

Reconfigurable I/O Configured with the LabVIEW FPGA Module

R Series

- Onboard I/O synchronization and control configured with the LabVIEW™ FPGA Module
- Up to 8 analog input channels, 16-bit resolution, 4.0 μ s conversions, ± 10 V
- Up to 8 analog output channels, 16-bit resolution, 1.0 μ s updates, ± 10 V
- Up to 160 digital lines configurable as input, output, counter, or custom functionality
- Configurable triggering and synchronization with 25 ns resolution

Operating Systems

- Windows 2000/XP
- LabVIEW Real-Time (ETS and RTX)

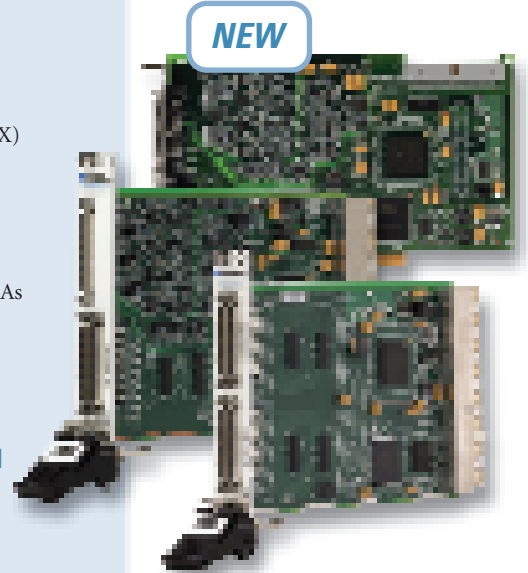
Recommended Software

- LabVIEW
- LabVIEW Real-Time Module
- LabVIEW FPGA Module
 - LabVIEW code compiler for FPGAs
 - Emulated debugging mode

Driver Software (included)

- NI-RIO

Calibration Certificate Included



Product	Bus	Analog Inputs	Sampling Period (μ s)	Input Resolution (bits)	Max Input (V)	Analog Outputs	Output Resolution (bits)	Digital I/O	Triggering (Configurable per Channel)
Multifunction R Series NI 7831R	PCI, PXI	8 SE/8 DI	4.0	16	± 10	8	16	96	Analog and Digital
Digital R Series PXI-7811R	PXI	–	–	–	–	–	–	160	Digital

Product Description

The National Instruments R Series devices are equipped with reconfigurable input/output (RIO) hardware technology. The core of RIO is an FPGA (field-programmable gate array), which is configurable with the LabVIEW FPGA Module. You can customize the behavior of the device, providing capabilities such as:

- Complete control over synchronization and timing of all operations with 25 ns resolution
- User-defined, onboard decision making and triggering with loop rates up to 40 MHz
- Digital lines individually configurable as input, output, counter/timer, pulse width modulator (PWM), flexible encoder inputs, or user-defined communication protocols

Because of these capabilities, R Series devices and the LabVIEW FPGA Module extend the National Instruments platform. By

combining these products with other NI hardware and software such as LabVIEW, LabVIEW Real-Time, and data acquisition, you can better address applications such as:

- PWM and digital communication protocols
- Hardware-in-the-loop (HIL) simulation
- Rapid control prototyping (RCP)
- Real-time analog or discrete control

Key Features

You can control each of the I/O signal lines independently or synchronize it with other lines. You can configure the DIO lines as custom counter/timers, PWM channels, or as ports for user-defined protocols. The user-defined configuration can optionally be stored in Flash memory on the R Series device. This feature provides benefits for automatic loading and or execution of the user program at power up.

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Recommended Accessories SCB-68 Shielded I/O Connector Block

This is a shielded I/O connector block for rugged, very low-noise signal termination for connecting to 68-pin devices. The SCB-68 also includes two general-purpose breadboard areas.

SCB-68776844-01
Dimensions – 19.5 by 15.2 by 4.5 cm (7.7 by 6.0 by 1.8 in.)

Cables with 68-Pin D-Type Connector

These cables feature a 68-pin VHDCI offset male connector on one end and a 68-pin 0.050 Series D-type female connector on the other end. The SH68-C68-S cable connects any of the connectors of an NI R Series device to 68-pin connector blocks.

2 m186381-02
The SHC68-68-RMIO is a cable with high noise immunity, wired specifically for the MIO connector of the NI 7831R devices.
1 m189588-01

Cables for Connecting to 5B and SSR Signal Conditioning or Custom Connectivity

The NSC68-262650 cable is 68-pin to two 26-pin and one 50-pin ribbon connectors, used to connect the MIO connector of NI 7831R devices to 5B and SSR signal conditioning backplanes. Each of the 26-pin connectors connects to an 8-channel 5B backplane and the 50-pin connector connects to a 16-channel SSR backplane.

