NI 9403
5 V/TTL, Bidirectional Digital I/O, 32 Ch Module

- 32-channel, 7 μS, digital I/O
- 5 V/TTL, sinking/sourcing digital I/O
- Bidirectional, configurable by line with shift-on-the-fly capability
- 60 VDC, CAT I isolation
- Industry-standard 37-pin D-SUB connector
- -40 °C to 70 °C operating, 5 g vibration, 50 g shock

Overview
The NI 9403 is a 32-channel, 7 μs bidirectional digital I/O module for any NI CompactDAQ or CompactRIO chassis. You can configure the direction of each digital line on the NI 9403 for input or output. Each channel is compatible with 5 V/TTL signals and features 1,000 Vrms transient isolation between the I/O channels and the backplane. The NI 9403 also features ±30 V overvoltage protection and can source up to 2 mA output current per channel.

In a NI CompactDAQ chassis, you can use the NI 9403 as only a static (software-timed) digital I/O module. Starting in NI-DAQmx 9.3, you can use the NI 9403 in buffered tasks for a single direction (either input or output). Due to the serial transfer of data, you cannot use these modules to route timing or triggering signals. With the NI 9403 in a CompactRIO chassis, you can use LabVIEW FPGA to program the NI 9403 for implementing custom counter/timers, pulse generation, and much more.

Recommended Accessories
- NI 9923 (or other 37-pin D-SUB connector)

Box Contents
- 1 NI 9403 C Series module
- 1 NI 9403 Operating Instructions and Specifications manual

Comparison Tables

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Signal Levels</th>
<th>Direction</th>
<th>Channels</th>
<th>Update Rate</th>
<th>Isolation</th>
<th>Connectivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 9401</td>
<td>5 V/TTL</td>
<td>Bidirectional</td>
<td>8</td>
<td>100 ns</td>
<td>60 VDC Ch-Earth</td>
<td>25-Pin D-SUB</td>
</tr>
<tr>
<td>NI 9402</td>
<td>LVTTL</td>
<td>Bidirectional</td>
<td>4</td>
<td>55 ns</td>
<td>None</td>
<td>BNC</td>
</tr>
<tr>
<td>NI 9403</td>
<td>5 V/TTL</td>
<td>Bidirectional</td>
<td>32</td>
<td>7 μs</td>
<td>60 VDC Ch-Earth</td>
<td>37-Pin D-SUB</td>
</tr>
</tbody>
</table>

Application and Technology
NI C Series Overview
NI C Series modules are engineered to provide high-accuracy measurements to meet the demands of advanced DAQ and control applications. Each module contains measurement-specific signal conditioning to connect to an array of sensors and signals, bank and channel-to-channel isolation options, and support for wide temperature ranges to meet a variety of application and environmental needs all in a single rugged package. You can choose from more than 100 C Series modules for measurement, control, and communication to connect your applications to any sensor on any bus.

Most C Series I/O modules work with both the NI CompactDAQ and CompactRIO platforms. The modules are identical, and you can move them from one platform to the other with no modification.

**NI CompactRIO Platform**

Powered by the LabVIEW RIO architecture, CompactRIO combines an open embedded architecture with small size, extreme ruggedness, and hot-swappable industrial I/O modules. 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.

Configure Your Complete CompactRIO System

**NI CompactDAQ Platform**

NI CompactDAQ is a portable, rugged DAQ platform that integrates connectivity and signal conditioning into modular I/O for directly interfacing to any sensor or signal. Using NI CompactDAQ with LabVIEW, you can easily customize how you acquire, analyze, present, and manage your measurement data. From research to development to validation, NI provides programable software, high-accuracy measurements, and local technical support to help ensure you meet your exact measurement application requirements.

