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DATA SHEET

U2500A Series

USB Modular Simultaneous Sampling Multifunction DAQ Devices

Introduction

The Keysight Technologies, Inc. U2500A Series USB Modular Simultaneous Sampling Multifunction (DAQ) devices are high-performance modules that consist of three models – the U2531A, U2541A and U2542A. The U2500A Series has up to four channels with 14-bit and 16-bit resolutions. The U2531A can sample up to 2 MSa/s for each channel with a resolution of 14 bits, while the U2541A and U2542A can sample up to 250 kSa/s and 500 kSa/s for each channel respectively with a resolution of 16 bits.



Note: The U2531A, U2541A, U2542A USB Modular Simultaneous Sampling Multifunction Data Acquisition will be discontinued on March 1st, 2022. The last day to place an order for this product is February 28th, 2022. Keysight will continue to provide world-class support for this product for the standard period of 5 years.

KEYSIGHT TECHNOLOGIES

Features

- Simultaneous sampling with a sampling rate of up to 2 MSa/s for each channel
- Multifunction DAQ solution - AI, AO, DIO, counter
- Dedicated ADC per channel
- 14-bit or 16-bit resolution
- 24-bit programmable digital input/output
- Functions as a standalone or modular unit
- Supports SCPI and IVI-COM
- Compatible with a wide range of Keysight Development Environments (KDEs)
- NEW! Control, automate and simplify with Keysight BenchVue software. Now included.
- USB 2.0 and USBTMC-USB488 standards.



U2500A Series

U2500A Series USB Modular Simultaneous Sampling Multifunction (DAQ) devices are high-performance modules that consist of three models:

- U2531A
- U2541A
- U2542A

Various features of the U2500A series

- Quick and easy USB setup
- High sampling rate of up to 2 MSa/s for each channel
- Dedicated analog-to-digital (ADC) that allows simultaneous sampling of data
- Flexible standalone or modular capability
- SCPI and IVI-COM supported with a wide range of KDE compatibility that minimizes work time and increases software choices
- Easy-to-use KMM application software and command logger function for easy SCPI command conversion into snippets of VEE, VB, C++, and C# code

High sampling rate of up to 2 MSa/s

The U2500A Series provides a high analog input sampling rate coverage of up to 2 MSa/s for each channel. The high sampling rate coverage offered is ideal for transient signal applications such as sonar analysis.

Simultaneous sampling of data

The U2500A Series has dedicated ADCs that enable simultaneous signals acquisition, which makes the U2500A Series suitable for your phase-sensitive applications

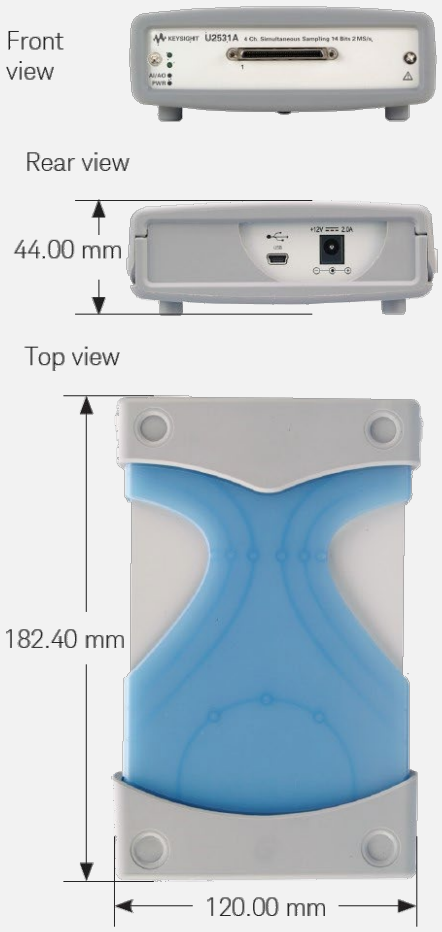
Product Characteristics and General Specifications

