DATA SHEET

U2300A Series USB Modular Multifunction Data Acquisition Devices



Introduction

The Keysight Technologies, Inc. U2300A Series USB Modular Multifunction Data Acquisition (DAQ) devices offer a high-performance PC data-acquisition solution. The U2300A Series DAQ devices consist of two families: the basic multifunction DAQ comes in four models while the high density multifunction DAQ is made up of three models. The U2300A Series DAQ devices applications extend across industrial and education environments. Extending across industrial and education environments, the U2300A series DAQ with fast sampling rates is well suited for research and development, manufacturing as well as design validation designers.

Features

- Up to 3 MSa/s sampling rate for a single channel
- Functions as a standalone or modular unit
- Easy to use: Plug-and-play and hot swappable with Hi-Speed USB 2.0
- Up to 384 channels when incorporated into U2781A modular product chassis
- Easy-to-use bundled software for quick setup and data logging to PC
- 12-bit or 16-bit analog-to-digital (A/D) resolution
- 24-bit programmable digital input/output
- Self-calibration capability
- Compatible with a wide range of Keysight Development Environments (KDEs)
- USB 2.0 and USBTMC-USB488 standards
- NEW! Control, automate and simplify with Keysight BenchVue software. Now included.

KEYSIGHT TECHNOLOGIES

High sampling rate

The U2300A Series DAQ devices can generate sampling rates of up to 3 MSa/s for a single channel. When multiple channels are configured, the device can sample data up to 1 MSa/s. The fast sampling capability allows users to perform intermittent detection easily. This is ideal when dealing with high density analog input/output signals especially when juggling between different input ranges and sampling requirements.

Flexible standalone or modular capability

The U2300A Series DAQ devices are uniquely designed with the flexibility to function as a standalone unit or as a part of a modular unit. When used together with the U2781A modular product chassis, the devices has the capability to support up to 384 channels.

Flexible system and control options with polling and continuous mode

The U2300A Series DAQ devices have two modes, polling mode and continuous mode. Selecting continuous mode enables you to acquire data continuously once the trigger signal is received.

Arbitrary waveform

Designed to support arbitrary waveforms, the U2300A Series allows you to generate arbitrary waveform via SCPI commands.

Burst mode

Equipped with the burst mode, the enhancement feature enables simultaneous mode for analog input acquisition. Now can you can perform sampling measurement up to the highest possible speed of the DAQ.

Trigger sources

U2300A Series offers various trigger options from immediate trigger (none), analog/external digital trigger, System Synchronous Interface (SSI)/ Star trigger and Master/Slave trigger sources. These entire trigger options has the capability to configure trigger sources during A/D and digital-to-analog (D/A) operations. Selecting the slave trigger and SSI/Star trigger are recommended when the USB modules are used together with the U2781A USB modular product chassis.

Predefined function generator

Aside from supplying DC voltage, the two analog output channels are capable of generating common and predefined waveforms such as sinusoidal wave, square wave, triangle wave, sawtooth wave and noise wave.

Product Outlook and Dimensions

Front view



Rear view



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
Power consumption +12 VDC, 550 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 & 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)

[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.

Electrical Specifications

Basic multifunction USB DAQ

Model number	U2351A	U2352A	U2353A	U2354A
Analog input				
Resolution	16 bits, no missing codes			
Number of channels	16 SE/8 DI (software selectable/channel)			
Maximum sampling rate [1]	250 kSa/s		500 kSa/s	
Scan list memory	Up to 100 selectable channel entries			
Programmable bipolar input range	± 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	± 7.5 $V_{maximum}$			
Overvoltage protection	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			

[1] When multiple channels are used, the sampling rate of each channel is the maximum sampling rate divided by the number of channels used.
[2] System Synchronous Interface (SSI) and Star trigger commands are used when modular devices are used in the product chassis.

Model number	U2351A	U2352A	U2353A	U2354A
Analog output				
Resolution	16 bits	-	16 bits	-
Number of channels	2	-	2	-
Maximum update rate	1 MSa/s	-	1 MSa/s	-
Output ranges	0 to 10 V, ± 10 V, 0 to AO_EXT_REF, ± AO_EXT_REF [1]	-	0 to 10 V, ± 10 V, 0 to AO_EXT_REF, ± AO_EXT_REF [1]	-
Output coupling	DC	-	DC	-
Output impedance	0.1 Ω typical	-	0.1 Ω typical	-
Stability	Any passive load up to 1500 pF	-	Any passive load up to 1500 pF	-
Power-on state	0 V steady state	-	0 V steady state	-
Trigger sources	External analog/digital trigger, SSI/Star trigger [2]	-	External analog/digital trigger, SSI/Star trigger [2]	-
Trigger modes	Post-trigger and delay-trigger	-	Post-trigger and delay-trigger	-
FIFO buffer size	One channel: Maximum 8 MSa Two channels: Maximum 4 MSa/ch	-	One channel: Maximum 8 MSa Two channels: Maximum 4 MSa/ch	-
Function generation mode	Sine, square, triangle, sawtooth, and noise waveforms	-	Sine, square, triangle, sawtooth, and noise waveforms	-
Digital I/O				
Number of channels	24-bit programmable input/output			
Compatibility	TTL			
Input voltage	V_{IL} = 0.7 V max, I_{IL} = 10 µA max V_{IH} = 2.0 V min, I_{IH} = 10 µA max			
Input voltage range	–0.5 V to +5.5 V			
Output voltage	V_{OL} = 0.45 V max, I_{OL} = 8 mA max V_{OH} = 2.4 V min, I_{OH} = 400 µA max			

[1] Maximum external reference voltage for analog output channels (AO_EXT_REF) is ±10 V.
[2] System Synchronous Interface (SSI) and Star trigger commands are used when modular devices are used in the product chassis.

