PROBUS

RS485 MODBUS I/O Modules

User Manual

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1. AN OVERVIEW OF THE PROBUS SYSTEM

1.1 Introduction

PROBUS is an innovative modular I/O system which provides a simple low cost solution for distributed I/O requirements.

The PROBUS system consists of stand-alone Digital and Analog Input and Output modules which are connected together on a RS485 two wire multi-drop network.

The modules plug into a special bus connector which fits inside the DIN rail.

The modules communicate using the MODBUS RTU protocol. A 32bit ARM CPU is used in the modules to provide high speed data processing and fast communications turnaround times. Multiple baud rates are selectable from 2400 to 115200 baud.

All PROBUS modules plug directly onto an industry standard DIN rail. All modules have a minimum isolation of 1500VAC rms between the field and logic and all RS485 circuits are isolated.

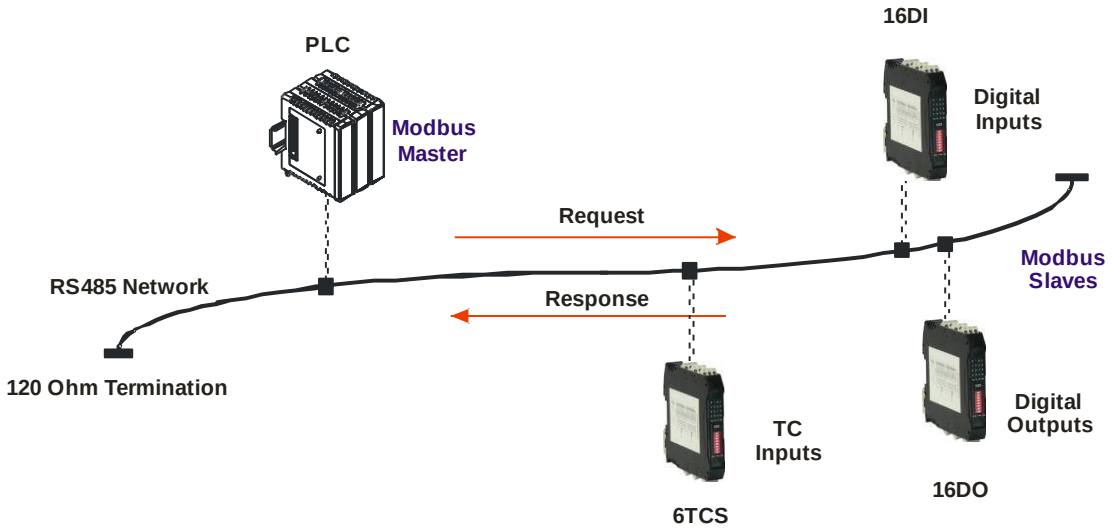
The modules have been equipped with status led's which are used to indicate the status of the Inputs or outputs. This visual indication assists with fault finding and diagnostics.

1.2 Application Configurations

There are a number of different configurations in which the PROBUS modules may be used in a system. Some are listed as follows:

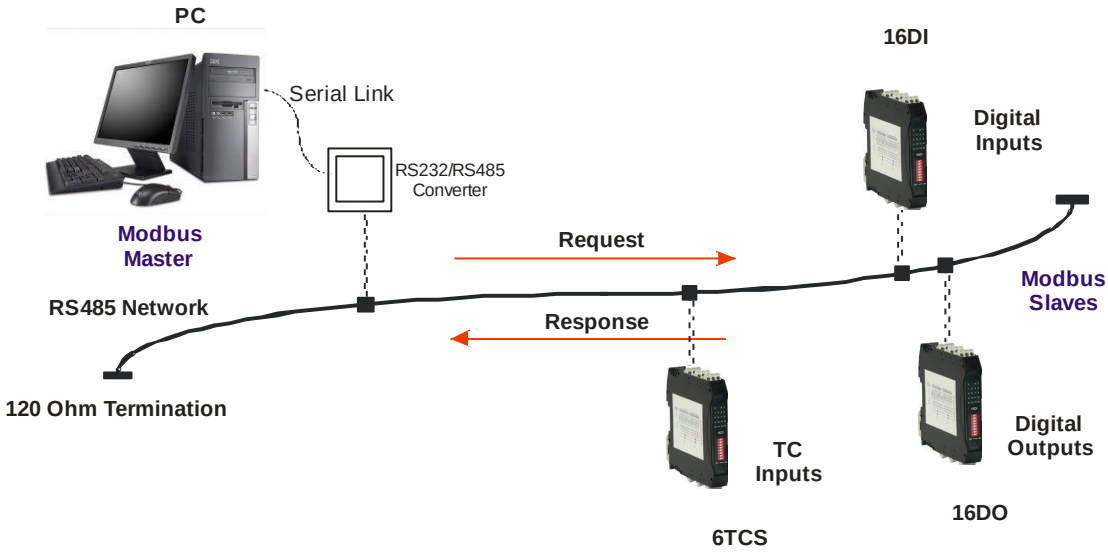
1.2.1 I/O Expansion.

There are a number of devices such as PLC's (Programmable Logic Controllers) which have a MODBUS Communications facility available. When configured as a MODBUS Master, and attached to the RS485 network, the PLC can use the PROBUS Modules as remote I/O reducing cabling costs and increasing the I/O capability of the PLC.



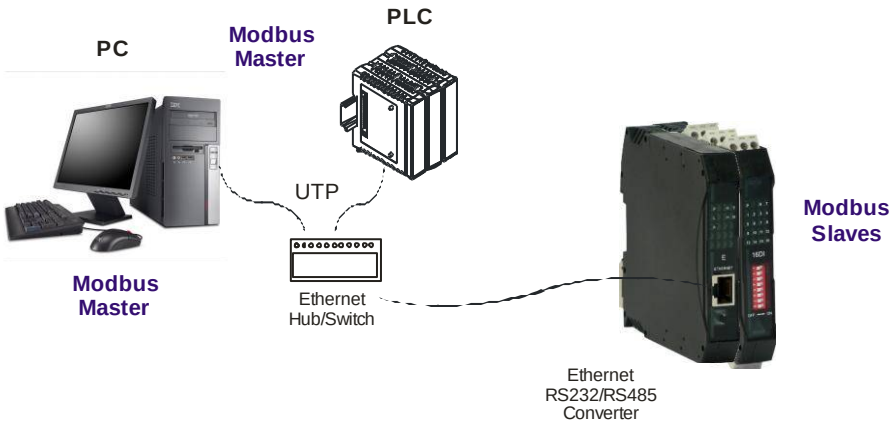
1.2.2 Data Acquisition.

Another use of the PROBUS Modules is for Data Acquisition where a PC (Personal Computer) is connected to the Network. Many SCADA software packages support the MODBUS Master Protocol and can hence retrieve data from Input Modules or send data to Output Modules. The serial port of the PC is connected to an RS232/RS485 Converter which in turn is connected to the Network.



1.2.3 Ethernet.

Procon has developed a Converter which connects to a standard 10/100BaseT Ethernet network. The Converter is given a network IP address and can be accessed by up to 8 PC's at a time. The converter enables PC's and PLC's using the MODBUS/TCP protocol to communicate with the range of PROBUS modules.



1.2.4 Other Applications.

PROBUS Modules can be connected to a PC or PLC for remote monitoring and control via radio telemetry using third party RF transceivers, Dial-up modems or GPRS modems.

1.3 Module Selection Table

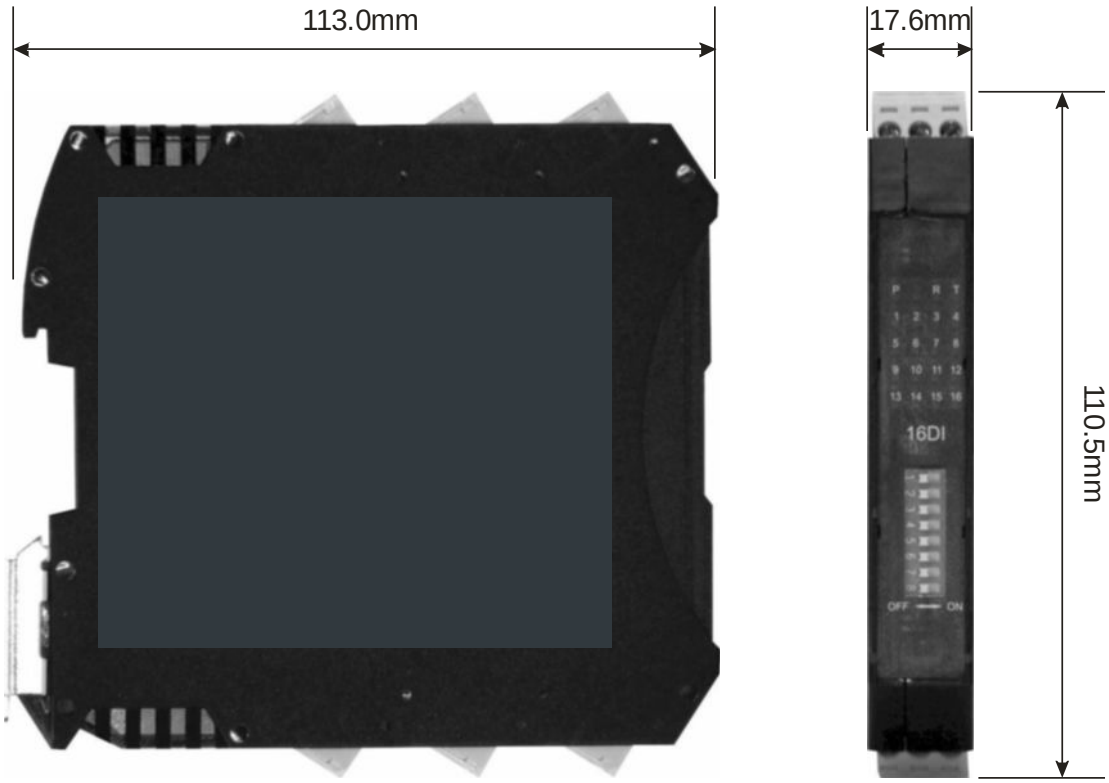
MODEL	MODULE TYPE
I/O MODULES	
PB16DI	16 DIGITAL INPUT MODULE INCLUDING COUNTERS
PB16DO	16 DIGITAL OUTPUT MODULE
PB6RO	6 RELAY OUTPUT MODULE
PB6DIO	6 DIGITAL INPUT / 6 DIGITAL OUTPUT MODULE
PB8AII	8 ANALOG INPUT 0 - 20mA / 4 - 20mA – 16bit
PB8AIV	8 ANALOG INPUT 0 - 10V / 2 - 10V – 16bit
PB6AIIS	8 ANALOG INPUT 0 - 20mA / 4 - 20mA / ±20mA FULLY ISOLATED
PB6AIVS	8 ANALOG INPUT 0 - 1V / 0 - 10V / ±1V / ±10V FULLY ISOLATED
PB6TCS	8 TC INPUT MODULE INCL. 0 - 50mV & ±100mV I/P FULLY ISOLATED
PB6RTD	6 RTD INPUT MODULE - PT100, Ni120, PT1000, Ni1000, Ni1000LG & Ohms
PB6AOI	8 ANALOG OUTPUT MODULE 0(4) – 20mA
PB6AOV	8 ANALOG OUTPUT MODULE 0(2) – 10V
PB-E	Modbus/TCP Ethernet to Serial RS485 gateway
PB-P	Profibus to Serial RS485 gateway

2. PROBUS GENERAL INFORMATION

2.1 Physical Dimensions

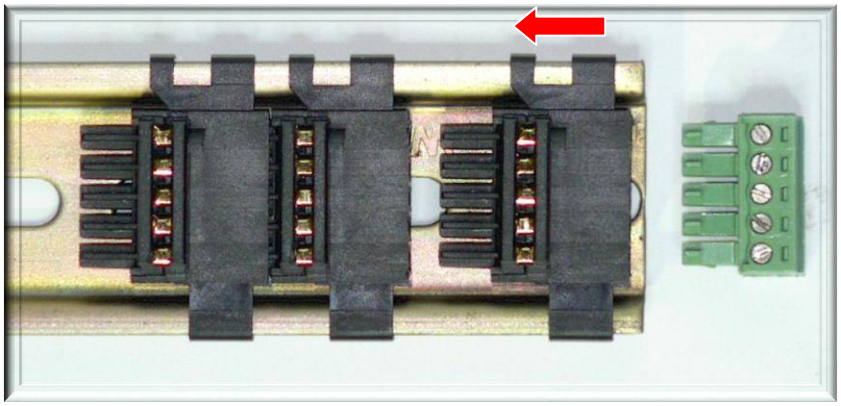
The PROBUS enclosure is shown below. The module clips directly onto an industry standard DIN rail. Field wiring is on the top and bottom of the module via 6 plug-in connectors. The module power and RS485 communications wiring is on a separate connector which clips onto the DIN rail on the back of the housing.

Allow at least 25mm on top and below the module to accommodate the wiring. Ensure that enough space is kept above and below the module for good ventilation.



2.2 DIN rail Bus adaptor

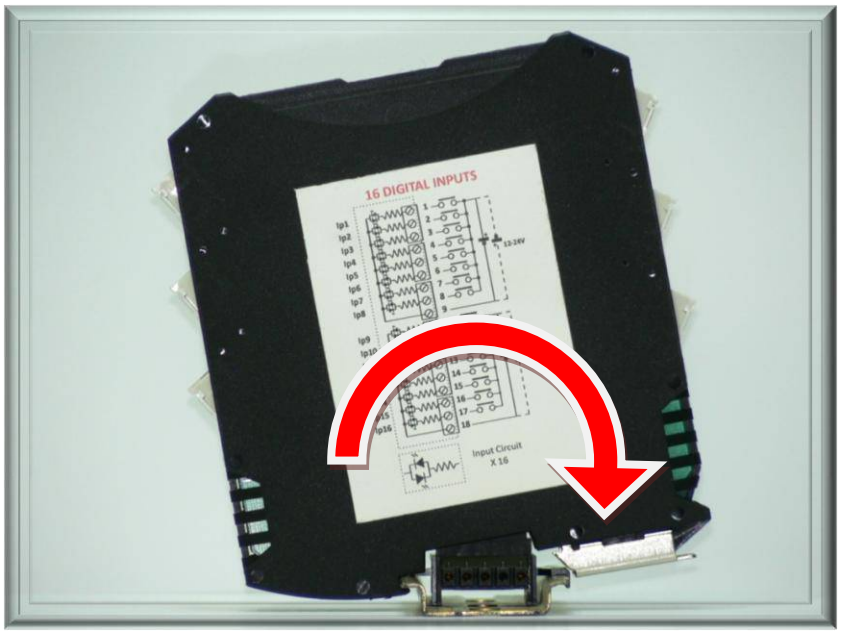
The PROBUS connector allows side-by-side install of the Modules. The picture below shows multiple PROBUS connectors installed on a DIN rail. First, install the PROBUS connector onto the DIN rail, then slide into the adjacent PROBUS connector.



2.3 Installing the module onto the DIN rail

The Probus modules are designed to be installed on a standard 35 mm DIN rail. Snap the PROBUS connector first into the rail as shown above. Next clip the top of the module onto the DIN rail and pivot the Module onto the DIN rail. The spring loaded clasp will latch around onto the DIN resulting in a firmly seated product. Do not force the module onto the connector otherwise the module or connector may be damaged.

Note: The modules are not designed for hot plug in. The power must be turned off before the modules are plugged into the base.



2.4 Removing the module from the DIN rail

To remove the module from the DIN Rail, use a flat blade screwdriver to pry the spring loaded clasp away from the DIN rail in the manner shown in the picture below. Next pivot the module up and away from the DIN rail and remove.

2.5 Grounding/Shielding

In most cases, PROBUS modules will be installed in an enclosure along with other devices which generate electromagnetic radiation. Examples of these devices are relays and contactors, transformers, motor controllers etc. This electromagnetic radiation can induce electrical noise into both power and signal lines, as well as direct radiation into the module causing negative effects on the system. Appropriate grounding, shielding and other protective steps should be taken at the installation stage to prevent these effects. These protective steps include control cabinet grounding, module grounding, cable shield grounding, protective elements for electromagnetic switching devices, correct wiring as well as consideration of cable types and their cross sections.

2.6 Network Termination

Transmission line effects often present a problem on data communication networks. These problems include reflections and signal attenuation.

To eliminate the presence of reflections from the end of the cable, the cable must be terminated at both ends with a resistor across the line equal to its characteristic impedance. Both ends must be terminated since the direction of propagation is bi-directional. In the case of an RS485 twisted pair cable this termination is typically 120 ohms.

2.7 RS485 Network Wiring

RS485 is designed to be used with a single twisted pair cable. One of the restrictions of this system is that the common mode voltages of the nodes on the network should not exceed -7V or +10V. In order to ensure that this condition is met, it is recommended that the RS485 GND connections on the

modules be connected together. For modules that are far apart, a second twisted pair should be used as the RS485 GND link.

In certain applications where there are strong possibilities of an earth loop being caused by the RS485 GND link, the link should be tied to the RS485 GND terminal on each module through a 100ohm resistor, to limit the earth loop current.

Where earth loop problems exist, it may be necessary to isolate the RS485 network either using optical fiber or an isolated RS485 repeater such as the PB485REP module.

RS485 Cabling Methodology

Method-1, Single Twisted pair, No shield

In this case, "Earth" is ground and it is inexpensive, easy to install. This kind of cabling is suitable if conduits are used for communication cables, power supply cables are not available and the environment is free from electrical noise. This method is not recommended for industrial applications.

Method-2, Shielded single twisted pair + Earth wire

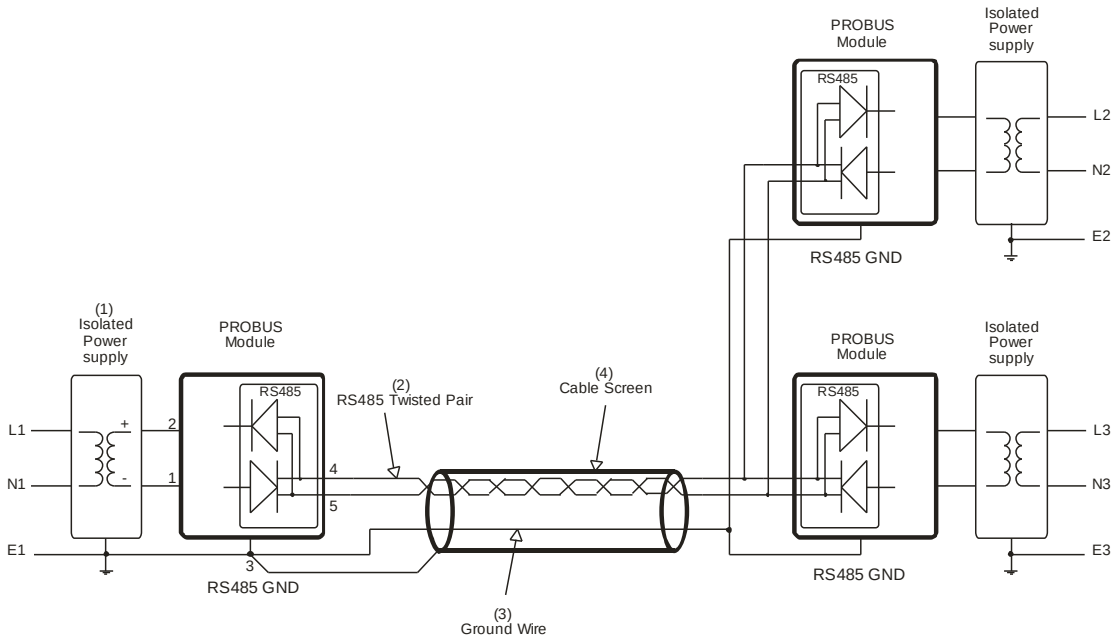
One pair is used for RS-485 communications and extra wire used specifically for a ground wire.

Method-3, Shielded single twisted pair cable

One pair is used for RS-485 communications and shield is used for return.

Method-4, Shielded twisted pair, 2 pairs

One pair is used for the RS-485 communications and another pair is used for ground.
Method 2 to 4 would reduce noise induced through ground potential differences. This is the preferred option in areas where there is a potential for high electrical noise or if cabling lacks the cleanliness of conduit or wire trays. The drawback of the three conductor option is elevated cable pricing and is slightly more difficult to install. Care must also be taking using this option not to create a ground loop.



Good installation practice for RS485 systems:

1. Use RS485 twisted cable to prevent electrical noise pickup.

2. Use a ground wire to connect all of the RS485 GND terminals on the modules together. This ensures that all of the modules are at the same potential. The ground wire must be earthed at one only.

3. Use a screened cable to prevent electrical noise pickup. This screen must be earthed at one end only. If a ground wire is not available then the screen can be used instead. To get the best performance this is not recommended.

4. The RS485 and power supply is wired correctly.

5. Do not carry RS485 and 24V DC power supply in same cables.

6. Use Separate isolated 24V DC for RS485 devices power supply and field inputs.

7. The 0V of the power supply must be earthed.

8. The screen of the RS485 cable must be earthed.

9. The RS485 devices must be at the same earth potential.

10. Use optical isolators in RS485 line to provide protection from low frequency interference from ground loops.

11. Do proper termination and/or shielding to provide isolation from high frequency interference, RFI, and transients.

12. The power supply must have good filters and protection on the 220V/110V side.

13. The RS485 line should have external over voltage protection to protect from high voltage electrical noise being induced into the RS485 cable.

14. Make sure there is a dedicated Instrumentation ground system to be used with RS485 devices.

2.8 RS485 Network Protection

Being used in an industrial environment, the RS485 network could pick up electrical noise from other machinery or even lightening. In this case it is advised that an RS485 network protection device be used at the entry point to the panel where the PROBUS modules are housed.

2.9 Setting the Modbus Node ID

2.9.1 Changing the DIP switch to set the Node ID and baud rate

The DIP switches are provided to manually configure the module node ID and baud rate. Switches 1 through 7 set the node ID sequentially starting at 0 and ending at 127. Switch 8 sets the baud rate at either 9600 or user programmed in memory.

The software in the module samples the dip switches on a reset when the power is cycled. Once sampled, the software writes the settings into the internal UART. The user is welcome to change the dip switches while the module is powered, however, a reset must be initiated afterward.

The DIP switch can be toggled using a small flat blade screwdriver, or equivalent tool, as shown in the picture below.

2.9.2 DIP Switch Status Register.

Each module uses register 30100 to store the status of the DIP switches.

MSB								DIP SWITCH REGISTER						LSB		ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30100

0 0 0 0 0 0 0 0

SW 1
SW 2
SW 3
SW 4
SW 5
SW 6
SW 7
SW 8

2.9.3 Node ID Table

The following table assists with the setting up of DIP switches for the required NODE ID.

