NetBiter® I/O Extender

4RO – 6RTD – 8DIO – DAIO – 8AIx – 8AIIx

User Manual

Revision 1.03

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1. AN OVERVIEW OF THE IO SYSTEM

1.1 Introduction

The NetBiter I/O Extender series provides a solution for distributed I/O requirements.

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

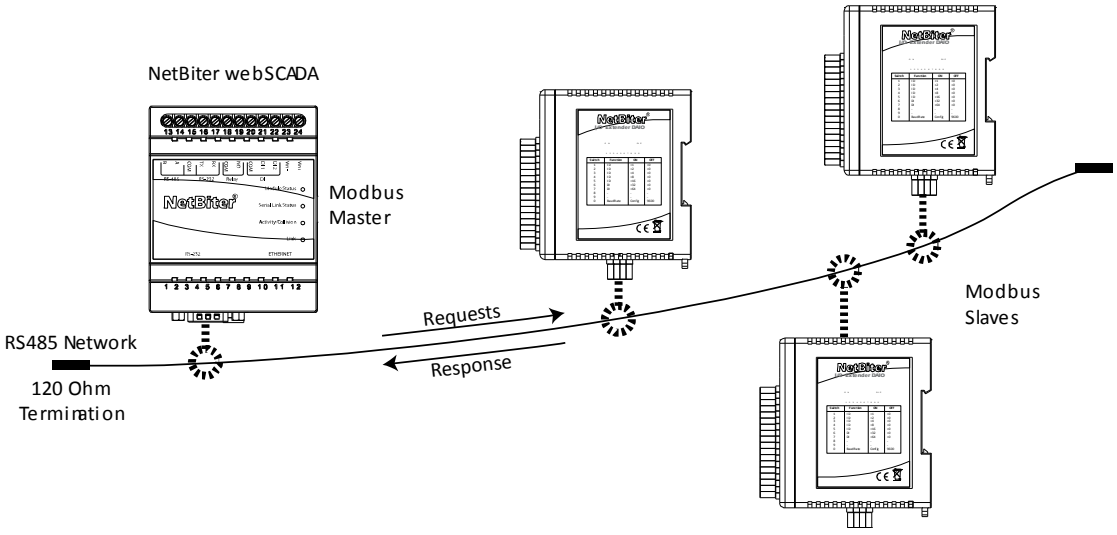
The modules communicate using the **MODBUS RTU** protocol. A 32bit ARM CPU is used in the modules to provide high speed data processing and fast communications turnaround times. Multiple baud rates are selectable from 2400 to 115200 baud.

All IO modules plug directly onto an industry standard DIN rail. All modules have a minimum isolation of 1000VAC rms between the field and logic.

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 Data Acquisition

The primary use of the NetBiter I/O Extender Modules is for Data Acquisition together with a NetBiter WebSCADA. The NetBiter WebSCADA is a MODBUS Master and can retrieve and send data from NetBiter I/O Extender Modules.



1.3 Module Selection Table

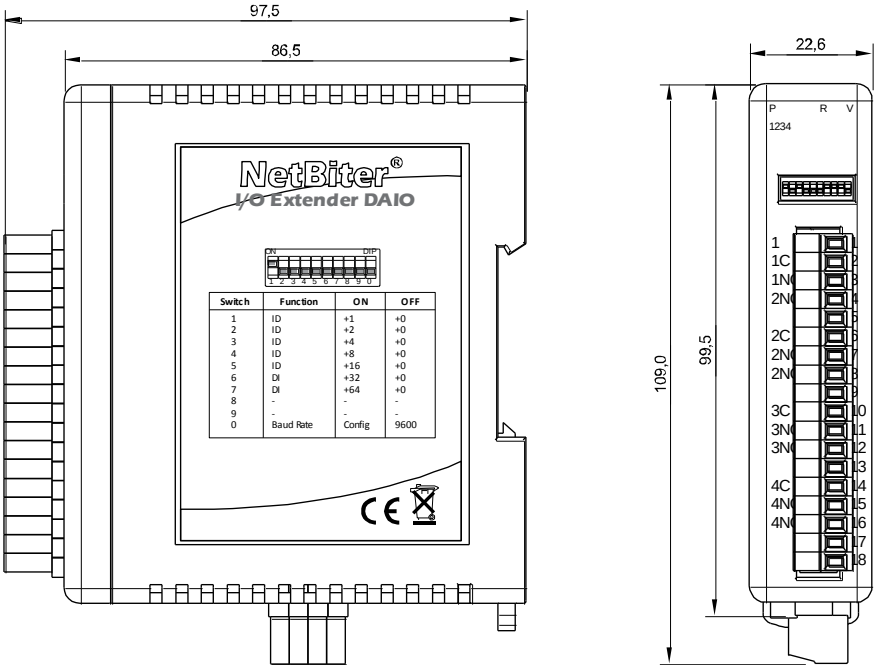
MODEL	MODULE TYPE
NetBiter I/O Extender 4RO	4 RELAY OUTPUT MODULE
NetBiter I/O Extender 8DIO	8 DIGITAL INPUT / 8 DIGITAL OUTPUT MODULE
NetBiter I/O Extender 6RTD	6 RTD INPUT MODULE - PT100, Ni120, PT1000, Ni1000, Ni1000LG & Ohms
NetBiter I/O Extender DAIO	2 RTD I/P, 2 ANALOG INPUT 0(4) - 20mA / 0(2) - 10V, 1 ANALOG OUTPUT 0(4) - 20mA / 0(2) - 10V, 4 DIGITAL INPUTS, 2 DIGITAL OUTPUTS

2. IO GENERAL INFORMATION

2.1 Physical Dimensions

The IO enclosure is shown below. The module clips directly onto an industry standard DIN rail. Field wiring is on the front of the module via a separate plug in connector. The module power and RS485 communications wiring is on a separate plug in connector on the bottom side of the housing.

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



2.2 Grounding/Shielding

In most cases, IO 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.

2.3 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.

2.4 Setting the Modbus Node ID

2.4.1 Node ID Table

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

	1	2	3	4	5	6	7
0							
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	1	2	3	4	5	6	7
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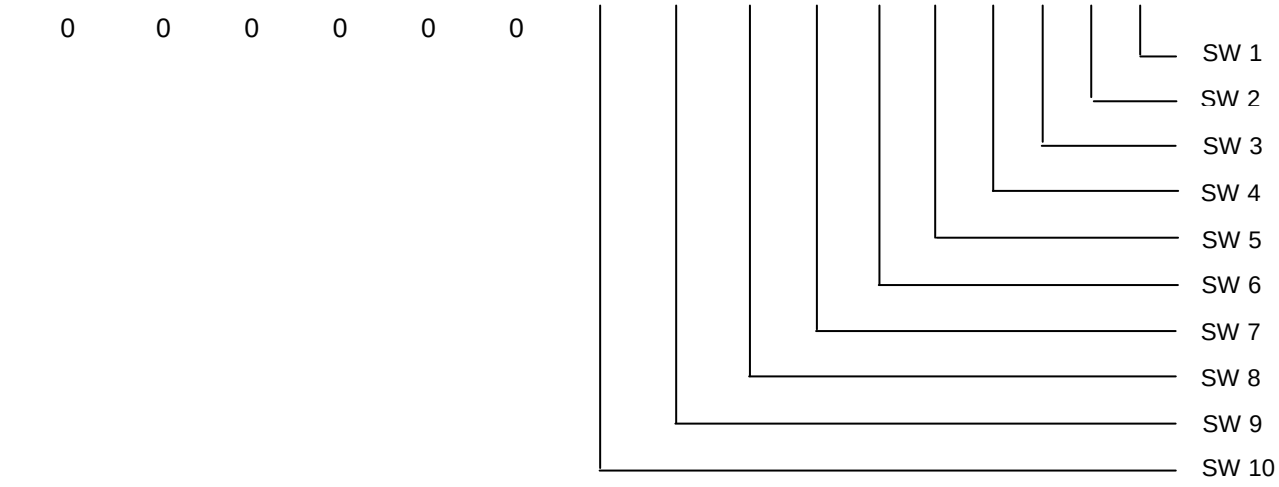
117							
118							
119							
120							
121							
122							
123							
124							
125							
126							
127							

