



PicoScope 4000 Automotive PC Oscilloscopes

User's Manual

Contents

1 Introduction	1
1 Overview	1
2 Minimum PC requirements	1
3 Installation instructions	2
4 Safety symbols	3
5 Safety warning	3
6 FCC notice	4
7 CE notice	4
8 Legal information	5
9 Company details	6
2 Product information	7
1 Specifications	7
3 Advanced features	8
1 Sampling modes	8
2 More on block mode	8
3 More on streaming mode	8
4 AC/DC coupling	8
5 Oversampling	8
4 Glossary	9
Index.....	11

1 Introduction

1.1 Overview

The [PicoScope 4000 Series Automotive](#) Oscilloscopes are a range of high-speed PC oscilloscopes for automotive diagnostic use. They are fully [USB 2.0](#)-capable and backwards-compatible with [USB 1.1](#). There is no need for an external power supply as power is supplied from the USB port, making these oscilloscopes highly portable.

The PicoScope 4000 Series Automotive Oscilloscopes are supplied with the [PicoScope software](#), which turns your PC into a powerful [PC Oscilloscope](#).

Your Automotive Oscilloscope is supplied with these items:

- USB cable, for use with USB 1.1 and USB 2.0 ports
- Automotive software and reference CD
- Quick start guide

1.2 Minimum PC requirements

For your [PicoScope 4000 Series Automotive](#) Oscilloscope to operate correctly, you must connect it to a computer with the minimum requirements to run Windows or the following (whichever is the higher specification):

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.

1.3 Installation instructions

Important

You must install the [PicoScope software](#) before connecting a [PicoScope 4000 Series Automotive](#) Oscilloscope to your PC for the first time.

Install the software by following the steps in the quick start guide supplied with your oscilloscope. You can then connect your oscilloscope to the PC. **To minimise the risk of electromagnetic interference, please use the USB cable supplied.** There is no need for an additional power supply, as the unit draws its power from the USB port.

Checking the installation

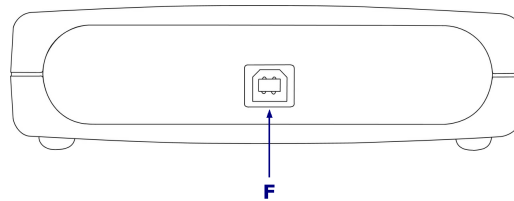
Once the software has been installed, ensure that the oscilloscope is connected to the PC and then start the PicoScope software. The software should now display the voltage of any signal that is connected to the oscilloscope. If you plug in a test lead into the scope and touch the red clip or probe with your finger, you should see a small signal (caused by mains pickup or other electrical noise) in the oscilloscope window.

Standard oscilloscope connectors

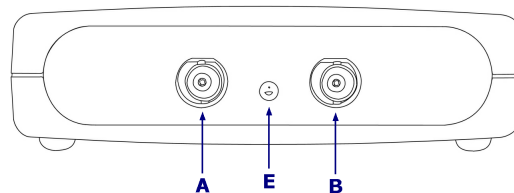
The [PicoScope 4000 Series Automotive](#) Oscilloscopes have standard oscilloscope connectors. The input impedance is also standard, so add-on sensors and probes will work correctly.

Connector diagrams

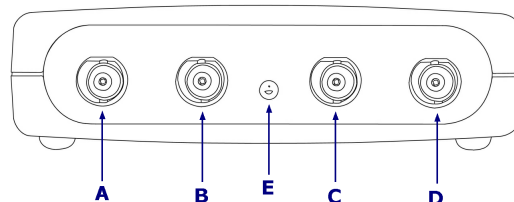
Rear view,
all models



Front view,
PicoScope 4223



Front view,
PicoScope 4423



A. Ch A. Input channel A. Similarly for channels B, C and D.

E. LED. Lights up when the PicoScope 4000 Series Automotive Oscilloscope is first powered up, switches off when the PicoScope software begins to run, and then lights up again when the oscilloscope is sampling data.

F. USB port connector. Compatible with USB 1.1 and USB 2.0 ports.

1.4 Safety symbols

Symbol 1: Warning Triangle



This symbol indicates that a safety hazard exists on the indicated connections if you do not take correct precautions. Ensure that you read in detail 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 (i.e. are 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 result in a large current flow, causing damage to the product and connected equipment.