NODE ID	DIP SWITCH SETTINGS						
	SW1	SW2	SW3	SW4	SW5	SW6	SW7
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF
6	OFF	ON	ON	OFF	OFF	OFF	OFF
7	ON	ON	ON	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON	OFF	OFF	OFF
10	OFF	ON	OFF	ON	OFF	OFF	OFF
11	ON	ON	OFF	ON	OFF	OFF	OFF
12	OFF	OFF	ON	ON	OFF	OFF	OFF
13	ON	OFF	ON	ON	OFF	OFF	OFF
14	OFF	ON	ON	ON	OFF	OFF	OFF
15	ON	ON	ON	ON	OFF	OFF	OFF
16	OFF	OFF	OFF	OFF	ON	OFF	OFF
17	ON	OFF	OFF	OFF	ON	OFF	OFF
18	OFF	ON	OFF	OFF	ON	OFF	OFF
19	ON	ON	OFF	OFF	ON	OFF	OFF
20	OFF	OFF	ON	OFF	ON	OFF	OFF
21	ON	OFF	ON	OFF	ON	OFF	OFF
22	OFF	ON	ON	OFF	ON	OFF	OFF
23	ON	ON	ON	OFF	ON	OFF	OFF
24	OFF	OFF	OFF	ON	ON	OFF	OFF
25	ON	OFF	OFF	ON	ON	OFF	OFF
26	OFF	ON	OFF	ON	ON	OFF	OFF
27	ON	ON	OFF	ON	ON	OFF	OFF
28	OFF	OFF	ON	ON	ON	OFF	OFF
29	ON	OFF	ON	ON	ON	OFF	OFF
30	OFF	ON	ON	ON	ON	OFF	OFF
31	ON	ON	ON	ON	ON	OFF	OFF
32	OFF	OFF	OFF	OFF	OFF	ON	OFF
33	ON	OFF	OFF	OFF	OFF	ON	OFF
34	OFF	ON	OFF	OFF	OFF	ON	OFF
35	ON	ON	OFF	OFF	OFF	ON	OFF
36	OFF	OFF	ON	OFF	OFF	ON	OFF
37	ON	OFF	ON	OFF	OFF	ON	OFF
38	OFF	ON	ON	OFF	OFF	ON	OFF
39	ON	ON	ON	OFF	OFF	ON	OFF
40	OFF	OFF	OFF	ON	OFF	ON	OFF
41	ON	OFF	OFF	ON	OFF	ON	OFF

NODE ID	DIP SWITCH SETTINGS						
	SW1	SW2	SW3	SW4	SW5	SW6	SW7
42	OFF	ON	OFF	ON	OFF	ON	OFF
43	ON	ON	OFF	ON	OFF	ON	OFF
44	OFF	OFF	ON	ON	OFF	ON	OFF
45	ON	OFF	ON	ON	OFF	ON	OFF
46	OFF	ON	ON	ON	OFF	ON	OFF
47	ON	ON	ON	ON	OFF	ON	OFF
48	OFF	OFF	OFF	OFF	ON	ON	OFF
49	ON	OFF	OFF	OFF	ON	ON	OFF
50	OFF	ON	OFF	OFF	ON	ON	OFF
51	ON	ON	OFF	OFF	ON	ON	OFF
52	OFF	OFF	ON	OFF	ON	ON	OFF
53	ON	OFF	ON	OFF	ON	ON	OFF
54	OFF	ON	ON	OFF	ON	ON	OFF
55	ON	ON	ON	OFF	ON	ON	OFF
56	OFF	OFF	OFF	ON	ON	ON	OFF
57	ON	OFF	OFF	ON	ON	ON	OFF
58	OFF	ON	OFF	ON	ON	ON	OFF
59	ON	ON	OFF	ON	ON	ON	OFF
60	OFF	OFF	ON	ON	ON	ON	OFF
61	ON	OFF	ON	ON	ON	ON	OFF
62	OFF	ON	ON	ON	ON	ON	OFF
63	ON	ON	ON	ON	ON	ON	OFF
64	OFF	OFF	OFF	OFF	OFF	OFF	ON
65	ON	OFF	OFF	OFF	OFF	OFF	ON
66	OFF	ON	OFF	OFF	OFF	OFF	ON
67	ON	ON	OFF	OFF	OFF	OFF	ON
68	OFF	OFF	ON	OFF	OFF	OFF	ON
69	ON	OFF	ON	OFF	OFF	OFF	ON
70	OFF	ON	ON	OFF	OFF	OFF	ON
71	ON	ON	ON	OFF	OFF	OFF	ON
72	OFF	OFF	OFF	ON	OFF	OFF	ON
73	ON	OFF	OFF	ON	OFF	OFF	ON
74	OFF	ON	OFF	ON	OFF	OFF	ON
75	ON	ON	OFF	ON	OFF	OFF	ON
76	OFF	OFF	ON	ON	OFF	OFF	ON
77	ON	OFF	ON	ON	OFF	OFF	ON
78	OFF	ON	ON	ON	OFF	OFF	ON
79	ON	ON	ON	ON	OFF	OFF	ON
80	OFF	OFF	OFF	OFF	ON	OFF	ON
81	ON	OFF	OFF	OFF	ON	OFF	ON
82	OFF	ON	OFF	OFF	ON	OFF	ON
83	ON	ON	OFF	OFF	ON	OFF	ON
84	OFF	OFF	ON	OFF	ON	OFF	ON
85	ON	OFF	ON	OFF	ON	OFF	ON
86	OFF	ON	ON	OFF	ON	OFF	ON
87	ON	ON	ON	OFF	ON	OFF	ON
88	OFF	OFF	OFF	ON	ON	OFF	ON
89	ON	OFF	OFF	ON	ON	OFF	ON
90	OFF	ON	OFF	ON	ON	OFF	ON

NODE ID	DIP SWITCH SETTINGS						
	SW1	SW2	SW3	SW4	SW5	SW6	SW7
91	ON	ON	OFF	ON	ON	OFF	ON
92	OFF	OFF	ON	ON	ON	OFF	ON
93	ON	OFF	ON	ON	ON	OFF	ON
94	OFF	ON	ON	ON	ON	OFF	ON
95	ON	ON	ON	ON	ON	OFF	ON
96	OFF	OFF	OFF	OFF	OFF	ON	ON
97	ON	OFF	OFF	OFF	OFF	ON	ON
98	OFF	ON	OFF	OFF	OFF	ON	ON
99	ON	ON	OFF	OFF	OFF	ON	ON
100	OFF	OFF	ON	OFF	OFF	ON	ON
101	ON	OFF	ON	OFF	OFF	ON	ON
102	OFF	ON	ON	OFF	OFF	ON	ON
103	ON	ON	ON	OFF	OFF	ON	ON
104	OFF	OFF	OFF	ON	OFF	ON	ON
105	ON	OFF	OFF	ON	OFF	ON	ON
106	OFF	ON	OFF	ON	OFF	ON	ON
107	ON	ON	OFF	ON	OFF	ON	ON
108	OFF	OFF	ON	ON	OFF	ON	ON
109	ON	OFF	ON	ON	OFF	ON	ON
110	OFF	ON	ON	ON	OFF	ON	ON
111	ON	ON	ON	ON	OFF	ON	ON
112	OFF	OFF	OFF	OFF	ON	ON	ON
113	ON	OFF	OFF	OFF	ON	ON	ON
114	OFF	ON	OFF	OFF	ON	ON	ON
115	ON	ON	OFF	OFF	ON	ON	ON
116	OFF	OFF	ON	OFF	ON	ON	ON
117	ON	OFF	ON	OFF	ON	ON	ON
118	OFF	ON	ON	OFF	ON	ON	ON
119	ON	ON	ON	OFF	ON	ON	ON
120	OFF	OFF	OFF	ON	ON	ON	ON
121	ON	OFF	OFF	ON	ON	ON	ON
122	OFF	ON	OFF	ON	ON	ON	ON
123	ON	ON	OFF	ON	ON	ON	ON
124	OFF	OFF	ON	ON	ON	ON	ON
125	ON	OFF	ON	ON	ON	ON	ON
126	OFF	ON	ON	ON	ON	ON	ON
127	ON	ON	ON	ON	ON	ON	ON

All modules will respond to a default Node ID of 254.

2.10 Communications Settings

The data in the modules are stored in 16 bit registers. These registers are accessed over the network using the MODBUS RTU communication protocol.

2.10.1 Communications Settings with DIP Switch 8 OFF (Default)

BAUD RATE	9600
DATA BITS	8
PARITY	NONE
STOP BITS	1

2.10.2 Communications Settings with DIP Switch 8 ON (Programmed Baud Rate)

BAUD RATE	2400, 4800, 9600, 19200, 38400, 57600, 115200, 187500
DATA BITS	8
PARITY	None, Even, Odd
STOP BITS	1, 2

2.10.3 Communications Settings Registers

40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	(x10ms)

2.10.3.1 Baud Rate Register (40121)

The baud rate value is programmed directly into the baud rate register. The only exception is the 115200 baud rate where the value 11520 is used and 187500 baud where the value 18750 is used.

2.10.3.2 Parity Register (40122)

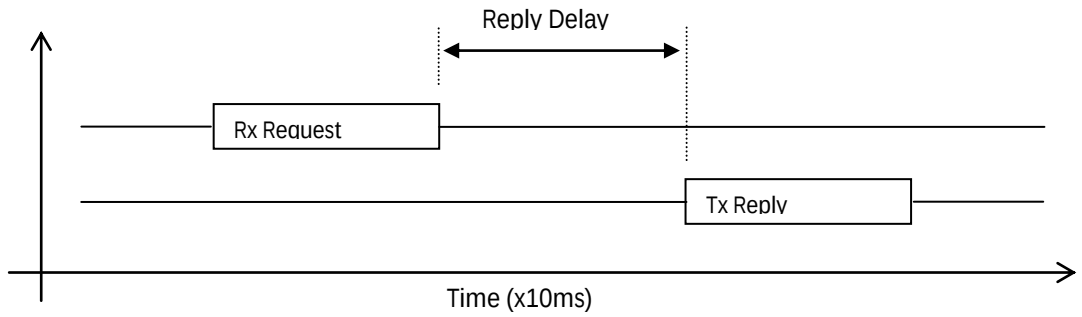
The parity can be set to none by writing a 0 to the parity register, set to even by writing a 1 to the parity Register or set to odd by writing a 2 to the parity register.

2.10.3.3 Stop Bits Register (40123)

The number of stop bits can be set to 1 by writing a 1 to the stop bits register or set to 2 by writing a 2 to the stop bits Register.

2.10.3.4 Reply Delay Register (40124)

The reply delay is a time delay between the Modbus message received to the reply being sent. In some applications where a modem or radio is used in the RS485 network, it may be necessary to add a reply delay due to turn around delays in the equiPBent.



2.10.4 Modbus Register Types

There are 4 types of variables which can be accessed from the module. Each module has one or more of these data variables.

Type	Start Address	Variable	Access
1	00001	Digital Outputs	Read & Write
2	10001	Digital Inputs	Read Only
3	30001	Input registers (Analog)	Read Only
4	40001	Output registers (Analog)	Read & Write

Note: The Modbus message length must be limited to 100 consecutive read or write registers. If more registers are required then a new poll group must be added for the next xxx registers.

2.10.5 Modbus Functions

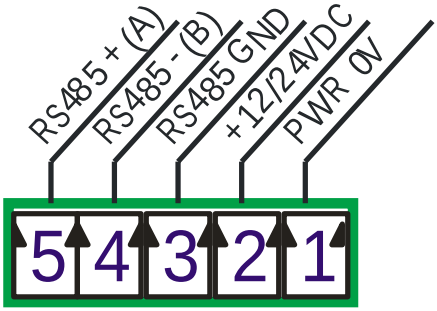
The PROBUS modules will respond to the following Modbus functions:

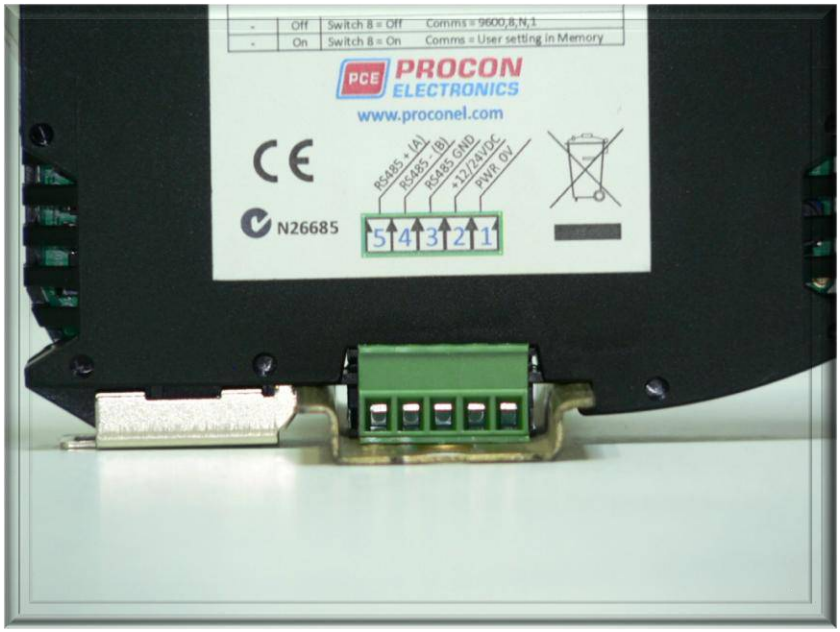
Function 1 – Read I/O status (Digital Inputs and Outputs)
Function 2 – Read I/O status (Digital Inputs and Outputs)
Function 3 – Read Register (Analog Inputs and Outputs)
Function 4 – Read Register (Analog Inputs and Outputs)
Function 5 – Write Single Digital Output (Digital Outputs)
Function 6 – Write Single Register (Analog Outputs)
Function 15 – Write Multiple Digital Outputs (Digital Outputs)
Function 16 – Write Multiple Registers (Analog Outputs)

2.11 Power supply and Communications Wiring

2.11.1 Wiring connections

The following diagram shows the wiring for the power and RS485 communications.





2.11.2 Wiring Descriptions

Terminal		Description
1	Power 0V	The DC power supply GND or 0V connection.
2	Power +24V	The DC power supply positive connection. 12V to 24V. Note some modules will only work with +24V.
3	RS485 GND	The RS485 circuit is isolated from the DC power supply for the module. The RS485 GND connection is not connected to the DC power supply GND. Use a seperate ground wire to connect all of the RS485 GND terminals on the modules together. This ensures that all of the modules are at the same potential. The ground wire must be earthed at one end only.
4	RS485 -	RS485 network connection
5	RS485 +	RS485 network connection

3. PROBUS MODULES

3.1 PB16DI - DIGITAL INPUTS WITH COUNTERS

3.1.1 Description

The PB16DI module is a 16 channel digital input module. The inputs are isolated from the logic by bi-directional opto-couplers. The inputs are divided into 2 isolated groups of 8 inputs each. This allows for a number of configurations in which the input module may be used. One such configuration could be where one group is connected as common positive and the second group connected as common negative.

The counters operate in three modes:
In mode 0: All the counters are disabled.

In mode 1: The counters are 32 bit counters allowing a count value from 0 to 4294967295. The count value can be cleared by writing a zero to the associated registers or preset to any other value using the same method.

In mode 2: The inputs are connected as up/down counters. Input 1 will increment counter 1 whilst input 2 decrements counter1. In the same way, inputs 3&4 operate counter 2, inputs 5&6 operate counter 3 and inputs 7&8 operate counter 4, etc.

The format of the registers allows the status of the inputs to be read as either single bits or all at once as a single register on the Modbus network.

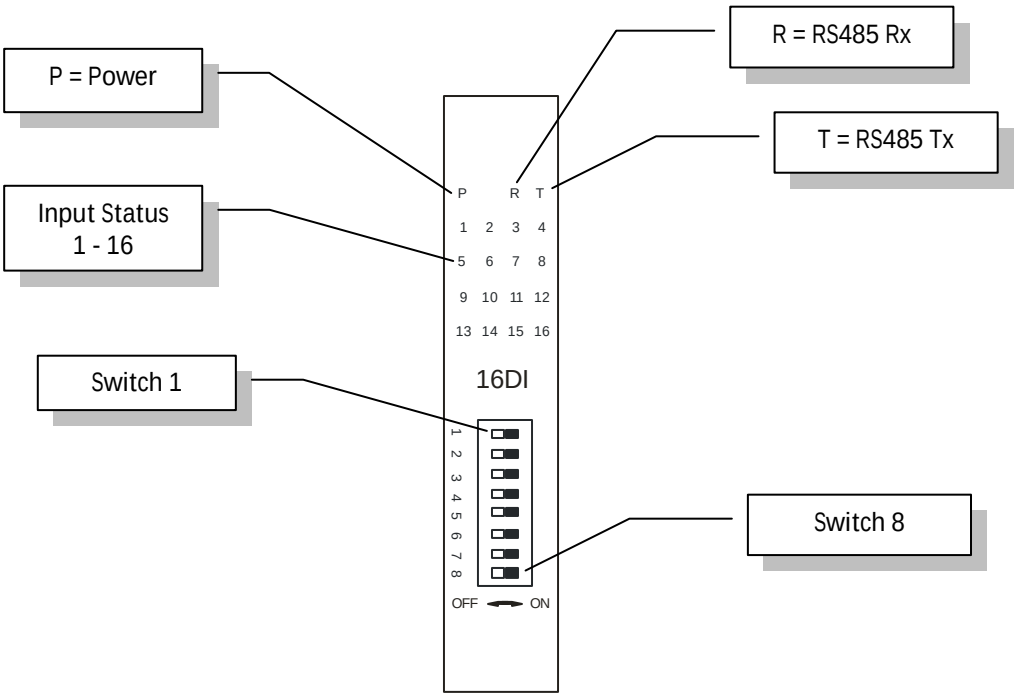
3.1.2 Technical Specification of PB16DI

Power Supply	Logic Supply Voltage	12 -24 Vdc
	Logic Supply Current	39mA @ 12V / 22mA @ 24V
Digital Inputs	Input Points	16
	Input Voltage Range	12 - 24 Vdc
	Input Current per input	5mA @ 12Vdc / 11mA @ 24Vdc
	Isolation	1500Vrms between field and logic
Counters	Inputs	1 to 16
	Resolution	32 Bits
	Frequency	1KHz (max)
	Pulse Width	500us (min)
Temperature	Operating Temperature.	-20°C to + 70°C
	Storage Temperature	-40°C to + 85°C
Connectors	Logic Power and Comms.	5 way connector that clips onto DIN rail
	Inputs	6 x 3 Way screw connector on top and bottom

Note: Inputs 1 to 16 are used as both digital inputs and counter inputs.

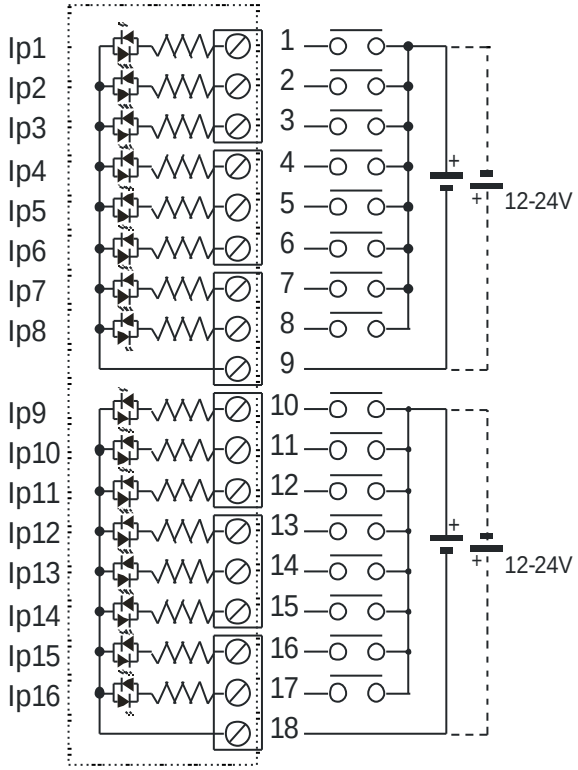
3.1.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Input Status: "OFF" when the input is off.
"ON" when the input is on.



3.1.4 Wiring

The following diagram shows how the digital inputs are connected to potential free switches. The common can be connected to positive or negative as indicated.



3.1.5 PB16DI Data Registers (MODULE TYPE = 150)

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
10001	Digital Input 1	0	1	R	Status of Digital Inputs.
10002	Digital Input 2	0	1	R	"
10003	Digital Input 3	0	1	R	"
10004	Digital Input 4	0	1	R	"
10005	Digital Input 5	0	1	R	"
10006	Digital Input 6	0	1	R	"
10007	Digital Input 7	0	1	R	"
10008	Digital Input 8	0	1	R	"
10009	Digital Input 9	0	1	R	"
10010	Digital Input 10	0	1	R	"
10011	Digital Input 11	0	1	R	"
10012	Digital Input 12	0	1	R	"
10013	Digital Input 13	0	1	R	"
10014	Digital Input 14	0	1	R	"
10015	Digital Input 15	0	1	R	"
10016	Digital Input 16	0	1	R	"
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 150
30002	Digital Inputs	N/A	N/A	R	Digital Inputs in 16 bits. 16 - 1.
40003	Counter 1 MSB	0	65535	R/W	Counter MSB and LSB combine to give a 32 bit
40004	Counter 1 LSB	0	65535	R/W	Counter with range 0 to 4294967295.
40005	Counter 2 MSB	0	65535	R/W	"
40006	Counter 2 LSB	0	65535	R/W	"
40007	Counter 3 MSB	0	65535	R/W	"
40008	Counter 3 LSB	0	65535	R/W	"
40009	Counter 4 LSB	0	65535	R/W	"
40010	Counter 4 LSB	0	65535	R/W	"
40011	Counter 5 MSB	0	65535	R/W	"
40012	Counter 5 LSB	0	65535	R/W	"
40013	Counter 6 MSB	0	65535	R/W	"
40014	Counter 6 LSB	0	65535	R/W	"
40015	Counter 7 MSB	0	65535	R/W	"
40016	Counter 7 LSB	0	65535	R/W	"
40017	Counter 8 MSB	0	65535	R/W	"
40018	Counter 8 LSB	0	65535	R/W	"
40019	Counter 9 MSB	0	65535	R/W	"
40020	Counter 9 LSB	0	65535	R/W	"
40021	Counter 10MSB	0	65535	R/W	"
40022	Counter 10LSB	0	65535	R/W	"

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
40023	Counter 11MSB	0	65535	R/W	Counter MSB and LSB combine to give a 32 bit
40024	Counter 11LSB	0	65535	R/W	Counter with range 0 to 4294967295.
40025	Counter 12MSB	0	65535	R/W	"
40026	Counter 12LSB	0	65535	R/W	"
40027	Counter 13MSB	0	65535	R/W	"
40028	Counter 13LSB	0	65535	R/W	"
40029	Counter 14MSB	0	65535	R/W	"
40030	Counter 14LSB	0	65535	R/W	"
40031	Counter 15MSB	0	65535	R/W	"
40032	Counter 15LSB	0	65535	R/W	"
40033	Counter 16MSB	0	65535	R/W	"
40034	Counter 16LSB	0	65535	R/W	"
40035	Counter Capture	0	65535	R/W	Bit1 = 1 to Capture Counter1, Bit2 = 1 to Capture Counter2, etc.
40036	CCounter 1 MSB	0	65535	R/W	Capture Counter Registers. MSB and LSB
40037	CCounter 1 LSB	0	65535	R/W	combine to give a 32 bit Value.
40038	CCounter 2 MSB	0	65535	R/W	Counter with range 0 to 4294967295.
40039	CCounter 2 LSB	0	65535	R/W	
40040	CCounter 3 MSB	0	65535	R/W	"
40041	CCounter 3 LSB	0	65535	R/W	"
40042	CCounter 4 LSB	0	65535	R/W	"
40043	CCounter 4 LSB	0	65535	R/W	"
40044	CCounter 5 MSB	0	65535	R/W	"
40045	CCounter 5 LSB	0	65535	R/W	"
40046	CCounter 6 MSB	0	65535	R/W	"
40047	CCounter 6 LSB	0	65535	R/W	"
40048	CCounter 7 MSB	0	65535	R/W	"
40049	CCounter 7 LSB	0	65535	R/W	"
40050	CCounter 8 MSB	0	65535	R/W	"
40051	CCounter 8 LSB	0	65535	R/W	"
40052	CCounter 9 MSB	0	65535	R/W	"
40053	CCounter 9 LSB	0	65535	R/W	"
40054	CCounter 10MSB	0	65535	R/W	"
40055	CCounter 10LSB	0	65535	R/W	"
40056	CCounter 11MSB	0	65535	R/W	"
40057	CCounter 11LSB	0	65535	R/W	"
40058	CCounter 12MSB	0	65535	R/W	"
40059	CCounter 12LSB	0	65535	R/W	"
40060	CCounter 13MSB	0	65535	R/W	"
40061	CCounter 13LSB	0	65535	R/W	"
40062	CCounter 14MSB	0	65535	R/W	"
40063	CCounter 14LSB	0	65535	R/W	"

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
40064	CCounter 15MSB	0	65535	R/W	"
40065	CCounter 15LSB	0	65535	R/W	"
40066	CCounter 16MSB	0	65535	R/W	"
40067	CCounter 16LSB	0	65535	R/W	"
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Counter Mode	0	2	R/W	0=Disable, 1=Up Counting, 2=Up/Down Count
40102	Input Filter	0	65535	R/W	0 = Disable, >0 = Enable. (x10ms)
40103	Capture Zero	0	65535	R/W	0 = Disabled, bit1 = auto zero counter 1.
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.1.5.1 Digital Input Register.

