



TOIP *Pty*
Ltd
Telemetry Over Internet Protocol

User Manual

TBS09DR

MODBUS to SDI-12

Converter

Version 1.2

November 2018

Copyright TOIP Pty Ltd

Table of Contents

1 TBS09DR Introduction.....	4
2 Specifications.....	5
3 Installation.....	6
3.1 Mounting.....	6
3.2 Wiring.....	6
4 Configuration.....	7
4.1 Configuration Using TBS03.....	7
4.2 Configuration Using an RTU.....	7
4.3 Changing the SDI-12 Address aAb!.....	8
4.4 Query the Sensor's Info String all!.....	8
4.5 Set Communication Parameters aXSB,s,p!.....	9
4.6 Sensor Warm Up Time aXSMBW,t!.....	9
4.7 Sensor Response Time aXSMBT,n,t!.....	10
4.8 Power Supply Settings aXSMVS,p!.....	11
4.9 MODBUS Device Mapping.....	11
4.9.1 MODBUS Address Mapping aXSMBA,b!.....	12
4.9.2 MODBUS Register Mapping aXSMBM,n,b!.....	12
4.10 Set the MODBUS Data Type aXSMBD,t!.....	13
4.11 Setting the Function Type aXSMBF,f!.....	13
4.12 Set Number of Digits to Return aXSDP,d!.....	14
4.13 Sensor Scaling aXSMBS,ff,ff!.....	14
4.14 Controlling the Measurement Mode aXSMSF,t!.....	15
4.14.1 To Enable Initialisation Mode aXSMSF,t!.....	15
4.14.2 Setting up the Initialisation Command aXSMSM,add,data!.....	16
4.15 Read Input or Holding Registers aXGMBR,add! And aXGMBD!.....	16
4.16 Restore Default Configuration aXSDF!.....	17
5 Setup for Specific Sensors.....	19
5.1 Micro Sensors MPM4700.....	19
6 Warranty.....	20

1 TBS09DR Introduction

This manual is written for the TBS09DR, an interface unit designed to allow connection of MODBUS sensors to SDI-12 telemetry and data loggers.



The TBS09DR is built into a DIN Rail compatible enclosure but the PCB may also be removed and installed in a polycarbonate box.

The TBS09DR is powered from the SDI-12 interface and feeds 12V to the sensors. It is compatible with 2 wire and 4 wire sensors.

The unit may be used with single or multiple sensors, on the proviso that each sensor is programmed for a different MODBUS address. The sensors are then mapped to different SDI-12 measurement commands.

The TBS09DR is fully programmable and, in addition to being able to set all of the MODBUS parameters, also allows custom scaling to be applied to the sensor output.

All input and output connections are made via screw terminals.

2 Specifications

Parameter	Value / Range	Comment
Dimensions	120 x 80 x 57 mm	Polycarbonate enclosure DIN Rail version also available
Environmental rating	IP63	
Cable entry	Screw terminals	SDI-12 4 terminals RS485 6 terminals
SDI-12 Compatibility	V 1.3	
Operating temperature range	-40 to +80 degrees C	
Power Supply	6 to 16 V DC	
Supply Current	Read typ 6mA Sleep 100uA	
RS485 Modes	Full Duplex Half Duplex	Jumper selectable
Bu Termination	Nil or 120 ohm	Jumper selectable
Current Protection	700mA fuse	
Max Sensor Count	10	

3 Installation

3.1 Mounting

The TBS09DR enclosure is designed to fit on a length of DIN Rail. It should be mounted within a suitably rated enclosure.

Should you wish to use the TBS09 PCB on its own, you can remove it from the housing and install it in a suitably sized polycarbonate or metal enclosure. Cable entry can then be achieved using cable glands fitted to the enclosure.

Using 3 core cable, make up a lead to connect from the SDI-12 port on the telemetry unit to the SDI-12 terminal blocks on the TBS09.

The sensor can be wired directly to the TBS09 or, if you are mounting the unit in a large enclosure, cabled to a terminal strip, with jumper wires running from the terminal strip to the TBS09's MODBUS terminals.

3.2 Wiring

The TBS09DR may be used in Half Duplex or Full Duplex Modes. In half duplex mode the sensor connects to the TX terminals and the RX terminals are not used.