Model number	U2351A	U2352A	U2353A	U2354A
General purpose digital counter				
Maximum count	$(2^{31}–1)$ bits			
Number of channels	Two 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 [1]	0.1 Hz to 6 MHz at 50% duty cycle			
Pulse width measurement range	0.167 µs to 178.956 s			
Analog trigger				
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 [2]				
On board reference voltage	5 V			
Temperature drift	± 2 ppm/°C			
Stability	± 6 ppm/1000 hrs			
General				
Remote interface	Hi-Speed USB 2.0			
Device class	USBTMC-USB488			
Programmable interface	Standard Commands for Programmable Instruments (SCPI) and IVI-COM			

[1] 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)
[2] 20 minutes warm-up time is recommended.

High density multifunction USB DAQ

Model number	U2355A	U2356A	U2331A
Analog input			
Resolution	16 bits, no missing codes		12 bits, no missing codes
Number of channels	64 SE/32 DI (software selectable/channel)		
Maximum sampling rate [1]	250 kSa/s	500 kSa/s	3 MSa/s (single channel) 1 MSa/s (multiple channels)
Scan list memory	Up to 100 selectable channel entries		
Programmable bipolar input range	± 10 V, ± 5 V, ± 2.5 V, ± 1.25 V		± 10 V, ± 5 V, ± 2.5 V, ± 1.25 V, ± 1 V, ± 0.5 V, ± 0.25 V, ± 0.2 V, ± 0.05 V
Programmable unipolar input range	0 to 10 V, 0 to 5 V, 0 to 2.5 V, 0 to 1.25 V		0 to 10 V, 0 to 5 V, 0 to 4 V, 0 to 2.5 V, 0 to 2 V, 0 to 1 V, 0 to 0.5 V, 0 to 0.4 V, 0 to 0.1V
Input coupling	DC		
Input impedance	1 GΩ / 100 pF		
Operational common mode voltage range	± 7.5 V maximum		
Overvoltage protection	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	Post-trigger and delay-trigger		
FIFO buffer size	One channel: Maximum 8 MSa Two channels: Maximum 4 MSa/ch		
Function generation mode	Sine, square, triangle, sawtooth, and noise waveforms		

[1] When multiple channels are used in the U2355A or U2356A, the sampling rate of each channel is the maximum sampling rate divided by the number of channels used. For multiple channels used in the U2331A, the sampling rate of each channel = (1 MSa/s) / number of channels used.
[2] System Synchronous Interface (SSI) and Star trigger commands are used when modular devices are used in the product chassis.
[3] Maximum external reference voltage for analog output channels (AO_EXT_REF) is ± 10 V.

Model number	U2355A	U2356A	U2331A
Digital I/O			
Number of bits	24-bit programmable input/output		
Compatibility	TTL		
Input voltage	V_{IL} = 0.7 V max, I_{IL} = 10 µA max V_{IH} = 2.0 V min, I_{IH} = 10 µA max		
Input voltage range	–0.5 V to +5.5 V		
Output voltage	V_{OL} = 0.45 V max, I_{OL} = 8 mA max V_{OH} = 2.4 V min, I_{OH} = 400 µA max		
General purpose digital counter			
Maximum count	$(2^{31} – 1)$ bits		
Number of channels	Two 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 [1]	0.1 Hz to 6 MHz at 50% duty cycle		
Pulse width measurement range	0.167 µs to 178.956 s		
Analog trigger			
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		

[1] 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)

Model number	U2355A	U2356A	U2331A
Calibration [1]			
On board reference	24-bit programmable input/output		
Temperature drift	TTL		
Stability	± 6 ppm/1000 hrs		
General			
Remote interface	Hi-Speed USB 2.0		
Device class	USBTMC-USB488		
Programmable interface	Standard Commands for Programmable Instruments (SCPI) and IVI-COM		

[1] 20 minutes warm-up time is recommended.

Electrical Measurement Specifications

Basic multifunction USB DAQ

Model number	U2351A, U2352A		U2353A, U2354A	
Analog input measurement [1]				
Function	**23 °C ± 5 °C**	**0 °C to 18 °C 28 °C to 45 °C**	**23 °C ± 5 °C**	**0 °C to 18 °C 28 °C to 45 °C**
Offset error	± 1 mV	± 5 mV	± 1 mV	± 5 mV
Gain error	± 2 mV	± 5 mV	± 2 mV	± 5 mV
–3 dB Small signal bandwidth [2]	760 kHz		1.5 MHz	
1% THD Large signal bandwidth [2]	300 kHz		300 kHz	
System noise	1 mVrms	2 mVrms	1 mVrms	2.5 mVrms
CMRR	62 dB		62 dB	
Spurious-Free Dynamic Range (SFDR) [3]	88 dB		82 dB	
Signal-to-Noise and Distortion Ratio (SINAD) [3]	80 dB		78 dB	
Total Harmonic Distortion (THD) [3]	–90 dB		–82 dB	
Signal-to-Noise Ratio (SNR) [3]	80 dB		78 dB	
Effective Number of Bits (ENOB) [3]	13		12.6	

[1] Specifications are for 20 minutes of warm-up time, calibration temperature at 23 °C and input range of ± 10 V.

