PicoScope 3425
PC Oscilloscope

User's Guide

Contents

1   Introduction

1.1   Overview

The **PicoScope 3425** PC Oscilloscope is a high-precision differential oscilloscope. (What is a differential oscilloscope?) It is 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.

With the PicoScope software, the PicoScope 3425 can be used as a PC Oscilloscope and spectrum analyser.

If you wish to develop your own programs to collect and analyse data from the oscilloscope using the API functions, refer to the PicoScope 3425 Programmer's Guide.

1.2   Minimum PC requirements

For the PicoScope 3425 PC 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):

Processor	Pentium-class processor or equivalent minimum.
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 directly to the port or a powered USB hub. Will not work on a passive hub.

1.3   Safety information

We strongly recommend that you read the general safety information below before using your oscilloscope for the first time. If you use the oscilloscope in a manner contrary to these instructions, safety protection built in to the equipment may cease to function. This could cause damage to your computer or other equipment, or lead to injury to yourself and others.

Maximum input range

The PicoScope 3425 PC Oscilloscope is designed to measure voltages in the range stated in the Specifications table. The oscilloscope can withstand the **Overvoltage** stated in the Specifications table, and operation with voltages exceeding this range may cause physical damage.

Mains voltages and measurement category

The PicoScope 3425 PC Oscilloscope is designed only for **CAT I** measurements as defined by **BS EN61010-1:2001,** which permits measurements on circuits that are not directly connected to the mains (line power). The oscilloscope is not designed for measurements on CAT II, III or IV circuits.

> **The PicoScope 3425 PC Oscilloscope must not be directly connected to the mains (line power).**
>
> **Failure to heed this warning may lead to injury or death.**

Safety grounding

The PicoScope 3425 PC Oscilloscope connects directly to the ground of a computer through the USB cable provided. This connection is intended only to minimise interference, and therefore you **must not** rely on it as a protective safety ground.

Do not connect the ground sockets on the front panel 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 oscilloscope's ground socket and point to which you intend to connect it. Failure to check may cause damage to your computer, or injury to yourself and others.

Repairs

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

Cleaning and decontamination
- Remove all connections from the unit
- Clean the external surfaces of the oscilloscope with a soft damp cloth. Do not use chemical cleaners.
- Make sure that the instrument is completely dry before using again.

1.4   Safety symbols

Symbol 1: Caution: risk of electric shock

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: Equipotentiality

This symbol indicates that the indicated 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 indicated terminals as this may result in a large current, causing damage to the product and connected equipment.

1.5   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.

1.6   CE notice

The PicoScope 3425 PC Oscilloscope meets the intent of the EMC directive **89/336/ EEC** and is designed to the **EN61326-1 (1997) Class B Emissions and Immunity** standard.

The oscilloscope also meets the intent of the **Low Voltage Directive** and is designed to the **BS EN 61010-1:2001 / IEC 61010-1:2001** (safety requirements for electrical equipment for measurement, control, and laboratory use) standard.

1.7   Legal information

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

As 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 or registered trademark of Microsoft Corporation. Pico Technology Limited and PicoScope are internationally registered trademarks.

1.8 Company details

You can obtain technical assistance from Pico Technology at the following address:

Address:	Pico Technology
	James House
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	United Kingdom

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Technical Support:	support@picotech.com
Sales:	sales@picotech.com

Web site: www.picotech.com

2   Product information

2.1   Pack contents

The PicoScope 3425 pack contains the following items:

Reorder code	Description	Quantity
MI144	Carry Case	1
PR090	PicoScope 3425 Differential PC Oscilloscope	1
MI106	USB cable, for use with USB 1.1 and USB 2.0 ports	1
TA039	Screened twisted-pair lead, 1.3 metre	4
TA038	Current clamp adaptor	4
TA001	Black test probe	1
TA002	Red test probe	1
TA003	Small crocodile clip (black)	2
TA004	Small crocodile clip (red)	2
TA005	Black dolphin clip	2
TA006	Red dolphin clip	2
TA089	Shrouded 4mm to sprung hook (black)	4
TA090	Shrouded 4mm to sprung hook (red)	4
DO115	Quick Start Guide	1
DI025	PicoScope software and reference CD	1

> ⚠ The accessories supplied with the PicoScope 3425 are rated for safe working at the maximum voltages stated in the [Specifications.](#) For your safety, if you use your own accessories with this oscilloscope, you **must** ensure that they are rated for the voltage you are measuring.

2.2   Installation instructions

> **Important**
> You must install the [PicoScope software](#) before connecting
> a PicoScope 3425 PC 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.