Terminal / Mode	Half Duplex	Full Duplex
TX +	RX+	RX+
TX -	RX -	RX -
RX +	n.c	TX +
RX -	n.c	TX -

4 Configuration

The TBS09 can be configured using the TBS03 USB to SDI-12 converter or using the Direct Command mode on an RTU (the Tekbox TBS12 and TBSL1 units provide this functionality as do the YDOC ML315 and ML417 units).

Other than the basic SDI-12 configuration commands (change address, get Information string) all of the configuration is completed using Extended SDI-12 commands

- extended SDI-12 commands all begin with an X (after the address).

Each command has two variants:

- Set command S sets the parameter
- Get command G gets the value of the parameter

4.1 Configuration Using TBS03

If you have not already done so, 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 TBS02PA.

To assist with the process of configuring the TBS09DR, TOIP have set up an SDI-12 configuration file for the TBS12. Contact TOIP to obtain a copy and then save it to the folder:

C:\Users\AppData\Local\SDI12-Commander\sdi12_networks

When you open the SDI-12 Commander program, select this SDI-12 network file. Then select the TBS09DR tab. Under the tab you will find a button for each of the configuration commands.

In all of the commands, the letter “a” is used to designate the sensor address.

4.2 Configuration Using an RTU

Connect the remote telemetry unit (RTU) to your PC using the appropriate communications cable:

- TBS12 USB to FTDI cable

e.g. to return info for TBS09 on address 0

```
0!  
013TEKBOXDSTBS9MB0.2000001
```

4.5 Set Communication Parameters *aXSB,s,p!*

This command is used to set the parameters for the MODBUS communications with the sensor. Two parameters are required.

To set the Communications Parameters **aXSB,s,p**

Where s = Speed 9600, 19200... 115200
p = Parity 0 = No parity 1 = Even 2 = Odd

e.g. to set the comms to 9600 baud with no parity

```
0XSB,9600,0!  
0X_ok
```

To query the current settings **0XGB!**

e.g. to check the settings for a sensor on address 0

```
0XGB!  
0,9600,0
```

4.6 Sensor Warm Up Time *aXSMBW,t!*

The warm up time or settling time is the delay from when the sensor is powered up to when a reading is taken. The default is 3 seconds.

The warm up time is applied to all sensors connected to the TBS09.

To set the Sensor Warm Up Time **aXSMBW,n!**

Where t = warm up time in seconds Range = 1 to 100 sec

e.g. To set the warm up time to 2 seconds

```
0XSMBW,2!  
0X_ok
```

To query the current settings **0XGMBW!**

e.g. to check the settings for a sensor on address 0

0XGMBW!
0,2

4.7 Sensor Response Time *aXSMBT,n,t!*

The Measurement Response Time is the time needed before the sensor will complete its measurement and write the value to the appropriate register. The default is 3 seconds.

The sensor measurement response time can be set separately for each sensor connected to the TBS09.

To set the Sensor Response Time **aXSMBT,n,t!**

Where n = Sensor number
t = warm up time in seconds Range = 1 to 999 sec

e.g. To set the response time to 1 seconds for the first sensor (0)

0XSMBT,0,1!
0X_ok

To query the current settings **0XGMBT!**

e.g. to check the settings for the first MODBUS sensor on address 0

0XGMBT,0!
0,aM0-001

SDI-12 Measurement Time

- when an SDI-12 measurement command (e.g. 0M1!) is issued, the sensor replies with its address (0) the time to wait before the values will be ready (e.g. 03) and the number of values to be returned (e.g. 1)
- after this time has elapsed the telemetry unit can issue the fetch command to retrieve the values e.g. 0D0!
- for each sensor / measurement command, the time to wait is the sum of the Warm Up Time and the Response Time

4.8 Power Supply Settings *aXSMVS,p!*

Some telemetry units will feed a permanent 12V power supply to the sensors, whilst others will switch the power on only when it is needed. If the RTU has a permanent The TBS09 allows you to independently control the supply to the sensors to save power.

The default setting is for permanent power i.e. the output power to the sensor is on whenever the unit is powered up over the SDI-12 bus.

