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**NI-9917**

## SPECIFICATIONS

# cDAQ™-9189

8-Slot, Extended Temperature, Ethernet CompactDAQ Chassis

## Definitions

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*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 expected performance met by a majority of the models.
- *Nominal* specifications describe parameters and attributes that may be useful in operation.

Specifications are *Typical* unless otherwise noted.

## Conditions

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Specifications are valid at 25 °C unless otherwise noted.

## Analog Input

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|                                  |                                                           |
|----------------------------------|-----------------------------------------------------------|
| Input FIFO size                  | 127 samples per slot                                      |
| Maximum sample rate <sup>1</sup> | Determined by the C Series module or modules              |
| Timing accuracy <sup>2</sup>     | 50 ppm of sample rate                                     |
| Internal base clocks             | 80 MHz, 20 MHz, 13.1072 MHz, 12.8 MHz,<br>10 MHz, 100 kHz |
| Number of channels supported     | Determined by the C Series module or modules              |

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<sup>1</sup> Performance dependent on type of installed C Series module and number of channels in the task.

<sup>2</sup> Does not include group delay. For more information, refer to the documentation for each C Series module.

# Analog Output

## Number of channels supported

|                                              |                                              |
|----------------------------------------------|----------------------------------------------|
| Hardware-timed task                          |                                              |
| Onboard regeneration                         | 16                                           |
| Non-regeneration                             | Determined by the C Series module or modules |
| Non-hardware-timed task                      |                                              |
| Determined by the C Series module or modules |                                              |

## Maximum update rate

|                      |                                              |
|----------------------|----------------------------------------------|
| Onboard regeneration | 1.6 MS/s (multi-channel, aggregate)          |
| Non-regeneration     | Determined by the C Series module or modules |

## Timing accuracy

|                      |                                                        |
|----------------------|--------------------------------------------------------|
| Internal base clocks | 80 MHz, 20 MHz, 13.1072 MHz, 12.8 MHz, 10 MHz, 100 kHz |
|----------------------|--------------------------------------------------------|

## Output FIFO size

|                      |                                          |
|----------------------|------------------------------------------|
| Onboard regeneration | 8,191 samples shared among channels used |
| Non-regeneration     | 127 samples per slot                     |

## AO waveform modes

|                                                                                                                                                                      |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Non-periodic waveform,<br>periodic waveform regeneration mode from<br>onboard memory,<br>periodic waveform regeneration from host<br>buffer including dynamic update |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

# Digital Waveform Characteristics

## Waveform acquisition (DI) FIFO

|                  |                      |
|------------------|----------------------|
| Parallel modules | 511 samples per slot |
| Serial modules   | 63 samples per slot  |

## Waveform generation (DO) FIFO

|                  |                        |
|------------------|------------------------|
| Parallel modules |                        |
| Slots 1 to 4     | 2,047 samples per slot |
| Slots 5 to 8     | 1,023 samples per slot |



**Note** When parallel modules in a digital task are in slots 1 through 4, FIFO is 2,047 samples per slot for all slots. When any parallel module in a digital task is in slots 5 through 8, FIFO is 1,023 samples per slot for all eight slots.

#### Digital input sample clock frequency

|                                 |                  |
|---------------------------------|------------------|
| Streaming to application memory | System-dependent |
| Finite                          | 0 MHz to 10 MHz  |

#### Digital output sample clock frequency

|                                   |                  |
|-----------------------------------|------------------|
| Streaming from application memory | System-dependent |
| Regeneration from FIFO            | 0 MHz to 10 MHz  |
| Finite                            | 0 MHz to 10 MHz  |

|                 |        |
|-----------------|--------|
| Timing accuracy | 50 ppm |
|-----------------|--------|

|                      |                                                        |
|----------------------|--------------------------------------------------------|
| Internal base clocks | 80 MHz, 20 MHz, 13.1072 MHz, 12.8 MHz, 10 MHz, 100 kHz |
|----------------------|--------------------------------------------------------|

## 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, chassis PFI, analog trigger, many internal signals                    |
| FIFO                          | Dedicated 127-sample FIFO                                                             |

# Frequency Generator

|                          |                                        |
|--------------------------|----------------------------------------|
| Number of channels       | 1                                      |
| Base clocks <sup>3</sup> | 20 MHz, 10 MHz, 100 kHz                |
| Divisors                 | 1 to 16 (integers)                     |
| Base clock accuracy      | 50 ppm                                 |
| Output                   | Any chassis PFI or module PFI terminal |

# Module PFI Characteristics

|                                    |                                                                                             |
|------------------------------------|---------------------------------------------------------------------------------------------|
| Functionality                      | Static digital input, static digital output, timing input, and timing output                |
| Timing output sources <sup>4</sup> | 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                                                                             |

# Chassis PFI Characteristics

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

<sup>3</sup> Base clocks can be synchronized with other chassis using the network synchronization feature.

