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# NI-9470

# Specifications

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# Contents

NI-9470 Specifications..... 3

# NI-9470 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 the range -40 °C to 70 °C unless otherwise noted.

### Related information:

- [Software Support for CompactRIO, CompactDAQ, Single-Board RIO, R Series, and EtherCAT](#)

## Output Characteristics

Number of output channels	8 push-pull
Current-sensing inputs	8 low-side sensing resistors
<b>Data rate</b>	

12.8 MHz timebase	3.2 kHz 3.125 kHz 2.56 kHz 2 kHz
13.1072 MHz timebase	3.277 kHz 3.2 kHz 2.621 kHz 2.048 kHz
PWM frequency configuration	Per channel
PWM frequency	$\frac{DataRate}{1}$ to $\frac{DataRate}{511}$
PWM frequency, maximum	2.048 kHz
PWM frequency accuracy	0.01%
Duty cycle range	0% to 100%
Pulse distortion	430 ns maximum

**Table 1.** Maximum Current Per Channel

Number of Channels	Maximum Current Per Channel
Two channels	3 A

Number of Channels	Maximum Current Per Channel
Four channels	2.3 A
All channels	1.6 A



**Note** Maximum current is the average output current for inductive loads and is the RMS current for resistive loads. The RMS current for a resistive load is given by the peak current times the square root of the duty cycle.

Maximum peak current per channel	3.5 A
<b>Maximum cable length</b>	
External power supply cable maximum length	10 m
Digital output cable maximum length	20 m

## Current Readback

Sample rate	Once every PWM cycle
ADC type	Oversampled SAR
Readback resolution	16 bits
Nominal input range	-0.35 A to 3.5 A

**Table 2.** Accuracy

Measurement Conditions	Percent of Reading (Gain Error)	Percent of Range <sup>1</sup> (Offset Error)
Maximum (-40 °C to 70 °C)	1.36%	0.571%
Typical (-40 °C to 70 °C)	0.652%	0.174%

### Stability

<sup>1</sup> Range = 3.5 A.

Gain drift	74 ppm/°C
Offset drift	51 $\mu\text{C}/^\circ\text{C}$
Integral non-linearity	0.073%
Noise	200 $\mu\text{A}$ RMS

## Voltage Readback

Sample rate	$\frac{\text{DataRate}}{10}$
ADC type	Sigma-Delta
Readback resolution	11 bits
Nominal input range	0 V to 40 V
Gain accuracy	1.2%
Offset accuracy	200 mV
Noise	10 mV RMS

## Temperature Readback

Sample rate	$\frac{\text{DataRate}}{10}$
ADC type	Sigma-Delta

Readback resolution	12 bits
Nominal measurement input range	-40 °C to 125 °C

## Output Mode Characteristics

Setpoint mode	Per channel
<b>Duty Cycle mode</b>	
Duty cycle setpoint	0% to 100%
Duty cycle setpoint resolution	0.025% maximum
<b>Average Current mode</b>	
Current setpoint	0 A to 3.5 A
Current setpoint resolution	12 bits
PID coefficients	$\frac{0\%}{A}$ to $\frac{16,383.999\%}{A}$
PID coefficient resolution	$\frac{0.001\%}{A}$

## Dither

Dither control	Per channel
Waveform	Triangle

Dither frequency	$\frac{PWMFrequency}{4}$ to $\frac{PWMFrequency}{4,095}$
Maximum dither period error <sup>2</sup>	4 PWM cycles
<b>Open-loop mode</b>	
Peak amplitude	0% to 100%
Amplitude resolution	12-bit
<b>Closed-loop mode</b>	
Peak amplitude	0 A to 3.5 A
Amplitude resolution	12-bit

## Diagnostics and Protection

<b>Error flags (per channel)</b>	
Voltage out-of-range flag	$V_{sup} < 4.2 \text{ V}$ or $V_{sup} > 34 \text{ V}$
Overcurrent flag	$I_{sup} > 8.5 \text{ A}$ (4.3 A minimum, 14 A maximum)



**Note**  $I_{sup}$  is the current sourced from the supply on  $V_{sup}$  to the load on DO+.

### PWM shut down conditions

- <sup>2</sup> NI recommends selecting a dither divisor that is a multiple of four to generate an optimal dither triangle wave with zero period error. Other values for the dither divisor will be rounded up to the next multiple of four in generating the dither waveform to ensure there is an even number of points in each quarter section of the triangle waveform. The dither triangle wave slope will differ from an ideal triangle wave, especially at small dither divisor values that are not multiples of four.



