



Agilent
U2500A Series USB Simultaneous Sampling
Multifunction DAQ Devices

Data Sheet



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 version²
- Agilent T&M Toolkit Redistributable Package 2.1 patch²
- Microsoft .NET Framework version 1.1 and 2.0²

[1] Available in Agilent Automation-Ready CD.

[2] Bundled with Agilent Measurement Manager software application installer.

Product Outlook and Dimension

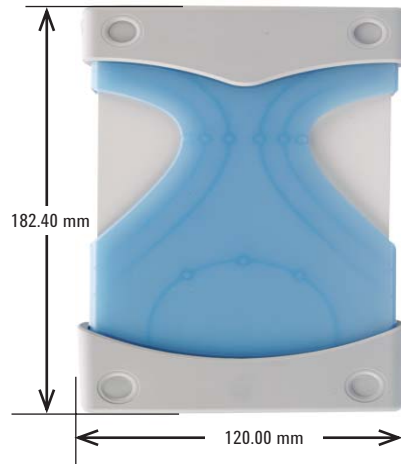
Front View



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

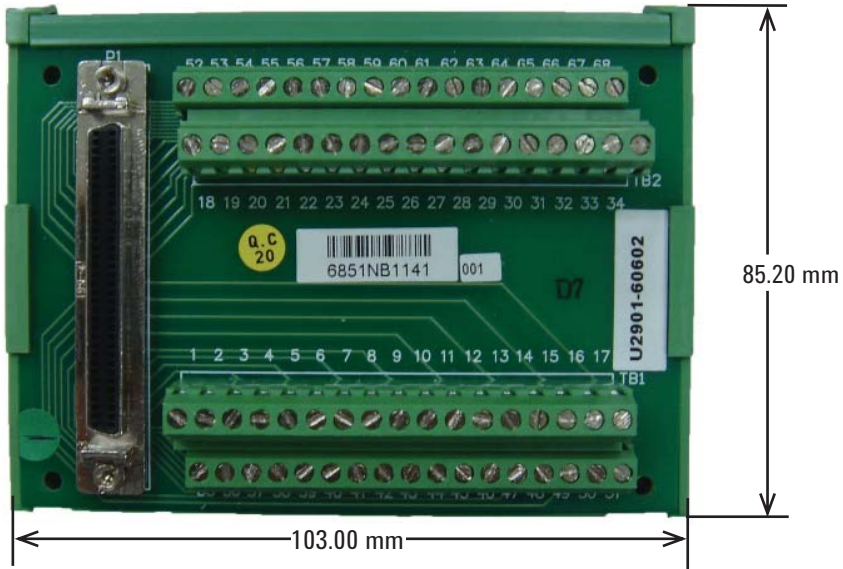
- 565 g (with plastic casing)
- 400 g (without plastic casing)

WARRANTY

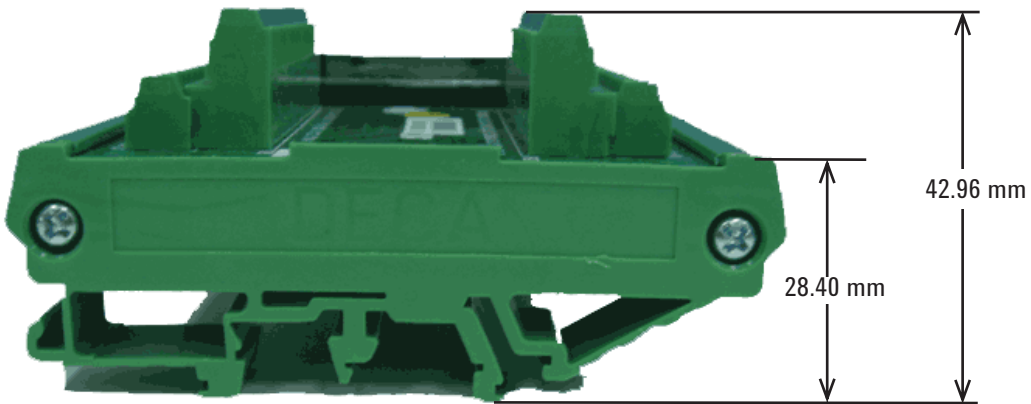
Three years

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 G Ω /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, \pm 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 μ A maximum V_{IH} = 2.0 V minimum; I_{IH} = 10 μ A 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 μ A 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 μ s to 178.956 s \pm 0.0833 μ s | | |

| 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 | | |
| Calibration⁵ | | | |
| 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 $F_{in} = \text{MaxSamplingRate}/2$.

