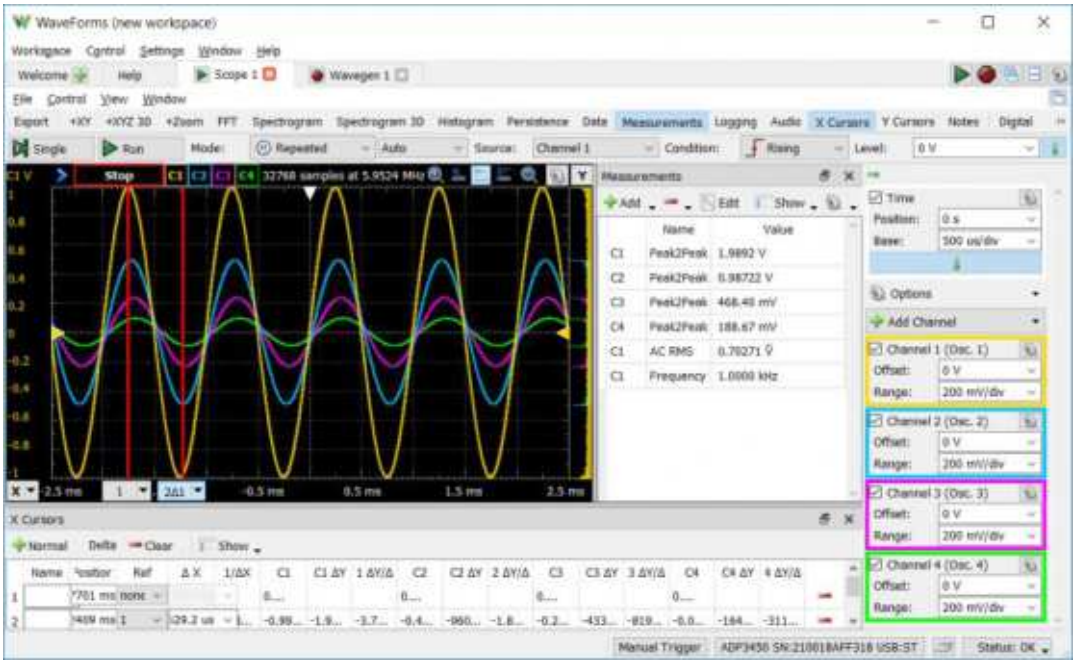
DIGILENT
A National Instruments Company

Analog Discovery Pro (ADP3450/ADP3250) Reference Manual



Oscilloscope



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' Oscilloscope instrument to capture analog data via the 4 analog input ("Scope") channels using BNC probes.

Since the Analog Discovery Pro's analog input channels are shared, the Oscilloscope instrument cannot be used at the same time as the Voltmeter, Data Logger, Spectrum Analyzer, Network Analyzer, or Impedance Analyzer instruments.

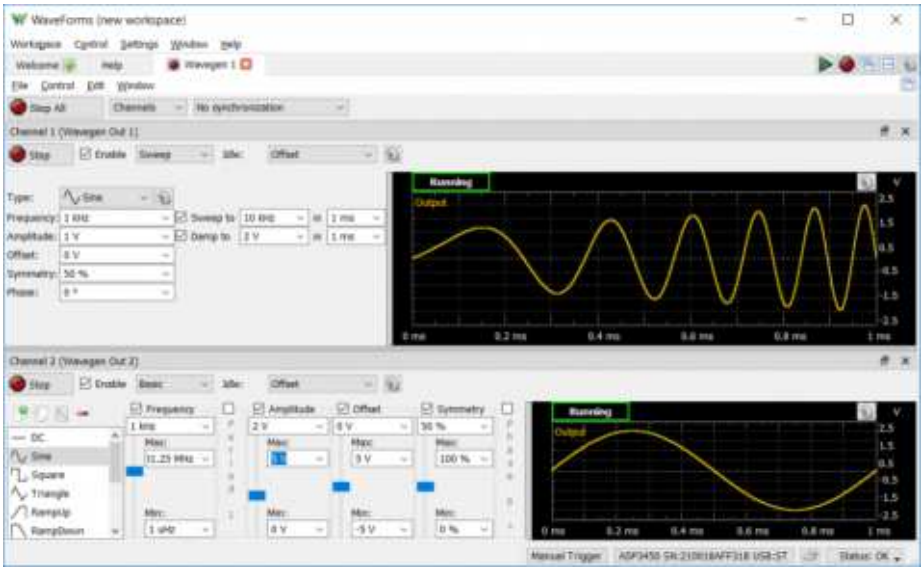
For more information on the analog input ("Scope") channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Oscilloscope instrument, please visit the Using the Oscilloscope guide.

