ACTION INSTRUMENTS
...the Industrial I/O Company

AIOS 2500 DIN Rail Controller

Installation and Operation Handbook

Action Instruments • 8601 Aero Drive • San Diego, CA 92123

(800) 767-5726 • fax (858) 279-6290

www.actionio.com • sales@actionio.com

MODEL 2500 DIN RAIL CONTROLLER

INSTALLATION AND WIRING HANDBOOK

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Important Information

1. SAFETY AND EMC INFORMATION

Before installing the 2500 DIN rail controller, please ensure that you are familiar with 'Safety and EMC Information'. This is given in Appendix A at the back of this manual.

2. EXITING CONFIGURATION MODE

When exiting from configuration mode to normal operation, it is important to ensure that the output power demand levels from the controller are in a safe state for your process. In IOC software releases prior to 2.21 this must be carried out manually, as follows:

1. Before exiting configuration mode switch all PID loops into Manual
2. Adjust the output to a level that is safe for the process. This would normally be zero output power.
3. Exit configuration level.

Chapter 1 INTRODUCTION

Thank you for selecting the 2500 DIN Rail Controller.

1.1. WHAT IS 2500

The 2500 DIN Rail Controller is a modular I/O system with local PID control blocks and "User Wiring" allowing local computation and combinational logic. It is configured using "iTools" running on a personal computer under Windows 95, 98 or NT®. The standard communications to it is Modbus RTU or Profibus DP.

The 2500s are designed to work as flexible controllers in a number of possible architectures:

- as stand alone programmer/controllers using the type 2900 ¼ VGA display
- as front end control and data aquisition for third party PLCs and SCADA packages.
- as extension I/O for the 2600 and 2700 programmer/controllers

The unit is normally supplied as a number of separate parts, identified by a unique model code printed on labels attached to each item.
The parts can generally be classified as follows:

the Base -	"2500B"
the I/O Controller Module -	"2500C"
the I/O Modules -	"2500M"
the Terminal Units -	"2500T"
the 24V Power Supply -	"2500P."

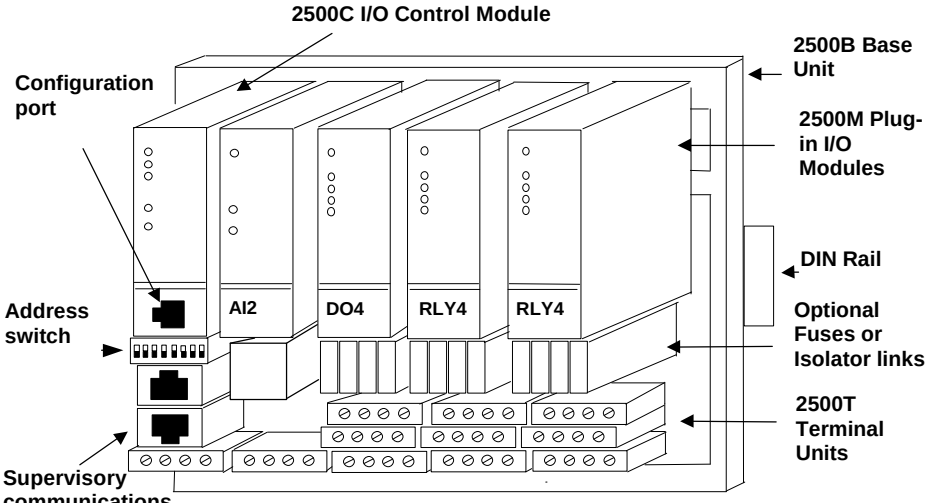


Figure 1-1: General View of the 2500 DIN rail Controller

The 2500B Base can either be fixed onto a DIN rail or wall mounted. Three sizes of base are available, taking the **2500C I/O Controller Module** plus 4, 8 or 16 **2500M I/O Modules** .

The **Terminal Units** provide the wiring interface between the plant or machine and the I/O modules. They can optionally be fitted with fuses or disconnects. The terminal unit also contains sockets to accept the plug in I/O Modules.

Intercommunication between the I/O modules is effected by the use of the internal module I/O bus. The signals on this bus are transferred between modules through a series of connectors mounted on a printed circuit board running the full width of the base.

Standard modules are:

Module description	Reference	
Input/output controller module	IOC	
Universal isolated two channel analogue input module	AI2	
Three channel mA analogue input with transmitter power supply	AI3	
Universal two channel analogue output module	AO2	See also Table 3-1 for
Four channel digital input module	DI4	a list of terminal units used with
Eight channel digital input module	DI8	each type of
Four channel digital output module	DO4	module
Four channel relay module	RLY4	

The Input Output Controller Module IOC (type 2500C), must always be fitted. It requires a 24V supply and is available to provide four levels of functionality, as follows:

1	ACQIO	Remote IO acquisition, makes all the I/O values available on communications
2	UW	As 1 above, plus User Wiring
3	2LOOP	As 1 above, plus 2 control blocks, each block may be single PID or cascade PIDs, and include self tune and gain scheduling.
4	2LOOPUW	As 3 above, plus User Wiring

A diagrammatic representation of the 2500 DIN rail controller is shown in Figure 1-2.

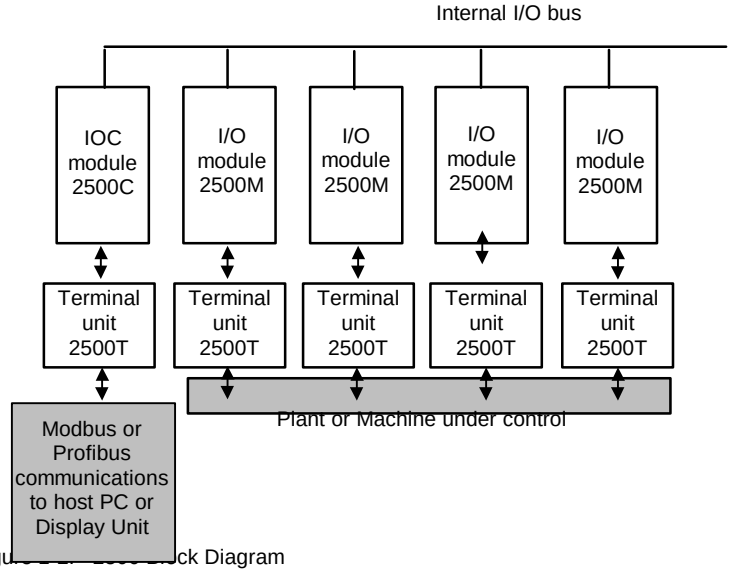


Figure 1-2 2500 Block Diagram

1.1. Before You Begin

Before installing the 2500 DIN rail controller ensure that:

- All parts are of the correct type for the application.
- Check the advice note and/or module labels against the product codes for correct identities.
- The location and wiring requirements for each module is understood.
- Refer to the chapters covering installation for each of the hardware components.

1.2. Unpacking

All parts comprising the system are packaged in shipping containers designed to withstand reasonable transit shocks. It is suggested that each item is unpacked carefully and the contents inspected for damage.

If there is evidence of shipping damage, please notify your supplier within 72 hours. The packaging should be retained for inspection by your supplier.

All packaging contains anti-static materials to prevent the build up of static which can damage electronic assemblies.

Chapter 2 Base 2500B

1. DESCRIPTION

The base consists of an aluminium extrusion, the internal I/O bus and mounting supports. The internal I/O bus is a printed circuit board, mounted horizontally at the top of the base, and contains a number of sockets bussed together. It is used to carry the module intercommunication and power signals.
The base is designed to be DIN rail mounted, using the fittings supplied, within an enclosure. If preferred, however, it can be bulkhead mounted directly on a mounting plate within the enclosure.
The modules are mounted on the base using 'Terminal Units'. These are described in more detail in Chapter 3. Terminal Units correspond to the type of module supplied and are located on the base in the positions shown in Figure 2-2.

Bases are available in three standard sizes to suit the number of modules required in a particular system, and are finished with two plastic side covers. The dimensions and weights of the three standard bases are detailed in table 2-1 overleaf.

Safety earth and screen connections are made to clearly marked earth terminals at the bottom of the base.

The assembly is shown in Figure 2-1.

2. IDENTIFICATION

The base may be identified by a label mounted on the rear of the unit. This shows model type and serial number.

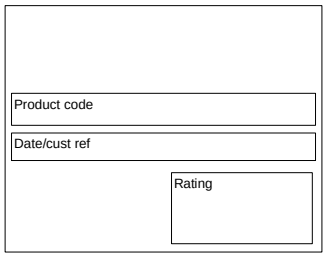
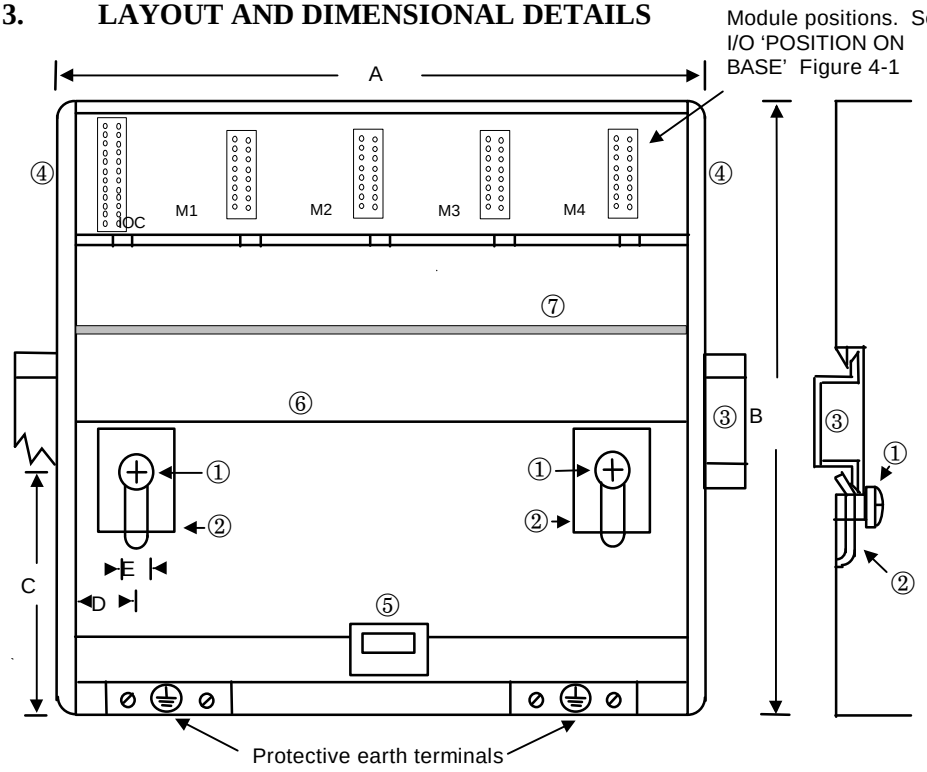


Figure 2-1: Product code label

3. LAYOUT AND DIMENSIONAL DETAILS



① Mounting screw
② Base retention clip
③ DIN rail
④ Side cover
⑤ Retention clip for terminal unit
⑥ Support for terminal unit
⑦ EMC earthing strip

Figure 2-2 The Base (Mounted Horizontally)

4. DIMENSIONS AND WEIGHTS

Model	Dimensions (mm)					Weights (Kgms)	
	Length A	Height B	C	D	E	No modules fitted	All modules fitted
2500B-SO4	137.0	180.0	68	15.0	5.0	0.6	1.0
2500B-SO8	238.6	180.0	68	15.0	5.0	1.1	1.7
2500B-SO16	441.8	180.0	68	15.0	5.0	2.1	2.7

Table 2-1: Dimensions and Weights

5. TO MOUNT THE BASE

This unit is intended to be mounted within an enclosure, or in an environment suitable for IP20 rated equipment.
It can be DIN rail or bulkhead mounted.
For DIN rail mounting, use symmetrical DIN rail to EN50022-35 X 7.5 or 35 X 15 mounted horizontally or vertically.

⚠ **Caution**
Do not operate the equipment without a protective earth conductor connected to one of the earth terminals on the base unit ⏚.
The earth cable should have at least the current rating of the largest power cable used to connect to the unit.
Connect the protective earth with a suitable tinned copper eyelet, and use the screw and washer supplied with the base unit, tightened to a torque of 1.2Nm 910.5lbin).
This connection also provides a ground for EMC purposes.

5.1. DIN Rail Mounting (horizontal)

1. Mount the DIN rail horizontally, using suitable bolts.
2. Ensure that the DIN rail makes good electrical contact with the metal base of the enclosure.
3. Loosen screws ① in the base, and allow them, and the associated base retention clips ②, to drop to the bottom of the screw slot.
4. In the back of the base is an extruded slot which locates with the DIN rail ③.

5. Fit the top edge of this into the top edge of the DIN rail ③
6. Slide the screws ① with the associated clips ② upwards as far as they will go towards the top of the screw slots The angled edge of the base retaining clip ② must locate behind the bottom edge of the DIN rail.
7. Tighten the screws ①.

5.2. DIN Rail Mounting (vertical)

Caution! It is acceptable to mount the 2500 base vertically. If it is mounted vertically, however, it is advisable to fit a fan in the cubicle to ensure a free flow of air around the modules.

1. Mount the DIN rail vertically, using suitable bolts.
2. Ensure that the DIN rail makes good electrical contact with the metal base of the enclosure.
3. Loosen screws ① in the base, and move them, and the associated base retention clips ②, to the bottom of the screw slot.
4. In the back of the base is an extruded slot which locates with the DIN rail ③.
5. Fit the top edge of this into the top edge of the DIN rail ③
6. Slide the screws ① with the associated clips ② upwards as far as they will go towards the top of the screw slots The angled edge of the base retaining clip ② must locate behind the bottom edge of the DIN rail.
7. Tighten the screws ①.

5.3. Direct Panel Mounting

1. Remove the screws ① and base retention clips ②.
2. Hold the base horizontally or vertically on the panel and mark the position of the two holes on the panel.
3. Drill two 5.2 mm holes in the panel.
4. Using M5 bolts secure the base to the metal panel.

Chapter 3 Terminal Units 2500T

1. DESCRIPTION

Terminal units provide theconnections between the plant wiring and the I/O modules. Each module has its own type of terminal unit. Some modules have more than one type of terminal unit, for example, the analogue input module has three basic types of terminal unit

1. with CJC measurement for thermocouples
2. without CJC for input signals such as V, mV,PRTs, etc.
3. with built in shunt resistors for mA inputs

In addition to these variants, some terminal units can have built in fuses or isolator links. For a full list of available terminal units see Table 3-1.

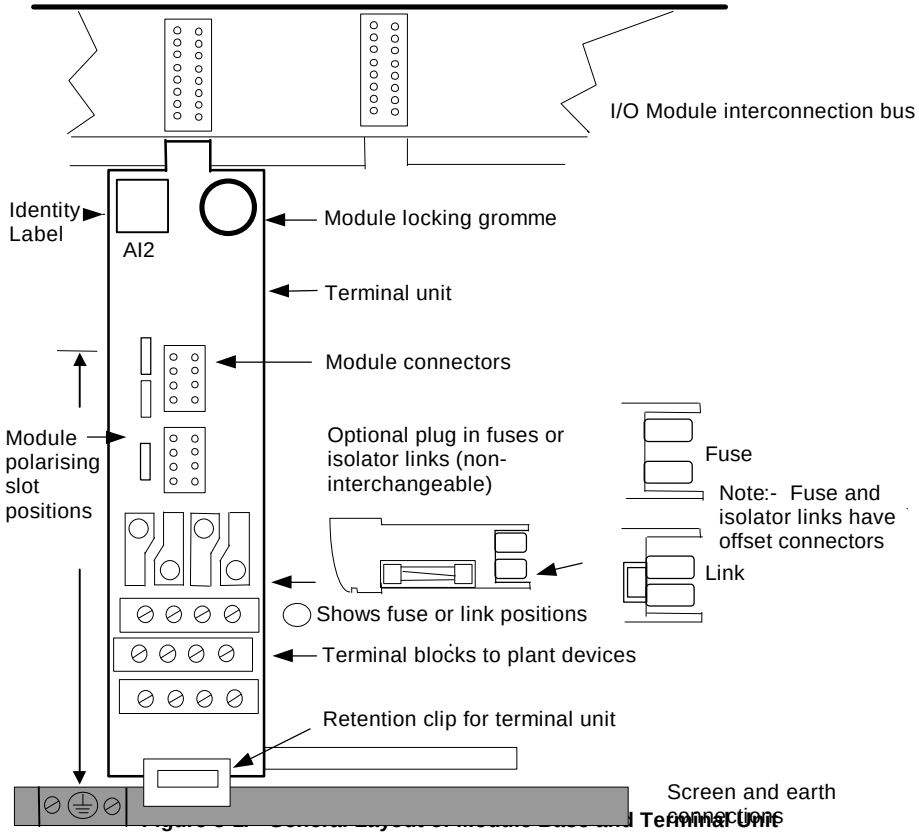


Figure 3-1 General Layout of Module Base and Terminal Unit

1.1. Isolator links and Fuses (optional)

Up to four isolator links or fuses are available as options for certain modules.
Isolator links disconnect plant connections from the module (for testing and commissioning).
The fuses supplied for the relay units are 2A (T type), 20mm to EN60127.
Fuses of a lower rating may be fitted to suit the application.
The label on the side of the fuse holder may be used to indicate the correct type of fuse.
The label on the top of the fuse holder may be used to identify or tag the protected circuit. If isolator links or fuses are not fitted then a dummy fuse cover is fitted to provide this function.

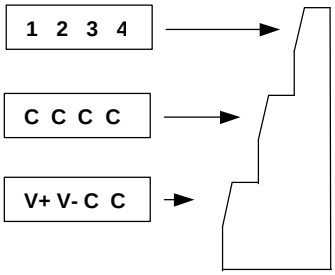
2. TYPES OF TERMINAL UNIT

Terminal Unit Name	Corresponding Module Type	Isolator link	Function
AI2	Dual channel Analogue Input, with 4 connections and common per channel	None	V, mV PRT, Hi Z, Pot
AI2 SHUNT	Dual Channel Analogue Input, with a 2Ω shunt resistor across each input	None	mA input
AI2 TC	Dual Channel Analogue Input, with CJC	None	T/C input mV
AI3	3 channel mA input	None	mA input
AI3 DCONNECT	3 individual link breakers on current i/p on each loop, 4th breaks PSU for all 3i/ps.	4 links (only 3 are used)	mA input
AO2	Dual Channel Analogue Output, for volts or mA outputs	None	V,mA output
AO2 DCONNECT	Dual Channel Analogue Output, for volts or mA outputs	2 x links 2 xblanks	V,mA output
DI4	Four Channel Digital Input, with common and external power supply terminals	None	Logic input
DI4 DCONNECT	Four Channel Digital Input, with common and external power supply terminals	4 x links	Logic input
DI8 DCONNECT	Four pairs of functionally isolated inputs, contact closure or 24V logic input	4 X links	Logic input Contact
D18	Four pairs of functionally isolated inputs, contact closure or 24V logic input	None	Logic input Contact
DO4	Four Channel Digital Output, with common and external power supply terminals	None	Logic output
DO4 DCONNECT	Four Channel Digital Output, with common and external power supply terminals	4 x links	Logic output
RLY4	Four Isolated Channels for relays	None	Relay output
RLY4 FUSE	Four Isolated channels for relays	4 x fuses	Relay output
IOC MODBUS	Specific for IOC with Modbus; two RJ45 connectors and address select switch	N/A	IOC
IOC PROFIBUS	Specific for IOC with Profibus; one 9 way connector and address select switch	N/A	IOC
IOC	Specific for IOC with Profibus; two RJ45	N/A	IOC

PROFIBUS	connectors and address select switch		

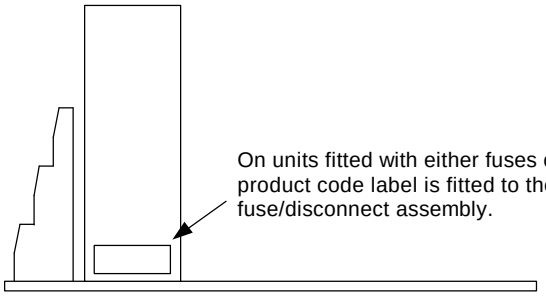
Table 3-1: Types of Terminal Unit

3. LABELS



Terminal unit labels are fitted to the sloping faces of each terminal block, as shown.

