Keysight Technologies

U2500A Series USB Modular Simultaneous Sampling Multifunction DAQ Devices

Data Sheet



KEYSIGHT TECHNOLOGIES

Introduction

The Keysight Technologies, Inc. U2500A Series USB modular simultaneous sampling multifunction data acquisition (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 resolutions of 14-bit and 16-bit. 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.

Features

- Simultaneous sampling with up to 2 MSa/s sampling rate 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 ADEs
- Easy-to-use bundled software
- Command logger function
- USB 2.0 and USBTMC-USB488 standards

Various features of the U2500A Series

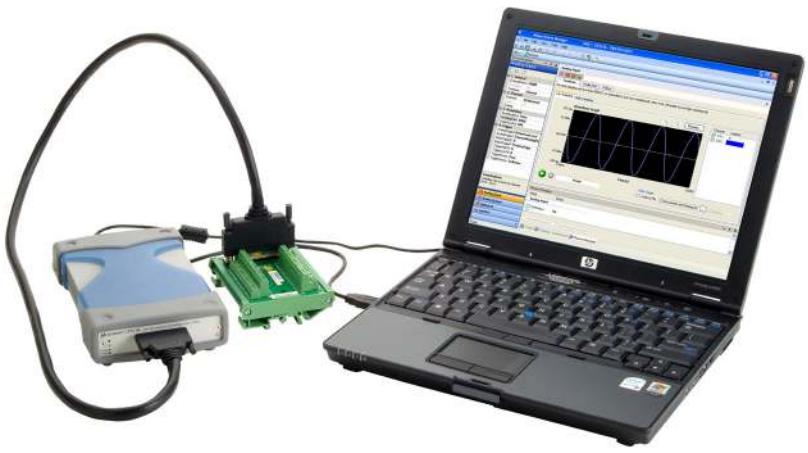
- Quick and easy USB setup
- High sampling rate of up to 2 MSa/s for each channel
- Dedicated analog-to-digital (ADC) that allows simultaneous sampling of data
- Flexible standalone or modular capability that enables lower startup cost
- SCPI and IVI-COM supported with a wide range of ADE compatibility that minimizes work time and increases software choices
- Easy-to-use 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 outlook and dimensions

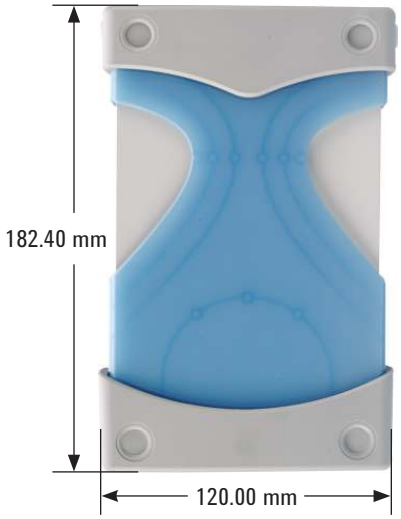
Front view



Rear view



Top view



Standard shipped accessories

- AC/DC Power adapter
- Power cord
- USB extension cable
- L-Mount kit (used with modular product chassis)
- Keysight USB Modular Products Quick Start Guide
- Keysight Measurement Manager for U2500A Series Quick Start Guide
- Keysight USB Modular Products Reference CD-ROM
- Keysight Automation-Ready CD-ROM (contains the Keysight IO Libraries Suite)
- Certificate of Calibration

Optional accessories

- 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

Product characteristics and General Specifications

REMOTE INTERFACE
- Hi-Speed USB 2.0
- USBTMC-USB488[1]

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 COMPLIANCE
–20 °C to 70 °C

SAFETY COMPLIANCE
Certified with:
- IEC 61010-1:2001/EN 61010-1:2001 (2nd Edition)
- USA: ANSI/UL 61010-1:2004
- Canada: CSA C22.2 No.61010-1:2004

