Model CP246
8 Channel CompactPCI/PXI Bridge Signal Conditioner with 16-bit ADC's
User's Manual

Revision History

2/9/09	KG	Initial Draft of CP246 User Manual
9/23/09	KG	Added buffered output section, updated tables 2, 3 and figure 7.6.
12/29/10	KG	Format corrections
3/2/11	KG	Table 1 Specification Updates (accuracy and CMR)

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Chapter 1: Introduction

Description

The CP246 is a single-width, 6U, CompactPCI/PXI module with 8 channels of Bridge Signal Conditioning feeding 8 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 CP246 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 CP246s together to synchronize simultaneous sampling across all of them.

The CP246 bridge conditioner inputs provide bridge completion, an excitation supply, 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. Standard filter cutoff frequency selections include 20Hz, 200Hz, 1kHz, 2kHz or 5kHz, 10 kHz, 20 kHz and 50kHz. The filter may also be bypassed for wideband applications. The gain settings are also programmable from 1 to 2000 in a 1,2,5 progression. Bridge offsets may be nulled using the on-board 12-bit DAC.

In addition to analog channels, the CP246 provides 16 multi-function digital I/O channels. Any of these channels can be configured as a digital input, a digital output or selectively configured as a counter, frequency counter, or timer.

CP246 Bridge Signal Conditioning Specifications

Item	Specifications
Number of Channels	8 Differential
Inputs	
Input Impedance	20 MΩ minimum, > 100 MΩ typical (DC - coupled)
Input Protection	± 35 V, continuous
Input Coupling	Programmable DC or AC
Analog Input Range	±10.24 Volts
Analog Output Range	±5 Volts @ 5mA
Gain	
Programmable	Yes
Gain Selections	1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 and 2000
Filter	
Filter Type	6 pole, Bessel or Butterworth (as ordering option)
Programmable	Yes, on a per channel basis
Filter Cutoff Frequencies	Ordering option of 20, 200, 1k, and 2kHz or 5k, 10k, 20k and 50k The filter may be bypassed for an extended frequency response to a –3dB point of 200 kHz. (Other options available on request)
Excitation	Independent excitation source for each channel.
Excitation Type	Voltage or Current
Excitation Sense	Programmable per channel for local or remote.
Excitation Voltages	Programmable per channel for 0 to 10 volts in 4096 steps.
Excitation Current	Programmable per channel for 0 to 50mA in 4096 steps.
Line Regulation	0.003 %/V
Load Regulation	0.00025 V/mA
Temperature Coefficient	2 ppm/°C
Bridge Completion	
Programmable	Yes
Bridge Configuration	¼, ½ and Full Bridge
Completion Resistance	120Ω, 350Ω or 1000Ω
Shunt Calibration	
Programmable	Yes
Shunt Resistor Location	External (User Selected and Supplied)
Bridge Balance	
Programmable	Yes
Bridge Offset Null	Utilizing 12–bit DAC
120Ω Bridge	± 24 mV
350Ω Bridge	± 70 mV
1000Ω Bridge	± 200 mV
Analog Input Connector Type	1 (2)- 68P High Density SCSI connector(s)

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CP246 Analog to Digital Converter Specifications

Item	Specifications
Number of ADC's	8, 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	Yes
Source(s)	Internal or External
Internal Selections	.01 Hz to 250kHz in 1 microsecond increments
External Source(s)	Front-panel mounted SMB or PXI trigger signals.
SMB Input	
Level	TTL Level Signal
Polarity	Programmable
Duty Cycle	50%
Connection	Through front panel mounted SMB connector
PXI Trigger	1 of 8 trigger lines or Star trigger
External Trigger	
Source(s)	Front panel mounted SMB or PXI trigger signals
SMB Input	
Level	TTL Level Signal
Polarity	Programmable
Minimum Pulse Width	30 nanoseconds
PXI Trigger	1 of 8 trigger lines or Star trigger
Limit Checking	
Type(s)	Min/Max or Level/Slope
Resolution	8 bits
Action	Trigger transient, Assert front panel trigger out, PXI trigger signal or generate a PXI/cPCI interrupt

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CP246 Multifunction Digital I/O Channel Specifications

Item	Specifications
Number of Multifunction Digital I/O Channels	16 digital I/O channels. (Channels may be configured as digital input, digital output or selectively attached to 2 frequency in, 2 counter in, or 2 timer out channels)
I/O type	Single-ended TTL
Direction Control	Yes
Input Termination	Pulled-Up
Input switching threshold "0" level "1" level	 0.8 V maximum 2.0V minimum
Output Voltage level "0" level "1" level	 0.4V maximum (i_{out} = 2.5 mA) 2.7V minimum (i_{out} = 2.5 mA) Programmable 60/40 minimum
Low level output current	24 mA, maximum
High level output current	-24 mA, maximum
Input Current	± 20 microamps
Frequency Channels (2) Frequency measuring range Observation Window Period	 0.06Hz to 1 MHz 1 millisecond
Counter Channels (2) Counter Size	 32 bits
Timer Channels (2) Timer Size	 32 bits
Digital I/O Connector Type	1 26 P Subminiature "D" connector

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CP246 Overall Specifications

Item	Specifications
Transfer Characteristics	
Linearity	Better than 0.005% FSR
Initial Accuracy, RTI (Referred to Input)	After automatic calibration:
Gain=1	± 600µV
Gain=2	± 300 µV
Gain=5	± 240 µV
Gain=10	± 120 µV
Gain=20	± 110 µV
Gain=50	± 50 µV
Gain=100	± 30 µV
Gain=200	± 25 µV
Gain=500	± 7 µV
Gain=1000	± 6 µV
Gain=2000	± 5 µV
Gain Stability	
All gains	± 15 ppm/°C maximum
Offset Stability, RTI	± 2µV/°C maximum @Gain=1000
Common Mode Rejection Ratio	-105 dB, DC to 120 Hz @Gain=2000
Noise, RTI	< 5µV rms @ Gain=1000, 20 Hz filter
Channel to Channel Crosstalk	-95 dB
Power Requirements	
+5 V	3790 mA
+3.3V	350 mA
+12 V	400 mA
-12 V	400 mA
Environmental and Mechanical	
Temperature range	
Operational	0°C to +50°C
Storage	-25°C to +75°C
Relative humidity	0 to 85%, non-condensing to 40°C
Cooling requirements	10 CFM
Dimensions	233.35 mm x 160 mm (6U CompactPCI/PXI module)
Front-panel potential	Chassis ground

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Table 1. Specifications

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Front Panel

Analog Connectors

The analog signal connections are available at a pair of 68-pin SCSI II shielded connectors. Orientation is shown in Figure 1.

