Model CP248

4 Channel Isolated cPCI/PXI Bridge Signal Conditioner with 16-bit ADC's

User's Manual

Revision History

12/09	KG	Initial Draft of CP248 User Manual.
12/12	KG	Added information on cable shield termination to Analog Connector section of page 5
5/13	KG	Added additional shield and ground termination information to Analog Connector Section

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Chapter 1: Introduction

Description

The CP248 is a single-width, 6U, CompactPCI/PXI module with 4 isolated channels of Bridge Signal Conditioning feeding 4 independent 16-bit Analog to Digital Converters (ADC's). This single-width instrument incorporates both signal conditioning and analog to digital conversion, eliminating the need for complex field wiring. The CP248 supports 10 wire transducer connections and contains fully programmable gain, shunt calibration, bridge balance, excitation and filter on a per channel basis. The maximum sampling rate of each analog to digital converter is 250 Ksamples per second. The ADC per channel architecture generates simultaneously sampled signals. PXI trigger and/or the front panel expansion bus connect multiple CP248s together to synchronize simultaneous sampling across all of them.

Two buffered outputs are provided with the CP248. One buffered output is a pre-filter output that is at sensor input ground potential. The second buffered output is an isolated version of the input signal at chassis ground potential. This second output can be selected to be either pre-filter or post-filter.

The CP248 bridge conditioner provides individually isolated inputs with operation up to ±300V common-mode, bridge completion, isolated excitation supplies, anti-aliasing filtering and amplification. On-board bridge completion handles 120Ω, 350Ω or 1000Ω bridges in ¼, ½ and full configurations. The per-channel excitation sources are programmable from 0 to 10 volts in 4096 steps and contain alarm circuitry to monitor excitation supply overload. Each channel can be programmed for either voltage or current excitation.

The on-board filters can be ordered as either Bessel or Butterworth type. Software selectable filter cutoff frequencies are programmed on a per-channel basis and include 20Hz, 200Hz, 500Hz, 1kHz, 2kHz, 5kHz, 25 kHz and 50kHz. The filter may also be bypassed for wideband applications. The gain settings are also programmable from 1 to 10,000 in a 1,2,5 progression. Bridge offsets may be nulled using the on-board 12-bit DACs.

CP248 Bridge Signal Conditioning Specifications

Item	Specifications
Number of Channels	4 Isolated differential inputs

Inputs
    Input Impedance
    Input Protection
    Input Coupling
	
	10 MΩ minimum, > 100 MΩ typical (DC-coupled)
	± 32 V differential, ±300 V common-mode
	Programmable DC or AC

Analog Differential Input Range	±10.24 Volts
Common-mode Range	300 Volts peak AC or DC
Analog Outputs Range	 ±10 Volts peak @ 20mA max (isolated and non-isolated outputs)

Gain
    Programmable
    Gain Selections
	
	Yes
	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000 and 10000

Filter
    Filter Type
    Programmable
    Filter Cutoff Frequencies
	
	6 pole, Bessel or Butterworth (as ordering option)
	Yes, on a per channel basis
	20Hz, 200Hz, 500Hz, 1kHz, 2kHz, 5kHz, 25kHz and 50k The filter may be bypassed for an extended frequency response to a –3dB point of 200 kHz.

Excitation
    Excitation Type
    Excitation Sense
    Excitation Voltages
    Excitation Current
    Line Regulation
    Load Regulation
    Temperature Coefficient
	Independent excitation source for each channel.
	Voltage or Current
	Programmable per channel for local or remote.
	Programmable per channel for 0 to 10 volts in 4096 steps, 50mA drive.
	Programmable per channel for 0 to 50mA in 4096 steps, 10 volt.
	0.003 %/V (0.005% for current excitation regulation)
	0.001 V/mA
	2 ppm/°C (2.8 ppm/°C for current excitation)

Bridge Completion
    Programmable
    Bridge Configuration
    Completion Resistance
	
	Yes
	¼, ½ and Full Bridge
	120Ω, 350Ω or 1000Ω

Shunt Calibration
    Programmable
    Shunt Resistor Location
	
	Yes
	Internal or External (User Selected and Supplied)

Bridge Balance
    Programmable
    Bridge Offset Null
	
	Yes
	Utilizing 12–bit DAC, range set by resistor value

Analog Input Connector Type	4- 15 contact DSUB connectors
Analog Output Connector Type	1- 9 contact DSUB connector

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CP248 Analog to Digital Converter Specifications

Item	Specifications
Number of ADC's	4, one per bridge input channel
ADC Type	Successive Approximation
Resolution	16 bits, monotonic over operating temperature range
Missing Codes	None, guaranteed
Maximum Sample (Conversion) Rate	250 kSamples/second (per channel)
Sample Clock 　　Programmable 　　Source(s) 　　Internal Selections 　　External Source(s) 　　　SMB Input 　　　　Level 　　　　Polarity 　　　　Duty Cycle 　　　　Connection 　　　PXI Trigger	 Yes Internal or External .01 Hz to 250kHz in 1 microsecond increments Front-panel mounted SMB or PXI trigger signals. TTL Level Signal Programmable 50% Through front panel mounted SMB connector 1 of 8 trigger lines or Star trigger
External Trigger 　　Source(s) 　　　SMB Input 　　　　Level 　　　　Polarity 　　　　Minimum Pulse Width 　　PXI Trigger	 Front panel mounted SMB or PXI trigger signals TTL Level Signal Programmable 30 nanoseconds 1 of 8 trigger lines or Star trigger
Limit Checking 　　Type(s) 　　Resolution 　　Action	 Min/Max or Level/Slope 8 bits Trigger transient, Assert front panel trigger out, PXI trigger signal or generate a PXI/cPCI interrupt

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CP248 Overall Specifications

Item	Specifications
Transfer Characteristics Gain Non-Linearity	0.005% FSR for gain settings <= 1000 0.006% FSR for gain setting = 2000 0.025% FSR for gain setting = 5000 0.035% FSR for gain setting = 10000

DC Accuracy, % of Full Scale Range
   Gain=1
   Gain=2
   Gain=5
   Gain=10
   Gain=20
   Gain=50
   Gain=100
   Gain=200
   Gain=500
   Gain=1000
   Gain=2000
   Gain=5000
   Gain=10000
	After automatic calibration:
	0.005%
	0.005%
	0.006%
	0.006%
	0.011%
	0.0125%
	0.015%
	0.025%
	0.025%
	0.030%
	0.060%
	0.150%
	0.300%

Gain Stability All gains	± 15 ppm/°C maximum
Offset Stability, RTI	± 2μV/°C maximum @Gain=1000
Common Mode Rejection Ratio	-105 dB minimum DC to 60 Hz for gain>=10; 80dB minimum at any gain DC to 60Hz
Noise, RTI	$<$ 5μV rms @ Gain=1000, ADC Rate = 100 kHz $<$ 1μV rms @ Gain=1000, ADC Rate = 100 kHz, 200 Hz filter
Channel to Channel Crosstalk	-110 dB minimum between adjacent channels DC to 2kHz

Power Requirements
   +5 V
   +3.3V
   +12 V
   -12 V
	
	3650 mA
	 325 mA
	 400 mA
	 400 mA

Environmental and Mechanical
   Temperature range
      Operational
      Storage
   Relative humidity
   Cooling requirements
   Dimensions
   Front-panel potential
	
	0°C to +50°C
	-25°C to +75°C
	0 to 90%, non-condensing to 40°C
	10 CFM
	233.35 mm x 160 mm (6U CompactPCI/PXI module)
	Chassis ground

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Table 1. Specifications

Front Panel

Analog Connectors

The analog input signal and bridge connections are available at four 15P subminiature D connectors, 1 per channel. Orientation is shown in Figure 1. Each input channel connection "floats" and will reference its individual sensor ground potential. Note however that the outer metal shell of the front panel input connectors is at chassis ground potential. Because of this, the cable shield (metal braid or foil with drain wire) of the mating cable should not be connected to the metal shell of the cable connector. The cable shield should only be connected to pin 15 of the connector. Additionally, it is recommended that individually shielded, twisted pair cable be used when running input and unfiltered output 1 connections through the same cable. When connecting a sensor or voltage source to the differential channel input, pin 15 (shield) and pin 14 (sensor ground) should be connected together and to ground at the sensor (signal source) end of the cable. Note that for single-ended configurations, pin 10 (input -) should be connected to pin 14 (sensor ground) and to pin 15 (shield).

⚠ **Caution** Voltage inputs should be limited to less than ± 10 volts differential, ±300V common-mode. Exceeding the overvoltage protection or isolation rating can damage the CP248. DynamicSignals is not liable for any damages or injury resulting from such signal connections.
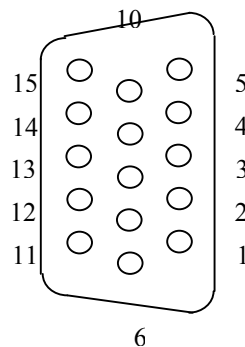
Figure 1. Analog Input/ Bridge Connectors

The analog outputs are available at a single 9P subminiature D connector. Orientation is shown in Figure 2. Note that this connector references chassis ground potential.
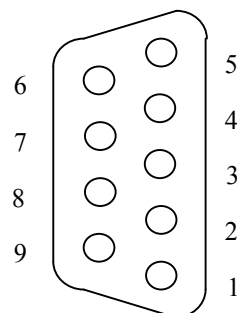
Figure 2. Analog Output Connector

V755 Bridge Termination Assembly

The V755-ZA11 single-channel bridge termination assembly attaches directly to a CP248 channel's front panel 15P DSUB front panel connector. The termination assembly provides fifteen screw terminals for connecting transducer field wiring to a CP248 channel. Each terminal accepts a single solid or stranded conductor in wire sizes AWG 22 to AWG 14. Sockets ("B"-size) are also provided for a customer supplied external shunt resistor.

Channels 1-4 Bridge Connector Pinout – V755 Termination Assembly

BRIDGE-TYPE SENSOR	V755	CP248
Signal	Terminal Position	Front Connector Pin
Input +	J1-1	5
Input −	J1-2	10
Excitation +	J1-3	3
Excitation −	J1-4	6
Sense +	J1-5	2
Sense −	J2-1	7
Monitor +	J2-2	1
Monitor −	J2-3	8
Calibrate Resistor	J2-4	4
Quarter Bridge	J2-5	9
Unfiltered Output 1	J3-1	11
Aux Cal +	J3-2	12
Aux Cal -	J3-3	13
Sensor Ground 1	J3-4	14
Shield 1	J3-5	15

Table 2. Channels 1-4 Analog Input/ Bridge Connector Pinout – V755

DIN-15S-01 DIN Rail Mount Termination Panel

The DIN-15S-01 DIN rail mount termination panel provides a convenient method for terminating one channel of transducer field wiring to the CP248. Each terminal accepts a single solid or stranded conductor in wire sizes AWG 22 to AWG 14. Four DIN-15S-01 termination panels are required for one CP248 module (one per channel). Four 5856-Nxyz cables are required to connect the termination panels to the CP248's four front panel connectors.

Channels 1-4 Analog Input/ Bridge Connector Pinout – DIN-15S Termination Panel

1

2

3

4
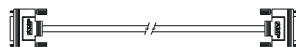
CP248
Channels
1 - 4

BRIDGE-TYPE SENSORS *(up to 4)*	TERMINATION PANEL (DIN-15S-01)		CABLE (5856-Nxyz)	CP248
Signal	**Terminal Position**	**15P D Connector**	*(xy = length in meters, z ls the multiplier)*	**Front Connector Channels 1-4**
Channel 1	**CN2**	**CN1**		**J5**
Input +	1	1	BLACK / RED	5
Input –	2	2	RED / BLACK	10
Excitation +	3	3	BLACK / WHITE	3
Excitation –	4	4	WHITE / BLACK	6
Sense +	5	5	BLACK / GREEN	2
Sense –	6	6	GREEN / BLACK	7
Monitor +	7	7	BLACK / BLUE	1
Monitor –	8	8	BLUE / BLACK	8
Calibrate Resistor	9	9	BLACK / YELLOW	4
Quarter Bridge	10	10	YELLOW / BLACK	9
Unfiltered Output 1	11	11	ORANGE / BLACK	11
Aux Cal +	12	12	BLACK / BROWN	12
Aux Cal -	13	13	BROWN / BLACK	13
Sensor Ground 1	14	14	BLACK / ORANGE	14
Shield 1	15	15	SHIELD	15
Channel 2	**CN2**	**CN1**		**J6**
Input +	1	1	BLACK / RED	5
Input –	2	2	RED / BLACK	10
Excitation +	3	3	BLACK / WHITE	3
Excitation –	4	4	WHITE / BLACK	6
Sense +	5	5	BLACK / GREEN	2
Sense –	6	6	GREEN / BLACK	7
Monitor +	7	7	BLACK / BLUE	1
Monitor –	8	8	BLUE / BLACK	8
Calibrate Resistor	9	9	BLACK / YELLOW	4
Quarter Bridge	10	10	YELLOW / BLACK	9
Unfiltered Output 2	11	11	ORANGE / BLACK	11
Aux Cal +	12	12	BLACK / BROWN	12
Aux Cal -	13	13	BROWN / BLACK	13
Sensor Ground 2	14	14	BLACK / ORANGE	14
Shield 2	15	15	SHIELD	15

BRIDGE-TYPE SENSORS *(up to 4)*	TERMINATION PANEL (DIN-15S-01)		CABLE (5856–Nxyz)	CP248
	Terminal Position	15P D Connector	*(xy = length in meters, z is the multiplier)*	Front Connector Channels 1-4
Channel 3	**CN2**	**CN1**		**J7**
Input +	1	1	BLACK / RED	5
Input −	2	2	RED / BLACK	10
Excitation +	3	3	BLACK / WHITE	3
Excitation −	4	4	WHITE / BLACK	6
Sense +	5	5	BLACK / GREEN	2
Sense −	6	6	GREEN / BLACK	7
Monitor +	7	7	BLACK / BLUE	1
Monitor −	8	8	BLUE / BLACK	8
Calibrate Resistor	9	9	BLACK / YELLOW	4
Quarter Bridge	10	10	YELLOW / BLACK	9
Unfiltered Output 3	11	11	ORANGE / BLACK	11
Aux Cal +	12	12	BLACK / BROWN	12
Aux Cal -	13	13	BROWN / BLACK	13
Sensor Ground 3	14	14	BLACK / ORANGE	14
Shield 3	15	15	SHIELD	15
Channel 4	**CN2**	**CN1**		**J8**
Input +	1	1	BLACK / RED	5
Input −	2	2	RED / BLACK	10
Excitation +	3	3	BLACK / WHITE	3
Excitation −	4	4	WHITE / BLACK	6
Sense +	5	5	BLACK / GREEN	2
Sense −	6	6	GREEN / BLACK	7
Monitor +	7	7	BLACK / BLUE	1
Monitor −	8	8	BLUE / BLACK	8
Calibrate Resistor	9	9	BLACK / YELLOW	4
Quarter Bridge	10	10	YELLOW / BLACK	9
Unfiltered Output 4	11	11	ORANGE / BLACK	11
Aux Cal +	12	12	BLACK / BROWN	12
Aux Cal -	13	13	BROWN / BLACK	13
Sensor Ground 4	14	14	BLACK / ORANGE	14
Shield 4	15	15	SHIELD	15

Table 3. Channels 1-4 Analog Input/ Bridge Connector Pinout – DIN-15S-01

Analog Output Connector Pinout

Pin Number	Signal Description
1	Channel 1 Buffered Out Hi
2	Channel 1 Buffered Out Lo
3	Channel 2 Buffered Out Hi
4	Channel 2 Buffered Out Lo
5	Channel 3 Buffered Out Hi
6	Channel 3 Buffered Out Lo
7	Channel 4 Buffered Out Hi
8	Channel 4 Buffered Out Lo
9	No Connection

Table 4. Analog Output Connector Pinout

CAL Connector

A front panel 2-pin LEMO connector is provided for use as an external calibration source input or to measure the output of the internal calibrator. Note that this connector "floats" and will reference an individual channels ground potential when programmatically switched into a channels path. When used to measure the output of the internal calibrator, the measuring devices ground will be referenced.
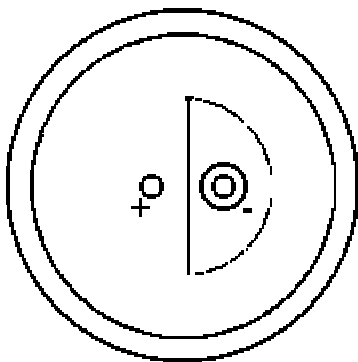

Figure 3. CAL Connector

SMB I/O 1 and I/O 2 Connectors

Two front panel SMB connectors are provided. Either of these connectors can be configured via software as a trigger input, clock input/output or limit violation output. The SMBs may be routed via software to any PXI trigger line (0-7 or star) and can be used to start and stop acquisition or trigger a transient. These connectors reference chassis ground.

