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Reconfigurable Chassis for NI CompactRIO

NI cRIO-911x





- Easy-to-use LabVIEW FPGA automatically synthesizes electrical circuit implementation
- NI CompactRIO Extreme Industrial Certifications and Ratings
- Design hardware in LabVIEW
- 4- or 8-slot chassis for any CompactRIO I/O module
- DIN-rail mount, 19 in. rack mount, and panel mount options
- RIO FPGA core executes at default rates of 40 MHz, and can be compiled to run even faster

Comparison Tables

Chassis	Module Slots	FPGA	LUTs and Flip-Flops	Multipliers
cRIO-9111	4	Virtex-5 LX30	19,200	32
cRIO-9112	8	Virtex-5 LX30	19,200	48
cRIO-9113	4	Virtex-5 LX50	28,800	48
cRIO-9114	8	Virtex-5 LX50	28,800	48
cRIO-9116	8	Virtex-5 LX85	51,840	48
cRIO-9118	8	Virtex-5 LX110	69,120	64

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Application and Technology

NI CompactRIO reconfigurable chassis are the heart of the CompactRIO system because they contain the reconfigurable I/O (RIO) core. You program the RIO field-programmable gate array (FPGA) core, which has an individual connection to each I/O module, with easy-to-use elemental I/O functions to read or write signal information from each module. Because there is no shared communication bus between the RIO FPGA core and the I/O modules, you can precisely synchronize I/O operations on each module with 25 ns resolution. The RIO core can perform local integer-based or fixed-point signal processing and decision making and directly pass signals from one module to another. It is connected to the CompactRIO real-time controller through a local PCI bus interface. The real-time controller can retrieve data from any control or indicator on the RIO FPGA application front panel through an easy-to-use scan interface or simple FPGA Read/Write function. The RIO FPGA can also generate interrupt requests (IRQs) to synchronize the real-time software execution with the RIO FPGA. Typically, the real-time controller is used to convert the integer-based I/O data to scaled floating-point numbers. In addition, it performs single-point control, waveform analysis, data logging, and Ethernet/serial communication. The reconfigurable chassis, real-time controller, and I/O modules combine to create a complete stand-alone embedded system.

Key Features

Create any local or timing, triggering, and synchronization scheme with 25 ns resolution
Use multiple While Loops to create a parallel processing application for high-performance signal processing or multirate control systems
Take advantage of built-in proportional integral derivative (PID) control functions for control system loop rates greater than 100 kHz
Generate waveforms or implement nonlinear lookup tables (LUTs) using LabVIEW FPGA Express VIs
Integrate widely available third-party HDL cores using the LabVIEW FPGA Module HDL Node
Enforce critical logic and interlocks in silicon hardware circuitry or use the parallel RIO architecture to create dual, triple, or quadruple redundant systems

Visit ni.com/compactrio for example programs, application notes, and other developer tools.

New Virtex-5 FPGAs

New NI cRIO-911x chassis use Virtex-5 FPGAs with improved optimization capabilities to help you execute code faster and increase code capacity. These FPGAs feature a new six-input LUT architecture for substantially improved resource utilization as well as DSP48 slices that make it possible for you to implement more complex digital signal processing at faster rates. Previous-generation Virtex-II FPGAs use four-input LUTs for up to 16 combinations of digital logic values. The new Virtex-5 FPGAs use six-input LUTs for up to 64 combinations, increasing the amount of logic that you can implement per slice. In addition, the slices themselves are placed in closer proximity to each other to reduce the propagation delay of electrons and increase overall execution rates. The single-cycle Timed Loop structure in LabVIEW FPGA takes full advantage of six-input LUTs for substantially improved resource utilization. This means you can optimize more LabVIEW FPGA code to fit within Virtex-5 FPGAs and perform more operations per clock cycle.

