

Switch & Sense 8/8

USB-based 8-relay Output, 8 Isolated Input, Digital I/O System

User's Guide



Switch & Sense 8/8

USB-based Isolated Input and Relay Output

User's Guide



**MEASUREMENT
COMPUTING™**

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About this User's Guide

What you will learn from this user's guide

This user's guide describes the Measurement Computing Switch & Sense 8/8 data acquisition device and lists device specifications.

Conventions in this user's guide

For more information

Text presented in a box signifies additional information related to the subject matter.

Caution! Shaded caution statements present information to help you avoid injuring yourself and others, damaging your hardware, or losing your data.

bold text **Bold** text is used for the names of objects on a screen, such as buttons, text boxes, and check boxes.

italic text *Italic* text is used for the names of manuals and help topic titles, and to emphasize a word or phrase.

Where to find more information

Additional information about Switch & Sense 8/8 hardware is available on our website at www.mccdaq.com. You can also contact Measurement Computing Corporation with specific questions.

- Knowledgebase: kb.mccdaq.com
- Tech support form: www.mccdaq.com/support/support_form.aspx
- Email: techsupport@mccdaq.com
- Phone: 508-946-5100 and follow the instructions for reaching Tech Support

For international customers, contact your local distributor. Refer to the International Distributors section on our website at www.mccdaq.com/International.

Introducing the Switch & Sense 8/8

Overview: Switch & Sense 8/8 features

This user's guide contains all of the information you need to install, configure, and program the Switch & Sense 8/8.

The Switch & Sense 8/8 is a USB 1.1 low-speed device used for data acquisition and control. It is designed for USB 1.1 ports, and was tested for full compatibility with both USB 1.1 and USB 2.0 ports. The Switch & Sense 8/8 is supported under popular Microsoft® Windows® operating systems.

The Switch & Sense 8/8 offers eight single pole double throw (SPDT) Form C relays and eight isolated inputs. You can configure each of the isolated inputs with an optional input filter. The input filters are enabled and disabled by software control.

The Switch & Sense 8/8 is shown in Figure 1-1. All I/O connections are made to four sets of screw terminals.



Switch & Sense 8/8 block diagram

Switch & Sense 8/8 functions are illustrated in the block diagram shown here.

