NetPod 4003 Series Instrumentation

Data Acquisition & Controls System

Download this catalogue at **http://www.aquabat.net/downloads/Catalogue4003v107.pdf**

Fully Synchronised Operations - Internal & Network
Local Area Network Connection
Digital Anti-alias Filters
Individual ADC / Channel
Full Galvonic Isolation
Automatic Interface Card Identification
Temperature Controlled fan for Low Noise Cooling
Bayonet Fitting - Self Lock Connectors
Modular Assembly - 4 Channel building blocks
In-built Lightning / Surge Protection
Options for 2000V Opto-isolation
Temperature Measurement - Thermocouple / Thermistor / RTD
ICP Accelerometer Interface
Voltage Measurements to 500V
Current Loop measurement & Excitation
Strain Gauge Support.
Analogue Output Ports
Automatic card ID

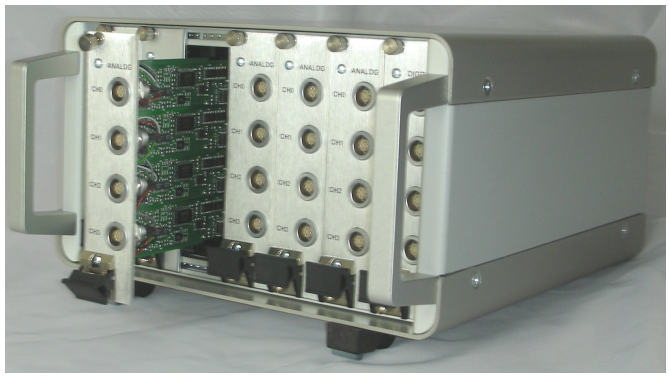
Windows 7

Last Updated 6 th March 2011

Introduction

The NetPod 4003 is a new member of the Keynes Controls NetPod series of instruments have been designed from the outset to offer everything needed in a stand-alone instrument for both local and distributed measurement solutions.

The 4003 high levels of data synchronisation both among channels within an instrument and instruments across a network. The sensors inputs are securely located using self aligning bayonet connectors and offer digital filtering and high level transient/lightning protection to safeguard the instrument in the harshest of application



NetPod 4003 System

Features

16 individually isolated Analogue inputs - or
16 individual Analogue outputs
4 Channel Analogue Input / output building blocks
Integrated sensor excitation
Hot-swap Support
24 bit ADC Resolution per channel
Sample rate to 2 KHz/channel
lightning protection - Gas Discharge/Transorb
Option for 2000V DC Opto-isolation
Digital Anti-alias filters.
Digital Interface Options

Sensor Inputs

Thermocouples	**Types B,C,J,K,R,S,T**
Thermistor	
Voltage inputs from	**5**V to 500V others on request
Resistance	**0-600 Ohm Standard -** **Adjusted for other ranges on request**
Current Interface	**0-20 mA, 4-20, 0-60 mA loops including excitation**
Strain Gauge	**Full, ½ and** ¼ bridges 120,350,500 and 1 K Ohm Gauge
ICP Accelerometer	
Sensor Excitation	**Options for +/- 12V supply**

Each sensor input uses a CNT bayonet fitting self aligning plug and socket to attach signal inputs to the instrument. A physical release catch needs to be operated to remove the sensor input from the device and so makes sure that the cabling remains reliably attached no matter the industrial

Software Support

The NetPod 4003 is supported by drivers for most modern data acquisition and SCADA software such as:

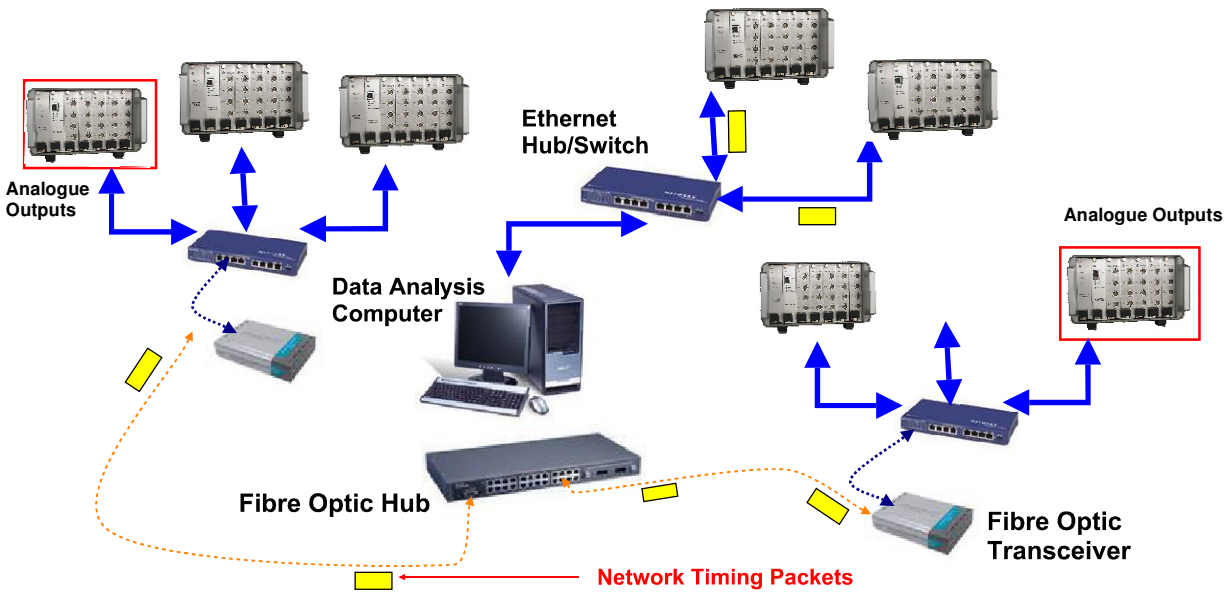
National Instruments Lab view
DasyLAB
Others on request

Full Software developers kit is available for the **Microsoft Windows** and **Linux/Unix** Operating Systems. Interface to any 3rd party package supporting DLL calls with only a few simple commands.

Network Data Synchronisation

The NetPod 4000 series of instruments supports network synchronised data acquisition operations in that all channels, for all instruments on a network can be synchronised together. The synchronisation ensures that all the individual analogue converters for each input channel, for all instruments set at the same sample rate operate together to make their readings at the same instance in time.

The networked synchronised readings are accurate to within a few microseconds. Different groups of instruments can be run across a network at different sample rates and yet still be synchronised together.



Timing & Synchronisation For NetPod 4000 Instruments

Each NetPod 4003 contains its' 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 host computer forms the basis for the timing systems used to provide the synchronisation timing within the driver software.

Driver Operations

The driver software starts by sending a synchronisation packet across the network. On detecting this packet the instrument determines the time difference among its internal clock and the timing information contained within the sync pulse. Once the timing information for an instrument is determined, it is returned to the driver. See Figure 2.

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

Figure 3 demonstrates how the synchronisation packets are sent out to multiple instruments on a network and timing information returned to the driver software running on the PC. There is a small delay between the Host 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 host PC and the number and different types of networks used to connect the system together. The driver effectively recreates the input signals packet by packet using the timing information received back from the instruments.

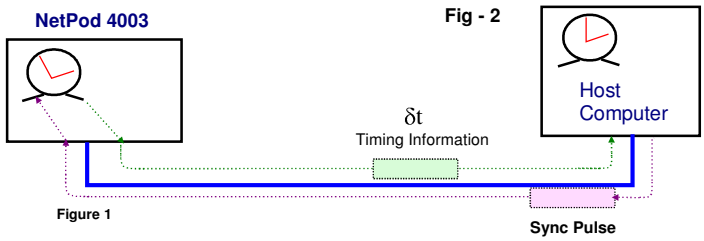


Fig - 2

Figure 1

δt = (Time difference) Linux Clock - Instrument Clock

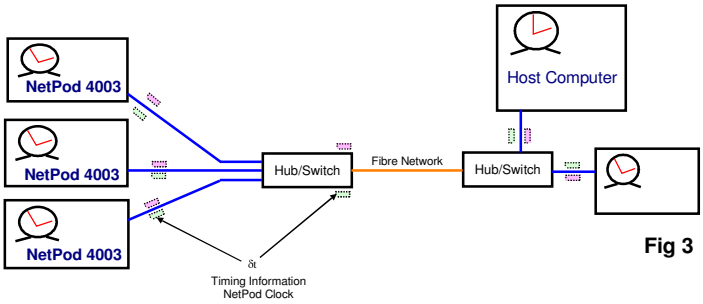


Fig 3

NetPod 4003 Digital Filters

The NetPod 4003 uses a 24 Bit Sigma Delta ADC converter to convert sensor input signals. The sigma delta ADC has in built digital anti-aliasing filter and these filters have sufficient roll-off to be used with any additional analogue filtering being required. All of the analogue converts within the NetPod 4003 are synchronised see Fig 5 and as such there is no phase delay between channels, no matter how many inputs are being used. A phase delay can be interpreted as a time delay between inputs and so could be misrepresented on a synchronised application.

