10 Sensors

The following chapter summaries some of the details for the many sensors that can be directly interfaced to the NetPod analogue input cards. This documentation is not meant as a dedicated guide for the choice of sensors but to help you select and explain various operating characteristics. The information has been provided in order to assist you to choose and setup the sensors required for use in your monitoring system:

Thermocouples: essentially compromise a thermo-element (a junction of two dissimilar metals) and an appropriate 2 wire extension lead. A thermocouple operates on the basis of the junction located in the processes of producing a small voltage which increases with temperature. It does so on a stable and repeatable basis.

Resistance Thermometers: utilise a precision resistor, the Ohms value of which changes with temperature. Most often changes increase the value of this resistance with increasing temperature. Most units have a positive temperature coefficient.

Thermistors: are an alternative group of temperature sensors which display a large value of temperature coefficient of resistance (usually negative, sometime positive). They provide high sensitivity over a limited range.

Strain Gauges: Consist of a thin aluminum or steel foil which is attached to a structure. The foil has the properties that the resistance changes with elongation or strain. The strain gauges are connected in a Wheatstone bridge configuration and powered with a constant voltage or current source.

The interface modules provide an accurate 2/2.5 volts bridge excitation level drive current to 20mA. The bridge can comprise of 4,2 or 1 strain gauges, together with 1,2 or 4 fixed resistors, forming quarter, half or full bridge circuits. Fixed resistors are already in place in the quarter and half bridge input modules.

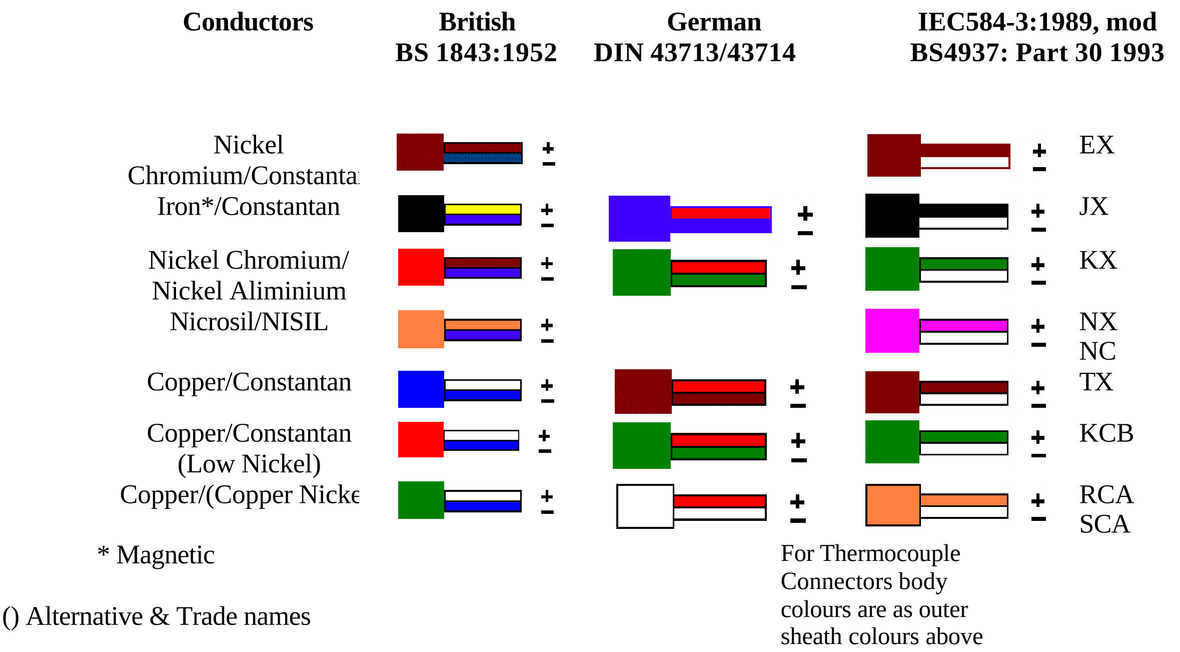
Pressure Sensors: The most common form of pressure sensor use a diaphragm with material that changes resistance with strain. In many cases the sensor contains signal conditioning that provides 4-20mA or 0-10V output.

Accelerometers: These sensors normally use piezo-electric, servo-accelerometer feedback or piezo-resistive materials to detect acceleration. All these sensor types are supported by the instrument range.

