



# **PicoScope 4000 Series**

## **PC Oscilloscopes**

User's Guide



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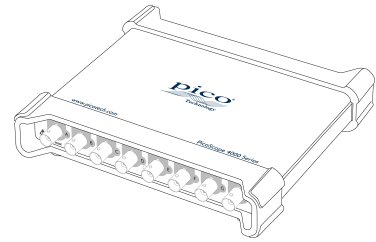
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# 1 Welcome

Thank you for buying a Pico Technology product!

The PicoScope 4000 Series of PC Oscilloscopes from Pico Technology is a range of compact units designed to replace and out-perform traditional bench-top models costing many times the price. This guide covers the various PicoScope 4000 Series Oscilloscopes.



The following models are available in the PicoScope 4000 series:

PicoScope 4262	5 MHz 16-bit 2-channel oscilloscope
PicoScope 4224	20 MHz 12-bit 2-channel oscilloscope
PicoScope 4224 IEPE	20 MHz 12-bit 2-channel IEPE oscilloscope
PicoScope 4424	20 MHz 12-bit 4-channel oscilloscope
PicoScope 4824	20 MHz 12-bit 8-channel oscilloscope

For detailed specifications on each model see the accompanying data sheet, available to download from [www.picotech.com](http://www.picotech.com).

Here are some of the benefits provided by your new PicoScope 4000 Series PC Oscilloscope:

- **Portability:** Take the unit with you and simply plug it in to any Windows PC.
- **Performance:** Industry leading high precision low distortion inputs, up to 16-bit resolution, large buffer with up to 256 Msamples, fast USB 3.0 or 2.0 interface.
- **Flexibility:** Use as an oscilloscope, spectrum analyzer, high performance signal generator (selected models) or high-speed data acquisition interface.
- **Programmability:** The PicoScope 4000 Series APIs allow you to write your own programs in your chosen programming language and to control all the features of the scope.
- **Long-term support:** Software upgrades are available to download from our [website](http://www.picotech.com). You can also call our technical specialists for support. You can continue to use both of these services free of charge for the lifetime of the product.
- **Value for money:** You don't have to pay twice for all the features that you already have in your PC. The PicoScope 4000 Series scope unit contains the special hardware you need and nothing more.
- **Convenience:** The software makes full use of the large display, storage, user interface and networking built in to your PC.
- **IEPE capability:** The PicoScope 4224 two-channel IEPE (Integrated Electronics Piezo Electric) model allows you to connect industry-standard sensors such as accelerometers and microphones without requiring an external IEPE power supply.

## Programming with the PicoScope 4000 Series

An Application Programming Interface (API) is supplied free of charge with the PicoScope 4000 Series scopes. You can download and install the correct API for your product from our website at [www.picotech.com](http://www.picotech.com). The software includes a Programmer's Guide in PDF format.

## 2 Introduction

### 2.1 Safety information

To prevent possible electrical shock, fire, personal injury, or damage to the product, carefully read this safety information before attempting to install or use the product. In addition, follow all generally accepted safety practices and procedures for working with and around electricity.

The product has been designed and tested in accordance with the European standard publication EN 61010-1: 2010, and left the factory in a safe condition.

The following safety descriptions are found throughout this guide:



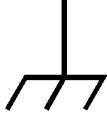
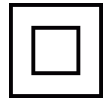



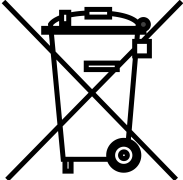
A **WARNING** identifies conditions or practices that could result in injury or death.

A **CAUTION** identifies conditions or practices that could result in damage to the product or equipment to which it is connected.

Each of these safety instructions applies to all of the 4000 Series oscilloscopes covered by this User's Guide, unless otherwise specified.

## 2.1.1 Symbols

These safety and electrical symbols may appear on the product and throughout this guide.

Symbol	Description
	Direct current.
	Alternating current.
	Chassis ground terminal. This symbol is now used in place of the equipotential symbol which may appear on older products.
	Equipment protected throughout by double insulation or reinforced insulation.
	Possibility of electric shock.
	Caution.
	Static awareness. Static discharge can damage part(s).
<b>CAT</b>	IEC 61010 overvoltage category.
	Do not dispose of this product as unsorted municipal waste.