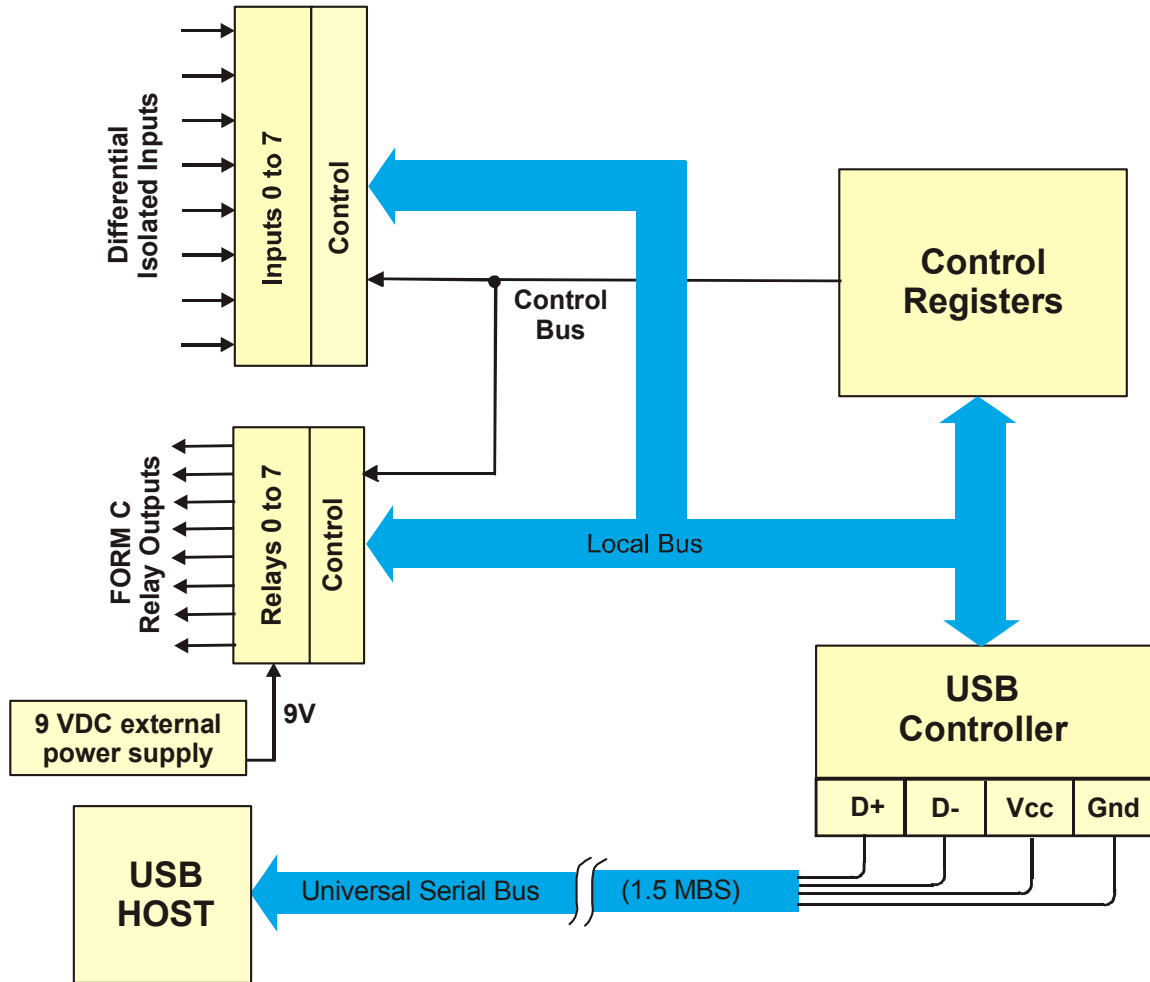


Figure 1-1. Switch & Sense 8/8 functional block diagram

Software features

For information on the features of *InstaCal* and the other software included with your Switch & Sense 8/8, refer to the *Quick Start Guide* that shipped with your device. The *Quick Start Guide* is also available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Check www.mccdaq.com/download.htm for the latest software version or versions of the software supported under less commonly used operating systems.

Connecting a Switch & Sense 8/8 to your computer is easy

Installing a data acquisition device has never been easier.

- The Switch & Sense 8/8 relies upon the Microsoft Human Interface Device (HID) class. The HID class ships with every copy of Windows that is designed to work with USB ports. We use the Microsoft HID because it is a standard, and its performance delivers full control and maximizes data transfer rates for your Switch & Sense 8/8. No third-party device driver is required.
- You can connect the Switch & Sense 8/8 before or after you install the software, and without powering down your computer first.
- When you connect an HID to your system, your computer automatically detects it and configures the necessary software. You can connect multiple HID peripherals to your system using a USB hub.
- You can connect your system to various devices using a standard four-wire cable. The USB connector replaces the serial and parallel port connectors with one standardized plug and port combination.
- Data can flow two ways between a computer and peripheral over USB connections.

Make sure that you have the latest Windows Updates installed for your USB driver, particularly "XP Hotfix KB822603."

Installing the Switch & Sense 8/8

What comes with your Switch & Sense 8/8 shipment?

The following items are shipped with the Switch & Sense 8/8.

Hardware

- Switch & Sense 8/8



- External power supply and cord (CB-PWR-9) – 9 volt, 1 amp DC power supply



Additional Documentation

In addition to this hardware user's guide, you should also receive the *Quick Start Guide* (available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf). This booklet supplies a brief description of the software you received with your Switch & Sense 8/8 and information regarding installation of that software. Please read this booklet completely before installing any software or hardware.

Unpacking the Switch & Sense 8/8

As with any electronic device, you should take care while handling to avoid damage from static electricity. Before removing the Switch & Sense 8/8 from its packaging, ground yourself using a wrist strap or by simply touching the computer chassis or other grounded object to eliminate any stored static charge.

If any components are missing or damaged, notify Measurement Computing Corporation immediately by phone, fax, or e-mail:

- Phone: 508-946-5100 and follow the instructions for reaching Tech Support.
- Fax: 508-946-9500 to the attention of Tech Support
- Email: techsupport@mccdaq.com

Installing the software

Refer to the *Quick Start Guide* for instructions on installing the software on the *Measurement Computing Data Acquisition Software CD*. This booklet is available in PDF at www.mccdaq.com/PDFmanuals/DAQ-Software-Quick-Start.pdf.