Features

- Triggering: edge, pulse, transition, hysteresis, and many others
- Cross-triggering with Logic Analyzer, Waveform Generator, Pattern Generator, or external trigger
- Sampling modes: average, decimate, min/max
- Mixed signal visualization (analog and digital signals share same view pane)
- Real-time views: FFTs, XY plots, histograms, spectrograms, and others
- Multiple math channels with complex functions
- Cursors with advanced data measurements
- Captured data files can be exported in standard formats
- Scope configurations can be saved, exported, and imported

Important Note: Grounding Circuitry

Waveform Generator



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' Waveform Generator instrument to output analog voltage waves via BNC cables. The Waveform Generator converts 14-bit digital samples to analog at a rate of up to 100 MS/s on each of the two channels. When the Waveform Generator instrument is used, the Analog Discovery Pro's analog output channels act as an Arbitrary Waveform Generator. The instrument supports everything from simple waveforms like Sine and Triangle waves, up to more complicated functions like AM and FM modulation. Custom sets of samples can be defined by the user in applications like Excel and imported to WaveForms.

Each waveform generator channel is considered a single ended pin, however, a connected circuit must share a ground with the Analog Discovery Pro. Each channel has a bandwidth of >15MHz through the BNC connectors. AC amplitudes of +-5V and DC offsets of +-5V are supported.

Since the Analog Discovery Pro's analog output channels are shared, the Waveform Generator instrument cannot be used at the same time as the Network Analyzer, or Impedance Analyzer instruments.

For more information on the analog output (“Wavegen”) channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Waveform Generator instrument, please visit the Using the Waveform Generator guide.

Features

- Standard waveforms: sine, triangle, sawtooth, noise, and many others
- Advanced waveforms: Sweeps, AM, FM
- User-defined arbitrary waveforms: defined within WaveForms software user interface or using standard tools (e.g. Excel)

Power Supplies



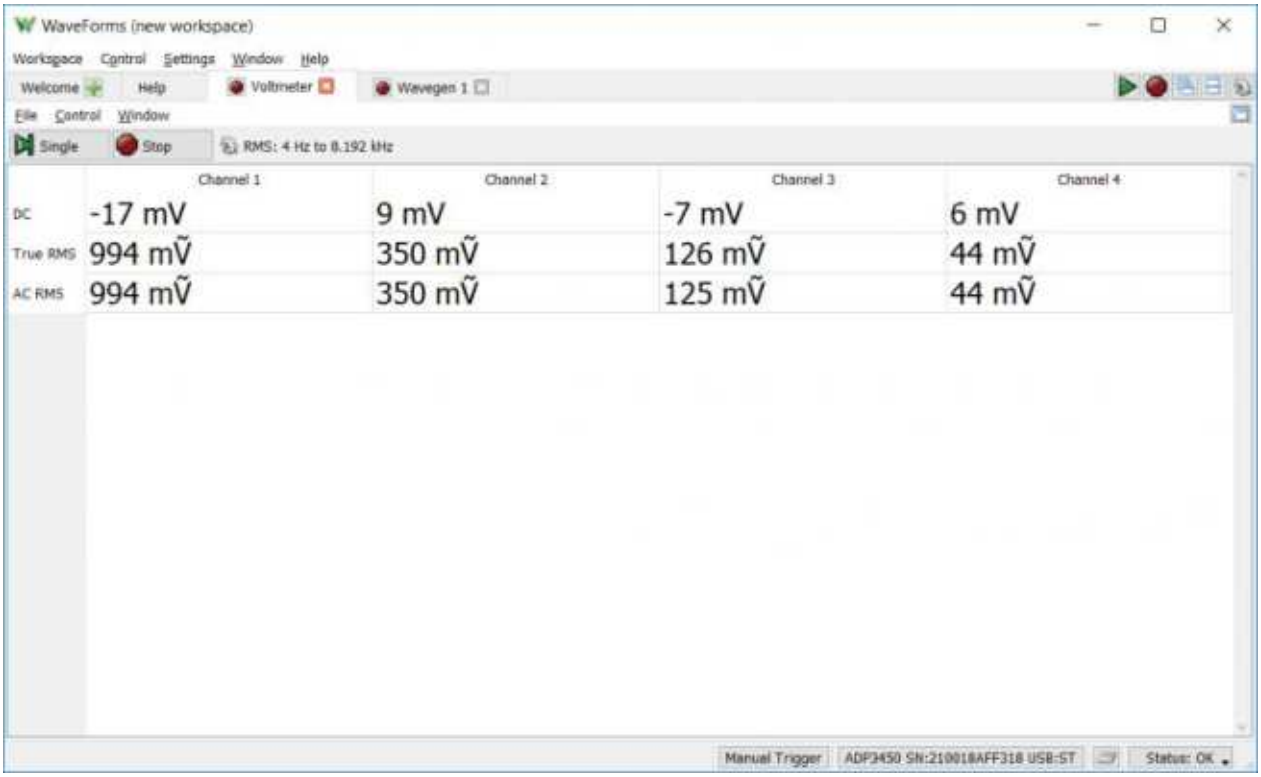
The Analog Discovery Pro (ADP3450/ADP3250) has one programmable Digital Voltage Supply, which can supply between 1.2V and 3.3V, through the Power Supplies (“Supplies”) instrument. The Digital I/O Pulls are also configured through the Power Supply instrument, where each digital I/O channel can be individually set to Up, Float or Down.