Product characteristics and general specifications	
Remote interface	• USBTMC-USB488 [1] • Hi-Speed USB 2.0
Power requirement	• +12 VDC (TYPICAL) • 2 A (MAX) input rated current • Installation Category II
Power consumption	+12 VDC, 480 mA maximum
Operating environment	• Operating temperature from 0 °C to +55 °C • Relative humidity at 15% to 85% RH (non-condensing) • Altitude up to 2000 meters • Pollution Degree 2 • For indoor use only
Storage compliant	–20 °C to 70 °C
Safety & EMC compliance	Refer to Declaration of Conformity for the latest revisions of regulatory compliance at: www.keysight.com/go/conformity
Shock and vibration	Tested to IEC/EN 60068-2
IO connector	68-pin female VHDCI Type
Dimension (W × D × H)	Module dimension: • 120.00 mm × 182.40 mm × 44.00 mm (with plastic casing) • 105.00 mm × 174.54 mm × 25.00 mm (without plastic casing) Terminal block dimension: • 103.00 mm × 85.20 mm × 42.96 mm
Weight	• 565 g (with plastic casing) • 400 g (without plastic casing)

Note:

1. Compatible with Microsoft Windows operating systems only. Requires a direct USB connection to the PC so the appropriate driver can be installed in the USB DAQ module.

Product Outlook and Dimensions



Product Specifications

Model number	U2531A	U2541A	U2542A
Analog input			
Resolution	14 bits	16 bits	
Number of channels	4 differential input channels (software selectable/channel)		
Maximum sampling rate	2 MSa/s	250 kSa/s	500 kSa/s
Programmable bipolar input range [1]	± 10 V, ± 5 V, ± 2.5 V, ± 1.25 V		
Programmable unipolar input range	0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.25 V		
Input coupling	DC		
Input impedance	1 GΩ/100 pF		
Operational common mode voltage range	± 8.0 V maximum		
Overvoltage range	Power-on: Continuous ± 30 V, Power-off: Continuous ± 15 V		
Trigger sources	External analog/digital trigger, SSI/star trigger [2]		
Trigger modes	Pre-trigger, delay-trigger, post-trigger, and middle-trigger		
FIFO buffer size	Up to 8 MSa		
Analog output			
Resolution	12 Bits		
Number of channels	2		
Maximum update rate	1 MSa/s		
Output ranges	0 to 10 V, ±10 V, 0 to AO_EXT_REF, ±AO_EXT_REF [3]		
Output coupling	DC		
Output impedance	0.1 Ω Typical		
Stability	Any passive load up to 1500 pF		
Power-on state	0 V steady state		
Trigger sources	External analog/digital trigger, SSI/star trigger [2]		
Trigger modes	Delay trigger, post trigger		
FIFO buffer size	1 Channel used: Maximum 8 MSa 4 Channels used: Maximum 2 MSa/ch		
Glitch energy	5 ns-V (Typical), 80 ns-V (Maximum)		
Driving capability	5 mA		
Function generation mode	Sine, square, triangle, sawtooth, and noise waveforms		
Digital input/output			
Number of bits	24-bit programmable input/output		
Compatibility	TTL		

Model number	U2531A	U2541A	U2542A
Input voltage	VIL = 0.7 V maximum; IIL = 10 µA maximum VIH = 2.0 V minimum; IIH = 10 µA maximum		
Input voltage range	–0.5 V to +5.5 V		
Output voltage	VOL = 0.45 V maximum; IOL = 8 mA maximum VOH = 2.4 V minimum; IOH = 400 µA maximum		
General purpose digital timer/counter			
Maximum count	(231 – 1) bits		
Number of channels	2 Independent up/down counter		
Compatibility	TTL		
Clock source	Internal or external		
Base clock available	48 MHz		
Maximum clock source frequency	12 MHz		
Input frequency range [4]	0.1 Hz to 6 MHz at 50% duty cycle		
Pulse width measurement range	0.167 µs to 178.956 s ± 0.0833 µs		
Analog input			
Trigger source	All analog input channels, External analog trigger (EXTA_TRIG)		
Trigger level	± Full scale for internal ± 10 V for external		
Trigger conditions	Above high, below low, and window (software selectable)		
Trigger level resolution	8 bits		
Bandwidth	400 kHz		
Input impedance for EXTA_TRIG	20 kΩ		
Coupling	DC		
Overvoltage protection	Continuous for ± 35 V maximum		
Digital trigger			
Compatibility	TTL/CMOS		
Response	Rising or falling edge		
Pulse width	20 ns minimum		
Calibration [5]			
On board reference voltage	5 V		
Temperature drift	± 2 ppm/°C		
Stability	± 6 ppm/1000 hours		
Power consumption			
Input voltage (DC)	+12 VDC		
Input current	480 mA maximum	390 mA maximum	

