

## USER GUIDE AND SPECIFICATIONS

# NI USB-9213

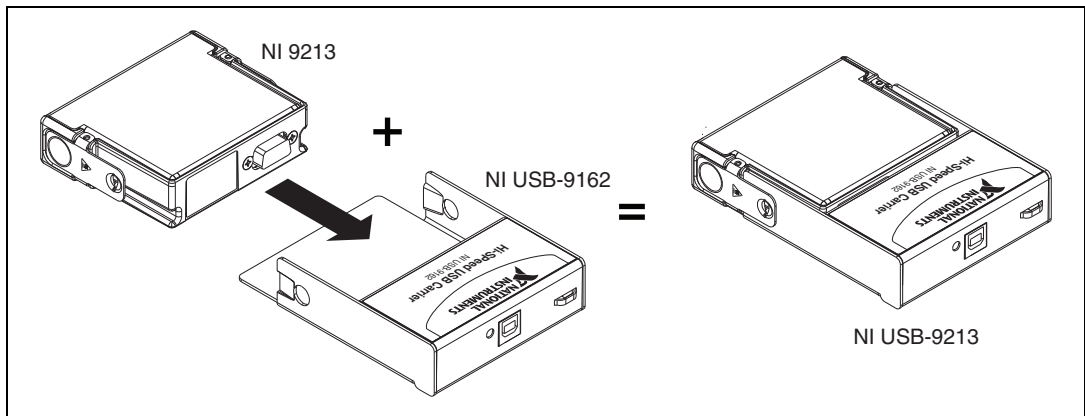
## 16-Channel Thermocouple Input Module

This user guide describes how to use the National Instruments USB-9213 and lists the device specifications.

## Introduction

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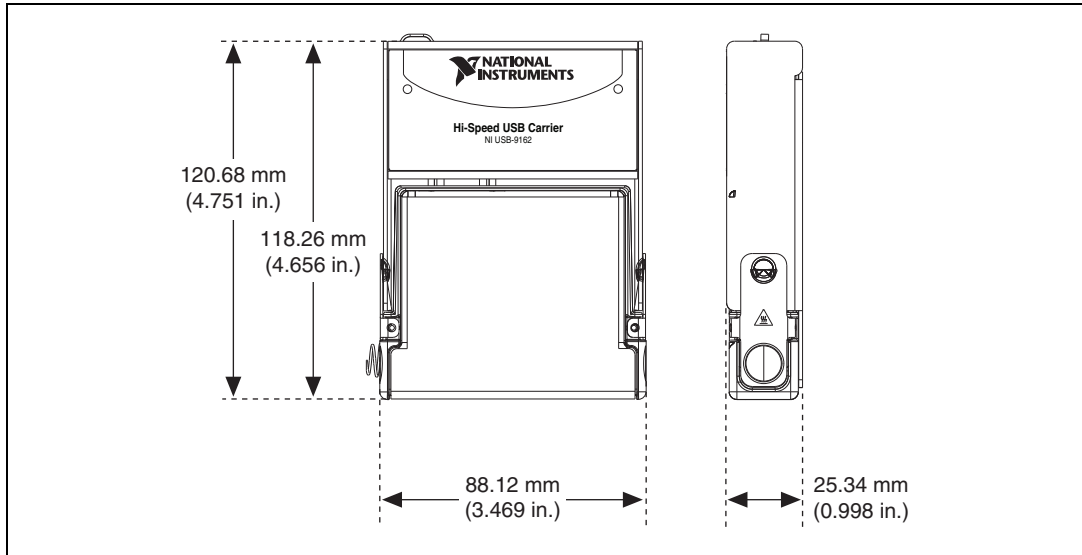
The NI USB-9213 consists of two components: an NI 9213 module and an NI USB-9162 carrier, as shown in Figure 1.



**Figure 1.** NI USB-9213 Components

# Dimensions

Figure 2 shows the NI USB-9213 device dimensions.



**Figure 2.** NI USB-9213 Device Dimensions in Millimeters (Inches)

## Safety Guidelines

Operate the NI USB-9213 only as described in this user guide.



**Hot Surface** This icon denotes that the component may be hot. Touching this component may result in bodily injury.

## Safety Guidelines for Hazardous Voltages

If hazardous voltages are connected to the module, take the following precautions. A hazardous voltage is a voltage greater than 42.4 V<sub>pk</sub> or 60 VDC to earth ground.



**Caution** Ensure that hazardous voltage wiring is performed only by qualified personnel adhering to local electrical standards.



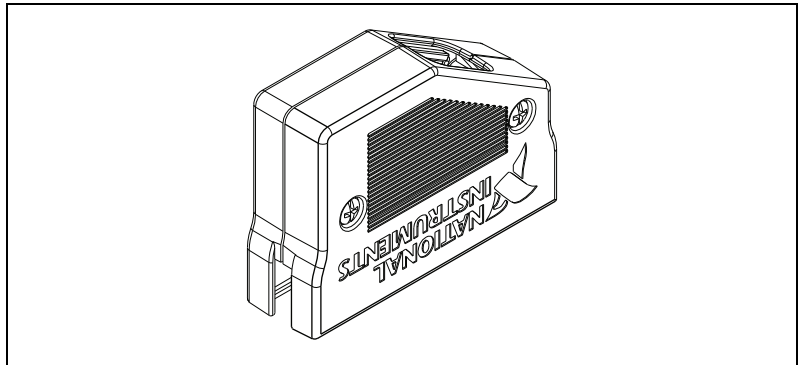
**Caution** Do *not* mix hazardous voltage circuits and human-accessible circuits on the same module.



**Caution** Make sure that devices and circuits connected to the module are properly insulated from human contact.



**Caution** When module terminals are hazardous voltage LIVE ( $>42.4 V_{pk}/60 VDC$ ), you must ensure that devices and circuits connected to the module are properly insulated from human contact. You must use the NI 9940 connector backshell kit, shown in Figure 3, to ensure that the terminals are *not* accessible.