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

2.4.2 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



2.5 Communications Settings

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

2.5.1 Communications Settings with DIP Switch 10 OFF (Default)

BAUD RATE	9600
DATA BITS	8
PARITY	NONE
STOP BITS	1

2.5.2 Communications Settings with DIP Switch 10 ON (Programmed Baud Rate)

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

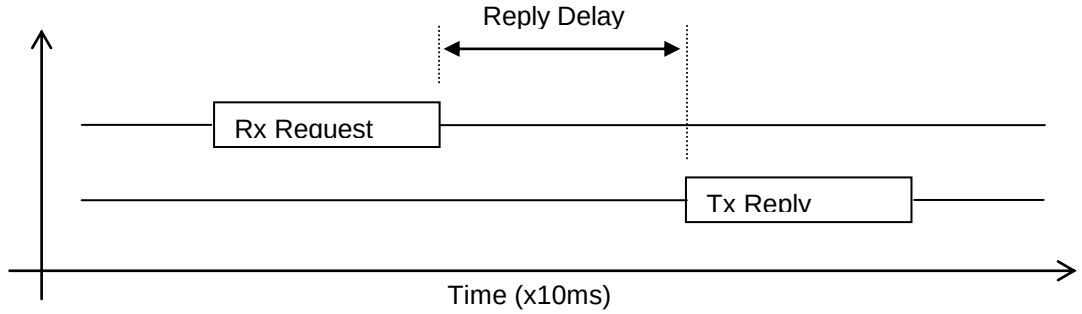
Note: These settings are changed from a Modbus Master device. During these changes, DIP switch10 should be OFF such that, the Master device can communicate with IO module on default communication settings.

2.5.3 Communications Settings Registers

40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,11520
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	65535	R/W	(x10ms)

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.

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 equipment.



2.5.4 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) (Holding type)	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.

3. IO MODULES

3.1 IOX-4RO - RELAY OUTPUTS

3.1.1 Description

The IOX-4RO module has 4 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.

When switch 9 is off, the module is configured as a slave module for the Modbus master device such as a PC / PLC / HMI. When used as a slave module, the outputs are written to by the Modbus master device such as a PC/PLC/HMI. 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.

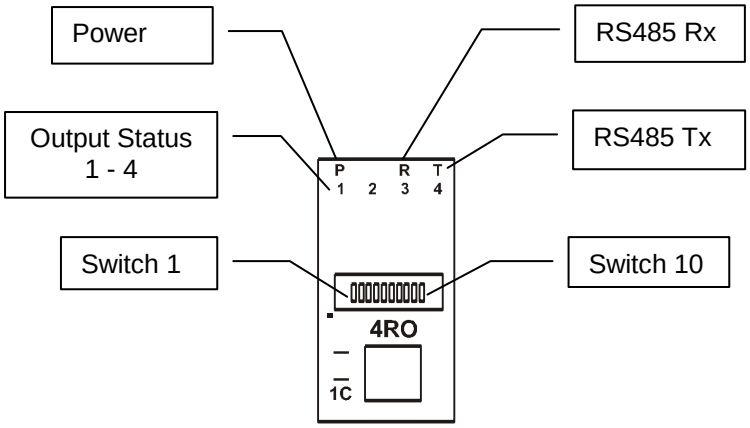
An output watchdog timer can be configured to switch off all the outputs if there has been no communications with the module for up to 255 seconds. A value of 0 seconds will disable this timer and the outputs will remain in the last programmed state.

3.1.2 Technical Specification of IOX-4RO

Power Supply	Logic Supply Voltage	24 Vdc
	Logic Supply Current	42 mA
Relay Outputs	Output Points	4
	Maximum Current	0.5A @ 220VAC / 1A @ 28VDC
	Isolation	1000Vrms between field and logic 1000Vrms between outputs
Temperature	Operating Temperature.	-10°C to + 50°C
	Storage Temperature	-40°C to + 85°C
Connectors	Logic Power and Comms.	4 Pin Connector on underside of unit
	Outputs	18 Way screw connector on front

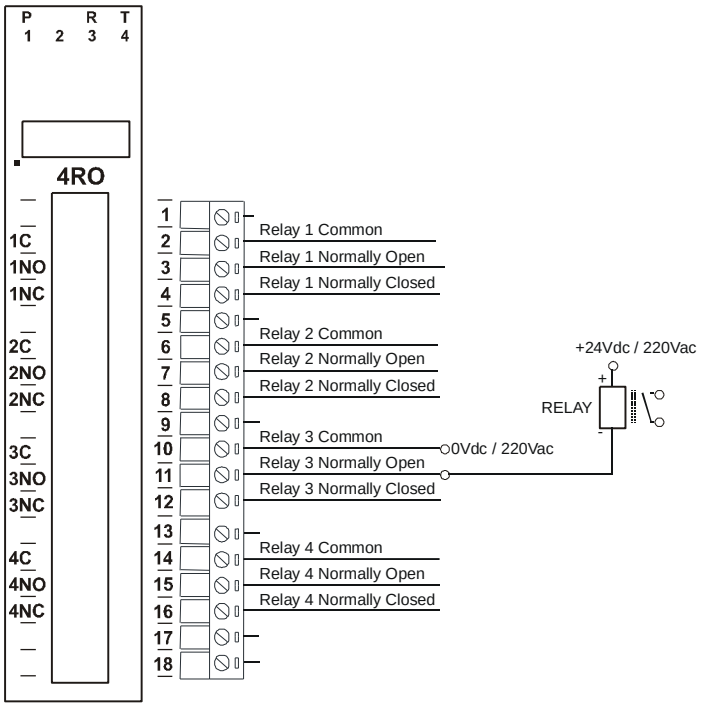
3.1.3 Status Indicators

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.
Output Status: "OFF" when the output is off
"ON" when the output is on.

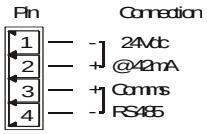


3.1.4 Wiring

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.



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



Note: If power/communication connections are reversed, module may become faulty.

3.1.5 Switch Setting

SWITCH	FUNCTION	DESCRIPTION
1	NODE ID +1	Node ID's from 0 to 127 are set up using switches 1 to 7
2	NODE ID +2	"
3	NODE ID +4	"
4	NODE ID +8	"
5	NODE ID +16	"
6	NODE ID +32	"
7	NODE ID +64	"
8	-	Not Used.
9	MODE	Slave (Off)
10	BAUD RATE	Selects 9600 (off) or Programmed Baud Rate (on)

3.1.6 IOX-4RO Data Registers (MODULE TYPE = 113)

Modbus Address	Register Name	Low Limit	High Limit	Access	Comments
00001	Relay Output 1	0	1	R/W	Status of Digital 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	"
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 113
40002	Digital Outputs	N/A	N/A	R/W	Digital Outputs in bits. 4(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	11520	R/W	2400, 4800, 9600,19200, 38400,57600,115200
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	65535	R/W	0 = Disable, >0 = Enable. (x10ms)

3.1.6.1 Relay Output Register

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

MSB					**IOX-4RO 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
-	-	-	-	-	-	-	-	-	-	-	-	4	3	2	1		

Relay Output

3.1.6.2 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.

3.2 IOX-8DIO - DIGITAL INPUTS / OUTPUTS

3.2.1 Description

The IOX-8DIO module is an 8 channel digital input and 8 channel digital output module.

The inputs are isolated from the logic by bi-directional opto-couplers. The common is connected internally to either the -volts or +volts field power supply terminals using a jumper link which is situated inside the housing.

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 counters can also be reset automatically when read. This is done by setting on DIP switch 9 on the front panel.

Note: The count values are not battery backed-up and will be lost if power is turned off.

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 8 digital outputs are open collector (NPN). 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 module may be configured as slave, where PC/ PLC/ HMI acting as master on the Modbus network. Dip switch 9 should be switched off to make this module as slave. Each output on the module 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.