[2] Specifications are based on the following test condition:

Bandwidth test	Model number	Test conditions (DUT setting at ± 10 V bipolar)	
–3 dB Small signal bandwidth 1% THD large signal bandwidth	U2351A U2352A	Sampling rate: Input voltage: • –3 dB Small signal bandwidth • 1% THD Large signal bandwidth	250 kSa/s • 10% FSR • FSR –1 dB FS
	U2353A U2354A	Sampling rate: Input voltage: • –3 dB Small signal bandwidth • 1% THD Large signal bandwidth	500 kSa/s • 10% FSR • FSR –1 dB FS

[3] Specifications are based on the following test condition:

Dynamic range test	Model number	Test conditions (DUT setting at ± 10 V bipolar)	
SFDR, THD, SINAD, SNR, ENOB	U2351A U2352A	• Sampling rate: • Fundamental frequency: • Number of points: • Fundamental input voltage:	250 kSa/s 2.4109 kHz 8192 FSR –1 dB FS
	U2353A U2354A	• Sampling rate: • Fundamental frequency: • Number of points: • Fundamental input voltage:	500 kSa/s 4.974 kHz 16384 FSR –1 dB FS

Model number	U2351A, U2353A	
Analog input measurement [1]		
Function	**23 °C ± 5 °C**	**0 °C to 18 °C 28 °C to 45 °C**
Offset error	± 1 mV	± 4mV
Gain error	± 4mV	± 5 mV
Slew rate	19 V/µs	
Rise time	0.9 µs	
Fall time	0.9 µs	
Settling time to 1% output error	4 µs	
Driving capability	5 mA	
Glitch energy	5 ns-V (typical), 80 ns-V (maximum)	

[1] Specifications are for 20 minutes of warm-up time, calibration temperature at 23 °C and input range of ± 10 V.

High density multifunction USB DAQ

Model number	U2355A		U2356A		U2331A	
Analog input measurement [1]						
Function	**23 °C ± 5 °C**	**0 °C to 18 °C 28 °C to 45 °C**	**23 °C ± 5 °C**	**0 °C to 18 °C 28 °C to 45 °C**	**23 °C ± 5 °C**	**0 °C to 18 °C 28 °C to 45 °C**
Offset error	± 1 mV	± 2 mV	± 1 mV	± 2 mV	± 2 mV	± 3 mV
Gain error	± 2 mV	± 3 mV	± 2 mV	± 6 mV	± 6 mV	± 7.5 mV
–3 dB small signal bandwidth [2]	760 kHz		1.3 MHz		1.2 MHz	
1% THD large signal bandwidth [2]	400 kHz		400 kHz		N/A	
System noise	1 mVrms	2 mVrms	1 mVrms	4 mVrms	3 mVrms	5 mVrms
CMRR	64 dB		61 dB		62 dB	
Spurious-Free Dynamic Range (SFDR) [3]	88 dB		86 dB		71 dB	
Signal-to-Noise and Distortion Ratio (SINAD) [3]	80 dB		78 dB		72 dB	
Total Harmonic Distortion (THD) [3]	–90 dB		–84 dB		–76 dB	
Signal-to-Noise Ratio (SNR) [3]	80 dB		78 dB		72 dB	
Effective Number of Bits (ENOB) [3]	13		12.6		11.6	

[1] Specifications are for 20 minutes of warm-up time, calibration temperature at 23 °C and input range of ± 10 V.

[2] Specifications are based on the following test condition:

Bandwidth test	Model number	Test conditions (DUT setting at ± 10 V bipolar)	
–3 dB Small signal bandwidth 1% THD large signal bandwidth	U2351A U2352A	Sampling rate: Input voltage: • –3 dB Small signal bandwidth • 1% THD Large signal bandwidth	250 kSa/s • 10% FSR • FSR –1 dB FS
	U2353A U2354A	Sampling rate: Input voltage: • –3 dB Small signal bandwidth • 1% THD Large signal bandwidth	500 kSa/s • 10% FSR • FSR –1 dB FS

[3] Specifications are based on the following test condition:

Dynamic range test	Model number	Test conditions (DUT setting at ± 10 V bipolar)	
SFDR, THD, SINAD, SNR, ENOB	U2351A U2352A	• Sampling rate: • Fundamental frequency: • Number of points: • Fundamental input voltage:	250 kSa/s 2.4109 kHz 8192 FSR –1 dB FS
	U2353A U2354A	• Sampling rate: • Fundamental frequency: • Number of points: • Fundamental input voltage:	500 kSa/s 4.974 kHz 16384 FSR –1 dB FS

Model number	U2355A, U2356A		U2331A	
Analog input measurement [1]				
Function	**23 °C ± 5 °C**	**0 °C to 18 °C 28 °C to 45 °C**	**23 °C ± 5 °C**	**0 °C to 18 °C 28 °C to 45 °C**
Offset error	± 1 mV	± 4 mV	± 1.5 mV	± 4 mV
Gain error	± 4 mV	± 5 mV	± 4 mV	± 5 mV
Slew rate	19 V/µs		19 V/µs	
Rise time	0.9 µs		0.9 µs	
Fall time	0.9 µs		0.9 µs	
Settling time to 1% output error	4 µs		4 µs	
Driving capability	5 mA		5 mA	
Glitch energy	5 ns-V (typical), 80 ns-V (maximum)		5 ns-V (typical), 80 ns-V (maximum)	

[1] Specifications are for 20 minutes of warm-up time, calibration temperature at 23 °C and input range of ± 10 V.

DC Characteristics

Accuracy specifications

Model number	U2351A, U2352A, U2353A, U2354A		
Analog input			
Unipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.5	2.0	0.04% + 1.5 mV
5	1.5	2.0	0.08% + 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)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.0	2.0	0.02% + 1.0 mV
5	1.0	2.0	0.04% + 1.0 mV
2.5	1.0	1.5	0.06% + 1.0 mV
1.25	1.0	1.5	0.12% + 1.0 mV
Model number	**U2355A, U2356A**		
Unipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.0	1.5	0.03% + 1.0 mV
5	1.0	1.5	0.06% + 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)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.0	2.0	0.02% + 1.0 mV
5	1.0	2.0	0.04% + 1.0 mV
2.5	1.0	1.5	0.06% + 1.0 mV
1.25	1.0	1.5	0.12% + 1.0 mV

[1] Offset error is measured at midscale of full range.
[2] Accuracy = ± [% of |(Gain error / (Measured value – Midscale of FSR))| + Offset error]

