

Keynes Controls Ltd

NetPod 4003 System & Software

User Manual

Version 1.06



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Warranty

The manufacturer warrants this system to be in working order for a period of one year from the date of shipment. If this product fails within one year of the warranty period the manufacturer will, at its option, repair or replace the product at no charge except as set forth below

Warranty service will be furnished on an exchange bases. The manufacturer may repair or replace your product with a new or reconditioned one. Any replace components or parts become the property of the manufacturer

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The manufacturer is not liable to any purchaser or end-user for any damages including, but not limited to, lost revenue, loss of wages, loss of savings, or any other inconsequential damages arising from the purchase, use, or inability to use the product.

CE-Certificate

This equipment is in compliance with the following regulations:

EN550022 Class B

Safety Instructions

Please read and follow these important steps:

1. Follow all warnings and instructions marked on the product
2. Unplug this product before cleaning it or connecting it into sensor inputs or network
3. Use a damp cloth with mild soap to clean this product. Do not apply cleaner directly to the unit. Do not use volatile or abrasive cleaners on this product.
4. Do not place this product on an unstable surface where it may fall
5. Do not block or cover the units ventilation's openings. Also never place this product near or over a radiator or heat register, or in a build in installation unless adequate ventilation is provided
6. Operate this product in accordance with its rated power specification.
7. This equipment must be properly earthed
8. Do not allow foreign matter to enter this product
9. Do not attempt to service this product yourself. Opening or removing covers may expose dangerous voltage points. Refer all repair work to qualified service personnel
10. Unplug this product from the mains source, do not operate it, and immediately seek proper services proper servicing if:
 - **The power cord or plug is damaged or frayed**
 - **Liquid or foreign matter has entered the product**
 - **Damage to the IEC main power connector**
 - **The product has been exposed to rain or water**
 - **The product has been dropped or damaged**
 - **The product exhibits a distinct change in performance indicating a need for a service**

Only use UL listed/CSA certified power cords rated to 3A 250V minimum (VDE approved or equivalent)

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INSTALLATION CHECK LIST

In order to install and operate a NetPod data acquisition and control system, ensure that the following operations have been undertaken:

Each instrument is supplied with a detailed configuration setup sheet. Please ensure that your system meets the instrument order.

Local Area Network Operations

1. Ensure that the network card is installed and configured. Get your network administrator to test the card prior to using it for control operations. Alternatively you can see if the network card is operating correctly by examining its properties from the Device Manager package within the Windows operating system.
2. Obtain and record the Network IP addresses to be assigned to the NetPod 4003 instruments.

Obtain IP address details to be assigned and used by the NetPod 4003 instruments from the network manager. All of the instruments are supplied with a unique ID address already assigned and should operate directly upon most networks without user intervention.
3. Ensure the latest copy of the NetPod manager software has been downloaded and installed. This software is available free of charge from the Keynes Controls web site
4. Using the Install Wizard, load and configure the NetPod software. You can set the software to run automatically when you boot the PC or activated via an icon from the main system screen.
5. Ensure that all network connections used to link the NetPod units to the hubs are operating correctly for Ethernet operations
6. Ensure that suitable mains power supply outlets are available for use with the NetPod units.

1. Hardware Test

Before each NetPod 4003 is deployed power on each unit in turn and observe the status lights illuminate to show power and network operations.

On applying power to the instruments you will observe the power status light will illuminate and the Receive and Transmit LED status lights will flash on and off. If the status lights do not illuminate then check that the mains power outlet is operating correctly. If you are still having problems then please contact your supplier for advice before returning the units for repair

The LED status lights are clearly labeled on the front of the instrument.



The Power Supply and Instrument status LED's are clearly shown on the instrument front panel

Installation Quick Guide

To install the NetPod 4003 do the following:

1. Attach the NetPod instruments to the network
2. Download driver software from the Keynes Controls website at

<http://www.keynes-controls.com/4003manual/DriverSoftware.htm>

3. Test that the instrument is operating correctly by running the Pod Manager software.
All new instruments will be identified. The IP address of the 4003 will be shown on the driver regardless to the default networking setting of the host PC. Should the IP address of the 4003 be lost then scanning on the PodMng software will show the address settings.
4. Select **Configure** from the NetPod icon on the task bar
5. Select **Scan Network** from the Config menu

Each instrument installed on a network will be identified by the driver and data made available.

6. Run your applications programs

2. Technical Specifications

The following chapter details the technical specifications for the various analogue .

2.1 Analogue Input Module Specifications - Features

The NetPod 4003 system uses only 24 bit analogue input modules to undertake signal measurements. All of the input modules regardless have the following features in common:

- 1) 4 x Individual Channel Opto-isolation
- 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.

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 the instrument will operate within common mode levels allowing up to 1000V between channels. The opto-isolation also helps to prevent accidental damage caused by incorrect wiring of. Any damage that may occur due to negligent connections will be limited to a single channel enabling all other inputs will function normally without stopping data acquisition operations.

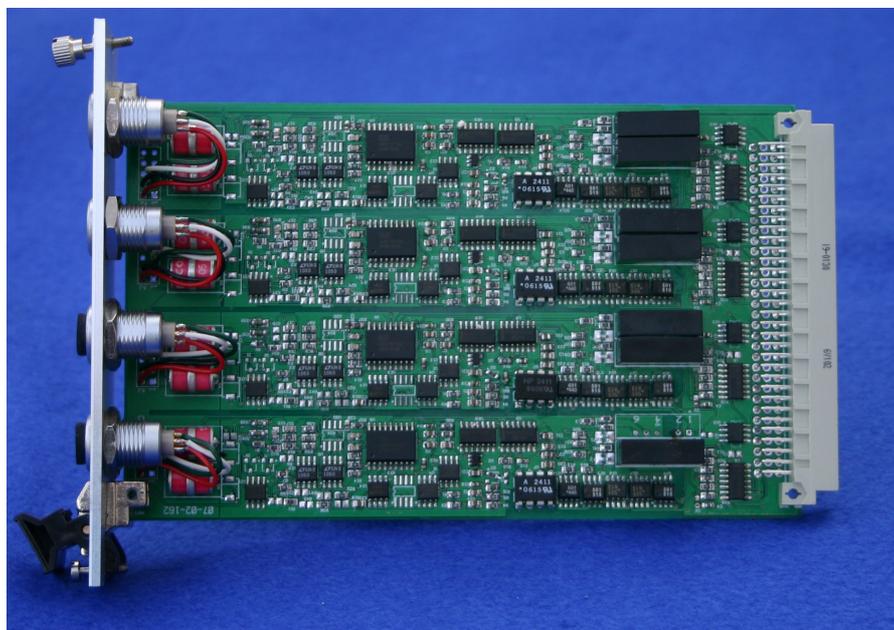


Figure 1 Standard NetPod 4003 Card

2.2 Standard Voltage Card Pin-out

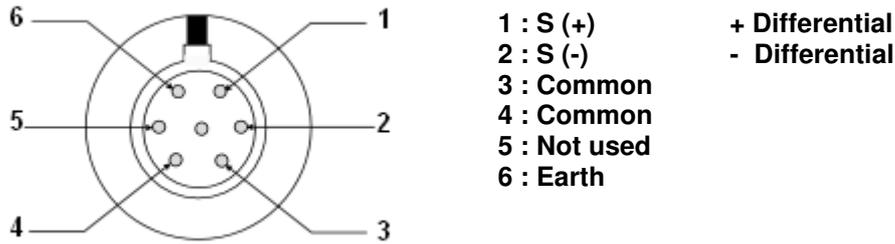


Figure 2 Analogue Input Module - Pin-out

2.3 Standard Features

Each of the analogue input cards contains 4 individually isolated 24 bit analogue input channels with 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:

A 24 bit ADC is used for the analogue conversion as it's high resolution is ideal for determining details in low level signals common in many applications.

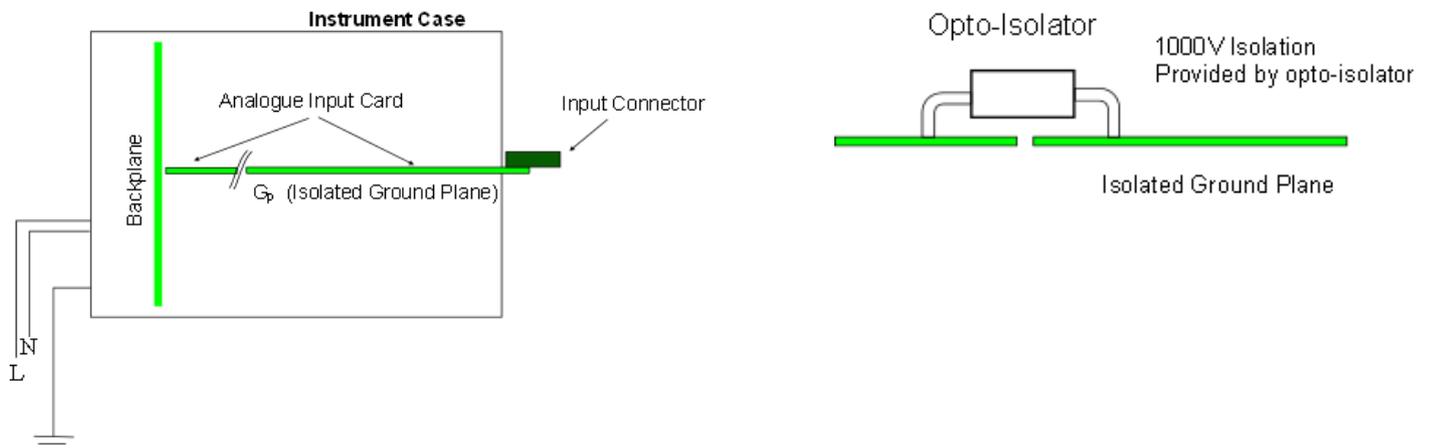


Figure 3 System Isolation

The figures above show how the opto-isolation is used within the NetPod 4003 to protect the instrument

2.4 24 Bit ADC Input Module (Standard) – Voltage Input Cards

The following page shows the technical specifications for the standard voltage input cards.

Like all the NetPod 4003 interface cards the NPAI24-X-H1-4 cards contains 4 independent input channels and each can be supplied with or without excitation. X = Range (See table below)

The lightening protection uses 20,000 amp gas discharge and these protect the instrument from anything but a direct strike. When using the protection of the gas discharge tubes it is essential that a good system Earth be available otherwise the protection will not work.

The opto-isolation ensures that the inputs can operate in a high common mode environment. There can be up to 1000V DC between input channels and the instrument will still operate.

Sample Rate	2KHz (Max) Standard - Per Channel
CMRR:	160 dB
Isolation:	1000 V DC
Lightening Protection	Gas Discharge Tube – 20,000 A @ 92 V non radio-active
Power Requirements:	400 mA (Max)
Input Range (Voltage):	V1: ± 5V (Nominal 5V) V2: ± 50.0V V3: ± 500 V V4: ± 300 mV (Ultra High Resolution)
Sensor Excitation	+/- 12V @ 20 mA (optional)
Accuracy:	0.1%
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 Impedance:	V1: 20 MΩ V2 & V3: 2 MΩ 1 GΩ 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)

2.4.1 Part Numbers

NPAI24-V1-H1-4	± 5 V	(Nominal 5V)	Note H1 = Standard Input Impedance
NPAI24-V2-H1-4	± 50 V		
NPAI24-V3-H1-4	± 500 V		

2.5 Strain Gauge Input Card Specifications -- Part Number – SGA-X-4 module

Keynes Controls can supply strain gauge signal conditioning using both Const Current and Precision Voltage sensor signal conditioning.

The following page shows the technical specifications for the strain gauge analogue input boards using voltage excitation.

Like all the NetPod 4003 interface cards the SGA-X-4 card contains 4 independent input channels and each is individually isolated from all other inputs within the instrument.

The lightning protection uses 20,00 amp gas discharge and these protect the instrument from anything but a direct strike.

Short circuit protection prevents damage to the input channels

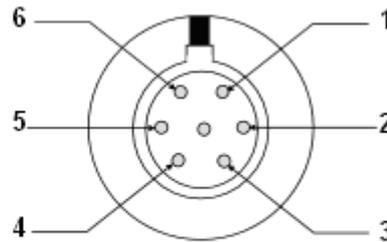
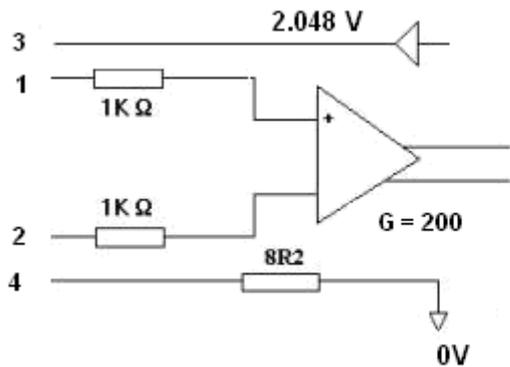
Specifications – SGA-X-4 module (24 Bit) where X = Gain

Number Channels	4
Bridge	Full, ½ and ¼ Bridge
CMMR	160 dB
Lightening Protection	20,000 A @ 92 V Gas Discharge
Gain:	User defined at manufacture,
Maximum Input Voltage:	± 2.5V, ±1.5V, ± User Defined Range
Bridge Excitation	2.048 V Precision Reference source
Bridge Excite Noise	0.05 mV
Drive Current to:	8.33 mA
Load Regulation	< 0.0005%
Drift	10.0 ppm/°C
Short Circuit Current:	30 mA
Operating Temp:	0 - 60 °C
Full & ½ Bridge:	120,350, 700 Ω
Frequency Range:	0 - 250 Hz (Standard)
Dynamic Response:	Sinc Filter.
Linearity:	± 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 4003 analogue Module.

2.6 Full Bridge Voltage Excitation Strain Gauge Connection Schematic

The following schematic summarizes the connection and operation of the voltage sensor excitation strain gauge cards.



Pin-outs

- 1 : +Differential
- 2 : - Differential
- 3 : Sensor Excitation (5V) +
- 4 : 0V
- 5 : N/A
- 6 : N/A

2.6.1 Part Numbers

NPAI24-SGA-100-4-F
 NPAI24-SGA-100-4-H
 NPAI24-SGA-100-4-Q

Full Bridge card
 Half Bridge card
 Quarter Bridge card

Gain = 100 and is typical for many strain gauge applications.

2.7 Strain Gauge interface Constant Source Sensor Excitation

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

Specifications – SC-X-4 module (24 Bit) where X = Gain

Number Channels	4
Bridge	Full, 1/2 and 1/4 Bridge
CMMR	160 dB
Lightening Protection	20,000 A @ 92 V Gas Discharge
Gain:	User Defined at manufacture
Maximum Input Voltage:	$\pm 2.5V, \pm 1.5V, \pm$ User Defined Range
Bridge Excitation	2.5 V Precision Reference source
Bridge Excite Noise	0.05 mV
Drive Current	7 mA = 350 Ohm 20 mA = 120 Ohm 3.5 mA = 700 Ohm
Load Regulation	< 0.0005%
Drift	2.0 ppm/°C
Short Circuit Current:	30 mA
Operating Temp:	-20 to + 60 °C
Full & 1/2 Bridge:	120,350, 700 Ω
Frequency Range:	0 - 500 Hz (Standard)
Dynamic Response:	Sinc Filter.
Linearity:	$\pm 0.05 \% \pm 2$ mE

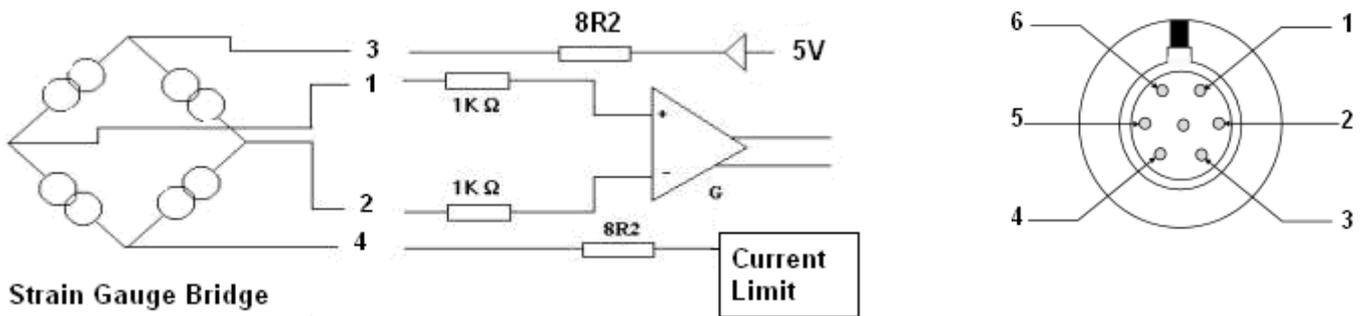


Figure 4 Full Bridge Constant Current Excitation Schematic

2.7.1 Part Numbers

NPAI24-SC-X-4-F	Full Bridge card
NPAI24-SC-X-4-H	Half Bridge card
NPAI24-SC-X-4-Q	Quarter Bridge card

Gain = X = Typical 100 and is typical for many strain gauge applications.