Even when several instruments are deployed on a network all the inputs are synchronised and so signals can be directly compared between channels on different systems. This is ideal for largely distributed applications.

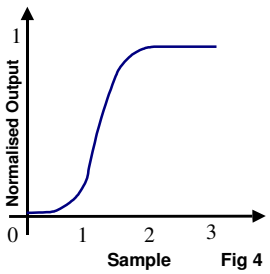


Fig 4

Figure 4 shows the Step Response for the NetPod 4000 digital filter. The filter settles to its steady state level after only 3 samples. The digital filter operations within the NetPod 4003 takes the average, of the average, of the average and presents this as the output value to be used. Apart from being a very good low pass filter, the averaging process ensures a very good signal to noise ratio for signals within the pass band of the instrument. The averaging process also removes false spikes from the input signals.

At 1 KHz sample rate it will take approximately 3 ms for the instrument to go from 0 to Full scale ie from 0V to 50V if using a high voltage card. Fig 6 shows the frequency response of the input channels. The band-pass setting for the filters is simply set by adjusting the instrument sample rate and is the same for input channels within a single instrument.

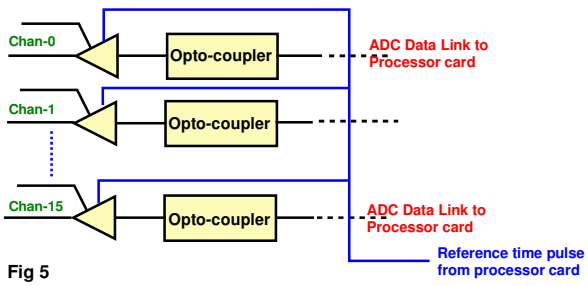
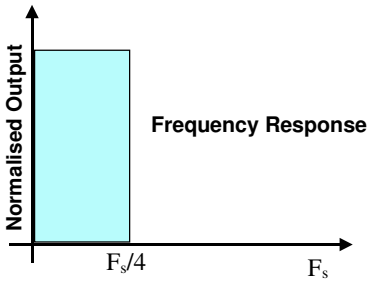
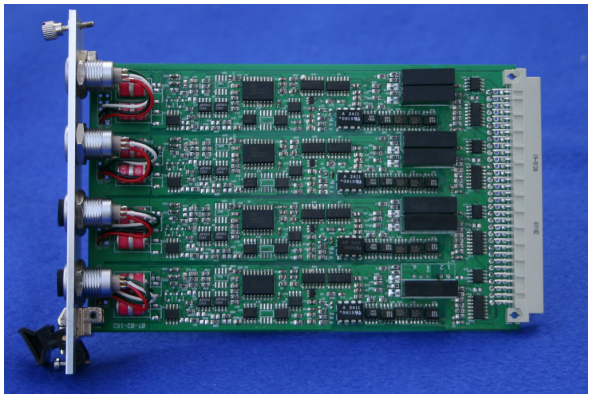


Fig 5



Frequency Response - Fig 6

Analogue Input Cards



All the analogue cards contain are supplied on the same quick mount chassis for installation and removal. The cards simply push into the rack and are secured with the mounting screws. It takes only a matter of a few seconds to insert and secure a card.

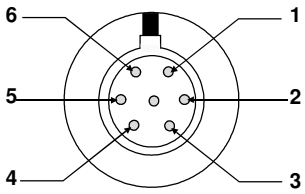
The analogue cards all support 4 input channels and containing digital anti-aliasing filters, individual ADC, signal conditioning where appropriate and options for lightning protection or opto-isolation to 2000V DC.

Analogue input support for Voltage, Thermocouple, RTD, Current loop, Piezo-electric, Resistance, Thermostor are available.

Surge/lightning Protection

Each of the input cards has the option to fit opto-isolation or Lightning/Surge protection depending on the environment into which the instrument is to operate.

Lightning/Surge protection is undertaken by Gas Discharge tube and transorbs. Any surge caused by local lightning strikes etc. is discharged to ground and so protects the instrument electronics.