For more information on using the programmable power supplies, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Power Supplies instrument, please visit the Using the Power Supplies guide.

Features

- Programmable power supply (1.2V…3.3V)
- Up to 300mA output current

Voltmeter



The Analog Discovery Pro (ADP3450/ADP3250)'s analog inputs can be used with WaveForms' Voltmeter instrument to act as a simple 4 channel voltmeter. DC voltages, AC RMS voltages, and True RMS voltages can be viewed for each Scope channel.

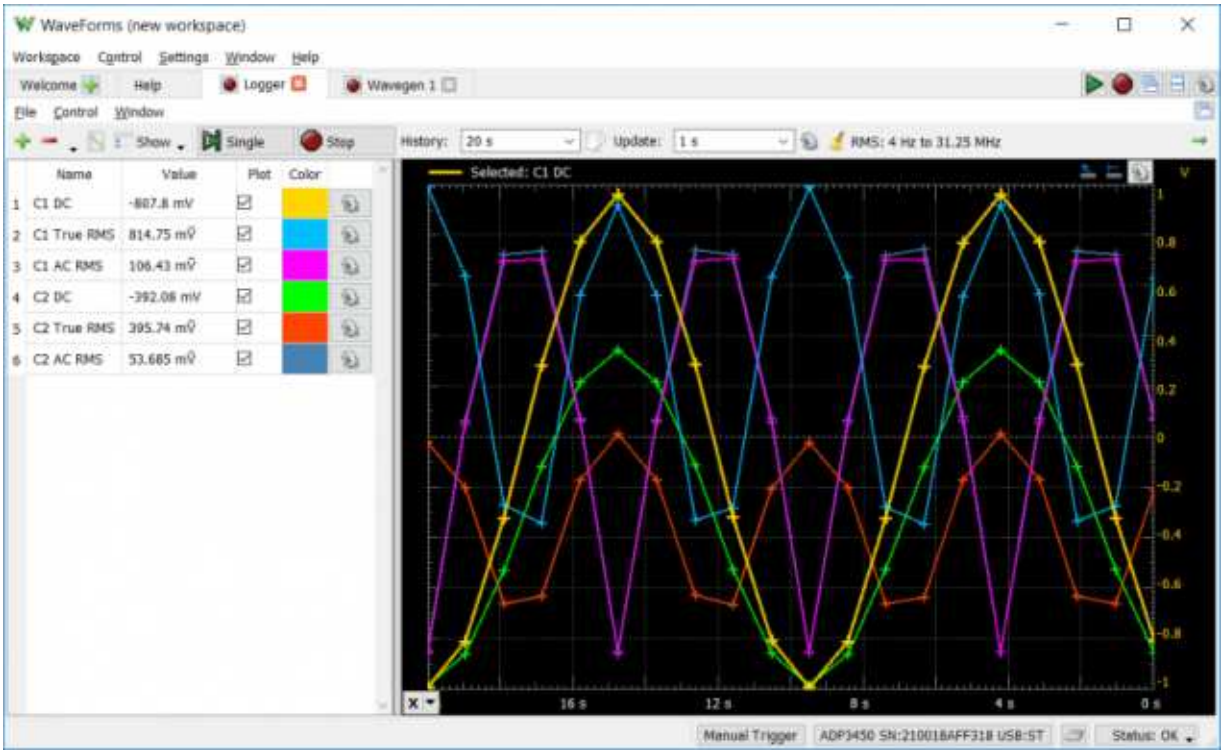
Since the Analog Discovery Pro's analog input channels are shared, the Voltmeter instrument cannot be used at the same time as the Oscilloscope, Data Logger, Spectrum Analyzer, Network Analyzer, or Impedance Analyzer instruments.

For more information on the analog input (“Scope”) channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Voltmeter instrument, please visit the Using the Voltmeter guide.

Features

- Measurements: DC, AC RMS, True RMS

Data Logger



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' “Logger” instrument in order to capture large buffers of analog input data on the 4 Scope channels.

The Data Logger can capture buffers of data at update rates of up to 10 samples per second. The maximum duration of a log is dependent on the update rate, but at the extreme, can run for over a thousand hours.