To set the Power Supply Mode *aXSMVS,p!*

Where p = power supply mode 0 = switched 1 = permanently on

e.g. To the power supply mode to switched

0XSMVS,0!

0X_ok

To query the current settings *0XGMVS!*

e.g. to check the settings for a sensor on address 0

0XGMVS!

0,aM0-001

4.9 MODBUS Device Mapping

The Mapping is completed in two steps:

- the first step adds an address to the list of supported units
 - The valid MODBUS address range is 1 to 247.
- the second step maps the sensor's address to an SDI-12 command
 - The commands available are M (M0) through M9.

If you are only connecting a single sensor, use the default measurement command (M). If you are connecting multiple sensors, each must be assigned a different MODBUS address (refer to manufacturer's manual for details on how to change the address) and SDI-12 command.

4.9.1 MODBUS Address Mapping aXSMBA,b!

The first step is to add a Sensor address to the list of supported addresses. The TBS09 uses this list to determine which MODBUS read commands to issue.

To add a MODBUS address to the map list aXSMBA,b!

Where b = MODBUS address (1 to 247)

e.g. to map a Sensor on address 99 to the TBS09

```
0XSMBA,99!  
0X_ok
```

To read the list of mapped sensor addresses aXGMBA!

e.g. to read the list of mapped addresses

```
0XGMBA!  
0,99
```

4.9.2 MODBUS Register Mapping aXSMBM,n,b!

The second step is to map a Modbus Register (0 to 65535) to one of the available Measurement Commands (0 to 9).

To map a MODBUS address to a command aXSMBM,n,b!

Where n = Command number; Range =0 to 9 for M! to M9!

b = MODBUS register

e.g. To map Measurement Command M (equiv to M0) to Register 1

```
0XSMBM,0,1!  
0X_ok
```

To Read the MODBUS Register Mapping aXGMBM,n!

Where n = Measurement Command ; Range = 0 to 9 for M! to M9!

e.g. To read the mapping for Command M!

```
0XGMBM,0!  
0,aM0-1
```

4.10 Set the MODBUS Data Type *aXSMBD,t!*

Each sensor will be programmed by the manufacturer to return values in a pre-determined format or type. If you have multiple sensors connected on the TBS09, all will be set to the same data type.

To set the Modbus Data Type **aXSMBD,t!**

Where t = MODBUS data type

- 0 Floating Point (2 registers or 64 Bits)
- 1 Unsigned Integer (1 register or 32 bits)
- 2 Signed Integer (1 register or 32 bits).

e.g. To set the data type to Unsigned Integer

`0XSMBD,1!`

`0X_ok`

To read the MODBUS Data Type Selection **0XGMBD!**

e.g. To read the data type

`0XGMBD!`

`0,1`

4.11 Setting the Function Type *aXSMBF,f!*

MODBUS sensors may return values through either a Holding Register or an Input Register. In the MODBUS system each function type is mapped to a specific register range:

03	Read Holding Registers	Start Add	30000
04	Read Input Registers	Start Add	40000

Even though the registers map to these start addresses, the offset (30000 or 40000) can be ignored and the registers to read start at 1. The sensor manual will indicate which of the two functions is used

To set the Function Type **aXSMBF,f!**

Where f = 3 Holding Register

4 Input Register

e.g. to set the Function Type to Input Register (4)

```
0XSMBF,4!  
0X_ok
```

To read the current Function Type

aXGMBF!

e.g To display current setting

```
0XGMBF!  
0,4
```

4.12 Set Number of Digits to Return aXSDP,d!

The maximum length of any measurement in the SDI-12 protocol is 9 digits. When integer readings from the MODBUS sensors are converted to SDI-12 format, they will be output with a minimum of 3 digits. If the number is smaller than that, leading zeroes will be added. To reduce the number of surplus characters you can change the number of digits that will be returned (default is 3)

To set the number of digits

aXSDP,d!

Where d = Number of digits (1 to 9)

e.g. to set the number of digits to 2

```
0XSDP,2!  
0X_ok
```

To read the number of digits

aXGDP!

e.g Checking current setting

```
0XGDP!  
0,2
```

4.13 Sensor Scaling aXSMBS,ff.ff!

A Scaling factor can be applied to the output of the MODBUS sensor(s) in order to apply a simple linear correction or calibration.