**Figure 3.** NI 9940 Connector Backshell

## Related Documentation

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Each application software package and driver includes information about writing applications for taking measurements and controlling measurement devices. Check [ni.com/manuals](http://ni.com/manuals) for the most recent hardware documentation and specifications, and refer to Table 1 for a list of locations for driver and application software documentation. The following document location references assume you have NI-DAQmx 9.0 or later, and where applicable, version 8.2.1 or later of the NI application software.

**Table 1.** Related Documentation

| Software             | Document/Description                                                                                                                                                                                           | Location/Topic                                                                                                                                                                |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| NI-DAQmx for Windows | The <i>DAQ Getting Started</i> guides—describe how to install the NI-DAQmx for Windows software, your NI-DAQmx supported DAQ device, and how to confirm that your device is operating properly.                | <b>Start»All Programs»National Instruments»NI-DAQ</b>                                                                                                                         |
|                      | <i>NI-DAQ Readme</i> —lists which devices are supported by this version of NI-DAQmx.                                                                                                                           | <b>Start»All Programs»National Instruments»NI-DAQ»NI-DAQ Readme</b>                                                                                                           |
|                      | <i>NI-DAQmx Help</i> —contains general information about measurement concepts, key NI-DAQmx concepts, and common applications that are applicable to all programming environments.                             | <b>Start»All Programs»National Instruments»NI-DAQ»NI-DAQmx Help</b>                                                                                                           |
| LabVIEW              | <i>Getting Started with LabVIEW</i> —describes the LabVIEW graphical programming environment and the basic LabVIEW features you use to build data acquisition and instrument control application.              | <b>Start»All Programs»National Instruments»LabVIEW»LabVIEW Manuals</b> or navigate to the <code>labview\manuals</code> directory and open <code>LV_Getting_Started.pdf</code> |
|                      | <i>LabVIEW Help</i> —provides information about LabVIEW programming concepts, step-by-step instructions for using LabVIEW, and reference information about LabVIEW VIs, functions, palettes, menus, and tools. | <b>Help»Search the LabVIEW Help</b>                                                                                                                                           |

**Table 1.** Related Documentation (Continued)

| Software                                                                                                                                     | Document/Description                                                                                                                                                                                                   |                                                                                                                                  | Location/Topic |
|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------------|
| LabVIEW Help Topics Specific to NI-DAQmx                                                                                                     |                                                                                                                                                                                                                        |                                                                                                                                  |                |
| Location                                                                                                                                     | Description                                                                                                                                                                                                            |                                                                                                                                  |                |
| From the <b>Contents</b> tab,<br><b>Getting Started with LabVIEW»Getting Started with DAQ</b>                                                | Includes overview information and a tutorial to learn how to take an NI-DAQmx measurement in LabVIEW using the DAQ Assistant.                                                                                          |                                                                                                                                  |                |
| From the <b>Contents</b> tab,<br><b>VI and Function Reference»Measurement I/O VIs and Functions»DAQmx-Data Acquisition VIs and Functions</b> | Describes the LabVIEW NI-DAQmx VIs and properties.                                                                                                                                                                     |                                                                                                                                  |                |
| From the <b>Contents</b> tab,<br><b>Taking Measurements</b>                                                                                  | Contains the conceptual and how-to information you need to acquire and analyze measurement data in LabVIEW, including common measurements, measurement fundamentals, NI-DAQmx key concepts, and device considerations. |                                                                                                                                  |                |
| LabWindows™/CVI™                                                                                                                             | LabWindows/CVI Help <b>Data Acquisition</b> book—contains NI-DAQmx measurement concepts and step-by-step instructions about creating a measurement task using the DAQ Assistant.                                       | <b>Help»Contents</b> , then select <b>Using LabWindows/CVI»Data Acquisition»Taking an NI-DAQmx Measurement in LabWindows/CVI</b> |                |
|                                                                                                                                              | LabWindows/CVI Help <b>NI-DAQmx Library</b> book—contains NI-DAQmx API overviews and function reference.                                                                                                               | <b>Library Reference»NI-DAQmx Library</b>                                                                                        |                |
| Measurement Studio/<br>Microsoft Visual Studio .NET                                                                                          | Microsoft Visual Studio .NET Help/NI Measurement Studio Help—contains NI-DAQmx methods and properties.                                                                                                                 | <b>Measurement Studio»NI Measurement Studio Help</b>                                                                             |                |

**Table 1.** Related Documentation (Continued)

| <b>Software</b>                                                                                                                                                                                                                                                                                      | <b>Document/Description</b>                                                                                         | <b>Location/Topic</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ANSI C without NI Application Software                                                                                                                                                                                                                                                               | <i>NI-DAQmx Help</i> —contains API overviews and general information about measurement concepts.                    | <b>Start»All Programs»National Instruments»NI-DAQ»NI-DAQmx Help</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                                                                                                                                                                                                                                                                                                      | <i>NI-DAQmx C Reference Help</i> —describes the NI-DAQmx Library functions.                                         | <b>Start»All Programs»National Instruments»NI-DAQ»NI-DAQmx C Reference Help</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| .NET Languages without NI Application Software*                                                                                                                                                                                                                                                      | <i>NI-DAQmx .NET Help</i> —contains conceptual topics for using NI-DAQmx with Visual C# and Visual Basic .NET.      | <p>To view the NI-DAQmx .NET documentation, go to <b>Start»All Programs»National Instruments»NI-DAQ»Text-Based Code Support»NI-DAQmx .NET Help</b>.</p> <p>For function reference, refer to the following topics:<br/> <i>NationalInstruments.DAQmx Namespace</i> and<br/> <i>NationalInstruments.DAQmx.ComponentModel Namespace</i></p> <p>For conceptual help, refer to the following sections: <i>Using the Measurement Studio NI-DAQmx.NET Library</i> and <i>Developing with Measurement Studio NI-DAQmx</i></p> <p>To get to the same help topics from within Visual Studio, go to <b>Help»Contents</b> and select <b>Measurement Studio</b> from the <b>Filtered By</b> drop-down list.</p> |
|                                                                                                                                                                                                                                                                                                      | <i>Visual Studio .NET Help</i> —contains conceptual topics for using NI-DAQmx with Visual C# and Visual Basic .NET. | <b>Help»Contents</b> . Select <b>Measurement Studio</b> from the <b>Filtered By</b> drop-down list and follow the location instructions for the <i>NI-DAQmx .NET Help</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <p>* With the Microsoft .NET Framework version 1.1 or later, you can use NI-DAQmx to create applications using Visual C# and Visual Basic .NET without Measurement Studio. You need Microsoft Visual Studio .NET 2003 or Microsoft Visual Studio 2005 for the API documentation to be installed.</p> |                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## Training Courses

