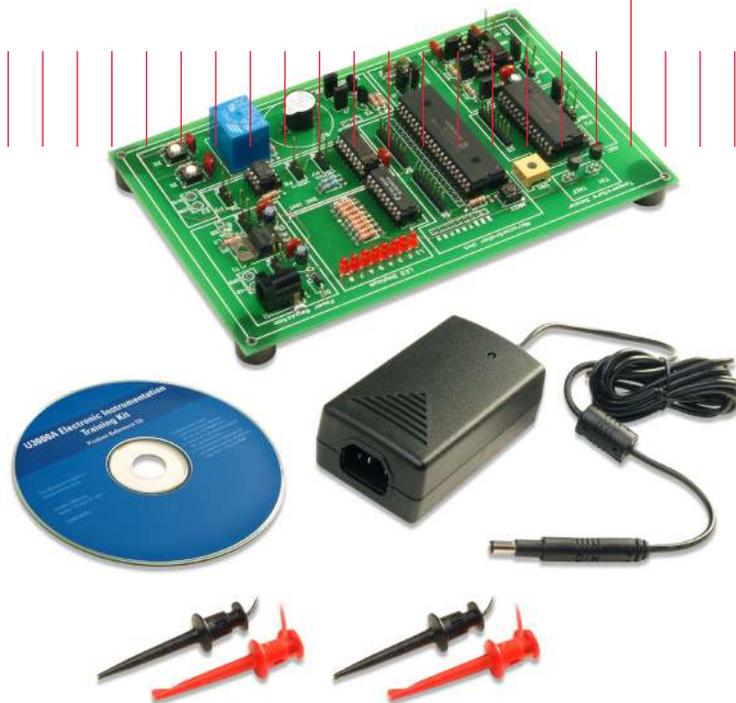


# Keysight Technologies

## U3000A Electronic Instrumentation Training Kit

Data Sheet



## Key Features

- Training board with up to eight selectable modes of operation
- Works with four basic test instruments and Keysight VEE Pro 8.0
- Comes with teaching materials, lab exercises and assessments
- Complete solution for instrumentation teaching
- Enables hands-on experience for students

## Solution for Basic Electronic Teaching Lab

The U3000A electronic instrumentation training kit provides a learning and teaching solution for electronic test instruments. With its multiple modes of operation, it offers an interactive learning experience to students. Step-by-step lab exercises enable students and engineers to explore the powerful features of Keysight Technologies, Inc.'s instruments and graphical test and measurement software. Comprehensive teaching materials on test instruments provide a link between your teaching and learning efforts and the application of electronic test instruments in real-world scenarios. The Keysight U3000A training kit works with four basic instruments and one graphical test software: power supply, digital multimeter, digital oscilloscope, function generator, and Keysight VEE Pro 8.0. This makes the training kit an essential tool for your teaching lab.

## Training Kit with Power Supply

Power supply is one of the most commonly used tools in design validation and manufacturing tests. The teaching and lab materials help students to better understand the key advantages of various power supply designs and ways to optimize the output.

## Training Kit with Digital Multimeter

Keysight offers a wide range of digital multimeters. The Keysight U3000A training kit enhances your students' knowledge of the operation of DMMs. In addition, the students learn techniques that enable them to avoid measurement errors and to carry out fast troubleshooting processes.

## Training Kit with Oscilloscope

For those who wish to explore the powerful features of Keysight's oscilloscope, the simulated waveforms and lab exercises of the U3000A will walk you through each function in great detail. Your students can also learn how to select an oscilloscope that meets their needs.

## Training Kit with Function Generator

Function generator is an essential tool in design validation. In the lab exercises, your students will learn ways to produce and send various signals to the training board using the Keysight's function generator. With the provided training materials, your students are able to learn operating principles and applications of various types of waveform generators.

