operating Temperature Range: - 40°C … + 85°C

1.2 Mechanical dimensions

Fibox housing: Fibox PC 081206
http://www.fibox.com/catalog/1999/product/611/7032580_ENG3.html

Dinrail housing: Bud Industries DMB-4770
http://www.budind.com/pdf/hb4770.pdf

2 Application

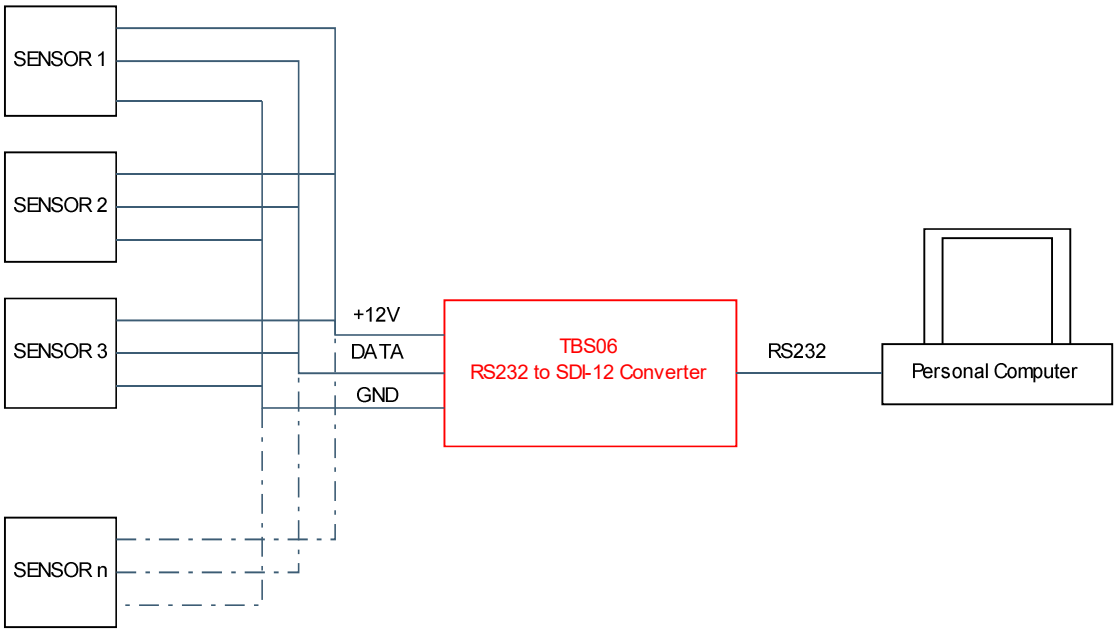


Figure 1 –TBS06-TS Application, standard setup for controlling / testing sensors

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 typically are ASCII strings generated by the data recorder/controller firmware. TBS06-TS can be controlled by a PC application or hyper terminal and converts the command strings to the logic levels and baud rate specified by the SDI-12 standard. Furthermore TBS06-TShandles breaks, marks and all other details of the SDI-12 protocol.

Upon receiving data or status information originated by a Sensor, TBS06-TS extracts the corresponding ASCII strings and sends it to COM Port of the PC.

3.2 SDI-12 Transfer mode

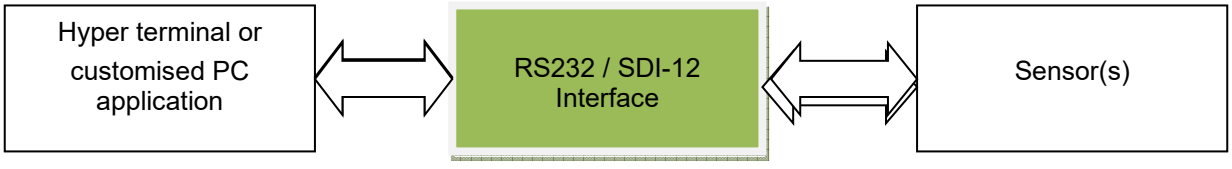


Figure 2 – TBS06-TS basic application setup

The application is built based on a SDI-12 Recorder Protocol Stack Module. It receives commands from the RS232 Interface (e.g. via data logger, RTU or PC), and transfers the commands to the SDI Interface, waits for sensor response and transfers the response (measurement results, etc.) back to the RS232 Interface of the data logger, RTU or PC. All SDI-12 commands are supported.