Product Ordering Information

CP248-xy11   4 Channel CompactPCI/PXI Bridge Conditioner with ADC

X: Filter Option
        A = 6-pole Bessel
        B = 6-pole Butterworth

Y: Completion Resistors
        1 = 120 Ω
        2 = 350 Ω
        3 = 1000 Ω

Related Products

Model T910-Axyz Cable: SMB to SMB; shielded
Model T910-Bxyz Cable: SMB to BNC; shielded
Model T910-Cxyz Cable: SMB to Unterminated

Model 5856-Lxyz Cable: 9 contact D to Unterminated
Model 5856-Nxyz Cable: 15 contact D to 15 contact DSUB
Model 5938-Z2A 15 contact DSUB mating connector; solder cup, pins
Model 59XX-wxyz 9P Subminiature D Mating Connector; solder cup

Model V755-ZA11 15-position Front Panel Mount Screw Termination Panel
Model DIN-15S-01 DIN Rail Mount Termination Panel

Chapter 2: Installation

⚠ Do not install hardware before installing accompanying software. Installing the software before the hardware ensures that the information in the module description file is available to the operating system when it needs to identify the hardware. A brief overview of the installation steps is as follows:

1. Install software
2. Register the instrument with VISA using the procedure provided by your VISA vendor.
3. Power the system down
4. Install the module.
5. Power the system up. The operating system will automatically identify the new hardware and install kernel mode drivers.

Software Installation

The CP248 Plug and Play driver depends on an installed VISA layer. This procedure assumes that VISA has already been installed.

1. Insert the accompanying CD into your system and run setup.exe. This will install the Plug and Play driver code and libraries, as well as the module.ini file.
2. Register the instrument with VISA. For example, under NI-VISA, run the Device Wizard.

Directory Structure

Software installation will place files as described below. `<VXIPNP>` denotes where VISA is installed (e.g., by default `C:\vxipnp\winnt` on a Windows based machine).

- `<VXIPNP>\include`: ks248.h (API header file)
- `<VXIPNP>\bin`: ksp248.dll (API library)
- `<VXIPNP>\lib\`*format*`: (API lib file ksp248.lib, in various formats)
- `<VXIPNP\cp248`: ksp248.c (API source code)

In addition, the module_cp248.ini file will be installed in the directory specified by registry setting `HKEY_LOCAL_MACHINE\SOFTWARE\PXISA\CURRENT_VERSION`, value `ModuleDescriptionFilePath`, or simply `<VXIPNP>` if the registry value is not set or does not exist.

Manual Registration with VISA

Typically, the VISA registration tool should get the information it needs from the module_cp248.ini file. If not, you may need to provide this information:

- Module Name: "CP248"
- Module Vendor: "KineticSystems"
- Model Code: 0x248
- Manufacturer Code: 0x11f4
- Interrupt Detect and Quiescent:
  ➢ Detect: true if a 32 bit read of space BAR2, offset 0xd8 returns bits 0 on, if a 32 bit read of space BAR2, offset 0xdc returns bits 0 on.

➤ Quiesce: Quiesce: To deassert the interrupt, perform a 32 bit write of value 0x1 to space BAR2, offset 0xd8, BAR2, offset 0xdc, and BAR0 offset 0xa8.

In PXI terms:

```
NumDetectSequences = 2
InterruptDetect0 = "C32 BAR2 0xd8 0x1 0x1;"
InterruptDetect1 = "C32 BAR2 0xdc 0x1 0x1;"
InterruptQuiesce = "W32 BAR2 0xd8 0x1;W32 BAR2 0xdc 0x1;W32 BAR0 0xa8 0x9;"
```

System Installation in a NI Configuration

Controller and Chassis Configuration

The following details the steps required to install the hardware and software required to create a system. The installation steps described here assume a National Instruments product is used to control the system from either a remote PC or an embedded processor.

For initial configuration, install the PXI system controller software as detailed by the controller manufacturer. This installation will include the hardware device specific software along with VISA. VISA (*Virtual Instrument Software Architecture)* provides a standard software layer in which PNP (*Plug and Play)* drivers access hardware resources. The VISA implementation installed in a specific system is dependent on the manufacturer of the hardware used to access the PXI hardware.

The VISA layer is responsible for handling the PXI resources as well as providing the kernel mode driver level access to the hardware. PXI devices are "registered" with VISA in order to complete the communication link from software to the lowest level hardware driver.

After the controller software drivers are installed, install the latest version of VISA. This is typically installed at the same installation step as the controller software. Various installation options are usually available at controller software installation to include the VISA installation. Once this installation is completed, install the controller hardware. Follow the manufacturers' guidelines for installation.

The next step is to configure the chassis that is used in the system. The best mechanism to accomplish this is through the use of NI Measurement Explorer (NI-MAX). This utility was installed when the controller software setup was performed. The typical program path to start this utility is:

*Start | Programs | National Instruments | Measurement& Automation*

The following is a screen shot of the NI-MAX utility.
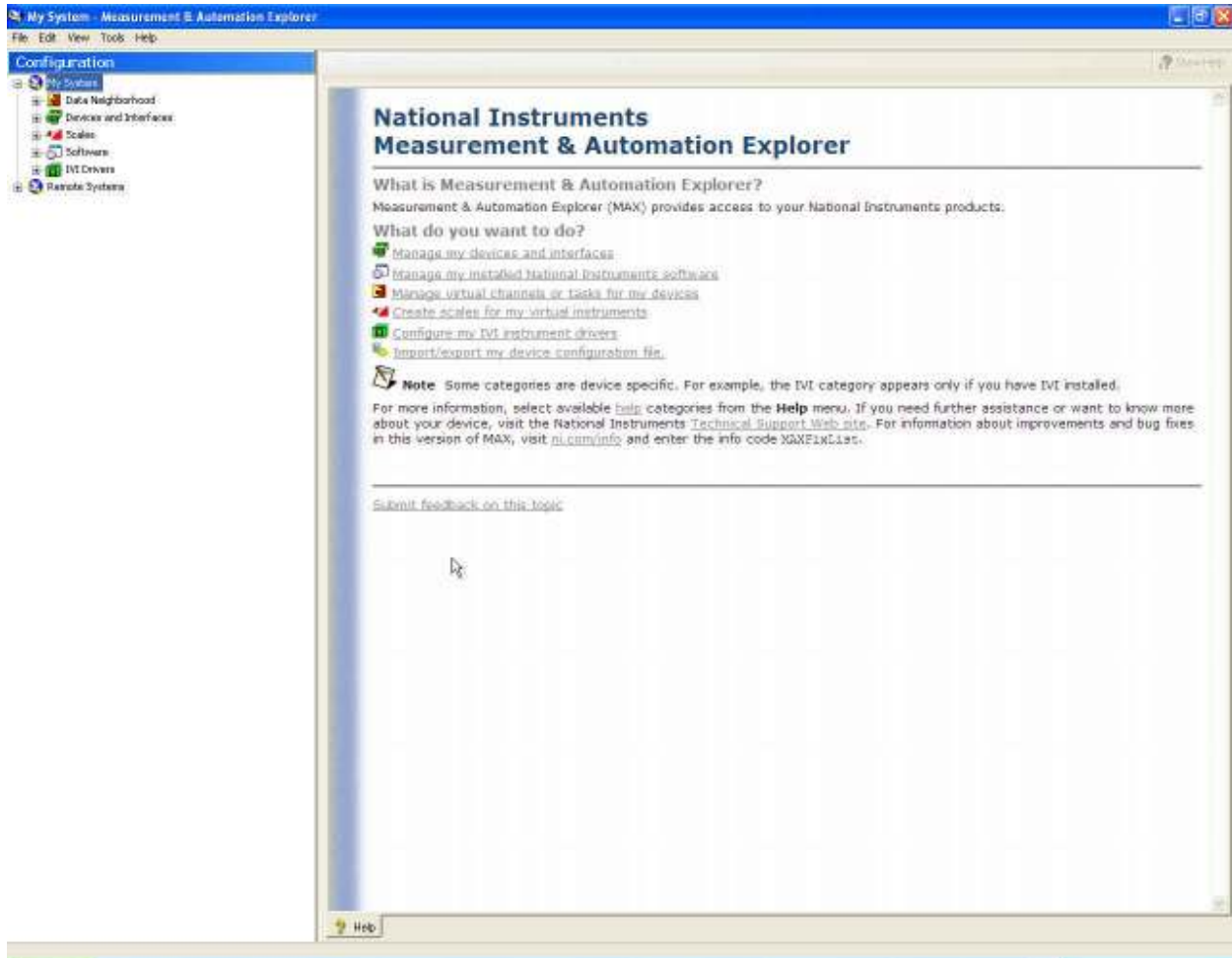
On the left side of the utility there is a tree view of all the components in the data acquisition system, both hardware and software.

The first step is to define the chassis that we are using in our system.

Expand the *Devices and Interfaces* node in order to see the currently located and assigned hardware. A screen shot of a typical installation is shown below.
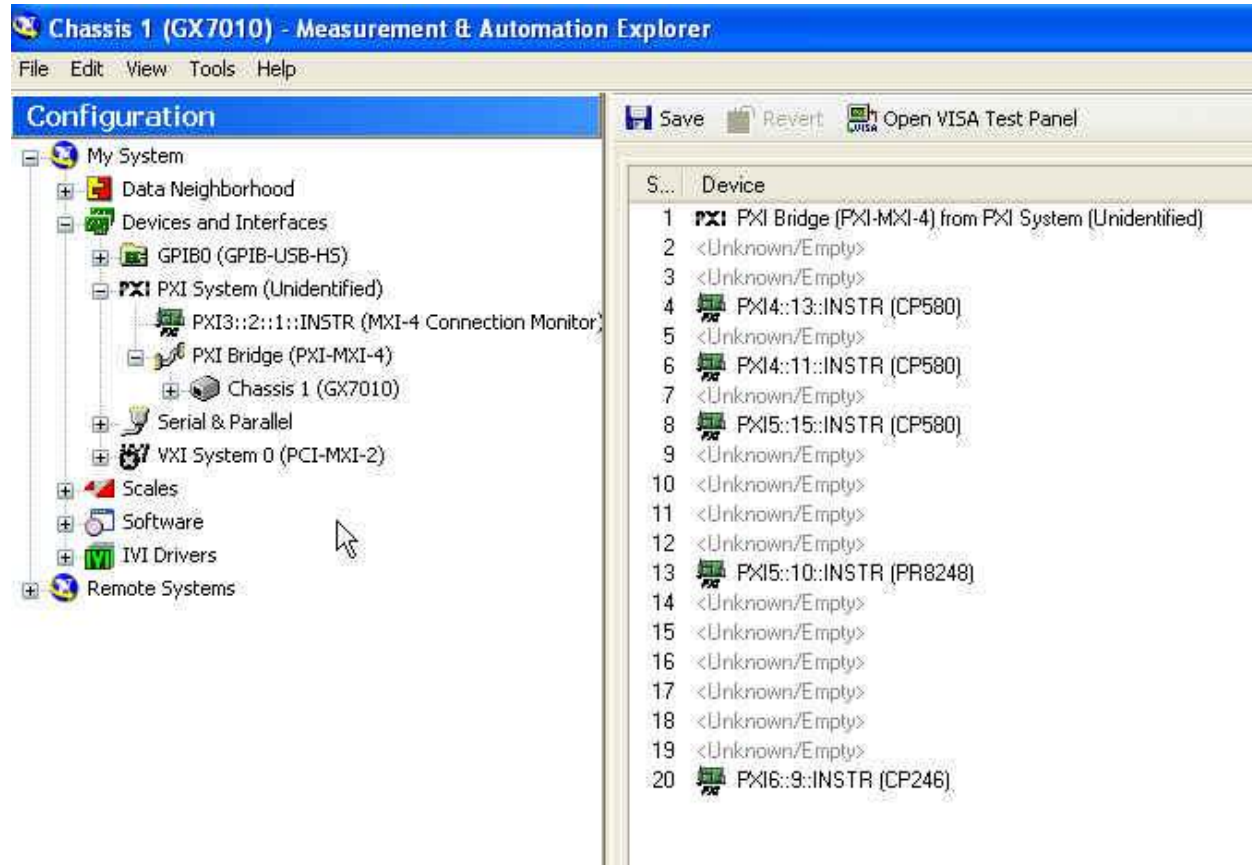
As you can see in this screen shot, chassis has already been assigned. In this case, the chassis is a model GX7010 from Geotest. Prior to assigning the chassis model number for the PXI system, the chassis will be displayed as *undefined.* In order to specify the chassis used in your system, right-click on the *Chassis* node and select the *Identify As* option. A drop-down list of the available defined chassis is displayed. Select the chassis from the list that matches the chassis in the system. The drop-down list of chassis is created from the *.ini* files located in the *C:\Program Files\National Instruments\PXI\Hardware Descriptions\Chassis* directory. These files are used to define the physical characteristics of the chassis in the system. This includes information such as trigger signaling, PCI bus segments, PCI Bridges, etc. Also contained in this file is the physical slot association. Since PCI by itself does not make any specific association between a PCI bus segment/device and a slot location, the *chassis.ini* file creates the association. The *chassis.ini* file is supplied by the vendor of the chassis, but can also be created if necessary. The format of the file, and other module descriptor files, can be obtained from the PXI System Alliance at www.pxisa.org.

Since for this procedure we are creating a new system, the modules identified on the right-side of the screen will not be displayed. We need to continue configuring the modules in the system before we obtain such a tree view of the hardware configuration.

Module Plug and Play Driver Installation

The next step is to install the module specific PNP (Plug and Play) drivers. Each manufacturer supplies a driver distribution disk that contains the PNP drivers for the associated hardware.

Install the driver installation media supplied by the manufacturer and run the *setup.exe* program if the installation does not automatically run when the distribution is installed.

