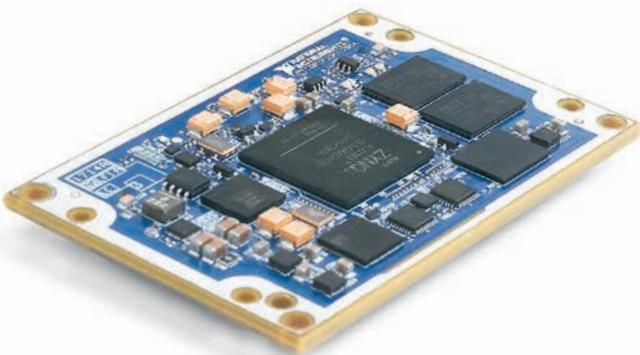
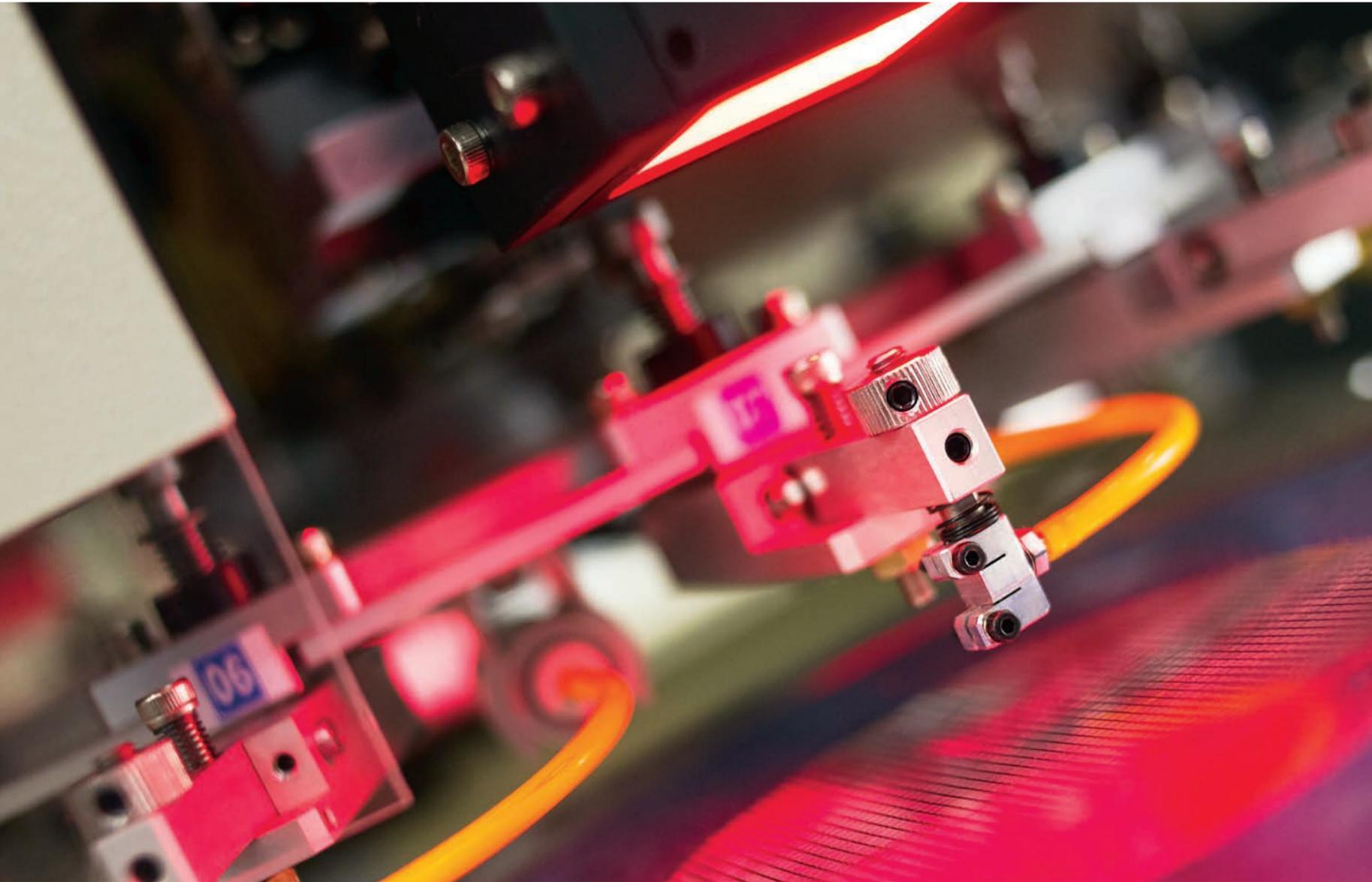