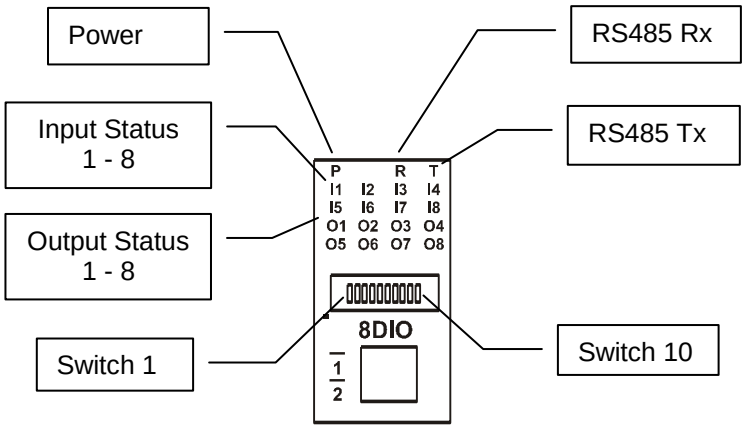
3.2.2 Technical Specification of IOX-DIO

Power Supply	Logic Supply Voltage	12 -24 Vdc
	Logic Supply Current	33mA @ 12V / 19mA @ 24V
	Field Supply Voltage	12 -24 Vdc
	Field Supply Current	6mA @ 12V / 6mA @ 24V
Digital Inputs	Input Points	8
	Input Voltage Range	12 -24 Vdc
	Input Current per input	5mA@12Vdc / 11mA @24Vdc
	Isolation	1500Vrms between field and logic
Digital Outputs	Output Points	8
	Maximum Voltage	36 Vdc
	Maximum Current	100 mA per output
	Vceon	1.1V Max.
	Isolation	1500Vrms between field and logic
Counters	Inputs	1 to 8
	Resolution	32 Bits
	Frequency	1KHz (max)
	Pulse Width	500us (min)
Temperature	Operating Temperature.	-10°C to + 50°C
	Storage Temperature	-40°C to + 85°C
Connectors	Logic Power and Comms.	4 Pin Connector on underside of unit
	Outputs	18 Way screw connector on front

Note: Inputs 1 to 8 are used as both digital inputs and counter inputs.

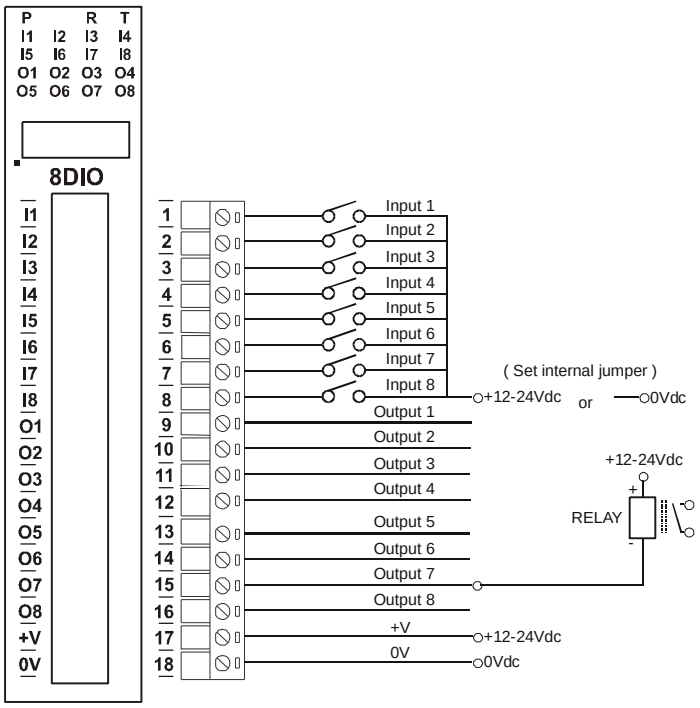
3.2.3 Status Indicators

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.
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.

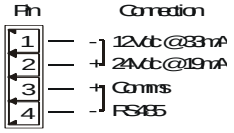


3.2.4 Wiring

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



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



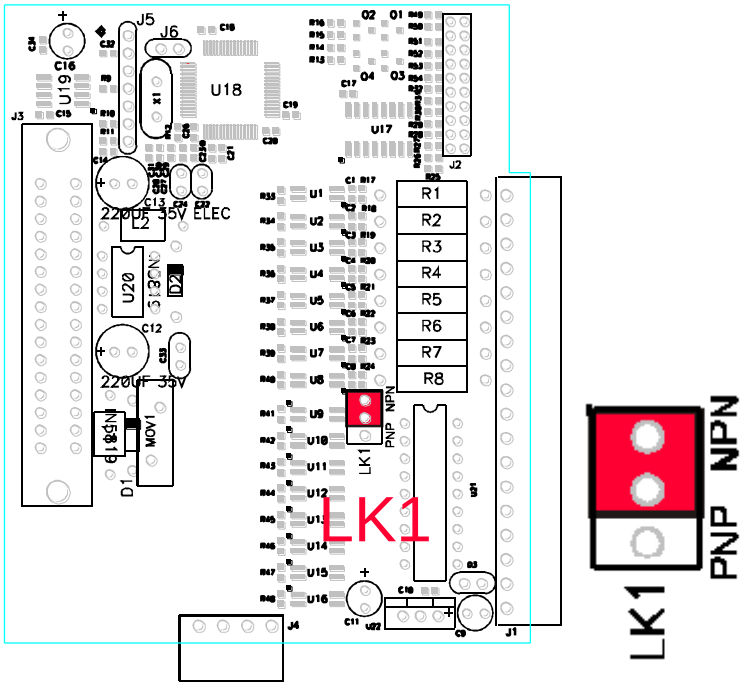
Note: If power/communication connections are reversed, module may become faulty.

3.2.5 Switch Settings

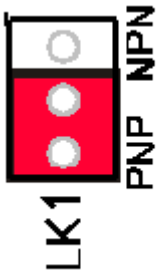
SWITCH	FUNCTION	DESCRIPTION
1	NODE ID +1	Node ID's from 0 to 127 are set up using switches 1 to 7
2	NODE ID +2	"
3	NODE ID +4	"
4	NODE ID +8	"
5	NODE ID +16	"
6	NODE ID +32	"
7	NODE ID +64	"
8	INVERT	When switched ON the status of the inputs is inverted in the Modbus status register (30002).
9	MODE	Off (Slave)
10	BAUD RATE	Selects 9600 (off) or Programmed Baud Rate (on)

3.2.6 Jumper Settings

The Digital inputs can be configured as NPN inputs. This means that the inputs can be operated by switching to 0V. Open the IO Module. Change the link **LK1** to the NPN position as shown below.



The Digital inputs can be configured as PNP inputs. This means that the inputs can be operated by switching to +12V to +24V. Open the IO Module. Change the link **LK1** to the PNP position as shown below.



3.2.7 IOX-8DIO Data Registers (MODULE TYPE = 102)

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	"
10007	Digital Input 7	0	1	R	"
10008	Digital Input 8	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	"
00023	Digital Output 7	0	1	R/W	"
00024	Digital Output 8	0	1	R/W	"
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 102
30002	Digital Inputs	N/A	N/A	R	Digital Inputs in lower 8 bits. 8 - 1.
40003	Digital Outputs	N/A	N/A	R/W	Digital Outputs in lower 8 bits. 8 - 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	"
40016	Counter 7 MSB	0	65535	R/W	"
40017	Counter 7 LSB	0	65535	R/W	"
40018	Counter 8 MSB	0	65535	R/W	"
40019	Counter 8 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	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
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	65535	R/W	0 = Disable, >0 = Enable. (x10ms)

3.2.7.1 Digital Input Register.

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

MSB					**IOX-8DIO 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

3.2.7.2 Digital Output Register

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

MSB					**IOX-8DIO 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

3.2.7.3 Counter Registers.

The counters are stored in 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 65535) + Counter Low Value.

3.2.7.4 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.

3.3 IOX-6RTD - RTD INPUTS

3.3.1 Description

The IOX-6RTD 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. All 6 RTD inputs adopt the same RTD type.

The DIP switch 9 is used to select upscale or downscale burnout for break detection. A value of 32768 is used to indicate upscale burnout and a value of -32767 is used to indicate downscale burnout.

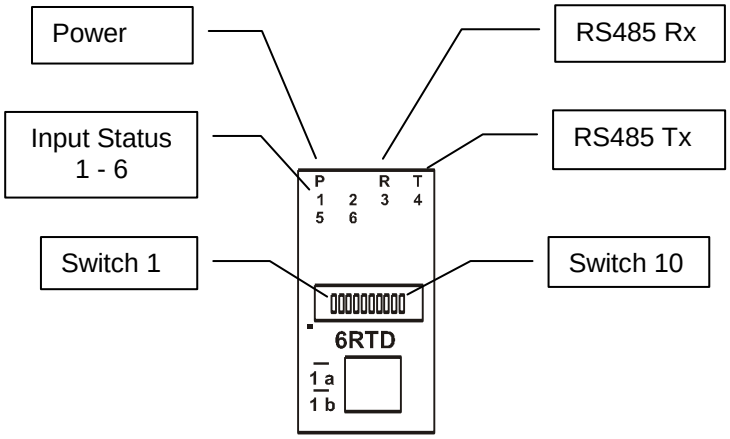
Note: As there is no inter-channel isolation, isolated RTD's must be used in order to prevent ground loops and reading errors.