A range of excitation boards are available to directly energise sensors such are piezo-electric, servo or accelerometers directly from the instrument. These excitation boards can supply voltage or current sources.

10.1 Thermocouple Colour Code

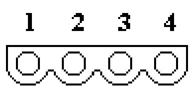
THERMOCOUPLE CONNECTORS, EXTENSION AND COMPENSATING WIRES AND CABLES



The British Standard Colour Code for Thermocouple cables, BS1843 : 1952 is superseded b BS4937 PART 30 1993 (=IEC 584-3 1989 modified)

When using thermocouples in water small electrochemical currents can develop, since the two metals produce an electrochemical cell. It is advisable in these circumstances to use insulated thermocouples.

Information provided in this documentation is intended as a general guidance and not necessarily deemed definitive. Every effort has been made to ensure the accuracy of the information presented but the user should refer to manufacturers data and published standard when procuring sensors.



Thermocouple Interface Pin-out diagram (Front view)

1 **Cold Junction Compensator (CJC)**
2 **Cold Junction Compensator (CJC)**
3 **-Ve Thermocouple Input**
4 **+Ve Thermocouple Input**

10.2 RTD Input Module

The RTD (Resistive Temperature Device) is a semi-conductor temperature sensitive device. The resistance of the RTD changes proportional to the applied temperature. A series of RTD interfaces are available for 2,3,4 wire configurations. A constant current circuit provides sensor engerisation. The low source current ensures that the self heating effect of the bias current is minimised. The RTD interface . pin-out is shown below:

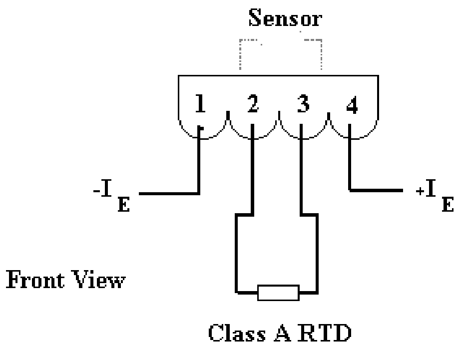


Figure 33 RTD Temperature Module - Pin-out

10.3 Sensors - Use & Configuration of Driver Software

The analogue input cards are capable of interpreting signals from a wide range of sensors. In order that the driver software can correctly process the input signals, it has to be told what type of sensor or signal is being applied to an input.

Follow the instructions listed below to assign the different sensor information:

10.4 Instructions - Assigning Sensor Types

1) Ensure that the driver software has stopped gathering data.

2) Select the Pod whose analogue input channels you are going to configure.

3) From the **Edit Channel** window select the Setup button.

You will now be presented with the **Sensor Setup** Window

4) Select the Sensor/Input signal type from the Tab marks at the top the screen.

Note. The driver software will restrict your choices automatically to those permissible for a given input card. For Example, T & K type thermocouples use the same software look-up tables and so you will only be able select T or K from the user menu.

Voltage Measurement
Current Measurement
Temperature (RTD) Measurement
Temperature (Thermocouple) Measurement
Strain Measurement
Resistance Measurement

5) Select the **OK** button. The Sensor parameters will be activated and the Sensor Setup will close.

Close the **Edit Channel** window. You will now be back at the main driver window.

10.5 Servo Accelerometer – Sensor Type Assignment

The servo accelerometer analogue interface NPAI24-SRV*G (G=gain)* card will appear as a voltage input within the PodMng driver sensor setup menu. See page for further information.

10.6 Piezo Electric Accelerometer – Sensor Type Assignment

The piezo electric sensor interface cards NPAI24-PE*G (G=gain)* will appear as a voltage input within the PodMang driver sensor setup menu. See page for further information.

10.7 Strain Gauge - Constant Current Interface Sensor Type Assignment

The constant current strain gauge interface NPAI24-SGC1 card will appear as a strain gauge type sensor within the PodMng driver sensor setup menu. See page for further information.

11 Technical Specifications

11.1 Technical Specifications

The following chapter details the technical specifications for the various analogue and digital interfaces.

