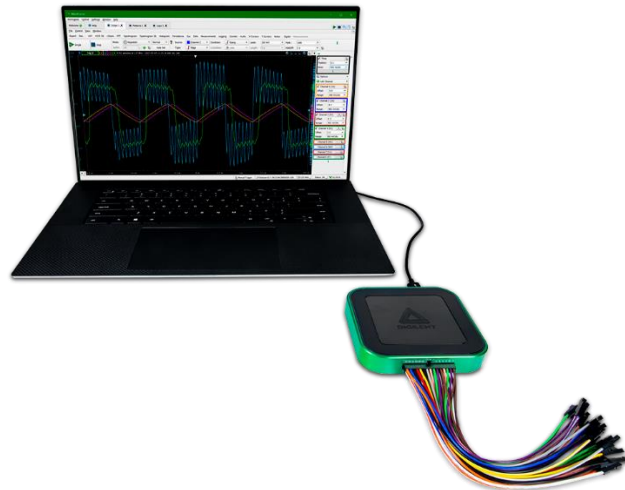# Analog Discovery 3 Datasheet

125 MS/s USB Oscilloscope, Waveform Generator, Logic Analyzer, and Variable Power Supply

Highlighted Features

- Two differential 14-bit oscilloscope channels with 9 MHz bandwidth
- Two 14-bit arbitrary waveform generator channels
- 16 digital I/O channels for MSO and pattern generation functionality
- Variable 0.5 to 5 V and -0.5 to -5 V power supplies
- Modern USB-C connector for power and data connection to a host PC
- Comprehensive software support through the WaveForms application and SDK
- Ecosystem of adapters for a broad array of experiments

Overview

The Digilent Analog Discovery 3, featuring Texas Instruments™ components, is a multi-function test and measurement device that allows users to measure, visualize, generate, record, and control mixed signal circuits of all kinds. The low-cost Analog Discovery 3 is small enough to fit in your pocket, but powerful enough to replace a stack of lab equipment, providing engineering students, hobbyists, and electronics enthusiasts the freedom to work with analog and digital circuits in virtually any environment, in or out of the lab.

Building off of Digilent's Analog Discovery product line, including the wildly popular Analog Discovery 2, the AD3 features a higher sample rate and bandwidth, USB C connectivity, and larger sample buffers, while maintaining backwards compatibility with existing projects and coursework.

1   Features

Analog Inputs

- Two differential input channels with 14-bit resolution and ±25 V input range
- Up to 125 MS/s per channel, 9 MHz bandwidth increased to 30+ MHz with BNC adapter

Analog Output

- Two output channels with 14-bit resolution, ±5 V output range
- Up to 125 MS/s per channel, 9 MHz bandwidth increased to 12 MHz with BNC adapter

Digital I/O

- 16 dynamically configurable digital input/output channels
- 3.3 V CMOS
- Up to 125 MS/s per channel

Power Supplies

- Two programmable power supplies, V+ and V-: 0.5 V to 5 V and -0.5 V to -5 V
- Up to 800 mA per channel when used with an external power supply

Additional Features

- Configurable input filters and internal AWG to scope loopback paths
- Additional software instruments including Spectrum, Network, Impedance, and Protocol Analyzers
- Complex software views like FFTs, spectrograms, fully customizable math channels, lock-in amplifier channels, eye diagrams, XY-plot views, and more
- Data logging, voltmeter display, and in-app scripting

Software Support

- WaveForms, Digilent's free software application for Windows, Mac, and Linux
- WaveForms SDK for custom applications and scripting through C/C++, Python, C#, Visual Basic
- Digilent WaveForms VIs for NI LabVIEW

Connectors

2x15 MTE Connector for External Signals
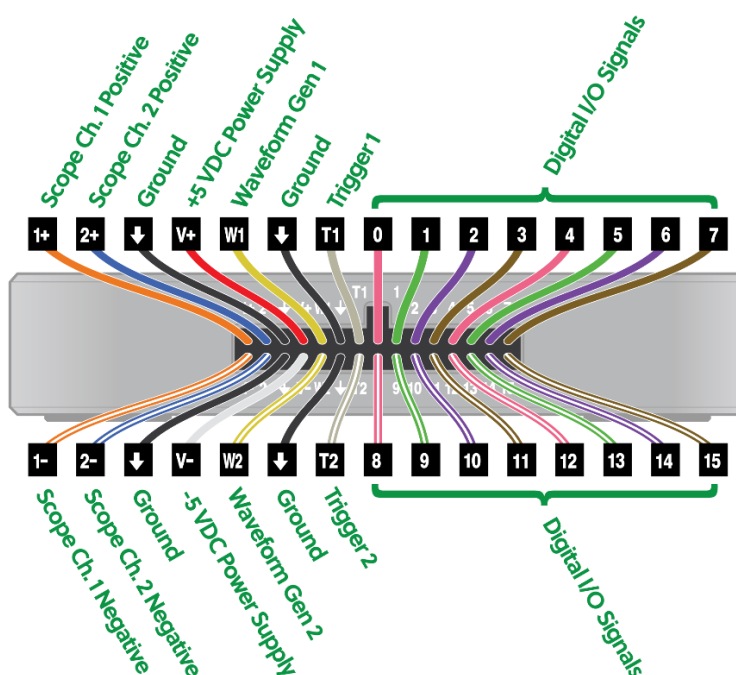
USB-C and Auxiliary Power Supply

The Analog Discovery 3 can be powered over USB and does not require an auxiliary power supply for most functions.

2   WaveForms Software

Digilent's free WaveForms software offers a unified device experience across all our Test and Measurement devices, enabling use of all hardware features and instruments. It features a friendly user interface that has the feel of traditional benchtop devices. WaveForms makes it easy to acquire, visualize, store, analyze, produce, and reuse both analog and digital signals simultaneously.

For even more customization potential, the free WaveForms Software Development Kit (SDK) can be used to create custom applications and scripts to control the T&M device in Python, C, and additional languages.

WaveForms is Windows, Mac, and Linux compatible.