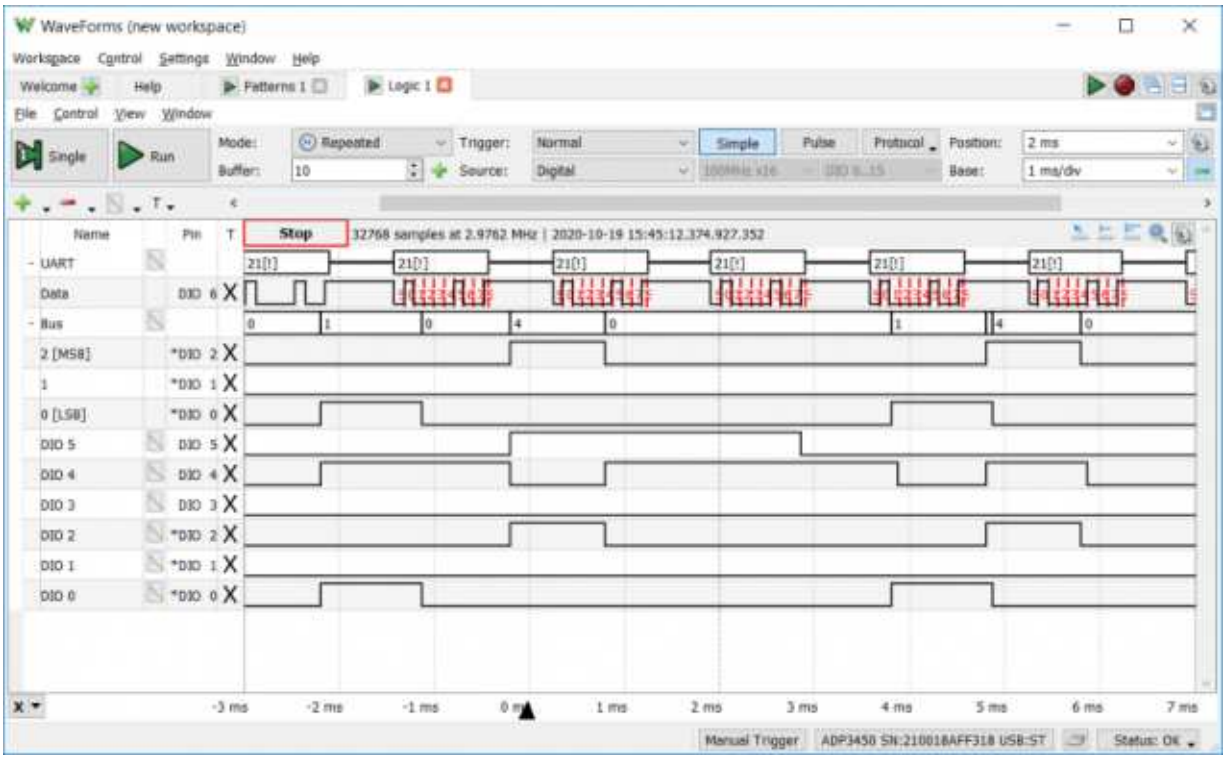
Since the Analog Discovery Pro's analog input channels are shared, the Data Logger instrument cannot be used at the same time as the Oscilloscope, Voltmeter, Spectrum Analyzer, Network Analyzer, or Impedance Analyzer instruments.

For more information on the analog input (“Scope”) channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Data Logger instrument, please visit the Using the Data Logger guide.

Features

- Measurements: DC, AC RMS, True RMS, with Averages, Minimums, and Maximums
- Up to 24 hours of data logged at a 1Hz sample rate
- Scriptable conversion functions

Logic Analyzer



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' “Logic” instrument to act as a Logic Analyzer. When used this way, the 16 digital input/output channels are configured to capture high/low logic states on connected pins at a sample rate of up to 125 MS/s. These channels are capable of interfacing with 3.3V and 1.2V logic signals, and when configured as inputs are tolerant of voltages of up to 5V.

Individual input/output channels can be grouped as buses and protocols. Protocol groups can be used to view the decoded contents of packets of many common communications protocols, including SPI, I2C, UART, CAN, and I2S.

Signal states, decoded bus values, and decoded protocols can be used to trigger a Logic Analyzer capture. Protocol triggers include protocol-specific events, like start of transmission, end of transmission, or packet contents matching a value.