1 m189151-01

The NSC68-5050 cable, 68-pin to two 50-pin ribbon connectors, is used to connect one of the DIO connectors of NI R Series devices to SSR signal conditioning backplanes. One of the 50-pin connectors connects to a 24-channel SSR backplane and the other connects to a 16-channel SSR backplane.

1 m189152-01

The SHC68-NT-S cable is a shielded cable with 1 68-pin VHDCI female connector and no connector on other side of cable (unterminated.) It is used to create custom cabling solutions for NI R Series devices, and is ideal for OEM applications.

1 m189041-02

Ordering Information

NI PXI-7831R.....778668-01
NI PCI-7831R.....778797-01
NI PXI-7811R.....778800-01
Includes NI-RIO driver software and calibration certificate.

BUY ONLINE!

Visit ni.com/info and enter rseries.

Specifications

Analog Input (NI 7831R only)

Input Characteristics

Number of channels 8
Input modes Differential or single-ended (referenced or nonreferenced) software-selectable
Resolution 16 bits, 1 in 65,536
Conversion time 4 μ s
Maximum sampling rate 200 kS/s (per channel)
Input impedance
Powered on 10 G Ω , in parallel with 100 pF
Powered off 4 k Ω , minimum
Overload 4 k Ω , minimum
Input signal range ± 10 V
Input bias current ± 2 nA
Input offset current ± 1 nA
Input coupling DC
Maximum working voltage (signal + common mode) Inputs should remain within ± 12 V of ground
Overvoltage protection ± 42 V
Data transfers Interrupts, programmed I/O

Accuracy Information

Nominal Range (V)	Absolute Accuracy					Relative Accuracy				
	% of Reading		Noise + Quantization			Absolute Accuracy at Full Scale		Resolution (μ V)		
Positive Full Scale	Negative Full Scale	24 Hours	Offset 1 Year	Single Point	Noise + Quantization	Temp Scale (%/°C)	Single Point	Averaged		
10.0	-10.0	0.0496	0.0507	2.542	1.779	165	0.0005	7.78	2170	217

Note: Accuracies are valid for measurements following an internal calibration. Measurement accuracies are listed for operational temperatures within ± 1 °C of internal calibration temperature and ± 10 °C of external or factory calibration temperature. Temp drift applies only if ambient is greater than ± 10 °C of previous external calibration.

DC Transfer Characteristics

INL ± 3 LSB typ, ± 6 LSB maximum
DNL -1.0 to $+2.0$ LSB maximum
No missing codes resolution 16 bits typ, 15 bits minimum
CMRR, DC to 60 Hz 86 dB

Dynamic Characteristics

Bandwidth
Small signal (-3 dB) 650 kHz
Large signal (1% THD) 55 kHz
System noise 1.8 LSBrms (including quantization)

Settling time

Step Size	Accuracy		
	16 LSB	4 LSB	2 LSB
± 20.0 V	7.5 μ s	10.3 μ s	40 μ s
± 2.0 V	2.7 μ s	4.1 μ s	5.1 μ s
± 0.2 V	1.7 μ s	2.9 μ s	3.6 μ s

Crosstalk -80 dB, DC to 100 kHz

Analog Output (NI 7831R only)

Output Characteristics

Number of channels 8 single-ended, voltage output
Resolution 16 bits, 1 in 65,536
Update time 1.0 μ s
Maximum update rate 1 MS/s
Type of DAC Enhanced R-2R
Data transfers Interrupts, programmed I/O

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Specifications

Accuracy Information

Nominal Range (V)		Absolute Accuracy				Temp Drift (%/°C)	Absolute Accuracy at Full Scale (mV)
Positive Full Scale	Negative Full Scale	24 Hours	1 Year	Offset (µV)			
10.0	-10.0	0.0335	0.0351	2366	0.0005	5.88	

Note: Accuracies are valid for analog output following an internal calibration. Analog output accuracies are listed for operation temperatures within ±1 °C of internal calibration temperature and ±10 °C of external or factory calibration temperature. Temp Drift applies only if ambient is greater than ±10 °C of previous external calibration.