2.1   Oscilloscope

The Oscilloscope instrument captures analog input data via the analog input scope channels. When this instrument is used, the Analog Discovery 3's analog input channels act as a two channel, 14-bit, 125 MS/s oscilloscope. Multiple sample and triggering modes are supported.
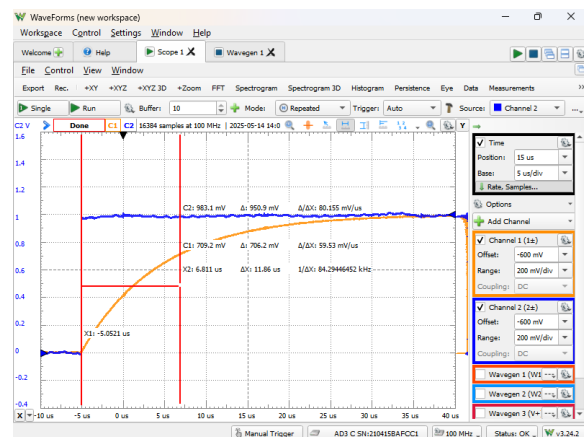

2.2   Waveform Generator

The Waveform Generator instrument can output analog voltage waveforms. 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.
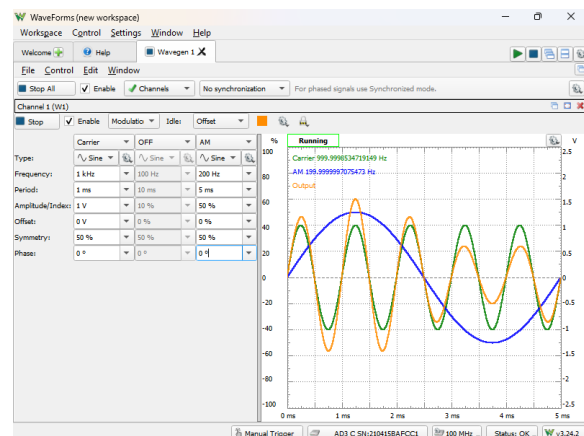

2.3   Power Supplies

The Analog Discovery Studio Max has two variable power supply rails that can be used to power your circuits. These rails can be set to voltage levels between 0.5 V to 5 V and -0.5 V to -5 V.
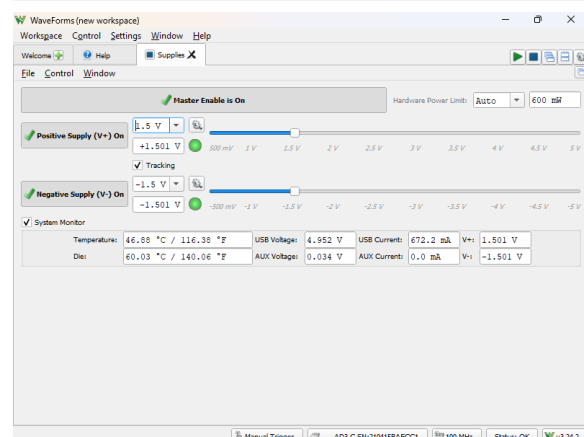
2.4   Voltmeter

The Analog Discovery 3's two oscilloscope channels can be used with WaveForms' Voltmeter instrument to act as a simple voltmeter. DC voltages, AC RMS voltages, and True RMS voltages can be viewed for each channel.
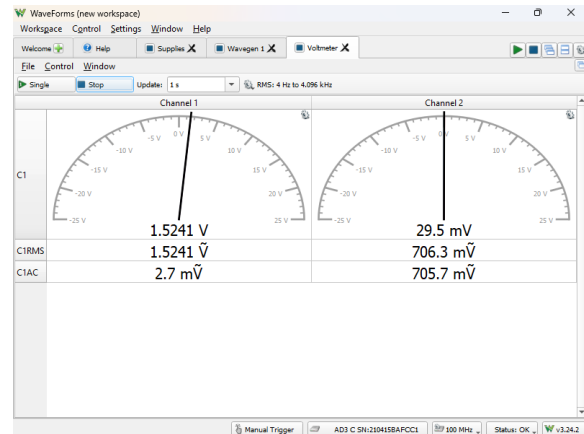
2.5   Data Logger

The Data Logger instrument can capture large buffers of analog input data on the Scope pins. The Data Logger can capture buffers of data at update rates of up to 1000 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.
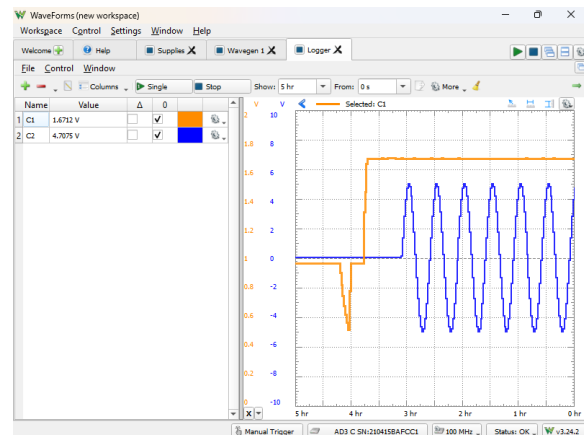
2.6   Logic Analyzer

With the Logic Analyzer, the 16 digital input/output channels are configured to capture high/low logic states. These 3.3 V channels are tolerant to voltages of up to 5 V.

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 user-specified value.
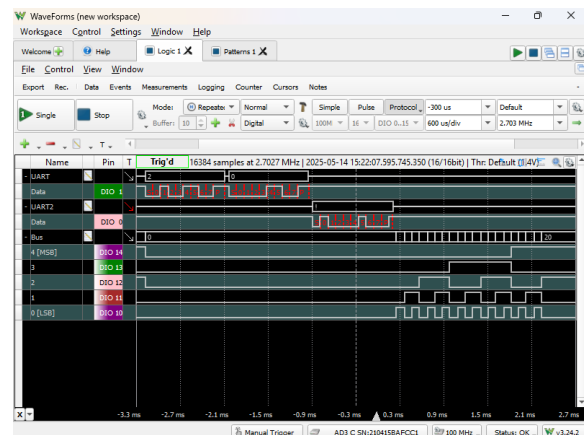
2.7   Pattern Generator

The Pattern Generator can generate logic signal sequences on the digital input/output pins. The pins can be configured to be push/pull, open drain, open source, or three-state logic.
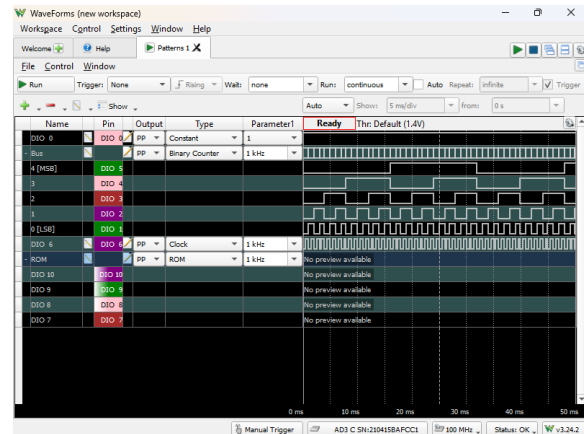
Various patterns can be generated, including clocks, random signals, multiple counter types, and fully custom digital data. ROM logic can map digital input pins to digital outputs, using user-defined truth tables.