NetPod 4003 Analogue Card Pin-outs

1. V1H1

1 : S (+)
2 : S (-)
3 : V (+ 12V)
4 : GND (COM)
5 : V (- 12V)

2. SC1

1 : S (+)
2 : S (-)
3 : REF
4 : GND (COM)

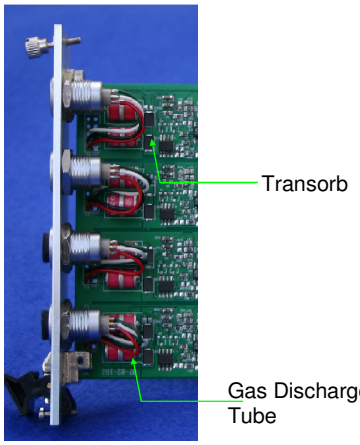


Fig 8

Fig 9

Figure 8 shows the gas discharge and transorb lightning protection fitted to an input card.

Connectors

The interface cards use CNT bayonet fitting 7 way connectors with automatic pin alignment. The sockets can only be released by pressing the release catch making them ideal for long term stand-alone operation even under the action of high vibration.

Once the sensor input cables are terminated with the sockets they can be fastened to the instrument and removed very quickly ensuring fast upgrade and maintenance. Figures 9 and 10 show cables terminated to the instrument.

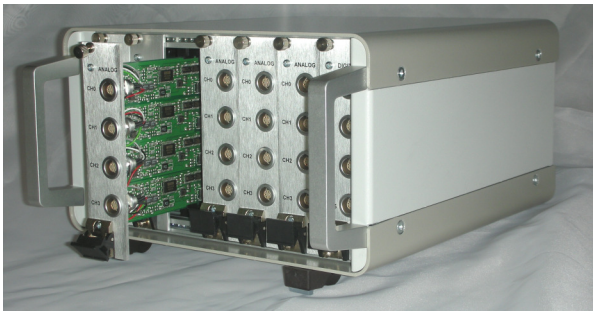


Fig 10

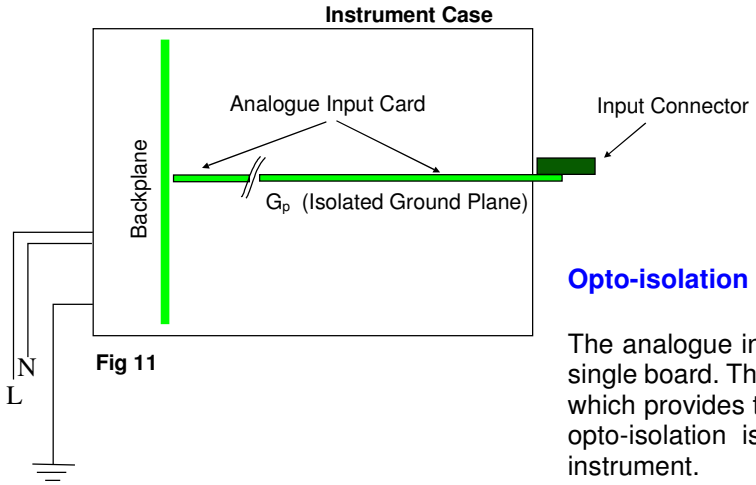


Fig 11

Opto-isolation

The analogue input boards are electrically in two halves but physically a single board. The two halves are electrically isolated using an opto-coupler which provides the high voltage insulation. Figures 11 & 12 show how the opto-isolation is connected to the ground plane and used within the instrument.

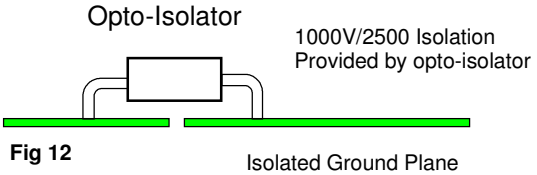


Fig 12

The input stage of the analogue card provides an individual isolated ground plane and it is to this ground plane that the input signals and screens are physically connected. No input signal passes directly into the instrument and all inputs are individually isolated.

The power supply needs to be Earthed always when utilising the gas discharge/transorb lightning protection.

NetPod 4003 - Data Acquisition & Control System

Part Number - NPAO16-1030

Analogue Output ± 10 V **Output** ± 30 mA **Software Selectable**

Introduction

The **NPAO16-1030** card is a 4 channel high speed analogue output card for the NetPod 4003 series data acquisition instrument. The NPAO16-1030 supports 4 independently configurable analogue outputs channels each individually set for voltage or current operations by the driver software . Preset output levels, for each channel at boot up time can be defined in the driver software. Optional CNT-21 bayonet locking connectors on request.

