



The New Standard for Signal Conditioning in CompactDAQ™ and CompactRIO™



Introduction

Precision Filters' family of high-performance signal conditioning modules add unprecedented function and performance to measurement systems built on National Instruments™ C Series platform. Choose from five different modules to measure charge, bridge, dynamic strain, IEPE or voltage-based sensors. With no software to write, you can build a turnkey signal conditioning system front end using the low cost NI™ Ethernet RIO chassis controlled by PFI's stand-alone Graphical User Interface. Or using the supplied LabView™ module driver VI, you can combine PFI's signal conditioner modules with proven NI voltage input A/D modules to build a complete high-performance sensor measurement system in any CompactDAQ or CompactRIO chassis. Choose charge, voltage, bridge or dynamic strain modules. Count on PFI's dependable signal conditioning technology for precise measurements.

All modules are fully programmable and are equipped with Precision Filters' Test Input for inserting calibration signals at the module input, allowing for full end-to-end verification. Real time sensor parametric health is continuously measured and reported "on-the-fly".

Features

- High performance programmable analog signal conditioning for NI CompactDAQ™ or CompactRIO™ System
- Conditioning for bridge type sensors, piezoelectric (charge mode) sensors, static or dynamic strain gages and others
- PFI Graphical User Interface software for stand-alone signal conditioning system control in low-cost 4 or 8-slot Ethernet RIO chassis
- 2 channels per module for 9102, 9302, 9452 and 9602
- 8 channels per module for 9608
- Up to 100 kHz bandwidth
- Programmable excitation, gain, and filtering
- Built-in hardware for system and sensor verification
- -40 to 70°C operating range

Benefits

- Integrate signal conditioning with NI A/D modules to build complete cDAQ™ or cRIO™ measurement systems.
- Stand-alone signal conditioning system operation controlled by PFI's GUI. No software to write.
- Measure load, torque, dynamic or static strain, dynamic force, static or dynamic pressure, vibration and acoustics on NI C Series platform
- Fully programmable gain and excitation to optimize measurements
- Perform quick and easy verification of entire signal chain with Precision Filters' built-in Test Bus and Sensor Health monitors
- Sharp, programmable low-pass filters provide alias protection for NI analog-to-digital converter modules
- Count on unsurpassed performance for high accuracy measurements

PFI-9102 Dual Bridge Conditioner for Pressure/Strain/Vibration/Load Measurements

High-performance programmable bridge signal conditioning for transducers that require constant voltage excitation.

PFI-9302 Dual Charge Conditioner for Piezoelectric Sensor Measurements

Charge mode conditioning for piezoelectric sensors with T-Insertion for verification of sensor health.

PFI-9452 Dual Dynamic Strain Conditioner with Precision Filters' BCC™ Technology

Perform dynamic strain measurements featuring Precision Filters' Balanced Constant Current™ (BCC™) technology.

PFI-9602 Dual Filter/Amplifier with Optional IEPE

Programmable 6-pole low-pass filter/amp with optional IEPE transducer support.

PFI-9608 Octal Programmable Filter

High density 8-channel programmable 4-pole low-pass filter for anti-aliasing applications.



Applications:

- Transient shock
- Wind tunnel testing
- Aircraft engine test cells
- Gas turbines for power generation
- Flight tests
- Piezoelectric crash tests
- Automotive
- Underwater acoustics and sonar
- Modal analysis and vibration

PFI-9102 Dual Channel Bridge Conditioner for Pressure/Strain/Vibration/Load Measurements

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 NI 9944/45 for 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. Calibration signals may be injected at the module input to verify system performance without disconnecting any signal cables.

Signal Types:

AC/DC voltage, bridge, static or dynamic strain

Supported Transducers:

Static or dynamic strain gages, full bridge pressure, RTD, load cells, accelerometers or any bridge type sensor

Recommended NI Analog Input A/D Modules:

9224/9239, 9228/9229, 9231/9234, 9250/9251

Interface:

2- to 8-wire plus shield via RJ50 input connector. Supports full, half, and quarter bridge connections.

Compatible with NI 9944/45 ¼-bridge completion accessories and NI 9949 screw terminal accessory. Fully automatic bridge balance.

Excitation:

Programmable constant voltage: 0 to 10 V, in 5 mV steps

Gain: Programmable x10, 30, 100, 300

Filter: 3-pole Butterworth low-pass, -3 dB at 100 kHz

Test Modes:

Test Input, Input Short, Excitation Monitor, Sensor Resistance Monitor, Shunt Cal, Sensor MUTE, EXC Off



PFI-9302 Dual Channel Charge Conditioner for Piezoelectric Sensor Measurements

The PFI-9302 C Series module provides two channels of charge mode conditioning for piezoelectric sensors. The module outputs may be connected to any cDAQ or cRIO analog input A/D module for a high-performance vibration measurement system. The low noise, high sensitivity charge input stage combined with programmable gain allows the PFI-9302 to resolve charge signals as low as 0.15 pC while still allowing full scale input charge up to 10,000 pC. The Precision PFI-9302 is compatible with high temperature accelerometers even with accelerometer shunt resistance as low as 100 kOhm.

