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CompactRIO Integrated Systems with Real-Time Controller and Reconfigurable Chassis

NI cRIO-907x

- Integrated CompactRIO systems with a reconfigurable FPGA chassis and embedded real-time controller
- Lower-cost systems for high-volume OEM applications
- Up to 2M gate reconfigurable FPGA
- 4 or 8 slots for C Series I/O modules
- Up to 400 MHz real-time processor
- Up to 256 MB DRAM memory, 512 MB of nonvolatile storage
- Up to two 10/100BASE-TX Ethernet ports with built-in FTP/HTTP servers and LabVIEW remote panel Web server
- RS232 serial port and available USB port for peripheral devices

Overview

NI cRIO-907x integrated systems combine an industrial real-time controller and reconfigurable field-programmable gate array (FPGA) chassis for industrial machine control and monitoring applications. The NI cRIO-9074 integrated system features an industrial 400 MHz real-time processor and an eight-slot chassis with an embedded, reconfigurable 2M gate FPGA chip. The new NI cRIO-9076 integrated system contains a 400 MHz real-time processor, a four-slot chassis with an embedded, reconfigurable LX45 FPGA chip, and a high-speed USB port. Both systems feature built-in nonvolatile memory and a fault tolerant file system. The new four-slot NI cRIO-9075 and NI cRIO-9076 systems provide a cost-optimized solution for high volume deployments and OEM applications.

Back to Top

Requirements and Compatibility

OS Information

- VxWorks

Driver Information

- NI-RIO

Software Compatibility

- LabVIEW
- LabVIEW FPGA Module
- LabVIEW Professional Development System
-

Back to Top

Comparison Tables

Product	Module Slots	Processor Speed (MHz)	FPGA	DRAM (MB)	Internal Nonvolatile Storage (MB)	10/100BASE-TX Ethernet Port	RS232 Serial Port	Power Supply Input Range	USB Port
NI cRIO-9072	8	266	Spartan-3 1M	64	128	yes	yes	19 to 30 VDC	no
NI cRIO-9073	8	266	Spartan-3 2M	64	128	yes	yes	19 to 30 VDC	no
NI cRIO-9074	8	400	Spartan-3 2M	128	256	yes (Dual)	yes	19 to 30 VDC	no
NI cRIO-9075	4	400	Spartan-6 LX25	128	256	yes	yes	9 to 30 VDC	no
NI cRIO-9076	4	400	Spartan-6 LX45	256	512	yes	yes	9 to 30 VDC	yes

Back to Top

Application and Technology

System Configuration

These NI CompactRIO real-time controllers combine a four- or eight-slot reconfigurable chassis into an integrated system. The user-defined FPGA circuitry in the chassis controls each I/O module and passes data to the controller through a local PCI bus using built-in communication functions.

Product	FPGA	Logic Cells	Multipliers	RAM (Kb)
NI cRIO-9073	Spartan-3 2M	46080	40	720
NI cRIO-9074	Spartan-3 2M	46080	40	720
NI cRIO-9075	Spartan-6 LX25	24051	38	936
NI cRIO-9076	Spartan-6 LX45	43661	58	2088

FPGA Resource Comparison

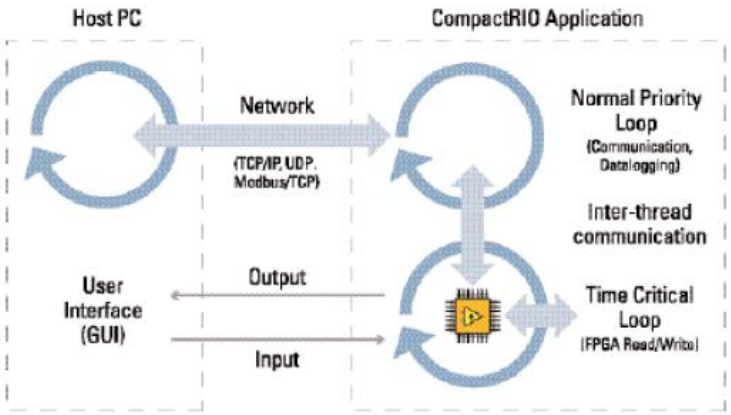
These systems also accept up to eight NI C Series I/O modules. A variety of I/O modules are available including voltage, current, thermocouple, RTD, accelerometer, and strain gage inputs; up to ±60 V simultaneous sampling analog I/O; 12, 24, and 48 V industrial digital I/O; 5 V/TTL digital I/O; counter/timers; pulse generation; and high voltage/current relays.

