



PicoScope 6407

Digitizer

User's Guide



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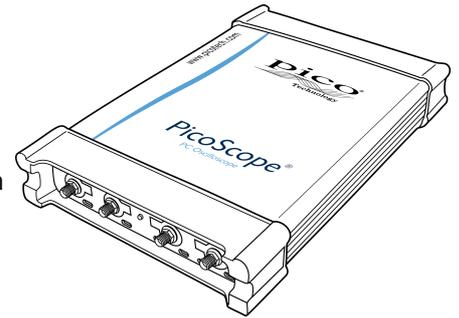
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1 Welcome

Thank you for buying a PicoScope 6407 Digitizer from Pico Technology!

This instrument accepts electrical signals in the frequency range of DC to 1 GHz, samples them at up to 5 GS/s and converts them to 8-bit digital values. The resulting data can be used in a wide variety of applications including research and development, debugging, instrumentation and pass/fail testing.



The PicoScope 6407 Digitizer has comparable features and specifications to traditional digitizers, but is more economical, takes up only a fraction of the space, and its USB interface removes the need for a specialized mainframe.

Here are some of the benefits provided by your new PicoScope 6407 Digitizer:

- **Portability:** Take the unit with you and plug it in to any Windows PC.
- **Performance:** Up to 5 GS/s sampling, 1 GHz bandwidth and 1 [GS](#)  buffer.
- **Programmability:** The PicoScope 6000 Series SDK lets you write your own programs, in your chosen programming language, to control all the features of the digitizer.
- **Long-term support:** Software upgrades are available to download from our [website](#). You can also call our technical specialists for support. You can continue to use both of these services free of charge for the lifetime of the product.
- **Value for money:** You don't have to pay twice for all the features that you already have in your PC, as the PicoScope 6407 Digitizer contains the special hardware you need and nothing more.
- **Convenience:** Your software can make full use of the full-sized display, disk storage, user interface and networking built in to your PC.
- **Five-year warranty:** Your digitizer is covered for five years from the day of purchase against manufacturing faults. We don't charge a penny extra for this benefit.

2 Introduction

2.1 Using this guide

You will sometimes see a symbol 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.

2.2 Safety symbols

The following symbols appear on the front and rear panel of the PicoScope 6407 Digitizer.

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 SMA (or BNC on rear panel) 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 SMA (or BNC on rear panel) connectors. Such a potential could cause a large current to flow, resulting in damage to the product or connected equipment, or both.

2.3 Safety warnings



We strongly recommend that you read the general safety information below before using your digitizer 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.

DO NOT exceed the overload protection range. The inputs can withstand a maximum voltage of ± 2 V. Contact with voltages outside the overload protection range may cause permanent damage to the unit.

DO NOT connect to mains voltages. The product is not designed for use with mains voltages (also known as line voltages, or house current). To measure mains voltages, use a differential isolating probe specifically rated for mains use.

DO NOT rely on the scope's ground as a safety ground. The product connects directly to the ground of a computer through the USB cable provided. This ground is for signalling and shielding, and is not a safety ground.

DO NOT connect 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 digitizer and the point to which you intend to connect it. Connecting the ground input to a voltage source may cause damage to the digitizer and the computer, and injury to yourself and others.

2.4 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 or her own expense.

For safety and maintenance information see the [safety warning](#)^[2].

2.5 CE notice

The product meets the intent of the EMC directive 89/336/EEC and has been tested to EN61326-1:2006 Class A Emissions and Immunity standard.

The product also meets the intent of the Low Voltage Directive and has been designed to meet the BS EN 61010-1:2010 IEC 61010-1:2010 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 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 Technology products or with data collected using Pico Technology products.

Copyright. Pico Technology Ltd. claims the copyright of, and retains the rights to, all material (software, documents etc.) contained in this release. You may copy and distribute the PicoScope software and drivers with no modifications, additions or omissions. You may copy and modify the SDK example programs.

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.

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 14 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.

2.7 Trademarks

Trademarks. Windows is a trademark of Microsoft Corporation in the United States and other countries. Pico Technology and PicoScope are internationally registered trademarks of Pico Technology Ltd.

Pico Technology and PicoScope are trademarks of Pico Technology Limited, 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 5 years 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.

2.9 Company details

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3 Product information

Using the API functions, you can develop your own programs to collect and analyze data from the digitizer. Refer to the PicoScope 6000 Series Programmer's Guide for more information.

Alternatively with the PicoScope software you can use PicoScope 6407 Digitizer as a high-bandwidth 4-channel oscilloscope.

A PicoScope 6407 Digitizer is supplied with the following items:

- USB cable, for use with any standard USB port
- Software and Reference CD
- Installation Guide
- AC adapter and cable

Whilst the above items are included, further accessories are available for purchase, as detailed below:

- TA077 - Attenuator -3dB SMA to SMA
- TA078 - Attenuator -6dB SMA to SMA
- TA061 - Oscilloscope probe 1.5 GHz, x10, 50 , SMA

3.1 System requirements

To ensure that your PicoScope 6407 Digitizer 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	Specification
Operating system	Windows XP SP2 Windows Vista Windows 7
	32 bit and 64* bit versions supported
Processor	As required by Windows
Memory	
Free disk space	
Ports	USB 1.1 compliant port, or USB 2.0 compliant port (recommended)

* While the driver will run on a 64 bit operating system, the driver itself is 32 bit, and therefore will run as 32 bit.