# CompactRIO Platform





## 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



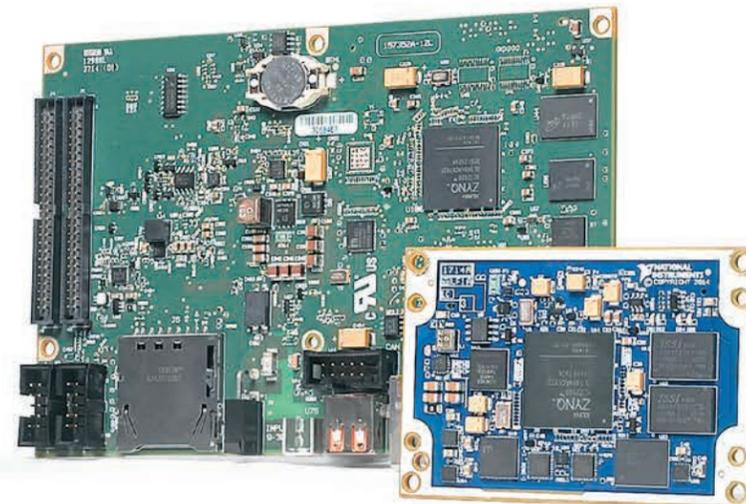
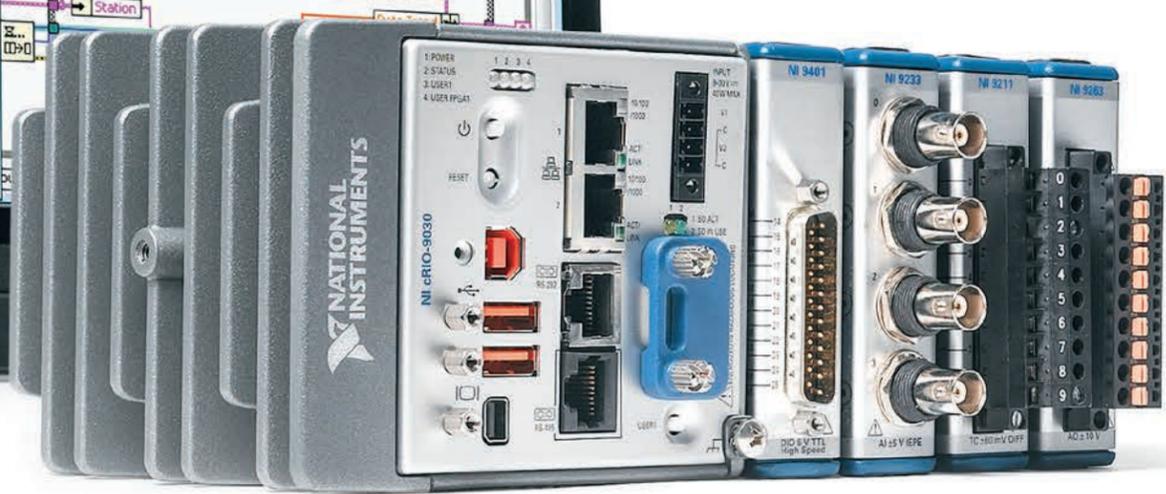
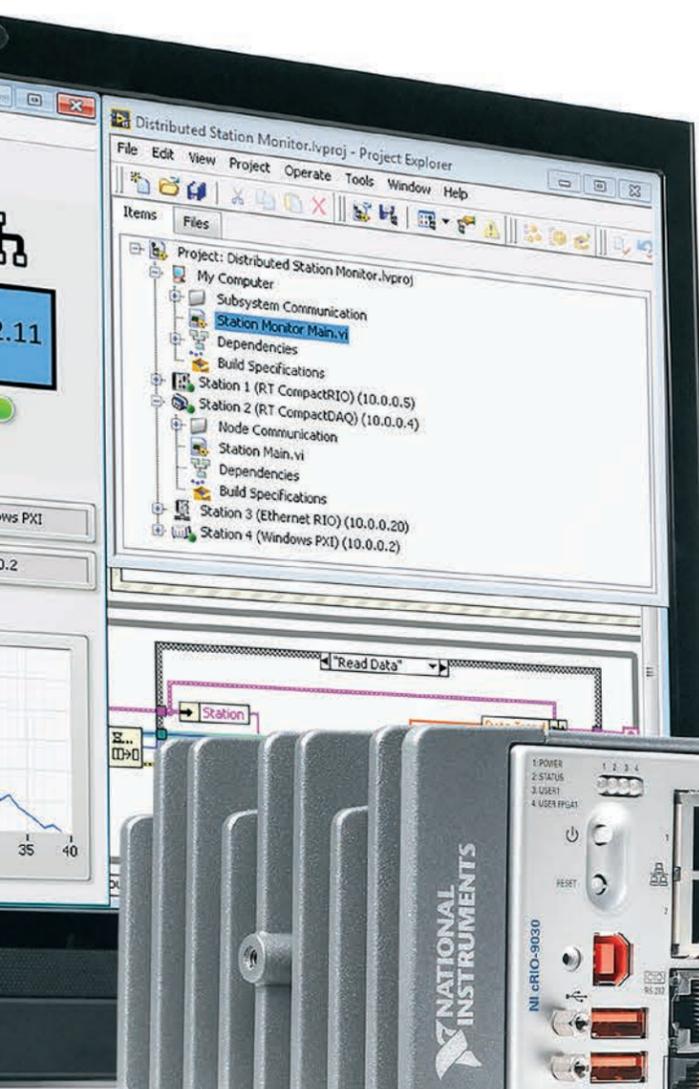
### Board-Level Controllers