If you need more help getting started developing an application with NI products, NI offers training courses. To enroll in a course or obtain a detailed course outline, refer to [ni.com/training](http://ni.com/training).

## Technical Support on the Web

For additional support, refer to [ni.com/support](http://ni.com/support) or [zone.ni.com](http://zone.ni.com).

## Installing the Software

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Software support for the NI USB-9213 for Windows Vista/XP is provided by NI-DAQmx. The *DAQ Getting Started* guides, which you can download at [ni.com/manuals](http://ni.com/manuals), offer NI-DAQmx users step-by-step instructions for installing software and hardware, configuring channels and tasks, and getting started developing an application.

## Installing Other Software

If you are using other software, refer to the installation instructions that accompany your software.

## Example Programs

The NI-DAQmx media contains example programs that you can use to get started programming with the NI USB-9213. Refer to the *NI-DAQmx for USB Devices Getting Started Guide* that shipped with your device, and is also accessible from **Start»All Programs»National Instruments»NI-DAQ**, for more information.

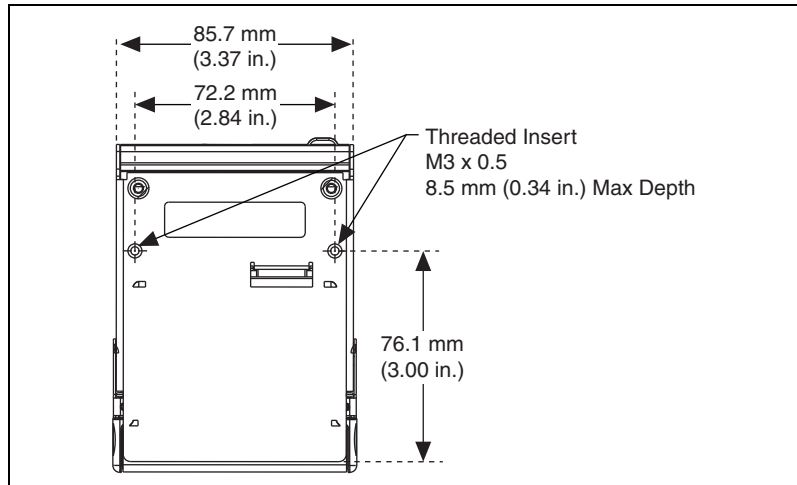
## Installing the NI USB-9213 Device

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Before installing the device, you must install the software you plan to use with the device. Refer to the *Installing the Software* section of this guide and the documentation included with the software for more information.

# Mounting the NI USB-9213 to a Panel

Threaded inserts are located in the NI USB-9162 for mounting it to a panel. Mount the NI USB-9162 before inserting the NI 9213. Refer to Figure 4 for mounting dimensions.

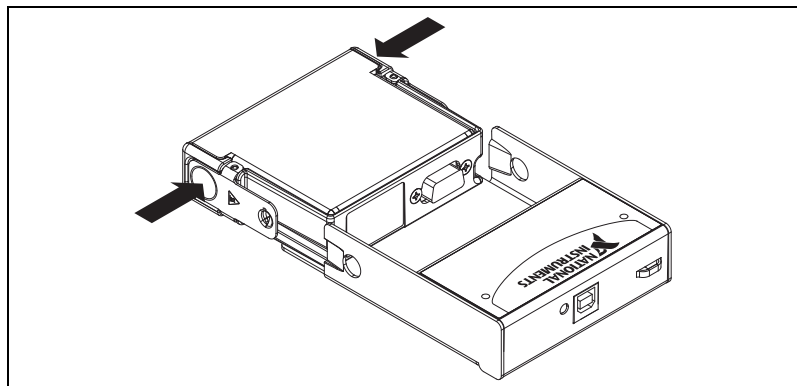


**Figure 4.** Module Mounting Dimensions In Millimeters (Inches)

## Installing the NI 9213 Device into the NI USB-9162 Carrier

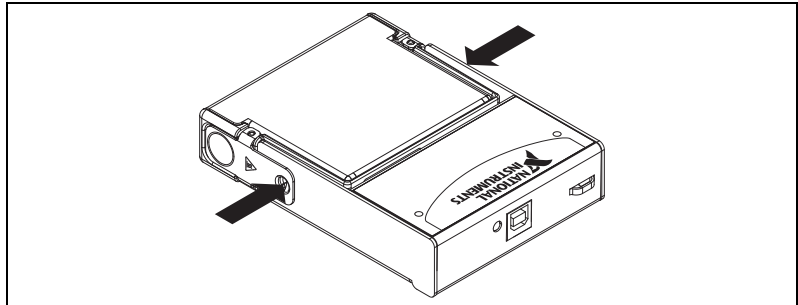
The NI 9213 module and NI USB-9162 carrier are packaged separately. Refer to Figure 5, while completing the following assembly steps:

1. Make sure that no signals are connected to the NI 9213 module and the USB cable is not attached to the USB-9162.
2. Remove the protective cover from the 15-pin D-SUB connector.
3. Align the I/O module with the carrier, as shown in Figure 5.



**Figure 5.** Module Installation

4. Squeeze the latches and insert the NI 9213 module into the NI USB-9162 carrier.
5. Press firmly on the connector side of the NI 9213 module until the latches lock the module into place, as shown in Figure 6.