EMC COMPLIANCE
- IEC 61326-1:2002/EN 61326-1:1997+A2:2001+A3:2003
- CISPR 11: 1990/EN 55011:1990-Group 1 Class A
- Canada: ICES-001:2004
- Australia/New Zealand: AS/NZS CISPR 11:2004

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)

WARRANTY
Three years for U2500A series DAQ devices
Three months for standard shipped accessories

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 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		
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		

Product specifications *(continued)*

Model number	U2531A	U2541A	U2542A
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
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		

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	
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	

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	

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.*

Test Condition

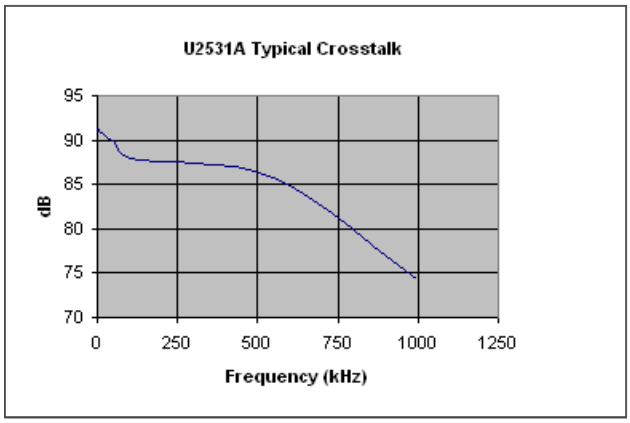
Dynamic range test for U2500A Series DAQ devices

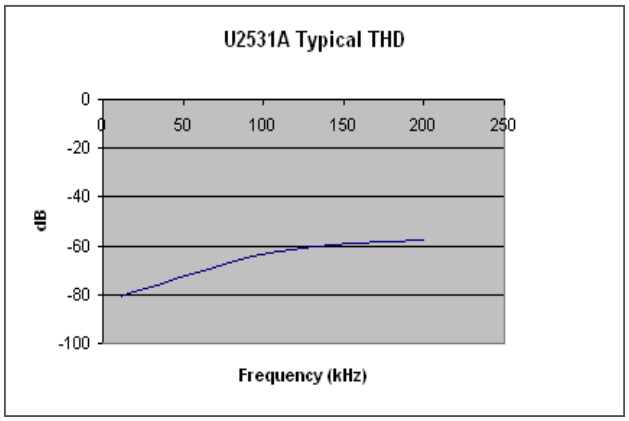
Dynamic range test	Model	Test conditions (DUT setting at ± 10 V bipolar)	
SFDR, THD, SINAD, SNR, ENOB	U2531A	– Sampling rate: – Fundamental frequency: – Number of points: – Fundamental input voltage:	2 MSa/s 19.927 kHz 65536 FSR –1 dB FS
	U2541A	– Sampling rate: – Fundamental frequency: – Number of points: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

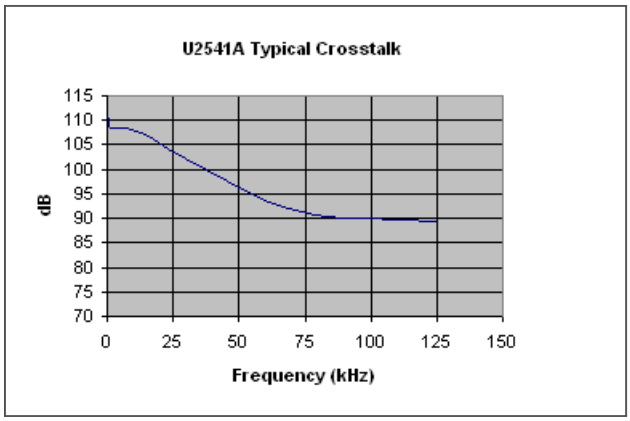
Bandwidth test for U2500A Series DAQ devices