Follow the installation instructions in order to complete the initial setup phase. Typically the disk paths will be automatically filled in with the traditional VISA paths so that you will not have to select any options during the install. The generic VISA disk path is referred to as <VXIPNP>. This is usually located in one of two places:
- C:\Program Files\IVI Foundation\VISA
- C:\VXIPNP\

The PNP drivers and example code are then placed under this directory in the *WinNT* location. The *.dlls* are placed in the */Bin* location, the *.h* include files are in the */include* location and the libraries are in the */lib* location. Under the main VXIPNP\WinNT directory you will also find the PNP driver source code and other ancillary information on the hardware modules.
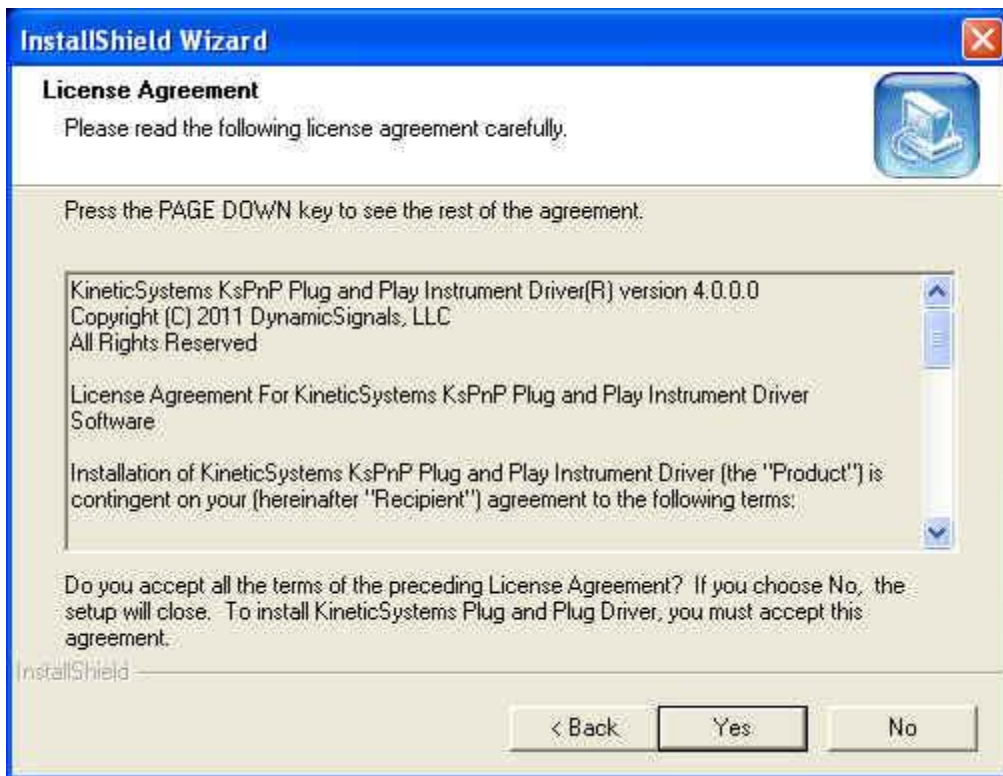
When installing the 8248AU PNP driver, you are presented with a splash screen as shown below:

After a moment the installation will continue with the traditional steps as outlined below:
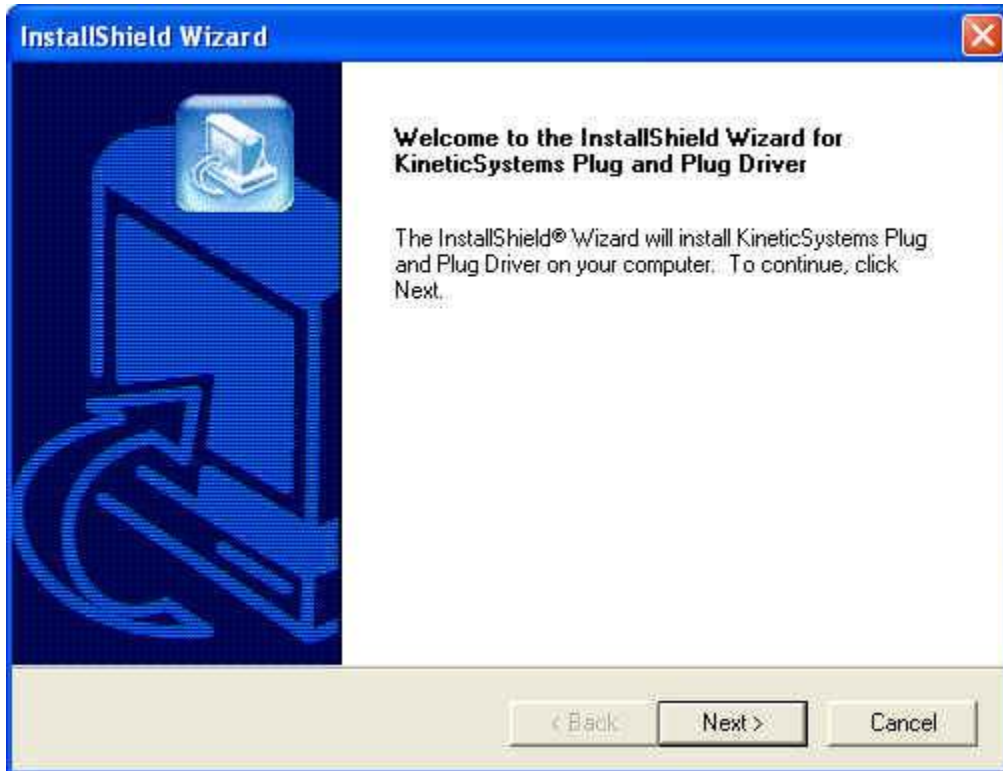
Select *Next* to proceed.

Read the license agreement and if you agree to the terms select *Yes*, or if not select *No*.

Enter the *User Name* and the *Company Name*, followed by *Next*.

InstallShield Wizard

Choose Destination Location
Select folder where Setup will install files.

Setup will install KineticSystems Plug and Plug Driver in the following folder.

To install to this folder, click Next. To install to a different folder, click Browse and select another folder.

Destination Folder

C:\Program Files\IVI Foundation\VISA\   Browse...

InstallShield

< Back   Next >   Cancel

Select the location for the installation. This is normally filled in with the path name obtained from the Registry where the VISA installation is located. If the path is as desired, select *Next*.

InstallShield Wizard

Setup Type
Choose the setup type that best suits your needs.

Please select which instrument drivers are to be installed. 'All' will install all drivers, while

Complete
Custom

Description

Install the complete set of KineticSystems PnP drivers.

InstallShield

< Back   Next >   Cancel

Select whether all the PNP drivers should be installed (*Complete)* or just a subset of the drivers *(Custom)*. It is recommended that you always do a *Complete* installation since some components of the PNP driver set have common use between devices. Installing or upgrading all drivers insures that they are all up to the most recent and compatible versions.

Once the selection is complete, select *Next*.
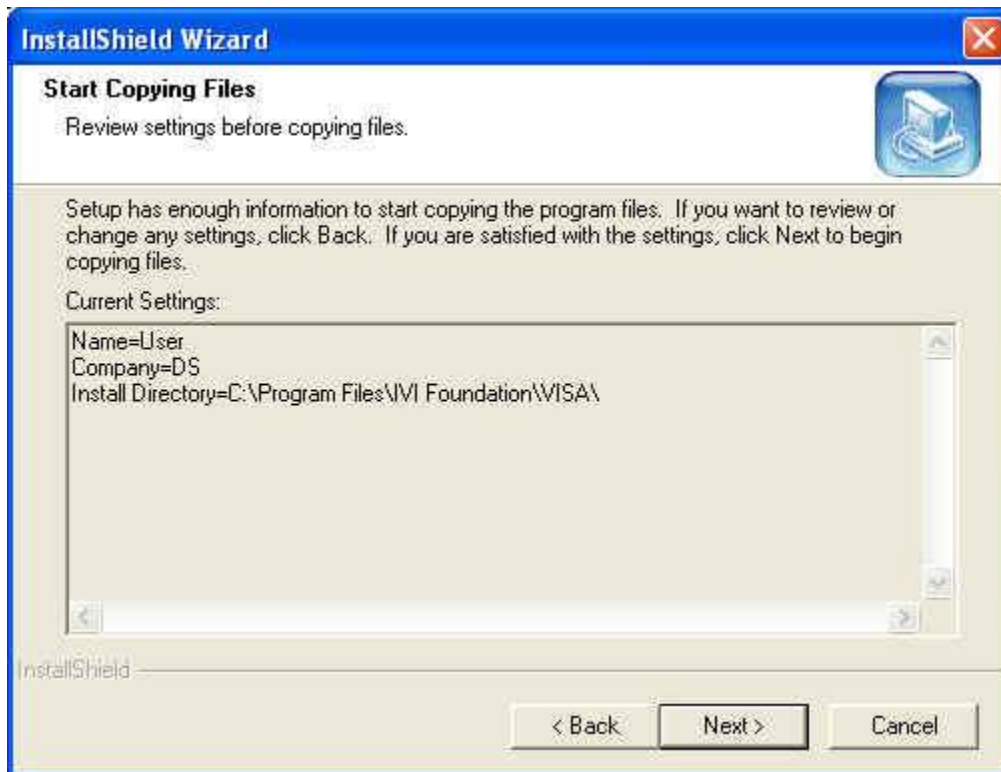
This screen displays are summary of the selections. If any corrections need to be made hit the *Back* button, otherwise proceed using the *Next* button.

This will start the installation procedure. A series of file copies will occur to place the PNP driver and associated files into their correct locations. Once the operation is complete, the following screen is displayed.

Click the *Finish* button to conclude the installation process.

Module Registration with VISA

Now that the hardware PNP driver has been installed for the module it must now be registered with VISA. If the module hardware were to be installed at this point without registering it with VISA, it would appear as a device without a driver in the *Device Hardware Manager* of the computer. The registration of the hardware with VISA establishes the kernel mode driver that will be used for the module. The kernel mode driver is a component of VISA.

To register a device with VISA follow the following steps.

Run the *National Instruments Driver Wizard* program to start the process. The program can typically be found at:

Start | Programs | National Instruments | VISA | Driver Wizard.

Once the program is started the initial setup screen is displayed as follows:
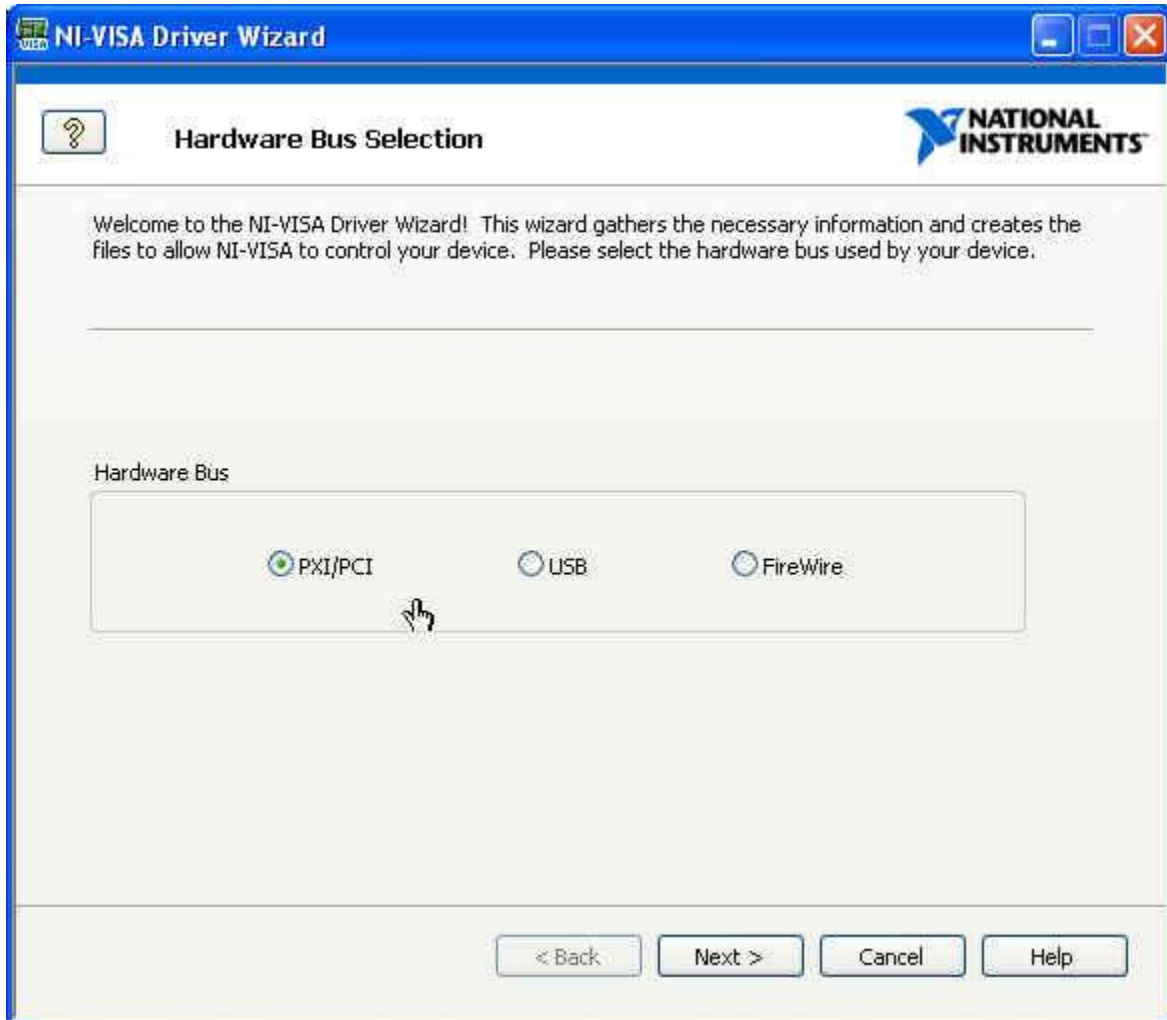
Click the *Next* button to proceed to the next screen. The default values on this screen are appropriate for the installation of the PXI instrument.
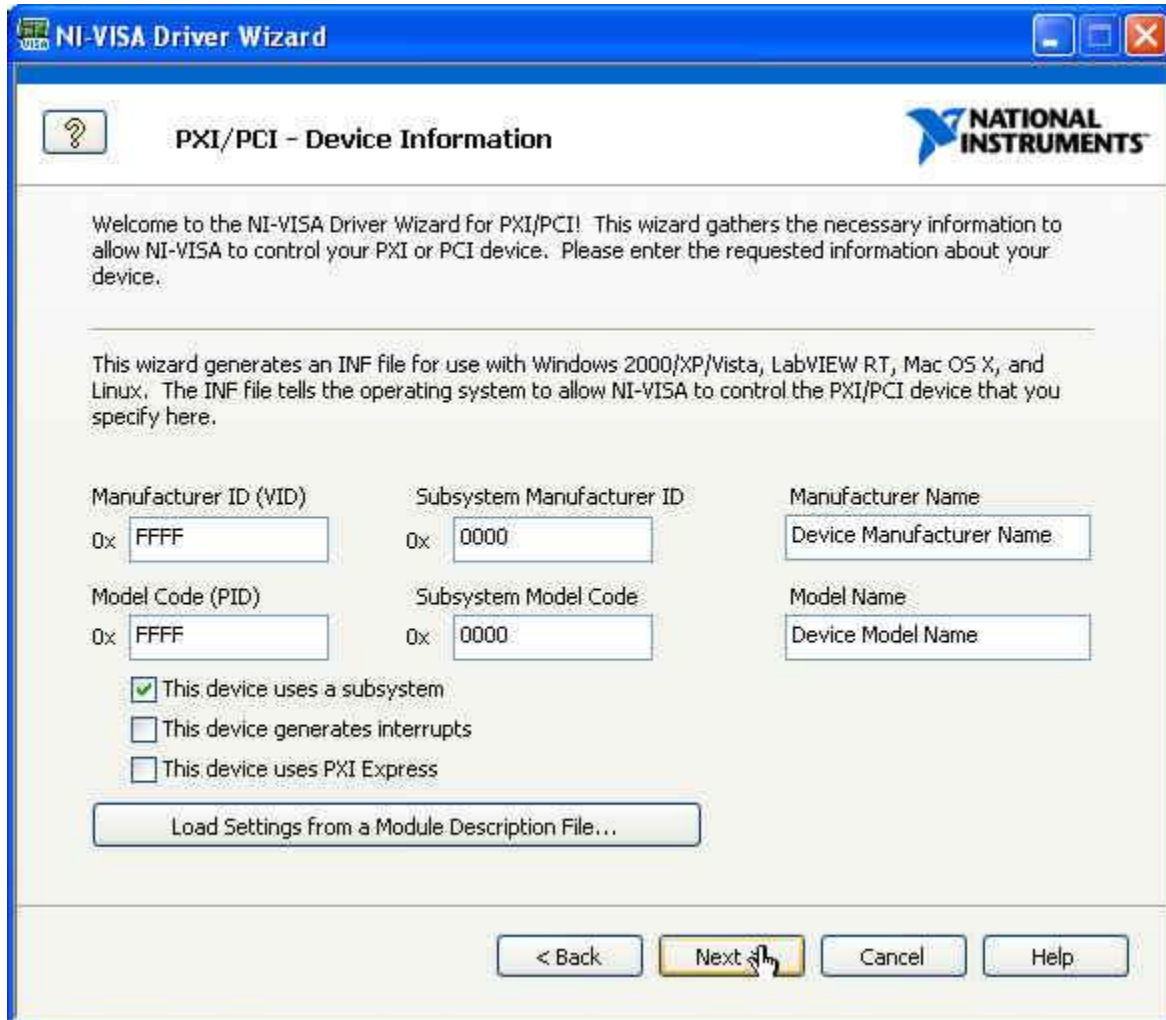
The default values of this screen are displayed. There is no manufacturer ID or Model code entered. One can proceed to fill in these values with the ones listed in the section **Manual Registration with VISA.** However, a more error-free and expedient way to associate the driver is to use the *Load Settings from a Module Descriptor File..* This option will use the *module_pr8248.ini* file that was installed onto the disk during the PNP driver installation procedure.