Figure 3-2: Terminal Unit Labels (Example Only)



On units fitted with either fuses or disconnects the product code label is fitted to the side of the fuse/disconnect assembly.

Figure 3-3: Product Identification Label

In the case of the AI2 DC Shunt, a label marked 'SHUNT' is fitted in the screen-printed outline of the printed circuit board.

On the IOC terminal unit the product code label is fitted in this position.

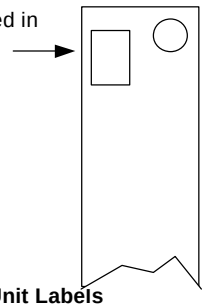


Figure 3-4: IOC and AI2 'SHUNT' Terminal Unit Labels

4. TO MOUNT TERMINAL UNITS

Notes:

1. The far left position is always reserved for theInput/Output Controller. (IOC), and is identified by the larger connector on the I/O module interconnection bus
2. All other terminal units can be fitted in any other position on the base.
3. In the event that the base is not fully populated a blank terminal unit is supplied, part number 026373. **To maintain IP20 rating it is important that this unit is mounted immediately to the right of the final module position.**

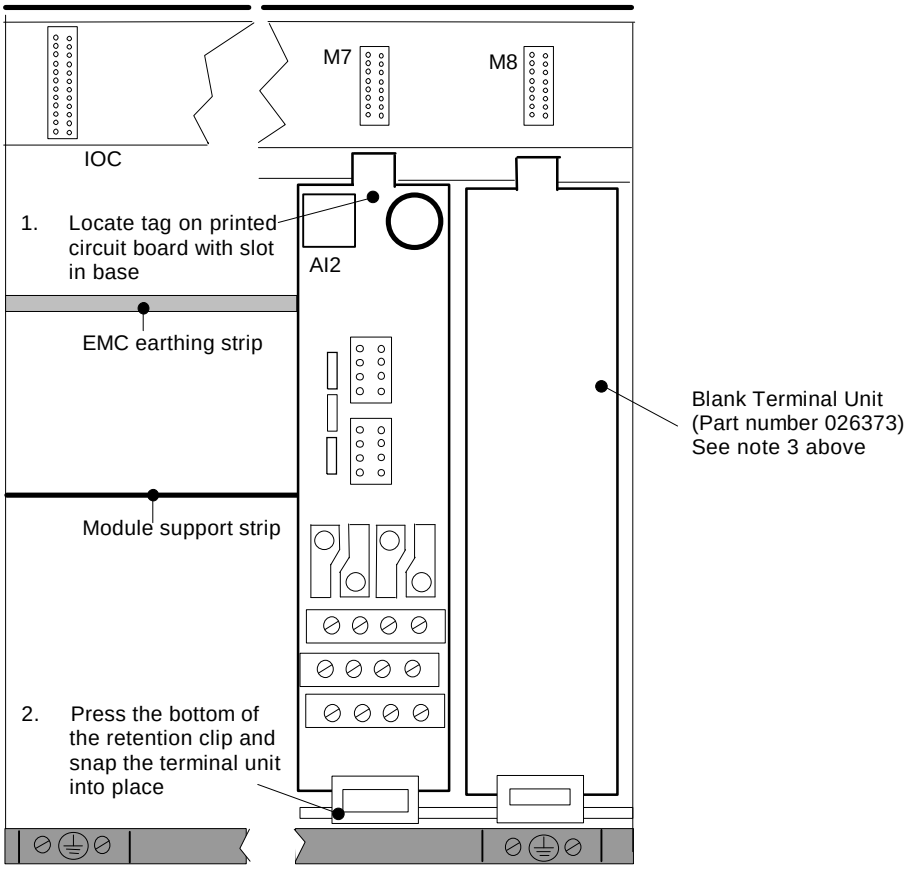


Figure 3-5: Mounting the Terminal Units

5. TO REMOVE THE TERMINAL UNIT

1. Remove any I/O module which is plugged into the terminal unit
2. Press the retention clip at the bottom of the terminal unit
3. Lift out the terminal unit

6. TO FIT MODULES

Each I/O module is supplied as a moulded plastic enclosure with the printed circuit board mounted internally. A polarising key is built into the printed circuit board which locates with a corresponding slot in the correct terminal unit. A row of LED indicators show the status of the module and are described in further detail in subsequent chapters.

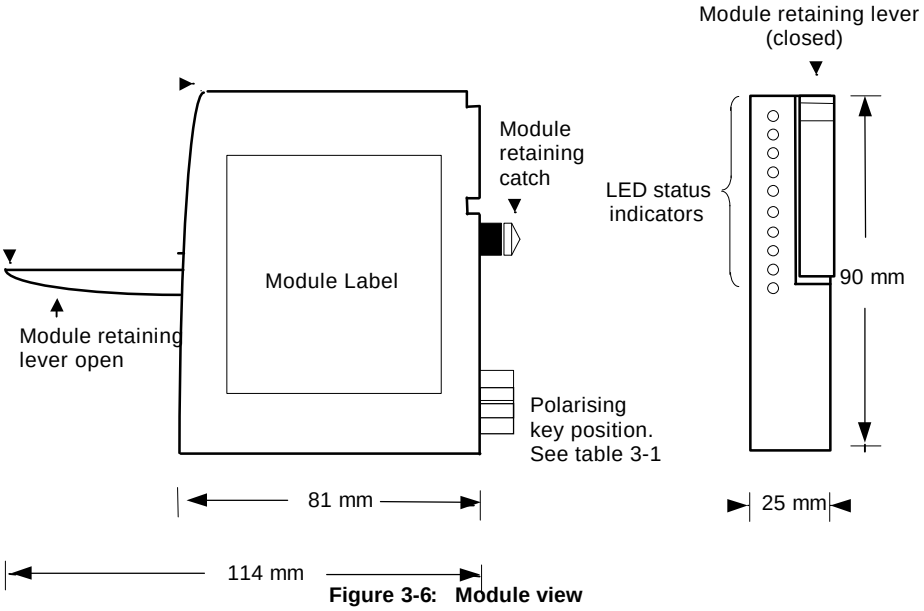


Figure 3-6: Module view

Important

1. Pull the module retaining lever forwards as shown in Figure 3-6
2. Line up the module in the correct terminal unit. The plugs on the module PCB should align with the sockets on the terminal unit and module interconnection bus. The module retaining catch should align with the corresponding hole in the terminal unit.

Note: A polarising key is provided on the module PCB which is designed to prevent a module from being inserted into the incorrect terminal unit.

3. When the module is correctly aligned, push the module retaining lever forwards to lock the module into place.

Wiring of the 2500 can take place with only the terminal units fitted or after the modules have been fitted, as preferred. Wiring is described in following chapters.

Chapter 4 Modbus I/O Controller Module 2500C/S

1. DESCRIPTION

The Input Output Controller (IOC) is the Central Processing Unit of the 2500 DIN rail controller. Every base must have an IOC module. It is identified by a label on the side of the module which gives details of model and serial number. The model number should be checked against the Ordering Code.

This module:

- Communicates with the slave modules connected to the internal IO bus, using the Module Interconnection printed circuit board mounted along the upper edge of the base.
- Communicates to external devices, such as third partyPLCs and SCADA packages, using RJ45 connection cables and, optionally, using MODBUScomms. This is sometimes referred to as the I/O network or ION. (See also section 5 of this chapter). Examples of external devices are:-
    - to connect to the operator interface unit;
    - to connect to a supervisory PC;
    - to link further slave 2500 controllers in a system;
    - to link further external devices such as discrete controllers, indicators, chart recorders, drives, etc.

- Is used for system configuration, using the front panel RJ11 socket. System configuration uses iTools, and is covered in a separate manual, part no. HA026179.

This chapter explains how connections are made to the IOC to achieve the above operation.

2. POSITION ON BASE

The IOC always occupies the slot furthest to the left hand side.

2500B/SO4		IOC	1	2	3	4											
2500B/SO8		IOC	1	2	3	4	5	6	7	8							
2500B/SO16		IOC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Figure 4-1: Module Positions

Note: The numbering used to define the physical location of each module, as shown in the above sketch, is the same as that used when configuring the modules.

3. THE MODBUS IOC TERMINAL UNIT

This unit provides:

- Terminal connections for the 24V DC supply to the system
- RJ45 comms connectors to the Operator Interface Unit and additional plant devices
- An IOC communication address switch
- A PCB mounted socket for the IOC module connections

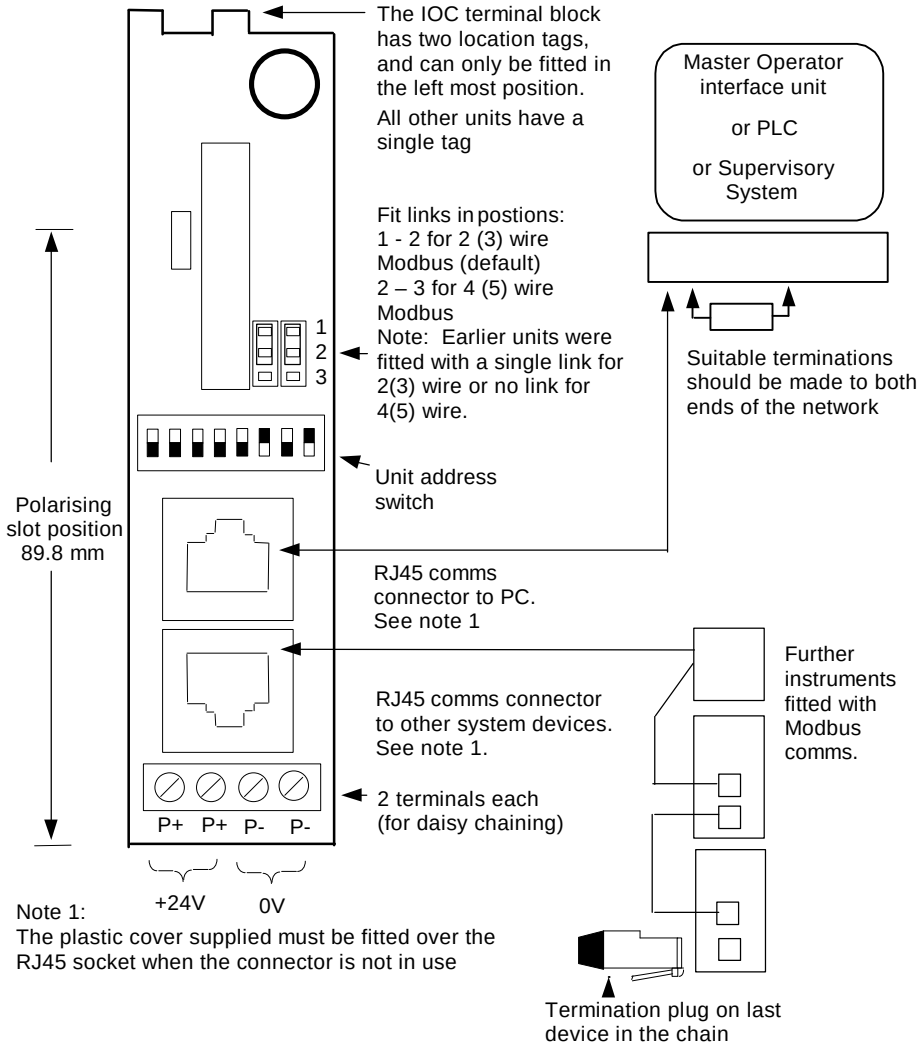


Figure 4-2: General View of the Modbus IOC Terminal Unit

4. TO CONNECT THE 24VDC POWER SUPPLY

Caution: Before proceeding with any wiring of this unit, please read Chapter 14 Wiring, and Appendix A Safety and EMC Information. It is the responsibility of the installer to ensure the safety and EMC compliance of any particular installation.

The power supply to the 2500 DIN rail controller is 24V DC. This may be derived from the 2500P power supply unit or from an alternative 24V DC source. Connections to the system are through the four way terminal block mounted on the IOC terminal unit. Unless otherwise stated power is supplied to all other modules in the system via the module interconnection bus.

A suitable power supply is the 2500P described in Chapter 13 of this manual. This is a DIN rail mounted unit which may be mounted adjacent to the 2500 base or remotely.

Alternatively, an existing power supply may be used provided that it has a voltage output of between 18.0 [1] to 28.8V DC.
To calculate the system current requirements an estimate of current ratings for each module is given in the Technical Specification, Appendix A.

The IOC terminal unit contains a fuse and a reverse biased power diode. If the power is wired reverse polarity the fuse will blow and protect the complete 2500 base from damage. This fuse is not user replaceable. The unit should be returned to the factory for replacement.

Note 1:- 18V is the absolute lower limit. The use of an18V power supply with any appreciable voltage drop may cause unpredictable or out of specification operation.

5. TO CONNECT AN OPERATOR INTERFACE UNIT

Two parallel connected RJ45 communications sockets are provided. The two sockets, therefore, have the same function.
One socket is used to connect the 2500 to an Operator Interface Unit, such as type T2900 OR to a conventional SCADA system. This will also allow configuration via iTools.
The second socket provides a convenient way to connect additional 2500 instruments onto the system, OR to terminate the last instrument in the chain using a MODBUS or PROFIBUS terminator, see 4.1. The terminator may also be used to terminate the 2900 Operator Interface Unit

The above devices are connected using RJ45 interconnection cables. These are available from your supplier in two lengths. Longer cables are available from a number of sources worldwide.

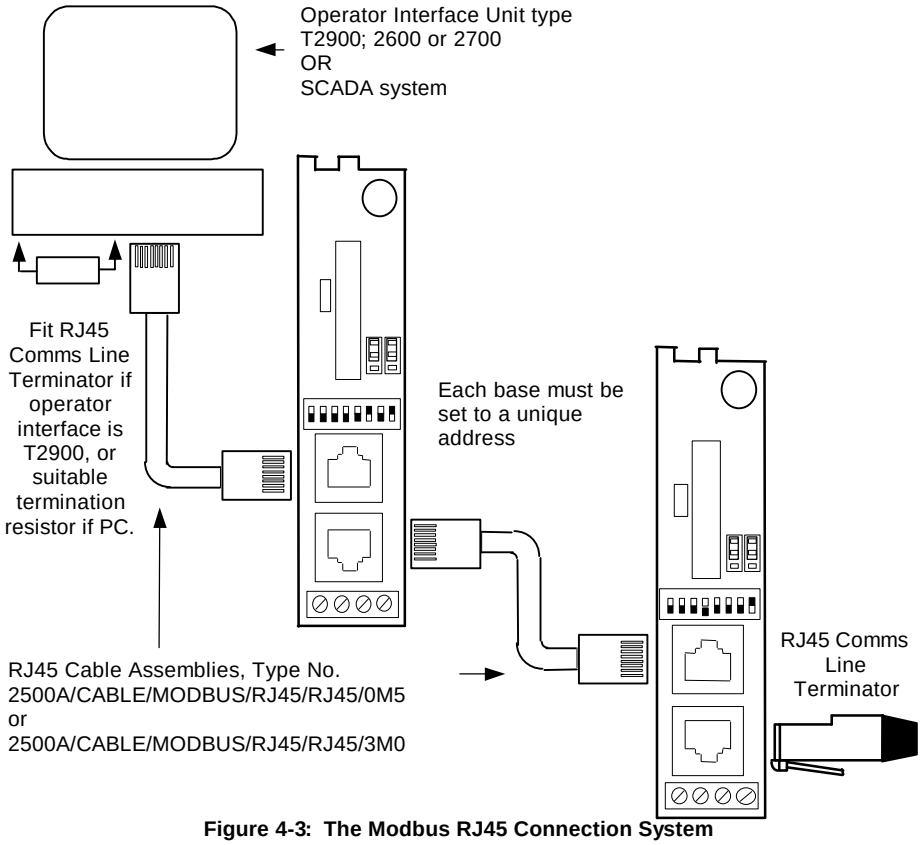


Figure 4-3: The Modbus RJ45 Connection System

5.1 The RJ45 Communications Line Terminator

The communications line must be terminated using the appropriate load resistors. To minimise on site wiring and to provide the correct resistor values, two versions of 'Terminator' are available from your supplier. These are:-
Part no 2500A/TERM/MODBUS/RJ45 for Modbus communications systems
or
Part no 2500A/TERM/PROFIBUS/RJ45 for Profibus communications systems

The terminator is plugged into the last RJ45 socket in the chain, as shown in Figure 4-3. It may also be used to terminate the T2900. If the operator interface is a PC or PLC this should be terminated in accordance using the appropriate load resistors.

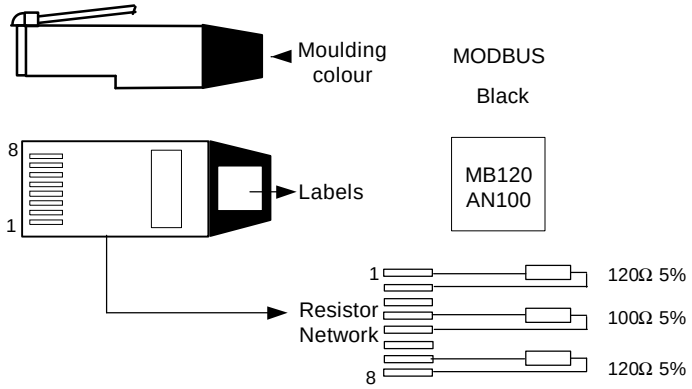


Figure 4-4:- The Modbus RJ45 Terminator

Connections to the RJ45 pins

RJ45 pin	Colour	EIA 485	2 wire	4 wire
1	Orange / White	B	D-	TX-
2	Orange	A	D+	TX+
3	Green / White	Gnd	Gnd	Gnd
4	Blue			
5	Blue / White			
6	Green	Gnd	Gnd	Gnd
7	Brown / White	B		RX-
8	Brown	A		RX+
Screen			-	-

NOTE: Blue and Blue/White Wires are not used.
WARNING CABLE COLOURS MAY CHANGE!

Table 4-1: Connections to the Modbus RJ45 Sockets

6. THE CONFIGURATION PORT

An RS232 configuration port is provided on the front of the IOC, via a RJ11 socket. When the IOC is powered up with a PC connected to the RJ11 configuration port, it will start in the configuration mode. Alternatively, the IOC is put into configuration mode by setting a command from the configuration software. This is further described in the 'iTools' manual.

Note:- Exiting configuration mode must be done using iTools or through communications.

The IOC will not control the process if:
1. It is in configuration mode or standby mode
2. A network watchdog time-out occurs (if configured)
3. It is removed from the system

Under these conditions all modules will enter a 'safe' state. Generally this defaults as digital output modules will go to an OFF state, and analogue output modules will go to a minimum output state (generally 0V or 4mA).

Connections to this socket are given below:

Pin connections RJ11 into IOC	Pin connections on 9 way D-type into PC	Pin connections on 25 way D-type into PC
6 no connection	-	
5 RX	3 TX	2 TX
4 TX	2 RX	3 RX
3 0V	5 0V	7 0V
2 no connection		
1 24V (in)		
Screen	Screen	1 Screen

Table 4-2: Connections to the RJ11 Sockets

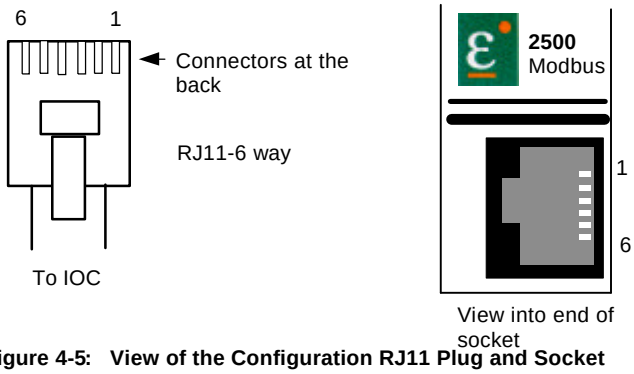


Figure 4-5: View of the Configuration RJ11 Plug and Socket

6.1 Configuration Connections

It is recommended that the connections between the PC and the IOC use a standard RJ11 to 9 pin cable assembly available from your supplier.
This cable plugs directly into the IOC and the PC as shown below.
Using this cable with the appropriate power supply allows the IOC to be programmed remote from the system providing desk top configuration.