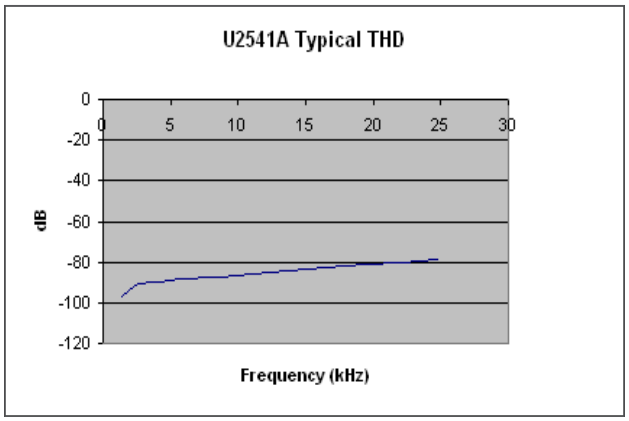
Bandwidth test	Model	Test conditions (DUT setting at ± 10 V bipolar)	
–3 dB Small signal bandwidth: 1% THD Large signal bandwidth:	U2531A	Sampling rate: Input voltage – –3 dB Small signal bandwidth: – 1% THD Large signal bandwidth:	2 MSa/s 10% FSR FSR – 1 dBFS
	U2541A	Sampling rate: Input voltage – –3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

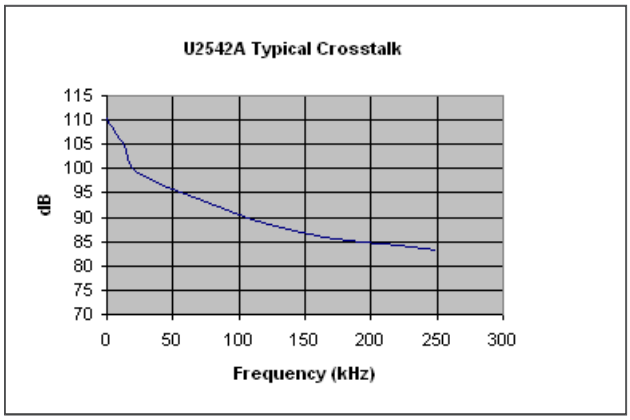
Typical Performance

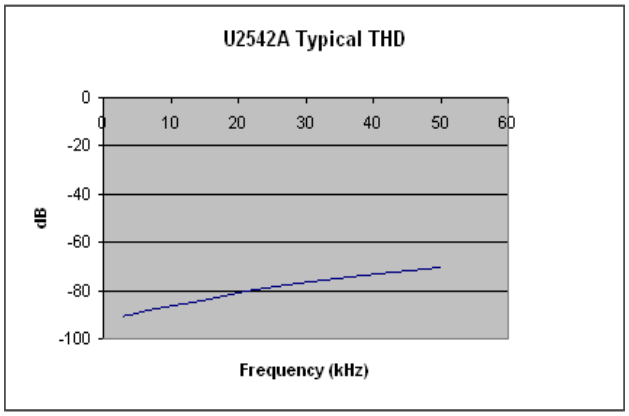












DC Characteristics

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

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)*

Keysight Measurement Manager

The Keysight Measurement Manager (KMM) is an application data viewer software that comes with the standard purchase of the U2500A Series USB modular data acquisition. This software is designed to help you perform quick device configuration, data logging and data acquisition using the products.

Supported features found in the U2500A Series USB modular simultaneous sampling multifunction DAQ device:

- Averaging
- Command logger
- Self-test
- Self-calibration
- Option to save the current instrument configuration to a file
- Data logging and export feature to CSV, HTML and text only format files that can be printed
- Data viewer to load and review previously logged data
- Trigger settings between modules in the instrument chases with Star trigger and Master/Slave trigger
- Synchronization display and data logging for modules in the instrument chassis

Keysight measurement manager prerequisites

Prior to installing the Keysight Measurement Manager software, ensure that your PC meets the following minimum system requirements for installation and operations.