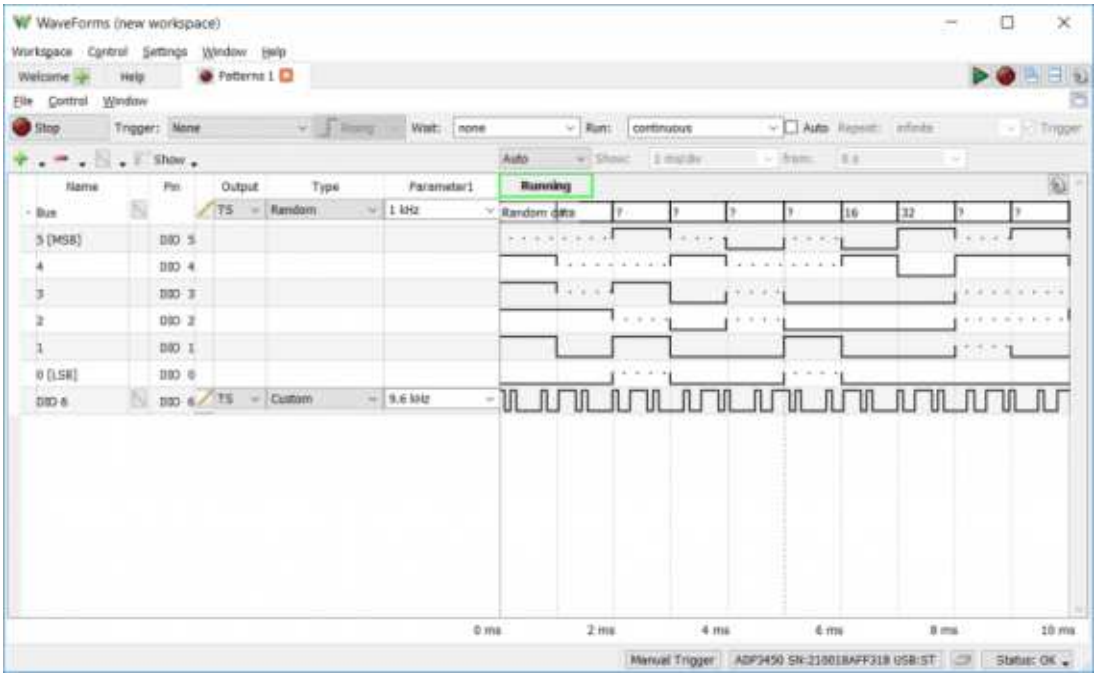
Digital input/output channels used by the Logic Analyzer instrument can still be used by other instruments using the same digital input/output channels.

For more information on the digital input/output channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Logic Analyzer instrument, please visit the Using the Logic Analyzer guide.

Features

- Multiple trigger options including pin change, bus pattern, and many others
- Cross-triggering between Analog input channels, Logic Analyzer, Pattern Generator, or external trigger
- Interpreter for SPI, I2C, UART, CAN, I2S, 1-Wire, parallel buses
- Scripted custom protocols
- Data file import/export using standard formats

Pattern Generator



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' “Patterns” instrument to generate logic signal sequences on the digital input/output pins. Each channel can be configured to be push/pull, open drain, open source, or three-state logic and set to generate Clock, pulse, random or custom patterns.

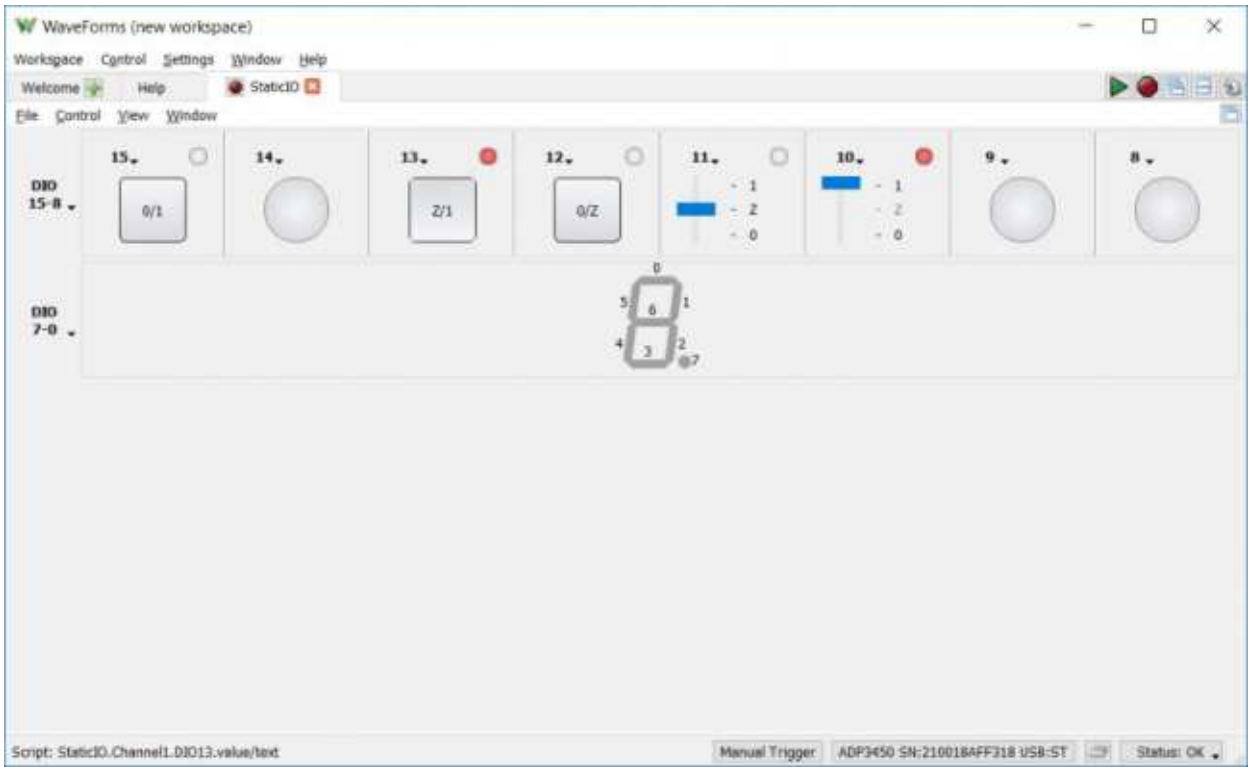
Digital input/output channels used by the Pattern Generator instrument can still be used by other instruments using the same digital input/output channels, however, other instruments can only use these shared channels as inputs.