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 are using the differential cable and test probes supplied, you should see a small 50 or 60 hertz noise signal in the oscilloscope window when you touch the test probes with your fingers.

See [Connector diagrams](#).

2.3   Connector diagrams

Front view (3425)   Rear view
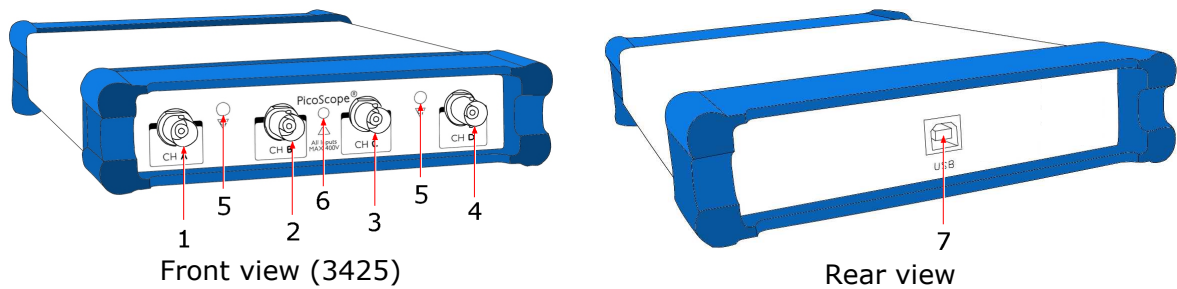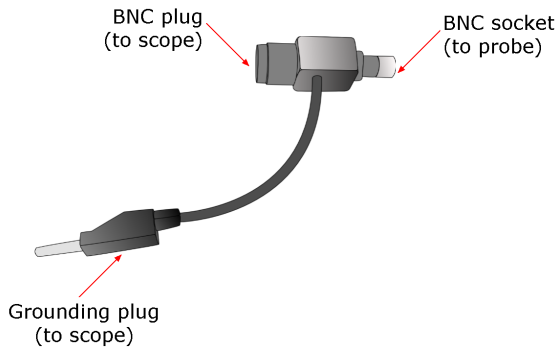
1. **Ch A.** Input channel A. As this is a <u>differential oscilloscope,</u> the channels have non-standard input impedances and **cannot be used with passive attenuated scope probes** such as the x1/x10 probes supplied with conventional oscilloscopes.

2. **Ch B.** Input channel B. Has the same characteristics as **Ch A**.

3. **Ch C.** Input channel C. Has the same characteristics as **Ch A**.

4. **Ch D.** Input channel D. Has the same characteristics as **Ch A**.

5. **Ground.** Can be used with the current clamp adaptor supplied to convert one or more of the differential inputs to single-ended inputs. Can also be used to ground the screen of the shielded twisted-pair cable supplied.

> **The scope's ground is connected to the PC's ground through the USB cable. You MUST NOT rely on the scope's ground as a protective safety ground.**
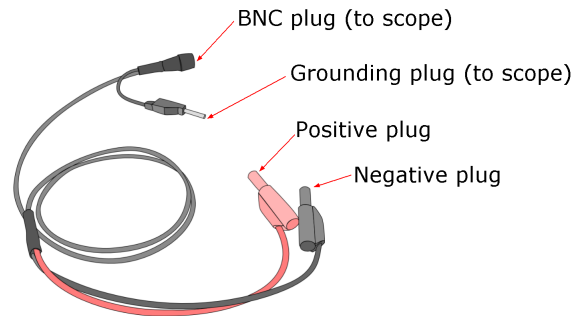
6. **LED.** Lights up when the oscilloscope is first powered up, switches off when the PicoScope software begins to run, and then flashes while the oscilloscope is capturing data.

7. **USB port.** Compatible with <u>USB</u> 1.1 and USB 2.0 ports.

2.4   Connecting the oscilloscope

The oscilloscope is supplied with the following cables and adaptors:

BNC plug
(to scope)

BNC socket
(to probe)

BNC plug (to scope)

Grounding plug (to scope)

Positive plug

Negative plug

Grounding plug
(to scope)

TA038 Current clamp adaptor   TA039 Screened twisted-pair cable

TA038 Current clamp adaptor

Use this adaptor to connect a current clamp to the oscilloscope. First fit the adaptor to one of the BNC inputs on the oscilloscope's front panel, then insert the adaptor's grounding plug into one of the ground sockets on the front panel.

It is important to ground the current clamp using the procedure just described. Most current clamps have an internal metal case that readily picks up electromagnetic noise from the environment, and if the case were not grounded, this noise would interfere with the signal.