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.



## CompactRIO Controller Specifications

| Features             | Specifications  |
|----------------------|---|
| Processor            | 667 MHz Dual-Core ARM Cortex-A9, 1.33 GHz Dual-Core Intel Atom, 1.91 GHz Quad-Core Intel Atom   |
| Operating System     | NI Linux Real-Time  |
| Onboard Storage      | Up to 16 GB   |
| FPGA                 | Zynq-7000 (Z-7020), Kintex-7 (70T, 160T, 325T)  |
| FPGA-Accessible DRAM | Up to 128 MB available on some models   |
| I/O                  | Up to 8 I/O module slots, Gigabit Ethernet, USB, RS232/RS485, Mini DisplayPort, SD, WiFi (802.11a/b/g/n)  |
| Power                | 9 VDC to 30 VDC supply range, up to 46W max   |
| Ruggedness           | Up to -40° C to 70° C, up to 50 g shock and 5 g vibration   |
| Size                 | Starts at 178 x 8.7 x 6.4 cm <sup>3</sup>   |
| Certifications       |        |

## C Series Module Specifications

| Signal Type            | Channels        | Measurement Types   | Max Rate      | Special Features   |
|------------------------|-----------------|---|---------------|--|
| <b>Analog Input*</b>   |                 |   |               |  |
| Voltage                | 2, 4, 8, 16, 32 | ±200 mV, ±500 mV, ±1 V, ±5 V, ±10 V, ±60 V, 3 V <sub>rms</sub> , 300 V <sub>rms</sub> , 400 V <sub>rms</sub> , 800 V <sub>rms</sub> | 1 MS/s/ch     | Ch-ch isolation, high-voltage bank isolation, anti-aliasing filters  |
| Current                | 4, 8, 16        | +/-20 mA, 5 Arms, 20 Arms, 50 Arms  | 200 kS/s      | Anti-aliasing filters, ch-ch isolation, built-in shunt resistors   |
| Universal              | 2, 4            | V, mA, TC, RTD, strain, Ω, IEPE   | 51.2 kS/s/ch  | Excitation, bridge completion, anti-aliasing filters, ch-ch isolation, built-in shunt resistors, amplification |
| Thermocouple           | 4, 8, 16        | J, K, T, E, N, B, R, and S types  | 75 S/s/ch     | CJC, bank isolation, amplification, filtering, ch-ch isolation   |
| RTD                    | 4, 8            | 100 Ω, 1000 Ω   | 400 S/s       | 50/60 Hz filtering   |
| Strain/Bridge Based    | 4, 8            | ¼, ½, full bridge (120 or 350 Ω)  | 50 kS/s/ch    | Excitation, bridge completion, anti-aliasing filters   |
| Acceleration and Sound | 3, 4            | ±5 V, ±30 V   | 102.4 kS/s/ch | IEPE, anti-aliasing filters  |
| <b>Analog Output*</b>  |                 |   |               |  |
| Voltage                | 2, 4, 16        | ±10 V, 3 V <sub>rms</sub>   | 100 kS/s/ch   | Ch-ch isolation, bank isolation  |
| Current                | 4               | 0 mA–20 mA  | 100 kS/s/ch   | Open-loop detection  |
| <b>Digital I/O</b>     |                 |   |               |  |
| Input                  | 4, 8, 16, 32    | LVTTTL, 5 VTTL, 12 V, 24 V, 30 V, 250 VDC/VAC   | 55 ns         | Ch-ch isolation, bank isolation, sinking and sourcing  |
| Output                 | 4, 8, 16, 32    | LVTTTL, 5 VTTL, 12 V, 24 V, 60 V, 0 V–50 V programmable   | 55 ns         | Ch-ch isolation, bank isolation, sinking and sourcing  |
| Input/Output           | 4, 8, 16, 32    | LVTTTL, 5 VTTL, 12 V, 24 V  | 55 ns         | Ch-ch isolation, bank isolation  |
| Relays                 | 4, 8            | 30 VDC, 60 VDC, 250 VAC; SPST and SS  | 1 op/sec      | Ch-ch isolation, bank isolation  |
| <b>Specialty</b>       |                 |   |               |  |
| Motion                 | 1, 4            | Step/dir, CW/CCW, analog PWM  | —             | Stepper and servo drive signals, incremental encoder feedback  |
| Synchronization        | 1, 3            | Cabled, GPS   | —             | Pulse per second accuracy of ±100 ns for multichassis synchronization  |