The Hardware Descriptors are typically located in the following directory:

C:\Program Files\National Instruments\PXI\Hardware Descriptions

Under this directory are three subdirectories; *Chassis, Controllers and Modules*

The *module_pr8248.ini* file can be found under the *Modules* subdirectory. This procedure will point the Driver Wizard to this directory and file to complete the registration process.

To continue, select the *Load Settings from a Module Descriptor File..* button.

When the directory navigation screen is displayed, navigate to the location where the module descriptor files are located:
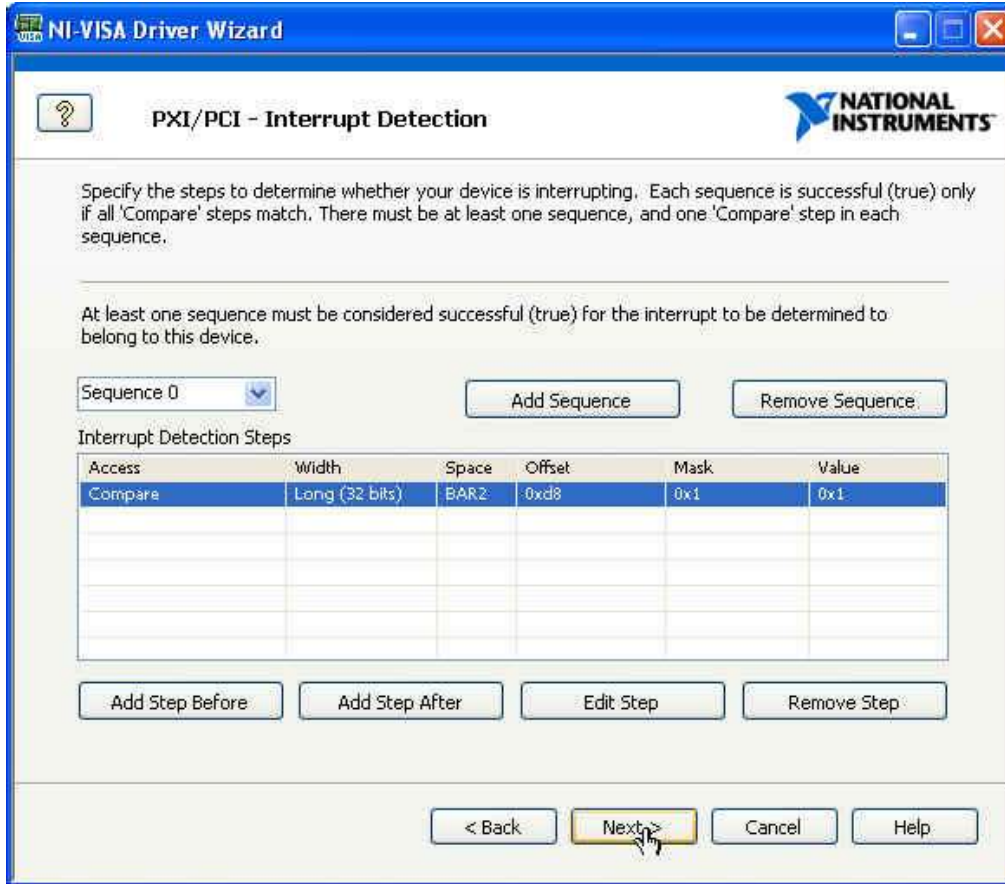
C:\Program Files\National Instruments\PXI\Hardware Descriptions\Modules
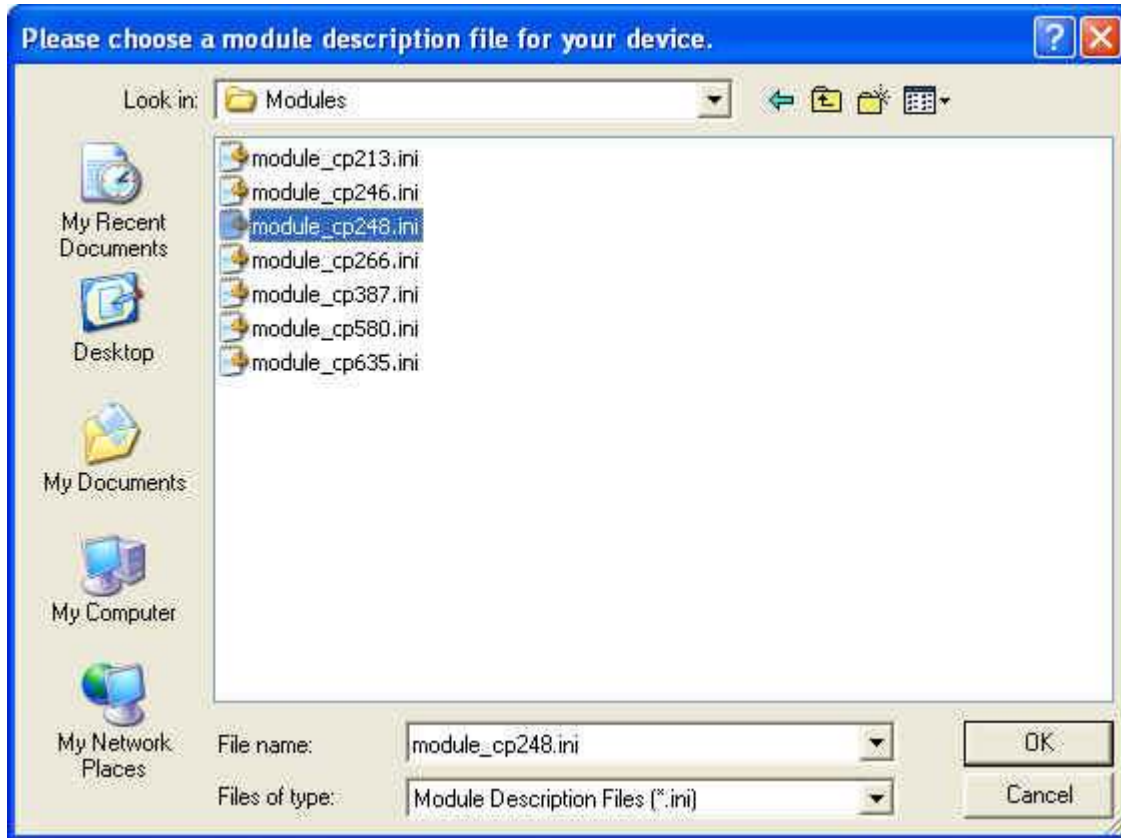

Select the *.ini* file associated with the module that is to be installed. In this case, select the *module_cp248.ini*. Then, hit the *OK* button.
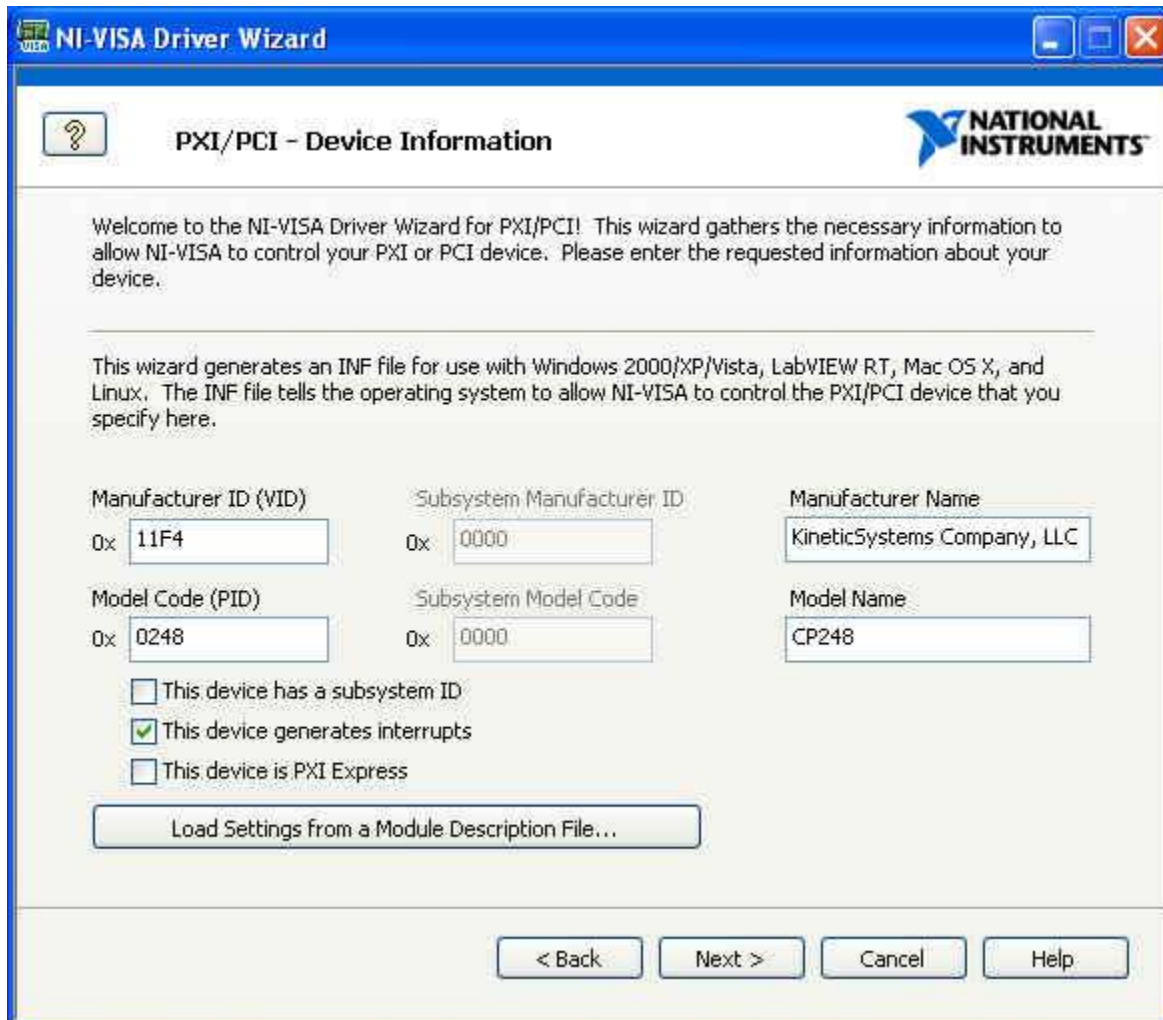
The Device Information screen has now been filled in with the information contained in the *module_cp248.ini* file. Continue the process by selecting the *Next* button.