**Figure 6.** Locking Module into Place

## Connecting the NI USB-9213 to a Computer

Plug one end of the USB cable into the NI USB-9213 and the other end into an available USB port on the computer. Refer to the *NI-DAQmx for USB Devices Getting Started Guide* that shipped with your device, and is also accessible from **Start»All Programs»National Instruments»NI-DAQ**, for more information.

## LED Indicator

The NI USB-9213 device has a green LED next to the USB connector. The LED indicator indicates device status, as listed in Table 2. When the device is connected to a USB port, the LED blinks steadily to indicate that the device is initialized and is receiving power from the connection.

If the LED is not blinking, it may mean that the device is not initialized or the computer is in standby mode. In order for the device to be recognized, the device must be connected to a computer that has NI-DAQmx installed on it. If your device is not blinking, make sure your computer has the latest version of NI-DAQmx installed on it, and the computer is not in standby mode.

**Table 2.** LED State/Device Status

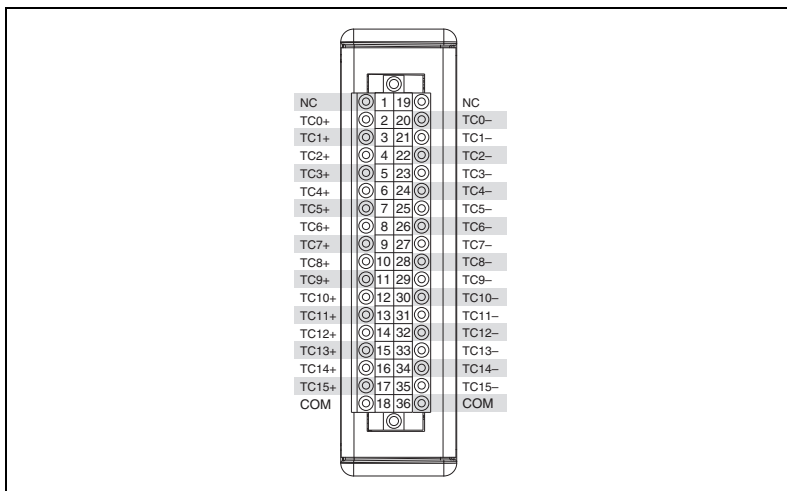
| LED State        | Device Status                                                               |
|------------------|-----------------------------------------------------------------------------|
| Not lit          | Device not connected or in suspend.                                         |
| On, not blinking | Device connected, but no module installed.                                  |
| Single-blink     | Operating normally.                                                         |
| Double-blink     | Operating normally.                                                         |
| Quadruple-blink  | Device error. Refer to <a href="http://ni.com/support">ni.com/support</a> . |

# Wiring the NI USB-9213 Device

The NI USB-9213 has a 36-terminal detachable spring-terminal connector that provides connections for 16 thermocouple channels.



**Caution** The NI 9940 high voltage screw terminal backshell, shown in Figure 3, must be installed when using hazardous voltages ( $>42.4 V_{pk}$ , 60 VDC).



**Figure 7.** NI USB-9213 Terminal Assignments

You can connect thermocouple input signals to the NI USB-9213. Connect the positive lead of the thermocouple to the TC+ terminal and the negative lead of the thermocouple to the TC– terminal. If you are unsure which of the thermocouple leads is positive and which is negative, check the thermocouple documentation or the thermocouple wire spool. The NI USB-9213 also has two common terminals, COM, that are internally connected to the isolated ground reference of the module.

## EMC Compliance

To ensure proper performance in the specified EMC environments, any connected cable must be provided with an overall shield that is connected to earth ground using an equipment grounding conductor of the shortest possible length. Ensure that any wires within the cable that extend beyond the shield are as short as possible so that the shield covers as much of the cable as possible. For the equipment grounding conductor, use AWG 16 or

larger, solid or stranded copper wire with a maximum length of 1.5 m (5 ft). One end of the equipment grounding conductor must be soldered to the overall cable shield. The other end of the equipment grounding conductor must be connected to one of the following:

- The grounding electrode system of the facility where the device is used. For more information about facility earth ground connections, refer to the *Earth Grounding for Test and Measurement Devices* KnowledgeBase document by going to [ni.com/info](http://ni.com/info) and entering the info code `earthground`.
- The chassis of the USB host, provided that the host is equipped with a safety ground conductor and a connection can be made to the host's conductive, metal housing.



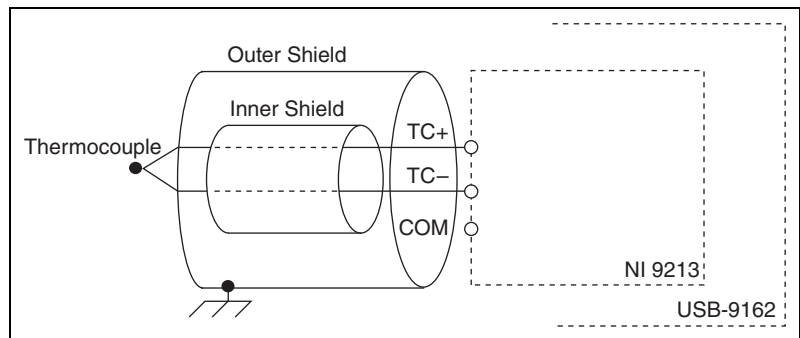
**Caution** Local electrical codes typically specify requirements for connecting equipment to the grounding electrode system of a facility. Ensure that your installation complies with all applicable safety requirements. When in doubt, contact a licensed electrician to perform the installation.

For applications where a thermocouple wire shield *does not* need to be connected to the COM terminal, a shielded, twisted pair thermocouple cable should be used. The overall shield of the shielded, twisted pair thermocouple cable must be connected to earth ground with the shortest possible connection.