3.3 SDI-12 Monitor mode

In SDI-12 monitor mode, TBS06-TS monitors the data traffic between recorder and sensor(s). This feature is useful in setting up or debugging SDI-12 installations. More details are available here.

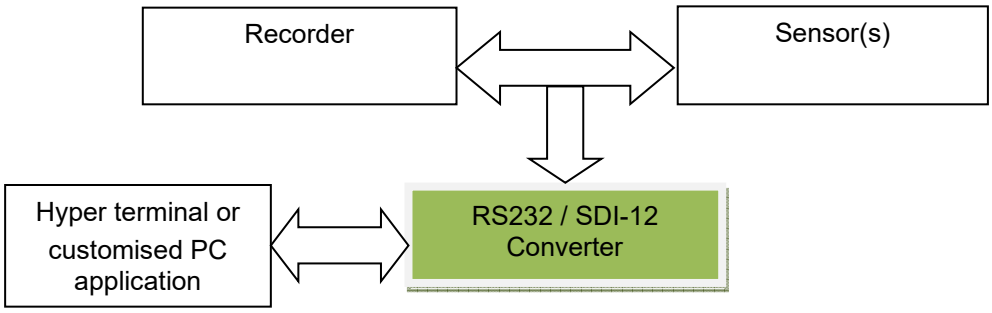


Figure 3 –TBS06-TS application; setup for monitor mode

4 Hardware Description

4.1 Board overview

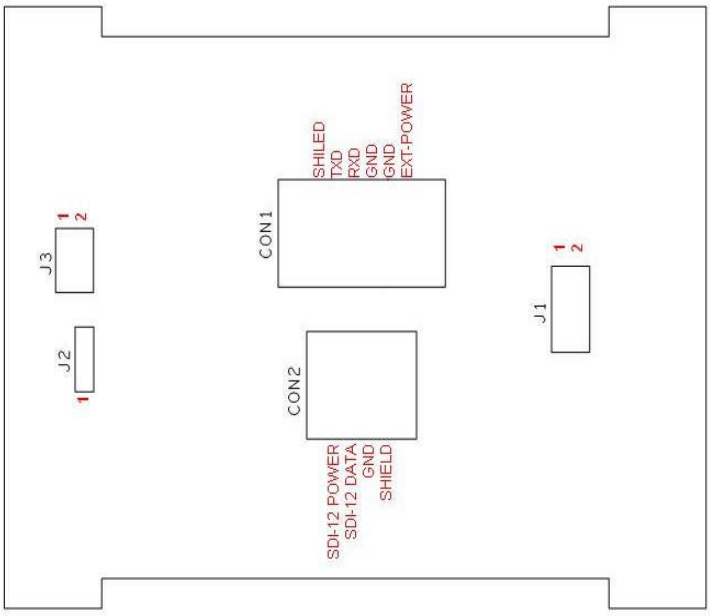


Figure 4 – Board Connections, Jumper Settings of Fibox variant

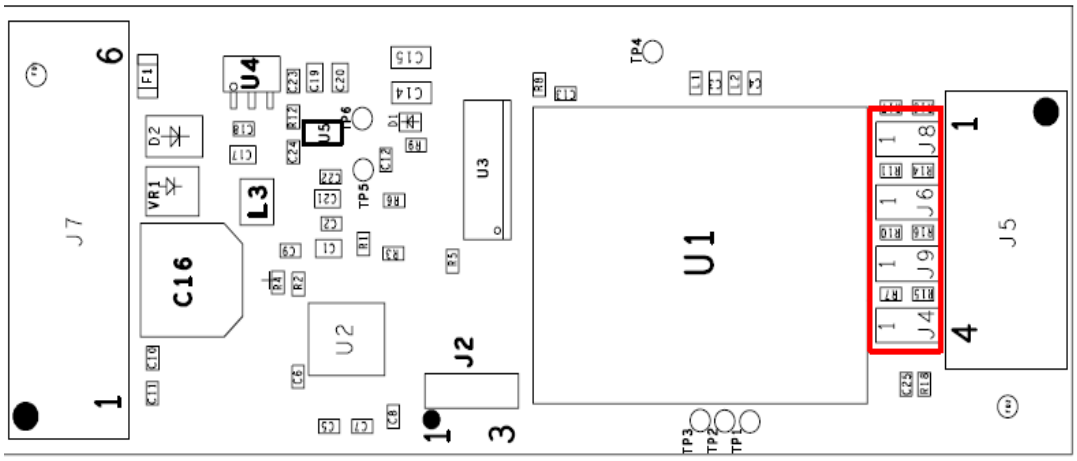


Figure 5 – Board Connections, Jumper Settings of Dinrail variant

4.2 Connections – Fibox Variant

TBS06-TS supports RS232 and gives access to the UART interface of the on board SDI-12 module.
CON2: RS232 interface connector; Pin 1-2 of J1 : access to UART interface

