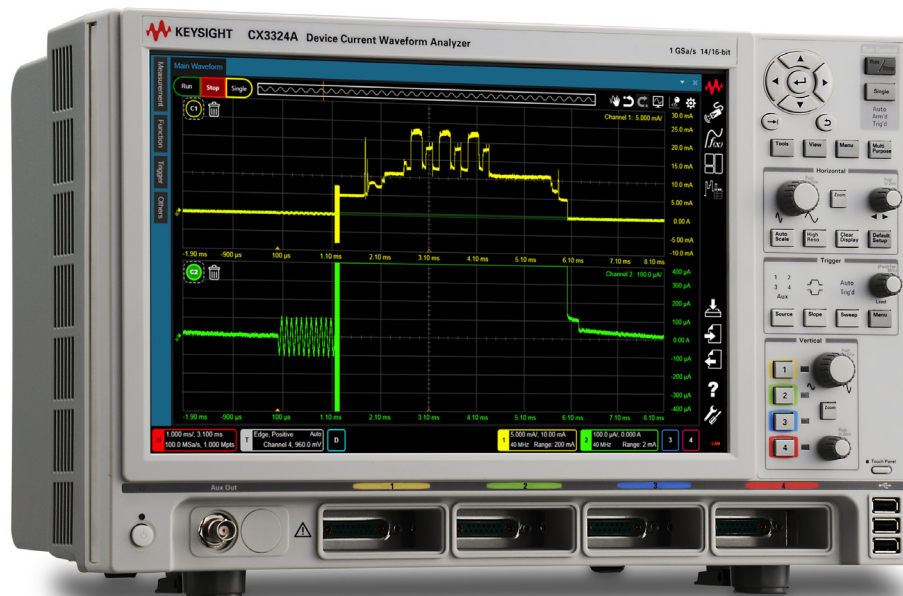


# Keysight Technologies

## The CX3300 Unveils Current Waveform Never Seen by Conventional Current Probes

### Application Brief



## Introduction

Computing technology and the Internet have dramatically change our lives and the boom of new technology, the Internet of Things (IoT), continues to expand the range of Internet connected devices including wearable devices, sensors, wireless networks, home appliances, electric vehicles and so on. These new devices and applications require long life operations with low signals and limited power supplies from batteries or other harvested energy supplies. With this ever expanding range of devices comes an increasing demand in the need to analyze the current profile for research, development and the debugging of low power devices and circuits.

A current probe with an oscilloscope has been commonly used for measuring such dynamic current behavior. However, it is becoming difficult to measure the low current of  $\mu\text{A}$  or less flowing in the next generation low power devices.

Keysight's CX3300 Device Current Waveform Analyzer is a new solution for measuring a current waveform more precisely. Its low noise design and unique ultra-wideband low current sensing technology allow you to quickly and interactively visualize never before seen current waveform. The CX3300 supports the current sensors covering a wide range from 100 pA to 10 A with 1 GSa/s sampling rate, 200 MHz bandwidth, 14/16 bit dynamic range and 256 Mpts memory depth capabilities on a 2ch or 4ch mainframe model.

The CX3300A enables a wide range of precision current waveform measurements that have been difficult to obtain using a conventional current probe. It enables you to accelerate the research, development, debugging and current profiling for a wide range of applications as follows.

- Battery powered mobile and wearable devices
- Low power wireless/communication/IoT chip
- MCU/ SoC/IP core
- ESD (Electro-Static-Discharge) test
- Non-volatile memory (NVM) characterization
- Time varied parameter characterization of materials and devices etc.

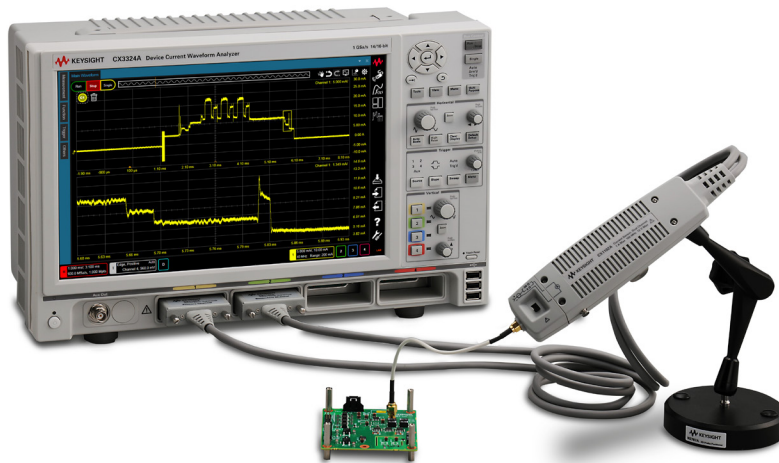


Figure 1. CX3300A Device Current Waveform Analyzer

## Requirements for a Precision Current Waveform Measurement

Many recent electronic devices consist of a range of chips as shown in the example in Figure 2 below. Electronic devices are becoming more powerful but their power is supplied from a limited power source such as a battery. Power saving and efficient power management are important and low power devices typically support intermittent operation between sleep and active mode. The current profile will depend on the operation mode and it is necessary to analyze a current profile that can be less than mA at sleep mode.