1.5 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 4000 Series Automotive](#) Oscilloscopes are designed to measure voltages in the range $\pm 100\text{V}$. Any voltages in excess of $\pm 200\text{V}$ may cause physical damage.

Mains voltages

Pico Technology products are not designed for direct connection to mains (line power) sources. To measure mains, use a differential isolating probe specifically designed for mains use.

Safety grounding

PicoScope 4000 Series Automotive Oscilloscopes connect direct to the ground of a computer through the interconnecting cable provided. This method minimises interference.

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. 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

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

1.6 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.

1.7 CE notice

The [PicoScope 4000 Series Automotive](#)⁹ Oscilloscopes meet the intent of the EMC directive **89/336/EEC** and are designed to the **EN61326-1 (1997) Class A Emissions and Immunity** standard.

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

1.8 Legal information

The material contained in this 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

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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 use in mission-critical applications, for example 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 28 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.

Trademarks

Windows is a trademark of Microsoft Corporation. **Pico Technology** and **PicoScope** are internationally registered trademarks of Pico Technology Ltd.

1.9 Company details

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2 Product information

2.1 Specifications

	PicoScope 4223	PicoScope 4423
Vertical Resolution ^[10]	12 bits	
Analog Bandwidth ^[9]	20 MHz*	
Channels	2	4
Maximum Sampling Rate ^[9] Single channel Two channels Three or four channels	80 MS/s 80 MS/s -	80 MS/s 80 MS/s ** 20 MS/s
Buffer Size ^[9] One channel in use Two channels in use Three or four channels in use	32M samples 16M samples -	32M samples 16M samples 8M samples
Inputs	2 x BNC input 1 M Ω impedance 22 pF	4 x BNC input 1 M Ω impedance 22 pF
Voltage Ranges ^[10]	± 100 V, ± 50 V, ± 20 V, ± 10 V, ± 5 V, ± 2 V, ± 1 V, ± 500 mV, ± 200 mV, ± 100 mV, ± 50 mV	
Accuracy	Voltage: 1% Time: 50 ppm	
Operating Environment Temperature range Humidity	0°C to 45°C (20°C to 30°C for quoted accuracy) 5% to 80% RH	
Overload Protection	± 200 V	
PC Connection	USB 2.0 ^[10] Compatible with USB 1.1	
Power Supply	From USB port: 500 mA @ 4.6 V No external power supply required	
Dimensions	200 mm x 140 mm x 35 mm	
Compliance	CE standard ^[4] ; FCC standard ^[4]	

* 10 MHz on ± 50 mV range

** Reduced to 20 MS/s if channels A and B, or C and D, enabled

3 Advanced features

3.1 Sampling modes

[PicoScope 4000 Series Automotive](#) Oscilloscopes run in various sampling modes. At high sampling rates, the oscilloscope collects data much faster than a PC can read it. To compensate for this, the oscilloscope stores a block of data in an internal memory buffer, delaying transfer to the PC until the required number of data points have been sampled. This is called [block mode](#). At very low sampling rates, you may want to switch to [streaming mode](#). This allows data to be transferred back to the PC as it is collected.

3.2 More on block mode

In block mode, the computer prompts a [PicoScope 4000 Series Automotive](#) Oscilloscope to collect a block of data into its internal memory. When the oscilloscope has collected the whole block, it will signal it is ready and transfer the whole block into the computer memory via the [USB](#) port. The maximum number of samples in each block depends upon the size of the oscilloscope's memory.

3.3 More on streaming mode

In streaming mode, the computer prompts the [PicoScope 4000 Series Automotive](#) Oscilloscope to start collecting data. The data is then transferred back to the PC without being stored in oscilloscope memory. Data can be sampled with a period of between 1 ms and 60 s, and the maximum number of samples is limited only by the amount of free space on the PC's hard disk.

3.4 AC/DC coupling

Each channel can be set to either AC or DC coupling. When AC coupling is used, any DC component of the signal is filtered out. This mode is useful for viewing ripple on signals such as the alternator and fuel pump currents, where the DC level of the signal is of no interest. DC coupling is recommended for most other automotive measurements.

To switch from alternating current to direct current, or vice versa, select AC or DC from the control on the oscilloscope toolbar of the PicoScope software application. The setting should be adjusted to suit the characteristics of the input signal.