3.3.2 Technical Specification of IOX-6RTD

Power Supply	Logic Supply Voltage		12 -24 Vdc	
	Logic Supply Current		87mA @ 12V / 45mA @ 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	
	Isolation		1500Vrms between field and logic	
RTD Type	**Number**	**Type**	**Range**	**Accuracy**
	1	PT100	-200 to 850°C	± 0.3°C,IEC 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	± 0.05%
	7	Ohms	100-4000ohms	± 0.05%
Temperature	Operating Temperature.		-10°C to + 50°C	
	Storage Temperature		-40°C to + 85°C	
Connectors	Logic Power and Comms.		4 Pin Connector on underside of unit	
	Inputs		18 Way screw connector on front	

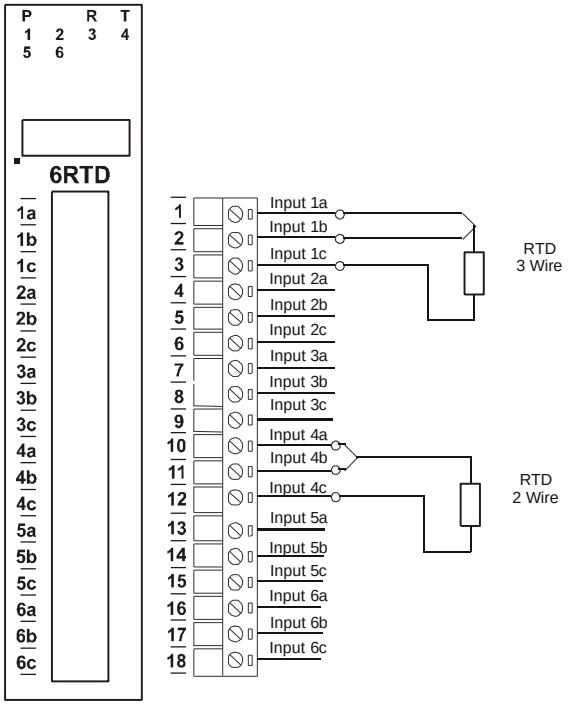
3.3.3 Status Indicators

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.
Input Status: "ON" when the RTD is open circuit.
"OFF" when the RTD is connected.

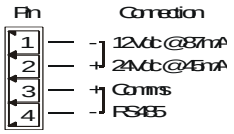


3.3.4 Wiring

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



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



Note: If power/communication connections are reversed, module may become faulty.

3.3.5 Switch Settings

SWITCH	FUNCTION	DESCRIPTION
1	NODE ID +1	Node ID's from 0 to 127 are set up using switches 1 to 7
2	NODE ID +2	"
3	NODE ID +4	"
4	NODE ID +8	"
5	NODE ID +16	"
6	NODE ID +32	"
7	NODE ID +64	"
8	-	Not used.
9	BREAK	RTD break. When switched off the RTD value will loaded with -32767 when the RTD is faulty. When switched on the RTD value will be loaded with 32768.
10	BAUD RATE	Selects 9600 (off) or Programmed Baud Rate (on)

3.3.6 IOX-6RTD Data Registers (MODULE TYPE = 109)

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 = 109
30002	RTD Input 1	-xxx.x	yyyy.y	R	RTD 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)
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40101	RTD Type	1	7	R/W	See RTD Tables.
40102	Line Frequency	50	60	R/W	Line Frequency
40103	Units Type	1	2	R/W	1=°C, 2=°F
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
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	65535	R/W	0 = Disable, >0 = Enable. (x10ms)

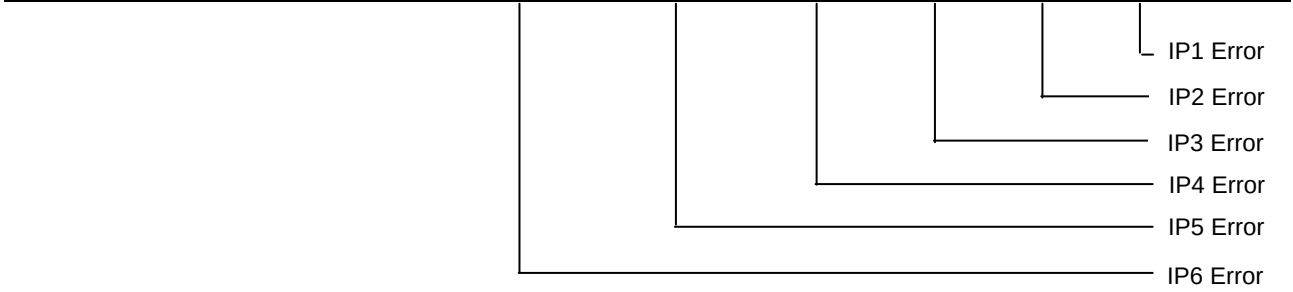
3.3.6.1 RTD Input Status.

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					**IOX-6RTD 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



3.4 IOX-DAIO – DIGITAL + ANALOG INPUTS AND OUTPUTS

3.4.1 Description

The IOX-DAIO module is a multipurpose combination of inputs and outputs. The module can accommodate either 2 or 3 wire RTD sensors, current (0-20mA) and voltage (0-10V) inputs, current (0-20mA) or voltage (0-10V) output, and digital inputs and outputs.

RTD INPUTS:

There are 2 RTD inputs on the module. 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.

A value of -32767 is used to indicate downscale burnout.

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

ANALOG INPUTS:

The Analog Inputs (2) can be configured by internal jumpers as either a current input (0-20mA) or a voltage input (0-10V).

An input of 0 - 20mA input current or 0 – 10V input voltage represents an output value of 0 - 4095 (12 bits) in the corresponding Modbus register.

ANALOG OUTPUT:

There is a single analog output which can be configured with internal jumpers for a current output (0-20mA) or voltage output (0-10V).

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.

DIGITAL INPUTS:

There are 4 digital inputs on the module. The inputs share a common terminal and can be configured for common positive or common negative.

The inputs have got counters associated with them. The counters operate in three modes.

In **mode 0** all the counters are disabled.

In **mode 1** all 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 while input 2 decrements counter1.

Note: The count values are not battery backed-up and will be lost if power is turned off.

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.

DIGITAL OUTPUTS:

The module has 2 open collector (NPN) digital outputs. The outputs may be used to drive lamps or external relays when more drive capability is required.

The outputs are written to by the Modbus master device such as a PC/ PLC/ HMI. 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.

3.4.2 Technical Specification of IOX-DAIO

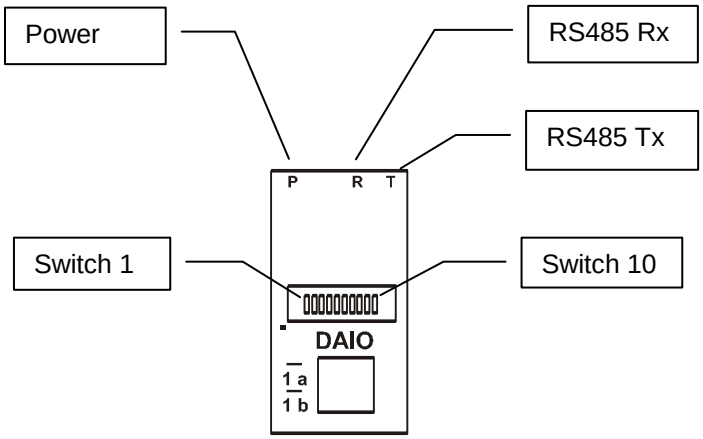
Power Supply	Logic Supply Voltage		12 -24 Vdc	
	Logic Supply Current		115mA @ 12V / 58mA @ 24V	
	Field Supply Voltage		24 Vdc	
	Field Supply Current		25mA	
RTD Inputs	Input Points		2	
	RTD Configuration		2 or 3 Wire	
	Resolution		0.1°C	
	Drift		100ppm/°C Typ.	
	Line resistance effect		< 0.1°C balanced	
	Max. line resistance		100ohms	
	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	± 0.05%
	7	Ohms	100-4000ohms	± 0.05%
Current Inputs	Input Points		2	
	Input Current		0(4) - 20 mA	
	Input Resistance		250ohms	
	Input Type	**Range**	**Resolution**	
	1	0 – 4095	12 bits	
	2	0–20.000mA	1uA	
	3	+/-20.000mA	1uA	
	Drift		100ppm/°C	
	Accuracy		0.2% of span	
	Isolation		1000Vrms between field and logic	
Voltage Inputs	Input Points		2	
	Input Voltage		0 - 1 Vdc or 0 – 10 Vdc	
	Input Resistance		190kohms	
	Input Type	**Range**	**Resolution**	
	4	0 – 4095	12 bits	
	5	0 – 10.000 V	1mV	
	6	+/- 10.000 V	1mV	
	7	0 – 1.0000 V	0.1mV	
	8	+/- 1.0000 V	0.1mV	
	Drift		100ppm/°C	
	Accuracy		0.2% of span	
	Isolation		1000Vrms between field and logic	
Current Output	Output Points		1	
	Output Current		0(4) - 20 mA	
	Output Type	**Range**	**Resolution**	
	1	0 – 4095	12 bits	
	Drift		100ppm/°C	
	Accuracy		0.05% of span	
	Compliance		1000 ohms max. @ 24Vdc 500 ohms max. @ 12Vdc	

