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For user manuals and dimensional drawings, visit the product page resources tab on ni.com.

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Industrial Digital I/O Device for USB – 60 V, Channel-to-Channel Isolated



- Small, portable digital I/O device
- Eight channel-to-channel optically isolated inputs (± 60 VDC)
- Eight channel-to-channel optically isolated, solid-state relay outputs (60 VDC/30 Vrms max)
- 500 mA maximum switching current per channel
- One 32-bit event counter
- USB cable strain relief
- Built-in, removable connectors for easy connectivity
- Industrial feature set with programmable power-up states, digital I/O watchdogs, event detection, and programmable input filters

Overview

The NI USB-6525 is a full-speed USB device with eight normally open, channel-to-channel isolated, solid-state relay outputs and eight ± 60 VDC channel-to-channel isolated digital inputs. The USB-6525 offers features for industrial control and manufacturing test applications, such as factory automation, embedded machine control, and production line verification. The solid-state relay outputs have a 60 VDC/30 Vrms switching voltage and 500 mA/ch maximum switching current, making them ideal for controlling pumps, valves, motors, and other industrial actuators. The eight isolated digital input channels break ground loops and offer protection from noise and spikes on external signals. You can also use one of the digital input channels as a 5 kHz, 32-bit event counter for counting digital pulses. Industrial digital I/O devices are designed to incorporate the latest hardware technologies for applications requiring ease of use, high reliability, and performance. The USB-6525 takes advantage of NI-DAQmx measurement services software to speed up application development with features such as the DAQ Assistant, automatic code generation, and high-performance multithreaded streaming technology.

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Requirements and Compatibility

OS Information

Windows 2000/XP
Windows Vista x64/x86

Driver Information

NI-DAQmx

Software Compatibility

LabVIEW
LabWindows/CVI
Measurement Studio
SignalExpress

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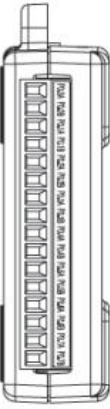
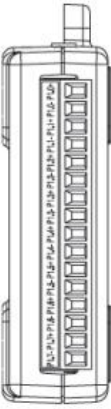
Application and Technology

Hardware

The USB-6525 has eight channel-to-channel optically isolated inputs, P1.<0..7>, and eight channel-to-channel optically isolated, solid-state relay outputs, P0.<0..7>. The isolated inputs consist of an optocoupler, a depletion-mode MOSFET-based current-limiting circuit, and a Schottky diode. Each channel has its own positive and negative terminals capable of detecting a wide range of DC signals, from 5 V TTL logic levels to DC power supply levels up to 60 V.

PFI 0 (an alias to P1.7) can also function as the source for a 32-bit counter. In this mode, the device counts low to high transitions on P1.7. You can arm and disarm the counter as well as read or reset the counter through software.

You can connect loads to the solid-state relay outputs with an AC or DC power source. The default power-on state of the solid-state relays is open. The relays also remain open when the computer and the USB-6525 device are powered off.

Module	Terminal	Signal	Module	Terminal	Signal
	1	P0.0A		17	P1.0+
	2	P0.0B		18	P1.0-
	3	P0.1A		19	P1.1+
	4	P0.1B		20	P1.1-
	5	P0.2A		21	P1.2+
	6	P0.2B		22	P1.2-
	7	P0.3A		23	P1.3+
	8	P0.3B		24	P1.3-
	9	P0.4A		25	P1.4+
	10	P0.4B		26	P1.4-
	11	P0.5A		27	P1.5+
	12	P0.5B		28	P1.5-
	13	P0.6A		29	P1.6+
	14	P0.6B		30	P1.6-
	15	P0.7A		31	P1.7+/PFI 0+
	16	P0.7B		32	P1.7-/PFI 0-

NI USB-6525 Pinout

Isolation

Isolation is a form of built-in signal conditioning that delivers an extended voltage range for direct connectivity to industrial sensors and actuators. The USB-6525 provides channel-to-channel isolation where each channel is physically and electrically separated from the others.