2.8   Static I/O

The Static I/O instrument can 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.
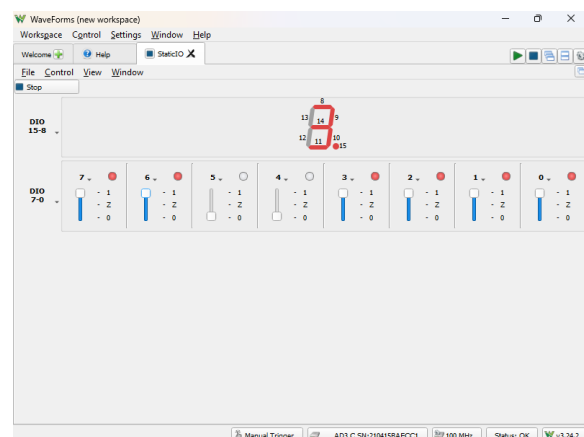
2.9   Spectrum Analyzer

The Spectrum Analyzer instrument is used to view the power of frequency-domain components of analog signals captured on the analog input channels. Cursors and automatic measurements include noise floor, SFDR, SNR, THD and more.
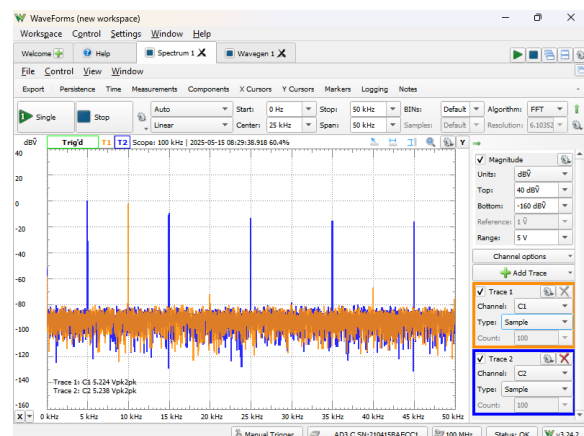
2.10   Network Analyzer

The Network Analyzer instrument can be used to view the amplitude and phase response of a circuit under test. Bode, Nichols, and Nyquist plots can also be viewed with this instrument. The Network Analyzer instrument uses the analog output and analog input channels of the Analog Discovery Studio Max to probe a test circuit, by generating a frequency sweep and measuring the circuit's response. 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.
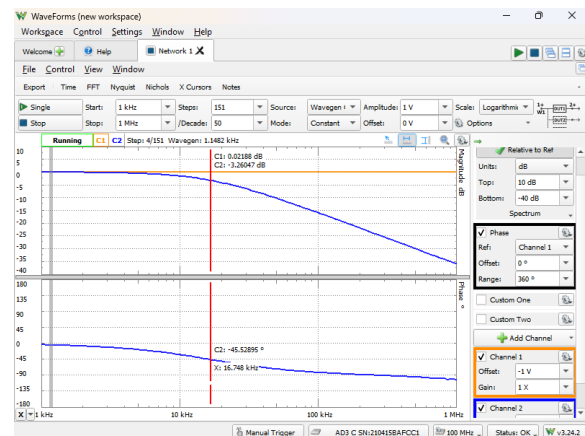
2.11   Impedance Analyzer

The Impedance Analyzer instrument is used 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.
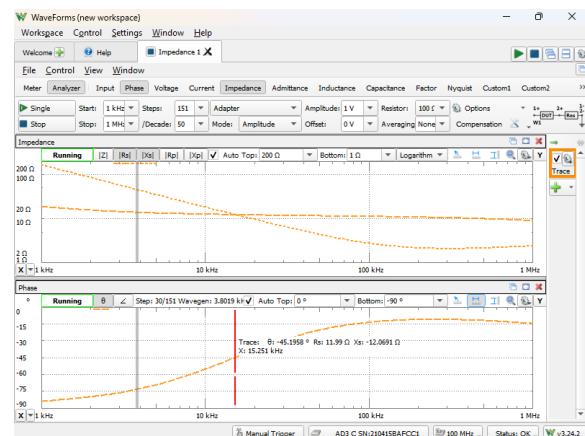
2.12 Tracer

The Tracer instrument analyzes the characteristics of discrete semiconductor devices like diodes, NPN and PNP transistors, and both P-Type and N-Type FETs.
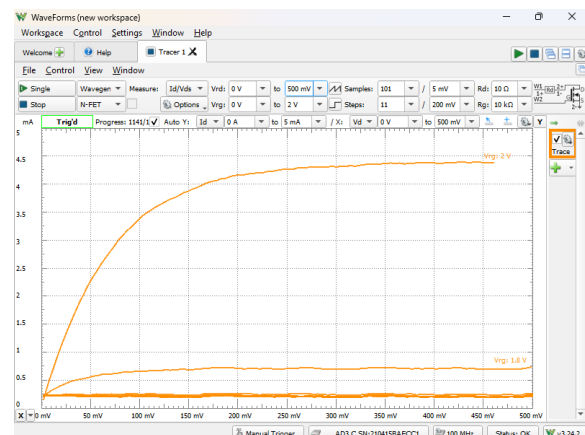
2.13 Protocol Analyzer

The Protocol Analyzer instrument generates and analyzes common communications protocols. UART, SPI, I2C, CAN, and various other kinds of transactions can be received, transmitted, and/or spied upon (depending on the protocol) by the Analog Discovery 3 using any of the digital input/output channels. Custom scripts can be written within the Protocol Analyzer instrument to generate sequences of SPI or I2C transactions.
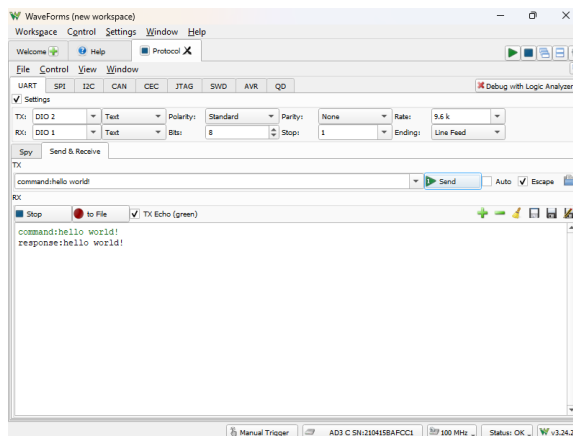
2.14 WaveForms Script Editor

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.
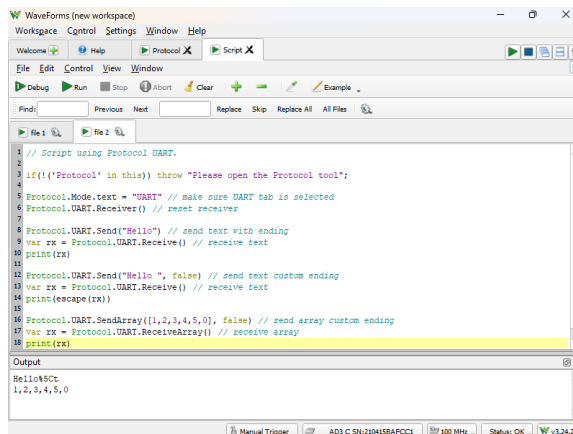
3   Extended Software Support