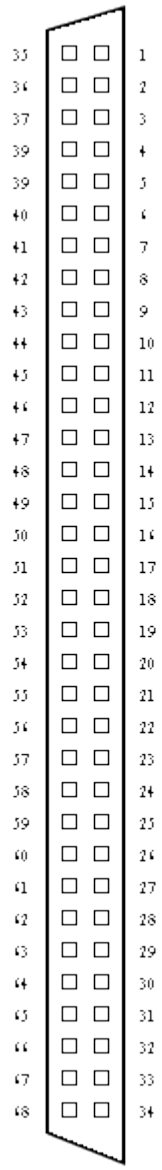
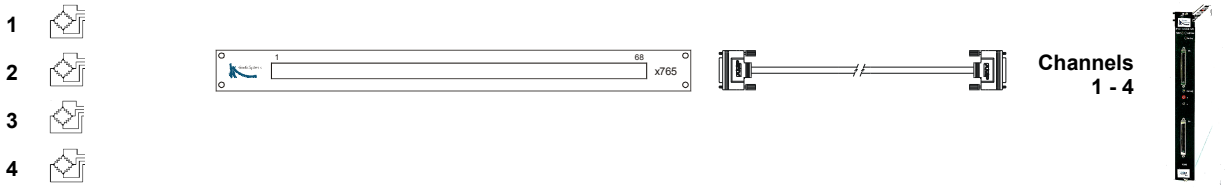


Figure 1. Analog Connectors

Channels 1-4 Connector Pinout

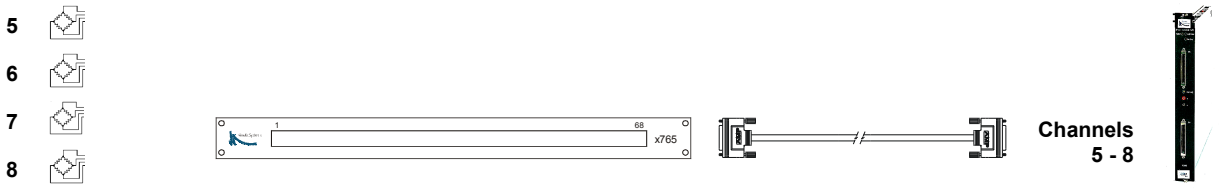


BRIDGE-TYPE SENSORS *(up to 4)*	**TERMINAL STRIP (x765–ZA11)**		**CABLE (5868–Fx0J)** *(x = length in meters)*	**CP246**
	Terminal Position Left to Right	**Term. Strip Label & Rear Conn. J4 Pin**		**Front Conn. Channels 1-4**
Channel 1				
Input +	1	1	TAN / **WHITE**	3
Input –	2	35	**WHITE** / TAN	4
Excitation +	3	2	BROWN / **WHITE**	2
Excitation –	4	36	**WHITE** / BROWN	38
Sense +	5	3	PINK / **WHITE**	35
Sense –	6	37	**WHITE** / PINK	5
Monitor +	7	4	ORANGE / **WHITE**	1
Monitor –	8	38	**WHITE** / ORANGE	39
Calibrate Resistor	9	5	YELLOW / **WHITE**	36
Quarter Bridge	10	39	**WHITE** / YELLOW	6
Shield	11	6	GREEN / **WHITE**	37
Channel 2				
Shield	12	40	**WHITE** / GREEN	43
Input +	13	7	BLUE / **WHITE**	9
Input –	14	41	**WHITE** / BLUE	10
Excitation +	15	8	VIOLET / **WHITE**	8
Excitation –	16	42	**WHITE** / VIOLET	44
Sense +	17	9	GRAY / **WHITE**	41
Sense –	18	43	**WHITE** / GRAY	11
Monitor +	19	10	BROWN / **TAN**	7
Monitor –	20	44	**TAN** / BROWN	45
Calibrate Resistor	21	11	PINK / **TAN**	42
Quarter Bridge	22	45	**TAN** / PINK	12
Channel 3				
Input +	23	12	ORANGE / **TAN**	15
Input –	24	46	**TAN** / ORANGE	16
Excitation +	25	13	YELLOW / **TAN**	14
Excitation –	26	47	**TAN** / YELLOW	50
Sense +	27	14	GREEN / **TAN**	47
Sense –	28	48	**TAN** / GREEN	17
Monitor +	29	15	BLUE / **TAN**	13
Monitor –	30	49	**TAN** / BLUE	51
Calibrate Resistor	31	16	VIOLET / **TAN**	48
Quarter Bridge	32	50	**TAN** / VIOLET	18