TA039 Screened twisted-pair cable

Use this cable to connect a signal directly to the oscilloscope. A positive signal will be displayed when you connect the red BNC plug to the more positive signal and the black BNC plug to the more negative signal. If you connect these the wrong way round, the oscilloscope will not be damaged but the signal will appear inverted on the scope display.

Insert the grounding plug into one of the ground sockets on the front of the oscilloscope. This grounds the screen of the cable to prevent it from picking up electromagnetic noise that might otherwise interfere with the signal.

2.5   Specifications

| Specification	Value
Vertical resolution	12 bits
Analogue bandwidth	5 MHz (3 MHz on 100 mV range)
Channels	4
Maximum sampling rate Single channel Two channels Three or four channels	20 MS/s 10 MS/s 5 MS/s
Capture memory One channel enabled Two channels enabled Three or four channels enabled	512 k samples 256 k samples 128 k samples
Input type	Differential voltage Selectable AC or DC coupling Touch-proof BNC connectors with 4 mm GND sockets
Input impedance	12.4 MΩ (on 100 mV to 5 V ranges) 10.1 MΩ (on 10 V to 400 V ranges)
Input capacitance	12 pF
Common-mode voltage range to ensure measurement accuracy	30 V (on 100 mV to 5 V ranges) 400 V (on 10 V to 400 V ranges)
Maximum safe voltages Differential Any input above scope GND	400 V 400 V (600 V transient)
Measurement category rating	CAT I
Voltage ranges	100 mV, 200 mV, 500 mV, 1 V, 2 V, 5 V, 10 V, 20 V, 50 V, 100 V, 200 V, 400 V
Accuracy	Voltage: ±1% Time: 50 ppm
Linearity	12 bits
Noise	< 10 LSB
Operating environment Temperature range Humidity range	0 °C to 40 °C (20 °C to 30 °C for quoted accuracy) Minimum 5% RH non-condensing Maximum 80% RH non-condensing, decreasing linearly to 50% at 40 °C
Storage environment Temperature range Humidity range	-20 °C to 60 °C 5% to 90% RH non-condensing
Other environmental conditions	Dry environments Altitude up to 2000 m No pollution, or only dry, non-conductive pollution
PC connection	USB 2.0 Compatible with USB 1.1
Power supply	From USB port 4.6 V to 5.25 V DC @ approx. 500 mA No external power supply required
Dimensions	255 mm x 170 mm x 40 mm (approximately 10.0 in x 6.7 in x 1.6 in)
Weight	920 g (approximately 2 lb)

2.6   What is a differential oscilloscope?

The PicoScope 3425 is a **differential PC Oscilloscope.** A differential oscilloscope measures the voltage difference between two points, regardless of the voltage of either point with respect to ground. This is unlike a conventional single-ended oscilloscope, which requires one of the points to be at ground potential.

For example, suppose that you want to measure the output voltage of a transformer with a grounded centre tap, as in the diagram below:
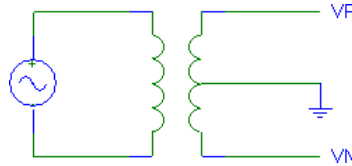
A single-ended oscilloscope can only measure a signal with reference to ground, so you need to connect the scope's ground clip to the centre of the secondary. You can then measure either V_P or V_N with respect to ground, but not the total voltage across the secondary. The diagram below shows a single-ended scope connected between V_P and ground:
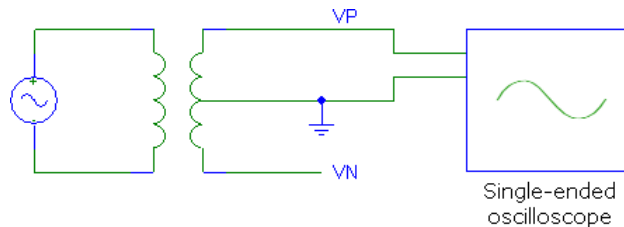
With a differential oscilloscope, you can directly measure the secondary voltage by connecting the positive probe to V_P and the negative to V_N. This is shown in the diagram below. A ground connection is not essential, although it is a good idea to use a shielded cable grounded at one end in order to prevent electromagnetic noise coupling into the cable.
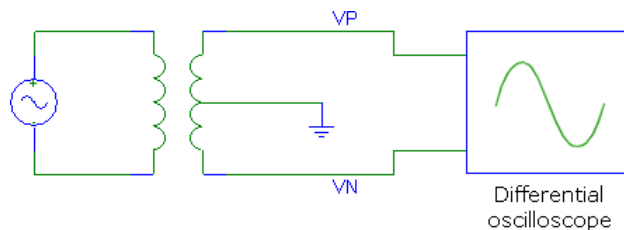
Differential oscilloscopes have many other applications where the voltage to be measured is not referenced to ground, or where it is not desirable to connect the scope ground to the ground of the device under test.