The LabVIEW WaveForms Toolkit is a powerful add-on to the LabVIEW software, combining the data acquisition capabilities of the Analog Discovery 3 with LabVIEW's extensive analysis functionality in an intuitive way. This leverages the strengths of both systems to create a curated experience for users wanting to merge the best of both worlds and enable engineering education to reach unprecedented heights. Further customization and control of the Analog Discovery 3 can be done through Digilent's WaveForms SDK, letting users create their own applications in C/C++, Python, C#, and Visual Basic.
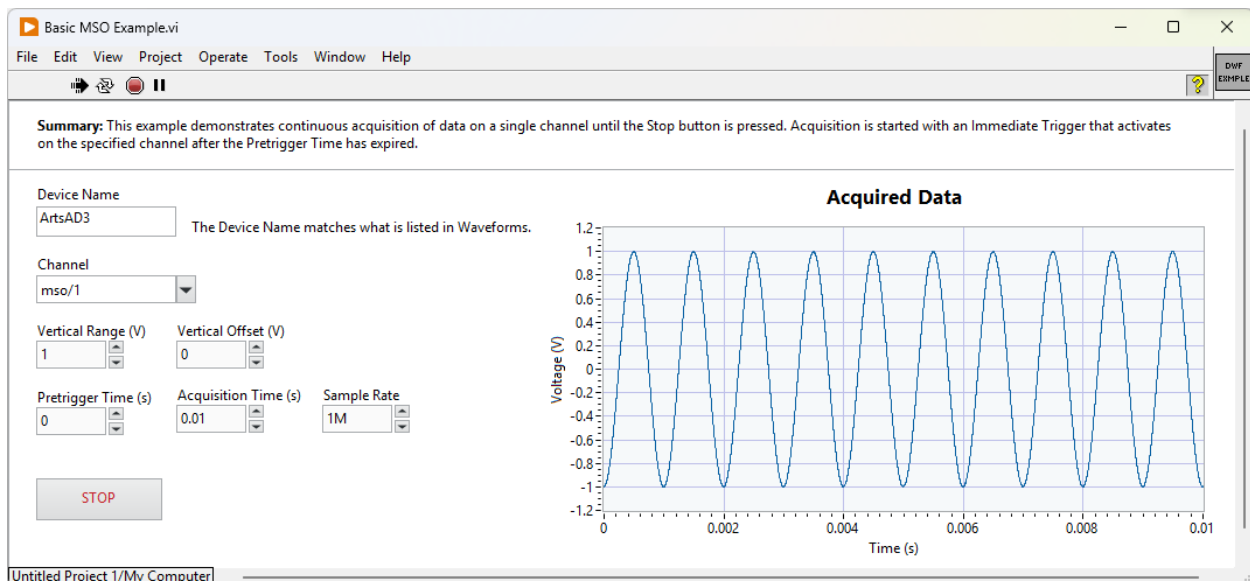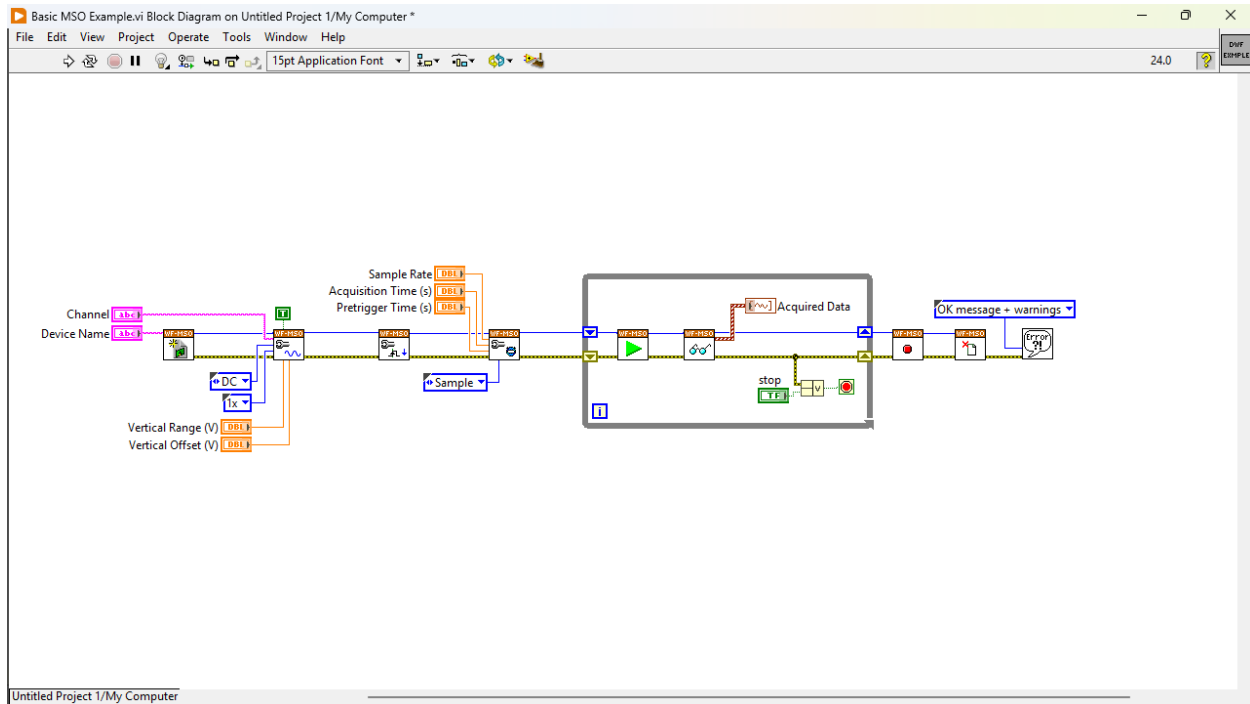
4   Educational Resources

The Analog Discovery 3 is an essential tool for engineering education, well suited to a hands-on, self-led, exploratory approach to learning in academic laboratory or remote learning environments. To help support educators in developing their courses, Digilent provides the Real Analog course, aimed at introductory electrical engineering instruction, which includes textbook-level instruction material and exercises for students and printable handouts, slides, and exercise solutions for educators. Chapter topics, each of which come with several lab experiments that make use of WaveForms alongside real hardware, include:

Real **Analog**
An Introduction to Electrical Circuits

- Circuit Fundamentals
- Circuit Reduction
- Nodal and Mesh Analysis
- Systems and Network Theorems
- Operational Amplifiers
- Energy Storage Elements
- First Order Circuits
- Second Order Circuits
- Introduction to State Variable Models
- Steady-state Sinusoidal Analysis
- Frequency Response and Filtering
- Steady-state Sinusoidal Power

Check out the full course on Digilent's Reference site: Real Analog: Circuits 1 - Digilent Reference

5 – Accessory Ecosystem

Audio Adapter+

The Audio Adapter+ is a module that plugs into the Analog Discovery 3's MTE cable connector and allows it to capture and analyze audio signals from external sources. It provides standard connectors and amplification circuitry to ease the use of the device to generate and receive audio signals used by audio devices like microphones, headphones, and speakers. It is capable of both Mono and Stereo audio, with both types of configuration connected to both the Wavegen and Scope instruments, selectable via several jumpers.

