

NI Single-Board RIO Embedded Control and Acquisition

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Overview

NI Single-Board RIO products are designed for high-volume, embedded control and acquisition applications that require high performance and reliability. Engineers and embedded developers can use these real-time, single-board computers to get embedded systems with I/O to market quickly. NI Single-Board RIO is powered by National Instruments LabVIEW FPGA and LabVIEW Real-Time technologies, giving engineers the ability to design, program, and customize the NI Single-Board RIO embedded system with easy-to-use graphical programming tools.

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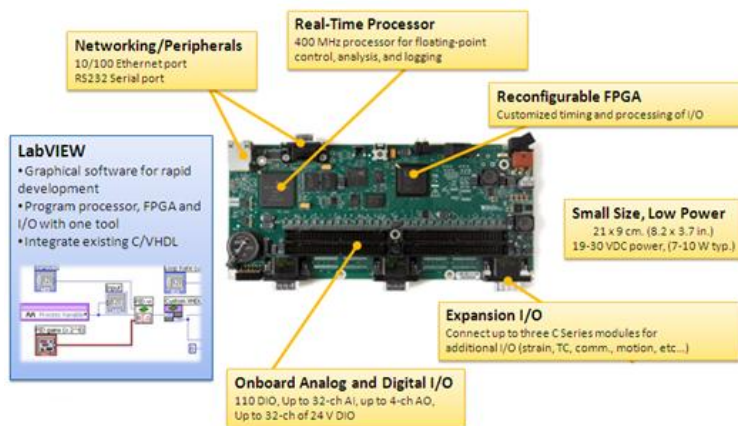


Figure 1. NI Single-Board RIO products are real-time single-board computers that contain a real-time processor, FPGA, and analog and digital I/O that are programmable with LabVIEW.

- Single-board embedded control and acquisition
- NI LabVIEW graphical programming tools for rapid development
- Onboard real-time processor for reliable stand-alone operation and signal processing
- Onboard field-programmable gate array (FPGA) chip for custom I/O timing and processing
- Onboard analog I/O and digital I/O
- Low-cost systems for board-level embedded design

Each NI Single-Board RIO device integrates an embedded real-time processor, a high-performance FPGA, and onboard analog and digital I/O in a single board. All I/O is connected directly to the FPGA, providing low-level customization of timing and I/O signal processing. The FPGA is connected to the embedded real-time processor via a high-speed PCI bus. LabVIEW contains built-in data transfer mechanisms to pass data from the I/O to the FPGA and also from the FPGA to the embedded processor for real-time analysis, postprocessing, data logging, or communication to a networked host computer.

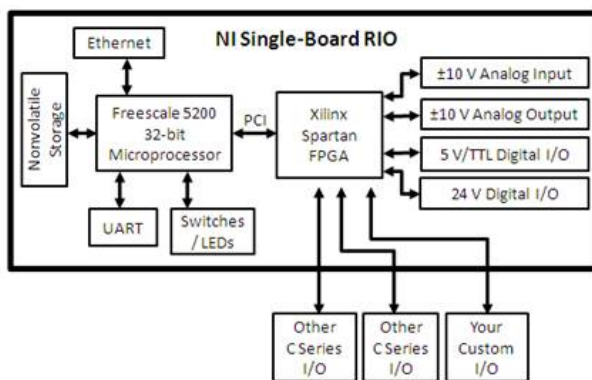


Figure 2. NI Single-Board RIO Architecture

NOTE: CompactRIO is available as a packaged embedded system that includes a rugged, mechanical enclosure to withstand extreme environments.

1. NI Single-Board RIO Products

The ten NI Single-Board RIO systems are differentiated by processor speed, FPGA size, amount of memory, power input, and I/O combinations. For more information on which models include specific features, see Table 1.

Model	Processor Speed (MHz)	Memory(DRAM)	Nonvolatile Memory	FPGA Size	3.3 V DIO	AI	AO	24 V DI/DO Lines	Power Input

sbRIO-9601	266	64 MB	128 MB	1M	110	0	0	0	19-30
sbRIO-9602/XT	400	128 MB	256 MB	2M	110	0	0	0	19-30
sbRIO-9605	400	128 MB	256 MB	LX25	96	0	0	0	9-30
sbRIO-9606	400	256 MB	512 MB	LX55	96	0	0	0	9-30
sbRIO-9611	266	64 MB	128 MB	1M	110	32	0	0	19-30
sbRIO-9612/XT	400	128 MB	256 MB	2M	110	32	0	0	19-30
sbRIO-9631	266	64 MB	128 MB	1M	110	32	4	0	19-30
sbRIO-9632/XT	400	128 MB	256 MB	2M	110	32	4	0	19-30
sbRIO-9641	266	64 MB	128 MB	1M	110	32	4	32/32	19-30
sbRIO-9642/XT	400	128 MB	256 MB	2M	110	32	4	32/32	19-30

