
NI-9401

Specifications

2023-04-25



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NI-9401 Datasheet



- DSUB connectivity
- CompactDAQ counter compatibility
- 60 V DC, CAT I, channel-to-earth isolation

The NI-9401 is a bidirectional digital module for any NI CompactDAQ or CompactRIO chassis. The eight DIO channels are grouped in two ports that you can configure independently for input or output. You can use the NI-9401 to implement custom digital systems such as counters/timers, digital communication protocols, pulse generation, and beyond.

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|---|--|
|  <p>Kit Contents</p> | <ul style="list-style-type: none"> • NI 9401 • NI 9401 Getting Started Guide |
|  <p>Accessories</p> | <p>Front-Mount</p> <ul style="list-style-type: none"> • NI 9924 Screw-Terminal Block (781922-01) <p>Cable</p> <ul style="list-style-type: none"> • DSUB Cable, 1 m (192568-01) • DIN Rail Screw-Terminal Block (781081-01) <p>EMC Compliance</p> <ul style="list-style-type: none"> • EMI Noise-Suppression Ferrite (782803-01) |

| C SERIES DIGITAL INPUT/OUTPUT MODULE COMPARISON | | | | | | |
|---|---------------|----------|-------------|---------------|--------------|----------------------|
| Product Name | Signal Levels | Channels | Update Rate | Direction | Connectivity | Isolation Continuous |
| NI 9381 | LVTTL | 4 | 1 μ s | Bidirectional | DSUB | None |
| NI 9401 | 5 V/TTL | 8 | 100 ns | Bidirectional | DSUB | 60 VDC Ch-Earth |
| NI 9402 | LVTTL | 4 | 55 ns | Bidirectional | BNC | None |
| NI 9403 | 5 V/TTL | 32 | 7 μ s | Bidirectional | DSUB | 60 VDC Ch-Earth |

NI C Series Overview



NI provides more than 100 C Series modules for measurement, control, and communication applications. C Series modules can connect to any sensor or bus and allow for high-accuracy measurements that meet the demands of advanced data acquisition and control applications.

- Measurement-specific signal conditioning that connects to an array of sensors and signals
- Isolation options such as bank-to-bank, channel-to-channel, and channel-to-earth ground
- -40 °C to 70 °C temperature range to meet a variety of application and environmental needs
- Hot-swappable

The majority of C Series modules are supported in both CompactRIO and CompactDAQ platforms and you can move modules from one platform to the other with no modification.

CompactRIO



CompactRIO combines an open-embedded architecture with small size, extreme ruggedness, and C Series modules in a platform powered by the NI LabVIEW reconfigurable I/O (RIO) architecture. Each system contains an FPGA for custom timing, triggering, and processing with a wide array of available modular I/O to meet any embedded application requirement.

CompactDAQ

CompactDAQ is a portable, rugged data acquisition platform that integrates connectivity, data acquisition, and signal conditioning into modular I/O for directly interfacing to any sensor or signal. Using CompactDAQ with LabVIEW, you can easily customize how you acquire, analyze, visualize, and manage your measurement data.



Software

LabVIEW Professional Development System for Windows

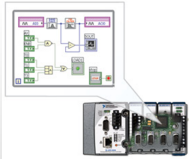


- Use advanced software tools for large project development
- Generate code automatically using DAQ Assistant and Instrument I/O Assistant
- Use advanced measurement analysis and digital signal processing
- Take advantage of open connectivity with DLLs, ActiveX, and .NET objects

LabVIEW Professional Development System for Windows

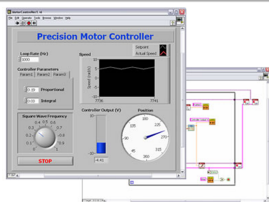
- Build DLLs, executables, and MSI installers

NI LabVIEW FPGA Module



- Design FPGA applications for NI RIO hardware
- Program with the same graphical environment used for desktop and real-time applications
- Execute control algorithms with loop rates up to 300 MHz
- Implement custom timing and triggering logic, digital protocols, and DSP algorithms
- Incorporate existing HDL code and third-party IP including Xilinx IP generator functions
- Purchase as part of the LabVIEW Embedded Control and Monitoring Suite

NI LabVIEW Real-Time Module



- Design deterministic real-time applications with LabVIEW graphical programming
- Download to dedicated NI or third-party hardware for reliable execution and a wide selection of I/O
- Take advantage of built-in PID control, signal processing, and analysis functions
- Automatically take advantage of multicore CPUs or set processor affinity manually

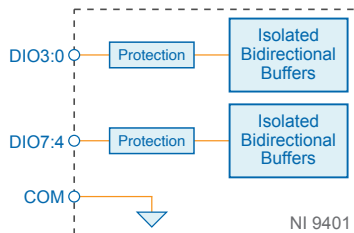
NI LabVIEW Real-Time Module

- Take advantage of real-time OS, development and debugging support, and board support
- Purchase individually or as part of a LabVIEW suite

NI-9401 Block Diagram

The eight DIO channels are internally referenced to COM, so you can use any of the nine COM lines as a reference for the external signal.