The settings from the .*ini* file have been entered on this screen for the module, so hit *Next* to continue.
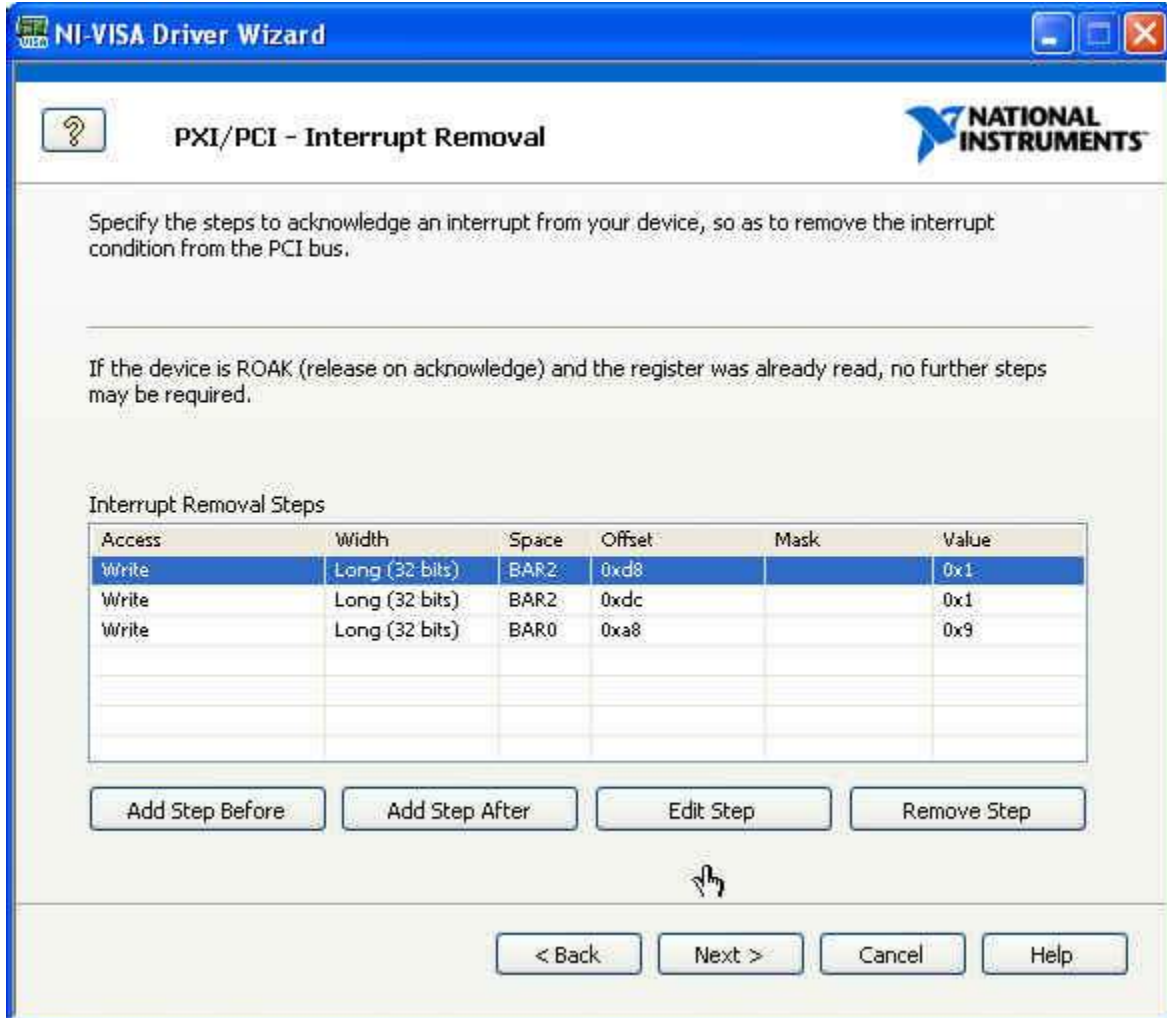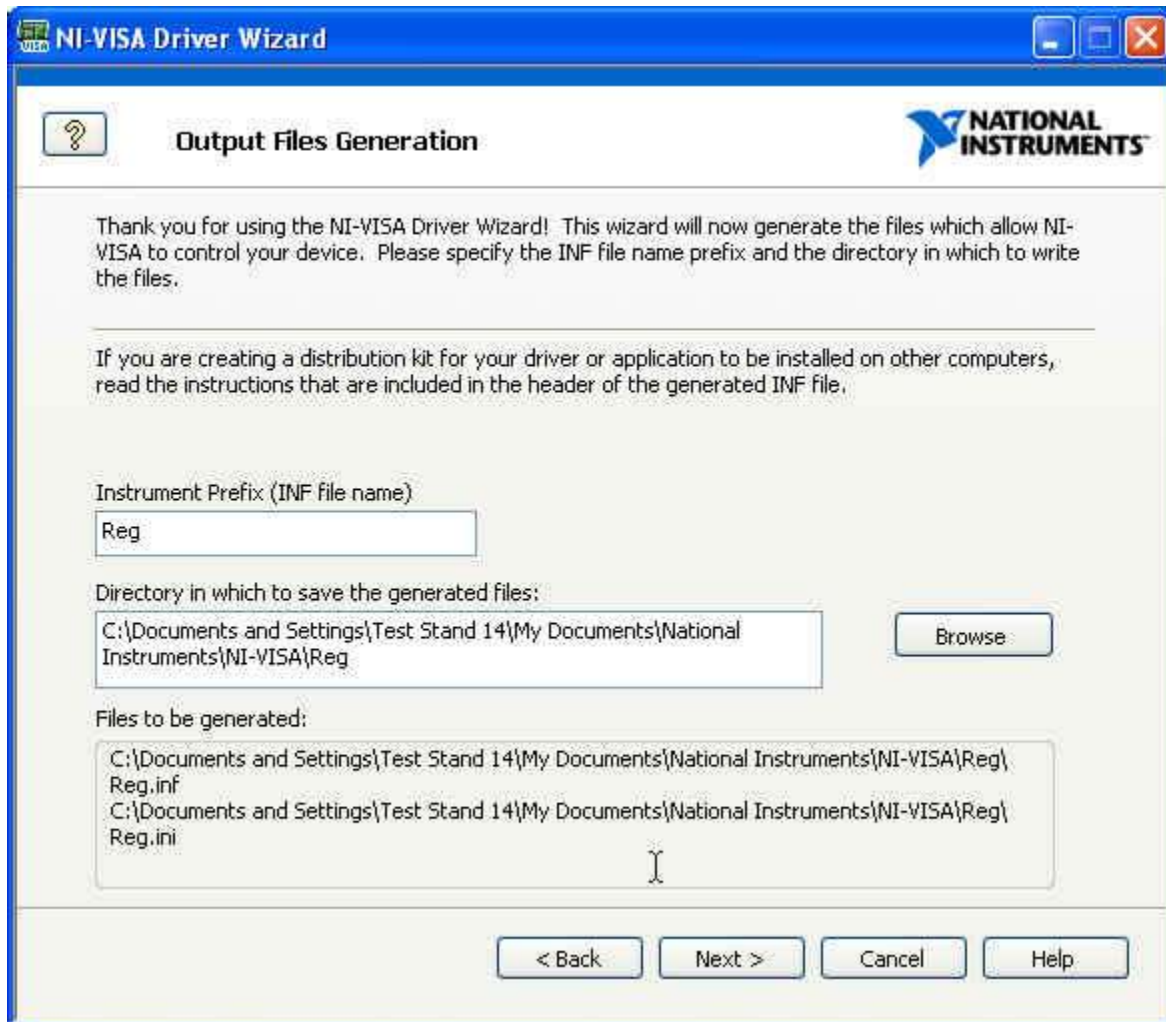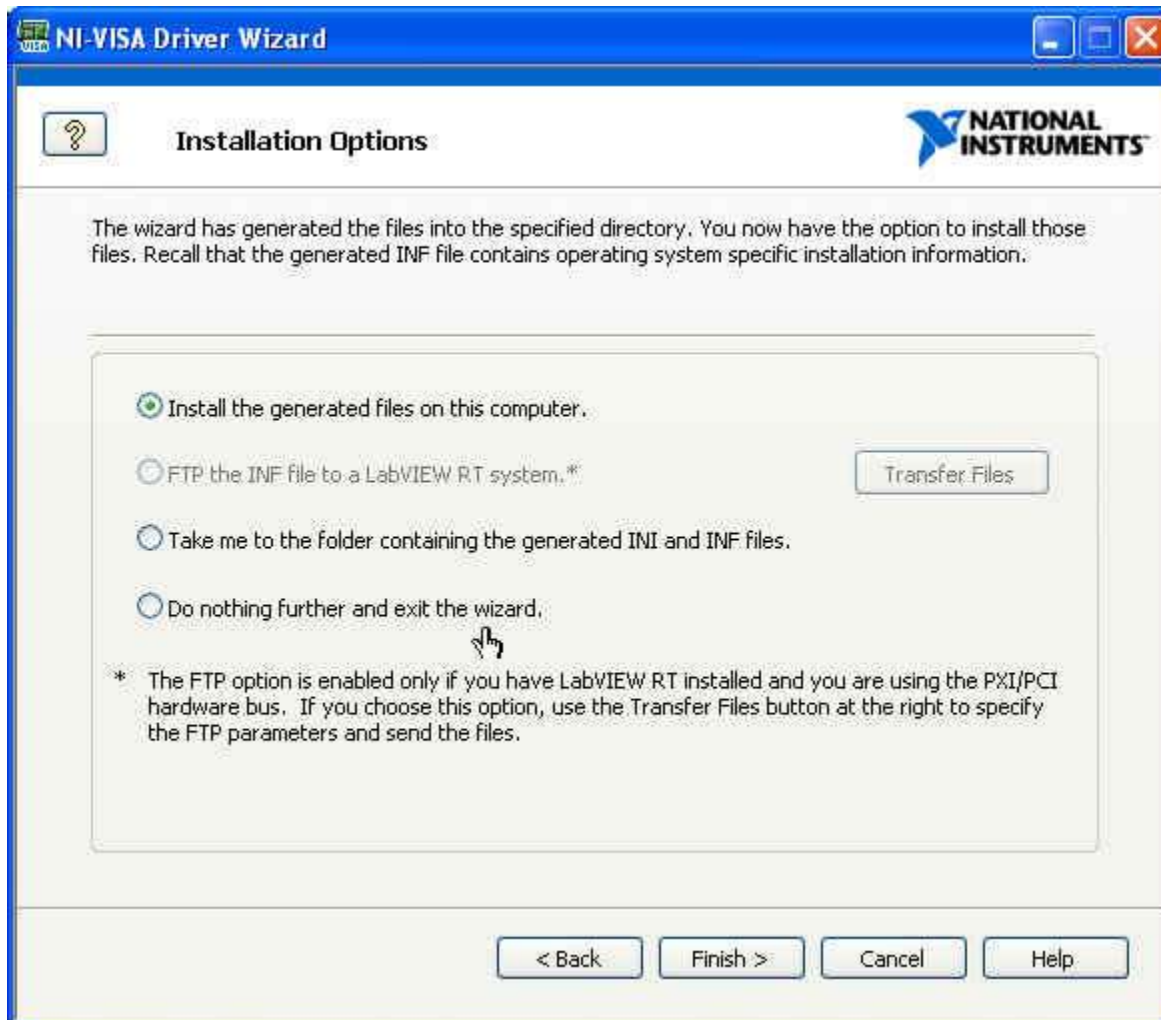
The settings from the *.ini* file have been entered on this screen for the module, so hit *Next* to continue.
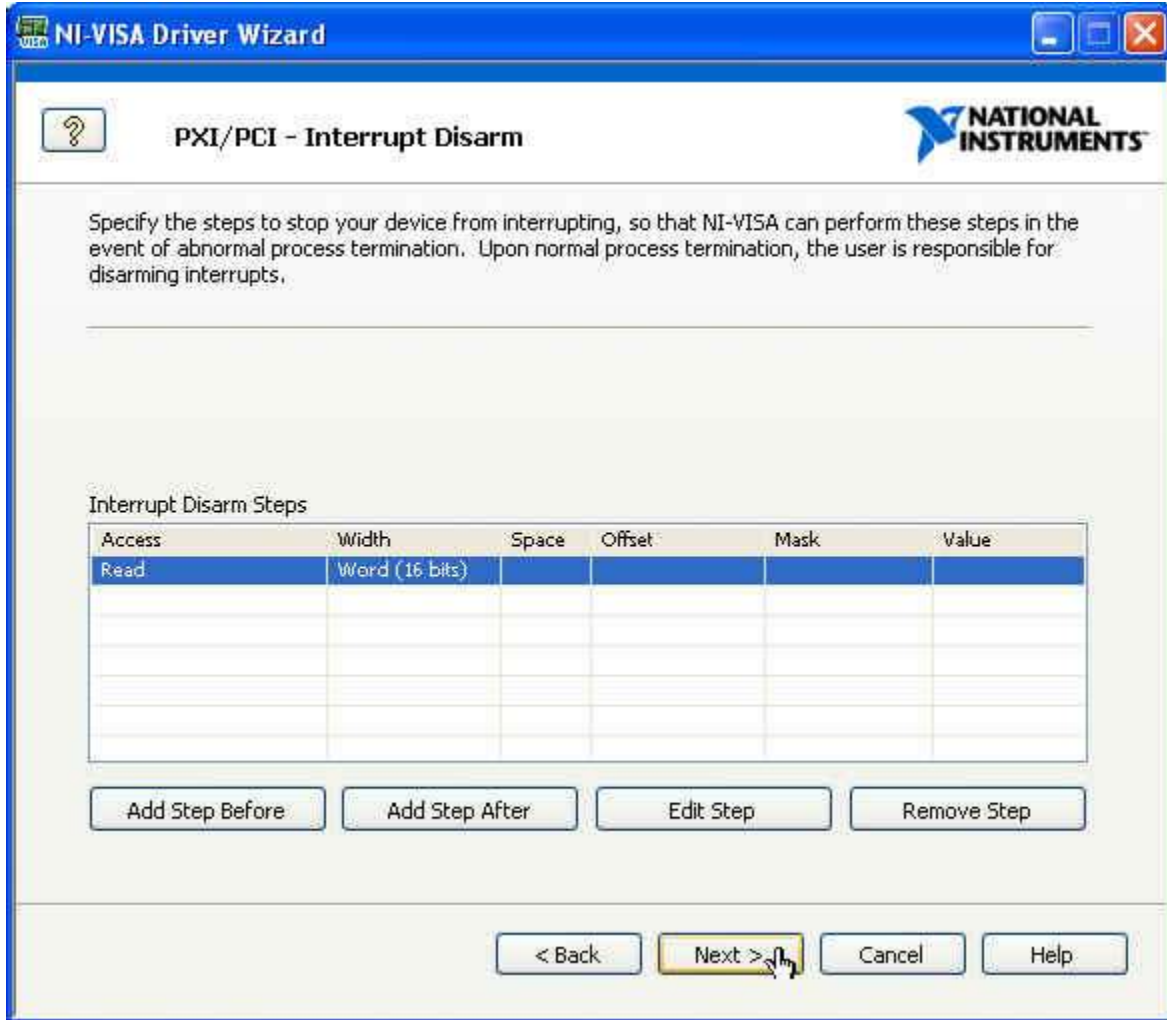
The settings from the *.ini* file have been entered on this screen for the module, so hit *Next* to continue.

This screen shows the files that are generated and the locations in which they are placed. Hit *Next* to continue.

Select the default option to install the files and click *Finish*.

This completes the registration of the device with VISA. Now the system can be shut down, the hardware module(s) inserted and power applied. Once the power-up sequence has completed we can verify that the devices have been registered with VISA. During the power-up sequence, the operating system will report that new PCI devices have been detected. Allow the system to search for an appropriate driver for the devices.

Verify VISA Registration

Verify that the newly installed devices have been detected and associated with VISA. Use the *Device Manager* of Windows to view the devices installed on the system. The *Device Manager* can usually be accessed by the *System* icon in the Control Panel or through a *Computer* icon on the desktop.
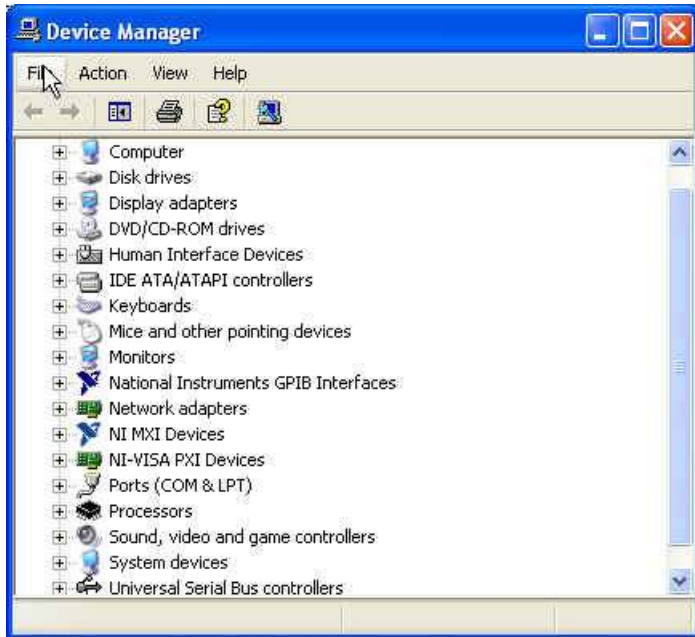
Once *Device Manager* is started a screen similar to the following is displayed.