2.7 Overflow indicators

PicoScope 6, the PC Oscilloscope software supplied with the PicoScope 3425, displays a yellow **common-mode overflow indicator** for each channel when either the positive or the negative input voltage with respect to ground is outside the range stated in the [Specifications.](#) Exceeding the common-mode range of the scope causes inaccurate measurements and can lead to severe signal distortion.

The red **differential overflow indicator** is used to warn when the differential voltage (the difference between the positive and negative inputs) on each channel exceeds the selected voltage range. This condition causes clipping of the displayed signal.

Channel A differential overflow indicator
Channel A common-mode overflow indicator
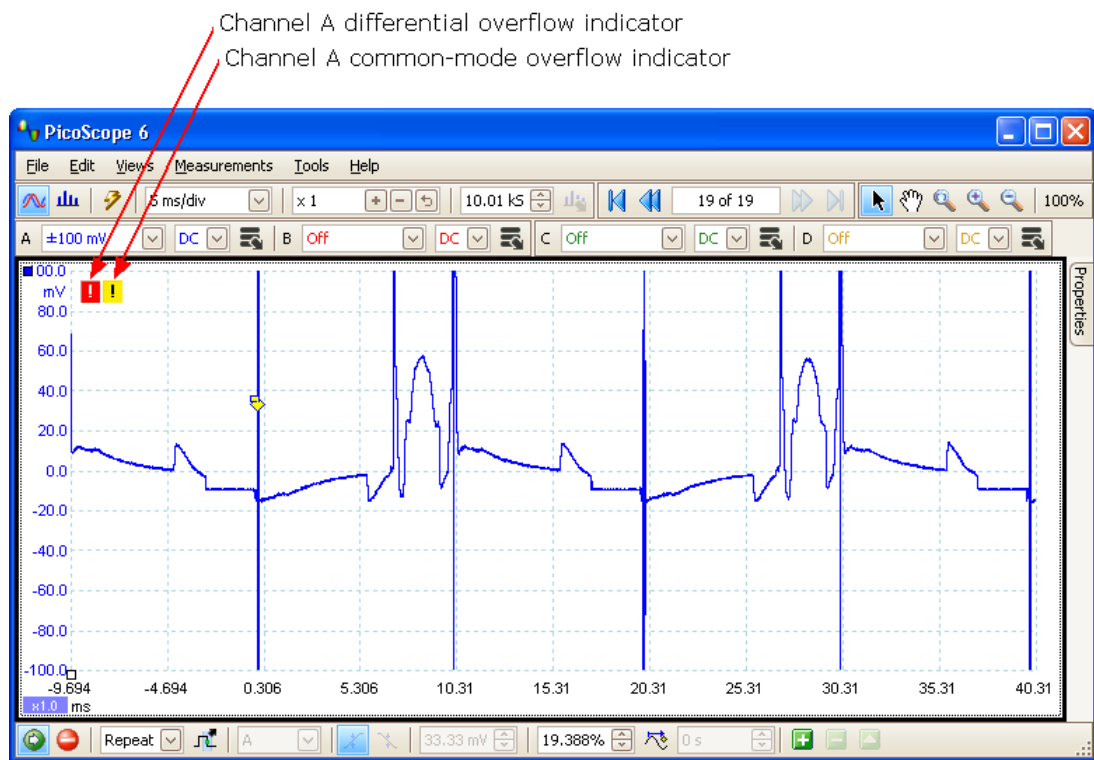
2.8 AC/DC coupling

Each channel can be set to use either AC or DC coupling. When AC coupling is used, any DC component of the signal below about 1 hertz is filtered out.

To change the coupling mode, select AC or DC from the control on the oscilloscope toolbar of the PicoScope software. The setting should be chosen to suit the characteristics of the input signal.

2.9 Resolution enhancement

The hardware resolution of the oscilloscope is 12 bits, but you can obtain an effective resolution of up to 16 bits using the Resolution Enhancement feature built in to the PicoScope software. See the PicoScope 6 User's Guide for details.

3 Troubleshooting

3.1 Software error codes

You may encounter these error codes if you are using PicoScope 5 or PicoLog.

Error code	Meaning
1	More than 4 PicoScope 3000 Series oscilloscopes are opened on one machine. It is not possible to use more than 4 oscilloscopes in the same application.
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 3425 PC Oscilloscope. Consult the system requirements section for more information.

