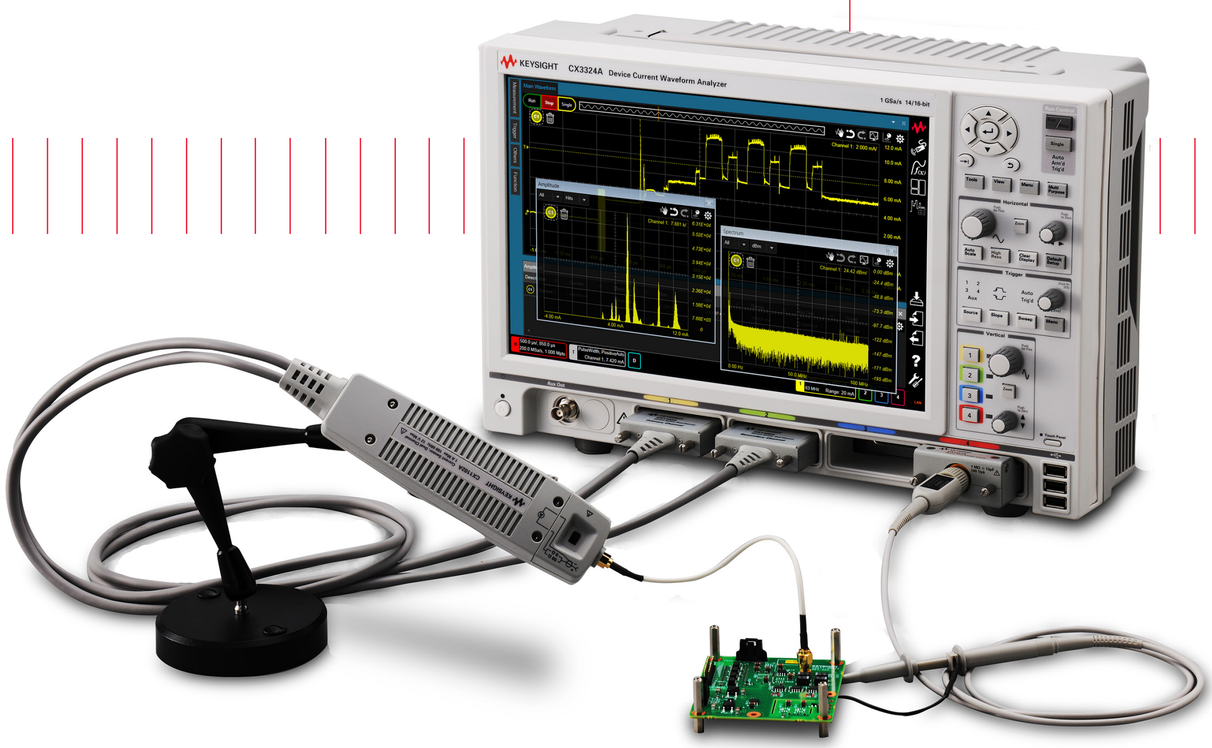
Technologies

Device Current Waveform Analyzer

CX3322A 2 Channel
CX3324A 4 Channel

Data Sheet

The world's first instrument that enables every electronics engineer to precisely visualize never before seen wideband low-level current waveforms.



Product Overview

When evaluating or debugging low power devices, most test engineers use a similar set of instruments: power supplies, multimeters, oscilloscopes, spectrum analyzers, network analyzers, function generators, etc. Measurements made by these instruments are mostly based on "voltage waveform measurements." However, a recent increase in demand for power reduction has resulted in an increase in current waveform measurement opportunities to precisely estimate low-level current and power consumption. In order to reduce the power consumption of your product, you need to know when, where and precisely how much current is consumed.

The CX3300 series of Device Current Waveform Analyzers can visualize wideband low-level, previously unmeasurable or undetectable, current waveforms. The main frame has either 2 or 4 channels to receive signals from the Current Sensors and digitize them by a maximum of 1 GSa/s and 14-bit or 16-bit wide dynamic range.

There are three types of Current Sensors that can detect a wide range of dynamic currents from 100 pA level up to 10 A, with a maximum of 200 MHz bandwidth. There are six types of detachable Sensor Heads designed to provide an appropriate choice of connection to the DUT (Device under Test) and they are available for two of the three types of Current Sensors.

Captured waveforms are displayed on the WGXA 14.1" LCD with multi touch screen. The CX3300 series can also measure dynamic voltage waveforms by using a Passive Probe Interface Adapter connected to a measurement channel, so that power consumption waveform can also be calculated and displayed.

The CX3300 series also features useful analysis capabilities such as an Automatic Power and Current Profiler, a Power Measurement Wizard, FFT Analyzer and Statistical Analysis functions, which accelerate the analysis of the measurement data without the need to use external analysis utilities.

With this new and powerful analyzer, you can achieve critical mission on power and current consumption reductions by precisely measuring, previously unmeasurable or undetectable, wideband low-level current waveforms.

Greater demand for transient current measurements

Researchers working on advanced semiconductor or non-volatile memory devices such as ReRAM and PRAM are struggling to observe the behavior of newly developed materials when a short voltage pulse (< 100 ns) is applied. Since the transient current ranges from sub-nA to over mA, it is very difficult to clearly detect entire transient current behavior.

Greater demand for power and current reduction

Engineers working on battery-powered device development are under greater pressure to obtain a reduction in power and current consumption. As the recent technology trend in low power IoT, M2M, wearables, etc. has significantly accelerated this pressure, there is a need to reduce more unused power from existing devices. As a result, engineers are forced to look into even component level dynamic current consumption, which is always very difficult to measure especially for low-power devices used in IoT enabled products.

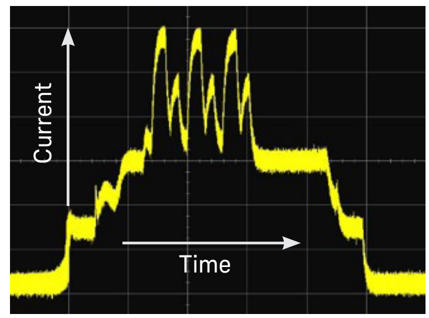


Figure 1. Current waveform measurements: limited dynamic range, large measurement noise and limited bandwidth

What makes wideband low-level current waveform measurements so difficult?

1. Limited dynamic range

For example, most of the battery-powered devices have low power status such as “sleep state” or “standby state” that consume very little supply current such as less than 1 µA, while the “active state” usually requires more than 10 mA current. It is difficult to measure such a wide dynamic range of currents with a single measurement.

2. Large measurement noise

Clamp-on type current probes are widely used, but measuring low-level current less than 1 mA is always difficult due to the large noise floor. Using a shunt resistor and an oscilloscope is very useful, but the minimum measurable current is limited due to the noise floor and the voltage drop across the resistor.

3. Limited bandwidth

Low-level current waveform measurements with a certain level of resolution need a tradeoff with bandwidth, otherwise wideband measurements may degrade the resolution. Using a multimeter or an ammeter is popular for high resolution measurements, but not appropriate for wideband current measurements due to the lesser bandwidth. It is also difficult to measure multiple ranges with the same wide bandwidth when you use a custom measurement instrument built using standard rather than specialist parts.

4. Multiple instruments required

A multimeter is commonly used to measure the averaged “sleep state” current, while the “active state” current can be captured using an oscilloscope. The total power and current consumptions must be manually estimated from these results, but the data is not always reliable and it can be time consuming to validate it.

As shown in Figure 2, engineers and researchers need a wideband low-level current waveform measurement solution with a single instrument, simultaneously meeting multiple key measurement requirements.

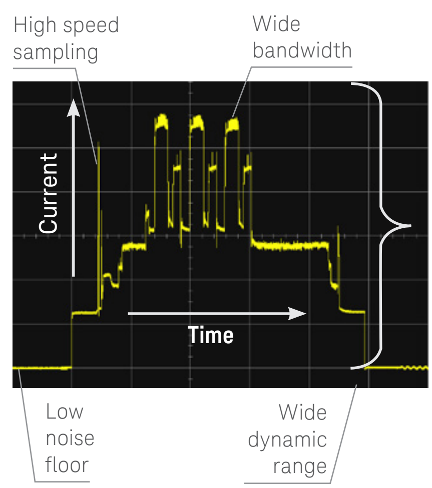


Figure 2. Expected key requirements for wide-band low-level current waveform measurements.

The new Device Current Waveform Analyzers precisely visualize never before seen wideband low-level current waveforms

The 14 and 16-bit wide dynamic range enables you to visualize current waveforms, including sleep and active states, with just a single measurement.

A current measurement always requires a wide dynamic range, especially for the low power device applications consisting of sleep and active states. The CX3300's dedicated current sensors enable up to 5-decade dynamic range measurements at one time and to easily measure the power and current profiles.

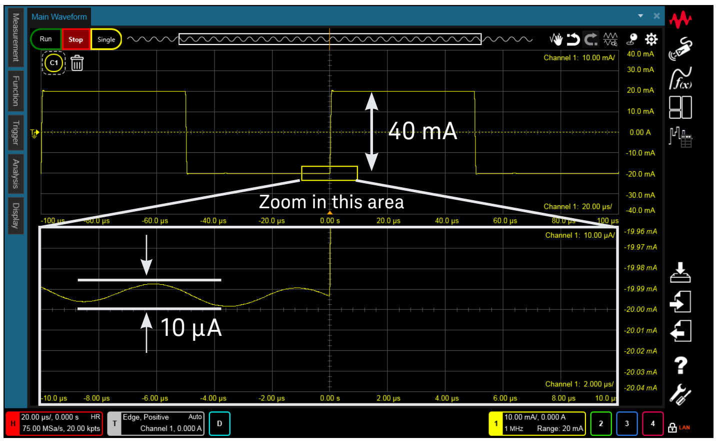


Figure 3. Wide dynamic range measurement example: 40 mA and 10 µA current waveform measurements at the same time.

You can measure low-level current waveform from 100 pA level using the low noise current sensing technology.

The high-frequency noise suppressed sensing technology enables you to measure current waveform from 100 pA level. The CX3300's superior low noise capability helps you achieve results that have never previously been obtainable with existing instruments.

Figure 4. Very-low current measurement example: 200 pA peak-to-peak current waveform.