4 x Independent Output Channels

± 10V / ± 30 mA User Software Selectable Output Type

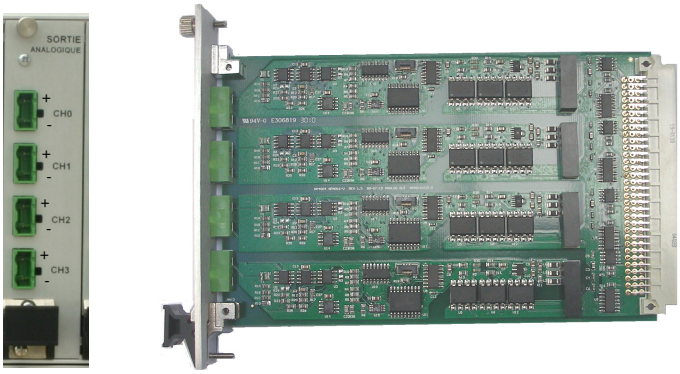
Maximum Isolation 2000V DC/Channel

Maximum Cable Size 1.5 mm ^{2}

Power Consumption < 1 W / Channel

User Defined Initialisation Levels

Output Signal Type Identification



NPAO16-1030 Card

Operation

The analogue output card supports voltage and current output under control from the driver software. The update rate of the output signals is at the same rate as sampling rate of analogue input channels.

Installation Limitation

The NetPod 4003 supports 16 analogue output channels within a single instrument along with a single digital I/O card.

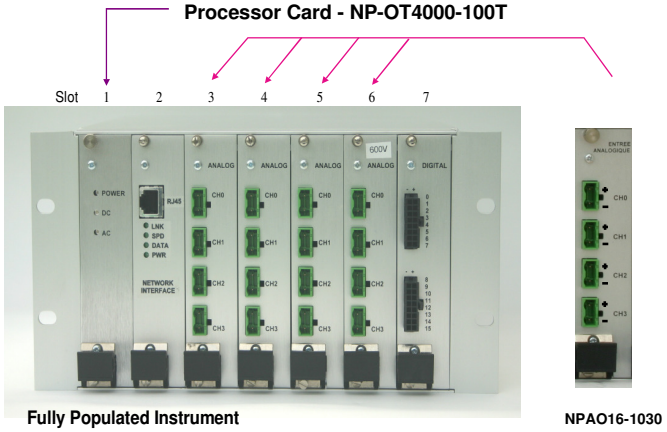
Output Signal Type Selection

The analogue output signal can be switched under software control between current and voltage without any user interaction on the card itself. The driver software must scan the network to obtain and store any new configuration details.

Test Results

The output errors shown below are worst case and are to be used as a guide only.

	Load Resistance			100 Ω	300 Ω	0 Ω
Setting	100 Ω	300 Ω	0 Ω	% Error Full Scale	% Error Full Scale	% Error Full Scale
-30	-30.001	-29.989	-30.007	-0.05	0.05	-0.05
0	-0.001	-0.001	-0.001	-0.05	-0.05	-0.05
30	30.002	29.989	30.008	0.05	-0.05	0.04



Fully Populated Instrument

NPAO16-1030

Pre-set Initialisation / Startup levels

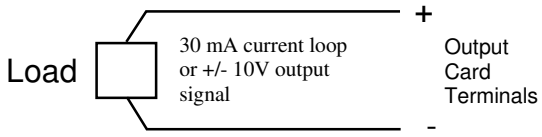
Each output channel can be independently configured using the driver software to give a pre-set output level on initialisation. The card has an initial zero level initialisation value held for 2 seconds after which the preset level is output. Since the output signal can be predefined then

The initial output level is zero no matter which output signal type has been chosen.

Load Circuit

The maximum load resistance that can be directly connected to the the **NPAO16-1030** is 350 Ohm.

Connecting an load circuit to the NPAO16-1030

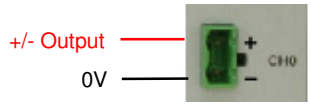


Specification

No Channels	4	**Isolation**	to 2 KV DC
Range	+/- 10V +/- 30 mA	**Protection**	short circuit < 1 min
Resolution	0.3 mV 0.001 mA	**Integral Non linearity**	+/- 1 LSB
Power	< 1 W / Channel		

Output Connection from the NPAO16-1030

The image below shows how to connect to the NPAO16-1030 to obtain a voltage output



Output Signal Type Identification

The output signal type for each channel can be identified by the driver software. Signal operational details can be accessed and processed by third party applications.