### 2.1.2 Maximum input ranges

Observe all terminal ratings and warnings marked on the product.

The table below indicates the full scale measurement range and overload protection range for each oscilloscope model. The full scale measurement ranges are the maximum voltages that can be accurately measured by each instrument. The overload protection ranges are the maximum voltages that can be applied without damaging the oscilloscope.



#### WARNING

To prevent electric shock, do not attempt to measure voltages outside the specified full scale measurement range below.

Model	Full scale measurement range	Overload protection	
		Input channels / EXT trigger	Signal generator
PicoScope 4262	±20 V	±50 V pk max.	±10 V pk max.
PicoScope 4224 IEPE	±20 V	±100 V pk max.	-
PicoScope 4824	±50 V	±100 V pk max.	±10 V pk max.
PicoScope 4224	±100 V	±200 V pk max.	-
PicoScope 4424			



#### WARNING

Signals exceeding the voltage limits in the table below are defined as "hazardous live" by EN 61010. To prevent electric shock, take all necessary safety precautions when working on equipment where hazardous live voltages may be present.

Signal voltage limits of EN 61010		
±70 V DC	33 V AC RMS	±46.7 V pk max.

#### WARNING

The PicoScope 4262, PicoScope 4224 IEPE, and PicoScope 4824 oscilloscopes are not designed to measure hazardous live signals as defined by EN 61010. To prevent electric shock, do not attempt to measure voltages outside of the limits shown in the table above or the specified full scale measurement range, whichever is lower.

#### WARNING

To prevent injury or death, the oscilloscope must not be directly connected to the mains (line power). To measure mains voltages, use a differential isolating probe specifically rated for mains use, such as the TAO41 listed on the Pico website.



#### CAUTION

Exceeding the overload protection range on any connector can cause permanent damage to the oscilloscope and other connected equipment.

#### CAUTION

Ensure no voltage is present when selecting IEPE Interface Mode, and no voltage is applied when in use. Failure to comply with this warning could result in damage to the PicoScope 4224 IEPE oscilloscope.



## 2.1.3 Grounding

**WARNING**

The oscilloscope's ground connection through the USB cable is for measurement purposes only. The oscilloscope does not have a protective safety ground.

**WARNING**

Never connect the ground input (chassis) to any electrical power source. To prevent personal injury or death, use a voltmeter to check that there is no significant AC or DC voltage between the oscilloscope ground and the point to which you intend to connect it.

**CAUTION**

Applying a voltage to the ground input is likely to cause permanent damage to the oscilloscope, the attached computer, and other equipment.

**CAUTION**

To prevent measurement errors caused by poor grounding, always use the high-quality USB cable supplied with the oscilloscope.

## 2.1.4 Environment

**WARNING**

To prevent injury or death, do not use in wet or damp conditions, or around explosive gas or vapor.

**CAUTION**

To prevent damage, always use and store your oscilloscope in appropriate environments.

	Storage	Operating
Temperature	-20 °C to +60 °C	0 °C to +45 °C (+20 to +30 °C for quoted accuracy)
Humidity	5% to 95% RH (non-condensing)	5% to 80% RH (non-condensing)

### 2.1.5 Care of the instrument

The oscilloscope and its accessories contain no user-serviceable parts. Repair and servicing require specialized test equipment and must only be performed by Pico Technology or an approved service provider. There may be a charge for these services unless covered by the Pico five year warranty.



#### WARNING

To prevent injury or death, do not use the instrument if it appears to be damaged in any way, and stop use immediately if you are concerned by any abnormal operations.

#### WARNING

When cleaning the oscilloscope, use a soft cloth and a solution of mild soap or detergent in water. To prevent electric shock, do not allow liquids to enter the casing, as this will cause damage to the electronics or insulation inside.



#### CAUTION

Do not tamper with or disassemble the oscilloscope, connectors or accessories. Internal damage will affect performance.

## 2.2 Conformance

### 2.2.1 FCC notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

For safety and maintenance information see the [safety information](#).

### 2.2.2 CE notice

The product meets the intent of the EMC directive 2004/108/EC and has been tested to EN61326-1:2006 Class A Emissions and Basic Immunity.

The product also meets the intent of the Low Voltage Directive and has been designed to meet BS EN 61010-1:2010 Safety requirements for electrical equipment for measurement, control, and laboratory use.

