Reconfigurable Chassis for CompactRIO
cRIO-911x

- Easy-to-use LabVIEW FPGA automatically synthesizes electrical circuit implementation
- CompactRIO extreme industrial certifications and ratings
- Design hardware in LabVIEW

Comparison Tables

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Application and Technology

CompactRIO reconfigurable chassis are the heart of the CompactRIO system because they contain the reconfigurable I/O (RIO) core. You program the RIO 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 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 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 hardware description language (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

For user manuals and dimensional drawings, visit the product page resources tab on ni.com.
New Virtex-5 FPGAs

The cRIO-91x1 chassis use Virtex-5 FPGAs with improved optimization capabilities to help you execute code faster and increase code capacity. These FPGAs feature a new 6-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 4-input LUTs for up to 16 combinations of digital logic values. The new Virtex-5 FPGAs use 6-input LUTs for up to 64 combinations, which increases 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 6-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.

Ordering Information

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

<table>
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<tr>
<th>Products</th>
<th>Part Number</th>
<th>Recommended Accessories</th>
<th>Part Number</th>
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</thead>
<tbody>
<tr>
<td>cRIO-9111 4-Slot, Virtex-5 LX30 Reconfigurable Chassis</td>
<td>780915-01</td>
<td>No accessories required.</td>
<td></td>
</tr>
<tr>
<td>cRIO-9112 8-Slot, Virtex-5 LX30 Reconfigurable Chassis</td>
<td>780916-01</td>
<td>No accessories required.</td>
<td></td>
</tr>
<tr>
<td>cRIO-9118 8-Slot, Virtex-5 LX110 Reconfigurable Chassis</td>
<td>780920-01</td>
<td>No accessories required.</td>
<td></td>
</tr>
<tr>
<td>cRIO-9114 8-Slot, Virtex-5 LX50 Reconfigurable Chassis</td>
<td>780918-01</td>
<td>No accessories required.</td>
<td></td>
</tr>
<tr>
<td>cRIO-9116 8-Slot, Virtex-5 LX85 Reconfigurable Chassis</td>
<td>780919-01</td>
<td>No accessories required.</td>
<td></td>
</tr>
<tr>
<td>cRIO-9113 4-Slot, Virtex-5 LX50 Reconfigurable Chassis</td>
<td>780917-01</td>
<td>No accessories required.</td>
<td></td>
</tr>
</tbody>
</table>

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.

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.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
- **Online instructor-led training** - lower-cost, remote training if classroom or on-site courses are not possible.
- **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.

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.

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.

Detailed Specifications
The following specifications are typical for the range – 40 °C to 70 °C unless otherwise noted. These specifications are for the cRIO-911x 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.

<table>
<thead>
<tr>
<th>Reconfigurable FPGA</th>
<th>cRIO-9111 and cRIO-9112</th>
<th>cRIO-9113 and cRIO-9114</th>
<th>cRIO-9116</th>
</tr>
</thead>
<tbody>
<tr>
<td>FPGA type</td>
<td>Virtex-5 LX30</td>
<td>Virtex-5 LX50</td>
<td>Virtex-5 LX85</td>
</tr>
<tr>
<td>Number of flip-flops</td>
<td>19,200</td>
<td>28,800</td>
<td></td>
</tr>
<tr>
<td>Number of 6-input LUTs</td>
<td>19,200</td>
<td>28,800</td>
<td></td>
</tr>
<tr>
<td>Number of DSP48 slices (25 × 18 multipliers)</td>
<td>32</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Embedded block RAM</td>
<td>1,152 kbits</td>
<td>1,728 kbits</td>
<td></td>
</tr>
</tbody>
</table>
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**

\(+5 \text{ VDC}\): 500 mW (max)
\(+3.3 \text{ VDC}\): 2,100 mW (max)
Total chassis power consumption: 2,600 mW (max)

**cRIO-9113 and cRIO-9114**

\(+5 \text{ VDC}\): 500 mW (max)
\(+3.3 \text{ VDC}\): 2,800 mW (max)
Total chassis power consumption: 3,300 mW (max)

**cRIO-9116**

\(+5 \text{ VDC}\): 500 mW (max)
\(+3.3 \text{ VDC}\): 4,600 mW (max)
Total chassis power consumption: 5,100 mW (max)

**cRIO-9118**

\(+5 \text{ VDC}\): 500 mW (max)
\(+3.3 \text{ VDC}\): 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

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, 10 to 500 Hz rms

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

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.

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 ni.com/environment/rohs_china.

(For information about China RoHS compliance, go to ni.com/environment/rohs_china.)