Model number	U2331A		
Analog input			
Unipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.5	4.0	0.08% + 1.5 mV
5	1.5	2.0	0.08% + 1.5 mV
4	1.5	2.0	0.10% + 1.5 mV
2.5	1.0	1.5	0.12% + 1.0 mV
2	1.0	1.0	0.10% + 1.0 mV
1	1.0	1.0	0.20% + 1.0 mV
0.5	1.0	1.0	0.41% + 1.0 mV
0.4	1.0	1.0	0.51% + 1.0 mV
0.1	1.0	1.0	2.04% + 1.0 mV
Bipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	2.0	6.0	0.06% + 2.0 mV
5	1.5	4.0	0.08% + 1.5 mV
2.5	1.5	2.0	0.08% + 1.5 mV
1.25	1.0	1.5	0.12% + 1.0 mV
1	1.0	1.0	0.10% + 1.0 mV
0.5	1.0	1.0	0.20% + 1.0 mV
0.25	1.0	1.0	0.40% + 1.0 mV
0.2	1.0	1.0	0.50% + 1.0 mV
0.05	1.0	1.0	2.02% + 1.0 mV

- The above specifications are typical for 23 °C
- Specifications are for 20 minutes warm-up and self-calibration
- The measurement are calculated with 100 points averaging of data

[1] Offset error is measured at midscale of full range.
[2] Accuracy = ± [% of |(Gain error / (Measured value – Midscale of FSR))| + Offset error]

Model number	U2351A, U2352A, U2353A, U2354A		
Analog output			
Unipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.0	2.0	0.02% + 1.0 mV
Bipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.0	4.0	0.04% + 1.0 mV
Model number	**U2355A, U2356A**		
Unipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.0	2.0	0.02% + 1.0 mV
Bipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.0	4.0	0.04% + 1.0 mV
Model number	**U2331A**		
Unipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	2.5	4.0	0.04% + 2.5 mV
Bipolar range (V)	**Offset error (mV) [1]**	**Gain error (mV)**	**Accuracy (% of reading + offset error) [2]**
10	1.5	4.0	0.04% + 1.5 mV

- The above specifications are typical for 23 °C
- Specifications are for 20 minutes warm-up and self-calibration

[1] Offset error is measured at 0 V.
[2] Accuracy = ± [% of |Gain error/Output value| + Offset voltage]

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.

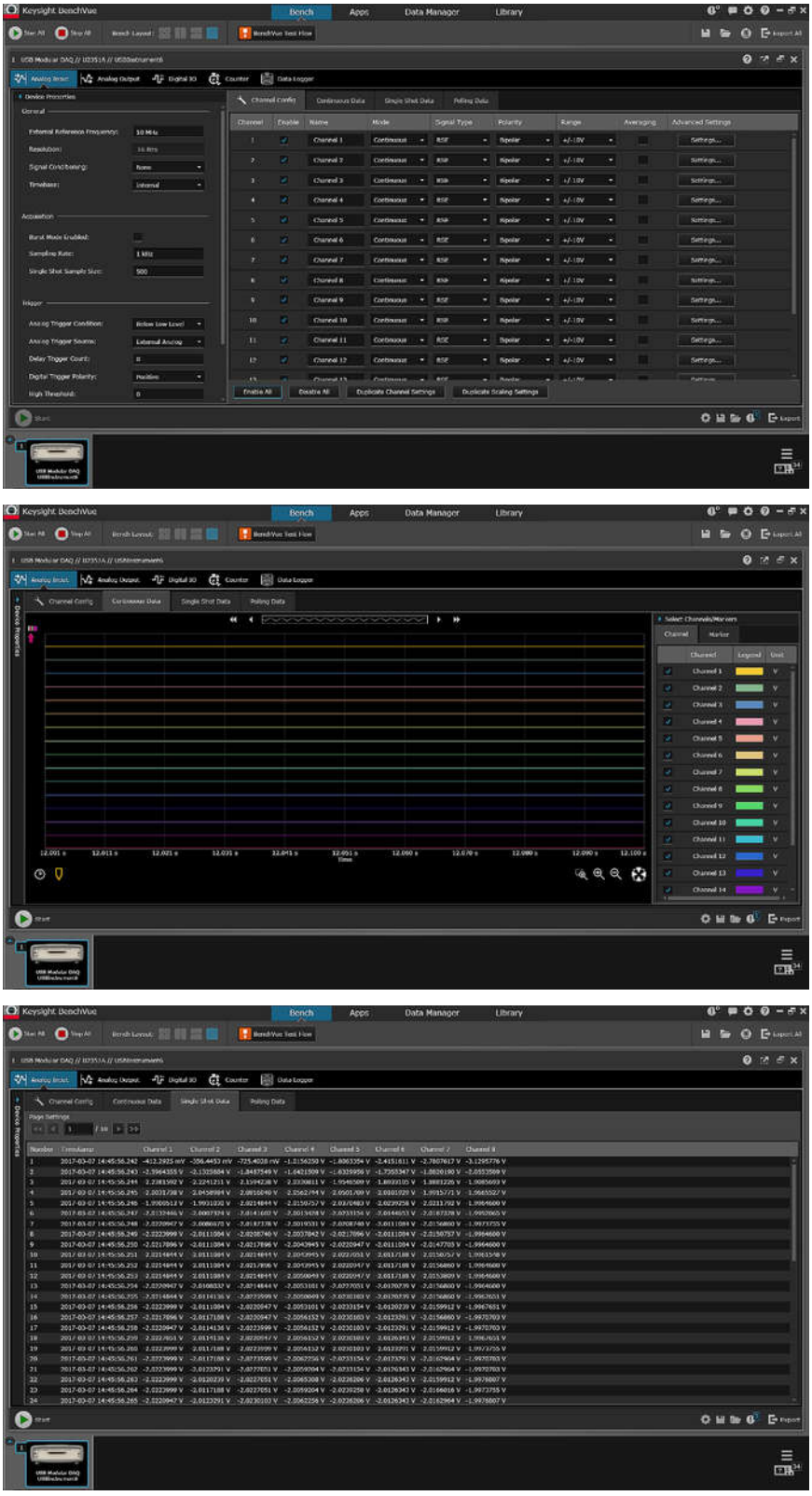
- Visualize multiple measurements simultaneously
- Easily log data, screen shots and system state
- Rapidly prototype custom test sequences
- Recall past states of your USB Modular DAQ device to replicate results
- Export measurement data in the desired format fast
- Quickly access manuals, drivers,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

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.