Features:

- Provides audio connectivity via 3.5 mm jacks for both Scope and Wavegen.
- Inputs and outputs can independently use 2 mono jacks or 1 stereo jack, selected via jumpers.
- Active circuitry powered by the Analog Discovery 3 power supplies.
- Pass-through connector for pins not requiring exclusive use, including Digital I/Os, Triggers, and Power Supplies.

Breadboard Adapter

The Breadboard Adapter for Analog Discovery is intended to be used with the Analog Discovery 3 to directly integrate portable circuits to be easily reconnected and demonstrated at any time. As an alternative to the 2x15 MTE cable set included in the base AD3 kit, this is ideal for a portable manufacturing test or a permanent setup for a demonstration or project.

Features:

- Direct connection with Analog Discovery.
- Additional passthrough Analog Discovery header for easy connection.
- Connected power rails.
- Solderless breadboard for an alternative setup.
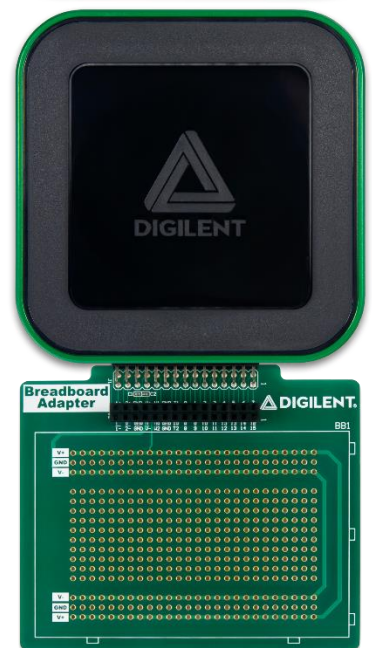
BNC Adapter

The Discovery BNC adapter board is intended to be used with Digilent's Analog Discovery tool to enable the use of standard BNC terminated test leads and probes. The adapter board enables the user to AC couple or DC couple single-ended signals to the oscilloscope in the Analog Discovery 3.

Improved specifications are detailed in the Specifications section of this document.

Features:

- Allows the use of standard BNC-terminated test leads & probes on your Analog Discovery
- Selectable AC and DC coupling to oscilloscope probes
- Selectable 50-ohm or 0-ohm output impedance on arbitrary waveform generator (AWG) channels
- Differential scope inputs of the Analog Discovery become single-ended with the negative input connected to the ground

Current and Power Adapter

The Current and Power Adapter helps you visualize currents, voltages, and powers in a DC or AC circuit. The Adapter is inserted between the power source and the load and provides standard banana plugs for connection to external circuitry. It provides the on-board circuitry required to convert analog current to voltages measurable by an Analog Discovery 3 without substantially affecting the load impedance.

Features:

- Low value shunt resistor and programmable gain current sense amplifier
- Current and Voltage range scaling
- Measure DC and AC signals
- ±25 V and ±25 A voltage and current ranges

Impedance Analyzer Adapter

The Impedance Analyzer helps you measure complex electrical impedance as a function of the test frequency. It simplifies the addition of otherwise cumbersome reference circuitry when testing components, providing a variety of different reference resistors appropriate for a variety of possible loads.

Features:

- Selection of an appropriate reference resistor via dropdown
- Constant Current/Voltage modes with automatic resistor selection
- Standard terminal block connector

Transistor Tester Adapter

The Transistor Tester Adapter is a module that allows you to add the functionality of a curve tracer to your test equipment suite. It supports the analysis of the characteristics of discrete semiconductor devices like diodes, NPN and PNP transistors, and both P-Type and N-Type FETs, and works in conjunction with the WaveForms software suite to draw IV response curves for these components.

Features:

- Works with diodes, NPN and PNP transistors, and P- and N-Type FETs
- Standard terminal block connector for E / C / B / E connections
- 10 kΩ Internal Resistor for R_b
- 100 Ω Internal Resistor for R_c

6   Analog Discovery 3 Specifications

These specifications are typical unless otherwise stated and are valid following 30 minutes of warm-up at 25 °C unless otherwise noted.

6.1   Mixed Signal Oscilloscope

Analog Input Channels

Supports the Oscilloscope, Voltmeter, Data Logger, Spectrum Analyzer, Network Analyzer, Impedance Analyzer, and Script Editor instruments.

Vertical System

	Without BNC Adapter	With BNC Adapter
Number of Channels	Two	
Input Type	Differential	Single-ended
Connector Type	100 mil 2x15 MTE Header	BNC[1]
Input Range	±2.5 V with respect to ground (5 V peak-to-peak) ±25 V with respect to ground (50 V peak-to-peak)	
Resolution	14 bits (16-bit with averaging), 14-bit noise[2]	
Absolute Resolution[3]	0.336 mV (scale ≤ 0.5 V/div) 3.36 mV (scale > 0.5 V/div)	
Accuracy	±10 mV ± 0.5% (scale ≤ 0.5 V/div, V_{inCM} = 0 V) ±100 mV ± 0.5% (scale > 0.5 V/div, V_{inCM} = 0 V)	
Bandwidth[4]	9 MHz @ -3 dB 2.9 MHz @ -0.5 dB 0.8 MHz @ -0.1 dB	30+ MHz @ -3 dB 15 MHz @ -0.5 dB 6 MHz @ -0.1 dB
Input Impedance	1 MΩ ‖ 24 pF	
Input Coupling	DC	DC or AC
Vertical Sensitivity (range)	200 µV/div to 5 V/div (10 divisions)[5]	
CMMR	±0.5% (typical)	
AC Coupling Cut-off Frequency	N/A	1.6 Hz at -3 dB[6]
Acquisition Modes	average, decimate, min/max, record	
Additional Channels	On-device FIR filter for both inputs[7], on device loopback for Wavegen and Supplies outputs	
Overvoltage Protection	±50 V_{DC} or ±30 V_{RMS}	

[1] Only Analog inputs and Analog outputs use BNC connectors. All other pins pass through the BNC Adapter to a 100 mil 2x15 MTE header.

[2] A separate small buffer to collect maximum and minimum samples when the sample rate is slower than the system frequency and is represented within WaveForms as noise.

[3] Ideal values based on hardware design ranges of 5.5 V and 55 V. Actual values may vary slightly due to component variations and are accounted for during factory calibration. WaveForms only exposes nominal ranges of 5 V and 50 V.

[4] When using a connector with the appropriate frequency response.

[5] Divisions in this context are the ten horizontal strips in the Analog Input graph window within WaveForms. Vertical sensitivity specifies the height of one strip in the plot.

[6] For a 5 V scope input range and 1.75 Hz for 50 V scope input range.

[7] Up to 16 coefficients.

