



PicoScope 4000 Series PC Oscilloscopes

User's Guide



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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 traditional bench-top oscilloscopes costing many times the price.



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

- **Portability:** Take the unit with you and plug it in to any Windows PC.
- **Performance:** 12-bit resolution, large buffer with up to 32 M samples, fast USB 2.0 interface.
- **Flexibility:** Use it as an oscilloscope, spectrum analyser or high-speed data acquisition interface.
- **Programmability:** The PicoScope 4000 series API lets you write your own programs, in your chosen programming language, to control all the features of the scope.
- **Long-term support:** Software upgrades are available to download from our [website](#). 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.

2 Introduction

2.1 Safety symbols

The following symbols appear on the top cover of the PicoScope 4000 Series PC Oscilloscope.

Symbol 1: Warning triangle



This symbol indicates that a safety hazard exists on the indicated connections if correct precautions are not taken. Read all safety documentation associated with the product before using it.

Symbol 2: Equipotential



This symbol indicates that the outer shells of the indicated BNC connectors are all at the same potential (shorted together). You must therefore take necessary precautions to avoid applying a potential across the return connections of the indicated BNC terminals. Such a potential could cause a large current to flow, resulting in damage to the product or connected equipment, or both.

2.2 Safety warning

We strongly recommend that you read the general safety information below before using your oscilloscope for the first time. Safety protection built in to equipment may cease to function if the equipment is used incorrectly. This could cause damage to your computer, or lead to injury to yourself and others.

Maximum input range. Do not exceed the "Overvoltage protection" range stated in the [Specifications table](#) for your model of oscilloscope. Contact with voltages outside the protection range may cause permanent damage to the unit.

Mains voltages. Pico Technology products are not designed for use with mains (line) voltages. To measure mains, use a differential isolating probe specifically rated for mains use.

Safety grounding. PicoScope 4000 Series PC Oscilloscopes connect directly to the ground of a computer through the USB cable provided to minimise interference.

As with most oscilloscopes, avoid connecting the ground input to any potential other than ground. If in doubt, use a meter to check that there is no significant AC or DC voltage between the ground input of the oscilloscope and the point to which you intend to connect it. Failure to check may cause damage to your computer or injury to yourself and others.

The product does not have a protective safety ground.

2.3 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 warning](#).

2.4 CE notice

The PicoScope 4000 Series PC Oscilloscopes meet the intent of the EMC directive 89/336/EEC and have been designed to EN61326-1 (2006) Class A Emissions and Immunity standard.

PicoScope 4000 Series PC Oscilloscopes also meet the intent of the Low Voltage Directive and have been designed to meet the BS EN 61010-1:2001 IEC 61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use standard.

2.5 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. We reserve the right to charge for updates or replacements sent out on physical media.

2.6 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.

2.7 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.

2.8 Company details

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Sales: sales@picotech.com

Web site: www.picotech.com

3 Product information

3.1 What do I get?

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

Part	Kit Order Code, PP...						Description
	478	479	492	493	671	672	
PP492	1		1				PicoScope 4224 20 MHz 2-channel oscilloscope
PP493		1		1			PicoScope 4424 20 MHz 4-channel oscilloscope
					1		PicoScope 4226 50 MHz 2-channel oscilloscope
						1	PicoScope 4227 100 MHz 2-channel oscilloscope
MI007	2	4			2		x1/x10 60 MHz oscilloscope probes
MI103						2	x1/x10 250 MHz oscilloscope probes
MI106	1	1	1	1	1	1	USB 2.0 cable
DI025	1	1	1	1	1	1	Software and reference CD
DO115	1	1	1	1	1	1	USB Oscilloscope Installation Guide
MI144	1	1			1	1	Carry case

3.2 System 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	Absolute minimum	Recommended minimum	Recommended full specification
Operating system	Windows XP SP2, Windows Vista or Windows 7 (32-bit or 64-bit)		
Processor	As required by Windows	300 MHz	1 GHz
Memory		256 MB	512 MB
Free disk space (Note 1)		1 GB	2 GB
Ports	USB 1.1 compliant port	USB 2.0 compliant port	

Note 1: The PicoScope software does not use all the disk space specified in the table. The free space is required to make Windows run efficiently.