Voltage Output	Output Points		1
	Output Voltage		0(2) - 10 V
	Output Type	**Range**	**Resolution**
	2	0 – 4095	12 bits
	Drift		100ppm/°C
	Accuracy		0.05% of span
	Compliance		2000 ohms min. load
Digital Inputs	Input Points		4
	Input Voltage Range		10 - 26 Vdc
	Input Current per input		4mA@12Vdc / 8mA @24Vdc
Counters	Inputs		1 to 4
	Resolution		32 Bits
	Frequency		50 Hz (max)
	Pulse Width		20 ms (min)
Digital Outputs	Output Points		2
	Maximum Voltage		36 Vdc
	Maximum Current		100 mA per output
	Vceon		1.1V Max.
Isolation	Between field and logic		1500Vrms between field and logic
Temperature	Operating Temperature.		-10°C to + 50°C
	Storage Temperature		-40°C to + 85°C
Connectors	Logic Power and Comms.		4 Pin Connector on underside of unit
	Inputs		18 Way screw connector on front

3.4.3 Status Indicators

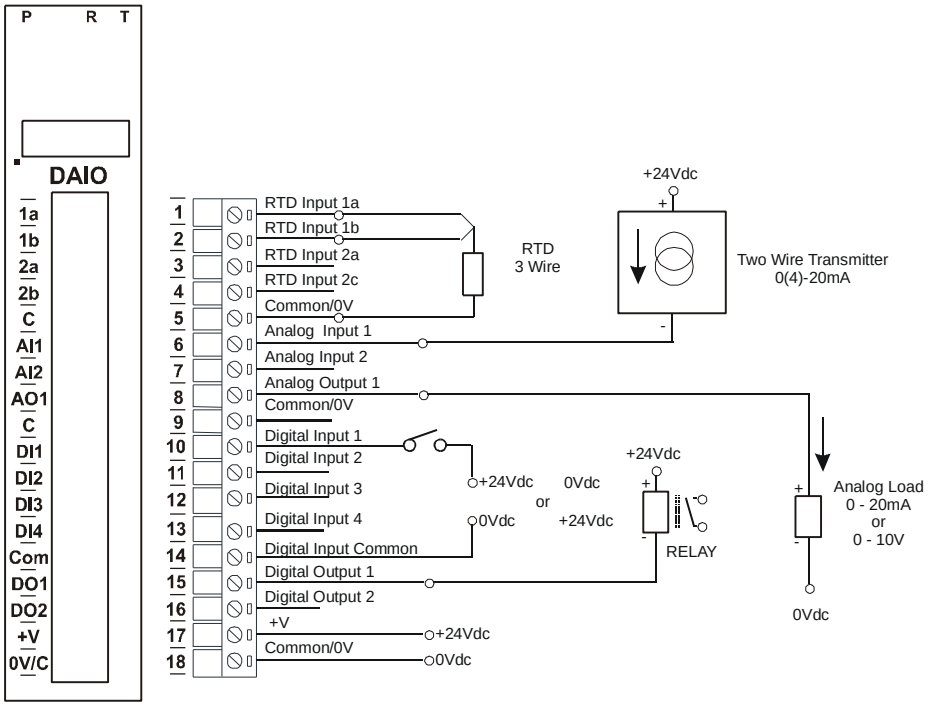
Power: "ON" when module has power.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.

*** Please note that LED status is not available for Digital and Analog IO's in IOX-DAIO Module**

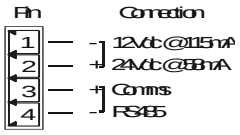


3.4.4 Wiring

The following diagram shows how the inputs and outputs are connected to the DAIO module.



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



Note: If power/communication connections are reversed, module may become faulty.

3.4.5 Switch Settings

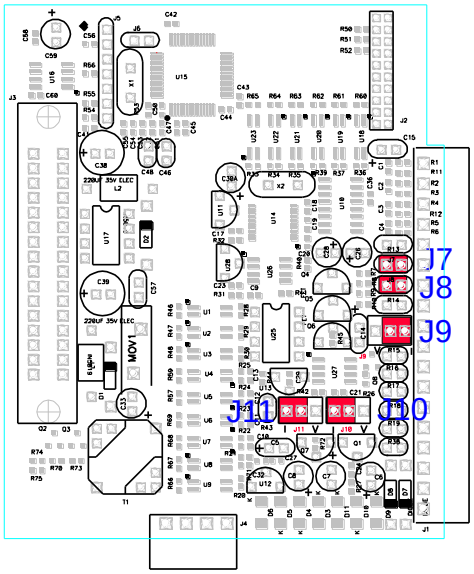
SWITCH	FUNCTION	DESCRIPTION
1	NODE ID +1	Node ID's from 0 to 127 are set up using switches 1 to 7
2	NODE ID +2	"
3	NODE ID +4	"
4	NODE ID +8	"
5	NODE ID +16	"
6	NODE ID +32	"
7	NODE ID +64	"
8	-	Not used.
9	-	Not used.
10	BAUD RATE	Selects 9600 (off) or Programmed Baud Rate (on)

3.4.6 Jumper Settings

3.4.6.1 Current Input and Output

The Analog inputs can be configured as a current 0(4)-20mA input by placing the jumper on **J7** for AI1 and **J8** for AI2.

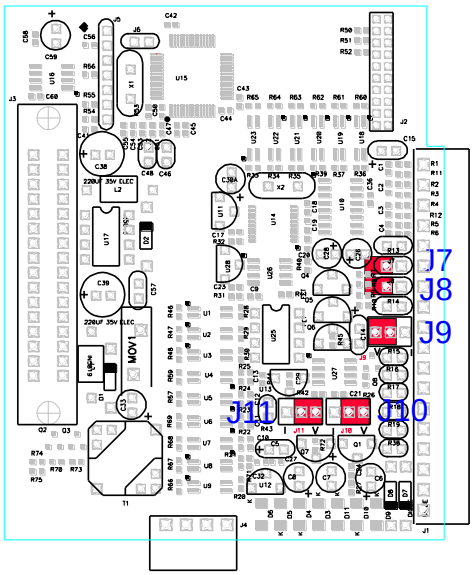
The Analog output can be configured as a current 0(4)-20mA output by placing the jumpers **J9**, **J10** and **J11** on the "**I**" position as shown below.



3.4.6.2 Voltage Input and Output

The Analog inputs can be configured as a voltage 0-10V input by removing the jumper from **J7** for AI1 and **J8** for AI2.

