



PicoScope 3000 Series PC Oscilloscopes

User's Guide

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1 Welcome

The PicoScope 3000 Series of PC Oscilloscopes from Pico Technology is a range of high-specification, real-time measuring instruments that connect to the USB port of your computer. The oscilloscopes obtain their power supply through the USB cable, so they do not need an additional power supply and are therefore highly portable. The 3000 Series consists of two ranges:

- General-purpose range (PicoScope 3204, 3205 and 3206 variants)
- High-precision range (PicoScope 3224 and 3424 variants)

With the PicoScope software you can use PicoScope 3000 Series PC Oscilloscopes as oscilloscopes and spectrum analysers; and with the PicoLog software you can use them as data loggers. Alternatively, using the API functions, you can develop your own programs to collect and analyse data from the oscilloscope. Refer to the Programmers Guide (PS3000pg.en) for more information.

A typical PicoScope 3000 Series PC Oscilloscope is supplied with the following items:

- USB cable, for use with USB 1.1 and 2.0 ports
- Software and Reference CD
- Installation Guide

2 Introduction

2.1 Safety symbols

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 as this may cause a large current to flow, resulting in damage to the product and/or connected equipment.

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

PicoScope 3000 Series PC Oscilloscopes are designed to measure voltages in the range -20 V to +20 V. Inputs are protected to ± 100 V (± 30 V for external trigger). 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 3000 Series PC Oscilloscopes connect direct 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 lead to injury to yourself and others.

You should not rely on the product to provide a protective safety earth.

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.

2.3 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 3000 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 3000 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.

2.5 Licence conditions

The material contained in this 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

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; for example, life-support systems.

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

2.7 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.

2.8 Company details

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3 Product information

3.1 Minimum system requirements

To ensure that your PicoScope 3000 Series PC Oscilloscope operates correctly, you must have a computer with the minimum system requirements to run Windows or the following (whichever is the higher specification):

Processor	Pentium-class processor or equivalent, or better.
Memory	256 MB minimum.
Disk space	10 MB minimum.
Operating system	Microsoft Windows XP SP2, Vista, or Windows 7.
Ports	USB 1.1 compliant port minimum. USB 2.0 compliant port recommended. Must be connected direct to the port or a powered USB hub. Will not work on a passive hub.

3.2 Installation instructions

Important

Do not connect your PicoScope 3000 Series PC Oscilloscope to the PC until you have installed the software.

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.
- There is no need for an additional power supply, as the unit obtains its power from the USB port.

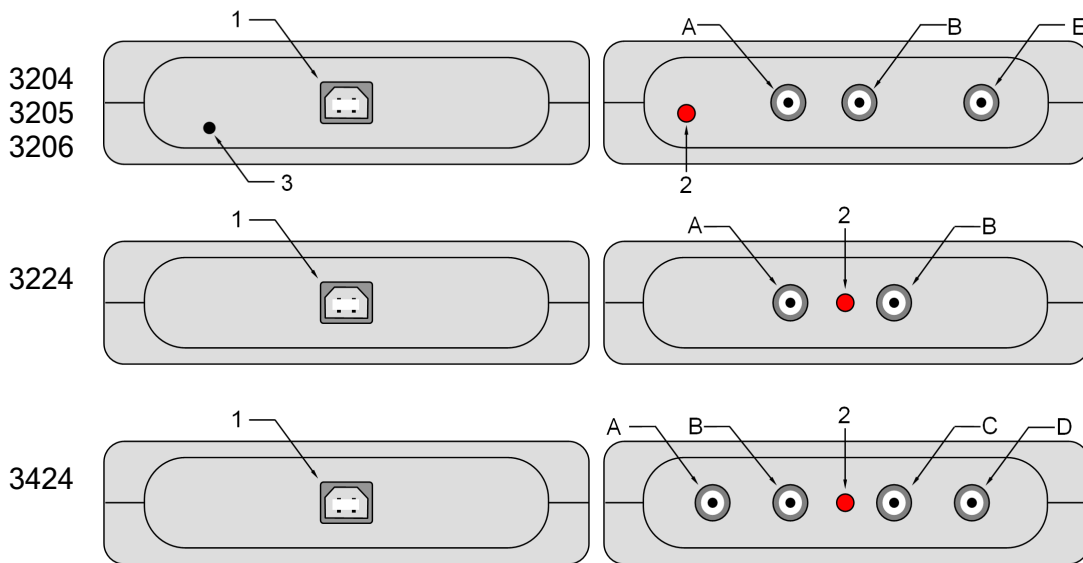
Checking the installation

Once you have installed the software and connected the PC Oscilloscope to the PC, start the PicoScope or PicoLog software. The software should now display any signal connected to the scope inputs. If you are using the PicoScope software and have a probe 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 .