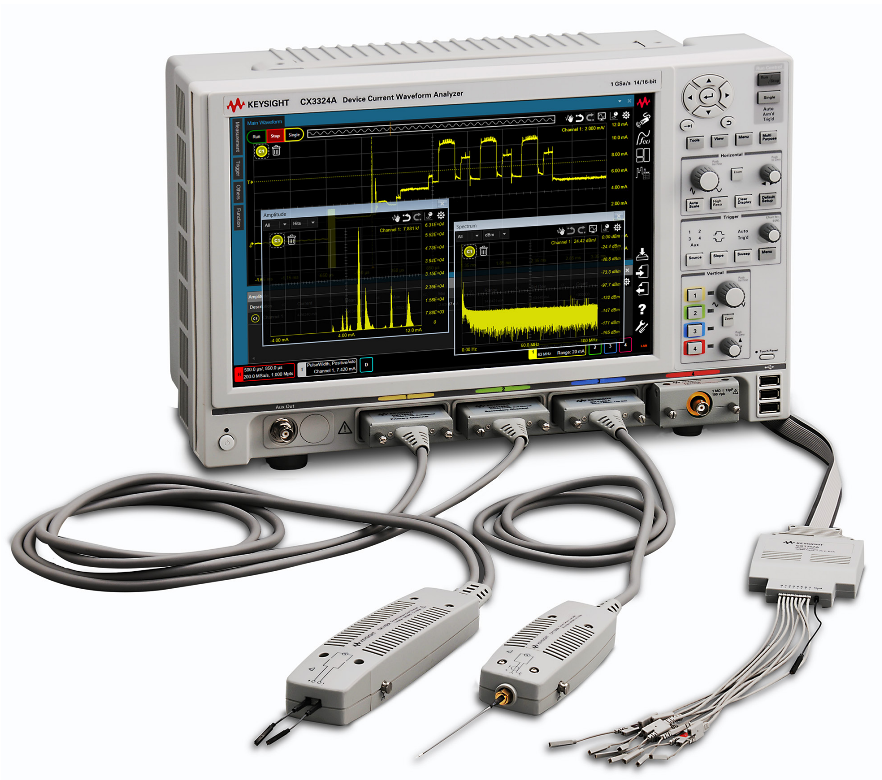


Figure 5. The CX3300's dedicated current sensors greatly suppress high frequency current noise without losing their low-burden current sensing capability. The dual channel sensor enables almost 5-decade dynamic range using the simultaneous dual range view technology.

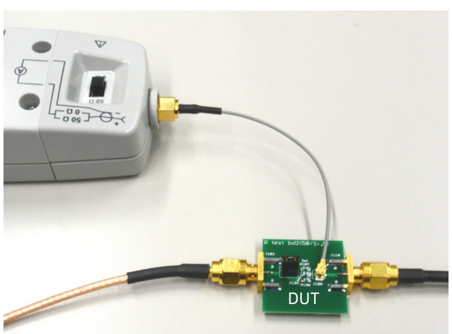


Figure 6a. SMA cable

Figure 6b. Test lead

Figures 6a and 6b. A wide variety of sensor head adapters provides the best connection interface for your DUT (device under test).

Figure 7. The CX3300 series can also measure and view voltage waveforms using a passive probe, so that you can view the dynamic power waveforms as well as current waveforms.

You will never overlook any transient current and can improve your debug efficiency by 1 GSa/s and up to 200 MHz bandwidth.

You might not be aware of a very sharp current pulse due to a lower measurement bandwidth and/or slow sampling rate. The CX3300's high frequency measurement capabilities capture never seen before fast transient current waveforms and clearly show them on the display. As a result, you can not only improve the debug efficiency, but can select the right components by knowing the peak current.

Figure 8. You can capture fast transient current waveforms and show them on the display.

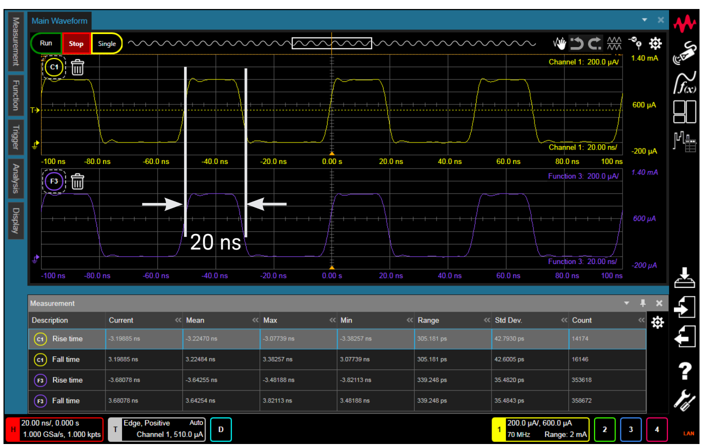


Figure 9. You can easily measure transient current with less than 100 ns pulse width, which can help you evaluate and analyze two terminal devices such as PRAM, ReRAM, MRAM, etc.

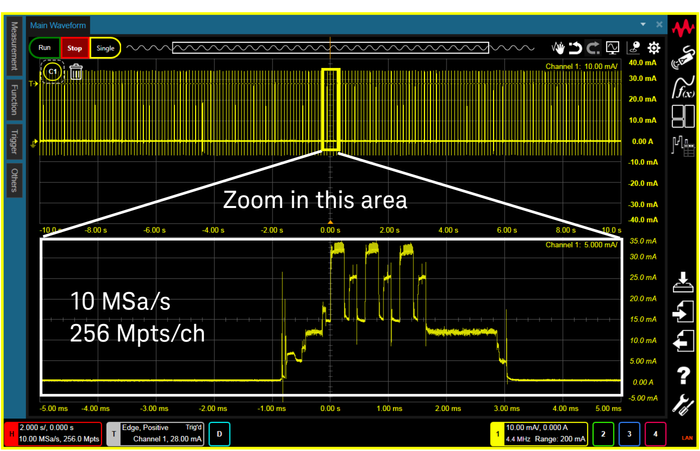


Figure 10. Up to 256 Mpts/ch memory depth and the fast acquisition rate allow you to capture long-term behaviors to find, for example, unexpected current peaks. Using the "Anywhere" zooming function (described in a later section) allows you to clearly identify any areas of interest on the measured waveform.

All the mainframes offer 14-bit or 16-bit high resolution

Simply pressing the "High Reso" button allows you to change the resolution from a 14-bit (high speed mode) to a 16-bit (high resolution mode) and observe clearer waveforms by the lower noise floor at lower frequencies.

Figure 11. High resolution button for 16-bit resolution

In addition to the intuitive measurement user interface, you can quickly make a wide range of analyses with a single benchtop size instrument.

Current waveform measurements can be immediately analyzed on the same instrument using the CX3300's powerful analysis capabilities. As these analyses can be applied to current, voltage and power waveforms, you can gain new insights into your DUT.

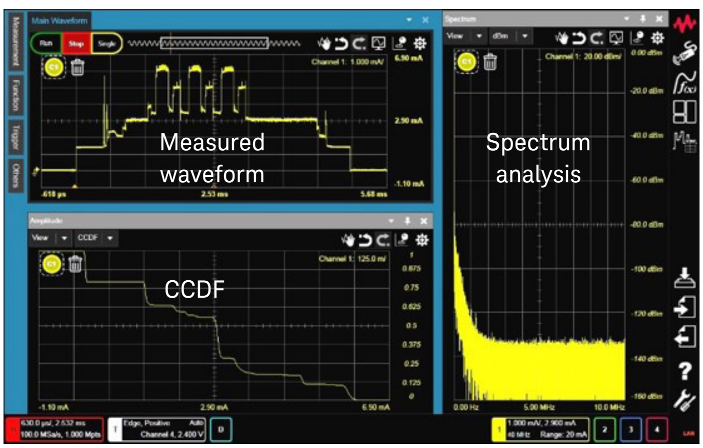


Figure 12. Analysis capabilities such as Spectrum Analysis or Statistical Analysis are available for all the mainframe models.

Dual Channel Current Sensor achieves a 100 dB dynamic range to visualize low-power device operations

The CX1102A Dual Channel Current Sensor enables simultaneous measurements under two different measurement ranges. For example, the primary channel is set to a 200 mA range, while the secondary channel is to a 2 mA range (primary channel range is 50 or 100 times of secondary channel). This current sensor is very useful for low-power applications that periodically operate in both sleep/standby state and active state.

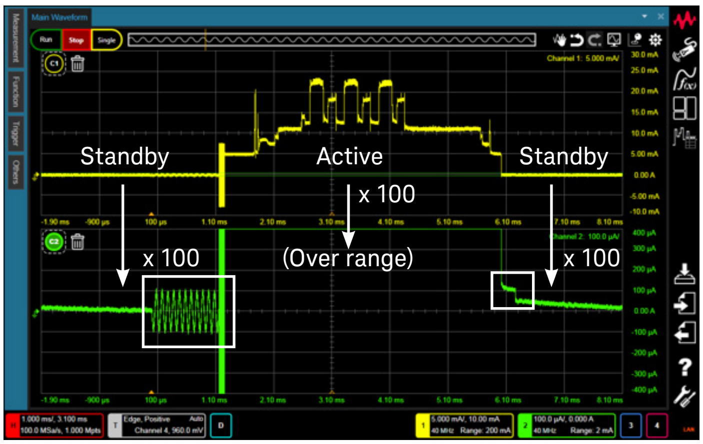


Figure 13. Wide dynamic range measurement by the CX1102A Dual Channel Current Sensor