BRIDGE-TYPE SENSORS *(up to 4)*	**TERMINAL STRIP (x765–ZA11)**		**CABLE (5868–Fx0J)** *(x = length in meters)*	**CP246**
	Terminal Position Left to Right	**Term. Strip Label & Rear Conn. J4 Pin**		**Front Conn. Channels 1-4**
Shield	33	17	GRAY / **TAN**	49
Channel 4				
Shield	34	51	**TAN** / GRAY	55
Input +	35	18	PINK / **BROWN**	21
Input –	36	52	**BROWN** / PINK	22
Excitation +	37	19	ORANGE / **BROWN**	20
Excitation –	38	53	**BROWN** / ORANGE	56
Sense +	39	20	YELLOW / **BROWN**	53
Sense –	40	54	**BROWN** / YELLOW	23
Monitor +	41	21	GREEN / **BROWN**	19
Monitor –	42	55	**BROWN** / GREEN	57
Calibrate Resistor	43	22	BLUE / **BROWN**	54
Quarter Bridge	44	56	**BROWN** / BLUE	24
No connection	45	23	VIOLET / **BROWN**	
No connection	46	57	**BROWN** / VIOLET	
No connection	47	24	GRAY / **BROWN**	
No connection	48	58	**BROWN** / GRAY	
No connection	49	25	ORANGE / **PINK**	
No connection	50	59	**PINK** / ORANGE	
No connection	51	26	YELLOW / **PINK**	58
No connection	52	60	**PINK** / YELLOW	25
Ext. out, High, 1	53	27	GREEN / **PINK**	26
Ext. out, Low, 1	54	61	**PINK** / GREEN	30
Ext. out, High, 2	55	28	BLUE / **PINK**	27
Ext. out, Low, 2	56	62	**PINK** / BLUE	31
Ext. out, High, 3	57	29	VIOLET / **PINK**	28
Ext. out, Low, 3	58	63	**PINK** / VIOLET	32
Ext. out, High, 4	59	30	GRAY / **PINK**	29
Ext. out, Low, 4	60	64	**PINK** / GRAY	33
Ext. out, High, 5	61	31	YELLOW / **ORANGE**	60
Ext. out, Low, 5	62	65	**ORANGE** / YELLOW	64
Ext. out, High, 6	63	32	GREEN / **ORANGE**	61
Ext. out, Low, 6	64	66	**ORANGE** / GREEN	65
Ext. out, High, 7	65	33	BLUE / **ORANGE**	62
Ext. out, Low, 7	66	67	**ORANGE** / BLUE	66
Ext. out, High, 8	67	34	VIOLET / **ORANGE**	63
Ext. out, Low, 8	68	68	**ORANGE** / VIOLET	67

Table 2. Channels 1-4 Connector Pinout

Channels 5-8 Connector Pinout



BRIDGE-TYPE SENSORS *(up to 4)*	**TERMINAL STRIP (x765–ZA11)**		**CABLE (5868–Fx0J)** *(x = length in meters)*	**CP246**
	Terminal Position Left to Right	**Term. Strip Label & Rear Conn. J4 Pin**		**Front Conn. Channels 5-8**
Channel 5				
Input +	1	1	TAN / **WHITE**	3
Input –	2	35	**WHITE** / TAN	4
Excitation +	3	2	BROWN / **WHITE**	2
Excitation –	4	36	**WHITE** / BROWN	38
Sense +	5	3	PINK / **WHITE**	35
Sense –	6	37	**WHITE** / PINK	5
Monitor +	7	4	ORANGE / **WHITE**	1
Monitor –	8	38	**WHITE** / ORANGE	39
Calibrate Resistor	9	5	YELLOW / **WHITE**	36
Quarter Bridge	10	39	**WHITE** / YELLOW	6
Shield	11	6	GREEN / **WHITE**	37
Channel 6				
Shield	12	40	**WHITE** / GREEN	43
Input +	13	7	BLUE / **WHITE**	9
Input –	14	41	**WHITE** / BLUE	10
Excitation +	15	8	VIOLET / **WHITE**	8
Excitation –	16	42	**WHITE** / VIOLET	44
Sense +	17	9	GRAY / **WHITE**	41
Sense –	18	43	**WHITE** / GRAY	11
Monitor +	19	10	BROWN / **TAN**	7
Monitor –	20	44	**TAN** / BROWN	45
Calibrate Resistor	21	11	PINK / **TAN**	42
Quarter Bridge	22	45	**TAN** / PINK	12
Channel 7				
Input +	23	12	ORANGE / **TAN**	15
Input –	24	46	**TAN** / ORANGE	16
Excitation +	25	13	YELLOW / **TAN**	14
Excitation –	26	47	**TAN** / YELLOW	50
Sense +	27	14	GREEN / **TAN**	47
Sense –	28	48	**TAN** / GREEN	17
Monitor +	29	15	BLUE / **TAN**	13
Monitor –	30	49	**TAN** / BLUE	51
Calibrate Resistor	31	16	VIOLET / **TAN**	48

BRIDGE-TYPE SENSORS *(up to 4)*	**TERMINAL STRIP (x765–ZA11)**		**CABLE (5868–Fx0J)** *(x = length in meters)*	**CP246**
	Terminal Position Left to Right	**Term. Strip Label & Rear Conn. J4 Pin**		**Front Conn. Channels 5-8**
Quarter Bridge	32	50	**TAN** / VIOLET	18
Shield	33	17	GRAY / **TAN**	49
Channel 8				
Shield	34	51	**TAN** / GRAY	55
Input +	35	18	PINK / **BROWN**	21
Input –	36	52	**BROWN** / PINK	22
Excitation +	37	19	ORANGE / **BROWN**	20
Excitation –	38	53	**BROWN** / ORANGE	56
Sense +	39	20	YELLOW / **BROWN**	53
Sense –	40	54	**BROWN** / YELLOW	23
Monitor +	41	21	GREEN / **BROWN**	19
Monitor –	42	55	**BROWN** / GREEN	57
Calibrate Resistor	43	22	BLUE / **BROWN**	54
Quarter Bridge	44	56	**BROWN** / BLUE	24
No connection	45	23	VIOLET / **BROWN**	
No connection	46	57	**BROWN** / VIOLET	
No connection	47	24	GRAY / **BROWN**	
No connection	48	58	**BROWN** / GRAY	
No connection	49	25	ORANGE / **PINK**	
No connection	50	59	**PINK** / ORANGE	
No connection	51	26	YELLOW / **PINK**	58
No connection	52	60	**PINK** / YELLOW	25
No connection	53	27	GREEN / **PINK**	26
Front Panel Ref High	54	61	**PINK** / GREEN	30
No connection	55	28	BLUE / **PINK**	27
No connection	56	62	**PINK** / BLUE	31
No connection	57	29	VIOLET / **PINK**	28
No connection	58	63	**PINK** / VIOLET	32
No connection	59	30	GRAY / **PINK**	29
No connection	60	64	**PINK** / GRAY	33
No connection	61	31	YELLOW / **ORANGE**	60
Front Panel Ref Low	62	65	**ORANGE** / YELLOW	64
Digital Ground	63	32	GREEN / **ORANGE**	61
No connection	64	66	**ORANGE** / GREEN	65
No connection	65	33	BLUE / **ORANGE**	62
No connection	66	67	**ORANGE** / BLUE	66
Cal Ref Out High	67	34	VIOLET / **ORANGE**	63
Cal Ref Out Low	68	68	**ORANGE** / VIOLET	67

Table 3. Channels 5-8 Connector Pinout

Digital I/O Connector

The digital I/O channels are available at a single 26P subminiature D connector.

