NI-9470
Specifications

Contents

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
Data rate	

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	$\dfrac{DataRate}{1}$ to $\dfrac{DataRate}{511}$
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
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
Maximum cable length	
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[1] (Offset Error)
Maximum (-40 °C to 70 °C)	1.36%	0.571%
Typical (-40 °C to 70 °C)	0.652%	0.174%

Stability		
Gain drift	74 ppm/°C	
Offset drift	51 µC/°C	
Integral non-linearity		0.073%
Noise		200 µA RMS

Voltage Readback

Sample rate	$\dfrac{DataRate}{10}$
ADC type	Sigma-Delta
Readback resolution	11 bits
Nominal input range	0 V to 40 V

1. Range = 3.5 A.

Gain accuracy	1.2%
Offset accuracy	200 mV
Noise	10 mV RMS

Temperature Readback

Sample rate	$\dfrac{DataRate}{10}$
ADC type	Sigma-Delta
Readback resolution	12 bits
Nominal measurement input range	-40 °C to 125 °C

Output Mode Characteristics

Setpoint mode	Per channel
Duty Cycle mode	
Duty cycle setpoint	0% to 100%
Duty cycle setpoint resolution	0.025% maximum

Average Current mode	
Current setpoint	0 A to 3.5 A
Current setpoint resolution	12 bits
PID coefficients	$\dfrac{0\ \%}{A}$ to $\dfrac{16,\ 383.999\ \%}{A}$
PID coefficient resolution	$\dfrac{0.001\ \%}{A}$

Dither

Dither control	Per channel
Waveform	Triangle
Dither frequency	$\dfrac{PWMFrequency}{4}$ to $\dfrac{PWMFrequency}{4,\ 095}$
Maximum dither period error[2]	4 PWM cycles

2. 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.

Open-loop mode	
Peak amplitude	0% to 100%
Amplitude resolution	12-bit
Closed-loop mode	
Peak amplitude	0 A to 3.5 A
Amplitude resolution	12-bit

Diagnostics and Protection

Error flags (per channel)	
Voltage out-of-range flag	V_{sup} < 4.2 V or V_{sup} > 34 V
Overcurrent flag	I_{sup} > 8.5 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	
Shut down behavior	Drive output low (DO+ = COM)
Overvoltage	V_{sup} > 35 V

Undervoltage	$V_{sup} < 4\ V$
Overcurrent	$I_{sup} > 8.5\ A$ (4.3 A minimum, 14 A maximum)
Overcurrent response time	2.5 µs
Overtemperature protection	Per module
PWM output tristate conditions	Power up, power down, master timebase loss
Reverse polarity protection (V_{sup}-to-COM)	-30 V

I/O Wiring

I/O plug type	Molex Ultra-Fit, part number 1722583116
Crimp terminal	
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_{sup}-to-COM	0 V DC to 30 V DC maximum, Measurement Category I	
Isolation		
Channel-to-channel		None
Channel-to-earth ground		
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

Temperature	
Operating	-40 °C to 70 °C
Storage	-40 °C to 85 °C

Humidity	
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

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 shock and vibration specifications, you must panel mount the system.

Power Requirements

Power consumption from chassis	
Active mode	571 mW

Sleep mode	1 mW
Thermal dissipation (at 70 °C)	
Active mode	1.5 W
Sleep mode	200 mW
Current per channel	
Two channels active	3 A
Four channels active	2.3 A
Eight channels active	1.6 A
V_{sup}	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.

Dimensional Drawings	Visit ni.com/dimensions and search by module number.
Dimensions	

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.

Calibration interval	2 years