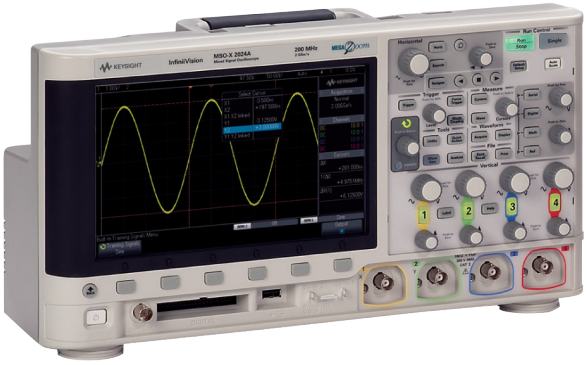
Keysight Technologies

Educator's Oscilloscope Training Kit for InfiniiVision X-Series Oscilloscopes

Data Sheet



KEYSIGHT TECHNOLOGIES

Introduction

The Keysight Technologies, Inc. InfiniiVision 2000, 3000, 4000 and 6000 X-Series digital storage and mixed signal oscilloscopes (DSOs and MSOs) are ideal for students to use in their undergraduate electrical engineering and physics circuits labs. These X-Series scope families include 50 different models ranging from the lowest priced DSOX2002A (2-channel, 70 MHz DSO), to the highest performance MSOX6004 (4 channel, 6 GHz MSO). What makes these scopes even more compelling for the EE and physics education environment is the optional Educator's Oscilloscope Training Kit (DSOXEDK).

The Educator's Oscilloscope Training Kit provides an array of built-in training signals, so that electrical engineering and physics students can learn what an oscilloscope does and how they can perform basic oscilloscope measurements. Also included in the kit is a comprehensive oscilloscope lab guide and tutorial written specifically for the undergraduate student. Professors and students can download this at no charge.

Keysight also provides a PowerPoint slide-set that professors and lab assistants can use as a pre-lab lecture on oscilloscope fundamentals. This lecture takes about 30 minutes and should be presented before electrical engineering and physics students begin their first circuits lab. Note that this PowerPoint slide-set also includes a complete set of speaker notes.

Features

- Up to 28 built-in student training signals
- Oscilloscope lab guide and tutorial
- Oscilloscope fundamentals PowerPoint slide-set

Built-in Oscilloscope Training Signals with Step-by-Step Instructions and Tutorial

An oscilloscope is the one measurement tool that students will use more than any other instrument to perform assigned circuit experiments. Students will also use oscilloscopes extensively after they graduate and enter today's electronics industry. So it is extremely important that they become proficient in the use of this vital tool.

The DSOXEDK Educator's Oscilloscope Training Kit provides the following 28 signals (and required options) to help teach undergraduate EE students what an oscilloscope is and how to use one effectively:

- Sine
- Sine with noise
- Phase shifted sine
- Sine with glitch
- Amplitude modulated sine wave
- RF burst
- FM burst (3000, 4000 and 6000 X-Series only)
- Repetitive pulse with ringing
- Single-shot pulse with ringing
- Clock with infrequent glitch
- Runt pulses (3000, 4000 and 6000 X-Series only)
- Edge transition violation signal (3000, 4000 and 6000 X-Series only)
- Setup and hold violation signal (3000, 4000 and 6000 X-Series only)
- Analog and digital signals (MSOX)
- Digital burst
- Digital burst with infrequent glitch
- Edge then edge (3000, 4000 and 6000 X-Series only)
- I²C (EMBD)
- RS232/UART (COMP)
- SPI (EMBD)
- I²S (AUDIO, 3000, 4000 and 6000 X-Series only)
- CAN (AUTO)
- LIN (AUTO)
- CAN & LIN (AUTO)
- FlexRay (FLX, 3000, 4000 and 6000 X-Series only)
- ARINC429 (AERO, 3000, 4000 and 6000 X-Series only)
- Mil-1553 (AERO, 3000, 4000 and 6000 X-Series only)
- Mil-1553 Dual (AERO, 3000, 4000 and 6000 X-Series only)
- USB (USBFL, 4000 and 6000 X-Series only)

These training signals are routed to two test lugs on the scope's front panel and should be probed using the scope's standard 10:1 passive probes. Some of the training signals such as sine waves are very simple, as shown in Figure 1. Other training signals can be quite complex in order to train students how to use the scope's more advanced triggering and measurement capabilities. No other test equipment is required other than the scope and two passive probes.