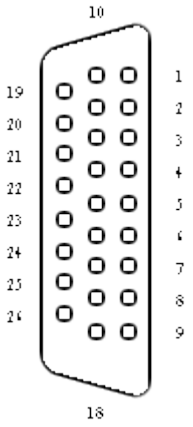


Figure 2. Digital I/O Connector

Digital I/O Connector Pinout

Pin Number	Signal Description
1	Channel 1
2	Channel 2
3	Channel 3
4	Channel 4
5	Channel 5
6	Channel 6
7	Channel 7
8	Channel 8
9	Channel 9
10	Channel 10
11	Channel 11
12	Channel 12
13	Channel 13
14	Channel 14
15	Channel 15
16	Channel 16
17	Ground
18	Ground
19	No Connect
20	No Connect
21	No Connect
22	No Connect
23	No Connect
24	No Connect
25	Ground
26	Ground

Table 4. Digital I/O 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.

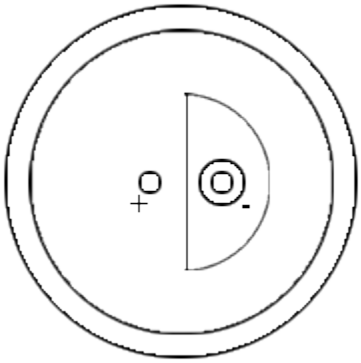


Figure 3. CAL Connector

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.

Product Ordering Information

CP246-wxyz 8 Channel CompactPCI/PXI Bridge Conditioner with ADC

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

X: Trifilar Transformer Option
A = Without Trifilar Transformers
B = With Trifilar Transformers

Y: Filter Cutoff Frequency
1 = Filter Cutoff of 20 Hz, 200 Hz, 1kHz and 2 kHz
2 = Filter Cutoff of 5 kHz, 10 kHz, 20 kHz and 50 kHz

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

Related Products

Model 5868-Bxyz Cable: 68S High Density to Unterminated
Model 5868-Fxyz Cable: 68P High Density to 68S High Density
Model T910-Axyz Cable: SMB to SMB; shielded
Model T910-Bxyz Cable: SMB to BNC; shielded
Model T910-Cxyz Cable: SMB to Unterminated

Model 59XX-wxyz 26P Subminiature D Mating Connector; solder cup

Model CP765-ZA11 Rack-mount Termination Panel (use with Model 5868-Fxyz cable)

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 CP246 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`: ks246.h (API header file)
- `<VXIPNP>\bin`: `ksp246.dll` (API library)
- `<VXIPNP>\lib\`*<format>*: (API lib file `ksp246.lib`, in various formats)
- `<VXIPNP\cp246`: `ksp246.c` (API source code)

In addition, the module_cp246.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_cp246.ini file. If not, you may need to provide this information:

- Module Name: “CP246”
- Module Vendor: “KineticSystems”