For applications where a thermocouple wire shield *does* need to be connected to the COM terminal, a shielded, twisted pair thermocouple cable with overbraiding (outer shield) should be used. The inner shield should be connected to the COM terminal. The outer, overbraid shield should be connected to earth ground with the shortest possible connection. Figure 8 shows a typical wiring configuration with the inner shield connected to COM and the outer shield connected to earth ground.



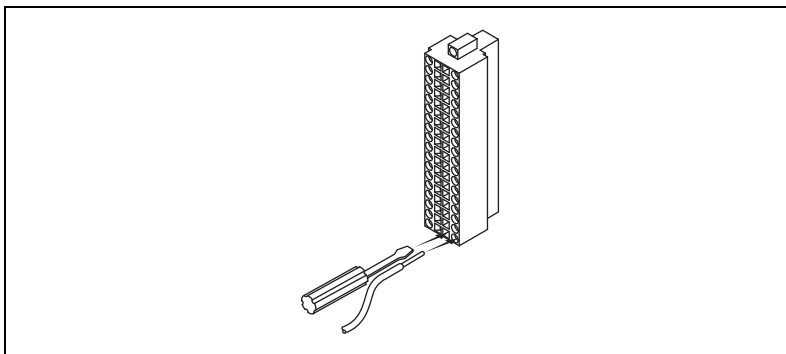
**Note** The inner shield is not necessary for EMC compliance.



**Figure 8.** Connecting a Shielded Thermocouple Input Signal to the NI USB-9213

## Connecting Wires to the NI USB-9213 Connector

Use a flathead screwdriver with a blade smaller than  $2.3 \times 1.0$  mm ( $0.09 \times 0.04$  in.) to connect wires to the detachable spring-terminal connector. Insert the screwdriver into a spring clamp activation slot and press a wire into the corresponding connector terminal, then remove the screwdriver to clamp the wire into the terminal. Refer to the [Specifications](#) section for more information about spring-terminal wiring. Refer to Figure 9 for an illustration of connecting wires to the NI USB-9213.



**Figure 9.** Connecting Wires to the NI USB-9213 Terminals

## Wiring for High-Vibration Applications

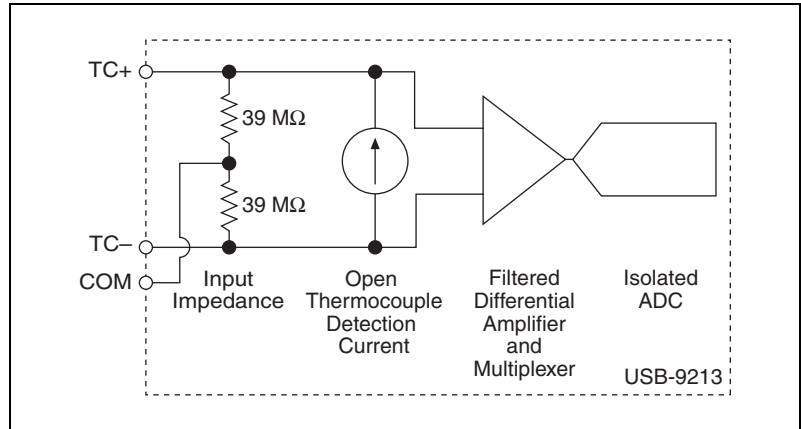
If an application is subject to high vibration, National Instruments recommends that you use the NI 9940 backshell kit to protect the connections. Refer to Figure 3 for an illustration of the NI 9940 connector backshell.

## NI USB-9213 Circuitry

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Each channel of the NI USB-9213 passes through a differential filter and then is multiplexed and sampled by a 24-bit analog-to-digital converter (ADC). Each channel also has an open thermocouple detection (OTD) circuit, which consists of a current source between the TC+ and TC– terminals. If an open thermocouple is connected to the channel, the current source forces a full-scale voltage across the terminals. Refer to Figure 10 for an illustration of the input circuitry for one channel of the NI USB-9213.

The NI USB-9213 multiplexes 16 thermocouple input channels, one cold-junction compensation (CJC) channel, and one autozero channel to a single ADC. Each channel has a resistor that produces an input impedance between the TC+ and COM terminals and between the TC– and COM terminals. The gain and offset errors resulting from the source impedance of connected thermocouples are negligible for most applications. Thermocouples with a higher lead resistance can introduce more significant errors. Refer to the [Specifications](#) section for more information about errors resulting from source impedance.



**Figure 10.** Input Circuitry for One Channel of the NI USB-9213

The channels share a common ground, COM, that is isolated from other modules in the system. The NI USB-9213 common-mode range is the maximum voltage between any channel and COM. If COM is not connected, then the common-mode voltage range is the maximum voltage between any two channels. The NI USB-9213 measures the common-mode voltage level of each channel and returns a warning in the software if the signal is outside the common-mode voltage range. Refer to the [Specifications](#) section for more information about the common-mode voltage range.

The NI USB-9213 supports high-resolution and high-speed timing modes. High-resolution timing mode optimizes accuracy and noise and rejects power line frequencies. High-speed timing mode optimizes sample rate and signal bandwidth. Refer to the [Specifications](#) section for more information about the high-speed and high-resolution timing modes. Refer to the software help for information about setting the timing mode, or conversion time, in software. Visit [ni.com/info](http://ni.com/info) and enter `cseriesdoc` for information about C Series documentation.

# Temperature Measurement Accuracy Considerations

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Temperature measurement errors depend partly on the thermocouple type, the accuracy of the thermocouple, the temperature being measured, and the cold-junction temperature. Refer to the *Temperature Measurement Accuracy Considerations* section of the [Specifications](#) for the errors for each thermocouple type when connected to the NI USB-9213. The errors do not account for the accuracy of the thermocouple itself.

For the best accuracy results, keep temperature gradients across NI USB-9213 terminals to a minimum and enable the autozero channel. Refer to the *Minimizing Thermal Gradients* and [Using the Autozero Channel](#) sections for more information.