Model number	U2531A	U2541A	U2542A
Physical attributes			
Dimensions (W × D × H)	120.00 mm × 182.40 mm × 44 mm (with plastic casing) 105.00 mm × 174.54 mm × 25.00 mm (without plastic casing)		
IO connector	68-pin female VHDCI type		
Weight	565 g with plastic casing 400 g without plastic casing		
Environmental condition			
Operating temperature	0 to 55 °C		
Storage temperature	–20 °C to 70 °C		
Relative humidity	15% to 85% RH (non-condensing)		
General			
Remote interface	Hi-Speed USB 2.0		
Device class	USBTMC-USB488		
Programmable interface	SCPI and IVI-COM		

Notes:
1. Maximum input voltage for analog input is ± 10 V.
2. System Synchronous Interface (SSI) and star trigger commands are applicable when modular devices are used in modular product chassis (U2781A).
3. Maximum external reference voltage for analog output (AO_EXT_REF) is ± 10 V.
4. Measurement frequency's resolution:
   - = 12 MHz/n, n = 2, 3, 4, 5, …, 120 M
   - = 6 MHz, 4 MHz, 3 MHz, 2.4 MHz, 2.0 MHz, …, 0.1 Hz (up to six decimal points)
5. Recommended for 20 minutes warm-up time.

Electrical Specifications and Characteristics

Analog input characteristics [1]

Model number	U2531A		U2541A		U2542A	
	23 °C ± 5 °C	0 °C to 18 °C 28 °C to 55 °C	23 °C ± 5 °C	0 °C to 18 °C 28 °C to 55 °C	23 °C ± 5 °C	0 °C to 18 °C 28 °C to 55 °C
Offset error [2]	± 2 mV	± 2 mV	± 1 mV	± 1 mV	± 1 mV	± 1 mV
Gain error [2]	± 6 mV	± 6 mV	± 2 mV	± 2.5 mV	± 2 mV	± 2.5 mV
–3 dB Small signal bandwidth	1.2 MHz		600 kHz		1.0 MHz	
1% THD Large signal bandwidth	400 kHz		400 kHz		400 kHz	
System noise [3]	2.0 mVrms		0.5 mVrms		0.5 mVrms	
CMRR (DC to 60 Hz)	64 dB		80 dB		80 dB	
Spurious-Free Dynamic Range (SFDR)	76 dB		88 dB		86 dB	

Model number	U2531A		U2541A		U2542A	
	23 °C ± 5 °C	0 °C to 18 °C 28 °C to 55 °C	23 °C ± 5 °C	0 °C to 18 °C 28 °C to 55 °C	23 °C ± 5 °C	0 °C to 18 °C 28 °C to 55 °C
Signal-to-Noise and Distortion Ratio (SINAD)	70 dB		82 dB		80 dB	
Total Harmonic Distortion (THD)	–72 dB		–86 dB		–84 dB	
Signal-to-Noise Ratio (SNR)	72 dB		84 dB		82 dB	
Effective Number of Bits (ENOB)	11.3-bit		13.3-bit		13.0-bit	
Channels crosstalk [4]	66 dB		84 dB		80 dB	

Notes:
1. Specifications are based on 20 minutes warm-up, self-calibration temperature at 23 °C, and bipolar input range of ± 10 V.
2. The measurements are calculated with 100 points averaging of data.
3. The noise rms value is the standard deviation of 20000 points.
4. The crosstalk measurements are tested up to input frequency of Fin = MaxSamplingRate/2.