Pin-outs

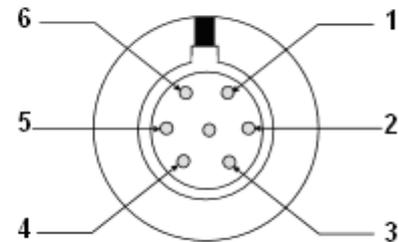
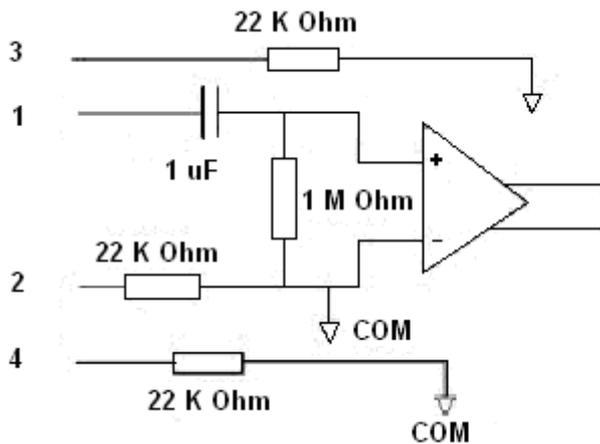
- 1 : +Differential
- 2 : - Differential
- 3 : Sensor Excitation (5V) +
- 4 : 0V
- 5 : N/A
- 6 : N/A

2.8 24 Bit Piezo Electric Interface - Technical Specifications

Like all the NetPod 4003 interface cards the SGA-X-4 card contains 4 independent input channels and each is individually isolated from all other inputs within the instrument.

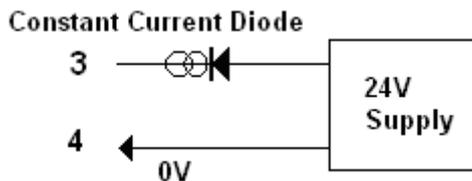
Note the Constant current excitation is built into the card and is not connected in by the user.

Sample Rate:	2K Hz (Max) Standard - Per Channel
Lightening Protection	20,000 A @ 92 V Gas Discharge Tube
CMRR:	160 dB
Isolation:	1000V _{DC} Standard
Power Requirements:	100 mA (Max)
Input Range (Voltage):	± 1.5V @ 10 Hz
Accuracy:	0.1 %
Pre-amp Gain:	1,2,4,8 (sample rate limited)
Resolution:	1 μ V
Input Offset:	V1: ± 1 mV/°C
Stability:	V2: 10 ppm/°C
Input Impedence:	1 M Ω (AC): 1 G Ω (DC)
Overload:	30 V rms
LPF time constant:	1 S
Sensor Excitation :	Const Curr 12V @ 40 mA



Pin-outs

- 1 : +Differential
- 2 : - Differential
- 3 : Const Currrent Supply 15V @ 20 mA
- 4 : 0V / Common
- 5 : N/A
- 6 : N/A



Part Numbers

NPAI24-PE-G-4 where G = is Gain and typically = 1
 NPAI24-PE-1-4 when gain = 1

1.15 24 Bit Servo Accelerometer - Technical specification

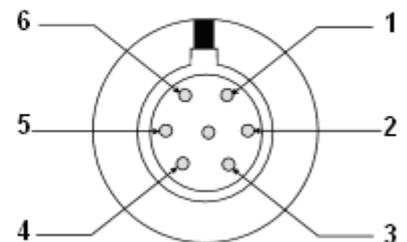
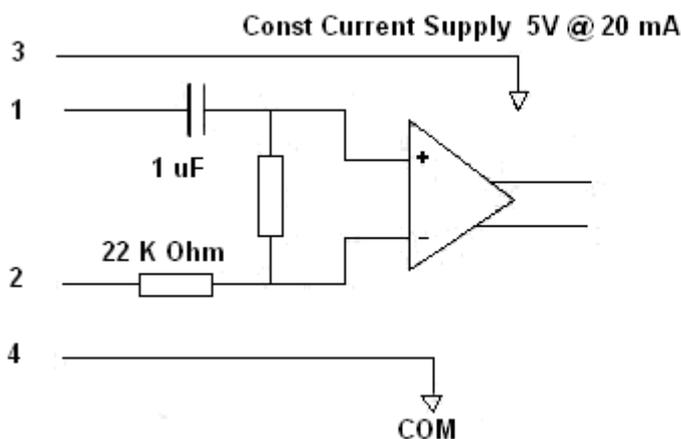
The following page summarises the technical specifications for the Servo Accelerometer analogue input board..

All of the the NetPod 4003 interface cards contains 4 independent input channels and each is individually isolated from all other inputs within the instrument.

The lightning protection for this input card can save the instrument form anything but a direct strike, however when fitted the isolation is reduced from 1000V to 92 V as used by the gas discharge tubes.

Short circuit protection on the signal conditioning protects the card in case of sensor failure or incorrectly installed wiring.

Number of Channels	4 Independently isolated inputs
Sample Rate	2 KHz / Channel
Lightening Protection	20,00 A @ 92 V Gas discharge tube
CMRR:	160 dB
Isolation: (Standard all cards)	1000V DC
Power Requirements	400 mA (Max)
Input Range (Voltage):	V1: $\pm 2V$
Accuracy	0.1 %
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 Impedance	V1: 10 M Ω
Overload:	250 V _{RMS}
Accuracy:	0.02 %
Imax Drive Current 5V Supply	20 mA
Drive Current Protection	Short Circuit Protected / Current limit



Pin-outs

- 1 : + Differential
- 2 : - Differential
- 3 : Const Current Supply 5V @ 20 mA
- 4 : 0V - Common
- 5 : N/A
- 6 : N/A

Part Numbers

NPAI24-SRV-B-4 where B = Range of sensor in g

For example a sensor operating over the range of 2g will have part number

NPAI-24-SRV-2-4

2.9 Digital Interface - NP4827JIO-16

The following page describes the specification and operation for the NP4827JIO-16 digital interface board for the NetPod 4003 instrument.

A photograph of the NP4827JIO-16 board layout is shown below.

The NP4827JIO-16 offers 16 channels of opto-isolated digital inputs and operates with both AC and DC signals. The control of the card is by the settings Jumper switches J1 and J2 shown below.

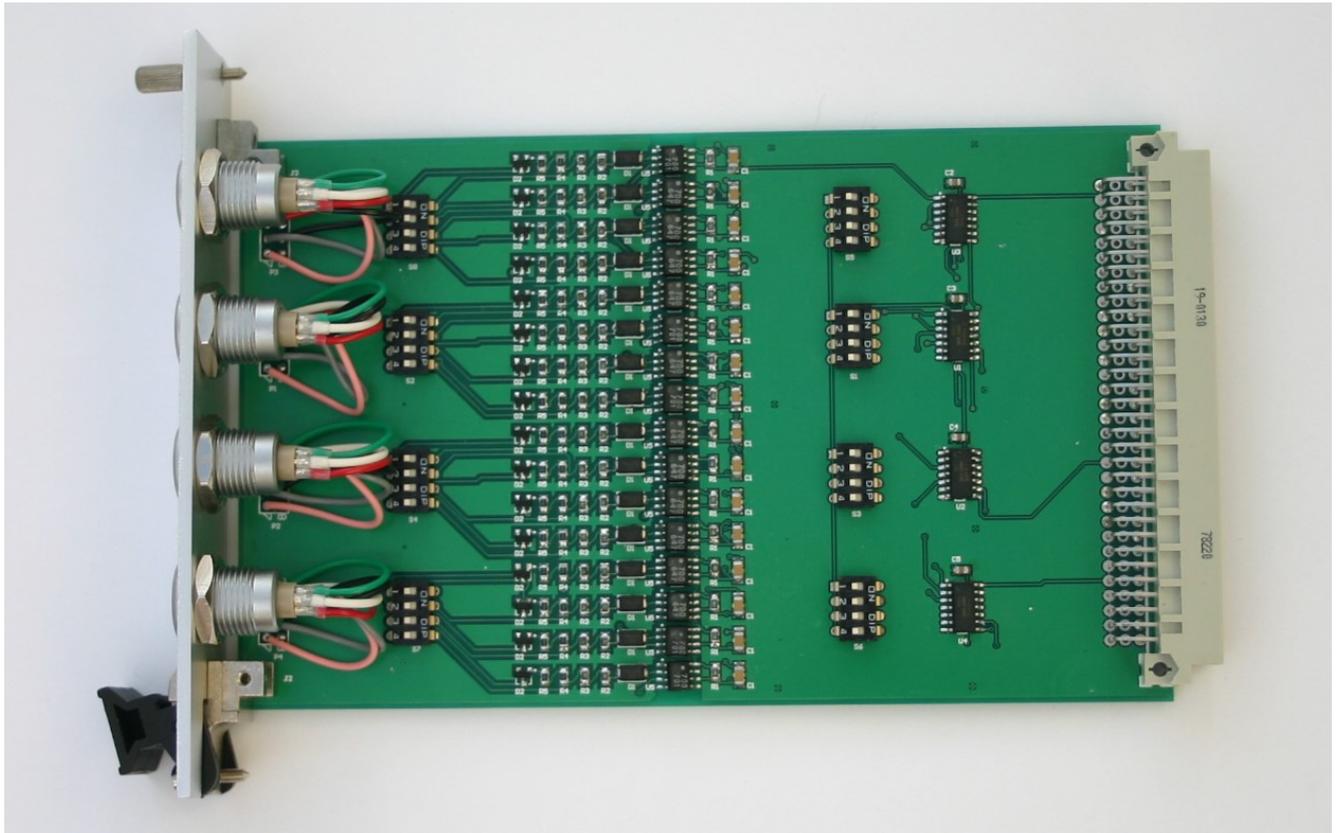


Figure 5 Digital Interface Card

Specification

16 Digital Input Channels - opto- isolated

Using 4 x 4 channel bayonet locking connectors

Isolation

The NP4827JIO-16 is an opto-isolated product.

Isolation channel to 0V = 2000V DC.

Isolation Channel-Channel = 2000V DC

2.9.1 Digital Card Operations

The digital input cards contain 16 opto-isolated inputs in 4 channel blocks. Each connector supports 4 inputs with a common 0V connection for each pair of inputs.

There are two jumper switches for each channel mounted on the board and these are used to select between high or low voltage input, and AC or DC input.

Jumpers J1, J2 select the voltage input mode as follows:



Jumper 1

Jumper 2

Jumper J1

On Low Voltage
Off High Voltage

Jumper J2

On AC
Off DC

Where High Voltage = 12 to 240 VAC 350V DC Threshold = 6V
 Low Voltage = 0 to 24V DC TTL compatible Threshold = 3V

Note: the threshold values above are approximate.

Example. To monitor a 210 V DC signal for digital signal application. J1 = Off and J2 = Off

Installation

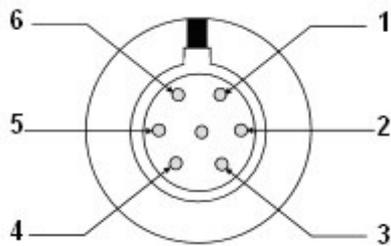
Keynes Controls recommends that the NetPod 4003 be powered off when installing or removing cards.

1. Slide the **NP4827JIO-16** into **slot 7** of the 4003 chassis until it locks into place
2. Lock the termination screw at the top of the panel into the 4003 chassis.
3. Power on the instrument

Digital Input Connector - NP4827JIO-16

- 6 1
- 5 2
- 4 3

Pin Number	Colour	Digital I/O
1	Green	Common Channels 0-1
2	White	In0
3	Red	In1
4	Black	Common Channels 2-3
5	Grey	In2
6	Pink	In3



View Clockwise looking into connector

Slot 1 2 3 4 5 6 7



Fit digital card into slot 7 only.

NP4827JIO-16

16 Channel Digital Output Card – isolated

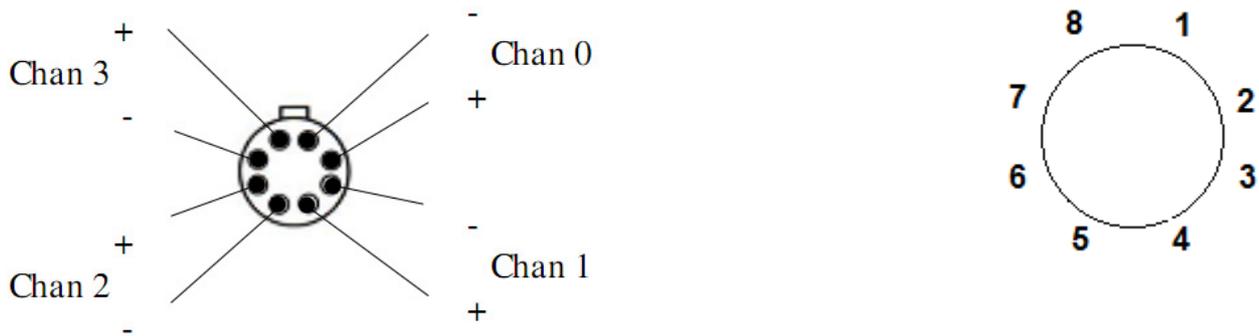
The NP4827JIO-16 is a 16 channel digital isolated input card

Connections

1	- Com 0
2	+ Com 0
3	- Com 1
4	+ Com 1
5	- Com 2
6	+ Com 2
7	- Com 3
8	+ Com 3

Pin-numbers

The following diagram shows the pin-outs as viewed looking into the connector



View looking into Connector

Installation

The NP4827JIO-16 card can only be fitted into slot 7 of the NetPod 4003 – see image on page 21

Operation

Threshold = 3V

Range = 0 – 24 V DC

The NP4827JIO-16 card reports a high level once the threshold input > 3 V

Sensors

The following chapter summaries some of the details for the many sensors that can be directly interfaced to the NetPod 4003 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 comprise 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 full, half or quarter bridge 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 as piezo-electric, servo or accelerometers directly from the instrument. These excitation boards can supply voltage or current sources.

2.10 Thermocouple Colour Code

THERMOCOUPLE CONNECTORS, EXTENSION AND COMPENSATING WIRES AND CABLES

Type	Conductors	British	German	IEC584-3:1989, mod
		BS 1843:1952	DIN 43713/43714	BS4937: Part 30 1993
E	Nickel Chromium/Constantan			
J	Iron*/Constantan			
K	Nickel Chromium			
N	Nickel Aluminium Nicrosil/NISIL			
T	Copper/Constantan			
V	Copper/Constantan			
U	(Low Nickel) Copper/(Copper Nickel)			

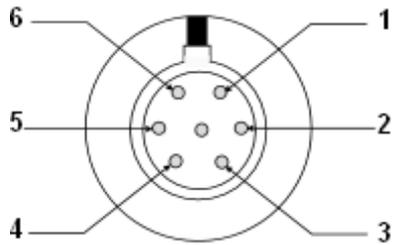
* Magnetic

For Thermocouple Connectors body colours are as outer sheath colours above

() Alternative & Trade name

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

Information provided in this documentation is intended as a general guide only and subject to change. 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)

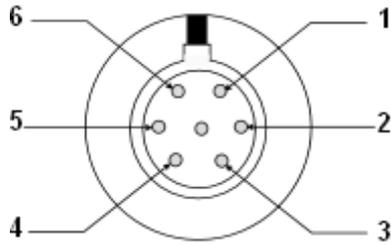
1. Therm

- 1 : T (+)
- 2 : T (-)
- 3 : N/A
- 4 : GND (COM)
- 5 : CJC
- 6 : CJC

2.11 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 energisation. The low source current ensures that the self heating effect of the bias current is minimised. The RTD interface . pin-out is shown below:

- 1 : S (+)
- 2 : S (-)
- 3 : N/A
- 4 : GND (COM)
- 5 - I_E
- 6 + I_E



2.12 24 bit High Input Impedance Card – NPAI24HZ-10V

The NPAI24HZ-10V card is the Keynes Controls high input impedance card for use with the NetPod 4003 instruments.

Technical Specifications

Sample Rate	Peak-Peak Noise 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

Description

Input Range	0 – 10 V DC
Number Channels	4
Opto-isolation	2000 V DC
Input Impedance Powered On	100 G Ohm
Powered Off	10 M Ohm
ADC Type	24 Bit Sigma Delta
Sample Rate	2 KHz Max

2.13 Operations

Due to the high input impedance of this card any input not in use should have the differential inputs for unused channels 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.