3.3 Installation instructions

IMPORTANT

Do not connect your [PicoScope 4000 Series](#) scope device 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 SP2

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 and Windows 7

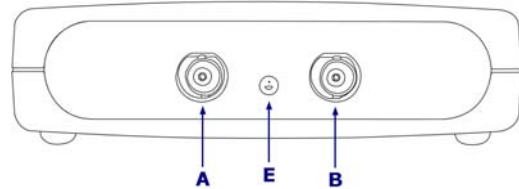
The process is automatic. When you move the device from one port to another, Windows displays an "Installing device driver software" message and then a "PicoScope 4000 series PC Oscilloscope" message. The PC Oscilloscope is then ready for use.

3.4 Connections

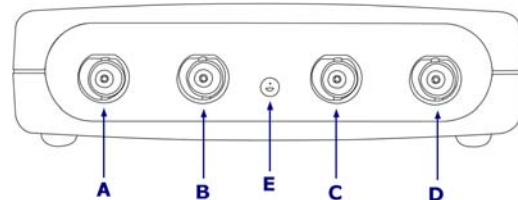
Standard oscilloscope connectors

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

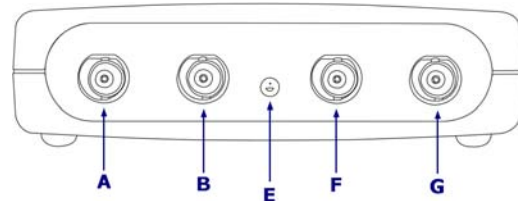
Connector diagrams



[PicoScope 4224](#)



[PicoScope 4424](#)



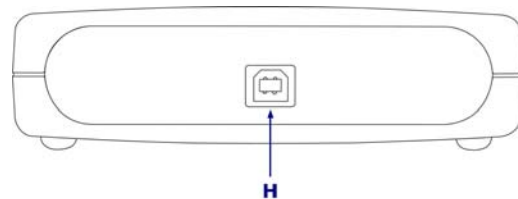
[PicoScope 4226](#)
[PicoScope 4227](#)

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
- F. External trigger input
- G. Function generator/arbitrary waveform generator output

Rear panel

- H. USB 2.0 port



3.5 Specifications

Oscilloscope model	PicoScope 4224	PicoScope 4424	PicoScope 4226	PicoScope 4227
Inputs				
Number of channels	2	4	2	2
Analog bandwidth	DC to 20 MHz (10 MHz on ± 50 mV range)		DC to 50 MHz	DC to 100 MHz
Impedance (nominal)	BNC, 1 M Ω 22 pF		BNC, 1 M Ω 16 pF	
Coupling	Software-selectable AC/DC			
Voltage ranges	± 50 mV, ± 100 mV, ± 200 mV, ± 500 mV, ± 1 V, ± 2 V, ± 5 V, ± 10 V, ± 20 V, ± 50 V, ± 100 V		± 50 mV, ± 100 mV, ± 200 mV, ± 500 mV, ± 1 V, ± 2 V, ± 5 V, ± 10 V, ± 20 V	
Overload protection	± 200 V		± 100 V	
Vertical resolution	12 bits			
Sampling				
Time bases (real-time sampling)	100 ns/div to 200 s/div		100 ns/div to 200 s/div	50 ns/div to 200 s/div
Maximum sampling rate (real-time sampling)				
One channel in use	80 MS/s	80 MS/s	125 MS/s	250 MS/s
Two channels in use	80 MS/s	80 MS/s [*1]	125 MS/s	125 MS/s
3 or 4 channels in use	-	20 MS/s	-	-
Maximum sampling rate (equivalent-time sampling)	-		10 GS/s	
Buffer size	32 MS shared between enabled channels			
Performance specifications				
Time base accuracy	50 ppm			
Trigger re-arm time	1 μ s on fastest time base			
DC accuracy	1% of full scale			
Trigger resolution	1 LSB			
Function generator/Arbitrary waveform generator				
Connector			BNC	
Frequency range			100 kHz	
Resolution			12 bits	
Buffer size			8192 samples	
DAC sample rate			20 MS/s	
Accuracy	-		1%	
Output range			± 250 mV to ± 2 V	
Output offset range			± 1 V	
Max. combined output			± 2.5 V	
Output resistance			600 Ω	
Overload protection			± 10 V	