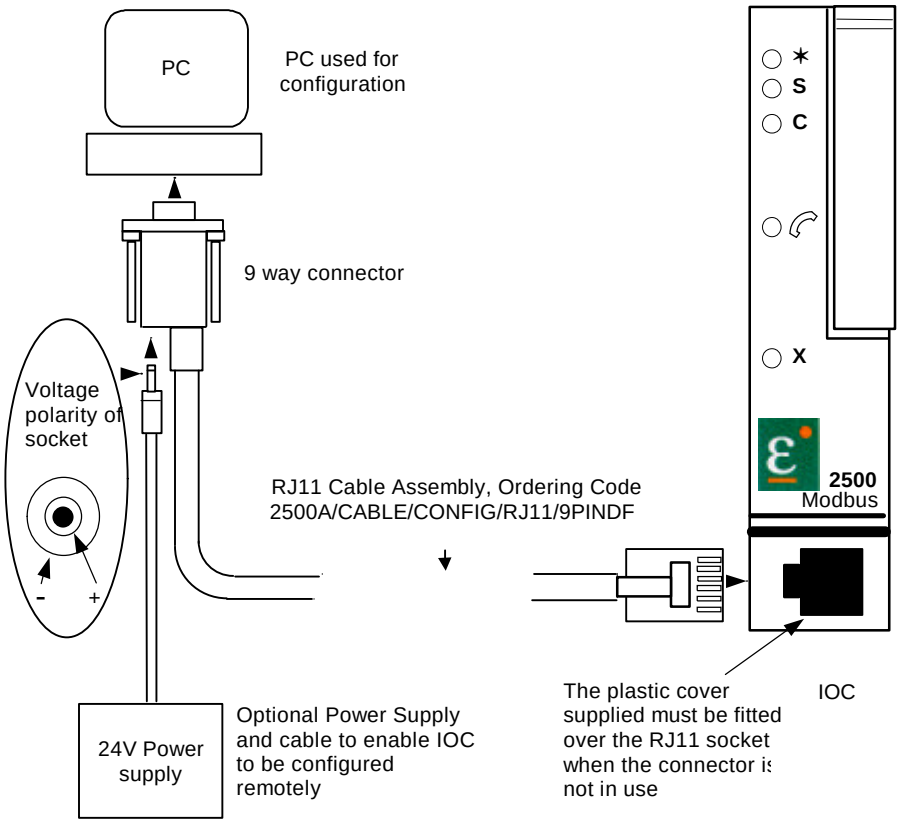


Figure 4-6: Connection Between IOC and PC using RJ11 Cable Assembly

Note:- The standard RJ45 socket can also be used to configure the IOC using RS485 communications, but the address is that set by the address switch. If the IOC is configured via the RJ11 system the unit will appear at BOTH address 255 AND the switch address. Address switch set to zero is a special case in which the controller is 'soft' configured, i.e. configured and stored in non-volatile memory.

7. TO SET THE ADDRESS SWITCH

The unit address and parity is selected by the dual in line (DIL) switch mounted on the terminal unit.
Sixty-three Modbus addresses can be set in binary using positions 1 to 6. Parity has three possible states - none/even/odd - thus using positions 7 & 8. The diagram below shows the setting of the switch:
If the address switch is set to all OFF, then the IOC expects to have its address set by the configuration tools. This is further described in the iTools manual, part no HA026179. For addresses between 65 and 255 the address switch must be set all OFF and the address set in iTools.

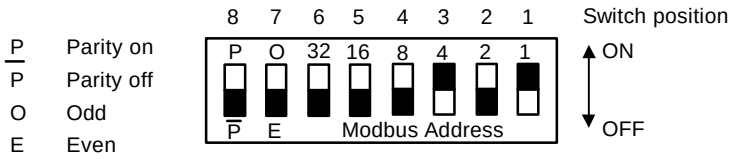


Figure 4-7: The Modbus Address Switch Set To -Unit Address 05, Parity off

8. BAUD RATE

Baud rate is set using the configuration software, see iTools Manual part no.HA026179. For information, however, the table below shows the rates that are supported.

Baud rate	Software version			
	V1.X	V2.X		
1200				
2400				
4800				
9600	✓	✓		
19,200	✓	✓		
38,400				

Table 4-3: Baud Rate

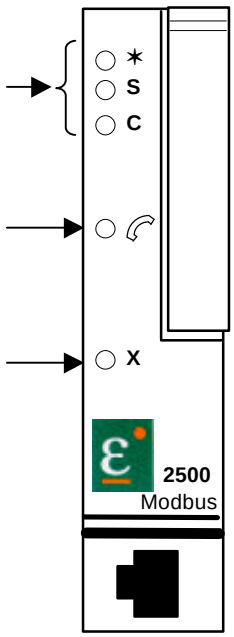
9. STATUS INDICATION

Five LED indicators show the status of the module as follows:

LED	Colour	ON	ALL OFF
✶	Green	Normal operation	Self test failed on power up
S	Yellow	Standby (See Note 1)	
C	Yellow	Configuration	

LED	Colour	ON	OFF
✆	Yellow	IO network or configuration port communicating	

LED	Colour	ON	OFF
X	Red	IOC reset or Module missing, faulty or wrong type or non-volatile memory failure	Normal operation
		Flashing	
X	Red	Power on self test failed	



Note 1:- Indication of standby condition using this LED is not implemented in software version 1.01

Figure 4-8: IOC Status Indication

10. INITIALISATION

The IOC goes through an initialisation sequence when power is applied, and will start in one of three modes.

1. Operating Mode. This is the usual start up mode. The I/O does not have to be correctly configured for the IOC to begin running.
2. Standby mode. This is intended to be used for strategy engine controlled start-up. A config mode parameter will provide the option to 'Start-up in Standby'.
3. Configuration Mode. When the IOC is powered up with a PC connected to the RJ11 config port, it will start in the config mode. To guarantee that this happens the PC should not be communicating at the time of powering up the IOC.

11. POWER ON SELF TEST

When the unit is switched on or when the module is in reset mode, a self test sequence takes place. During this self test period, the LEDs follow a sequence lasting approximately 5-10 seconds. The sequence is shown in Figure 4-9 and shows the state of the LEDs for both pass and fail conditions.

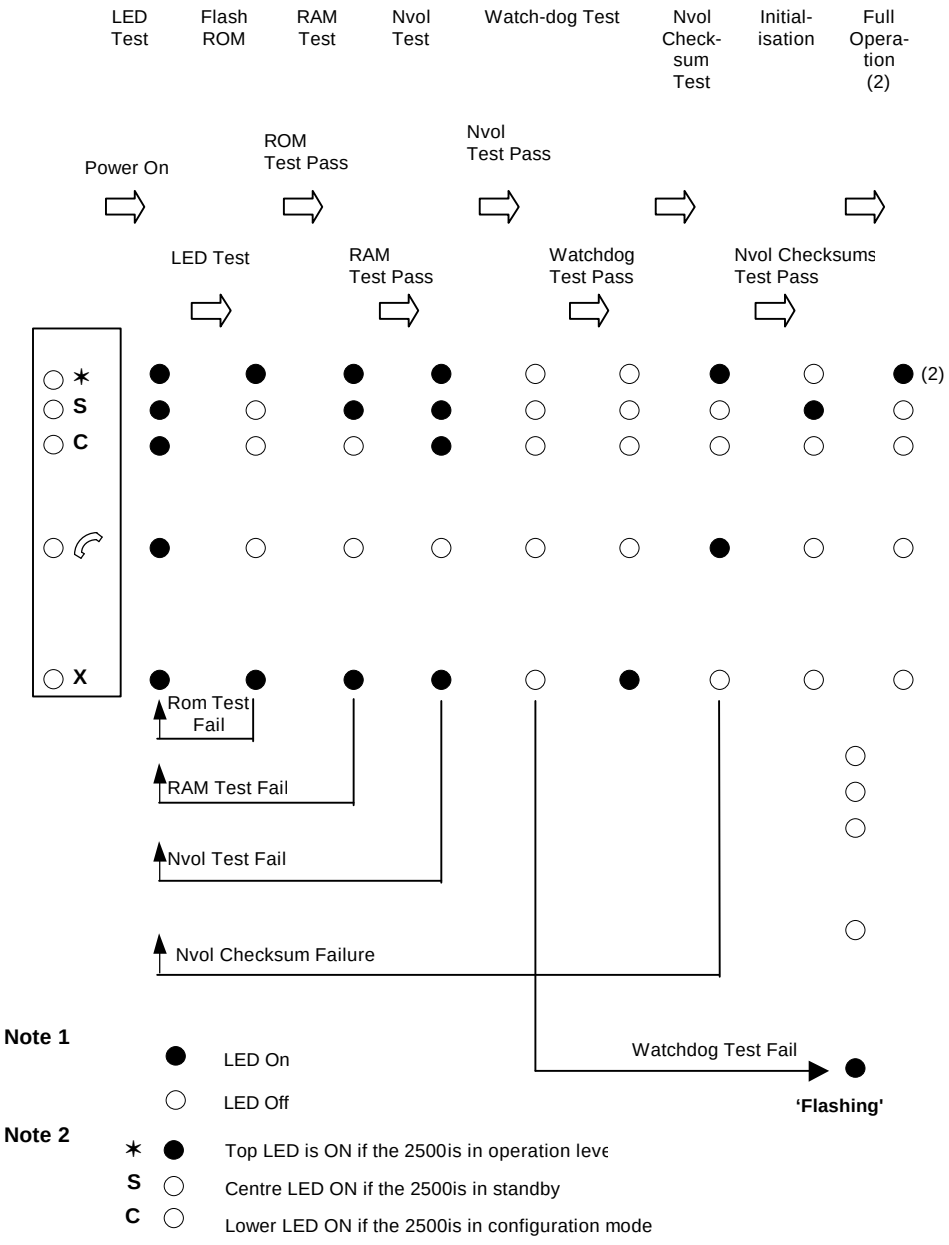


Figure 4-9: Power On Self Test - LED Status Indication

12. MODES OF OPERATION

12.1 STANDBY MODE

Indication that the IOC is in standby mode is via a yellow LED on the front of the module, (See 'Status Indication' page 4-9). The behaviour in standby mode is asfollows :

1. The Inputs continue to be scanned and linearised.
2. Outputs go to their 'off' values, e.g. Digitals - Off, Analogues - to their minimum settings or low limits (not necessarily zero output).
3. Deviation Alarms are disabled.i.e. Full scale alarms will continue to function.
4. The Alarm Blocking feature is re-initialised on **leaving** standby mode for Deviation alarms only. i.e. Full scale alarms will not be blocked.
5. The outputs from the deviation Alarms are disabled.
6. The status LED's on the front of the IOS will indicate that the IOS is not operating the plant in standby mode
7. Standby mode will be indicated overcomms by setting the Instrument Mode parameter to 1 (one) i.e.

Operating Mode	0
Standby Mode	1
Configuration Mode	2

8. The transfer from standby to operating mode does not require an instrument reset.
9. Control outputs behave as follows:
    - The PID output set to 0.0%.
    - The PID will bumpless transfer on changing to operating mode
    - The analogue output ranges will still operate.i.e. A 4-20mA output will be clipped to 4 mA.

12.2 Configuration Mode

The behaviour in Configuration mode is the same as in Standby mode with the additional ability to re-configure the 2500.
Configuration of the IOC uses the configuration software, 'iTools'. A description of this configuration tool is given in the iTools handbook, part number HA026179. Configuration mode can be entered as follows:
When the IOC detects the presence of a PC connected to the RJ11 socket during power up.
By setting the 'Instrument Mode' to 2 over the communications link.
Configuration mode is indicated by a yellow LED on the front of the module (See 'Status Indication' page 4-9).
Notes:

1. If an I/O slot is not populated or the IOC is stand alone (i.e. not connected to an I/O base at all) then a slot may be configured for any function.
2. It is possible to exit configuration mode without the configured slot functions matching the actual modules.
3. Where a slot function has been previously been defined in CONFIG mode, modules may be removed and replaced *outside* CONFIG mode.

If the IOC has been put into configuration mode over the communications link, it will stay in configuration unless it is explicitly set into operating mode.

Chapter 5 PROFIBUS I/O Controller Module 2500C/S

1. DESCRIPTION

The Input Output Controller (IOC) is the Central Processing Unit of the 2500 DIN rail controller. Every base must have an IOC module. It is identified by a label on the side of the module, which gives details of model and serial number. The model number should be checked against the Ordering Code.
The module can be fitted into one of two terminal units. These are the 'Profibus IOC Terminal Unit', described in section 3, and the 'RJ45 IOC Terminal Unit', described in section 4.

This module:

- Communicates with the slave modules connected to the internal IO bus, using the Module Interconnection printed circuit board mounted along the upper edge of the base.
- Communicates to external devices, such as third partyPLCs and SCADA packages, using a 9 PIN D connector (or RJ45 connectors) and PROFIBUS DP communications. This is sometimes referred to as the I/O network or ION. Examples of external devices are:-
    - to connect to a supervisory PC or PLC;
    - to link further slave 2500 controllers in a system;
    - to add further external slave devices such as discrete controllers, indicators, chart recorders, drives, etc.
- Is used for system configuration, using the front panel RJ11 socket. System configuration uses iTools, and is covered in a separate manual, part no. HA026179.

This chapter explains how connections are made to the IOC to achieve the above operation.

2. POSITION ON BASE

The IOC is always in the slot furthest to the left.

2500B/SO4		IOC	1	2	3	4												
2500B/SO8		IOC	1	2	3	4	5	6	7	8								
2500B/SO16		IOC	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Figure 5-1: Module Positions

Note: The numbering used to define the physical location of each module, as shown in the above sketch, is the same as that used when configuring the modules.

3. THE PROFIBUS IOC TERMINAL UNIT

The Profibus IOC terminal unit has a single 9 Pin D socket commonly used with PROFIBUS DP. The unit provides:

- Terminal connections for the 24V DC supply to the system
- A 9 Pin D comms connector to the PROFIBUS master and additional slave devices
- An IOC communication address switch
- A PCB mounted socket for the IOC module connections

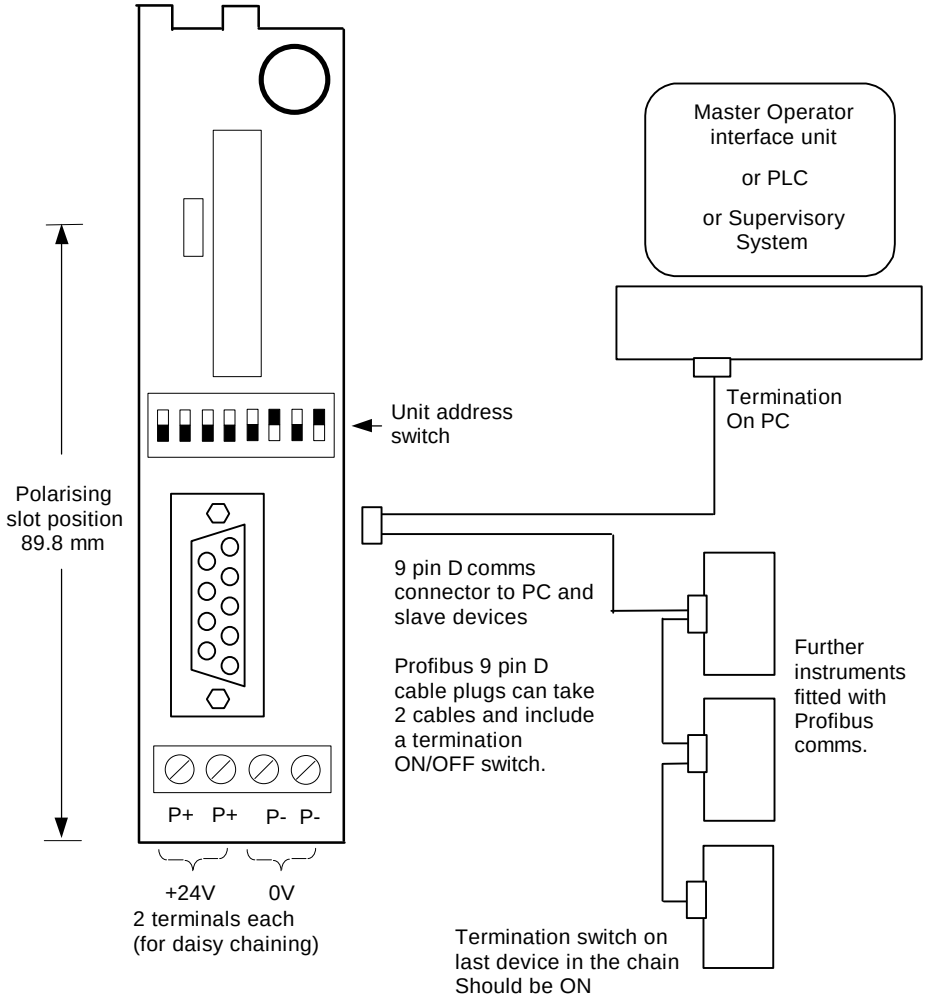


Figure 5-2: General View of the 9 pin D Profibus IOC Terminal Unit

4. TO CONNECT AN IOC IN A PROFIBUS DP NETWORK.

Each slave must have a unique address, set on the IOC terminal unit. The communications cable should be run in a single link running from device to device, and not in a 'star' arrangement. The first and last device in the link must have a termination load.

4.1 9 Pin Connectors

For 9 pin D connectors standard Profibus cables should be used. These cables have special headers on the 9 pin D male connector which allow one or two cables to be connected into them and have a small termination load built in with an ON/OFF switch, which is set to ON at the two ends of the link.
The Profibus standard states that two types of cable, 'Line A' and 'Line B', may be used. The termination details for these two types of cable are shown in Figure 5-3.

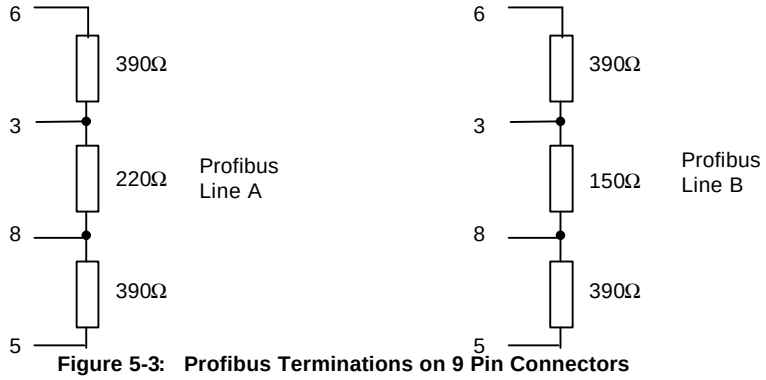


Figure 5-3: Profibus Terminations on 9 Pin Connectors

Profibus 9 Pin D Connections

Pin No.	RS 485 Ref	Signal Name	Meaning
1		Shield *	Shield, Protective ground resp.
2		Not used in 2500	
3	B/B	RxD/TxD-P	Receive/Transmit – Data - P
4		Not used in 2500	
5	C/C	DGND	Data ground
6		VP [1]	Voltage – Plus
7		Not used in 2500	
8	A/A	RxD/TxD-N	Receive/Transmit – Data – N
9		Not used in 2500	
* Signals are optional For further information on recommended wiring, see EMC Installation Guide Part No. HA025464.			

Table 5-1: Profibus 9 Pin Connections

5. THE RJ45 IOC TERMINAL UNIT.

It is also possible to use the 2500 with the RJ45 connector system but it is not fully compliant with the Profibus standard. This system is intended for use with other products in the 2500 range.