11.2 Analogue Input Module Specifications - Features

The Keynes Controls NetPod system utilises both 16 and 24 bit analogue input modules to undertake signal measurements. All of the input modules regardless to sensor interface, ADC resolution and sample rate have the following features in common:

1) **Opto-isolation - Except High Speed ADC Card**
2) **Sample rate tracking anti-alias filters.**
3) **Integral Sigma Delta ADC on each input module.**
4) **Instantaneous sample & hold per channel - No Mux**
5) **EEPROM configuration storage memory. Retains settings even after power off or removal.**

The instruments are highly suited to dynamic as well as static measurement systems. The high phase match between channels, caused by using instantaneous sampling across the input modules, ensures that no additional processing of the recorded information need be performed to correct for phase distortions through the signal conditioning.

Opto-isolation ensures that incorrect wiring of signals to the input units will prevent damage to the system occurring. Any damage that may occur due to negligent connections will be limited to a single channel. All other inputs will function normally.

11.3 Analogue Input Module - Pin-out

Both the 16 bit low sample rate and 24 bit high resolution analogue input modules have identical pin-outs.

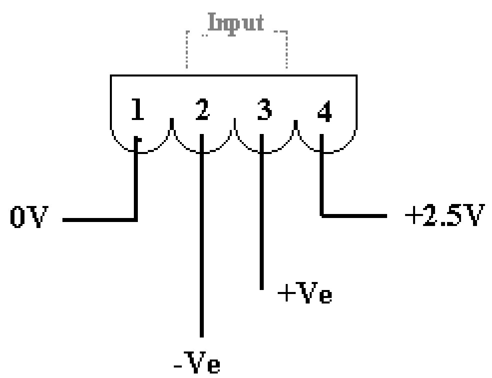


Figure 34 Analogue Input Module - Pin-out

11.4 16 Bit ADC Input Modules - Specifications

The following page summarises the technical specification for the 16 bit ADC modules. The 16 bit ADC cards provide the lowest resolution of any of the Keynes Controls data acquisition cards. Two different modes of operation are available with the 16 bit input cards:

1) Low cost - simple low resolution input modules
2) High Speed - 78 KHz burst mode acquisition.

11.5 Low Cost - 16 Bit Module

The low cost 16 bit modules can be supplied as a low cost option for distributed data acquisition and control operations. The low cost modules provide all of the standard features of their higher resolution counter parts but are limited to a maximum sample rate of 60 Hz/Chan.

11.6 Standard Features

Each of the analogue input cards contain integral signal conditioning, over voltage protection, opto-isolation and sample rate tracking anti-alias filters. The on board EEPROM memory records channel configuration details. Cards can be removed, inserted in further units and updated without loss of their configuration details:

11.7 24 Bit ADC Input Module - Specifications

The following page summarises the technical specification for the 24 bit ADC module. The 24 bit ADC card provides the highest resolution of any of the Keynes Controls data acquisition cards and is ideally suited for low level signal measurements.

Each of the analogue input cards contain integral signal conditioning, over voltage protection, opto-isolation and sample rate tracking anti-alias filters. The on board EEPROM memory records channel configuration details. Cards can be removed, inserted in further units and updated without loss of their configuration details:

11.8 24 Bit ADC Input Module (Standard) – Technical Specification

The following section lists the current operating specifications

Sample Rate:	1KHz (Max) Standard - Per Channel 2 KHz (Optional)
CMRR:	160 dB
Isolation:	500 VRMS (1500V) Q3 1999
Power Requirements:	100 mA (Max)
Input Range (Voltage):	V1:± 4.5V (Nominal 5V) V2: ± 50.0V V3: ± 500 V V4: ± 300 mV (Ultra High Resolution)
Accuracy:	0.15%
Pre-amp Gain:	1,2,4,8 (sample rate limited)
Resolution:	V1: 0.6 mV V2: 6.0 mV V3: 60.0 mV V4: 6 nV
Input Offset:	V1: ± 1 mV/°C V2: ± 10 mV/°C V3: ± 1 mV/°C
Stability:	V1: 1 ppm//°C V2: 10 ppm//°C
Input Impeadence:	V1: 20 M? V2 & V3: 2 M? 1 G? ??up on request
Overload:	250 V rms
Drive Current:	± 80 mA. Suitable for 4-20, 0-60 mA current loops
Accuracy:	0.02 % (Current loop)

11.9 Strain Gauge Input Card Specifications

The following page summerises the technical specifications for the strain gauge analogue input boards.