Connecting the external power supply

Power to the Switch & Sense 8/8 is provided with the 9 V, 1 A external power supply (CB-PWR-9). To connect the power supply to your Switch & Sense 8/8, do the following:

1. Connect the external power cord to the power connector labeled **7.5-20Vdc** on the back of the Switch & Sense 8/8.
2. Plug the AC adapter into a power outlet.

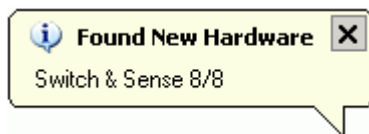
The **EXTERNAL POWER** LED illuminates green when 9 V power is supplied to the Switch & Sense 8/8. If the voltage supply is less than 7.5 V or more than 20 V, the LED does not light.

Installing the Switch & Sense 8/8

To connect the Switch & Sense 8/8 to your system, do the following:

1. Turn your computer on.
2. Connect the USB cable to a USB port on your computer or to an external USB hub that is connected to your computer. The USB cable provides communication to the Switch & Sense 8/8.

When you connect the Switch & Sense 8/8 to the computer for the first time, a **Found New Hardware** popup balloon (Windows XP) or dialog (other Windows versions) opens as the Switch & Sense 8/8 is detected.



A **Found New Hardware** balloon or dialog opens that identifies the Switch & Sense 8/8 as a USB Human Interface Device.

When installation is complete, the **STATUS** LED should flash and then remain lit. This indicates that communication is established between the Switch & Sense 8/8 and your computer.

If the STATUS LED turns off

If the STATUS LED is lit but then turns off, the computer has lost communication with the Switch & Sense 8/8. To restore communication, disconnect the USB cable from the computer, and then reconnect it. This should restore communication, and the LED should turn back *on*.

If you are running Windows XP and connect the Switch & Sense 8/8 to a USB 1.1 port, a balloon displays the message "**Your USB device can perform faster if you connect to a USB 2.0 port.**" You can ignore this message. The Switch & Sense 8/8 will function properly when connected to a USB 1.1 port

Caution! Do not disconnect **any** device from the USB port while the computer is communicating with the Switch & Sense 8/8, or you may lose data and/or your ability to communicate with the Switch & Sense 8/8.

If your system does not detect the Switch & Sense 8/8

If a "**USB device not recognized**" message appears when you connect the Switch & Sense 8/8, do the following.

1. Unplug the USB cable from the Switch & Sense 8/8.
2. Unplug the external power cord from the power connector labeled **7.5-20Vdc** on the back of the Switch & Sense 8/8.
3. Plug the external power cord back into the power connector.
4. Plug the USB cable back into the Switch & Sense 8/8.

Your system should now properly detect the Switch & Sense 8/8 hardware. Contact technical support if your system still does not detect the Switch & Sense 8/8.

Functional Details

The Switch & Sense 8/8 expands the capabilities of desktop personal computers by providing SPDT relay control and isolated inputs in a plug-and-play package. Screw terminals provide easy field wiring to the three output lines for each of the eight on-board relays (see [Figure 3-2](#) on page 3-2).

In addition, two terminals are provided for the differential input signals associated with each of the eight isolated inputs.

External components

The Switch & Sense 8/8 has the following external components, as shown in Figure 3-1.

- Direct current (dc) power connector
- External power LED
- Status LED
- USB connector /cable