## Training Kit with Keysight VEE Pro 8.0 and IO Connectivity

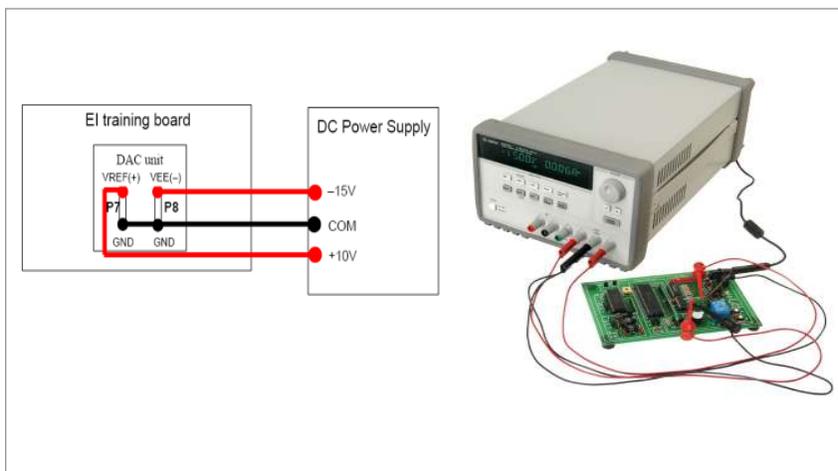
The Keysight VEE Pro 8.0 graphical language environment software keeps programming simple and less complex development screen. This enables users to start making measurements easily. With the bundled teaching materials, students are able to learn the graphical programming basics, to control the instruments from their PC, to automate repetitive and iterative measurement tasks, and to send a measurement data to a log file. In addition, the 82357B USB/GPIB interface allows a direct connection from the USB port to GPIB instruments. The 10833A GPIB-to-GPIB cable allows flexibility and scalability without compromising the performance.

Visit [www.keysight.com](http://www.keysight.com) for more information on Keysight's electronic instrumentation training kit

## How does the U3000A work with your instruments?

### U3000A + Power Supply

The Keysight E3631A triple output power supply is the most recommended model to be operated with U3000A training board. For operation modes 3 through 8, two regulated voltage supplies are required for the Digital-to-Analog converter (ADC) as negative supply (VEE = -15 V) and output voltage reference (VREF = +10 V). The microcontroller processes the input from the ADC in order to generate various types of signals for the lab exercises.†



### U3000A + Digital Multimeter

The recommended 34405A digital multimeter is used to teach you how to perform voltage, current, resistance, capacitance, frequency, and diode measurements in practice. Use the U3000A training board with the digital multimeter to understand measurement connections and methods.†



† User is required to supply VREF (+) with +10 and VEE (-) with -15 V externally with a DC power supply for mode three to mode eight.

## U3000A + Digital Oscilloscope

The Keysight DSO3000 Series economy oscilloscope represents the best choice when used in combination with the U3000A training board. Going through the provided lab exercises, you will learn to analyze various types of signals or waveforms generated by the U3000A training board, including counter signals, square waves from a 555 timer, irregular pulse waves, triangular waves, and sinusoidal waves.

The automatic measurement functions of the oscilloscopes allow you to make and display any or all different measurements simultaneously. In addition, you will also learn to display a waveform in a frequency domain using the Fast Fourier Transform (FFT) function and to filter a mixed sinusoidal signal using the digital filtering technique.†



## U3000A + Function Generator

The U3000A training board consists of an on-board timer and a crystal oscillator. The provided lab exercises guide you through the necessary steps to generate input signals using the Keysight 33220A function generator, to replace the on-board timer and microcontroller's clock. You are enabled to control the microcontroller's clock using the 33220A function generator and to observe the resulting output from the U3000A training board.†



† User is required to supply VREF (+) with +10 and VEE (-) with -15 V externally with a DC power supply for mode three to mode eight.

## U3000A + Keysight VEE Pro 8.0 + IO Connectivity

Software Solution:  
Keysight VEE Pro 8.0

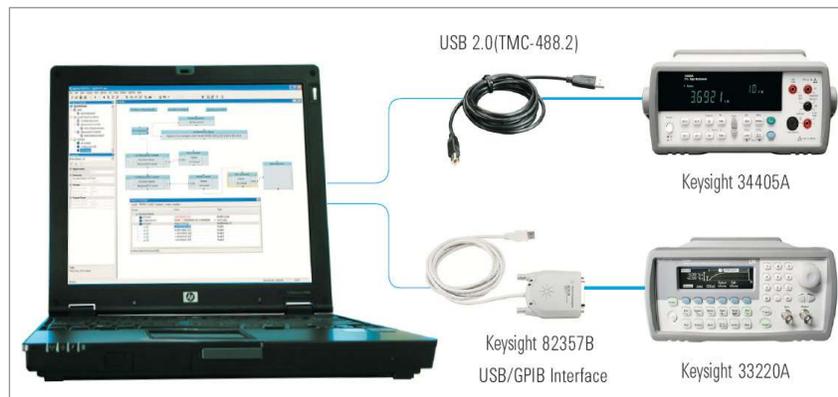
The Keysight Visual Engineering Environment (VEE) Pro 8.0 software provides you a quick and easy path to measurement and analysis. By keeping programming simple and utilizing the high-level task oriented “flowchart” design, Keysight VEE makes learning so straightforward that you can get started on your measurement tasks instantly.