4 Pin terminal block:
CON2 – SDI-12 Interface

Shield: connect to the shield of the SDI-12 cable or leave it unconnected
Ground: connect to the GND wire of the SDI-12 cable
SDI-12 data: connect to the data wire of the SDI-12 cable
SDI-12 Power: connect to the positive supply voltage wire of the SDI-12 cable; the SDI-12 supply voltage is directly connected to the RS232 supply line

6 Pin terminal block:

Shield: connect to the shield or leave it unconnected
Ground1: connect to the GND of supply for TBS06-TS
EXT- Power: connect to an external power supply (6V…16V)
Ground2: connect to the GND of COM port (Pin 5 of DB9)
TxD: connect to RXD of the RS232 interface (Pin 2 of DB9)
RxD: connect to TxD of the RS232 interface (Pin 3 of DB9)

Jumper 1 (SDI12 module connectivity)

Connect to RS232 Interface:
Jumper: 5-7 and 6-8
Connects to RS232 ines of CON1

Access to UART Interface of the on-board TBS01 SDI-12 module:
Jumper: 3-5 and 4-6
Connect UART to pin 1-2 of J1

Jumper 2 (Power management)
Jumper 1-2: Always On (6 mA); default factory setting
Jumper 2-3: Power saving mode (>250uA), TBS06-TS will wakup automatically when data is present at the Rx pin, and switches into sleep mode 2.5 seconds after RX becomes idle

Jumper 3 (Baud Rate selection)
4800 Baud: jumper 1-3, 2-4
9600 Baud: jumper 3-5, 2-4
19200 Baud: jumper 1-3, 4-6; default factory setting
38400 Baud: jumper 3-5, 4-6

Other communication settings:

- 8 Bits
- No Parity
- 1 Stop Bit
- No Handshake

4.3 Connections – DIN-rail variant

RS232 Side, from left to right:

Cable shield
RS232 TX (TBS06-TSDR output)
RS232 RX (TBS06-TSDR input)
Ground
Ground
6-12V external supply input

SDI-12 Side, from left to right:

Cable shield
Ground
SDI-12 data line
SDI-12 supply voltage output

Figure 6 – Connections

TBS06-TSDR is shipped with RS232 jumpered to 19200 Baud.
Following other Baud rates can be factory - jumpered upon specification in the order: 4800, 9600 and 32400 Baud.

Other communication settings:

- 8 Bits
- No Parity
- 1 Stop Bit
- No Handshake

4 Pin terminal block:

CON1 – SDI-12 Interface

Shield: connect to the shield of the SDI-12 cable or leave it unconnected

Ground: connect to the GND wire of the SDI-12 cable

SDI-12 data: connect to the data wire of the SDI-12 cable

SDI-12 Power: connect to the positive supply voltage wire of the SDI-12 cable; the SDI-12 supply voltage is directly connected to the RS232 supply line

6 Pin terminal block:

CON2 – Power supply & RS232 interface

+12V: connect to an external power supply (7V…12V)

Ground1: connect to the GND of supply for TBS06-TSDR

Ground2: connect to the GND of COM port (Pin 5 of DB9)

RxD: connect to TxD of the RS232 interface (Pin 3 of DB9)

TxD: connect to RXD of the RS232 interface (Pin 2 of DB9)

Shield: connect to the shield or leave it unconnected

Shield, Ground 1, Ground 2 and SDI-12 Ground are internally connected together

Jumper settings

Refer to Figure 4

Baud rate

4800 Baud	set jumpers J6, J8
9600 Baud	set jumpers J6, J9
19200 Baud	set jumpers J4, J8
38400 Baud	set jumpers J4, J9

Power management:

Jumper J2, position 1-2 jumpered: Always On (6 mA); default factory setting

Jumper J2, position 2-3 jumpered: Power saving mode (>250uA), TBS06-TS will wakup automatically when data is present at the Rx pin, and switches into sleep mode 2.5 seconds after RX becomes idle

5 SDI-12 Basics

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 typically can measure one or more parameters.
Sensor manufacturers usually specify Extended Commands to configure or calibrate sensors. This 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 indicatesthat the data are 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.