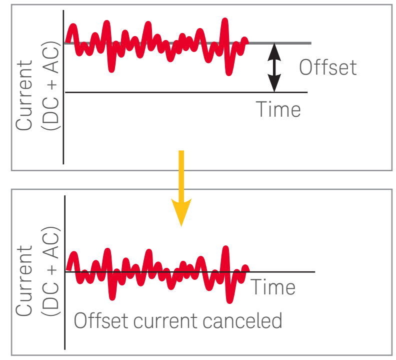
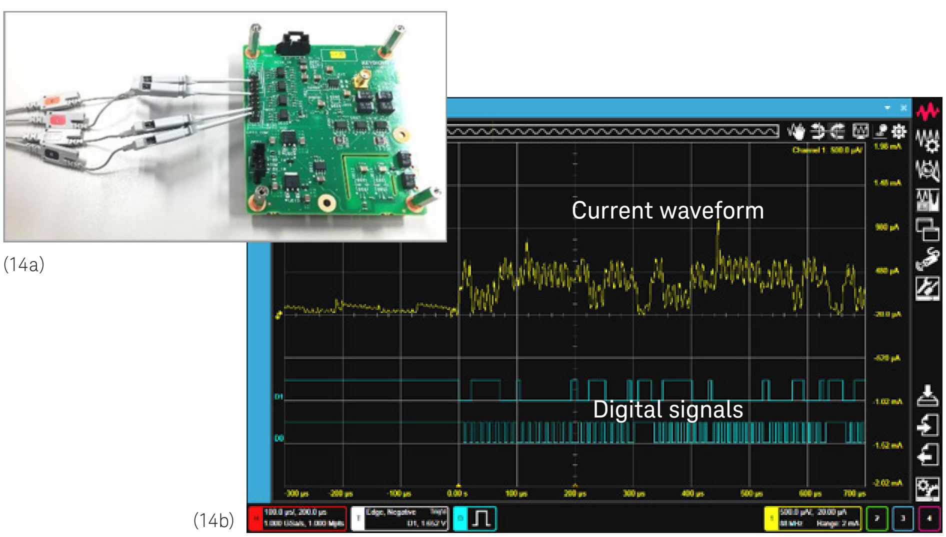


Figure 15. The CX1103A Low Side Current Sensor employs offset adjustable ultra-wideband transimpedance technology, which can cancel the large DC current offset and extract only the required dynamic current. This feature is quite useful to measure low-level dynamic sensor current signals on a larger DC current.

High input impedance digital channel minimizes load current in the probe (CX3324A option)

The CX1152A Digital Channel is useful when you need digital triggers to measure current synchronized with digital signals such as controller's I/O or data bus up to 8 channels. Unlike conventional digital probes, each probe for the CX1152A has large 10 MΩ input resistance, which enables you to make accurate low power measurements by minimizing the load current.



(14a)

(14b)

Figure 14a and 14b. Current waveform measurement and connection example using the Digital Channel

Software is also customized to measure and analyze wideband low-level current waveforms

An easy-to-use "anywhere" zoom function allows you to, at any time, zoom in anywhere on the waveform

Following a few simple steps on the front panel or clicking an icon in the waveform window instantly enables the magnifying lens function, which allows you to zoom in on any areas of interest including both vertical and horizontal scaling independent of the main waveform. As a result, you can fully utilize the CX3300's 14-bit and 16-bit high resolution.

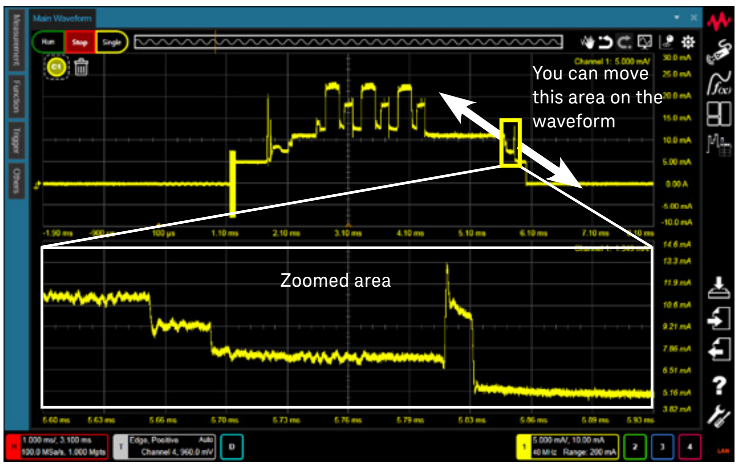


Figure 16. The "Anywhere" Zoom works like a magnifying lens on the waveform.

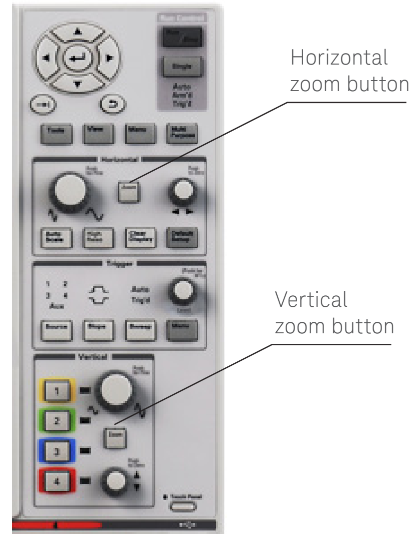


Figure 18. Easy-to-access zoom buttons for both horizontal and vertical

The CX3300 always tells you how much bandwidth each channel is measuring.

When you measure a wide range of dynamic currents, you need to consider the measurement bandwidth due to the mainframe, sensors, filters and acquisition rate. It is not easy to manually calculate the measurement bandwidth, but the CX3300 series automatically calculates these parameters and indicates real-time effective measurement bandwidth in each channel. You therefore don't have to be concerned about the measurement bandwidth when using the CX3300 series.

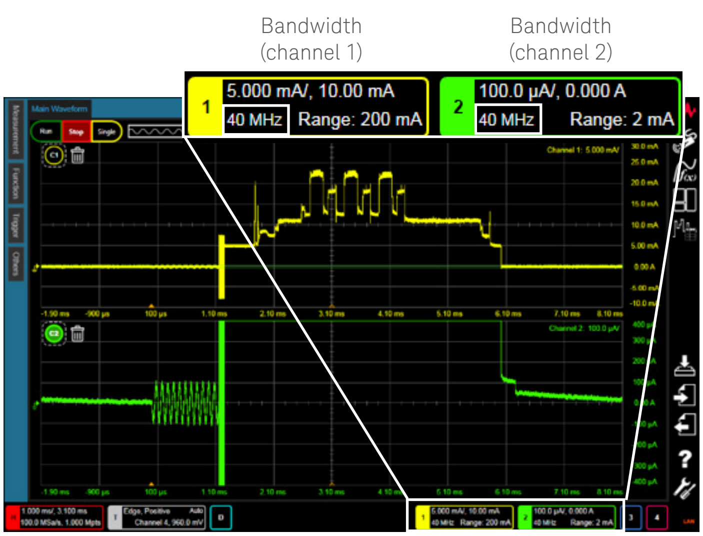
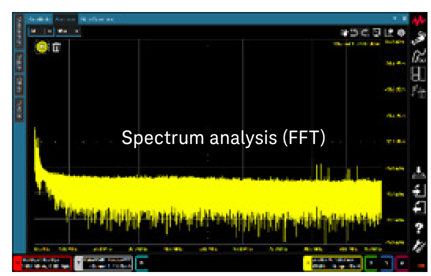


Figure 17. The effective measurement bandwidth is always shown in the mini dialog boxes.



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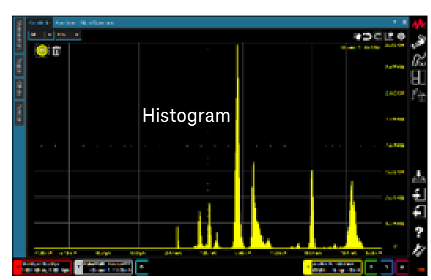
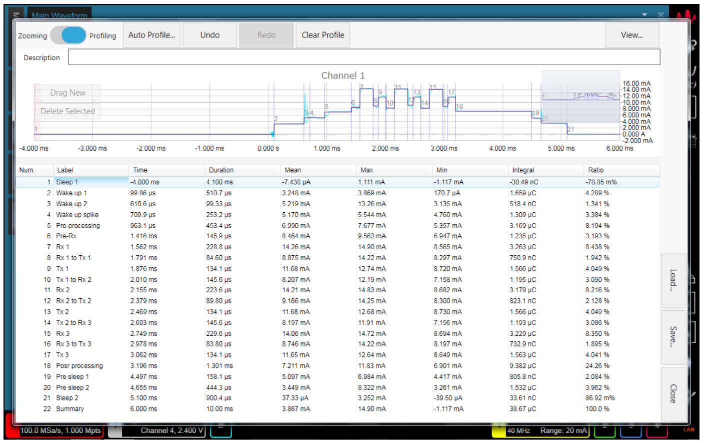


(19b)

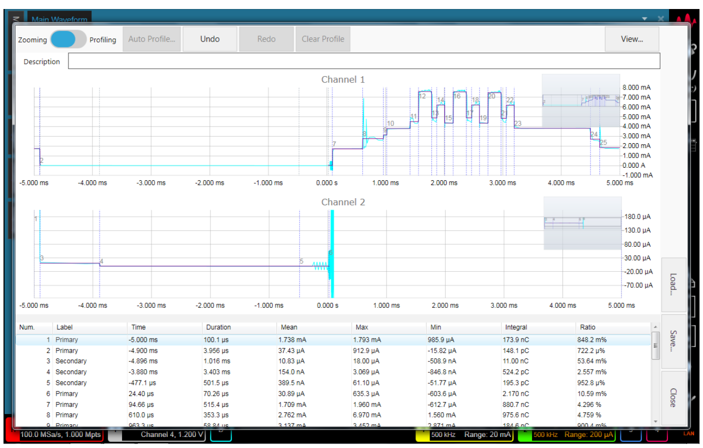
Figures 19a and 19b. Analysis capabilities are important when debugging your DUT. The CX3300 series features essential analysis tools that help you improve your development efficiency.

Automatic Power and Current Profiler can eliminate time-consuming power and current profile analysis.

Analysis of power or current profile is essential in order to know how much current is consumed at a certain event or status, but it is time-consuming process. This profiler automatically draws lines in the time scale by the vertical level difference and instantly calculates key parameters such as average current, max./min. current, accumulated charge, etc. for each segment in the adjacent table. You can also manually adjust the segment according to your measured profile.



(20a)



(20b)

Figure 20a and 20b. The Automatic Power and Current Profiler appropriately segments the measured waveform and creates tables showing key parameters (20a). When used with the Dual Channel Current Sensor (CX1102A), this feature operates on the waveforms captured by both the primary and secondary channels (20b).

