

# PFI-9102 C Series Module

Bridge Analog I/O Module for Pressure/Strain/Vibration/  
Load Measurements



- High-performance analog input/output modules for use in any National Instruments™ CompactDAQ™ or CompactRIO™ chassis
- 2 Channels per module
- 100 kHz bandwidth
- Programmable excitation to 10 V, with remote sense
- Automatic bridge balance
- Programmable full bridge or half bridge completion
- Compatible with NI™ 9944/9945 quarter bridge completion accessory
- Sensor health monitor – real time monitor of excitation level, sensor resistance, sensor open/short
- Shunt calibration
- Programmable AC/DC coupling
- Programmable gain
- 3-Pole low-pass filter
- Test bus for system calibration signal injection
- –40 to 70° C operating range



Precision Filters, Inc. Model PFI-9102 C Series module provides two channels of high-performance programmable signal conditioning for bridge type transducers that require constant voltage excitation. The module is fully compatible with the National Instruments CompactDAQ or CompactRIO C Series hardware family that features more than 50 measurement modules and several sizes of chassis and carriers for deployment. The module outputs may be connected to a suitable National Instruments C Series analog input A/D module to form a complete high performance signal measurement system.

The PFI-9102 has a fully programmable bipolar excitation supply with remote sense to compensate for voltage drops in the leads to the bridge. Each channel supports measurements for full or half bridges. The module inputs are compatible with NI 9944/45 completion accessories to support ¼-Bridge 120 or 350 ohm gage completion for single-arm bridge measurements. On-the-fly monitoring of sensor excitation and resistance is supported for real time sensor health indication.

The bridge balance circuit automatically zeros the bridge output or may be operated in a manual control mode to establish an initial bridge output other than 0 V. Shunt calibration may be used as a verification of the bridge and to create a known unbalance to verify bridge span.

A fully programmable distributed gain amplifier is provided for out-of-band noise protection and a precision fixed frequency 100 kHz 3-pole low-pass filter is supplied for alias protection. Via the 9102 test bus, calibration signals may be injected at the module input to verify system performance without disconnecting any signal cables.

## Description

### Applications

- High performance signal conditioning front end to any NI C series analog-to-digital converter
- Static or dynamic strain measurements using a Wheatstone bridge
- Full bridge pressure sensor measurements
- Piezoresistive accelerometer measurements
- Load cell conditioner
- MEMs accelerometer measurements
- Piezoresistive microphone measurements

## Specifications

---

### Input Characteristics:

**Type:**

Balanced DC coupled differential input with programmable AC/DC coupling

**Input Impedance:**

10 M $\Omega$  || 10 pF per side

**Programmable AC Coupling Frequency:**

0.25 Hz (-3.01 dB)

**Max Level:**

$\pm 0.5$  Vpk for  $f \leq 100$  kHz;  $\pm 0.5$  Vpk x (100 kHz/f) for  $f > 100$  kHz

**Max Common Mode Level:** 5 V**Protection:**

15 V continuous, 50 Vpk for 1 mS, 10% duty cycle

**Noise:**

13 nV per root Hz at 1 kHz and gain  $> \times 100$

**Drift:** 2  $\mu$ V/ $^{\circ}$ C, RTI**CMRR:**

**DC Coupled:** 100 dB, DC to 500 Hz; 80 dB 500 Hz to 10 kHz

**AC Coupled:** 80 dB 50 Hz to 10 kHz

**Sensor MUTE Mode:**

Terminate unused channels or channels with faulty sensors to quietest state

### Excitation:

**Type:** Bipolar (zero centered)

**Maximum Output:**

10 V, 10 mA with remote sense

**Steps:**

Programmable from 0 to 10 V in 5 mV steps

**Accuracy:**  $\pm 0.05\%$ ;  $\pm 500$   $\mu$ V

**Noise:** 100  $\mu$ Vrms, 3 Hz to 100 kHz

**Drift:**

$\pm 0.0025\%$ / $^{\circ}$ C of setting or  $\pm 50$   $\mu$ V/ $^{\circ}$ C, whichever is greater

### Bridge Completion:

**Type:**

Programmable full bridge or half bridge completion.

