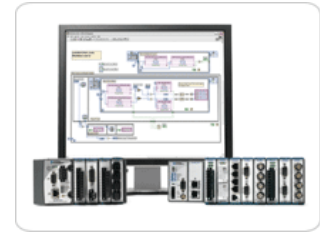


What Is CompactRIO?

Publish Date: Feb 22, 2012

Table of Contents

The NI CompactRIO programmable automation controller (PAC) is a low-cost reconfigurable control and acquisition system designed for applications that require high performance and reliability. The system combines an open embedded architecture with small size, extreme ruggedness, and hot-swappable industrial I/O modules. CompactRIO is powered by reconfigurable I/O (RIO) field-programmable gate array (FPGA) technology.



Understanding the CompactRIO Architecture

CompactRIO systems consist of reconfigurable chassis housing the user-programmable FPGA, hot-swappable I/O modules, real-time controller for deterministic communication and processing, and graphical NI LabVIEW software for rapid real-time and FPGA programming. Learn more about each of these components in the sections below.

Jump to [Controller](#) | [Chassis](#) | [Device/Module](#) | [Software](#)

Controller

Standard Controller Types

Value Integrated Chassis and Controller



[Learn More](#)
[Shop Now](#)

High-Performance Controller



[Learn More](#)
[Shop Now](#)

Rugged-Performance Controller



[Learn More](#)
[Shop Now](#)



Value Integrated Chassis and Controller

National Instruments offers a value line of CompactRIO integrated systems that combines the high performance of the CompactRIO architecture with a smaller feature set compared to the CompactRIO modular systems. The integrated systems couple the CompactRIO real-time controller with an 8-slot backplane in a single chassis that includes the user-programmable FPGA. These integrated systems work with the easy-to-use NI LabVIEW graphical programming environment to help you develop real-time and FPGA applications.

[Shop Now](#)



High-Performance Controller

When your application needs the highest performance and most flexible CompactRIO systems, choose the high-performance CompactRIO line. These systems combine the highest performance real-time controller with a user-upgradable backplane that includes the largest and most powerful FPGAs from National Instruments. CompactRIO high-performance systems have the most processing power and resources that make these systems ideal for advanced control applications, high-speed data transfer and logging, and processing-intensive applications. The modular systems work with LabVIEW to help you develop real-time and FPGA applications.

[Shop Now](#)



Rugged-Performance Controller

Rugged-performance CompactRIO systems offer a high level of performance and flexibility. They combine a 400 MHz real-time controller with a user-upgradable backplane that includes the largest and most powerful FPGAs from National Instruments. These are the most rugged CompactRIO systems—they feature a wide -40 to 70 °C operating temperature and 50 g shock ratings, so they are ideal for automotive, industrial automation, and advanced control applications. These modular systems work with LabVIEW to help you develop real-time and FPGA applications.

[Shop Now](#)

Jump to [Controller](#) | [Chassis](#) | [Device/Module](#) | [Software](#)

Chassis

Standard Chassis Types

4-Slot Chassis

8-Slot Chassis

Expansion Chassis



[Learn More](#)
[Shop Now](#)



[Learn More](#)
[Shop Now](#)



[Learn More](#)
[Shop Now](#)



Integrated Chassis and Controller

National Instruments offers a value line of CompactRIO integrated systems that combines the high performance of the CompactRIO architecture with a smaller feature set compared to the CompactRIO modular systems. The integrated systems couple the CompactRIO real-time controller with an 8-slot backplane in a single chassis that includes the user-programmable FPGA. These integrated systems work with the easy-to-use LabVIEW graphical programming environment to help you develop real-time and FPGA applications.

[Shop Now](#)



4-Slot Chassis

The 4-slot, reconfigurable embedded chassis is part of the high-performance CompactRIO PAC platform. It features a user-programmable Xilinx Virtex-5 FPGA, giving you high processing power and the ability to design custom hardware using LabVIEW software. The NI cRIO-9111 provides low-level hardware access to any CompactRIO I/O module, so you can create unprecedented timing, triggering, control, and synchronization schemes for embedded and industrial applications.