## 2.3 Software licence conditions

The material contained in this software release is licensed, not sold. Pico Technology Limited grants a licence to the person who installs this software, subject to the conditions listed below.

**Access.** The licensee agrees to allow access to this software only to persons who have been informed of these conditions and agree to abide by them.

**Usage.** The software in this release is for use only with Pico products or with data collected using Pico products.

**Copyright.** Pico Technology Ltd. claims the copyright of, and retains the rights to, all material (software, documents etc.) contained in this release. You may copy and distribute the PicoScope and PicoLog software and drivers with no modifications, additions or omissions. You may copy and modify the SDK example programs.

**Liability.** Pico Technology and its agents shall not be liable for any loss, damage or injury, howsoever caused, related to the use of Pico Technology equipment or software, unless excluded by statute.

**Fitness for purpose.** Because no two applications are the same, Pico Technology cannot guarantee that its equipment or software is suitable for a given application. It is your responsibility, therefore, to ensure that the product is suitable for your application.

**Mission-critical applications.** This software is intended for use on a computer that may be running other software products. For this reason, one of the conditions of the licence is that it excludes usage in mission-critical applications such as life-support systems.

**Viruses.** This software was continuously monitored for viruses during production, but you are responsible for virus-checking the software once it is installed.

**Support.** If you are dissatisfied with the performance of this software, please contact our technical support staff, who will try to fix the problem within a reasonable time. If you are still dissatisfied, please return the product and software to your supplier within 14 days of purchase for a full refund.

**Upgrades.** We provide upgrades, free of charge, from our web site at [www.picotech.com](http://www.picotech.com). We reserve the right to charge for updates or replacements sent out on physical media.

## 2.4 Trademarks

Windows is a registered trademark or trademark of Microsoft Corporation in the USA and other countries.

Pico Technology Limited and PicoScope are trademarks of Pico Technology Limited, registered in the United Kingdom and other countries.

PicoScope and Pico Technology are registered in the U.S. Patent and Trademark Office.

ICP is an acronym for "integrated circuit piezoelectric", and is a registered trademark of PCB Group, Inc.

## 2.5 Warranty

Pico Technology warrants upon delivery, and for a period of 5 years unless otherwise stated from the date of delivery, that the Goods will be free from defects in material and workmanship.

Pico Technology shall not be liable for a breach of the warranty if the defect has been caused by fair wear and tear, wilful damage, negligence, abnormal working conditions or failure to follow Pico Technology's spoken or written advice on the storage, installation, commissioning, use or maintenance of the Goods or (if no advice has been given) good trade practice; or if the Customer alters or repairs such Goods without the written consent of Pico Technology.

## 2.6 Company details

Address: Pico Technology  
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Colmworth Business Park  
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PE19 8YP  
United Kingdom

Phone: +44 (0) 1480 396 395

Fax: +44 (0) 1480 396 296

Email  
Technical Support: [support@picotech.com](mailto:support@picotech.com)  
Sales: [sales@picotech.com](mailto:sales@picotech.com)

Web site: [www.picotech.com](http://www.picotech.com)

## 3 Product information

### 3.1 Pack contents

Your PicoScope 4000 Series PC Oscilloscope kit or product pack contains the following items:

Part	Description	PicoScope 4000 Series oscilloscope model number						
		4224 (scope only)	4224 (kit)	4224 IEPE	4424 (scope only)	4424 (kit)	4262	4824
-	Oscilloscope	1	1	1	1	1	1	1
MI007	x1/x10 60 MHz scope probe		2			4	2	
MI106	USB 2.0 cable	1	1	1	1	1	1	
TA146	USB 2.0 cable, double-headed							1
TA155	USB 3.0 cable							1
DI025	Software and reference CD	1	1	1	1	1	1	1
DO115	Installation Guide	1	1	1	1	1	1	1
MI136	Carry case		1			1		

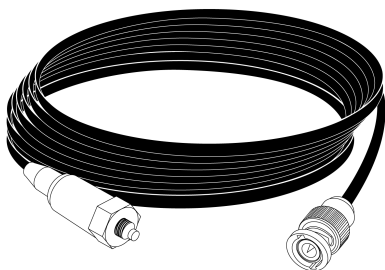
### 3.2 Optional extras

For a complete list of optional accessories, please visit [www.picotech.com](http://www.picotech.com).