Specifications – SGA1 module (24 Bit)

CMMR	160 dB
Gain:	Same as voltage Inputs. 1,2,4,8,
Maximum Input Voltage:	± 2.5V,±1.5V,± User Defined V
Bridge Excitation	2.5V
Bridge Excite Noise	0.05 mV
Drive Current to:	10 mA
Load Regulation	< 0.0005%
Drift	2.0 ppm/°C
Short Circuit Current:	30 mA
Operating Temp:	0 - 60 °C
Full & ½ Bridge:	120,350, 700 ? ?
Frequency Range:	0 - 250 Hz (Standard)
Dynamic Response:	Sinc Filter.
Linerarity:	± 0.05 % ± 2 mE

Zero balance is carried out by software operations and is not part of the hardware signal conditioning Filter modules available in most applications software can be used for this task. All configuration parameters are stored in EEPROM just as in any other NetPod analogue Module.

Specifications – SGA2 module (24 bit)

Only available in 24 Bit cards

CMMR	160 dB
Gain:	Same as voltage Inputs. 1,2,4,8
Maximum Input Voltage:	± 2 mV
Bridge Excitation:	2.0V with 350 Ohm Load
Bridge Excite Noise:	< 0.05 mV
Drive Current	5.8 mA
Load Regulation	< 0.0005%
Drift:	2.0 ppm/°C
Short Circuit Current:	30 mA
Operating Temp:	0 - 60 °C (temperature controlled environment to extend range)
Full & ½ Bridge:	120, 350 ? ?
Frequency Range:	0 - 250 Hz (Standard) 24 Bit Unit
Dynamic Response:	Sinc Filter.
Linerarity:	± 0.05 % ± 2 mE

Zero balance is carried out by software operations and is not part of the hardware signal conditioning. Filter modules available in most applications software can be used for this task. All configuration parameters are stored in EEPROM just as in any other NetPod analogue Module.

11.10 Strain Gauge Applications

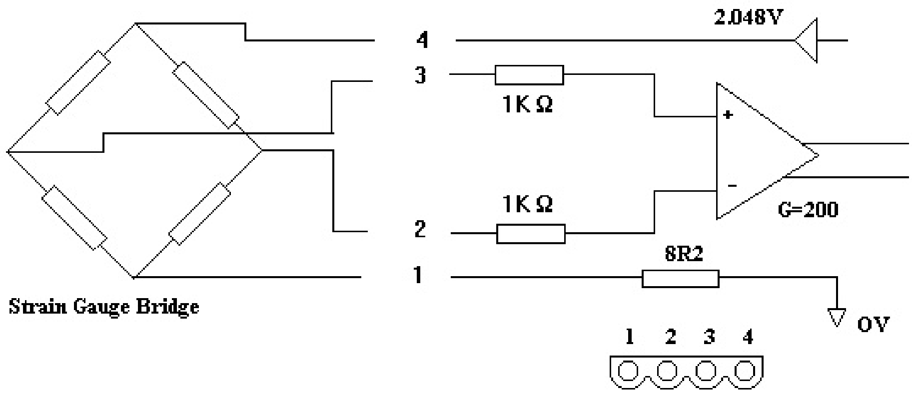
Strain monitoring can be carried out using most types of popular strain gauges. The signal conditioning units provided suitable energisation for most bridge configurations using constant voltage, ultra high stability supplies.

The signal conditioning boards can except gauges of resistance 120 ? ??? ? ?? ??? ? ?? ?and others on request.

Part Number	Signal Conditioning Board
16 Bit Card	
NPAI16-SG1	¼ and ½ Bridge
NPAI16-SG2	Full bridge
NPAI16-SG3	Full bridge with external Ref.
24 Bit Card	
NPAI24-SG1	¼ and ½ Bridge

11.11 Strain Gauge interface Modules – 24 Bit Constant Current & Precision Voltage Source

All of the full bridge strain gauge interface connection schematics are identical. The diagram below shows the bridge connections for the constant current strain gauge interface



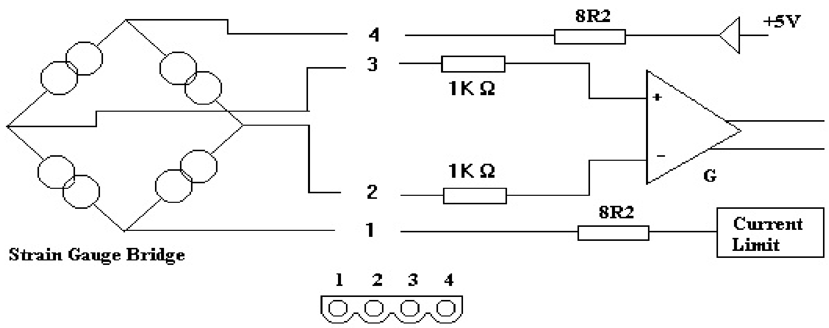
Pin-outs SG2A Interface module

1 = 0V
2 = -Ve Differential Input
3 = + Ve Differential Input
4 = Excitation Source

This module utilises precision 2.00V Bridge excitation.