The default scaling factor is 1.

The scaling factor applies to all sensors connected to the TBS09.

To set the Scaling Factor**aXSMBS,ff.ff!**

Where ff.ff = multiplier as a floating point number

e.g. to set the scaling factor to 0.5

0XSMBS,0.5!

0X_ok

To read the Scaling Factor**aXGMBS!**

e.g. Reading the scaling factor from TBR09 on address 0

0XGMBS!

0+0.500

4.14 Controlling the Measurement Mode

aXSMSF,t!

Most MODBUS sensors will automatically initiate a read sequence when power up. However some sensors require a command to be sent to them to initiate the measurement process.

After enabling Measurement Mode you set the string to be used by the initialisation. This will then be sent in advance of every measurement command.

4.14.1 To Enable Initialisation Mode aXSMSF,t!

To enable sending of the initialisation command prior to measurement you must set this function to on.

To enable Initialisation Mode

aSMSF,t

Where t = 1 Turn on Initialisation mode

0 Turn off initialisation mode (default)

e.g. To enable Initialisation mode

0XSMSF,1!

0X_ok

To query the current initialisation mode setting aGMSF!

e.g Querying current mode

0XGMSF!

0,1

4.14.2 Setting up the Initialisation Command aXSMSM,add,data!

Once you have enable Initialisation Mode, you need to enter the command to be sent to the sensor to trigger the measurement process.

To set the Initialisation Character aXSMSM,add,data

Where add = MODBUS Sensor address
 data = Initialisation command character (0 to 255)

e.g to set initialisation string for sensor on add 99 to 0xF or 16 decimal

0XSMSM,99,15!

0X_ok

To Query the Initialisation Command aXGMSM

This function will return the initialisation string for all sensors for which it has been set.

e.g Get Initialisation command

0XGMSM!

0,99,15

4.15 Read Input or Holding Registers aXGMBR,add! And aXGMBD!

Many MODBUS sensors write information such as the calibration or units settings to either an Input or Holding register. Some sensors may make raw values or additional values available in these registers.

According to the Function you have set in Section 4.11 , you can then read any of the Input or Holding Registers on the MODBUS Sensor.

The process is completed as follows:

- Select Function Type (Input or Holding)** **aXSMBF,f!**
Where f = 3 (Holding) or 4 (Input)
- Read Input/Holding Register** **aXGMBR,add!**
Where add = Register address
- Retrieve Register Value** **aXGMBRD!**

e.g. To read the contents of Holding Register 130

Select Holding Register

0XSMBF,4!

0X_ok

Read Holding Register 130

0XGMBR,130!

0X_ok

Retrieve Register Value

0XGMBRD!

0,127

4.16 Restore Default Configuration **aXSDF!**

This command may be used to return the TBS09 to its default settings.

To restore TBS09 to default **aXSDF!**

The default values are:

Function	Value
Address	0
Serial Number	00001
Comms Setting	19200, No parity
Modbus Address	1

Command Mapping	M! 0x0000 M1! 0x0002 ... M9! 0x12 (18 decimal)
Measurement response time	1 sec
Warm up time	10 sec
Data format	Floating point
Data length	3 digits
Power Supply	Permanent power

e.g. Restore TBS09 to defaults

0XSDF!

0X_ok

5 Setup for Specific Sensors

This section shows the configuration for some specific MODBUS Sensors. Any values not shown may be left at the default settings.

5.1 Micro Sensors MPM4700

Wiring	Power (12V	Black	
	Ground	Red	
	RS485A (+)	Yellow	
	RS485B (-)	White	
Bus Address	99		0XSMBA,99!
Register Address	1	Map to M!	0XSMBM,0,1!
Function Type	3 (Holding)		0XSMBF,3!
Communications	9600, 8, N, 1		0XSB,9600,0!
Data Type	Unsigned Int		0XSMBD,1!
Scaling Factor	Input mm	Output m	0XSMBS,0.001!
		mm Resolution	0XSDP,3!

6 Warranty

The TBS09DR 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 and 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.