

Low-Cost Digital I/O Device for USB

NI USB-6501

- Small, portable digital I/O device
- 24 digital I/O lines, one 32-bit counter
- Overvoltage protection, 8.5 mA current drive
- Full-speed USB (12 Mb/s) bus interface
- Built-in screw terminals with removable connectors for easier connectivity
- OEM version available with 34-pin IDC mass termination connectivity

Operating Systems

- Windows Vista/XP/2000
- Mac OS X¹
- Linux^{®1}

Recommended Software

- LabVIEW
- LabWindows™/CVI

Measurement Services Software (included)

- NI-DAQmx driver software
- Measurement & Automation Explorer configuration utility

¹Mac OS X and Linux users need to download NI-DAQmx Base.



Overview

The National Instruments USB-6501 is a portable digital I/O device, providing reliable data acquisition and control at a low price. With plug-and-play USB connectivity, the NI USB-6501 is simple enough for home/academic applications but robust and versatile enough for laboratory/industrial applications. The board-only version is ideal for embedded OEM applications.

| Product | Bus | Digital I/O Lines | Counter/Timers | Current Drive | Logic Level | Industrial Feature Set |
|---------|-----|-------------------|----------------|---------------|----------------|------------------------|
| NI 6501 | USB | 24 | 1 | 8.5 mA | 5 V TTL / CMOS | – |

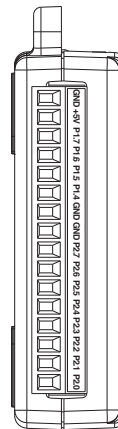
Table 1. USB-6501 Features

Hardware

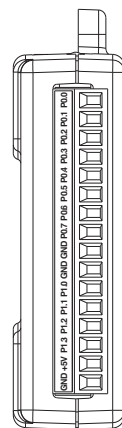
The USB-6501 is a full-speed USB device that provides 24 DIO lines and a 32-bit counter. The 24 digital lines are arranged in three ports: P0.<0..7>, P1.<0..7>, and P2.<0..7>. P2.7 can also function as a 32-bit counter. You can individually program each of the USB-6501 DIO lines as a DI or DO line and use the DIO lines to monitor or control digital signals. All samples of the DI lines and updates of the DO lines are software-timed.

The default configuration of the USB-6501 DIO ports is open-drain, for 5 V operation with an onboard 4.7 kΩ pull-up resistor. You can add an external, user-provided, pull-up resistor to increase the source current drive up to 8.5 mA per line.

Each DIO signal is protected against overvoltage, undervoltage, and overcurrent conditions, as well as ESD events. At system startup and reset, the hardware sets all DIO lines to high-impedance inputs.



| Terminal | Signal |
|----------|--------|
| 1 | GND |
| 2 | +5 V |
| 3 | P1.7 |
| 4 | P1.6 |
| 5 | P1.5 |
| 6 | P1.4 |
| 7 | GND |
| 8 | GND |
| 9 | P2.7 |
| 10 | P2.6 |
| 11 | P2.5 |
| 12 | P2.4 |
| 13 | P2.3 |
| 14 | P2.2 |
| 15 | P2.1 |
| 16 | P2.0 |



| Terminal | Signal |
|----------|--------|
| 17 | P0.0 |
| 18 | P0.1 |
| 19 | P0.2 |
| 20 | P0.3 |
| 21 | P0.4 |
| 22 | P0.5 |
| 23 | P0.6 |
| 24 | P0.7 |
| 25 | GND |
| 26 | GND |
| 27 | P1.0 |
| 28 | P1.1 |
| 29 | P1.2 |
| 30 | P1.3 |
| 31 | +5 V |
| 32 | GND |