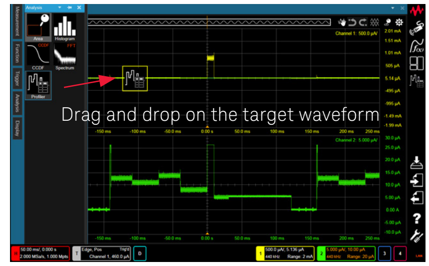


Figure 20c. All analysis functions can be performed by simply dragging and dropping the analysis icon onto the target waveform.

Executing user calibration before a measurement ensures that you can make full use of the CX3300's superior performance.

For low-level current measurements it is important to set "zero current" level before the measurement. The CX3300 series mainframe features easy-to-use calibration capability including mainframe and a current sensor connected. It can also calibrate with a passive probe for more accurate dynamic power measurements.

Figure 21. Aux Out is used in the calibration procedure for each channel by connecting the sensors and probe adapter. As the connection cable is included in the mainframe, you can immediately start the User Calibration.

An upgradable mainframe allows you to purchase the current most affordable CX3300 series without sacrificing future measurement needs.

The CX3300 mainframe has the following options, allowing you to choose the best specifications according to your budget and application needs.

- A two-channel model (CX3322A) and a four-channel model (CX3324A) [1]
- Three maximum bandwidth options: 50 MHz, 100 MHz and 200 MHz
- Three memory depth options per channel: 16 Mpts, 64 Mpts and 256 Mpts

These upgrade license products are available for you to easily and quickly enhance the bandwidth and the memory depth of the mainframe that you have previously purchased. Please see the "CX3300 Series Configuration Guide" in detail.

1. Number of channels is not upgradable.

CX3300 Series Standard Features and Key Accessories

The mainframe enables both wide bandwidth and low noise current measurements

The CX3300 series never compromises in terms of wide bandwidth or low noise current measurements, and clearly visualizes low-level current waveforms on its 14.1 inch wide screen. Both an advanced and a familiar graphical user interface with a user friendly touch screen, allow you to easily undertake measurements and obtain accurate data for analysis from first use. It also provides common interface connectivity to meet various customer needs.

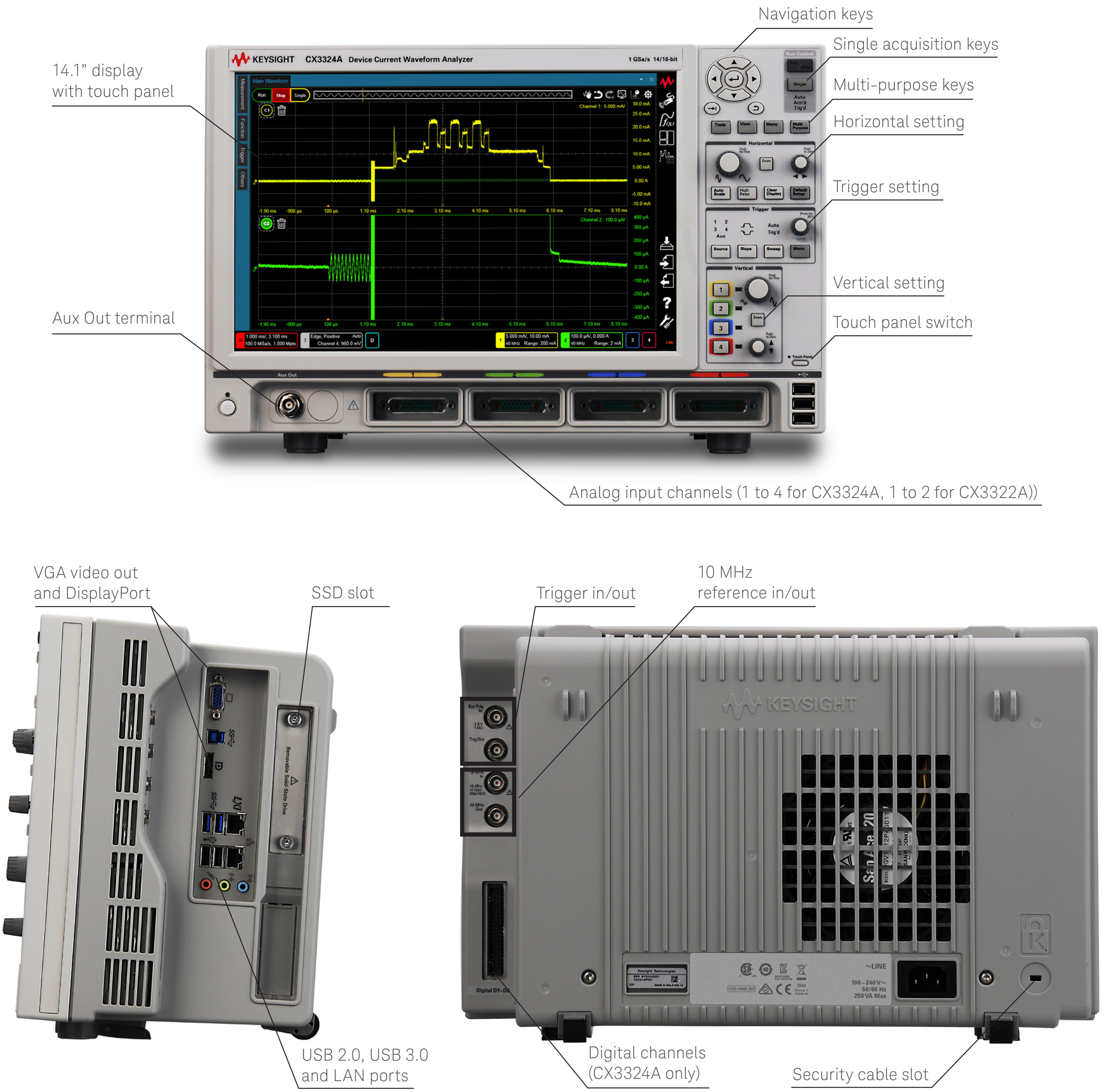


Figure 22. CX3324A front, rear and side views

Dedicated current sensors and accessories to meet the wide variety of measurement needs for your applications

Providing a wide application coverage without compromising both wide bandwidth and low noise requirements is quite challenging. Accessories for the CX3300 series are dedicated to wideband low-level current waveform measurements and help you meet various application needs.

The CX1101A covers wide measurement ranges from 40 nA to 10 A and operates under higher common mode voltage up to ± 40 V. The CX1102A enables the equivalent of a 100 dB (5-decade) dynamic range at a single measurement, which is useful when you measure a current waveform for both sleep/standby and active states at one time. The CX1103A can be used for what is known as low side current sensing and features the series minimum measurable current (150 pA at 20 MHz bandwidth) and the series maximum bandwidth (200 MHz sensor alone).

The CX3300 series also offers voltage measurement capability by using a Passive Probe Interface Adapter (CX1151A) and a Digital Channel (CX1152A) up to 8 channels. See the "CX3300 Series Selection Guide" to find out which accessory can be used for your applications.

Figure 23. CX1101A Single Channel Current Sensor (Furnished CX1203A)

Figure 24. CX1102A Dual Channel Current Sensor (Furnished CX1203A)

Figure 25. CX1103A Low Side Current Sensor

Figure 26. CX1151A Passive Probe Interface Adapter

Figure 27. CX1152A 10 MΩ Input Digital Channel

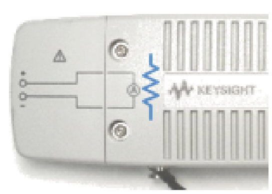


Figure 28. Small series resistance

Despite the wide dynamic range measurement capability, the minimum equivalent series resistance of CX1101A and CX1102A current sensors is minimized to 410 mΩ typ. for wide measurement ranges. As a result, you don't have to worry about a large voltage drop (burden voltage) across the internal resistor (see Figure 28).

You can find the best connection interface for your DUT from the six sensor head adapters that can be easily and safely attached to and detached from the current sensors (CX1101A and CX1102A only. Not available for CX1103A). The SMA connector type adapters enable wideband measurements, while twisted pair and test lead adapters are quite useful for quick current waveform measurements that do not necessarily need a wide bandwidth.

CX1201A

CX1202A

CX1203A

CX1206A (for up to 10 A)

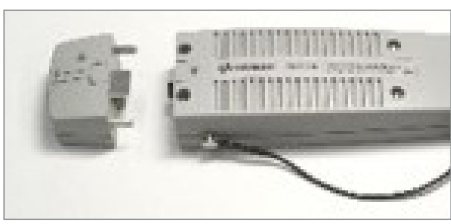
CX1204A

CX1205A

Figure 29. CX120XA Sensor head adapters

Figure 32. CX1206A and CX1101A. Even when you evaluate low power devices, you may occasionally need to measure higher current at more than 1 A. The CX1206A sensor head with expander enables CX1101A current sensor to measure from 3 mA to 10 A current waveforms based on the ESL (Effective Series Inductance) reduced shunt resistor technology.

Attaching a sensor head to a current sensor is quite simple, requiring no extra effort. Connecting a sensor to a mainframe channel is also a simple process, by firmly screwing in the adapter. All these connections are hot swappable.



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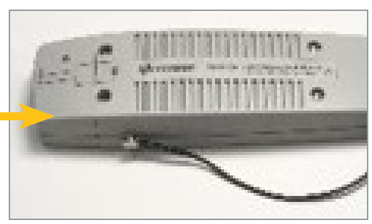

(30b)

Figure 30a and 30b. Attaching a sensor head to a current sensor

(31a)

(31b)

Figure 31a and 31b. Connecting a sensor to a mainframe channel

The CX3300 series offers you the complete measurement environment for visualizing wideband and low-level, previously unmeasurable or undetectable, current waveforms.

The latest battery powered or energy harvested devices must further reduce power/current consumptions. For repeatable and quantitative power reductions, it is necessary to be able to visualize previously unmeasurable or undetectable wideband low-level current waveforms. By adding the CX3300 series to our instrument lineup, has provided a complete solution for low power device measurements that covers both static/dynamic and voltage/current.