Panel mount holes are included in all CompactRIO chassis. For DIN-rail or panel mount options, you can purchase a CompactRIO mounting kit separately.

[Shop Now](#)



8-Slot Chassis

When your application requires the highest performance and most flexible CompactRIO systems, you need the high-performance CompactRIO line. These systems combine the highest performance real-time controller with a user-upgradable backplane that includes the largest and most powerful FPGAs from National Instruments. CompactRIO high-performance systems have the most processing power and resources, so they are ideal for advanced control applications, high-speed data transfer and logging, and processing-intensive applications. The modular systems work with LabVIEW to help you develop real-time and FPGA applications.

[Shop Now](#)



EtherCAT RIO Expansion Chassis

EtherCAT RIO offers deterministic, distributed I/O to maintain the tight timing and synchronization needed for time-critical systems. Using real-time Ethernet, this 8-slot rugged chassis for NI C Series modules communicates deterministically with any CompactRIO real-time industrial controller or any real-time PXI system that has two Ethernet ports.

You can daisy chain multiple slave chassis from the controller to expand time-critical applications to high-channel counts while maintaining hard determinism. Plus, you can embed FPGA code on your expansion I/O to offload processing from the controller and reduce response time.

The NI 9144 features eight C Series I/O slots per chassis and a 2M gate FPGA for custom timing, inline processing, and control.

[Shop Now](#)

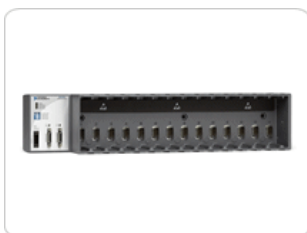


Ethernet RIO Expansion Chassis

Ethernet RIO delivers the most flexible expansion RIO solution, making it easy to add a user-programmable FPGA and mixed-signal conditioned I/O to any Ethernet network. Ethernet RIO chassis are ideal for distributed, remote measurement systems and can integrate easily with any real-time CompactRIO system, real-time PXI system, or Windows PC using standard 10/100 Ethernet.

The NI 9148 features eight C Series I/O slots per chassis; a 2M gate FPGA for custom timing, inline processing, and control; a Network fail-safe for increased reliability; and support for LabVIEW FPGA and NI RIO Scan Mode

[Shop Now](#)



MXI-Express RIO

MXI-Express RIO provides the highest performance expansion reconfigurable I/O solution for applications that require custom signal processing and control algorithms as well as mixed-signal conditioned I/O. Featuring high throughput and best-in-class FPGAs, MXI-Express RIO chassis are ideal for hardware-in-the-loop, real-time test and complex research applications.

You can daisy chain multiple MXI-Express RIO chassis from compatible controllers, which include real-time or Windows PXI, PC, rack-mount, and industrial controllers. The NI 9157 and NI 9159 feature 14 C Series I/O slots per chassis, with up to six chassis per daisy chain and up to eight daisy chains per controller. And with 250 MB/s bus throughput, MXI-Express RIO can handle the most intense data-streaming applications.

[Shop Now](#)

[Jump to](#) [Controller](#) | [Chassis](#) | [Device/Module](#) | [Software](#)

Device/Modules

Standard Module Types

- [Voltage](#)
- [Temperature](#)
- [Resistance](#)
- [Voltage and Current Outputs](#)
- [Digital I/O](#)
- [Relay](#)
- [CAN Communication](#)
- [Serial Communication](#)
- [Motion](#)

- [Strain and Bridge](#)
- [Current](#)
- [Counter/Pulse Generation](#)
- [Accelerometers and Microphones](#)
- [Removable Storage](#)

CompactRIO offers direct hardware access to the input/output circuitry of each I/O module using LabVIEW FPGA elemental I/O functions. Each I/O module contains built-in signal conditioning and screw terminal, BNC, or D-SUB connectors. A variety of I/O types is available, including ± 80 mV thermocouple inputs, ± 10 V simultaneous sampling analog I/O, 24 V industrial digital I/O with up to 1 A current drive, differential/TTL digital inputs with 5 V regulated supply output for encoders, and $250\text{ V}_{\text{rms}}$ universal digital inputs.