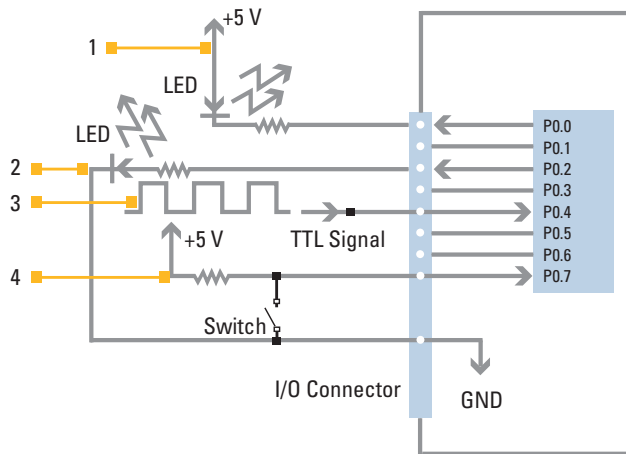
Figure 1. USB-6501 Pinout

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The data acquisition device does not drive the signal high or low. Each line has a weak pull-up resistor connected to it.

You can configure P2.7 as the source for a 32-bit counter. In this mode, the device counts high to low transitions (falling edges) on P2.7. You can arm and disarm the counter and read or reset the count through software.

The USB-6501 supplies a nominal 5 V from two pins, one on each screw-terminal block. You can use the voltage source, which is provided by the USB host, to power external components. The USB-6501 features current limiting short circuit protection for safe USB host power use.



1. P0.0 configured as an open-drain digital output driving an LED
2. P0.2 configured as a push-pull digital output driving an LED
3. P0.4 configured as a digital input receiving a TTL signal from a gated inverter
4. P0.7 configured as a digital input receiving a 0 V or 5 V signal from a switch

Figure 2. Example of Connecting a Load

Software

The USB-6501 is shipped with NI-DAQmx measurement services software, a high-performance multithreaded driver for interactive configuration and data acquisition. Use it to develop customized data acquisition applications with NI LabVIEW or C-based development environments. Examples include an interactive control panel to help you get started with your application quickly.

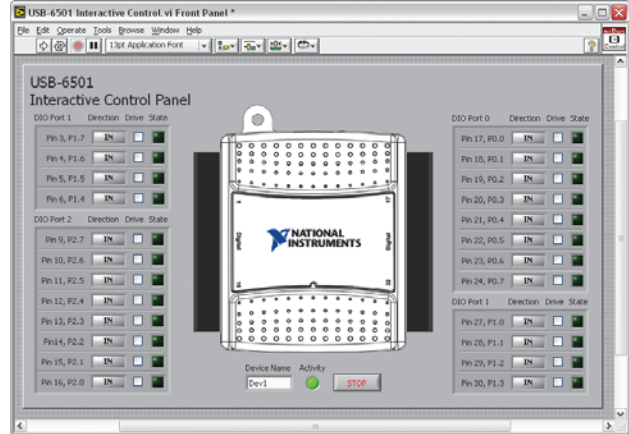


Figure 3. Interactive Control Panel Example Program Shipped with the USB-6501

Recommended Accessories

The USB-6501 has built-in screw terminals for connectivity; no additional accessories are required.

Board-Only Version for OEMs

A board-only version of the USB-6501 is available to OEMs for use in embedded applications. The OEM version offers a 34-pin IDC ribbon cable header for mass termination instead of screw-terminal connectivity. You can mount the OEM version using standoffs (not included in kit) with your own enclosure. For information on special configurations and pricing, visit ni.com/oem.

Ordering Information

| | |
|--|-----------|
| NI USB-6501 | 779205-01 |
| Includes NI-DAQmx Base software and a USB cable. | |
| NI USB-6501 hardware only (for OEM) | 192317-50 |

BUY NOW!

For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to ni.com/daq.