3. LED Status Light Sequences

Sequence A



Sequence B



Sequence C



Sequence A

Instrument Powered On

Sequence B

Instrument connected to an Ethernet Hub

Sequence C

Instrument transmitting data

4. Driver Installation - PodMng Application Package

The NetPod driver software is freely available and can be downloaded from the Keynes Control web site.

No special installation instructions are required. Simply load the two driver files and activate the software

Download all the NetPod software from

The driver supports 2000, NT, XP operating systems

<http://www.keynes-controls.com/4000manual/DriverSoftware.htm>

5. Data Transmission Protocol

The following chapter describes the data transmission operations of the NetPod 4003

The pods operates using a non-pre-emptive packet sending system i.e. when a run command has been sent to an instrument it responds by sending at regular intervals the data to the host computer system. Data is sent from the instruments to the User computer systems in the form of data packets.

The data from the input channels is broken into packets call UDP **datagrams**. Note. up to 16 samples can be sent in any particular data packet.

5.1 Small Packet Size

Advantages: Data is returned to the host computer system very quickly (ideal where short response time is requires, i.e. real time operations are essential)

Dis-advantage: small packet size results in high network overhead

5.2 Large Packet Size

Advantage: Large packet sizes provide efficient use of network traffic. Data from each analogue channel is easily packed and sent across the network.

Disadvantage: Data packets are sent slowly across a network making them ideal for use in control system loops. PID etc.

5.3 Broadcast vs Single-Host Operations

When a single User/Operator is accessing data from the instruments, and standard PodMng application software is in Run mode, the instruments send data only to the single computer system. All other computers connected to the network, using a standard network interface card will ignore the data from the NetPod. The software contained within the network card filters out instrument packets from the standard user operations i.e. print servers etc. and enables normal network operations to be undertaken.

However, should more than one user be running the Pod Manager software, then the instruments sends special packets called broadcast packets instead of the normal datagrams. The broadcast packets will be received by every computer system connected to the network which results in a small overhead in processing for machines that have nothing to do with the acquisition of data from the instruments. The user of broadcast packets enables many users to access and process data from the instruments simultaneously yet independently from each other.

For the most efficient use of the Ethernet network for data transmission operations, then only one user should be running the Pod Manager software at any one time. This is especially the case when high sample rates are required. Should data be required for more than one user, then it is recommended that the computer running the Pod Manager software re-sends information to the next PC after it has been processed.

Data re-transmission can be undertaken by third party software supporting TCP/IP functions, or by NetDDE, For user software which can send a NetDDE Poke command to a channel being sampled

at 1 KHz should this channel go above a threshold level, then considerably lower processing overhead will be required than would be the case if 1000 packets data/sec were being transmitted across a network to each user.

Note: Most SCADA packages have the facility to share processed data in this way.

5.4 Data Synchronization

One of the important features of the NetPod 4003 instrumentation is the integral synchronisation operations available between instruments across an Ethernet network. These operations enable widely separated units to be combined to provide static as well as dynamic measuring systems.

The instruments are kept in synchronization by requesting, at regular intervals the current time from each pod. The time returned from each instrument is examined and compared to the master clock within the processing system. If the drift between instruments is greater than a preset amount then the clock within the instrument is reset. The resolution of the clock within the pod is considerably greater than that of the PC .i.e.10us for the instrument against 20ms for the PC.

The synchronization packets are sent every 5 seconds across the network to each instrument. so that the time skew between instrument clocks is very low (1 - 2 microseconds). The timing within the instruments surpasses that available within nearly all processor systems unless extremely accurate precautions are made to improve time keeping.

Each NetPod 4003 supports direct synchronization for all inputs within a single instrument both analogue and digital and between instruments across a LAN

See Appendix A for a full description of the NetPod 4003 data synchronisation operations.

5.5 Datagram Construction

The figure below shows how the datagrams used to transmit data from the NetPod 4003 to the applications software are constructed:

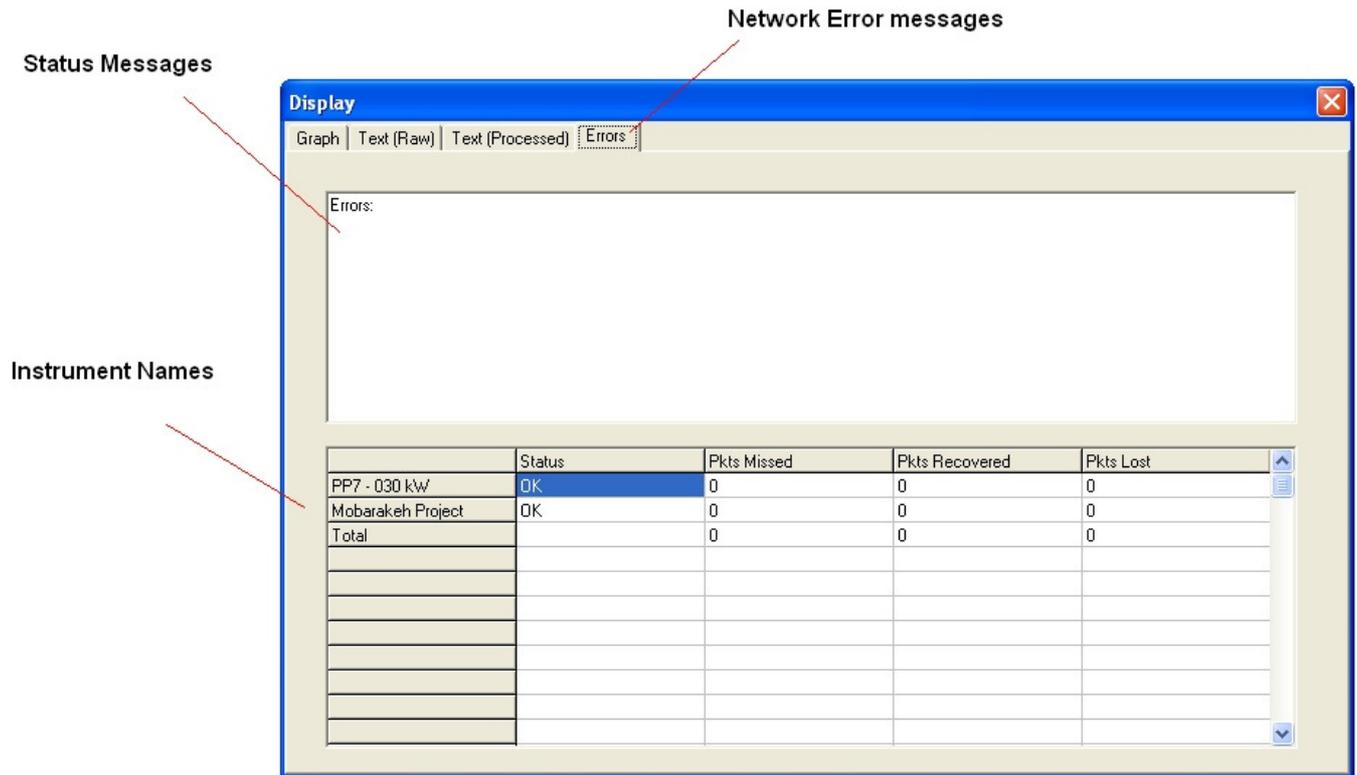


Figure 6 Datagram Construction

6. Driver Software Operations

The Keynes Controls NetPod manager software is the package provided by Keynes Controls when you purchase any of our network products. The software operates under Microsoft Windows 2000, NT, and XP operating systems. The following operations are supported:

Password Protected Operating Environment
Starting & Stopping data acquisition operations.
Channel Configuration.
Data Recording.
Calibration Operations.
Sensor Selection.
Multi-user operations.
Real Time Display
Multi-instrument Operations.

All of the graphical operations of the driver are identical no matter which type network is being used to gather data.

Upon initialisation the NetPod driver software scans local area network interface within the host system for Pod traffic. If any traffic is identified as originating from NetPod instruments then the software auto-configures the instruments for operation. All the user need do is to assign channel names to the instruments that can be used to easily identify the source of data.

6.1 Password Protected Operating Environment

The PodMng driver software provides a password protected operating environment. There are two modes of operation Admin and Operator.

Operator mode enables data to be presented to third party applications software but prevents any changes of configuration and data transmission operations from the driver of third party software. You cannot change any instrument configurations or start and stop the data transmissions. Operator mode operations are ideal where you require terminals to display data only.

Admin Mode enables full configuration of the instruments. You can select and configure any instrument operation.

6.2 Software Mode Changes

To change the mode of operation of the driver software:

From the Default PodMng Window select **File > Access Control**

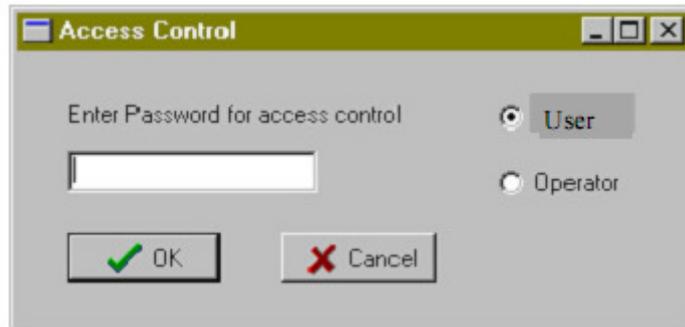


Figure 7 PodMng - Access Control Window

The Access Control Window will appear. Enter your password.

Select the Mode of Operation

Press the **OK** button to activate the mode change.

When the Access Control Window disappears the Operating Mode has changed.

6.3 Starting and Stopping Global Data Acquisition Operations

The driver software allows the user to have full control of all aspects of the data acquisition operations of the instruments. You can start and stop all data acquisition operations for all instruments simultaneously across a network or individually to a dedicated unit.

The aim of this section is to describe the data acquisition operations that control all instrument operations simultaneously across a network, for the purpose of this manual it is called Global Data Acquisition Operations.

The status of the data acquisition operations can be clearly seen directly from the instrument status lights and from the driver by the colour of the task bar icon. The task bar icon is coloured green when data transmission operations are active and red when no data is present. See images below

Data Acquisition operations stopped



Data Acquisition operations active



6.4 Starting Global Data Transmission Operations

The following section shows the instruction to follow to start global data acquisition operations ie start all instruments up on a network to broadcast data.

1. From the main menu select the **FILE** menu item.
2. Using the mouse pointer or cursor keys select the **Run Mode** menu item.

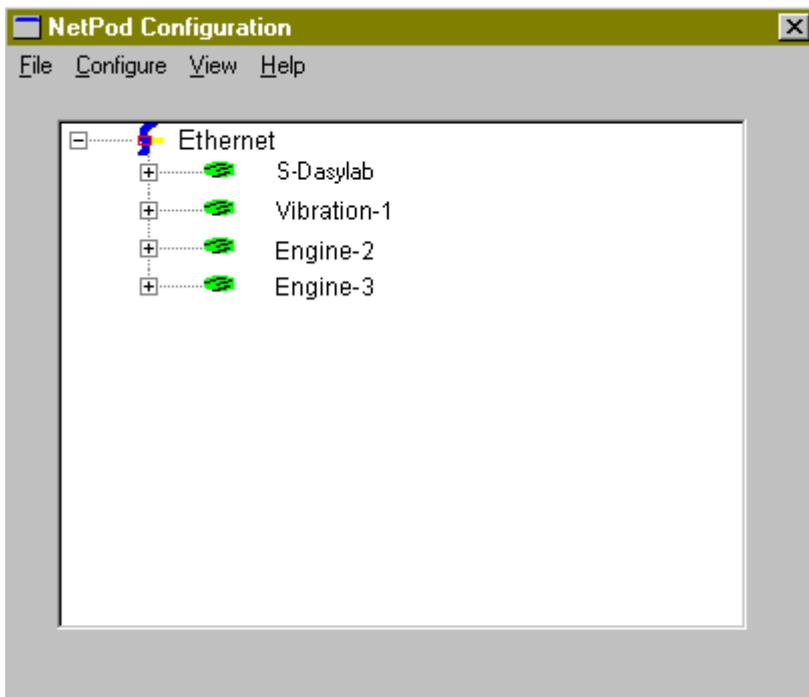


Figure 8 PodMng Software - Run Mode Active

A tick mark will appear adjacent to the **Run Mode** menu option. The tick mark is used to indicate that data recording and control operations are under way.

3. The File menu options will disappear and the main menu be displayed. You can now carry out any further operations.

Note. In order to check the status of the logging operations from the NetPod manager simply select the **FILE** menu option from the main display. You will see a series of menu items displayed on the screen , one of them being the **Run Mode** option.

If a tick mark is displayed adjacent to the **Run Mode** menu item then data acquisition operations are underway.

The task bar icon will appear to be flashing green in colour.

Stopping Data Transmission Operations

The following section shows the instruction to follow to start global data acquisition operations ie start all instruments up on a network to broadcast data.

1. From the main menu select the **FILE** menu option.
2. Using the mouse pointer or cursor keys select the **Run Mode** menu item.

The tick mark which appears adjacent to the **Run Mode** menu item will disappear.

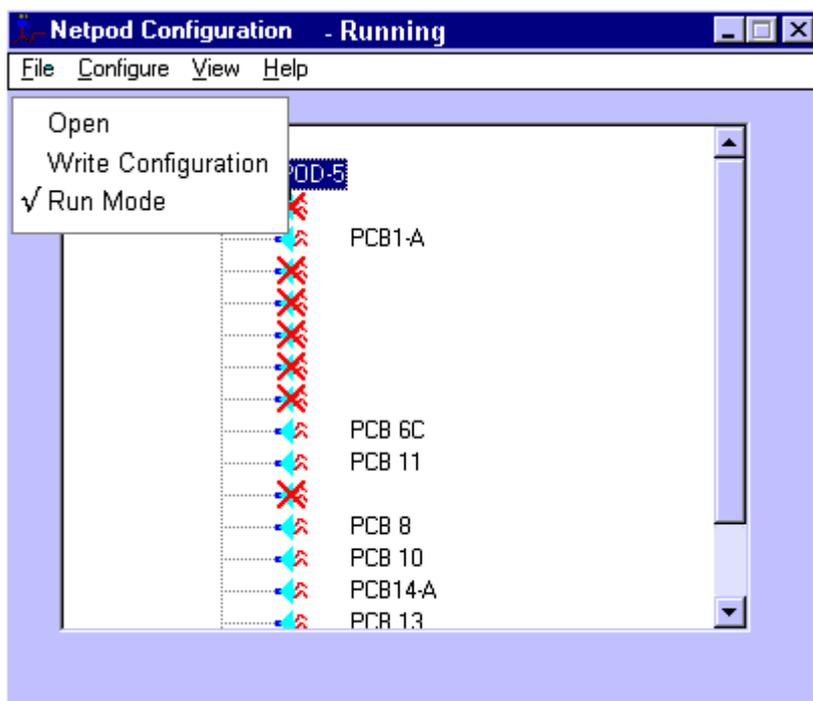


Figure 9 Figure4 PodMng Software – Stopped Data Acquisition Operations

A tick mark is used to indicate that data recording and control operations are active and that data may be in the process of being recorded.

3. The File menu options will disappear and the main menu be displayed. You can now carry out any further operations.

The instrument Tx and Rx LEDs will stop flashing (LAN operations only)

The task bar icon will appear to be flashing green in colour.

6.5 Starting and Stopping Data Acquisition Operations for a Specified Instrument

The following section describes the operations to follow to start and stop data acquisition operations for a single specified instrument. These operations are meant as an aid to testing the network prior to acquisition operations are overridden by the use of global acquisition commands.

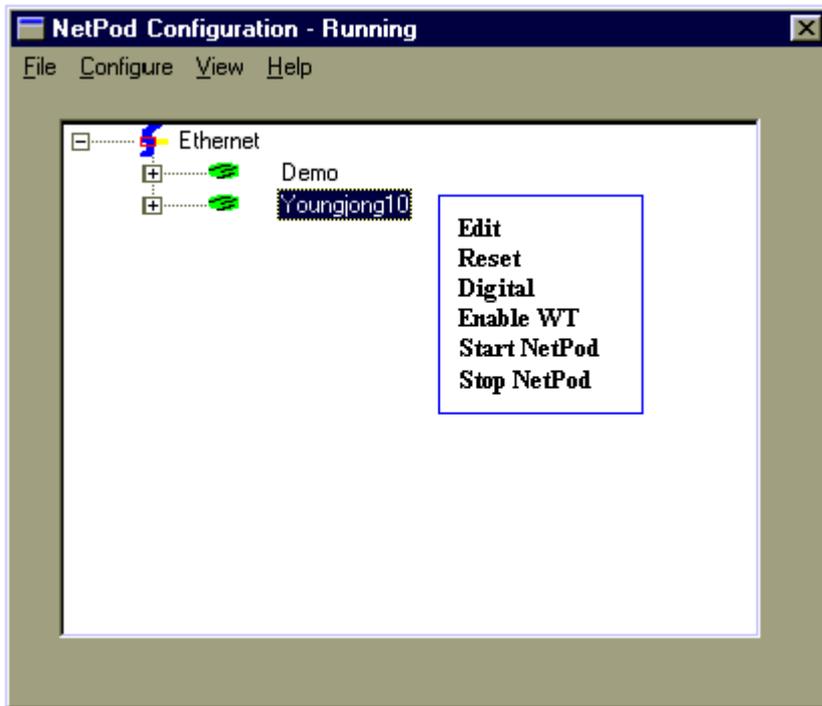


Figure10 - Start and Stop acquisition - menu options

Stopping Data Acquisition Operations for Specified Instrument.

