Agilent
U2500A Series USB Simultaneous Sampling Multifunction DAQ Devices

Data Sheet

Agilent Technologies

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**
- **Hi-Speed USB 2.0 (480 Mbps)**
- **Supports SCPI and IVI-COM**
- **Compatible with a wide range of ADEs**
- **Easy-to-use bundled software**
- **Command logger function**
- **USBTMC 488.2 standards**

Overview

The Agilent U2500A Series USB simultaneous sampling multifunction data acquisition (DAQ) devices are high-performance modules that consist of three models—the U2531A, U2541A, and U2542A. The U2500A Series provides 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.

Various features of the U2500A Series

- Quick and easy USB setup
- High sampling rate of up to 2 MSa/s for each channel
- Dedicated 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

Quick and easy setup
The USB 2.0 interface provides easy connectivity and setup that allows the automatic detection of the U2500A Series. This easy setup makes the U2500A Series ideal for the education environment. With the quick and easy USB connectivity, the U2500A Series is simple enough for academic application and yet robust and versatile enough for industrial laboratory applications.

Flexible Standalone or Modular Capability
The U2500A Series is uniquely designed for the flexibility of functioning as a standalone or modular unit. You can reduce your startup cost by using the U2500A Series as a standalone unit. On the other hand, using the U2500A Series as a modular unit, you will be able to expand your application system—in terms of channel count and functionality—by slotting in various modular units into the U2781A.

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.

Supports SCPI and IVI-COM, compatible with wide range of ADE
With IVI-COM, you are able to program with any popular Application Development Environment (ADE) that is available in the market. Thus, you can pick any programming language that you are most familiar with. The U2500A Series is compatible with a wide range of ADEs, thus it minimizes the time required to set up the devices in different software environments as they can be programmed directly using SCPI commands.

The following list contains some of the popular development environments that the U2500A Series is compatible with:
- Agilent VEE and Agilent T&M Toolkit
- MATLAB® R2007a
- Microsoft® Visual Studio® .NET™, C/C++ and Visual Basic®
- LabVIEW®

Easy-to-use bundled software and the command logger function
The Agilent Measurement Manager application software provides you with a quick and easy means to configure and control your device without requiring any programming work. Simplifying this further is the command logger function offered in the Agilent Measurement Manager that allows capturing of configuration commands that can be easily converted to snippets of VEE code. Other supported languages are VB, C++, and C#.

Standard Shipped Items

- AC/DC Power Adapter
- Power Cord
- USB Extension Cable
- L-Mount Kit (used with modular instrument chassis)
- Agilent U2500A Series USB Multifunction Simultaneous Sampling DAQ Devices Quick Start Guide
- Agilent Measurement Manager for U2500A Series Quick Start Guide
- Agilent USB Modular Products Reference CD-ROM
- Agilent Automation-Ready CD (contains the Agilent 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
- U2781A 6-slot USB modular instrument chassis

System Requirements

PROCESSOR
1.6 GHz Pentium IV or higher

OPERATING SYSTEM
One of the following Microsoft Windows® versions:
- Windows XP Professional or Home Edition (Service Pack 1 or later)
- Windows 2000 Professional (Service Pack 4 or later)

BROWSER
Microsoft Internet Explorer 5.01 or higher

AVAILABLE RAM
512 MB or higher recommended

HARD DISK SPACE
1 GB

VIDEO
Super VGA (800x600) 256 colors or higher

PREREQUISITES
- Agilent IO Libraries Suite 14.2 or higher
- Agilent T&M Toolkit 2.1 Runtime version [2]
- Agilent T&M Toolkit Redistributable Package 2.1 patch [2]
- Microsoft .NET Framework version 1.1 and 2.0 [2]

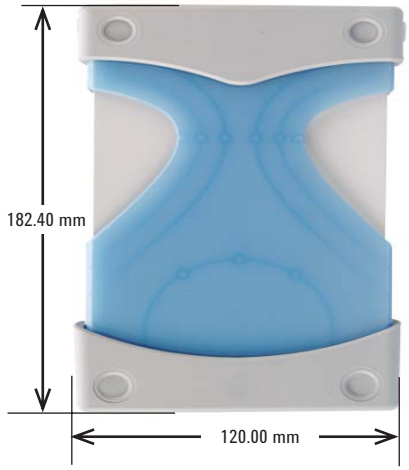
[1] Available in Agilent Automation-Ready CD.
[2] Bundled with Agilent Measurement Manager software application installer.