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Specifications

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

Digital I/O

| | |
|-----------------------------|--|
| Number of lines | |
| P0.<0..7>..... | 8 |
| P1.<0..7>..... | 8 |
| P2.<0..7>..... | 8 |
| Direction control | Input or output, software-selectable |
| Output driver type | Push-pull or open-drain, software-selectable |
| Pull-up resistor | 4.7 kΩ |
| Absolute voltage range..... | -0.5 to 5.8 V with respect to GND |
| Power-on state..... | Input (high impedance) |
| Digital logic levels | |

| Level | Min | Max | Units |
|---|------|-----|-------|
| Input low voltage | -0.3 | 0.8 | V |
| Input high voltage | 2.0 | 5.8 | V |
| Input leakage current | – | 50 | µA |
| Output low voltage (I = 2 mA) | – | 0.4 | V |
| Output low voltage (I = 8.5 mA) | – | 0.8 | V |
| Output high voltage | | | |
| Push-pull, I = -2 mA | 2.8 | 3.6 | V |
| Push-pull, I = -8.5 mA | 2.0 | 3.5 | V |
| Open-drain, I = -0.4 mA, nominal | 2.0 | 5.0 | V |
| Open-drain, I = -7.5 mA, with external pull-up resistor | 2.0 | – | V |

Counter

| | |
|-------------------------------|---|
| Number of counters | 1 (P2.7 can be configured as the counter) |
| Resolution | 32 bits |
| Counter measurements..... | Falling edge counting |
| Maximum input frequency..... | 5 MHz |
| Minimum high pulse width..... | 100 ns |
| Minimum low pulse width..... | 100 ns |

Bus Interface

| | |
|-------------------------|--------------------------|
| USB specification | USB full-speed (12 Mb/s) |
|-------------------------|--------------------------|

External Voltage

| | |
|---------------|------------------------|
| +5 V output | |
| Voltage..... | 4.00 V min, 5.25 V max |
| Current | 230 mA max |

Power Requirements

| | |
|----------------------|--|
| USB | |
| 4.5 to 5.25 VDC..... | 80 mA typical, 500 mA max |
| USB Suspend | 500 µA max, all DIO lines disconnected |

Physical Characteristics

| | |
|--------------------------|--|
| Dimensions | |
| Without connectors | 6.35 by 8.51 by 2.31 cm (2.50 by 3.35 by 0.91 in.) |

| | |
|---------------------------------|--|
| With connectors | 8.18 by 8.51 by 2.31 cm (3.22 by 3.35 by 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 to 0.25 N · m (2.0 to 2.2 lb · in.) |
| Weight..... | 84 g (3 oz) |

Safety Standards

The USB-6501 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 visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Overvoltage Protection

Connect only voltages that are within these limits.

| | |
|------------------------------------|-----------------------------------|
| Channel-to-COM (one channel) | ±30 V max, Measurement Category I |
|------------------------------------|-----------------------------------|

| | |
|---|------------------------------------|
| Channel-to-COM (one port, all channels) | ±8.9 V max, Measurement Category I |
|---|------------------------------------|

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

Hazardous Locations

The USB-6501 is not certified for use in hazardous locations.

Environmental

The USB-6501 device is intended for indoor use only.

| | |
|--|--|
| Operating temperature (IEC 60068-2-1 and IEC 60068-2-2)..... | 0 to 55 °C |
| Operating humidity (IEC 60068-2-56) | 10 to 90% RH, noncondensing |
| Maximum altitude..... | 2,000 m (at 25 °C ambient temperature) |
| Storage temperature (IEC 60068-2-1 and IEC 60068-2-2)... | -40 to 85 °C |
| Storage relative humidity (IEC 60068-2-56) | 5 to 90%, noncondensing |
| Pollution degree (IEC 60664) | 2 |

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Electromagnetic Compatibility

| | |
|-----------------|--|
| Emissions | EN 55011 Class A at 10 m FCC Part 15A above 1 GHz |
| Immunity..... | Industrial levels per EN 61326:1997 + A2:2001, Table 1 |
| EMC/EMI..... | CE, C-Tick, and FCC Part 15 (Class A) Compliant |

Note: For EMC compliance, operate this device with shielded cabling.