1. Ensure that the Podmng software is active and receiving data. The task bar icon should be flashing green
2. From the **NetPod Configuration Window** (as above) select the instrument whose data acquisition operation you want to suspension (stop) using left hand mouse.
3. Once you have selected the instrument whose data transmission operations you want to suspend press the right hand mouse button. You will observe a menu appear adjacent to the selected instrument with the following options: EDIT, RESET, DIGITAL, ENABLE WT, START NetPod, STOP NetPod
4. Select " Stop NetPod" option – you will observe the Tx status light on the instrument is off.
5. The Error log will report Time (00:00:00) Pod-id disabled

Starting Data Acquisition Operations for Specified Instrument.

1. Ensure that the driver is active and receiving data. The task bar icon should be flashing green
2. From the main driver window (as above) select the instrument whose data acquisition operation you want to activate (start) using left hand mouse.
3. Once you have selected the instrument whose data transmission operations you want to activate press the right hand mouse button. You will observe a menu appear adjacent to the selected instrument with the following options:
EDIT, RESET, DIGITAL, ENABLE WT, START NetPod, STOP NetPod
4. Select “*Start NetPod*” option – you will observe the Tx status light on the instrument is now active.
5. The Error log will report “Time (00:00:00) Pod-id Enabled”

REMEMBER – activating logging from the driver for all units will over ride these actions.

6.6 Configuring the Analogue Input Channels

The following instructions detail the procedures followed to assign channel configuration details for use within the Pod Manager software package:

From the main menu select a NetPod 4003 whose analogue input channel is to be configure.

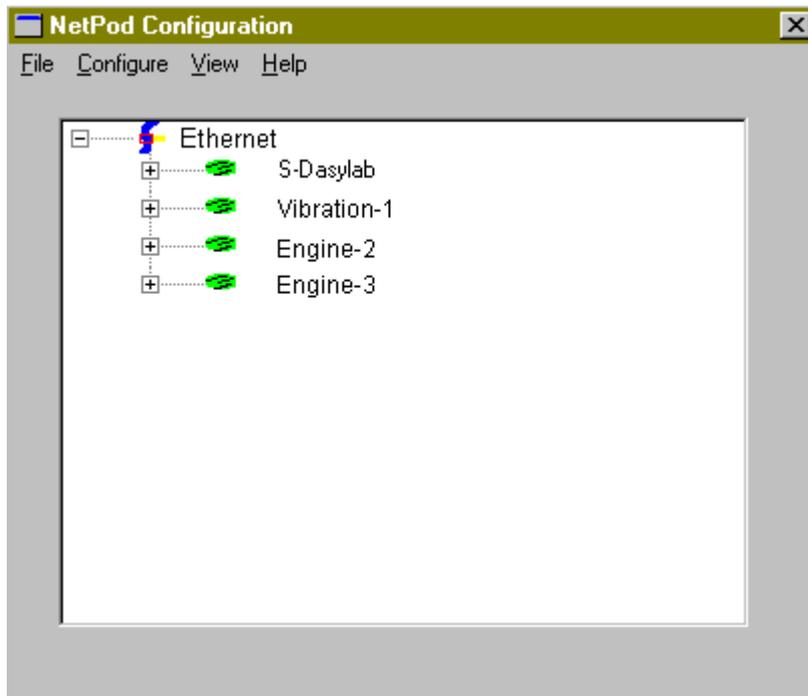


Figure 11 PodMng Software - Default Screen (Multi-user operations)

The Window shown above is the main configuration Window that appears when the PodMng software first activated and the network scanned in a multi-instrument environment. Each of the NetPod 4003 instruments for which data traffic has been identified will be shown on the main screen below the title listing the interface upon which traffic was detected.

- 1 Move the mouse pointer over the 4003 unit chosen for channel configuration.
- 2 Select by pressing the left hand mouse button either the + symbol that appears adjacent to the NetPod 4003 for which channel details are going to be adjusted, or directly the channel which is going to be configured.

NOTE.

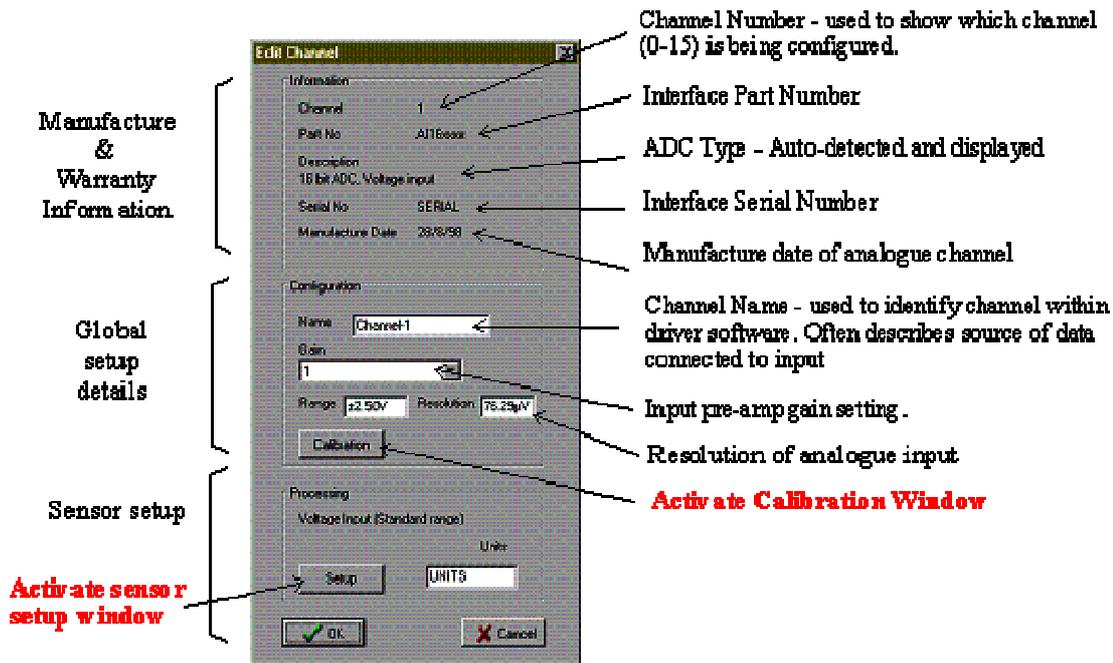
On selecting the + symbol the channel details associated with the chosen instrument will be listed. The Pod manager software will interrogate all identified units and report details of any analogue and digital interface cards installed within the instruments.

2. Move the mouse pointer until it is above the channel name which has been selected for configuration.

Double click the left hand mouse button.

The **Edit Channel** window will appear.

- Using either the Tab key or mouse pointer, select the parameter that is to be adjusted.



If at any time the configuration process is to be stopped simply select the "Cancel" button on the **Edit Pod** menu. The Edit Pod menu will disappear and you will return to the main system configuration menu.

6.7 Setting the Sample Rate

The following section details the operations that are to be undertaken to set the sample rate of the NetPod. Unlike most data acquisition systems the NetPod 4003 supports multiple sample rate operations.

6.8 Multi-Rate Data Acquisition

NetPod 4003 enables multi-rate sampling to be undertaken across a network. You cannot mix sample rates directly within a single unit but you can have multiple units running on a network operating at different rates.

For example, if you have three units on a network, Pod-1 can operate at 1 KHz, Pod-2 at 500 Hz, and Pod-3 at 10 Hz. There are no limitations on how to mix the sample rates.

6.9 Data Decimation

In order that you can undertake multi-rate data processing for analogue channels contained within the same unit, you will have to develop your own processing software. A drivers developers kit has been created to enable you to design your own applications and utilise the functionality within the instruments

To set the sample rate of a chosen NetPod 4003 unit follow the instructions specified below

6.10 Sample Rate - Options.

The following section details the operations that are to be undertaken to set the sample rate of the NetPod. Unlike most data acquisition systems the NetPod 4003 supports multiple sample rate operations.

Multi-Rate Data Acquisition

NetPod 4003 enables multi-rate sampling to be undertaken across a network..

For example, if you have three units on a network, Pod-1 can operate at 1 KHz, Pod-2 at 500 Hz, and Pod-3 at 10 Hz. There are no limitations on how you mix the sample rates. You can choose any option specified on the sample rate setup menu. The sample rates at which are unit will operate are automatically determined and are based upon the technical specifications of the input modules.

Data Decimation

In order that you can undertake multi-rate data processing for analogue channels contained within the same unit, you will have to develop you own processing software. A drivers developers kit has been created to enable you to design you own applications and utilise the functionality within the instruments

To set the sample rate of a chosen NetPod 4003 unit follow the instructions specified below

6.11 Sample Rate - Instructions.

Using either the Config or Podmng software, stop the data transmission operations across the network.

For sample rate changes the data transmission operations must be stopped regardless of type of network from which data is being acquired. The Podmng software displays a green flashing icon while data is being broadcast by NetPod 4003 instruments across a network. The Podmng software displays a red icon when data transmission operations are suspended.

1) Display the NetPod Configuration Window

Move the mouse pointer until it is above the Podmng icon and press the right hand mouse button.

Select the *Config* menu option.

2) The Default driver screen will appear. Select the 4003 instrument whose sample rate is to be changed

Move the mouse pointer until it is directly above the specified instrument

Double click the left hand mouse button.

3) The **Edit Pod** window will appear. Note. It is using the **Edit Pod** Window that the sample rate can be adjusted.

4) Using the mouse pointer or **Tab** key select the Sample Rate pull down menu list.

Once you have selected the Sample Rate pull down menu, you can select the new sample rate by using the Up and Down cursor keys to adjust the highlight bar or by simply selecting the new rate directly by the mouse pointer.

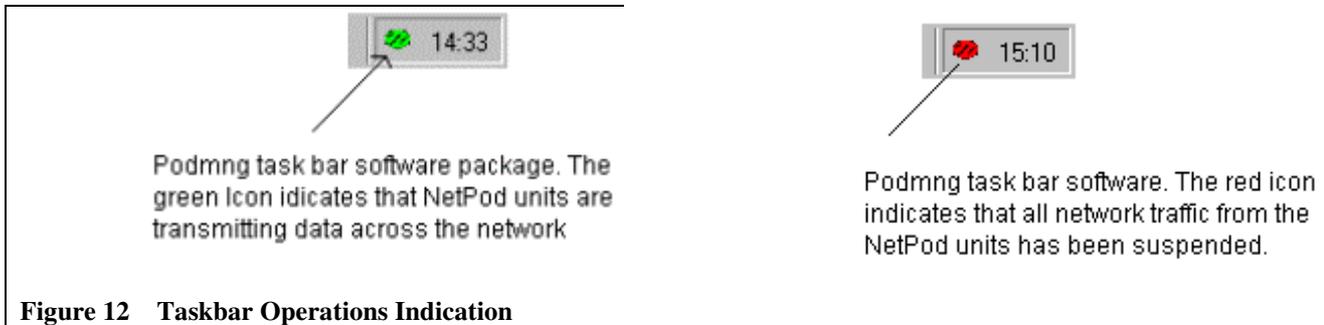
5) Upon selecting the new sample rate press the **OK** button to store new option. The *Confirm*_Window will appear.

6) Select the **OK** button on the Confirm screen to store new sample in the specified pod.

Once you re-start the data transmission operations the new sample rate will take effect.

6.12 Multi-user Operations

When operating in a Multi-User environment the PodMng software will appear in just the same way as described for single user operations. The software automatically determines the state of the data emissions from the instruments on a network. If any data transmissions from the instruments is detected the task bar Icon colour will change from red to green.



Depending upon the mode of operation, *Admin* or *User* Mode. It is possible to configure the instruments, start and stop data transmissions and record data directly from each User's terminal. Most third party drivers call the NetPod.dll to transmit and receive configuration details to and from the instruments.

The control of the instruments is a global operation i.e. effects all users and instruments. Starting and stopping data transmissions and configuration changes are reflected directly to each user connected to the network. The driver software automatically detects any changes and updates each user automatically. There are no configuration files to maintain. The automatic updating of the Keynes Controls software is not necessarily a feature of third party packages.

6.13 Real Time Data Display

To observe real time data from any of the instruments on the network follow the instruction below. You must ensure that that the network data transmission operations are active.

1) At the PodMng Window select **View** window option

The **Display** window will appear

2) The Display window has the following Tab options. Graph, Raw, Processed Errors

3) Select the Graph Tab The Chart Recorder display will appear.

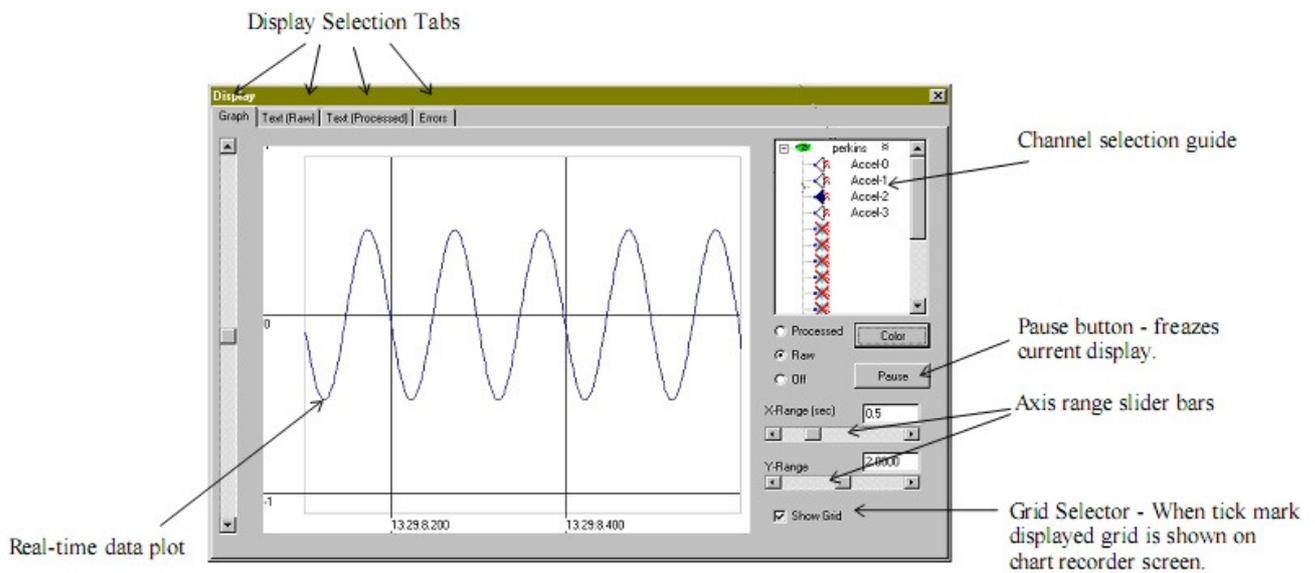


Figure 13 PodMng Software - Chart Recorder Display

- 4) You can observe data from any instrument on the network. Using the Channel selection guide select the instrument and channel whose data you require to plot.
- 5) For each channel you are using select either Raw or Processed data type options. You can mix raw and processed data on the screen.

6.14 Text Display - Raw and Processed Data

To observe the raw and processed data in a text format follow the instructions below:

- 1) At the Display Window select the **Text (Raw)** or **Text (Processed)** tab.

A display similar to the one shown below.

Each instrument will be listed horizontally across the screen

Listed below each instrument will be the data from the analogue input channels. A blank space in the channel list shows that no channel is installed in the instrument.

The display should match directly the configuration of your channels in the instruments.

When you have finished with the display. Close the Display window. Closing the window does not stop the driver from operating. No data is lost if your are streaming results to disk.