<sup>4</sup> Actual available signals are dependent on type of installed C Series module.

**Table 1. Input/Output Voltage Protection**

| Voltage | Minimum | Maximum |
|---------|---------|---------|
| Input   | -20 V   | 25 V    |
| Output  | -15 V   | 20 V    |

Maximum operating conditions<sup>5</sup>

|                              |               |
|------------------------------|---------------|
| $I_{OL}$ output low current  | 8 mA maximum  |
| $I_{OH}$ output high current | -8 mA maximum |

**Table 2. 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 3. DC Output Characteristics**

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

## Digital Triggers

|          |                                        |
|----------|----------------------------------------|
| Source   | Any chassis PFI or module PFI terminal |
| Polarity | Software-selectable for most signals   |

<sup>5</sup> Stresses beyond those listed under *Maximum operating conditions* may cause permanent damage to the chassis.

|                        |                                                                                            |
|------------------------|--------------------------------------------------------------------------------------------|
| Analog input function  | Start Trigger, Reference Trigger,<br>Pause Trigger, Sample Clock,<br>Sample Clock Timebase |
| Analog output function | Start Trigger, Pause Trigger, Sample Clock,<br>Sample Clock Timebase                       |
| Counter/timer function | Gate, Source, HW_Arm, Aux, A, B, Z,<br>Up_Down                                             |

## Module I/O States

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

## Time-Based Triggers and Timestamps

|                               |                                                |
|-------------------------------|------------------------------------------------|
| Number of time-based triggers | 5                                              |
| Number of timestamps          | 4                                              |
| 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               |

# Network Interface

|                               |                                                                                                                                                                               |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Network protocols             | TCP/IP, UDP                                                                                                                                                                   |
| Network ports used            | HTTP:80 (configuration only), TCP:3580; UDP:5353 (configuration only), TCP:5353 (configuration only); TCP:31415; UDP:7865 (configuration only), UDP:8473 (configuration only) |
| Network IP configuration      | DHCP + Link-Local, DHCP, Static, Link-Local                                                                                                                                   |
| High-performance data streams | 7                                                                                                                                                                             |
| Data stream types available   | Analog input, analog output, digital input, digital output, counter/timer input, counter/timer output, NI-XNET <sup>6</sup>                                                   |
| Default MTU size              | 1500 bytes                                                                                                                                                                    |

# Ethernet

|                                    |                                                                                                                                                          |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of ports                    | 2 ports, internally switched <sup>7</sup>                                                                                                                |
| Network interface                  | 1000 Base-TX, full-duplex; 1000 Base-TX, half-duplex; 100 Base-TX, full-duplex; 100 Base-TX, half-duplex; 10 Base-T, full-duplex; 10 Base-T, half-duplex |
| Communication rates                | 10/100/1000 Mbps, auto-negotiated                                                                                                                        |
| Maximum cabling distance           | 100 m/segment                                                                                                                                            |
| Maximum hops per line <sup>8</sup> | 15                                                                                                                                                       |

<sup>6</sup> When a session is active, CAN or LIN (NI-XNET) C Series modules use a total of two data streams regardless of the number of NI-XNET modules in the chassis.

<sup>7</sup> This allows for line topologies or network redundancy.

<sup>8</sup> With default software configuration. For information about creating reliable Ethernet-based systems, visit [ni.com/info](http://ni.com/info) and enter Info Code `cdaqenet`.



# Timing and Synchronization

|                                                                             |                                                                         |
|-----------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Protocol                                                                    | IEEE 802.1AS for network synchronization over 1000 Base-TX, full-duplex |
| Network synchronization accuracy <sup>9</sup>                               | <1 $\mu$ s                                                              |
| Network synchronization accuracy with optimized configuration <sup>10</sup> | <100 ns                                                                 |

## Power Requirements



**Caution** The protection provided by the cDAQ-9189 chassis can be impaired if it is used in a manner not described in the *cDAQ-9185/9189 User Manual*.



**Note** Some C Series modules have additional power requirements. For more information about C Series module power requirements, refer to the documentation for each C Series module.