Analog output characteristics [1]

Model number	U2531A		U2541A		U2542A	
	23 °C ± 5 °C	28 °C to 55 °C	23 °C ± 5 °C	28 °C to 55 °C	23 °C ± 5 °C	28 °C to 55 °C
Offset error	± 1 mV	± 3 mV	± 1 mV	± 3 mV	± 1 mV	± 3 mV
Gain error	± 3 mV	± 4 mV	± 2 mV	± 4 mV	± 2 mV	± 4 mV
Slew rate	15 V/µs		15 V/µs		15 V/µs	
Rise time	1.1 µs	1.2 µs	1.1 µs	1.2 µs	1.1 µs	1.2 µs
Fall time	1.1 µs	1.2 µs	1.1 µs	1.2 µs	1.1 µs	1.2 µs
Settling time(s) to 1% output error	2 µs		2 µs		2 µs	

Notes:
1. Specifications are based on 20 minutes warm-up, self-calibration temperature at 23 °C, and bipolar input range of ± 10 V.

Test Condition

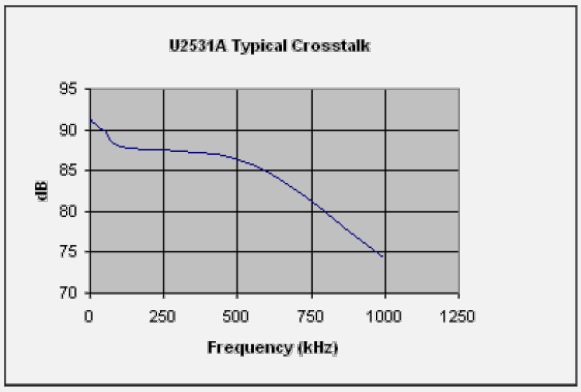
Dynamic range test for U2500A Series DAQ devices

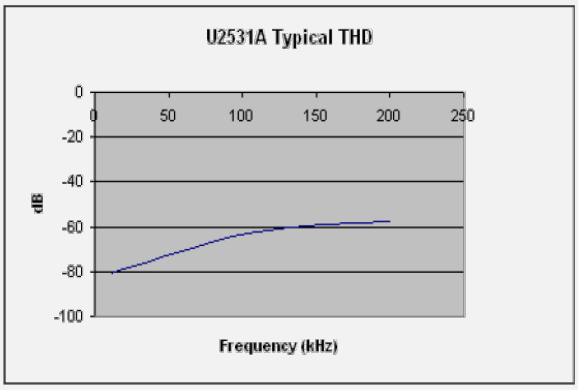
Dynamic range test	Model	Test conditions (DUT setting at ± 10 V bipolar)	
SFDR, THD, SINAD, SNR, ENOB	U2531A	Sampling rate: Fundamental frequency: Number of points: Fundamental input voltage:	2 MSa/s 19.927 kHz 65536 FSR –1 dB FS
	U2541A	Sampling rate: Fundamental frequency: Number of points: Fundamental input voltage:	250 kSa/s 2.4109 kHz 8192 FSR – 1 dBFS
	U2542A	Sampling rate: Fundamental frequency: Number of points: Fundamental input voltage:	500 kSa/s 4.974 kHz 16384 FSR – 1 dBFS

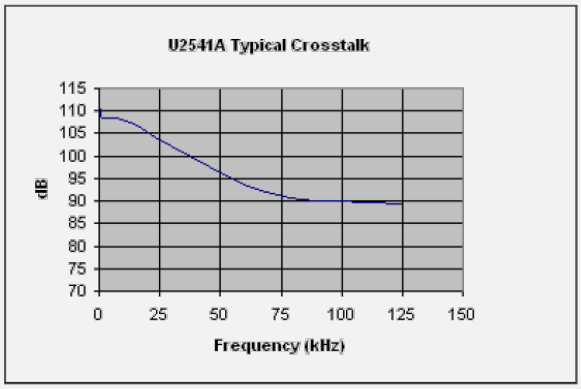
Bandwidth test for U2500A Series DAQ devices