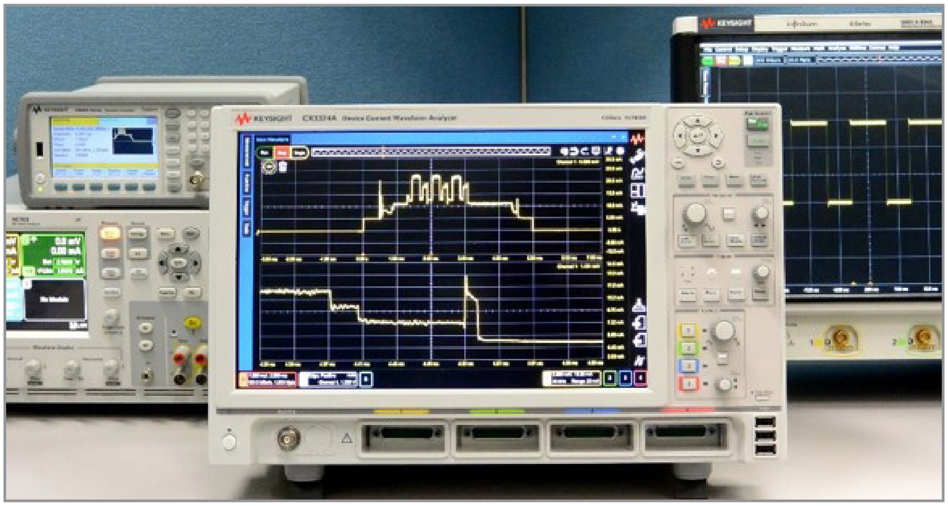

Figure 33. The CX3300 series can be an additional powerful instrument on your benchtop.

Table 1. CX3300 series mainframe key characteristics

Models	Input channel	Analog bandwidth options	Max. sample rate	Dynamic range (ADC bits)	Memory depth options	Digital channel	User installed upgrade
CX3322A	2	50 MHz, 100 MHz, 200 MHz	1 GSa/s	14 (high speed mode) and 16 (high resolution mode)	16 Mpts, 64 Mpts, 256 Mpts	No	Bandwidth, memory depth
CX3324A	4	50 MHz, 100 MHz, 200 MHz	1 GSa/s	14 (high speed mode) and 16 (high resolution mode)	16 Mpts, 64 Mpts, 256 Mpts	Yes	Bandwidth, memory depth

Table 2. Current sensors key characteristics

Models	Description	RMS noise @ 20 MHz NBW	Max. measurable current	DC measurement accuracy (with mainframe) [1]	Max. bandwidth (standalone)
CX1101A	Current sensor, single channel	40 nA	10 A [2]	± (0.6 % + 0.3 %)	100 MHz
CX1102A [3]	Current sensor, dual channel	40 nA	1 A	± (0.6 % + 0.3 %)	100 MHz
CX1103A	Current sensor, low side	150 pA	20 mA	± (0.6 % + 0.3 %)	200 MHz

1. 24 hrs after executing the user calibration. At 20 mA range.
2. With CX1206A sensor head
3. CX1102A occupies two input channels of mainframe

Current Sensor measurement range

Table 3. CX1101A Current Sensor, Single Channel, ± 40 V, 100 MHz, 40 nA - 1 A

Channel		Maximum bandwidth (-3 dB)	Input resistance (Typical)	Maximum common mode voltage
Range	RMS noise [1]			
10 A	10 mA	3 MHz [2]	15 mΩ	± 40 V
1 A	2 mA	100 MHz	410 mΩ	
200 mA	0.2 mA			
20 mA	20 µA			
2 mA	3 µA			
200 µA	400 nA	25 kHz	50 Ω	
20 µA	40 nA			

Table 4. CX1102A Current Sensor, Dual Channel, ± 12 V, 100 MHz, 40 nA - 1 A

Primary channel		Secondary channel		Maximum bandwidth (-3 dB)	Input resistance (Typical)	Maximum common mode voltage
Range	RMS noise [1]	Range	RMS noise [1]			
1 A	2 mA	20 mA	20 µA	100 MHz	410 mΩ	± 12 V
200 mA	0.2 mA	2 mA	3 µA			
20 mA	20 uA	200 µA	500 nA	500 kHz	50 Ω	
2 mA	2 µA	20 µA	200 nA			
20 mA [3]	8 µA [3]	200 µA [3]	400 nA [3]	90 kHz [3]	50 Ω [3]	
2 mA [3]	1 µA [3]	20 µA [3]	40 nA [3]	25 kHz [3]		

Table 5. CX1103A Current Sensor, Low Side, 200 MHz, 100 pA - 20 mA

Channel		Maximum bandwidth (-3 dB)	Maximum offset current	Input resistance (Typical)	Maximum common mode voltage
Range	RMS noise [1]				
20 mA	5 µA	200 MHz	± 20 mA	50 Ω (50 Ω Input ON) 4 Ω (50 Ω input OFF)	± 1 V (50 Ω Input ON) ± 0.5 V (50 Ω Input OFF)
2 mA	1.5 µA	75 MHz			
200 µA	150 nA	9 MHz	± 200 µA		
20 µA	25 nA	2.5 MHz			
2 µA	1.5 nA	250 kHz	± 2 µA		
200 nA	150 pA	100 kHz			

1. Noise measurement bandwidth = 20 MHz
2. At –4 dB.
3. Built-in low pass filter mode is ON.

Table 6a. CX3300 series ordering information

Category	Model number	Description
Mainframe model	CX3322A	Device Current Waveform Analyzer, 1 GSa/s, 14/16-bit, 2 Channel
	CX3322A-B05	Bandwidth – 50 MHz
	CX3322A-B10	Bandwidth – 100 MHz
	CX3322A-B20	Bandwidth – 200 MHz
	CX3322A-016	Memory – 16 Mpts/ch
	CX3322A-064	Memory – 64 Mpts/ch
	CX3322A-256	Memory – 256 Mpts/ch
	CX3300A-KBD	Mini-Keyboard and Optical Mouse
	CX3322A-A6J	ANZI Z540-1-1994 Calibration
	CX3322A-UK6	Commercial Calibration Certificate with Test Data
	CX3324A	Device Current Waveform Analyzer, 1 GSa/s, 14/16-bit, 4 Channel
	CX3324A-B05	Bandwidth – 50 MHz
	CX3324A-B10	Bandwidth – 100 MHz
	CX3324A-B20	Bandwidth – 200 MHz
	CX3324A-016	Memory – 16 Mpts/ch
	CX3324A-064	Memory – 64 Mpts/ch
	CX3324A-256	Memory – 256 Mpts/ch
	CX3300A-KBD	Mini-Keyboard and Optical Mouse
	CX3324A-A6J	ANZI Z540-1-1994 Calibration
	CX3324A-UK6	Commercial Calibration Certificate with Test Data
Sensor model	CX1101A	Current Sensor, Single Channel, ± 40 V, 100 MHz, 40 nA – 1 A
	CX1101A-A6J	ANZI Z540-1-1994 Calibration
	CX1101A-UK6	Commercial Calibration Certificate with Test Data
	CX1102A	Current Sensor, Dual Channel, ± 12 V, 100 MHz, 40 nA - 1 A
	CX1102A-A6J	ANZI Z540-1-1994 Calibration
	CX1102A-UK6	Commercial Calibration Certificate with Test Data
	CX1103A	Current Sensor, Low Side, 200 MHz, 100 pA - 20 mA
	CX1103A-A6J	ANZI Z540-1-1994 Calibration
	CX1103A-UK6	Commercial Calibration Certificate with Test Data
Adapter [1]	CX1151A	Passive Probe Interface Adapter
	CX1151A-A6J	ANZI Z540-1-1994 Calibration
	CX1151A-UK6	Commercial Calibration Certificate with Test Data
Digital channel	CX1152A	Digital Channel, 10 MΩ Input, ± 25 V, 8 Channel
Sensor accessory	CX1201A	Sensor Head, Coaxial Through
	CX1202A	Sensor Head, Coaxial Through with V Monitor
	CX1203A [2]	Sensor Head, Coaxial Termination
	CX1204A	Sensor Head, Twisted Pair Adapter
	CX1205A	Sensor Head, Test Lead Adapter
	CX1206A	Sensor Head, High Current Adapter with Expander, 10 A

1. Recommended passive probe: N2843A
2. CX1203A is furnished for CX1101A and CX1102A.

Table 6a. CX3300 series ordering information (continued)

Category	Model number	Description (Preliminary)
Upgrade product	CX1601U	Bandwidth Upgrade from 50 MHz to 100 MHz for CX3322A
	CX1602U	Bandwidth Upgrade from 50 MHz to 200 MHz for CX3322A
	CX1603U	Bandwidth Upgrade from 100 MHz to 200 MHz for CX3322A
	CX1611U	Bandwidth Upgrade from 50 MHz to 100 MHz for CX3324A
	CX1612U	Bandwidth Upgrade from 50 MHz to 200 MHz for CX3324A
	CX1613U	Bandwidth Upgrade from 100 MHz to 200 MHz for CX3324A
	CX1651U	Memory Upgrade from 16 Mpts to 64 Mpts for CX3322A
	CX1652U	Memory Upgrade from 16 Mpts to 256 Mpts for CX3322A
	CX1653U	Memory Upgrade from 64 Mpts to 256 Mpts for CX3322A
	CX1661U	Memory Upgrade from 16 Mpts to 64 Mpts for CX3324A
	CX1662U	Memory Upgrade from 16 Mpts to 256 Mpts for CX3324A
	CX1663U	Memory Upgrade from 64 Mpts to 256 Mpts for CX3324A
Other accessories	CX1903A	Rack Mount Kit for CX3300 Series
	CX1905A [1]	Attachment for 3D Probe Positioner

1. Recommended 3D positioner: N2787A

Effective current measurement bandwidth

As described in the data sheet section of this document, the effective maximum measurement bandwidth when a current sensor is connected to a mainframe can be estimated by the equation shown below.

$$BW_{effective} = \frac{1}{\sqrt{\left(\frac{1}{BW_{sensor}}\right)^2 + \left(\frac{1}{BW_{mainframe}}\right)^2}}$$

As an example, table 3 shows the total effective measurement bandwidth for each of the three sensors when combined with a mainframe possessing 200 MHz of bandwidth.

