

***TOIP*** *Pty*  
*Ltd*  
*Telemetry Over Internet Protocol*

# **User Manual**

## **TBS02A4**

### **Analogue to SDI-12**

### **Converter**

Version 1.4  
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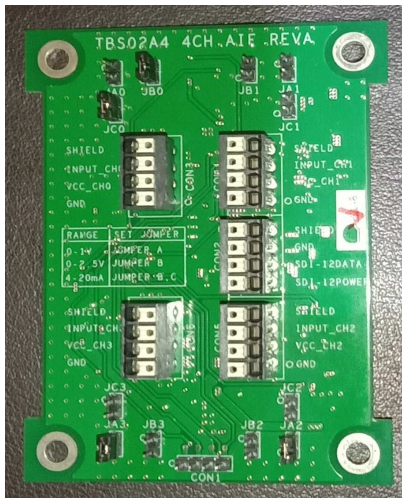
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# 1 TBS02A4 Introduction

This manual is written for the TBS02A4, an interface unit designed to allow up to 4 analogue sensors to be connected to SDI-12 telemetry units.

The inputs may be programmed for any of three modes: Analogue 0-1V, Analogue 0-2.5V and 4-20mA.

The TBS02A4 is configured using extended SDI-12 commands and is supplied as a bare PCB which users must mount in an enclosure of their choosing.



## 2 Specifications

Parameter	Value / Range	Comment
Dimensions	120 x 80 x 57 mm	PCB Only
Environmental rating	IP67	
Analogue Inputs		
AN 0 to AN3	Mode 0 0 – 1V Mode 1 0 – 2.5V Mode 2 4-20mA	
Analogue channel Resolution	12 Bit	2.5V voltage reference +/- 2.5 mV, 5ppm/°C
Temperature	-40 to +85 °C	+/- 0.25 °C at 25 °C Max error +/- 1 °C
	Resolution 0.1 °C	
Power Supply	6 to 16 V DC	
Supply Current	Read typ 10mA Sleep 30uA	

## 3 Setup and Configuration

Before using the TBS02A4 you need to choose the operating mode for the 4 inputs and set the hardware and firmware configuration to suit.

You will need to mount the TBS02A4 inside a suitable enclosure. Cable glands are the easiest way to route sensor cables to the unit. Strip the ends of the wires back and tin them, before cutting them back to a length of 6mm. The wires can then be inserted into the Cage Clamps on the PCB: depress the white level on the end of the clamp with a screwdriver and push the wire into the hole.

### 3.1 Hardware Configuration

The inputs of the TBS02A4 may be used in any of 3 modes: 0-1V, 0-2.5V, 4-20mA. The selection of which mode to use is made using sets of jumpers on the PCB. Each input has its own set of jumpers :

<b>Mode</b>	<b>Jumpers</b>
0-1V	A
0-2.5V	B
4-20mA	B and C

### 3.2 Wiring

Connect the wires as follows:

<b>Terminal</b>	<b>Function</b>
VCC_CHn	Switched sensor supply for channel 0 to 3
INPUT CHn	Input signal (output from sensor)
GROUND	Ground line for voltage sensors (not used with 4-20mA sensors)
SHIELD	Sensor shield / screen

The sensors are connected as follows:

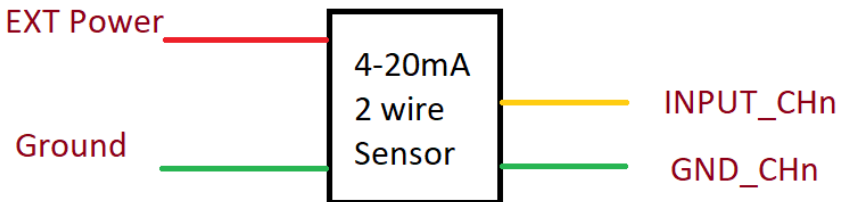
- Analogue sensors
  - the sensor power is connected to VCC
  - sensor ground wire to GND
  - sensor output is connected to INPUT



- 2 wire (loop powered) 4-20mA sensors
  - connect sensor + lead to VCC
  - connect sensor – to INPUT CH 0/1/2/3.
  - GND – not used



- 3 or 4 wire (externally powered ) 4-20mA sensors
  - connect sensor Power to VCC
    - if the sensor has its own power supply you do not need to connect VCC
  - connect sensor Ground to GND
  - connect Sensor Out to INPUT CH 0/1/2/3.



## 3.3 Firmware Configuration

### 3.3.1 Configuration with SDI Commander and TBS03

Install the SDI Commander software on your PC. Connect the TBS03 to a USB port on your PC and open SDI Commander. Use SDI Commander to send the configuration commands to the TBS02A4.

### 3.3.2 Change Address `<old add>A<new add>!`

The address of the interface can be changed using the standard SDI-12 address change command.

e.g. to change the address from 0 to 4 `0A4!`

### 3.3.3 Measurement Commands `<add>Mn!` `<add>C>n!`

Use the SDI-12 Measure (M) or Concurrent Measure (C) commands to read the sensor values.