The Analog output can be configured as a voltage 0-10V output by placing the jumpers **J9**, **J10** and **J11** on the "**V**" position as shown below



3.4.7 IOX-DAIO Data Registers (MODULE TYPE = 112)

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	"
00017	Digital Output 1	0	1	R/W	Status of Digital Outputs.
00018	Digital Output 2	0	1	R/W	"
30001	S/W Version / Module Type	N/A	N/A	R	High Byte = Software Version Low Byte = 112
30002	Digital Inputs	N/A	N/A	R	Digital Inputs in lower 8 bits. 8 - 1.
40003	Digital Outputs	N/A	N/A	R/W	Digital Outputs in lower 8 bits. 8 - 1.
40004	RTD Input 1	-xxx.x	yyyy.y	R	RTD Inputs. See table for range.
40005	RTD Input 2	-xxx.x	yyyy.y	R	Resolution in 0.1°C.
40006	Analog Input 1	0	4095	R	Analog Input lower 12 Bits
40007	Analog Input 2	0	4095	R	Analog Input lower 12 Bits
40008	Analog Output 1	0	4095	R/W	Analog Output lower 12 Bits
40009	Counter 1 MSB	0	65535	R/W	Counter MSB and LSB combine to give a 32 bit
40010	Counter 1 LSB	0	65535	R/W	Counter with range 0 to 4294967295.
40011	Counter 2 MSB	0	65535	R/W	"
40012	Counter 2 LSB	0	65535	R/W	"
40013	Counter 3 MSB	0	65535	R/W	"
40014	Counter 3 LSB	0	65535	R/W	"
40015	Counter 4 MSB	0	65535	R/W	"
40016	Counter 4 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.
40102	Counter Mode	0	2	R/W	0=Disable, 1=Up Counting, 2=Up/Down Count
40103	Input Filter	0	65535	R/W	0 = Disable, >0 = Enable. (x10ms)
40104	RTD 1 Type	1	7	R/W	See RTD Tables.
40105	RTD 2 Type	1	7	R/W	See RTD Tables.
40106	AI 1 Type	1	8	R/W	(20mA): 1=0-4095, 2=0-20mA, 3=+/-20mA, (10V): 4=0-4095, 5=0-10V, 6=+/-10V, 7=0-1V, 8=+/-1V
40107	AI 2 Type	1	8	R/W	"
40108	AO Type	1	2	R/W	1 = 0-20mA, 2 = 0-10V
40109	Line Frequency	50	60	R/W	Line Frequency
40110	Units Type	1	2	R/W	1=°C, 2=°F
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
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	65535	R/W	0 = Disable, >0 = Enable. (x10ms)

3.5 IO-8AII and IO-8AIV - ANALOG INPUTS

3.5.1 Description

The Analog Input modules are supplied as either a current input module (IO8AII) or a voltage input module (IO-AIV). The inputs are isolated from the logic and share a common negative terminal.

The standard setting for the IO-8AII 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 offset switch is switched on.

The same applies to the IO-8AIV module. An input voltage of 0 - 10Volts represents an output of 0 - 4095 and 2 volts would give a reading of 819 ± 1LSB. To obtain an output value of 0 to 4095 for an input signal of 2 to 10V the offset switch is switched on. An input range of 0(1) to 5Vdc is available by removing the jumper link located on the analogue board inside the enclosure.

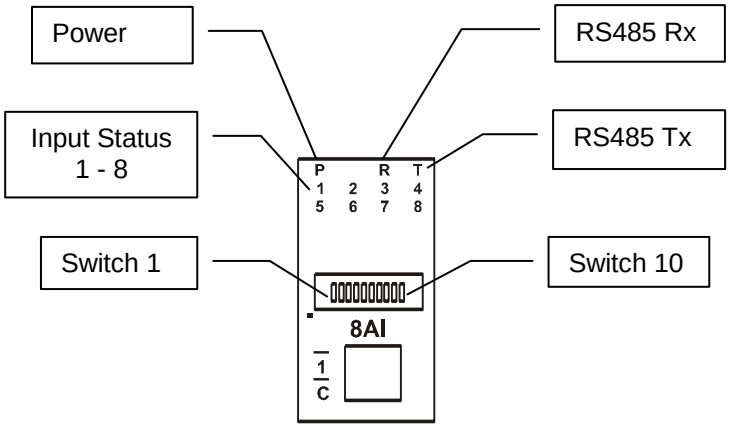
3.5.2 Technical Specification of IO-8AI

Power Supply	Logic Supply Voltage	12 -24 Vdc
	Logic Supply Current	27mA @ 12V / 16mA @ 24V
	Field Supply Voltage	12 -24 Vdc
	Field Supply Current	8mA @ 12V / 15mA @ 24V
Voltage Inputs – IO-8AIV	Input Points	8
	Input Voltage	0(2) - 10 Vdc or 0(1) - 5 Vdc
	Input Resistance	20kohms
	Resolution	12 bits
	Drift	50ppm/°C
	Accuracy	0.2% of span
	Isolation	1500Vrms between field and logic
Current Inputs – IO-8AII	Input Points	8
	Input Current	0(4) - 20 mA
	Input Resistance	250ohms
	Resolution	12 bits
	Drift	50ppm/°C
	Accuracy	0.2% of span
	Isolation	1500Vrms between field and logic
Temperature	Operating Temperature.	-10°C to + 50°C
	Storage Temperature	-40°C to + 85°C
Connectors	Logic Power and Comms.	4 Pin Connector on underside of unit
	Inputs	18 Way screw connector on front

3.5.3 Status Indicators

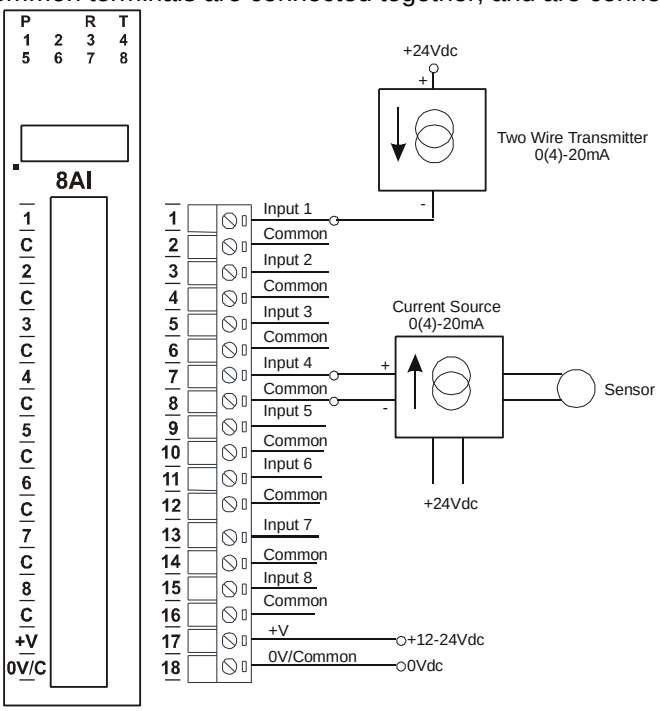
Power: Flashes to indicate the CPU is running.
RS485 Rx: Flashes to indicate the unit has received a valid Modbus message.
RS485 Tx: Flashes to indicate the unit has sent a Modbus message.

Input Status: "ON" when the input is zero.
"OFF" when the input is greater than zero and less than 4095.
"Flashing" when the input is over range, greater or equal to 4095

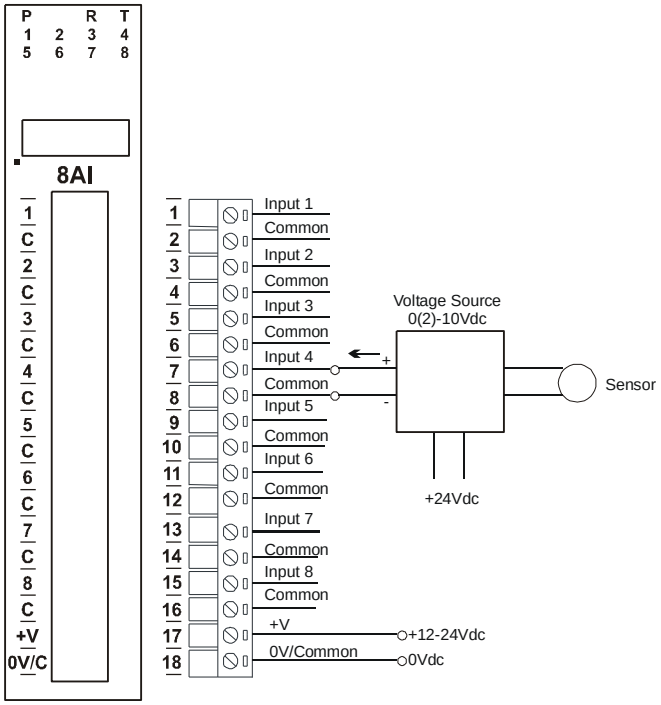


3.5.4 Wiring

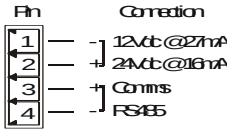
The following diagram shows how the analog inputs are connected to a 0(4)-20mA source. All of the common terminals are connected together, and are connected to 0V internally.