Product Outlook and Dimension

Front View

Rear View

Top View



Product Characteristics and General Specifications

REMOTE INTERFACE
- Hi-Speed USB 2.0
- USBTMC class device

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 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 (Second Edition)
- Canada: CAN/CSA-C22.2 No.61010-1-04
- USA: ANSI/UL 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 (WxDxH)

Module Dimension:
- 120.00 mm x 182.40 mm x 44.00 mm (with plastic casing)
- 105.00 mm x 174.54 mm x 25.00 mm (without plastic casing)

Terminal Block Dimension:
- 85.20 mm x 103.00 mm x 42.96 mm

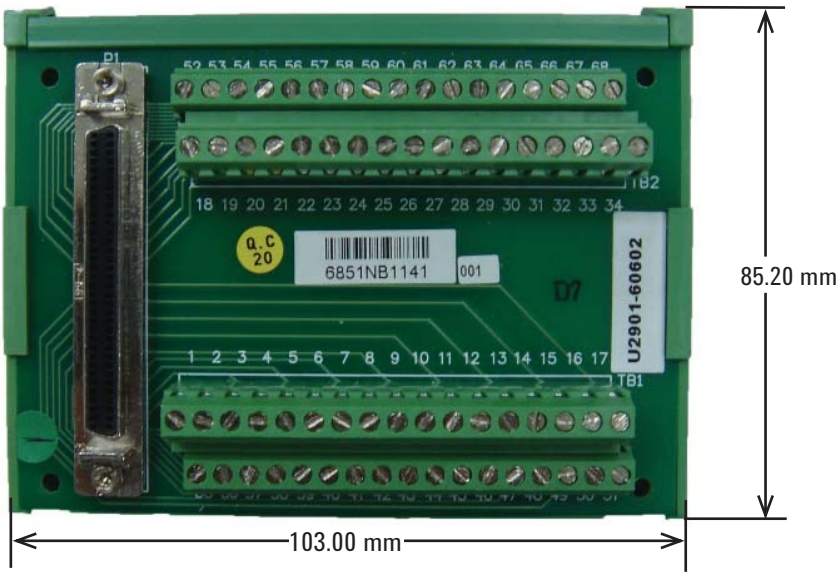
WEIGHT
- 565 g (with plastic casing)
- 400 g (without plastic casing)

WARRANTY

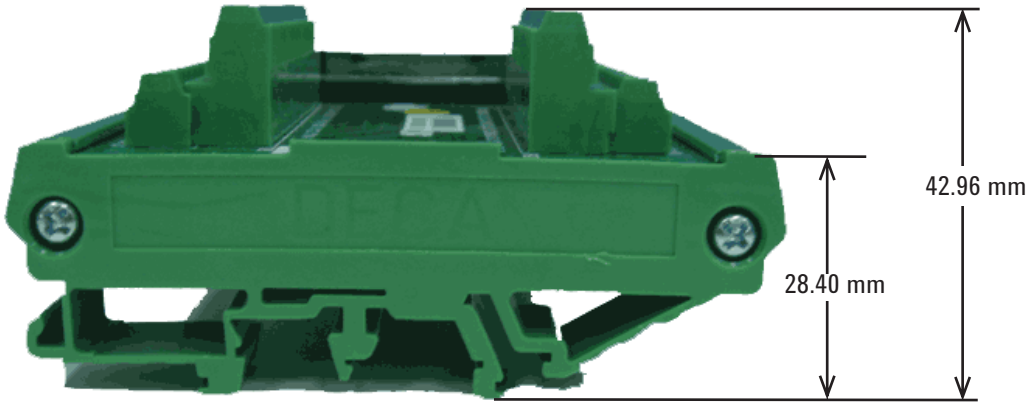
Three years

Terminal Block Overview

Front View



Side View



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	V_{IL} = 0.7 V maximum; I_{IL} = 10 µA maximum V_{IH} = 2.0 V minimum; I_{IH} = 10 µA maximum		
Input voltage range	–0.5 V to +5.5 V		
Output voltage	V_{OL} = 0.45 V maximum; I_{OL} = 8 mA maximum V_{OH} = 2.4 V minimum; I_{OH} = 400 µA maximum		
General Purpose Digital Timer/Counter			
Maximum count	$(2^{31} – 1)$ 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		

Model Number	U2531A	U2541A	U2542A
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 [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 x D x H)	120.00 mm x 182.40 mm x 44 mm (with plastic casing) 105.00 mm x 174.54 mm x 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 Class Device		
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 instrument 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 mV_{rms}		0.5 mV_{rms}		0.5 mV_{rms}	
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	**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	±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 F_{in} = MaxSamplingRate/2.