Standard oscilloscope connectors

PicoScope 3000 Series PC Oscilloscopes have standard oscilloscope connectors. The input impedance is also standard, so the x10 function on scope probes works correctly.

Connector diagrams



1 USB port

2 LED: lights when the oscilloscope is sampling data

3 Power socket: 12 V DC at 500 mA

A Input channel A

B Input channel B

C Input channel C

D Input channel D

E External trigger input / signal generator output *

* The BNC connector labelled 'E' on the 3204/5/6 models has two functions. In normal use it is the external trigger input with an adjustable threshold. Alternatively, on some oscilloscopes, it can also be used to output sine, square and triangle waveforms which can be swept back and forth at a user-defined frequency. The integrated signal generator can be controlled by the PicoScope software or by API calls. The signal generator can also be used to compensate x10 scope probes when set to output a square wave.

Ground loops

If you experience excessive noise or voltage offsets when using the PicoScope 3204/5/6 variants, you may have a ground loop problem. See [Powering the 3204/5/6](#) for advice on overcoming this.

Moving your PicoScope PC Oscilloscope to another USB port

When you install the PicoScope 3000 Series PC Oscilloscope by plugging it into a USB port, Windows associates 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, simply follow the steps listed in the Installation Guide after the instruction "Connect the PicoScope 3000 Series PC Oscilloscope to the PC..." As all the software you need is already installed on your computer, there is no need to insert the Pico Software and Reference CD again.

3.3 Specifications

Variant	3204	3205	3206	3224	3424
Vertical resolution	8 bits			12 bits	
Analog bandwidth	50 MHz	100 MHz	200 MHz	10 MHz	
Max. sampling rate					
One channel in use	50 MS/s	100 MS/s	200 MS/s	20 MS/s	20 MS/s
Two channels in use	50 MS/s	100 MS/s	100 MS/s	10 MS/s	10 MS/s
3 or 4 channels in use	-	-	-	-	5 MS/s
Repetitive signals	2.5 GS/s	5 GS/s	10 GS/s	-	-
Trigger bandwidth	50 MHz	100 MHz	150 MHz	10 MHz	
Buffer size (samples per channel)					
One channel in use	256 K	512 K	1 M	512 K	512 K
Two channels in use	128 K	256 K	512 K	256 K	256 K
3 or 4 channels in use	-	-	-	-	128 K
Inputs	2 BNC channels				4 BNC channels
	1 MΩ impedance AC/DC coupling 20 pF capacitance				
Outputs					
Signal generator	Fixed (Note 1)	Variable (Note 2)		None	
External trigger	1 BNC input shared with signal generator Variable trigger threshold ± 20 V Rising/falling 12.2 mV resolution 1 MΩ impedance			None	
Voltage ranges	± 100 mV to ± 20 V in 8 ranges			± 20 mV to ± 20 V in 10 ranges	
Accuracy	3% voltage 50 ppm time			1% voltage 50 ppm time	
Operating environment					
Temperature range	0°C to 70°C (25°C for quoted accuracy)			0°C to 70°C (20°C to 30°C for quoted accuracy)	
Humidity	25% to 75% RH			25% to 75% RH	
Overload protection					
Channels	± 100 V			± 100 V	
External trigger	± 30 V			-	
PC connection	USB 2.0 Compatible with USB 1.1				
Power supply	From USB port: 4.6 to 5.25 V 500 mA External power supply is not required			From USB port	
Dimensions	140 mm x 200 mm x 45 mm				
Weight	374g				
Compliance	CE standard 4 ⁵ ; FCC Part 15 3 ⁵				



(1) 1 BNC shared with external trigger. Fixed frequency 1 kHz. 5 V square wave. 600 Ω output impedance.

(2) 1 BNC shared with external trigger. Variable frequency 100 Hz to 1 MHz. 5 V square wave, 1 V sine wave and triangle functions. Repeat sweep function. Dual slope function. 600 Ω output impedance.

4 Troubleshooting

4.1 Software error codes

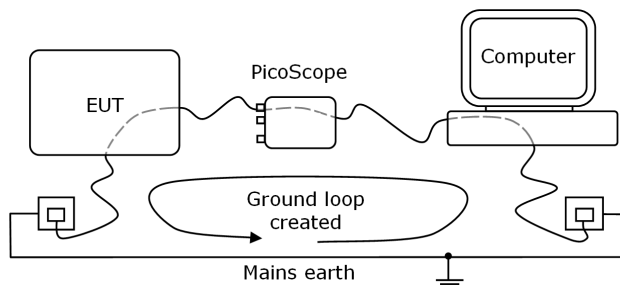
Consult this section if you are a PicoScope 5 or PicoLog user. If you are writing your own program, refer to the Programmer's Guide (PS3000pg.en).

