

cRIO-9040

Specifications

Contents

cRIO-9040 Specifications. 3

cRIO-9040 Specifications

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

Characteristics describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

- **Typical** specifications describe the performance met by a majority of models.
- **Nominal** specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are **Typical** unless otherwise noted.

Conditions

Specifications are valid for -20 °C to 55 °C unless otherwise noted.

Processor

| | |
|-----------------|---------------------------------|
| CPU | Intel Atom E3930 |
| Number of cores | 2 |
| CPU frequency | 1.3 GHz (base), 1.8 GHz (burst) |
| On-die L2 cache | 2 MB |

Software



Note For minimum software support information, visit ni.com/info and enter the Info Code swsupport.

| | |
|---|---|
| Supported operating system | NI Linux Real-Time (64-bit) |
| Supported C Series module programming modes | Real-Time (NI-DAQmx) Real-Time Scan (I/O Variables) LabVIEW FPGA |
| Application software | |
| LabVIEW ^[1] | LabVIEW 2017 or later, LabVIEW Real-Time Module 2017 or later, LabVIEW FPGA Module 2017 or later, |
| C/C++ Development Tools for NI Linux Real-Time ^[2] | Eclipse Edition 2014 or later |
| Driver software | NI CompactRIO Device Drivers December 2017 or later |

Network/Ethernet Port

| | |
|---------------------|---|
| Number of ports | 2 |
| Network interface | 10Base-T, 100Base-TX, and 1000Base-T Ethernet |
| Compatibility | IEEE 802.3 |
| Communication rates | 10 Mb/s, 100 Mb/s, 1000 Mb/s/auto-negotiated |

| | |
|--------------------------|---------------|
| Maximum cabling distance | 100 m/segment |
|--------------------------|---------------|

Network Timing and Synchronization

| | |
|---|--|
| Protocol | IEEE 802.1AS-2011 IEEE 1588-2008 (default end-to-end profile) |
| Supported ethernet ports | Port 0, port 1 |
| Network synchronization accuracy ^[3] | <1 μ s |



Note The cRIO-9040 employs time-aware transmission support. For more information about time-aware transmission support, visit ni.com/info and enter Info Code timeaware.

RS-232 Serial Port

| | |
|----------------------------|----------------------------|
| Maximum baud rate | 115,200 b/s |
| Data bits | 5, 6, 7, 8 |
| Stop bits | 1, 2 |
| Parity | Odd, even, mark, space |
| Flow control | RTS/CTS, XON/XOFF, DTR/DSR |
| RI wake maximum low level | 0.8 V |
| RI wake minimum high level | 2.4 V |

| | |
|--------------------------|-------|
| RI overvoltage tolerance | ±24 V |
|--------------------------|-------|

RS-485 Serial Port

| | |
|-------------------|--|
| Maximum baud rate | 230,400 b/s |
| Data bits | 5, 6, 7, 8 |
| Stop bits | 1, 2 |
| Parity | Odd, even, mark, space |
| Flow control | XON/XOFF |
| Wire mode | 4-wire, 2-wire, 2-wire auto |
| Isolation voltage | 60 V DC continuous, port to earth ground |



Note The RS-485 serial port ground and shield are functionally isolated from chassis ground to prevent ground loops, but do not meet IEC 61010-1 for safety isolation.

| | |
|-------------------|--|
| Cable requirement | Unshielded, 30 m maximum length (limited by EMC/surge) |
|-------------------|--|



Note RS-485 is capable of 1.2 km (4,000 ft) length without surge limitation.