3.5 Oversampling

When the oscilloscope is operating in [block mode](#) at speeds that are less than maximum, it is possible to oversample. Oversampling is taking more than one measurement during a time interval and returning an average. This reduces the effects of noise, and increases the effective [resolution](#) of the oscilloscope.

4 Glossary

AC/DC control. Each channel can be set to either AC coupling or DC coupling. With DC coupling, the voltage displayed on the screen is equal to the true voltage of the signal with respect to ground. With AC coupling, any DC component of the signal is filtered out, leaving only the variations in the signal (the AC component).

Aliasing. Like all digital scopes, the PicoScope 4000 Series cannot reliably capture signals with a frequency higher than half the scope's maximum sampling rate. For example, with a 80 MS/s sampling rate, the frequency limit is 40 MHz. If the signal frequency exceeds this limit then a distorted waveform appears. This distortion is called aliasing.

Analog bandwidth. All oscilloscopes have an upper limit to the range of frequencies at which they can measure accurately. The analog bandwidth of an oscilloscope is defined as the frequency at which a displayed sine wave has half the power of the input sine wave (about 71% of the amplitude).

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. This mode of operation is effective when the input signal being sampled is high frequency. Note: To avoid [aliasing](#) effects, the maximum input frequency must be less than half the sampling rate.

Buffer size. The size of the oscilloscope buffer memory. The buffer memory is used by the oscilloscope to temporarily store data. This helps to compensate for the differences in data transfer rate from one device to another.

Maximum sampling rate. A figure indicating the maximum number of samples the oscilloscope 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 capability of the oscilloscope, the more accurate the representation of the fine details in a fast signal.

PC Oscilloscope. A generic term used to describe a PicoScope 4000 Series Automotive PC Oscilloscope and the PicoScope software application.

PicoScope 4000 Series Automotive. An oscilloscope range comprising the PicoScope 4223 and PicoScope 4423 Automotive 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.

Spectrum analyser. An instrument that measures the energy content of a signal in each of a large number of frequency bands. It displays the result as a graph of energy (on the vertical axis) against frequency (on the horizontal axis). The PicoScope software includes a spectrum analyser.

Streaming mode. A sampling mode in which the oscilloscope samples data and returns it to the computer in an unbroken stream. This mode of operation is effective when the input signal being sampled is low frequency.

Timebase. The timebase controls the time interval across the scope display. If you select **Timebase is time per division** in the **Preferences** dialogue box, this works like a traditional bench top scope. There are ten divisions across the screen, so the total time interval is ten times the timebase.

USB 1.1. USB is the abbreviation for Universal Serial Bus. 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 Mbps (12 megabits per second), and is much faster than a serial port.

USB 2.0. USB is the abbreviation for Universal Serial Bus. 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 that is 40 times faster than that supported by USB 1.1. An additional feature of USB 2.0 is that it is backwards compatible with USB 1.1.

Vertical resolution. A value, in bits, indicating the degree of precision with which the oscilloscope can turn input voltages into digital values. Calculation techniques can improve the effective resolution.

Voltage range. The voltage range is the range between the maximum and minimum voltages that can be accurately captured by the oscilloscope.

Index

A

AC coupling 8
AC/DC control 9
Accuracy 7
Analog bandwidth 7, 9

B

Block mode 8, 9
BNC connector 2
Buffer 8
Buffer size 7, 9

C

Calibration 3
Channels 7, 8
Compliance 7
Contact details 6

D

DC coupling 8
Dimensions 7

F

Functions 8

I

Inputs 7

L

Legal information 5

M

Maximum input range 3
Memory buffer 8

O

Operating environment 7
Oscilloscope probe 2
Overload protection 7
Oversampling 8

P

PC connection 7
PC Oscilloscope 1, 4, 9
PC requirements 1
PicoScope 4000 Series Automotive 1
PicoScope software 1, 2, 9
Power supply 7

R

Repair 3
Resolution, vertical 7, 8, 9

S

Safety warning 4
Sampling rate 7, 9
Signal generator 2
Specifications 7
Spectrum analyser 1, 9
Streaming mode 8, 9

T

Test equipment 3
Time interval 8
Timebase 9

U

USB 1, 9

V

Voltage range 7, 9

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ps4000a.en-1

28.10.08

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