DC Offset Range

Range	Full Scale	Offset	Offset Accuracy
Low range (≤0.5 V/div)	5 V peak-to-peak	±2.5 V	±10 mV ± 0.5%
High range (>0.5 V/div)	50 V peak-to-peak	±25 V	±100 mV ± 0.5%

Horizontal System

Maximum Sample Rate	125 MS/s per channel
Fine System Frequency Adjustment	50 MHz to 125 MHz[1]
Buffer Size	Up to 32,768 samples per channel[2,3]
Noise Buffer	Up to 1,024 samples

The above horizontal system specifications apply to Repeated/Shift/Screen modes. Record mode allows streaming acquisition data into host computer RAM at up to ~10 MS/s total, or to a file on the host computer disk at up to ~5 MS/s total. Achievable sample rates and recording lengths depend on host computer specifications.

[1] Adjustable through the WaveForms Device Options. Shared with Analog Outputs and Digital I/O.

[2] 65,536 samples when a single analog input channel is used.

[3] Different preset buffer can be chosen based on device configuration within the WaveForms Device Manager.

Digital Channels

Supports the Logic Analyzer, Pattern Generator, Static I/O, Protocol Analyzer, Oscilloscope (mixed signal view), and Script Editor instruments.

Vertical System

Number of Channels	16	
Connector	100 mil 2×15 MTE Header	
Function Control	Individually programmable as Digital I/O, Logic Analyzer, Pattern Generator, or Protocol	
Input Voltage	0 V to 3.3 V (5 V tolerant)	
Input Logic Standard	LVCMOS (3.3 V, 5 V tolerant)	LVCMOS (1.2 V, 5 V tolerant)[1]
Input Logic Levels	Low Voltage: Min 0 V, Max 0.8 V High Voltage: Min 2 V, Max 5.25 V	Low Voltage: Min 0 V, Max 0.42 V High Voltage: Min 0.78 V, Max 5.25 V
Output Type	LVCMOS (3.3 V)	
Output Logic Level	Output Low Voltage, V_{OL}, Min 0 V, Max 0.5 V Output High Voltage, V_{OH}, Min 2.4 V, Max 3.3 V	
Slew Rate	Slow (default), Fast[1]	
Drive Strength	4 (default), 8, 12, or 16 mA[1]	
Configurable Pull Resistors	None (default), pull-up, pull-down, or keeper[2]	
Hardware Pull Resistors	1 MΩ pull-down resistors	
Logic Analyzer Interpreters	SPI, I2C, UART, CAN, I2S, 1-Wire, PS/2, HDMI CEC, Manchester codes, JTAG, GPIB, SWD, custom[3]	
Pattern Generator	Constant, clock, pulse, random, number, Binary counter, Gray counter, Johnson counter, Decimal counter, walking 0/1, ROM Logic, custom[3]	
Custom Patterns File	Import and export custom data as *.csv, *.txt or *.tdms file	
Channel-to-Channel Skew	2 ns, typical	
Overvoltage Protection	Short-circuit to ground, ±20 V	

Horizontal System

Maximum Sampling Rate	125 MS/s per channel
Fine System Frequency Adjustment	50 MHz to 125 MHz[4]
Logic Analyzer Buffer Memory	Up to 32,768 samples per channel[5]
Pattern Generator Buffer Memory	Up to 32,768 samples per channel[5]

The above horizontal system specifications apply to Repeated/Shift/Screen modes. Record mode allows streaming acquisition data into host computer RAM at up to ~10 MS/s total, or to a file on the host computer disk at up to ~5 MS/s total. Achievable sample rates and recording lengths depend on host computer specifications.

---

[1] Configurable within WaveForms. Selected setting shared with all DIOs and Trigger IOs.

[2] Internal to the FPGA and configurable within WaveForms. Selected setting shared with all DIOs and Trigger IOs.

[3] More options may be available in the latest version of the WaveForms software.

[4] Adjustable through the WaveForms Device Options. Shared with Analog Outputs and Digital I/O.

[5] Different preset buffer sizes can be chosen based on device configuration within the WaveForms Device Manager. See the Device Configurations section of this document for more info.

6.2   Arbitrary Waveform Generator (Wavegen)

Supports the Waveform Generator, Network Analyzer, Impedance Analyzer, and Script Editor instruments.

Vertical System

	Without BNC Adapter	With BNC Adapter
Number of Channels	2	
Output Type	Single-ended	
Connector Type	100 mil 2x15 MTE Header	BNC[1]
Standard Functions	Sine, square, triangle, ramp up, ramp down, DC voltage, noise, trapezium, others	
Advanced Waveforms	Sweep, modulation (AM/FM), math, play mode, custom Raw, averaged, or filtered Scope input data	
Output Voltage Range	±5 V	
Resolution	14 bits[2]	
Absolute Resolution	166 µV (│Vout│ ≤ 1.25 V) 665 µV (│Vout│ > 1.25 V)	
Accuracy	±10 mV (│Vout│ ≤ 1.25 V) ±25 mV (│Vout│ > 1.25 V)	
Output Impedance	0 Ω[3]	0 Ω[3] or 50 Ω (selectable by jumper)
Bandwidth[4]	9 MHz @ -3 dB 2.9 MHz @ -0.5 dB 0.8 MHz @ -0.1 dB	12 MHz @ -3 dB 4 MHz @ -0.5 dB 1 MHz @ -0.1 dB
Sweep Modes	Frequency and Amplitude. Up and down with selectable start/stop frequencies and settable time increments	
Custom Waveform Files Supported	Import files *.csv, *.txt, *.mp3, *.wav, *.wmv & *.avi, export as image, or as raw data in *.csv, *.txt or *.tdms formats	
DC Current Drive	30 mA maximum[5]	
Slew Rate	400 V/µs (10 V step)	
Overvoltage Protection	Short-circuit to ground, ±15 V	

DC Offset Range

Range	Full Scale	Offset	Offset Accuracy
Low range	2.5 V peak-to-peak	±1.25 V	±10 mV ± 0.5%
High range	10 V peak-to-peak	±5 V	±25 mV ± 0.5%

[1] Only Analog inputs and Analog outputs use BNC connectors. All other pins pass through the BNC Adapter to a 100 mil 2×15 MTE header.

[2] Each channel also has a pair of 16-bit buffers used to store up to 8,192 samples of FM/PM and AM/SUM modulation parameters.

[3] Output impedance is not precisely controlled.

[4] Bandwidth specifications applicable when using a connector with the appropriate frequency response.

[5] Maximum value for distortion free generation. Up to 40 mA can be supplied before hardware cutoff.

Horizontal System

Maximum Sample Rate	125 MS/s per channel
Fine System Frequency Adjustment	50 MHz to 125 MHz[1]
Buffer Size	Up to 32,768 samples per channel[2,3]

6.3   Pattern Generator

Shares digital input/output channels with Mixed Signal Oscilloscope: See the Digital Channels Specifications for characteristics.

