Analog Discovery 3 Specifications

These specifications are valid following 30 minutes of warm-up and are typical at 25 °C unless otherwise noted. WaveForms was used to determine these specifications.

Mixed Signal Oscilloscope

Analog Input Channels

Supports the Oscilloscope, Voltmeter, Data Logger, Spectrum Analyzer, Network Analyzer, Impedance Analyzer, Tracer, 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 2×15 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	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[4]
Input Impedance	1 MΩ ││ 24 pF	
Input Coupling	DC	DC or AC
Vertical Sensitivity (range)	500 µV/div to 5 V/div (10 ranges)[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[7]	
Additional Channels	On-device FIR filter for both inputs[8], on-device loopback for Wavegen and Supplies outputs	
Overvoltage Protection	±50 V DC or ±30 V RMS	

DC Offset Range

Range	Full Scale	Offset	Offset Accuracy
Low range (≤500 mV/div)	10 V peak-to-peak	±5 V	±10 mV ±0.5%
High range (>0.5 V/div)	100 V peak-to-peak	±50 V	±100 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] 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 probe with the appropriate frequency response.

[5] The ranges are shown in the Analog Input graph windows within WaveForms.

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

[7] Up to 10 MHz for single channel acquisition.

[8] Up to 16 coefficients.

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	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 sizes 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, 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 Type	LVCMOS (3.3 V, 5 V tolerant)
Input Logic Level	Input Low Voltage, VIL, Min 0 V, Max 0.8 V Input High Voltage, VIH, Min 2.0 V, Max 5 V
Output Type	LVCMOS (3.3 V)
Output Logic Level	Output Low Voltage, VOL, Min 0 V, Max 0.5 V Output High Voltage, VOH, Min 2.4 V, Max 3.3 V
Slew Rate	Slow (default), Fast[1]
Drive Strength	4 (default), 8, 12, or 16 mA[2]
Configurable Pull Resistors	None (default), pull-up, pull-down, or keeper[3]
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[4]
Pattern Generator	Constant, clock, pulse, random, number, Binary counter, Gray counter, Johnson counter, Decimal counter, walking 0/1, ROM Logic, custom[5]
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

[1], [2] Configurable within WaveForms. Selected setting shared with all DIOs and Trigger IOs.

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

[4], [5] More options may be available in the latest version of the WaveForms software.

Horizontal System

Maximum Sampling Rate	125 MS/s per channel
Fine System Frequency Adjustment	50 MHz to 125 MHz[1]
Logic Analyzer Buffer Memory	up to 32,768 samples per channel[2]
Pattern Generator Buffer Memory	up to 32,768 samples per channel[3]

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 Inputs, Analog Outputs, and Digital Outputs.

[2], [3] Different preset buffer sizes can be chosen based on device configuration within the WaveForms Device Manager.

Arbitrary Waveform Generator (Wavegen)

Supports the Waveform Generator, Network Analyzer, Impedance Analyzer, Tracer, and Script Editor

instruments.

Vertical System

	Without BNC Adapter	With BNC Adapter
Number of Channels	2	
Output Type	Single-ended	
Connector Type	100 mil 2×15 MTE Header	BNC[1]
Standard Functions	Sine, square, triangle, sawtooth, ramp up, ramp down, DC voltage, noise, trapezium, others	
Advanced Waveforms	Sweep, modulation and summing (phase, AM, FM), math, play mode, custom Raw, averaged, or filtered Scope input data	
Output Voltage Range	±5 V	
Resolution	14 bits	
Absolute Resolution	166 µV ($\lvert$Vout$\rvert$ ≤ 1.25 V) 665 µV ($\lvert$Vout$\rvert$ > 1.25 V)	
Accuracy	±10 mV ± 0.5% ($\lvert$Vout$\rvert$ ≤ 1.25 V) ±25 mV ± 0.5% ($\lvert$Vout$\rvert$ > 1.25 V)	
Output Impedance	0 Ω[2]	0 Ω[3] or 50 Ω (selectable by jumper)
Bandwidth	9 MHz @ -3 dB, 2.9 MHz @ -0.5 dB, 0.8 MHz @ -0.1 dB[4]	12 MHz @ -3 dB, 4 MHz @ -0.5 dB, 1 MHz @ -0.1 dB[5]
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	
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%

Horizontal System

Maximum Sample Rate	125 MS/s per channel
Fine System Frequency Adjustment	50 MHz to 125 MHz[6]
Buffer Size	Up to 32,768 samples per channel[7]

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[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.

[2,3] Output impedance is not precisely controlled.

[4] When using the included 2×15 flywire signal cable assembly.

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[5] When using a probe with the appropriate frequency response.
[6] Adjustable through the WaveForms Device Options. Shared with Analog Inputs and Digital I/O.
[7] Different preset buffer sizes can be chosen based on device configuration within the WaveForms Device Manager.

Pattern Generator

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

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 [1]
Digital/Logic Analyzer Trigger Resolution	8 to 20 ns, depending on system frequency, 10 ns by default [2]

[1], [2] WaveForms uses interpolation for much more accurate value positioning.

External Triggers (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 Triggers.

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 (dB$\tilde{V}$, 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 uHz to 9 MHz (30 MHz with external AWG)[1], up to 10,001 steps
Display Modes	Magnitude, Phase
Y Axis	Linear or Logarithmic
X Axis	Linear or Logarithmic
Plots	Bode, Time, FFT, Nichols, Nyquist

[1] Higher frequencies up to half of the system frequency can be selected within WaveForms but results with 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.

Protocols[1]	UART, SPI, I2C, CAN, CEC, JTAG, SWD, AVR

[1] This functionality is implemented by WaveForms software on the host system.

Impedance Analyzer

Frequency Range	20 uHz to 31.25 MHz, up to 10,001 steps
Display Modes	Magnitude, Phase
Y Axis	Linear or Logarithmic
X Axis	Linear or Logarithmic
Plots	Bode, Time, FFT, Nichols, Nyquist, Custom

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 analog and digital input channels, reference waveforms, time, constants, Pi
Custom Channels	Butterworth, Chebyshev, Lock-In Amplifier

Programmable Power Supply

Number of Channels	2
Voltage Range	0.5 V to 5 V, -0.5 V to -5 V[1]
Current Output	Up to 800 mA or to 2.4 W per channel[2], whichever limit is reached first
Voltage Readback Resolution	8 mV
Connector Type	2 pins included in the Header 100 mil 2×15 MTE

[1] Optional tracking of the two supplies available within the Supplies Tool.
[2] While using AUX power supply.

Connectivity

USB Interfaces

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

[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.

Power Requirements

The Analog Discovery 3 does not require an auxiliary power supply for most functions.

Power Supply Voltage	5 V
Power Supply Current	2.5 A recommended
Power Consumption	12.5 W maximum
Barrel Connector Size	5.5 mm × 2.1 mm (positive inner pin)

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)

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

Certifications

Analog Discovery 3 Declaration of Conformity

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