The 10/100 Mbits/s Ethernet port allows for programmatic communication over the network and the cRIO-9074 features dual Ethernet ports, which allows for the use of one port for network communication to a host PC or enterprise system and the other port for expansion I/O (easily connect another CompactRIO system or another Ethernet-based device for additional I/O). The new cRIO-9076 also features a USB 2.0 port for data storage and connection to peripheral devices.

NI CompactRIOs have the ability to by synchronized with an SNTP time server on a network and the cRIO-9072, cRIO-9073, and cRIO-9074 also feature a built-in backup battery to maintain operation for the Real-Time Clock when external power is removed. The cRIO-9075 and cRIO-9076 do not contain a backup battery for the Real-Time Clock.

Embedded Software

You can synchronize embedded code execution to an FPGA-generated interrupt request (IRQ) or an internal millisecond real-time clock source. The LabVIEW Real-Time ETS OS provides reliability and simplifies the development of complete embedded applications that include time-critical control and acquisition loops in addition to lower-priority loops for postprocessing, data logging, and Ethernet/serial communication. Built-in elemental I/O functions such as the FPGA Read/Write function provide a communication interface to the highly optimized reconfigurable FPGA circuitry. Data values are read from the FPGA in integer format and are then converted to scaled engineering units in the controller.



CompactRIO Software Architecture

Note: NI Scan Engine is not supported on the cRIO-9075 and cRIO-9076.

Built-In Servers

In addition to programmatic communication via TCP/IP, UDP, Modbus/TCP, IrDA, and serial protocols, the CompactRIO controllers include built-in servers for Virtual Instrument Software Architecture (VISA), HTTP, and FTP. The VISA server provides remote download and communication access to the reconfigurable I/O (RIO) FPGA over Ethernet. The HTTP server provides a Web browser user interface to HTML pages, files, and the user interface of embedded LabVIEW applications through a Web browser plug-in. The FTP server provides access to logged data or configuration files.

Back to Top

Ordering Information

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

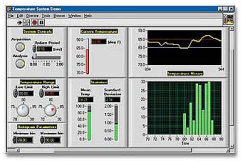
Products	Part Number	Recommended Accessories	Part Number
NI cRIO-9072			
cRIO-9072 8-Slot Integrated 266 MHz Real-Time Ctrlr, 1M Gate FPGA Requires:	779998-01	**Connector Block:** Screw Terminal - NI 9978 4-pos screw terminal power supply plugs (quantity 5)	196938-01
NI cRIO-9073			
cRIO-9073 8-Slot Integrated 266 MHz Real-Time Ctrlr, 2M Gate FPGA Requires:	780471-01	**Connector Block:** Shielded - NI PS-15 Power Supply, 24 VDC, 5 A, 100-120/200-240 VAC Input ***Also Available: Screw Terminal*	781093-01
		Connector Block: Screw Terminal - NI 9979 Strain relief kit for 4-pos power connector	196939-01
NI cRIO-9076			
cRIO-9076 4-Slot Integrated 400 MHz Real-Time Ctrlr,	781716-01	**Connectivity Accessory:** Shielded - NI PS-15 Power Supply, 24 VDC, 5 A,	781093-01