Shut down behavior	Drive output low (DO+ = COM)
Overvoltage	$V_{\text{sup}} > 35 \text{ V}$
Undervoltage	$V_{\text{sup}} < 4 \text{ V}$
Overcurrent	$I_{\text{sup}} > 8.5 \text{ A}$ (4.3 A minimum, 14 A maximum)
Overcurrent response time	2.5 $\mu\text{s}$
Overtemperature protection	Per module
PWM output tristate conditions	Power up, power down, master timebase loss
Reverse polarity protection ( $V_{\text{sup-to-COM}}$ )	-30 V

## I/O Wiring

I/O plug type	Molex Ultra-Fit, part number 1722583116
<b>Crimp terminal</b>	
18 AWG to 16 AWG	Molex Ultra-Fit, part number 1722536012
22 AWG to 20 AWG	Molex Ultra-Fit, part number 1722536112
Wire gauge	22 AWG to 16 AWG



**Note** NI recommends using 2x Molex Ultra-Fit terminal position assurance retainers (Molex part number 1722644008) with each connector to prevent terminal back-out.

## Safety Voltages

Connect only voltages that are below these limits.

$V_{\text{sup-to-COM}}$	0 V DC to 30 V DC maximum, Measurement Category I
<b>Isolation</b>	
Channel-to-channel	None
<b>Channel-to-earth ground</b>	
Continuous	60 V DC, Measurement Category I
Withstand	1,000 V RMS, verified by a 5 s dielectric withstand test

## Measurement Category I

**Warning** Do not connect the product to signals or use for measurements within Measurement Categories II, III, or IV, or for measurements on MAINS circuits or on circuits derived from Overvoltage Category II, III, or IV which may have transient overvoltages above what the product can withstand. The product must not be connected to circuits that have a maximum voltage above the continuous working voltage, relative to earth or to other channels, or this could damage and defeat the insulation. The product can only withstand transients up to the transient overvoltage rating without breakdown or damage to the insulation. An analysis of the working voltages, loop impedances, temporary overvoltages, and transient overvoltages in the system must be conducted prior to making measurements.

**Mise en garde** Ne pas connecter le produit à des signaux dans les catégories de mesure II, III ou IV et ne pas l'utiliser pour des mesures dans

ces catégories, ou des mesures sur secteur ou sur des circuits dérivés de surtensions de catégorie II, III ou IV pouvant présenter des surtensions transitoires supérieures à ce que le produit peut supporter. Le produit ne doit pas être raccordé à des circuits ayant une tension maximale supérieure à la tension de fonctionnement continu, par rapport à la terre ou à d'autres voies, sous peine d'endommager et de compromettre l'isolation. Le produit peut tomber en panne et son isolation risque d'être endommagée si les tensions transitoires dépassent la surtension transitoire nominale. Une analyse des tensions de fonctionnement, des impédances de boucle, des surtensions temporaires et des surtensions transitoires dans le système doit être effectuée avant de procéder à des mesures.

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.



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

## Environmental Characteristics

<b>Temperature</b>	
Operating	-40 °C to 70 °C
Storage	-40 °C to 85 °C
<b>Humidity</b>	

Operating	10% RH to 90% RH, noncondensing
Storage	5% RH to 95% RH, noncondensing
Ingress protection	IP40
Pollution Degree	2
Maximum altitude	5,000 m
<b>Shock and Vibration</b>	
<b>Operating vibration</b>	
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 shock and vibration specifications, you must panel mount the system.

## Power Requirements

<b>Power consumption from chassis</b>	
Active mode	571 mW
Sleep mode	1 mW
<b>Thermal dissipation (at 70 °C)</b>	
Active mode	1.5 W

Sleep mode	200 mW
<b>Current per channel</b>	
Two channels active	3 A
Four channels active	2.3 A
Eight channels active	1.6 A
V <sub>sup</sub>	5 V to 30 V
External power supply	5 V to 30 V

## Physical Characteristics



**Tip** For two-dimensional drawings and three-dimensional models of the NI-9470 and connectors, visit [ni.com/dimensions](https://ni.com/dimensions).

Dimensional Drawings	Visit <a href="https://ni.com/dimensions">ni.com/dimensions</a> and search by module number.
<b>Dimensions</b>	
Length	76 mm (3 in.)
Width	23 mm (0.9 in.)
Height	88 mm (3.5 in.)
Weight	140 g (4.9 oz)

## Calibration

You can obtain the calibration certificate and information about calibration services for the NI-9470 at [ni.com/calibration](https://ni.com/calibration).

Calibration interval	2 years
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