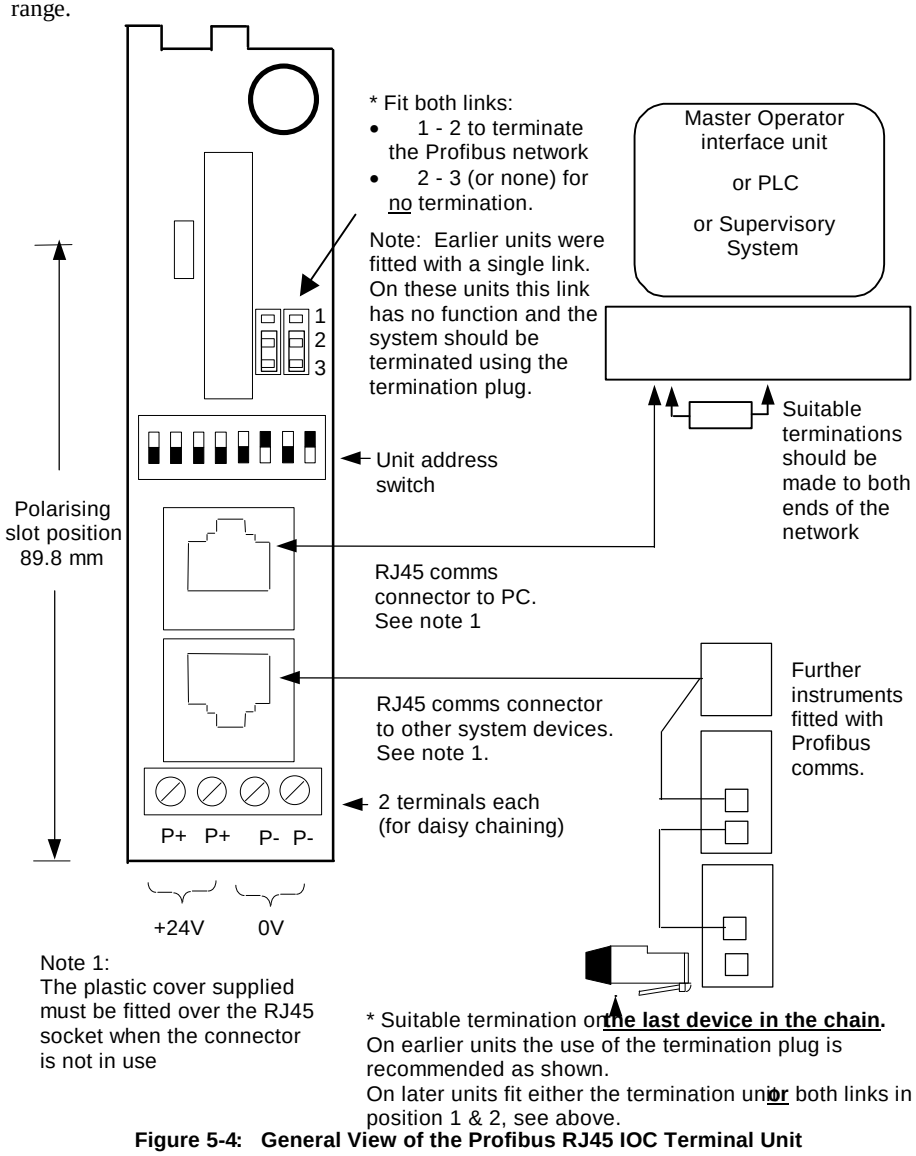


Figure 5-4: General View of the Profibus RJ45 IOC Terminal Unit

6. TO CONNECT AN IOC IN A PROFIBUS DP NETWORK.

Each slave must have a unique address, set on the IOC terminal unit. The communications cable should be run in a single link running from device to device, and not in a 'star' arrangement. The first and last device in the link must have a termination load.

6.1 RJ45 Connector System

If the RJ45 connector system is used a standard cable is available. Similarly, to provide suitable terminations for the system a standard part is available to terminate the system.

The terminator is plugged into the **last** RJ45 socket in the chain, as shown in Figure 5-4. If the operator interface is a T2900 a second terminator should be plugged into this. If the operator unit is a PC or PLC this should be terminated using the appropriate load resistors.

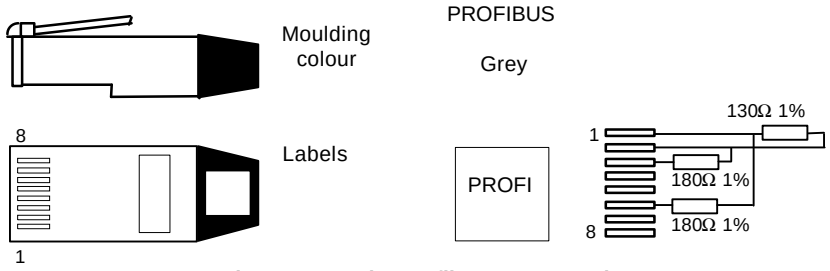


Figure 5-5:- The Profibus RJ45 Terminator

RJ45 Pin Connections

RJ45 pin	Definition	Colour	Profibus
1	Line most NEGATIVE when UART is low (0v/space/start-bit)	Orange / White	D-
2	Line most POSITIVE when UART is low (0v/space/start-bit)	Orange	D+
3	Ground	Green / White	Gnd
4	-	Blue	
5	-	Blue / White	
6	Ground	Green	+5V
7	-	Brown / White	
8	-	Brown	
Screen	Chassis		-

Warning: cable colours may change!

Table 5-2: Connections to the Profibus RJ45 Sockets

7. TO CONNECT THE 24VDC POWER SUPPLY

Caution: Before proceeding with any wiring of this unit, please read Chapter 11 Wiring, and Appendix A Safety and EMC Information. It is the responsibility of the installer to ensure the safety and EMC compliance of any particular installation.

The power supply to the 2500 DIN rail controller is 24V DC. This may be derived from the 2500P power supply unit or from an alternative 24V DC source. Connections to the system are through the four way terminal block mounted on the IOC terminal unit. Unless otherwise stated power is supplied to all other modules in the system via the module interconnection bus.

A suitable power supply is the 2500P described in Chapter 13 of this manual. This is a DIN rail mounted unit which may be mounted adjacent to the 2500 base or remotely.

Alternatively, an existing power supply may be used provided that it has a voltage output of between 18.0[1] to 28.8V DC.
To calculate the system current requirements an estimate of current ratings for each module is given in Chapter 13, Section 1.

The IOC terminal unit contains a fuse and a reverse biased power diode. If the power is wired reverse polarity the fuse will blow and protect the complete 2500 base from damage. This fuse is not user replaceable. The unit should be returned to the factory for replacement.

Note 1:- 18V is the absolute lower limit. The use of an18V power supply with any appreciable voltage drop may cause unpredictable or out of specification operation.

8. THE CONFIGURATION PORT

An RS232 configuration port is provided on the front of the IOC, via a RJ11 socket. When the IOC is powered up with a PC connected to the RJ11 configuration port, it will start in the configuration mode. Alternatively, the IOC is put into configuration mode by setting a command from the configuration software. This is further described in the 'iTools' manual.

Note:- Exiting configuration mode must be done using iTools or through communications.

The IOC will not control the process if:
1. It is in configuration mode or standby mode
2. A network watchdog time-out occurs (if configured)
3. It is removed from the system

Under these conditions all modules will enter a 'safe' state. Generally this defaults as digital output modules will go to an OFF state, and analogue output modules will go to a minimum output state (generally 0V or 4mA).

Connections to this socket are given below:

Pin connections RJ11 into IOC	Pin connections on 9 way D-type into PC	Pin connections on 25 way D-type into PC
6 no connection	-	
5 RX	3 TX	2 TX
4 TX	2 RX	3 RX
3 0V	5 0V	7 0V
2 no connection		
1 24V (in)		
Screen	Screen	1 Screen

Table 5-3: Connections to the RJ11 Sockets

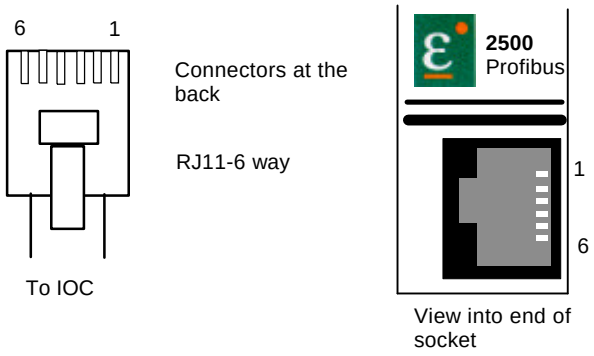


Figure 5-6: View of the RJ11 Plug and Socket

8.1 Configuration Connections

It is recommended that the connections between the PC and the IOC use a standard RJ11 to 9 pin cable assembly available from your supplier.
This cable plugs directly into the IOC and the PC as shown below.
Using this cable with the appropriate power supply allows the IOC to be programmed remotely from the system, permitting desk top configuration.

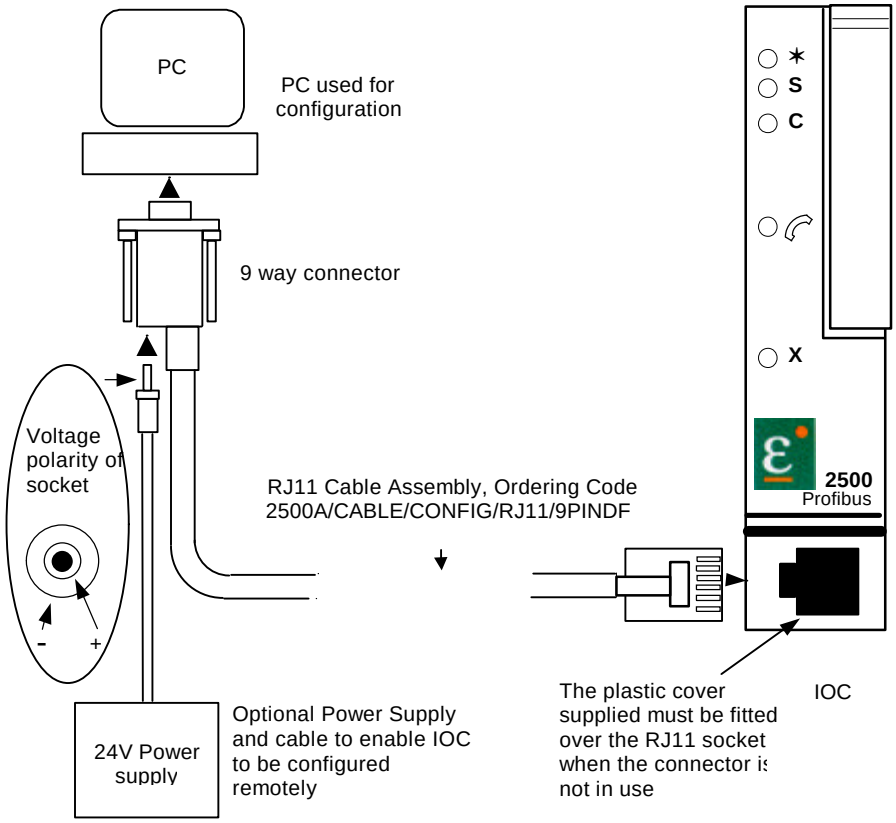
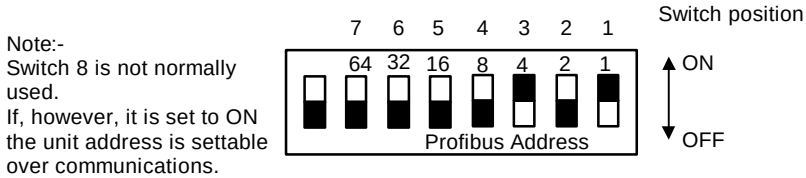


Figure 5-7: Connection Between IOC and PC using RJ11 Cable Assembly

Note:- The Profibus communications interface does not operate whilst the configuration port is connected.

9. TO SET THE ADDRESS SWITCH

The unit address and parity is selected by the dual in line (DIL) switch mounted on the terminal unit.
The switch gives 127 addresses from 1 to 127. Address 0 is invalid.



Note:-
Switch 8 is not normally used.
If, however, it is set to ON the unit address is settable over communications.

Figure 5-8: The Profibus Address switch

10. BAUD RATE

Baud rate is set by the Profibus Masterwhich is able to detect the fastest Baud at which all slaves can operate. The Profibus IOC is capable of operating at 12Mbaud.

11. STATUS INDICATION

Five LED indicators show the status of the module as follows:

LED	Colour	ON	ALL OFF
✶ **S** **C**	Green Yellow Yellow	Normal operation Standby (See Note 1) Configuration	Self test failed on power up

LED	Colour	ON	OFF
✆	Yellow	IO network or configuration port communicating	

LED	Colour	ON	OFF
X	Red	IOC reset or Module missing, faulty or wrong type or non-volatile memory failure.	Normal operation
		Flashing	
X	Red	Power on self test failed	

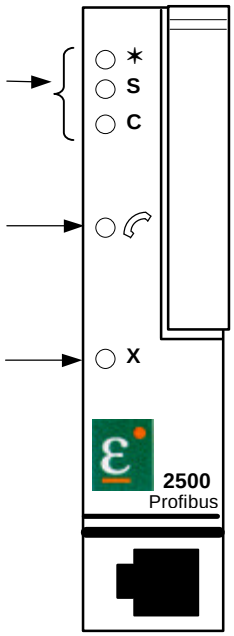


Figure 5-9: IOC Status Indication

12. INITIALISATION

The IOC goes through an initialisation sequence when power is applied, and will start in one of three modes.

1. Operating Mode. This is the usual start up mode. The I/O does not have to be correctly configured for the IOC to begin running.
2. Standby mode. This is intended to be used for strategy engine controlled start-up. A config mode parameter will provide the option to 'Start-up in Standby'.
3. Configuration Mode. When the IOC is powered up with a PC connected to the RJ11 config port, it will start in the config mode. To guarantee that this happens the PC should not be communicating at the time of powering up the IOC.

13. POWER ON SELF TEST

When the unit is switched on or when the module is in reset mode, a self test sequence takes place. During this self test period, the LEDs follow a sequence lasting approximately 5 to 10 seconds. The sequence is shown in Figure 4-9 (Chapter 4) and shows the state of the LEDs for both pass and fail conditions.

14. MODES OF OPERATION

14.1 Standby Mode

Indication that the IOC is in standby mode is via a yellow LED on the front of the module, (See 'Status Indication' page 5-10). The behaviour in Configuration mode is the same as in Standby mode with the addition of the ability to re-configure the 2500.

The behaviour of the instrument in standby mode is as follows-

1. The Inputs continue to be scanned and linearised.
2. Outputs go to their 'off' values, e.g. Digitals - Off, Analogues - to their minimum settings or low limits (not necessarily zero output).
3. Deviation Alarms are disabled i.e. Full scale alarms will continue to function.
4. The Alarm Blocking feature is re-initialised on **leaving** standby mode for Deviation alarms only. i.e. Full scale alarms will not be blocked.
5. The outputs from the deviation Alarms are disabled
6. The status LED's on the front of the IOS will indicate that the IOS is not controlling the plant in standby mode
7. Standby mode will be indicated overcomms by setting the Instrument Mode parameter to 1 (one) i.e.

Operating Mode	0
Standby Mode	1
Configuration Mode	2

8. The transfer from standby to operating mode does not require an instrument reset.
9. Control outputs behave as follows:
    - The PID output set to 0.0%.
    - The PID will bumpless transfer on changing to operating mode
    - The analogue output ranges will still operate.i.e. A 4-20mA output will be clipped to 4 mA.

14.2 Configuration Mode

The behaviour in Configuration mode is the same as in Standby mode with the addition of the ability to re-configure the 2500.
Configuration of the IOC uses the configuration software, 'iTools'. A description of this configuration tool is given in the iTools handbook, part number HA026179. Configuration mode can be entered as follows:
When the IOC detects the presence of a PC connected to the RJ11 socket on the front of the module at power up.
By setting the 'Instrument Mode' to 2 over the communications link.
Configuration mode is indicated by a yellow LED on the front of the module (See 'Status Indication' page 5-10).
Notes:
1. If an I/O slot is not populated or the IOC is stand alone (i.e. not connected to an I/O base at all) then a slot may be configured for any function.
2. It is possible to exit configuration mode without the configured slot functions matching the actual modules.
3. Where a slot function has been previously been defined in CONFIG mode, modules may be removed and replaced *outside* CONFIG mode.

If the IOC has been put into configuration mode over the communications link, it will stay in configuration unless it is explicitly set into operating mode.

Chapter 6 Two Channel Analogue Input Module 2500M/AI2

1. DESCRIPTION

The analogue input module is used to measure analogue signals from a range of plant sensors. These include :

- Thermocouples
- Platinum Resistance Thermometers (2 & 3 wire)
- Voltage ±10V and ±100mV
- High Impedance (Zirconia)
- Current ±20mA.

The analogue input module consists of two input channels, isolated from each other and isolated from the system electronics, (see specification Appendix A for further details).

For thermocouple inputs Cold Junction Temperature is measured by a RTD sensor fitted to the terminal unit.

2. MODULE IDENTIFICATION

The module may be identified by means of labels on the side and front of the case. The side label includes details of the product code and serial number.

3. CONFIGURATION

The configuration of the Analogue Input Module is stored in the IOC. It can be configured or modified using the PC based configuration station connected to the configuration port in the IOC. This is covered by the 'iTools Handbook' part number HA026179.

Typical parameters which can be configured or changed include:

- Input Type
- Range
- Input Filter Time Constant
- Sensor Break Action
- User Calibration. This allows you to offset the 'permanent' factory calibration to :

a) Calibrate the controller to your reference standards
b) Match the calibration of the controller to that of a particular transducer or sensor
c) Calibrate the controller to suit the characteristics of a particular installation

4. LOCATION

The module may be located, with its matching terminal unit, in any position on the base, other than the left hand position reserved for the IOC.

