PicoScope 5000 Series PC Oscilloscopes

User Guide

PS5000044-1.0

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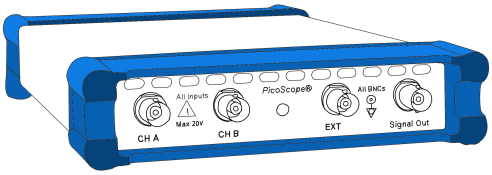
1 Welcome

Thank you for buying a Pico Technology product!



The **PicoScope 5000 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 you will enjoy with your new PicoScope 5000 Series PC Oscilloscope:

- **Portability:** Take the unit with you and plug it in to any PC.
- **Performance:** Fast sampling up to 1 GS/s, 250 MH bandwidth, large buffer with up to 128 M samples, fast USB 2.0 interface.
- **Flexibility:** Use it as an oscilloscope, spectrum analyser, multimeter, data logger or data acquisition interface.
- **Long-term support:** Software upgrades will be 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 haven't paid twice for all the features that you already have in your PC. The PicoScope 5000 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.

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2 Introduction

2.1 Cross-references

The cross-reference symbol looks like this: 2 It indicates the number of a page on which you can find more information about a topic.

2.2 Safety symbols

The following symbols appear on the front panel of the PicoScope 5000 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.

2.3 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

PicoScope 5000 Series PC Oscilloscopes are designed to measure voltages in the range -20 V to +20 V. The A, B and External Trigger inputs are protected to 100 V, whilst the AUX IO input can accept 0 V to 10 V. 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 voltages. To measure mains, use a differential isolating probe specifically designed for a high source voltage.

Safety grounding

PicoScope 5000 Series PC Oscilloscopes connect directly to the ground of a computer through the interconnecting 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.

Repairs

The oscilloscope contains no user-serviceable parts. Repair or calibration of the oscilloscope requires specialised test equipment and must be performed by Pico Technology.

Cooling fan

The unit contains a low-noise cooling fan that expels air through the holes in the back of the unit (shown in the Connections 9 section). Do not block these holes, as this might cause the unit to overheat. Do not insert anything in the holes, as this could damage the unit or cause injury.

2.4 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 3.

2.5 CE notice

The PicoScope 5000 Series PC Oscilloscopes meet the intent of the **EMC directive 89/336/EEC** and have been designed to **EN61326-1 (1997) Class A Emissions and Immunity** standard.

PicoScope 5000 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, control, and laboratory use) standard.

2.6 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 Limited claims the copyright of, and retains the rights to, all material (software, documents etc.) contained in this release. You may copy and distribute the entire release in its original state, but must not copy individual items within the release other than for backup purposes.

Liability

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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; for example, life-support systems.

2.7 Trademarks

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

Pico Technology Limited, **PicoLog** 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.

2.8 Warranty

Pico Technology **warrants** upon delivery, and for a period of 24 months 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.

2.9 Company details

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3 Product information

3.1 What do I get?

Your PicoScope 5000 Series PC Oscilloscope kit contains the following items:

Reorder code	Quantity	Description
PR088	1	PicoScope 5203 scope unit (PicoScope 5203 kit only)
PR089	1	PicoScope 5204 scope unit (PicoScope 5204 kit only)
MI145	2	Calibrated x1/x10 switchable 250 MH oscilloscope probe
MI106	1	USB cable, for connection to the USB 1.1 or USB 2.0 port on your PC
PS006	1	Universal power adaptor with UK, US, EU and AUS/N plugs
DI042	1	5000 Series software CD
DO115	1	USB Oscilloscope Installation Guide
MI144	1	Carry case

3.2 System requirements

To ensure that your PicoScope 5000 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.