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 **0M1!**
Sensor 0 might respond **00302** which means the measurement will take 30 seconds and deliver 2 values.
After min. 30 seconds, the data recorder can send the Read Data Command **0D0!** to which Sensor 0 might reply **0+27+1050**. +27+1050 is the two measurement results which may be 27°C and 1050 milibar.

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.

6 Setting up TBS06-TS

6.1 User Interface

Any RTU, data logger or PC hyper terminal (e.g.: Windows Hyper Terminal, Terminal V1.9B, RealTerm, Docklight or specific application software such as LabVIEW)

- Set hyper terminal to 19200 baud, 8 Bits, No Parity, 1 Stop Bit, No Handshake

6.2 Hardware Interface

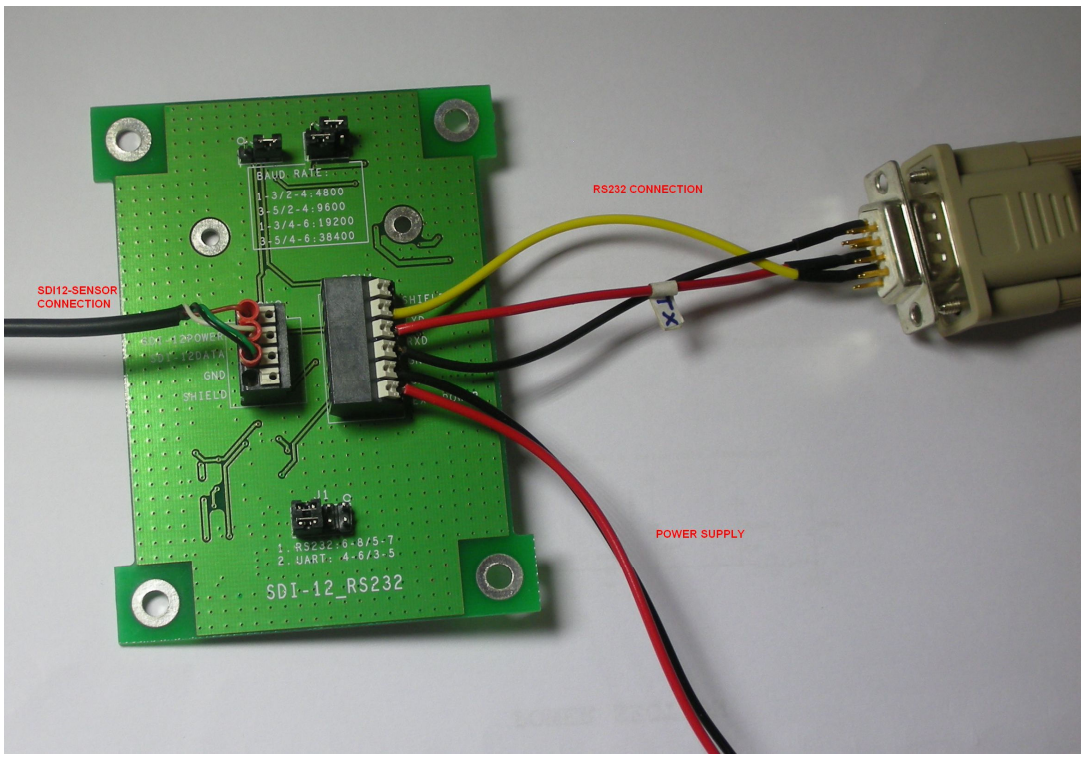


Figure 7 – RS232 connection

6.3 Operating modes

TBS06-TS supports two operating modes:

- Transfer mode
  - This mode allows sending SDI-12 commands to SDI-12 sensors over RS232.
- Monitor mode
  - In this mode the module operates as a SDI-12 bus sniffer mode
- Default mode
  - The default mode when powering up the module for the first time is transfer mode.

Both modes are exclusive but it is possible to switch from one mode to another:

- *run sdi monitor* to enter monitor mode and act as a SDI-12 bus sniffer.
- *run sdi recorder* to enter transfer mode and send SDI-12 commands.

7 Transfer mode

In transfer mode, SDI-12 commands can be sent over RS232 to SDI-12 sensors connected to TBS06-TS.