**Internal Half Bridge Zero Drift:**

12.5 ppm/ $^{\circ}$ C of excitation setting

**Quarter Bridge Completion:**

1/4-Bridge supported via NI 9944/45 1/4 Bridge 120 or 350 ohm completion accessory

### Shunt Calibration:

Precision 100 k $\Omega$ , 0.1%, 25 ppm resistor applied across plus and minus shunt pins under program control

### Sensor Health Monitor:

**Sensor Excitation Monitor:**

Transducer excitation voltage is measured and reported on the fly.

**Sensor Resistance Monitor:**

Transducer resistance is measured and reported on the fly.

**Sensor Open/Short Monitor:**

Transducer open or short condition is monitored and reported.

### Amplifier:

**Programmable Gain:** x10, 30, 100, 300

**DC Accuracy:**

$\pm 0.05\%$

**Temperature Coefficient of DC Gain:**

$\pm 0.001\%$ / $^{\circ}$ C

**DC Linearity:**

0.01% re: Full-scale, relative to best straight line

### Automatic Bridge Balance:

**Type:**

Voltage insertion at amplifier input.

**Range:**

51.2 mV per V of excitation

**Resolution:**

1  $\mu$ V per V RTI,

Bridge output zeroed to less than 1 mV per V RTO

### Analog Filter:

**Type:**

Three-Pole Butterworth (60 dB/Decade),  
-3.01 dB at 100 kHz

**Conformance to Theoretical Response:**

$\pm 0.05$  dB, DC to 50 kHz,

$\pm 0.2$  dB, 50 kHz to 100 kHz

## Specifications (Continued)

### Test Modes:

#### Amplifier Short:

A switch at the amplifier input is utilized to ground the input stage for measurement of noise and DC offset.

#### Test Bus:

A switch at the channel input allows for automated injection of an external calibration signal via front panel SMB connectors. A second SMB connector allows the test bus signal to be daisy chained across multiple modules.

### Output:

#### Type:

Single-ended

#### Impedance:

$10\ \Omega // 10\ \text{pF}$

#### Max Output:

$\pm 5\ \text{Vpk}, \pm 0.5\ \text{mApk}$

#### DC Offset:

$< 5\ \text{mV}$  after auto adjust at any gain setting

#### Offset Drift:

$2\ \mu\text{V}/^\circ\text{C}, \text{RTI} + 150\ \mu\text{V}/^\circ\text{C RTO}$

#### Crosstalk:

$-90\ \text{dB DC to } 100\ \text{kHz}$

#### Noise:

$6\ \mu\text{Vrms RTI} + 80\ \mu\text{Vrms RTO}$

### Programming:

There are two methods of controlling the settings of the PFI-9102.

- PFI supplied LabView™ Driver VI to control the module from a LabView project.
- Alternately, stand-alone turnkey signal conditioning systems supplied by Precision Filters can be controlled using PFI executable GUI requiring no software programming. Stand-alone system requires use of NI 9147 4-slot or 9149 8-slot chassis.

### Power:

950 mW maximum

### Physical:

NI C-Series Compatible

#### Input Connector:

2 ea. RJ50 (10P10C)