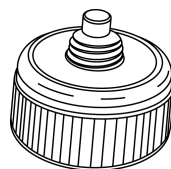
Part	Description
MI007	x1/x10 60 MHz passive voltage probe*
TA041	x10/x100 25 MHz active differential probe, $\pm 700$ V CAT III
TA057	x20/x200 25 MHz active differential probe, $\pm 1400$ V CAT III
PS008	Optional power supply for TA041 and TA057 probes
TA167	2000 A AC/DC current clamp
TA095	IEPE accelerometer with BNC connector**
TA096	Mounting magnet for IEPE accelerometer**

\* Already included with some PicoScope 4000 Series oscilloscope kits.

\*\* For use with IEPE oscilloscopes only.



TA095



TA096



MI007

### 3.3 Minimum PC requirements

To ensure that your PicoScope 4000 Series PC Oscilloscope operates correctly, you must have a computer with at least the minimum system requirements to run one of the supported operating systems, as shown in the following table. The performance of the software will increase with more powerful PCs, including those with multi-core processors.

Item	Specification
Operating system	Windows XP (SP3), Windows Vista, Windows 7, Windows 8 (not Windows RT). 32 bit and 64 bit versions.
Processor	As required by Windows
Memory	
Free disk space	
Ports	<a href="#">USB 2.0</a> or <a href="#">USB 3.0</a> port <a href="#">USB 1.1</a> port (absolute minimum)*

\* The oscilloscopes will run slowly on a USB 1.1 port. Not recommended.

### 3.4 Installation instructions

#### IMPORTANT

Do not connect your [PicoScope 4000 Series](#) scope to the PC before you have installed the Pico software. If you do, Windows might not recognise the scope device correctly.

#### Procedure

- Follow the instructions in the USB Oscilloscope Installation Guide included with your product package.
- Connect your PC Oscilloscope to the PC using the USB cable supplied.

#### Checking the installation

Once you have installed the software and connected the PC Oscilloscope to the PC, start the [PicoScope](#) software. PicoScope should now display any signal connected to the scope inputs. If a probe is connected to your oscilloscope, you should see a small 50 or 60 hertz signal in the oscilloscope window when you touch the probe tip with your finger.

#### Moving your PicoScope PC Oscilloscope to another USB port

##### ● Windows XP (SP3)

When you first installed the PicoScope 4000 Series PC Oscilloscope by plugging it into a [USB](#) port, Windows associated the Pico driver with that port. If you later move the oscilloscope to a different USB port, Windows will display the New Hardware Found wizard again. When this occurs, just click Next in the wizard to repeat the installation. If Windows gives a warning about Windows Logo Testing, click Continue Anyway. As all the software you need is already installed on your computer, there is no need to insert the Pico Software CD again.

##### ● Windows Vista, Windows 7 and Windows 8

The process is automatic. When you move the device from one port to another, Windows displays an Installing device driver software message and then a PicoScope 4000 series PC Oscilloscope message. Your PC oscilloscope is then ready for use.

### 3.5 Connections for the PicoScope 4224 and 4424

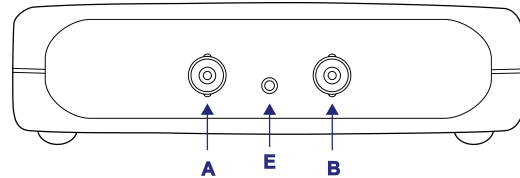
Standard oscilloscope connectors

[PicoScope 4000 Series](#) PC Oscilloscopes have BNC oscilloscope connectors. The inputs have an impedance of 1 M $\Omega$ , so they are compatible with all standard scope probes including x1, x10 and switched types.