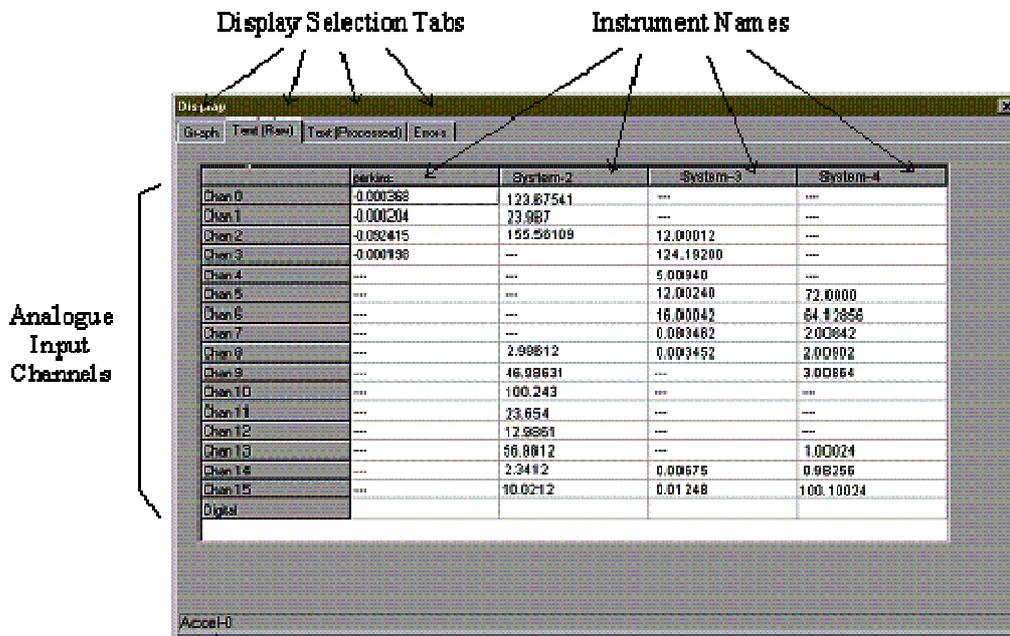


Figure14 PodMng Software - Real Time Text Display

6.15 Channel Configuration - Edit Channel Menu

The following instructions detail the procedures to be followed to assign channel configuration details for use within the Pod Manager software package:

1. From the main menu select a Pod whose channel you want to configure.

NOTE.

The main configuration menu is the menu that appears when you first activate the NetPod manager software. Each of the NetPod instruments for which data traffic has been identified will be shown on the main screen below the title listing the interface upon which traffic was detected.

2. Move the mouse pointer over the Pod chosen for channel configuration. Select by pressing the left hand mouse button or the + symbol; which appears adjacent to the Pod for which channel details are going to be adjusted, or directly the channel which is going to be configured. Figure 15 shows the **Edit Channel Window**

NOTE.

Select the + symbol. The channel details associated with the chosen pod will be listed.

The Pod manager software will interrogate all identified units and report details of any analogue and digital interface cards installed within the instruments.

3. Move the mouse pointer until it is above the channel name which has been selected for configuration.

Double click the left hand mouse button. The **Edit Channel** window will appear. If you do not double click the left hand mouse button quickly enough then only the text on the menu will change. The text will change from black on a white background to white on a blue background.

4. Using either the Tab key or mouse pointer, select the parameter that is to be adjusted.
5. On completing the channel configuration details select the "OK" button. All of the newly configured parameters will now take effect.

NOTE.

If at any time you want to stop the configuration process simply select the "Cancel" button on the Edit Pod window. The Edit Pod Window will disappear and you will return to the main system configuration menu.

6.16 Multi-instrument Operations

To install additional instruments on to an Ethernet network simply power on the instrument and connect the local area network from the hub to the NetPod RJ45 socket. Instantly the instrument detects network data you will see the link status light illuminate.

The Link Status light is mounted on the front panel of the 4003 instrument illuminates.

Also Ensure that each instrument has its own unique IP address before connecting onto a network.

6.17 Data Recording Operations

The following page details the instructions that should be followed to store data to disk. Each user can record data using the PodMng software or third party application packages.

- 1) From the main menu select the *Configure* menu option
- 2) Select the *Logging* menu item to access the data recording operations setup screen.

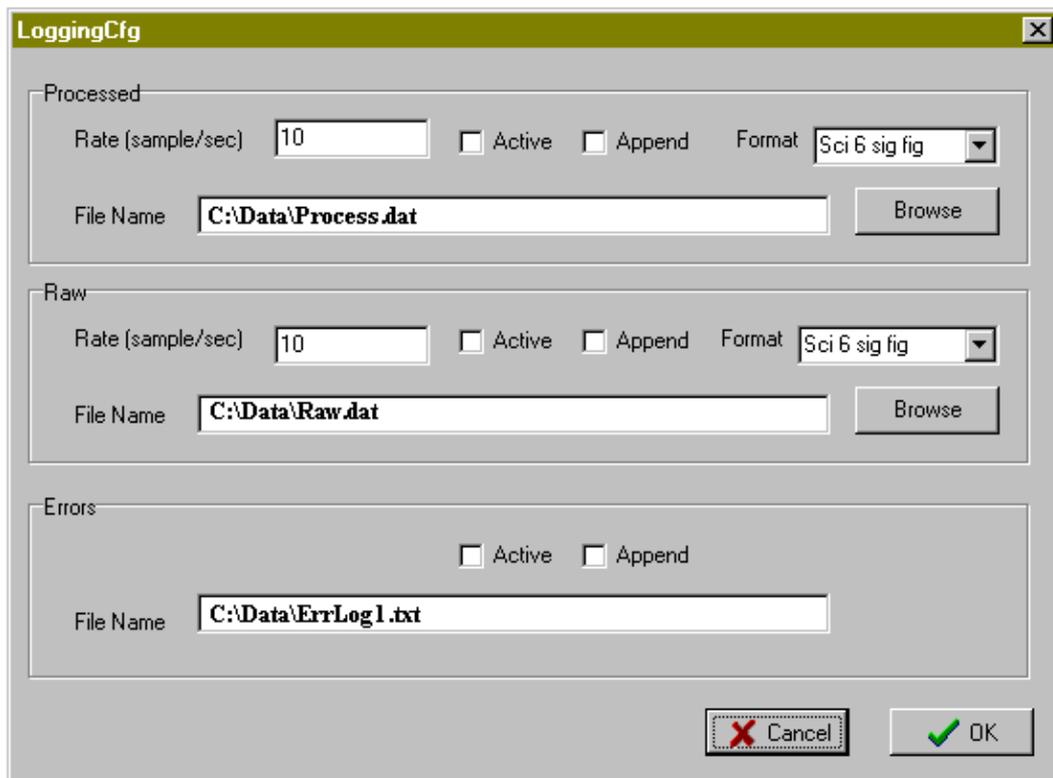


Figure15 PodMng Software - LoggingCfg Window

Using the LoggingCfg setup dialog box simply enter the file names and directory locations where you want to store processed and raw data.

Processed Data: This is data converted into engineering units by a mathematical process.

Raw data: This is the data gathered by the NetPod instruments prior to any data processing

- 3) Enter in the “Rate (Sample/sec)” boxes the desired sample rate.

Only enter sample rates up to the maximum rate set for the NetPod4003 instrumentation. The recording of data does not include any multi-rate filtering to eliminate aliasing effects.

- 4) Using the mouse pointer select the desired type of recording operations.

Active: Data is recorded to a new file each time storage operations are activated. Old files are over written.

Append: Data is appended to the end of the specified file at the resumption of data recording operations.

Move the mouse pointer over the data recording function tick boxes. Use the left mouse button to select the desired option. You can only select one option at any one time for either of the raw and processed data file.

- 5) Once you have completed the setup operations select the OK button. The **LoggingCfg** Window will disappear and you will return to the default screen.

6.18 Error Recording

Error recording is useful to show the status of the instruments and network operations for a series of instruments widely separated on an Ethernet network. It is possible to locate and in many cases identify the source of any system error without need of manually inspecting the instruments.

The following page details the instructions that should be followed to record the instrument and network error messages to disk. Each user can record an error log using the PodMng software or third party application packages.

- 1) From the main menu select the **Configure** menu option
- 2) Select the **Logging** menu item to access the data recording operations setup screen.
- 3) Using the LoggingCfg setup dialog box simply enter the file name and directory location where you want to store the error log. Enter the error log file name in the space provided for this information.
- 4) Using the mouse pointer select the desired type of recording operations.

Active: Data is recorded to a new file each time storage operations are activated. Old files are overwritten.

Append: Data is appended to the end of the specified file at the resumption of data recording operations.

Move the mouse pointer over the data recording function tick boxes. Use the left mouse button to select the desired option. You can only select one option at any one time for either of the raw and processed data file.

- 5) Once you have completed the setup operations select the OK button. The **LoggingCfg** Window will disappear and you will return to the default screen.

6.19 Network Error Report

In order to provide a clear indication as to the operating characteristics for each instrument connected to a LAN a network reporting system has been created.

To view the Error Report Window you should.

1. Select the **View** menu option from the PodMng default Window.
2. Select **Error** Tab on the Display Window. On selecting the Error tab the Error Display Window will appear.

The Error Display Window is split into two parts. The top screen shows the instantaneous messages that are directed to the PodMng from the instruments. The bottom of the screen shows each instrument connected to the network and a real time summary of the network statistics.

For each instrument connected to the LAN the following network statistics are reported:

- Packets Missed
- Packets Resent
- Packets Lost

Status: OK (Normal Operations) Failed (Network time out, power failure)

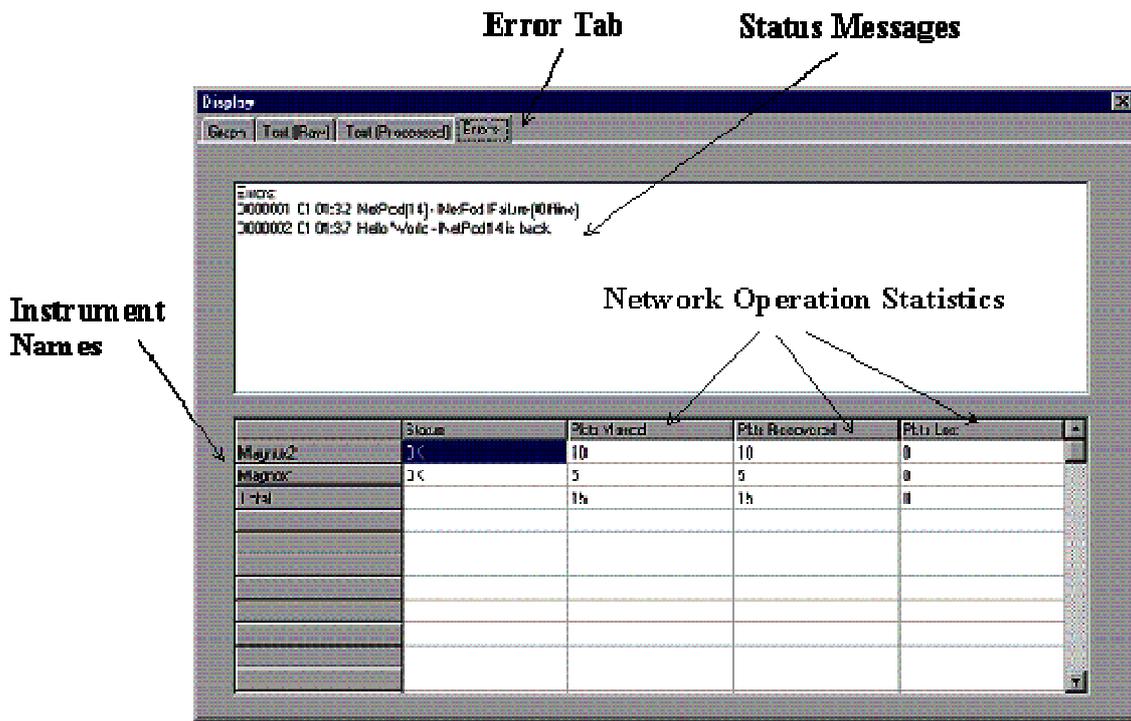


Figure16 Error Report Window

The Status message indicates the instantaneous action of the instruments. OK for successful operations and Failed for any instrument that have timed out or become disconnected.

6.20 Hiding Error Screen From User

It is not possible to have a perfect network where no packets will be lost. In order to prevent confusion with a user, a facility has been included with the driver software to remove the error log from a users screen. The error log is removed by a simple command included in the operating system registry.

Remove error log from screen insert following command into Registry

Command1= nopackerr

6.21 Setting Watchdog Timer

The NetPod 4003 has an in-built watchdog timer that is used to reset the instrument should there be a network problem detected. The instrument monitors the network traffic and should no traffic be detected for a 30 seconds then it resets.

If the NetPod 4003 watchdog timer has not been enabled then if an instrument goes off line it will not communicate until its is physically reset by the operator.

Once the watchdog timer has been enabled it cannot be disabled.

Operation

1. Stop Data Recording
2. Select the NetPod for Watchdog enable

Move the mouse over the instrument name and select using the right mouse button.

3. The Control menu will appear
Select *Enable Watchdog* option
4. Re-start data recording

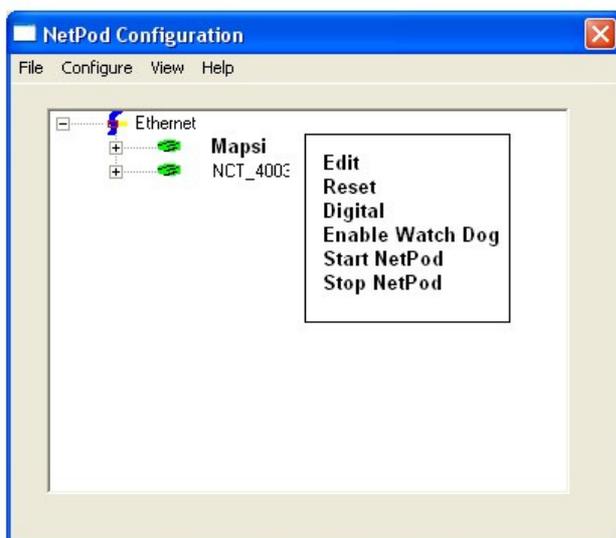


Figure 17 Enable Watchdog Menu

7. Anti-alias Filter Characteristics

The following chapter summarises the anti-alias filter characteristics used within the NetPod 4003 analogue input modules:

All analogue input modules used within the NetPod 4003 contain individual digital anti-alias filters for each input channel. The anti-alias filters are used to reduce the aliasing effect present in sampling converters.

Digital anti-alias filters are used since they do not degrade with time, change performance with temperature, and form a perfect match in both phase and frequency.

A simple low pass low order filter is used on the immediate signal entry to the inputs to attenuate any out of band signals

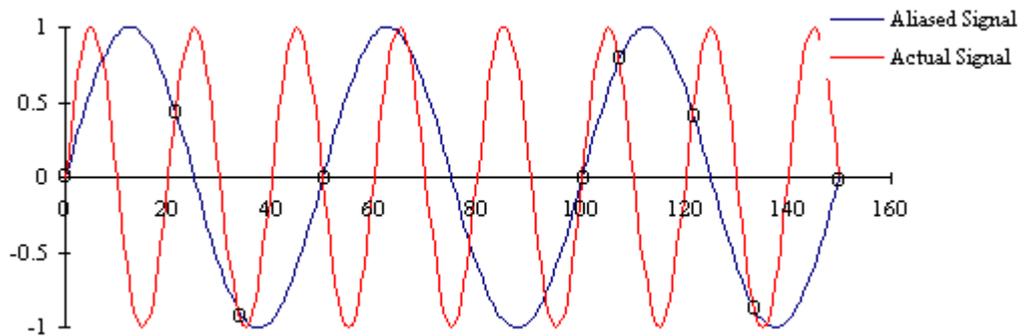


Figure 18 Example Aliased Signal

Shannons sampling theorem states that the maximum frequency recoverable from a data acquisition system is exactly half the sampling rate (Known at the Nyquist frequency). With a sampling converter, frequencies above this maximum can alias into the operating frequency of the input as shown below:

7.1 Analogue Filter Types

The NetPod has the following types of filters:

For the high resolution 24 bit cards, the filter response equation is given by $H(x) = (\sin x/x)^3$. This equation known as the Sinc(3) (Sinc cubed) provides a low pass frequency response.