Technical Specifications

The following tables summarise the technical guidelines for the various input modules which can be supplied for use with the NetPod instrumentation. The specifications shown for the strain gauge interfaces are worst case and supplied units should operate above the results displayed in the table

Table 1

Specifications	High Resolution 24 Bit Card
CMMR	138 dB
Sample Rate	0.1 - 2 KHz
Isolation	to 2000V RMS
Dynamic Range	150 dB
Signal/Noise Ratio Average:	See Note 1
Gain Accuracy (Accuracy as % reading)	0.1 % or better
Settling Time	2 ms
Input Range: V1	± 5.0 V
V2	± 50 V
V3	± 500 V
Resolution: V1	0.6 µV
V2	6.0 µV
V3	60.0 µV
Input Offset: V1	± 1 µV/°C
V2	±10 µV/°C
V3	±100 µV/°C
Stability: V1	10 ppm/°C
V2	10 ppm/°C
V3	10 ppm/°C
Input Impedance V1	2 MΩ
V2	2 MΩ
V3	20 MΩ
	Higher input impedance option
Current Input	± 60 mA, 0-20 mA
	0-60 mA, 4-20 mA
	User Defined
Overload	250 V RMS
Converter Type	Sigma Delta
Gain (Software Selectable)	1,2,4,8,16 note 2
Linearity (accuracy as % of range)	0.0015 %

Resistance Measurement

NPAI24- RES83-4 cards Accuracy 0.05% FS
RANGE Set at manufacture 0 - 600 Ohm
Other ranges on request
Temp Drift 25-50 ppm/Deg C

Digital Interface Specifications

Interface	Specification
Isolated Digital Input	1000V Standard 2500 V on request
No. Channels/Board:	8/16
Low Level (0):	0-1 V, 0-2 V
High Level (1):	4-30 V, 6-300 V
Switch Rate:	2 KHz, max
Digital Output (*1)	
No Channels/Board	8/16 options
Low Level (0):	0V/ User Option
High Level (1):	5V Standard
Relay Switch Card	Any level up to 240 V
Switch Rate:	2 KHz
Drive Current	20 mA/Channel

Sample Rate **All Cards**	The sample rate for all NetPod 4003 input cards are identical no matter what type or how they are installed within an instrument. 0 - 2 KHz / Channel - faster on request

Note 1 (range V1)

Sample Rate	Typical Noise Level(RMS)	
10 Hz	3 µV	130 dB
100 Hz	7 µV	
1 KHz	10 µV	

Note two

The pre-amp gain settings on all the analogue input modules are sample rate limited.

Strain Gauge & Load Cell Specifications

Specification	High Resolution 24 Bit Card
Linearity	0.02% FS
Range	±20,000 µε
Bridge Balance	50% FS
Resolution	0.05 µε
Input Noise	1 µV RMS
Bridge Type	'/4, 120,350,1KΩ, For 1/2 and full bridges and gauge greater that 120 Ohm gauges Gauge values same for both card types
Gauge Factor	0 - 10
Input Impedance	20 MΩ
Excitation	2.5V
Output Noise	5 µV RMS

Thermocouples

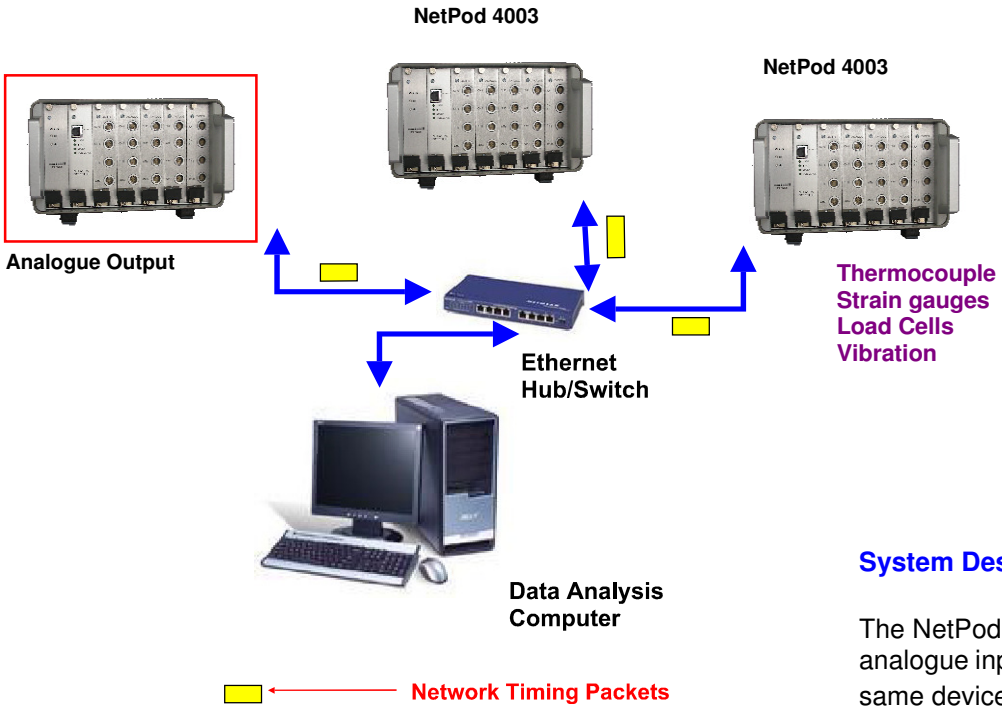
Sensor	Sensor Accuracy / Deg C	
Fe-Con (J)	Class 1 -40 to + 750	±1.5
	Class 1 -40 to + 750	± 2.5
Cu-Con (T)	Class 1 -40 to + 750	±0.5
	Class 2 -40 to + 750	± 1.0
	Class 3 -200 to + 40	± 2.5
BiCr-Ni (K)	Class 1 -40 to + 1000	±1.5
	Class 1 -40 to + 1200	± 2.5
NrCrSi-NiSi (N)	Class 3 -200 to + 40	± 2.5
NiCr-Con (E)	Class 1 -40 to + 800	±0.5
	Class 2 -40 to + 900	± 2.5
	Class 3 -200 to + 40	± 2.5
Pt10Rh-Pt (S)	Class 1 0 to + 1600	±1.0
	Class 1 -40 to + 1600	± 1.5
Pt6Rh (B)	Class 2 600 to 1700	± 2.5
	Class 3 -200 to + 40	± 2.5