Test Condition

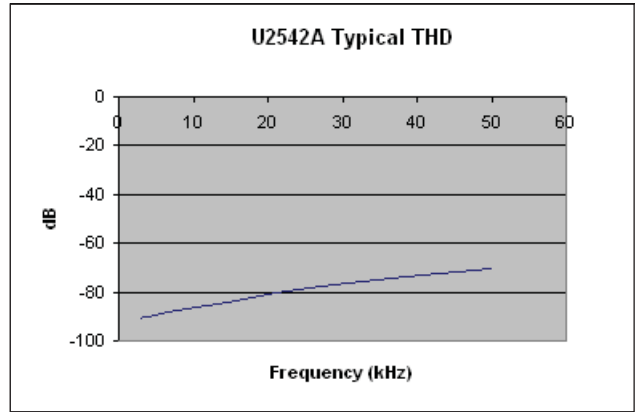
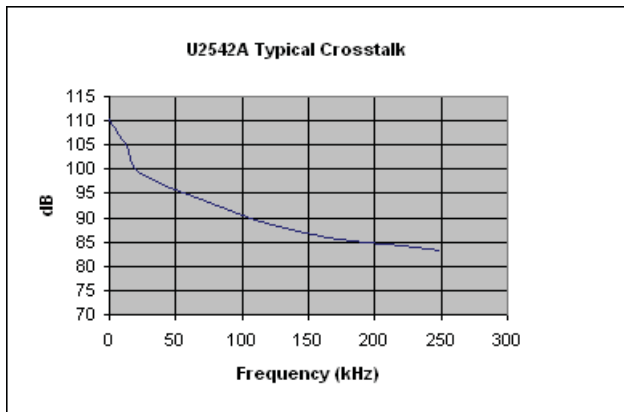
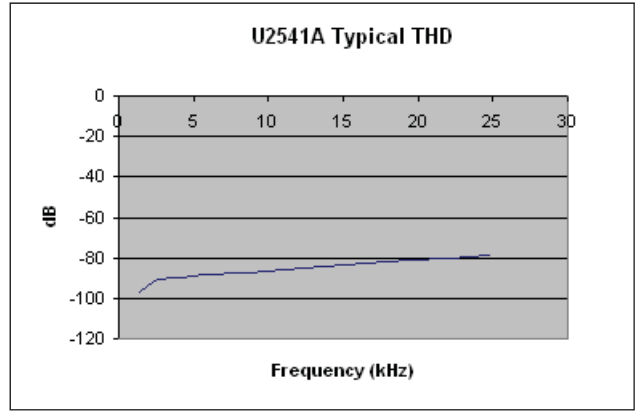
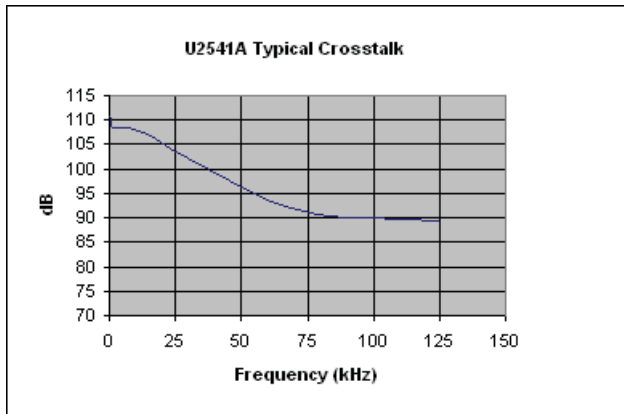
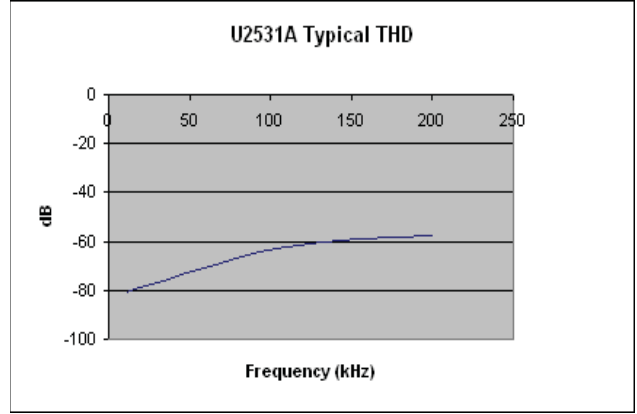
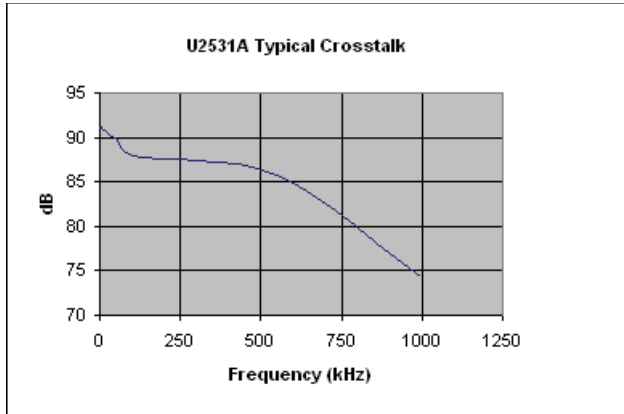
Dynamic Range Test for U2500A Series DAQ devices