Get started with BenchVue, downloadable at no cost at www.keysight.com/find/benchvue.



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



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

Optional Accessories: U2802A Thermocouple Input Signal Conditioner

The Keysight U2802A is a 31-channel Thermocouple Input Signal Conditioner with a built-in thermistor for cold junction compensation. The U2802A converts low input voltage signals (less than ± 100 mV) from a thermocouple into an output voltage range suitable for data acquisition devices (± 10 V). The U2802A is designed for use with the U2355A/U2356A USB Modular Multifunction DAQ device for temperature measurements with thermocouples (standalone operation only). The U2802A can be attached to the DAQ device via two SCSI-II 68 conductor cables. The thermocouple complements eight standard thermocouple types which caters to a wide range of application and industrial settings.

Features to meet your demands

- 31 input channels that can be independently configured to either differential thermocouple input mode, single-ended voltage input mode, or differential voltage input mode using two input channels set to voltage input mode
- Supports the standard thermocouple types (J, K, R, S, T, N, E, and B) defined in the NIST ITS-90 Thermocouple Database
- Error detection for open thermocouple channels
- Built-in isothermal construction on terminal block for improved measurement accuracy
- Built-in thermistor for cold junction compensation
- Built-in zeroing function to compensate for overall system offset errors due to temperature drift and long term drift
- Up to ± 10 V input voltage range for higher voltage inputs
- Sampling rate of 500 kSa/s for overall module
- Sampling rate of 10 kSa/s total for all channels in thermocouple mode
- Quick and easy USB setup
- Robust, cost-effective, and user friendly

Applications

The U2802A Thermocouple Input Signal Conditioner can be used in various applications, including:

- Product thermal analysis and characterization
- Environmental chamber profiling
- Process monitoring in consumer electronics markets
- Material properties testing in education environments
- Study of electronic temperature properties
- Appliances testing



Thermocouple input mode

In thermocouple input mode, the U2802A can acquire up to ± 100 mV input signals. Each channel includes an instrumentation amplifier and a 4 Hz low-pass filter. The low-pass filter removes unwanted noise from the thermocouple wires to obtain accurate measurement data.

Voltage input mode

Alternatively, you can select separate voltage input modes for each channel. The channel will be set to bypass the amplifier and filter, allowing up to ± 10V input signals to be directly routed to the DAQ device analog input. The bandwidth in this mode is more than 500 kHz.

Zero mode

In zero mode, the positive and negative inputs of the instrumentation amplifier are shorted together. The voltage measured in this mode corresponds to the offset voltage of the channel. You can subtract this offset voltage from subsequent thermocouple mode measurements to increase measurement accuracy. This mode is only applicable in thermocouple mode.

Thermocouple compatibility

The U2802A is compatible with a wide range of standard thermocouple types defined in the NIST ITS-90 Thermocouple Database. This includes types J, K, R, S, T, N, E, and B.

Open thermocouple detection

The U2802A includes open thermocouple detection circuitry to indicate the presence of an open thermocouple.

Calibration EEPROM

The U2802A gain and offset calibration factors for each channel are stored in the EEPROM during factory calibration and can be retrieved prior to taking measurements. This on-board EEPROM also stores the module ID, serial number, and date of calibration for your reference. A section of the EEPROM is also allocated for you to save your calibration data.



U2802A Product Outlook and Dimensions

Front view



Rear view



Top and side view



Product characteristics and general specifications

Power consumption +12 VDC, 480 mA maximum
Operating environment Operating temperature from 0 °C to +55 °C Relative humidity at 50% to 85% RH (non-condensing) Altitude up to 2000 meters
Storage compliance –40 °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 2 × 68-pin female SCSI connector 2 × 34 pin screw terminal block 1 × 24 pin screw terminal block
Dimension (W × D × H) 158.70 mm × 254.20 mm × 40.50 mm
Weight 1.036 kg

U2802A Product Specifications

General characteristics	
Number of channels	31 differential and 1 CJC
Input voltage range for voltage mode	± 10 V (signal + common mode)
Input voltage (thermocouple mode)	± 100 mV
Sampling rate for thermocouple mode	10 kSa/s total for all channels
Sampling rate for overall module	500 kSa/s
Thermocouple types	J, K, R, S, T, N, E, and B
Input specifications	
Accuracy (thermocouple mode) Overall gain error Overall offset error Nonlinearity	 0.06% (23 °C ± 5 °C) 15 µV (without zeroing) (23 °C ± 5 °C) 6 µV (with zeroing) < 0.005% of full scale range
System noise (rms) • Gain (× 1) • Gain (× 100)	 100 µVrms 5 µVrms
Common Mode Rejection Ratio (CMRR) • Voltage mode • Thermocouple mode	 > 60 dB > 80 dB
Cold junction accuracy	± 1.0 °C typical (23 °C ± 5 °C) ± 1.5 °C typical (0 °C to 18 °C, 28 °C to 55 °C)
Input characteristics	
Bandwidth (voltage mode)	> 500 kHz
Bandwidth (thermocouple mode)	4.0 Hz
Overvoltage protection [1]	TC Mode [2] Common mode: ± 17 V (TC+ and TC– with respect to GND) Differential mode: ± 7 V (Differential voltage between TC+ and TC–) Bypass mode ± 20 V (TC+ input with respect to GND) Power-off Mode ± 11 V (TC+, TC– input with respect to GND)
Input impedance	1 G Ω
Input bias current	± 2.5 nA max
Input offset current	± 1.5 nA max