- Model Code: 0x246
- 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;"
```

Unpacking the CP246

The CP246 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 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 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 CP246 contains eight channels of bridge signal conditioning with 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 eight 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 CP246s 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 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 CP246 provides gain settings that are programmable from 1 to 2000 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, 10 and 100. 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.

Plug-in mezzanine cards provide filtering in four channel groups. Standard filters are 6-pole Bessel or 6-pole Butterworth. Software-selectable cutoff frequencies include 20 Hz, 200 Hz, 1 kHz, 2kHz or 5kHz, 10kHz, 20kHz and 50kHz. The filter may also be bypassed for wideband applications. The filter bypass –3dB point is 200kHz.

Optional tri-filar transformers are available 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 CP246. Termination panels and cables that allow you to easily and economically connect your transducers to the CP246 are also available.

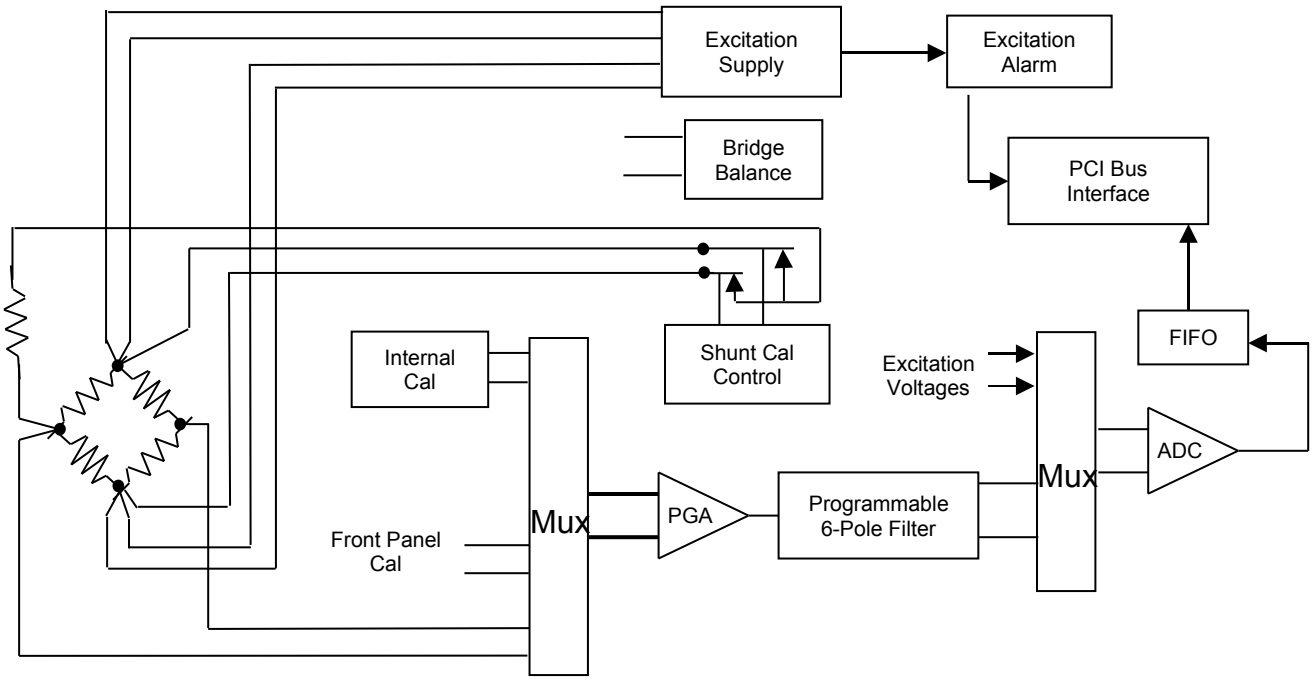


Figure 4. CP246 Block Diagram

The instrumentation amplifiers used at the front end of the CP246 exhibit low values of input bias current and offset current. For most applications, these currents are not of concern. 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. Since these currents are quite small (typically a few nanoamps), a large value of resistance may be added (on the order of megohms). Refer to Figure 5.

Voltage inputs should be limited to less than ± 10 volts.

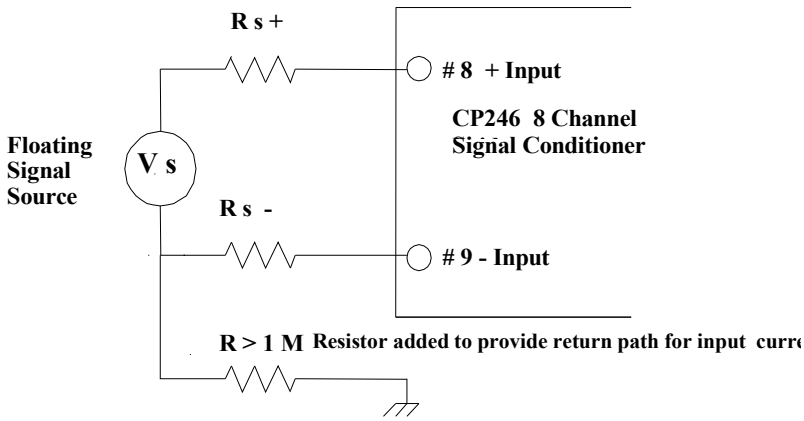


Figure 5. Providing Ground Path for Return Currents

Calibration

The CP246 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 CP246 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 or more of the analog inputs.

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.

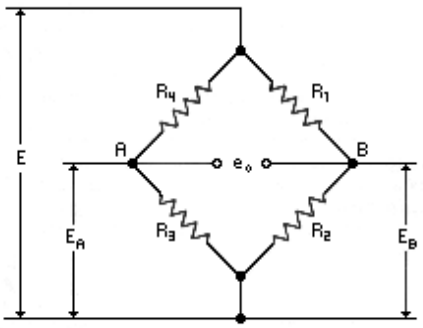


Figure 6. Basic Wheatstone bridge circuit

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 CP246 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 CP246 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 Outputs

The CP246 provides one buffered, external analog output for each channel. These buffered outputs are available at the top front panel I/O connector. The outputs are post-gain and can be programmed to monitor a channels analog input signal before