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SPECIFICATIONS

cRIO-9045

1.30 GHz Dual-Core CPU, 2 GB DRAM, 4 GB Storage, Kintex-7 70T FPGA, 8-Slot CompactRIO Controller

Definitions

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

The following characteristic specifications 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

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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, NI-DAQmx 17.6 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

[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-9045, 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-9045 processor. Visit *ni.com/info* and enter Info Code `RIOCdev` for more information about the C/C++ Development Tools for NI Linux Real-Time.

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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 µs

Note The cRIO-9045 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

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

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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:

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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-9045.

Memory

Nonvolatile memory (SSD)	4 GB

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

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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

Table 1. DC Input Characteristics

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 2. DC Output 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

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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-9045 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 modules and slots programmed in LabVIEW FPGA mode or Real-Time Scan (I/O Variables) mode, refer to the C Series module specifications on *ni.com/manuals*.

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

[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.

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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	
Slots 1 to 4	2,047 samples per slot
Slots 5 to 8	1,023 samples per slot
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

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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

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

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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

Note Time-based triggers and timestamps are only supported in NI-DAQmx 18.1 or later.

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

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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-9045 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

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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

Physical Characteristics

Weight (unloaded)	2,250 g (4 lbs, 15 oz)
Dimensions (unloaded)	328.8 mm × 88.1 mm × 121.2 mm (12.94 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

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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

This product was tested in accordance with IEC 60068-2.

Temperature	
Operating	-20 °C to 55 °C
Storage	-40 °C to 85 °C
Ingress protection	IP20
Operating humidity	10% RH to 90% RH, noncondensing
Storage humidity	5% RH to 95% RH, noncondensing
Pollution Degree	2
Maximum altitude	5,000 m

Indoor use only.

Shock and Vibration

To meet these specifications, you must mount the cRIO-9045 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.

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This product was tested in accordance with IEC 60068-2.

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

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