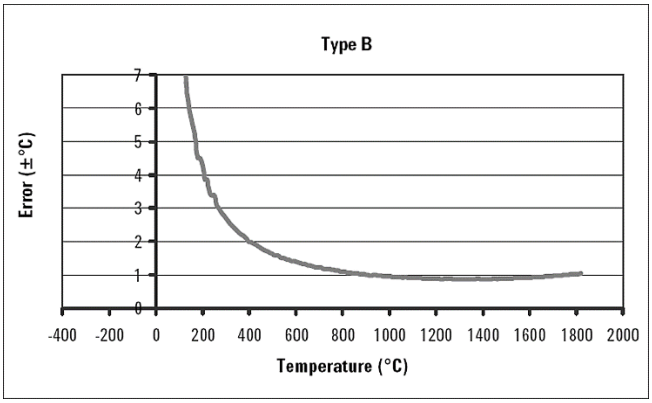
[1] The overvoltage protection levels specified above indicate the maximum voltage each input pin can tolerate without resulting in any damages. However, prolonged exposure to these levels may affect device safety and reliability. Hence, it should be avoided where possible.

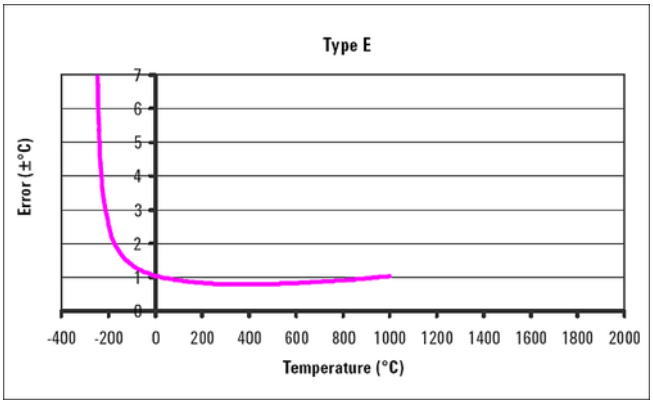
[2] On the channels configured for thermocouple mode, the TC+ and TC– pins can tolerate up to ±17 V of differential voltage for a few minutes. However, exceeding a voltage range of ± 100 mV on these channels can cause additional current to be drawn from the device's power supply regulators, which may damage the device if multiple channels are overdriven for prolonged periods. This is the case when a voltage source is tied across the TCn+ and TCn– pin. Voltage sources greater than ± 100 mV should be tied to TCn+ and GND (floating source), or TCn+ and TCn+1+ (grounded source), and have the channels set for bypass mode.

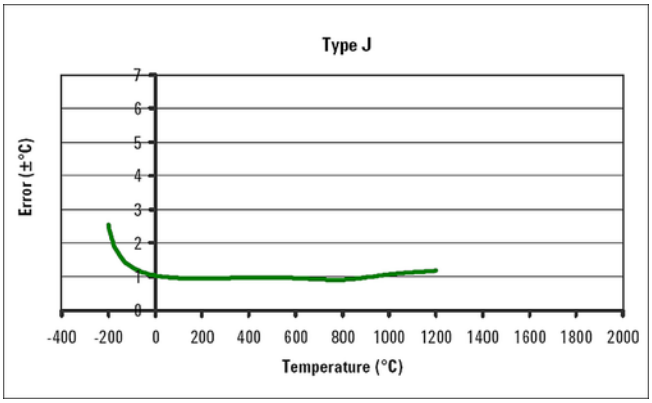
Gain drift	60 ppm/°C max
Offset drift	1 µV/°C max
Filter cutoff frequency (–3 dB) (thermocouple mode)	4.0 Hz
Filter type (thermocouple mode)	Low Pass RC Filter
Other features	
Recommended warm up time	30 minutes

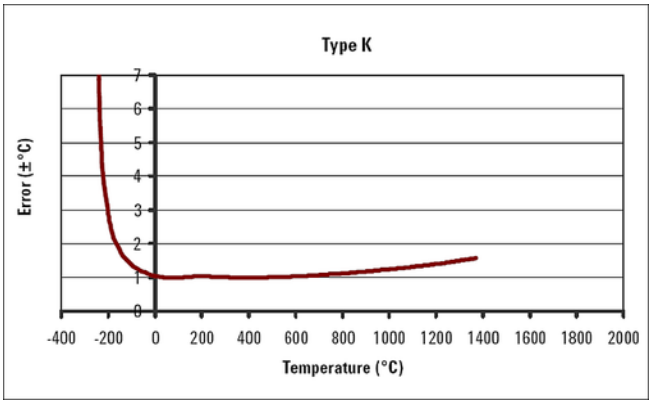
Thermocouples Typical Measurement Accuracy

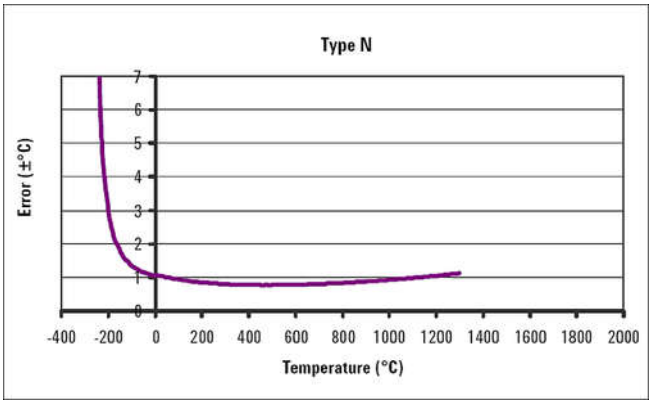
The U2802A measurement error with U2355A or U2356A at 23 °C ± 5 °C is shown below.