**Note** Sleep mode for C Series modules is not supported in the cDAQ-9189.



**Note** When operating the cDAQ-9189 in hazardous locations, you must use the power connector with an external power supply rated for hazardous locations. The power supply included in the cDAQ-9189 kit is intended only for desktop use. For all other applications use the included 2-position power connector plug and a power supply rated for your application power requirements. Visit [ni.com](http://ni.com) to find hazardous locations-certified power supplies.

|                                         |                                                         |
|-----------------------------------------|---------------------------------------------------------|
| Voltage input range                     | 9 V to 30 V (measured at the cDAQ-9189 power connector) |
| Maximum power consumption <sup>11</sup> | 16 W                                                    |

<sup>9</sup> I/O synchronization is system-dependent. Assumes the chassis are connected in a line topology with a typical selection of C Series modules containing a variety of timing architectures. For information about network synchronization accuracy, visit [ni.com/info](http://ni.com/info) and enter Info Code `syncacc`.

<sup>10</sup> I/O synchronization is system-dependent. Assumes a system containing one hop with optimized C Series module selection. For information about achieving high accuracy synchronization, visit [ni.com/info](http://ni.com/info) and enter Info Code `cdaqsync`.

<sup>11</sup> Includes maximum 1 W module load per slot across rated temperature and product variations.



**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 consuming the maximum allowed power.

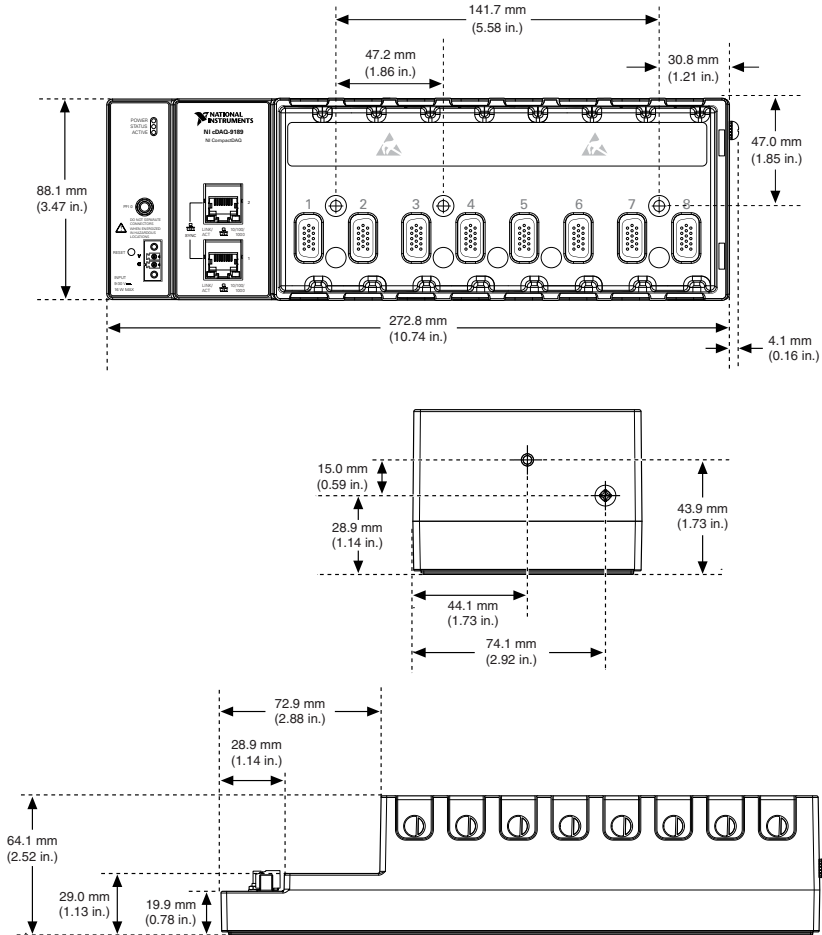
|                              |                                                                                                 |
|------------------------------|-------------------------------------------------------------------------------------------------|
| Power input connector        | 2 positions 3.5 mm pitch mini-combicon screw terminal with screw flanges, Sauro CTMH020F8-0N002 |
| Power input mating connector | Sauro CTF020V8, Phoenix Contact 1714977, or equivalent                                          |

## Physical Characteristics

|                            |                                                                                               |
|----------------------------|-----------------------------------------------------------------------------------------------|
| Weight (unloaded)          | 1065.9 g (37.6 oz)                                                                            |
| Dimensions (unloaded)      | 272.8 mm × 88.1 mm × 62.3 mm (10.74 in. × 3.47 in. × 2.45 in.) Refer to the following figure. |
| Screw-terminal wiring      |                                                                                               |
| Gauge                      | 0.2 mm <sup>2</sup> to 2.1 mm <sup>2</sup> (24 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   | 0.3 N · m to 0.4 N · m (2.7 lb · in. to 3.5 lb · in.)                                         |

If you need to clean the chassis, wipe it with a dry towel.

