CompactRIO Platform
The CompactRIO Advantage

Improve the way you design and deploy advanced control and monitoring systems for the Industrial Internet of Things by leveraging the endless capabilities and unrivaled performance of the CompactRIO platform. From controlling complex machines to monitoring critical assets, CompactRIO offers unsurpassed advantages in any application.

Simplify System Design
Connect to sensors, displays, cameras, motors, databases, and the enterprise directly from CompactRIO controllers to create a powerful system that you can customize and reconfigure through software—even after deployment.

Innovate With a Platform
Choose the performance and form factor that are right for your application, reuse code across hardware, and take advantage of open, integrated software with a vibrant community of users and IP.

Ensure the uptime of critical assets by spending less time collecting data and more time analyzing and acting on it.

When quality, ruggedness, reliability, and time to market matter, you can’t afford to start from scratch.
Endless Capabilities, Unrivaled Performance

Simplify system complexity in even the most advanced applications with CompactRIO, the ultimate multipurpose controller. Eliminate the need for separate subsystems by connecting components directly to CompactRIO and use integrated software for custom processing, analytics, and data visualization.

**MACHINE VISION AND IMAGE PROCESSING**
Connect directly to industrial cameras, use built-in IP, and create custom algorithms for advanced image processing.

**MOTION CONTROL**
Interface directly with drives and motors and use built-in motion IP to configure axis settings, tune motors, and implement custom control algorithms.

**INTEGRATED SOFTWARE**
Define—and redefine—functionality through software to customize your application and accommodate future system requirements.

**DISPLAYS AND DATA VISUALIZATION**
Design interactive, feature-rich GUIs and connect to local, remote, or mobile HMIs for data visualization and operator interfaces.

**PROCESSING AND ANALYTICS**
Process and analyze acquired data in real time and across the enterprise to make informed decisions fast.

**LOGGING AND MONITORING**
Perform advanced data logging or online monitoring—even in extreme conditions. Use native APIs to store data locally or transfer to the enterprise or the cloud.

**INDUSTRIAL COMMUNICATION**
Take advantage of native support for industrial protocols like PROFINET, OPC UA, and EtherCAT to connect to a variety of devices and infrastructure.

**ANALOG AND DIGITAL I/O**
Leverage NI’s leadership in acquiring high-quality signals with measurement-specific signal conditioning, built-in isolation, and industrial I/O.
Innovate With a Platform

With highly integrated software, a community of users and IP, and a common architecture featuring a real-time processor, a user-programmable FPGA, and modular I/O across a variety of form factors, you can take advantage of a single platform to meet the unique needs of any application.

High Performance
From complex motion to critical protection systems, CompactRIO controllers offer the performance to execute advanced control algorithms with deterministic response times and low latency.

Precise and Accurate
CompactRIO controllers combine custom timing, triggering, and synchronization capabilities with world-class analog and digital I/O.

Rugged and Reliable
CompactRIO controllers are built according to stringent design practices and undergo extensive testing and validation to ensure you can deploy reliable systems that last.

Packaged Controllers
Our highest performance controllers, with industrial I/O, extreme ruggedness, and integrated motion, vision, and HMI capabilities

Board-Level Controllers
Small, flexible controllers that support more customizability and ship with a complete middleware stack including deployment-ready I/O drivers and RTOS

Integrated Software
A complete software toolchain that offers extensive math and analysis libraries, tight integration with hardware, and support for multiple programming languages
Packaged Controllers

CompactRIO Controllers feature extreme ruggedness, industry-standard certifications, modular I/O, and integrated motion, vision, industrial communication, and HMI capabilities. C Series modules deliver high-accuracy I/O with measurement-specific signal conditioning so you can connect to any sensor or device on any bus.

Expansion I/O
Add high-performance I/O to any EtherCAT or Ethernet network.

C Series MDK
Use the C Series Module Development Kit (MDK) to develop custom modules that meet your unique system needs.

Vision and Motion
Connect directly to cameras, motors, and drives to simplify overall system complexity.