Figure 35 Full Bridge Voltage Excitation Strain Gauge Connection Schematic

Part No: NP24AI24-SGC *W* *where w = gain*



Pin-outs SGC1 Interface module

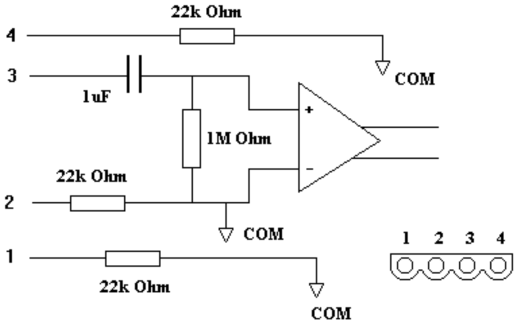
5 = 0V
6 = -Ve Differential Input
7 = + Ve Differential Input
8 = Bridge Excitation Source

Drive current for interface is:

350 ? Bridge = I_{drive} = 2.5/350
= 7 mA

Figure 36 Full Bridge Constant Current Excitation Strain Gauge Connection Schematic

11.12 PE1 – 24 Bit Piezo Electric Module Connection Schematic



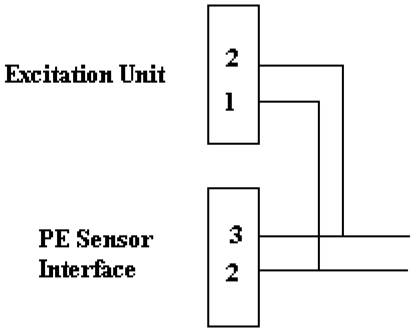
Front

Figure 37 Connection schematic for Piezo Electric Interface card

Part Number details
PE = Piezo Electric
G = Gain

NPAI24-PEG so
NPAI24-PE1 has a gain of 1

Pin connections
1 = Shield Common
2 = -Ve Differential Input
3 = +Ve Differential Input
4 = Shield Common



Fron

The diagram opposite shows how the constant current excitation interface is connected to the Piezo electric sensor.

Eac . Use pins 3 and 4 on the interface to drive the second channel.

Figure 38 Current Excitation Board Installation Schematic

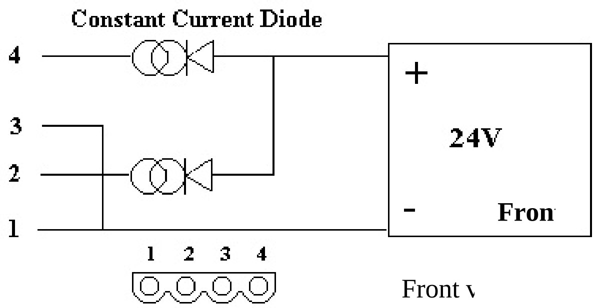


Figure 39 Circuit Schematic constant current excitation board

The diagram opposite shows the schematic for the constant current excitation module. As you will observe the interface modules support 2 channels each.

Max Drive Current: to 40 mA/channel

11.13 24 Bit Piezo Electric Interface - Technical Specifications

The following section summaries the operating specification of the piezo electric interface.

Sample Rate:	1KHz (Max) Standard - Per Channel
CMRR:	160 dB
Isolation:	1500V Standard
Power Requirements:	100 mA (Max)
Input Range (Voltage):	± 1.5V @ 10 Hz
Accuracy:	0.15%
Pre-amp Gain:	1,2,4,8 (sample rate limited)
Resolution:	1 ?V
Input Offset:	V1: ± 1 mV/°C
Stability:	V2: 10 ppm//°C
Input Impeadence:	1 M? ??AC???? G? (DC?
Overload:	30 V rms
LPF time constant:	1 S

Note. For details on a 16 bit servo accelerometer card please contact Keynes Controls for further information.

11.14 24 Bit Servo Accelerometer Module Connection Schematic

The following section summaries the operating technical specifications for the 24 bit servo accelerometer interface.