<table>
<tr><th>Item</th><th>Absolute minimum</th><th>Recommended minimum</th><th>Recommended full specification</th></tr>
<tr><td>Operating system</td><td colspan="2">• Windows 98 Second Edition
• Windows ME
• Windows 2000</td><td>• Windows XP</td></tr>
<tr><td>Processor</td><td rowspan="3">As required by Windows</td><td>300 MH</td><td>1 GH</td></tr>
<tr><td>Memory</td><td>128 MB</td><td>512 MB</td></tr>
<tr><td>Free disk space (Note 1)</td><td>1 GB</td><td>2 GB</td></tr>
<tr><td>Ports</td><td>USB 1.1 compliant port</td><td colspan="2">USB 2.0 compliant port</td></tr>
</table>

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 5000 Series scope device to the PC before you have installed the Pico software. Otherwise, Windows might not recognise the scope device correctly.

Procedure

- Follow the instructions in the Installation Guide included with your product package.
- Connect your PC Oscilloscope to the PC using the USB cable supplied.
- Plug the power adaptor supplied with the unit into the mains. Plug the output lead of the adaptor into the scope unit.

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 hert signal in the oscilloscope window when you touch the probe tip with your finger.

Moving your PicoScope PC Oscilloscope to another USB port

When you first installed the PicoScope 5000 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 Wi ard" again. When this occurs, just click "Next" in the wi ard 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.

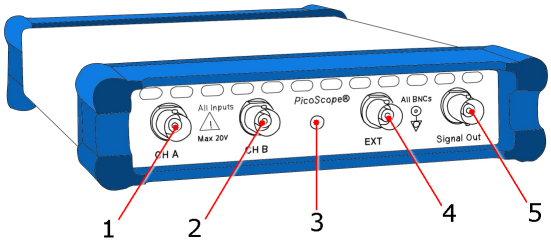
3.4 Connections

Standard oscilloscope connectors

PicoScope 5000 Series PC Oscilloscopes have BNC oscilloscope connectors. The inputs have an impedance of 1 MΩ, so they are compatible with all standard scope probes including x10 attenuated types.

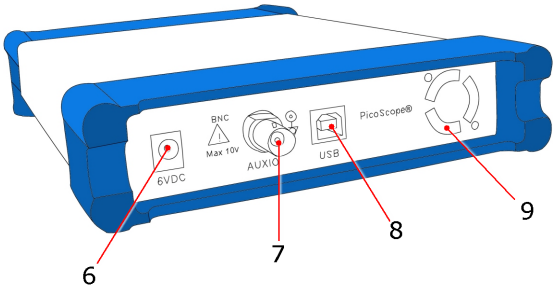
Connector diagrams

PicoScope 5203
PicoScope 5204



1. Input channel A
2. Input channel B
3. LED: shows when the oscilloscope is sampling data
4. External trigger input
5. Signal generator output 10

PicoScope 5203
PicoScope 5204

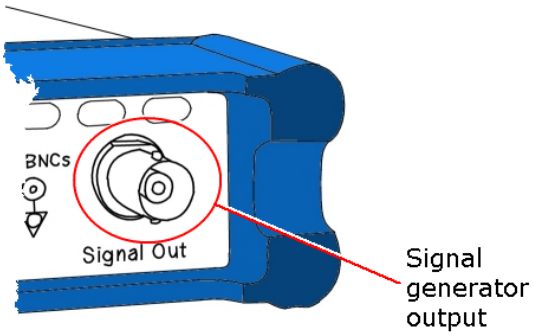


6. Power socket: for use with the AC adaptor supplied with the unit
7. Auxiliary input / output. Reserved for future expansion.
8. USB 2.0 port
9. Cooling holes. There is a low-noise fan inside the unit that blows air through these holes.

Do not block the cooling holes or insert any objects through them, as this could damage the unit or cause injury.

3.4.1 Signal generator output

This connector provides the output of the unit's built-in arbitrary waveform signal generator, which can create a waveform from a user-defined table of data. The PicoScope PC Oscilloscope software has a number of built-in waveforms, and also allows you to load your own data to define the output waveform.



Signal generator output specifications

Refer to the Specifications 11 table.

File format

Please refer to your PicoScope 6 software documentation for details of the arbitrary waveform file format.