Table 6b. Maximum effective measurement bandwidth

Sensor maximum bandwidth (–3 dB)		Mainframe maximum bandwidth (–3 dB)	Maximum effective measurement bandwidth (–3 dB)
CX1101A	100 MHz	200 MHz	~ 90 MHz
CX1102A	100 MHz		~ 90 MHz
CX1103A	200 MHz		~ 140 MHz

CX3300 Series performance characteristics

Warranted specifications are denoted by **, and all others are supplemental characteristics. Specifications are valid after a 30-minute warm-up and 23 ± 5 °C.

About the measurement accuracy

Measurement accuracy can be affected by RF electro-magnetic field having the strengths greater than 3 V/m in the frequency range of 80 MHz to 2 GHz or 1 V/m in the frequency range of 2 GHz to 2.7 GHz. The extent of this effect depends upon how the instrument is positioned and shielded.

Table 7. CX3300 series mainframe characteristics overview

Analog bandwidth		50 MHz (Option B05), 100 MHz (Option B10), 200 MHz (Option B20)
Number of analog channels	CX3322A	2
	CX3324A	4
Number of digital channels	CX3322A	N/A
	CX3324A	8 with CX1152A
Vertical resolution		14-bit (High speed mode), 16-bit (High resolution mode)
Maximum sampling rate		1 GHz full channel
Memory depth per channel		16 Mpts (Option 016), 64 Mpts (Option 064), 256 Mpts (Option 256)

Table 8. Vertical system - analog channels [1]

Analog bandwidth (–3 dB)	14-bit resolution	50 MHz	100 MHz	200 MHz
	16-bit resolution	14 MHz	14 MHz	14 MHz
Input coupling		DC		
Input impedance **		50 Ω: ± 3.5%		
Input range		± 0.65 V nominal, ± 2 V peak		
Vertical hardware resolution		14 bits or 16 bits		
DC measurement accuracy **		± (0.7% of reading + 0.7% of range) [2]		
RMS noise (± 0.5 V fix, full BW)	14-bit resolution	120 µVrms	170 µVrms	250 µVrms
	16-bit resolution	46 µVrms	46 µVrms	46 µVrms

1. Analog channels only work with CX1100 series of sensors and CX1151A adapter and do not allow to be used for other purposes.
2. ADC Offset user calibration required.

Table 9. Horizontal system

Main time base range	1 ns/div to 20 s/div
Resolution	1 ns
Modes	Main
Reference position	Left, center, right
Time scale accuracy	10 ppm
Channel deskew	Range = –100 ns to +100 ns

Table 10. Acquisition - analog channels

Maximum real time sample rate [1]	14 bit resolution	1 GSa/s for each channel
	16 bit resolution	75 MSa/s for each channel
Standard memory depth		16 Mpts per channel (Option 016)
Memory depth options		Option 016: 16 Mpts per channel
		Option 064: 64 Mpts per channel
		Option 256: 256 Mpts per channel
Sampling modes		Real time with average (Normal)
		Real time with discard
		Real time with peak detect
Filters		sin (x) / x interpolation
		Averaging
		1 MHz, 2 MHz, 5 MHz, 10 MHz, 20 MHz, 50 MHz (Option B10, B20), 100 MHz (Option B20) [2]

1. 14-bit and 16-bit can be toggled by pressing “High Reso” button. All channels are set to the same resolution.
2. Per channel filters characterized by Math functions.

Table 11. Acquisition - digital channels - CX3324A only

Maximum real time sample rate	500 MSa/s
Maximum memory depth per channel [1]	128 Mpts
Minimum width glitch detect	7 ns

1. The memory depth depends on that of analog channels.

Table 12. Trigger

Source	CX3322A	Ch 1, 2, aux and line
	CX3324A	Ch 1, 2, 3, 4, aux, line and digital channels
Sensitivity		Analog channel: 5% of Sensor range
		Digital channel: See CX1152A characteristics
		External Trigger Input: DC to 100 MHz (minimum input: Vpp = 300 mV)
Trigger level range		Analog channel: ± Sensor range [1]
		Digital channel: see CX1152A
		External Trigger Input: ± 8 V (1 MΩ)
		External Trigger Output: 2.5 V (50 Ω, 100 ns pulse width)
Trigger coupling	Analog channel	DC: high frequency reject (50 kHz low pass filter)
	External Trigger input	DC, or AC: (10 Hz) low frequency reject (50 kHz high pass filter), high frequency reject (50 kHz low pass filter)
Sweep modes		Auto, triggered, single
Trigger hold off range		100 ns to 10 s
Trigger actions		Specify an action to occur (and the frequency of the action) when a trigger condition occurs.

1. Trigger level range for analog channels is the same as the sensor range connected to mainframe. ± Sensor range = ± 4 div. at default setting.

Table 13. Trigger modes

Edge (analog and digital)	Rising, Falling, Either
Edge transition (analog)	Rising edge > Time, Rising edge < Time, Falling edge > Time, Falling edge < Time
Glitch (analog and digital)	Positive glitch > Time, Positive glitch < Time, Positive glitch in range, Negative glitch > Time, Negative glitch < Time, Negative glitch in range
Pulse width (analog and digital)	Positive pulse width > Time, Positive pulse width > Timeout, Positive pulse width < Time, Negative pulse width > Time, Negative pulse width > Timeout, Negative pulse width < Time
Runt (analog)	Positive runt, Positive runt (time qualified), Negative runt, Negative runt (time qualified)
Timeout (analog and digital)	High too long, Low too long, Unchanged too long
Pattern/pulse range (analog and digital)	Pattern entered, Pattern exited, Pattern present > Time, Pattern present > Timeout, Pattern present < Time, Pattern present in range
State (analog and digital)	Rising edge (AND), Rising edge (NAND), Falling edge (AND), Falling edge (NAND), Either edge (AND), Either edge (NAND)
Window (analog)	Entering range, Exiting range, Inside range > Time, Inside range > Timeout, Inside range < Time, Outside range > Time, Outside range > Timeout, Outside range < Time

Table 14. Measurements and analysis

Waveform measurements	Can be made on either main or zoom region. Up to 8 simultaneous measurements.	
	Amplitude	Peak-to-Peak, Minimum, Maximum, Average, DC RMS, AC RMS, Amplitude, Base, Top, Overshoot, Preshoot, Upper, Middle, Lower
	Time	Rise time, Fall time, Positive width, Negative width, Period, Frequency, Duty cycle, Tmin, Tmax
	Mixed	Slew rate, Area
Math functions	Can operate on any combination of channels, memories, or other functions. Up to 8 independent functions.	
	Operators	Add, Subtract, Multiply, Divide, Absolute value, Average, Delay, Invert, Magnify, Max, Min, Differentiate, Integrate, Square, Square root
		High pass filter, Low pass filter, Smoothing filter
Waveform memory	Can be used for Measurements, Math functions and Analyses. Up to 8 independent memories.	
Markers		Cross hair, A-B, Area
Statistics analysis		Mean, Min, Max, Std dev. for waveform and waveform measurements
Amplitude analysis		Histogram (Hits, PDF, CDF, CCDF) and Statistics with windowing
Spectrum analysis (FFT)		Magnitude and Phase with horizontal gating
Utilities		Power measurement wizard
		Power and Current Profiler

Table 15. Visualization

View	Waveform, Histogram, Spectrum, Statistics, Setup summary, Side bar
Display style	Single, Dual, Single plus Zoom (Vertical, Horizontal, Both)
	Persistence, Color grade
	Plot: Auto, Dots, Lines, Area, Gradation, Diamonds
	Axis: Auto, Linear, Log, Invert
Annotation	Can be inserted into display area and on specified waveform

Table 16. Save and load

Screen capture [1]	JPG, BMP, PNG
Trigger setup	HDF5
Setup	HDF5 (contains all setup including trigger setup)
Waveform	HDF5 (Save and Load) and CSV [1]
Composite	HDF5 (contains setup, waveforms, measurement results, and analysis results)
Report	XPS (contains screen capture, waveforms, measurement results, and analysis results) [1]

1. Save only.

Table 17. Computer system and peripherals, I/O ports

Display		WXGA 14.1" capacitive multi touch screen
Resolution		Application runs with 1280 pixels horizontally x 800 pixels vertically
Computer system and peripherals	Operating system	Windows 7 Embedded Standard
	CPU	3 GHz Intel i5 quad core
	PC system memory	8 GB RAM
	Drives	≥ 250 GB removable SSD (solid state drive)
	Peripherals	Optical USB mouse and compact keyboard supplied. All models support any Windows compatible input device with a USB interface
I/O Ports	LAN	LAN RJ-45 connector, supports 10Base-T, 100Base-T, and 1000Base-T. Enables Web-enabled remote control
	USB [1]	7 total ports:
		Three USB 2.0 ports on the front
		Four USB ports on the side (two are USB 3.0 and two are USB 2.0)
	External display	Drivers support up to two simultaneous displays.
		DisplayPort and VGA video out
	Auxiliary output	± 7 V max., ± 200 mA max.: DC, Pulse, Square
	Time base reference output	10 MHz, 8.33 dBm (Vpp = 1.65 V) into 50 Ω
	Time base external reference input	10 MHz, 16 dBm (Vpp = 4 V) max. into 50 Ω
	LXI compliance	LXI 1.4 Core, LXI HiSLIP, LXI IPv6

1. USB communication functionality can be affected by RF electro-magnetic field having the strengths greater than 3 V/m in the frequency range of 80 MHz to 2 GHz or 1 V/m in the frequency range of 2 GHz to 2.7 GHz. The extent of this effect depends upon how the instrument is positioned and shielded.

Table 18. Environmental and general

Temperature	Operating	0 to 40 °C
	Storage	–20 to 60 °C
Humidity	Operating	Up to 80% relative humidity (non-condensing) at 40 °C
	Storage	Up to 90% relative humidity (non-condensing) at 60 °C
Altitude	Operating	Up to 2000 meters
	Storage	Up to 4600 meters
Power		100 V to 240 V ± 10%, 50 Hz / 60 Hz
	Max power dissipated	250 VA
Weight		Mainframe: 11 kg
Dimensions (with feet retracted)		425.6 mm (W), 266.1 mm (H), 196.7 mm (D)
Safety		IEC 61010-1
Electromagnetic compatibility standards		IEC 61326-1

CX1100 Series Current Sensors performance characteristics

Warranted specifications are denoted by **, and all others are supplemental characteristics. Specifications are valid after a 30-minute warm-up and 23 ± 5 °C. All these characteristics are defined by 14-bit acquisition resolution unless otherwise stated.