Figure 1. NI-9401 Circuitry



NI 9401 Specifications

The following specifications are typical for the range -40 °C to 70 °C unless otherwise noted. All voltages are relative to COM unless otherwise noted.



Caution Do not operate the NI-9401 in a manner not specified in this document. Product misuse can result in a hazard. You can compromise the safety protection built into the product if the product is damaged in any way. If the product is damaged, return it to NI for repair.



Caution Le NI-9401 ne doit en aucun cas être utilisé d'une autre façon que celle spécifiée dans ce document. Une mauvaise utilisation du produit peut s'avérer dangereuse. Si le produit est endommagé de quelque manière que ce soit, la sécurité intégrée dans le produit risque

d'en être compromise. Si le produit est endommagé, le renvoyer à NI pour réparation.

Input/Output Characteristics

| | |
|--|-------------------|
| Number of channels | 8 DIO channels |
| Default power-on line direction | Input |
| Input/output type | TTL, single-ended |
| Digital logic levels | |
| Input | |
| Voltage | 5.25 V maximum |
| High, V_{IH} | 2 V minimum |
| Low, V_{IL} | 0.8 V maximum |
| Output High, V_{OH} (5.25 V maximum) | |
| Sourcing 100 μ A | 4.7 V minimum |
| Sourcing 2 mA | 4.3 V minimum |
| Output Low, V_{OL} | |
| Sinking 100 μ A | 0.1 V maximum |
| Sinking 2 mA | 0.4 V maximum |
| Maximum signal switching frequency, per channel | |
| Input | |
| 8 input channels | 9 MHz |

| | |
|---|--|
| 4 input channels | 16 MHz |
| 2 input channels | 30 MHz |
| Output^[1] | |
| 8 output channels | 5 MHz |
| 4 output channels | 10 MHz |
| 2 output channels | 20 MHz |
| I/O propagation delay | 100 ns maximum |
| I/O pulse width distortion | 10 ns |
| Input current ($0\text{ V} \leq V_{\text{IN}} \leq 4.5\text{ V}$) | $\pm 250\text{ }\mu\text{A}$ |
| Input capacitance | 30 pF |
| Input rise/fall time | 500 ns maximum |
| Overvoltage protection, channel-to-COM ^[2] | $\pm 30\text{ V}$ maximum on one channel at a time |
| MTBF | 1,244,763 hours at 25 °C; Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method |

Power Requirements

| | |
|---------------------------------------|----------------|
| Power consumption from chassis | |
| Active mode | 580 mW maximum |
| Sleep mode | 1 mW maximum |

| Thermal dissipation (at 70 °C) | |
|--------------------------------|----------------|
| Active mode | 580 mW maximum |
| Sleep mode | 1 mW maximum |

Physical Characteristics

| | |
|------------|---|
| Dimensions | Visit ni.com/dimensions and search by module number. |
| Weight | 145 g (5.1 oz) |

Safety Voltages

Connect only voltages that are within the following limits:

| Maximum voltage ^[3] | |
|--------------------------------|--|
| Channel-to-COM | ±30 V maximum on one channel at a time, Measurement Category I |
| Isolation voltages | |
| 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 |

Hazardous Locations

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

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 61010-1
- EN 60079-0:2012, EN 60079-15:2010
- IEC 60079-0: Ed 6, IEC 60079-15; Ed 4
- UL 60079-0; Ed 5, UL 60079-15; Ed 3
- CSA 60079-0:2011, CSA 60079-15:2012



Note For UL and other safety certifications, refer to the product label or the [Online Product Certification](#) section.

Electromagnetic Compatibility

- EN 61326 EMC requirements; Industrial Immunity
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

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)
- 94/9/EC; Potentially Explosive Atmospheres (ATEX)

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.

Shock and Vibration

To meet these specifications, you must panel mount the system.

| 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 |

Environmental

Refer to the manual for the chassis you are using for more information about meeting these specifications.

| | |
|---|---------------------------------|
| Operating temperature (IEC 60068-2-1, IEC 60068-2-2) | -40 °C to 70 °C |
| Storage temperature (IEC 60068-2-1, IEC 60068-2-2) | -40 °C to 85 °C |
| Ingress protection | IP40 |
| Operating humidity (IEC 60068-2-78) | 10% RH to 90% RH, noncondensing |
| Storage humidity (IEC 60068-2-78) | 5% RH to 95% RH, noncondensing |
| Pollution Degree | 2 |
| Maximum altitude | 2,000 m |

Indoor use only.

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.

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.)

¹ By number of output channels with an output load of 1 mA, 50 pF

² Continued use at this level will degrade the life of the module.

³ The maximum voltage that can be applied or output between any channel and COM without damaging the module or other devices.