Configure Your Complete NI CompactDAQ System

**Ordering Information**

For a complete list of accessories, visit the product page on ni.com.
Software Recommendations

LabVIEW Professional Development System for Windows

- Advanced software tools for large project development
- Automatic code generation using DAQ Assistant and Instrument I/O Assistant
- Tight integration with a wide range of hardware
- Advanced measurement analysis and digital signal processing
- Open connectivity with DLLs, ActiveX, and .NET objects
- Capability to build DLLs, executables, and MSI installers

NI LabVIEW FPGA Module

- Design FPGA applications for NI reconfigurable I/O (RIO) hardware targets
- 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 CORE Generator functions
- Included in 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
- Includes real-time OS, development and debugging support, and board support
- Purchase individually or as part of a LabVIEW suite

Support and Services

System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reconfigurable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at ni.com/advisor to find a system assurance program to meet your needs.

Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
- **Discussion Forums** - Visit forums.ni.com for a diverse set of discussion boards on topics you care about.
- **Online Community** - Visit community.ni.com to find, contribute, or collaborate on customer-contributed technical content with users like you.

Repair

While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications

The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- **Classroom training in cities worldwide** - the most comprehensive hands-on training taught by engineers.
- **On-site training at your facility** - an excellent option to train multiple employees at the same time.
Online instructor-led training - lower-cost, remote training if classroom or on-site courses are not possible.

Course kits - lowest-cost, self-paced training that you can use as reference guides.

Training memberships and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty

NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM

NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance

Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

Detailed Specifications

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

<table>
<thead>
<tr>
<th>Input/Output Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of channels</td>
</tr>
<tr>
<td>Input/output type</td>
</tr>
<tr>
<td>Default power-on line direction</td>
</tr>
<tr>
<td>Digital logic levels</td>
</tr>
<tr>
<td>Input</td>
</tr>
<tr>
<td>Voltage</td>
</tr>
<tr>
<td>High, $V_{IH}$</td>
</tr>
<tr>
<td>Low, $V_{IL}$</td>
</tr>
<tr>
<td>Hysteresis, $V_{h}$</td>
</tr>
<tr>
<td>Output</td>
</tr>
<tr>
<td>High, $V_{OH}$ (5.2 V max)</td>
</tr>
<tr>
<td>Sourcing 100 μA</td>
</tr>
<tr>
<td>Sourcing 2 mA</td>
</tr>
<tr>
<td>Low, $V_{OL}$</td>
</tr>
<tr>
<td>Sinking 100 μA</td>
</tr>
<tr>
<td>Sinking 2 mA</td>
</tr>
<tr>
<td>Input current (0 V ≤ $V_{in} ≤ 4.5$ V)</td>
</tr>
<tr>
<td>Module output current$^1$</td>
</tr>
<tr>
<td>Input capacitance</td>
</tr>
<tr>
<td>Timing</td>
</tr>
<tr>
<td>Input</td>
</tr>
<tr>
<td>Setup time$^2$</td>
</tr>
<tr>
<td>Hold time$^3$</td>
</tr>
<tr>
<td>Output</td>
</tr>
<tr>
<td>Propagation delay$^4$</td>
</tr>
</tbody>
</table>
### Channel-to-channel skew

<table>
<thead>
<tr>
<th>Component</th>
<th>Max Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>cRIO-9151 R Series Expansion chassis</td>
<td>265 ns max</td>
</tr>
<tr>
<td>All other chassis</td>
<td>265 ns max</td>
</tr>
</tbody>
</table>

### Update/transfer time

<table>
<thead>
<tr>
<th>Component</th>
<th>Max Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>cRIO-9151 R Series Expansion chassis</td>
<td>8 μS max</td>
</tr>
<tr>
<td>All other chassis</td>
<td>8 μS max</td>
</tr>
</tbody>
</table>

### Direction change time

<table>
<thead>
<tr>
<th>Component</th>
<th>Max Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>cRIO-9151 R Series Expansion chassis</td>
<td>18 μS max</td>
</tr>
<tr>
<td>All other chassis</td>
<td>18 μS max</td>
</tr>
</tbody>
</table>

### Overvoltage protection Channel-to-COM

<table>
<thead>
<tr>
<th>Component</th>
<th>Max Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>cRIO-9151 R Series Expansion chassis</td>
<td>±30 V max</td>
</tr>
<tr>
<td>All other chassis</td>
<td>±30 V max</td>
</tr>
</tbody>
</table>