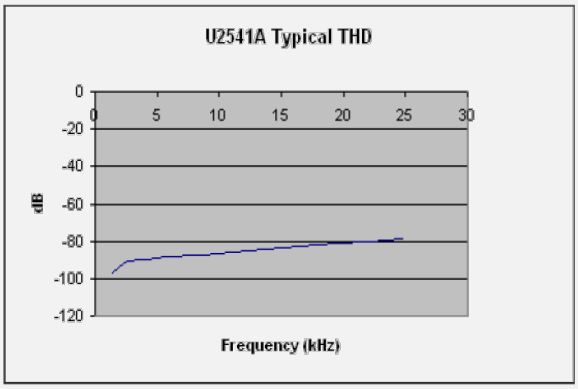
Bandwidth test	Model	Test conditions (DUT setting at ± 10 V bipolar)	
–3 dB Small signal bandwidth: 1% THD Large signal bandwidth:	U2531A	Sampling rate: Input voltage –3 dB Small signal bandwidth: 1% THD Large signal bandwidth:	2 MSa/s 10% FSR FSR – 1 dBFS
	U2541A	Sampling rate: Input voltage –3 dB Small signal bandwidth: 1% THD Large signal bandwidth:	250 kSa/s 10% FSR FSR – 1 dBFS
	U2542A	Sampling rate: Input voltage –3 dB Small signal bandwidth: 1% THD Large signal bandwidth:	500 kSa/s 10% FSR FSR – 1 dBFS

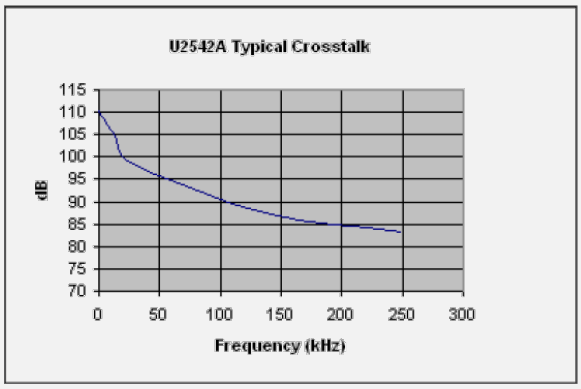
Typical Performance

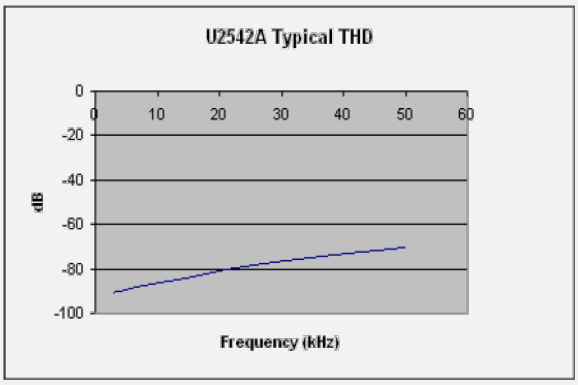












DC Characteristics

Accuracy specifications [1]

Model	U2541A, U2542A		
Analog input			
Unipolar range (V)	Offset error (mV) [2]	Gain error (mV)	Accuracy (% of reading + offset error) [3]
10	1.0	1.0	0.02% + 1.0 mV
5	1.0	1.0	0.04% + 1.0 mV
2.5	1.0	1.0	0.08% + 1.0 mV
1.25	1.0	1.0	0.16% + 1.0 mV
Bipolar range (V)			
10	1.0	2.0	0.02% + 1.0 mV
5	1.0	1.0	0.02% + 1.0 mV
2.5	1.0	1.0	0.04% + 1.0 mV
1.25	1.0	1.0	0.08% + 1.0 mV

Model	U2531A		
Unipolar range (V)	Offset error (mV) [2]	Gain error (mV)	Accuracy (% of reading + offset error) [3]
10	2.0	3.0	0.06% + 2.0 mV
5	1.5	1.5	0.06% + 1.5 mV
2.5	1.0	1.0	0.08% + 1.0 mV
1.25	1.0	1.0	0.16% + 1.0 mV
Bipolar range (V)			
10	2.0	6.0	0.06% + 2.0 mV
5	1.5	3.0	0.06% + 1.5 mV
2.5	1.0	2.0	0.08% + 1.0 mV
1.25	1.0	1.0	0.08% + 1.0 mV