Along with the built-in training signals, professors and/or lab assistants and students can download the Oscilloscope Lab Guide and Tutorial. This guide provides a series of short oscilloscope labs with simple step-by-step instructions on accessing the training signals and setting up the scope to measure these signals. This training guide also provides a tutorial on oscilloscope theory of operation, bandwidth and triggering basics. Although triggering is probably the most important oscilloscope capability, it is often the least understood.

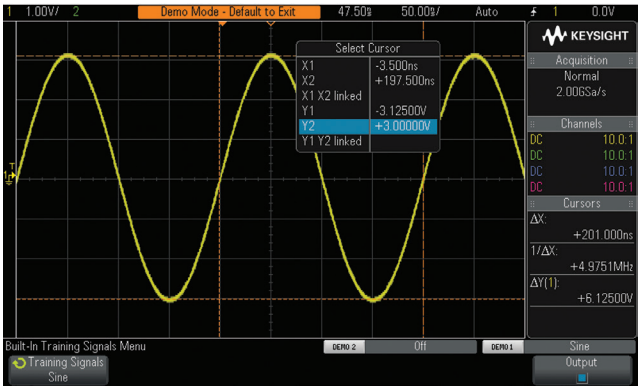


Figure 1: The sine wave signal teaches students how to scale waveforms for optimum viewing, how to trigger on edge crossings, and how to make basic voltage and timing measurements.

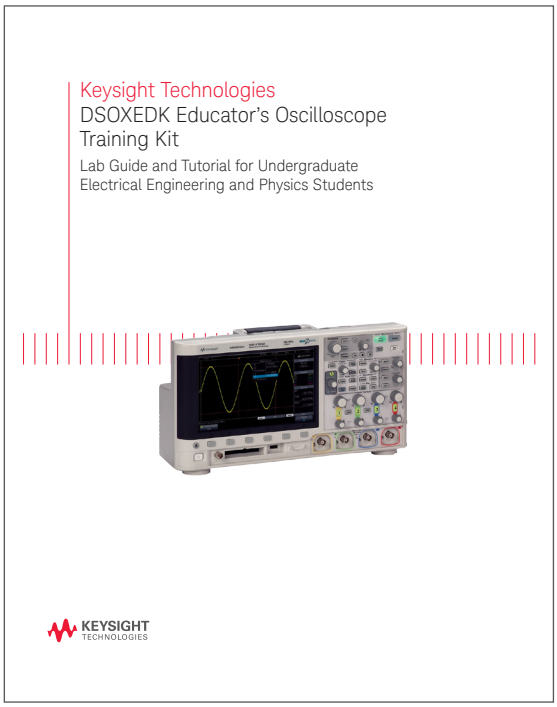


Figure 2: The downloadable Oscilloscope Lab Guide and Tutorial for Undergraduate Electrical Engineering and Physics Students.

To download the Oscilloscope Lab Guide and Tutorial, go to:
www.keysight.com/find/edk

Built-in Oscilloscope Training Signals with Step-by-Step Instructions and Tutorial

Keysight recommends that the first six labs (covered in Chapter 2: Basic Oscilloscope and WaveGen Measurements Labs) be completed by students during their first circuits lab session, before beginning any assigned circuit design experiments. Students will learn the following while completing the labs in Chapter 2 of the training guide:

- Probing basics
- Setting up vertical scaling (V/div)
- Setting up horizontal scaling (s/div)
- Making voltage and timing measurements the old-fashioned way
- Using cursors for voltage and timing measurements
- Triggering basics
- Averaging waveforms
- Electronically documenting measurement results
- Using the built-in function generator (optional feature)

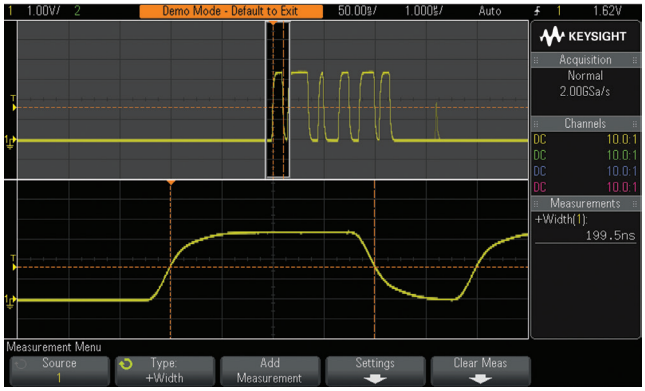


Figure 3: More complex training signals such as the "digital burst with infrequent glitch" signal, train students to use some of the scope's more advanced triggering and measurement capabilities.