\* Up to 24-bit resolution



### 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

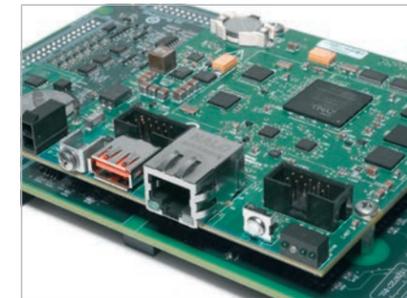
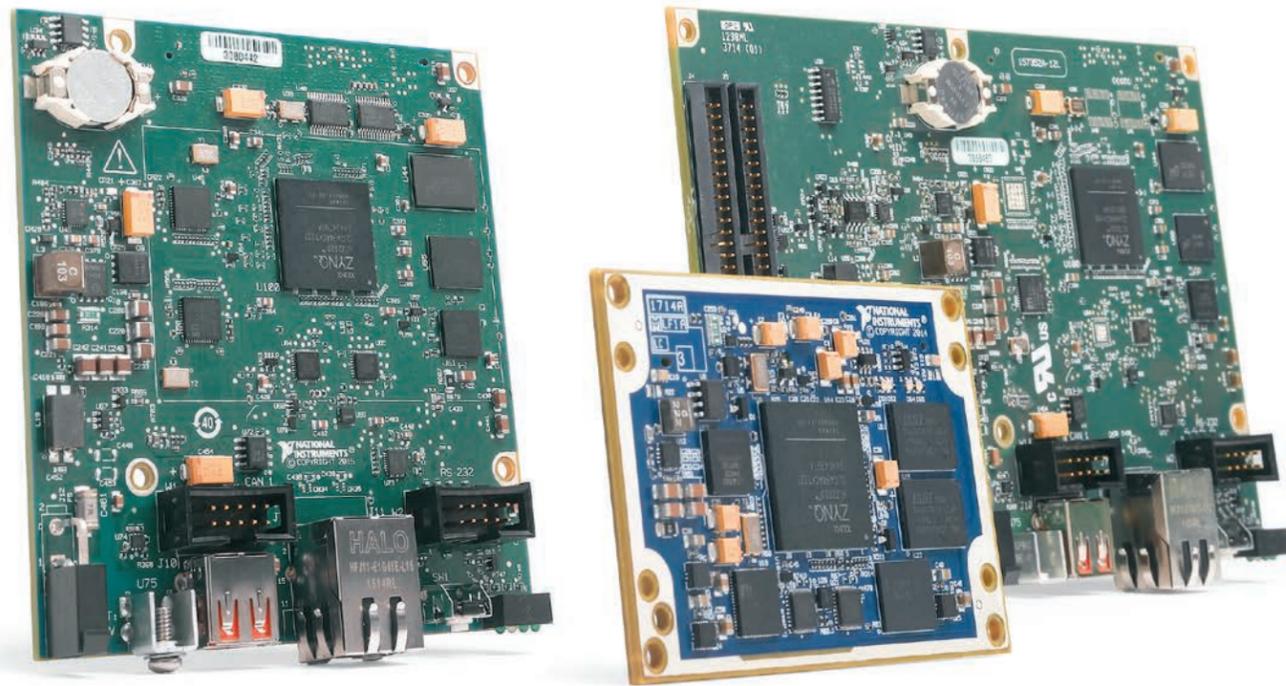
Connect directly to cameras, motors, and drives to simplify overall system complexity.

## Integrate With Existing Systems

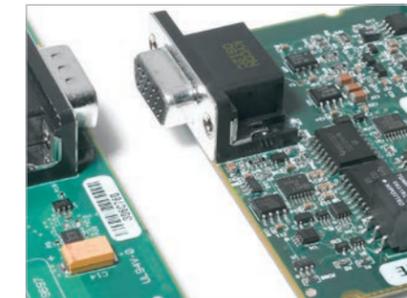


# Board-Level Controllers

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.



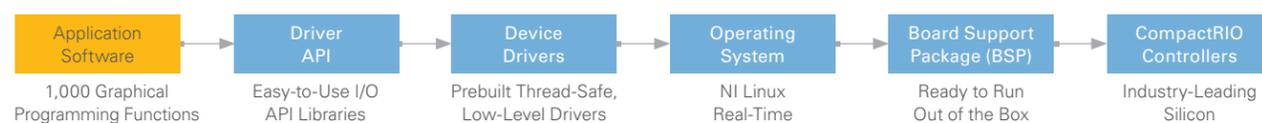
**SOM Reference Carrier Board**  
Save development effort by using validated design files (schematics and Gerber designs) for all of the onboard peripherals.