Model	U2541A, U2542A		
Analog output			
Unipolar range (V)	Offset error (mV) [2]	Gain error (mV)	Accuracy (% of reading + offset error) [4]
10	1.0	2.0	0.02% + 1.0 mV
Bipolar range (V)			
10	1.0	2.0	0.02% + 1.0 mV

Model	U2531A		
Unipolar range (V)	Offset error (mV) [2]	Gain error (mV)	Accuracy (% of reading + offset error) [4]
10	1.0	3.0	0.03% + 1.0 mV
Bipolar range (V)			
10	1.0	3.0	0.03% + 1.0 mV

Notes:

1. Specifications are based on 20 minutes warm-up, and self-calibration temperature at 23 °C.
2. Offset error is measured at 0 V.
3. Accuracy = ± % of Gain error/(Measured value – Midscale) + Offset error
4. Accuracy = ± (% of Gain error/Output value + Offset error)

USB Modular DAQ App within BenchVue

BenchVue software for the PC makes it simple to connect, control, capture and view multiple Keysight instruments simultaneously with no additional programming. You can derive answers faster than ever by easily viewing, logging and exporting measurement data and screen images with a few clicks from a single environment.

- Visualize multiple measurements simultaneously
- Easily log data, screen shots and system state
- Rapidly prototype custom test sequences
- Recall past states of your USB Modular DAQ device
- Export measurement data in the desired format fast
- Quickly access manuals, drivers, FAQs and videos



Figure 1. View measurements across USB DAQ, modular and bench instruments all on one BenchVue interface.

The USB Modular DAQ App within BenchVue allows you to quickly configure and control any of the USB DAQ devices to perform data logging and visualize measurements. With six different display options, including grids and strip charts, zooming in to details the way you want is so much easier—so you can nail that measurement error in no time. In just a few clicks, you can also record measurements and export results to popular PC-friendly applications such as Microsoft Excel and Microsoft Word for further analysis.

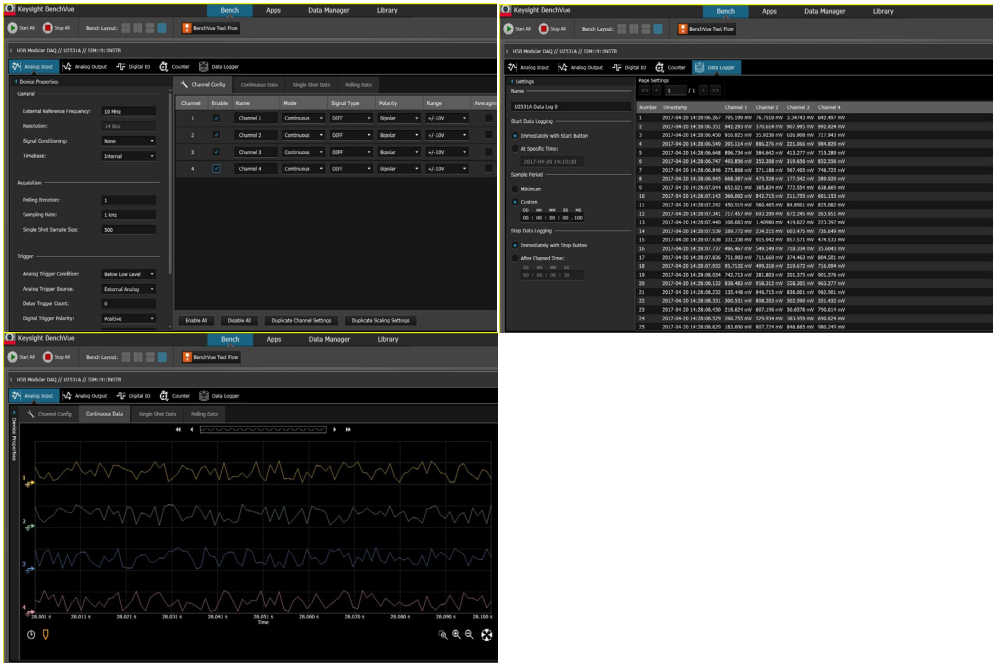


Figure 2. Configure and visualize measurements flexibly and easily on BenchVue's modern interface.