| 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) | |
|---|--------|--|--|
| <ul style="list-style-type: none"> • -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 = $\pm(\% \text{ of Gain Error} / (\text{Measured value} - \text{Midscale}) + \text{Offset Error})$.

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 = \pm (% of Gain Error/Output value + Offset Error).



Agilent Email Updates

www.agilent.com/find/emailupdates

Get the latest information on the products and applications you select.



Agilent Direct

www.agilent.com/find/agilentdirect

Quickly choose and use your test equipment solutions with confidence.



www.agilent.com/find/open

Agilent Open simplifies the process of connecting and programming test systems to help engineers design, validate and manufacture electronic products. Agilent offers open connectivity for a broad range of system-ready instruments, open industry software, PC-standard I/O and global support, which are combined to more easily integrate test system development.

Microsoft, Windows, and Visual Studio are registered trademarks of Microsoft Corporation in the United States and/or other countries.

MATLAB is a U.S. registered trademark of The Math Works, Inc.

安捷伦合作伙伴：北京康泰电子有限公司
北京：010-58731155 上海：021-64851591
深圳：0755-25885188
www.quatronix-cn.com

Remove all doubt

Our repair and calibration services will get your equipment back to you, performing like new, when promised. You will get full value out of your Agilent equipment throughout its lifetime. Your equipment will be serviced by Agilent-trained technicians using the latest factory calibration procedures, automated repair diagnostics and genuine parts. You will always have the utmost confidence in your measurements.

Agilent offers a wide range of additional expert test and measurement services for your equipment, including initial start-up assistance onsite education and training, as well as design, system integration, and project management.

For more information on repair and calibration services, go to

www.agilent.com/find/removealldoubt

www.agilent.com

For more information on Agilent Technologies' products, applications or services, please contact your local Agilent office. The complete list is available at:

www.agilent.com/find/contactus

Phone or Fax

United States:
(tel) 800 829 4444
(fax) 800 829 4433

Canada:
(tel) 877 894 4414
(fax) 800 746 4866

China:
(tel) 800 810 0189
(fax) 800 820 2816

Europe:
(tel) 31 20 547 2111

Japan:
(tel) (81) 426 56 7832
(fax) (81) 426 56 7840

Korea:
(tel) (080) 769 0800
(fax) (080) 769 0900

Latin America:
(tel) (305) 269 7500

Taiwan:
(tel) 0800 047 866
(fax) 0800 286 331

Other Asia Pacific Countries:
(tel) (65) 6375 8100
(fax) (65) 6755 0042
Email: tm_ap@agilent.com
Revised: 11/08/06

Product specifications and descriptions in this document subject to change without notice.

© Agilent Technologies, Inc. 2007, 2008
Printed in USA, March 4, 2008
5989-7396EN



Agilent Technologies