the filter stage (wideband) or after the filter stage (post-filter). Two stages of gain and an attenuation stage are used to scale an input signal to the ±5V ADC full-scale input range. Because the buffered outputs are post-gain and attenuation, the buffered output signals are also scaled to a ±5V full-scale range. Table 5 below shows the signal scaling that occurs at each gain setting.

Gain	Channel Input Full-Scale	Stage 1 Gain	Attenuation	Stage 2 Gain	Buffered Output Full-Scale
1	±10V	1	.5	1	±5V
2	±5V	1	1	1	±5V
5	±2V	1	.5	5	±5V
10	±1V	1	1	5	±5V
20	±500mV	1	1	10	±5V
50	±200mV	10	.5	5	±5V
100	±100mV	10	1	5	±5V
200	±50mV	10	1	10	±5V
500	±20mV	100	.5	5	±5V
1000	±10mV	100	.5	10	±5V
2000	±5mV	100	1	10	±5V

Table 5. Buffered Output Gain Scale

Connecting to the CP246

The following figures 7.1 through 7.5 show how to utilize strain-gage sensors in a number of bridge configurations. Figures 7.6,7.7 and 7.8 show how to accommodate RTD sensors, potentiometer inputs and voltage inputs. The pin numbers shown are for channel 1 of a 765 termination panel.

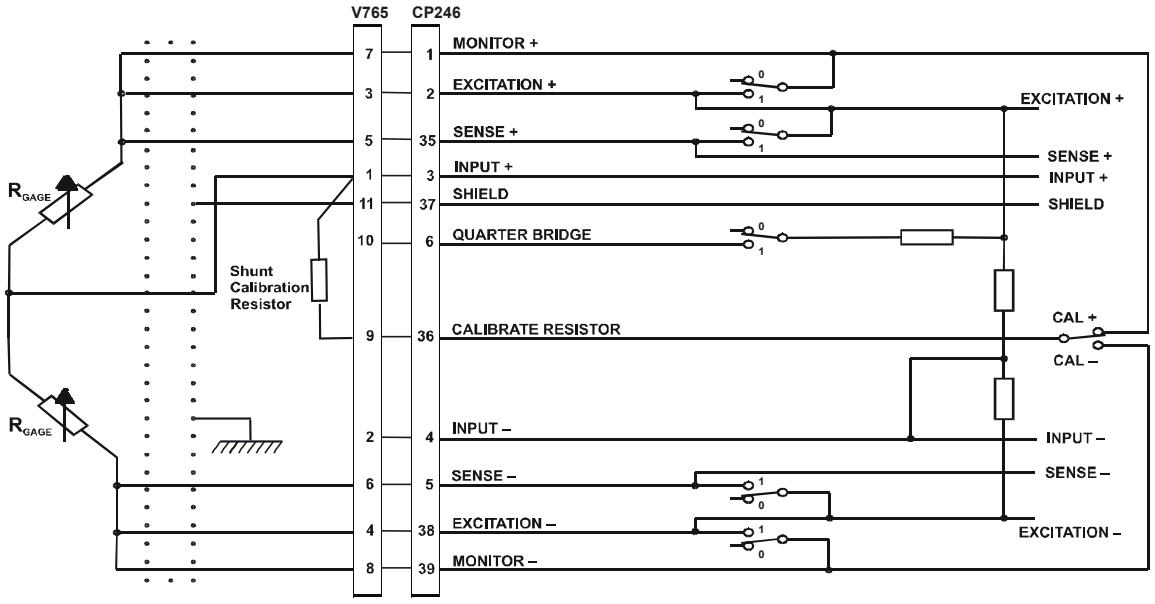


Figure 7.1. Half Bridge with Remote Sensing

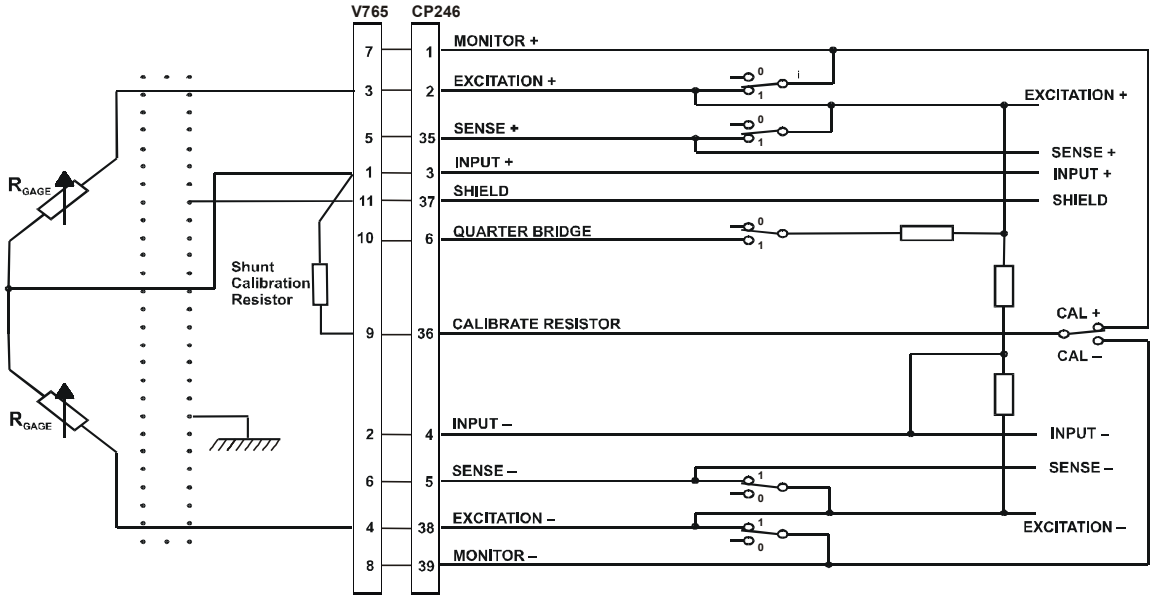


Figure 7.2. Half Bridge with Local Sensing

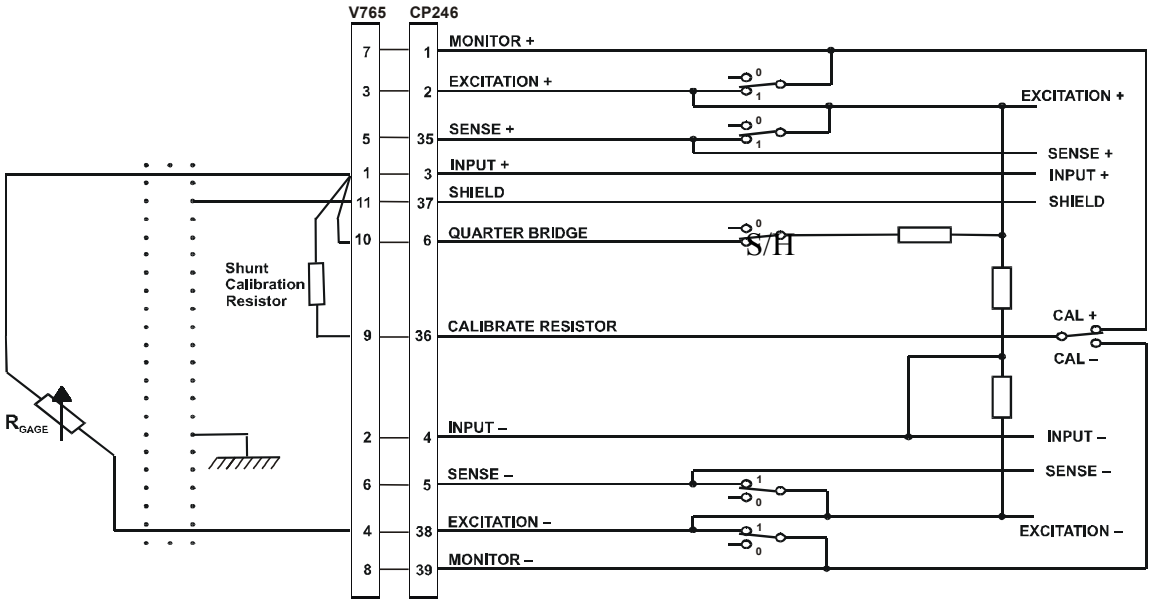


Figure 7.3. Quarter Bridge with Local Sensing