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.



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



Note: If power/communication connections are reversed, module may become faulty.

3.5.5 Switch Settings

SWITCH	FUNCTION	DESCRIPTION
1	NODE ID +1	Node ID's from 0 to 127 are set up using switches 1 to 7
2	NODE ID +2	"
3	NODE ID +4	"
4	NODE ID +8	"
5	NODE ID +16	"
6	NODE ID +32	"
7	NODE ID +64	"
8	-	Not used.
9	OFFSET	When switched ON the inputs scaled to accept a 2V or 4mA offset
10	BAUD RATE	Selects 9600 (off) or Programmed Baud Rate (on)

3.5.6 IO-8AI Data Registers (IO8AII TYPE = 103 / IO-8AIV TYPE = 104)

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 = 103(IO-8AII) or 104(IO-8AIV)
30002	Analog Input 1	0	4095	R	Analog Input lower 12 Bits
30003	Analog Input 2	0	4095	R	"
30004	Analog Input 3	0	4095	R	"
30005	Analog Input 4	0	4095	R	"
30006	Analog Input 5	0	4095	R	"
30007	Analog Input 6	0	4095	R	"
30008	Analog Input 7	0	4095	R	"
30009	Analog Input 8	0	4095	R	"
30010	Input Status	0	65535	R	bit2 = 0(open circuit or < 2), bit2 = 1(over range) bit1 = 0(OK),bit1 = 1(error)
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
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	65535	R/W	0 = Disable, >0 = Enable. (x10ms)

3.5.6.1 Analog Input Registers.

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

MSB				**IO-8AI 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)

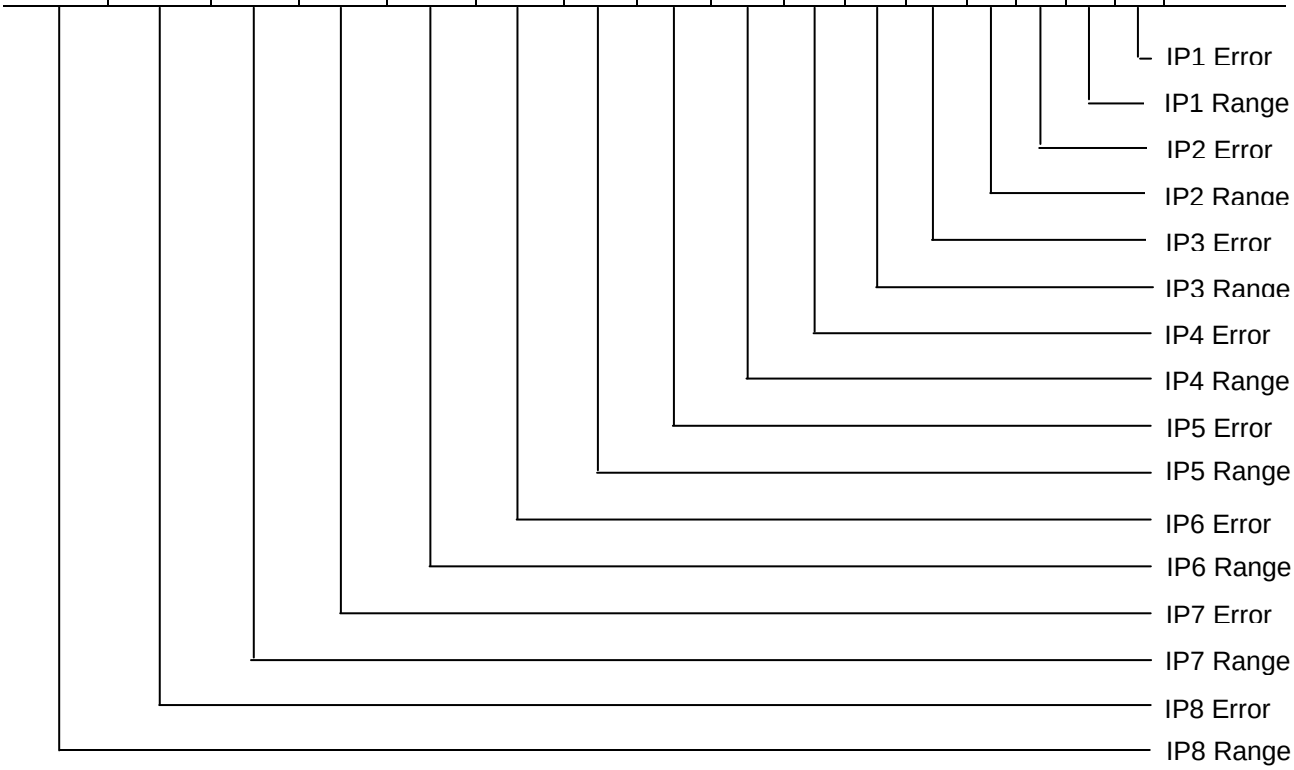
3.5.6.2 Analog Input Status

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 0-4095, 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				**IO-8AI 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 IO-8AIIS and IO-8AIVS - ISOLATED ANALOG INPUTS

3.6.1 Description

The Analog Input modules are supplied as either a current input module (IO-8AIIS) or a voltage input module (IO-8AIVS). 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 IO-8AIIS 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 offset switch is switched on. This module can also be configured for a 0 – 20.000mA input range or +/- 20.000mA input.

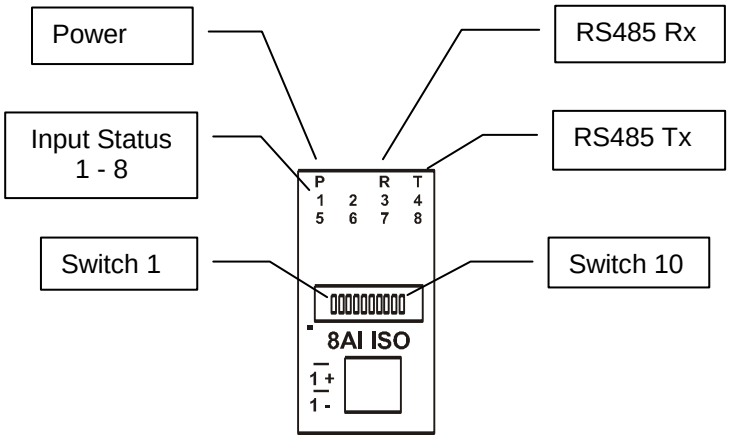
The same applies to the IO-8AIV module. An input voltage of 0 - 10Volts represents an output of 0 - 4095 and 2 volts would give a reading of 819 ± 1LSB. To obtain an output value of 0 to 4095 for an input signal of 2 to 10V the offset switch is switched on. This module can also be configured for a 0 – 10.000V input range or +/- 10.000V input.

3.6.2 Technical Specification of IO-8AIIS and IO-8AIVS

Power Supply	Logic Supply Voltage		12 -24 Vdc
	Logic Supply Current		58mA @ 12V / 31mA @ 24V
Voltage Inputs – IO-8AIVS	Input Points		8
	Input Voltage		0(2) - 10 Vdc
	InputType	**Range**	**Resolution**
	1	0 – 4095	12 bits
	2	0 – 10.000 V	1mV
	3	+/- 10.000 V	1mV
	4	0 – 1.0000 V	0.1mV
	5	+/- 1.0000 V	0.1mV
	Drift		100ppm/°C
	Isolation		1500Vrms between field and logic 350Vpeak between each input
Current Inputs – IO-8AIIS	Input Points		8
	Input Current		0(4) - 20 mA
	InputType	**Range**	**Resolution**
	1	0 – 4095	12 bits
	2	0–20.000mA	1uA
	3	+/-20.000mA	1uA
	Drift		100ppm/°C
	Isolation		1000Vrms between field and logic 350Vpeak between each input
Temperature	Operating Temperature.		-10°C to + 50°C
	Storage Temperature		-40°C to + 85°C
Connectors	Logic Power and Comms.		4 Pin Connector on underside of unit
	Inputs		18 Way screw connector on front