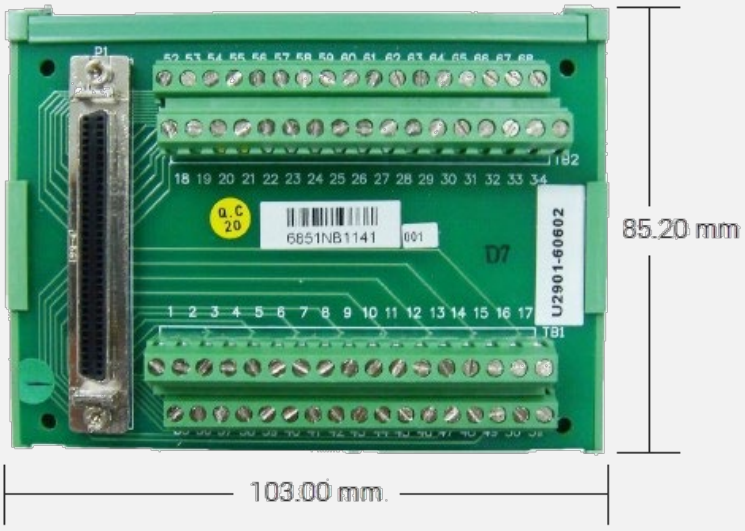
Optional Accessories

U2901A/U2902A -Terminal block and SCSI-II 68-pin connector with 1-meter/ 2-meter cable

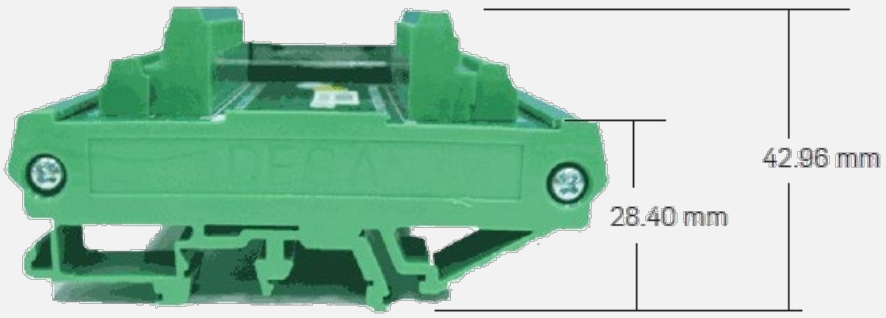
The U2901A/U2902A is a terminal block and SCSI-II 68-pin connector with 1 meter cable or 2-meter cable that can be used conjunction with the U2300A Series and U2500A Series

Terminal block overview

Front view



Side view



Other Products in The Keysight USB Modular Data Acquisition (DAQ) Family



U2300A Series USB Modular Multifunction DAQ

Features:

- High analog input sampling rate coverage of up to 3 MSa/s for a single channel
- High analog input up to 64 channels
- High speed USB 2.0
- Multifunction capabilities — analog input (AI), analog output (AO), digital input output (DIO), and counter

For more information: http://www.keysight.com/find/U2300A



U2600A Series USB Modular Isolated Digital I/O

Features:

- 64 opto-isolated lines that can meet demand up to 24 V
- High speed USB 2.0
- Isolation voltage of 1250 Vrms for protection from transient voltage spikes

For more information: http://www.keysight.com/find/U2600A



U2781A USB modular product chassis

Features:

- Expansion of channels for each modular product
- Multiple instrument synchronization
- Internal and external 10 MHz reference clock
- High-speed USB 2.0
- SSI/Star trigger bus synchronization between external trigger source and modules

For more information: http://www.keysight.com/find/U2781A

Ordering Information

Model	Description
U2541A	250 kSa/s USB modular simultaneous sampling multifunction DAQ
U2542A	500 kSa/s USB modular simultaneous sampling multifunction DAQ
U2531A	2 MSa/s USB modular simultaneous sampling multifunction DAQ

Optional accessories

Model	Description
U2901A	Terminal block and SCSI-II 68-pin connector with 1-meter cable
U2902A	Terminal block and SCSI-II 68-pin connector with 2-meter cable

Web Resources

Learn more about U2500A at: www.keysight.com/find/U2500A

Learn more at: www.keysight.com

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

KEYSIGHT TECHNOLOGIES

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