5. TERMINAL CONNECTIONS

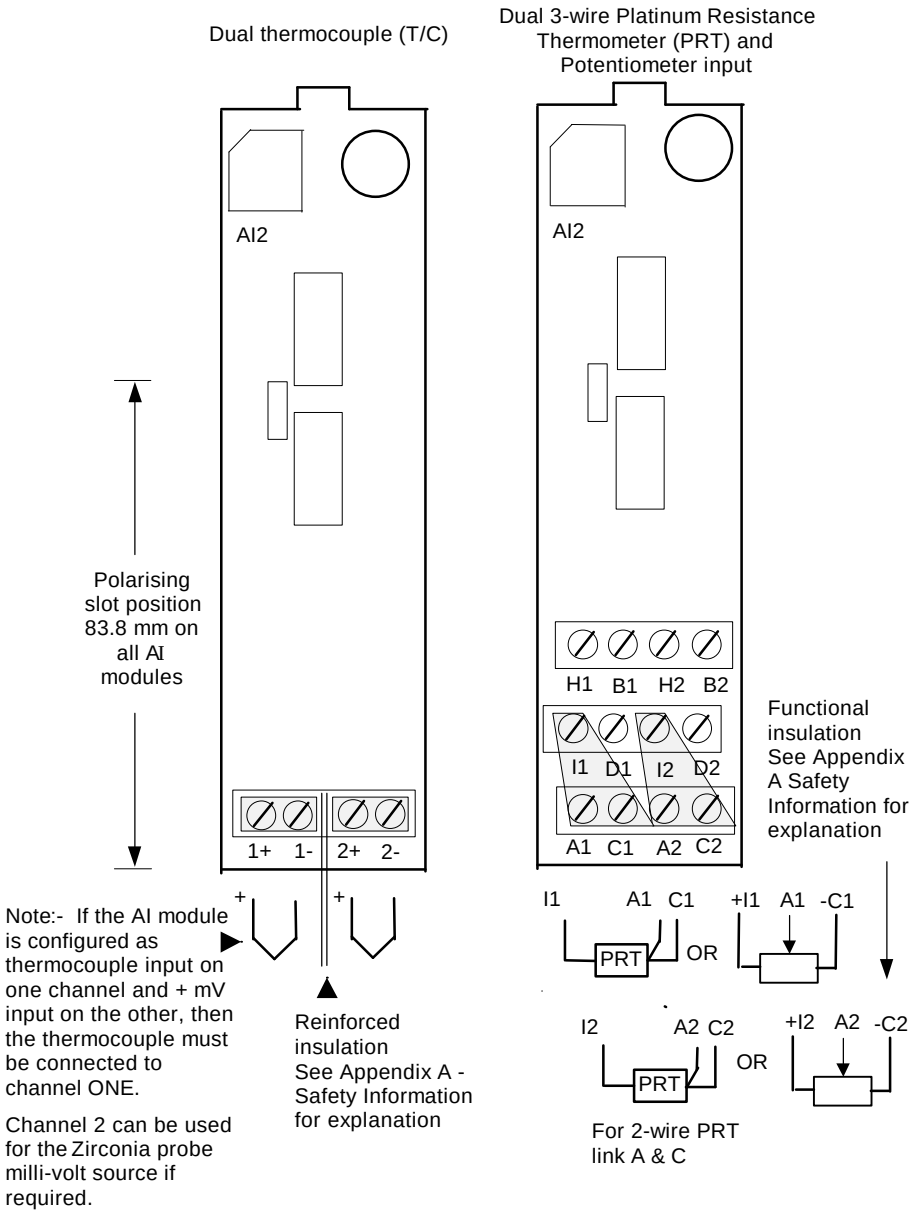
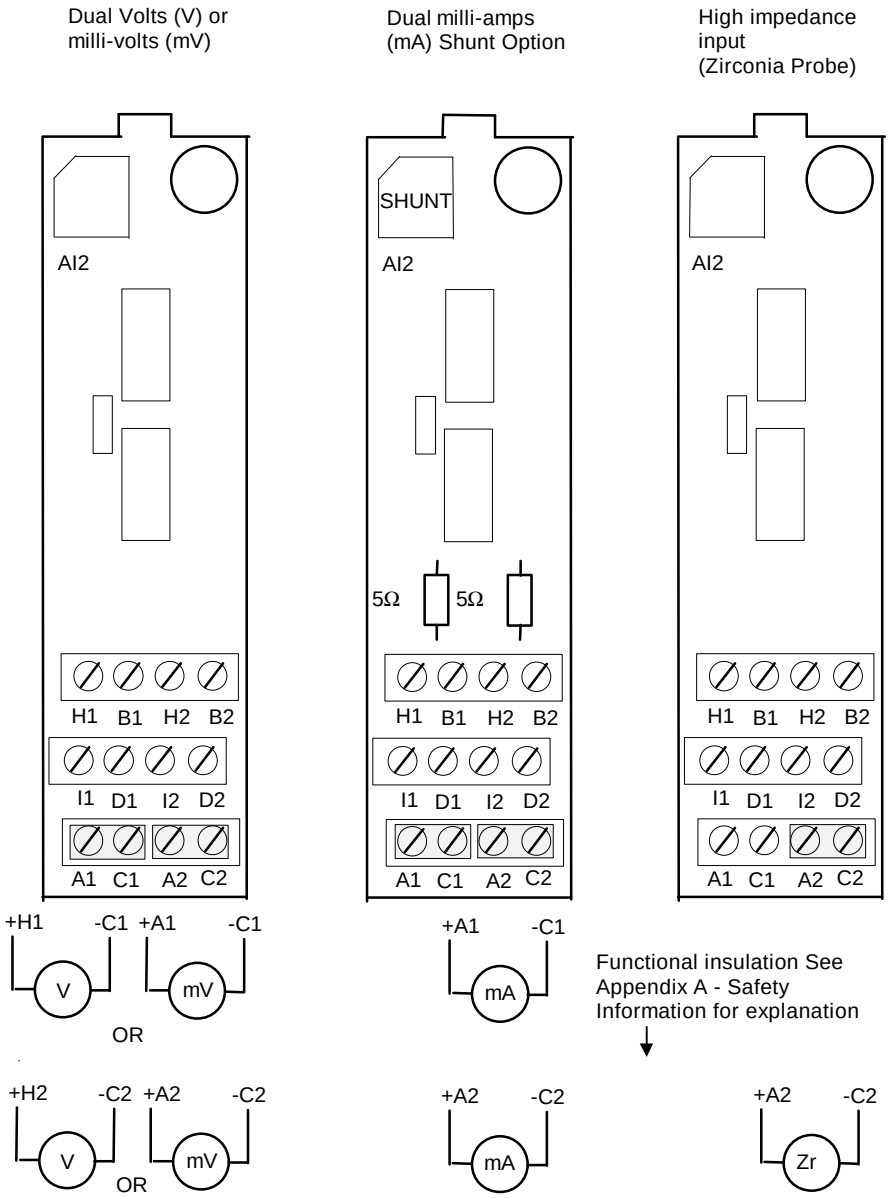


Figure 6-1a: Dual Analogue Input Terminal Connections



Notes:-
The shunt option has 5Ω resistors mounted on the rear of the PCB.
The mV option may also be used for mA inputs if fitted with suitable 5Ω external burden resistors. It permits a 0-20mA input to provide a full scale range of 0-100mV.

Figure 6-1b: Dual Analogue Input Terminal Connections

6. ANALOGUE INPUT EQUIVALENT CIRCUITS

The equivalent circuits below show details of analogue inputs, in particular sensor break circuits.

Thermocouple Input

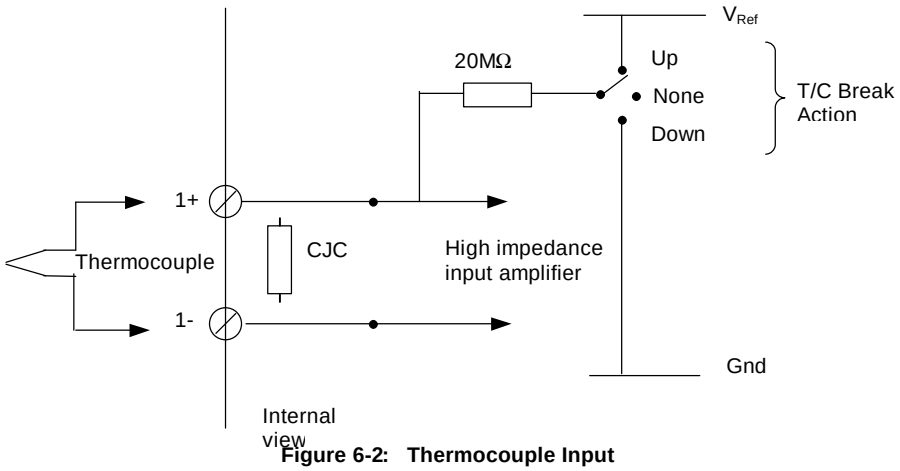


Figure 6-2: Thermocouple Input

3-Wire PRT Input

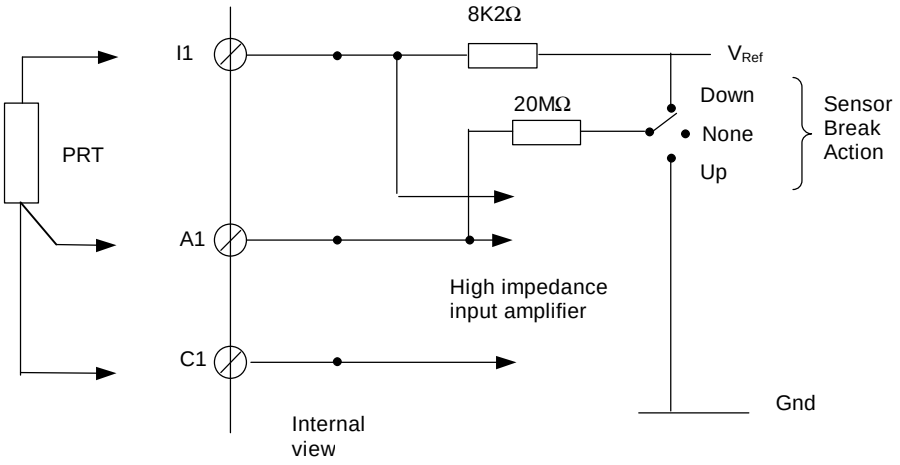


Figure 6-3: 3-Wire PRT Input

Milli-Volt Input

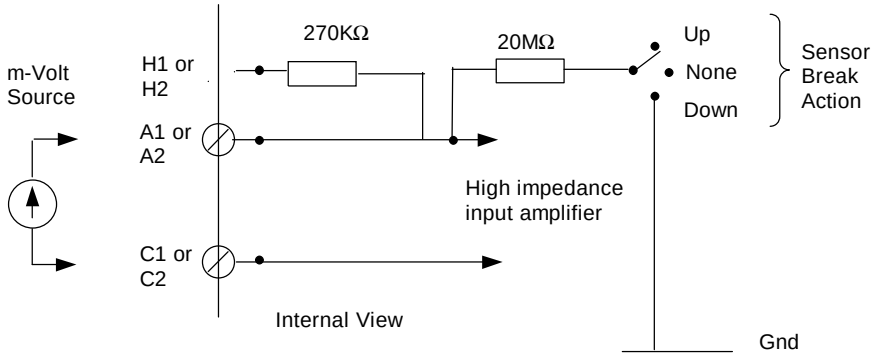


Figure 6-4: mV Input

Volts Input

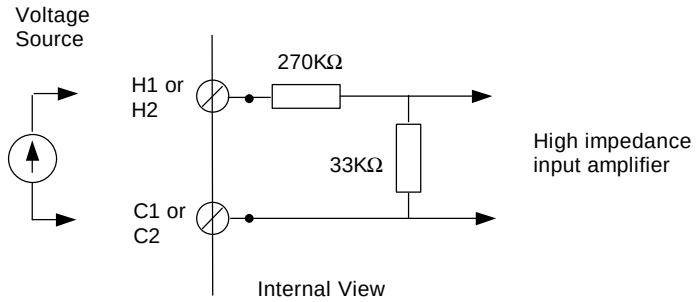


Figure 6-5: Volts Input

Milli-Amp Input

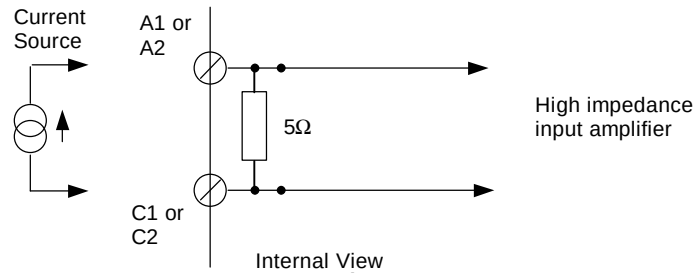


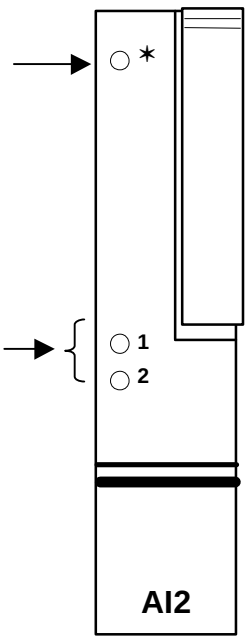
Figure 6-6: mA Input

7. STATUS INDICATION

Three LED indicators show the status of the module as follows:

LED	Colour	ON	OFF
✶	Green	Normal operation	Fault Condition No power or No comms or Wrong module type

LED	Colour	ON	OFF
1 Ch1	Red	Ch1 sensor break or Initialising	Normal operation ch1
2 Ch2	Red	Ch 2 sensor break or Initialising	Normal operation ch2
		Flashing	**Blinking ON**
1 Ch1	Red	Ch1 CJC fail or Ch1 bad cal data	Calibrating ch1
2 Ch2	Red	Ch2 CJC fail or Ch2 bad cal data	Calibrating ch2



Definitions	Approx. ON time	Approx. OFF time	Approx. flash rate
Flashing	0.5 sec	0.5 sec	1 sec
Blinking ON	0.2 sec	2 sec	2 sec

Figure 6-7: Dual Analogue Input Status Indication

Chapter 7 Three Channel Analogue Input Module 2500M/AI3

1. DESCRIPTION

The AI3 offers 3 isolated current input channels. The module hardware provides fixed range capable of ±20mA at high resolution; configuration provides applications ranging. Each channel has an internal burden resistor requiring less than 1 volt and in most applications the inputs will be used for 4-20mA signals.
Each isolated channel has its own 24V supply for external transmitter excitation.

2. MODULE IDENTIFICATION

The module may be identified by means of labels on the side and front of the case. The side label includes details of the product code and serial number.

3. CONFIGURATION

The configuration of the Analogue Input Module is stored in the IOC. It can be configured or modified using the PC based configuration station connected to the configuration port in the IOC. This is covered by the 'iTools Handbook' part number HA026179.

Typical parameters which can be configured or changed include:

- Input Range
- Input Filter Time Constant
- User Calibration. This allows you to offset the 'permanent' factory calibration to :

a) Calibrate the controller to your reference standards
b) Match the calibration of the controller to that of a particular transducer or sensor
c) Calibrate the controller to suit the characteristics of a particular installation

4. LOCATION

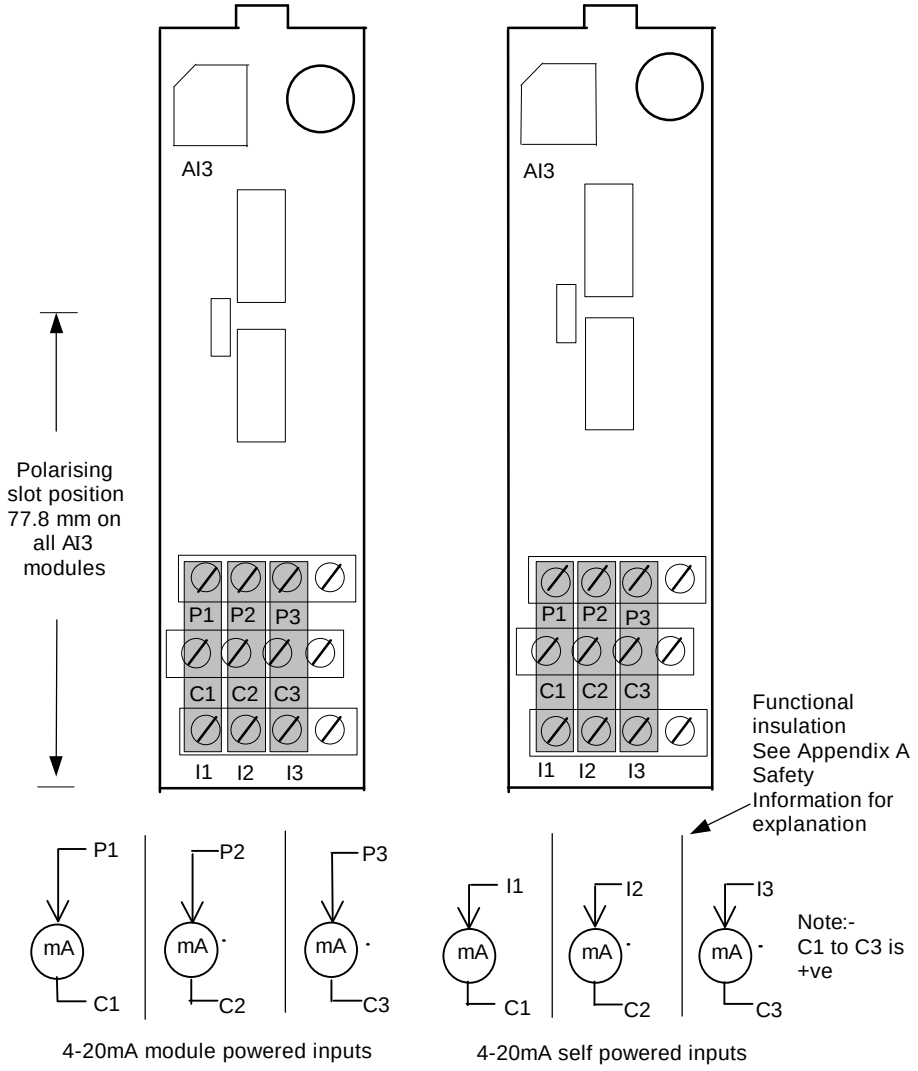
The module may be located, with its matching terminal unit, in any position on the base, other than the left-hand position reserved for the IOC.

5. BRIEF SPECIFICATION

Parameter	Values
Input Range	-20 to +20mA
Max input resistance	100 Ω (or 250Ω if link broken on terminal unit)
Channel sample period	110mS
Transducer Power Supply	21.0 to 25.0 V
Transducer power supply Output Impedance	10Ω
Transducer power supply Current Trip	>25mA and < 55mA
Transducer power supply Current Trip Reset	Auto – every 14 sec

6. BRIEF SPECIFICATIONTERMINAL CONNECTIONS

Connections are shown below for inputs where the transmitter requires excitation, and for those generating their own current. Each channel can be wired as required.



7. ANALOGUE INPUT EQUIVALENT CIRCUIT

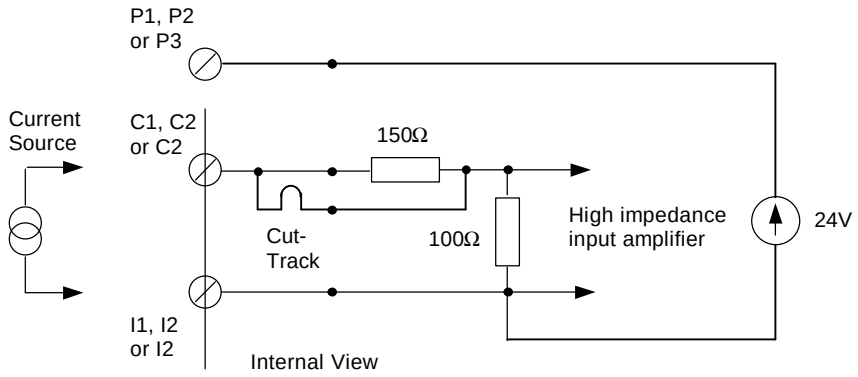


Figure 7-2: mA Input

8. HART COMPATIBILITY

The module does not directly support HART data extraction or injection functions.

The module is compatible with HART systems but with the following notes and provisos:

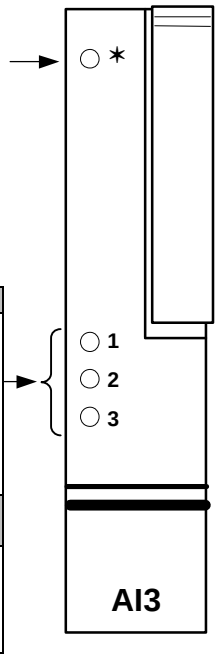
- The PSU is specified witha low AC impedance, so permitting normal HART connections (e.g., with master connected across the field device (near or far), or across the loop burden).
- Each channel offers full galvanic isolation, easing wiring and preventing HART signals from becoming interfering signals.
- Power Supply noise and ripple at HART frequencies are at very low amplitude, thus minimising risk of interference with HART signals.
- For HART loops where the main burden resistor is that provided by the AI3, the resistor must be padded with an external series resistor, normally by adding 150Ω in series with the C connection. This can be achieved by cutting the track as shown in Figure 7-2. The resistor can be wired using the spare terminals and wire-ended resistors. Such padding does not affect the specification, except in that the excess input voltage would reduce the headroom required to power external devices (as would all HART compliant loops).

9. STATUS INDICATION

The status of the module is shown by three LED indicators as follows:

LED	Colour	ON	OFF
✶	Green	Normal operation	Fault Condition No power or No comms or Unrecognised module type * or Wrong module type

LED	Colour	ON	OFF
1	Red	**Channel 1** loop break or Initialising	Normal
2	Red	**Channel 2** loop break or Initialising	Normal
3	Red	**Channel 3** loop break or Initialising	Normal
		Flashing	**Blinking ON**
1	Red	**Channel 1** bad calibration	Calibrating
2	Red	**Channel 2** bad calibration	Calibrating
3	Red	**Channel 3** bad calibration	Calibrating



Definitions	Approx. ON time	Approx. OFF time	Approx. flash rate
Flashing	0.5 sec	0.5 sec	1 sec
Blinking ON	0.2 sec	2 sec	2 sec

* IOC firmware prior to software issue 2.21 will not recognise an AI3 module.

Figure 7-3: Three Channel Analogue Input Status Indication

Chapter 8 Two Channel Analogue Output Module 2500M/AO2

1. DESCRIPTION

The analogue output module provides two analogue output channels, isolated from each other and isolated from the system electronics. Each output may be configured as either voltage or current:

2. MODULE IDENTIFICATION

The module may be identified by means of labels on the side and front of the case. The side label includes details of the product code and serial number.

3. CONFIGURATION

The configuration of the Analogue Output Module is stored in the IOC. It can be configured or modified using the PC based configuration station connected to the configuration port in the IOC. Configuration is covered by the 'iTools Handbook' part number HA026179.

Typical operating outputs which can be configured include:

- 10V 5mA max
- 20mA 12V dc max
- 5V 10mA max
- Output range limit 30V max, 40mA max.

4. LOCATION

The module may be located, with its matching terminal unit, in any position on the base, other than the left hand position reserved for the IOC.