The remaining nine labs (found in Chapter 3: Advanced Oscilloscope Measurement Labs) provide instructions on how to trigger on, and make measurements on more complex signals. These short labs, which are optional and require about 15 minutes each, can be completed by students who want to learn how to use some of the scope's more advanced functions. Alternatively professors may choose to assign specific labs they consider as important for students to complete. Students will learn the following while completing the advanced oscilloscope measurement labs in Chapter 3 of the training guide:

- Using trigger holdoff to trigger on a digital burst signal
- Using pulse-width triggering to trigger on an infrequent glitch
- Using infinite-persistence display mode to accumulate all variations of a signal
- Capturing a single-shot event
- Making automatic pulse parametric measurements
- Using the scope's horizontal zoom mode to perform "gated" measurements
- Making two channel phase delay measurements
- Using the scope's XY mode to view Lissajous waveforms
- Using waveform math including Fast Fourier Transformation (FFT)
- Using the scope's peak detect mode to overcome under-sampling
- Using segmented memory to capture multiple low duty cycle events (optional feature)

Related Products

In addition to oscilloscopes, educational EE circuits or physics labs typically include a variety of test equipment. This equipment may include power supplies, digital multimeters, and function generators, which are used as a dynamic input source for assigned experiments. Another option available on Keysight's InfiniiVision X-Series scopes is the WaveGen built-in 20-MHz function/arbitrary waveform generator. Not only does the built-in function generator save valuable bench space in labs, it can also help stretch the limited test equipment budgets of electrical engineering and physics departments.

It should be noted that signals generated by WaveGen are different from the oscilloscope training signals that are provided with the DSOXEDK Educator's Training Kit. The WaveGen provides general-purpose 20-MHz function generator capabilities with user-definable frequencies, amplitudes, offset, and pulse widths. The WaveGen's output is routed to a BNC on the front panel of the scope below the display. The WaveGen can produce the following wave shapes:

- Sine wave
- Square wave (with variable duty cycle)
- Ramp
- Pulse (with variable pulse width)
- DC
- Noise
- Arbitrary
- Modulation

Output levels can range from 20 mVp-p up to 5.0 Vp-p when terminated into high impedance, or 10 mVp-p to 2.5 Vp-p- when terminated into 50-Ω. Note that dual WaveGen option on the 4000 and 6000 X-Series models has twice the output drive capability.

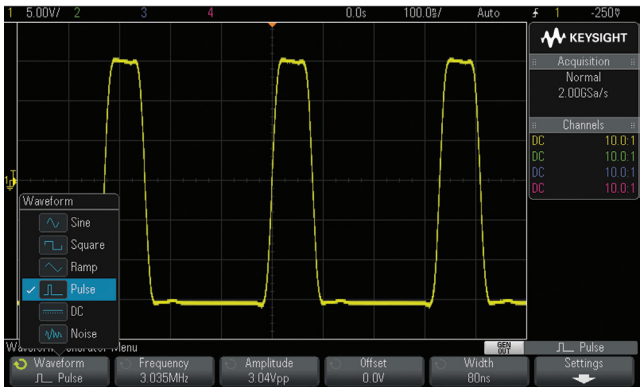


Figure 4: The WaveGen general-purpose function generator provides a built-in stimulus source for student experiments.

University Courseware from DreamCatcher

Learning how to use an oscilloscope is just the first step in the electrical engineering lab curriculum. Depending upon the specific EE courses, the core content of lab assignments will probably be focused on a variety of analog and digital circuit design experiments. For ready-to-use EE lecturer slide-set and application-specific student training kit resources, Keysight recommends considering courseware from DreamCatcher.[1] DreamCatcher provides the following EE courseware:

RF/microwave and wireless communications

- RF circuit design
- Digital RF communications
- Antenna and propagation
- EMI and EMC

Digital and embedded systems

- Microcontroller system design (8051)
- Embedded system design (ARM9)
- Digital systems
- Digital signal processing

General electronics

- Analog electronics
- Analog circuit design
- Electronic instrumentation and measurement

1. DreamCatcher is not affiliated with Keysight. For additional information about DreamCatcher courseware, go to www.dreamcatcher.asia/cw.