## Cold-Junction Temperature Measurement Accuracy

Heat dissipated by adjacent modules or other nearby heat sources can cause errors in thermocouple measurements by heating up the NI USB-9213 terminals to a different temperature than the cold-junction compensation sensor. The thermal gradient across the terminals can cause the terminals of different channels to be at different temperatures, in which case the resulting measurement creates errors not only in absolute accuracy but also in the relative accuracy between channels. Refer to the [Specifications](#) section for the cold-junction compensation accuracy specifications. If the NI USB-9213 module is lying flat or facing upward, the thermocouple accuracy specifications include the errors caused by the thermal gradient across the module terminals. Refer to the [Temperature Measurement Accuracy](#) section in the [Specifications](#) for the thermocouple accuracy specifications.

## Minimizing Thermal Gradients

Thermal gradients can be caused by changes in the ambient air temperature near the front connector or by the thermocouple wire if it conducts heat or cold directly to the terminal junctions. For the best accuracy results, follow these guidelines for minimizing thermal gradients:

- Use the NI 9940 connector backshell shown in Figure 3.
- Use small-gauge thermocouple wire. Smaller wire transfers less heat to or from the terminal junction.
- Run thermocouple wiring together near the spring-terminal connector to keep the wires at the same temperature.
- Avoid running thermocouple wires near hot or cold objects.
- If you connect any extension wires to thermocouple wires, use wires made of the same conductive material as the thermocouple wires.
- Minimize adjacent heat sources and air flow across the terminals.

- Keep the ambient temperature as stable as possible.
- Make sure the module is lying flat or facing upward. Keep the module in a stable and consistent orientation.
- Allow the thermal gradients to settle after a change in system power or in ambient temperature. A change in system power can happen when the system powers on, the system comes out of sleep mode, or you insert/remove modules. Refer to the *Specifications* section for more information about the warm-up time.

## Using the Autozero Channel

The NI USB-9213 has an internal autozero channel to compensate for the offset error. The NI USB-9213 specifications all assume the autozero channel is on for every sample, however, you can choose not to use the autozero channel in software. When the autozero channel is on, the NI USB-9213 measures the autozero channel and subtracts that measurement from the measurement of each thermocouple channel. Refer to the software help for information about using the autozero channel. Visit [ni.com/info](http://ni.com/info) and enter *cseriesdoc* for information about C Series documentation.

## Specifications

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The following specifications are typical for the range 0 to 60 °C unless otherwise noted.

Warm-up time<sup>1</sup> ..... 15 minutes

### Input Characteristics

Number of channels ..... 16 thermocouple channels,  
1 internal autozero channel,  
1 internal cold-junction  
compensation channel

ADC resolution ..... 24 bits

Type of ADC..... Delta-Sigma

Sampling mode ..... Scanned

Voltage measurement range.....  $\pm 78.125$  mV

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<sup>1</sup> The warm-up time assumes the module is lying flat or facing upward and is in a constant ambient temperature. National Instruments recommends allowing the full warm-up time.

Temperature measurement ranges ..... Works over temperature ranges defined by NIST  
(J, K, T, E, N, B, R, S thermocouple types)

#### Timing modes

| Timing Mode                                                                                                                                                                                                                                                                                                                                                                              | Conversion Time (Per Channel) | Sample Rate* (All Channels <sup>†</sup> ) |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------------------------------------------|
| High-resolution                                                                                                                                                                                                                                                                                                                                                                          | 55 ms                         | 1 S/s                                     |
| High-speed                                                                                                                                                                                                                                                                                                                                                                               | 740 $\mu$ s                   | 75 S/s                                    |
| <p>* If you are using fewer than all channels, the sample rate might be faster. The maximum sample rate = <math>1/(\text{Conversion Time} \times \text{Number of Channels})</math>, or 100 S/s, whichever is smaller. Sampling faster than the maximum sample rate may result in the degradation of accuracy.</p> <p><sup>†</sup> Including the autozero and cold-junction channels.</p> |                               |                                           |

#### Common-mode voltage range

Channel-to-COM .....  $\pm 1.2$  V min  
COM-to-earth ground .....  $\pm 250$  V

#### Common-mode rejection ratio

High-resolution mode (at DC and 50–60 Hz)  
Channel-to-COM ..... 100 dB  
COM-to-earth ground ..... >170 dB  
High-speed mode (at 0–60 Hz)  
Channel-to-COM ..... 70 dB  
COM-to-earth ground ..... >150 dB

#### Input bandwidth

High-resolution mode ..... 14.4 Hz  
High-speed mode ..... 78 Hz

#### High-resolution noise rejection

(at 50 and 60 Hz) ..... 60 dB

Overvoltage protection .....  $\pm 30$  V between any two inputs

Differential input impedance ..... 78 M $\Omega$

Input current ..... 50 nA

#### Input noise

High-resolution mode ..... 200 nV<sub>rms</sub>

High-speed mode ..... 7  $\mu$ V<sub>rms</sub>

#### Gain error

High-resolution mode ..... 0.03% typ at 25 °C,  
0.07% typ at 0 to 60 °C,  
0.15% max at 0 to 60 °C

High-speed mode ..... 0.04% typ at 25 °C,  
0.08% typ at 0 to 60 °C,  
0.16% max at 0 to 60 °C

#### Offset error

High-resolution mode ..... 4  $\mu$ V typ, 6  $\mu$ V max

High-speed mode ..... 14  $\mu$ V typ, 17  $\mu$ V max

#### Offset error

from source impedance ..... Add 0.05  $\mu$ V per  $\Omega$ , when source  
impedance >50  $\Omega$