Analogue Output Modules

Resolution	16 bit
Output	+/- 10V or +/- 30mA
Accuracy	0.05 % FS
Isolation	1500V

Other options available on request

NetPod 4003 General Application



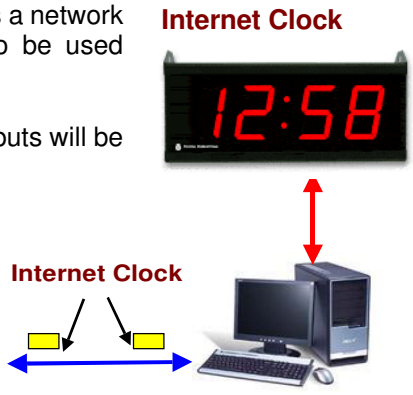
System Design Information

The NetPod 4003 instruments do not support analogue input and output cards fitted into the same device.

System Operation

The diagram above demonstrates a typical NetPod 4003 application mixing analogue inputs and output signals. The advanced timing system that runs the NetPod 4003 systems across a network and through network switches and Hubs requires the analogue output channels to be used independently to the analogue inputs and mounted in their own instrument.

Installing the analogue outputs in their own instrument reduces the chance that the outputs will be wired incorrectly.

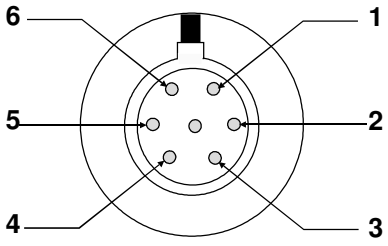


Enhanced Synchronisation

Improved synchronisation can be obtained by connection to the world time clock via an Internet link.

Output Control Systems

Each of the outputs can be individually configured in level and is operated independently



NetPod 4003 4 Wire Resistance Card Pin-outs

1. V1H1

1 : S (+)
2 : S (-)
3 : V (+8.3 ma Const I_c
4 : GND (COM)
5 : N/A

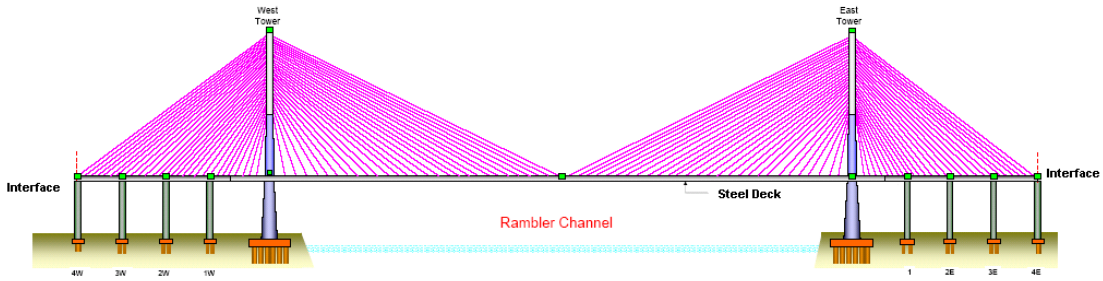
Free issue driver software
SDK for Microsoft Windows & Unix Operating Systems