**Figure 1. cDAQ-9189 Dimensions**



## Safety Voltages

Connect only voltages that are within these limits.

V terminal to C terminal

30 V maximum, 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.



**Note** Measurement Categories CAT I and CAT O (Other) are equivalent. These test and measurement circuits are not intended for direct connection to the MAINS building installations of Measurement Categories CAT II, CAT III, or CAT IV.

# Environmental

|                                                         |                               |
|---------------------------------------------------------|-------------------------------|
| Operating temperature (IEC 60068-2-1 and IEC 60068-2-2) | -40 °C to 70 °C <sup>12</sup> |
|---------------------------------------------------------|-------------------------------|



**Note** Failure to follow the mounting instructions in the *cDAQ-9185/9189 User Manual* can cause temperature derating.

|                                                       |                 |
|-------------------------------------------------------|-----------------|
| Storage temperature (IEC 60068-2-1 and IEC 60068-2-2) | -40 °C 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 |
|-----------------------------------|-----------------------------|

|                              |   |
|------------------------------|---|
| Pollution Degree (IEC 60664) | 2 |
|------------------------------|---|

|                  |         |
|------------------|---------|
| Maximum altitude | 5,000 m |
|------------------|---------|

Indoor use only.<sup>13</sup>

# Hazardous Locations

|                                         |                                                                                  |
|-----------------------------------------|----------------------------------------------------------------------------------|
| U.S. (UL)                               | Class I, Division 2, Groups A, B, C, D, T4;<br>Class I, Zone 2, AEx nA IIC T4 Gc |
| Canada (C-UL)                           | Class I, Division 2, Groups A, B, C, D, T4; Ex<br>nA IIC T4 Gc                   |
| Europe (ATEX) and International (IECEx) | Ex nA IIC T4 Gc                                                                  |

<sup>12</sup> When operating the cDAQ-9189 in temperatures below 0 °C, you must use the PS-15 power supply or another power supply rated for below 0 °C.

<sup>13</sup> Use NI 9917 and NI 9918 industrial enclosures to protect the device in harsh, dirty, or wet environments.

# Shock and Vibration

To meet these specifications, you must direct mount the cDAQ-9189 system and affix ferrules to the ends of the terminal lines.

|                                  |                                                                                |
|----------------------------------|--------------------------------------------------------------------------------|
| Operating vibration              |                                                                                |
| Random (IEC 60068-2-64)          | 5 g RMS, 10 Hz to 500 Hz                                                       |
| Sinusoidal (IEC 60068-2-6)       | 5 g, 10 Hz to 500 Hz                                                           |
| Operating shock (IEC 60068-2-27) | 30 g, 11 ms half sine,<br>50 g, 3 ms half sine,<br>18 shocks at 6 orientations |

# Safety 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 60079-0:2012, EN 60079-15:2010
- IEC 60079-0: Ed 6, IEC 60079-15; Ed 4
- UL 60079-0; Ed 6, UL 60079-15; Ed 4
- CSA C22.2 No. 60079-0, CSA C22.2 No. 60079-15



**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 61326-1 (IEC 61326-1): Class A emissions; Industrial immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- EN 55022 (CISPR 22): Class A emissions
- EN 55024 (CISPR 24): Immunity
- AS/NZS CISPR 11: Group 1, Class A emissions
- AS/NZS CISPR 22: Class A emissions

- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions



**Note** In the United States (per FCC 47 CFR), Class A equipment is intended for use in commercial, light-industrial, and heavy-industrial locations. In Europe, Canada, Australia and New Zealand (per CISPR 11) Class A equipment is intended for use only in heavy-industrial 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.



**Note** For EMC declarations and certifications, and additional information, refer to the [Online Product Certification](#) section.

## CE Compliance

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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)

## Online Product Certification

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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](https://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## Environmental Management

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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 *Minimize Our Environmental Impact* web page at [ni.com/environment](https://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 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](https://ni.com/environment/weee).

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