#### Cold-junction compensation accuracy

0 to 60 °C ..... 0.8 °C typ, 1.7 °C max

## Temperature Measurement Accuracy

#### Measurement sensitivity<sup>1</sup>

##### High-resolution mode

Types J, K, T, E, N ..... <0.02 °C

Types B, R, S ..... <0.15 °C

##### High-speed mode

Types J, K, T, E ..... <0.25 °C

Type N ..... <0.35 °C

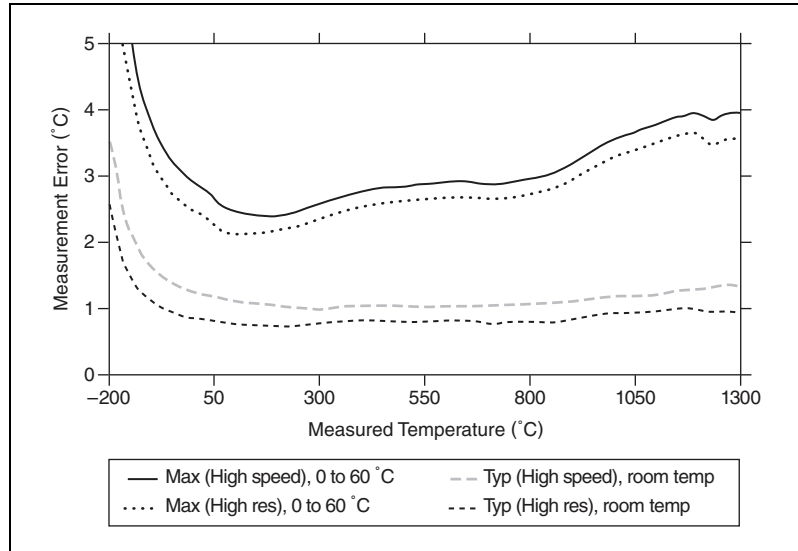
Type B ..... <1.2 °C

Types R, S ..... <2.8 °C

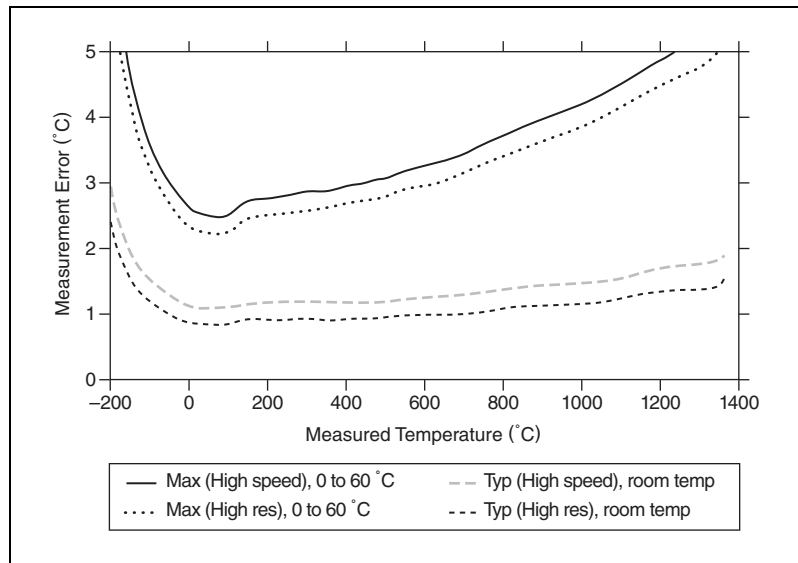
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<sup>1</sup> Measurement sensitivity represents the smallest change in temperature that a sensor can detect. It is a function of noise. The values assume the full measurement range of the standard thermocouple sensor according to ASTM E230-87.

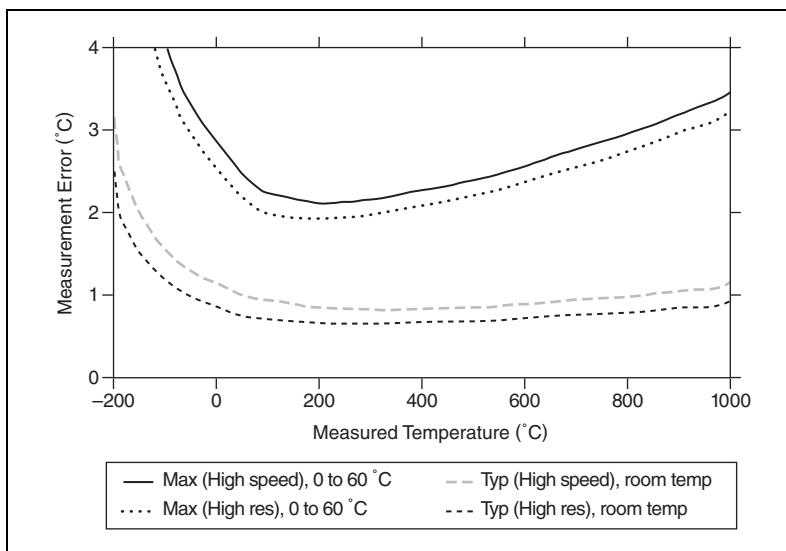
Figures 11, 12, 13, 14, and 15 show the errors for each thermocouple type when connected to the NI USB-9213 with the autozero channel on. The figures display the maximum errors over a full temperature range and typical errors at room temperature. The figures account for gain errors, offset errors, differential and integral nonlinearity, quantization errors, noise errors, 50  $\Omega$  lead wire resistance, and cold-junction compensation errors. The figures do not account for the accuracy of the thermocouple itself.