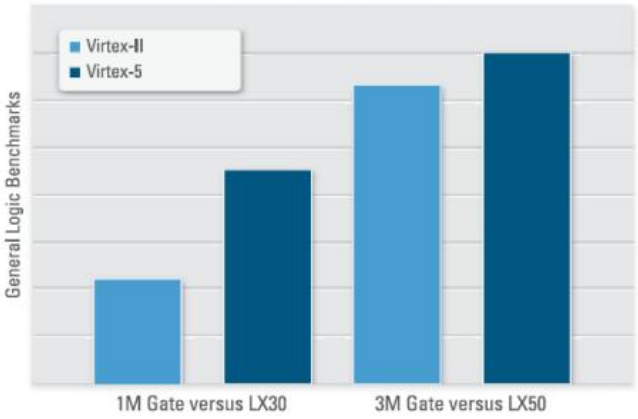


Figure 1. General logic benchmarks show that Virtex-5 FPGAs offer larger sizes than Virtex-II FPGAs.

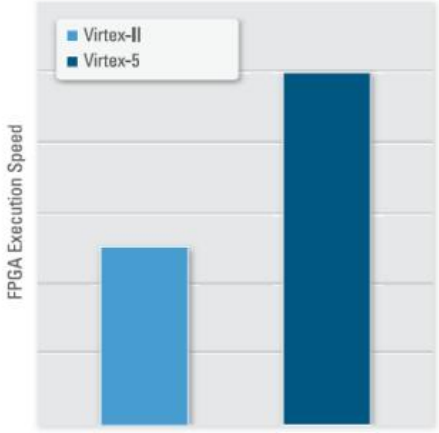


Figure 2. Execution speed benchmarks show that Virtex-5 FPGAs feature faster processing capabilities than Virtex-II FPGAs.

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Ordering Information

For a complete list of accessories, visit the product page on ni.com.

Products	Part Number	Recommended Accessories	Part Number
NI cRIO-9111			
4-Slot, Virtex-5 LX30 CompactRIO Reconfigurable Chassis	780915-01	No accessories required.	
NI cRIO-9112			
8-Slot, Virtex-5 LX30 CompactRIO Reconfigurable Chassis	780916-01	No accessories required.	
NI cRIO-9118			
8-Slot, Virtex-5 LX110 CompactRIO Reconfigurable Chassis	780920-01	No accessories required.	
NI cRIO-9114			
8-Slot, Virtex-5 LX50 CompactRIO Reconfigurable Chassis	780918-01	No accessories required.	
NI cRIO-9116			
8-Slot, Virtex-5 LX85 CompactRIO Reconfigurable Chassis	780919-01	No accessories required.	
NI cRIO-9113			
4-Slot, Virtex-5 LX50 CompactRIO Reconfigurable Chassis	780917-01	No accessories required.	

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Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

Support - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
Discussion Forums - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
Online Community - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

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Course kits - lowest-cost, self-paced training that you can use as reference guides.
Training memberships and training credits - to buy now and schedule training later.
Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

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Detailed Specifications

The following specifications are typical for the range – 40 °C to 70 °C unless otherwise noted. These specifications are for the cRIO-911*x* reconfigurable embedded chassis only. For the controller and I/O module specifications, refer to the operating instructions for the controller and I/O modules you are using.

Reconfigurable FPGA	
cRIO-9111 and cRIO-9112	
FPGA type	Virtex-5 LX30
Number of flip-flops	19,200
Number of 6-input LUTs	19,200
Number of DSP48 slices (25 × 18 multipliers)	32
Embedded block RAM	1,152 kbits
cRIO-9113 and cRIO-9114	
FPGA type	Virtex-5 LX50
Number of flip-flops	28,800
Number of 6-input LUTs	28,800
Number of DSP48 slices (25 × 18 multipliers)	48
Embedded block RAM	1,728 kbits
cRIO-9116	
FPGA type	Virtex-5 LX85
Number of flip-flops	51,840

Number of 6-input LUTs	51,840
Number of DSP48 slices (25 × 18 multipliers)	48
Embedded block RAM	3,456 kbits
cRIO-9118	
FPGA type	Virtex-5 LX110
Number of flip-flops	69,120
Number of 6-input LUTs	69,120
Number of DSP48 slices (25 × 18 multipliers)	64
Embedded block RAM	4,608 kbits
Timebases	40, 80, 120, 160, or 200 MHz
Accuracy	±100 ppm (max)
Frequency-dependent jitter (peak-to-peak, max)	
40 MHz	250 ps
80 MHz	422 ps
120 MHz	422 ps
160 MHz	402 ps
200 MHz	402 ps

Power Requirements

These power requirements are for a fully loaded chassis and exclude the power requirements of the controller and the I/O modules in the chassis. For more information about the controller and the I/O module power requirements, refer to the operating instructions for the controller and for each I/O module.