Because the modules contain built-in signal conditioning for extended voltage ranges or industrial signal types, you can usually make your wiring connections directly from the CompactRIO module to your sensors/actuators. In most cases, the CompactRIO modules provide isolation from channel-to-earth ground.

CompactRIO modules connect directly to RIO FPGA devices to create high-performance embedded systems that deliver the optimization and flexibility of a custom electrical circuit completely dedicated to your I/O application. The RIO FPGA hardware provides unlimited options for timing, triggering, synchronization, and sensor-level signal processing and decision making.

C Series Modules



You can choose from more than 50 NI C Series modules for different measurements including thermocouple, voltage, resistance temperature detector (RTD), current, resistance, strain, digital (TTL and other), accelerometers, and microphones. Channel counts on the individual modules range from three to 32 channels to accommodate a wide range of system requirements.

[Jump to Controller](#) | [Chassis](#) | [Device/Module](#) | [Software](#)

Software

With LabVIEW, you can develop applications for industrial control, data acquisition, and human machine interfaces (HMIs) using one development environment to ensure maximum skill reuse. Because of the capabilities of LabVIEW and the ease of use of graphical programming, LabVIEW is well-suited for applications that require the following.

Measurement and Analysis

Whether you are taking measurements from thermocouples, strain gages, integrated electronic piezoelectric (IEPE) accelerometers, bridge-based sensors, or quadrature encoders, LabVIEW offers a reliable and easy platform to gather data. LabVIEW can also directly take high-accuracy measurements at the millions of samples per second rate required in applications such as vibration and power quality measurements to monitor a machine's health. In addition to the above mentioned sensors and actuators, LabVIEW can acquire images from thousands of cameras and analyze the images in real time using the software image libraries.

You can then either readily analyze the acquired data using the thousands of built-in analysis functions in LabVIEW or pass the data directly to the control loop for further processing.

Advanced Control

With LabVIEW, you can develop control systems spanning from simple proportional integral derivative (PID) control to advanced dynamic control such as model predictive control, which helps you choose the appropriate hardware and control methodology without changing your software development approaches. Additionally, using NI SoftMotion technology in LabVIEW, you can create customized motion controllers using LabVIEW and NI PACs for better performance and flexibility. You also have the flexibility of implementing custom circuitry using the FPGA backplane on CompactRIO PACs.

You can run these control algorithms deterministically on a wide variety of NI PACs such as CompactRIO and Compact FieldPoint running real-time operating systems. With the power of LabVIEW and NI PACs, you can run multiple high-speed PID loops simultaneously.

Communication

LabVIEW makes it easy for you to pass data to and from existing programmable logic controllers (PLCs) and operator interfaces and up to the enterprise. It supports multiple industrial FOUNDATION fieldbus and Ethernet protocols such as Modbus, OPC, EtherNet/IP, EtherCAT, CANopen, TCP/IP, and serial. Therefore, you are not bound to a specific protocol or standard to communicate to existing PLCs and other automation devices.

You can establish a connection to the enterprise and IT-friendly databases through the database connectivity tools in LabVIEW. LabVIEW can also host web services on NI PACs, so that you can connect to your controllers remotely through a web browser or any thin client application.

HMI/SCADA

With the configuration-based tools in addition to the programming capabilities of LabVIEW, you can develop a simple HMI application into a full-fledged SCADA system with thousands of tags. LabVIEW includes tools for logging data to a built-in networked historical database, tracking real-time and historical trending, managing alarms and events, networking NI PACs and OPC devices into one complete system, and adding security to user interfaces.

You can decide to deploy your HMI systems on NI touch panel computers (TPCs) or any third-party touch panels. You can also choose from Windows CE, Windows XP Embedded, and Windows XP as your OS to deploy HMI/SCADA systems based on LabVIEW.

[Learn more about LabVIEW for industrial measurement and control.](#)

[Jump to Controller](#) | [Chassis](#) | [Device/Module](#) | [Software](#)