Isolation offers three main benefits:

- Safety from hazardous high voltages and transients
- Rejection of common-mode voltages
- Removal of ground loops

Safety from High-Voltage Transients

Isolation electrically separates high-voltage front-end channels from each other and the low-voltage back end of the USB-6525. Signals are passed between the two sections of the device using optocouplers. By separating the two sections, any voltages within the isolation specifications are prevented from entering the USB section or other channels. Isolation provides protection for the user, data acquisition system, and measurement data.

Common-Mode Voltage Rejection

A voltage common to both sides of a differential circuit pair is called common-mode voltage. This phenomenon is typical in noisy environments containing machinery and inductive loads. The differential voltage across the circuit pair is the desired signal, whereas the common voltage signal is the unwanted signal that may have been coupled into the transmission line. The USB-6525 can measure signals from lines with signal plus common-mode voltage of up to 60 VDC.

Ground Loop Removal

Ground loops are the most common source of noise in data acquisition applications. They occur when two connected terminals in a circuit are at different ground potentials, causing current to flow between the two points. This additional voltage can cause significant error in the measurement. When a ground loop exists, the measured voltage is the sum of the signal voltage and the potential difference that exists between the signal source ground and the measurement system ground. This potential is generally not a DC level; therefore, the result is a noisy measurement system. By offering an isolated floating ground on the front end, the isolated USB-6525 devices are able to prevent ground loops from forming.

Glitch-Free Startup with Programmable Power-Up States

Using programmable power-up states, you can configure the initial USB-6525 output states in software to ensure consistent, reliable operation when connected to industrial actuators such as pumps, valves, motors, and relays. A USB-6525 holds these output states after receiving power, so your computer can boot and your software application can begin running. Programmable power-up states are glitch-free, meaning the outputs never go through an incorrect state during power up.

You can configure each digital line as high-output or low-output. A USB-6525 stores the settings in onboard nonvolatile memory and implements the power-up states instantaneously after power is applied to the device.

Detect and Recover with Digital I/O Watchdogs

Digital I/O watchdogs are an innovative technology that can detect a variety of fault conditions such as an application crash and automatically respond by setting the outputs to a user-configured safe state. Watchdogs are important whenever the module is connected to actuators such as pumps, valves, motors, and relays. A USB-6525 monitors the software application; if the application fails to respond within a preset time limit, the device automatically sets the output lines to a user-defined safe state. A USB-6525 remains in the watchdog state until the watchdog timer is disarmed, the device is reset, or the computer is restarted.

Trigger Your Application with Change Detection

With change detection, you can automatically trigger your software application to perform a digital read operation upon a digital change of state. A digital change of state is defined as the rising edge (0 to 1 transition) or falling edge (1 to 0 transition) on one or more digital lines. Using change detection, you can monitor for digital events with minimal processor usage. No polling is necessary because the digital I/O module generates an interrupt to automatically wake up your application. Using NI-DAQmx software technology, the USB-6525 notifies the software application when it detects an event, causing the application to automatically perform a read operation. To minimize the effects of noisy input lines, use programmable input filters in combination with change detection to eliminate spurious change-detection events caused by noise or glitches.

Eliminate Noise with Programmable Input Filters

Programmable input filters remove noise, glitches, and spikes on inputs as well as provide debouncing for digital switches and relays. These features are important for applications in industrial environments to prevent false readings caused by noise. You can configure the programmable input filter for each digital line by setting the filter time. The USB-6525 blocks any digital noise, glitch, or spike that is shorter than half of the specified filter time, preventing invalid readings and false triggers for change-detection events.

Software

National Instruments measurement services software, built around NI-DAQmx driver software, includes intuitive application programming interfaces, configuration tools, I/O assistants, and other tools designed to reduce system setup, configuration, and development time. National Instruments recommends using the latest version of NI-DAQmx driver software for application development in NI LabVIEW, LabWindows™/CVI, and Measurement Studio. To obtain the latest version of NI-DAQmx, visit ni.com/support/daq/versions. NI measurement services software speeds up your development with features including the following:

- A guide to create fast and accurate measurements with no programming using the DAQ Assistant
- Automatic code generation to create your application in LabVIEW; LabWindows/CVI; LabVIEW SignalExpress; and Visual Studio .NET, C/C++/C#, or Visual Basic using Measurement Studio
- Multithreaded streaming technology
- More than 3,000 free software downloads to jump-start your project available at ni.com/zone
- Software configuration of all digital I/O features without hardware switches/jumpers
- Free LabVIEW SignalExpress LE data-logging software