Chassis power consumption/dissipation	
cRIO-9111 and cRIO-9112	
+5 VDC	500 mW (max)
+3.3 VDC	2,100 mW (max)
Total chassis power consumption	2,600 mW (max)
cRIO-9113 and cRIO-9114	
+5 VDC	500 mW (max)
+3.3 VDC	2,800 mW (max)
Total chassis power consumption	3,300 mW (max)
cRIO-9116	
+5 VDC	500 mW (max)
+3.3 VDC	4,600 mW (max)
Total chassis power consumption	5,100 mW (max)
cRIO-9118	
+5 VDC	500 mW (max)
+3.3 VDC	5,400 mW (max)
Total chassis power consumption	5,900 mW (max)

Note The power consumption specifications in this document are maximum values for a LabVIEW FPGA application compiled at 80 MHz. Your application power requirements may be different. To calculate the power requirements of the CompactRIO system, add the power consumption/dissipation for the chassis, the controller, and the I/O modules you are using. Keep in mind that the resulting total power consumption is a maximum value and that the CompactRIO system may require less power in your application.

Physical Characteristics

If you need to clean the chassis, wipe it with a dry towel.

Chassis weight	
cRIO-9111 and cRIO-9113	Approx. 581 g (20 oz)
cRIO-9112, cRIO-9114, cRIO-9116, and cRIO-9118	Approx. 880 g (31 oz)

Environmental

CompactRIO systems are intended for indoor use only. For outdoor use, mount the CompactRIO system in a suitably rated enclosure.

Operating temperature (IEC-60068-2-1 and IEC-60068-2-2)	– 40 °C to 70 °C

Caution If the ambient temperature is 56 °C to 70 °C, you must mount the chassis on a thermally conductive material. For information about how mounting configuration can affect the accuracy of C Series modules, go to ni.com/info and enter the info code rdcriotemp. Measure the ambient temperature at each side of the CompactRIO system, 63.5 mm (2.5 in.) from the side, and 25.4 mm (1 in.) from the rear cover of the system.

Storage temperature (IEC-60068-2-1 and IEC-60068-2-2)	– 40 °C to 85 °C
Ingress protection	IP 40
Operating humidity (IEC-60068-2-56)	10 to 90% RH, noncondensing
Storage humidity (IEC-60068-2-56)	5 to 95% RH, noncondensing
Maximum altitude	2,000 m
Pollution Degree	2

Shock and Vibration

To meet these specifications, you must panel mount the CompactRIO system and affix ferrules to the ends of the terminal lines.

Operating vibration, random (IEC 60068-2-64)	5 g_{rms}, 10 to 500 Hz
Operating vibration, sinusoidal (IEC 60068-2-6)	5 g, 10 to 500 Hz
Operating shock (IEC 60068-2-27)	30 g, 11 ms half sine, 50 g, 3 ms half sine, 18 shocks at 6 orientations

Safety

Safety Standards

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:
IEC 61010-1, EN 61010-1
UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nA IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA IIC T4
Europe (DEMKO)	Ex nA IIC T4

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:
EN 61326 (IEC 61326): Class A emissions; Industrial Immunity
EN 55011 (CISPR 11): Group 1, Class A emissions
AS/NZS CISPR 11: Group 1, Class A emissions
FCC 47 CFR Part 15B: Class A emissions
ICES-001: Class A emissions

Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

Note For EMC compliance, operate this product according to the documentation.

CE Compliance CE

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:
2006/95/EC; Low-Voltage Directive (safety)
2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit ni.com/certification, search by module number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at ni.com/environment. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of the product life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers, National Instruments WEEE initiatives, and compliance with WEEE Directive 2002/96/EC on Waste Electrical and Electronic Equipment, visit ni.com/environment/weee.htm.

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