



PicoScope 2203, 2204, 2205 PC Oscilloscopes

User's Guide

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1 Welcome

Thank you for buying a Pico Technology product!

The PicoScope 2203, 2204 and 2205 PC Oscilloscopes from Pico Technology are compact units designed to replace traditional bench-top oscilloscopes costing many times the price.



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

- **Portability:** Take the unit with you and plug it in to any Windows PC.
- **Performance:** Fast sampling from 40 MS/s to 200 MS/s, probe-tip bandwidth from 5 MHz to 25 MHz and fast USB 2.0 interface. See [Specifications](#) for the details of each scope model.
- **Flexibility:** Use it as an oscilloscope, spectrum analyser, data logger or high-speed data acquisition interface.
- **Programmability:** The PicoScope 2000 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 specialists for technical support. You can continue to use both of these services free of charge for the lifetime of the product.
- **Value for money:** Buying a Pico PC Oscilloscope means that you don't have to pay twice for all the features that you already have in your PC. The PicoScope 2000 Series oscilloscope contains the special hardware you need and nothing more.
- **Convenience:** The software makes full use of the display, storage, user interface and networking built in to your PC.

2 Introduction

2.1 Using this guide

In this guide you will see symbols like this:  This is the cross-reference symbol, and it indicates the number of a page on which you can find more information about a topic.

The abbreviation MS/s is used in this guide to mean megasamples per second.

2.2 Safety symbols

The following symbols appear on the top of the PicoScope 2203, 2204 and 2205 PC Oscilloscopes.

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 the 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

The PicoScope 2203, 2204 and 2205 PC Oscilloscopes are designed to measure voltages in the range -20 V to +20 V. The Ch A and Ch B inputs are protected to ± 100 V. Contact with voltages outside the protection range may cause permanent damage to the unit.

Mains voltages

These products are not designed for use with mains (line power) voltages. To measure mains, use a differential isolating probe specifically designed for high voltages.

Safety grounding

The PicoScope 2203, 2204 and 2205 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.

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.

2.4 FCC notice

This equipment has been tested to meet CFR47 (2006) Part 15 of the FCC limits for Class A equipment. 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.

The PicoScope 2203, 2204 and 2205 PC Oscilloscopes were successfully tested to the standard.

For safety and maintenance information see the [safety warning](#)³.

2.5 CE notice

The PicoScope 2203, 2204 and 2205 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.

The PicoScope 2203, 2204 and 2205 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.

2.6 Software licence conditions

The material contained in this software release is licensed, not sold. Pico Technology 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 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

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.

2.7 Trademarks

Windows, Excel and Visual Basic are registered trademarks or trademarks of Microsoft Corporation in the USA and other countries. Delphi is a registered trademark of Borland Software Corporation. Agilent VEE is a registered trademark of Agilent Technologies, Inc. LabView is a registered trademark of National Instruments Corporation.

Pico Technology Limited, PicoScope and PicoLog are trademarks of Pico Technology, 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.

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Web site: www.picotech.com

3 Product information

3.1 What do I get?

Your PicoScope PC Oscilloscope kit contains the following items:

Reorder code	Quantity	Description
-	1	PicoScope 2203, 2204 or 2205 PC Oscilloscope
MI106	1	USB cable, for connection to the USB 1.1 or USB 2.0 port on your PC
DI042	1	Software and Reference CD, with PicoScope ^[12] and PicoLog ^[12] software, drivers ^[12] , and example programs.
DO115	1	USB Oscilloscope Installation Guide

3.2 System requirements

To ensure that your PicoScope 2000 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 or Vista (32-bit versions only)		
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 2000 Series PC Oscilloscope 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 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 noise 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 2000 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

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 2000 series PC Oscilloscope" message. The PC Oscilloscope is then ready for use.

3.4 Connections

3.4.1 Connector diagrams

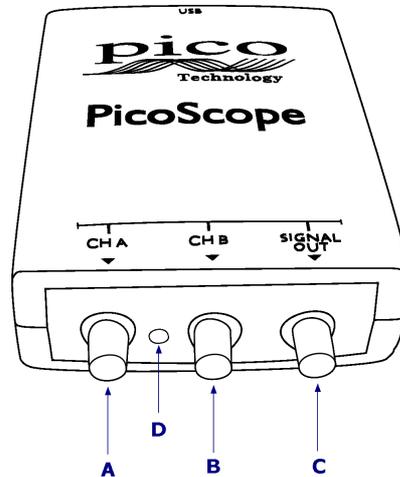
Connector diagrams

Front panel

PicoScope 2203

PicoScope 2204

PicoScope 2205



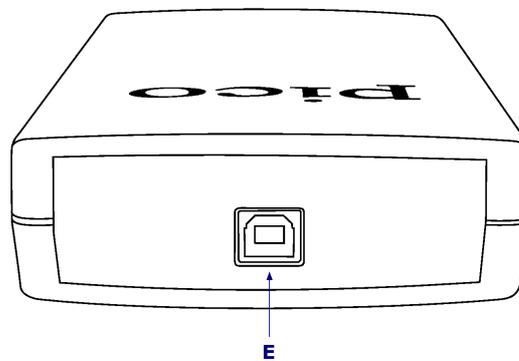
- A. [Input channel A](#)
- B. [Input channel B](#)
- C. [Signal generator output](#)
- D. LED: shows when the oscilloscope is sampling data

Rear panel

PicoScope 2203

PicoScope 2204

PicoScope 2205



- E. [USB port](#)

3.4.2 Signal inputs

The PicoScope 2203, 2204 and 2205 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 x10 attenuated types.