## CompactRIO Single-Board Controller and System on Module Specifications

| Features               | Single-Board Controller                               | System on Module                    |
|------------------------|---|-------------------------------------|
| Processor              | 667 MHz Dual-Core ARM Cortex-A9                       |                                     |
| Operating System       | NI Linux Real-Time                                    |                                     |
| FPGA                   | Zynq-7000 (Z-7020)                                    |                                     |
| High-Density Connector | RMC   | Carrier board                       |
| Analog I/O             | AI—up to 16 SE/8 DIFF<br>AO—up to 4                   | 0                                   |
| Digital I/O            | Up to 100 SE  | 160 SE/72 DIFF                      |
| CAN*                   | Up to 1/2   | 0/2                                 |
| Serial*                | Up to 3/9   | 0/6                                 |
| Ethernet*              | Up to 1/2   | 0/2                                 |
| USB*                   | Up to 1/2   | 0/2                                 |
| SD*                    | Up to 1/2   | 0/1                                 |
| Power                  | 9 VDC to 30 VDC supply range, up to 29 W max          | 3.3 VDC supply range, up to 8 W max |
| Ruggedness             | -40° C to 85° C**; up to 50 g shock, 5 g vibration*** |                                     |
| Size                   | Starts at 9.7 x 10.3 x 2.2 cm <sup>3</sup>            | 7.6 x 5.1 x 0.8 cm <sup>3</sup>     |

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

## DEPLOYMENT-READY SOFTWARE STACK



Eliminate the risks and overhead associated with building and maintaining I/O drivers and operating systems by using a fully tested, deployment-ready software stack that you can build on.

“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 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.

## Reduced Development Time

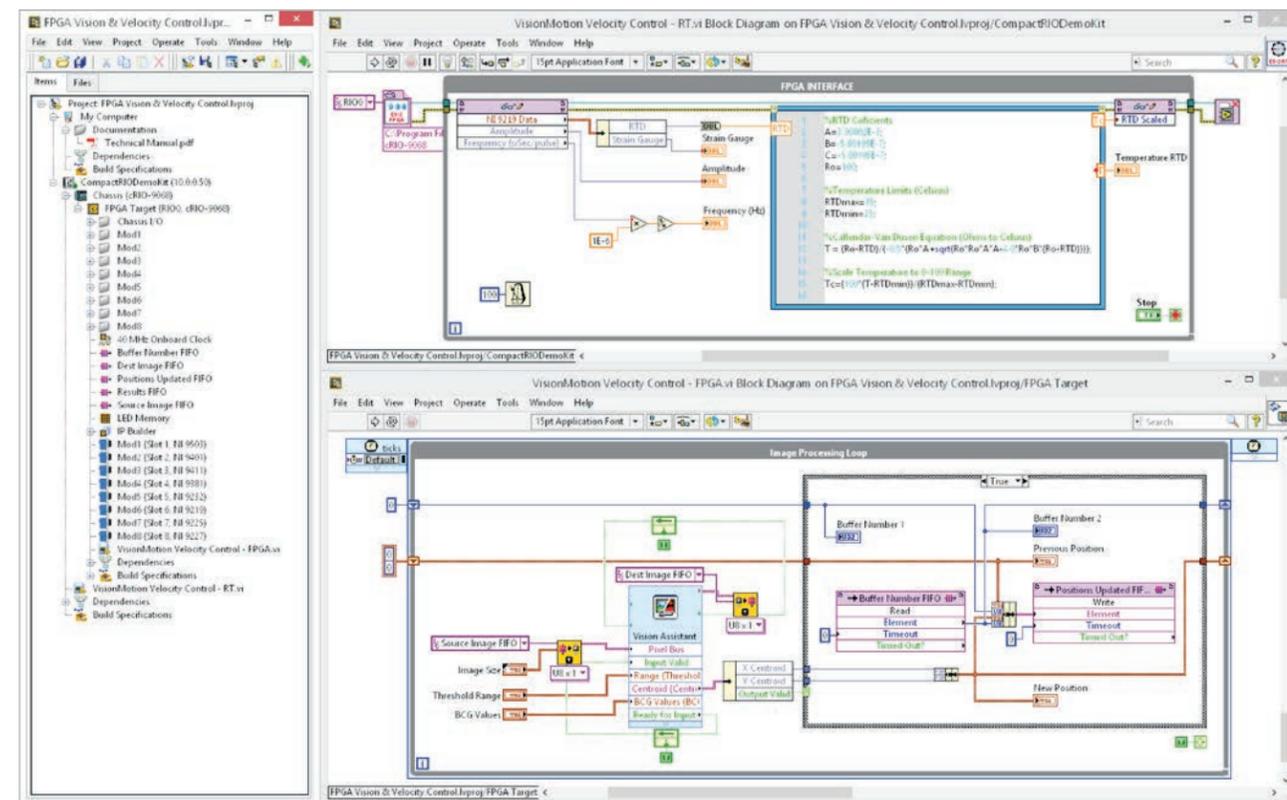
Focus on solving problems, not low-level programming tasks, with built-in constructs to manage timing and memory in an intuitive programming environment.