The digital inputs can be read in a single register as follows:

MSB					PB16DI DIGITAL INPUTS								LSB			ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30002

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

Digital Input Number

3.1.5.2 Counter Registers.

The counters are stored as two 16 bit registers. The first register is the High Register and the second register is the Low Register. To get the actual 32 bit count value the registers must be combined as follows:

Counter High Value = Register 40003.
Counter Low Value = Register 40004.

Counter Value = (Counter High Value X 65536) + Counter Low Value.

3.1.5.3 Counter Capture.

To capture a counter a 1 must be written to the corresponding bit position in the Counter Capture Register 40035. For example:

1. Writing 1 to Register 40035 results in Counter 1 value being captured to Counter Capture 1.
2. Writing 2 to Register 40035 results in Counter 2 value being captured to Counter Capture 2.
3. Writing 3 to Register 40035 results in Counter 1 value being captured to Counter Capture 1 and Counter 2 value being captured to Counter Capture 2.

Once the module has Captured the counters, the Counter Capture Register 40035 is cleared to zero. It is possible to read this register to get confirmation that the capture is complete before reading the captured counter values.

3.1.5.4 Counter Auto Zero.

The counter being captured can be auto zeroed. The purpose of this function is to let the module zero the counter so that no counts get lost due to delays from communication latency, etc.

To ensure that a counter is auto zeroed, a 1 must be written to the corresponding bit position in the Capture Zero Register 40103. For example:

Writing 1 to Register 40103 results in Counter 1 value being zeroed when the Counter Capture bit is 1.

The value in the Capture Zero Register 40103 is permanently stored in memory and only has to be configured once.

3.2 PB16DO - DIGITAL OUTPUTS

3.2.1 Description

This module has 16 open drain MOSFET (N-TYPE) digital outputs. The outputs may be used to drive lamps or external relays when more drive capability is required. The outputs are isolated from the logic and they share a common negative terminal. Each output is protected against over current and voltage.

The outputs are written to by the Modbus master device such as a PC or PLC. Each output can be individually switched on or off, or all outputs can be set up at the same time by writing a single number to the output register which represents the status of all outputs.

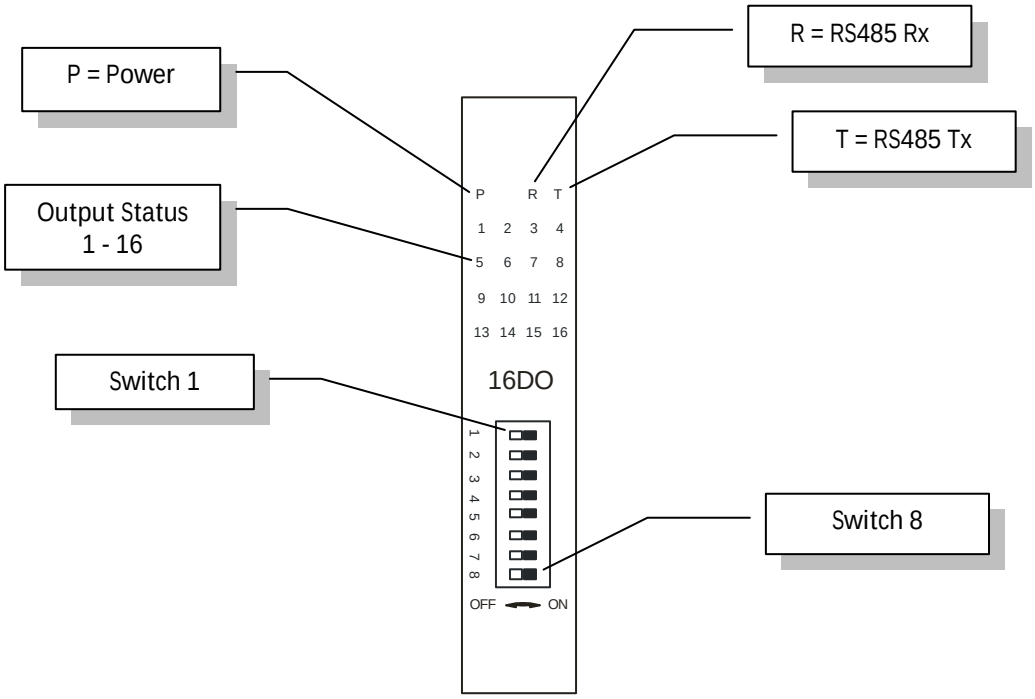
An output watchdog timer can be configured to switch off all the outputs if there has been no communications with the module for up to 255 seconds. A value of 0 seconds will disable this timer and the outputs will remain in the last programmed state.

3.2.2 Technical Specification of PB16DO

Power Supply	Logic Supply Voltage	12 -24 Vdc
	Logic Supply Current	39mA @ 12V / 22mA @ 24V
	Field Supply Voltage	12 -24 Vdc
	Field Supply Current	6mA @ 12V / 6mA @ 24V
Digital Outputs	Output Points	16
	Maximum Voltage	48 Vdc
	Maximum Current	0.5A per output
	On-state resistance	0.55 ohms
	Output update rate	All outputs every 10ms
	Isolation	1500Vrms between field and logic
Temperature	Operating Temperature.	-20°C to + 70°C
	Storage Temperature	-40°C to + 85°C
Connectors	Logic Power and Comms.	5 way connector that clips onto DIN rail
	Outputs	6 x 3 Way screw connector on top and bottom

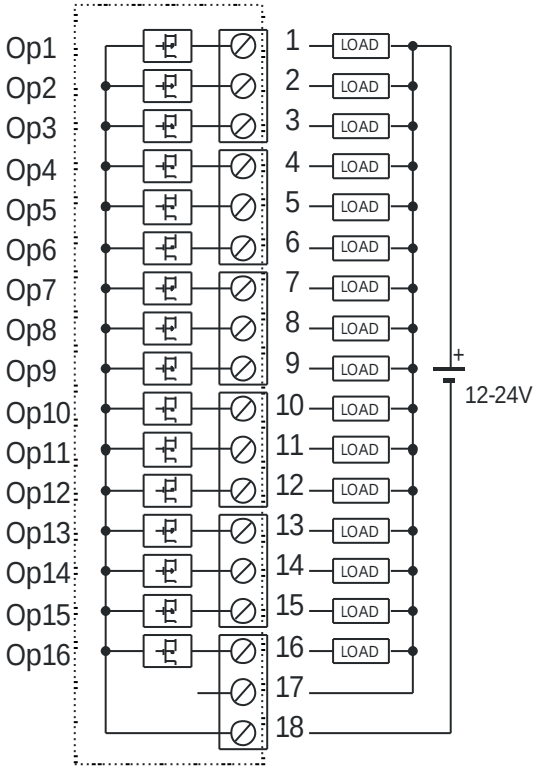
3.2.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Output Status: "OFF" when the output is off.
"ON" when the output is on.



3.2.4 Wiring

The following diagram shows how the digital outputs are connected to the coil of a relay. The coil is connected to positive and switched to negative.



3.2.5 PB16DO Data Registers (MODULE TYPE = 151)

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
00001	Digital Output 1	0	1	R/W	Status of Digital Outputs.
00002	Digital Output 2	0	1	R/W	"
00003	Digital Output 3	0	1	R/W	"
00004	Digital Output 4	0	1	R/W	"
00005	Digital Output 5	0	1	R/W	"
00006	Digital Output 6	0	1	R/W	"
00007	Digital Output 7	0	1	R/W	"
00008	Digital Output 8	0	1	R/W	"
00009	Digital Output 9	0	1	R/W	"
00010	Digital Output 10	0	1	R/W	"
00011	Digital Output 11	0	1	R/W	"
00012	Digital Output 12	0	1	R/W	"
00013	Digital Output 13	0	1	R/W	"
00014	Digital Output 14	0	1	R/W	"
00015	Digital Output 15	0	1	R/W	"
00016	Digital Output 16	0	1	R/W	"
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 151
40002	Digital Outputs	N/A	N/A	R/W	Digital Outputs in bits. 16(msb) – 1(lsb).
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Watchdog Timer	0	255	R/W	Timer in seconds. 0 = disabled. 1 - 255 = enabled.
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.2.5.1 Digital Output Register.

The digital outputs can be read/written in a single register as follows:

MSB					PB16DO DIGITAL OUTPUTS								LSB				ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	40002

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Digital Output

3.2.5.2 Output Watchdog Timer.

The watchdog timer is used to switch off all of the outputs in the event of a communications failure. When set to zero (register 40101) the watchdog timer is disabled.

3.3 PB6RO - RELAY OUTPUTS

3.3.1 Description

The PB6RO module has 6 normally open/ normally closed relay outputs. These modules may be used when a higher drive capability is required, or when isolation between outputs are required.

The outputs are written to by the Modbus master device such as a PC or PLC. Each output can be individually switched on or off, or all outputs can be set up at the same time by writing a single number to the output register which represents the status of all outputs.

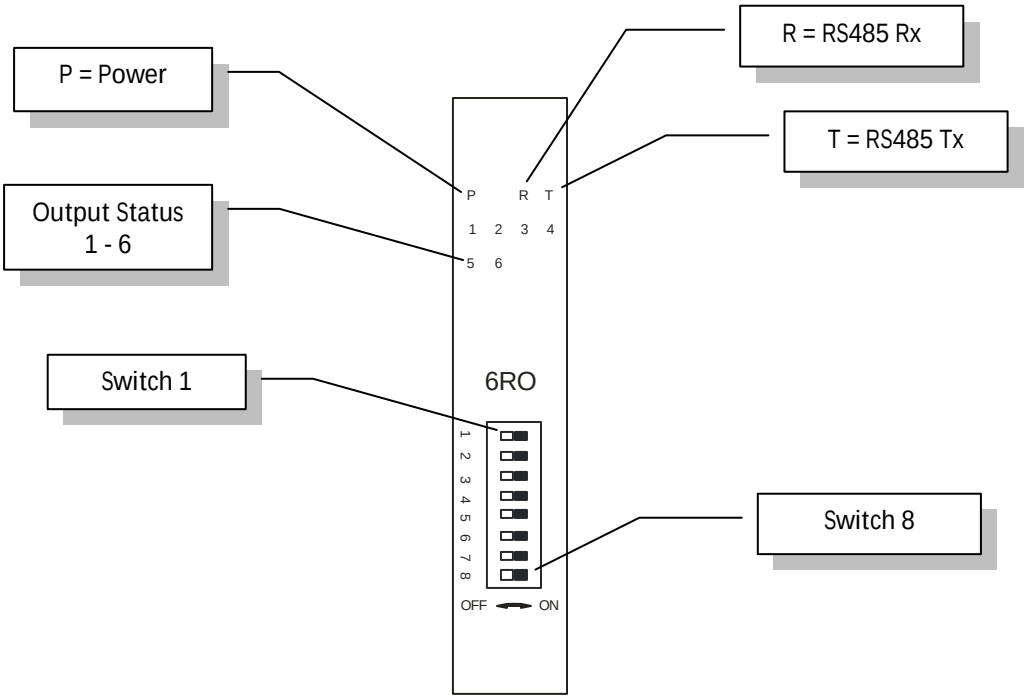
An output watchdog timer can be configured to switch off all the outputs if there has been no communications with the module for up to 255 seconds. A value of 0 seconds will disable this timer and the outputs will remain in the last programmed state.

3.3.2 Technical Specification of PB6RO

Power Supply	Logic Supply Voltage	24 Vdc
	Logic Supply Current	71 mA
Relay Outputs	Output Points	6
	Maximum Current	1A @ 220VAC / 1A @ 28VDC
	Output update rate	All outputs every 10ms
	Isolation	4000Vrms between field and logic 1500Vrms between outputs
Temperature	Operating Temperature.	-20°C to + 70°C
	Storage Temperature	-40°C to + 85°C
Connectors	Logic Power and Comms.	5 way connector that clips onto DIN rail
	Outputs	6 x 3 Way screw connector on top and bottom

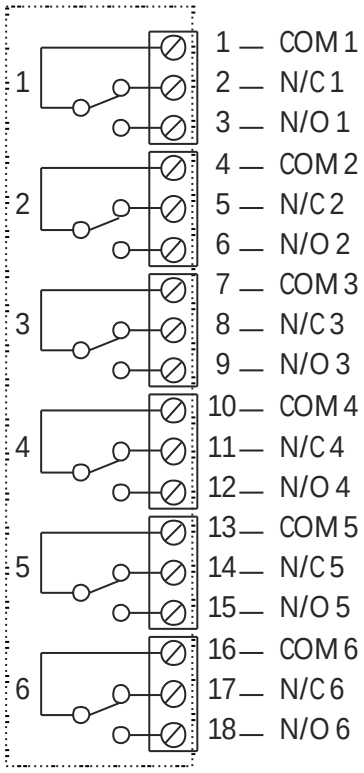
3.3.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Output Status: "OFF" when the output is off
"ON" when the output is on.



3.3.4 Wiring

The following diagram shows how the relay contacts are connected to the wiring terminals.



3.3.5 PB6RO Data Registers (MODULE TYPE = 162)

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
00001	Relay Output 1	0	1	R/W	Status of Relay Outputs.
00002	Relay Output 2	0	1	R/W	"
00003	Relay Output 3	0	1	R/W	"
00004	Relay Output 4	0	1	R/W	"
00005	Relay Output 5	0	1	R/W	"
00006	Relay Output 6	0	1	R/W	"
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 162
40002	Relay Outputs	N/A	N/A	R/W	Relay Outputs in bits. xxxx xxxx xx6,5, 4,3,2,1 bit6(msb) – bit1(lsb).
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Watchdog Timer	0	255	R/W	Timer in seconds. 0 = disabled. 1 - 255 = enabled.
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.3.5.1 Relay Output Register.

The relay outputs can be read/written in a single register as follows:

MSB					PB6RO DIGITAL OUTPUTS						LSB					ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	40002

-	-	-	-	-	-	-	-	-	-	6	5	4	3	2	1

Relay Output Number

3.3.5.2 Output Watchdog Timer.

The watchdog timer is used to switch off all of the outputs in the event of a communications failure. When set to zero (register 40101) the watchdog timer is disabled.

3.4 PB6DIO - DIGITAL INPUTS / OUTPUTS

3.4.1 Description

The PB6DIO module is an 6 channel digital input and 6 channel digital output module.

The inputs are isolated from the logic by bi-directional opto-couplers. The inputs have internal counters associated with them. These counters are 32 bit counters allowing a count value from 0 to 4294967295. The count value can be cleared by writing a zero to the associated registers or preset to any other value using the same method.

The format of the registers allows the status of the inputs to be read as either single bits or all at once as a single register on the Modbus network.

The 6 digital outputs are open drain MOSFET (N-TYPE). The outputs may be used to drive lamps or external relays when more drive capability is required. The outputs are isolated from the logic and they share a common negative terminal.

The outputs are written to by the Modbus master device such as a PC or PLC. Each output can be individually switched on or off, or all outputs can be set up at the same time by writing a single number to the output register which represents the status of all outputs.

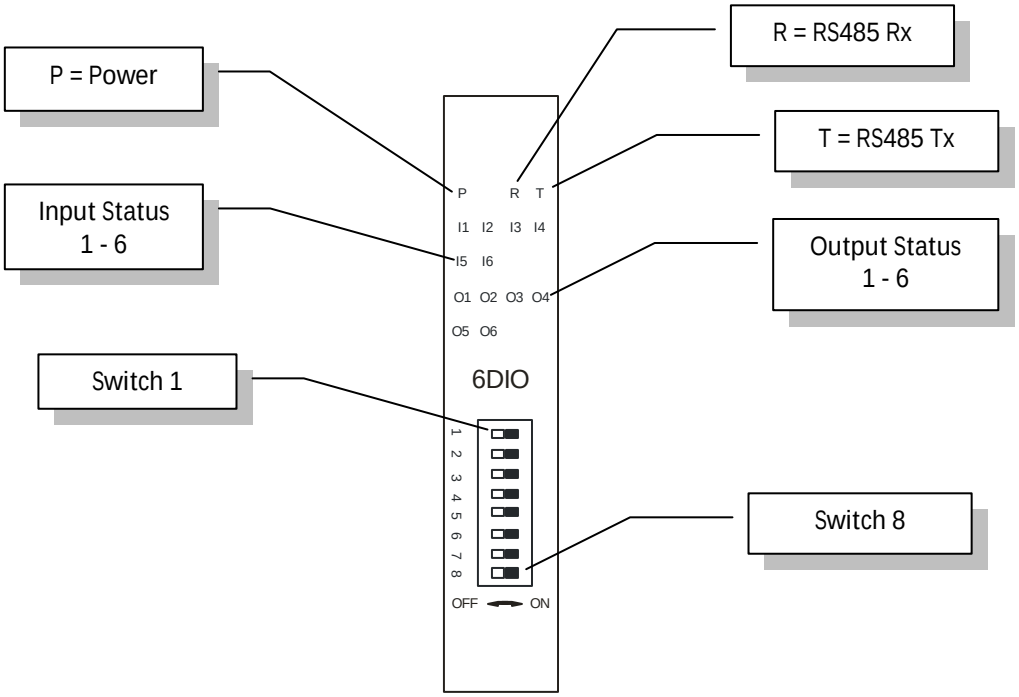
3.4.2 Technical Specification of PB6DIO

Power Supply	Logic Supply Voltage	12 -24 Vdc
	Logic Supply Current	37mA @ 12V / 21mA @ 24V
	Field Supply Voltage	12 -24 Vdc
	Field Supply Current	6mA @ 12V / 6mA @ 24V
Digital Inputs	Input Points	6
	Input Voltage Range	12 -24 Vdc
	Input Current per input	5mA@12Vdc / 11mA @24Vdc
	Isolation	1500Vrms between field and logic
Digital Outputs	Output Points	6
	Maximum Voltage	48 Vdc
	Maximum Current	0.5A per output
	On-state resistance	0.55 ohms
	Output update rate	All outputs every 10ms
	Isolation	1500Vrms between field and logic
Counters	Inputs	1 to 6
	Resolution	32 Bits
	Frequency	1KHz (max)
	Pulse Width	500us (min)
Temperature	Operating Temperature.	-20°C to + 70°C
	Storage Temperature	-40°C to + 85°C
Connectors	Logic Power and Comms.	5 way connector that clips onto DIN rail
	Inputs/Outputs	6 x 3 Way screw connector on top and bottom

Note: Inputs 1 to 6 are used as both digital inputs and counter inputs.

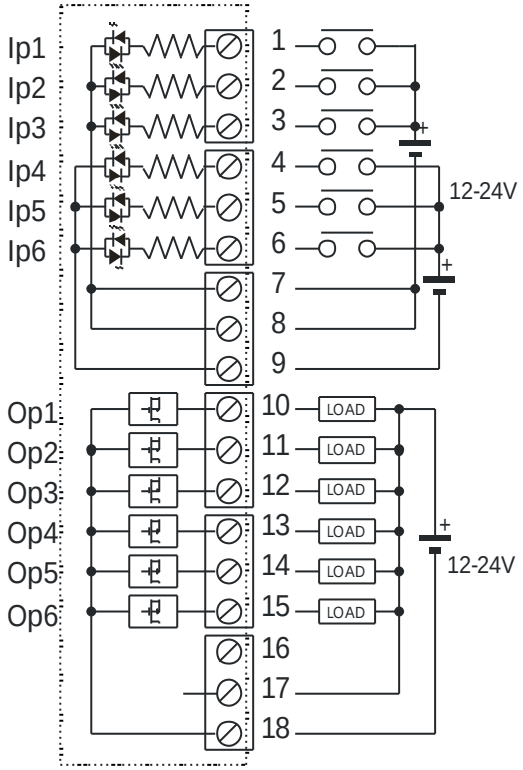
3.4.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Input Status: "OFF" when the input is off
"ON" when the input is on.
Output Status: "OFF" when the output is off
"ON" when the output is on.



3.4.4 Wiring

The following diagram shows how the digital inputs and outputs are connected.



3.4.5 PB6DIO Data Registers (MODULE TYPE = 152)

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
10001	Digital Input 1	0	1	R	Status of Digital Inputs.
10002	Digital Input 2	0	1	R	"
10003	Digital Input 3	0	1	R	"
10004	Digital Input 4	0	1	R	"
10005	Digital Input 5	0	1	R	"
10006	Digital Input 6	0	1	R	"
00017	Digital Output 1	0	1	R/W	Status of Digital Outputs.
00018	Digital Output 2	0	1	R/W	"
00019	Digital Output 3	0	1	R/W	"
00020	Digital Output 4	0	1	R/W	"
00021	Digital Output 5	0	1	R/W	"
00022	Digital Output 6	0	1	R/W	"
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 152
30002	Digital Inputs	N/A	N/A	R	Digital Inputs in lower 6 bits. 6 - 1.
40003	Digital Outputs	N/A	N/A	R/W	Digital Outputs in lower 6 bits. 6 - 1.
40004	Counter 1 MSB	0	65535	R/W	Counter MSB and LSB combine to give a 32 bit
40005	Counter 1 LSB	0	65535	R/W	Counter with range 0 to 4294967295.
40006	Counter 2 MSB	0	65535	R/W	"
40007	Counter 2 LSB	0	65535	R/W	"
40008	Counter 3 MSB	0	65535	R/W	"
40009	Counter 3 LSB	0	65535	R/W	"
40010	Counter 4 LSB	0	65535	R/W	"
40011	Counter 4 LSB	0	65535	R/W	"
40012	Counter 5 MSB	0	65535	R/W	"
40013	Counter 5 LSB	0	65535	R/W	"
40014	Counter 6 MSB	0	65535	R/W	"
40015	Counter 6 LSB	0	65535	R/W	"
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Watchdog Timer	0	255	R/W	Timer in seconds. 0 = disabled. 1 - 255 = enabled.
40105	Counter Mode	0	2	R/W	0=Disable, 1=Up Counting, 2=Up/Down Count
40106	Input Filter	0	65535	R/W	0 = Disable, >0 = Enable. (x10ms)
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.4.5.1 Digital Input Register.