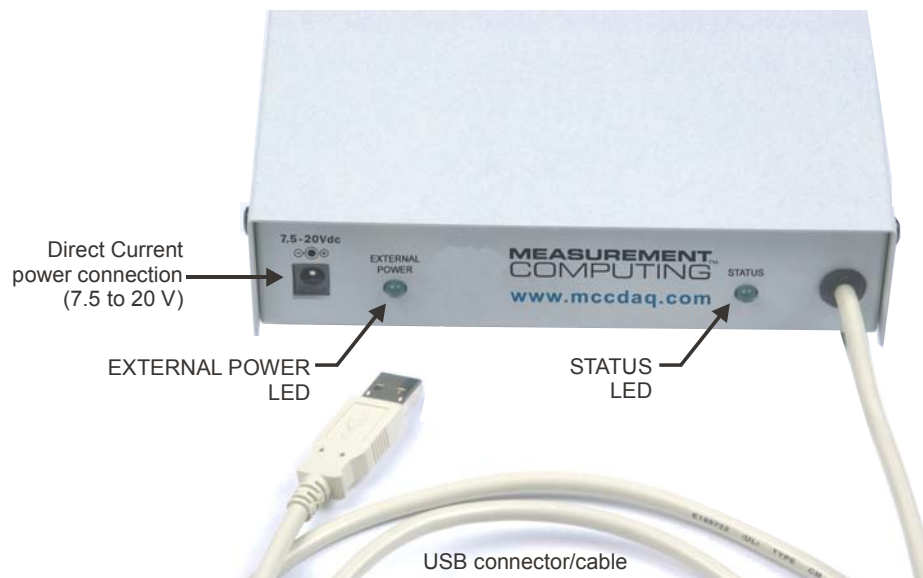


Figure 3-1. Switch & Sense 8/8 external components (rear view)

Direct current (dc) power connector and +9 V power supply

The Switch & Sense 8/8 requires between +7.5 V and +20 V of external power. Your computer can configure the Switch & Sense 8/8 without external power. However, external power connection is required to activate the relays and to run tests in *InstaCal*.

The USB specification allows high power devices to draw up to 500 mA. When all eight relays are energized, the collective current draw exceeds the maximum allowed for high power USB devices. Therefore, external power is required.

Use the +9-volt (V) DC power supply cord shipped with the Switch & Sense 8/8 to provide external power to this connector.

External power LED

The LED labeled **EXTERNAL POWER** lights up when the Switch & Sense 8/8 is connected to an external power source. It uses up to 5 mA of current and cannot be disabled.

Status LED

The LED labeled **STATUS** indicates the communication status of the Switch & Sense 8/8. It uses up to 5 mA of current and cannot be disabled. Table 3-1 explains the function of the Switch & Sense 8/8 status LED.

Table 3-1. Status LED illumination

LED Illumination	Indication
Steady green	The Switch & Sense 8/8 is connected to a computer or external USB hub.
Blinks continuously	Data is being transferred.
Blinks three times	Initial communication is established between the Switch & Sense 8/8 and the computer.

USB connector

The USB connector on the back of the Switch & Sense 8/8 enclosure provides +5 V power and communication.

Internal components

Screw terminals and relays

The Switch & Sense 8/8 has four rows of screw terminals — two outer rows containing 12 terminals each, and two inner rows containing eight terminals each.

- The outer rows of terminals connect to the eight relays available from the Switch & Sense 8/8.
- The inner rows connect to the differential isolated digital inputs. No additional components are required to terminate any of the input or output signals.