The PFI-9302 built in "T-Insertion" capability electronically stimulates the attached piezoelectric sensors to output a charge signal. Charge output during T-insertion is dependent on the impedance of the sensor and connecting cable and can be used as a sensor-based test signal for true end-to-end system verification. The PFI-9302 also has built-in shunt calibration; the measured NIST traceable value of the internal shunt calibration capacitor is readable from the PFI-9302 module allowing for in-situ calibration of the PFI-9302 and attached data acquisition system.

Signal Types:

Charge

Supported Transducers:

Piezoelectric accelerometers and pressure sensors, including high temperature sensors

Recommended NI Analog Input A/D Modules:

9224/9239, 9228/9229, 9231/9234, 9250/9251

Interface:

BNC input

Full-Scale Range:

Programmable 333.3 pC, 1,000 pC, 3,333 pC, 10,000 pC

Filter: 3-pole Butterworth low-pass, -3 dB at 100 kHz

Test Modes: T-Insert, Shunt Cal



High-Performance Signal Conditioning Modules Selection Guide

Module	Type	Applicable Transducer	Interface	Excitation
PFI-9102	AC/DC Voltage, Bridge, Static Strain, Dynamic Strain	Static or dynamic strain, pressure, RTD, load, accel, AC/DC filter/amp, any bridge type sensor	2- to 8-wire + shield via RJ50 input	Programmable Constant Voltage: 0 to 10 V, in 5 mV steps. 10 mA source current
PFI-9302	Charge	Grounded or floating piezoelectric accels and pressure sensors, including high temp sensors	BNC	N/A
PFI-9452	Dynamic Strain	Dynamic strain gages	2-wire + shield via DE9 male	Programmable Constant Current: 0 to 10 mA in 100 µA steps
PFI-9602	Programmable Filter	AC/DC voltage, IEPE accels and microphones	2-wire + shield via DE9 male	IEPE: 2.5 mA (Option I) Requires PFI-IEPE-9602 Adapter.
PFI-9608	Programmable Filter	AC/DC voltage inputs	2-wire + shield via 37-pin D-sub male	N/A

PFI-9452 Dual Channel Dynamic Strain Conditioner with Balanced Constant Current™ (BCC™) Technology

The measurement of dynamic strain using a single active strain gage is commonly performed using a Wheatstone bridge. The Wheatstone bridge topology can be problematic for measurements using long cable runs since the cable resistance will cause potentially large measurement errors. The circuit is also highly susceptible to electrostatic noise pickup. In high temperature environments, cable resistance uncertainty precludes the use of the Wheatstone bridge circuit.

Precision Filters developed and perfected BCC for measuring dynamic strain. The technique is insensitive to cable resistance, provides a balanced connection to the strain gage for reduced electrostatic noise pickup and requires only two wires to connect to the strain gage. Balanced Constant Current is widely used for making dynamic strain measurements on rotating machinery. It is also used for shock and vibration measurements using shaker tables, wind tunnels, vehicle and aircraft survivability and many other applications that require the measurement of dynamic strain.

Signal Types: AC strain

Supported Transducers: Dynamic strain gages

Recommended NI Analog Input A/D Modules:

9224/9239, 9228/9229, 9231/9234, 9250/9251

Interface: 2-wire plus shield via 9-pin D-sub input connector

Excitation:

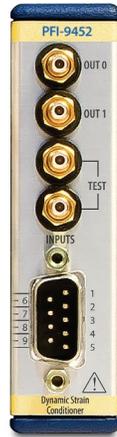
Programmable Balanced Constant Current: 0 to 10 mA in 100 µA steps

Gain: Programmable x10, 30, 100, 300

Filter: 3-pole Butterworth low-pass, -3 dB at 100 kHz

Test Modes:

Test Input, Input Short, Excitation Monitor, Sensor Resistance Monitor, AC Current, Sensor MUTE



PFI-9602 Dual Channel and PFI-9608 Octal Channel Programmable Filters

The PFI-9602 dual channel module is equipped with a fully programmable 6-pole, 6-zero low-pass filter and a distributed gain amplifier. The PFI-9608 is a high-density 8-channel unity gain programmable 4-pole, 4-zero low-pass filter module. Many sampling A/D converters are not equipped with low-pass filters to band limit the spectrum and are prone to aliasing. The sharp frequency responses of the 9602 or 9608 make them ideal for use as an anti-aliasing filter front end to sampling A/D converters that lack alias protection, such as the NI 9220. The low-pass filters may operate either in a “flat” mode for maximally flat passband amplitude response with sharp roll-off or in a “pulse” mode for low phase distortion and optimized transient response. Outstanding channel-to-channel phase and amplitude match makes these filters ideal for applications where time coherence between channels must be maintained.