Test Condition

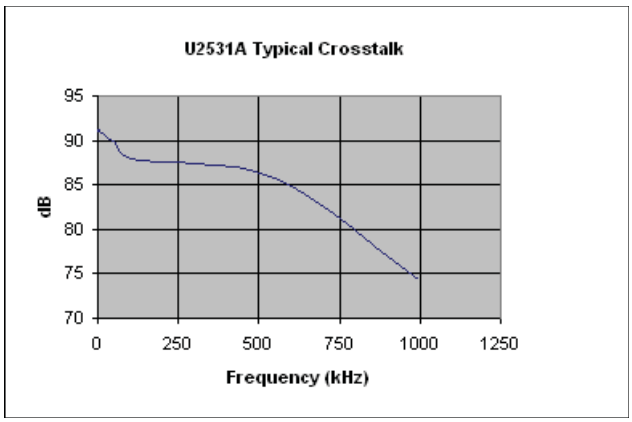
Dynamic Range Test for U2500A Series DAQ devices

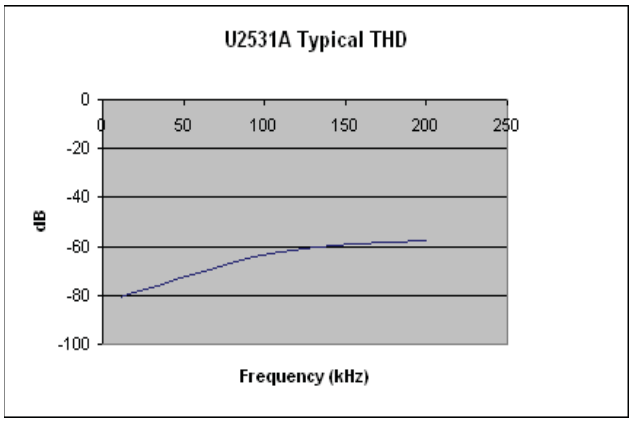
Dynamic Range Test	Model	Test Conditions (DUT setting at ±10 V bipolar)	
SFDR, THD, SINAD, SNR, ENOB	U2531A	Sampling Rate: Fundamental Frequency: Number of Points: Fundamental Input Voltage:	2 MSa/s 19.927 kHz 65536 FSR –1 dB FS
	U2541A	Sampling Rate: Fundamental Frequency: Number of Points: Fundamental 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

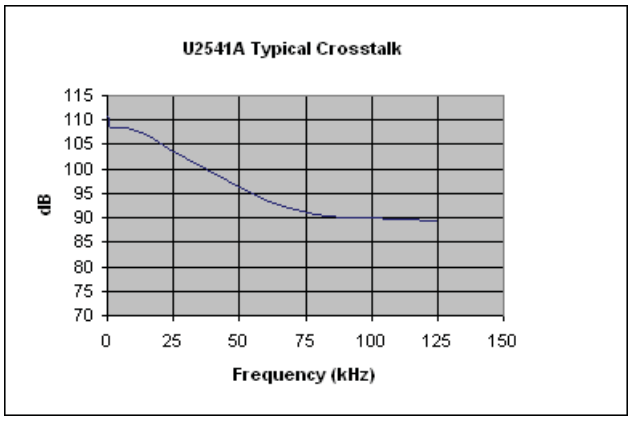
Bandwidth Test for U2500A Series DAQ devices