6.4   Trigger System

Trigger Features

Trigger Sources	Oscilloscope analog channels, Arbitrary waveform generator start, Digital I/O lines, External triggers (TRIG1/TRIG2), Manual
Trigger Modes	None, Auto, Manual (Forced Trigger), Single
Analog Trigger	Edge, pulse, transition, condition, level, hysteresis, hold-off
Digital Trigger	Edge, level, pattern, glitch
Analog/Oscilloscope Trigger Resolution	8 to 20 ns, depending on system frequency, 10 ns by default[4]
Digital/Logic Analyzer Trigger Resolution	8 to 20 ns, depending on system frequency, 10 ns by default[4]

External Trigger (TRIG1/TRIG2) Characteristics

Trigger 1 can be used to export or import a reference clock for the purposes of device synchronization.

See the Digital Channels Specifications for the electrical characteristics of the External Trigger.

---

[1] Adjustable through the WaveForms Device Options. Shared with Analog Inputs and Digital I/O.

[2] Different preset buffer sizes can be chosen based on device configuration within the WaveForms Device Manager. See the Device Configurations section of this document for more info.

[3] Each channel also has a pair of 16-bit buffers used to store up to 8,192 samples of FM/PM and AM/SUM modulation parameters.

[4] WaveForms uses interpolation for much more accurate value positioning.

6.5   Device Configurations

The Analog Discovery Studio Max has one configuration which can be applied, primarily affecting the analog input, analog output, and digital I/O buffer sizes available to the user.

Configuration	Scope Buffer Size	Wavegen Buffer Size	Logic Buffer Size	Patterns Buffer Size
1 (Default)	16 kS per channel	16 kS per channel for AWG channels 2 kS per channel for power supplies	16 kS per channel	2 kS per channel
2	32 kS per channel	4 kS per channel for AWG channels 1 kS per channel for power supplies	4 kS per channel	2 kS per channel
3	8 kS per channel	32 kS per channel for AWG channels 2 kS per channel for power supplies	2 kS per channel	2 kS per channel
4	16 kS per channel	4 kS per channel for AWG channels 2 kS per channel for power supplies	32 kS per channel	2 kS per channel
5	4 kS per channel	4 kS per channel for AWG channels 1 kS per channel for power supplies	32 kS per channel	32 kS per channel
6	8 kS per channel	16 kS per channel for AWG channels 4 kS per channel for power supplies	2 kS per channel	2 kS per channel

Note: Memory sizes, including buffer sizes, specified in units like kS and MS, are rounded from equivalent binary power units, such as MiS. For example, a listed 16 kS is rounded from 16 kiS, which is 16,384 samples.

6.6   Additional Features

Spectrum Analyzer

Frequency Range	0 Hz to half of system clock frequency (50 MHz default)
Display Modes	Magnitude, average, peak hold, min hold, count
Y Axis	Logarithmic (dBṼ, dBu, dBm) or linear (volts)
X Axis	Linear or Logarithmic
Power Spectrum Algorithms	FFT, CZT
Windowing Functions	Rectangular, Triangular, Hamming, Hann, Cosine, Blackman-Harris, Flat Top, Kaiser

Network Analyzer

Frequency Range	20 µHz to 9 MHz[1], up to 10,001 steps
Display Modes	Magnitude, Phase, Custom
Y Axis	Linear or Logarithmic
X Axis	Linear or Logarithmic
Plots	Bode, Time, FFT, Nichols, Nyquist

[1] Higher frequencies up to one quarter the system frequency can be selected within WaveForms but results will be limited by the analog input bandwidth of the hardware.

Protocol Analyzer

Shares digital input/output channels with Mixed Signal Oscilloscope: See the Digital Channels Specifications for the physical characteristics.

Protocol Interpreters	UART, SPI, I2C, CAN, CEC, JTAG, SWD, AVR, QD
Protocol Generators	UART, SPI, I2C, CAN, CEC, SWD, AVR

Impedance Analyzer

Frequency Range	20 µHz to 9 MHz[1], up to 10,001 steps
Display Modes	Magnitude, Phase
Y Axis	Linear or Logarithmic
X Axis	Linear or Logarithmic
Plots	Impedance, Phase, Voltage, Admittance, Capacitance, Custom[2]

Math Channels

Operations	Addition "+", Subtraction "-", Multiplication "*", Division "/", Remainder "%"
Brackets	Parenthesis "()", Square "[]"
Constants	Exp, Ln, Log, Pi
Functions	Logarithm, power, minimum, maximum, square root, sine, cos, tan, arccos, arctan, arctan2, absolute value, round, floor, ceiling
Operands	All input and digital channels, reference waveforms, time, constants, Pi
Custom Channels	Butterworth, Chebyshev, Lock-In Amplifier

Programmable Power Supply

Number of Channels	2
Voltage Range	0.5 to 5 V, -0.5 to -5 V[3]
Current Output	Up to 800 mA or to 2.4 W per channel[4], whichever limit is reached first
Voltage Readback Resolution	8 mV
Connector Type	2 pins included in the 100 mil 2x15 MTE Header

---

[1] Higher frequencies up to one quarter the system frequency can be selected within WaveForms but results will be limited by the analog input bandwidth of the hardware.

[2] Additional calculations not listed here are available within the WaveForms software.

[3] Optional tracking of the two supplies available within the Supplies tool.

[4] While using the AUX power supply.

6.7　Connectivity

USB Interfaces

Device Connector	USB Type-C®[1,2]
Host Connector	USB Type-C® or USB Standard-A[3,4]

6.8　Power Requirements

The Analog Discovery 3 does not require an auxiliary power supply for most functions. An auxiliary power supply is recommended when utilizing a significant amount of power on the programmable power supplies, analog output channels, and digital channels.

Auxiliary Power Supply Voltage	5 V
Auxiliary Power Supply Current	4 A recommended (3.1 A minimum)
Barrel Connector Size	5.5 mm x 2.1 mm (positive inner pin)

6.9　Physical Characteristics

Dimensions	10.0 cm × 10.0 cm × 2.0 cm (L × W × H) (~3.94 in × ~3.94 in × ~0.79 in)
Weight	128 g (4.5 oz)

6.10　Environmental

Ambient Operating Temperature	0 °C to 40 °C (32 °F to 104 °F)
Storage Temperature	-20 °C to 60 °C (-4 °F to 140 °F)
Operating Humidity	10% to 90% RH non-condensing
Storage Humidity	5% to 95% RH non-condensing
Pollution Degree	2
Maximum Altitude	2000 m

6.11　Certifications and Statements

- CE Certification
- Statement of Volatility

---

[1] USB Type-C® and USB-C® are registered trademarks of USB Implementers Forum.

[2] USB-C® to USB-C® cable included.

[3] Device uses USB 2.0 data rates.

[4] USB Standard-A ports must provide USB 3.2 compatible power when an auxiliary power supply is not used.