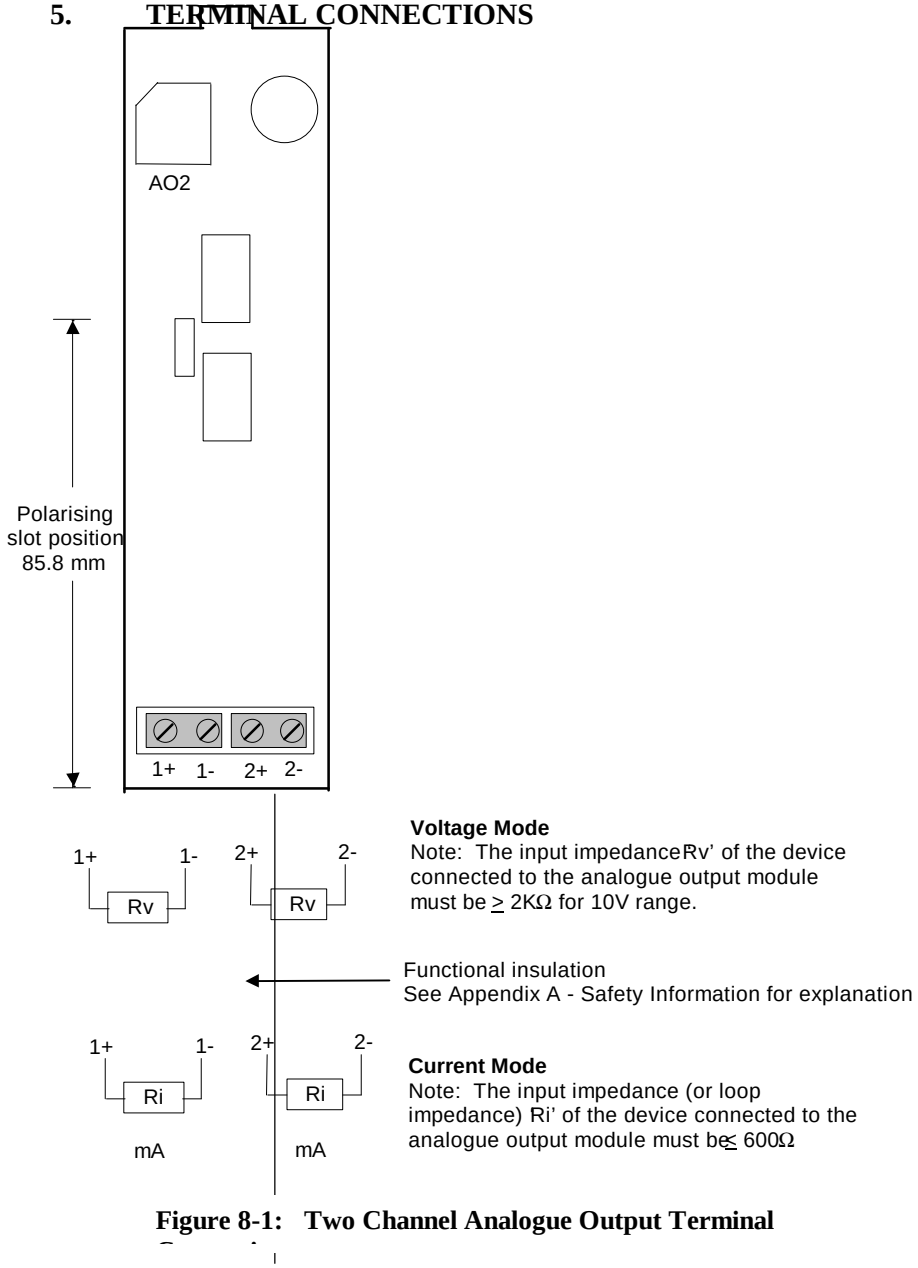


Figure 8-1: Two Channel Analogue Output Terminal

6. ANALOGUE OUTPUT EQUIVALENT CIRCUITS

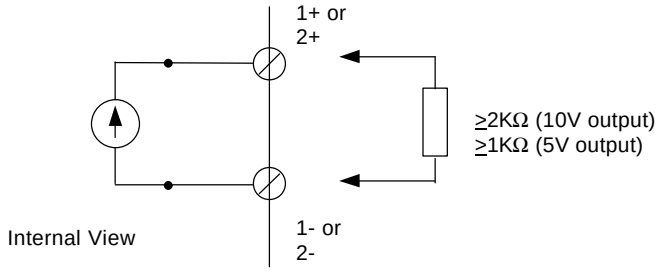


Figure 8-2: Voltage Output

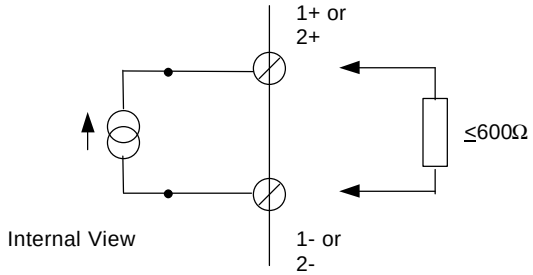


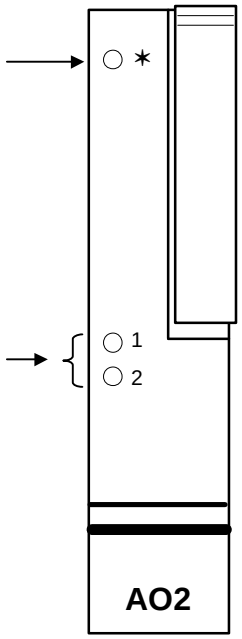
Figure 8-3: Current Output

7. STATUS INDICATION

The status of the module is shown by three LED indicators as follows:

LED	Colour	ON	OFF
✶	Green	Normal operation	Fault Condition No power or No comms or Wrong module type

LED	Colour	ON	OFF
1 Ch1	Red	Output 1 saturated or Initialising	Normal operation
2 Ch2	Red	Output 2 saturated or Initialising	Normal operation
		Flashing	**Blinking ON**
1 Ch1	Red	Ch1 bad cal data	Calibrating ch1
2 Ch2		Ch2 bad cal data	Calibrating ch2



Definitions	Approx. ON time	Approx. OFF time	Approx. flash rate
Flashing	0.5 sec	0.5 sec	1 sec
Blinking ON	0.2 sec	2 sec	2 sec

Figure 8-4: Two Channel Analogue Output Status Indication

Chapter 9 Quad Digital Output Module 2500M/DO4

1. DESCRIPTION

The Quad Digital Output module provides four logic outputs, which are typically used for control, alarms or events. There are two variants:

1. A logic output with 10mA capability, typically used for driving thyristor units or single phase Solid State Relays (SSRs).
2. A 24V output with 100mA capability, typically used for driving solenoids, relays, lamp drives, small motors, fans or some three phase SSRs.

The module requires an external power supply of between 18 and 30 volts which may be linked to any number of logic output modules. The current rating of this power supply depends upon the number and type of modules in use and the currents drawn from each digital output.

A suitable power supply is the type 2500P, described in Chapter 10.

2. MODULE IDENTIFICATION

The module may be identified by means of labels on the side and front of the case. The side label includes details of the product code and serial number.

3. CONFIGURATION

The configuration of the Quad Digital Output Module is stored in the IOC. It can be configured or modified using the PC based configuration station connected to the configuration port in the IOC. Configuration is covered by the 'iTools Handbook' part number HA026179.

Typical parameters which can be configured include:

- On/ Off or Time Proportioning output mode
- High and low output limit.

4. LOCATION

The module may be located, with its matching terminal unit, in any position on the base, other than the left hand position reserved for the IOC.

5. BRIEF SPECIFICATION

	LOGIC (10mA)	**24V** (100mA)
Active ON state maximum	Vs	Vs
Active ON state minimum (o/c)	Vs - 3V	Vs - 3V
Minimum load resistance	0Ω	120Ω at Vs = 12V; 240Ω at Vs = 24V; 300Ω at Vs = 30V

6. TERMINAL CONNECTIONS

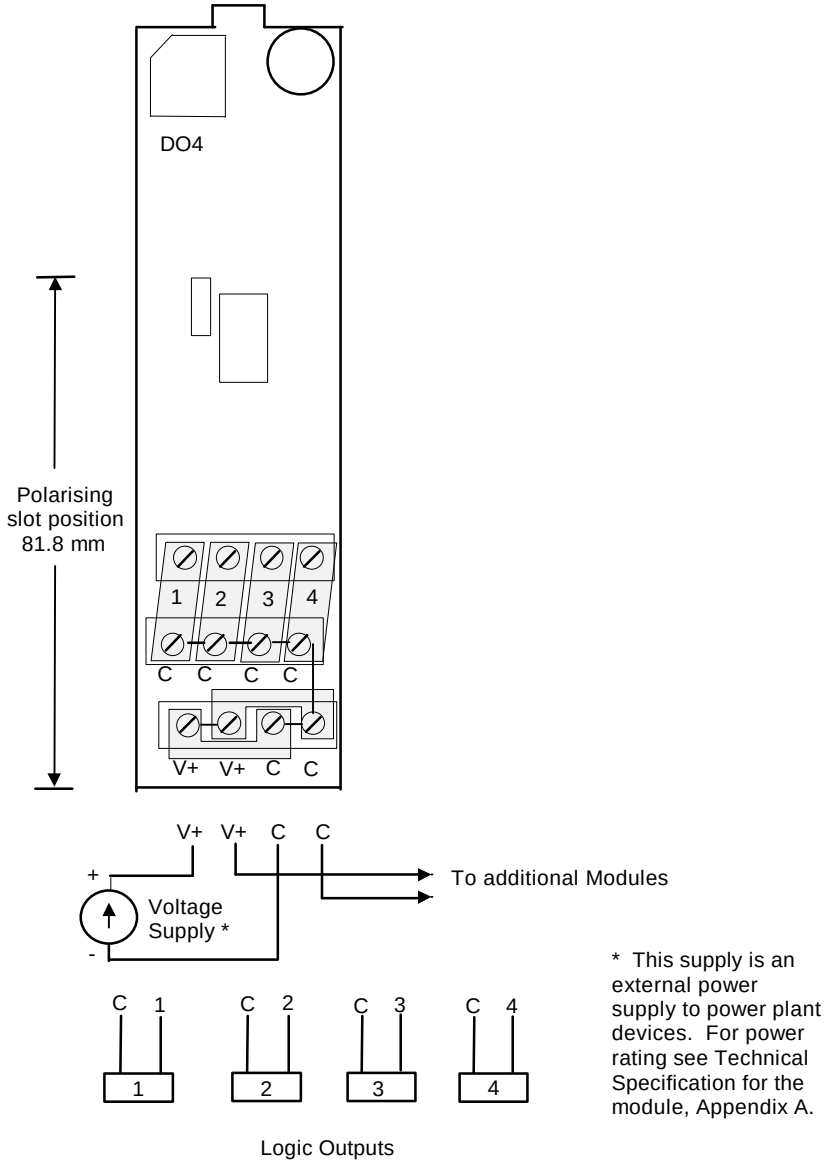


Figure 9-1: Quad Digital Output Module Terminal Connections

7. DIGITAL OUTPUT EQUIVALENT CIRCUITS

The equivalent circuits below show the output drive from the Quad Digital Output Module for purposes of determining the load conditions.

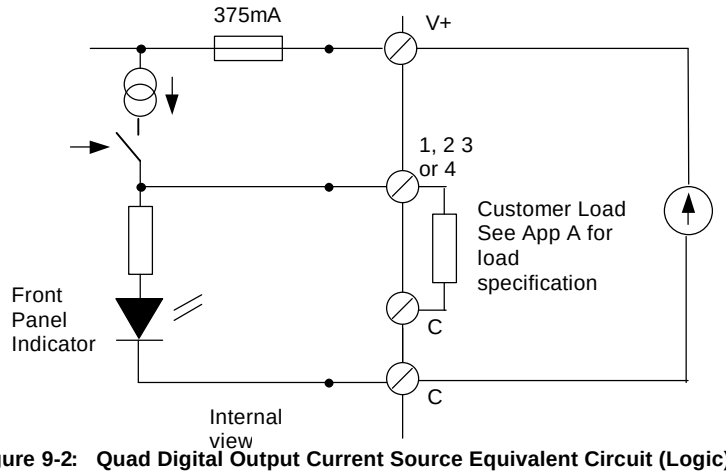


Figure 9-2: Quad Digital Output Current Source Equivalent Circuit (Logic)

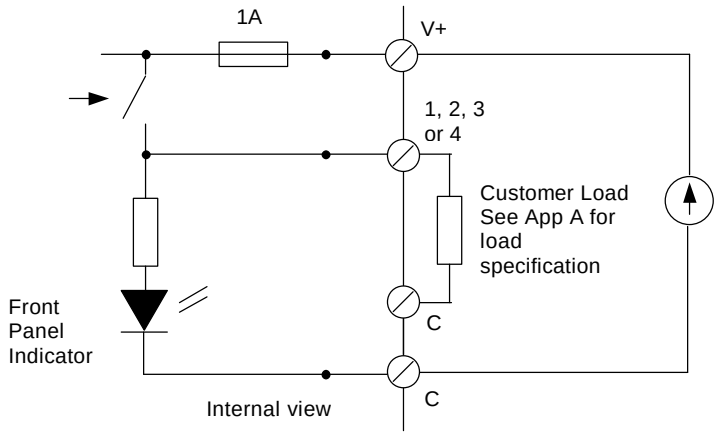


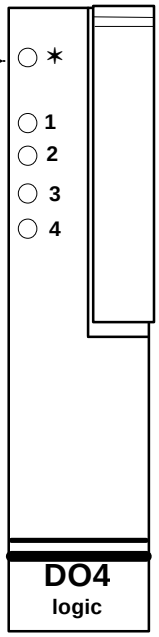
Figure 9-3: Quad Digital Output Voltage Switch Equivalent Circuit (24V)

8. STATUS INDICATION

The status of the module is shown by five LED indicators as follows:

LED	Colour	ON	OFF
✶	Green	Normal operation	Fault Condition No power or No comms or Wrong module type

LED	Colour	ON	OFF
1	Yellow	Digital output 1 ON	Digital output 1 OFF
2	Yellow	Digital output 2 ON	Digital output 2 OFF
3	Yellow	Digital output 3 ON	Digital output 3 OFF
4	Yellow	Digital output 4 ON	Digital output 4 OFF



Note 1:- The digital outputs are physically measured at the output terminals.
The channel LED, therefore, represents the state at the terminal and not necessarily the drive from the module.

Note 2:- The operating LED is turned on for 1sec when the module is reset for test purposes.

Figure 9-4: Quad Digital Output Module Status Indication

Chapter 10 Quad Digital Input Module 2500M/DI4

1. DESCRIPTION

The Quad Digital Input module accepts four logic inputs which may be either from a voltage source or a contact closure.
For voltage source inputs, the ON state requires between ±10.8V and ± 30V, and the OFF state requires ±5V.
For contact closure inputs, an external power supply of between +18V and +30V is required at a current rating suitable for the size of the system (this module provides a transient current of 100mA for 1mS at the point of switching). See also module specification, Appendix A, for input current.
A suitable 24V DIN rail mounted power supply, is the 2500P/2A5 rated at 2.5 amps, 2500P/5A0 rated at 5 amps or 2500P/10A rated at 10 amps, - see Chapter 13.

2. MODULE IDENTIFICATION

The module may be identified by means of labels on the side and front of the case. The side label includes details of the product code and serial number.

3. CONFIGURATION

The configuration of the Quad Digital Input Module is stored in the IOC. It can be configured or modified using the PC based configuration station connected to the configuration port in the IOC. Configuration is covered by the 'iTools Handbook' part number HA026179.
A limited number of parameters are required to be configured in this module, such as:

- Contact bounce suppression

4. LOCATION

The module may be located, with its matching terminal unit, in any position on the base, other than the left hand position reserved for the IOC.

5. BRIEF SPECIFICATION

Plant side interface	Voltage source[1]	Contact closure[2]
Supply voltage	-	18V to 30V
Input resistance	4KΩ	
Minimum & maximum contact current		8mA - 16mA
Minimum pulse input time to guarantee recognition	20mS	20mS
Minimum time between pulses	220mS	220mS

Notes:-

1 The unit is bipolar with the same specification for negative voltages.

2 Exceeds the wetting current requirements specified in EN61131 and provides short duration high pulse current to help whet industrial contact materials.

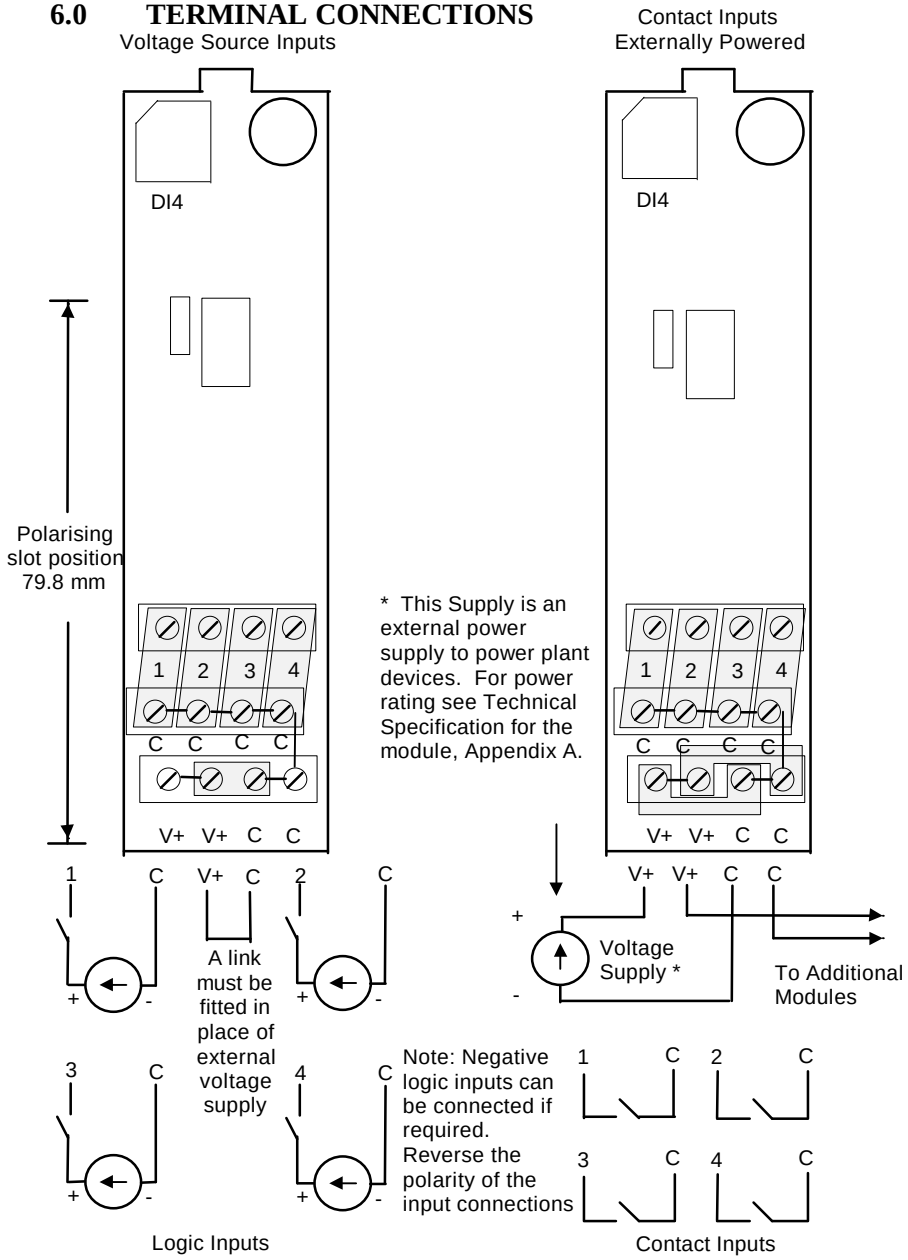


Figure 10-1: Quad Digital Input Module Terminal

7. DIGITAL INPUT EQUIVALENT CIRCUITS

The equivalent circuits below show the input into the Quad Digital Input Module for purposes of determining the source conditions.