About the measurement accuracy

Measurement accuracy can be affected by RF electro-magnetic field having the strengths greater than 3 V/m in the frequency range of 80 MHz to 2 GHz or 1 V/m in the frequency range of 2 GHz to 2.7 GHz. The extent of this effect depends upon how the instrument is positioned and shielded.

Table 19. CX1101A characteristics overview

	Range	R_{IN} [2]	Noise (rms) [3]	Maximum bandwidth (-3 dB) [4]
Current measurement [1]	10 A	15 mΩ (typ)	10 mA	3 MHz [5]
	1 A	410 mΩ (typ) 550 mΩ (max)	2 mA	100 MHz
	200 mA		0.2 mA	100 MHz
	20 mA		20 µA	100 MHz
	2 mA		3 µA	100 MHz
	200 µA	50 Ω (typ) 77 Ω (max)	400 nA	25 kHz
	20 µA		40 nA	25 kHz

1. Sensor Head used to measure the characteristics: CX1206 for 10 A range and CX1203A for all other ranges.
2. The slide switch of CX1203A to be set to “0 Ω”.
3. 20 MHz noise bandwidth measured with mainframe
4. Standalone bandwidth. The effective measurement bandwidth when connected to mainframe can be estimated by the following equation.

$$BW_{effective} = \frac{1}{\sqrt{\left(\frac{1}{BW_{sensor}}\right)^2 + \left(\frac{1}{BW_{mainframe}}\right)^2}}$$

5. -4 dB bandwidth

Table 20. CX1101A DC measurement accuracy [1]

Range		Standalone	With mainframe	
		23 ± 5 °C	23 ± 5 °C	$T_{USERCAL}$ ± 3 °C, 24 hrs [2]
10 A	Gain [% of readings] + Offset [% of range]	± (5% + 5%)	± (5.7% + 5.9%)	N/A
1 A		± (2% + 2%) **	± (2.7% + 2.9%) **	± (1.8% + 0.4%)
200 mA		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.7% + 0.4%)
20 mA		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.3%)
2 mA		± (2% + N/A) **	± (2.7% + N/A) **	± (0.7% + 1.1%)
200 µA		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.7% + 0.3%)
20 µA		± (2% + N/A) **	± (2.7% + N/A) **	± (0.7% + 1.1%)

1. Accuracy is defined at VCM = 0 V (zero Common Mode input voltage at either $+I_{IN}$ or $-I_{IN}$). Add 0.7% typical to Offset error for Vcm up to 40 V.
   The “readings” means measured data by mainframe. DC measurement condition: 20 ms averaged.
2 After executing the User Calibration (both gain and offset) with mainframe. Supplemental characteristics.

Table 21. CX1101A other characteristics

Rise time (10% to 90%)		0.35 / Bandwidth [MHz]
Input common mode impedance [1]		750 MΩ // 31 pF (Nominal)
Measurable over range		10% of range
Burden voltage		R_{IN} * Measured current
Maximum input voltage (common mode) [2]	Peak voltage (DC + AC) limit	± 40 V
	AC voltage limit	± 5 V above 1 MHz
Absolute maximum input current	Range	
	10 A	11 A
	1 A	1.5 A [3]
	200 mA	
	20 mA	
	2 mA	
	200 µA	50 mA
	20 µA	

1. Measured with a CX1201A. Both inputs has this same input impedance. When using a CX1203A Sensor Head, the minus (-) terminal is internally connected to the circuit common through a 10 MΩ resistor.
2. For all current measurement ranges.
3. CX1203A with 50 Ω setting: 125 mA

Table 22. CX1101A general information [1]

Cable length	Sensor cable: 1.5 m, Gnd lead: 16 cm
Dimension [2]	46.8 mm (W), 31.9 mm (H), 205.3 mm (D)
Weight	400 g
Furnished accessories	1 each Coaxial Termination Adapter Sensor Head (CX1203A)
	1 each SMA(P) to BNC(J) 50 Ω Coaxial Adapter
	1 each GND lead

1. Refer to mainframe's "Environmental and general" part for other information.
2. CX1203A Sensor Head is included. Cable and adapter are not included.

Table 23. CX1102A characteristics overview

	Range		R_{IN} [2]	Noise (rms) [3]		Maximum bandwidth (–3 dB) [4]
	Primary channel	Secondary channel		Primary channel	Secondary channel	
Current measurement [1]	1 A	20 mA	410 mΩ (typ) 550 mΩ (max)	2 mA	20 µA	100 MHz
	200 mA	2 mA		0.2 mA	3 µA	
	20 mA	200 µA	50 Ω (typ) 77 Ω (max)	20 µA	500 nA	500 kHz
				8 µA [5]	400 nA [5]	90 kHz [5]
	2 mA	20 µA	50 Ω (typ) 77 Ω (max)	2 µA	200 nA	500 kHz
				1 µA [5]	40 nA [5]	25 kHz [5]

1. Sensor Head used to measure the characteristics: CX1203A.
2. The slide switch of CX1203A to be set to “0 Ω”.
3. 20 MHz noise bandwidth measured with mainframe.
4. Standalone bandwidth. The effective measurement bandwidth when connected to mainframe can be estimated by the following equation.

$$BW_{effective} = \frac{1}{\sqrt{\left(\frac{1}{BW_{sensor}}\right)^2 + \left(\frac{1}{BW_{mainframe}}\right)^2}}$$

5. The sensor built-in low pass filter is ON.

Table 24. CX1102A DC measurement accuracy [1]

Range		Standalone	With mainframe	
		23 ± 5 °C	23 ± 5 °C	$T_{USERCAL}$ ± 3 °C, 24 hrs [2]
1 A primary	Gain [% of readings] + Offset [% of range]	± (2% + 2%) **	± (2.7% + 2.9%) **	± (1.8% + 0.4%)
200 mA primary		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.4%)
20 mA secondary		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.4%)
2 mA secondary		± (2% + N/A) **	± (2.7% + N/A) **	± (0.6% + 0.9%)
20 mA primary		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.3%)
2 mA primary		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.7% + 0.3%)
200 µA secondary		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.4%)
20 µA secondary		± (2% + N/A) **	± (2.7% + N/A) **	± (0.7% + 0.9%)

1. Accuracy is defined at VCM = 0 V (zero Common Mode input voltage at either $+I_{IN}$ or $-I_{IN}$). Add 0.9% typical to Offset error for Vcm up to 12 V. “Readings” means measured data by mainframe. DC measurement condition: 20 ms averaged.
2. After executing the User Calibration (both gain and offset) with mainframe. Supplemental characteristics.

Table 25. CX1102A other characteristics

Rise time (10% to 90%)		0.35 / Bandwidth [MHz]
Input common mode impedance [1]		750 MΩ // 18 pF (Nominal)
Measurable over range		10% of range
Burden voltage		R_{IN}* Measured current
Maximum input voltage (common mode) [2]	Peak voltage (DC + AC) limit	± 12 V
Absolute maximum input current	Range	
	1 A primary	1.5 A [3]
	200 mA primary	
	20 mA secondary	
	2 mA secondary	
	20 mA primary	50 mA
	2 mA primary	
	200 µA secondary	
	20 µA secondary	

1. Measured with CX1201A. Both inputs has this same input impedance. When using a CX1203A Sensor Head, the minus (-) terminal is internally connected to the circuit common through a 10 MΩ resistor.
2. All current measurement ranges.
3. CX1203A with 50 Ω setting: 125 mA

Table 26. CX1102A general information [1]

Cable length	Sensor cable: 1.5 m, Gnd lead: 16 cm
Dimension [2]	46.8 mm (W), 31.9 mm (H), 205.3 mm (D)
Weight	400 g
Furnished accessories	1 each Coaxial Termination Adapter Sensor Head (CX1203A)
	1 each SMA(P) to BNC(J) 50 Ω Coaxial Adapter
	1 each GND lead

1. Refer to mainframe's "Environmental and general" part for other information.
2. CX1203A Sensor Head is included. Cable and adapter are not included.

Table 27. CX1103A characteristics overview

	Range	R_{IN}	Noise (rms) [1]	Maximum bandwidth (–3 dB) [2]	DC offset range and resolution
Current measurement	20 mA	50 Ω typ, 55 Ω max (50 Ω input ON)	5 µA	200 MHz	± 20 mA 0.8 µA resolution
	2 mA		1.5 µA	75 MHz	
	200 µA	4 Ω typ, 6 Ω max (50 Ω input OFF)	150 nA	9 MHz	± 200 µA 8 nA resolution
	20 µA		25 nA	2.5 MHz	
	2 µA		1.5 nA	250 kHz	± 2 µA 80 pA resolution
	200 nA		150 pA	100 kHz	

1. 20 MHz noise bandwidth measured with mainframe.
2. Standalone bandwidth. The effective measurement bandwidth when connected to mainframe can be estimated by the following equation.

$$BW_{effective} = \frac{1}{\sqrt{\left(\frac{1}{BW_{sensor}}\right)^2 + \left(\frac{1}{BW_{mainframe}}\right)^2}}$$

Table 28. CX1103A DC measurement accuracy [1]

Range		Standalone	With mainframe	
		23 ± 5 °C	23 ± 5 °C	$T_{USERCAL}$ ± 3 °C, 24 hrs [2]
20 mA	Gain [% of readings] + Offset [% of readings]	± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.3%)
2 mA		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.4%)
200 µA		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.4%)
20 µA		± (2% + 2%) **	± (2.7% + 2.9%) **	± (0.6% + 0.4%)
2 µA		± (2% + 2%) **	± (2.7% + 2.9%) **	± (1.3% + 0.4%)
200 nA		± (2% + 2%) **	± (2.7% + 2.9%) **	± (1.3% + 0.3%)

1. Accuracy is defined at DC offset = 0 A. The “readings” means measured data by mainframe. DC measurement condition: 20 ms averaged.
2. After executing the User Calibration (both gain and offset) with mainframe. Supplemental characteristics.