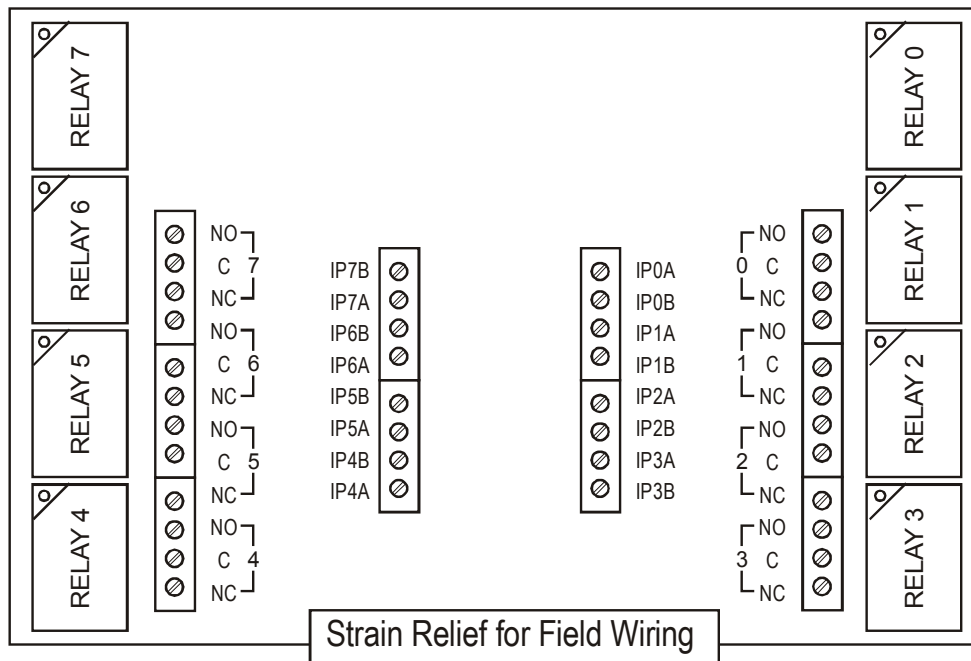


Figure 3-2. Switch & Sense 8/8 screw terminals and relays

Main connector and pin out

Table 3-2. Connector specifications

Connector type	Screw terminal
Wire gauge range	12 AWG to 20 AWG

Table 3-3. Screw terminal pin out

Pin	Signal Name	Pin	Signal Name
IP0A	Input 0 terminal A	IP4A	Input 4 terminal A
IP0B	Input 0 terminal B	IP4B	Input 4 terminal B
IP1A	Input 1 terminal A	IP5A	Input 5 terminal A
IP1B	Input 1 terminal B	IP5B	Input 5 terminal B
IP2A	Input 2 terminal A	IP6A	Input 6 terminal A
IP2B	Input 2 terminal B	IP6B	Input 6 terminal B
IP3A	Input 3 terminal A	IP7A	Input 7 terminal A
IP3B	Input 3 terminal B	IP7B	Input 7 terminal B
0-NO	Relay 0 Normally Open contact	4-NO	Relay 4 Normally Open contact
0-C	Relay 0 Common contact	4-C	Relay 4 Common contact
0-NC	Relay 0 Normally Closed contact	4-NC	Relay 4 Normally Closed contact
1-NO	Relay 1 Normally Open contact	5-NO	Relay 5 Normally Open contact
1-C	Relay 1 Common contact	5-C	Relay 5 Common contact
1-NC	Relay 1 Normally Closed contact	5-NC	Relay 5 Normally Closed contact
2-NO	Relay 2 Normally Open contact	6-NO	Relay 6 Normally Open contact
2-C	Relay 2 Common contact	6-C	Relay 6 Common contact
2-NC	Relay 2 Normally Closed contact	6-NC	Relay 6 Normally Closed contact
3-NO	Relay 3 Normally Open contact	7-NO	Relay 7 Normally Open contact
3-C	Relay 3 Common contact	7-C	Relay 7 Common contact
3-NC	Relay 3 Normally Closed contact	7-NC	Relay 7 Normally Closed contact

Relay contact terminals (NO, C, NC (0) to NO, C, NC (7))

The two outer groups of 12 screw terminals shown in Figure 3-2 connect to the normally open (NO), common (C), and normally closed (NC) contacts for relays 0 through 7.

Form C relay output

A schematic for Form C relay contacts is shown in Figure 3-3. The Form C relay has a C, NO, and NC contact.

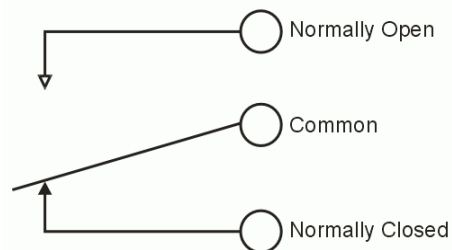


Figure 3-3. Form C SPDT relay

- When a (0) is written to the output bit, the C and NC are in contact.
- When a (1) is written to the output bit, the C and NO are in contact.

At power-up, the relays are put into a non-energized state (NC in contact to Common).

Relay contact protection circuit for inductive loads

If you are using the relays to control inductive loads, place a diode across the load terminals to suppress the kickback voltage. If the diode is not present, the kickback voltage could cause the on-board processor to enter an unstable state. To return the processor to a stable state, unplug the power cable from the Switch & Sense 8/8 and then reconnect.

A contact protection circuit is shown in Figure 3-4. For AC loads, install a metal oxide varistor (MOV).

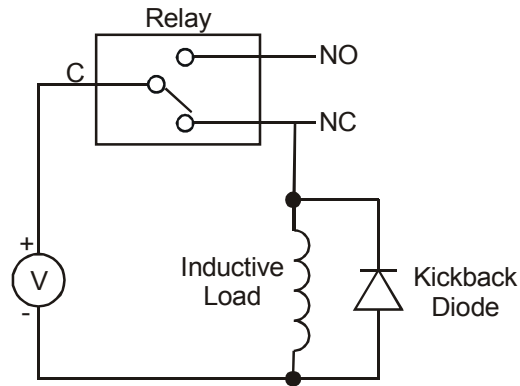


Figure 3-4. Relay contact protection circuit

Differential isolated digital input terminals (IP0A to IP7B)

Connect up to eight isolated digital input signals using the following screw terminal pairs:

- IP0A and IP0B
- IP1A and IP1B
- IP2A and IP2B
- IP3A and IP3B
- IP4A and IP4B
- IP5A and IP5B
- IP6A and IP6B
- IP7A and IP7B

A schematic of a single channel is shown in Figure 3-5. Each signal is applied to a bridge rectifier so that the input is not polarity-sensitive. It can be driven by either AC (50 - 1000 Hz) or DC voltage.