#### Output Connector:

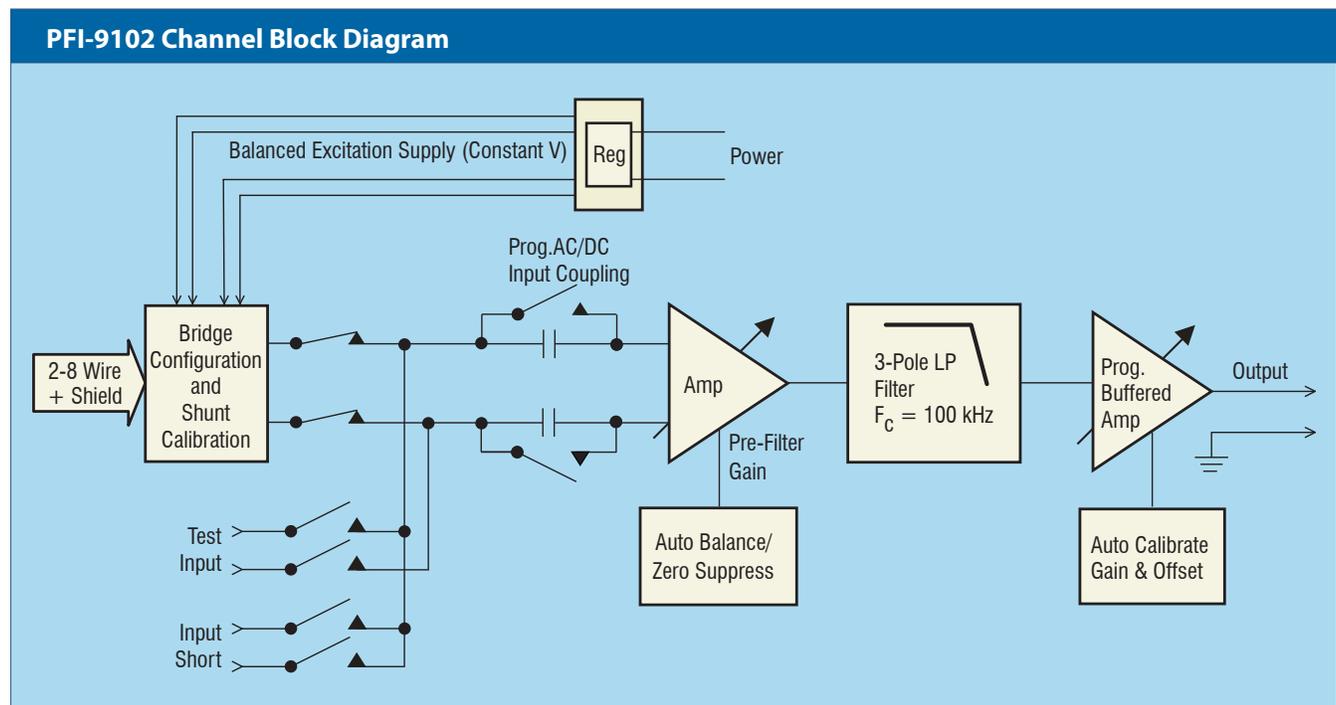
2 ea. SMB Jack

#### Test Bus Connector:

2 ea. SMB Jack

#### Weight:

6 oz.



PFI-9102 Channel Block Diagram

## Certifications:

CE, RoHS, Ex Eu ropean Union Hazardous Locations

### Safety Standards

EN 61010-1

### EMC Standards

EN 61326-1

### Hazardous Location Standards:

EN 60079-0 & EN 60079-15

## Accessories:

### Quarter Bridge Completion for PFI-9102 Bridge Conditioner:

120  $\Omega$ : National Instruments NI9944  
P/N 194738-01 (Qty 4)

350  $\Omega$ : National Instruments NI9945  
P/N 194739-01 (Qty 4)

### Screw Terminal Input Adapter for PFI-9102 Bridge Conditioner:

National Instruments NI9949  
P/N 196809-01 (Qty 4)