## 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.



## 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.

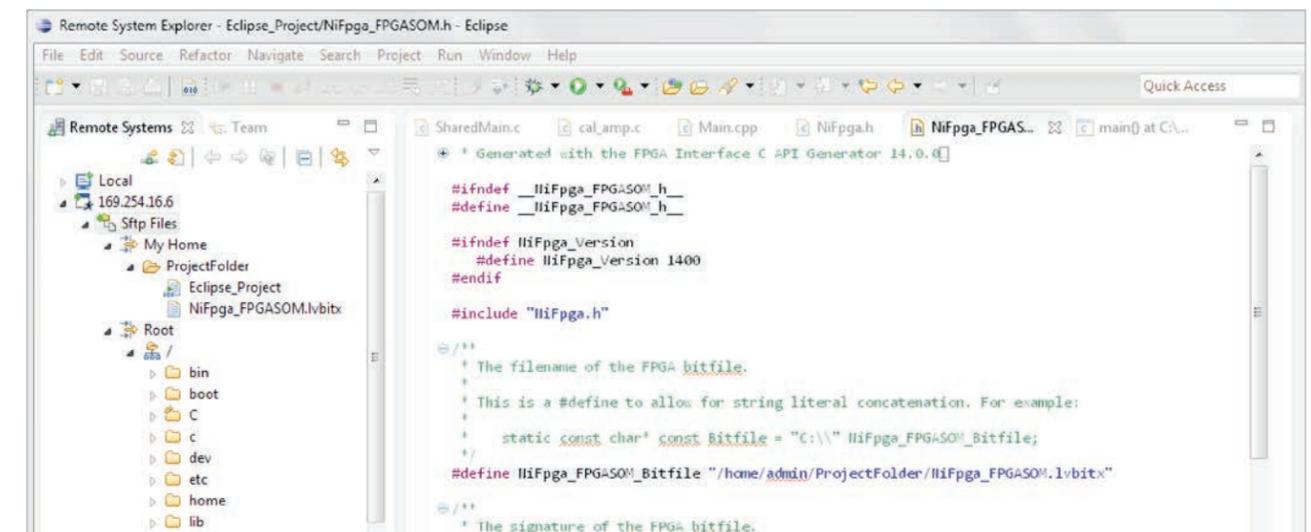
## LabVIEW Tools Network

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



## Development Tool Options

Program the real-time processor with LabVIEW, C/C++, or textural math and reuse code from past projects to save development time.

## Linux Ecosystem

Access thousands of open-source applications, IP, and examples and collaborate with an active community of users and developers.

## Security

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

## Customize Programmable Hardware With LabVIEW FPGA

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 times
- 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

# 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 real-time 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**

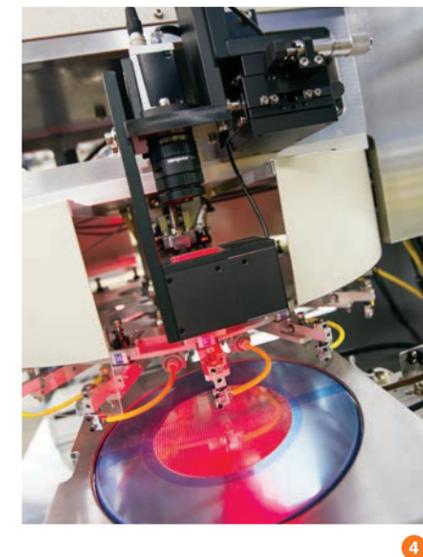
National Grid relies on the performance and flexibility of CompactRIO to meet its complex and challenging power quality measurement needs today and define and redefine its system for the demands of tomorrow.

**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





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## 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.

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