The USB-6525 is compatible with the following versions (or later) of NI application software – LabVIEW, LabWindows/CVI, and Measurement Studio versions 7.x or LabVIEW SignalExpress. You can also use your NI digital I/O device with ANSI C, Microsoft Visual C++, Visual Basic, and the Microsoft .NET languages C# and Visual Basic .NET. The USB-6525 is not compatible with the Traditional NI-DAQ (Legacy) driver.

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Ordering Information

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

Products	Part Number	Recommended Accessories	Part Number
NI USB-6525			

NI USB-6525	779640-01	No accessories required.	
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Software Recommendations

LabVIEW Professional Development System for Windows



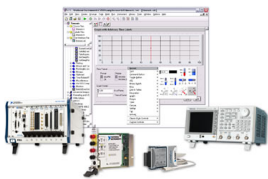
Advanced software tools for large project development
Automatic code generation using DAQ Assistant and Instrument I/O Assistant
Tight integration with a wide range of hardware
Advanced measurement analysis and digital signal processing
Open connectivity with DLLs, ActiveX, and .NET objects
Capability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

SignalExpress for Windows



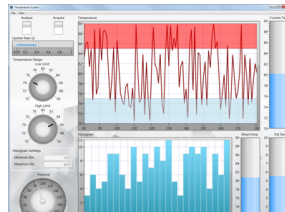
Quickly configure projects without programming
Control over 400 PC-based and stand-alone instruments
Log data from more than 250 data acquisition devices
Perform basic signal processing, analysis, and file I/O
Scale your application with automatic LabVIEW code generation
Create custom reports or easily export data to LabVIEW, DIAdem or Microsoft Excel

NI LabWindows™/CVI for Windows



Real-time advanced 2D graphs and charts
Complete hardware compatibility with IVI, VISA, DAQ, GPIB, and serial
Analysis tools for array manipulation, signal processing statistics, and curve fitting
Simplified cross-platform communication with network variables
Measurement Studio .NET tools (included in LabWindows/CVI Full only)
The mark LabWindows is used under a license from Microsoft Corporation.

NI Measurement Studio Enterprise Edition



Customizable graphs and charts for WPF, Windows Forms, and ASP.NET Web Forms UI design
Enterprise analysis libraries for spectral measurements, linear algebra, statistics curve fitting
Hardware integration support with native .NET data acquisition and instrument control libraries
Automatic code generation for all NI-DAQmx data acquisition hardware
LabWindows™/CVI ANSI C development environment
Support for Microsoft Visual Studio .NET 2012/2010/2008

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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, reorderable 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.

Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

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.

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Detailed Specifications

The following specifications are typical at 25 °C, unless otherwise noted.

Isolated Inputs

Number of input channels	8, ch-ch isolated
Input voltage range	-60 VDC to 60 VDC

Level	Min	Max
Input low voltage	-60 VDC	1 VDC
Input high voltage	3.2 VDC	60 VDC

Input current	3.0 mA/channel max
Minimum pulse-width for change detection	200 µs
Propagation delay	65 µs, typical

Solid-State Relay Outputs

Number of output channels	8, ch-ch isolated
Relay type	Normally open solid-state relay (SSR)
Switching voltage	60 VDC/30 Vrms max
Switching current (per channel)	500 mA max, full operation temperature range
Switching rate (90% duty cycle)	5 operations per second
Relay open time	60 µs typ
Relay close time	1.2 ms typ
On resistance	550 mΩ max
Off state leakage	0.6 µA typ

Counter

Number of counters	1 (P1.7 can be configured as a counter)
Resolution	32 bits

Counter measurements	Rising edge counting
Maximum input frequency	5 KHz
Minimum high pulse width	20 μ s
Minimum low pulse width	180 μ s

Bus Interface

USB specification	USB 2.0 full-speed (12 Mb/s)
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Power Requirements

USB

Input voltage	4.5 to 5.25 VDC in configured state
Active current	150 mA max
Suspend current	350 μ A typ