USB Ports

Port 1: 

| | |
|-------------------|-----------------------|
| Type | USB Type-A, host port |
| USB interface | USB 2.0, Hi-Speed |
| Maximum data rate | 480 Mb/s |
| Maximum current | 900 mA |

Port 2:



| | |
|-------------------|--------------------------|
| Type | USB Type-C, host port |
| USB interface | USB 3.1 Gen1, SuperSpeed |
| Maximum data rate | 5 Gb/s |
| Maximum current | 900 mA |
| Alternate modes | DisplayPort |

Port 3:

| | |
|-------------------|---|
| Type | USB Type-C, dual role port (device or host) |
| USB interface | USB 3.1 Gen1, SuperSpeed |
| Maximum data rate | 5 Gb/s |
| Maximum current | 900 mA |

DisplayPort over USB Type-C

| | |
|--------------------|----------------------|
| Maximum resolution | 3840 × 2160 at 60 Hz |
|--------------------|----------------------|

| | |
|---------------------|--|
| Supported standard | DisplayPort 1.2 |
| Supported USB ports | Port 2:   |

SD Card Slot

| | |
|----------------------------|-----------------------|
| SD card support | SD and SDHC standards |
| Supported interface speeds | UHS-I SDR50 and DDR50 |



Notice Full and high speed SD cards are prohibited for use with the cRIO-9040.

Memory

| | |
|-------------------------------|-----------------|
| Nonvolatile memory (SSD) | 4 GB |
| Nonvolatile memory (SSD) type | Planar SLC NAND |



Note Visit ni.com/info and enter the Info Code ssdbp for information about the life span of the nonvolatile memory and about best practices for using nonvolatile memory.

Volatile memory (DRAM)

| | |
|-------------------------------|-----------|
| Density | 2 GB |
| Type | DDR3L |
| Maximum theoretical data rate | 12.8 GB/s |

Reconfigurable FPGA

| | |
|--|-----------------------|
| FPGA type | Xilinx Kintex-7 7K70T |
| Number of flip-flops | 82,000 |
| Number of 6-input LUTs | 41,000 |
| Number of DSP slices (18 × 25 multipliers) | 240 |
| Available block RAM | 4,860 kbits |
| Number of DMA channels | 16 |
| Number of logical interrupts | 32 |

Internal Real-Time Clock

| | |
|----------|--------------------------|
| Accuracy | 200 ppm; 40 ppm at 25 °C |
|----------|--------------------------|

Controller PFI 0

| | |
|-----------------------------------|----------------|
| Maximum input or output frequency | 1 MHz |
| Cable length | 3 m (10 ft) |
| Cable impedance | 50 Ω |
| PFI 0 connector | SMB |
| Power-on state | High impedance |

| | |
|-------------------------------------|---------------|
| I/O standard compatibility | 5 V TTL |
| I/O voltage protection | ±30 V |
| Maximum operating conditions | |
| I _{OL} output low current | 8 mA maximum |
| I _{OH} output high current | -8 mA maximum |

| Voltage | Minimum | Maximum |
|--------------------------|---------|---------|
| Positive going threshold | 1.43 V | 2.28 V |
| Negative going threshold | 0.86 V | 1.53 V |
| Hysteresis | 0.48 V | 0.87 V |

Table 1. DC Input Characteristics

| Voltage | Conditions | Minimum | Maximum |
|---------|-----------------|---------|---------|
| High | — | — | 5.25 V |
| | Sourcing 100 µA | 4.65 V | — |
| | Sourcing 2 mA | 3.60 V | — |
| | Sourcing 3.5 mA | 3.44 V | — |
| Low | Sinking 100 µA | — | 0.10 V |
| | Sinking 2 mA | — | 0.64 V |
| | Sinking 3.5 mA | — | 0.80 V |

Table 2. DC Output Characteristics

Real-Time Streaming Performance

Data throughput is dependent on the application, system, and performance of the removable storage media. For information about optimizing data throughput on the cRIO-9040 visit ni.com/info and enter Info Code optdata.

Data throughput from system memory to target

| | |
|------------|----------|
| SD card | 40 MB/s |
| USB Type-C | 100 MB/s |

Real-Time (NI-DAQmx) Mode

The following specifications are applicable for modules and slots programmed in Real-Time (NI-DAQmx) mode. For more information about using modules in LabVIEW FPGA mode or Real-Time Scan (I/O Variables) mode, visit ni.com/r/swsupport.