Command	Function
<code>&lt;add&gt;M!</code>	Read Analogue 0
<code>&lt;add&gt;M1!</code>	Read Analogue 1
<code>&lt;add&gt;M2!</code>	Read Analogue 2
<code>&lt;add&gt;M3!</code>	Read Analogue 3
<code>&lt;add&gt;M8!</code>	Read on chip temperature

### 3.3.4 Get / Set Serial Number

To read the Serial Number use the I command `<add>!`

To set the Serial Number `<add>XNsssss!`

e.g. to set the Serial number to 452130 `0XN452130!`

### 3.3.5 To Get the Current Input Type Selection

To read which mode an input is set to `<add>XGICn!`

e.g To read the mode of sensor 2 `0XGIC2!`

### 3.3.6 To Set the Input Type

To set the mode of an input `<add>XSICn,m`

where n = Channel number (0 to 3)  
m = input type 0 = 0-1V  
1 = 0 – 2.5V  
2 = 4-20mA

e.g to set channel 3 to 4-20mA `0XSIC3,2!`

### 3.3.7 To Set the Response Time

Refer to the sensor manual for details on any required warm up time. The default setting is 1 second.

To set the response time `<add>XRTMn,xxx!`

where n = Channel number (0 to 3)  
xxx = warm up time in seconds

### 3.3.8 To Set the Turn off Delay

The turn off delay can be set for each sensor `<add>XDTn,xxx!`

where n = Channel number (0 to 3)  
xxx = turn off delay in seconds

### 3.3.9 Sensor Scaling

The scaling of the analogue channels can be set using a 3<sup>rd</sup> order polynomial equation:

$$Y = a*x^3 + b*x^2 + c*x + d$$

The constants a to d can be a floating point value containing up to 7 digits (including the decimal point)

The default is a linear expression (a =0, b = 0, c = 1, d = 0)

To set the Scaling `<add>XSCn,aa.bb,cc.cc,dd.dd!`

To determine the scaling for a Linear sensor, use the formula:

$l_o$  = minimum current = 4mA  
 $l_m$  = maximum current = 20 mA  
 $l_r$  = current range =  $l_o - l_m = 20 - 4 = 16$  mA  
 $S_o$  = Sensor minimum value e.g 0 at 4mA  
 $S_m$  = Sensor maximum value e.g. 2000 at 20mA  
 $c$  = Scaling factor =  $(S_m - S_o) / l_r$   
 $d$  = offset =  $-1 * c * l_o$

e.g. To set the scaling for channel 0 to suit a PH sensor with a range of 0 to 14:

- $c$  = Scaling factor :  $14 / (20 - 4) = 0.875$
- $d$  = Offset :  $4 * 0.875 = 3.5$
- $A = 0, B = 0, C = 0.875, D = -3.5$   
`0XSC0,0,0,0.875,-3.5!`

e.g. To set the scaling for channel 1 to suit an EC sensor with a range of 0 to 5000:

- $c$  = Scaling factor :  $5000 / (20 - 4) = 312.5$
- $d$  = Offset :  $4 * 312.5 = 1250$
- $A = 0, B = 0, C = 312.5, D = -1250$   
`0XSC1,0,0,312.5,-1250!`

e.g. To set the scaling for channel 2 to suit a 0 to 10m level sensor (with display in cm):

- $c$  = Scaling factor :  $1000 / (20 - 4) = 62.5$
- $d$  = Offset :  $4 * 62.5 = 250$
- $A = 0, B = 0, C = 62.5, D = -250$   
`0XSC2,0,0,62.5,-250!`

### 3.3.10 Temperature Calibration

The TBS02A4 includes an on board temperature sensor which may be used to return the current board temperature. You can calibrate the sensor against a reference temperature sensor.

To set the temperature to a reference value `<add>XCT,ttt.ttt!`

Where  $t_{tt.ttt}$  = current reference temperature

### 3.3.11 Rest to Factory Defaults

Should it ever be necessary, you can reset the board to the factory default settings `<add>XGD!`

The default settings are as follows:

Sensor address :	0
ADC Scale:	a = 0, b = 0, c = 1; d = 0
Response Time is	001(second)
Time for turn off ADC :	all 0(second)

## **4 Warranty**

The TBS02A4 is covered by a one (1) year warranty.

Warranty is available on a return to base basis only. End users must pay for return shipment of faulty products either TOIP Pty Ltd or their local distributor. If the unit is assessed by TOIP Pty Ltd and found to be a warranty failure, it will be replaced free of charge TOIP Pty Ltd will pay the return shipment to the owner.

The warranty does not cover mechanical damage, damage inflicted during installation or removal or damage caused by animals.

Prior to using the product, please ensure that you read, understand and accept the Warranty Statement. If you do not accept the conditions of the Warranty Statement, please return the probe for a refund.