The Keysight VEE Pro 8.0 enables you to connect your instruments in 3 simple steps. The software also provides you a complete software solution in accomplishing your tasks easily. For instant, the Keysight VEE Pro 8.0 will enable you to connect your instruments, to perform measurements, to analyze, and lastly, to report the data. Besides, the Keysight Vee Pro 8.0 is able to handle different data types, providing automatic conversion and giving you powerful data handling capabilities with minimal complex programming.

The Keysight VEE Pro 8.0 is an essential productivity tool for all programmers. It interfaces with popular software tools – Microsoft Excel and Matlab®. These software are included in Keysight VEE at no extra cost. The Keysight VEE provides easy, menu-driven control of Microsoft Excel for exchanging data with spreadsheet operations.

Furthermore, with the MATLAB Script and The MathWorks Signal Processing Toolbox embedded in the Keysight VEE, you get 1700 MATLAB functions; 500 of most popular MATLAB analyses and visualization functions are programmed as on-click object in the Keysight VEE Pro 8.0. This enables you to transform your measurement data into usable information immediately without the needs to exit the Keysight VEE program. The built-in MATLAB functions are numeric computation, engineering and scientific graphics, signal processing, arrays, matrix math, and many more.

## Measurement Automation with Keysight VEE Pro and Keysight IO Hardware Connectivity



Visit [www.keysight.com/find/vee](http://www.keysight.com/find/vee) for more information regarding the Keysight Vee Pro 8.0

Connectivity solution: 10833A GPIB-to-GPIB cable (1 m)

The 10833A cable is used to link the GPIB-based instruments. Its robust design allows flexibility and scalability without compromising performance.

The 10833A cable is highly durable and enables seamless connectivity for instrument access, control and data exchange. It is scalable for up to 14 instruments.

82357B USB/GPIB interface

The 82357B allows direct connection from the USB port on your laptop/PC to your GPIB instruments. By having the USB/GPIB interface, there are no switches to set, no PC cards to install, and no external power supplies are required.

The 82357B features an outstanding read performance – transfer rate over 1.15MB/s. The plug-and-play USB interface allows you to make your connections without any effort.

Nowadays, the USB offers bandwidths of up to 12 Mbits/s for USB 1.1 and 480 Mbits/s for USB 2.0. Even though the Keysight 82357B USB/GPIB interface runs at USB 2.0, it is also backward compatible with USB 1.1. This is because the 82357B USB/GPIB interface uses a thin, flexible and high quality cable that is USB 1.1 and 2.0 compliant. In addition, to ensure a durable connection and reliable data transfer, the cable is shielded and specified to 1,500 insertions.

# Modes of Operation

## Mode 1:

Temperature monitoring by comparing a precision input temperature sensor and a reference temperature sensor. The 8-bit ADC data of the input temperature is displayed in an 8-bit LED display. If the input temperature is higher than the reference temperature, the buzzer will be triggered.

## Mode 2:

Temperature monitoring simulation using a potentiometer and a reference temperature sensor. The 8-bit ADC data of the potentiometer is displayed in an 8-bit LED display. The potentiometer is adjustable from 0 V to 5 V, which acts as an input to be compared with the reference temperature. If the input voltage is higher than the ADC voltage of the reference temperature, the buzzer will be triggered.

## Mode 3:

Generating an incremental counter signal, a slow varying sawtooth signal with approximately 0.8 Hz to 48 Hz (adjustable using a potentiometer). The Digital-to-Analog Converter (DAC) yields an output voltage of 256 levels between 0 V to 4.98 V, see Figure 1.

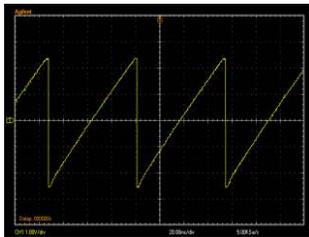


Figure 1 An Incremental Counter Signal

## Mode 4:

Generating a 5 V triangular wave with approximately 0.4 Hz to 48 Hz (adjustable using potentiometer), see Figure 2.