Ordering Information

The Educator's Oscilloscope Training Kit (DSOXEDK) and the WaveGen function/arbitrary generator options are compatible with all InfiniiVision X-Series (DSO and MSO) models from Keysight. Existing InfiniiVision X-Series oscilloscopes can also be upgraded:

Model number for user-installed license or for after-purchase upgrade	Option number for factory-installed license	Description
DSOXEDK	Option EDK	Educator's Training Kit option that enables 11 oscilloscope training signals
DSOX2WAVEGEN	Option 001	Built-in 20-MHz function generator for 2000 X-Series
DSOX3WAVEGEN	Option 001	Built-in 20-MHz function/arbitrary generator for 3000 X-Series
DSOX4WAVEGEN2	Option WAV	Built-in dual 20-MHz function/arbitrary generator for 4000 X-Series
DSOX6WAVEGEN2	Option WAV	Built-in dual 20-MHz function/arbitrary generator for 6000 X-Series

Additional options and accessories are available for Keysight's InfiniiVision X-Series oscilloscopes. Refer to the appropriate oscilloscope data sheets (see below) for information on ordering options and accessories, as well as ordering information for specific oscilloscope models.

You can download the "Oscilloscope Lab Guide and Tutorial" as well as the "Oscilloscope Fundamentals PowerPoint Slide-set," from Keysight's Web site at www.keysight.com/find/edk.

Related Literature

Publication Title	Publication Type	Publication Number
InfiniiVision 2000 X-Series Oscilloscope	Data Sheet	5990-6618EN
InfiniiVision 3000 X-Series Oscilloscope	Data Sheet	5990-6619EN
InfiniiVision 4000 X-Series Oscilloscope	Data Sheet	5991-1103EN
InfiniiVision 6000 X-Series Oscilloscope	Data Sheet	5991-4087EN
InfiniiVision Series Oscilloscope Probes and Accessories	Selection Guide	5968-8153EN
Serial Bus Applications for InfiniiVision X-Series Oscilloscopes	Data Sheet	5990-6677EN

To download these documents, insert the publication number in the URL:
http://literature.cdn.keysight.com/litweb/pdf/xxxx-xxxxEN.pdf

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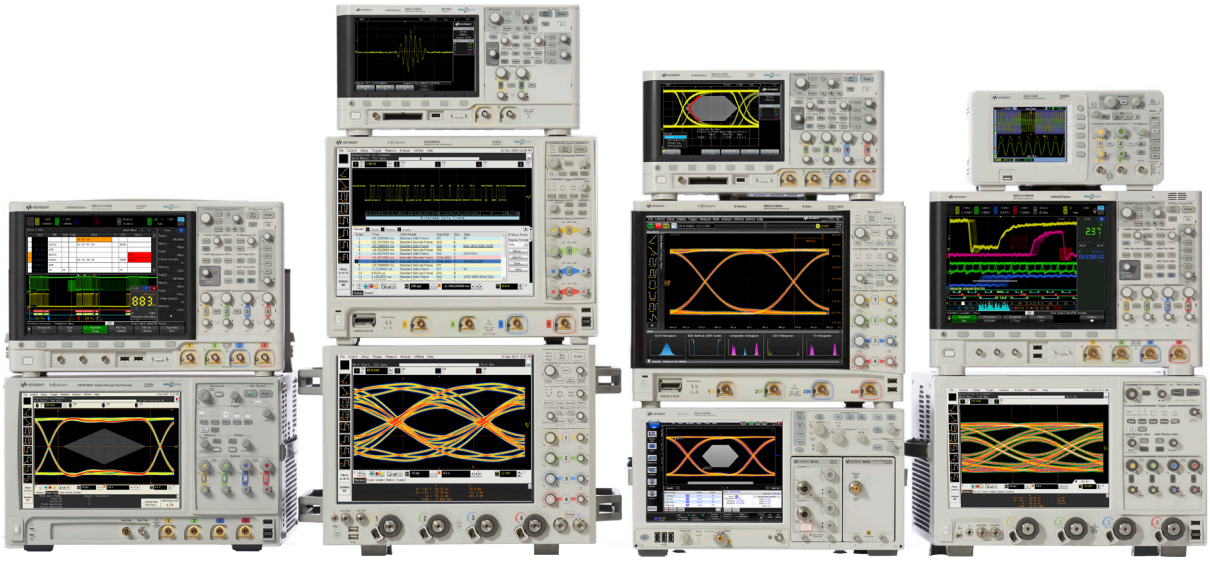

Keysight Oscilloscopes

Multiple form factors from 20 MHz to > 90 GHz | Industry leading specs | Powerful applications

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www.axiestandard.org
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www.lxistandard.org
LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Keysight is a founding member of the LXI consortium.

www.pxisa.org
PCI eXtensions for Instrumentation (PXI) modular instrumentation delivers a rugged, PC-based high-performance measurement and automation system.

Three-Year Warranty
www.keysight.com/find/ThreeYearWarranty
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For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
www.keysight.com/find/contactus

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