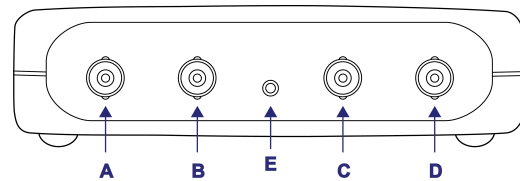
Connector diagrams

#### Front panel

- A. Input channel A
- B. Input channel B
- C. Input channel C
- D. Input channel D
- E. LED: shows when the oscilloscope is sampling data



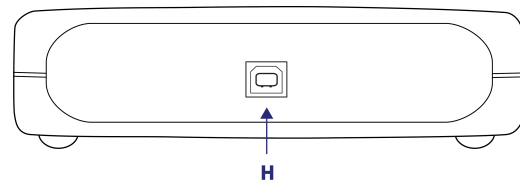
PicoScope 4224



PicoScope 4424

#### Rear panel

- H. USB 2.0 port



### 3.6 Connections for the PicoScope 4262

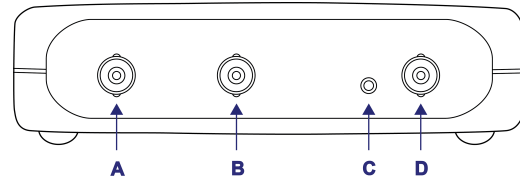
#### Standard oscilloscope connectors

The PicoScope 4262 PC Oscilloscope has BNC oscilloscope connectors. The inputs have an impedance of 1 M $\Omega$ , so they are compatible with all standard scope probes including x1, x10 and switched types.

#### Connector diagrams

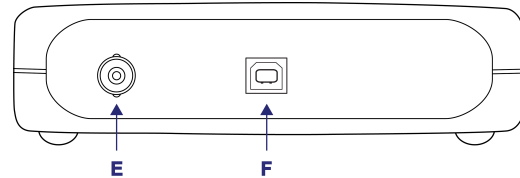
##### Front panel

- A. Input channel A
- B. Input channel B
- C. LED: shows when the oscilloscope is sampling data
- D. Function generator/  
arbitrary waveform  
generator output



##### Rear panel

- E. External trigger input
- F. USB 2.0 port





### 3.7 Connections for the PicoScope 4224 IEPE

#### Standard oscilloscope connectors

The [PicoScope 4224 IEPE](#) PC Oscilloscope has two BNC oscilloscope connectors. The inputs have an impedance of 1 M $\Omega$ , so they are compatible with all standard scope probes including x1, x10 and x1/x10 switched types. When used in IEPE Interface Mode, the connector outputs are rated at 4 mA (up to 24 V).

#### CAUTION



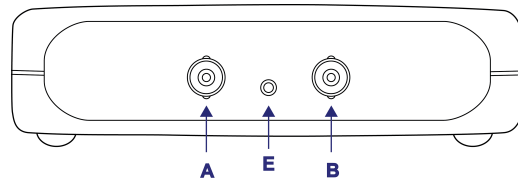
Ensure no voltage is present when selecting IEPE Interface Mode, and no voltage is applied when in use. Failure to comply with this warning could result in damage to the PicoScope 4224 IEPE PC Oscilloscope unit.

IEPE mode is intended only for use with a suitable transducer. Other connections and particularly other sources of voltage or current should not be connected.

#### Connector diagrams

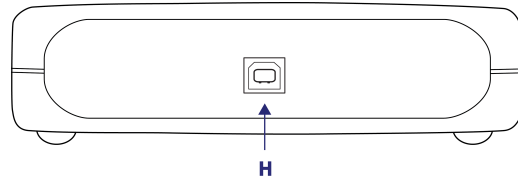
##### Front panel

- A. Input channel A
- B. Input channel B
- E. LED: shows when the oscilloscope is sampling data



##### Rear panel

- H. USB 2.0 port



### 3.8 Connections for the PicoScope 4824

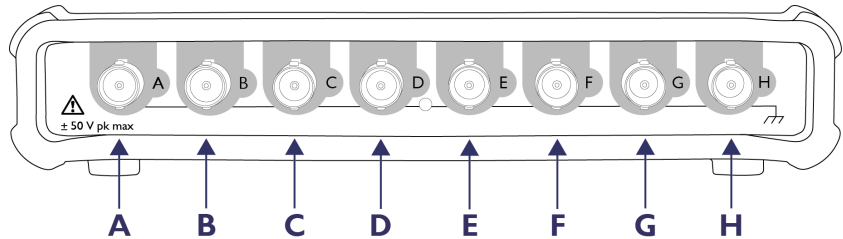
#### Standard oscilloscope connectors

The PicoScope 4824 PC Oscilloscope has 8 BNC oscilloscope connectors. The inputs have an impedance of  $1\text{ M}\Omega$ , so they are compatible with all standard scope probes including x1, x10 and switched types.