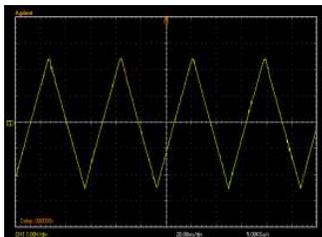


Figure 2 A 5V Triangular Wave

## Mode 5:

Generating a 1.6 V square wave with approximately 52 Hz to 7 kHz (adjustable using a potentiometer), see Figure 3.

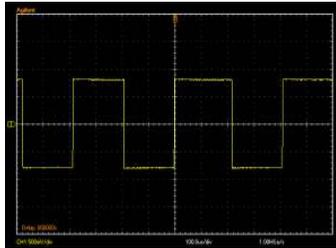


Figure 3 A 1.6 V Square Wave Signal

## Mode 6:

Generating a 5 V irregular pulse wave with period of approximately 0.4 Hz to 48 Hz and a total width of 2.6 ms to 300 ms (adjustable using a potentiometer), see Figure 4.

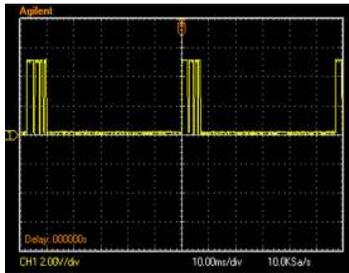


Figure 4 A 5 V Irregular Pulse Signal

## Mode 7:

Generating a 5 V sinusoidal wave with approximately 0.4 Hz to 48 Hz (adjustable using a potentiometer), see Figure 5.

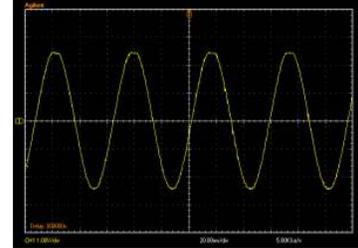


Figure 5 A 5V Sinusoidal Signal

## Mode 8:

Generating a mixed sinusoidal signal with digital noise, see Figure 6. The maximum achievable frequencies are approximately 4.2 kHz and 6.2 kHz. The digital noise can be filtered using digital scope filtering.

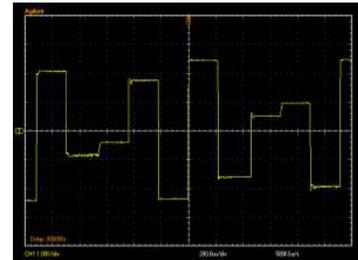


Figure 6 Mixed Sinusoidal Signal with Digital Noise

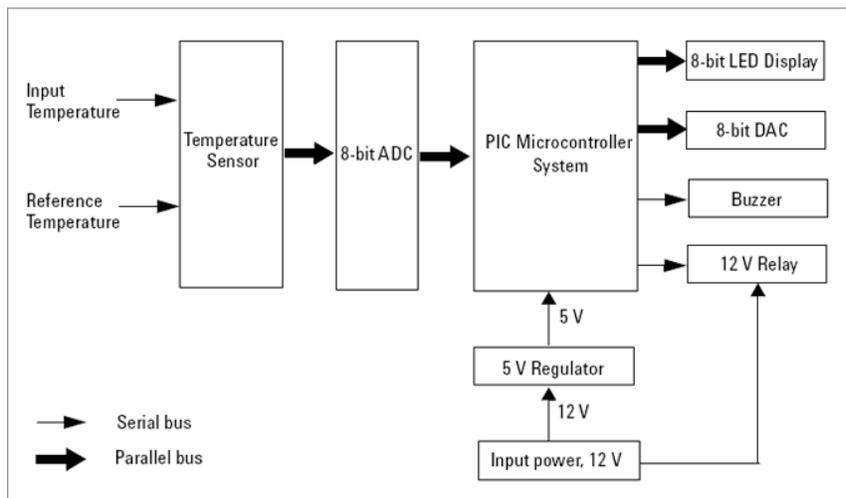


Figure 7 Block Diagram of U3000A Electronic Instrumentation Training Kit

## Teaching Modules

### Power supply teaching material coverage

- Power supply design overview
- Advantages and disadvantages of linear power supplies and switching power supplies
- Operating principle of DC-DC converters
- Methods of power supply protection
- Basic principle of linear power supply — operating modes, unwanted signals, unregulated states, remote programming
- Practical tips to optimize power supply capability for different applications