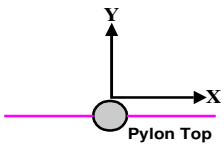
Windows 7

Linux & Unix
Driver Software Options

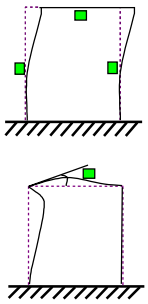
KEYNES CONTROLS

Example Application





Sensor



Bridge Structural Monitoring

One main feature of the NetPod 4003 series instruments are its ability to synchronise with other instruments on a network. For a bridge monitoring application the instruments can be connected to sensors mounted on the main structural members for example using strain gauges. Simple analysis of the results will show the bending of structural members under various loads. Combining the results from all the instruments will enable a full structural understanding of the relationships to be obtained.

The NetPod 4003 instruments can be connected onto industry standard Ethernet network. So long as the instruments are connected to the same network string as the host data analysis PC they can be used over long distances. The only limitation on the systems deployment is that the timing pulses sent out by the driver is received, processed and returned to the host PC with the minimum delay

The true direction of motion of the top if the pylon can only be made using a synchronised measurement so the vector magnitude for the displacement can be calculated.

Enhanced Synchronisation

Improved synchronisation can be obtained by connection to the world time clock via an Internet link.

Part Numbers - The following table lists the part numbers used by the NetPod 4000 and interface

4003 Series Instruments

Digital I/O Modules
Standard for each instrument

NP4809-JIO	8 digital input channels - 2 KV isolation - ID memory
NP4810-JIO	16 digital Input channel - 1 KV isolation
NP4811-RLY	8 input, Jumper Select TTL/24 Dig Input
NP4812-TRC	8 relay switch cards
NP4818-DO-8	8 digital output channels - 2 KV isolation - memory ID
NP4808-JIO-8	8 TTL output channel card
NPSYS-4003-16	Complete 24 bit fully populated analogue system. Any analogue input combination

Software

NPDKIT03	Software developers tool kit
NPDRIVER	Multi-user, Multi instrument driver
NP-DLABV23	DASYLab Multi-instrument driver
NP-OPCSerV104	OPC Server Package
NP-NICVIv103	National Instruments Labview Driver
NPCitectV101	Citect Driver

NP-SF4000-100T-24	DSP Card
NP4203BF-V110	Motherboard + microprocessor controlled fan unit
NPCAB-4003	Enclosure
NPGPSU-01	Power Supply module
NPFAN-01	Fan
NPRCK-013	84 HP X 6U Plug In Module Frame

24 Bit ADC Analogue Input Modules
Standard for all instruments

NPAI24-V1HI-4	4 Channel ± 5V. 24 bit ADC board.
NPAI24-V2HI-4	4 Channel± 50V. 24 bit ADC board
NPAI24-V3HI-4	4 Channel± 500V. 24 bit ADC board
NPAI24-SC1-4	4 Channel of 24 bit Current loop . 4-20mA, 0-60 mA
NPAI24-SC5A-4	4 Channel of 24 bit Current Input 5A
NPAI24-SG1-4	4 Channel of 24 bit ¼ and ½ bridge strain gauge card
NPAI24-SG2-4	4 Channel of 24 bit full bridge strain gauge card
NPAI24-SG3-4	4 Channel of 24 bit full bridge strain gauge - No Excitation
NPAI24-TC-B-4	4 Channel of 24 bit thermocouple type B
NPAI24-TC-C-4	4 Channel of 24 bit thermocouple type C
NPAI24-TC-E-4	4 Channel of 24 bit thermocouple type E
NPAI24-TC-K-4	4 Channel of 24 bit thermocouple type K
NPAI24-TC-N-4	4 Channel of 24 bit thermocouple type N
NPAI24-TC-R-4	4 Channel of 24 bit thermocouple type R
NPAI24-TC-S-4	4 Channel of 24 bit thermocouple type S
NPAI24-TC-T-4	4 Channel of 24 bit thermocouple type T
NPAI24-RT1-4	4 Channel of 24 bit RTD - Type A & B
NPAI24-RE83-4-X	4 Channel resistance measurement card - 8.3 mA excitation X = range
NPAO16-1030	4 Channel 16 bit Analogue output card +/- 10V, +/- 30 mA

KEYNES CONTROLS

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