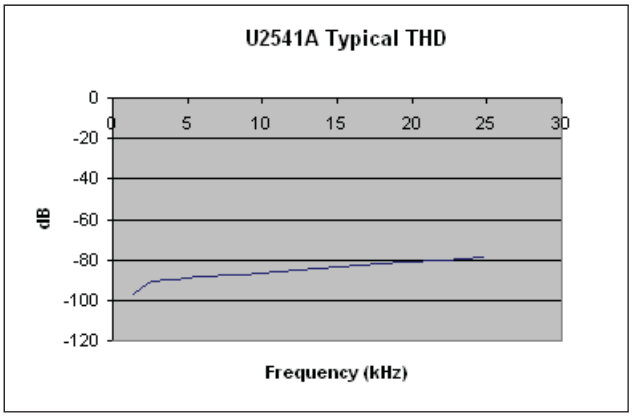
Bandwidth Test	Model	Test Conditions (DUT setting at ±10 V bipolar)	
• **–3 dB Small Signal Bandwidth** • **1% THD Large Signal Bandwidth**	U2531A	Sampling Rate: Input Voltage • –3 dB Small Signal Bandwidth: • 1% THD Large Signal Bandwidth:	2 MSa/s 10% FSR FSR – 1 dBFS
	U2541A	Sampling Rate: Input Voltage • –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

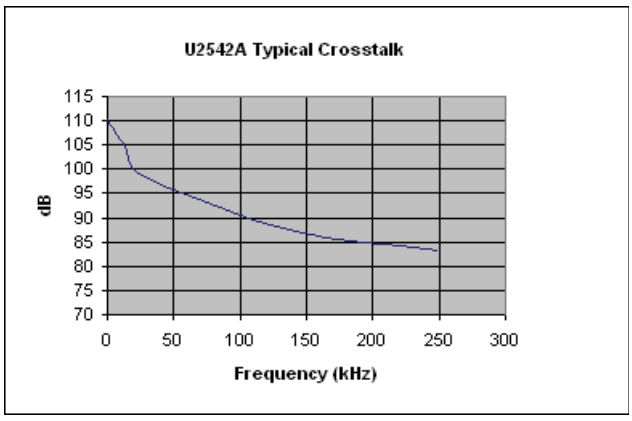
Typical Performance Graph

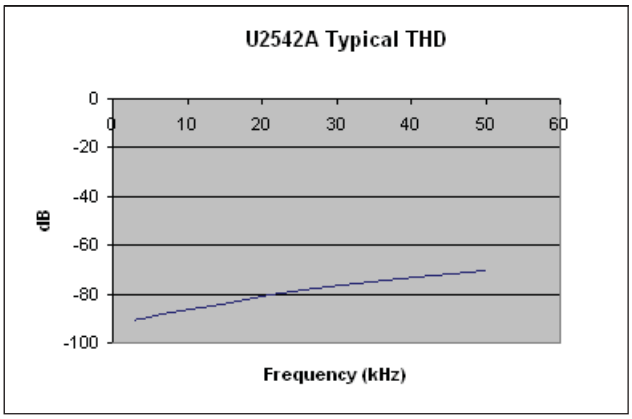












DC Characteristics

Accuracy Specifications

Analog Input

U2541A | U2542A

Unipolar Range (V)	Offset Error (mV) [1]	Gain Error (mV)	Accuracy (% of reading + offset error) [2]
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

U2531A

Unipolar Range (V)	Offset Error (mV) [1]	Gain Error (mV)	Accuracy (% of reading + offset error) [2]
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

- The above specifications are typical for 23 °C.
- Specifications are based on 20 minutes warm-up, and self-calibration temperature at 23 °C.
- The measurements are calculated with 100 points averaging of data.

[1] Offset error is measured at midscale of full scale range.

[2] Accuracy = ±(% of Gain Error/(Measured value – Midscale) + Offset Error).

DC Characteristics

Accuracy Specifications

Analog Output

U2541A | U2542A

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)			
10	1.0	2.0	0.02% + 1.0 mV

U2531A

Unipolar Range (V)	Offset Error (mV) [1]	Gain Error (mV)	Accuracy (% of reading + offset error) [2]
10	1.0	3.0	0.03% + 1.0 mV
Bipolar Range (V)			
10	1.0	3.0	0.03% + 1.0 mV

- The above specifications are typical for 23 °C.
- Specifications are based on 20 minutes warm-up, and self-calibration temperature at 23 °C.

[1] Offset error is measured at 0 V.

[2] Accuracy = ±(% of Gain Error/Output value + Offset Error).

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