Select the *Hardware* tab to get access to the *Device Manager*.
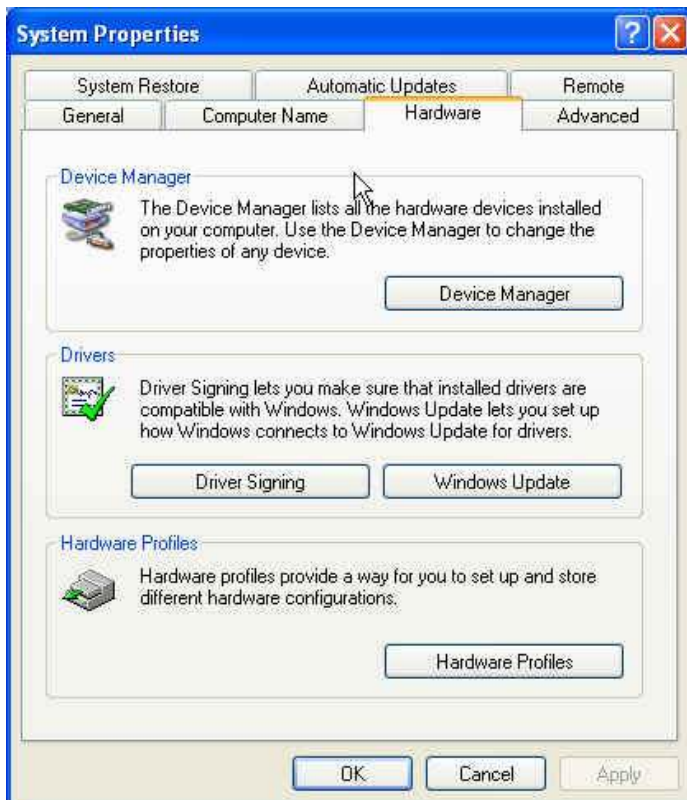
Select the *Device Manager* button to get the list of system devices.

A list of the devices in the system is displayed in a tree view. Select the + sign located by the *NI-VISA PXI Devices* node to see the hardware resources registered with VISA. Any devices that have been registered with VISA through the *NI Driver Wizard* should appear in the list.
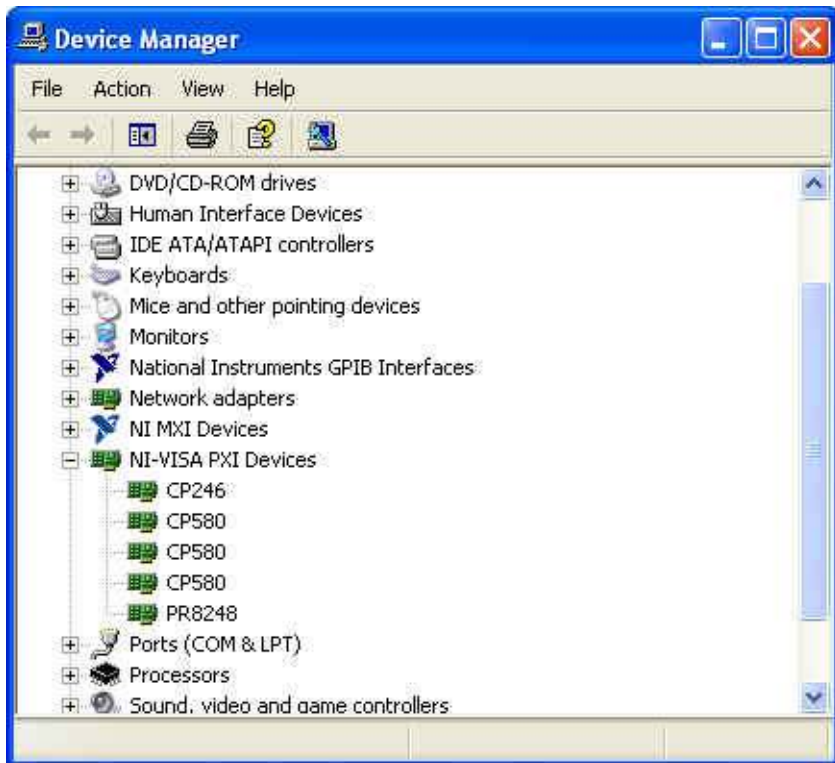
The device list in this configuration are a CP246, three CP580's and a PR8248. You may right-click on a device of interest and display various system assignments as shown below.


If a device that was installed does not appear as a registered device with VISA, repeat the procedure. Check for any devices in the *Device Manager* tree list that do not have any associated driver.

Verify Installed Device Through NI_MAX

Verify that the newly installed device is visible under the NI Measurement and Explorer utility. Start the NI-MAX utility:

Start | Programs | National Instruments | Measurement& Automation

Once the utility open, click on the *Devices and Interfaces* followed by the *PXI System* and then the *PXI Bridge* (for an externally controlled chassis). Navigate to the chassis that was configured and verify that the required modules appear in the system at the expected slot locations. If the slot locations do not match the physical locations in the chassis, check to make sure that the correct chassis manufacturer and model number are selected.
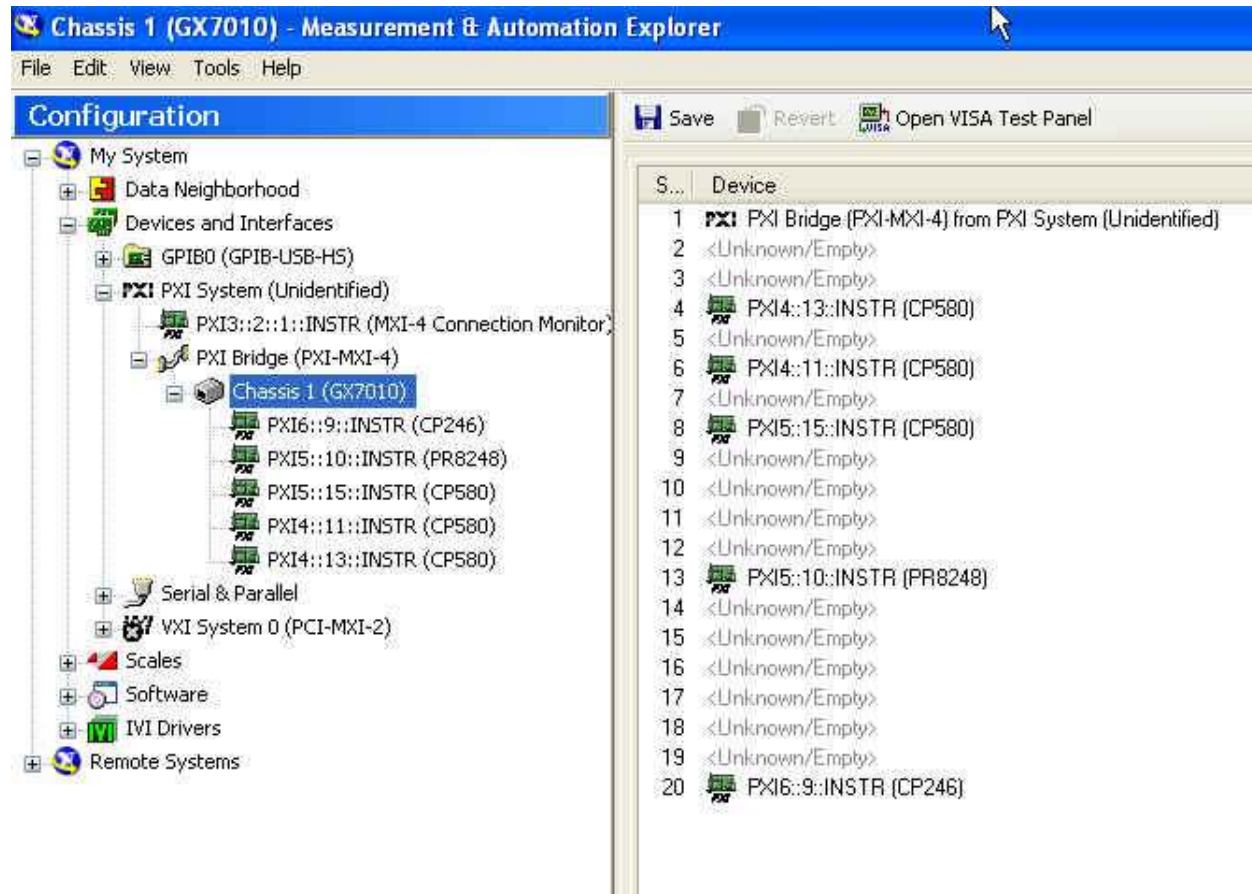
This completes the installation and verification of the hardware and software.

Please note that if an additional module is inserted into the PXI system that the operating system will detect it and install the correct driver, if that specific module's driver had already been installed. If a module is removed from a slot and replaced in another slot, the operating system will detect this move and require the installation of the driver. If the module type had already been installed in the system then an automatic driver association will occur. The association between VISA and a specific module type only needs to be done once, not every time a new module is inserted.

In the installation directory for the PXI device(s) there are examples and documentation. The location of the examples for the CP248 are located in:

C:\VXIPNP\WinNT\ksp248\examples or
C:\Program Files\IVI Foundation\VISA\WinNT\ksp248\examples

If the VISA installation used a non-standard directory location, use that directory prefix to locate the examples and documentation.

Unpacking the CP248

The CP248 comes in an anti-static bag to avoid electrostatic damage to the module. Please take the following precautions when unpacking the module:

- Ground yourself with a grounding strap or by touching a grounded object.
- Touch the anti-static package to a metal part of your PXI/CompactPCI chassis before removing the module from the package.
- Remove the module from the package and inspect the module for damage.
- Do not install the module into the PXI/CompactPCI chassis until you are satisfied that the module exhibits no obvious mechanical damage and is configured to conform to the desiring operating environment.

Chapter 3: Device Operation

Overview

The CP248 contains 4 individually isolated channels of bridge signal conditioning with operation up to ±300V common-mode, optional bridge-completion resistors and independent bridge excitation. Each channel features input gain, filtering, and protection against electrostatic discharge (ESD) as well as protection against input voltages up to ± 35 volts via a high-impedance, differential input stage. The bridge signal conditioning channels feed four independent 16-bit Analog to Digital Converters (ADC's) that sample at a maximum rate of 250 Ksamples per second. The ADC per channel architecture generates simultaneously sampled signals. PXI trigger and/or the front panel expansion bus connect multiple CP248s together to synchronize simultaneous sampling across all of them.

Bridge completion can be inserted, under software control, via low thermal-EMF, latching relays. Quarter, half or full bridge configurations can be selected. On-board bridge completion resistors are available in values of 120Ω, 350Ω or 1000Ω. Per-channel, isolated excitation supplies, balanced with respect to ground, are provided and are programmable from 0 to 10V in 4096 steps. Each channel can be programmed for either voltage or current excitation. Over-current conditions or an open sense lead shut the supply down and generate an Excitation Alarm interrupt. Each channel also provides the ability to balance its bridge. A 12-bit DAC is used to inject current into the bridge to remove initial offset voltages, or pre-loads, of up to 70 mV.

The CP248 provides gain settings that are programmable from 1 to 10000 in a 1,2,5 progression. Two stages of gain and an attenuation stage are used to scale an input signal to the ±5V ADC input range. The first gain stage, a programmable instrumentation amplifier, provides gains of 1, 100 and 1000. It features high input impedance and high common-mode rejection. The second gain stage is a programmable-gain amplifier with selectable gains of 1, 5 and 10. The programmable attenuation stage is located between the first and second gain stages.

Shunt calibration may be performed across two arms of the bridge. Programmable solid state switches provide the switching. Socketed locations (B-size) are provided for user selected and supplied shunt calibration resistors.

Standard filters are 6-pole Bessel or 6-pole Butterworth. Software-selectable cutoff frequencies include 20 Hz, 200 Hz, 500Hz, 1 kHz, 2kHz, 5kHz, 25kHz and 50kHz. The filter may also be bypassed for wideband applications. The pre-filter buffered output –3dB point is 200kHz. The isolated buffered output –3dB point is also 200kHz. However, be aware that signal aliasing may occur at frequencies above half the 250kHz ADC sampling rate for the isolated buffered output, whether pre-filter or post-filter is selected.

Tri-filar transformers are provided for use in environments that are "noisy" or where long input cabling is required. These transformers reduce RF and common-mode voltages to the input of the CP248. Termination panels and cables that allow you to easily and economically connect your transducers to the CP248 are also available.
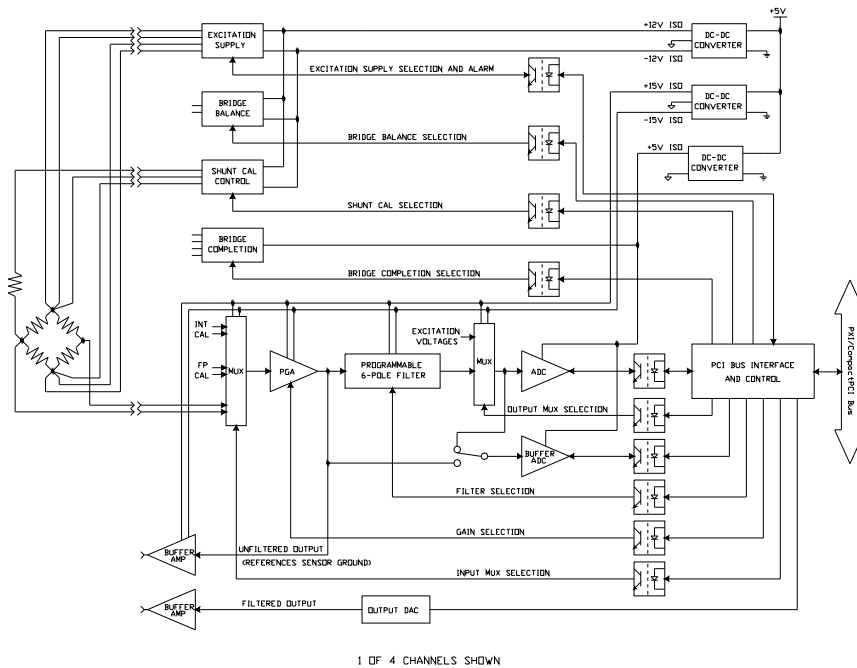
Figure 4. CP248 Block Diagram

The instrumentation amplifiers used at the front end of the CP248 exhibit low values of input bias current and offset current. These input currents—however small—must have a return path to ground or the amplifier will saturate. If the signal source is ground-referenced no problem will arise. If the signal source is floating, a return path must be provided. The CP248 provides 10MΩ bias current return resistors on board to support floating signal sources. Refer to Figure 5. These bias current return resistors may be omitted in cases where a higher input impedance is required and an external current path is provided. Contact the factory for assistance regarding alternate configurations.
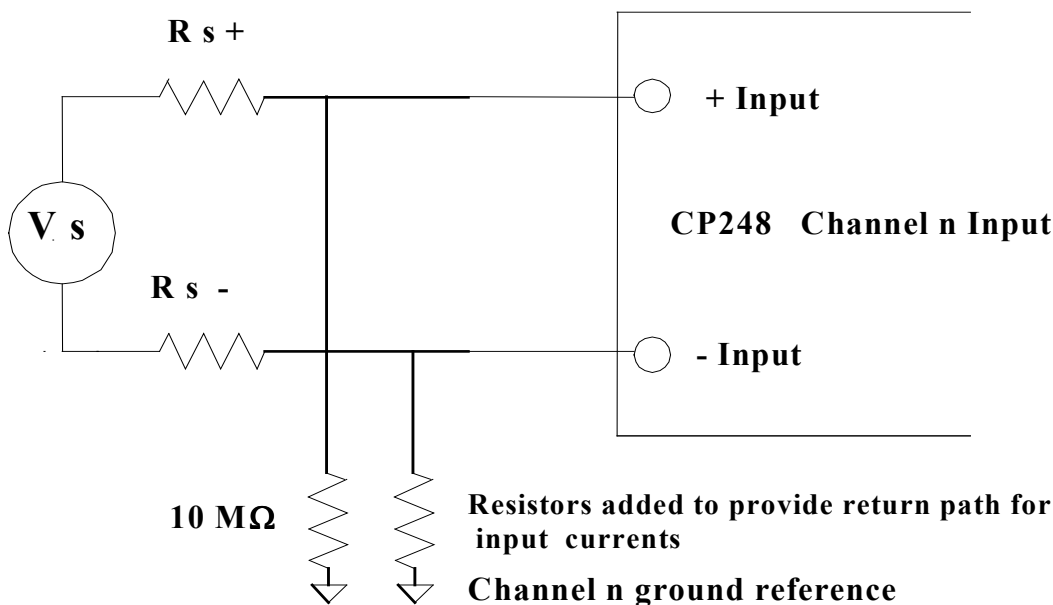
Figure 5. Providing Ground Path for Return Currents

Calibration
The CP248 is a highly accurate measuring device, requiring proper calibration. Since components are subject to drift and are sensitive to temperature and humidity, it is good practice to perform calibration at regular intervals. Calibration of a CP248 is done under software control and can occur as often as required or desired.

