PicoScope 2104 & 2105

Handheld PC Oscilloscopes

User's Guide

Contents

1   Introduction

1.1   Overview

The PicoScope 2104 and 2105 PC Oscilloscopes are low-cost handheld instruments that are fully USB 2.0-capable and backwards-compatible with USB 1.1. There is no need for an additional power supply, as power is taken from the USB port.

With the PicoScope software, you can use your instrument as a PC Oscilloscope and spectrum analyser; and with the PicoLog software, you can use it as a data logger.

Each product pack contains the following items:

- PicoScope 2104 or 2105 PC Oscilloscope
- Software CD
- Accessories kit
- Quick start guide

Please read the important information in this introductory section and then proceed to the Installation instructions.

For information on programming with the PicoScope 2000 Series API, see the PicoScope 2000 Series Programmer's Guide, which can be downloaded from our website.

1.2   Safety symbols

Warning Triangle

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

1.3   Safety warning

We strongly recommend that you read the general safety information below before using your PicoScope PC Oscilloscope for the first time. Safety protection built in to the 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 2104 and 2105 PC oscilloscopes are designed to measure voltages in the range -20 V to +20 V and are protected against continuous or transient overvoltages of up to ±50 V. Any voltages in excess of ±50 V may cause permanent damage to the oscilloscope or to your computer.

Measurement category

PicoScope 2000 Series PC Oscilloscopes are rated for use in measurement category I (EN61010 CAT I), which covers measurements on circuits not connected to the mains. You must not use your PicoScope PC Oscilloscope to make measurements on any circuit directly connected to the mains, unless you use a purpose-built isolating probe rated for the appropriate voltage and measurement category.

Safety grounding

The PicoScope PC Oscilloscopes connect directly to the ground of a computer through the interconnecting cable provided.

As with most oscilloscopes, avoid connecting the ground input to any source 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 assume that the product does not have a protective safety earth.

Repairs

PicoScope PC Oscilloscopes contain no user-serviceable parts. Repair or calibration of the unit requires specialised test equipment and must be performed only by Pico Technology. Spare probe tips are available from Pico Technology and its authorised distributors.

1.4   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 own expense.

For safety and maintenance information see the safety warning.

1.5   CE notice

The PicoScope 2104 and 2105 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.

The devices 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.

1.6   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.

1.7   Trademarks

- Delphi is a registered trademark of Borland Software Corporation.
- LabView is a registered trademark of National Instruments Corporation.
- Pentium is a registered trademark of Intel Corporation.
- Pico Technology Limited, PicoLog and PicoScope are internationally registered trademarks.
- Windows, Excel and Visual Basic are registered trademarks of Microsoft Corporation.

1.8   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.

1.9   Company details

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2 Product information

2.1 Minimum system requirements

For the PicoScope PC Oscilloscope to operate, a computer with the minimum system requirements to run Windows or the following (whichever is the higher specification) is required:

Processor	Pentium class processor or equivalent, minimum.
Memory	32 MB minimum.
Disk space	10 MB minimum.
Operating system	Microsoft Windows XP SP3 or later.
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.

2.2 Installation instructions

> <u>Important</u>
>
> Do not connect the PicoScope PC Oscilloscope to your PC until you have installed the software.
>
> • Install the software by following the steps in the installation guide supplied with your oscilloscope.
> • Connect the oscilloscope's USB cable to the PC.
> • There is no need for an additional power supply as power is drawn from the USB port.

Checking the installation

Once you have installed the software, ensure that the PicoScope PC Oscilloscope is connected to the PC and then start the PicoScope or PicoLog software. PicoScope should show a small 50 Hz or 60 Hz mains signal in the oscilloscope window when you touch the probe tip with your finger. PicoLog, once configured for a PicoScope 2000 Series oscilloscope, should show a small noise voltage.

Input connector

The PicoScope 2104 and 2105 PC Oscilloscopes have a built-in oscilloscope probe. This can be unscrewed if damaged, and replaced with a spare part available from Pico Technology or its authorised distributors.

Connectors and controls
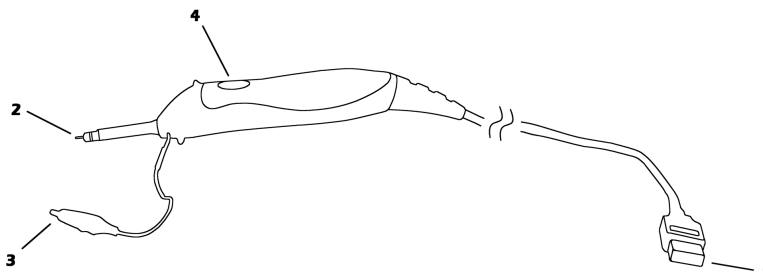
1. USB cable. After installing the Pico software, plug the free end of this cable into your computer's USB port.
2. Probe. Touch this to the signal to be measured. You can fit a probe hook or insulating collar to the end of the probe. All these accessories are supplied with the oscilloscope.
3. Ground clip. You must connect this clip, which is supplied in the accessories pack, to the ground reference point of the circuit or equipment under test. Do not rely on your computer to supply a ground connection through the USB cable.
4. Illuminated button. Press this briefly to start or stop the oscilloscope. Press and hold to activate automatic setup when running PicoScope. The light glows or flashes green when the oscilloscope is running, and glows red when the instrument is stopped.