Table 1. NI Single-Board RIO Platform of Real-Time, Single-Board Computers

NI Single-Board RIO products contain the following specifications and peripherals:

- -20 to 55 °C and -40 to 70 °C standard operating temperatures
- Optional -40 to 85 °C extended operating temperature for XT variants
- RS232 serial port for connection to peripherals and devices
- Available USB and CAN ports
- 10/100 Ethernet port for networking
- Up to 512 MB nonvolatile storage
- Up to 256 MB RAM
- Available Real-time clock with battery backup

2. Analog and Digital I/O and Expansion I/O

The following onboard I/O is available with NI Single-Board RIO:

- Up to 110 3.3 V/TTL digital I/O lines
- Up to 32 ± 10 V, 16-bit, 250 kS/s analog inputs
- Up to 4 ± 10 V, 16-bit, 100 kS/s analog outputs
- Up to 32 24 V industrial digital input lines
- Up to 32 24 V industrial digital output lines

For expansion I/O, the sbRIO-9605 and sbRIO-9606 feature a RIO Mezzanine Card connector, which is a high-density, high-bandwidth connector that provides direct access to FPGA DIO lines and processor functions. The connector enables users to design custom daughter cards for applications requiring specific I/O combinations while giving that I/O access to the reconfigurable FPGA and processor, all programmed with LabVIEW for fast time to market deployments.



Figure 3. Digital-only version of NI Single-Board RIO with RIO Mezzanine Card connector

For NI Single-Board RIO systems without the RIO Mezzanine Card connector, you can plug up to three C Series I/O modules directly into each system. You can choose from a variety of C Series I/O types including voltage, current, thermocouple, RTD, accelerometer, and strain gage inputs; up to ± 60 V simultaneous-sampling analog I/O; 12, 24, and 48 V industrial digital I/O; 5 V/TTL digital I/O; counter/timers; pulse generation; and high voltage/current relays. Because the modules contain built-in signal conditioning for extended voltage ranges or industrial signal types, you can usually connect wires directly from the C Series modules to your sensors and actuators. With this open platform, you can also build your own custom I/O module to meet the specific I/O or communication needs of your application.



Figure 4. You can connect up to three of the more than 50 C Series I/O and communication modules to add I/O capabilities to certain NI Single-Board RIO products or build your own custom I/O module.

3. Reconfigurable FPGA

The embedded FPGA is a high-performance, reconfigurable chip that you can program with LabVIEW FPGA tools. Traditionally, FPGA designers were forced to learn and use complex design languages such as VHDL to program FPGAs. Now, any engineer or scientist can use graphical LabVIEW tools to program and customize FPGAs. With the FPGA hardware embedded in CompactRIO, you can implement custom timing, triggering, synchronization, control, and signal processing for your analog and digital I/O. LabVIEW FPGA is an open environment that you can use to integrate existing VHDL code or IP cores.

4. Onboard Real-Time Processor

The NI Single-Board RIO products feature an industrial 266 MHz or 400 MHz Freescale processor that deterministically executes your LabVIEW Real-Time applications on the reliable Wind River VxWorks real-time operating system. LabVIEW has built-in functions for transferring data between the FPGA and the real-time processor within the CompactRIO embedded system. Choose from more than 600 built-in LabVIEW functions to build your multithreaded embedded system for real-time control, analysis, data logging, and communication. You can also integrate existing C/C++ code with LabVIEW Real-Time code to save on development time.

5. Application Examples

With the low cost and reliability of NI Single-Board RIO, as well as its suitability for high-volume embedded measurement and control applications, you can adapt it to meet a wide variety of industry and application challenges. Examples include:

- Medical device monitoring and control
- Robotics and unmanned vehicle control
- Machine condition monitoring and protection
- Embedded data logging
- Electrical power monitoring and power electronics control
- Mobile/portable noise, vibration, and harshness (NVH) analysis

6. Learn More

Watch the [NI Single-Board RIO out-of-box video](#).

View the [NI Single-Board RIO Product Selection Guide](#).

Target [embedded systems](#) with LabVIEW.