The transfer function for this filter in the frequency domain is given by:

$$|H(f)| = \frac{|\text{Sin}(\pi f / f_s)|^3}{|N \times \text{Sin}(\pi f / N f_s)|}$$

where N is the ratio of the modulator rate to the output rate, and f_s is sampling rate. N = 512 for the high resolution 24 bit cards (depending on sample rates). For Large N, and for $f < N.f_s$ the above equation simplifies to:

$$|H(f)| = \frac{|\text{Sin}(\pi f / f_s)|^3}{|\pi f / f_s|}$$

A plot of normalised filter response is given below:

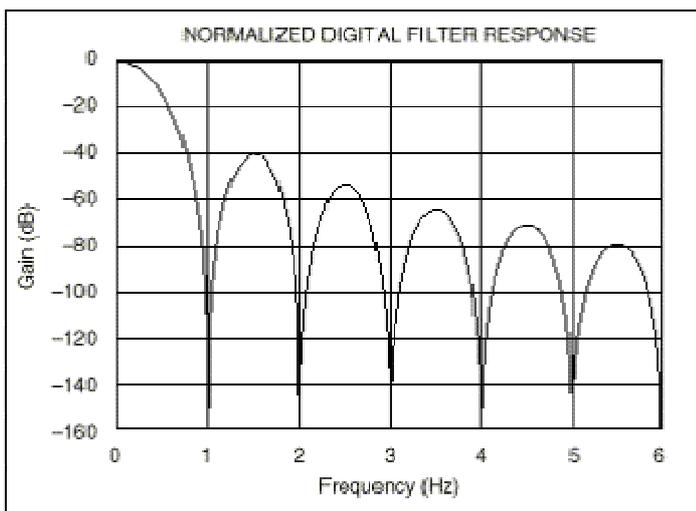


Figure 19 Normalised Filter Response - 24 Bit High Resolution Cards

8. NetPod 4003 Data Synchronisation

8.1 Introduction

Each Netpod 4003 contains it's own individual real-time clock and is used to control the timing operations for the data acquisition within the instrument. The instrument clock in collaboration with the clock within the data acquisition computer forms the basis for the timing systems used to provide the synchronisation timing within the Podmng driver software.

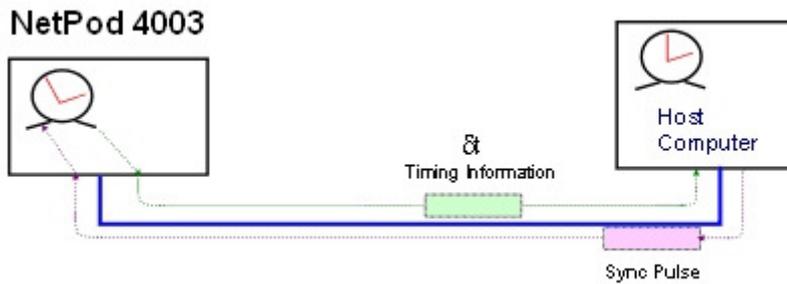
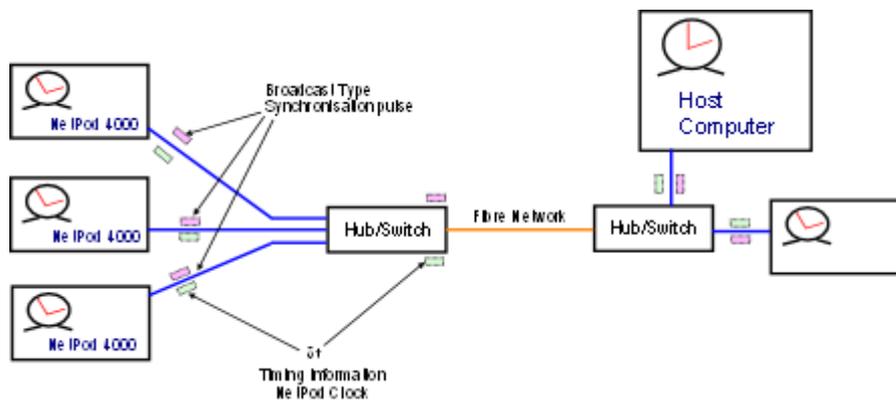


Figure 20 Timing Information

$$\delta t = (\text{Time difference}) \text{ Linux Clock} - \text{Instrument Clock}$$



Driver Operations

The driver software, no matter if it is running under Microsoft Windows or Linux operating systems starts by sending a synchronisation packet across the network. Upon detecting this packet the 4003 instrument determines the time difference between its internal clock and the timing information contained within the sync pulse.

Once the time difference for the instrument is determined for a specific instrument it is returned back to the driver software running on the host PC. See Figure 18.

The time difference for each instrument is sent back to the driver several times a second and its determination is essential in the reconstruction of the input signal within the driver.

Figure 19 demonstrates how the synchronisation packets are sent out to multiple instruments upon a network and timing information returned to the driver software running on the PC.

Note. the synchronisation packet is a broadcast type packet and as such passes through all hubs and switches etc. on the network in order to reach instruments

There is a small delay between the PC sending the sync packet out across a network before an instrument receives the sync packet and processes it. This delay is related to the distance from the data analysis PC and the number and different types of networks used to connect the system together.

The driver effectively creates and maintains a table of time differences between the clocks, see Table 1, with the timing information updated each time the sync pulse is sent out across the network. The sync pulse is sent out by the driver several times a second.

8.2 NetPod 4003 Ethernet Operations

The NetPod operates upon the Ethernet network and as such transmits data in an asynchronous manner. When there are multiple instruments operating, they take turns to send packets of data back to the PC. In the case of the NetPod 4003 the data packets consist of :

- 1) Timing details at the instant a reading is made
- 2) Analogue channel and status information from the digital Interfaces.
- 3) A sample number - this number is unique but increasing number

For instruments deployed upon a network it is not possible to start the data acquisition operations simultaneously as there will be a finite delay for the instruments to receive instructions to start logging and a difference between the time set upon the instrument clock from the instance that the 4003 initialises. Each real-time clock within the instrument may be set at different times from any other instrument upon the network and it's operation is corrected for within the signal reconstructed within the driver software.

To get around the differences in the instrument real-time clocks, the different starting times for the data transmission from instruments and the fact that data is sent asynchronously, the NetPod driver reconstructs the data into its synchronised form using the timing information of the clock with the details in the data packet formed after each sample is taken. The data is sorted out and reconstructed packet by packet into its original form within the driver software.

8.3 Internal Instrument Synchronisation

Within the 4003 instrument all data acquisition operations for both the analogue inputs and digital I/O are absolutely synchronised. Each analogue input as an individual ADC and each digital input an individual port.

Signal Reconstruction.

Once the time difference between the instrument and PC clock is obtained then the correct sequence for the data reconstruction for the input signals can be undertaken by correcting the time stamp for the each record and ensuring the correct sequence is made based upon incremental packet number. This way the recorded time stamp for each acquisition will be correct as well as the information being synchronised. Once the time difference between the clocks is taken into consideration then after the signals are reconstructed the synchronisation between instruments will be observed.

Figure 19 shows an example of a common signal applied to two analogue channels installed into separate instruments.

Figure 20 shows the acquired signals with the time differences between instrument and Linux systems clocks. The time difference has been enhanced above what happens in practice in order to further clarify the data reconstruction and synchronisation operations.

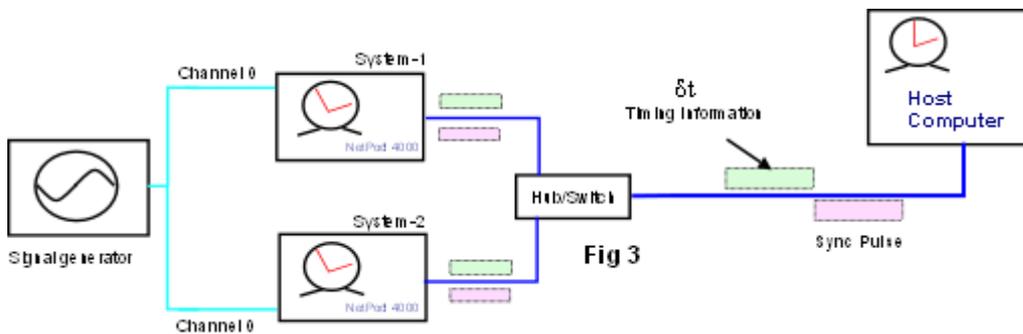


Figure 21 Common Signal Applied 2 Systems

Table 1

δt	POD ID
1023	23
862	24
894	26
1203	27
987	31

Example Signal Reconstruction

Figure 21 also demonstrates a snap shot of data gathered from the from individual channels on separate instruments as acquired from the test system. Clearly shown below are the time stamp differences between 2 instruments but with the same analogue signal values. The data values are identical to show that the original input signal has been obtained from the same source.

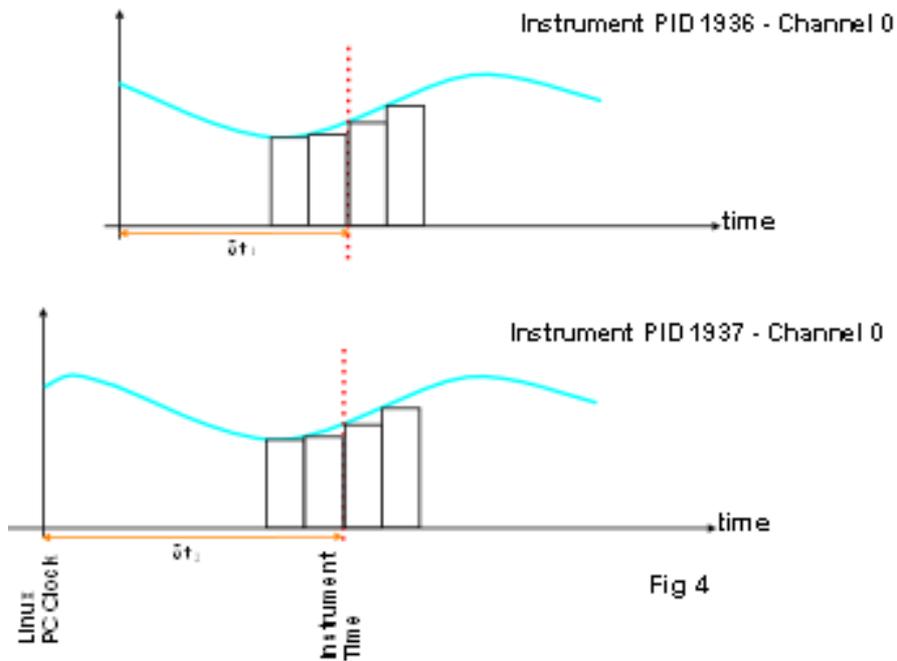


Figure 22 Timing Between Instruments

Figure 20 shows a snap shot of data from the Keynes test system and clearly shows signals synchronised using inputs from separate instruments

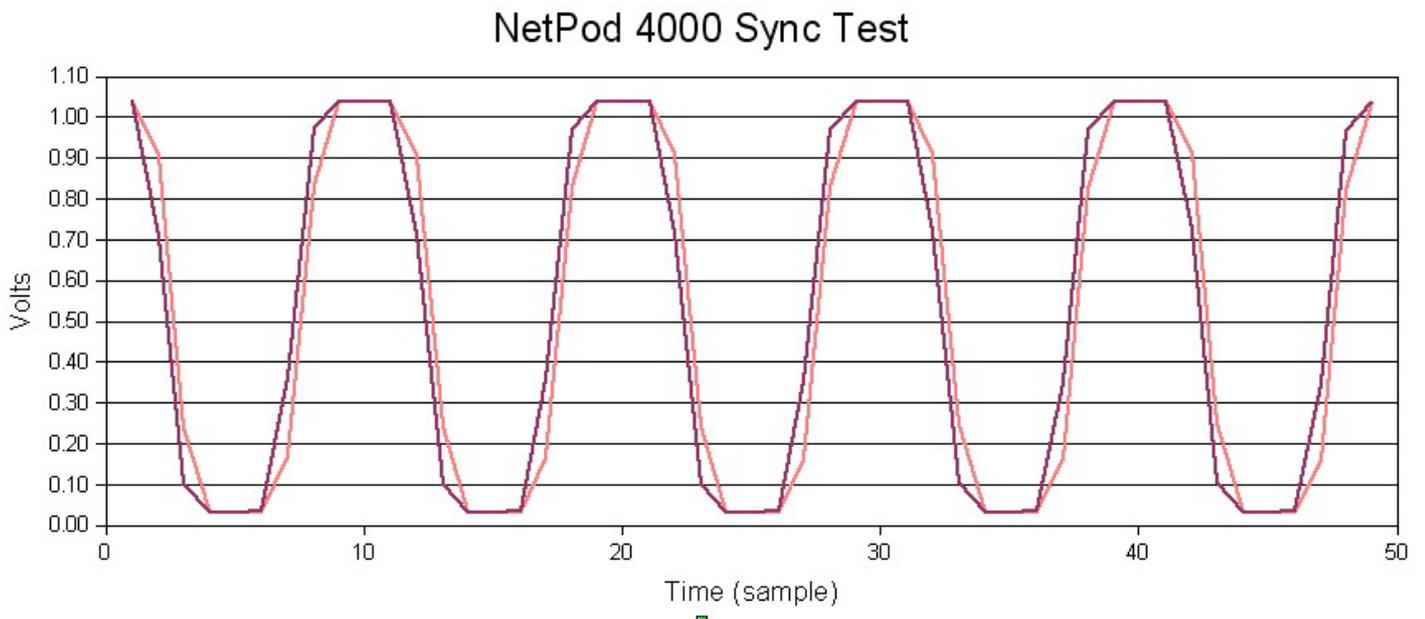


Figure 23 - Sample Test Data Separate Instruments

In practice losses within the cables and small differences with the channel calibrations will show minor different amplitudes on the input signals.

NetPod 4003 Sync Test

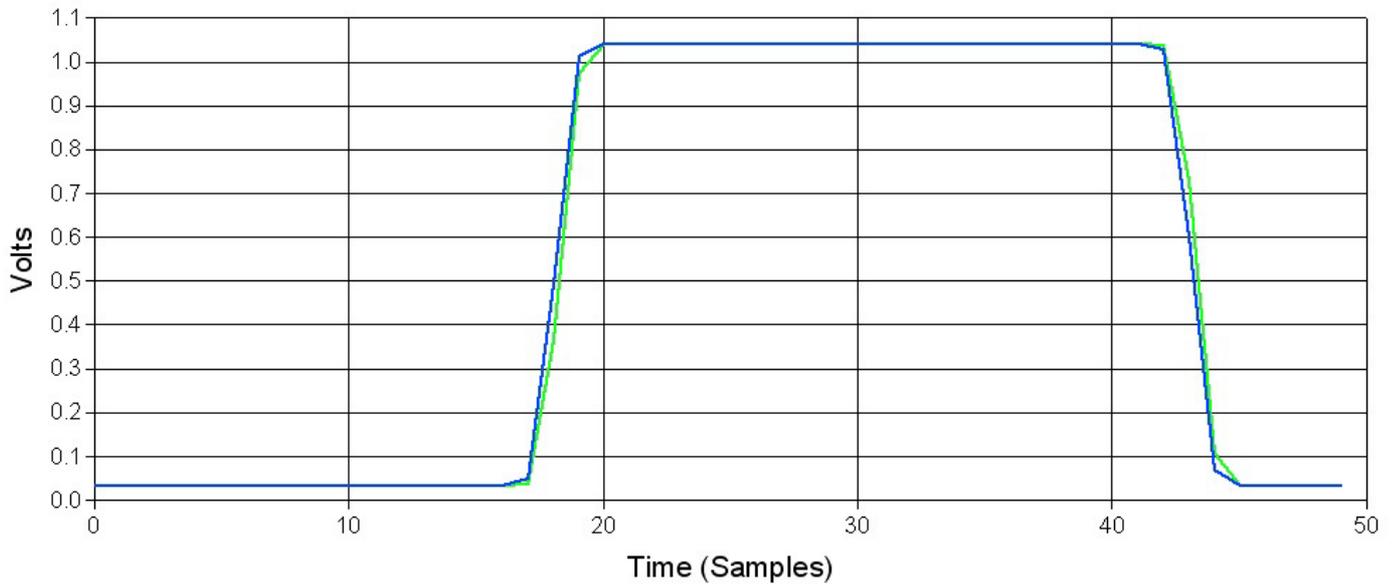


Figure 24 Overlaid Square Wave Trace

Fig 22 shows a square wave input overlaid for channel 0 on PID 1936 and 1937 after 12 hours of operation after the first recording was made and clearly demonstrates the synchronisation operation fully operational. A square wave input was chosen for tests due to its high harmonic frequency components.

As is clearly shown there is no phase delay between channels from separate instruments. The digital filters ensure that all inputs are identical.

9. Configuring NetPod For Ethernet Operations

The following chapter details the operations that you can carry out to alter the instrument configurations to suit your organisations operating requirements. Every care is undertaken to ensure that the instruments will operate directly upon arrival but for some users it may be advisable to change network addresses of multiple network string and bridging equipment is in operation.

The NetPod instrument contains interfaces to enable the unit to be directly connected to local area Ethernet network. Upon initialisation the NetPod 4003 monitors for traffic on the Ethernet port.