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 across the differential inputs. With AC coupling, any DC component of the signal is filtered out, leaving only the variations in the signal (the AC component).

Aliasing. An effect that can cause digital oscilloscopes to display fast-moving waveforms incorrectly, by showing spurious low-frequency signals ("aliases") that do not exist in the input. To avoid this problem, choose a sampling rate that is at least twice the frequency of the fastest-changing input signal.

Analogue 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 (or, equivalently, 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, in samples, of the oscilloscope buffer memory. The buffer memory is used by the oscilloscope to temporarily store data before transferring it to the PC.

Common-mode overflow. The scope measures the difference between the positive and negative input voltages on each channel. The voltage of each input with respect to ground does not affect the measurement as long as it does not exceed the common-mode voltage limit. If this limit is exceeded, a common-mode overflow occurs and the scope will not measure the signal accurately. PicoScope 6 shows a warning indicator when this happens.

Common-mode voltage. The common-mode voltage of two points is the average voltage of the two points with respect to ground. A differential oscilloscope accurately measures the voltage difference between its two inputs and ignores their common-mode voltage, as long as the input voltages with respect to ground remain within a defined range. Outside this range the accuracy of the measurement cannot be guaranteed.

Differential oscilloscope. A differential oscilloscope measures the voltage difference between two points, regardless of the voltage of either point with respect to ground. This is unlike a conventional oscilloscope, which requires one of the two points to be at ground potential. More details.

Differential overflow. Occurs when the difference between the positive and negative inputs on one channel exceeds the selected measuring range. The result is an inaccurate measurement. PicoScope 6 shows a warning indicator when this happens.

Differential voltage limit. The differential voltage (the voltage difference between the positive and negative inputs on one channel) must not exceed this limit, or the oscilloscope may be permanently damaged.

Maximum sampling rate. A figure indicating the maximum number of samples the oscilloscope is capable of acquiring per second. Maximum sample rates are given in MS/s (megasamples per second). The higher the sampling capability of the oscilloscope, the more accurate the representation of the high frequencies in a fast signal.

Overview buffer. A buffer in which the PicoScope 3000 Series driver temporarily stores data on its way from the scope device to the application's buffer.

PC Oscilloscope. A measuring instrument consisting of a Pico Technology scope device and the PicoScope software. It provides all the functions of a bench-top oscilloscope without the cost of a display, hard disk, network adapter and other components that your PC already has.

PicoScope 3000 Series. A PC Oscilloscope range comprising the PicoScope 3204, 3205, 3206 general-purpose scopes, the PicoScope 3223 and 3423 automotive scopes, the PicoScope 3224 and 3424 high-resolution scopes and the 3425 differential scope.

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 on an oscilloscope 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 down 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.

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 contains only low frequencies.

Timebase. The timebase controls the time interval across the scope display. There are ten divisions across the screen and the timebase is specified in units of time per division, so the total time interval is ten times the timebase.

USB 1.1. USB (Universal Serial Bus) 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 (Universal Serial Bus) 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. USB 2.0 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 difference between the maximum and minimum voltages that can be accurately captured by the oscilloscope.

5   Appendix A: Declaration of Conformity

pico
Technology

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EC Declaration of Conformity

Pico Technology, as suppliers of the following product:

PS3425 Four Channel Differential Oscilloscope.

Declare that it meets the Electromagnetic Compatibility requirements specified in the European Community Directive EMC Directive 89/336/EEC as amended by: 92/31/EEC & 93/68/EEC.

The following standards have been applied :

EN61326: 1997	Electrical equipment for measurement, control and laboratory use – EMC requirements. Class A emissions (emissions section only).
EN61326: 1997	Electrical equipment for measurement, control and laboratory use – EMC requirements. Industrial Location Immunity (immunity section only).
CFR 47: 2006 Class A	Code of Federal Regulations: Part 15 Subpart B – Frequency Devices – Unintentional Radiators.
EN61000-3-2:200	Electromagnetic compatibility – part 3-2.
EN61000-3-3:1995	Electromagnetic compatibility – part 3, section 3.

Signed

Alan Tong
Managing Director
11th February 2008

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Registered in England and Wales No. 2626181

$$pico^®$$

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EC Declaration of Conformity

Pico Technology, as suppliers of the following product:

PS3425 Four Channel Differential Oscilloscope.

Declare that it meets the Safety requirements specified in the European Community
Directive 73/23/EEC as amended by: 93/68/EEC.

The following standards have been applied :

EN 61010-1: 2001

Safety requirements for electrical
equipment for measurement, control and
laboratory use, general requirements.
CATI / 400v rating.

Signed

Alan Tong
Managing Director
11th February 2008

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