The digital inputs can be read in a single register as follows:

MSB					PB6DIO DIGITAL INPUTS								LSB			ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30002

0	0	0	0	0	0	0	0	8	7	6	5	4	3	2	1

Digital Input Number

3.4.5.2 Digital Output Register.

The digital outputs can be read/written in a single register as follows:

MSB					PB6DIO DIGITAL OUTPUTS								LSB			ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	40003

0	0	0	0	0	0	0	0	8	7	6	5	4	3	2	1

Digital Output Number

3.4.5.3 Counter Registers.

The counters are stored a two 16 bit registers. The first register is the High Register and the second register is the Low Register. To get the actual 32 bit count value the registers must be combined as follows:

Counter High Value = Register 40003.
Counter Low Value = Register 40004.

Counter Value = (Counter High Value X 65536) + Counter Low Value.

3.4.5.4 Output Watchdog Timer.

The watchdog timer is used to switch off all of the outputs in the event of a communications failure. When set to zero (register 40101) the watchdog timer is disabled.

3.5 PB8AII –ANALOG INPUTS (CURRENT)

3.5.1 Description

The PB8AII is an eight channel 16 bit 0(4)-20mA input module. The inputs are isolated from the logic and share a common negative terminal.

The current input can be represented in a number of formats according to the type which is setup by writing a value to the Type register. The value is obtained from the table below.

The standard setting for the PB8AII module is 0 - 20mA input current which represents an output value of 0 - 4095 (12 bits). 4 mA would give a reading of 819 ± 1LSB.

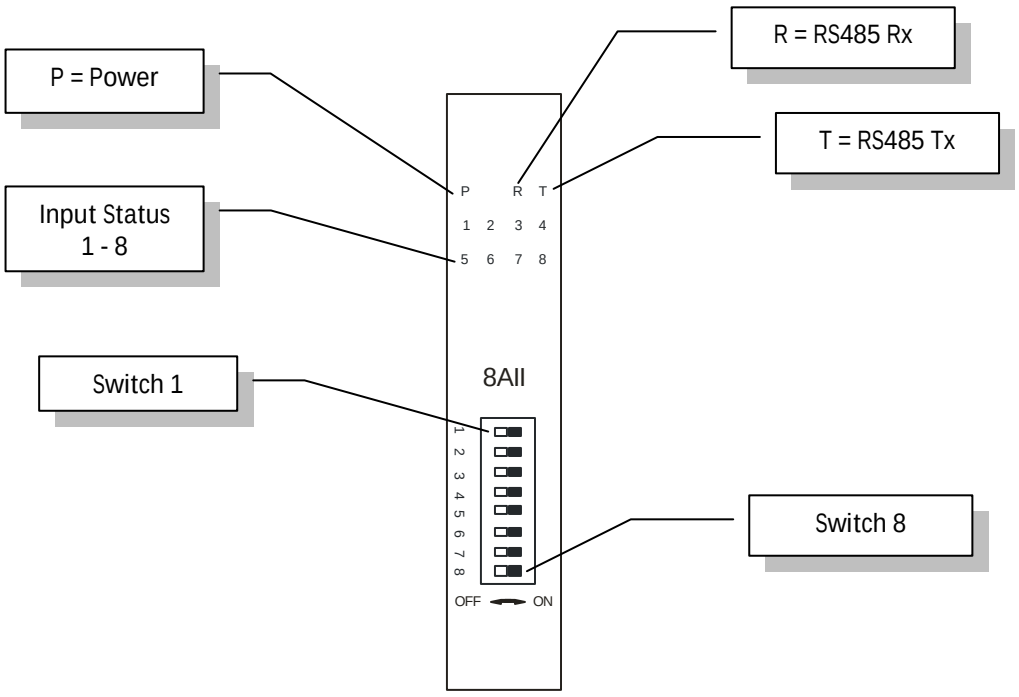
The module can also be configured for a 0 – 20.000mA input range and also supports 16 bit ranges.

3.5.2 Technical Specification of PB8AII

Power Supply	Logic Supply Voltage		12 -24 Vdc
	Logic Supply Current		53mA @ 12V / 28mA @ 24V
Current Inputs	Input Points		8
	Input Current		0(4) - 20 mA
	Input Resistance		120ohms
	InputType	Range	Resolution
	1	0–20.000mA	12 bits
	2	4–20.000mA	12 bits
	3	0–20.000mA	16 bits
	4	4–20.000mA	16 bits
	5	0 - 20.000mA	1uA
	Drift		50ppm/°C
	Accuracy		0.2% of span
	Input update rate		All inputs every 10ms
	Isolation		1500Vrms between field and logic
Temperature	Operating Temperature.		-20°C to + 70°C
	Storage Temperature		-40°C to + 85°C
Connectors	Logic Power and Comms.		5 way connector that clips onto DIN rail
	Inputs		6 x 3 Way screw connector on top and bottom

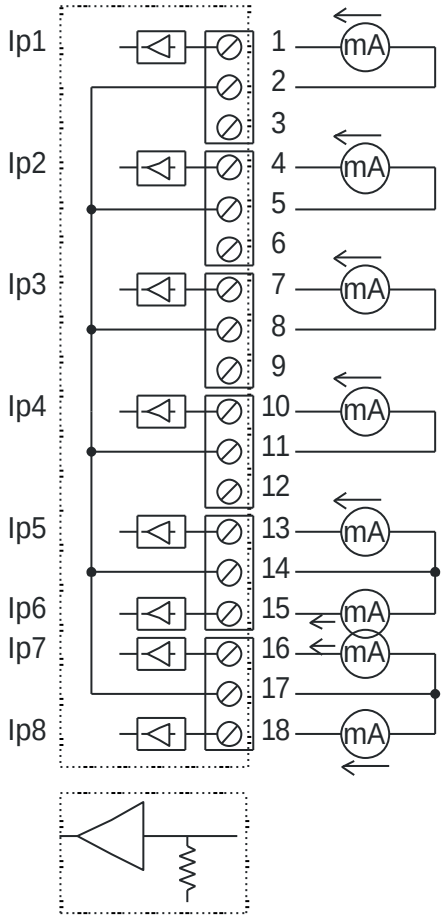
3.5.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Input Status: "ON" when the input is zero.
"OFF" when the input is greater than zero and less than 20mA.
"Flashing" when the input is over range, greater or equal to 20mA.



3.5.4 Wiring

The following diagram shows how the analog inputs are connected to a 0(4)-20mA source. All of the common terminals are connected together, and are connected to 0V internally.



3.5.5 Module Calibration

To calibrate an input, perform the following steps:

1. Run IOStudio on a PC to easily access the Modbus registers used for calibration.
2. Connect a 20mA current source to the input to be calibrated. Set to 0.000mA.
3. Write the channel number into the “Calibrate Channel Number” register 40018.
4. Allow the input to settle for a few seconds. Monitor the “Calibrate Raw Data” input register 30016 to check that the data has settled.
5. Write the value 1 into the “Calibrate Control Data” output register 40017 to save the zero value.
6. Set the input to 20.000mA and allow the input to settle for a few seconds.
7. Write the value 2 into the “Calibrate Control Data” output register 40017 to save the span value.
8. Check that the “Analog Input x” input register shows 4095 or 65536 or 20000 depending on the input type.
9. Repeat the steps for the remaining channels.

3.5.6 PB8AII Data Registers (MODULE TYPE = 153)

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 153
30002	Analog Input 1	0	65535	R	Analog Input 16 Bits
30003	Analog Input 2	0	65535	R	"
30004	Analog Input 3	0	65535	R	"
30005	Analog Input 4	0	65535	R	"
30006	Analog Input 5	0	65535	R	"
30007	Analog Input 6	0	65535	R	"
30008	Analog Input 7	0	65535	R	"
30009	Analog Input 8	0	65535	R	"
30010	Input Status	0	65535	R	bit2 = 0(open circuit or < 2), bit2 = 1(over range) bit1 = 0(OK),bit1 = 1(input < 2mA)
30016	Calibrate Raw Data	0	65535	R	Raw data used to verify that the data has settled during calibration.
40017	Calibrate Control	0	2	R/W	Used to step through the calibration sequence.
40018	Calibrate Channel	1	8	R/W	Enter the channel number to be calibrated.
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Input 1 Type	1	5	R/W	See specification table.
40102	Input 2 Type	1	5	R/W	See specification table.
40103	Input 3 Type	1	5	R/W	See specification table.
40104	Input 4 Type	1	5	R/W	See specification table.
40105	Input 5 Type	1	5	R/W	See specification table.
40106	Input 6 Type	1	5	R/W	See specification table.
40107	Input 7 Type	1	5	R/W	See specification table.
40108	Input 8 Type	1	5	R/W	See specification table.
40111	Input 1 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40112	Input 2 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40113	Input 3 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40114	Input 4 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40115	Input 5 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40116	Input 6 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40117	Input 7 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40118	Input 8 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.5.6.1 Analog Input Registers.

The analog inputs are read as a 16 bit value in the registers as follows:

MSB				PB8AI ANALOG INPUTS											LSB	ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	300XX

0	0	0	0	x	x	x	x	x	x	x	x	x	x	x	x	

Analog Input: 12 Bit Value (0 - 4095)

x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	

Analog Input: 16 Bit Value (0 - 65535)

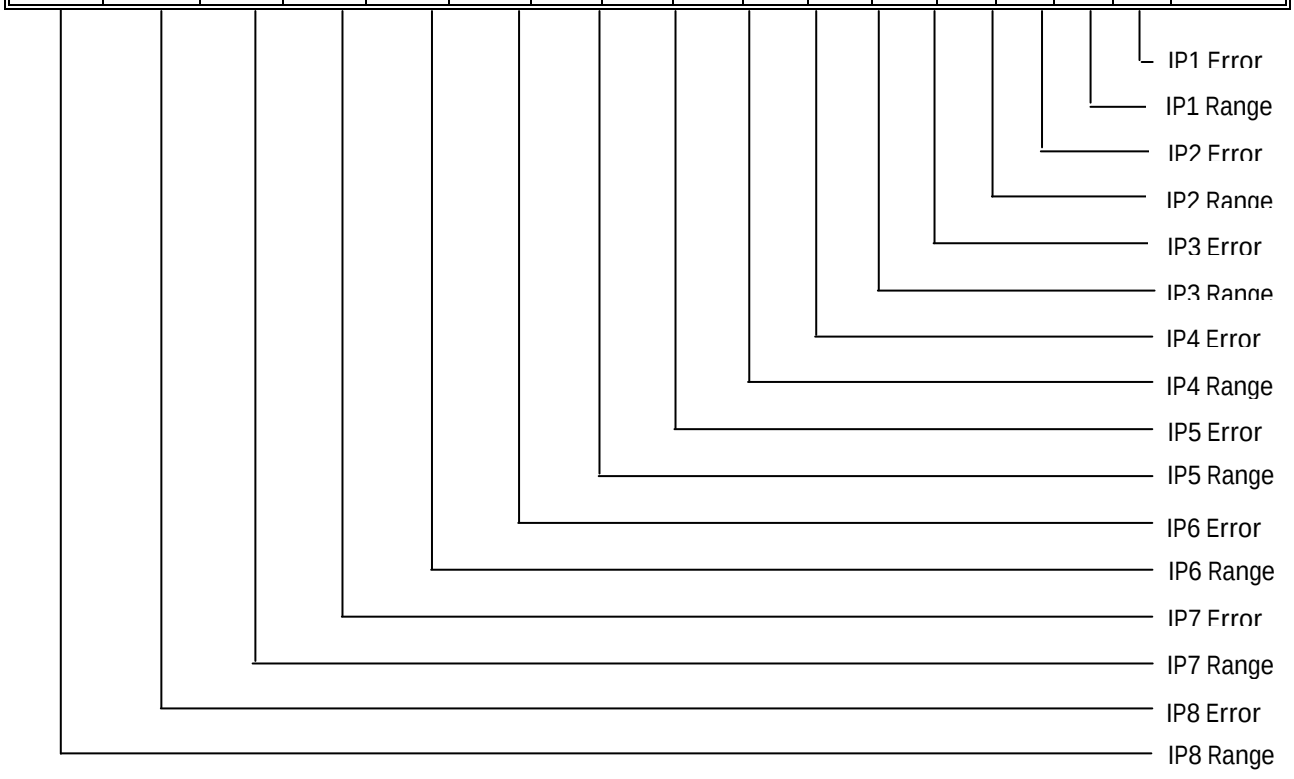
3.5.6.2 Analog Input Status.

There are two status bits associated with each analog input. These bits are used to indicate if the input is zero or open circuit , in the working range 0-65535, or over range. If the input is open circuit or over range, then the error bit will be set. When the error bit is set, the range bit is zero if the input is open circuit and set if the input is over range, ie:

Bit 1- Error	Bit 2-Range	Condition	Status LED
0	don't care	Input working OK.	(LED OFF)
1	0	Input Open circuit (<3mA) or zero	(LED ON)
1	1	Input Over range.	(LED FLASH)

The analog input status can be read in a single register as follows:

MSB				PB8AI ANALOG INPUT STATUS											LSB	ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30010



3.6 PB8AIV – VOLTAGE ANALOG INPUTS

3.6.1 Description

The PB8AIV is an eight channel 16 bit 0-10V input module. The inputs are isolated from the logic and share a common negative terminal.

The voltage input can be represented in a number of formats according to the type which is setup by writing a value to the Type register. The value is obtained from the table below.

The standard setting for the PB8AIV module is 0 – 10V input voltage which represents an output value of 0 - 4095 (12 bits). An input of 2V would give a reading of 819 ± 1LSB.

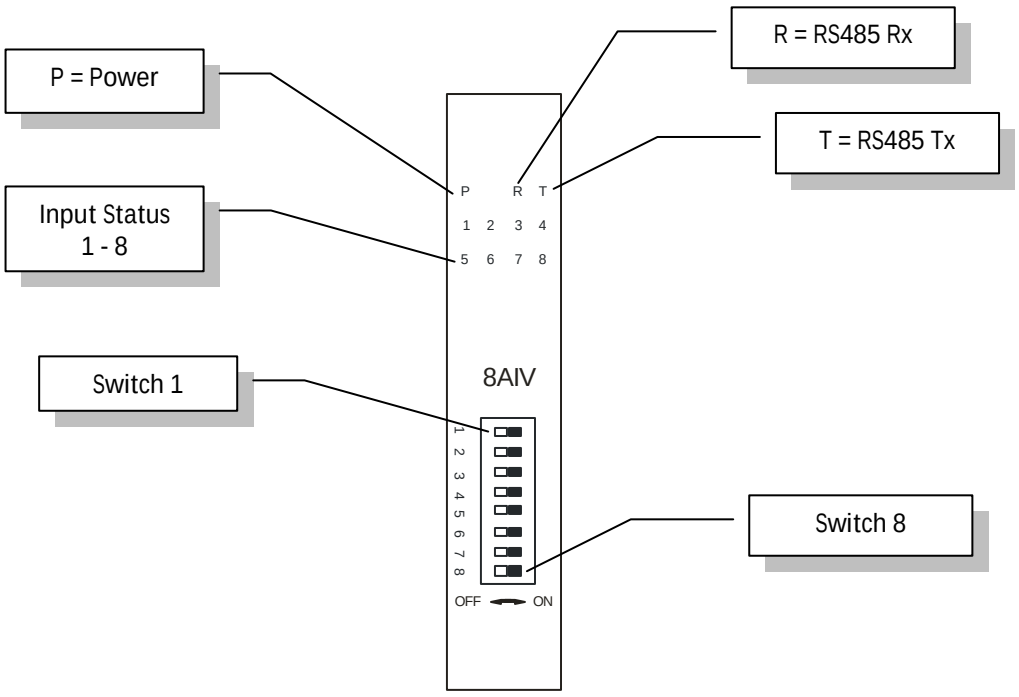
The module can also be configured for a 0 – 10.000V input range and also supports 16 bit ranges.

3.6.2 Technical Specification of PB8AIV

Power Supply	Logic Supply Voltage		12 -24 Vdc
	Logic Supply Current		53mA @ 12V / 28mA @ 24V
Voltage Inputs	Input Points		8
	Input Voltage		0(2) - 10 Vdc or 0(1) - 5 Vdc
	Input Resistance		43kohms
	InputType	Range	Resolution
	1	0 – 10.000 V	12 bits
	2	0 – 10.000 V	16 bits
	3	0 – 10.000 V	1mV
	Drift		50ppm/°C
	Accuracy		0.2% of span
	Input update rate		All inputs every 10ms
	Isolation		1500Vrms between field and logic
Temperature	Operating Temperature.		-20°C to + 70°C
	Storage Temperature		-40°C to + 85°C
Connectors	Logic Power and Comms.		5 way connector that clips onto DIN rail
	Inputs		6 x 3 Way screw connector on top and bottom

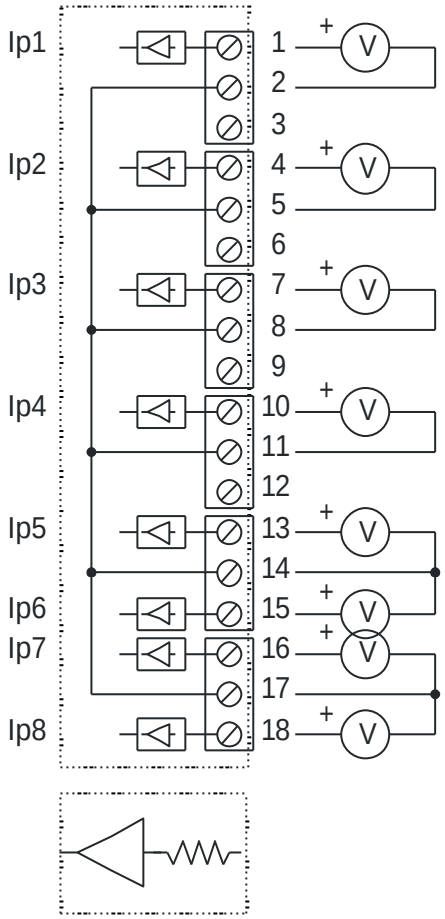
3.6.3 Status Indicators

Power:	Flashes to indicate the CPU is running.
RS485 Rx:	Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx:	Flashes to indicate the unit has sent a Modbus message.
Input Status:	"ON" when the input is zero.
	"OFF" when the input is greater than zero and less than 10V.
	"Flashing" when the input is over range, greater or equal to 10V.



3.6.4 Wiring

The following diagram shows how the analog inputs are connected to a 0(2)-10Vdc source. All of the common terminals are connected together, and are connected to 0V internally.



3.6.5 Module Calibration

To calibrate an input, perform the following steps:

1. Run IOStudio on a PC to easily access the Modbus registers used for calibration.
2. Connect a 10V voltage source to the input to be calibrated. Set to 0.000V.
3. Write the channel number into the “Calibrate Channel Number” register 40018.
4. Allow the input to settle for a few seconds. Monitor the “Calibrate Raw Data” input register 30016 to check that the data has settled.
5. Write the value 1 into the “Calibrate Control Data” output register 40017 to save the zero value.
6. Set the input to 10.000V and allow the input to settle for a few seconds.
7. Write the value 2 into the “Calibrate Control Data” output register 40017 to save the span value.
8. Check that the “Analog Input x” input register shows 4095 or 65536 or 10000 depending on the input type.
9. Repeat the steps for the remaining channels.

3.6.6 PB8AIV Data Registers (MODULE TYPE = 154)

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 154
30002	Analog Input 1	0	65535	R	Analog Input 16 Bits
30003	Analog Input 2	0	65535	R	"
30004	Analog Input 3	0	65535	R	"
30005	Analog Input 4	0	65535	R	"
30006	Analog Input 5	0	65535	R	"
30007	Analog Input 6	0	65535	R	"
30008	Analog Input 7	0	65535	R	"
30009	Analog Input 8	0	65535	R	"
30010	Input Status	0	65535	R	bit2 = 0(open circuit or < 2), bit2 = 1(over range) bit1 = 0(OK),bit1 = 1(input < 1V)
30016	Calibrate Raw Data	0	65535	R	Raw data used to verify that the data has settled during calibration.
40017	Calibrate Control	0	2	R/W	Used to step through the calibration sequence.
40018	Calibrate Channel	1	8	R/W	Enter the channel number to be calibrated.
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Input 1 Type	1	5	R/W	See specification table.
40102	Input 2 Type	1	5	R/W	See specification table.
40103	Input 3 Type	1	5	R/W	See specification table.
40104	Input 4 Type	1	5	R/W	See specification table.
40105	Input 5 Type	1	5	R/W	See specification table.
40106	Input 6 Type	1	5	R/W	See specification table.
40107	Input 7 Type	1	5	R/W	See specification table.
40108	Input 8 Type	1	5	R/W	See specification table.
40111	Input 1 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40112	Input 2 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40113	Input 3 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40114	Input 4 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40115	Input 5 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40116	Input 6 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40117	Input 7 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40118	Input 8 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.6.6.1 Analog Input Registers.