Requirement	Windows XP operating systems	Windows Vista operating systems	Windows 7 operating systems
Operating system	Windows XP Service Pack 3 (or later) [1]	Windows Vista (32-bit) Service Pack 1 and 2 [2]	Windows 7 (32-bit and 64-bit) [3,4]
Processor speed	600 MHz or higher required, 800 MHz recommended	1 GHz 32-bit (x86)	3 GHz 32-bit (x86)
Memory	256 MB minimum (1 GB or greater recommended)	1 GB minimum	2 GB minimum
Hard-disk space	1.5 GB minimum	1.5 GB minimum	1.5 GB minimum
Video	Super VGA (800 × 600) 256 colors or more	Support for DirectX 9 graphics with 128 MB graphics memory recommended [5]	Support for DirectX 9 graphics with 128 MB graphics memory recommended [5]
CD-ROM drive or DVD-ROM drive [6]	Required	Required	Required
Browser	Microsoft Internet Explorer 5.01 or greater	Microsoft Internet Explorer 7 or greater	Microsoft Internet Explorer 7 or greater

1. *Supported Windows XP editions — Home or Professional*
2. *Supported Windows Vista (32-bit) editions — Home Basic, Home Premium, Business, or Ultimate*
3. *Supported Windows 7 (32-bit and 64-bit) editions — Home Basic, Home Premium, Professional, Enterprise, or Ultimate*
4. *Keysight Measurement Manger for Windows 7 64-bit support is a 32-bit application running on a WOW64 (Windows-on-Windows 64-bit) emulator.*
5. *Super VGA graphics is supported for Windows Vista and Windows 7.*
6. *The type of media provided with the product determines whether a CD-ROM drive or DVD-ROM drive is required.*

Software requirements
Keysight IO Libraries Suite 15.1 and above [1]
Keysight T&M Toolkit Runtime version 2.1 [2]
Keysight T&M Toolkit Redistributable Package 2.1 patch [2]
Microsoft .NET Framework version 2.0 [2]

1. *Available on the Keysight Automation-Ready CD-ROM*
2. *Bundled with Keysight Measurement Manager software application installer*



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

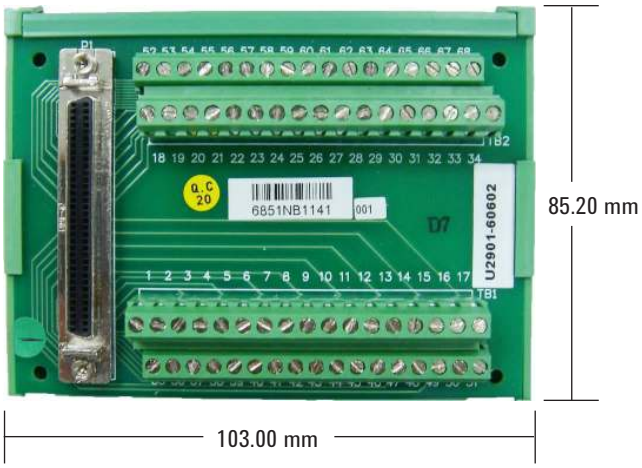
Optional Accessories

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

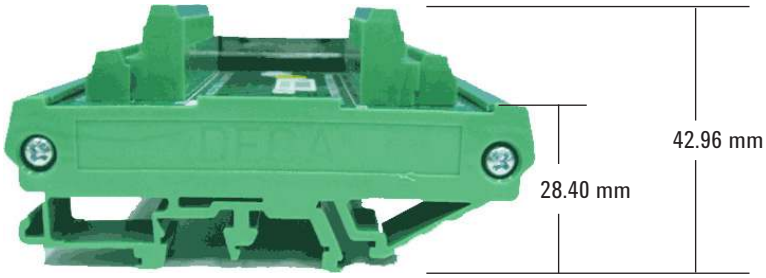
The U2901A/U2902A is a terminal block and SCSI-II 68-pin connector with 1 meter cable or 2 meter cable that can be used conjunction with the U2300A Series and U2500A Series.

Terminal block overview

Front view



Side view



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

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