Physical Characteristics

Dimensions

Without connectors	6.35 cm \times 8.51 cm \times 2.31 cm (2.50 in. \times 3.35 in. \times 0.91 in.)
With connectors	8.18 cm \times 8.51 cm \times 2.31 cm (3.22 in. \times 3.35 in. \times 0.91 in.)
I/O connectors	USB series B receptacle, (2) 16 position (screw terminal) plug headers
Screw-terminal wiring	16 to 28 AWG copper conductor wire with 10 mm (0.39 in.) of insulation stripped from the end
Torque for screw terminals	0.22 – 0.25 N \cdot m (2.0 – 2.2 lb \cdot in.)

Weight

With connectors	Approx. 87 g (3.1 oz)
Without connectors	Approx. 64 g (2.3 oz)

Safety

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

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.

Isolation

Channel-to-channel	60 VDC continuous
Channel-to-earth ground	60 VDC continuous
Withstand	60 VDC continuous



Caution Do not use this module for connection to signals or for measurements within Measurement Categories II, III, or IV.

Hazardous Locations

This device is not certified for use in hazardous locations.

Environmental

The USB-6525 device is intended for indoor use only.

Operating temperature (IEC 60068-2-1 and IEC 60068-2-2)	0 to 55 $^{\circ}$ C
Operating humidity (IEC 60068-2-56)	10 to 90% RH, noncondensing
Maximum altitude	2,000 m (at 25 $^{\circ}$ C ambient temperature)
Storage temperature (IEC 60068-2-1 and IEC 60068-2-2)	– 40 to 85 $^{\circ}$ C
Storage humidity (IEC 60068-2-56)	5 to 90% RH, noncondensing
Pollution Degree (IEC 60664)	2

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

EN 61326 (IEC 61326): Class A emissions; Basic immunity

EN 55011 (CISPR 11): Group 1, Class A emissions

AS/NZS CISPR 11: Group 1, Class A emissions

FCC 47 CFR Part 15B: Class A emissions

ICES-001: Class A emissions



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



Note For EMC compliance, operate this product according to the documentation.

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.

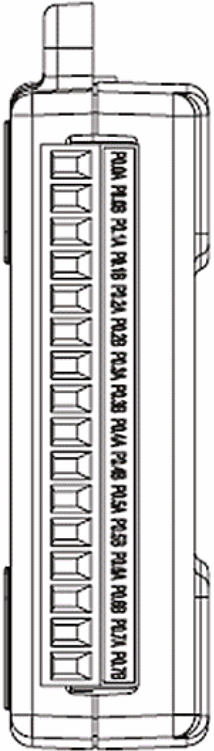
电子信息产品污染控制管理办法（中国 RoHS）

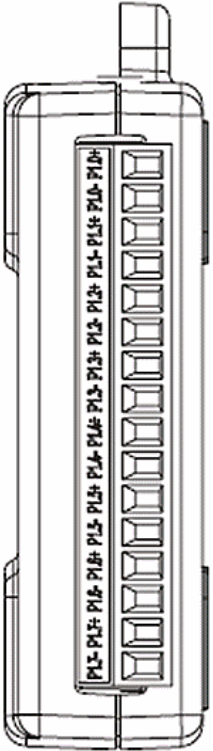


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Pinouts/Front Panel Connections

Module	Terminal	Signal
	1	P0.0A
	2	P0.0B
	3	P0.1A
	4	P0.1B
	5	P0.2A
	6	P0.2B
	7	P0.3A
	8	P0.3B
	9	P0.4A
	10	P0.4B
	11	P0.5A
	12	P0.5B
	13	P0.6A
	14	P0.6B
	15	P0.7A
	16	P0.7B

Module	Terminal	Signal
	17	P1.0+
	18	P1.0-
	19	P1.1+
	20	P1.1-
	21	P1.2+
	22	P1.2-
	23	P1.3+
	24	P1.3-
	25	P1.4+
	26	P1.4-
	27	P1.5+
	28	P1.5-
	29	P1.6+
	30	P1.6-
	31	P1.7+/PFI 0+
	32	P1.7-/PFI 0-

NI USB-6525 Digital Terminal Assignments

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