The eight optically isolated (500 V) inputs can be read back as a single byte. Each input has a software-controlled filter with a time constant of 5 ms (200 Hz). The filter is required for AC inputs, and recommended for almost all DC inputs. Unless you have a good reason to turn off a filter, we recommend that you enable it.

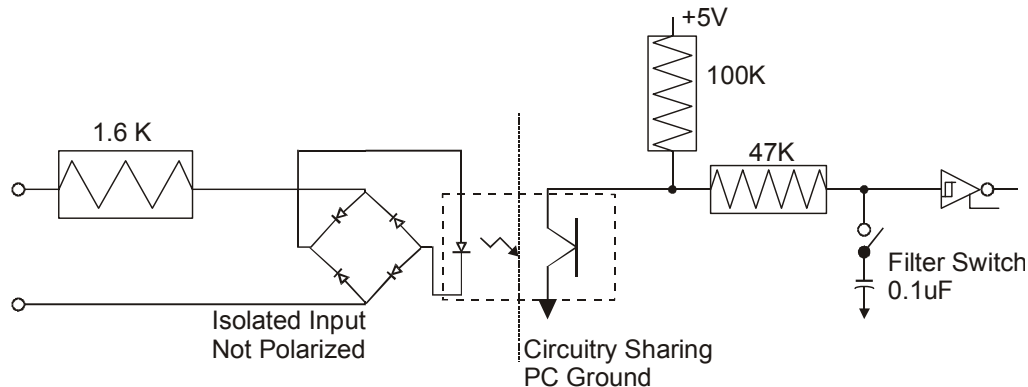


Figure 3-5. Switch & Sense 8/8 single-channel configuration

Figure 3-6 illustrates a simple connection from a +9 V battery to the relay 4 terminals. When the relay is energized, the relay 4 NO terminal connects the battery voltage to the input 4 terminal (IP4B).



Figure 3-6. Simple battery-to relay connection

Figure 3-7 shows the schematic of this connection.

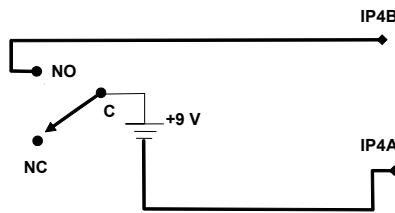


Figure 3-7. Schematic of battery-to relay connection

Extending the input range

You can extend the input range beyond the 5 to 30 V specified by adding an external resistor. Figure 3-8 shows the external resistor (R_{ext}).

The equation $R_{ext} = 100 * (V_{in} - 30)$ calculates the resistor value for a given V_{in} .

Make sure the external resistor is capable of handling the power generated by the input. Calculate the power requirement in watts (P_w) using the equation $P_w = R_{ext}/10000$.

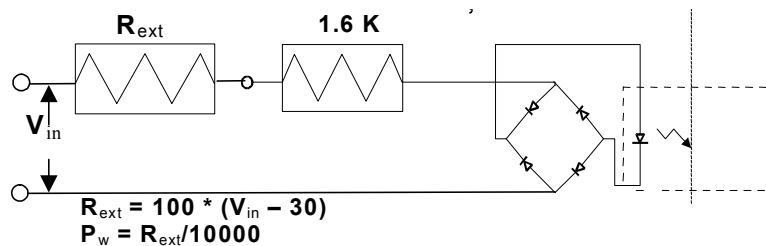


Figure 3-8. External resistor added to extend input range

Specifications

Typical for 25 °C unless otherwise specified.

Specifications in *italic text* are guaranteed by design.