For more information on the digital input/output channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Pattern Generator instrument, please visit the Using the Pattern Generator guide.

Features

- Customized visualization for signals and buses
- User defined patterns: Truth-table based ROM logic
- Data file import/export using standard formats

Static I/O



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' Static I/O instrument to emulate a variety of user input/output devices on the digital

input/output pins. Virtual LEDs, buttons, switches, sliders, and displays can be assigned to specific digital I/O pins, and interacted with within the WaveForms user interface.

Important Note: *To prevent damage to the device, care must be taken not to drive input signals to the digital input/output channels over 5V.*

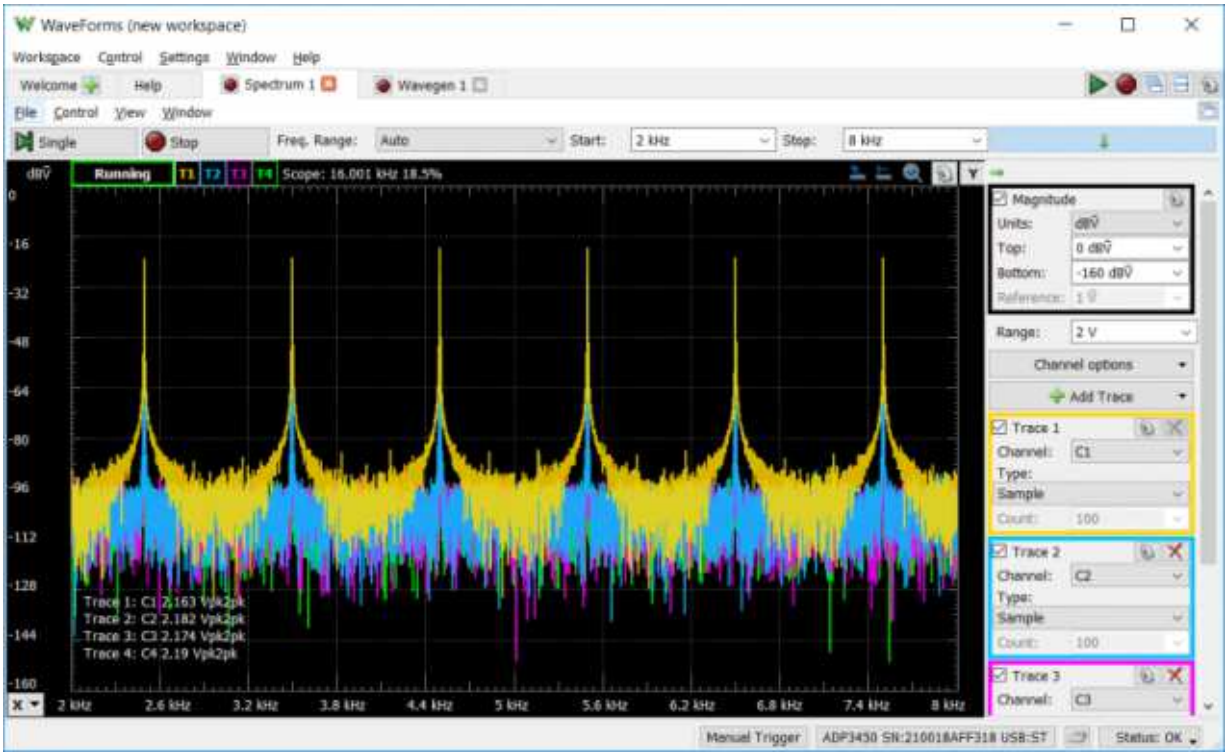
Digital input/output channels used by the Static I/O instrument can still be used by other instruments using the same digital input/output channels, however, other instruments can only use these shared channels as inputs.

For more information on the digital input/output channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Static I/O instrument, please visit the Using the Static I/O guide.

Features

- Virtual I/O devices (LEDs, buttons, switches & displays)
- Customized visualization options available

Spectrum Analyzer



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' “Spectrum” instrument to view the power of frequency-domain components of analog signals captured on the analog input channels.

Signals with minimum/maximum frequencies between 0 Hz and 50Mhz can be plotted in units of peak voltage, RMS voltage, and various voltage level ratio units.

Since the Spectrum Analyzer instrument uses the same hardware resources as the Oscilloscope, Network Analyzer, and Impedance Analyzer instruments, it cannot be used at the same time as these other instruments.

Since the Analog Discovery Pro's analog input channels are shared, the Oscilloscope instrument cannot be used at the same time as the Oscilloscope, Voltmeter, Data Logger, Network Analyzer, or Impedance Analyzer instruments.