DC Transfer Characteristics

INL	±0.5 LSB typ, ±4.0 LSB maximum
DNL	±0.5 to ±1.0 LSB maximum
No missing codes resolution.....	16 bits, guaranteed

Voltage Output

Range	±10 V
Output coupling	DC
Output impedance.....	1.25 Ω
Current drive.....	±2.5 mA
Protection	Short-circuit to ground
Power-on state	User configurable

Dynamic Characteristics

Settling time

Step Size	Accuracy		
	16 LSB	4 LSB	2 LSB
±20.0 V	6.0 µs	6.2 µs	7.2 µs
±2.0 V	2.2 µs	2.9 µs	3.8 µs
±0.2 V	1.5 µs	2.6 µs	3.6 µs

Slew rate	10 V/µs
Noise	150 µV _{rms} , DC to 1 MHz
Glitch energy at midscale transition	±100 mV for 3 µs

Digital I/O

Number of channels	
NI 7831R	96 input/output
PXI-7811R	160 input/output
Compatibility	TTL

Digital logic levels

Level	Min	Max
Input low voltage (V _{IL})	0.0 V	0.8 V
Input high voltage (V _{IH})	2.0 V	5.5 V
Output low voltage (V _{OL}), where I _{O(LT)} = -I _{max} (sink)	—	0.4 V
Output high voltage (V _{OH}), where I _{O(HT)} = I _{max} (source)	2.4 V	—

Maximum output current	
I _{max} (source).....	5.0 mA
I _{min} (sink).....	5.0 mA
Input leakage current	±10 µA
Power-on state	Programmable, by line
Data transfers	Interrupts, programmed I/O
Protection	
Input	-0.5 to 7.0 V
Output	Short-circuit (up to eight lines may be shorted at a time)

Reconfigurable FPGA

System gates.....	1 M
Number of logic slices	5,120
Equivalent number of logic cells.....	11,520
Embedded RAM available.....	81,920 B
Timebase	40 MHz
Timebase reference sources	
PCI-7831R	Onboard clock only
PXI-7831R	Onboard clock, phase-locked to PXI 10 MHz clock
PXI-7811R	Onboard clock, phase-locked to PXI 10 MHz clock
Timebase accuracy	
Onboard clock.....	±100 ppm, 250 ps jitter
Phase locked to PXI 10 MHz clock (PXI-7831R and PXI-7811R only)	Adds 350 ps jitter, 300 ps skew

Calibration (NI 7831R Only)

Recommended warm-up time.....	15 minutes
Calibration interval.....	1 year
Onboard calibration reference	
DC level	5.000 V (±3.5 mV) (actual value stored in flash memory)
Temperature coefficient.....	±5 ppm/°C maximum/Long-term stability ±20 ppm/√10000h

Physical

Dimensions (not including connectors)	
PXI	16 cm by 10 cm (6.3 in. by 3.9 in.)
PCI	17 cm by 11 cm (6.7 in. by 4.3 in.)
I/O connectors	
NI 7831R	Three 68-pin female high-density VHDCI type
PXI-7811R	Four 68-pin female high-density VHDCI type

Environmental

Operating Environment

Ambient temperature.....	0 to 55 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2
Relative humidity	10 to 90% noncondensing, tested in accordance with IEC-60068-2-56
Altitude	2,000 m at 25 °C ambient temperature

Storage Environment

Ambient temperature.....	-20 to 70 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2
Relative humidity	5 to 95%, noncondensing, tested in accordance with IEC-60068-2-56

Shock and Vibration (PXI Only)

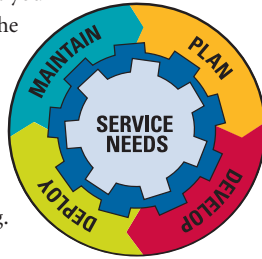
Operational shock	30 g peak, half-sine, 11 ms pulse, tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.
Random vibration	
Operating	5 to 500 Hz, 0.3 g _{rms}
Nonoperating	5 to 500 Hz, 2.4 g _{rms} tested in accordance with IEC-60068-2-64. Nonoperating test profile exceeds the requirements of MIL-PRF-28800F, Class 3.

Certifications and Compliances

CE Mark Compliance

NI Services and Support

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NI Factory Installation Services

NI Factory Installation Services (FIS) is the fastest and easiest way to use your PXI or PXI/SCXI™ combination systems right out of the box. Trained NI technicians install the software and hardware and configure the system to your specifications. NI extends the standard warranty by one year on hardware components (controllers, chassis, modules) purchased with FIS. To use FIS, simply configure your system online with ni.com/pxiadvisor.

Calibration Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit ni.com/calibration.

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