USB compliance

<i>Device type</i>	<i>USB version 1.1 low speed (1.5 Mbs) device</i>
Device compatibility	USB 1.1, USB 2.0

Power consumption

5 V USB Bus power	20 mA typical , 25 mA max.	
External 9V unregulated supply (Power supply included)	All relays off	30 mA typical, 40 mA max.
	All relays on	500 mA typical, 625 mA max.
Power supply voltage range	7.5V – 20V	

Output specification

Number	8	
Contact configuration	8 FORM C (SPDT) NO, NC and Common available at connector	
<i>Contact rating</i>	<i>6 amperes (A) @ 120 volts AC (VAC) or 28 volts DC (VDC) resistive</i>	
Contact resistance	100 milliohms (mΩ) max	
<i>Operate time</i>	<i>10 milliseconds(ms) max</i>	
<i>Release time</i>	<i>5 ms max</i>	
<i>Vibration</i>	<i>10 to 55 hertz (Hz) (Dual amplitude 1.5 millimeters (mm))</i>	
<i>Shock</i>	<i>10 G (11 ms)</i>	
<i>Dielectric isolation</i>	<i>500 V (1 minute)</i>	
<i>Life expectancy</i>	<i>10 million mechanical operations, min</i>	
Power on RESET state	Not energized. NC in contact to Common.	

Isolated inputs

Number	8	
<i>Isolation</i>	<i>500 volts (V)</i>	
Resistance	1.6K ohms (Ω) min.	
Voltage range	DC	Input high: +5.0 VDC min or –5.0 VDC min
		Input low: +1.5 VDC max. or –1.5VDC max.
		Input range: ± 30 VDC max
	AC (with filter)	Input high: 3.0 Vrms min (50-1000 Hz)
		Input low: 1.5 Vrms max (50-1000 Hz)
Response	w/o filter	20 μs
	w/ filter	5 ms
Filters	Time constant	5 ms (200 Hz)
	Filter control	Software programmable at each input.
	Power-up /reset	Filters off

USB connection

<i>Captive pigtail cable</i>	<i>USB Type A connector</i>
<i>Length</i>	<i>2 meters</i>

Environmental

Operating temperature range	0 to 70 °C
Storage temperature range	-40 to 100 °C
Humidity	0 to 95% non-condensing

Mechanical

Card dimensions	165 mm long x 150 mm wide x 20 mm high, 6.5 in. long x 5.9 in. wide x 0.8 in. high
Case dimensions	185 mm long x 160 mm wide x 46 mm high, 7.3 in. long x 6.3 in. wide x 1.8 in. high
<i>Case material</i>	<i>20 gage steel</i>
Weight of complete unit	2.1 lbs.
Weight of card alone	0.6 lbs.

Screw terminal

<i>Wire sizes</i>	<i>12-22 AWG</i>
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Miscellaneous

Case strain relief rating	20 lbs.
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Screw terminal pinouts

Pin	Signal Name	Pin	Signal Name
IP0A	Input 0 terminal A	IP4A	Input 4 terminal A
IP0B	Input 0 terminal B	IP4B	Input 4 terminal B
IP1A	Input 1 terminal A	IP5A	Input 5 terminal A
IP1B	Input 1 terminal B	IP5B	Input 5 terminal B
IP2A	Input 2 terminal A	IP6A	Input 6 terminal A
IP2B	Input 2 terminal B	IP6B	Input 6 terminal B
IP3A	Input 3 terminal A	IP7A	Input 7 terminal A
IP3B	Input 3 terminal B	IP7B	Input 7 terminal B
0-NO	Relay 0 Normally Open contact	4-NO	Relay 4 Normally Open contact
0-C	Relay 0 Common contact	4-C	Relay 4 Common contact
0-NC	Relay 0 Normally Closed contact	4-NC	Relay 4 Normally Closed contact
1-NO	Relay 1 Normally Open contact	5-NO	Relay 5 Normally Open contact
1-C	Relay 1 Common contact	5-C	Relay 5 Common contact
1-NC	Relay 1 Normally Closed contact	5-NC	Relay 5 Normally Closed contact
2-NO	Relay 2 Normally Open contact	6-NO	Relay 6 Normally Open contact
2-C	Relay 2 Common contact	6-C	Relay 6 Common contact
2-NC	Relay 2 Normally Closed contact	6-NC	Relay 6 Normally Closed contact
3-NO	Relay 3 Normally Open contact	7-NO	Relay 7 Normally Open contact
3-C	Relay 3 Common contact	7-C	Relay 7 Common contact
3-NC	Relay 3 Normally Closed contact	7-NC	Relay 7 Normally Closed contact

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