For more information on the analog input channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Spectrum Analyzer instrument, please visit the Using the Spectrum Analyzer guide.

Features

- Power spectrum algorithms: FFT, CZT
- Frequency range modes: center/span, start/stop
- Frequency scales: linear, logarithmic
- Vertical axis options: voltage-peak, voltage-RMS, dBV, and dBu
- Windowing: options: rectangular, triangular, hamming, cosine, and many others
- Cursors and automatic measurements: noise floor, SFDR, SNR, THD and many others
- Data file import/export using standard formats

Network Analyzer



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' “Network” instrument to view the amplitude and phase response of a circuit under test. Nichols and Nyquist plots can also be viewed with this instrument.

Frequency sweeps can be performed in ranges between 1 mHz and 10 MHz with up to 10k samples per decade. The wave used for the sweep can be customized, and uses the same resources as the Waveform Generator instrument.

The Network Analyzer instrument uses the analog output and analog input channels of the Analog Discovery Pro (ADP3450/ADP3250) to probe a test circuit. The Network Analyzer can be configured to use an external signal to provide input to the circuit under test, rather than using the analog output channels.

Since the Analog Discovery Pro's analog input and output channels are shared, the Network Analyzer instrument cannot be used at the same time as the Oscilloscope, Waveform Generator, Voltmeter, Data Logger, Spectrum Analyzer, or Impedance Analyzer instruments.

For more information on the analog output and analog input channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Network Analyzer instrument, please visit the Using the Network Analyzer guide.

Features

- Available diagrams: Bode, Nichols, Nyquist, and FFTs
- Settable input amplitude and offset
- Analog input records response at each frequency

Impedance Analyzer



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' “Impedance” instrument to view a wide variety of frequency response characteristics of a circuit under test. Input, Phase, Voltage, Current, Impedance, Admittance, Inductance, Factor, and Nyquist plots are all available. In addition, Custom plots can be used to present the results of a wide variety of different mathematical operations on buffered data.

Frequency sweeps can be performed with in ranges between 100 uHz and 25 MHz, with as many as 10k samples per decade. The signal used to perform the sweep can be selected from a variety of preset, with configurable amplitude and offset. An external network analyzer reference circuit can be selected from a variety of options.

The Impedance Analyzer instrument uses the Analog Discovery Pro's analog output channels and analog input channels to probe a test circuit.

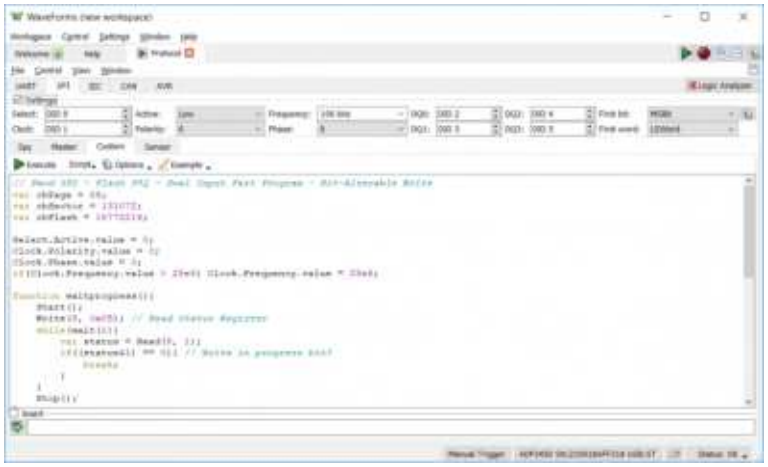
Since the Analog Discovery Pro's analog input and output channels are shared, the Impedance Analyzer instrument cannot be used at the same time as the Oscilloscope, Waveform Generator, Voltmeter, Data Logger, Spectrum Analyzer, or Network Analyzer instruments.

For more information on the analog output and analog input channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Impedance Analyzer instrument, please visit the Using the Impedance Analyzer guide.

Features

- Chart views for Voltage, Current, Impedance, Admittance, Capacitance, and others
- Alternative simple Meter view
- Selectable external compensation circuit
- Data file export using standard formats

Protocol Analyzer



The Analog Discovery Pro (ADP3450/ADP3250) can be used with WaveForms' “Protocol” instrument to work with common communications protocols. UART, SPI, I2C, and CAN transactions can be received, transmitted, and/or spied upon by the Analog Discovery Pro using any of the 16 digital input/output channels at a sample rate of 100 MS/s. AVR microcontrollers can be programmed through the instrument as well.

Custom scripts can be written within the Protocol Analyzer instrument to generate sequences of SPI or I2C transactions.