CompactRIO Controller Specifications

<table>
<thead>
<tr>
<th>Features</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>867 MHz Dual-Core ARM Cortex-A9, 1.33 GHz Dual-Core Intel Atom, 1.91 GHz Quad-Core Intel Atom</td>
</tr>
<tr>
<td>Operating System</td>
<td>NI Linux Real-Time</td>
</tr>
<tr>
<td>Onboard Storage</td>
<td>Up to 16 GB</td>
</tr>
<tr>
<td>FPGA</td>
<td>Xilinx Spartan-6, Xilinx Kintex-7, Xilinx Virtex-7, Xilinx Zynq-7000</td>
</tr>
<tr>
<td>FPGA-Accessible DRAM</td>
<td>Up to 32 MB available on some modules</td>
</tr>
<tr>
<td>I/O</td>
<td>Up to 8 I/O module slots, Gigabit Ethernet, USB, RS232/RS485, Mini DisplayPort, SD, WiFi (802.11abgn)</td>
</tr>
<tr>
<td>Power</td>
<td>4-36 VDC, 360 W</td>
</tr>
<tr>
<td>Ruggedness</td>
<td>IP65, up to 20 g shock and 5 g vibration</td>
</tr>
<tr>
<td>Size</td>
<td>Starts at 119 x 8.7 x 6.4 cm³</td>
</tr>
</tbody>
</table>

C Series Module Specifications

<table>
<thead>
<tr>
<th>Signal Type</th>
<th>Channels</th>
<th>Measurement Types</th>
<th>Max Rate</th>
<th>Special Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Input</td>
<td>2, 4, 8, 16, 32</td>
<td>±200 mV, ±500 mV, ±1 V, ±5 V, ±10 V, ±60 V, ±120 V, ±300 V, ±500 V</td>
<td>1 MS/s/ch</td>
<td>Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Analog Input</td>
<td>2, 4</td>
<td>±10 V, ±30 V</td>
<td>50 kS/s/ch</td>
<td>Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Universal</td>
<td>2, 4, 8</td>
<td>0.01 V, ±10 V, ±30 V</td>
<td>100 kS/s/ch</td>
<td>Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Thermostepper</td>
<td>2, 4, 8, 16</td>
<td>±0.5 °C, ±1 °C, ±2 °C</td>
<td>50 kS/s/ch</td>
<td>Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>RTD</td>
<td>2, 4, 8</td>
<td>±0.5 °C, ±1 °C</td>
<td>100 kS/s/ch</td>
<td>Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Strain / Bridge</td>
<td>2, 4, 8</td>
<td>±0.01 %, ±0.1 %, ±0.2 %</td>
<td>100 kS/s/ch</td>
<td>Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Acceleration</td>
<td>2, 4, 8</td>
<td>±500 °C, ±600 °C</td>
<td>100 kS/s/ch</td>
<td>Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Analog Output</td>
<td>2, 4, 8, 16, 32</td>
<td>±10 V, ±20 V, ±30 V, ±50 V, ±100 V, ±200 V, ±300 V</td>
<td>100 kS/s/ch</td>
<td>Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Digital I/O</td>
<td>2, 4, 8, 16, 32</td>
<td>TTL, 5 V, 12 V, 24 V, 30 V, 250 VDC/WAC</td>
<td>50 ns</td>
<td>Ch-ch isolation, bank isolation, high-voltage bank isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Output</td>
<td>2, 4, 8, 16, 32</td>
<td>TTL, 5 V, 12 V, 24 V, 30 V, 250 VDC/WAC</td>
<td>50 ns</td>
<td>Ch-ch isolation, bank isolation, high-voltage bank isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Relay</td>
<td>2, 4, 8, 16, 32</td>
<td>±0.5 °C, ±1 °C, ±2 °C, ±5 °C, ±10 °C, ±20 °C, ±30 °C, ±50 °C, ±60 °C</td>
<td>10 ns</td>
<td>Ch-ch isolation, bank isolation, high-voltage bank isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
<tr>
<td>Specialty</td>
<td>2, 4, 8, 16, 32</td>
<td>±0.5 °C, ±1 °C, ±2 °C, ±5 °C, ±10 °C, ±20 °C, ±30 °C, ±50 °C, ±60 °C</td>
<td>10 ns</td>
<td>Ch-ch isolation, bank isolation, high-voltage bank isolation, high-voltage bank isolation, anti-aliasing filters</td>
</tr>
</tbody>
</table>

Integrate With Existing Systems
Board-Level Controllers

With smaller size, lower power consumption, and increased flexibility, CompactRIO Single-Board Controllers and the CompactRIO System on Module (SOM) offer a more versatile approach to custom embedded control and monitoring applications. Reuse code across form factors and add application-specific I/O with custom daughterboards.