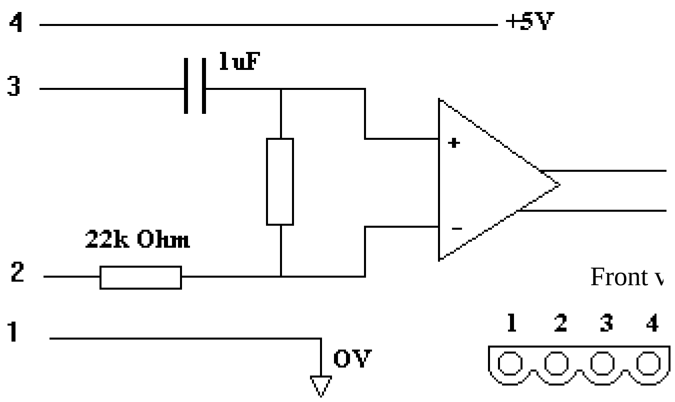


Figure 40 Servo Accelerometer Connection Schematic

Part Number details
SRV = Servo accelerometer
G = range in G

Sensor with range of 2g is
NPAI24-SRV2 accepts signals to 2g

Pin connections
1 = +5V @ 20 mA
2 = -Ve Differential Input
3 = +Ve Differential Input
4 = Shield Common

11.15 24 Bit Servo Accelerometer - Technical specification

The following table summerises the operating specification for the 24 bit servo accelerometer card.

Sample Rate:	1KHz (Max) Standard - Per Channel 2 KHz (Optional)
CMRR:	160 dB
Isolation:	1500V
Power Requirements:	100 mA (Max)
Input Range (Voltage):	V1: ± 2V
Accuracy:	0.15%
Pre-amp Gain:	1,2,4,8 (sample rate limited)
LP Filter Time Constant:	10 Seconds
Resolution:	1 uV
Stability:	V2: 10 ppm//°C
Input Impeadence:	V1: 10 M?
Overload:	250 V rms
Accuracy:	0.02 %
Imax Drive Current 5V Supply:	20 mA

11.16 24 bit High Input Impedance Card – NPAI24HZ-10V

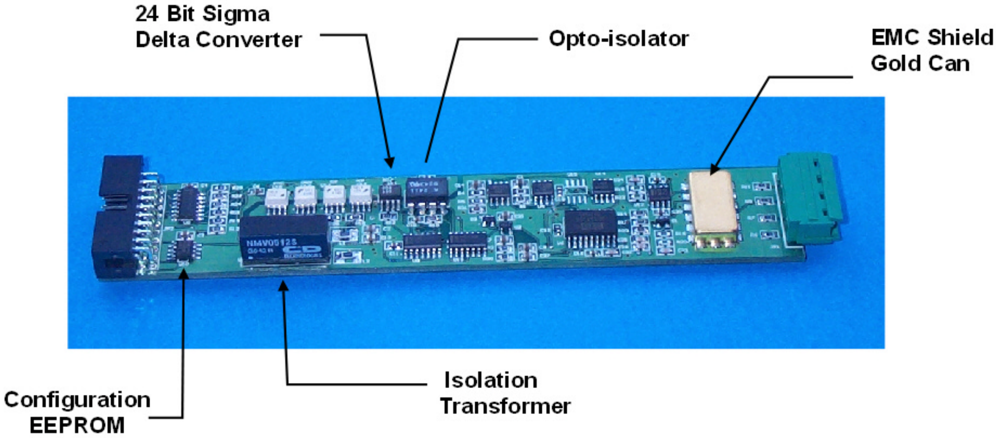


Figure 41 High Impedance 24bit Voltage Input

The NPAI24HZ-10V card is the Keynes Controls high input impedance card for use with the NetPod 4000 instruments.

Technical Specifications

Sample Rate/Channel		**Peak-Peak Nose uV**		**RMS Noise uV**
1 Hz		15.9		3.0
10 Hz		37.1		6.3
100 Hz		81.6		16.5
1 KHz		700.1		156.6

Input Range	0 – 10V DC
Opto-isolation	> 2000V DC
Input Impedance Power On	> 100 G Ohm
Input Impedance Power Off	> 10 M Ohm
ADC	24 Bit Sigma Delta
Sample Rate	1 KHz/channel (2 KHz/channel optional)

11.17 Operations

Due to the high input impedance of this card any input not in use should have pins 2 & 3 shorted together. This action is required as the input amplifiers may not settle correct level after being attached to a floating input not connected to any load and is a feature of this type of card.