3.5 Specifications

Variant	PicoScope 5203	PicoScope 5204
Number of channels	2	
Vertical resolution	8 bits	
Analog bandwidth	250 MH at probe tip	
Maximum sampling rate (real time) One channel in use Two channels in use	 1 GS/s 500 MS/s	
Maximum sampling rate (repetitive signals)	20 GS/s	
Buffer size	32 MS	128 MS
	If two channels in use, buffer shared between channels.	
Inputs Input characteristics Coupling Voltage ranges Accuracy Overload protection	 BNC, 1 MΩ in parallel with about 15 pF Selectable AC/DC 100 mV to 20 V in 8 ranges 3% 100 V	
Timebase Range Accuracy	 5 ns/div to 100 s/div 50 ppm	
Signal generator output 10 Standard waveforms Arbitrary waveform buffer Sample rate Output characteristics Resolution Amplitude Offset	 Sine, square, triangle, ramp (up/down), (sin x)/x, Gaussian, half sine, white noise 8192 samples 125 MS/s BNC, 50 Ω 12 bits 250 mV to 2 V 1 V	
External trigger Trigger threshold Resolution Input characteristics Bandwidth Overload protection	 Variable up to 20 V 9.8 mV BNC, 1 MΩ 150 MH 100 V	
Auxiliary input/output Input impedance Output impedance Input voltage range Input threshold	 100 kΩ 600 Ω 0 V to 10 V 1.65 V (nominal)	
Operating environment Temperature range Humidity	 0 C to 40 C for normal operation 20 C to 30 C for quoted accuracy 5% to 80% RH, non-condensing	
Storage environment Temperature range Humidity	 -20 C to +60 C 5% to 95% RH, non-condensing	
PC connection	USB 2.0 Compatible with USB 1.1	
Power supply Protection AC adaptor	6 V 5% Auto shutdown on excess or reverse voltage Universal adaptor supplied	
Dimensions	170 mm x 255 mm x 40 mm (6.7" x 10.0" x 1.6")	
Weight	0.9 kg (31.7 o)	
Compliance	European EMC and LVD standards 4 FCC Rules Part 15 Class A 4	

4 Glossary

AC/DC switch. To switch from AC coupling to DC coupling, or vice versa, 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 si e of the oscilloscope buffer memory, measured in samples. The buffer allows the oscilloscope to sample data faster than it can transfer it to the computer.

Device Manager. Device Manager is a Windows program that displays the current hardware configuration of your computer. On Windows 98SE or Windows ME, right click on 'My Computer' and choose the 'Device Manager' tab. On Windows 2000 or XP, right-click on 'My Computer,' choose 'Properties', then click the 'Hardware' tab and the 'Device Manager' button.

Driver. A program that controls a piece of hardware. The driver for the PicoScope 5000 Series PC Oscilloscopes is supplied in the form of a 32-bit Windows DLL, `ps5000.dll`. This is used by the PicoScope and PicoLog software to control the oscilloscopes.

External trigger. The BNC socket marked **E T** on the PicoScope 5000 Series PC Oscilloscopes. It can be used to start a data collection run but cannot be used to record data.

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. "GS/s" is an abbreviation for gigasamples (1,000,000,000 samples) per second.

Oversampling. Oversampling is 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 5000 Series scope unit to a computer running the PicoScope software.

PicoScope 5000 Series. Pico Technology's fifth generation of PC Oscilloscopes.

PicoScope software. A software product that accompanies all Pico PC Oscilloscopes. It turns your PC into an oscilloscope, spectrum analyser, and meter display.

Signal generator. Generates an arbitrary waveform and outputs it on the BNC socket marked **Signal Out** on the oscilloscope. This output can be used to drive a test signal through a BNC cable into one of the scope's input channels. The signal generator can generate any waveform stored in its buffer. The PicoScope software allows the generator to output regular waveforms, such as sine and square waves, or arbitrary waveforms defined by the user.

Timebase. The timebase controls the time interval that each hori ontal division of a scope view represents. There are ten divisions across the scope view, so the total time across the view is ten times the timebase per division.

Trigger bandwidth. The external trigger input is less sensitive to very high-frequency input signals than to low-frequency signals. The trigger bandwidth is the frequency at which a trigger signal will be attenuated by 3 decibels.

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 (High 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, but can 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 of 100 V.

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