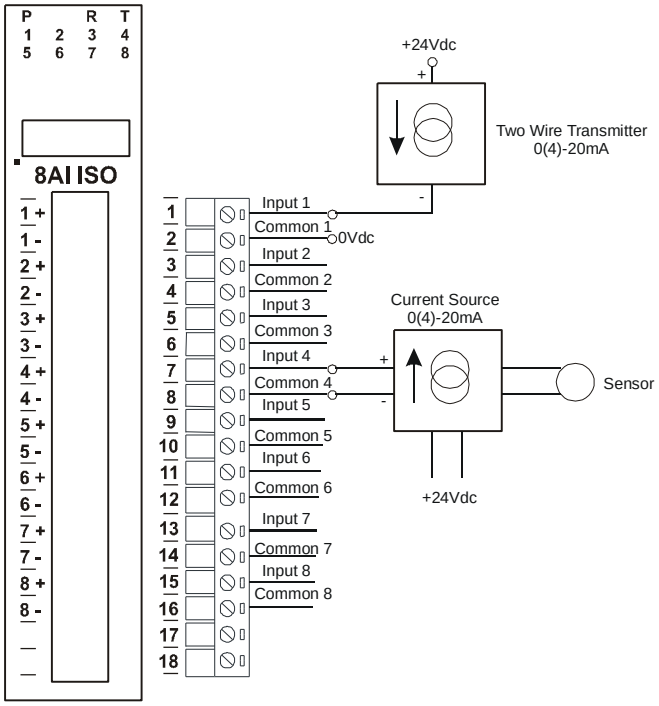
3.6.3 Status Indicators

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 4095.
"Flashing" when the input is over range, greater or equal to 4095

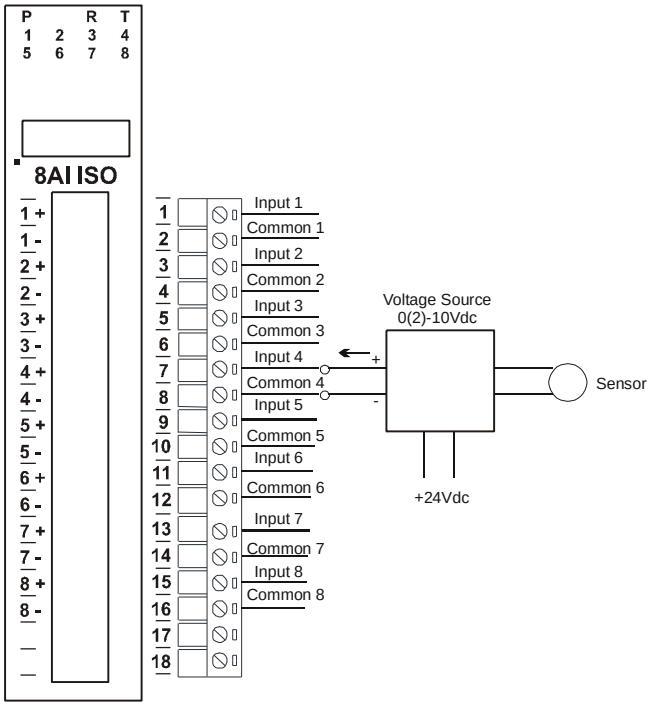


3.6.4 Wiring

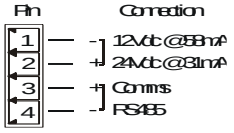
The following diagram shows how the analog inputs are connected to a 0(4)-20mA source. All of the common terminals are isolated from each other.



The following diagram shows how the analog inputs are connected to a 0(2)-10Vdc source. All of the common terminals are isolated from each other.



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



Note: If power/communication connections are reversed, module may become faulty.

3.6.5 Switch Settings

SWITCH	FUNCTION	DESCRIPTION
1	NODE ID +1	Node ID's from 0 to 127 are set up using switches 1 to 7
2	NODE ID +2	"
3	NODE ID +4	"
4	NODE ID +8	"
5	NODE ID +16	"
6	NODE ID +32	"
7	NODE ID +64	"
8	OFF SET	When switched ON the inputs scaled to accept a 2V or 4mA offset
9	OUT OF RANGE	An out of range is given when the input is too negative or too positive. When switched off the analog value will be loaded with -32767 when out of range. When switched on the analog value will be loaded with 32768 when out of range
10	BAUD RATE	Selects 9600 (off) or Programmed Baud Rate (on)

3.6.6 IO-8AIIS Data Registers (8AII TYPE = 107/8AIV TYPE = 108)

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 = 107(IO8AII) or 108(IO8AIV)
30002	Analog Input 1	0	4095	R	Analog Input lower 12 Bits
30003	Analog Input 2	0	4095	R	"
30004	Analog Input 3	0	4095	R	"
30005	Analog Input 4	0	4095	R	"
30006	Analog Input 5	0	4095	R	"
30007	Analog Input 6	0	4095	R	"
30008	Analog Input 7	0	4095	R	"
30009	Analog Input 8	0	4095	R	"
30010	Input Status	0	65535	R	bit2 = 0(open circuit or < 2), bit2 = 1(over range) bit1 = 0(OK),bit1 = 1(error)
30100	DIP Switch	0	65535	R	Status of DIP Switch on Front Panel
40121	Baud Rate	2400	11520	R/W	2400, 4800, 9600, 19200, 38400,57600,115200
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	65535	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				**IO-8AI 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)

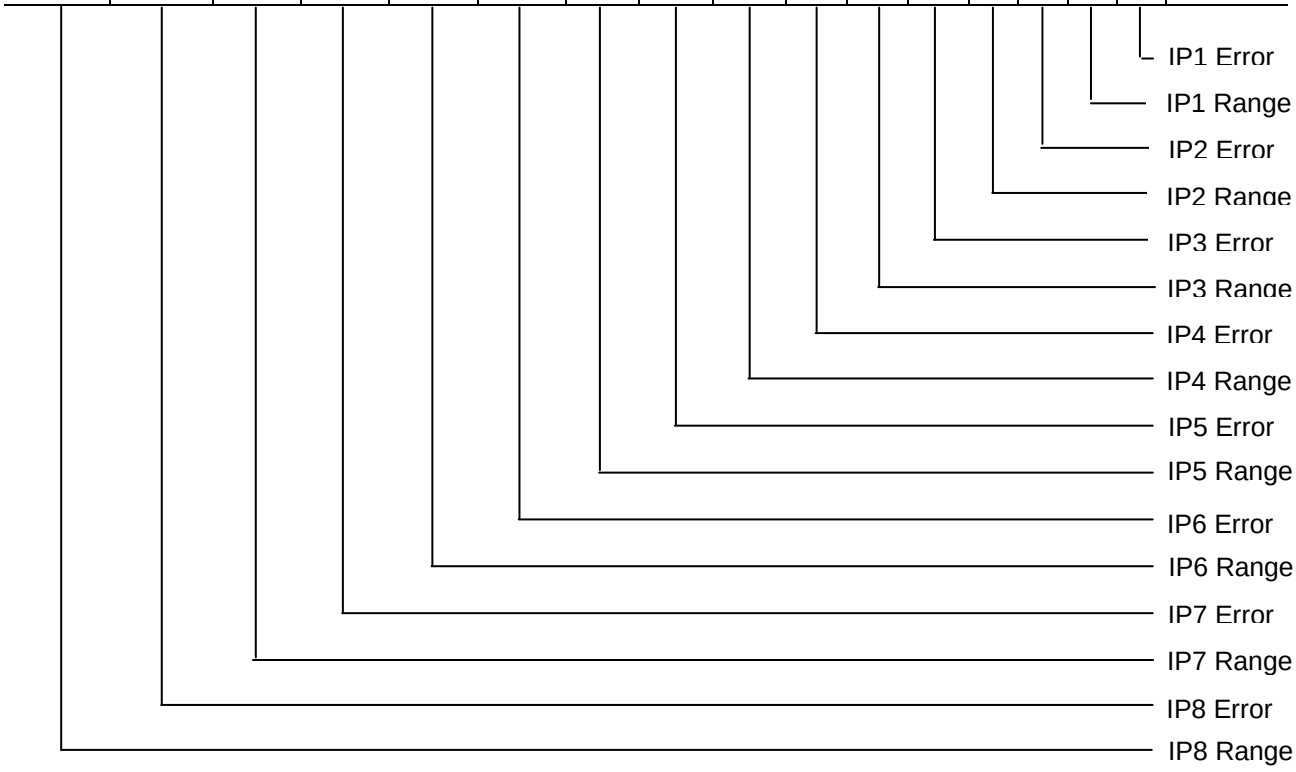
3.6.6.2 Analog Input Status

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 0-4095, 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				**IO-8AI 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



4. SPECIFICATIONS

4.1 ENVIRONMENTAL

Operating Temperature	-10°C to +50°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 120ohm 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 IO module as possible.