3.2 Installation instructions

IMPORTANT

Always install the PicoScope software before connecting your [PicoScope 6407 Digitizer](#) to the PC. This ensures that Windows will correctly recognize the digitizer.

Procedure

- Follow the instructions in the 'USB Oscilloscope Quick Start Guide' included with your product package.
- Connect the AC adapter (supplied) to a power socket using the appropriate cable (also supplied), and connect the DC output of the AC adapter to the "DC Power" socket on the back of the digitizer.
- Connect the digitizer to the PC using the USB cable supplied.

Checking the installation

Once you have installed the software and connected the digitizer to the PC, start the [PicoScope](#) software. PicoScope should now display any signal connected to the digitizer inputs.

Moving the PicoScope 6407 Digitizer to another USB port

- Windows XP SP2 (or later)

When you first installed the digitizer by plugging it into a [USB](#) port, Windows associated the Pico driver with that port. If you later move the digitizer 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 and Windows 7

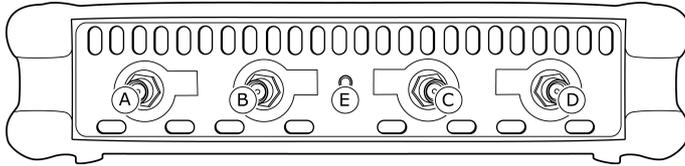
The process is automatic. When you move the device from one port to another, Windows displays an "Installing device driver software" message and then a "PicoScope 6000 Series oscilloscope" message. The digitizer is then ready for use.

3.3 Connections

SMA and BNC Connectors

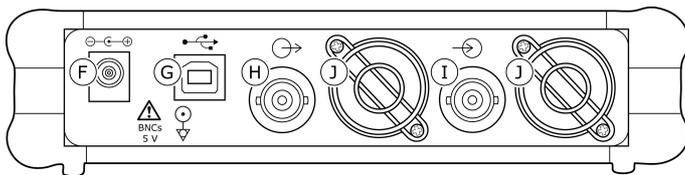
The PicoScope 6407 Digitizer has SMA connectors on the front panel for the four channel inputs, and BNC connectors on the rear for the AUX IN and SIGNAL OUT connections. The channel inputs have an impedance of 50 Ω .

Connector diagrams



Front panel
PicoScope 6407 Digitizer

- A. [Input channel A](#)
- B. [Input channel B](#)
- C. [Input channel C](#)
- D. [Input channel D](#)
- E. LED: flashes when the digitizer is sampling data



Rear panel
PicoScope 6407 Digitizer

- F. [DC power socket](#) : for use with the AC adaptor supplied with the unit
- G. [USB 2.0 port](#) : connects to your PC using the Hi-Speed USB cable supplied
- H. [SIGNAL OUT connector](#) : carries the output of the arbitrary waveform generator and signal generator
- I. [AUX IN connector](#) : carries the auxiliary (AUX) trigger and reference clock inputs
- J. Ventilation holes. Do not block the air intake holes or insert any objects through them, as this could damage the unit and cause injury.

3.4 Specifications

Model number	PicoScope 6407 Digitizer
Vertical section	
Number of channels	4
Analog bandwidth ^{[1][2]}	1 GHz (-3 dB)
Rise time (10%-90%)	350 ps
Connectors	SMA female
Input coupling ^{[1][2]}	DC
Input impedance	50 \pm 2%
VSWR	< 1.5:1 DC to 1 GHz typical over full bandwidth of scope
Voltage ranges ^{[1][2]}	\pm 100 mV
Input Sensitivity (x1 zoom)	20 mV/div (10 divisions) in PicoScope software
DC accuracy	3% of full scale
Overvoltage protection	\pm 2 V (DC+ Peak AC)
Crosstalk	100:1 DC to 100 MHz 30:1 100MHz to 1 GHz
Acquisition	
Vertical resolution ^{[1][2]}	8 bits (up to 12 in enhanced resolution mode)
Maximum sampling rate ^{[1][2]} (real-time)	
One channel in use	5 GS/s
Two channels in use	2.5 GS/s (when using channels A/C, A/D, B/C, B/D only)
Three or four channels in use	1.25 GS/s
Maximum streaming data rate	1 MS/s in PicoScope software, >10 MS/s using supplied SDK (PC-dependent)
Buffer size ^{[1][2]}	1 GS
Timebase accuracy	\pm 5 ppm
Triggering	
Trigger Modes	Auto, repeat, single, rapid
Basic triggers	Rising, falling,
Advanced triggers	Edge, window, pulse width, window pulse width, dropout, window dropout, interval, logic, runt pulse
Trigger level	Adjustable over whole of voltage range
Maximum trigger rate	Up to 10,000 waveforms in a 10 ms burst
Re-arm time	Less than 1 μ s on fastest timebase
Trigger sources	Ch A to Ch D, AUX
Maximum trigger delay	Pre-trigger: 100% of capture size Post-trigger: 4 billion samples
CLOCK/AUX input	
Trigger types (AUX input)	Edge, pulse width, dropout, interval, logic, delayed
Input characteristics	Rear panel female BNC, 50 \pm 1%
Voltage range	\pm 5 V, DC coupled
Bandwidth (AUX input)	25 MHz (-3 dB)
Threshold adjustment range	\pm 1 V
Overvoltage protection	\pm 5 V
Frequency range (Clock input)	Reference frequency 5 MHz to 25 MHz
Signal generator and arbitrary waveform generator (AWG)	
Connector	BNC female (rear mounted)
Frequency range	DC to 20 MHz
Standard waveforms	Sine, square, triangle, ramp, sin(x)/x, Gaussian, half-sine, white noise, DC level, PRBS
DAC resolution	12 bits
AWG sample rate	200 MS/s
AWG buffer size	16,384 samples
DC accuracy	1%
Amplitude flatness	<1.5 dB DC to 20 MHz, typical
Amplitude range	\pm 250 mV to \pm 2 V
Offset adjustment	\pm 1 V (max. combined output \pm 2.5 V)
Impedance	50
Overvoltage protection	\pm 5 V