Error code	Meaning
1	More than 4 PicoScope 3000 Series oscilloscopes are opened on one machine using PicoLog. It is not possible to use more than 4 oscilloscopes with PicoLog.
2	The driver cannot allocate enough of the computer's memory to operate the oscilloscope. Consult the system requirements  section for more information.
3	A PicoScope 3000 Series PC Oscilloscope could not be found on your machine. Make sure the software is installed before the oscilloscope is plugged into the USB socket and restart your computer.
4, 5 or 6	There is a problem with the oscilloscope itself. These problems could arise from configuration settings being corrupted, or a firmware or hardware error.
7	The operating system is not recent enough to support the PicoScope 3000 Series PC Oscilloscope. Consult the system requirements  section for more information.

4.2 Powering the 3204, 3205 and 3206

The PicoScope 3204, 3205 and 3206 PC Oscilloscopes are normally powered from the USB port of the computer. If the computer and the equipment under test (labelled "EUT" in the diagram below) are both referenced to the same ground, a "ground loop" may be created. This may degrade the DC accuracy and noise performance when measuring small signals.

Typically, a ground loop is created when the oscilloscope is connected to a mains-powered computer and is used to measure a signal on another mains-powered device. In this case the ground loop is created through mains earth, as illustrated below:



The majority of laptop power supplies (chargers) are floating and have no ground reference. If, however, connecting your grounded laptop power supply causes noise/offset problems, you can either use the oscilloscope with the laptop running on its batteries or power the oscilloscope using the supplied mains adaptor.

If necessary, you should plug the mains adaptor into the socket on the back of the oscilloscope (near the USB socket). It can be safely connected and disconnected during operation without risk of damage to the oscilloscope.

5 Glossary

AC/DC switch

To switch from AC coupling to DC coupling, or vice versa, select AC or DC from the control on the oscilloscope toolbar of the PicoScope software application. The AC setting filters out any DC component of the input signal, 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 its true value.

API

Application Programming Interface. A set of function calls that give programmers access to the PicoScope 3000 Series driver.

Block mode

A sampling mode in which the computer prompts the oscilloscope to collect a block of data into its internal memory before stopping the oscilloscope and transferring the whole block into computer memory. Choose this mode of operation when the input signal being sampled contains high frequencies. Note: To avoid sampling errors, the maximum input frequency must be less than half the sampling rate.

Buffer size

The size of the oscilloscope buffer memory, measured in samples. In block mode, the buffer memory is used by the oscilloscope to store data temporarily. This allows the oscilloscope to sample data independently of the speed at which it can transfer data to the computer.

Device Manager

Device Manager is a Windows program that displays the current hardware configuration of your computer. 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 3000 Series PC Oscilloscopes is supplied in the form of a 32-bit Windows DLL, `ps3000.dll`. This is used by the PicoScope and PicoLog software, and by user-designed applications, to control the oscilloscopes.

ETS

Equivalent Time Sampling. ETS constructs a picture of a repetitive signal by accumulating information over many similar wave cycles. This means the oscilloscope can capture fast-repeating signals that have a higher frequency than the maximum sampling rate. Note: ETS should not be used for one-shot or non-repetitive signals.

External trigger

This is the BNC socket marked E on the PicoScope 3204/5/6 PC Oscilloscopes. It can be used to start a data collection run but cannot be used to record data. As it shares the same connector as the signal generator output, these two functions cannot be used at the same time. It is possible, however, to use the output from the signal generator as a trigger.

Maximum sampling rate

A figure indicating the maximum number of samples the oscilloscope can acquire per second. Maximum sample rates are usually given in MS/s (megasamples per second) or GS/s (gigasamples per second.) The higher the sampling rate of the oscilloscope, the more accurate the representation of the high-frequency details in a fast signal.

Oversampling

Oversampling is taking more than one measurement during a time interval and returning an average. If the signal contains a small amount of noise, this technique can increase the effective vertical resolution of the oscilloscope.

PC Oscilloscope

The instrument formed by connecting a PicoScope 3000 Series PC Oscilloscope to a computer running the PicoScope software application.

PicoLog software

This is a software product that accompanies all our oscilloscopes. It turns your PC into a data logger and chart recorder.


PicoScope 3000 Series

An oscilloscope range comprising the PicoScope 3204, 3205, 3206, 3224 and 3424 PC Oscilloscopes.

PicoScope software

This is a software product that accompanies all our oscilloscopes. It turns your PC into an oscilloscope, spectrum analyser, and meter display.