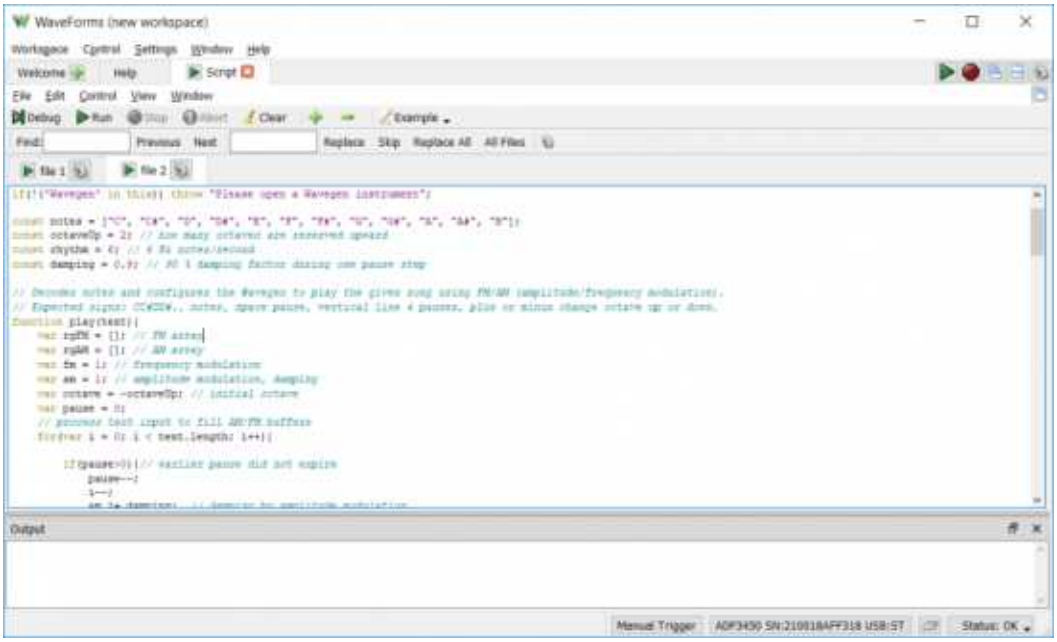
Since it uses the same hardware resources as the Logic Analyzer and Pattern Generator instruments, the Protocol Analyzer cannot be used at the same time as these instruments.

For more information on the digital input/output channels, please visit the Analog Discovery Pro (ADP3450/ADP3250) Specifications. For a walkthrough of the different features of WaveForms' Protocol Analyzer instrument, please visit the Using the Protocol Analyzer guide.

Features

- Supports UART, SPI, I2C, and CAN protocols
- Program AVR microcontrollers
- Scriptable transaction sequences for SPI and I2C
- Configurable data rates, modes, and others
- Send/receive directly from/to data files

WaveForms Script Editor



Each of WaveForms' instruments can be controlled through scripts within the WaveForms application itself. WaveForms' “Script” instrument allows the user to write and run JavaScript code that can control the rest of the application through an extensive API. This allows the user to configure and run many instruments at the same time, in an easily repeatable way.

A variety of code examples are available in the application to aid in learning to write WaveForms scripts. Additional resources for writing scripts can be found on the Scopes and Instruments section of the Digilent Forum.

A plot pane within the Script instrument itself can be used to integrate data from many different instruments, and display it in a highly customizable way.

For a walkthrough of the different features of WaveForms' Script instrument, please visit the Using Scripts guide.

Features

- Available within the WaveForms application
- Simultaneous control of all instruments through JavaScript
- Automatable GUI actions
- Custom data analysis and manipulation functions

Operation Modes

The Analog Discovery Pro has multiple modes to provide alternative ways to interact with and use the instrumentation device.

Standard mode allows for communication over USB or Ethernet. Standard mode provides slightly a faster transfer rates than Linux mode.

Linux mode, accessible through a serial terminal, provides standalone operation of the ADP3450/ADP3250 and allows the use of the four USB host ports on the back panel of the Analog Discovery Pro. Linux mode supports communication between the device and the host computer over USB, Ethernet, and Wifi and also allows for internet access.

In Linux mode, the 4 USB ports on the back of the device are enabled and can be used to connect different peripherals including WiFi dongles. Any of the USB host ports can host a flash drive that contains a new or updated Linux image. Instructions on updating to the latest Digilent provided images can be found here.

Supported WiFi dongles can also be used in Linux mode. The supported WiFi chipsets are listed in the ADP3450/ADP3250 Specifications.

WaveForms Software Development Kit (SDK)

WaveForms SDK is a set of software libraries and examples that can be used to develop custom applications that can control Digilent Test and Measurement devices. Supported languages include C, C++, C#, Visual Basic, and Python. Third-party toolkits are available for LabVIEW and MATLAB. Instructions for using WaveForms with LabVIEW are available through our guide Getting Started with LabVIEW and a Test and Measurement Device. More information about WaveForms SDK can be found through the WaveForms SDK Resource Center.

Features

- Downloaded via the WaveForms installer, used independently of the WaveForms application
- Languages supported: C/C++, C#, MATLAB, Python, Visual Basic
- Provides control of hardware channels and virtual instruments to custom applications