Pin 2 = -Vin Pin 3 = +Vin for full differential inputs.

The inputs are the same on this card as any other voltage input module.

11.18 Digital Interfaces

The following chapter details the technical specifications, software configuration and operations of the various digital interfaces.

11.19 Digital Port Operations - What can I do

The NetPod supports both digital input and output boards. The input board status levels can be examined to see if a high signal level "1" is being applied to a port. The output port levels can be checked to see if a high "1" is being supplied to an output.

These operations are generally carried out by application software. The tests available within the driver software are only provided to give you an over view of what a system is doing. The driver software is limited to examining a single instrument at any one time.

11.20 Triac Interface Modules

The triac interface module - Part No. **NP4212-TRC** fits into any of the digital interface ports and is used to switch power circuits under control of the digital I/O interface.

The triac board acts as a solid state switch. The triac takes a power input circuit and passes the power to a load circuit up on command. Changing the output port status from low to high i.e. setting the port for output operations will cause the input power to be applied to the load circuit.

Each triac module contains only a single interface channel and is the only interface module that is a single channel device.

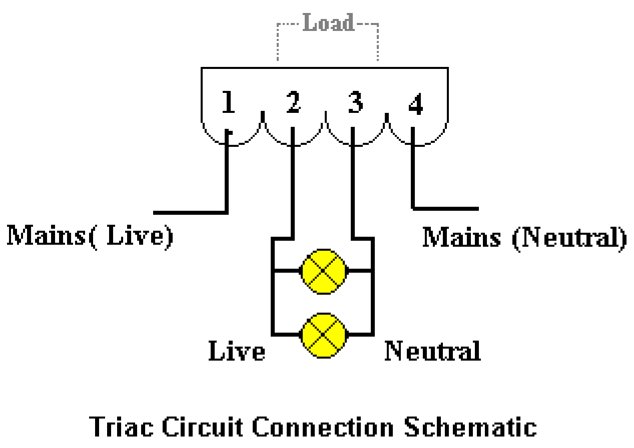


Figure 42 Triac Connection Schematic

This control module consists of a single triac with a zero voltage crossing detector. The triac is opto-isolated from the main chassis, and writing a "1" to the digital output register will cause the triac to trigger on the next zero crossing cycle.

A jumper JP1 on the board selects the operating voltage to be either 230 or 110 volts

Jumper	**Mode**
open	230V
closed	110V

WARNING:

Using the triac with the jumper closed in 110V mode will cause excessive currents to be generated. The triac system works only on an AC supply. If DC is used, then once the triac is triggered, it can not be reset.

11.21 Digital Interface Cards

The digital cards that can be installed in the NetPod system are as follows:

NP4209-JIO	Digital input
NP4211-RLY	Digital relay output
NP4212-TRC	Triac output
NP4213-JIO	TTL output

11.22 Digital Input - Interface

The digital input cards contain two independent opto-isolated inputs. Jumpers can select between high or low voltage input, and AC or DC input. **Jumpers JPA1, JPB1** select the voltage input mode as follows:

Jumper	**Threshold**	**Max**
open	6V	500V
closed	3V	50V

Note: the threshold values above are approximate.

WARNING: Exceeding the maximum voltage may cause excessive heating in the unit.

Jumpers JPA2, JPB2 select AC or DC input mode.

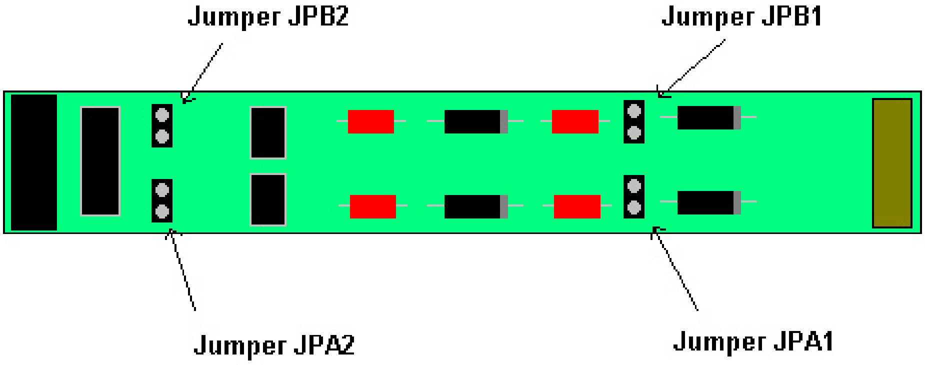


Figure 43 Digital Input Board - Jumper Connectors

When using AC input mode, the output is filtered by a simple low pass filter with a time constant of around 0.1 seconds. Therefore negative going pulses of less than this time will not appear as an "off" state by the system.