Math channels	
Functions	$-x$, $x+y$, $x-y$, $x*y$, x/y , \sqrt{x} , x^y , $\exp(x)$, $\ln(x)$, $\log(x)$, $\text{abs}(x)$, $\text{norm}(x)$, $\text{sign}(x)$, $\sin(x)$, $\cos(x)$, $\tan(x)$, $\arcsin(x)$, $\arccos(x)$, $\arctan(x)$, $\sinh(x)$, $\cosh(x)$, $\tanh(x)$, Pi
Operands	A to D (input channels), T (time), reference waveforms
Mask limit testing	
Statistics	Pass/fail, failure count, total count
Display	
Interpolation	Linear or $\sin(x)/x$
Persistence modes	Digital color, analog intensity, custom, or none
Environmental conditions	
Operating environment	
Temperature range	0 °C to 40 °C operational 20 °C to 30 °C for quoted accuracy
Humidity	5% to 80% RH, non-condensing
Fan speed	Automatic, to reduce noise
Storage environment	
Temperature range	-20 °C to +60 °C
Humidity	5% to 95% RH, non-condensing
IP rating	IP 20
Miscellaneous	
PC connection	Hi-Speed USB 2.0
Power supply	External AC to 12 V 3.5 A DC adapter and cables (cords) included
Dimensions	170 mm x 255 mm x 40 mm (6.7" x 10.0" x 1.6")
Weight	< 1 kg (approx. 2 lb 3 oz)
Compliance	Europe: EMC EN61326, LVD EN61010-1, RoHS, WEEE USA: FCC Rules Part 15 Class A ^[3]
Languages supported (PicoScope only)	English, Chinese (Traditional and Simplified), Czech, Danish, Dutch, Finnish, French, German, Greek, Hungarian, Italian, Japanese, Norwegian, Polish, Portuguese, Romanian, Spanish, Swedish, Turkish

4 Glossary

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

Buffer size. The size of the oscilloscope/digitizer buffer memory, measured in samples. The buffer allows the digitizer to sample data faster than it can transfer it 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", select "Manage" and then select "Device Manager".

Driver. A program that controls a piece of hardware. The driver for the oscilloscope/digitizer is supplied in the form of a 32-bit Windows DLL, `ps6000.dll`. This is used by the PicoScope software, and by user-designed applications, to control the digitizer.

GS. Gigasamples (1,000,000,000 samples).

Maximum sampling rate. A figure indicating the maximum number of samples the oscilloscope/digitizer can acquire per second. The higher the sampling rate of the device, the more accurate the representation of the high-frequency details in a fast signal.

MS. Megasamples (1,000,000 samples).

PC Digitizer. A virtual instrument formed by connecting a PicoScope oscilloscope/digitizer to a computer running a custom application or the PicoScope software.

PicoScope 6000 Series. A range of 8-bit USB oscilloscopes and digitizers from Pico Technology, with a sampling rate of 5 GS/s, a bandwidth of 350 MHz to 1 GHz and buffer sizes up to 1 GS.

PicoScope software. A software product that accompanies all PicoScope oscilloscopes and digitizers. It turns your PC into an oscilloscope, digitizer, and spectrum analyzer.

USB 2.0. Universal Serial Bus. This is a standard port used to connect external devices to PCs. The port supports a data transfer rate of up to 480 megabits per second, so is much faster than the RS-232 COM ports found on older PCs.

Vertical resolution. A value, in bits, indicating the precision with which the oscilloscope/digitizer converts input voltages to digital values. Software enhancement can improve the effective vertical resolution.

Voltage range. The range of input voltages that the oscilloscope/digitizer can measure. For example, a voltage range of ± 100 mV means that the oscilloscope/digitizer can measure voltages between -100 mV and +100 mV. Input voltages outside this range will not damage the instrument as long as they remain within the protection limits stated in the [Specifications](#) table.



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