Voltage calibration is performed end-to-end: a precise on-board analog voltage is routed internally under software control to the analog channel inputs of the instrument, and resulting measurements are compared to the internal signal. A transfer function is generated to correlate the ADC output to the known input signal. Voltage calibration can also be performed by connecting an externally provided precision voltage to a connector on the front panel; this signal is then routed internally under software control to one of the analog inputs. Note that the on-board calibrator "floats" and will reference an individual channels ground potential when programmatically switched into a channels path. When an external voltage source is provided, it must also "float" in order to reference an individual channels ground potential.

⚠ **Caution** Failure to "float" the output of an external calibration voltage source can result in ground loops and potential damage when high common-mode voltages are present at a channels input.

Additional bridge calibration measures the excitation voltage either through an internal signal path or from the remote sense lines. Finally, shunt calibration is performed by switching a user supplied shunt resistor representing a known transducer change across one or two arms of the

bridge; the resulting change in measured input is correlated to the expected change based on the shunt resistor.

All calibration procedures are automated under software control. Additionally, the user can control the various signal path mux connections to control each step of the calibration procedure directly.

Basic Shunt Calibration
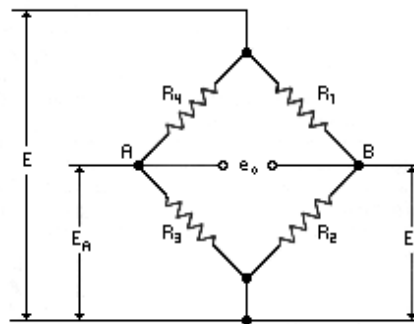Illustrated below is the Wheatstone bridge circuit in a simple form.

Figure 6. Basic Wheatstone Bridge Circuit

With the bridge excitation provided by the constant voltage E, the output voltage, e_o, is equal to the voltage difference between points A and B:

$$E_B = E\left(1 - \frac{R_1}{R_1 + R_2}\right)$$

$$E_A = E\left(1 - \frac{R_4}{R_4 + R_3}\right)$$

And,

$$e_o = E_A - E_B = E\left(\frac{R_1}{R_1 + R_2} - \frac{R_4}{R_4 + R_3}\right)$$

Or, in more convenient form,

$$\frac{e_o}{E} = \frac{R_1/R_2}{R_1/R_2 + 1} - \frac{R_4/R_3}{R_4/R_3 + 1}$$

It is evident from the form of this equation that the output depends only on the resistance ratios R_1/R_2 and R_4/R_3, rather than on the individual resistances. Furthermore, when $R_1/R_2 = R_4/R_3$, the output is zero and the bridge is described as resistively balanced. Whether the bridge is balanced or unbalanced, this equation permits calculating the change in output voltage due to decreeasing any one of the arm resistances by shunting. The equation also demonstrates that the sign of the change depends on which arm is shunted. For example, decreasing R_1/R_2 by shunting R_1, or

increasing R_4/R_3 by shunting R_3 will cause a negative change in output. Correspondingly, a positive change in output is produced by shunting R_2 or R_4 (increasing R_1/R_2, and decreasing R_4/R_3, respectively).

Calibrator Calibration

To achieve the high degree of accuracy, the CP248 stores factory-generated coefficients in non-volatile RAM representing imperfections in the internal calibrator output and the signal loss between the calibrator mux and the input pins. Both of these correction factors are applied during regular user-initiated calibration. These coefficients must be re-evaluated by qualified technicians approximately every six months.

Current Excitation

The CP248 can be programmed for either voltage or current excitation. When current excitation is selected, the excitation voltage source sense lines are switched across an internal precision 50Ω resistor creating a constant current source. This current source provides a maximum of 50mA to a resistance load with a step resolution of 48.8μA. The current source has a maximum compliance voltage of 7 volts. The series resistance of the load (including lead resistances) must be kept within a range that does not exceed the maximum compliance voltage. For a 50mA current excitation setting, the maximum load resistance is 140Ω (7V ÷ 50mA). For load resistances greater than 140Ω, a lower current setting is required to stay within the maximum compliance voltage of 7 volts. For example, the maximum current setting for a 1000Ω load would be 7mA (7V ÷ 1000Ω).

Buffered Analog Outputs

 Two buffered analog outputs are provided with the CP248. One buffered output is a pre-filter output that is at sensor input ground potential. The second buffered output is an isolated version of the input signal at chassis ground potential. This second output can be selected to be either pre-filter or post-filter. Refer to Figure 4, CP248 block diagram.

Channel-to-Channel Isolation

Each channel's input and excitation supply is fully isolated from the other channels and from chassis ground. With this individual isolation per channel, each channel can "float" to its own ground reference thereby preventing ground loops and providing a common-mode voltage range up to +/-300 volts.
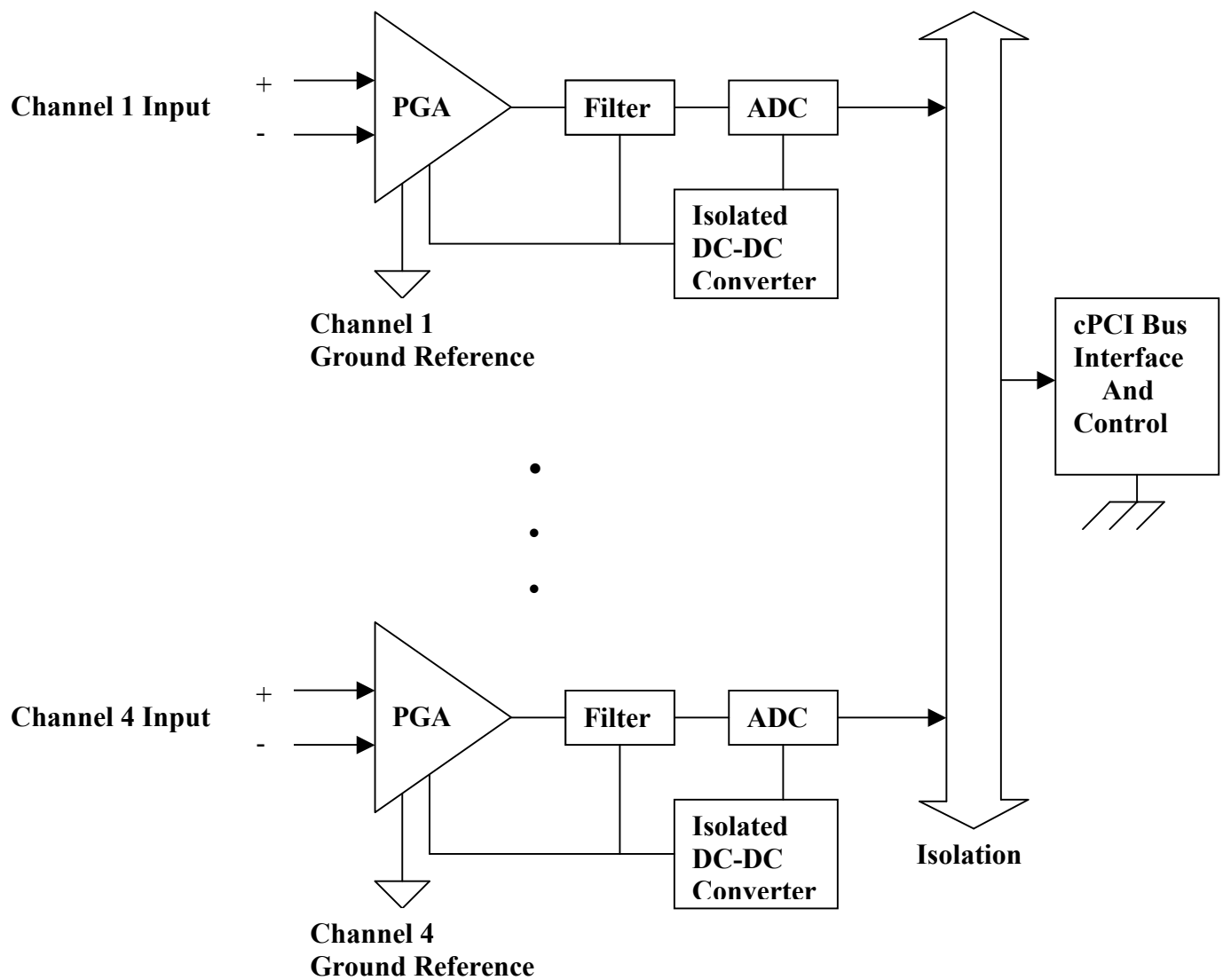

Figure 7. Channel-to-Channel Isolation

Connecting to the CP248

The following figures 8 through 12 show how to utilize strain-gage sensors in a number of bridge configurations. Figures 13,14 and 15 show how to accommodate RTD sensors, potentiometer inputs and voltage inputs.
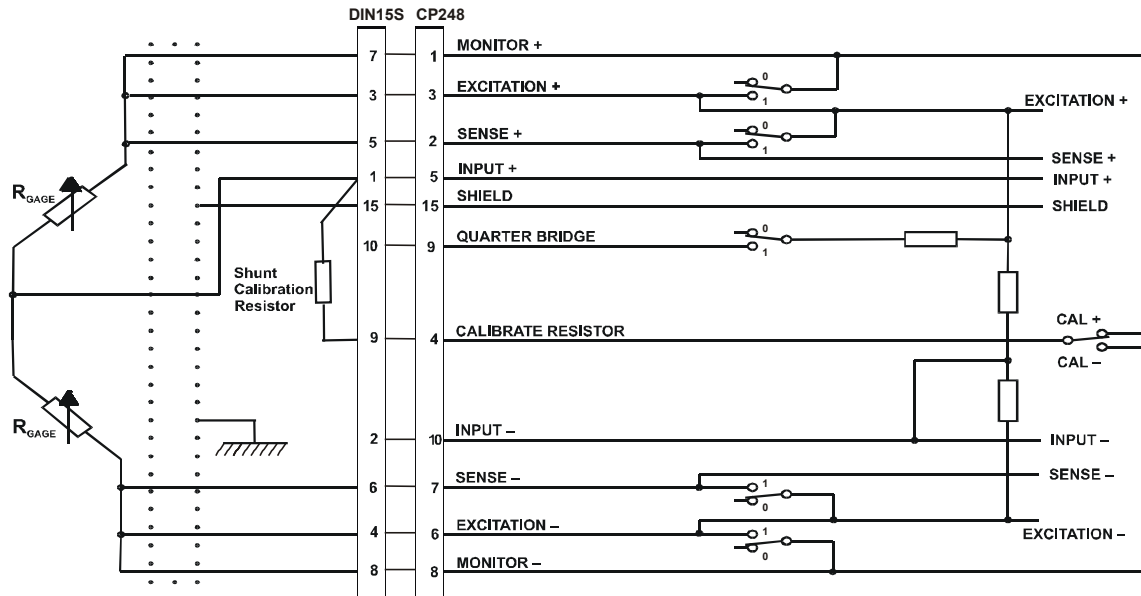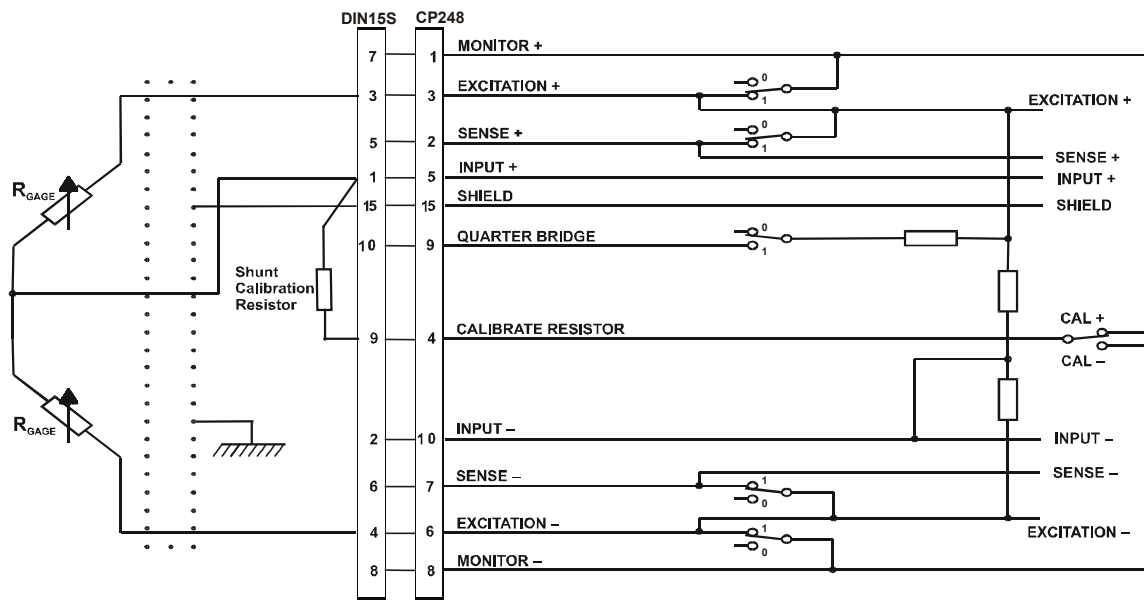

Figure 8. Half Bridge with Remote Sensing

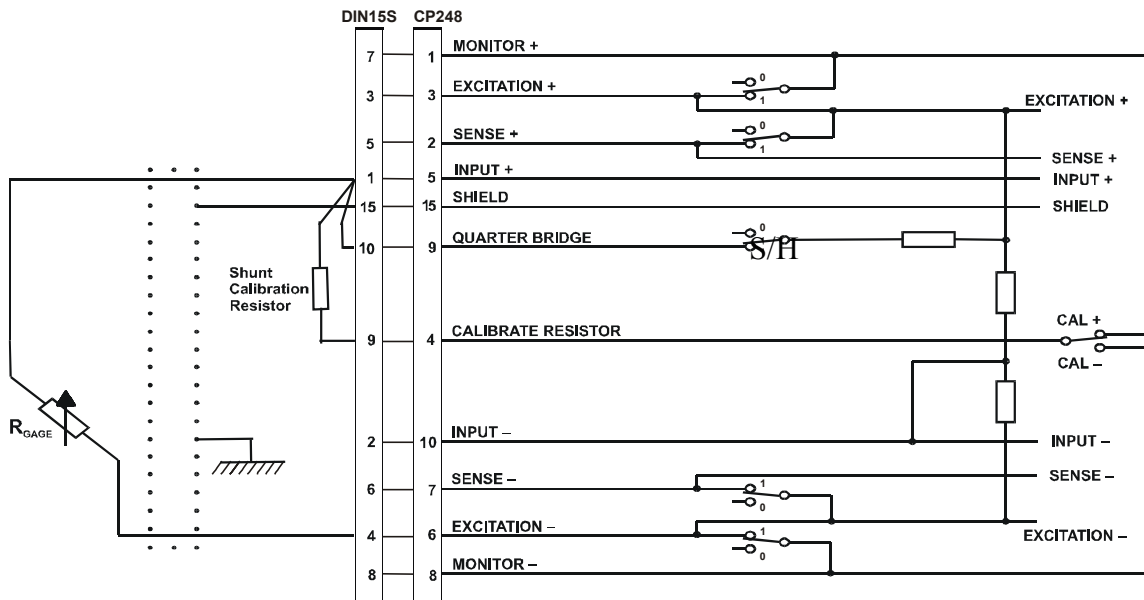**Figure 9. Half Bridge with Local Sensing**