#### Connector diagrams

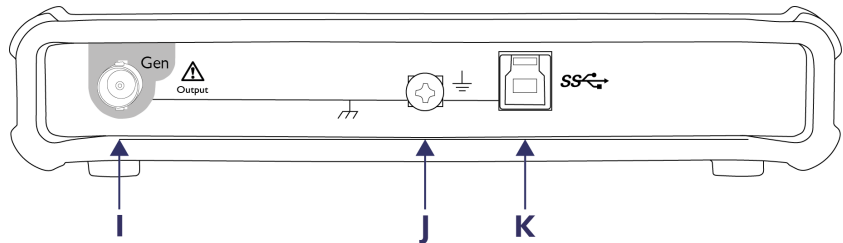
##### Front panel

- A. Input channel A
- B. Input channel B
- C. Input channel C
- D. Input channel D
- E. Input channel E
- F. Input channel F
- G. Input channel G
- H. Input channel H



##### Rear panel

- I. Arbitrary waveform generator output
- J. Earth terminal
- K. USB 3.0 port



## 4 Glossary

**AC/DC switch.** To switch between AC coupling and DC coupling, select AC or DC from the control on the PicoScope toolbar. When AC coupling is selected the signal is capacitively coupled. The DC portion of the signal is blocked and low frequencies attenuated.

**Analog bandwidth.** The input frequency at which the measured signal amplitude is 3 decibels below the true signal amplitude.

**Buffer size.** The size of the oscilloscope buffer memory, measured in samples. The buffer allows the oscilloscope to sample data at a fast sampling rate before transferring the data to the computer at a slower rate. Once the buffer fills up, the scope must stop sampling, so on longer timebases the buffer size places an upper limit on the sampling rate that can be used.

**IEPE Interface Mode.** When in this mode the connected probes are powered by a current from the two BNC IEPE connectors.

**Integrated Circuit Piezoelectric (ICP® *Registered to the PCB Group*).** See IEPE.

**Integrated Electronics Piezoelectric (IEPE).** An industry standard for accelerometers and other sensors with built-in electronics. IEPE connections use a DC current to power a small pre-amplifier embedded in the probe, enabling the use of long cables without a remote power supply. 'ICP' is one of several proprietary names for the same system.

**GS/s.** Gigasamples (billions of samples) per second.

**Maximum sampling rate.** A figure indicating the maximum number of samples the oscilloscope can acquire per second. The higher the sampling rate of the oscilloscope, the more accurate the representation of the high-frequency details in a fast signal.

**MS/s.** Megasamples (millions of samples) per second.

**PC Oscilloscope.** A virtual instrument formed by connecting a PicoScope 4000 Series oscilloscope to a computer running the PicoScope software.

**PicoScope 4000 Series.** Pico Technology's high-resolution PC Oscilloscopes.

**PicoScope software.** A program that accompanies all Pico PC Oscilloscopes. It turns your PC into an oscilloscope, spectrum analyser and measuring instrument.

**Real-time sampling.** The normal operating mode of a digital oscilloscope. The scope collects a single, unbroken sequence of samples at or below its maximum sampling rate.

**(Vertical) Resolution (bit).** The number of bits used to digitize an input signal. The higher the resolution, the smaller the voltage change that can be detected.

**Timebase.** The time base controls the time intervals marked on the horizontal divisions of the scope view. There are ten divisions across the scope view, so the total time across the view is ten times the time base per division.

**USB 1.1.** This is an early version of the Universal Serial Bus (USB) standard, which may be found on older PCs. Although your PicoScope will work with a USB 1.1 port, its operation will be greatly improved by using the recommended USB 2.0 or 3.0 port.

USB 2.0. The second generation of USB interface. The port supports a data transfer rate of up to 480 megabits per second.

USB 3.0. A USB 3.0 port uses signaling speeds of up to 5 gigabits per second and is backwards-compatible with USB 2.0 and USB 1.1.

Voltage range. The range of input voltages that the oscilloscope can measure. For example, a voltage range of  $\pm 100$  mV means that the oscilloscope can measure voltages between -100 mV and +100 mV. Input voltages outside this range will not damage the instrument as long as they remain within the protection limits stated in the relevant specifications table.

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