IP Address

In order to identify data originating from an instrument on an Ethernet network each instrument is assigned it's own unique IP address. This address is appended to each data packet originating from the chosen instrument prior to its broadcast across a network. The IP address can be user assigned in order to enable the instrument to meet network management requirements.

Setting The IP Address of the instrument

The following page details the operations you are to carry out to modify the IP address of a NetPod instrument.

Operations

- 1) Stop network data transmission operations.
- 2) From the default driver screen select the NetPod instrument whose IP address you want to change.

To select the NetPod unit for configuration, simply move the mouse pointer until it is above NetPod unit you want to configure then double click with the left mouse button the unit whose IP address you require to set.

- 3) The **Edit Pod** window will appear.

Observe on the **Edit Pod** window that the chosen IP address for the chosen NetPod unit is displayed. The IP address shown on the menu is the current setting for the instrument.

- 4) Using the Mouse pointer or Tab key select the IP address on the menu system.

Edit the current I.P. address and insert the new address values.

Ensure that you do not insert a repeat address i.e. one already assigned to an earlier unit.

- 5) Once the new address is assigned select the **OK** button.

Upon selecting the OK button the **Confirm** Window will appear. Pressing the OK button on the Confirm menu will cause the new IP address to be sent to the chosen NetPod unit and stored for use.

The status lights on each of the NetPod units flash on and off quickly to show that the new configuration parameters have been sent across the network.

- 6) Start the data transmission operations again. The new IP address will take effect as soon as data transmission operations are activated.

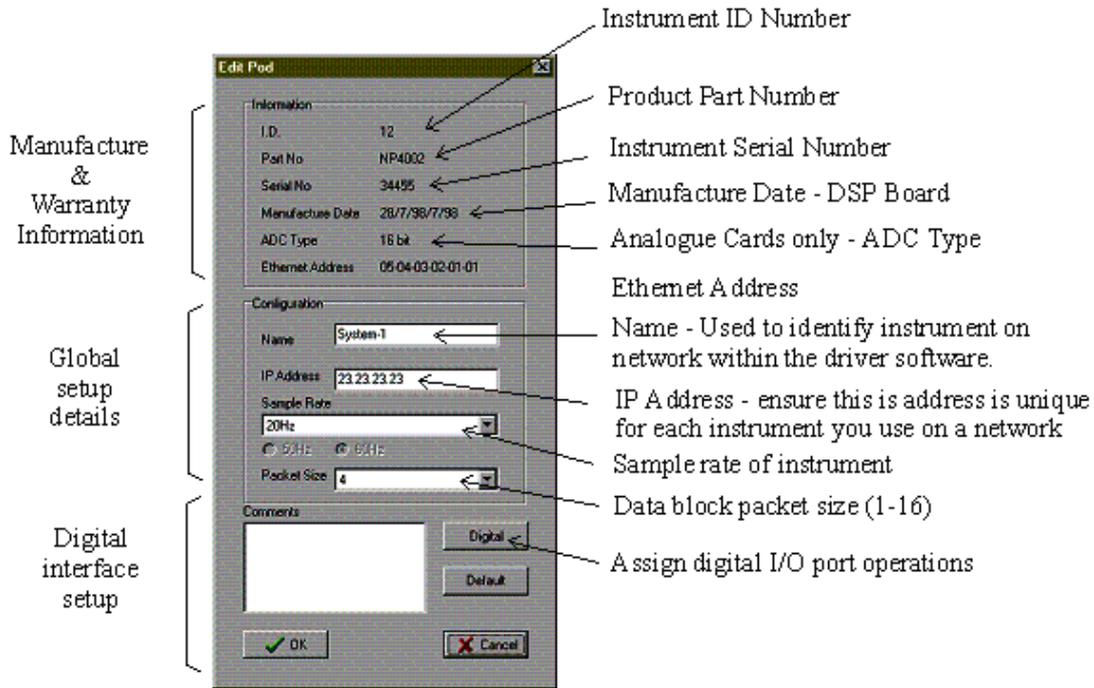


Figure 25 PodMng Software - Edit Pod Window

9.1 Automatic Restart

The instrument will restart data transmission operations automatically should a network link fail or be reset. This action may occur during network maintenance. Data is restarted across local area networks

The Error Display Window will indicate the operating status of each instrument.

If an instrument has timed out or been disconnected then the status message will indicate a failed status message. The status message will revert back to OK up on the PodMng software detecting new data packets.

The default Timeout period used to indicate an instrument failure is 20 seconds.

The figure below shows how the task bar icon indicates that an instrument has failed or timed out. The task bar icon will automatically change status to indicate correct operations or stopped data transmission operations. (Timeout task bar icon)



The red bar through the icon indicates that an instrument has failed/timed out somewhere on the LAN

Figure 26 Task bar icon - Instrument Failure or Timeout

Should the instrument not restart automatically after a timeout operation then please ensure that the watchdog timer has been energized.

Software Parameters

The following chapter details the names and functions of the parameters used by the software for the NetPod instrumentation. The system parameters are described in two parts, global and channel. Global parameters are those that are stored within the main processor board. They contain manufacture, warranty and parameters that describe instrument operations. Channel parameters, are those that describe the setup and operation of a particular analogue input module. Just like the global parameters they are retained even if the channel is removed, stored or moved to another instrument.

9.2 Global Configuration Parameters

The following page details the global User Defined parameters that can be assigned by an operator to assist in the control and configuration of the control units for project specific tasks. Some of the parameters you can adjust when you configure the instrument. Others are set on manufacture and are used to assist us to provide technical support.

The following details are assigned via the EDIT POD menu. See *Assigning Pod System Information* for further instructions on how to apply parameters.

FACTORY SPECIFIED MANUFACTURE DETAILS

ID	Pod Instrument Identification number.
Part No	DSP mother board part number and firmware details.
Serial No	Pod serial number.
Manufacture Date	Date on which instrument is manufactured..
ADC Type	Details the resolution of the ADC system installed in the instrument.
Ethernet Address	Default Ethernet network address assigned at manufacture time.

USER DEFINED SYSTEM CONFIGURATION DETAILS

Name.	User specified instrument identifier.
IP Address	User specified IP address.
Sample Rate	Global instrument sampling rate. Sets sample rate for acquisition.
Packet Size	Data block packet size.
Comments. (Box)	Area for user defined comments and reports. Maximum length 1024 characters.
Digital Button	Used to define status of the digital I/O interface for a specified POD.
Default Button.	Used to set the default status of the digital I/O interface.
OK Button	

9.3 Analogue Channel Parameters

Each of the configuration settings shown below are stored directly within each channel using the onboard EEPROM built into each block of channels

The following details are configured at the time of manufacture. No parameter contained within the "Factory Configured Analogue Input" details list can be adjusted by the operator. Information is used to confirm warranty information.

FACTORY CONFIGURED ANALOGUE INPUT PARAMETERS

Channel.	Channel position in instrument where input is installed.
Part No.	Part number associated with the analogue interface.
Description.	Details the operations of the specified analogue interface.
Serial Number.	System management information..
Manufacture date.	Record of manufacture date.

The following section details the user configurable channel parameters.

USER DEFINED ANALOGUE INPUT CHANNEL PARAMETERS

User definable channel name.
Gain setting . Range is sample rate limited.
Direct analogue input signal range.
Expected noise level for a set sample rate and pre-amp gain configuration.

Calibration.	Linear calibration details for specified channel. Offset and gain settings only.
---------------------	--

The processing section provides the user with a simple pull down menu system that is used to assign the type of sensor processing options..

PROCESSING

Setup.	Assign sensor type and operating characteristics.
OK Button.	Select this button to confirm the selection of the new configuration details.
Cancel Button.	Select this button to cancel any modifications made to the configuration details.

CONFIG MENU

Yes	Select this button to store new configuration details to EEPROM.
No	Select this button to reject any changes to the config details stored within the channel EEPROM.

Note. This is same effect as pressing cancel button mentioned above.

10. General System Information

The following chapter details general information. Listed below are driver files that can be downloaded from the Keynes Controls web site.

10.1 File lists

The following page summerises the files used by the PodMng.exe software package.

nomenclature:

[windows]	current windows directory (e.g. C:\WINDOWS)
[system]	system directory (e.g. C:\WINDOWS\SYSTEM)
[windows]\podmng.exe	NetPod manager interface

<http://www.keyne-controls.com/4003/manual4003.pdf> downloads this manual

[system]\netpod.dll	NetPod driver
---------------------	---------------

In addition there may be drivers specific to your SCADA, MMI or data processing software.

10.2 Registry settings

Registry setting are placed under the **HKEY_CURRENT_USER\Software\NetPod** key.

Use Regedit to modify the settings (from the start menu, select run, and type Regedit) The keys are listed as follows:

Access	User access mode, e.g. user or operator if this key is set to UA5098 , then user access mode is selected.
---------------	---

The user has full access to configure any model of NetPod on a network. All other keys default to operator mode. Operators cannot configure the NetPod 4003 only access the real-time data.

The subkey *InitCommands* contains commands to be run when the NetPod driver software is initialises. The sequence of commands is as follows:

InitCommands\Command1	
InitCommands\Command2	
InitCommands\Command3	etc.

These commands are run sequentially and the keys are string values that can be any combination of the following:

SCANNET	Scan the network on initialisation
SCANNET D	Scan the network on initialisation, and display the progress bar
SCANPORT 1	scan comm port 1 (COM1)
SCANPORT 2	scan comm port 2 (COM2) etc.
STARTRUN	start acquisition operations
NOPACKERR	Prevent the error log screen from being viewed in driver.

10.3 Reporting Problems

If you have any problems with your instrument contact your local distributor or direct to Keynes Controls

Additional information or would like to develop new units then please contact Keynes Controls directly.

Tel: (+44) 01344-752036

Fax: (+44) 01344-772244

E-mail: support@Keynes-controls.com

11. Optional Interface Units

The following sections show details of the optional interface modules available for use with the NetPod 4003.

11.1 Temperature Controlled Fan Unit

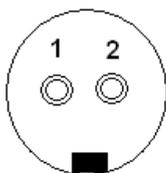
In order to improve the operating characteristics of the instrument a microprocessor controlled variable speed fan unit is fitted as standard. Unlike the earlier versions of the instrument the fan controller continuously monitors the internal temperature of the instrument and adjusts the fan speed to maintain the correct and stable internal operating temperature. Depending upon the use of the instrument the fan controller can be factory preset to operate any where between 15 – 40 Deg C. Typical factory setting being 20 Deg C

Testing the fan unit is straight forward simply blow hot air into the unit via the fan exit hole and the fan controller will increase speed of the fan.



Figure 27 Fan Controller & Power Supply Connectors

Battery Connector



Pin 1 = Gnd Pin 2 = 12 V DC

Figure 28 View looking into connector

11.2 Power Supply Options

The following pages describe the specification and fitting of the NetPod 4003 power supply module.

The **NP403-220V5D** module operates with 230/240 V 50/60 HZ AC mains supply or 9 – 30 V DC supply and provides a regulated supply for the 4003 series of instruments.

The **NP403-220V5D** power supply module fits into 1st slot of the 4003 chassis only, see photo below.



Specifications

Part Number	NP403-220V5D
Input Range	110/240 VAC 50/60 Hz
	25W
Battery Backup	Optional

Operations

Once fitted in to the 4003 chassis power on the instrument. If the 230/240V AC mains supply is being used then the Power and AC blue indicator lights will be illuminated.

If the 4003 is being powered by an external DC power supply then the Power and DC status lights will be illuminated.

Installation



1. Slide the **NP403-220V5D** into slot 1 of the 4003 chassis until it locks into place
2. Lock the termination screw at the top of the panel into the chassis.
3. Power on the instrument

Slots **1** 2 3 4 5 6 7

12. OPC Server

OPC stands for OLE for process control. OLE stands for Object linking and embedding and is a Microsoft mechanism for linking programs together. OPC enables data transfer from a data server program (such as NetPod OPC server) to a data client (such as a SCADA system).

OPC provides a common interface between data acquisition and control equipment and SCADA and MMI software systems. OPC simplifies the task of connecting the hardware to the software providing a much more open architecture than is generally the case using standard hardware driver modules. The use of OPC enables system from many different suppliers to be easily integrated.

Instead of providing a multitude of individual device drivers, each having to be individually tested with the application software, a SCADA system manufacturer need only to provide a single OPC Client Interface package. The OPC Client interface software will enable the SCADA application to connect to a large number of different control equipment from many manufacturers. Similarly, a hardware manufacturer need only write a single OPC server program to enable compatibility with a large number of modern SCADA systems.

Sample rates using OPC is not very fast and rates to 100 Hz is about the maximum possible speed with OPC.

For further information on the OPC specification, systems, standards etc. contact the OPC foundation (<http://www.opcfoundation.org>).

12.1 NetPod OPC Server

The NetPod 4003 OPC server program is an OPC-2 compliant data server. It requires the standard Pod Manager software to be running in collaboration with the OPC Server software in order for it to operate.

The main **NetPod OPC Server** Window displays the OPC names available and the data quality. The quality field is defined by the profile bus specification, and can be good (0xC0), bad(0) or uncertain.

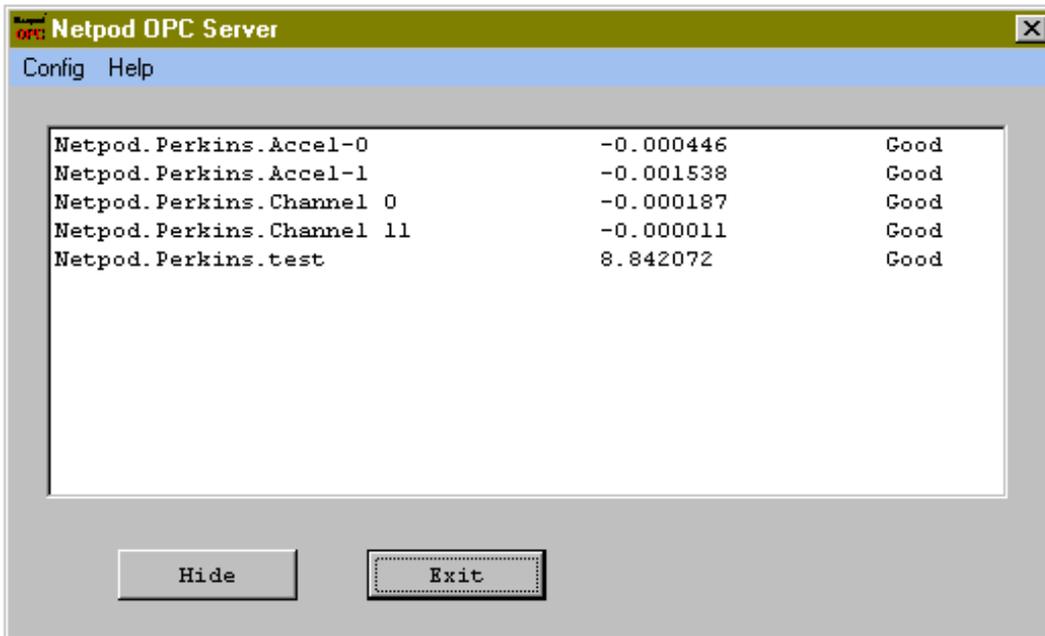


Figure 29 OPC Server Window

12.2 Registration

The first time the NetPod OPC server is run it will need to be registered the software. The registration operation is used to write setup information to the Windows registry, and is used to inform the system that a new OLE application is being used.

To register the software, select **Register** form the main config menu within the NetPod OPC software. If the server has to be re-installed for any reason, you are required to select the Unregister menu item before attempting re-installation.

Update

After scanning the network (PodMng operation) the configuration Window will automatically update and show the NetPod details such as instrument name and channel information. However, should changes be made to the channel or NetPod name the OPC server will not update system details automatically, however, it can be made to do so by selection the **Update** menu item. The Update function is one of the functions available from config menu list.

12.3 Sample Rate Settings

The setting of the data acquisition rate for the NetPod OPC server is carried out by selecting the **Settings** menu item from the Config menu. Up on activating the Settings menu item the dialog box as shown below will appear:



Figure 30 Setup Window - OPC Server

12.4 Data Acquisition Parameters

The following data acquisition parameters are specified within the Setup Window:

Update Time Number of milliseconds between updates

- Uncertain after** If no data has been received from a NetPod for a time greater than this interval, then the data quality indicator is changed to 1 (uncertain)
- Bad after** If no data is received from a NetPod for a time greater than this interval, then the data quality indicator is changed to 0 (bad)
- Show main dialog** Select this check box should you require the main screen to be displayed at startup, otherwise, only the icon will be displayed on the control bar.

Main screen

The main screen can be examined at any time by double clicking using the right hand mouse pointer on the OPC icon on the main control bar. (Insert OPC ICON image).