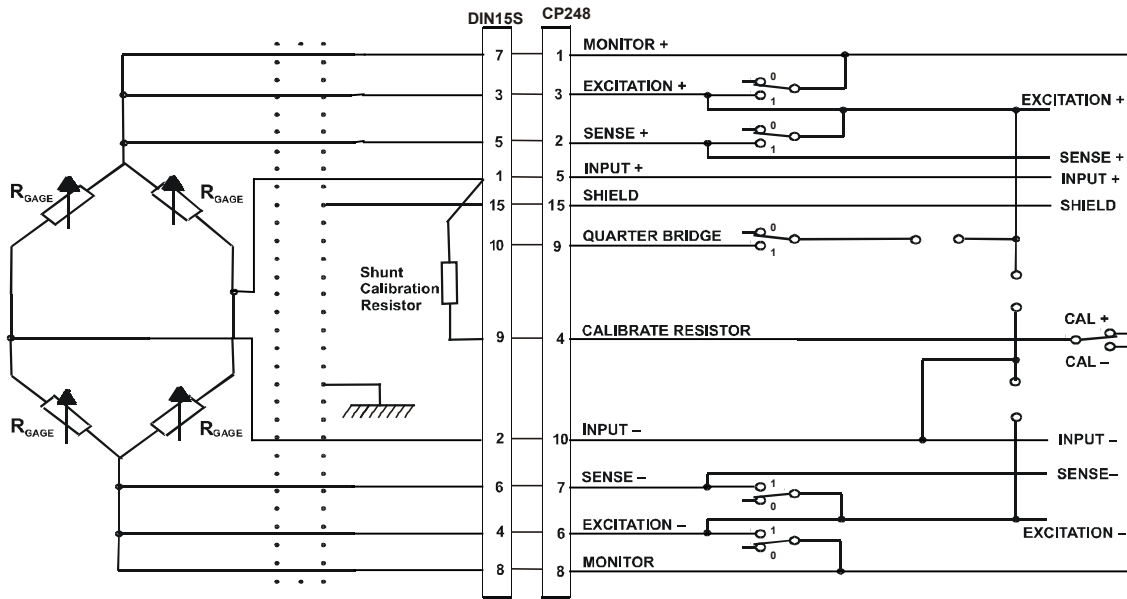**Figure 10. Quarter Bridge with Local Sensing**

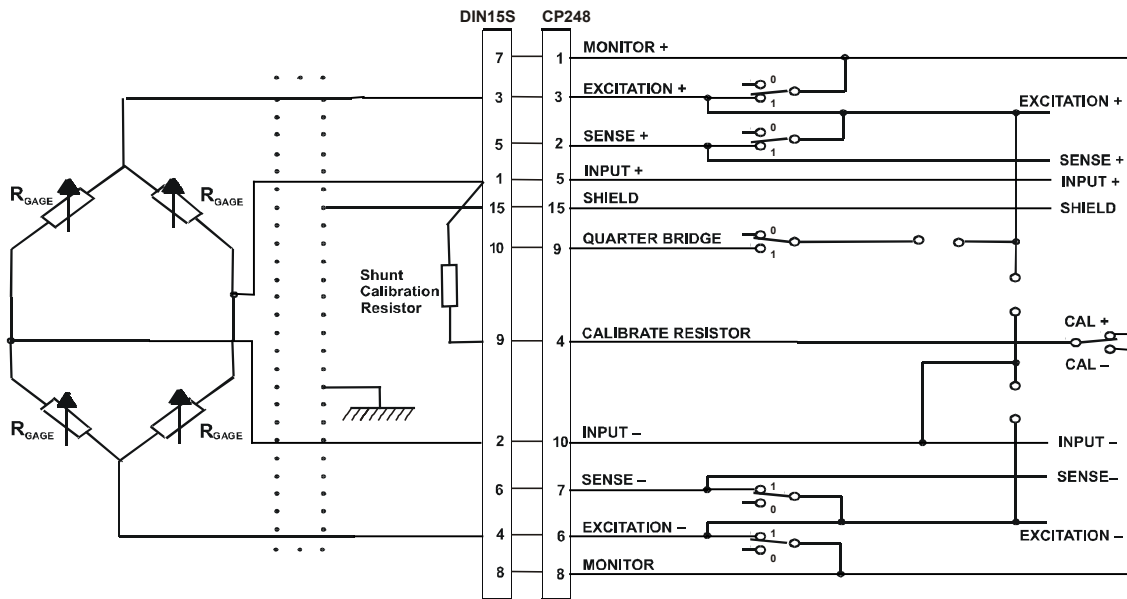**Figure 11. Full Bridge with Remote Sensing**

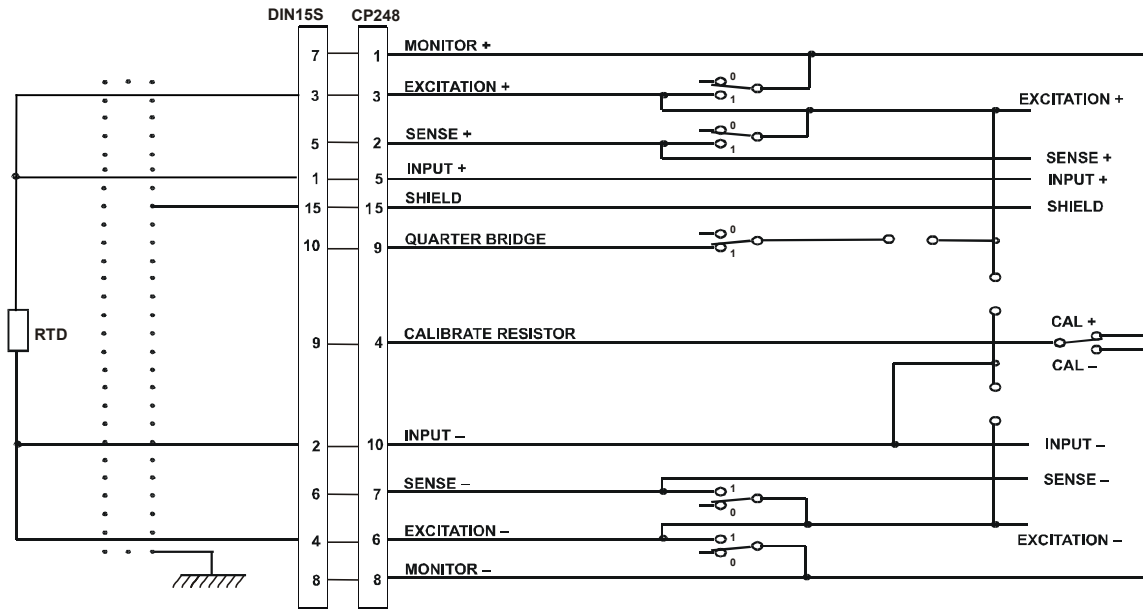**Figure 12. Full Bridge with Local Sensing**

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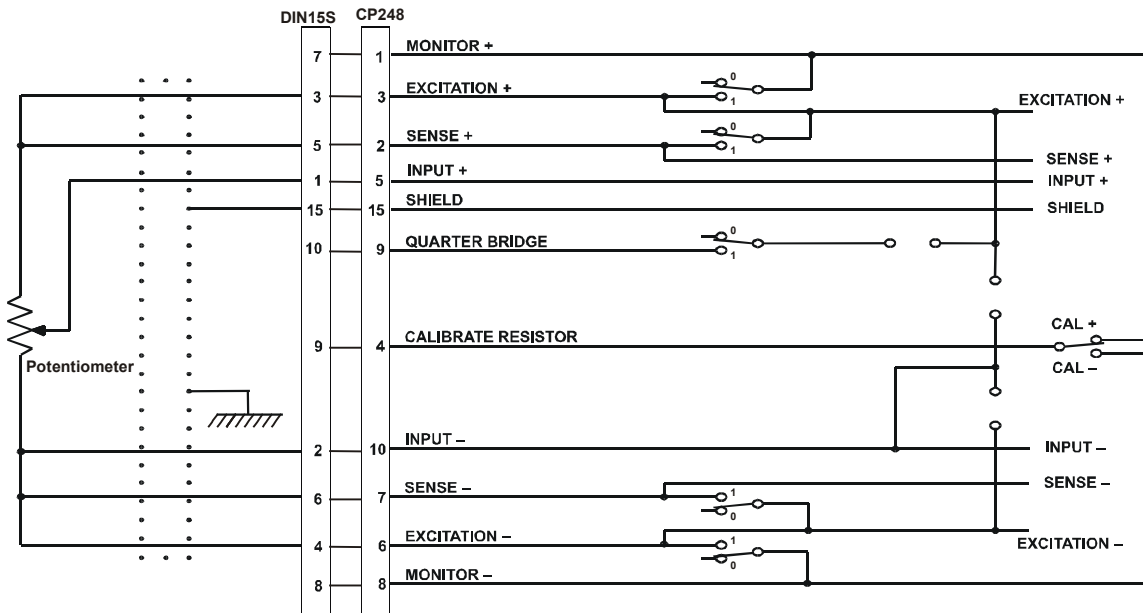**Figure 13. RTD Sensor w/Current Excitation**
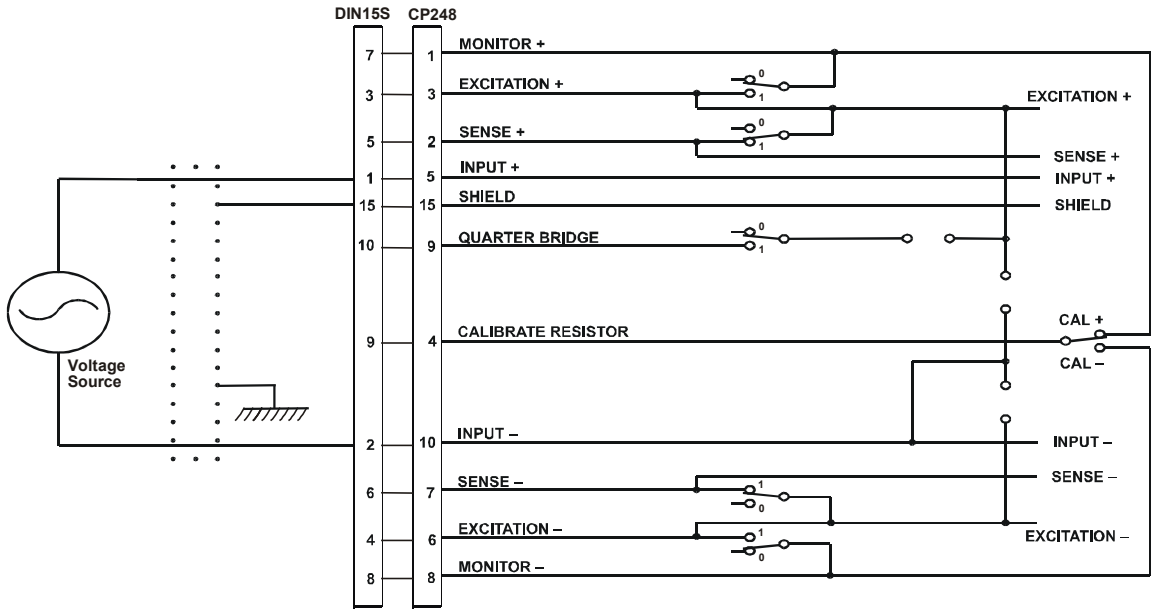

Figure 14. Potentiometer Input

Figure 15. Voltage Input

Appendix A
Technical Support and Warranty

DynamicSignals warrants its standard hardware products to be free of defects in workmanship and materials for a period of one year from the date of shipment to the original end user. DynamicSignals warrants its software products to conform to the software description applicable at the time of purchase for a period of ninety days from the date of shipment. Products purchased for resale by DynamicSignals carry the original equipment manufacturer's warranty.

DynamicSignals will, at its option, either repair or replace products that prove to be defective in materials or workmanship during the warranty period.

Transportation charges for shipping products to DynamicSignals are prepaid by the purchaser, while charges for returning the repaired product to the purchaser, if located in the United States, are paid by DynamicSignals. Return shipments are made by UPS, where available, unless the purchaser requests a premium method of shipment at his expense. The selected carrier is not the agent of DynamicSignals, and DynamicSignals assumes no liability relating to the services provided by the carrier.

The product warranty may vary outside the United States and does not include shipping, customs clearance or any other charges. Consult your local authorized representative for more information regarding specific warranty coverage and shipping details.

Product specifications and descriptions in this document subject to change without notice.
DynamicSignals specifically makes no warranty of fitness for a particular purpose or any other warranty either expressed or implied, except as is expressly set forth herein. This warranty does not cover product failures created by unauthorized modifications, product misuse or improper installation.

Products are not accepted for credit or exchange without prior written approval. If it is necessary to return a product for repair replacement or exchange, a Return Authorization (RA) Number must first be obtained from the Repair Service Center before shipping the product to DynamicSignals.

Please take the following steps if you are having a problem and feel you may need to return a product for service:

Contact DynamicSignals and discuss the problem with a Technical Service Engineer.
Obtain a Return Authorization (RA) Number.
Initiate a purchase order for the estimated repair charge if the product is out of warranty.
Include with the product a description of the problem and the name of the technical contact person at your facility.
Ship the product prepaid with the RA Number marked on the outside of the package to:

DynamicSignals Company, LLC
Repair Service Center
900 North State Street
Lockport, IL 60441

Telephone: (815) 838-0005
Fax: (815) 838-4424

Ways to contact us:
✉
DynamicSignals Company, LLC
900 N. State Street
Lockport, IL 60441-2200

☎
Phone: (800) DATA NOW (1-800-328-2669)
       (815) 838-0005
 Fax: (815) 838-4424

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       sales@kscorp.com
Web: http://www.kscorp.com

Feedback

The purpose of this manual is to provide you with the information you need to make the CP248 as easy as possible to understand and use. It is very important that the information is accurate, understandable and accessible. To help us continue to make this manual as "user friendly" as possible, we hope you will fill out this form and Fax it back to us at (815) 838 0095. Or mail a copy to DynamicSignals Company, LLC 900 N. State, Lockport, IL 60441. Your input is very valuable.

Please rate each of the following.

The information in this manual is:

	Yes								No
Accurate	10	9	8	7	6	5	4	3	2 1
Readable	10	9	8	7	6	5	4	3	2 1
Easy to find	10	9	8	7	6	5	4	3	2 1
Well organized	10	9	8	7	6	5	4	3	2 1
Sufficient	10	9	8	7	6	5	4	3	2 1

We would appreciate receiving any thoughts you have about how we can improve this user's manual:

(Include additional sheets if needed)

Name   Phone

Company