Signal generator

This is a feature of some oscilloscopes which allows a signal to be generated without an external input device being present. The signal generator output is the BNC socket marked E on the oscilloscope. If you connect a BNC cable between this and one of the channel inputs, you can send a signal into one of the channels. On some units, the signal generator can generate a simple TTL square wave, while on others it can generate a sine, square or triangle wave that can be swept back and forth. Consult the [specifications](#)  for further details.

Note: The signal generator output is physically the same as the external trigger input, so these two functions cannot be used at the same time. It is possible, however, to use the output from the signal generator as a trigger.

Streaming mode

A sampling mode in which the oscilloscope samples data and returns it to the computer in an unbroken stream. This mode allows the capture of data sets whose size is not limited by the size of the scope's memory buffer, at sampling rates up to a few million samples per second.

Temperature range

The minimum and maximum temperatures between which the oscilloscope is guaranteed to meet its specifications. The 3204/5/6 PC Oscilloscopes are specified at a nominal temperature of 25°C, and the 3224/3424 are specified over the range 20°C to 30°C.

Timebase

The timebase controls the time interval that the width of the scope display represents. If you select Timebase is time per division in the Preferences dialog box, it works like a traditional bench top scope. There are ten divisions across the screen, so the total time interval is ten times the timebase.

Trigger bandwidth

The maximum frequency at which the trigger circuit will reliably generate a trigger event.

USB 1.1

Universal Serial Bus (Full Speed). This is a standard port that enables you to connect external devices to PCs. A typical USB 1.1 port supports a data transfer rate of 12 megabits per second, and is much faster than a serial port.

USB 2.0

Universal Serial Bus (High Speed). This is a standard port that enables you to connect external devices to PCs. A typical USB 2.0 port supports a data transfer rate 40 times faster than USB 1.1, and all USB 2.0 ports are backwards-compatible with USB 1.1.


Vertical resolution

A value, in bits, indicating the degree of precision with which the oscilloscope can convert input voltages to digital values.

Voltage range

The range of input voltages that the oscilloscope will measure in a given mode.

6 Appendix A: Declaration of Conformity



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EC Declaration of Conformity

Pico Technology Ltd. as manufacturers of the following products:

PS3224 MK2 Two Channel PC based Oscilloscope.
PS3424 MK2 Four Channel PC based Oscilloscope.
PS2202 MK2 Two Channel PC based Oscilloscope.

declare that they meet the intent of the EMC Directive 89/336/EEC as amended by:
92/31/EEC, 93/68/EEC & 91/263/EEC.


The following standards have been applied :

EN61326:1997 (+A1/A2) Class A Emissions
EN61326:1997 (+A1/A2) General Immunity

The following FCC standard has also been applied:

CFR47:2004 – Part15, Subpart B, Class A.

Signed



Alan Tong
Managing Director
31st March 2006

Pico Technology Limited is an internationally registered trade mark
Registered in England and Wales No. 2626181



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EN61326:1997 (+A1/A2) General Immunity

The following FCC standard has also been applied:

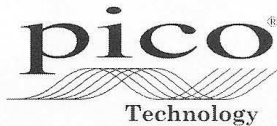
CFR47:2004 – Part15, Subpart B, Class A.

Signed

A handwritten signature in black ink, appearing to be "Alan Tong".

Alan Tong
Managing Director
11th April 2005

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EC Declaration of Conformity

Pico Technology declare that the following products comply with the requirements of the specified Directives and Standards as listed below. Technical documentation required to demonstrate compliance to the standards is available for inspection by the relevant enforcement authorities. Products carry the CE mark.

Products covered by this Declaration:

PicoScope 3204 & 3205 & 3206 two channel USB oscilloscopes.

EU Directives covered by this Declaration:

2004/108/EC Electromagnetic Compatibility Directive.
 2006/95/EC Low Voltage Equipment Directive.

The Basis on which Conformity is being Declared:

EN61010-1:2001	Safety requirements for electrical equipment for measurement, control and laboratory use, general equipment requirements.
EN61326-1:2006	EMC Immunity and Emissions for measurement, control and laboratory equipment - general requirements. Test limits and frequencies are specified in CISPR11 and EN61000-4.
CISPR11:2006	Industrial, scientific and medical equipment – radio frequency disturbance characteristics – limits and methods of measurement. Radiated and Conducted emissions. Class A emissions.
CFR 47:2006	Code of Federal Regulations FCC: part 15 Subpart B – Frequency devices – unintentional Radiators. Radiated emissions standard. Class A emissions.
EN61000-4 EN61000-4-2:1995 +A1:1998 +A2:2001 EN61000-4-3:2006 EN61000-4-4:2004 EN61000-4-6:2007	Radiated and Conducted Immunity, including Electrostatic Discharge. Radiated RF. Electrical fast transients and bursts. Conducted RF

Alan Tong
 Managing Director
 February 2010

Signed

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