13. SCADA Systems

The SCADA systems listed below have been directly tested with the NetPod Client software.

System/Package	Driver Installation
Wonderware In-Touch www.wonderware.com	Install the OPCLink I/O server from the main setup program. This is part of the standard distribution discs. Version 7.0.1.31 or higher is required
Intalloution Dynamics/iFIX www.intelloution.com	Install the OPC server package. Run the InstallServer program to link the OPC server.
Ci-Technologies Citect for windows www.cit.com.au	Run Express I/Osetup in the Communications page in Citect Explorer and select OPC server
Honywell Scan3000	
PC Soft Wizcon www.pcsoftintl.com	

For additional details requiring the setup and operation of the OPC Client software provided with any applications package please contact the software supplier or consult your manuals.

14. HP-VEE OPERATIONS

Install VP-VEE. The NetPod driver is compatible with Windows 2000, NT and XP versions of HP-VEE only (not UNIX version).

Download the NetPod.dll and Podmng.exe software from the Keynes Controls web site

The following files are copied to the disk:

Into the windows directory (e.g. c:\Windows):

NetPod.dll **Main NetPod driver interface**
Podmng.exe **pod manager program (taskbar icon)**

Into the *HP-VEE directory* (e.g. C:\Program Files\HPVEE

download this manual at <http://www.keynes-controls.com/NetPod4003/Manualv101.pdf>

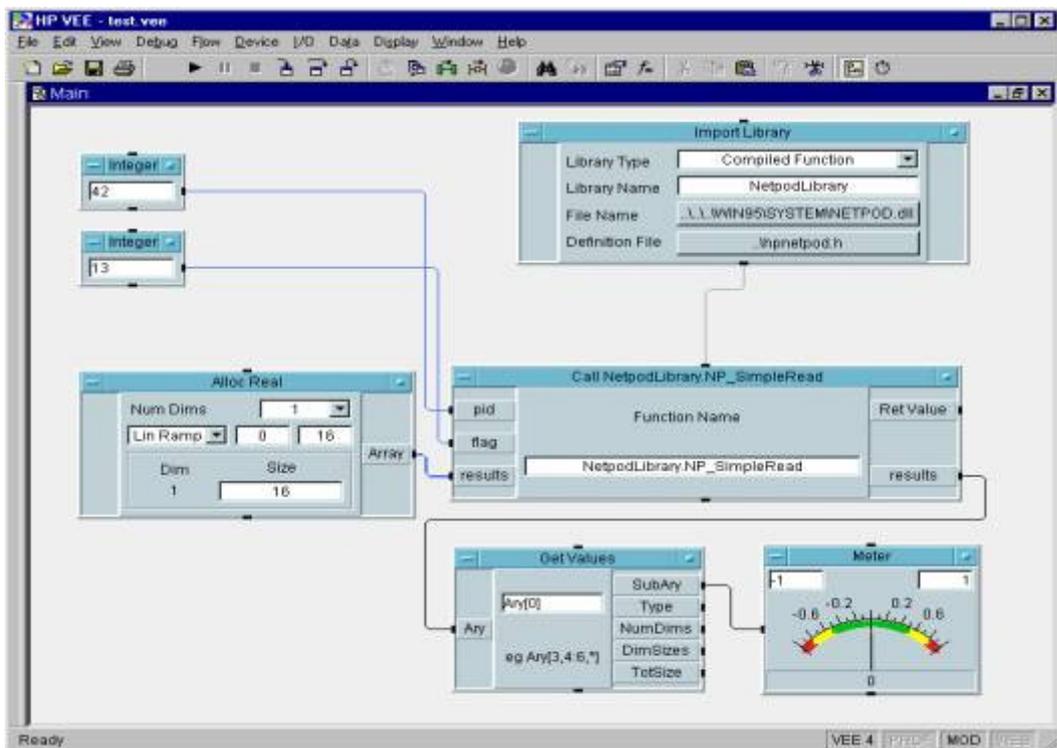
HP-VEE call function blocks can be used to directly call the driver routines in the NetPod.dll driver.

Create an import library to import the NetPod.dll common driver library.

The **hpNetPod.h** library definition file is required. This file can be downloaded from the protected part of the Keynes Controls web site.

Functions within the NetPod.dll can then be accessed via a call block.

The example below shows a simple reading operation of a single NetPod using the NP_SimpleRead command, and then displaying the results on a meter. Refer to the device driver tool kit for full information on the NetPod interface calls.



And also needs hpNetPod.h library definition file to be installed.

Functions can then be accessed via a call block. The example below shows a simple reading operation of a single NetPod using the NP_SimpleRead command, and then displaying the results on a meter.

15. DIAdem DRIVER INSTALLATION

Ensure you have a 32 bit version of DIAdem (versions 6.0 and above) installed on your computer. The driver is not compatible with older 16 bit versions. If you have an old version of DIAdem you must contact GfS for an upgrade.

The software setup and operations is the same no matter which NetPod model is being used. It is possible to mix NetPod 4003 and 4000 units on the same network.

Download the driver software from the Keynes Controls web site

The following files are copied to the disk:

Into the windows directory (e.g. [c:\Windows](#)):

NetPod.dll Main NetPod driver interface
Podmng.exe pod manager program (taskbar icon)

Use this manual as the help facility in PDF format

Into the DIAdem GPI extensions directory (e.g. C:\DIAdem\Addinfo):

gfsnp.dll DIAdem driver interface

- 1) Start DIAdem and select GPI-DLL registration. The GPI extension registration dialog box will then appear as shown below.

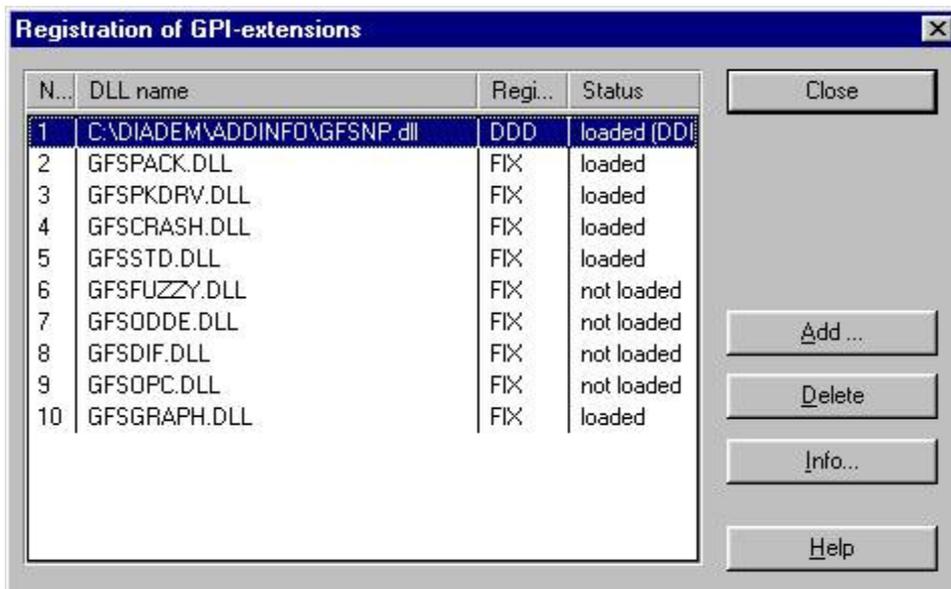


Figure 31 Registration GPI-Extension Window - DIAdem

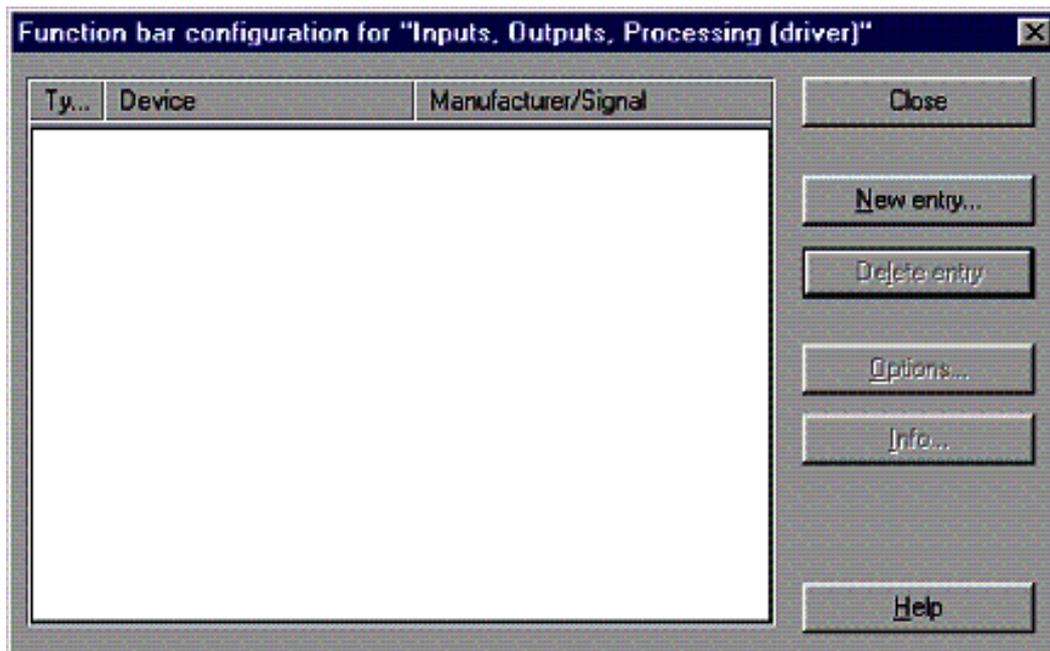
The first time that DAIdem runs, the GFSNP.DLL module (item 1 in the listbox shown above) will not be shown. You will have to add it by clicking on the Add button, which will display a file selection dialog. Select GFSNP.DLL from the GPI extensions directory (normally Addinfo).



Figure 32 DLL Selection Window

On closing the registration dialog, DIAdem may restart itself, and on restarting, the DLL will be loaded into memory.

Next the NetPod software will have to be loaded as an IO device. To do this select the DIAdem-DAC page from the Window menu item on the main DAIdem menu. From this, select Options > Single Value Processing > Configure Driver. The Driver configuration dialog box will then appear.



Click on the New entry button, and select NetPod driver as new hardware. You will have to do this for every new NetPod that you wish to use.

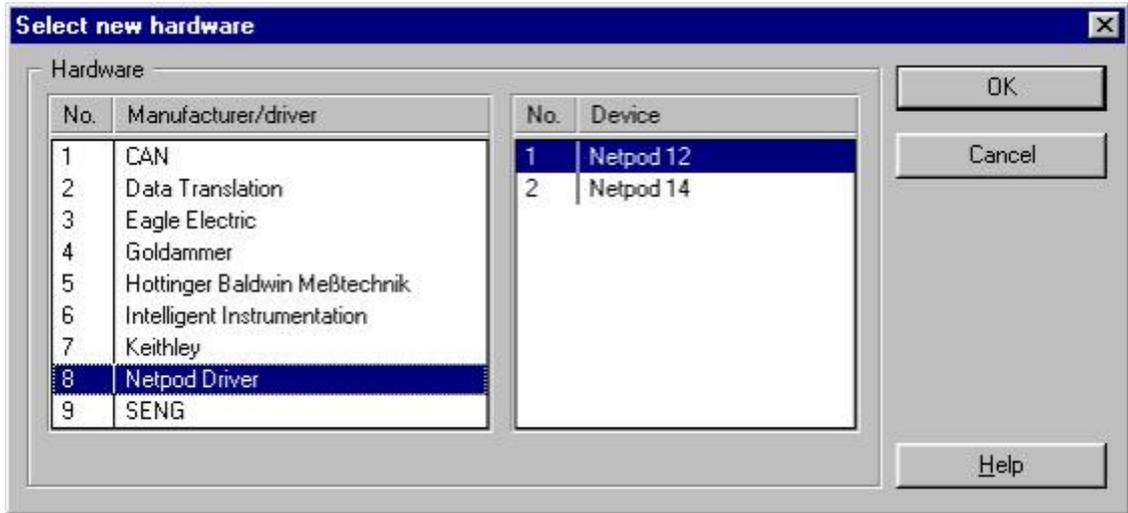


Figure 33 New Hardware Selection Window - Diadem

Each device is listed together with the unique NetPod ID number (in the above example numbers 12 and 14 are listed). The devices must be recognised by the Pod manager software, and displayed in the NetPod configuration dialog box.

15.1 Using NetPod Devices in DIAdem

To select an analog or digital input click on the Inputs button in the DAIdem-DAC page.

In the above example the GPI buttons will be listed as Ain 12, Din 12, Ain 14, Din 14 representing the analog and digital inputs for NetPods 12 and 14.

Double clicking on the IO box will bring up the configuration dialog for that instrument

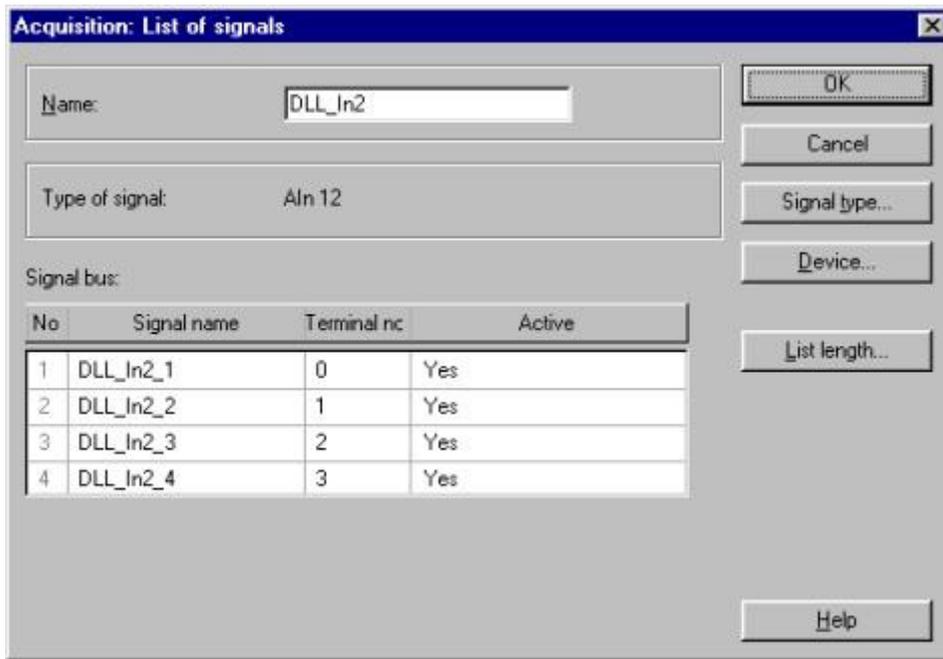


Figure 34 Acquisition List of Signals Windows - Diadem

You must select the list length for the maximum number of channels that are in use. The terminal number matches that channel number on the NetPod, and will produce a bus of up to 16 signals for analogue inputs. Similarly the digital I/O have a signal between 0 and 1 for each of the switches or inputs.

16. Part Numbers

The following part numbers are used for the NetPod 4003

Description	Part Number
Processor Card	NP-4200-V103
Backplane	NP42BF-V110 -4
Power Supply	NP43-230-12
Microprocessor Controlled Fan Unit	NP42BF-FNDEXT-1
Voltage Input Cards	
± 5 V	NPAI24-V1-H1-4
± 50 V	NPAI24-V2-H1-4
± 500 V	NPAI24-V3-H1-4
Strain Gauge Cards	
Voltage Sensor Excitation 2.5 V X = Gain	
Full Bridge	NPAI24-SGA-X-4-F
Half Bridge	NPAI24-SGA-X-4-H
Quarter Bridge	NPAI24-SGA-X-4-Q
Const Current Excitation 8.33 mA X = Gain	
Full Bridge	NPAI24-SC-X-4-F
Half Bridge	NPAI24-SC-X-4-H
Quarter Bridge	NPAI24-SC-X-4-Q
Piezo Electric Sensor Interface X = Gain	
Sensor Excitation 12 V @ 40 mA Maximum	NPAI24-PE-X-4
Servo Accelerometer Interface B = Sensor Range (g	
	NPAI-24-SRV-B-4
Thermocouple Interface Cards	
Thermocouple interface cards	NPAI-24-THRM-M-4
Where M = E,J,K,N,R,S,T	
RTD Sensor	
- 2 wire sensor	NPAI-24-RTD-2-4
- 3 wire sensor	NPAI-24-RTD-3-4
High Impedance Card 0 – 10V DC	
	NPAI24HZ-10V-4

Keynes Controls manufactures a wide range of cards for the 4003 instrument range. Should a sensor interface not be listed above then Please contact Keynes Controls directly for further information.