Pin outs:

1 Input A
2 Gnd A
3 Input B
4 Gnd B

11.23 Digital Output Cards

The following page summerises the pin outs etc. for the digital output cards.

Relay Output   **-** NP4211-RLY

The relay output consists of two fused relays.

A "1" bit sets the relay on (closed contact) and a "0" bit written to the digital output register turns the relay off (open contact)

There maximum specifications are as follows:
Voltage   250   Current   5A

Pin outs

1 IN   **- relay A**
2 Out **- relay A**
3 In   **- relay B**
4 Out **- relay B**

Pin-outs

1 Output A
2 GND
3 Output B
4 GND

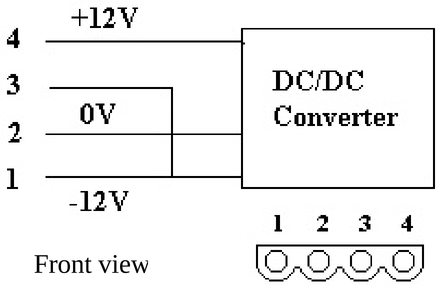
TTL Output - NP4213-JIO 2 channel output card

The TTL output cards are not isolated, and provide a means of connecting the output's to other equipment with TTL digital input. The output specification are as follows:

'0' output: 0V 0.2V typical at 4mA Max 24mA output
'1' output: 5V 4.8V typical at -4mA, Max -24mA output

11.24 Excitation Board - +/- 12V Interface NP-V12D

Supply specification:	Part No
+12v @ 42 mA -12v @ -42 mA	NP-V12D



12 Serial Port Operations

12.1 Introduction

The following chapter details the operations to be followed to undertake data acquisition and control operations using the serial port. Instructions for using the RS-232 single port and RS-485 multi-instrument operations are shown below.

12.2 RS-485 Network Operations - multi-user

Follow the instructions detailed below to use the instrumentation on RS-485 networks.

1. Connect the interface cable from the workstation serial port to the 9 pin RS-485 port mounted on the front panel of the NetPod. (See Figure 5)

2. Start the NetPod manager software.

   The title bar on the main screen will display the message "Looking For Hosts" This message will eventually disappear and be replaced with the window title "NetPod Configuration".

   The main program will be clear and display no interface type until data is detected through one of the communication ports.

3. Select the ***<u>Configure</u>*** menu option from the main menu.

4. From the menu items select the ***Scan Port*** menu item.

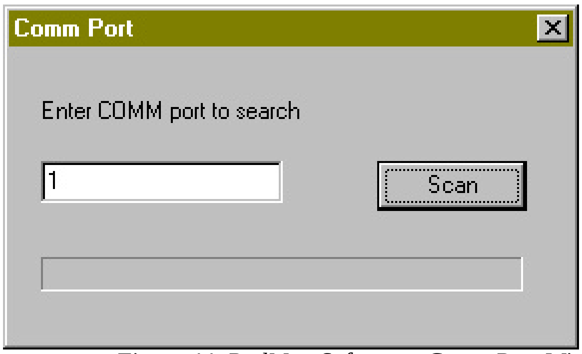


Figure 44 PodMng Software - Comm Port Window

5. Enter the comm port number within the **Comm Port** window and select the ***Scan*** button.

   To activate the specified comm port for control operations, select the ***Scan*** button which is located adjacent to the port number in the Comm Port window.

6. On activating the Scan button the **Comm Port** Window will indicate that the specified serial port is being scanned for data. The menu will remain on the screen for approximately 10 seconds. During this time you will not be able to access any other windows applications or controls.

7. On detecting data originating from a NetPod instrument the software will display the type of interface from which data packets have been detected. For serial data the NetPod manager software will display the message ***PORT*** on the main screen**.**

8. Displayed under the ***PORT*** icon on the main screen will be shown the name of the NetPod instruments which are connected to the computer system.