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

Description

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.

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.

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 MΩ || 10 pF per side
Programmable AC Coupling Frequency: 0.25 Hz (~3.01 dB)
Max Level:
±0.5 Vpk for f ≤ 100 kHz; ±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 >x100
Drift: 2 μV/°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: ±0.05%; ±500 μV
Noise: 100 μVrms, 3 Hz to 100 kHz
Drift:
±0.0025%/°C of setting or ±50 μV/°C, whichever is greater

Bridge Completion:
Type:
Programmable full bridge or half bridge completion.
Internal Half Bridge Zero Drift:
12.5 ppm/°C of excitation setting
Quarter Bridge Completion:
¾-Bridge supported via NI 9944/45 ¼ Bridge 120 or 350 ohm completion accessory

Shunt Calibration:
Precision 100 kΩ, 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: ±0.05%
Temperature Coefficient of DC Gain:
±0.001% /°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 μV 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:
±0.05 dB, DC to 50 kHz,
±0.2 dB, 50 kHz to 100 kHz
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 Ω // 10 pF

Max Output:
±5 Vpk, ±0.5 mA pk

DC Offset:
<5 mV after auto adjust at any gain setting

Offset Drift:
2 μV/°C, RTI + 150 μV/°C RTO

Crosstalk:
–90 dB DC to 100 kHz

Noise:
6 μVrms RTI + 80 μVrms RTO

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

A) PFI supplied LabView™ Driver VI to control the module from a LabView project.

B) 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 European 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 Ω: National Instruments NI9944
P/N 194738-01 (Qty 4)
350 Ω: 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/BNCM-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