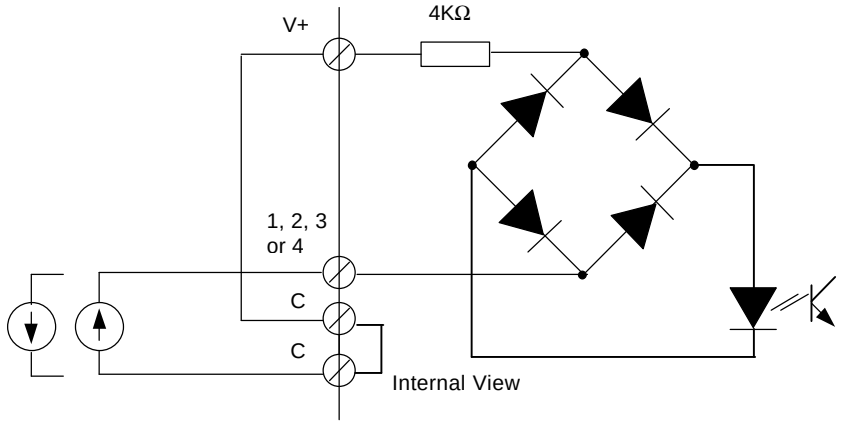


Figure 10-2: Quad Digital Input Voltage Source Equivalent Circuit

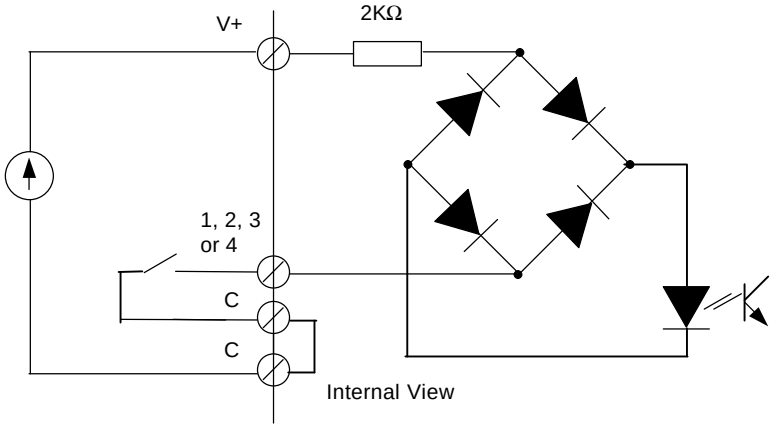


Figure 10-3: Quad Digital Input Contact Closure Equivalent Circuit

8. STATUS INDICATION

The status of the module is shown by five LED indicators as follows:

LED	Colour	ON	OFF
✶	Green	Normal operation	Fault Condition No power or No comms or Wrong module type

LED	Colour	ON	OFF
1	Yellow	Digital input 1 ON	Digital input 1 OFF
2	Yellow	Digital input 2 ON	Digital input 2 OFF
3	Yellow	Digital input 3 ON	Digital input 3 OFF
4	Yellow	Digital input 4 ON	Digital input 4 OFF

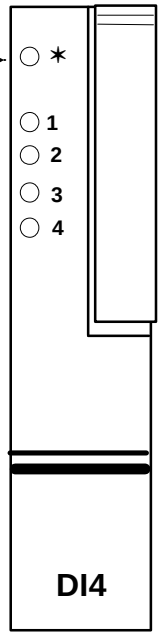


Figure 10-4: Quad Digital Input Module Status Indication

Note:
When the module is reset allLEDs are lit for 1sec for test purposes.

Chapter 11 Octal Digital Input Module 2500M/DI8

1. DESCRIPTION

The Octal Digital Input module accepts eight digital inputs which may be either from a voltage source ($DI8_{LOGIC}$) or contact closure ($DI8_{CONTACT}$). The two versions are factory assembled options and cannot be converted in the field.
For the $DI8_{LOGIC}$ option (voltage source inputs), the ON state requires between +10.8V to + 30V, and the OFF state requires between -3V and +5V.
For the $DI8_{CONTACT}$ option (contact closure inputs), an internal supply is provided which provides an open circuit wetting voltage of at least 9V. The input is ON if the contact resistance is < 100 ohms, OFF if it is > 10kohm.
The inputs for both build options are arranged as 4 pairs of 2 inputs, each pair sharing a common terminal and having basic isolation (50V max) from the other pairs of inputs.

2. MODULE IDENTIFICATION

The module may be identified by means of labels on the side and front of the case. The side label includes details of the product code and serial number.

3. CONFIGURATION

The configuration of the Octal Digital Input Module is stored in the IOC. It can be configured or modified using the PC based configuration station connected to the configuration port in the IOC. Configuration is covered by the 'iTools Handbook' part number HA026179.
A limited number of parameters are required to be configured in this module, such as

- Contact bounce suppression.

4. LOCATION

The module may be located, with its matching terminal unit, in any position on the base, other than the left hand position reserved for the IOC.

5. BRIEF SPECIFICATION

Plant side interface	Voltage source*	Contact closure
Active state max. continuous	30V	Short circuit
Input resistance	5KΩ	
Minimum & maximum contact current		2.5mA - 5mA
Minimum pulse input time to guarantee recognition	20mS	20mS
Minimum time between pulses	220mS	220mS

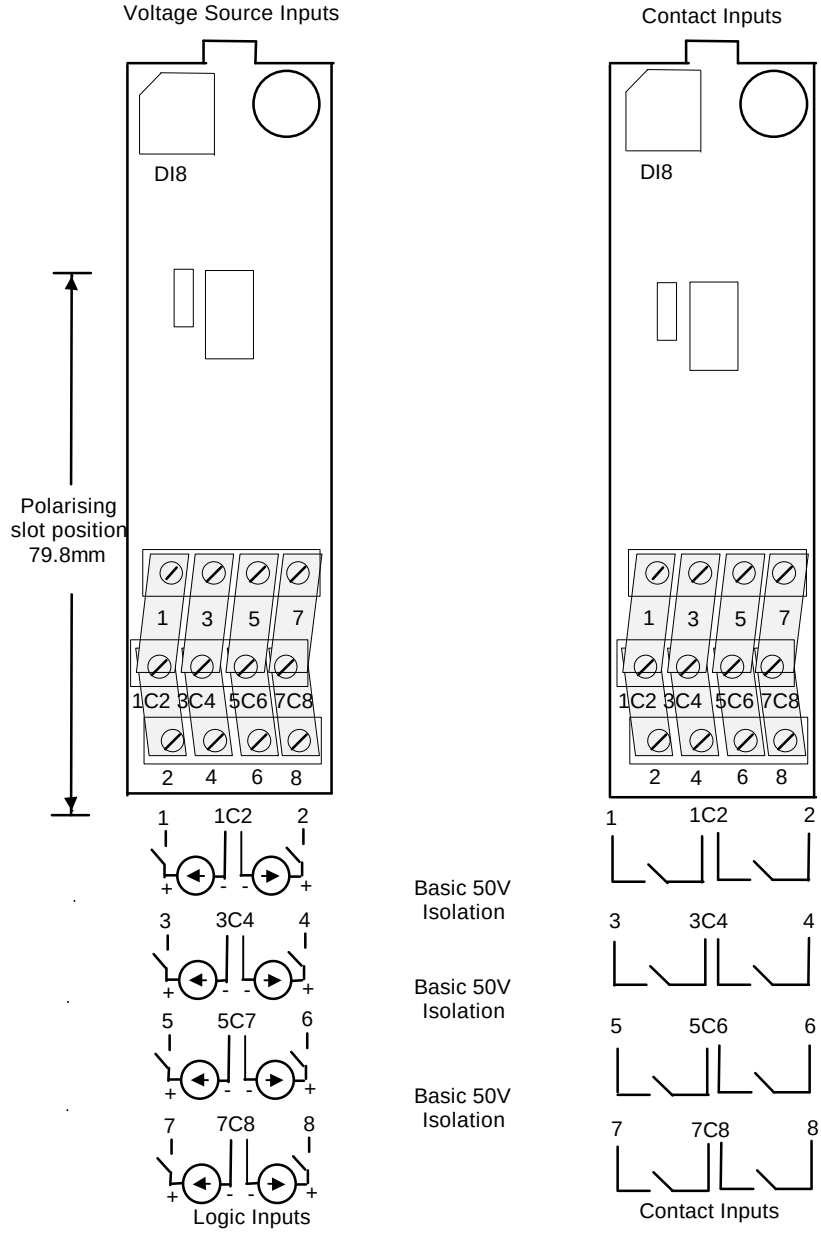


Figure 11-1: Octal Digital Input Module Terminal Connections

7. DIGITAL INPUT EQUIVALENT CIRCUITS

The equivalent circuits below show the input into the Quad Digital Input Module for purposes of determining the source conditions.

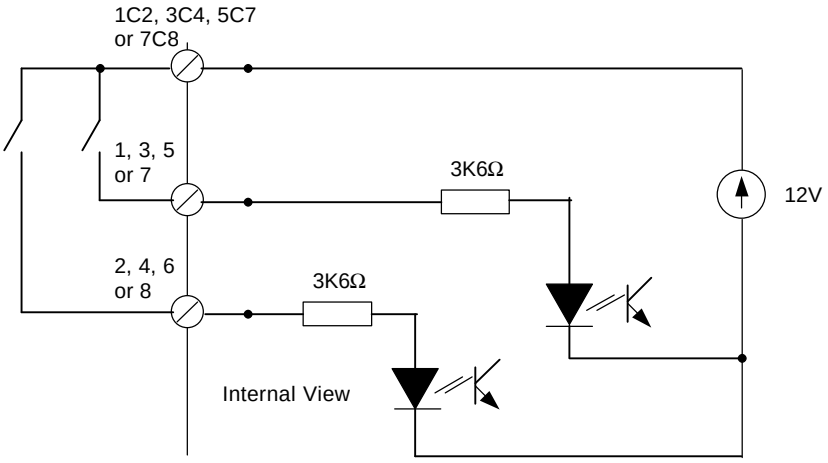


Figure 11-2: Octal Digital Input Contact Closure Equivalent Circuit

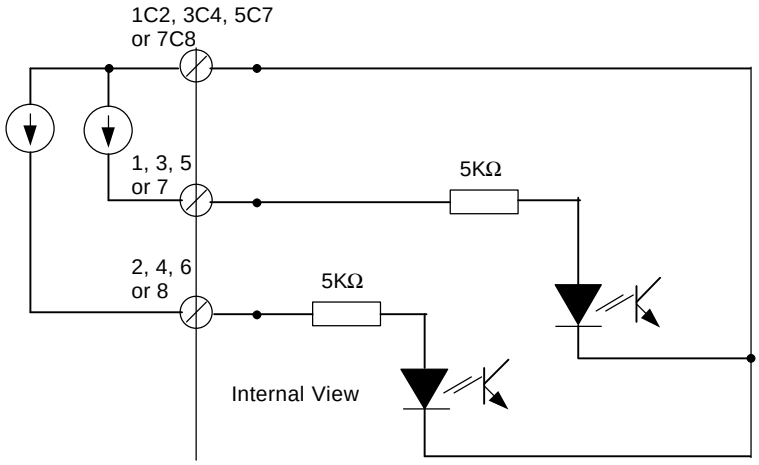


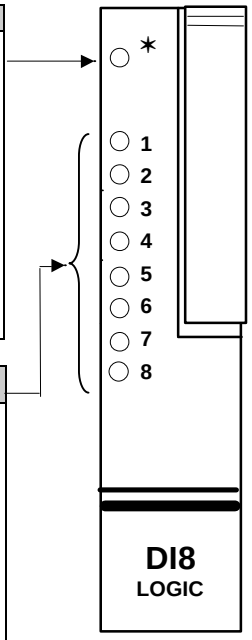
Figure 11-3: Octal Digital Input Voltage Source Equivalent Circuit

8. STATUS INDICATION

Nine LED indicators show the status of the module as follows:

LED	Colour	ON	OFF
✶	Green	Normal operation	Fault Condition No power or No comms or Unrecognised module type* or Wrong module type

LED	Colour	ON	OFF
1	Yellow	Digital input 1 ON	Digital input 1 OFF
2	Yellow	Digital input 2 ON	Digital input 2 OFF
3	Yellow	Digital input 3 ON	Digital input 3 OFF
4	Yellow	Digital input 4 ON	Digital input 4 OFF
5	Yellow	Digital input 5 ON	Digital input 5 OFF
6	Yellow	Digital input 6 ON	Digital input 6 OFF
7	Yellow	Digital input 7 ON	Digital input 7 OFF
8	Yellow	Digital input 8 ON	Digital input 8 OFF



Note:-
When the module is reset allLEDs are lit for 1sec for test purposes.

* IOC firmware prior to software issue 2.10 will not recognise an AI3 module.

Figure 11-4: Octal Digital Input Module Status Indication

Chapter 12 Relay Module 2500M/RLY4

1.` DESCRIPTION

The relay module provides four relay outputs, one relay with changeover contacts, and three with normally open contacts.
There are three operational modes:
1. On/off - for alarms and events, typically driving indicator lamps or solenoid valves
2. Time Proportioning - for control, typically driving contactors
3. Valve Position - raise/lower outputs

1.1 Snubber Circuits

Each relay is fitted with a 'snubber' (22nF + 100Ω) wired across the contacts. The snubbers are used to prolong contact life and to suppress interference particularly when switching inductive loads such as mechanical contactors and solenoid valves.
Snubbers pass a small current typically 1.0mA at 110V 60Hz and 1.7mA at 240V 50Hz, which may be sufficient to hold in high impedance loads as, for example, found in some relay coils. Should it be necessary to remove any of the snubbers, refer to Appendix C for the procedure.

WARNING

When a relay contact is used in an alarm circuit, ensure that the current passing through the snubber when the relay contact is open does not hold in low power electrical loads and thereby interfere with the fail-safe operation of the alarm circuit.

2. MODULE IDENTIFICATION

The module may be identified by means of labels on the side and front of the case. The side label includes details of the product code and serial number. It also provides a place to record the removal of a snubber.

3. CONFIGURATION

The configuration of the Relay Module is stored in the IOC. It can be configured or modified using the PC based configuration station connected to the configuration port in the IOC. Configuration is covered by the 'iTools Handbook' part number HA026179.

Typical parameters which can be configured include:
- On/Off mode, Time Proportioning mode, Valve Position mode (raise/lower)
- Minimum pulse time for time proportioning outputs

4. LOCATION

The module may be located, with its matching terminal unit, in any position on the base, other than the left hand position reserved for the IOC.

5. TERMINAL CONNECTIONS

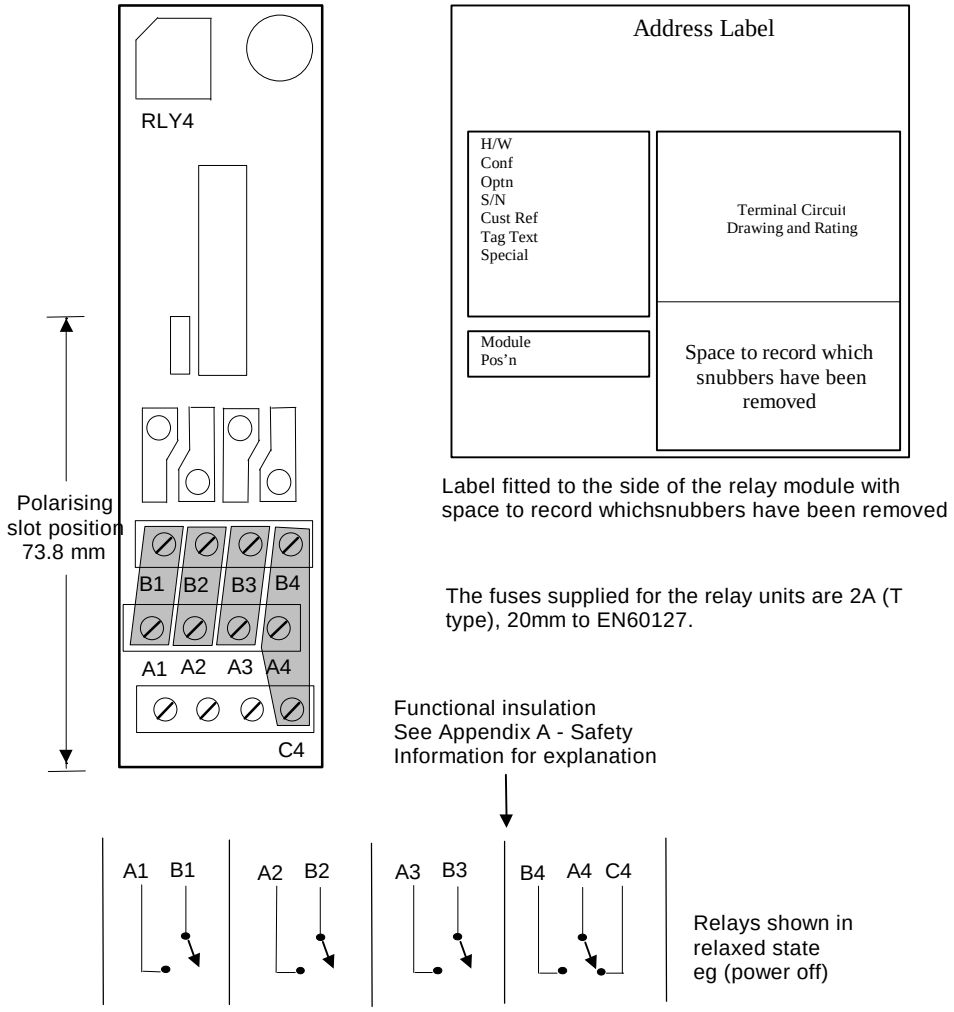


Figure 12-1: Relay Module Terminal Connections

6. RELAY RATINGS

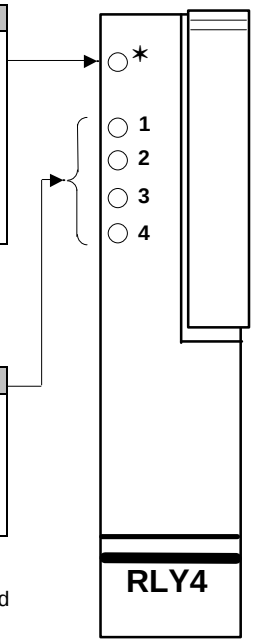
Contact	Outputs 1 - 3	Output 4
	Normally open, closed when energised	Changeover
Max Switched Voltage	264V AC rms, 120V DC, resistive	264V AC rms 120V DC
Min Switched Voltage	12V DC resistive	12V DC
Max Switched Current	2A AC rms resistive	2A AC rms
Min Switched Current	100mA AC rms or DC resistive	100mA AC rms or DC

7. STATUS INDICATION

The status of the module is shown by five LED indicators as follows:

LED	Colour	ON	OFF
✶	Green	Normal operation	Fault condition No power or No comms or Wrong module type

LED	Colour	ON	OFF
1	Yellow	Relay output 1 ON *	Relay output 1 OFF
2	Yellow	Relay output 2 ON*	Relay output 2 OFF
3	Yellow	Relay output 3 ON *	Relay output 3 OFF
4	Yellow	Relay output 4ON !	Relay output 4 OFF



* Contacts closed. ON = Relay Energised
! Changeover contacts. OFF = Relay De-energised

Note:- When the module is reset all LEDs are lit for 1sec for test purposes.

Figure 12-2: Relay Module Status Indication

Chapter 13 24V Power Supply 2500P

1. DESCRIPTION

The 2500P is a fully protected stabilised power supply unit which provides 24V DC to power the 2500 DIN rail controller, from a mains supply of 115 or 230V AC, 47 - 63 Hz. The maximum power rating of a 2500 DIN rail controller is 90W, but the actual size depends upon the power rating of the modules in use. This can be calculated from the Module Power Consumptions given in the Technical Specification, see Appendix A.

The 2500P power supply can also be used to supply external plant devices if required. To calculate the power rating for this purpose see Technical Specification, Appendix A.

The power supply is designed to mount directly on to a DIN rail either next to or separated from the 2500 base, and three versions are available:

1. 2500P/2A5 rated at 24V, 2.5amp, 60 watt, input 70VA.
2. 2500P/5A0 rated at 24V, 5.0 amp, 120 watt, input 140VA
3. 2500P/10A rated at 24V, 10 amp, 240watt, input 275VA

Additional power supplies can be wired in parallel if currents greater than that available from an individual supply are required or to provide power supply redundancy.