Analog Input

| | |
|------------------------------------|--|
| Input FIFO size | 253 samples per slot |
| Maximum sample rate ^[4] | Determined by the C Series module or modules |
| Timing accuracy ^[5] | 50 ppm of sample rate |
| Timing resolution | 12.5 ns |
| Number of channels supported | Determined by the C Series module or modules |
| Number of hardware-timed tasks | 8 |

Analog Output

Hardware-timed tasks

| | |
|--------------------------------|---|
| Number of hardware-timed tasks | 8 |
|--------------------------------|---|

Number of channels supported

| | |
|------------------------------------|--|
| Onboard regeneration | 16 |
| Non-regeneration | Determined by the C Series module or modules |
| Non-hardware-timed tasks | |
| Number of non-hardware-timed tasks | Determined by the C Series module or modules |
| Number of channels supported | Determined by the C Series module or modules |
| Maximum update rate | 1.6 MS/s |



Note Streaming applications are limited by system-dependent factors and the capability of C Series modules.

| | |
|------------------------------------|--|
| Timing accuracy | 50 ppm of sample rate |
| Timing resolution | 12.5 ns |
| Waveform onboard regeneration FIFO | 8,191 samples shared among channels used |
| Waveform streaming FIFO | 253 samples per slot |

Digital Waveform

| | |
|--|----------------------|
| Waveform acquisition (DI) FIFO | |
| Parallel modules | 255 samples per slot |
| Serial modules | 127 samples per slot |
| Waveform onboard regeneration (DO) FIFO | |

| | |
|-------------------------------------|---------------------------------------|
| Parallel modules | 2,047 samples shared among slots used |
| Waveform streaming (DO) FIFO | |
| Parallel modules | 255 samples per slot |
| Serial modules | 127 samples per slot |
| Sample clock frequency | |
| Digital input | 0 MHz to 10 MHz |
| Digital output | |
| ot0:6 timing engine | 0 MHz to 3.5 MHz |
| ot7 timing engine | 0 MHz to 10 MHz |



Note Streaming applications are limited by system-dependent factors and the capability of C Series modules.

| | |
|---|--------|
| Timing accuracy | 50 ppm |
| Number of digital input hardware-timed tasks | 8 |
| Number of digital output hardware-timed tasks | 8 |

General-Purpose Counters/Timers

| | |
|---------------------------|---------|
| Number of counters/timers | 4 |
| Resolution | 32 bits |

| | |
|-------------------------------|---|
| Counter measurements | Edge counting, pulse, semi-period, period, two-edge separation, pulse width |
| Position measurements | X1, X2, X4 quadrature encoding with Channel Z reloading; two-pulse encoding |
| Output applications | Pulse, pulse train with dynamic updates, frequency division, equivalent time sampling |
| Internal base clocks | 80 MHz, 20 MHz, 13.1072 MHz, 12.8 MHz, 10 MHz, 100 kHz |
| External base clock frequency | 0 MHz to 20 MHz |
| Base clock accuracy | 50 ppm |
| Output frequency | 0 MHz to 20 MHz |
| Inputs | Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down |
| Routing options for inputs | Any module PFI, controller PFI, analog trigger, many internal signals |
| FIFO | Dedicated 127-sample FIFO |

Frequency Generator

| | |
|--------------------|-------------------------|
| Number of channels | 1 |
| Base clocks | 20 MHz, 10 MHz, 100 kHz |
| Divisors | 1 to 16 (integers) |

| | |
|---------------------|---|
| Base clock accuracy | 50 ppm |
| Output | Any controller PFI or module PFI terminal |

Module PFI

| | |
|--------------------------------------|---|
| Functionality | Static digital input, static digital output, timing input, and timing output |
| Timing output sources ^[6] | Many analog input, analog output, counter, digital input, and digital output timing signals |
| Timing input frequency | 0 MHz to 20 MHz |
| Timing output frequency | 0 MHz to 20 MHz |