### RJ50 Input Cables for PFI-9102 Bridge Conditioner:

CB-RJ50/RJ50-6: RJ50 to RJ50 shielded cable, 6 feet

CB-RJ50/RJ50-30: RJ50 to RJ50 shielded cable, 30 feet

CB-RJ50/RJ50-Pigtail-6: RJ50 to pigtail, prepped/tinned leads, 6 feet

CB-RJ50/RJ50-Pigtail-30: RJ50 to pigtail, prepped/tinned leads, 30 feet

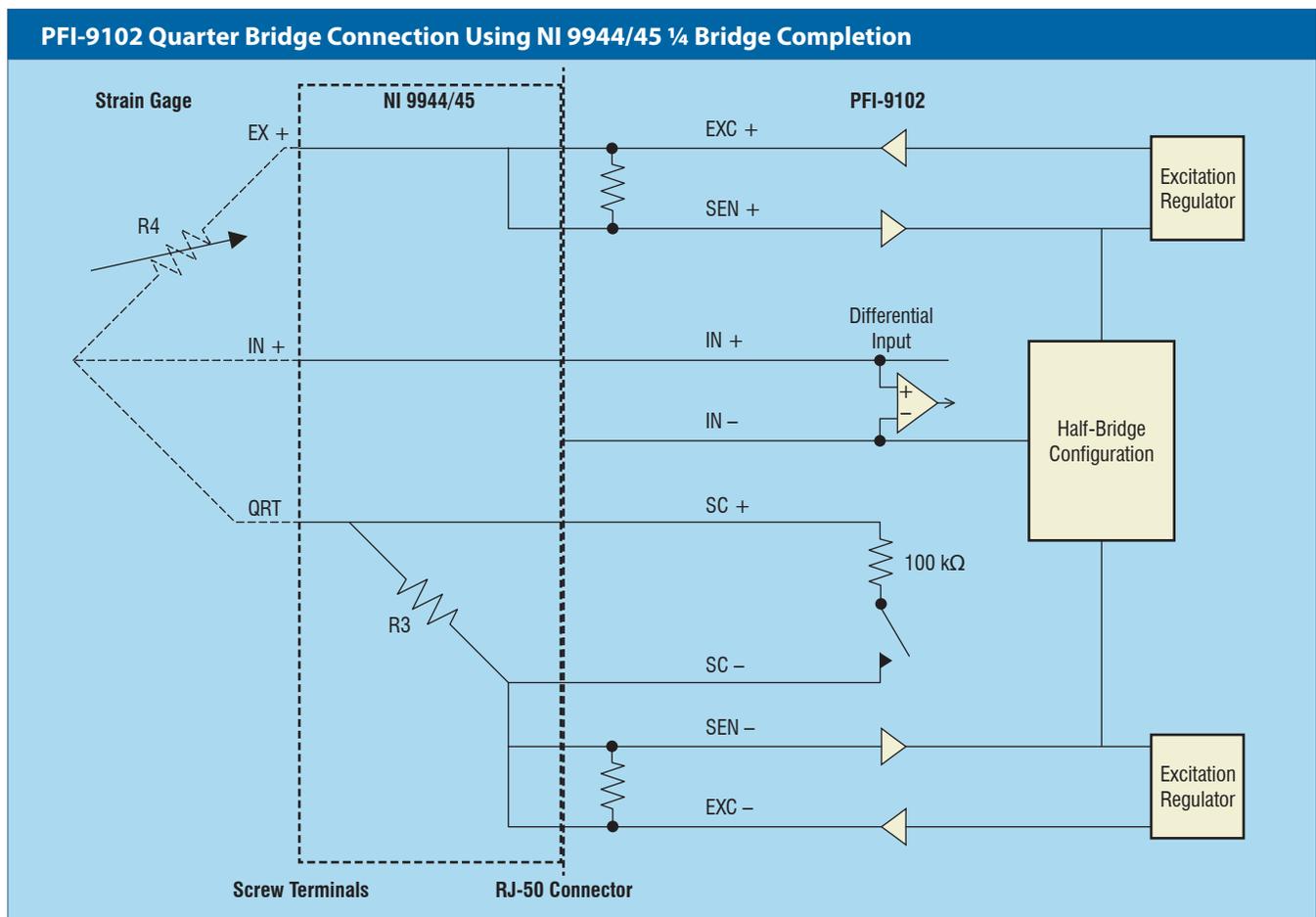
### Module Output Cables:

CB-SMB/BNCL-L: SMB plug to BNC male cable; L = 0.5, 1, 3, 10 feet

CB-SMB/PIGTAIL-L: SMB plug to prepped/tinned leads for NI screw terminal connections; L = 0.5, 1, 3, 10 feet

CB-16XSMB/DC37S-L: 16 SMB plug to DC37 sockets for connection to NI 9220; L = 1, 3 feet

CB-SMB/SMB-L: SMB plug to SMB cable for bussing test input; L = 0.5, 1 feet



PFI-9102 Quarter Bridge Connection Using NI 9944/45 ¼-Bridge Completion Accessory