7   Ordering Information and Purchasing Options

Associated Digilent Part Numbers:

- 410-415 – Analog Discovery 3 (base purchase kit)
  - One Analog Discovery 3
  - One plastic project box
  - One 2x15 MTE cable assembly
  - One USB-C to USB-C programming cable
  - 5-pack of 6-pin male headers
  - MTE cable labels
- 471-059 – Analog Discovery 3 Student Bundle
  - The AD3 base purchase kit
  - One Analog Parts Kit, including breadboards, resistors, capacitors, and a variety of other standard components.
- 471-060 – Analog Discovery 3 Pro Bundle
  - The AD3 base purchase kit
  - One BNC Adapter for Analog Discovery
  - Pair of P6100 BNC Oscilloscope Probes
  - 6-pack of Mini Grabber test clips

8   Recommended Accessories

Digilent Part Numbers:

- 350-036 – Soft case for Analog Discovery 3
- 240-030 – 5 V / 4 A switching power supply suitable for AUX power for the AD3
- 410-418 – Audio Adapter+
- 410-263 – BNC Adapter
- 410-413 – Transistor Tester Adapter
- 410-378 – Impedance Analyzer Adapter
- 410-361 – Breadboard Adapter

9   Additional Resources

Reference material for the Analog Discovery 3 including a getting started guide, reference manual, specifications, and tutorials on each of the instruments within WaveForms can be found on the [Analog Discovery 3's Resource Center](#) on Digilent's Reference site.

10   The Essential Instruments Family
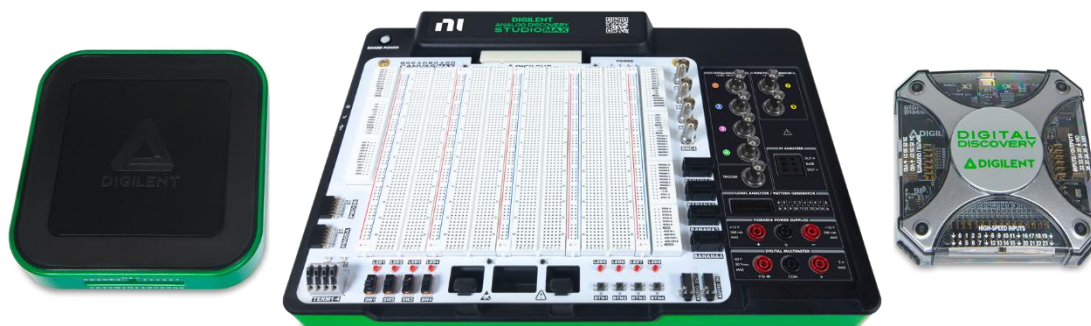
Digilent's Essential Instruments family is the premier offering for engineers looking for a low barrier to entry while broadening their expertise with Test and Measurement equipment. These devices are cost-optimized for students and engineers alike, provide maximum value for minimal cost. From the Digital Discovery, a dedicated workhorse for debugging digital interfaces, to the Analog Discovery Studio Max, an all-in-one electronics laboratory, to the legendary Analog Discovery 3, in conjunction with Digilent's freely available WaveForms software, each device provides a solid foundation for any engineer who needs to test or debug their projects.

Analog Discovery Studio Max

The Analog Discovery Studio Max (ADS Max) is a comprehensive electronics laboratory solution designed for academic instruction and hands-on learning. Equipped with 14 built-in instruments, supporting everything from a multimeter and bode plots to digital protocol generation and spectral analysis, the ADS Max is ideal for circuit design, signal analysis, and embedded systems coursework. With a variety of removable and curriculum tailored Canvas boards to enhance its functionality, the ADS Max enables dynamic, hands-on experiences in both classroom and remote learning environments. Compared to the AD3, it offers a robust solution with built-in DMM, programmable +15 V and -15 V power supplies, built-in IV analyzer circuitry, and ecosystem of canvas top boards tailored for different classes within a larger engineering curriculum. Its larger form factor makes it better for group learning in lab environments, where the AD3 is ideal for individual students and remote learning.

Digital Discovery

The Digital Discovery is a combination USB logic analyzer and pattern generator, featuring 24 high-speed digital inputs and 16 digital I/O channels. With a high-speed adapter, the device can sample up to 800 MS/s on up to 8 input channels. Sampling up to 100 MS/s is supported on all channels. DDR memory offers deep input buffers, with 64 MS of input buffer per high-speed input channel.

11 Analog Discovery Pro Line

Digilent's Analog Discovery Pro line is for users who are ready to go pro. With expanded feature sets not offered in Digilent's Test and Measurement Essentials line including deep memory, higher bandwidth, networking capability, and USB 3.0, an Analog Discovery Pro device has already stepped up to the challenging task ahead of you.

Devices in the Analog Discovery Pro family provide the utility of professional benchtop equipment with the flexibility of a portable instrument. The series includes mixed signal oscilloscope and programable power supply instruments that give engineers the ability to tap into the efficiency of the WaveForms software while offering a wider selection of specifications in products created with the professional in mind. Other members of the Analog Discovery Pro family include:

Analog Discovery Pro 2000-Series

ADP2230:

- Mixed signal oscilloscope
- BNC connectors and an aluminum case
- Two analog inputs – 50+ MHz bandwidth
- One analog output – 15 MHz bandwidth
- 16 Digital I/O
- Sample rates up to 125 MS/s
- Two programmable power supply outputs
- Deep memory buffers for long acquisitions – up to 128 MS per channel for analog input
- USB 3.0 connectivity
- Dual Mode for synchronization of multiple devices

Analog Discovery Pro 3000-Series

ADP3450/ADP3250:

- Mixed signal oscilloscope
- Four or two analog inputs, two analog outputs
- 0.5 GS/s sample rate (with oversampling), per channel
- 55+ MHz bandwidth
- 16 Digital I/O
- Ethernet connectivity
- Embedded Linux Mode

Analog Discovery Pro 5000-Series

ADP5470/ADP5490:

- Mixed signal oscilloscope
- Four analog inputs, one analog output
- 1.5 GS/s or 2 GS/s sample rate, per channel
- 350 MHz or 500 MHz bandwidth
- 34 Digital Inputs at 1 GS/s, 8 Digital I/O
- Dedicated Digital Multimeter and DC Power Supplies

Discovery USB-Programmable Power Supply (DPS3340)

- USB programmable power supply
- Three programmable output channels with optional waveform generator control
- 1 V to 5 V (up to 1 A), -1 V to -15 V (up to 500 mA), 1 V to 15 V (up to 500 mA)
- Integrated voltage and current readback of each channel

12 About Digilent

Digilent, part of the NI Product Family from Emerson, has been at the forefront of innovation since 2000, crafting hardware and software solutions that empower engineers, researchers, educators, and scientists to design and test with unparalleled flexibility. Our customizable solutions cater to both seasoned professionals and emerging engineers, accelerating development while maintaining a low barrier to entry.

We're committed to making engineering accessible, offering competitive pricing, portable products, and comprehensive documentation. With a global presence spanning three continents, Digilent ensures speedy and cost-effective access to our products through an extensive distribution network. Specializing in USB-based test and measurement devices, flexible and intuitive software, low-cost data acquisition and data logging tools, and AMD-based FPGA development boards, our products' design philosophy champions your creativity. By providing world class documentation and support and keeping our hardware and software flexible and practical, we are continuing to provide the building blocks while you bring the brilliance.