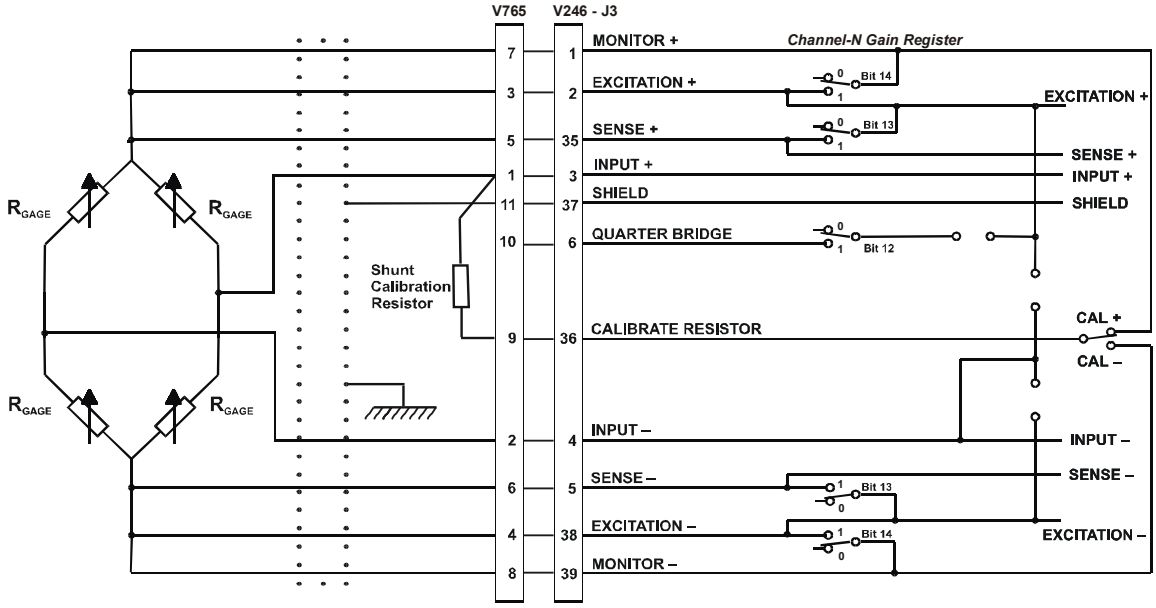


Figure 7.4. Full Bridge with Remote Sensing

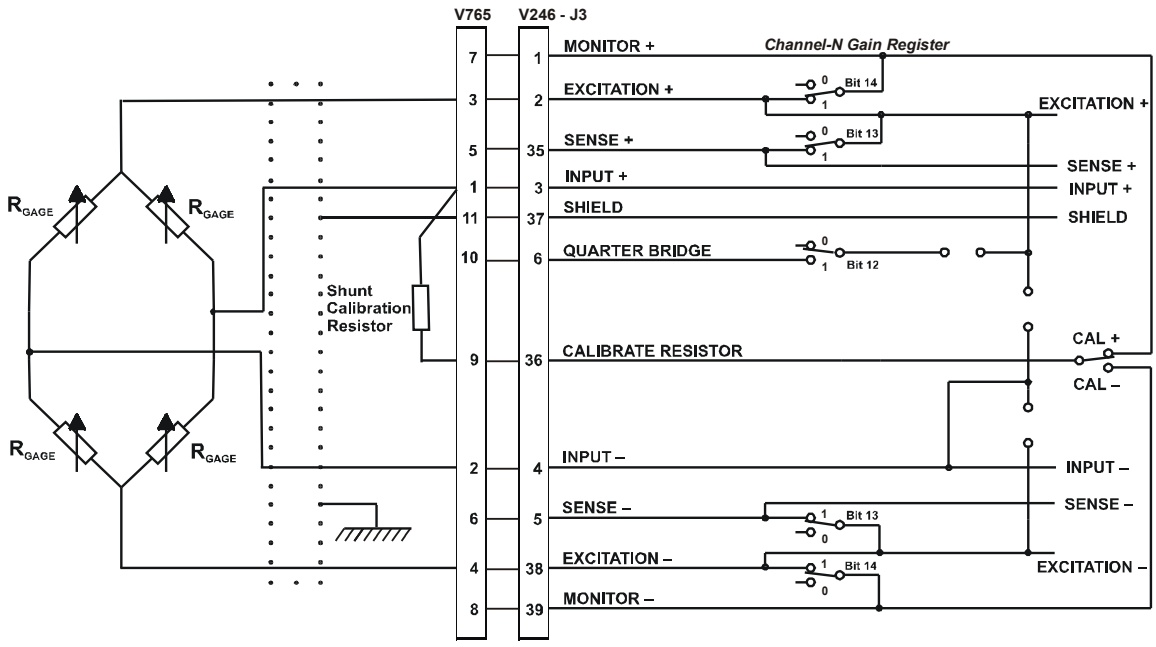


Figure 7.5. Full Bridge with Local Sensing

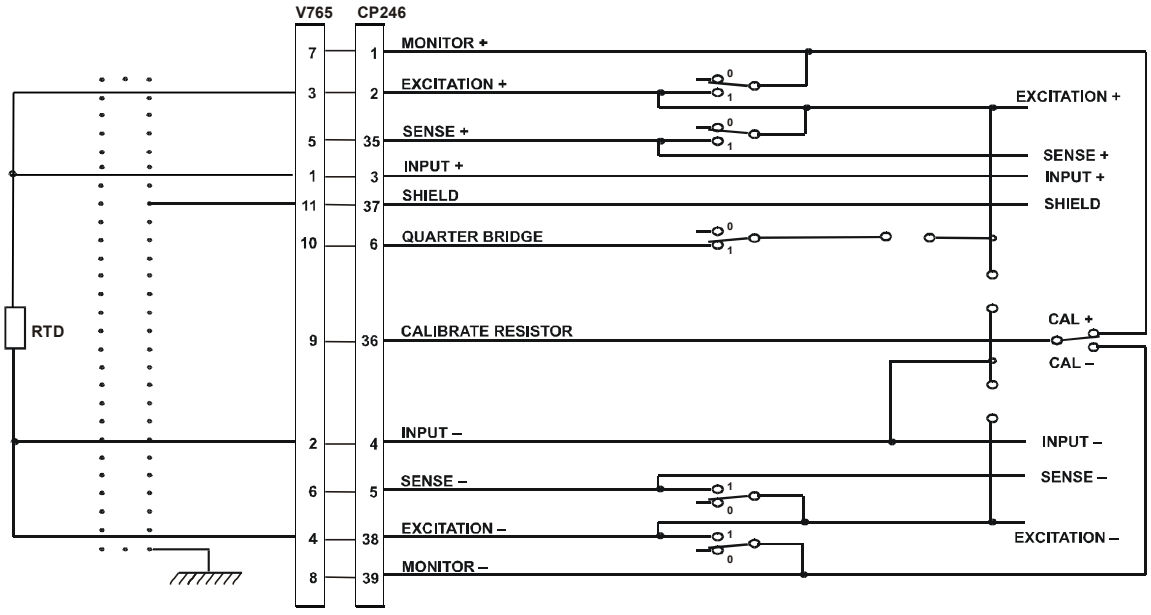


Figure 7.6. RTD Sensor w/Current Excitation

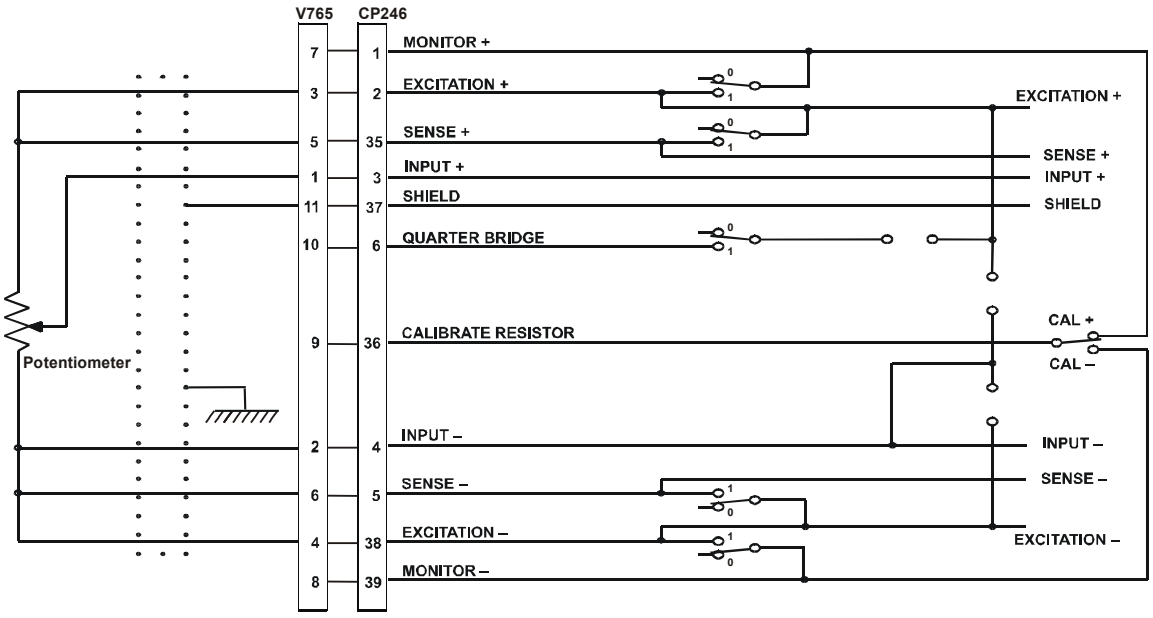


Figure 7.7. Potentiometer Input

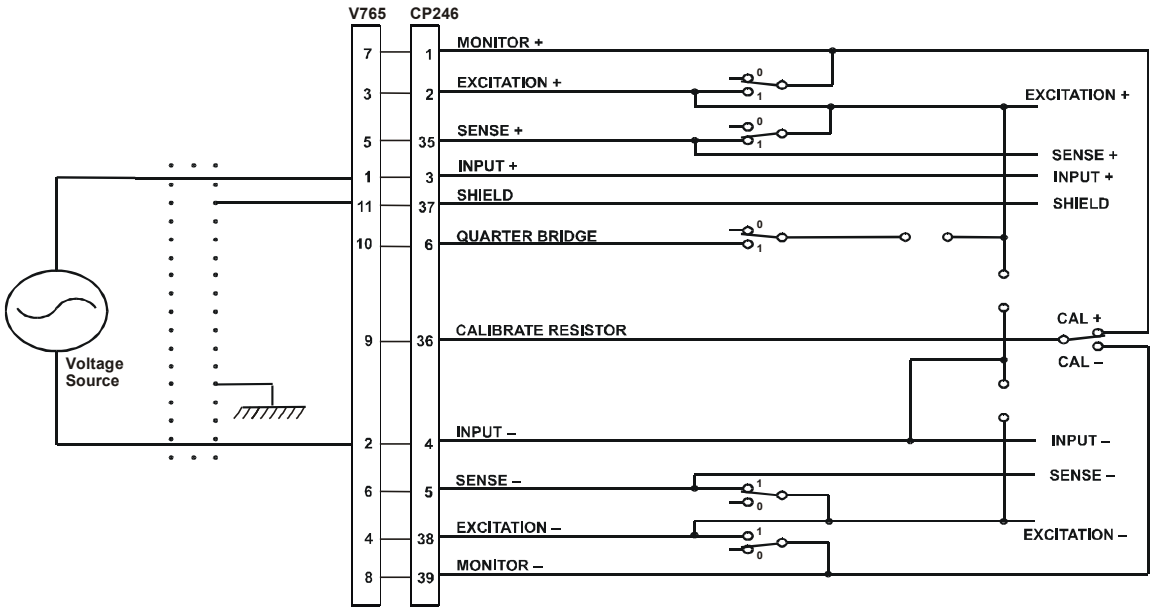


Figure 7.8. Voltage Input

Digital I/O Channels

The CP246 provides 16 multi-function digital TTL I/O channels. Any of these channels may be configured as a digital input or output. Digital inputs may be routed to one of two counters or one or two frequency counters. Frequency counters have an input range of 0.06 Hz to 1 MHz. Digital inputs may also be configured to generate an interrupt event on a change of state. Digital outputs may be routed to one of two pulse or level change-timer channels. The rate and pulse width are configurable between .009 to 40M Hz and 100 microseconds to 200 nanoseconds, respectively. Each digital channel is able to source or sink a minimum of 24 mA.

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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Web: http://www.kscorp.com

Feedback

The purpose of this manual is to provide you with the information you need to make the CP246 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