LX45 FPGA Requires: 1 Connectivity Accessory		100-120/200-240 VAC Input	
NI cRIO-9075			
cRIO-9075 4-Slot Integrated 400 MHz Real-Time Ctrlr, LX25 FPGA Requires: 1 Connectivity Accessory	781715-01	**Connectivity Accessory:** Shielded - NI PS-15 Power Supply, 24 VDC, 5 A, 100-120/200-240 VAC Input	781093-01
NI cRIO-9074			
cRIO-9074 8-Slot Integrated 400 MHz Real-Time Ctrlr, 2M Gate FPGA Requires: 1 Connectivity Accessory	779999-01	**Connectivity Accessory:** Shielded - NI PS-15 Power Supply, 24 VDC, 5 A, 100-120/200-240 VAC Input	781093-01

Back to Top

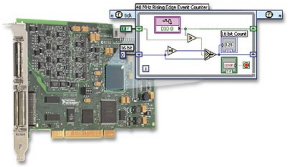
Software Recommendations

LabVIEW Professional Development System for Windows



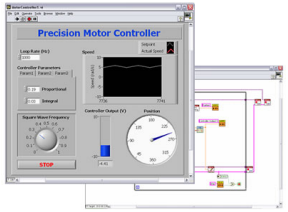
- Advanced software tools for large project development
- Automatic code generation using DAQ Assistant and Instrument I/O Assistant
- Tight integration with a wide range of hardware
- Advanced measurement analysis and digital signal processing
- Open connectivity with DLLs, ActiveX, and .NET objects
- Capability to build DLLs, executables, and MSI installers

NI LabVIEW FPGA Module



- Define your own control algorithms with loop rates up to 40 MHz
- Execute multiple tasks simultaneously and deterministically
- Create your own I/O hardware without VHDL coding or board design
- Implement custom timing and triggering logic with 25 ns resolution
- Graphically configure FPGAs on NI reconfigurable I/O (RIO) hardware targets

LabVIEW Real-Time Module



- Design real-time applications with graphical programming
- Download to a dedicated target for reliable, deterministic performance
- Deploy as a distributed, stand-alone, or embedded system
- Use built-in PID control functions or create your own control algorithms
- Purchase individually or as part of the NI Developer Suite

Back to Top

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. NI offers a number of calibration services to help maintain the ongoing accuracy of your measurement hardware. These services allow you to be completely confident in your measurements, and help you maintain compliance to standards like ISO 9001, ANSI/NCSL Z540-1 and ISO/IEC 17025. 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.

- **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.

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 600 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

Back to Top

Detailed Specifications

The following specifications are typical for the – 20 to 55 °C operating temperature range unless otherwise noted.

Network	
Network interface	10BaseT and 100BaseTX Ethernet
Compatibility	IEEE 802.3
Communication rates	10 Mbps, 100 Mbps, auto-negotiated

Maximum cabling distance	100 m/segment
RS-232 Serial Port	
Maximum baud rate	115,200 bps
Data bits	5, 6, 7, 8
Stop bits	1, 2
Parity	Odd, Even, Mark, Space
Flow control	RTS/CTS, XON/XOFF, DTR/DSR
SMB Connector (cRIO-9074 Only)	
Output Characteristics	
Minimum high-level output voltage	
With –100 µA output current	2.9 V
With –16 mA output current	2.4 V
With –24 mA output current	2.3 V
Maximum low-level output voltage	
With 100 µA output current	0.10 V
With 16 mA output current	0.40 V
With 24 mA output current	0.55 V
Driver type	CMOS
Maximum sink/source current	±24 mA
Maximum 3-state output leakage current	±5 µA
Input Characteristics	
Minimum input voltage	0 V
Minimum low-level input voltage	0.94 V
Maximum high-level input voltage	2.43 V
Maximum input voltage	5.5 V
Typical input capacitance	2.5 pF
Typical resistive strapping	1 kΩ to 3.3 V
Memory	
cRIO-9072, cRIO-9073	
Nonvolatile	128 MB
System memory	64 MB
cRIO-9074	
Nonvolatile	256 MB
System memory	128 MB