2.3   Specifications

Variant	PicoScope 2104	PicoScope 2105
Vertical Resolution	8 bits	
Analog Bandwidth	10 MHz	25 MHz
Maximum Sampling Rate Real-time Repetitive (using ETS)	50 MS/s 1 GS/s	100 MS/s 2 GS/s
Timebases	10 ns/div to 50 s/div	5 ns/div to 50 s/div
Buffer Size	8k samples	24k samples
Input	Oscilloscope probe 1 MΩ || 20 pF AC/DC coupling	
Voltage Ranges	±100 mV to ±20 V in 1, 2, 5 steps	
Accuracy	3 % (voltage) 100 ppm (time)	
Linearity	< 1 LSB at 25 °C	
Environmental Limits Operating temperature Operating humidity Storage temperature Storage humidity	0 °C to 45 °C (20°C to 30°C for quoted accuracy) 5% to 80% RH, non-condensing -20°C to +60°C 5% to 95% RH, non-condensing	
Overload Protection	±50 V (input to ground)	
PC Connection	USB 2.0 Compatible with USB 1.1	
Power Supply	From USB port: 4.6 to 5.25 V @ 300 mA	
Maximum Dimensions	220 mm long (probe only) 3 m long (including cable) 32 mm diameter	
Weight	100 grams	
Compliance	CE standard; FCC standard	

3   Troubleshooting

3.1   Software error codes

PicoLog reports error code 1

This error is reported when you try to open more than 4 PicoScope PC Oscilloscopes on one machine. It is not possible to use more than 4 units with PicoLog.

PicoScope or PicoLog reports error code 2

This error is reported when the driver cannot allocate enough of the computer's memory to operate the unit. Consult the system requirements section for more information.

PicoScope or PicoLog reports error code 3

This error indicates that a PicoScope 2000 Series PC Oscilloscope could not be found on your machine. Make sure the software is installed before the unit is plugged into the USB socket, and restart your computer.

Ensure that the Windows Device Manager mentions the PicoScope 2000 Series unit. If the unit is not mentioned there, contact Pico Technical Support for further advice.

PicoScope or PicoLog reports error code 4, 5 or 6

These errors are reported when there is a problem with the unit itself. They could arise from configuration settings being corrupted, or a firmware or hardware error.

Unplug the unit, wait a few seconds, and reconnect it to the USB port. If the error is still reported, consult Pico Technical Support for further advice.

PicoScope or PicoLog reports error code 7

This error is reported if the operating system is not recent enough to support the PicoScope 2000 Series PC Oscilloscope. Consult the system requirements section for more information.

4   Glossary

AC/DC switch. To switch between measuring alternating current and direct current, select AC or DC from the control on the oscilloscope toolbar of the PicoScope software application. Choose the setting to suit the characteristics of the input signal.

Analog bandwidth. The input frequency at which the signal amplitude has fallen by 3 dB, or by half the power, from its nominal value.

Block mode. A sampling mode in which the computer prompts the PC Oscilloscope to collect a block of data into its internal memory before stopping the unit and transferring the whole block into computer memory. This is the best mode to use when the input signal being sampled contains high frequencies. Note: To avoid aliasing effects, the sampling rate must be greater than twice the maximum frequency in the input signal.

Buffer size. The size of the PicoScope PC Oscilloscope buffer memory. The unit uses this to store data temporarily, so that it can sample data independently of the speed at which it can transfer data to the computer.

Driver. A software application 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. This is used by the PicoScope and PicoLog software to control the units.

ETS. Equivalent time sampling. The PicoScope 2104 and 2105 can collect data over a number of cycles of a repetitive waveform to give a higher effective sampling rate than is possible for a single cycle. Equivalent time sampling allows the oscilloscope to use faster timebases than those available in real-time mode.

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

Oversampling. A method of increasing the effective resolution of a measurement by sampling faster than the required sampling rate, then averaging the extra samples. An oversampling factor of four increases the effective resolution by one bit, but this increased resolution comes at the expense of reducing the maximum sampling rate by the same factor.

PC Oscilloscope. A virtual instrument consisting of a PicoScope PC Oscilloscope and 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 2000 Series. A range of low-cost PC Oscilloscopes that includes the PicoScope 2202 entry-level unit and 2104 and 2105 variants.

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

Real-time continuous mode. A sampling mode in which the software repeatedly requests single samples from the PC Oscilloscope. This mode is suitable for low sampling rates when you require the latest sample to be displayed as soon as it is captured.

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Streaming mode. A sampling mode in which the PC Oscilloscope samples data and returns it to the computer in an unbroken stream. This mode of operation is suitable when the input signal being sampled contains only low frequencies.

Timebase. The timebase controls the time interval represented across the width of the oscilloscope screen. If you select "Scope timebase is time per division" in the Scope Advanced Options dialog box in the PicoScope application (Settings | Options, Advanced), it works like a traditional bench-top oscilloscope. There are ten divisions across the screen, so the total time interval is ten times the timebase.

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 an RS-232 or COM 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. USB 2.0 is backwards-compatible with USB 1.1.

Vertical resolution. A value, in bits, that indicates the number of input voltage levels that the oscilloscope can distinguish. Calculation techniques can improve the effective resolution.

Voltage range. The range of input voltages that the PC Oscilloscope will measure in a given mode.

Windows Device Manager. Windows Device Manager is a component of Microsoft Windows that displays the current hardware configuration of your computer. On Windows 2000, XP or Vista, right-click My Computer, choose Properties, click the Hardware tab and then the Device Manager button.

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