Digital Triggers

| | |
|------------------------|--|
| Source | Any controller PFI or module PFI terminal |
| Polarity | Software-selectable for most signals |
| Analog input function | Start Trigger, Reference Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |
| Analog output function | Start Trigger, Pause Trigger, Sample Clock, Sample Clock Timebase |
| Counter/timer function | Gate, Source, HW_Arm, Aux, A, B, Z, Up_Down |

Module I/O States

| | |
|-------------|--|
| At power-on | Module-dependent. Refer to the documentation for each C Series module. |
|-------------|--|

Time-Based Triggers and Timestamps

| | |
|-------------------------------|--|
| Number of time-based triggers | 5 |
| Number of timestamps | 6 |
| Analog input | |
| Time-based triggers | Start Trigger, Sync Pulse |
| Timestamps | Start Trigger, Reference Trigger, First Sample |
| Analog output | |
| Time-based triggers | Start Trigger, Sync Pulse |
| Timestamps | Start Trigger, First Sample |
| Digital input | |
| Time-based triggers | Start Trigger |
| Timestamps | Start Trigger, Reference Trigger, First Sample |
| Digital output | |
| Time-based triggers | Start Trigger |
| Timestamps | Start Trigger, First Sample |

Counter/timer input

| | |
|---------------------|-------------------|
| Time-based triggers | Arm Start Trigger |
| Timestamps | Arm Start Trigger |

Counter/timer output

| | |
|---------------------|----------------------------------|
| Time-based triggers | Start Trigger, Arm Start Trigger |
| Timestamps | Start Trigger, Arm Start Trigger |

CMOS Battery

| | |
|--|-----------|
| Typical battery life with power applied to power connector | 10 years |
| Typical battery life when stored at temperatures up to 25 °C | 7.8 years |
| Typical battery life when stored at temperatures up to 85 °C | 5.4 years |

Power Requirements



Note Some C Series modules have additional power requirements. For more information about C Series module power requirements, refer to the C Series module(s) documentation.



Note Sleep mode for C Series modules is not supported in Real-Time (DAQmx) Mode.

Voltage input range (measured at the cRIO-9040 power connector)

| | |
|----|-------------|
| V1 | 9 V to 30 V |
|----|-------------|

| | |
|---------------------------|-------------|
| V2 | 9 V to 30 V |
| Maximum power consumption | 60 W |



Note The C terminal of the power connector is functionally isolated from chassis ground to prevent ground loops, but does not meet IEC 61010-1 for safety isolation



Note The maximum power consumption specification is based on a fully populated system running a high-stress application at elevated ambient temperature and with all C Series modules and USB devices consuming the maximum allowed power.

| | |
|-----------------------------------|------------------------|
| Typical standby power consumption | 3.4 W at 24 V DC input |
| Recommended power supply | 100 W, 24 V DC |

Typical leakage current from secondary power input (V2) while system is powered from primary power input (V1)

| | |
|---------|---------|
| At 9 V | 0.4 mA |
| At 30 V | 1.93 mA |



Notice Do not connect V2 to a DC Mains supply or to any supply that requires a connecting cable longer than 3 m(10 ft). A DC Mains supply is a local DC electricity supply network in the infrastructure of a site or building. V1 may be connected to DC Mains.



Notice Include a switch or circuit breaker in the installation to disconnect the system from DC Mains. The switch or circuit breaker must be suitably rated, accessible, and marked as the disconnecting device for the system.

EMC ratings for inputs as described in IEC 61000

V1 Short lines, long lines, and DC distributed networks

V2 Short lines only

| | |
|-----------------------|--|
| Power input connector | 4-position, 3.5 mm pitch, pluggable screw terminal with screw locks, Sauro CTF04BV8-AN000A |
|-----------------------|--|

Battery Guidelines



Caution Fire, explosion, and severe burn hazard. Do not open, crush, insert improperly, recharge or disassemble the battery. Do not heat the battery or the product above 100 °C. Do not incinerate the battery or the product. Do not expose the battery contents to water. Take precautions to ensure correct polarity of the battery in the product. Risk of explosion if battery is replaced by an incorrect type. Dispose of used batteries according to the instructions.