Reconfigurable FPGA	
cRIO-9072	
Number of logic cells	17,280
Available embedded RAM	432 kbits
cRIO-9073, cRIO-9074	
Number of logic cells	46,080
Available embedded RAM	720 kbits

Internal Real-Time Clock	
Accuracy	200 ppm; 35 ppm at 25 °C

Power Requirements	
Caution You must use a National Electric Code (NEC) UL Listed Class 2 power supply with the cRIO-9072/3/4.	
Recommended power supply	48 W, 24 VDC
Power consumption	20 W maximum
Power supply input range	19 to 30 V

Physical Characteristics	
If you need to clean the controller, wipe it with a dry towel.	
Screw-terminal wiring	0.5 to 2.5 mm 2 (24 to 12 AWG) copper conductor wire with 10 mm (0.39 in.) of insulation stripped from the end
Torque for screw terminals	0.5 to 0.6 N · m (4.4 to 5.3 lb · in.)
Weight	929 g (32.7 oz)

Safety Voltages	
Connect only voltages that are within these limits.	
V terminal to C terminal	35 V max, Measurement Category I

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.

Caution Do not connect the system to signals or use for measurements within Measurement Categories II, III, or IV.

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.

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.

Battery Replacement and Disposal

This device contains a long-life coin cell battery. If you need to replace it, use the Return Material Authorization (RMA) process or contact an authorized National Instruments sevice representative.

After replacement, recycle the old battery. For additional information, visit ni.com/environment.

Hazardous Locations

U.S. (UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nL IIC T4
Canada (C-UL)	Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nL IIC T4
Europe (DEMKO)	Ex nL IIC T4 (part numbers beginning with 192172F and 198944 only)

Environmental

The cRIO-9072/3/4 is intended for indoor use only, but it may be used outdoors if mounted in a suitably rated enclosure.

Operating temperature (IEC 60068-2-1, IEC 60068-2-2)	– 20 to 55 °C

Note To meet this operating temperature range, follow the guidelines in the installation instructions for your CompactRIO system.

Storage temperature (IEC 60068-2-1, IEC 60068-2-2)	– 40 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 (IEC 60664)	2

Shock and Vibration

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

Operating shock (IEC 60068-2-27)	30 g, 11 ms half sine 50 g, 3 ms half sine, 18 shocks at 6 orientations
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

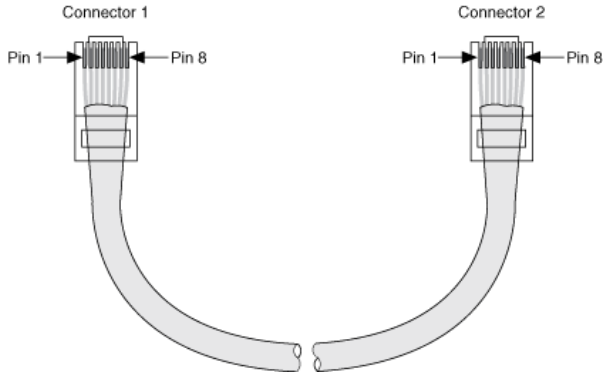
Cabling

The following table shows the standard Ethernet cable wiring connections for both normal and crossover cables.

Ethernet Cable Wiring Connections			
Pin	**Connector 1**	**Connector 2 (Normal)**	**Connector 2 (Crossover)**
1	white/orange	white/orange	white/green
2	orange	orange	green
3	white/green	white/green	white/orange
4	blue	blue	blue
5	white/blue	white/blue	white/blue
6	green	green	orange
7	white/brown	white/brown	white/brown
8	brown	brown	brown

Back to Top

Pinouts/Front Panel Connections



Ethernet Connector Pinout

Back to Top