The analog inputs are read as a 12 bit value in the registers as follows:

MSB				PB8AI ANALOG INPUTS											LSB	ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	300XX

0	0	0	0	x	x	x	x	x	x	x	x	x	x	x	x	

Analog Input: 12 Bit Value (0 - 4095)

x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	

Analog Input: 16 Bit Value (0 - 65535)

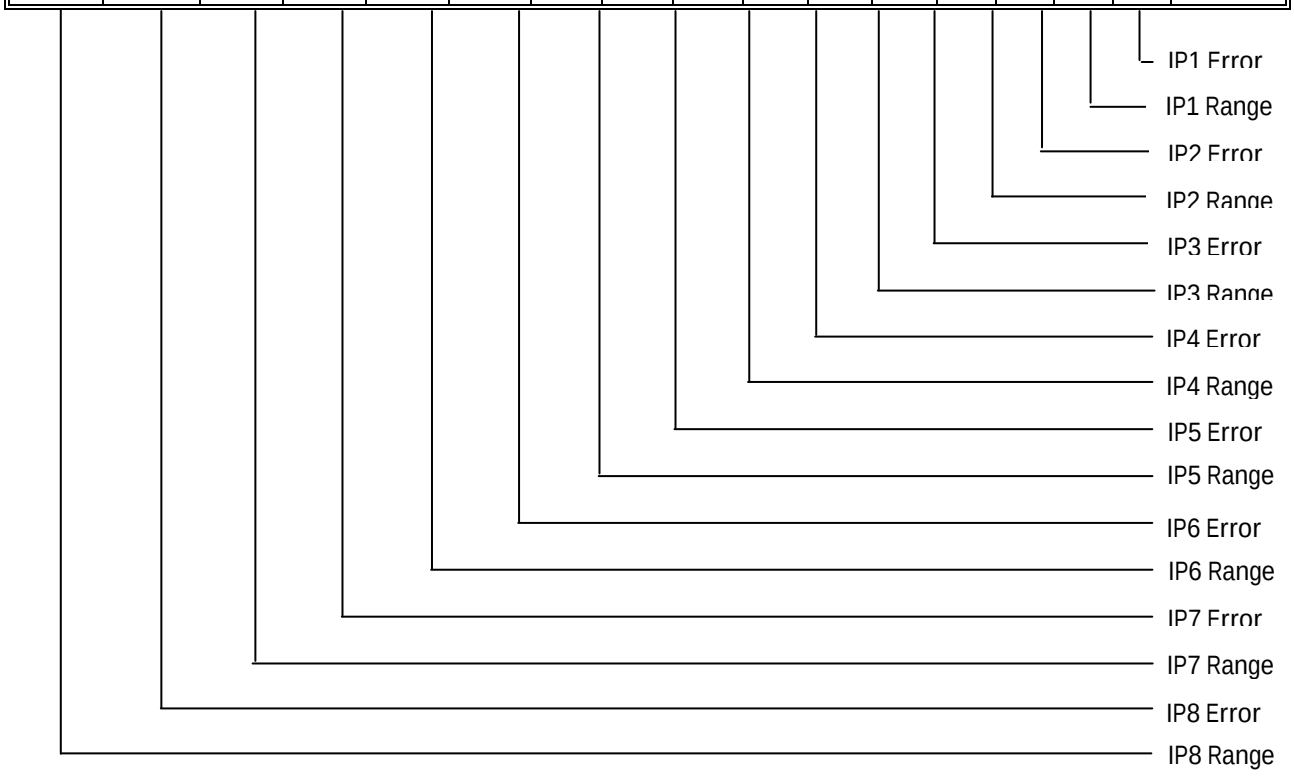
3.6.6.2 Analog Input Status.

There are two status bits associated with each analog input. These bits are used to indicate if the input is zero or open circuit , in the working range 0-65535, or over range. If the input is open circuit or over range, then the error bit will be set. When the error bit is set, the range bit is zero if the input is open circuit and set if the input is over range, ie:

Bit 1- Error	Bit 2-Range	Condition	Status LED
0	don't care	Input working OK.	(LED OFF)
1	0	Input Open circuit (<1V) or zero.	(LED ON)
1	1	Input Over range.	(LED FLASH)

The analog input status can be read in a single register as follows:

MSB				PB8AI ANALOG INPUT STATUS											LSB	ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30010



3.7 PB6AIIS - ISOLATED CURRENT ANALOG INPUTS

3.7.1 Description

The PB6AIIS is a six channel 16 bit 0(4)-20mA input module. The inputs are fully isolated from input to logic and between inputs. This module is ideal for monitoring existing 4-20mA current loops which are isolated from each other and cannot be connected to a common point of reference.

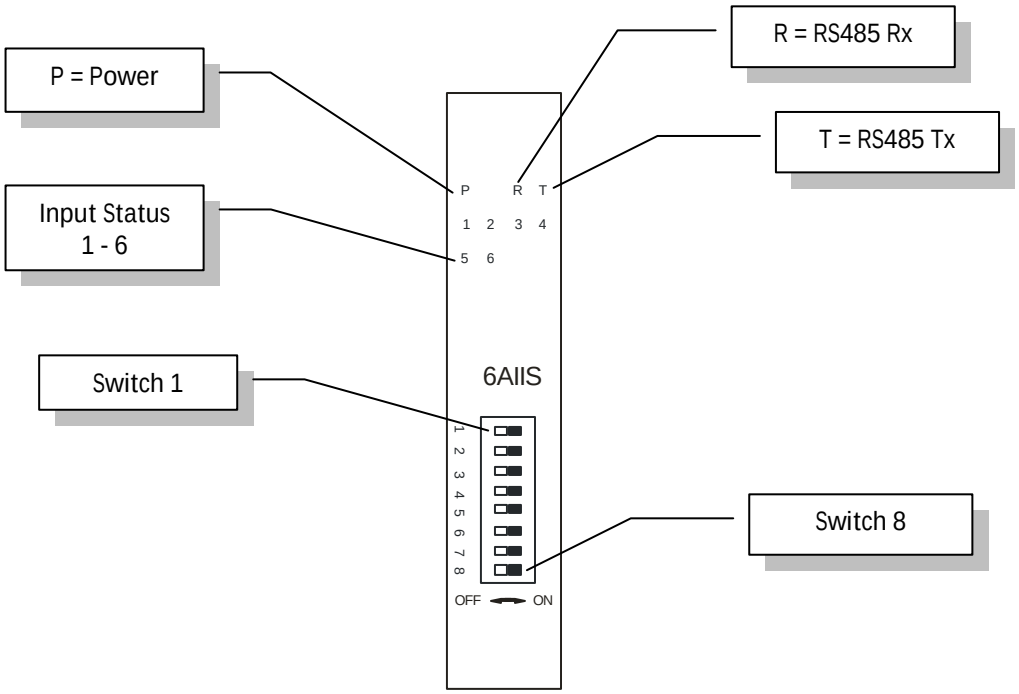
The standard setting for the PB6AIIS module is 0 - 20mA input current which represents an output value of 0 - 4095 (12 bits) in the corresponding Modbus register. To obtain an output value of 0 to 4095 for an input signal of 4 to 20mA the input type must be programmed into the Modbus registers. This module can also be configured for a 0 – 20.000mA input range or +/- 20.000mA input. The module also supports 16 bit ranges.

3.7.2 Technical Specification of PB6AIIS

Power Supply	Logic Supply Voltage		12 -24 Vdc
	Logic Supply Current		86mA @ 12V / 45mA @ 24V
Current Inputs	Input Points		6
	Input Current		0(4) - 20 mA
	Input Resistance		22 ohms
	InputType	Range	Resolution
	1	0–20.000mA	12 bits
	2	4–20.000mA	12 bits
	3	0–20.000mA	16 bits
	4	4–20.000mA	16 bits
	5	0 - 20.000mA	1uA
	6	+/- 20.000mA	1uA
	Drift		100ppm/°C
	Input update rate		No. of inputs enabled X 180ms eg: All inputs enabled 6 x 180 = 1080ms eg: 1 input enabled 1 x 180 = 180ms
	Isolation		1500Vrms between field and logic 350Vpeak between each input
Temperature	Operating Temperature.		-20°C to + 70°C
	Storage Temperature		-40°C to + 85°C
Connectors	Logic Power and Comms.		5 way connector that clips onto DIN rail
	Inputs		6 x 3 Way screw connector on top and bottom

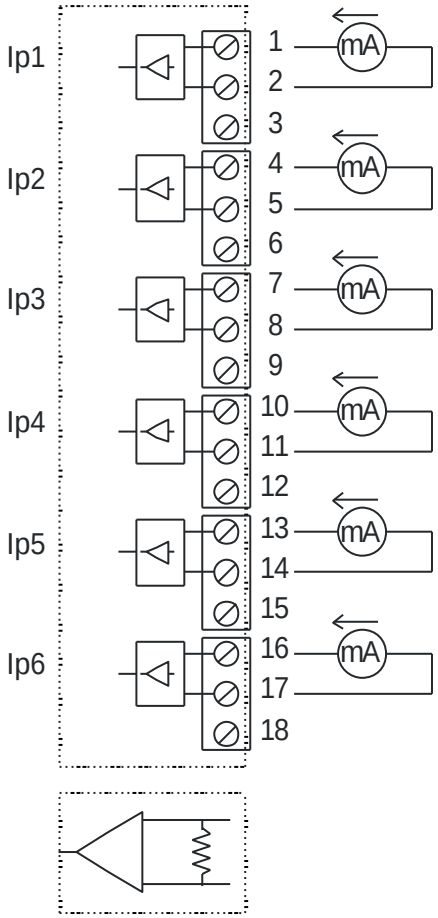
3.7.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Input Status: "ON" when the input is zero.
"OFF" when the input is greater than zero and less than 20mA.
"Flashing" when the input is over range, greater or equal to 20mA.



3.7.4 Wiring

The following diagram shows how the analog inputs are connected to a 0(4)-20mA source. All of the common terminals are isolated from each other.



3.7.5 Module Calibration

To calibrate an input, perform the following steps:

10. Run IOStudio on a PC to easily access the Modbus registers used for calibration.
11. Connect a 20mA current source to the input to be calibrated. Set to 0.000mA.
12. Write the channel number into the “Calibrate Channel Number” register 40018.
13. Allow the input to settle for a few seconds. Monitor the “Calibrate Raw Data” input register 30016 to check that the data has settled.
14. Write the value 1 into the “Calibrate Control Data” output register 40017 to save the zero value.
15. Set the input to 20.000mA and allow the input to settle for a few seconds.
16. Write the value 2 into the “Calibrate Control Data” output register 40017 to save the span value.
17. Check that the “Analog Input x” input register shows 4095 or 65536 or 20000 depending on the input type.
18. Repeat the steps for the remaining channels.

3.7.6 PB6AIIS Data Registers (TYPE = 157)

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 157
30002	Analog Input 1	0	65535	R	Analog Input 16 Bits
30003	Analog Input 2	0	65535	R	"
30004	Analog Input 3	0	65535	R	"
30005	Analog Input 4	0	65535	R	"
30006	Analog Input 5	0	65535	R	"
30007	Analog Input 6	0	65535	R	"
30010	Input Status	0	65535	R	bit2 = 0(open circuit or < 2), bit2 = 1(over range) bit1 = 0(OK),bit1 = 1(error)
30016	Calibrate Raw Data	0	65535	R	Raw data used to verify that the data has settled during calibration.
40017	Calibrate Control	0	2	R/W	Used to step through the calibration sequence.
40018	Calibrate Channel	1	6	R/W	Enter the channel number to be calibrated.
30100	DIP Switch	0	255	R	Status of DIP Switch on Front Panel
40101	Input 1 Type	1	5	R/W	See specification table.
40102	Input 2 Type	1	5	R/W	See specification table.
40103	Input 3 Type	1	5	R/W	See specification table.
40104	Input 4 Type	1	5	R/W	See specification table.
40105	Input 5 Type	1	5	R/W	See specification table.
40106	Input 6 Type	1	5	R/W	See specification table.
40111	Input 1 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40112	Input 2 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40113	Input 3 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40114	Input 4 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40115	Input 5 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40116	Input 6 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40119	Line Frequency	50	60	R/W	Line Frequency
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.7.6.1 Analog Input Registers.

The analog inputs are read as a 16 bit value in the registers as follows:

MSB							PB8AI ANALOG INPUTS							LSB		ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	300XX

0 0 0 0 x | x x x x x x x x x x x x

Analog Input: 12 Bit Value (0 - 4095)

x x x x x x x x x x x x x x x x

Analog Input: 16 Bit Value (0 - 65535)

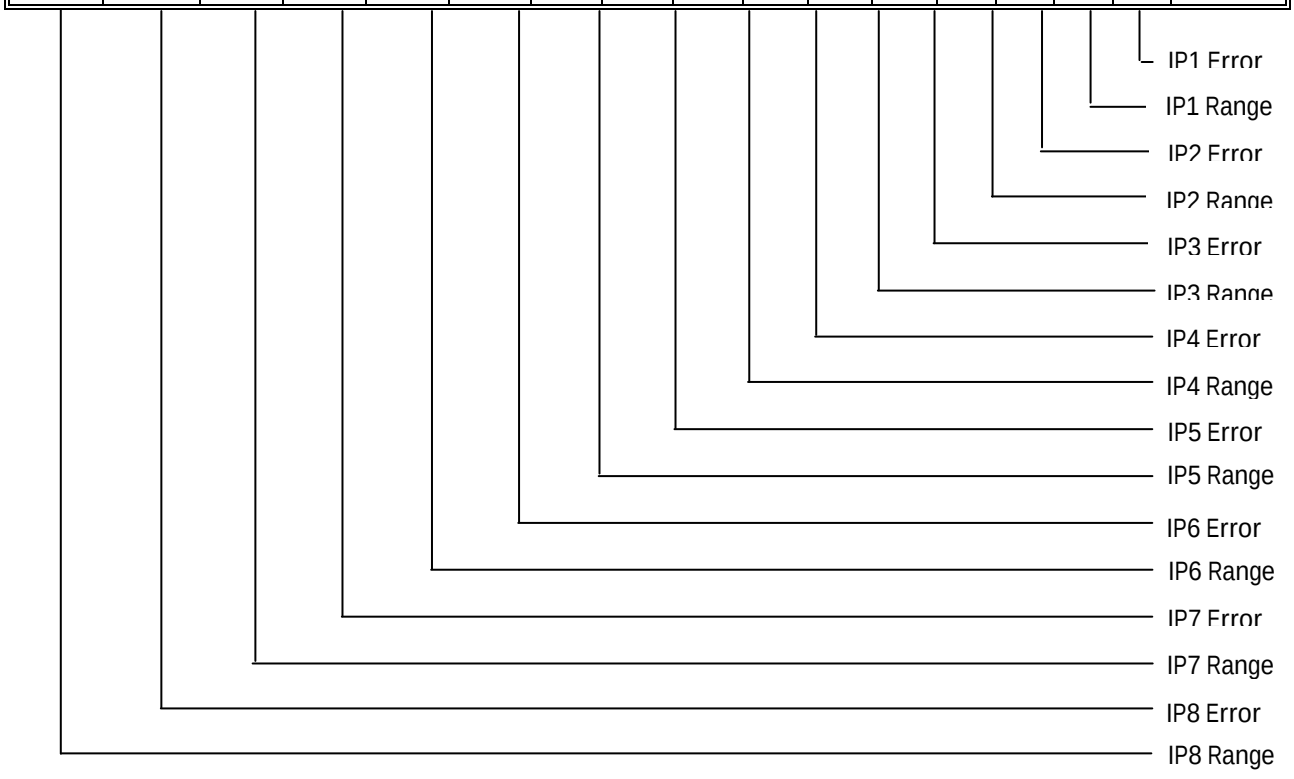
3.7.6.2 Analog Input Status.

There are two status bits associated with each analog input. These bits are used to indicate if the input is zero or open circuit , in the working range 0-4095, or over range. If the input is open circuit or over range, then the error bit will be set. When the error bit is set, the range bit is zero if the input is open circuit and set if the input is over range, ie:

Bit 1- Error	Bit 2-Range	Condition	Status LED
0	don't care	Input working OK.	(LED OFF)
1	0	Input Open circuit (<3mA) or zero	(LED ON)
1	1	Input Over range.	(LED FLASH)

The analog input status can be read in a single register as follows:

MSB							PB8AI ANALOG INPUT STATUS							LSB		ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30010



3.8 PB6AIVS - ISOLATED VOLTAGE ANALOG INPUTS

3.8.1 Description

The PB6AIVS is a six channel 16 bit 0-10V input module. The inputs are fully isolated from input to logic and between inputs. This module is ideal for monitoring existing 0-10V circuits which are isolated from each other and cannot be connected to a common point of reference.

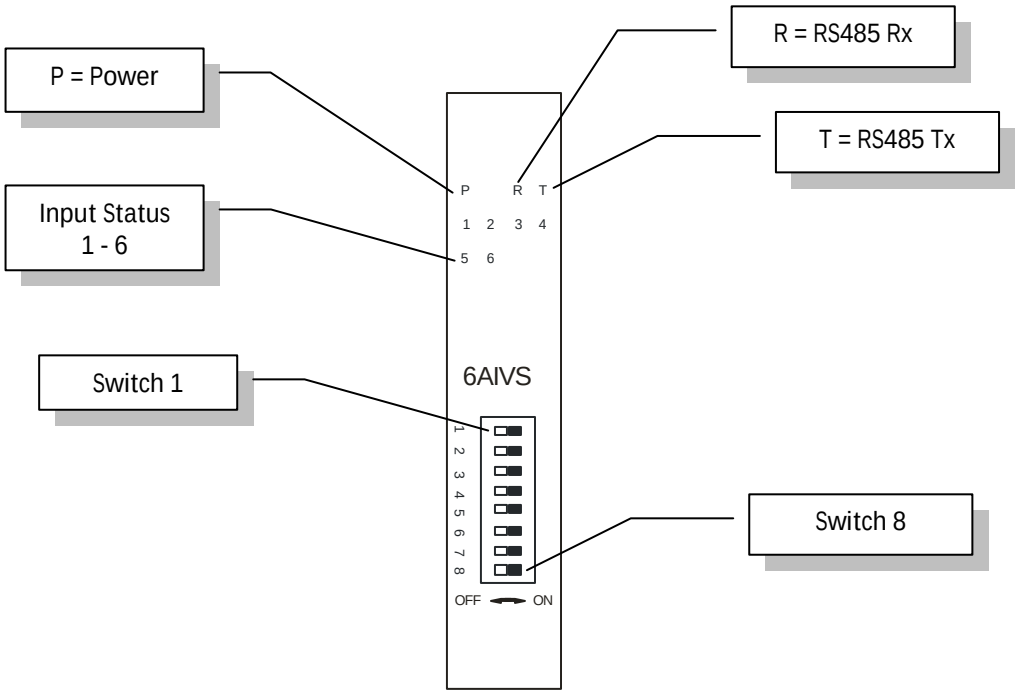
The standard setting for the PB6AIVS module is 0 – 10V input voltage which represents an output value of 0 - 4095 (12 bits) in the corresponding Modbus register. This module can also be configured for a 0 – 10.000V input range or +/- 10.000V input. The module also supports 16 bit ranges.

3.8.2 Technical Specification of PB8AIVS

Power Supply	Logic Supply Voltage		12 -24 Vdc
	Logic Supply Current		86mA @ 12V / 45mA @ 24V
Voltage Inputs – PB8AI/V ISO	Input Points		6
	Input Voltage		0 - 10 Vdc
	Input Resistance		110 Kohms
	InputType	Range	Resolution
	1	0 – 4095	12 bits
	2	0 - 65535	16 bits
	3	0 – 10.000 V	1mV
	4	+/- 10.000 V	1mV
	5	0 – 1.0000 V	0.1mV
	6	+/- 1.0000 V	0.1mV
	Drift		100ppm/°C
	Input update rate		No. of inputs enabled X 180ms eg: All inputs enabled 6 x 180 = 1080ms eg: 1 input enabled 1 x 180 = 180ms
	Isolation		1500Vrms between field and logic 350Vpeak between each input
Temperature	Operating Temperature.		-20°C to + 70°C
	Storage Temperature		-40°C to + 85°C
Connectors	Logic Power and Comms.		5 way connector that clips onto DIN rail
	Inputs		6 x 3 Way screw connector on top and bottom

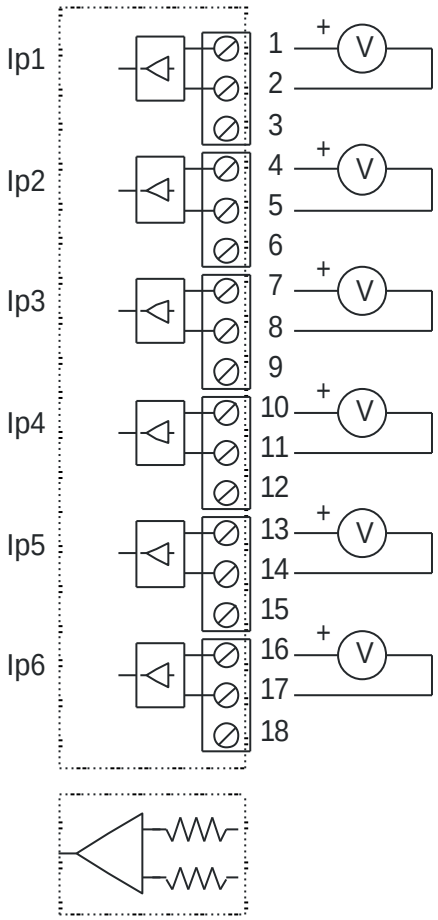
3.8.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Input Status: "ON" when the input is zero.
"OFF" when the input is greater than zero and less than 10V.
"Flashing" when the input is over range, greater or equal to 10V.



3.8.4 Wiring

The following diagram shows how the analog inputs are connected to a 0-10Vdc source. All of the input circuits are isolated from each other.



3.8.5 Module Calibration

To calibrate an input, perform the following steps:

1. Run IOStudio on a PC to easily access the Modbus registers used for calibration.
2. Connect a 10V voltage source to the input to be calibrated. Set to 0.000V.
3. Write the channel number into the "Calibrate Channel Number" register 40018.
4. Allow the input to settle for a few seconds. Monitor the "Calibrate Raw Data" input register 30016 to check that the data has settled.
5. Write the value 1 into the "Calibrate Control Data" output register 40017 to save the zero value.
6. Set the input to 10.000V and allow the input to settle for a few seconds.
7. Write the value 2 into the "Calibrate Control Data" output register 40017 to save the span value.
8. Check that the "Analog Input x" input register shows 4095 or 65536 or 10000 depending on the input type.
9. Repeat the steps for the remaining channels.

3.8.6 PB6AIVSData Registers (TYPE = 158)

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 158
30002	Analog Input 1	0	65535	R	Analog Input 16 Bits
30003	Analog Input 2	0	65535	R	"
30004	Analog Input 3	0	65535	R	"
30005	Analog Input 4	0	65535	R	"
30006	Analog Input 5	0	65535	R	"
30007	Analog Input 6	0	65535	R	"
30010	Input Status	0	65535	R	bit2 = 0(open circuit or < 2), bit2 = 1(over range) bit1 = 0(OK),bit1 = 1(error)
30016	Calibrate Raw Data	0	65535	R	Raw data used to verify that the data has settled during calibration.
40017	Calibrate Control	0	2	R/W	Used to step through the calibration sequence.
40018	Calibrate Channel	1	6	R/W	Enter the channel number to be calibrated.
30100	DIP Switch	0	255	R	Status of DIP Switch on Front Panel
40101	Input 1 Type	1	5	R/W	See specification table.
40102	Input 2 Type	1	5	R/W	See specification table.
40103	Input 3 Type	1	5	R/W	See specification table.
40104	Input 4 Type	1	5	R/W	See specification table.
40105	Input 5 Type	1	5	R/W	See specification table.
40106	Input 6 Type	1	5	R/W	See specification table.
40111	Input 1 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40112	Input 2 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40113	Input 3 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40114	Input 4 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40115	Input 5 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40116	Input 6 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40119	Line Frequency	50	60	R/W	Line Frequency
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.8.6.1 Analog Input Registers.