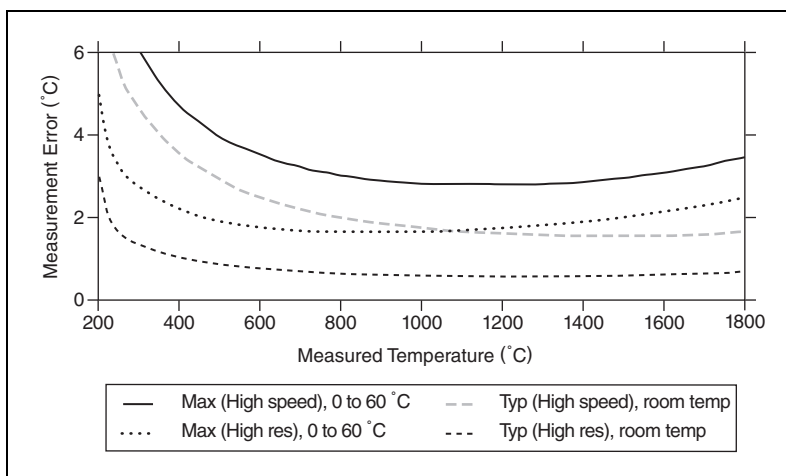
**Figure 11.** Thermocouple Types J and N Errors



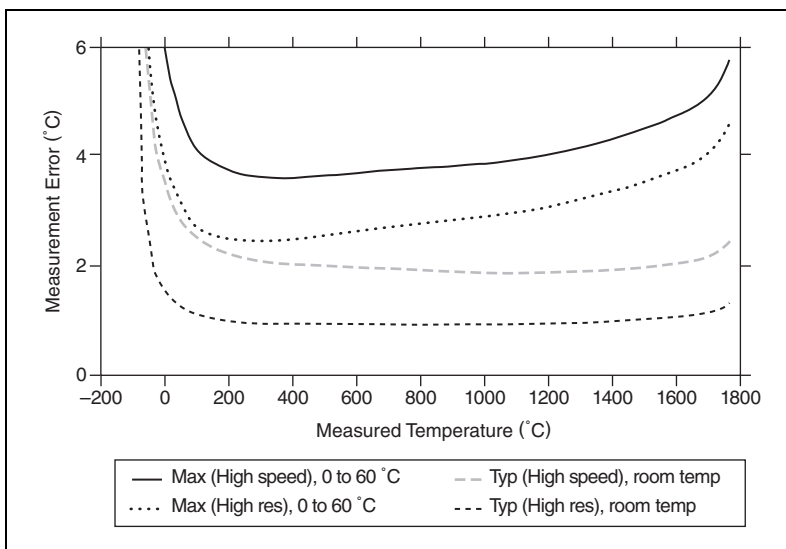
**Figure 12.** Thermocouple Type K Errors



**Figure 13.** Thermocouple Types T and E Errors



**Figure 14.** Thermocouple Type B Errors



**Figure 15.** Thermocouple Types R and S Errors

## Power Requirements

Power consumption from USB .....370 mW max  
Suspend mode.....2.5 mA max

## Bus Interface

USB specification .....USB 2.0 Hi-Speed

## Physical Characteristics



**Note** For two-dimensional drawings and three-dimensional models of the C Series module and connectors, visit [ni.com/dimensions](http://ni.com/dimensions) and search by module number.

Spring-terminal wiring .....18 to 28 AWG copper conductor wire with 7 mm (0.28 in.) of insulation stripped from the end  
Weight .....Approx. 260 g (9.2 oz)

## Safety Standards

This product meets 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

This device is not certified for use in hazardous locations.

## Environmental

National Instruments C Series modules are intended for indoor use only but may be used outdoors if installed in a suitable enclosure.

Operating temperature  
(IEC 60068-2-1, IEC 60068-2-2)..... –0 to 60 °C

Storage temperature  
(IEC 60068-2-1, IEC 60068-2-2)..... –40 to 85 °C

Ingress protection ..... IP 40

Operating humidity (IEC 60068-2-56).....10 to 90% RH, noncondensing

Storage humidity (IEC 60068-2-56) ..... 5 to 95% RH, noncondensing

Maximum altitude ..... 2,000 m

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 performance of this product, refer to the [Online Product Certification](#) section.



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

# CE Compliance

This product meets the essential requirements of applicable European Directives as follows:

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

## 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](http://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 to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at [ni.com/environment](http://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](http://ni.com/environment/weee).

## 电子信息产品污染控制管理办法（中国 RoHS）



**中国客户** National Instruments 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 National Instruments 中国 RoHS 合规性信息，请登录 [ni.com/environment/rohs\\_china](http://ni.com/environment/rohs_china)。(For information about China RoHS compliance, go to [ni.com/environment/rohs\\_china](http://ni.com/environment/rohs_china).)

## Calibration

You can obtain the calibration certificate and calibration procedures for the NI USB-9213 at [ni.com/calibration](http://ni.com/calibration).

Calibration interval .....1 year

# Where to Go for Support

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The National Instruments Web site is your complete resource for technical support. At [ni.com/support](http://ni.com/support) you have access to everything from troubleshooting and application development self-help resources to email and phone assistance from NI Application Engineers.

National Instruments corporate headquarters is located at 11500 North Mopac Expressway, Austin, Texas, 78759-3504.

National Instruments also has offices located around the world to help address your support needs. For telephone support in the United States, create your service request at [ni.com/support](http://ni.com/support) and follow the calling instructions or dial 512 795 8248. For telephone support outside the United States, contact your local branch office:

Australia 1800 300 800, Austria 43 662 457990-0,  
Belgium 32 (0) 2 757 0020, Brazil 55 11 3262 3599,  
Canada 800 433 3488, China 86 21 5050 9800,  
Czech Republic 420 224 235 774, Denmark 45 45 76 26 00,  
Finland 358 (0) 9 725 72511, France 01 57 66 24 24,  
Germany 49 89 7413130, India 91 80 41190000, Israel 972 3 6393737,  
Italy 39 02 41309277, Japan 0120-527196, Korea 82 02 3451 3400,  
Lebanon 961 (0) 1 33 28 28, Malaysia 1800 887710,  
Mexico 01 800 010 0793, Netherlands 31 (0) 348 433 466,  
New Zealand 0800 553 322, Norway 47 (0) 66 90 76 60,  
Poland 48 22 328 90 10, Portugal 351 210 311 210,  
Russia 7 495 783 6851, Singapore 1800 226 5886,  
Slovenia 386 3 425 42 00, South Africa 27 0 11 805 8197,  
Spain 34 91 640 0085, Sweden 46 (0) 8 587 895 00,  
Switzerland 41 56 2005151, Taiwan 886 02 2377 2222,  
Thailand 662 278 6777, Turkey 90 212 279 3031,  
United Kingdom 44 (0) 1635 523545

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