Oscilloscope model	PicoScope 4224	PicoScope 4424	PicoScope 4226	PicoScope 4227
External trigger				
Connector	-			BNC
Modes				Rising/falling edge
Bandwidth				100 MHz
Impedance				1 MΩ 20 pF
Voltage range				±20 V
Coupling				DC
Overload protection				±100 V
Digital trigger				
Types	Edge, window, pulse, interval, dropout, runt, delayed			
Environment				
Operating environment	0 °C to 45 °C 20 °C to 30 °C 5% to 80% RH non-condensing			
Temperature range (for stated accuracy)				
Humidity				
Storage environment	-20°C to +60°C 5% to 95% RH non-condensing			
Temperature range				
Humidity				
PC connection	USB 2.0. Compatible with USB 1.1.			
Power supply	5 V @ 0.5 A max. (from USB port)			
Dimensions	200 mm x 140 mm x 38 mm			
Weight	< 0.5 kg			
Compliance	European EMC and LVD standards RoHS and WEEE FCC Rules Part 15 Class A			

* 1: 80 [MS/s](#) with channels A+C, A+D, B+C, B+D, 20 [MS/s](#) for other combinations.

* 2: Tested on 1 V range.

4 Programming with the PicoScope 4000 Series

An Application Programming Interface (API) is supplied free of charge with the PicoScope 4000 Series scopes. You can install it from the product CD (if you enable this option in the installer) or by downloading it from our website at www.picotech.com. The software includes a Programmer's Guide in PDF format.

5 Glossary

AC/DC switch. To switch between AC coupling and DC coupling, select AC or DC from the control on the PicoScope toolbar. The AC setting filters out very low-frequency components of the input signal, including DC, and is suitable for viewing small AC signals superimposed on a DC or slowly changing offset. In this mode you can measure the peak-to-peak amplitude of an AC signal but not its absolute value. Use the DC setting for measuring the absolute value of a signal.

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 time bases the buffer size places an upper limit on the sampling rate that can be used.

Equivalent-time sampling (ETS). A specialised sampling mode that can be used to increase the effective sampling rate of an oscilloscope as long as the signal is a stable, repetitive waveform. A single sample is collected during one cycle of the waveform. The scope then re-arms and re-triggers on another cycle of the waveform, and collects another sample with a slight time offset relative to the previous one. Over a large number of cycles, enough samples are collected to display a high-resolution picture of the waveform. Also called sequential sampling.

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" is an abbreviation for megasamples (millions of samples) per second.

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

Oversampling. The process of taking measurements more frequently than the requested sample rate, and then combining them to produce the required number of samples. If, as is usually the case, the signal contains a small amount of noise, this technique can increase the effective [vertical resolution](#) of the oscilloscope.

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. Compare with equivalent-time sampling.

Time base. 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. Universal Serial Bus (Full Speed). This is a standard port used to connect external devices to PCs. A typical USB 1.1 port supports a data transfer rate of 12 megabits per second, so is much faster than an RS232 COM port.

USB 2.0. Universal Serial Bus (Hi-Speed). This is a standard port used to connect external devices to PCs. A typical USB 2.0 port supports a data transfer rate 40 times faster than USB 1.1 when used with a USB 2.0 device, but can also be used with USB 1.1 devices.

Vertical resolution. A value, in bits, indicating the precision with which the oscilloscope converts input voltages to digital values. [Oversampling](#) (see above) can improve the effective vertical resolution.

Voltage range. The range of input voltages that the oscilloscope can measure. For example, a voltage range of ± 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 [Specifications](#) table.



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