### Digital multimeter teaching material coverage

- Basic functions of digital multimeter
- Operating principles of the basic functions
- Measurement errors overview
- Advanced functions that simplify common measurement tasks
- Circuit fault finding with digital multimeter

### Digital oscilloscope teaching material coverage

- Basic functions of digital oscilloscope
- Types of oscilloscopes
- Digital oscilloscope parameters overview
- Performing measurements with digital oscilloscopes
- Tips for selecting your ideal digital oscilloscope

### Function generator teaching material coverage

- Operating principles of the function generator
- Comparison of function generator and arbitrary waveform generator
- Function generator design and operating principles
- Applications of the function generator

### Keysight VEE Pro 8.0 teaching material coverage

- Graphical programming language for test and measurement applications
- Basic VEE objects that control data flow, display or process data
- Control instruments from a PC
- Automate repetitive and iterative measurement tests
- Send measurement data to a log file

## Lab Exercises

### Power supply lab exercises

- Rated voltage and current settings check
- Voltage and current measurement in Constant Voltage (CV) and Constant Current (CC) modes
- Waveform analysis with power supply to training board

### Digital multimeter lab exercises

- Voltage and current measurements
- Resistance, capacitance, frequency, and diode measurements

### Digital oscilloscope lab exercises

- Waveform measurements
- Digital noise filtering

### Function generator lab exercises

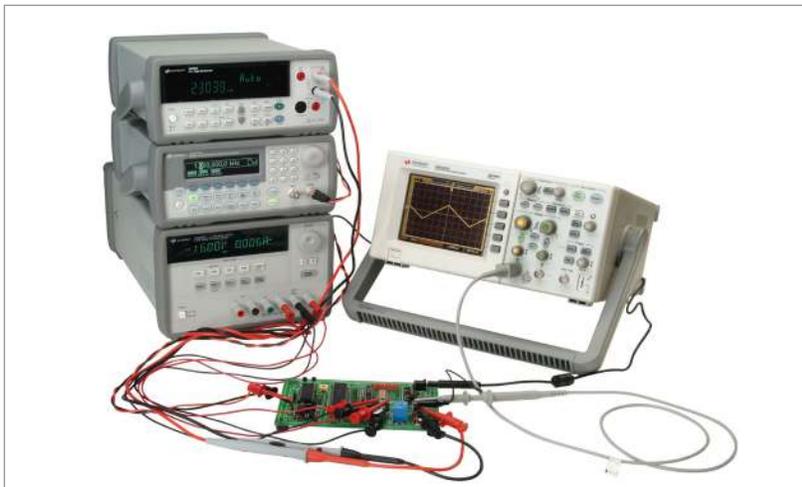
- Modulated waveform generation
- Waveform generation to training board
- Frequency sweep generation

### Automated lab exercises using Keysight VEE Pro 8.0

- Utilized a GUI developed in Keysight VEE Pro to control the instruments (power supply, digital multimeter, digital oscilloscope, and function generator)
- To see what are the SCPI command used in controlling the instruments

### Student lab exercises using Keysight VEE Pro 8.0

- Learn to generate virtual waveform and view it using the Waveform (Time) and Spectrum Magnitude objects
- Learn to upload an arbitrary waveform to a function generator



## General Specifications

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### POWER SUPPLY

Line voltage range 50/60 Hz, 100 VAC to 240 VAC

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### POWER ADAPTER

Output voltage 12 VDC

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### OPERATING ENVIRONMENT

Operating temperature at 0 °C to 40 °C  
Up to 95% RH at 40 °C (non-condensing)  
Altitude up to 2000 meters

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### STORAGE COMPLIANCE

-40 °C to 70 °C

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### SAFETY

Certified to IEC61010-1:2001/EN61010-1:2001  
Pollution degree 2  
This product is rated for indoor use only.

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### EMC

IEC 61326:2002/EN61326:1997+A1:1998+A2:2001+A3:2003

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### DIMENSIONS (HxWxD)

26 mm x 172 mm x 118 mm

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### WEIGHT

0.12 kg

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### WARRANTY

3 months

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Accessories included:

- Mini grabbers/banana jacks
- Power cord
- AC power adaptor
- U3000A Quick Start Guide
- Product Reference CD-ROM

**Experience the new Keysight U3000A  
electronic instrumentation training kit.**

**Learn more about the training kit from  
the U3000A homepage at  
[www.keysight.com/find/educationkit](http://www.keysight.com/find/educationkit).**



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