Attention Risque d'incendie, d'explosion et de brûlures graves. Ne pas ouvrir, écraser, recharger ou démonter la pile. Ne pas chauffer la pile ou le produit au-dessus de 100 °C. Ne pas incinérer la pile ou le produit. Éviter tout contact du contenu de la pile avec de l'eau. Prenez des précautions pour vous assurer que la polarité de la batterie dans le produit est correcte. Risque d'explosion si la pile est remplacée par un type de pile incorrect. Reportez-vous à la documentation de l'appareil sur ni.com/manuals pour obtenir des informations sur le remplacement, l'élimination et le recyclage de sa pile.



Caution The battery must be replaced by a trained service technician. Refer to the product documentation on ni.com/manuals for instructions for replacing the battery.



Attention La pile doit être remplacée par un technicien de maintenance qualifié. Reportez-vous à la documentation du produit sur ni.com/manuals pour obtenir les instructions pour changer la pile.

Battery Rating

| | |
|-----------------------|--------------------------|
| Manufacturer | Tadiran |
| Model | TLH-2450/P |
| Quantity | 1 |
| Cell chemistry system | Lithium Thionyl Chloride |

Physical Characteristics

| | |
|-----------------------|---|
| Weight (unloaded) | 1,800 g (3 lb, 15 oz) |
| Dimensions (unloaded) | 219.5 mm × 88.1 mm × 121.2 mm (8.64 in. × 3.47 in. × 4.77 in.) |

Power connector wiring

| | |
|----------------------------|---|
| Gauge | 0.5 mm ² to 2.1 mm ² (20 AWG to 14 AWG) copper conductor wire |
| Wire strip length | 6 mm (0.24 in.) of insulation stripped from the end |
| Temperature rating | 85 °C |
| Torque for screw terminals | 0.20 N · m to 0.25 N · m (1.8 lb · in. to 2.2 lb · in.) |

Wires per screw terminal One wire per screw terminal

Connector securement

Securement type Screw flanges provided

Torque for screw flanges 0.20 N · m to 0.25 N · m (1.8 lb · in. to 2.2 lb · in.)

| | |
|-------------------|----------------|
| Insulation rating | 300 V, maximum |
|-------------------|----------------|

Safety Voltages

Connect only voltages that are below these limits.

| | |
|------------------------------|---------------|
| V1 terminal to C terminal | 30 V, maximum |
| V2 terminal to C terminal | 30 V, maximum |
| Chassis ground to C terminal | 30 V, maximum |

Environmental Characteristics

Temperature

Operating -20 °C to 55 °C

Storage -40 °C to 85 °C

Humidity

Operating 10% RH to 90% RH, noncondensing

Storage 5% RH to 95% RH, noncondensing

| | |
|----------------------------|--|
| Ingress protection | IP20 |
| Pollution Degree | 2 |
| Maximum altitude | 5,000 m |
| Shock and Vibration | |
| Operating vibration | |
| Random | 5 g RMS, 10 Hz to 500 Hz |
| Sinusoidal | 5 g, 10 Hz to 500 Hz |
| Operating shock | 30 g, 11 ms half sine; 50 g, 3 ms half sine; 18 shocks at 6 orientations |

To meet these specifications, you must mount the cRIO-9040 system directly on a flat, rigid surface as described in the user manual, affix ferrules to the ends of the terminal wires, and use retention accessories for the USB 2.0 host port (NI USB Extender Cable, 152166-xx), USB type-C ports (NI Locking USB Cables, 143556-xx; NI USB Extender Cable, 143555-xx; NI USB Display Adapters, 143557-xx or 143558-xx). All cabling should be strain-relieved near input connectors. Take care to not directionally bias cable connectors within input connectors when applying strain relief.

Environmental Standards

This product meets the requirements of the following environmental standards for electrical equipment.

- IEC 60068-2-1 Cold
- IEC 60068-2-2 Dry heat
- IEC 60068-2-30 Damp heat cyclic (12 + 12h cycle)
- IEC 60068-2-64 Random operating vibration

- IEC 60068-2-6 Sinusoidal operating vibration
- IEC 60068-2-27 Operating shock



Note To verify marine approval certification for a product, refer to the product label or visit ni.com/certification and search for the certificate.