RIO Mezzanine Card (RMC)

Use the high-density RMC connector to add a custom daughterboard to your CompactRIO Single-Board Controller.

Board-Only C Series Modules

Add validated, off-the-shelf I/O to your board-level controller with board-only C Series modules.

SOM Reference Carrier Board

Save development effort by using validated design files (schematics and Gerber designs) for all of the onboard peripherals.

CompactRIO Single-Board Controller and System on Module Specifications

<table>
<thead>
<tr>
<th>Features</th>
<th>Single-Board Controller</th>
<th>System on Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>667 MHz Dual-Core ARM Cortex-A9</td>
<td></td>
</tr>
<tr>
<td>Operating System</td>
<td>NI Linux Real-Time</td>
<td></td>
</tr>
<tr>
<td>FPGA</td>
<td>Zynq 7000 (Z-7020)</td>
<td></td>
</tr>
<tr>
<td>High-Density Connector</td>
<td>RMC</td>
<td>Carrier board</td>
</tr>
<tr>
<td>Analog I/O</td>
<td>AI—up to 16 SE/DIFF</td>
<td></td>
</tr>
<tr>
<td>Digital I/O</td>
<td>AO—up to 4</td>
<td></td>
</tr>
<tr>
<td>CAN*</td>
<td>Up to 1/2</td>
<td>Q2</td>
</tr>
<tr>
<td>Serial*</td>
<td>Up to 3/9</td>
<td>Q6</td>
</tr>
<tr>
<td>Ethernet*</td>
<td>Up to 1/2</td>
<td>Q2</td>
</tr>
<tr>
<td>USB*</td>
<td>Up to 1/2</td>
<td>Q2</td>
</tr>
<tr>
<td>Power</td>
<td>9 VDC to 36 VDC supply range, up to 20 W max</td>
<td>3.3 VDC supply range, up to 8 W max</td>
</tr>
<tr>
<td>Ruggedness</td>
<td>-40° C to 85° C**; up to 50 g shock, 5 g vibration**</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>Starts at 9.7 x 10.3 x 2.2 cm³</td>
<td>7.6 x 5.1 x 0.8 cm³</td>
</tr>
</tbody>
</table>

*Built-in/total—Built-in onboard ports versus total available ports when using the high-density connector
**Local ambient temperature
***Dependent on enclosure

“There is no comparison to the software integration offered by NI. We estimate that our time to deliver with the [CompactRIO System on Module] is a 1/10th of the time using alternative approaches because of the productivity gains of NI’s approach to system design.”

Sébastien Boria, Airbus
Integrated Software

Define—and redefine—the functionality of your CompactRIO system with intuitive software, and use a single toolchain for every phase of your design cycle: from modeling and simulation, to prototyping and validation, to deployment and beyond. NI software reduces risk, enhances productivity, and eliminates the need to create and maintain I/O drivers, operating systems, and other middleware.

Increased Development Time

Focus on solving problems, not low-level programming tasks, with built-in constructs to manage timing and memory in an intuitive programming environment.

Open Software Interoperability

Leverage other programming approaches alongside or within LabVIEW to reuse existing IP and take advantage of existing expertise.

Built-In Libraries

LabVIEW contains over 950 built-in signal processing, analysis, control, and mathematics functions to accelerate the development of embedded control and monitoring systems.

Security

Boost security and reliability with native support for Security-Enhanced Linux, which delivers mandatory access control through custom policy creation.

Integrated Software

Define—and redefine—the functionality of your CompactRIO system with intuitive software, and use a single toolchain for every phase of your design cycle: from modeling and simulation, to prototyping and validation, to deployment and beyond. NI software reduces risk, enhances productivity, and eliminates the need to create and maintain I/O drivers, operating systems, and other middleware.

Reduced Development Time

Focus on solving problems, not low-level programming tasks, with built-in constructs to manage timing and memory in an intuitive programming environment.

User-Programmable FPGA

Implement high-speed signal and image processing, custom timing and triggering, and control algorithms directly in hardware to maximize reliability and determinism.

Remote System Management

Transfer data between systems or remotely update hundreds of controllers at once with built-in system management utilities.

LabVIEW Tools Network

Extend the capabilities of your system with a vast ecosystem of certified, application-specific add-ons.