On hyper terminal, send SDI-12 commands to read data from sensor.
Notice: every SDI-12 command must be terminated by **CR/LF** character (0x0D, 0x0A)

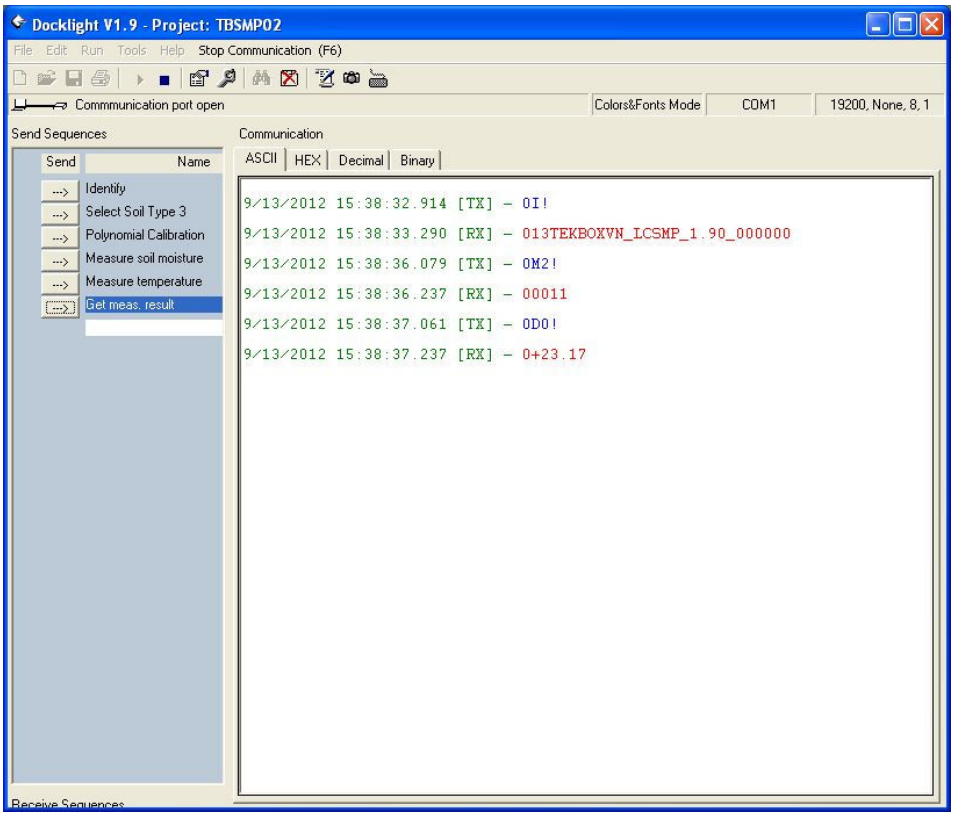


Figure 8 – Example: SDI-12 command flow on a terminal application

8 SDI-12 Monitor mode

TBS06-TS can also be used as a SDI-12 bus sniffer module that captures all SDI-12 commands and responses passing on the bus.

In SDI-12 monitor mode, the TBS06-TS is connected in parallel to a data recorder and sensor(s) and monitors the data on the SDI-12 interface.

TBS06-TS can then operate in two different modes: transfer and monitor.
By default, and then whenever TBS06-TS is powered up/reset, the transfer mode is active.

Switching from one mode to another is done by issuing a specific command from the PC terminal application connected to the RS232 port:

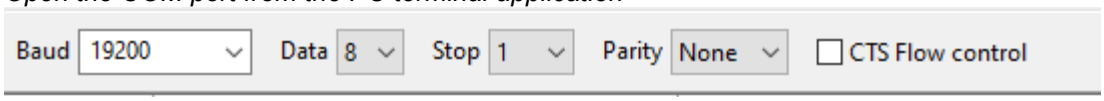
Command (ASCII format with \r\n termination)	Description
*run sdi monitor**\r\n***	Switch to Monitor mode
*run sdi recorder**\r\n***	Switch to recorder (transfer) mode

The setup of the module in this mode is like transfer mode except for these points:

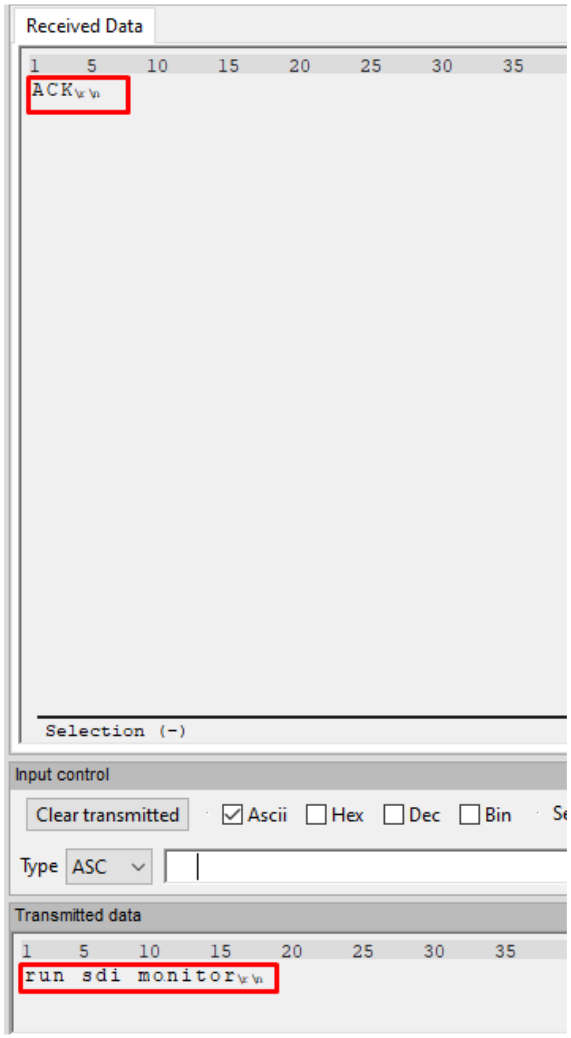
- No external power supply is required (otherwise it may damage the board). TBS06-TS power supply pins *+12V* and *GND* from the 6 pins connector must be left unconnected.
- TBS06-TS 4 pins SDI-12 interface connector must be connected to the data logger/recorder SDI-12 bus
- The data logger/recorder must **constantly** deliver power on the SDI-12 power line

Once setup, the SDI-12 bus monitoring can be done as described below:

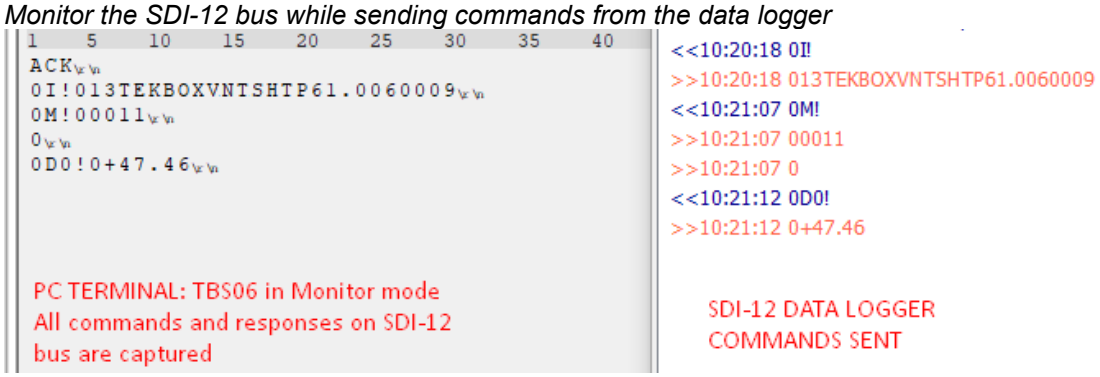
Open the COM port from the PC terminal application



Switch to SDI-12 Monitor mode



Monitor the SDI-12 bus while sending commands from the data logger



Switching back to transfer mode can be done at any time by sending from the PC terminal application the following command in ASCII: *run sdi recorder\r\n (*or *run sdi recorder* if the terminal application automatically appends *\r\n*).

9 Ordering Information

Part Number	**Description**
TBS06-TS	RS232 to SDI-12 interface in IP67 housing – Transfer mode, Monitor mode
TBS06-TS-DR	RS232 to SDI-12 interface in DIN-rail housing – Transfer mode, Monitor mode
Default baud rate is 19200 Baud; default power management setting is “Always On” If you want different settings, please specify in your order	

Table 1 – Ordering Information

10 History

Version	Date	Author	Changes
V1.0	27.01.2021	Philippe Hervieu	Creation

Table 2 – History