The analog inputs are read as a 16 bit value in the registers as follows:

MSB							PB8AI ANALOG INPUTS							LSB		ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	300XX

0 0 0 0 x | x x x x x x x x x x x

Analog Input: 12 Bit Value (0 - 4095)

x x x x x x x x x x x x x x x x

Analog Input: 16 Bit Value (0 - 65535)

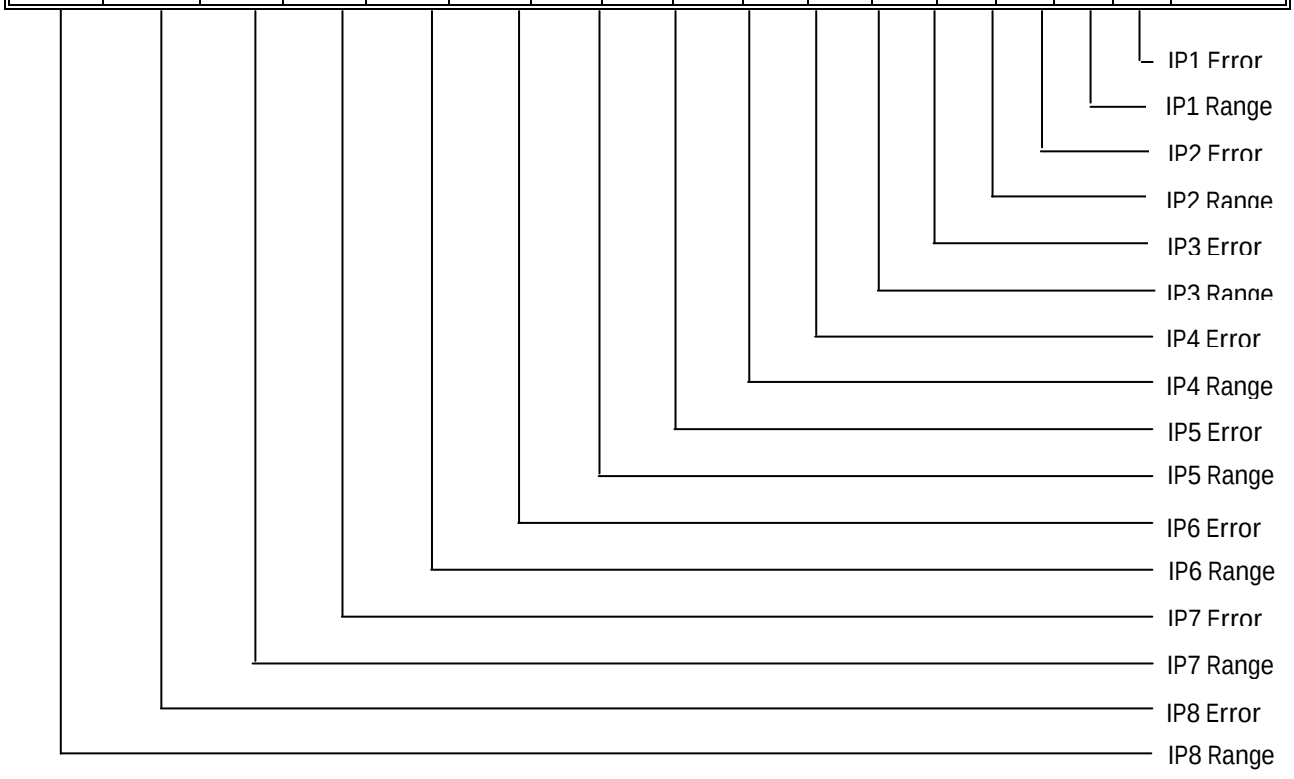
3.8.6.2 Analog Input Status.

There are two status bits associated with each analog input. These bits are used to indicate if the input is zero or open circuit , in the working range 0-4095, or over range. If the input is open circuit or over range, then the error bit will be set. When the error bit is set, the range bit is zero if the input is open circuit and set if the input is over range, ie:

Bit 1- Error	Bit 2-Range	Condition	Status LED
0	don't care	Input working OK.	(LED OFF)
1	0	Input Open circuit or zero	(LED ON)
1	1	Input Over range.	(LED FLASH)

The analog input status can be read in a single register as follows:

MSB							PB8AI ANALOG INPUT STATUS							LSB		ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30010



3.9 PB6TCS - ISOLATED THERMOCOUPLE INPUTS

3.9.1 Description

The PB6TCS module is a 6 isolated thermocouple input module. The module uses differential inputs to reduce effects of electrical noise and mains pickup. The thermocouple inputs are isolated from the logic and from each other.

The thermocouple voltage is read by the module circuitry, linearised and converted to degrees Centigrade. No ranging is required as the module covers the full range as indicated in the TC table. The value that is read from the Modbus register is the actual temperature in degrees centigrade to 0.1°C resolution. ie: a value of 3451 corresponds to a temperature of 345.1°C.

The thermocouple type is setup by writing a value to the TC Type register. The value is obtained from the table below. For example to select type K thermocouples, the value "2" must be written to the TC Type register. Each thermocouple channel can be individually enabled/disabled and configured with the thermocouple type.

The module has built in Cold Junction Compensation. Use must be made of the correct thermocouple extension wire to avoid reading errors.

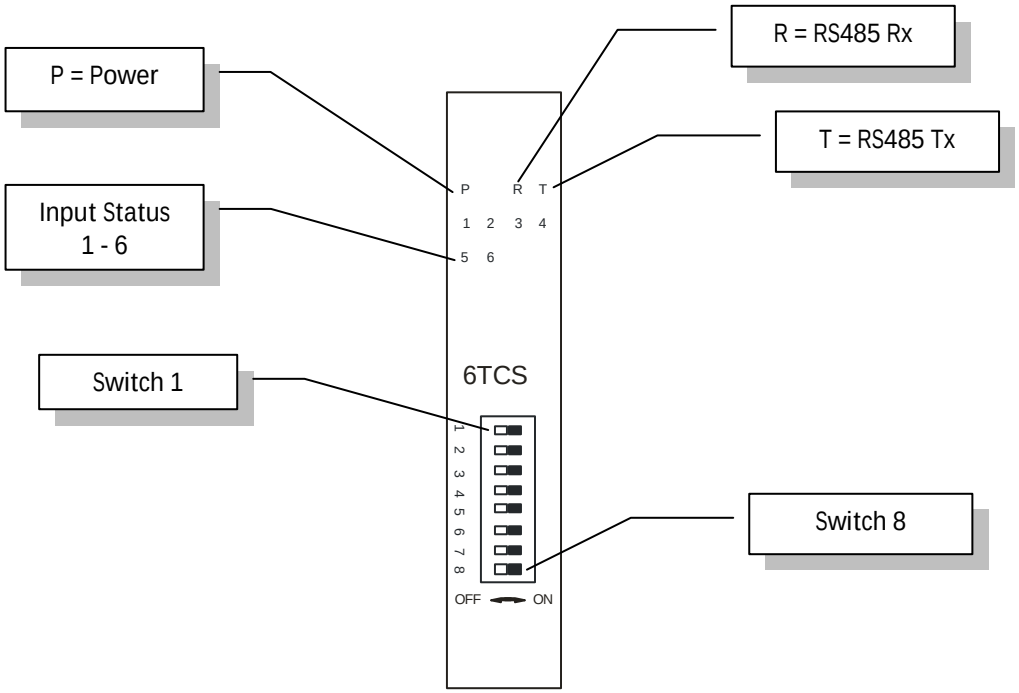
The thermocouple module can also be configured for a 0 - 50mV or +/- 100mV input range.

3.9.2 Technical Specification of PB6TCS

Power Supply	Logic Supply Voltage		12 -24 Vdc	
	Logic Supply Current		86mA @ 12V / 45mA @ 24V	
TC Inputs	Input Points		6	
	Resolution		0.1°C	
	Drift		100ppm/°C Typ.	
	Input update rate		(No. of inputs enabled + 1) X 180ms eg: All inputs enabled (6 + 1) x 180 = 1260ms eg: 1 input enabled (1+1) x 180 = 360ms	
	Isolation		1500Vrms between field and logic 350Vpeak between each TC input	
TC Type	Number	Type	Range	Accuracy
	1	J	-150 to 760 °C	0.2°C
	2	K	-200 to 1370 °C	0.3°C
	3	E	-200 to 1000 °C	0.1°C
	4	T	-200 to 400 °C	0.3°C
	5	N	0 to 1300 °C	0.3°C
	6	B	400 to 1820 °C	0.5°C
	7	S	-50 to 1767 °C	0.6°C
	8	R	-50 to 1767 °C	0.7°C
	9	mV	0 to 50mV	0.1%
	10	C	0 to 2315.5 °C	0.7°C
	11	D	0 to 2315.5 °C	0.7°C
	12	G	0 to 2315.5 °C	0.9°C
	13	m V	+/- 100mV	0.1%
Cold Junction	CJC Error		Less than 1°C Typ. after 60 minutes warm up time.	
Temperature	Operating Temperature.		-20°C to + 70°C	
	Storage Temperature		-40°C to + 85°C	
Connectors	Logic Power and Comms.		5 way connector that clips onto DIN rail	
	Inputs		6 x 4 Way screw connector on top and bottom with CJC sensor.	

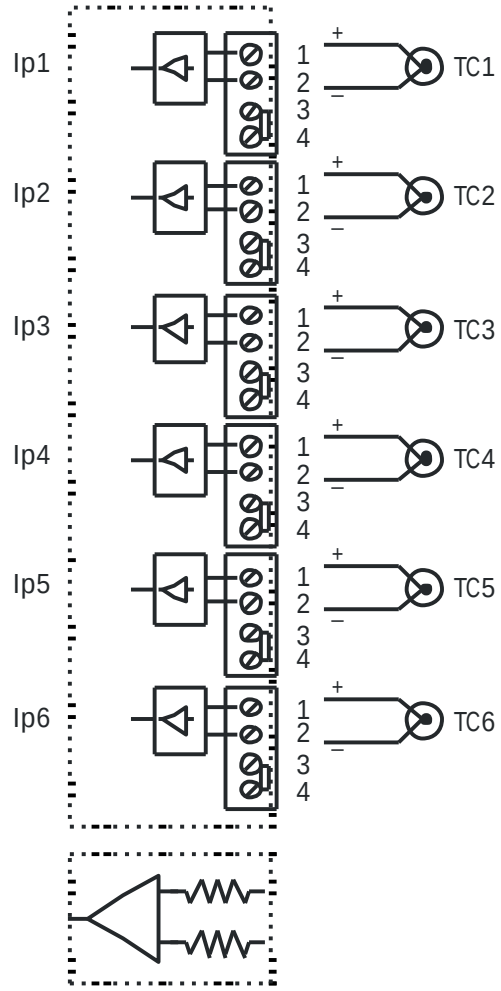
3.9.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Input Status: "ON" when the thermocouple is open circuit.
"OFF" when the thermocouple is connected.



3.9.4 Wiring

The following diagram shows how the inputs are connected to a thermocouple.



3.9.5 Module Calibration

To calibrate an input, perform the following steps:

1. Run IOStudio on a PC to easily access the Modbus registers used for calibration.
2. Power up the module and let it settle for 30 minutes.
3. Connect a mV voltage source to input 1. Set to 0.000mV.
4. Allow the input to settle for a few seconds. Monitor the “Calibrate Raw Data” input register 30016 to check that the data has settled.
5. Write the value 1 into the “Calibrate Control Data” output register 40017 to save the zero value.
6. Set the input to 60.000mV and allow the input to settle for a few seconds.
7. Write the value 2 into the “Calibrate Control Data” output register 40017 to save the span value.
8. Check that the input 1 register shows 60000 when the input type is set to Type 9.

3.9.6 PB6TCS Data Registers (MODULE TYPE = 156)

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 156
30002	TC Input 1	-xxx.x	yyyy.y	R	Thermocouple Inputs. See table for range.
30003	TC Input 2	-xxx.x	yyyy.y	R	Resolution in 0.1°C.
30004	TC Input 3	-xxx.x	yyyy.y	R	"
30005	TC Input 4	-xxx.x	yyyy.y	R	"
30006	TC Input 5	-xxx.x	yyyy.y	R	"
30007	TC Input 6	-xxx.x	yyyy.y	R	"
30010	CJC Temp.	-xxx.x	yyyy.y	R	CJC Temperature in 0.1°C resolution.
30011	Input Status	0	65535	R	bit1 = 0(OK),bit1 = 1(error or open circuit)
30016	Calibrate Raw Data	0	65535	R	Raw data used to verify that the data has settled during calibration.
40017	Calibrate Control	0	2	R/W	Used to step through the calibration sequence.
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	TC 1 Type	1	13	R/W	See TC Tables.
40102	TC 2 Type	1	13	R/W	See TC Tables.
40103	TC 3 Type	1	13	R/W	See TC Tables.
40104	TC 4 Type	1	13	R/W	See TC Tables.
40105	TC 5 Type	1	13	R/W	See TC Tables.
40106	TC 6 Type	1	13	R/W	See TC Tables.
40107	Input 1 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40108	Input 2 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40109	Input 3 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40110	Input 4 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40111	Input 5 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40112	Input 6 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40113	CJC Offset 1	1	199	R/W	100 = zero offset (0.0)
40114	CJC Offset 2	1	199	R/W	100 = zero offset (0.0)
40115	CJC Offset 3	1	199	R/W	100 = zero offset (0.0)
40116	CJC Offset 4	1	199	R/W	100 = zero offset (0.0)
40117	CJC Offset 5	1	199	R/W	100 = zero offset (0.0)
40118	CJC Offset 6	1	199	R/W	100 = zero offset (0.0)
40119	Line Frequency	50	60	R/W	Line Frequency
40120	Units Type	1	2	R/W	1=°C, 2=°F
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 115200, 187500
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.10 PB6RTD - RTD INPUTS

3.10.1 Description

The PB6RTD module is a 6 RTD input module. The module can accommodate either 2 or 3 wire RTD sensors. The RTD inputs are isolated from the logic.

The RTD resistance is read by the module circuitry, linearised and converted to degrees Centigrade. No ranging is required as the module covers the full range of the RTD as indicated in the RTD table. The value that is read from the Modbus register is the actual temperature in degrees centigrade to 0.1°C resolution. ie: a value of 3451 corresponds to a temperature of 345.1°C.

The RTD type is setup by writing a value to the RTD Type register. The value is obtained from the table below. For example to select a PT100 RTD, the value "1" must be written to the RTD Type register. Each RTD input can be disabled/enabled and the RTD type can be individually configured.

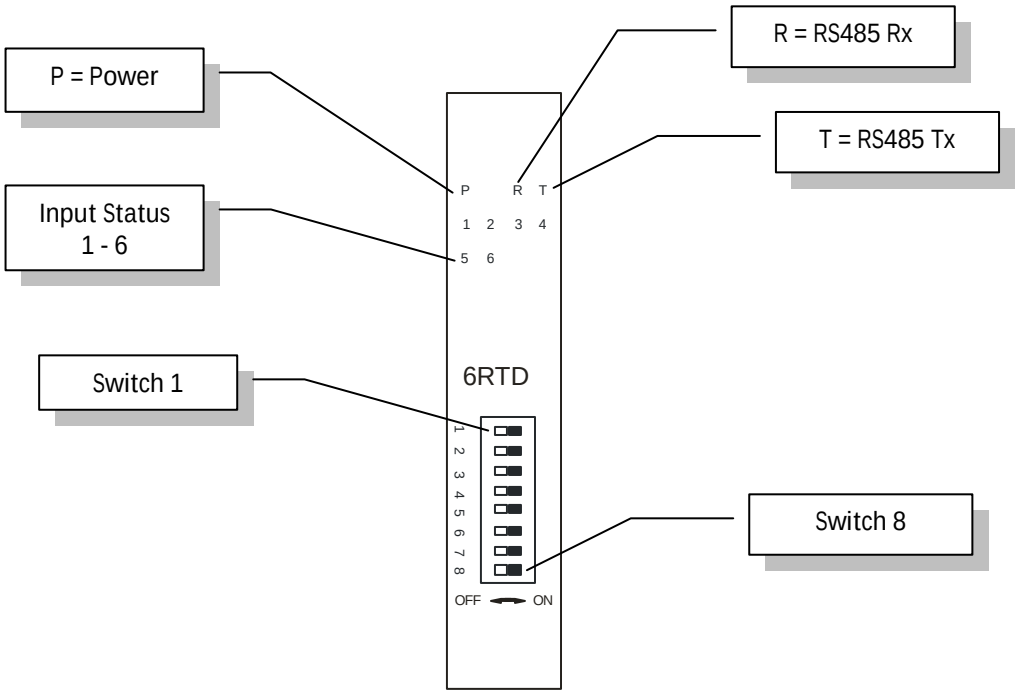
Note: As there is no inter-channel isolation, isolated RTD's must be used in order to prevent ground loops and reading errors.

3.10.2 Technical Specification of PB6RTD

Power Supply	Logic Supply Voltage		12 -24 Vdc	
	Logic Supply Current		83mA @ 12V / 43mA @ 24V	
RTD Inputs	Input Points		6	
	RTD Configuration		2 or 3 Wire	
	Resolution		0.1°C	
	Drift		100ppm/°C Typ.	
	Line resistance effect		< 0.1°C balanced	
	Max. line resistance		100ohms	
	Input update rate		No. of inputs enabled X 320ms eg: All inputs enabled 6 x 320 = 1920ms eg: 1 input enabled 1 x 320 = 320ms	
	Isolation		1500Vrms between field and logic	
RTD Type	Number	Type	Range	Accuracy
	1	PT100	-200 to 850°C	0.3°CIEC 751:1983
	2	Ni120	-80 to 320°C	0.3°C
	3	PT1000	-200 to 850°C	0.3°C
	4	Ni1000-DIN	-200 to 850°C	0.3°C
	5	Ni1000-Landys&Gyr	-200 to 850°C	0.3°C
	6	Ohms	10 - 400 ohms	
	7	Ohms	100-4000ohms	
Temperature	Operating Temperature.		-20°C to + 70°C	
	Storage Temperature		-40°C to + 85°C	
Connectors	Logic Power and Comms.		5 way connector that clips onto DIN rail	
	Inputs		6 x 3 Way screw connector on top and bottom	

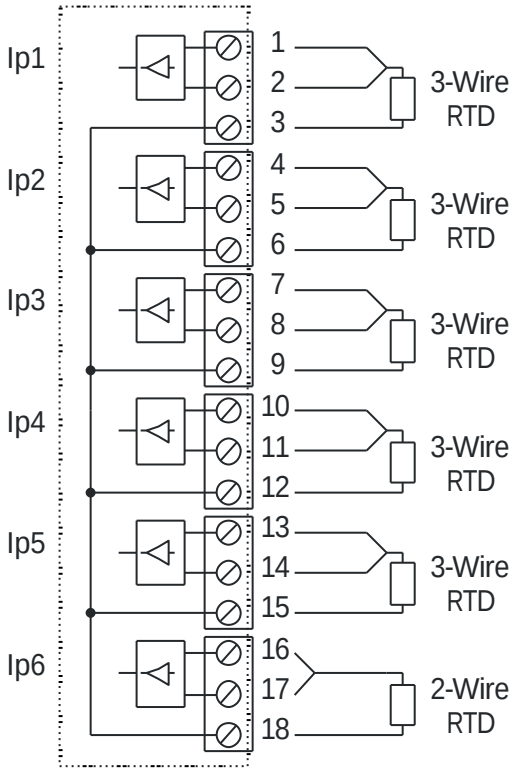
3.10.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Input Status: "ON" when the RTD is open circuit.
"OFF" when the RTD is connected.



3.10.4 Wiring

The following diagram shows how the inputs are connected to a 2 and 3 wire RTD.



3.10.5 Module Calibration

To calibrate an input, perform the following steps:

1. Run IOStudio on a PC to easily access the Modbus registers used for calibration.
2. Power up the module and let it settle for 30 minutes.
3. Connect a resistance box to input 1. Set to 10.00 ohms. One wire is connected to 1a and 1b (linked). The other wire to 1c. Allow the input to settle for a few seconds.
4. Write the value 1 into the “RTD type” output register 40101 to select PT100.
5. Write the value 1 into the “Calibrate Control Data” output register 40017 to save the zero value.
6. Set the input to 400.00 ohms and allow the input to settle for a few seconds.
7. Write the value 2 into the “Calibrate Control Data” output register 40017 to save the span value.
8. Write the value 3 into the “RTD type” output register 40101 to select PT1000.
9. Set the input to 100.00 ohms and allow the input to settle for a few seconds.
10. Write the value 1 into the “Calibrate Control Data” output register 40017 to save the zero value.
11. Set the input to 4000.00 ohms and allow the input to settle for a few seconds.
12. Write the value 2 into the “Calibrate Control Data” output register 40017 to save the span value.

3.10.6 PB6RTD Data Registers (MODULE TYPE = 159)

Modbus Address	Register Name	Low Limit	High Limit	Access	Description
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 159
30002	RTD Input 1	-xxx.x	yyyy.y	R	Thermocouple Inputs. See table for range.
30003	RTD Input 2	-xxx.x	yyyy.y	R	Resolution in 0.1°C.
30004	RTD Input 3	-xxx.x	yyyy.y	R	"
30005	RTD Input 4	-xxx.x	yyyy.y	R	"
30006	RTD Input 5	-xxx.x	yyyy.y	R	"
30007	RTD Input 6	-xxx.x	yyyy.y	R	"
30008	Input Status	0	65535	R	bit1 = 0(OK),bit1 = 1(error or open circuit)
30016	Calibrate Raw Data	0	65535	R	Raw data used to verify that the data has settled during calibration.
40017	Calibrate Control	0	2	R/W	Used to step through the calibration sequence.
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	RTD 1 Type	1	7	R/W	See RTD Tables.
40102	RTD 2 Type	1	7	R/W	See RTD Tables.
40103	RTD 3 Type	1	7	R/W	See RTD Tables.
40104	RTD 4 Type	1	7	R/W	See RTD Tables.
40105	RTD 5 Type	1	7	R/W	See RTD Tables.
40106	RTD 6 Type	1	7	R/W	See RTD Tables.
40111	Input 1 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40112	Input 2 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40113	Input 3 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40114	Input 4 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40115	Input 5 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40116	Input 6 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40117	Line Frequency	50	60	R/W	Line Frequency
40118	Units Type	1	2	R/W	1=°C, 2=°F
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 115200, 187500
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.10.6.1 RTD Input Status.

There is one status bits associated with each RTD input. These bits are used to indicate if the input is open circuit or over range. If the input is open circuit or over range, then the error bit will be set.

Bit 1- Error	Bit 2-Not Used	Condition	Status LED
0	0	Input working OK.	(LED OFF)
1	0	Open circuit / Over range.	(LED ON)

The analog input status can be read in a single register as follows:

MSB								PB6RTD ANALOG INPUT STATUS							LSB	ADDRESS
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1	30008

IP1 Error
IP2 Error
IP3 Error
IP4 Error
IP5 Error
IP6 Error

3.11 PB6AOI - ANALOG OUTPUTS

3.11.1 Description

The PB6AOI is a 6 channel current output module. Each channel can be set to output a current in the range 0 - 20mA. The outputs are isolated from the logic and share a common negative terminal.

The resolution is 12 bits, so writing a value to the Modbus register for each output of 0 - 4095 would give an output current of 0 - 20mA. A value of 819 ± 1LSB will give a current output of 4mA.