Programming Heterogeneous Architectures

Overcome the traditional challenges of programming these architectures with the combination of NI Linux Real-Time and LabVIEW FPGA, which allows you to develop your system faster by programming both the real-time processor and the user-programmable FPGA with a single, intuitive software toolchain. Take advantage of built-in drivers and APIs to move data between the processor and FPGA so you can focus on innovation, not implementation.

Leverage the Openness of NI Linux Real-Time: A Prebuilt, Validated RTOS

From high-speed signal and image processing to custom timing and ultra-precise control, FPGAs deliver the performance and reliability to meet even the most demanding technical requirements. Take advantage of the graphical LabVIEW environment to program the onboard FPGA and unlock the incredible power of these devices—even without any knowledge of hardware description languages like VHDL or Verilog.

- Built-in language constructs to manage clocks/timing, memory, I/O, and data transfer (DMA)
- Cycle-accurate simulation and debugging capabilities
- Cloud compile support to reduce compile time
- Support for HDL code integration
- Access to free IP for complex mathematics, high-speed control, image processing, signal analysis, and more in the FPGA IPNet community

Customize Programmable Hardware With LabVIEW FPGA

NI software reduces risk, enhances productivity, and eliminates the need to create and maintain I/O drivers, operating systems, and other middleware.
Experience the Difference

From controlling complex machines to monitoring critical assets, the CompactRIO platform offers unsurpassed advantages in any control or monitoring application.

1. Airbus Improves Production Quality With Factory of the Future
   Airbus used the CompactRIO platform to quickly validate its ideas, rapidly move from prototype to deployment, and build smart tools that provide realtime data to operators for improving production quality.

2. Hyundai Develops Smart Robotic Exoskeleton 4X Faster With CompactRIO
   Hyundai used the advanced control and data visualization capabilities of CompactRIO to rapidly iterate on its complex control algorithm, expand its sensing capabilities, and significantly reduce its development time.

3. Ventura Aerospace Accelerates Transition From Prototype to Deployment
   Ventura Aerospace relied on the CompactRIO platform to seamlessly move from prototyping with packaged controllers to deploying with board-level controllers to create a cost-effective fire suppression control system for FedEx.

4. Master Machinery Speeds Development With Integrated Vision and Motion
   Master Machinery used the integrated motion and vision capabilities of CompactRIO and extensive built-in libraries to simplify its system and rapidly design a series of smart semiconductor wafer production machines.

5. National Grid Prepares Today for the Grid of Tomorrow
   National Grid relies on the performance and flexibility of CompactRIO to meet its complex and challenging power quality measurement needs today and define and redefine its system for the demands of tomorrow.

6. London Underground Improves Safety and Reliability
   London Underground deployed a CompactRIO condition monitoring system on time and under budget to gain deeper insight into track conditions and proactively detect failures, resulting in more reliable operation and a safer commute.

“With the advanced processing power of CompactRIO, National Grid UK can easily maintain its network of connected systems and push intelligence down the grid to turn massive amounts of raw data into bits of useful information, keeping the lights on for millions of businesses and homes throughout the United Kingdom.”

Peter Haigh, National Grid

Image courtesy of Airbus

Image courtesy of Ventura Aerospace
NI Global Services and Support

**Leverage Expertise**—Alliance Partner Network
Over 1,000 Alliance Partners are available worldwide, many of which offer deep expertise in embedded applications. Increase productivity and mitigate risk by including a partner on your design team.

**Develop the Skills You Need**—Training
Design and develop high-quality applications that scale. NI provides specialized training plans for embedded applications and an Embedded Systems Certification program.

**Overcome Challenges**—Technical Support
NI’s award-winning global support includes online communities, forums, and phone and email support from NI engineers. NI also provides dedicated support specialists, priority escalations, and architecture reviews.

**Reduce Setup Time**—System Configuration and Assembly
Get up and running faster by letting NI perform your installation work. Receive your CompactRIO systems fully assembled and tested, with software preinstalled, per your custom configuration.

**Ensure Longevity**—Life-Cycle Services
NI partners with you from day one to ensure long-term success. This can include a range of life-cycle services to help you effectively plan for, and support, long-term applications.

**Receive Global Support, Locally Delivered**
Rely on a single service network that includes over 30 service locations (including repair centers, calibration labs, and logistics hubs) and more than 600 support and systems engineers in 49 countries.