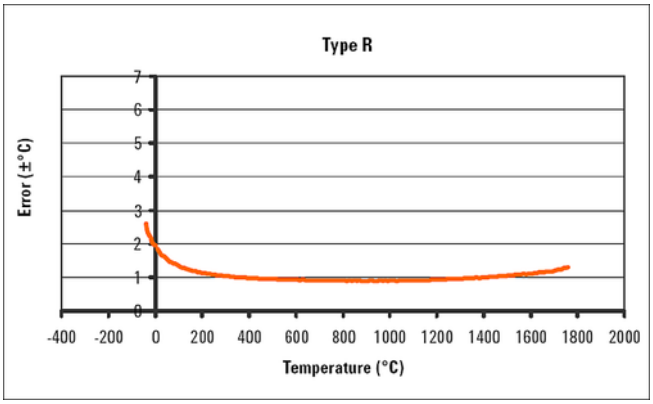


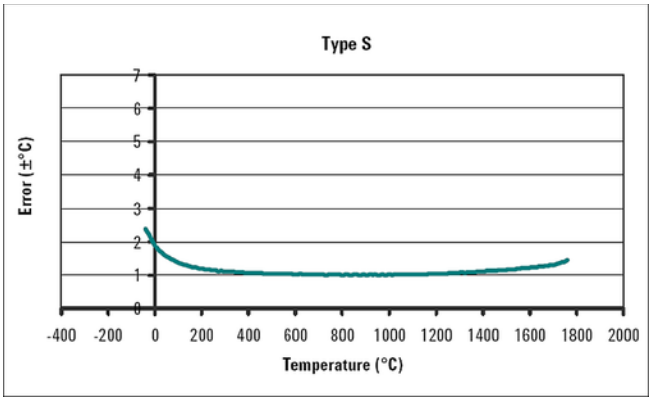


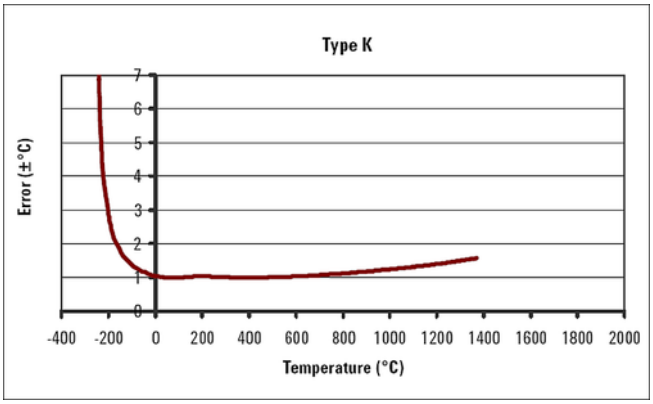












System Accuracy Specifications

The U2802A system accuracy specifications are shown in Table 1, Table 2, and Table 3. These measurements are derived from the U2802A and DAQ input accuracy specifications without including the thermocouple error. Refer to “Calculating System Accuracy” section in the Keysight U2802A 31-Channel Thermocouple Input Device User’s Guide for calculation methodology.

Table 1. Measurement accuracy of the U2355A and U2356A at 23 °C ± 5 °C

Thermocouple measurement accuracy (U2355A, U2356A at 23 °C ± 5 °C)							
T/C type	ITS-90 Temperature range (°C)		Optimum measurement range (°C)		Without averaging (± °C)	50 points averaging (± °C)	500 points averaging (± °C)
	Low	High	Low	High			
B	0	1820	1100	1820	1.9	1.2	1.0
			400	1100	4.4	2.5	2.0
E	–270	1000	–150	1000	1.7	1.6	1.6
			–200	–150	2.4	2.3	2.3
J	–210	1200	–150	1200	1.6	1.5	1.5
			–200	–150	2.7	2.6	2.5
K	–270	1372	–100	1200	1.5	1.4	1.4
			–200	–100	2.7	2.6	2.6
N	–270	1300	–100	1300	1.5	1.3	1.3
			–200	–100	3.0	2.7	2.6
R	–50	1768	300	1760	2.0	1.4	1.3
			–50	300	5.0	3.1	2.6
S	–50	1768	400	1760	2.1	1.6	1.4
			–50	400	4.5	2.8	2.4
T	–270	400	–100	400	1.5	1.4	1.4
			–200	–100	2.7	2.5	2.5

Table 2. Measurement accuracy of the U2355A at 0 to 18 °C and 28 to 45 °C

Thermocouple measurement accuracy (U2355A at 0 to 18 °C and 28 to 45 °C)							
T/C type	ITS-90 Temperature range (°C)		Optimum measurement range (°C)		Without averaging (± °C)	50 points averaging (± °C)	500 points averaging (± °C)
	Low	High	Low	High			
B	0	1820	1100	1820	3.4	2.4	2.2
			400	1100	7.5	3.6	2.2
E	–270	1000	–150	1000	2.7	2.6	2.5
			–200	–150	3.8	3.6	3.6
J	–210	1200	–150	1200	2.5	2.4	2.4
			–200	–150	4.2	4.0	3.9
K	–270	1372	–100	1200	2.9	2.8	2.8
			–200	–100	4.3	4.0	3.9
N	–270	1300	–100	1300	2.6	2.5	2.5
			–200	–100	4.9	4.2	4.0
R	–50	1768	300	1760	3.8	3.1	3.0
			–50	300	8.5	4.6	3.3
S	–50	1768	400	1760	4.2	3.4	3.2
			–50	400	7.7	4.2	3.1
T	–270	400	–100	400	2.4	2.2	2.2
			–200	–100	4.3	4.3	3.9