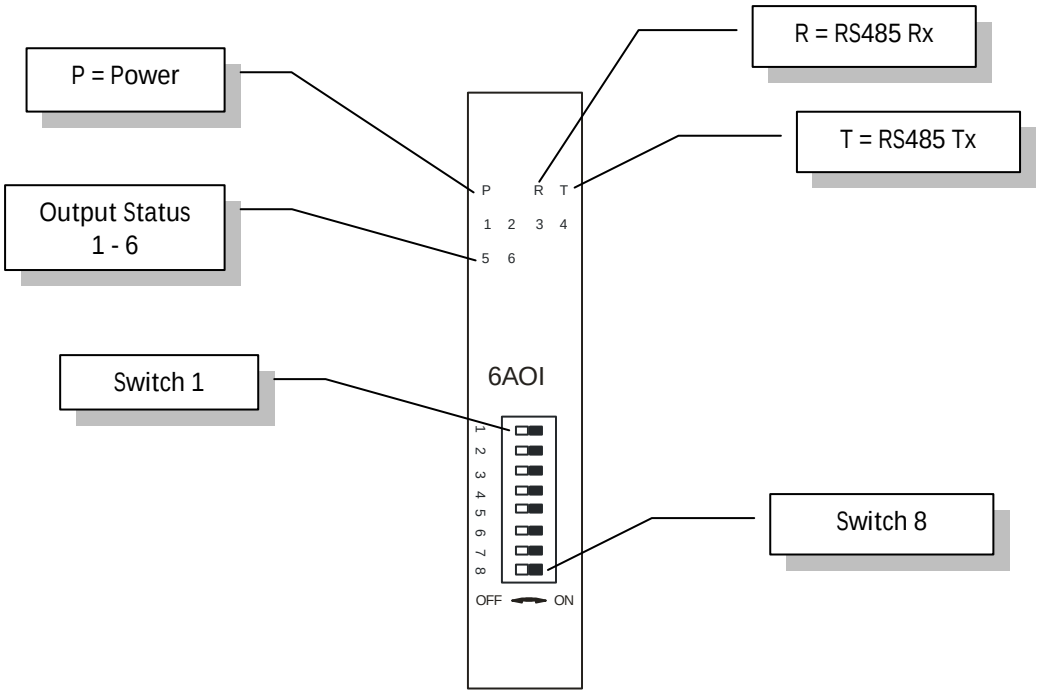
There are a number of different output formats that can be selected such as 12 bits, 16 bits, 0-20mA and 4-20mA.

3.11.2 Technical Specification of PB6AOI

Power Supply	Logic Supply Voltage		12 -24 Vdc
	Logic Supply Current		44mA @ 12V / 25mA @ 24V
	Field Supply Voltage		24 Vdc
	Field Supply Current		175mA
Current Outputs	Output Points		6
	Output Current		0(4) - 20 mA
	OutputType	Range	Resolution
	1	0–20.000mA	12 bits 0 – 4095
	2	4–20.000mA	12 bits 0 – 4095
	3	0–20.000mA	16 bits 0 – 65535
	4	4–20.000mA	16 bits 0 – 65535
	5	0–20.000mA	1uA 0 - 20000
	Drift		100ppm/°C
	Accuracy		0.05% of span
	Output update rate		All outputs every 60ms
	Compliance		1000 ohms max. @ 24Vdc
Isolation	Between field and logic		1500Vrms between field and logic
Temperature	Operating Temperature.		-20°C to + 70°C
	Storage Temperature		-40°C to + 85°C
Connectors	Logic Power and Comms.		5 way connector that clips onto DIN rail
	Inputs		6 x 3 Way screw connector on top and bottom

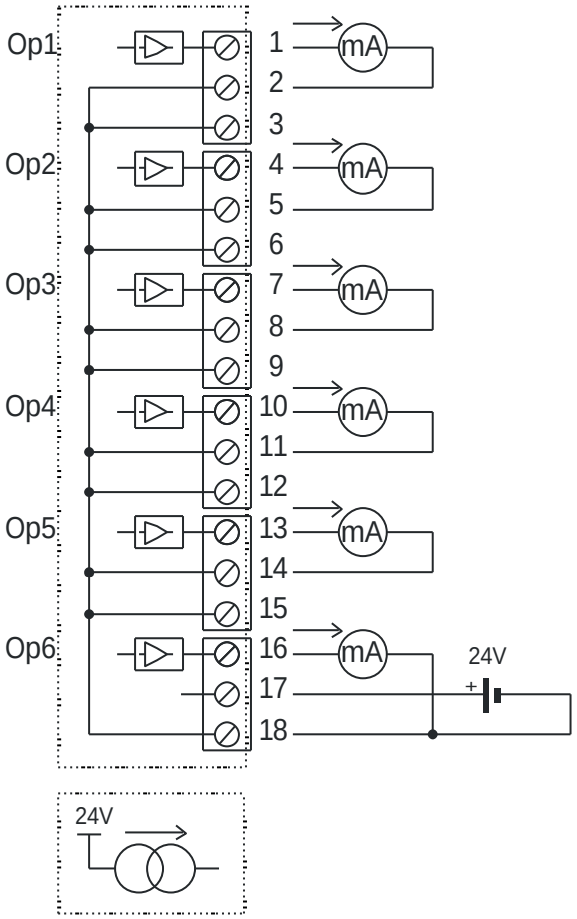
3.11.3 Status Indicators

Power:	Flashes to indicate the CPU is running.
RS485 Rx:	Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx:	Flashes to indicate the unit has sent a Modbus message.
Output Status:	"ON" when the output is zero.
	"OFF" when the output is between zero and full scale.
	"Flashing" when the output is at full scale.



3.11.4 Wiring

The following diagram shows how the analog outputs are connected to a load.



3.11.5 Module Calibration

To calibrate an output, perform the following steps:

1. Run IOStudio on a PC to easily access the Modbus registers used for calibration.
2. Connect a 20mA current meter to the output to be calibrated.
3. Write the channel number into the “Calibrate Channel Number” register 40018.
4. Write the value 1 into the “Calibrate Control Data” output register 40017.
5. Write the reading from the meter into the “Calibrate Data” output register 40016.
6. Write the value 2 into the “Calibrate Control Data” output register 40017.
7. Write the reading from the meter into the “Calibrate Data” output register 40016.
8. Write the value 3 into the “Calibrate Control Data” output register 40017 to complete the calibration.
9. Repeat the steps for the remaining channels.

3.11.6 PB6AOI Data Registers (MODULE TYPE = 160)

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 160
40002	Current Output 1	0	4095	R/W	Current Outputs. 0 - 4095 = 0(4) - 20mA.
40003	Current Output 2	0	4095	R/W	"
40004	Current Output 3	0	4095	R/W	"
40005	Current Output 4	0	4095	R/W	"
40006	Current Output 5	0	4095	R/W	"
40007	Current Output 6	0	4095	R/W	"
40010	Output Status	0	65535	R	bit2 = 0(0), bit2 = 1(4095) bit1 = 0(OK),bit1 = 1(error)
40016	Calibrate Data	0	65535	R	Data entered by user for calibration.
40017	Calibrate Control	0	3	R/W	Used to step through the calibration sequence.
40018	Calibrate Channel	1	6	R/W	Enter the channel number to be calibrated.
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Output 1 Type	1	5	R/W	See Specification Tables.
40102	Output 2 Type	1	5	R/W	See Specification Tables.
40103	Output 3 Type	1	5	R/W	See Specification Tables.
40104	Output 4 Type	1	5	R/W	See Specification Tables.
40105	Output 5 Type	1	5	R/W	See Specification Tables.
40106	Output 6 Type	1	5	R/W	See Specification Tables.
40111	Output 1 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40112	Output 2 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40113	Output 3 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40114	Output 4 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40115	Output 5 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40116	Output 6 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40119	Watchdog Timer	0	255	R/W	Timer in seconds. 0 = disabled. 1 -255 = enabled.
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 11520, 18750
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.12 PB6AOV - ANALOG OUTPUTS

3.12.1 Description

The PB6AOV is a 6 channel voltage output module. Each channel can be set to output a voltage in the range 0 – 10V. The outputs are isolated from the logic and share a common negative terminal.

The resolution is 12 bits, so writing a value to the Modbus register for each output of 0 - 4095 would give an output current of 0 – 10V. A value of 819 ± 1LSB will give a current output of 2V.

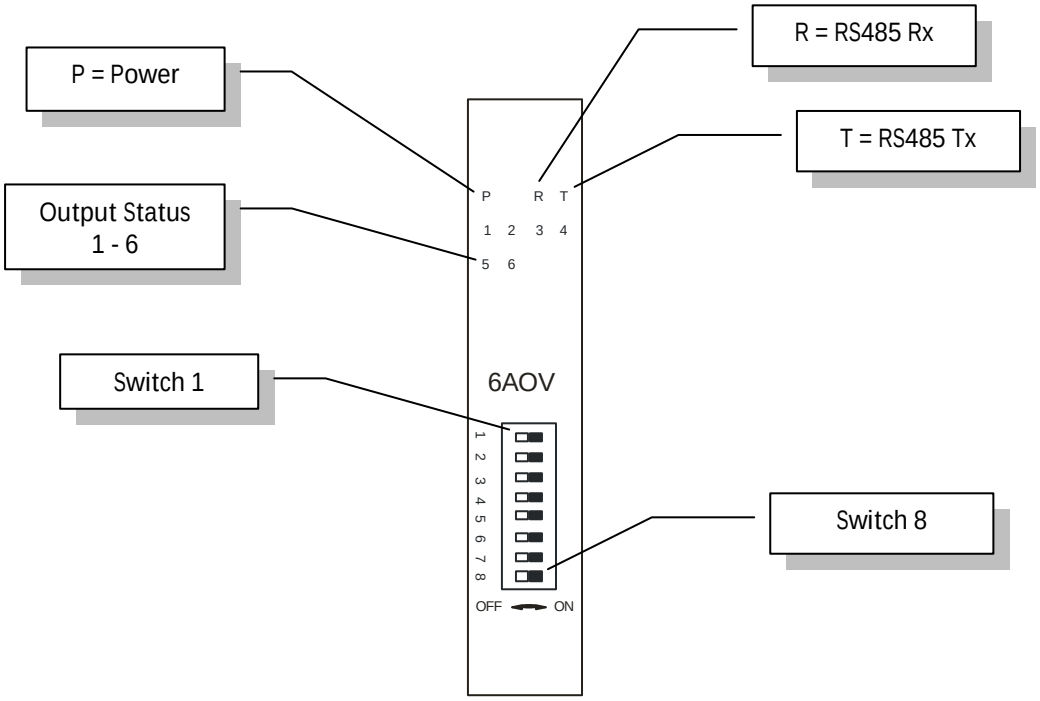
There are a number of different output formats that can be selected such as 12 bits, 16 bits, 0-20mA and 4-20mA.

3.12.2 Technical Specification of PB6AOV

Power Supply	Logic Supply Voltage		12 -24 Vdc
	Logic Supply Current		44mA @ 12V / 25mA @ 24V
	Field Supply Voltage		24 Vdc
	Field Supply Current		85 mA max.
Voltage Output	Output Points		6
	Output Voltage		0(2) - 10 V
	InputType	Range	Resolution
	1	0–10.000V	12 bits 0 – 4095
	2	2–10.000V	12 bits 0 – 4095
	3	0–10.000V	16 bits 0 – 65535
	4	2–10.000V	16 bits 0 – 65535
	5	0–10.000V	1mV 0 – 10000
	Drift		100ppm/°C
	Accuracy		0.05% of span
	Output update rate		All outputs every 60ms
	Compliance		2000 ohms min. load
Isolation	Between field and logic		1500Vrms between field and logic
Temperature	Operating Temperature.		-20°C to + 70°C
	Storage Temperature		-40°C to + 85°C
Connectors	Logic Power and Comms.		5 way connector that clips onto DIN rail
	Inputs		6 x 3 Way screw connector on top and bottom

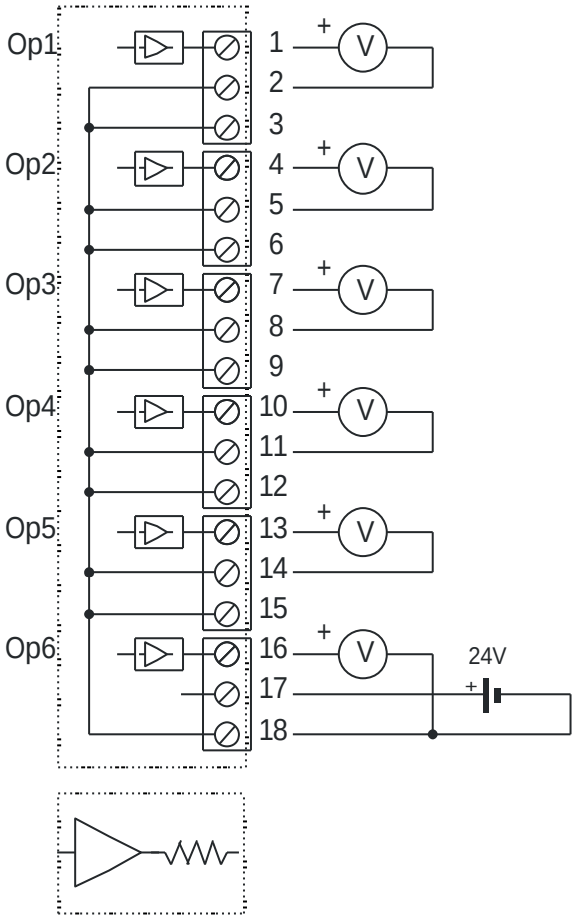
3.12.3 Status Indicators

Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.
Output Status: "ON" when the output is zero.
"OFF" when the output is between zero and full scale.
"Flashing" when the output is at full scale.



3.12.4 Wiring

The following diagram shows how the analog outputs are connected to a load.



3.12.5 Module Calibration

To calibrate an output, perform the following steps:

1. Run IOStudio on a PC to easily access the Modbus registers used for calibration.
2. Connect a 10V volt meter to the output 1.
3. Write the value 1 into the “Calibrate Control Data” output register 40017.
4. Write the reading from the meter into the “Calibrate Data” output register 40016.
5. Write the value 2 into the “Calibrate Control Data” output register 40017.
6. Write the reading from the meter into the “Calibrate Data” output register 40016.
7. Write the value 3 into the “Calibrate Control Data” output register 40017 to complete the calibration.

3.12.6 PB6AOV Data Registers (MODULE TYPE = 161)

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 161
40002	Voltage Output 1	0	4095	R/W	Voltage Outputs. 0 - 4095 = 0 - 10V.
40003	Voltage Output 2	0	4095	R/W	"
40004	Voltage Output 3	0	4095	R/W	"
40005	Voltage Output 4	0	4095	R/W	"
40006	Voltage Output 5	0	4095	R/W	"
40007	Voltage Output 6	0	4095	R/W	"
40010	Output Status	0	65535	R	bit2 = 0(0), bit2 = 1(4095) bit1 = 0(OK),bit1 = 1(error)
40016	Calibrate Data	0	65535	R	Data entered by user for calibration.
40017	Calibrate Control	0	3	R/W	Used to step through the calibration sequence.
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	Output 1 Type	1	5	R/W	See Specification Tables.
40102	Output 2 Type	1	5	R/W	See Specification Tables.
40103	Output 3 Type	1	5	R/W	See Specification Tables.
40104	Output 4 Type	1	5	R/W	See Specification Tables.
40105	Output 5 Type	1	5	R/W	See Specification Tables.
40106	Output 6 Type	1	5	R/W	See Specification Tables.
40111	Output 1 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40112	Output 2 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40113	Output 3 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40114	Output 4 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40115	Output 5 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40116	Output 6 Enable	0	1	R/W	0 = Enable, 1 = Disable.
40119	Watchdog Timer	0	255	R/W	Timer in seconds. 0 = disabled. 1 -255 = enabled.
40121	Baud Rate	2400	18750	R/W	2400, 4800, 9600, 19200, 38400, 57600, 115200, 187500
40122	Parity	0	2	R/W	0 = none, 1 = even, 2 = odd
40123	Stop Bits	1	2	R/W	1 = 1 stop bit, 2 = 2 stop bits
40124	Reply Delay	0	255	R/W	0 = Disable, >0 = Enable. (x10ms)

3.13 PBE – MODBUS TCP ETHERNET to MODBUS RS485 GATEWAY

3.13.1 Description

The PBE GATEWAY is an Ethernet to serial converter and connects the PROBUS modules to a 10/100 Base-TX Ethernet network.

The PBE GATEWAY includes a web server which enables access to internal parameters for configuration. This allows configuration of IP address, default gateway IP address and subnet mask. The web server can be accessed by most web browsers.

The PBE GATEWAY is factory programmed with a default IP address of 169.254.111.111. This address must be changed before the converter is added to an existing network.

The web page address for viewing the setup parameters is http://169.254.111.111/index.htm The web page address for configuring the converter is http://169.254.111.111/ip.htm

The master device which is polling the modules must be configured with the IP address of the PBE GATEWAY and with the modbus ID of the PROBUS modules. As each PROBUS communications bus is separate, it is possible to have repeated Modbus ID's on the PROBUS modules provided they are attached to a different PBE GATEWAY. The IP address differentiates between the different PROBUS systems. Consequently, many hundreds of PROBUS modules may be added to an Ethernet network.

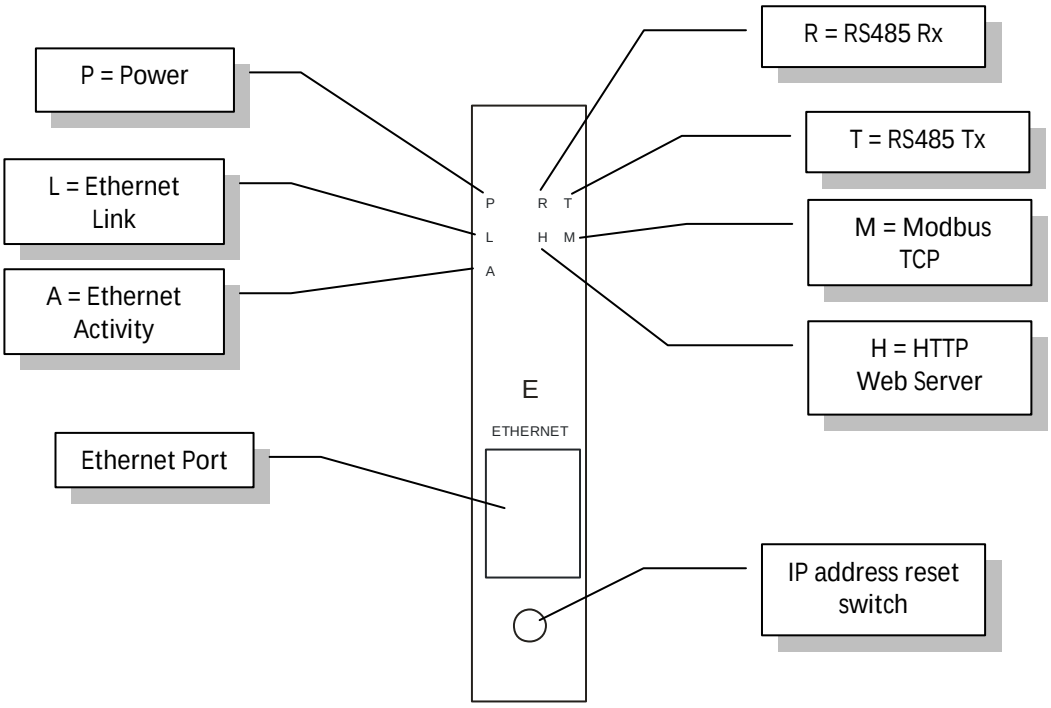
The PBE GATEWAY is a Modbus gateway and the client must be configured to use Port 502. This is a reserved port number for Modbus TCP applications and informs the PBE GATEWAY that it must implement the protocol conversion from Modbus TCP on the Ethernet network to Modbus RTU on the PROBUS serial communications bus.

3.13.2 Technical Specification of PBE

Power Supply	Logic Supply Voltage	12 -24 Vdc
	Logic Supply Current	68mA @ 12V / 36mA @ 24V
Ethernet	10/100 Mbits/s	10/100Base-TX
	Connector	RJ45
Serial	RS485	2 Wire Multidrop twisted pair + GND
	Baud Rate	2400, 4800, 9600, 19200, 38400, 57600, 115200
	Data Bits	8
	Parity	none, even, odd.
	Stop Bits	1, 2.
Temperature	Operating Temperature.	-20°C to + 70°C
	Storage Temperature	-40°C to + 85°C
Connectors	Logic Power and Comms.	5 way connector that clips onto DIN rail
Humidity		Up to 95% non condensing.

3.13.3 Status Indicators

Power:	Flashes to indicate the CPU is running.
Serial Bus Rx:	Flashes to indicate the unit has received a valid Modbus message from a PROBUS module.
Serial Bus Tx:	Flashes to indicate the unit has sent a Modbus message to a PROBUS module.
Modbus TCP Rx:	Flashes to indicate the unit has received a valid Modbus message on the Ethernet network.
Modbus TCP Tx:	Flashes to indicate the unit has transmitted a Modbus message on the Ethernet network.
Web Server:	Flashes to indicate the HTTP web server is being accessed.



3.13.4 Configuration

3.13.4.1 Power Connections.

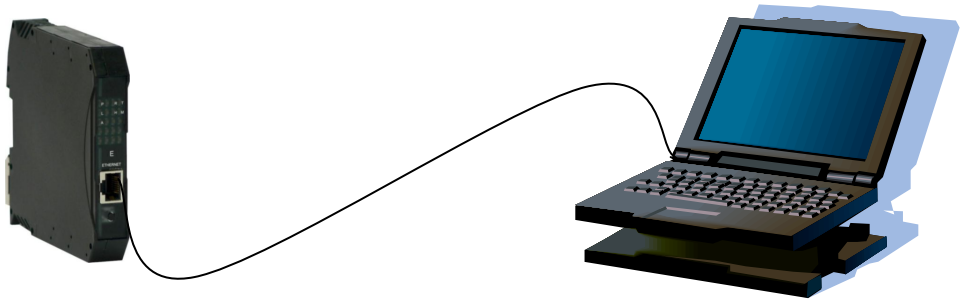
The PBE GATEWAY Module must be clipped onto a DIN rail. Power for the PBE GATEWAY must be applied to terminal 2 (+12/24VDC) and terminal 1 (0V). The power LED will flash and all LED's will be off.

3.13.4.2 Ethernet Connection.

Next the Ethernet connection is required, either through a network or directly to a PC. The Ethernet interface uses a standard RJ45 connector.

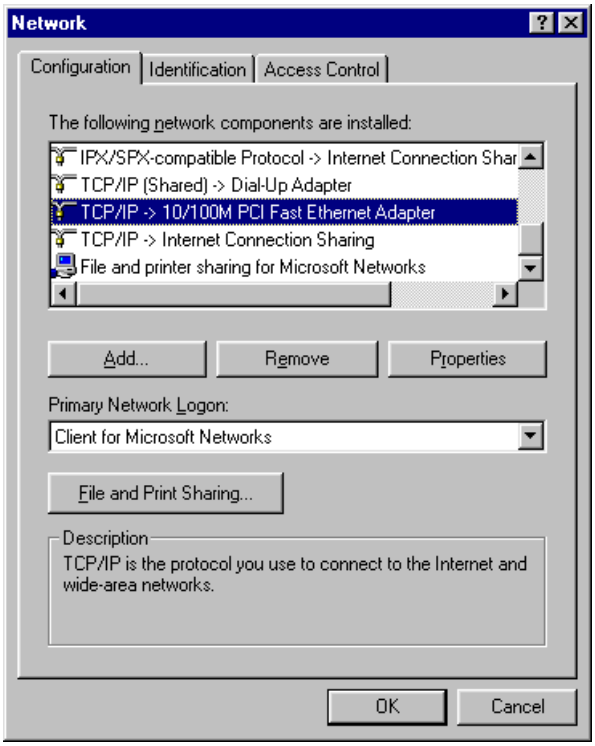
3.13.4.3 Connecting To a PC which is not Connected to a Network.