2. BRIEF SPECIFICATION

	2500P 2A5	2500P 5A0	2500P 10A
Nominal input voltage Range	110-120/220-240V AC (selected by front panel switch), 47-63Hz 85-132 VAC/176-264 VAC		
	With the switch in the 230V position the power supply unit operates at low and moderate loads at any input voltage between 95 and 275 Vac. See Output Current.		
Frequency	47 to 63 Hz		
Nominal input current	<1.3A (switch in 115V position) <0.7A (switch in 230V position)	<2.6A (switch in 115V position) <1.4A (switch in 230V position)	
In-rush current	< 25A	< 15A	<30A
	Recommended input fusing - 10A, B-type 'circuit breaker'		
Nominal output voltage Ripple (inc. spikes)	24 V dc ± 0.5% < 30mV pp incl. spikes		
Nominal output current	2.5A (60W)	5A (120W)	10A (240W)
Voltage regulation	Better than 1%Vout overall		
Parallel operation	yes		
Front panel indicator	Green LED, goes out atVout <12V		
Relay contact	1A, at 28Vdc		

2.1 Dimensions and Weight

Code	Width mm	Depth mm	Height mm	Weight gm
2500P 2A5	50	103	125	460
2500P 5A0	65	103	125	620
2500P 10A	122	103	125	1100

Ventilation space Above and below 25mm
right (front view) 10mm (2.5A model). 15mm (5 & 10A models)

Top & bottom connectors may be unplugged from the power supply

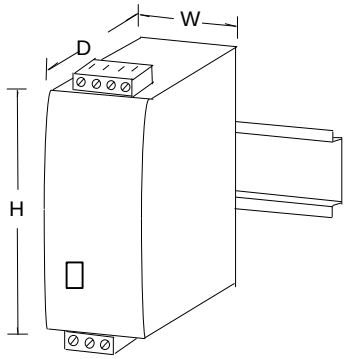


Figure 13-1: General View of the 2500P Power Supply

3.0 TO MOUNT THE POWER SUPPLY

1) Tilt unit slightlybackwards

2) Put it onto the DIN rail

3) Push downwards until stopped

4) Push at the lower front edge to lock

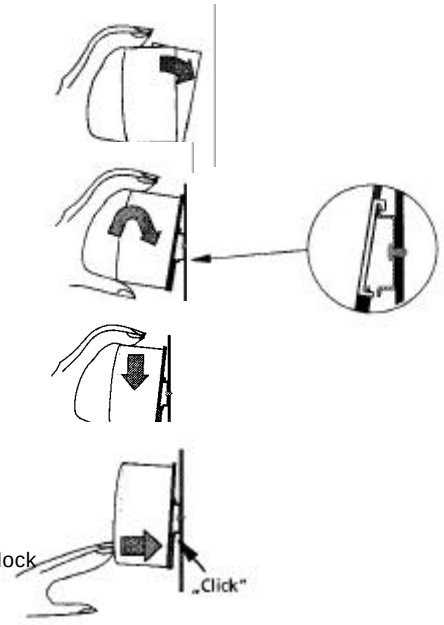


Figure 13-2: Mounting the 2500P Power Supply

4.0 TO DETACH FROM THE DIN RAIL

Press button downwards (to unlock)
and remove the unit from the DIN rail

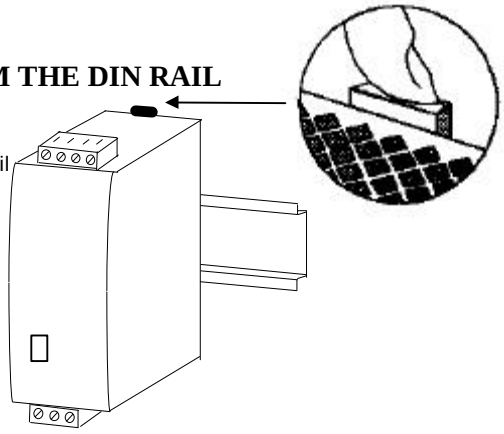
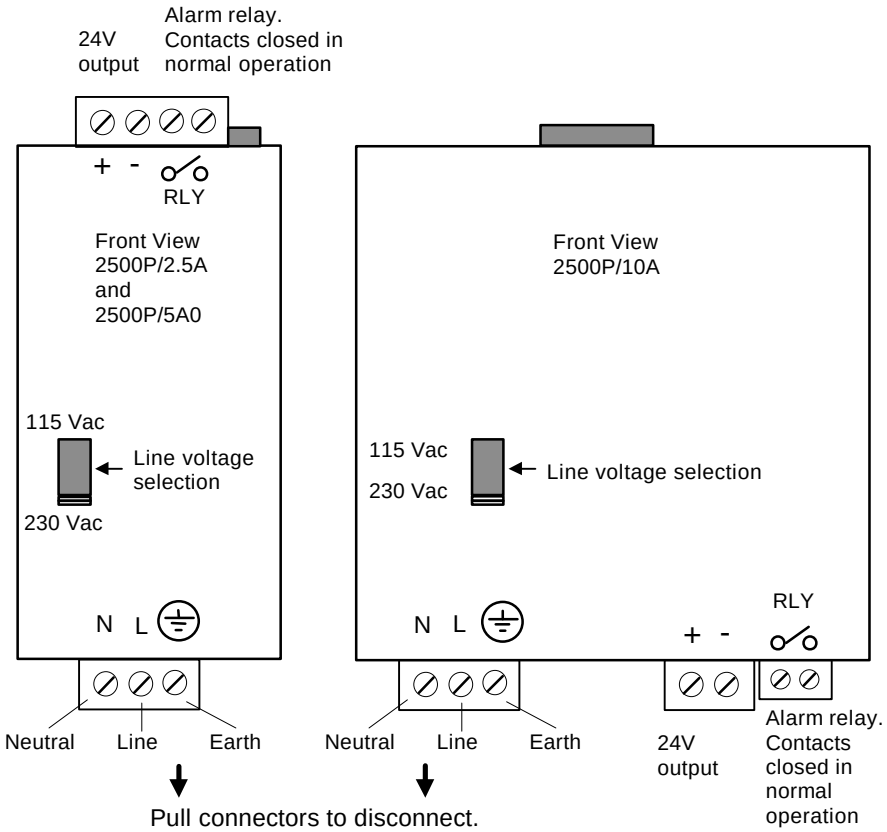


Figure 13-3: Detaching the 2500P Power Supply

5. TERMINAL CONNECTIONS



Note:-
The PSU 24V connections should not be connected to earth since this will bias comms at an elevated level. (A 10 kΩ resistor is connected from RJ45 comms to earth which provides a bleed for static).

Figure 13-4: 2500P Power Supply Terminal Connections

6. STATUS INDICATION

LED	Colour	ON	OFF
1	Green	Normal operation	Output voltage <12V

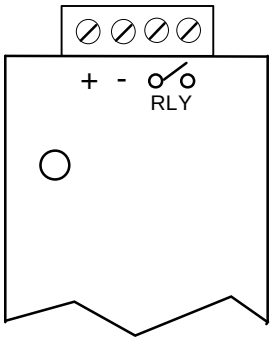


Figure 13-5: 2500P Power Supply Status Indication

Chapter 14 Examples and Recommendations

This chapter provides general information, including a typical wiring diagram, and should be read in conjunction with the **SAFETY and EMC INFORMATION, Appendix A**.

WARNING!

Please ensure that the controller is correctly configured for your application. Incorrect configuration could result in damage to the process being controlled, and/or personal injury. The controller may either have been configured when ordered, or may need configuring now.

---

1. POWER SUPPLY

The 2500 DIN rail controller is powered from 24V dc. A suitable DIN rail mounted power supply is 2500P described in chapter 13, but the user may wish to use an existing power supply of similar specification.

2. WIRE SIZES

All electrical connections are made to the screw terminals mounted on the terminal unit. These accept wire sizes from 0.5 to 1.5 mm^2 (16 to 22 AWG). Terminal screws should be tightened to a torque of 0.4 Nm (3.5 lb in).
Connections to the earthing bar should be made using suitable eyelets and tightened to a torque of 1.2Nm (10.5lbin) using the screw and washer provided.
No additional strain relief for cabling is incorporated, the product should be wired from cable conduit in fixed, not back of door, applications.

3. EXAMPLE WIRING DIAGRAM

This example is for two zones of control, one for temperature, using a thermocouple sensor, the second with humidity, using mV input. Also alarm indication, event relay, and external push-buttons.

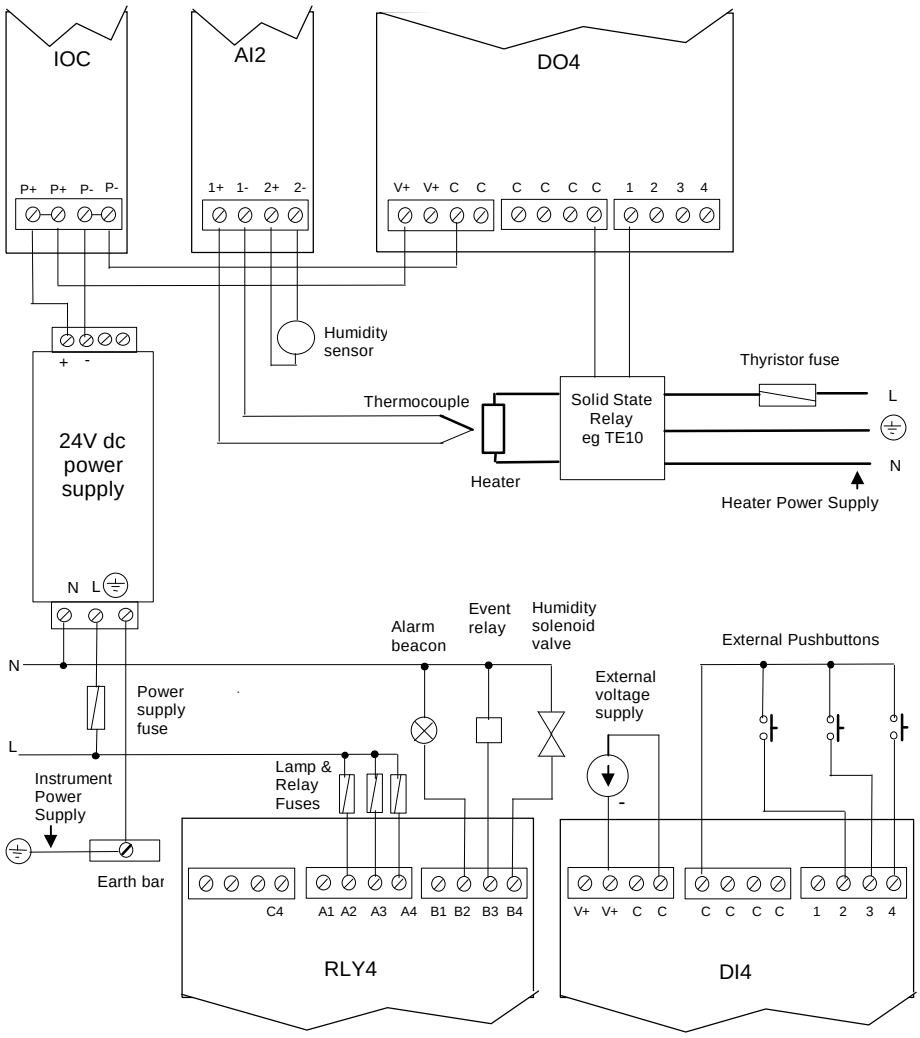


Figure 14-1: Example Wiring Diagram

4. OVER TEMPERATURE PROTECTION

STANDARD PRECAUTIONS TO BE TAKEN WHEN USING TEMPERATURE CONTROLLERS

When designing any control system it is essential to consider what will happen if any individual part of the system malfunctions.

In a temperature control application, for example, the danger is that for some reason the heating system remains permanently switched on.
This could happen if:

1. The thermocouple or sensor becomes 'detached' from the temperature source; i.e it is no longer measuring the actual temperature of the system
2. The thermocouple or thermocouple wiring becomes short circuited
3. Component failure within the controller in such a way as to leave the output power switched on
4. Microprocessor or software failure in a system
5. Failure of valve movement or valve linkage
6. Failure of contactor or solid state relay in such a way as to supply full power to the heater system
7. Remote setpoint to controller is faulty
8. Operation by unauthorised personnel eg:
    a) Controller left in manual with high output power set
    b) Setpoint set too high
9. Any lack of maintenance in serviceable parts

……...and many other unforeseen situations

If leaving the heater on all the time can cause damage, either to the plant itself or to its contents, then an independent protection device must be provided.

The best form of protection is a completely independent 'policeman'. This is a separate over temperature alarm with its own thermocouple or sensor and, on alarm will pull out the main contactor or shut off an independent valve to ensure the plant's safety.

The circuit below gives an example of an over temperature policeman fitted to a furnace installation.

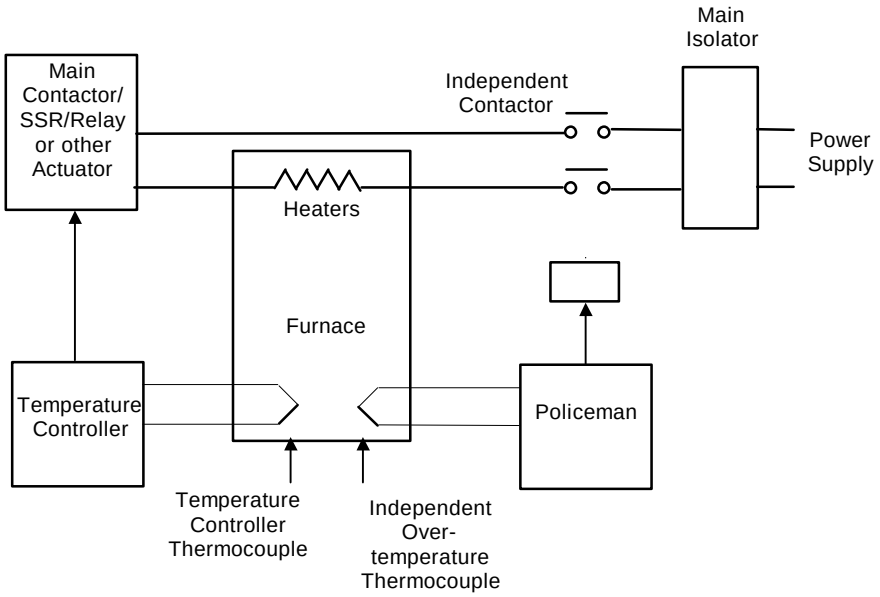


Figure 14-2: Over Temperature Protection

A suitable policeman is the type 2132 or 2116*i* Indicator and Alarm Unit.

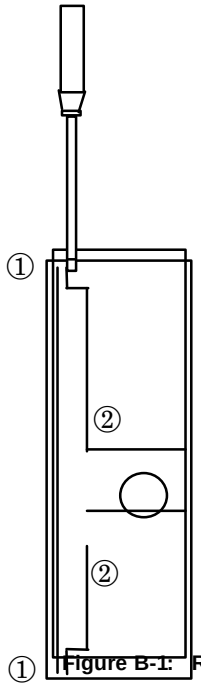
Note: An alarm relay fitted in the Temperature Controller is not sufficient protection for all eventualities.

Appendix B To Remove Snubber Circuits From The Relay Module

Each relay is fitted with a 'snubber' (22nF + 100Ω) wired across the contacts. The snubbers are used to prolong contact life and to suppress interference particularly when switching inductive loads such as mechanicalcontactors and solenoid valves.
Snubbers pass a small current typically 1.0mA at 110V 60Hz and 1.7mA at 240V 50Hz, which may be sufficient to hold in high impedance loads as, for example, found in some relay coils.
If this is found to be the case, the snubber can be removed by cutting all or any one of the snubber resistors from the printed circuit board.

The procedure below may be followed

1. Remove the rear cover from the module:



1. Open the module retaining lever
2. Gently ease the rear cover out of the module by inserting a small screwdriver in the slots ① at the top and bottom of the cover
3. Gently ease the rear cover over the module retaining catch. It may be necessary to use the screwdriver in positions ② to gently lever the cover over the catch.

Figure B-1: Removing the Rear Cover from the Relay Module

2. Remove the printed circuit board from module case as follows:

1. Invert the module and support it securely on a bench or table top
2. Squeeze the sides of the module so that the edge of the module bows outwards
3. Very carefully insert a screwdriver into the slot in the edge of the module.

Take care that the screwdriver does not slip which may cause injury

4. Gently ease the PCB out of module case.

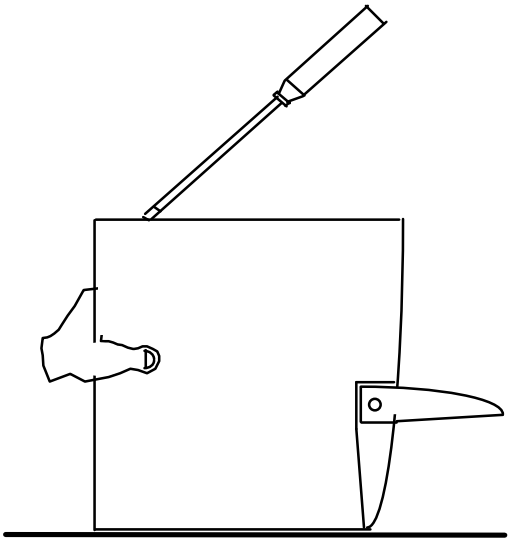


Figure B-2: Removing the Case from the Relay Module

3. Remove the snubber resistors

5. Using a suitable pair of wire cutters, snip out and remove the 100Ω resistor to remove the required snubber circuit.
6. Record the removal of the snubber resistor on the side of the module in the place provided. This will provide easy identification of which snubbers have been removed in the event that the module needs to be replaced.

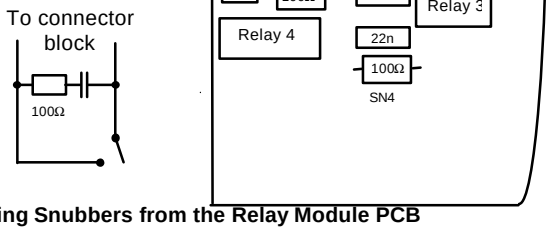


Figure B-3: Removing Snubbers from the Relay Module PCB

Appendix C Glossary of Terms

Config	Short for configuration or configuration mode
Config Mode	A security level in the 2500 in which Configuration Mode Parameters are made alterable
Configuration	*1.* The operation and inter-action of the 2500 functional elements *2.* The act of defining the operation and inter-action of the 2500 functional elements by means of selecting parameters and adjusting parameter values
Config Mode Parameters	A subset of the configuration parameters which can only be altered in Config Mode. *NB c.f. configuration parameters*
Configuration Parameter	A parameter which defines part of the Configuration of the 2500 *NB c.f. config mode parameters*
Configuration Port	A comms port intended for configuration of the 2500
CJC	Cold Junction Compensation
DIN	Deutsche Industrie Normand
EM	Electro-magnetic, as in EMC ~ Compliance
On/Off control	The control output switches on when the setpoint is above process variable and off when the setpoint is below
Hysteresis	The difference between the on and off points normally applied to an output relay. Used to prevent relay 'chatter'.
I/O	Abbreviation used to mean the Inputs and/or Outputs
ICP	Industrial Control Package. This is a combination of the T2900 and 2500 DIN rail controller
IOBase	The complete mechanical 2500 assembly - DIN rail mount, base etc.
IOBus	Internal controller to I/O module interface
IOC	Input/output controller

ION	Internal low-level input/output network
Parameter	A value stored in a database which is accessible via comms.
Parameterised	‘ Made accessible as a parameter
PID	Proportional + Integral + Derivative. Also called three term control
Program	Provide a list of general instructions to define operation
Programmable	Able to be programmed
PSU	Power Supply Unit
PRT or RTD	Abbreviation for Platinum Resistance Thermometer or Resistance Temperature Detector
SE	Strategy Engine (generic), or specific: the ISE (industrial) and PSE (process)
Snubber	A resistor and capacitor in series, connected across relay contacts, used to prolong contact life and reduce interference
SSR	Solid State Relay
TBD.	To be defined
TC or T/C	Abbreviation for thermocouple
Time proportioning	The control output (digital) switches with a variable on to off time