Hazardous Locations Certifications

| | |
|---|---|
| U.S. (UL) | Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx ec IIC T4 Gc |
| Canada (C-UL) | Class I, Division 2, Groups A, B, C, D, T4; Ex ec IIC T4 Gc |
| Europe (ATEX) and International (IECEX) | Ex ec IIC T4 Gc; Ⓜ II 3 G UL 21 ATEX 2518X; IECEX UL 21.0013X |



Safety Compliance and Hazardous Locations Standards

This product is designed to meet the requirements of the following electrical equipment safety standards for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA C22.2 No. 61010-1
- EN 60079-0, EN 60079-7
- IEC 60079-0, IEC 60079-7
- UL 60079-0, UL 60079-7
- CSA C22.2 No. 60079-0, CSA C22.2 No. 60079-7



Note For safety certifications, refer to the product label or the [Product Certifications and Declarations](#) section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326-1 (IEC 61326-1): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions



Note In Europe, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in non-residential locations.



Note Group 1 equipment (per CISPR 11) is any industrial, scientific, or medical equipment that does not intentionally generate radio frequency energy for the treatment of material or inspection/analysis purposes.



Notice For EMC declarations and certifications, and additional information, refer to the [Product Certifications and Declarations](#) section.

CE Compliance

This product meets the essential requirements of applicable European Directives, as follows:

- 2014/35/EU; Low-Voltage Directive (safety)
- 2014/30/EU; Electromagnetic Compatibility Directive (EMC)
- 2014/34/EU; Potentially Explosive Atmospheres (ATEX)
- 2011/65/EU; Restriction of Hazardous Substances (RoHS)

Product Certifications and Declarations

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for NI


products, visit ni.com/product-certifications, search by model number, and click the appropriate link.

Environmental Management


NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the **Engineering a Healthy Planet** 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.


EU and UK Customers

-  Waste Electrical and Electronic Equipment (WEEE)—At the end of the product life cycle, all NI products must be disposed of according to local laws and regulations. For more information about how to recycle NI products in your region, visit ni.com/environment/weee.

Battery Replacement and Disposal

-  Battery Directive—This product contains a long-life coin cell battery. If you need to replace it, use the Return Material Authorization (RMA) process or contact an authorized NI service representative. For more information about compliance with the EU Battery Directive 2006/66/EC about Batteries and Accumulators and Waste Batteries and Accumulators, visit ni.com/environment/batterydirective.

电子信息产品污染控制管理办法 (中国 RoHS)

-  中国 RoHS—NI 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 NI 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.)

NI Services

Visit ni.com/support to find support resources including documentation, downloads, and troubleshooting and application development self-help such as tutorials and examples.

Visit ni.com/services to learn about NI service offerings such as calibration options, repair, and replacement.

Visit ni.com/register to register your NI product. Product registration facilitates technical support and ensures that you receive important information updates from NI.

NI corporate headquarters is located at 11500 N Mopac Expwy, Austin, TX, 78759-3504, USA.

¹ LabVIEW FPGA Module is not required when using Real-Time Scan (I/O Variables) mode or Real-Time (NI-DAQmx) mode. To program the user-accessible FPGA on the cRIO-9040, the LabVIEW FPGA Module is required.

² C/C++ Development Tools for NI Linux Real-Time is an optional interface for C/C++ programming of the cRIO-9040 processor. Visit ni.com/info and enter Info Code RIOCDdev for more information about the C/C++ Development Tools for NI Linux Real-Time.

³ Network synchronization is system-dependent. For information about network synchronization accuracy, visit ni.com/info and enter Info Code criosync.

⁴ Performance dependent on type of installed C Series module and number of channels in the task.

⁵ Does not include group delay. For more information, refer to the documentation for each C Series module.

⁶ Actual available signals are dependent on type of installed C Series module.