The PFI-9602 amplifier adds precise, low-noise, wide bandwidth amplification of up to x3000 for low-level voltage input signals. The optional 9602 current source accessory allows for direct connection to IEPE microphones or accelerometers.

Signal Types: AC/DC voltage, IEPE (9602), externally excited bridge

Supported Transducers: AC/DC voltage (differential or single-ended), IEPE accelerometers and microphones (9602 only)

Recommended NI Analog Input A/D Modules: 9201, 9205, 9215, 9220, 9222/9223, 9228/9229, 9231/9234, 9250/9251

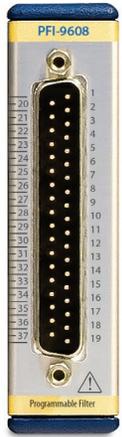
Interface: 2-wire plus shield

Gain: 9602: Programmable x1, 3, 10, 30, 100, 300, 1,000, 3,000
9608: Unity gain

Filter: 9602: 6-Pole Flat/Pulse low-pass filter with over 200 programmable cutoffs from 10 Hz to 127 kHz

9608: 4-Pole Flat/Pulse low-pass filter with 5 programmable cutoffs up to 30 kHz

Test Modes: Test Input, Input Short, Sensor MUTE



High-Performance Signal Conditioning Modules Selection Guide

Card	Bandwidth	Gain/Range	Filter	Cutoff Frequencies	Test Features
PFI-9102	100 kHz	x10, 30, 100, 300	3-pole Butterworth Low-Pass	100 kHz	Test Input, Input Short, Excitation Monitor, Sensor Resistance Monitor, Shunt Cal, Sensor MUTE, EXC Off
PFI-9302	100 kHz	333.3 pC, 1,000 pC, 3,333 pC, 10,000 pC	3-pole Butterworth Low-Pass	100 kHz	Shunt Cal, T-Insert
PFI-9452	100 kHz	x10, 30, 100, 300	3-pole Butterworth Low-Pass	100 kHz	Test Input, Input Short, Excitation Monitor, Sensor Resistance Monitor, Shunt Cal, Sensor MUTE
PFI-9602	127 kHz	x1, 3, 10, 30, 100, 300, 1,000, 3,000	Programmable 6-Pole Flat/Pulse Low-Pass	10 Hz to 1.27 kHz in 10 Hz steps; 2 kHz to 127 kHz in 1 kHz steps	Test Input, Input Short, Sensor MUTE
PFI-9608	Up to 30 kHz	Unity Gain	Programmable 4-Pole Flat/Pulse Low-Pass	FX00: 10, 30, 100, 300, 1,000 Hz FX02: 300 Hz, 1, 3, 10, 30 kHz	Test Input, Input Short



Building C Series Measurement System

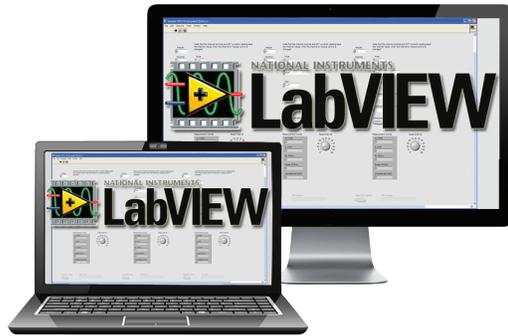
1 Choose National Instruments CompactDAQ or CompactRIO Chassis



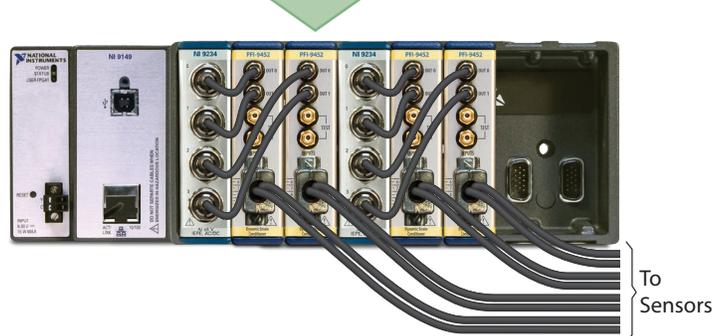
2 Choose Precision Filters Hot Swappable Signal Conditioning Modules



4 Control with National Instruments LabVIEW Software



3 Connect PFI Module Outputs to NI Voltage Input Digitizer Modules



Building Stand-Alone Turn-Key Signal Conditioning System

1 Choose National Instruments Ethernet RIO 9147 4-Slot or 9149 8-Slot Chassis



2 Mix and Match Precision Filters Hot Swappable Signal Conditioning Modules



4 Control with Precision Filters GUI for Ethernet RIO – No Software to Write



3 Connect Inputs to Sensors
Outputs to Preferred DAS