Table 29. CX1103A other characteristics

Rise time (10% to 90%)		0.35 / Bandwidth [MHz]
Measurable over range		10% of range
Burden voltage		R_{IN} • Measured current
Maximum input voltage (common mode) [1]	Input 50 Ω OFF	± 0.5 V
	Input 50 Ω ON	± 1.0 V
Absolute maximum input current		125 mA

1. All current measurement ranges.

Table 30. CX1103A general information [1]

Cable length	Sensor cable: 1.5 m, Gnd lead: 16 cm
Dimension	45.8 mm (W), 28.1 mm (H), 163.1 mm (D)
Weight	300 g
Furnished accessories	1 each SMA(P) to BNC(J) 50 Ω Coaxial Adapter
	1 each GND lead

1. Refer to mainframe’s “Environmental and general” part for other information.

CX1151A Passive Probe Interface Adapter characteristics

Warranted specifications are denoted by**, and all others are supplemental characteristics. Specifications are valid after a 30-minute warm-up and 23 ± 5 °C. All these characteristics are defined by 14-bit acquisition resolution unless otherwise stated.

About the measurement accuracy

Measurement accuracy can be affected by RF electro-magnetic field having the strengths greater than 3 V/m in the frequency range of 80 MHz to 2 GHz or 1 V/m in the frequency range of 2 GHz to 2.7 GHz. The extent of this effect depends upon how the instrument is positioned and shielded.

Table 31. CX1151A characteristics overview

	Range	Noise (rms) [1]	Maximum bandwidth (-3 dB) [2]	DC offset range and resolution
Voltage measurement	8 V	5.0 mV	300 MHz	± 16 V, 16-bit resolution
	4 V	2.8 mV		
	1.6 V	1.8 mV		
	0.4 V	250 µV		
	0.2 V	140 µV		± 0.8 V, 16-bit resolution
	0.08 V	90 µV		

1. Full bandwidth measured with mainframe (Option B20; 200 MHz bandwidth).
2. Standalone bandwidth with an N2843A passive probe. The effective measurement bandwidth when connected to mainframe can be estimated by the following equation.

$$BW_{effective} = \frac{1}{\sqrt{\left(\frac{1}{BW_{adaptor}}\right)^2 + \left(\frac{1}{BW_{probe}}\right)^2 + \left(\frac{1}{BW_{mainframe}}\right)^2}}$$

Table 32. CX1151A DC measurement accuracy [1]

Range		Standalone 23 ± 5 °C	With mainframe 23 ± 5 °C	With mainframe $T_{USERCAL}$ ± 3 °C, 24 hrs (High speed mode) [2]	With mainframe $T_{USERCAL}$ ± 3 °C, 24 hrs (High resolution mode) [3]
8 V	Gain [% of readings] + Offset [% of range]	± (0.6% + 0.8%) **	± (1.3% + 1.7%) **	± (0.4% + 0.6%)	± (0.3% + 0.4%)
4 V		± (0.6% + 0.8%) **	± (1.3% + 1.7%) **	± (0.8% + 0.6%)	± (0.5% + 0.4%)
1.6 V		± (0.6% + 0.8%) **	± (1.3% + 1.7%) **	± (0.8% + 0.6%)	± (0.5% + 0.4%)
0.4 V		± (0.6% + 0.8%) **	± (1.3% + 1.7%) **	± (0.4% + 0.6%)	± (0.3% + 0.4%)
0.2 V		± (0.6% + 0.8%) **	± (1.3% + 1.7%) **	± (0.8% + 0.6%)	± (0.5% + 0.4%)
0.08 V		± (0.9% + 1.2%) **	± (1.6% + 2.1%) **	± (0.8% + 0.6%)	± (0.5% + 0.4%)

Range with 10:1 passive probe [4]

			$T_{USERCAL}$ ± 3 °C, 24 hrs (High speed mode) [2]	$T_{USERCAL}$ ± 3 °C, 24 hrs (High resolution mode) [3]
80 V	Gain [% of readings] + Offset [% of range]		± (2.1% + 0.6%)	± (1.1% + 0.4%)
40 V			± (1.5% + 0.6%)	± (0.8% + 0.4%)
16 V			± (0.7% + 0.6%)	± (0.4% + 0.4%)
4 V			± (1.7% + 0.6%)	± (0.9% + 0.4%)
2 V			± (1.2% + 0.6%)	± (0.7% + 0.4%)
0.8 V			± (0.4% + 0.6%)	± (0.3% + 0.4%)

1. DC measurement condition: 20 ms averaged.
2. After executing the User Calibration with mainframe. High speed mode (14-bit). Supplemental characteristics.
3. After executing the User Calibration with mainframe. High resolution mode (16-bit). Supplemental characteristics.
4. Passive probe used: N2843A.

Table 33. CX1151A other characteristics

Rise and fall times (10% to 90%)	0.35 / Bandwidth [MHz]
Input impedance	1 MΩ ± 0.1%, 13 pF
Input coupling	DC, AC (3.5 Hz)
Maximum input voltage	± 100 V peak (DC + AC)

Table 34. CX1151A general information

Dimension	58.6 mm (W), 30.2 mm (H), 87.5 mm (D)
Weight	130 g
Recommended passive probe products [1]	N2843A
Supported passive probe products [2]	(1:1) 10070D, N2870A (10:1) 10073D, 10074D, N2862B, N2863B, N2871A, N2872A, N2873A, N2890A, N2894A, N2853A, N2843A, N2842A, N2841A, N2840A (20:1) N2875A, (100:1) 10076C

1. N2843A is used to measure characteristics shown above.
2. Supported probe's ratio can be detected by mainframe.

CX1152A Digital Channel characteristics (mainframe: CX3324A only)

Warranted specifications are denoted by**, and all others are supplemental characteristics. Specifications are valid after a 30-minute warm-up and 23 ± 5 °C.

Table 35. CX1152A vertical system - digital channels

Input channels	8 channels
User-defined threshold range	± 25 V, 10 mV step
Maximum input voltage	± 40 V peak
Threshold accuracy	± (150 mV + 3% of threshold setting)
Input dynamic range	± 25 V
Minimum input voltage swing	500 mV peak-to-peak
Input impedance	10 MΩ ± 2% with approximately 8 pF in parallel
Channel-to-channel skew	4 ns
Resolution	1 bit

1. 50 Ω input impedance
2. CX1152A is required to enable the input digital channels.

Table 36. CX1152A general information

Cable length	Digital channel cable: 1.15 m, probe lead: 28.5 cm
Dimension [1]	68.1 mm (W), 18.5 mm (H), 103.0 mm (D)
Weight	130 g
Furnished accessories	5 probe ground leads
	10 grabbers
	1 each BNC-probe tip adapter

1. Dimension of pod. Leads and cables are not included.

CX3300 Series dimensional drawing (mainframe)

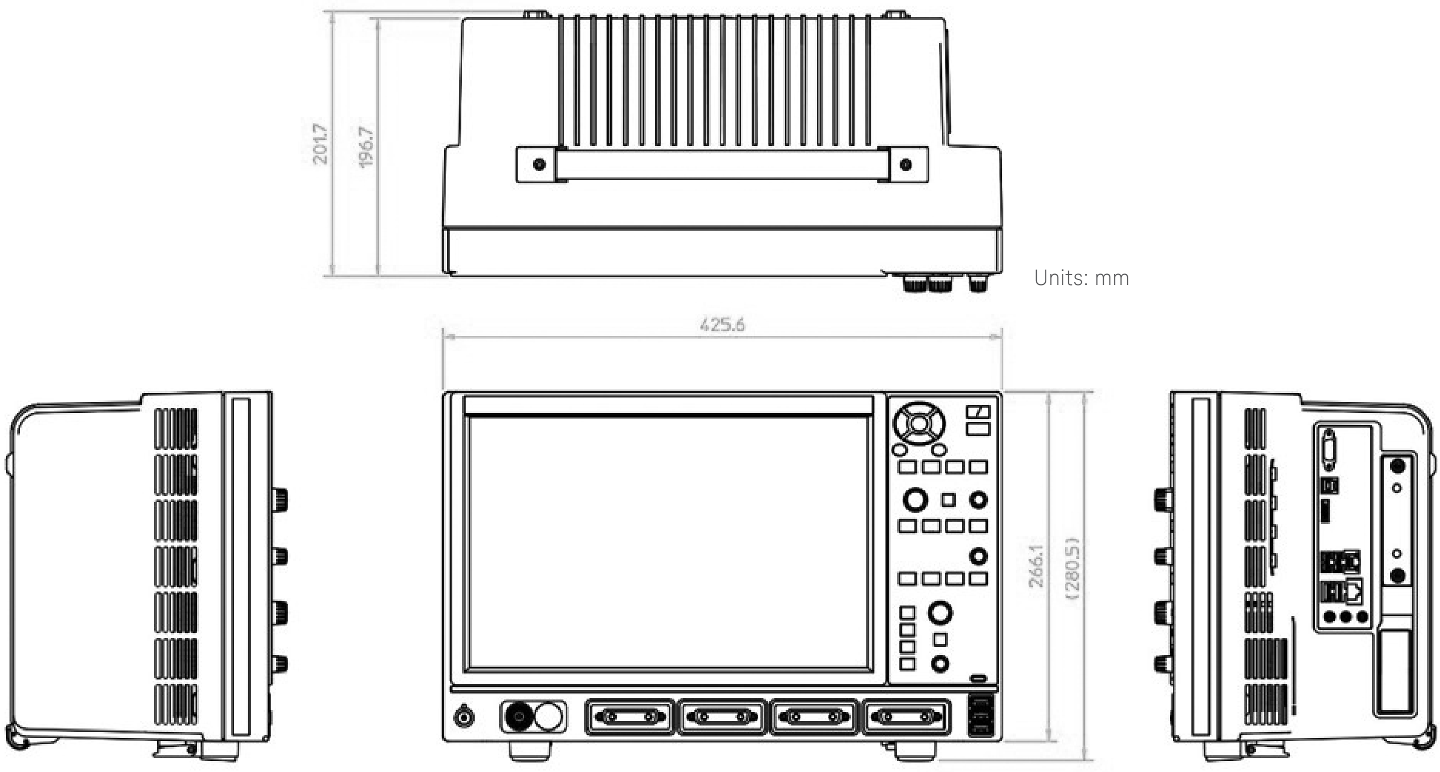

Figure 34. CX3300 Series schematic diagram.