If the PC is equipped with an Ethernet card but not connected to a network, a local network address should be used for communication between the PBE GATEWAY and the PC. The PBE GATEWAY is shipped with a default IP address 169.254.111.111. This address is in the address area reserved for local networks not connected to the Internet. For direct connection between the PC and the PBE GATEWAY, a crossover Ethernet cable is required.

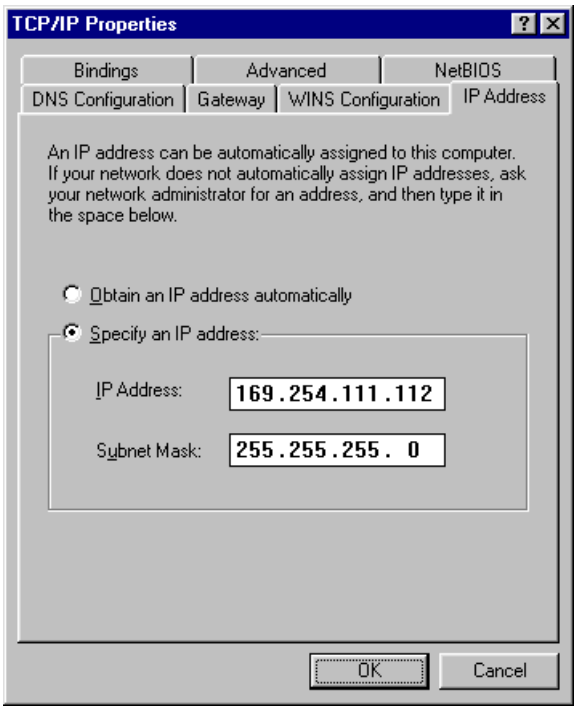


To setup your PC to connect directly to the PBE GATEWAY, an IP address in the same range as the PBE GATEWAY must be assigned to the PC. In Windows environments, this should be done as follows:

- Connect the PC and the PBE GATEWAY together using a crossover cable
- Open the Windows Control Panel
- Select Network
- Select TCP/IP -> the PC's Ethernet adaptor from the Configuration tab as shown below



- Click the properties button. A TCP/IP Properties box similar to the one below should appear

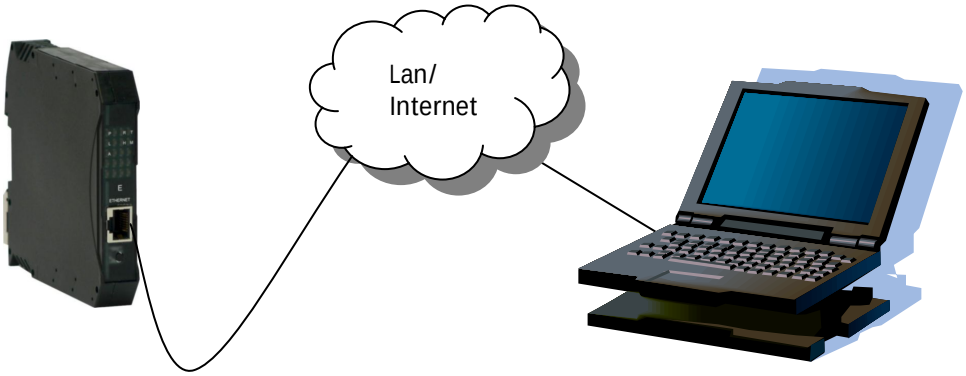


- Select the IP Address tab
- Choose to Specify an IP address as shown in the figure
- Insert the IP address 169.254.111.112 and the corresponding subnet mask as shown

- Save your settings by pressing OK in both TCP/IP properties and Network properties
- Reboot your PC

3.13.4.4 Connecting to a PC which is connected to a Network.

If there is an Ethernet network available, the PBE GATEWAY can be connected to any Ethernet connection or hub belonging to the network. If the PC is connected to a network, there is a strong possibility that the default IP address of the PBE GATEWAY is outside the range of the network (the address doesn't belong to the IP subset of the network). If the Ethernet network is connected to the Internet, this is certain. In this case a new IP address for the PBE GATEWAY is required. Contact the local network administrator to be assigned a free IP address for the PBE GATEWAY. The new IP address is programmed into the PBE GATEWAY using a Web browser software such as Internet explorer. In this case the PBE GATEWAY must first be connected directly to a PC as described above.



In the remainder of this chapter, the IP address 169.254.111.111 is used as an example. Exchange this IP address with the IP address you have set up in all the occurrences.

3.13.4.5 Testing the Connection

To test the connection between the PC and the PBE GATEWAY, a simple program called *ping* can be used. *Ping* sends a number of messages to the specified IP address and displays the response. The ping program can be run from the command line or from a DOS window on the PC, as follows:

- Open the Windows Start Menu
- Click Run
- In the Open box, type: "ping 169.254.111.111"

If the network connection is OK, the program will respond with:
"Reply from 169.254.111.111" and information about the response time.

If there is a problem with the network setup the program will respond:
"Destination host unreachable". There may be two solutions to this problem:

- If the PC is connected in a network, change the IP address to an address accessible from the local network.
- If the PBE GATEWAY is connected directly to the PC(or through a hub), change the PC's IP address to one in the same address range as the PBE GATEWAY.

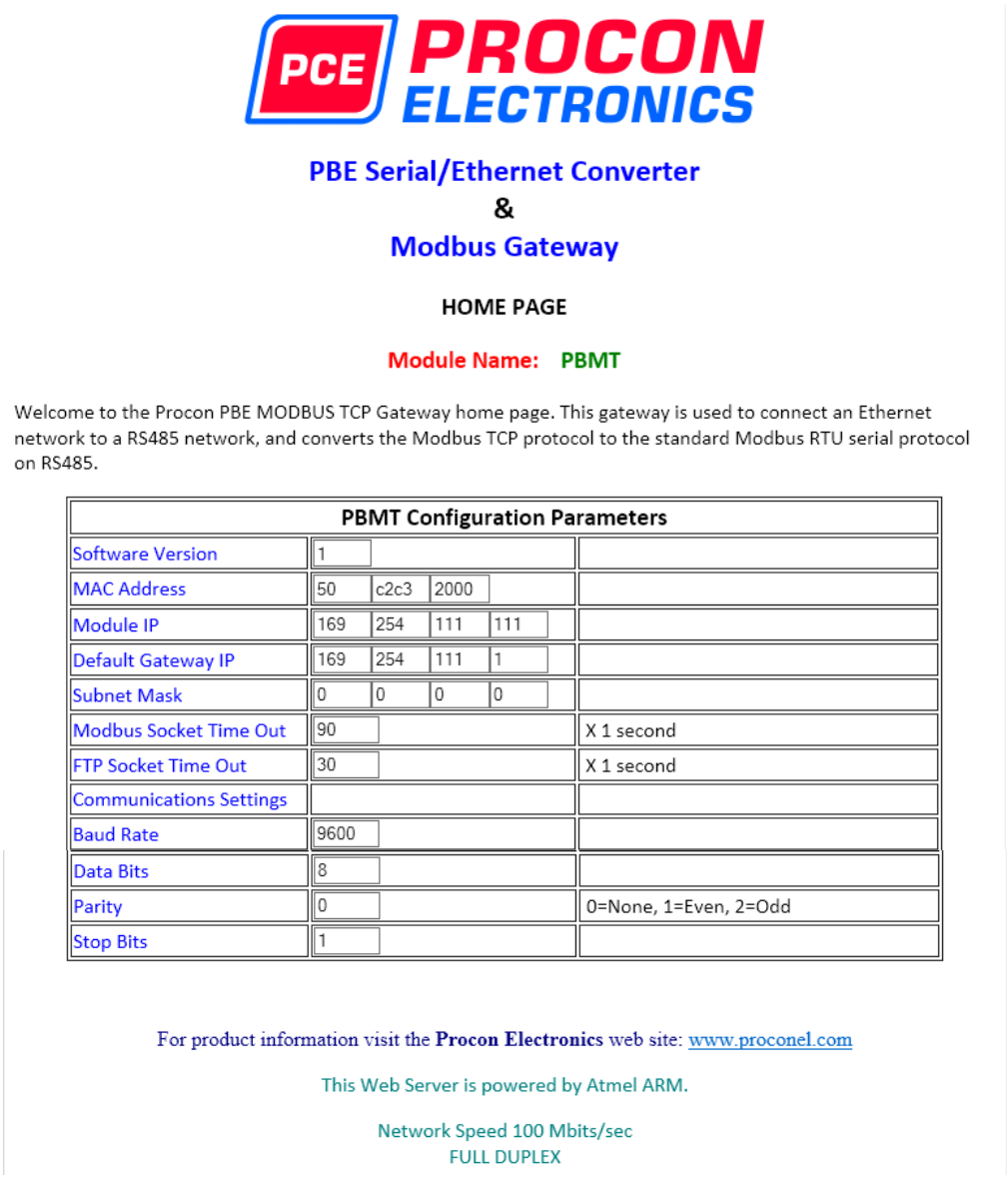
If there is a problem with the PBE GATEWAY the program will respond:
"Request timed out", this means that the PBE GATEWAY can not respond to messages. Check the power connection. Check that the Link LED is illuminated when the cable is plugged into the RJ45 connector.

3.13.5 Viewing Web Pages

The PBE GATEWAY has built in web pages. These are used for checking the configuration and dynamic data, and for altering the configuration. To view these Web pages, a Web browser such as Internet Explorer or Netscape is needed.

To view the default Web page in PBE GATEWAY, start the Web browser and type "169.254.111.111" into the address line of the browser window. The main page of the PBE GATEWAY will now be displayed in the browser window.

If no Web page is displayed, go back to testing the network connection to the PBE GATEWAY by using the ping command. If the PBE GATEWAY replies to the ping messages, check the setup of the Web browser. If the PBE GATEWAY is directly connected to the same network as the PC, "direct connection to the network" or "bypass proxy server for local addresses" should be selected in the Web browser configuration menu. If the PBE GATEWAY is connected to the PC through a firewall, a proxy server should be selected in the configuration menu. Contact the local network administrator for information about the network configuration.



PROCON ELECTRONICS

PBE Serial/Ethernet Converter
&
Modbus Gateway

HOME PAGE

Module Name: PBMT

Welcome to the Procon PBE MODBUS TCP Gateway home page. This gateway is used to connect an Ethernet network to a RS485 network, and converts the Modbus TCP protocol to the standard Modbus RTU serial protocol on RS485.

PBMT Configuration Parameters		
Software Version	1	
MAC Address	50 c2c3 2000	
Module IP	169 254 111 111	
Default Gateway IP	169 254 111 1	
Subnet Mask	0 0 0 0	
Modbus Socket Time Out	90	X 1 second
FTP Socket Time Out	30	X 1 second
Communications Settings		
Baud Rate	9600	
Data Bits	8	
Parity	0	0=None, 1=Even, 2=Odd
Stop Bits	1	

For product information visit the **Procon Electronics** web site: www.proconel.com

This Web Server is powered by Atmel ARM.

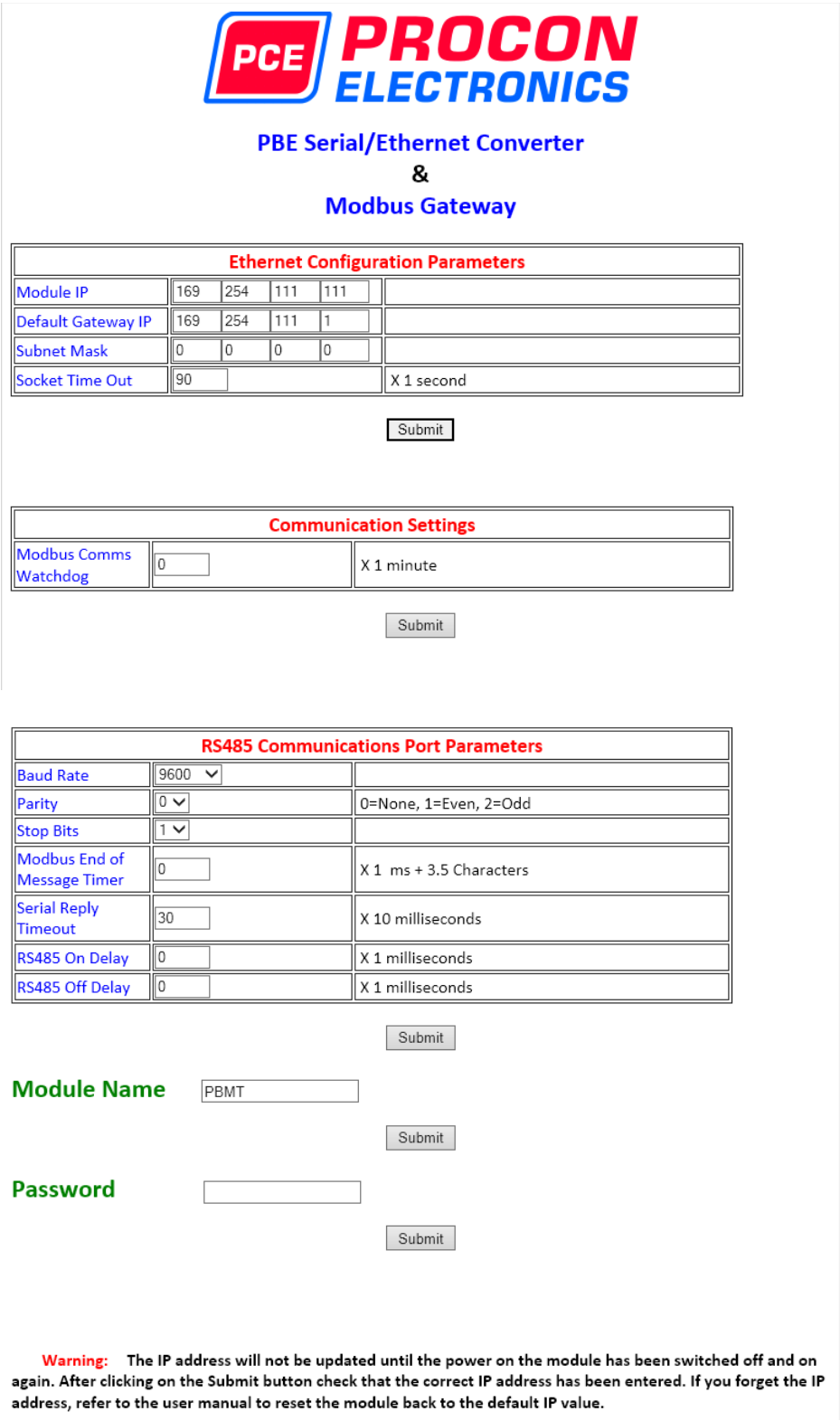
Network Speed 100 Mbits/sec
FULL DUPLEX

3.13.6 Troubleshooting Guide.

No	Checkpoint		Solution
1	Is the LINK LED on and is the ACTIVITY LED flashing with short pulses?	No	No network connection is detected. The Ethernet cable is either not plugged in or wrong type of cable is used. For connection to a network with a hub or switch, a normal network cable can be used. For direct connection to a PC network card, a twisted cable must be used.
		Yes	A network connection is detected, the PBE GATEWAY is connected to the network.
2	Does the PBE GATEWAY respond to PING requests?	No	Either the PC or the PBE GATEWAY is setup with wrong IP address. To change the IP address of the PBE GATEWAY back to the default address, remove the power, open the PBE GATEWAY housing and remove the jumper labeled DEFAULT IP. Apply power to the PBE GATEWAY for a short while. Now replace the jumper and close the enclosure. To change the IP address of a PC, use the Windows "control panel -> network -> TCP/IP properties" and setup an IP address close to the PBE GATEWAY address. The PBE GATEWAY is shipped with a default IP address of 169.254.111.111, the PC can be setup with an IP address of 169.254.111.112
		Yes	The PC and PBE GATEWAY are setup with a correct IP address and they are able to communicate with each other.
3	Can the default Web page be accessed in a Web browser?	No	This is normally caused by the setup of the Web browser. In the "options" or "preferences" menu, check that the Web browser is configured for direct network connection or local area network and NOT using a proxy server.
		Yes	No problems.

3.13.7 Parameter Configuration

The Web page address "169.254.111.111/ip.htm" is entered into the address line of the browser window to access the configuration page. This page allows you to change the IP address of the PBE GATEWAY, Default Gateway, Subnet Mask, and to enter a Module Description Name for identification/maintenance purposes.



- Module IP Address: The new IP address can be entered into the web page as shown above. After this has been done, you must click the Submit button to send the values to the Converter Module. The screen will now be updated and if successful will continue to display the new IP address. The new IP address will only be effective after the PBE Gateway power has been switched off and on again. This feature allows you to check that the correct IP address has been entered before being activated. If the IP address has been entered incorrectly and the power has not been switched off, it is possible to re-enter the correct IP address. If the power has been switched off and back on again, the PBE Gateway will not communicate until you enter the new IP address into the address line of the browser window. The push button reset switch on the front of the module is used to reset back to the default factory IP address.
  Perform the following steps to reset the IP to factory default (169.254.111.111)
  a. Switch off the power.
  b. Push and hold the switch.
  c. Switch on power for 5 seconds.
  d. Release the switch.
- Default Gateway IP Address: A default gateway is a node (a router) on a computer network that serves as an access point to another network. In enterprises, however, the gateway is the computer that routes the traffic from a PC to the outside network that is serving the Web pages. It is only necessary to configure the default gateway IP address if the PC that is accessing the PBE Gateway is on a different network.
- Subnet Mask: In computer networks, a subnetwork or subnet is a range of logical addresses within the address space that is assigned to an organization. The subnet mask is used to inform the Converter that it must send its replies to the gateway if the IP address of the PC is on a different network. When the subnet mask is set to "0.0.0.0" then it is effectively disabled and the default gateway is not used. A typical subnet mask would be "255.255.255.0".
- Socket Timeout: If a socket connection is broken, say due to a network fault, it must timeout to free it up so that it can be used again. This timer is triggered by activity on the PBE Gateway, so if there is no communications activity for longer than the timeout period, the socket will close.
- Modbus Communications Watchdog: If a value other than zero is entered into this field, the watchdog will be enabled and will be reset every time there is a Modbus message. If there is a break in the Modbus communications which is longer than the timeout value, then the module will be reset.
- Baud Rate, Parity, Stop Bits: The configuration of the serial port can be configured by selecting the parameters from the pull-down menu. Note: The power must be cycled to reset the unit after the communication settings have been changed.
- Modbus End of Message Timer: The standard way of determining the end of a Modbus message is to time 3.5 characters. (as per the Modbus protocol specification) Some Modbus slaves are not compliant with the Modbus specification and have time delays between characters which would normally result in an error. This field enables the converter to have a longer end of message timeout to be able to function correctly with these slave devices.
- Serial Reply Timeout: This timeout is the time the module waits for a reply from a slave device. If a reply is received then this timeout is cancelled and the converter looks for the next TCP message. If the slave does not send a reply, then this timeout will expire and allow the converter to look for the next TCP message. This timeout must be longer than the turn-around time of the slave device or it will timeout before the slave replies.
- RS485 On Delay: This is the time the RS485 transmitter will be enabled before data is transmitted.
- RS485 Off Delay: This is the time the RS485 transmitter will be enabled after data is transmitted.
- Module Name: This field allows you to enter a module description name into the PBE GATEWAY. This is an identifier for diagnostic/maintenance purposes and is chosen to best describe the PBE GATEWAY in the system by name or number.

4. SPECIFICATIONS

4.1 ENVIRONMENTAL

Operating Temperature	-20°C to +70°C
Storage Temperature	-40°C to +85°C
Humidity	Up to 95% non condensing.

4.2 EMC INSTALLATION INSTRUCTIONS

1. Screened twisted pair RS485 cable must be used with the screen grounded at one point only.
2. The RS485 cable must be terminated at both ends using a 120 ohm resistor.
3. Use should be made of screened I/O, T/C, RTD cable with the screens grounded at one point as close to the PROBUS module as possible.
4. The PROBUS modules must be installed in an appropriate enclosure inaccessible to the operator during normal use.

4.3 CONFORMITY CERTIFICATE

DECLARATION OF CONFORMITY
according to EN 45014

Manufacturer's Name:	Procon Electronics Pty Ltd
Manufacturer's Address:	22/195 Prospect Highway Seven Hills NSW 2147 Australia

declares that the product

Product Name:	PROBUS
Model Number(s):	PB16DI, PB16DO, PB6DIO, PB6RO, PB8AII, PB8AIV, PB6AIIS, PB6AIVS, PB6AOI, PB6AOV, PB6TCS, PB6RTD, PBE

complies with EMC Directive 2004/108/EC and Low Voltage Equipment Directive 2006/95/EC and conforms to the following Product specifications:

EMC:	EN 61326-1:2013 Electrical Equipment for measurement, control and laboratory use.

Seven Hills	23 April 2013	
Location	Date	D.Ruddock

4.4 EMC Test Results

PROBUS EMC Test Results									
Test	Standard	Test Value	PROBUS Product Compliance (PB)						
Immunity Test Results EN 61326-1			16DI	16DO	6RO	6DIO	8AII	6AIIS	8AIV
Electrostatic Discharge	IEC 61000-4-2	8KV Air	A	A	A	A	A	A	A
		4KV Contact	A	A	A	A	A	A	A
Radiated Field	IEC 61000-4-3	10V/m	A	A	A	A	A	A	A
Fast Transients	IEC 61000-4-4	Power 2KV	A	A	A	A	A	A	A
		I/O 1KV	A	A	A	A	B	B	B
Surge	IEC 61000-4-5	Power 1KV/2KV	A	A	A	A	A	A	A
RF Conducted	IEC 61000-4-6	Power 3 Vrms	A	A	A	A	A	A	A
Voltage Interrupt	IEC 61000-4-11	0.5cycle 100%	A	A	A	A	A	A	A
Emissions Test Results EN 61326-1 Class A									
Radiated Emissions	CISPR 22	Class A	✓	✓	✓	✓	✓	✓	✓
Conducted Emissions	CISPR 22	Class B	✓	✓	✓	✓	✓	✓	✓

Test	Standard	Test Value	PROBUS Product Compliance (PB)						
Immunity Test Results EN 61326-1			6AIVS	6TCS	6RTD	6AOI	6AOV	E	
Electrostatic Discharge	IEC 61000-4-2	8KV Air	B	B	A	A	A	A	
		4KV Contact	A	A	A	A	A	A	
Radiated Field	IEC 61000-4-3	10V/m	A	A	A	A	A	A	
Fast Transients	IEC 61000-4-4	Power 2KV	A	A	A	A	A	A	
		I/O 1KV	B	A	B	A	A	A	
Surge	IEC 61000-4-5	Power 1KV/2KV	A	A	A	A	A	A	
RF Conducted	IEC 61000-4-6	Power 3 Vrms	A	A	A	A	A	A	
Voltage Interrupt	IEC 61000-4-11	0.5cycle 100%	A	A	A	A	A	A	
Emissions Test Results EN 61326-1 Class A									
Radiated Emissions	CISPR 22	Class A	✓	✓	✓	✓	✓	✓	
Conducted Emissions	CISPR 22	Class B	✓	✓	✓	✓	✓	✓	