3.4.3 Signal Out connector

The SIGNAL OUT connector on the front panel carries the output of the oscilloscope's built-in signal generator, which can generate a number of built-in waveforms as well as arbitrary waveforms from a user-defined table of data.

Instructions for use

- If you are using the PicoScope 6 program, refer to the *PicoScope 6 User's Guide* for information on how to configure the signal generator.
- If you are writing your own software, refer to the *PicoScope 2000 Series Programmer's Guide*.

Signal generator output specifications

Refer to the [Specifications table](#) .

3.4.4 USB port

Connect the oscilloscope's USB port to your PC's USB 2.0 port using the USB cable supplied. You can also connect it to a USB 1.1 port, but in this configuration the oscilloscope will not operate at full performance.

3.5 Specifications

Variant	PicoScope 2203	PicoScope 2204	PicoScope 2205
Number of channels	2		
Vertical resolution ^[13]	8 bits		
Analog bandwidth ^[12]	5 MHz	10 MHz	25 MHz
Maximum sampling rate ^[12] (real time)			
One channel in use	40 MS/s	100 MS/s	200 MS/s
Two channels in use	20 MS/s	50 MS/s	100 MS/s
Maximum sampling rate (repetitive signals)	1 GS/s	2 GS/s	4 GS/s
Buffer size ^[12]	8,000 samples	8,000 samples	16,000 samples
	If two channels in use, buffer shared between channels.		
Timebase			
Ranges	2 ns/div (ETS) or 50 ns/div (real-time) to 200 s/div		
Accuracy	100 ppm		
Sampling jitter	3 ps		
Inputs			
Connectors	BNC female		
Input impedance	1 M		
Input capacitance	20 pF or less		
Coupling	AC or DC, software-controlled		
Voltage ranges ^[13]	±50 mV, ±100 mV, ±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V, ±10 V, ±20 V		
Accuracy	3%		
Noise	1 LSB on ±1 V range		
Dynamic range	48 dB		
Overload protection	±100 V on single input		
Trigger			
Source	Ch A or Ch B		
Modes	Rising edge, falling edge	Rising edge, falling edge	Rising edge, falling edge, hysteresis, pulse width, interval, dropout, windowed, logic
Signal generator output ^[10]			
Standard waveforms	Sine, square, triangle, ramp (up/down)		
Arbitrary waveform buffer	4,096 samples		
DAC clock frequency	2 MHz		
Maximum signal frequency using standard waveforms	100 kHz		
Output impedance	600		
Resolution	8 bits		
Amplitude	±125 mV to ±2 V with ±1 V offset		
Operating environment			
Temperature range	0 °C to 45 °C (20 °C to 30 °C for quoted accuracy)		
Humidity	5% to 80% non-condensing		
Storage environment			
Temperature range	-20 °C to +60 °C		
Humidity	5% to 95% non-condensing		
PC connection	Designed for USB 2.0 Will work with USB 1.1 at reduced performance		
Power supply	4.60 V to 5.25 V @ 500 mA max. Obtained from USB port		
Dimensions	100 x 150 x 37 mm (3.9 x 5.9 x 1.5 in)		
Weight	210 g (7.4 oz)		
Compliance	European EMC and LVD standards ^[4] FCC Rules Part 15 Class A ^[4]		

4 Glossary

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

Block mode—A fast data collection mode. The PicoScope software puts the oscilloscope into this mode to achieve the fastest possible sampling rates. The oscilloscope collects data as fast as possible and then stops to transfer the data to the PC. During data transfer to the PC in block mode, the oscilloscope cannot sample data from its inputs.

Buffer size—The size of the oscilloscope's buffer memory, measured in samples. The buffer allows the oscilloscope to sample data faster than it can transfer it to the computer.

Coupling mode—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.

Device Manager—Device Manager is a Windows program that displays the current hardware configuration of your computer. On Windows XP or Vista, 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 2000 Series PC Oscilloscopes is supplied in the form of a 32-bit Windows DLL, `ps2000.dll`. This is used by the PicoScope software to control the oscilloscope.

ETS—Equivalent Time Sampling. Constructs a picture of a repetitive signal by accumulating information over many similar wave cycles. This allows the oscilloscope to create a composite cycle that has more samples, and therefore better time resolution, than a single cycle. ETS cannot be used for one-shot signals.

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 used in this manual as an abbreviation for "millions of samples per second".

Oversampling—A technique for reducing noise in sampled signals. Measurements are taken more frequently than the requested sample rate, and then merged 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](#)^[13] of the oscilloscope.

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

PicoLog software—An application that accompanies all Pico PC Oscilloscopes, turning your PC into a data logger.

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

Signal generator—Generates a waveform and outputs it on the BNC socket marked Signal Out. This output can be used to drive a test signal through a BNC cable into an external circuit or into one of the oscilloscope's input channels. The PicoScope software allows the generator to output standard waveforms, such as sine and square waves, or arbitrary waveforms defined by the user.

Streaming mode—A data collection mode in which the oscilloscope samples data and returns it to the computer in a continuous stream. This mode allows the capture of more data than will fit in the oscilloscope's memory buffer, at sampling rates up to 13.3 million samples per second. The PicoScope program selects this mode for long timebases to enable the capture of very long sets of data.

Timebase—A timer that controls the speed at which the scope device captures data. At slow timebases this process is visible as PicoScope draws the trace across the scope view from left to right, but at fast timebases PicoScope draws the whole trace in a single operation. The timebase is measured in units of time (such as seconds) per division. There are ten divisions across the scope view, so the total time across the width of the view is ten times the "per division" setting.

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 RS-232 or '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 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 be measured correctly, but will not damage the instrument as long as they remain within the protection limits of ± 100 V.

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