### MTBF

- **cRIO-9151 R Series Expansion chassis**: 763,325 hours at 25 °C, Bellcore Issue 2, Method 1, Case 3, Limited Part Stress Method
- **All other chassis**: 7 μS max

#### Note
Contact NI for Bellcore MTBF specifications at other temperatures or for MIL-HDBK-217F specifications.

### Power Requirements

#### Power consumption from chassis

<table>
<thead>
<tr>
<th>Mode</th>
<th>Max Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active mode</td>
<td>1 W max</td>
</tr>
<tr>
<td>Sleep mode</td>
<td>25 μW max</td>
</tr>
</tbody>
</table>

#### Thermal dissipation (at 70 °C)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Max Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active mode</td>
<td>1 W max</td>
</tr>
<tr>
<td>Sleep mode</td>
<td>25 μW max</td>
</tr>
</tbody>
</table>

### Physical Characteristics

#### Weight

- 150 g (5.3 oz)

### Safety

#### Safety Voltages

Connect only voltages that are within the following limits.

- **Channel-to-COM**: ±30 V max on up to 8 channels at a time, Measurement Category I

#### Isolation

- **Channel-to-channel**: None
- **Channel-to-earth ground**: Continuous 60 VDC, Measurement Category I
- **Withstand**: 1,000 V, verified by a 5 s dielectric withstand test

Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS 7 voltage. 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 NI 9403 to signals or use for measurements within Measurement Categories II, III, or IV.

#### Safety Standards

This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

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

### Hazardous Locations

#### U.S. (UL)

- Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nA IIC T4

#### Canada (C-UL)

- Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nA IIC T4

#### Europe (DEMKO)

- Ex nA IIC T4

### Environmental

National Instruments C Series modules are intended for indoor use only but may be used outdoors if installed in a suitable enclosure. Refer to the manual for the chassis you are using for more information about meeting these specifications.

- **Operating temperature**: –40 to 70 °C
- **Storage temperature**: –40 to 85 °C
- **Ingress protection**: IP 40
- **Operating humidity**: 10 to 90% RH, noncondensing
Storage humidity (IEC 60068-2-56) 5 to 95% RH, noncondensing

Maximum altitude 2,000 m

Pollution Degree (IEC 60684) 2

**Shock and Vibration**

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

Operating vibration

- Random (IEC 60068-2-64) 5 g\_rms, 10 to 500 Hz
- Sinusoidal (IEC 60068-2-6) 5 g, 10 to 500 Hz

Operating shock (IEC 60068-2-27) 30 g, 11 ms half sine, 50 g, 3 ms half sine, 18 shocks at 6 orientations

**Electromagnetic Compatibility**

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Industrial Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A

**Note** For EMC compliance, operate this device with shielded cables.

**CE Compliance**

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

**Note** For the standards applied to assess the EMC of this product, refer to the Online Product Certification section.

**Online Product Certification**

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, search by module number or product line, and click the appropriate link in the Certification column.

**Environmental Management**

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the NI and the Environment 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.

**Waste Electrical and Electronic Equipment (WEEE)**

**EU Customers** At the end of their life cycle, all products must be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit ni.com/environment/weee.htm.

**Calibration**

You can obtain the calibration certificate for this device at ni.com/calibration.

Calibration interval 1 year

1. Module output current is the maximum guaranteed current that the module can drive from all the I/O lines without going into an overcurrent state.
2. Setup time is the amount of time input signals must be stable before reading from the module.
3. Hold time is the amount of time input signals must be stable after initiating a read from the module.
4. Propagation delay is the amount of time after writing to the module that the output signals become valid.
5. Channel-to-channel skew is the amount of time between the first output signal updating and the last output signal updating.
6. The update/transfer and direction change times are valid when the module is used in a CompactRIO system. When used in other systems, driver software and latencies impact these times.
7. MAINS is defined as the (hazardous live) electrical supply system to which equipment is designed to be connected for the purpose of powering the equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.
Pinouts/Front Panel Connections

NI 9403 Pin Assignments

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