Table 3. Measurement accuracy of the U2356A at 0 to 18 °C and 28 to 45 °C

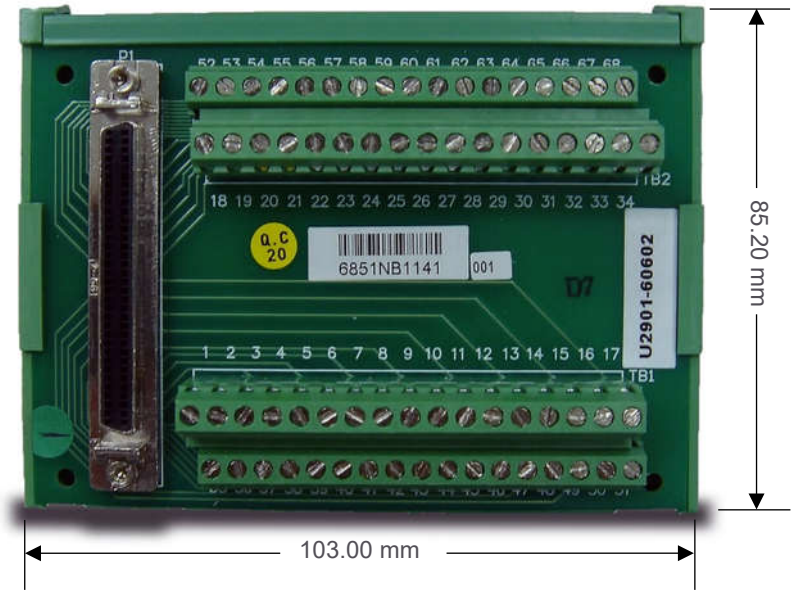
Thermocouple measurement accuracy (U2356A @ 0 to 18 °C and 28 to 45 °C)							
T/C type	ITS-90 Temperature range (°C)		Optimum measurement range (°C)		Without averaging (± °C)	50 points averaging (± °C)	500 points averaging (± °C)
	Low	High	Low	High			
B	0	1820	1100	1820	6.1	3.1	2.4
			400	1100	14.4	6.3	2.7
E	–270	1000	–150	1000	3.0	2.6	2.6
			–200	–150	4.2	3.7	3.6
J	–210	1200	–150	1200	2.9	2.5	2.5
			–200	–150	4.9	4.1	4.0
K	–270	1372	–100	1200	3.3	2.9	2.9
			–200	–100	5.3	4.2	4.0
N	–270	1300	–100	1300	3.4	2.7	2.6
			–200	–100	6.8	4.6	4.1
R	–50	1768	300	1760	6.2	3.7	3.2
			–50	300	15.7	7.2	3.8
S	–50	1768	400	1760	6.4	4.0	3.4
			–50	400	14.2	6.6	3.4
T	–270	400	–100	400	3.0	2.4	2.2
			–200	–100	5.3	4.2	3.9

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

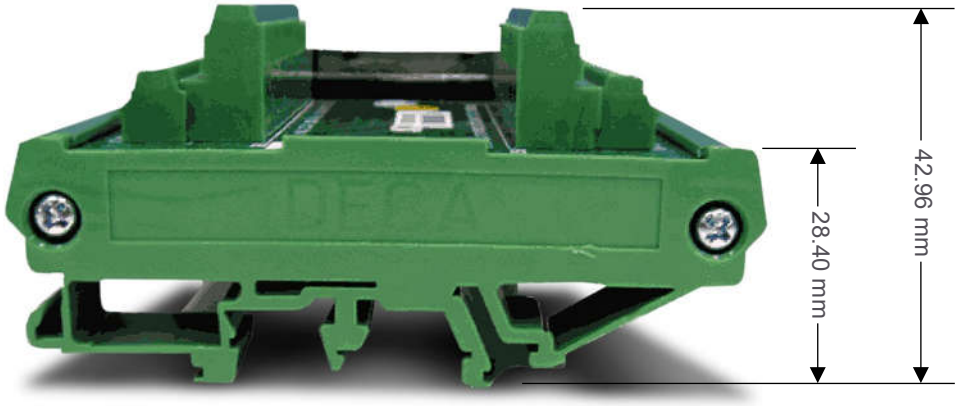
The U2901A/U2902A is a terminal block and SCSI-II 68-pin connector with 1 meter cable or 2 meter cable that can be used conjunction with the U2300A Series and U2500A Series.

Terminal block overview

Front view



Side view



Ordering Information

Model	Description
U2351A	16-Channel 250kSa/s USB modular multifunction DAQ
U2352A	16-Channel 250kSa/s USB modular multifunction DAQ; without analog output
U2353A	16-Channel 500kSa/s USB modular multifunction DAQ
U2354A	16-Channel 500kSa/s USB modular multifunction DAQ; without analog output
U2355A	64-Channel 250kSa/s USB modular multifunction DAQ
U2356A	64-Channel 500kSa/s USB modular multifunction DAQ
U2331A	64-Channel 1MSa/s USB modular multifunction DAQ

Optional accessories

Model	Description
U2802A	U2802A 31-Channel Thermocouple Input Device
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

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

U2500A Series USB modular simultaneous sampling multifunction DAQ

Features:

- High analog input sampling rate coverage of up to 2 MSa/s for each channel
- High speed USB 2.0
- Simultaneous acquisition of multiple data points
- Multifunction capabilities — analog input (AI), analog output (AO), digital input output (DIO), and counter

For more information: www.keysight.com/find/U2500A



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: 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: www.keysight.com/find/U2781A

Learn more at: www.keysight.com

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