CE Compliance

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

| | |
|---|------------|
| Low-Voltage Directive (safety) | 73/23/EEC |
| Electromagnetic Compatibility Directive (EMC)..... | 89/336/EEC |

Note: Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain the DoC for this product, visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column.

Safety Guidelines

Caution: Operate the hardware only as described in these operating instructions.

The following section contains important safety information that you must follow when installing and using the USB-6501.

Do not operate the USB-6501 in a manner not specified in this document. Misuse of the device can result in a hazard. You can compromise the safety protection built into the device if the device is damaged in any way. If the device is damaged, contact National Instruments for repair.

Do not substitute parts or modify the device except as described in this document. Use the device only with the chassis, modules, accessories, and cables specified in the installation instructions. You must have all covers and filler panels installed during operation of the device.

Do not operate the device in an explosive atmosphere or where there may be flammable gases or fumes. If you must operate the device in such an environment, it must be in a suitably rated enclosure.

If you need to clean the device, use a dry cloth. Make sure that the device is completely dry and free from contaminants before returning it to service. Operate the device only at or below Pollution Degree 2. Pollution is foreign matter in a solid, liquid, or gaseous state that can reduce dielectric strength or surface resistivity. The following is a description of pollution degrees:

- Pollution Degree 1 means no pollution or only dry, nonconductive pollution occurs. The pollution has no influence.
- Pollution Degree 2 means that only nonconductive pollution occurs in most cases. Occasionally, however, a temporary conductivity caused by condensation must be expected.
- Pollution Degree 3 means that conductive pollution occurs, or dry, nonconductive pollution occurs that becomes conductive due to condensation.

You must insulate signal connections for the maximum voltage for which the device is rated. Do not exceed the maximum ratings for the device. Do not install wiring while the device is live with electrical signals. Do not remove or add connector blocks when power is connected to the system. Avoid contact between your body and the connector block signal when hot swapping modules. Remove power from signal lines before connecting them to or disconnecting them from the device.

Operate the device at or below Measurement Category I¹. Measurement circuits are subjected to working voltages² and transient stresses (overvoltage) from the circuit to which they are connected during measurement or test. Measurement categories establish standard impulse withstand voltage levels that commonly occur in electrical distribution systems. The following is a description of measurement categories:

- Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS³ 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.

¹ Measurement Category as defined in electrical safety standard IEC 61010-1. Measurement Category is also referred to as Installation Category.

² Working Voltage is the highest rms value of an AC or DC voltage that can occur across any particular insulation.

³ MAINS is defined as a hazardous live electrical supply system that powers equipment. Suitably rated measuring circuits may be connected to the MAINS for measuring purposes.

- Measurement Category II is for measurements performed on circuits directly connected to the electrical distribution system. This category refers to local-level electrical distribution, such as that provided by a standard wall outlet (for example, 115 V for U.S. or 230 V for Europe). Examples of Measurement Category II are measurements performed on household appliances, portable tools, and similar E Series devices.
- Measurement Category III is for measurements performed in the building installation at the distribution level. This category refers to measurements on hard-wired equipment such as equipment in fixed installations, distribution boards, and circuit breakers. Other examples are wiring, including cables, bus-bars, junction boxes, switches, socket-outlets in the fixed installation, and stationary motors with permanent connections to fixed installations.
- Measurement Category IV is for measurements performed at the primary electrical supply installation (<1,000 V). Examples include electricity meters and measurements on primary overcurrent protection devices and on ripple control units.

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NI Factory Installation Services

NI Factory Installation Services (FIS) is the fastest and easiest way to use your PXI or PXI/SCXI combination systems right out of the box. Trained NI technicians install the software and hardware and configure the system to your specifications. NI extends the standard warranty by one year on hardware components (controllers, chassis, modules) purchased with FIS. To use FIS, simply configure your system online with ni.com/pxiadvisor.

Calibration Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit ni.com/calibration.

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2007-8562-301-101-D