A current probe with an oscilloscope is commonly used for a dynamic current measurement, however, with the increase in the number of low power devices, there is a demand for an analyzer that can undertake the following:

- High sensitivity to measure the current even at sleep mode
- Dynamic range to measure the sleep and active mode transition
- Wide frequency range starting from DC
- Accurate and reliable measurement without the core saturation effect of a current probe.
- Visualization of current waveform, not an averaged current

Keysight's CX3300A is designed for precision current waveform measurement for these highly demanded needs. The CX3300A enables you to analyze the real current waveform and improve the power management. Current waveform visualization unveils the phenomena that is not possible to obtain with only a voltage measurement, and accelerates the development, evaluation and debugging of new generation devices.

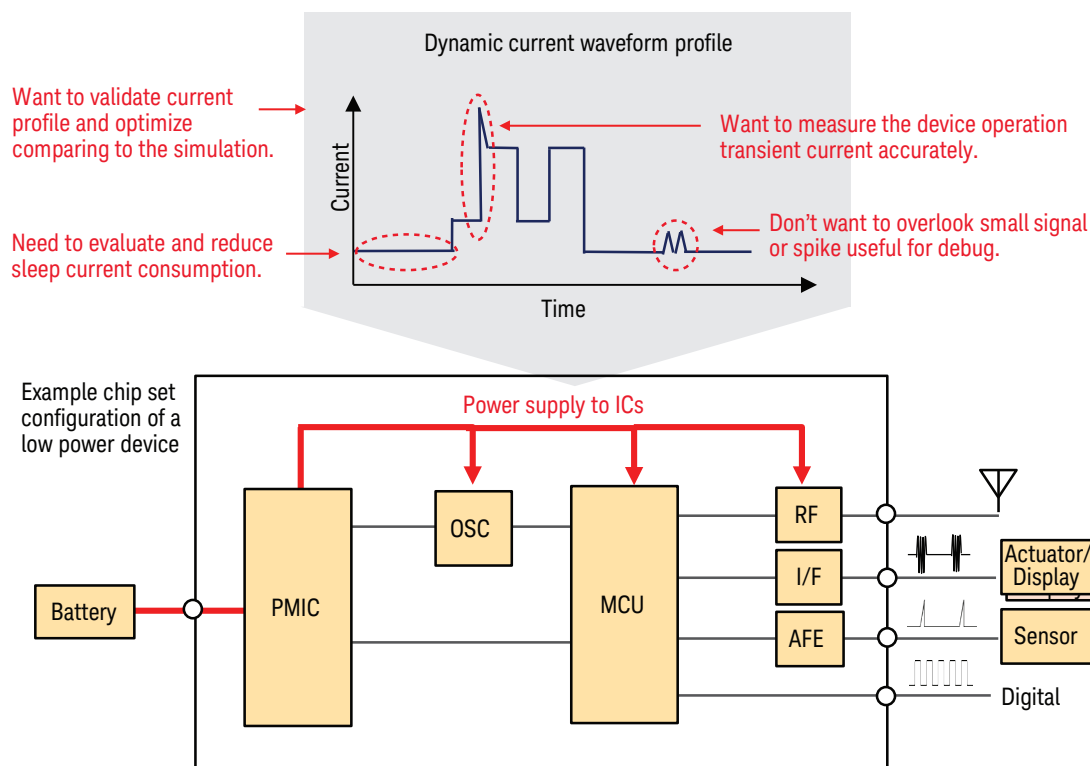


Figure 2. Example of a low power device and measurement requirements

## The CX3300 Unveils Never Before Seen Current Waveform

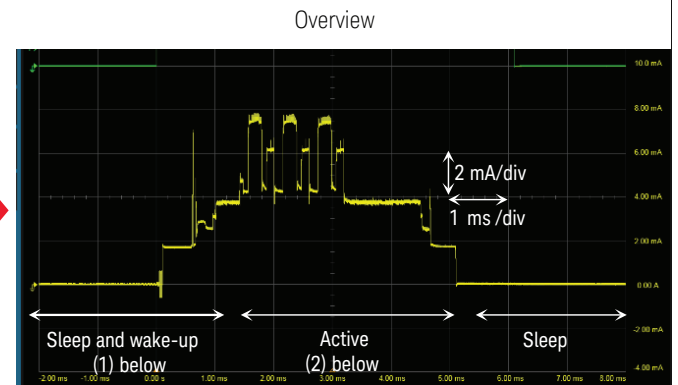
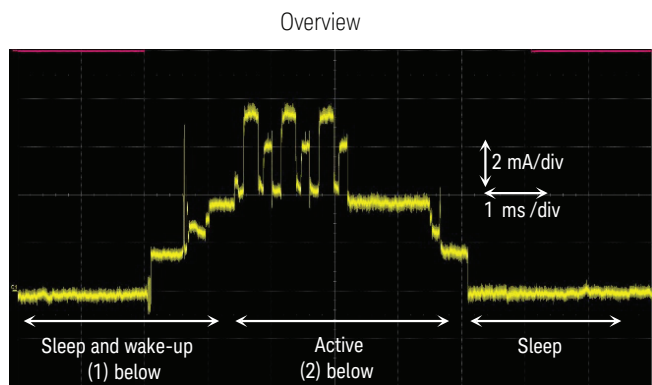
The followings are some examples measured by the CX3300A. In comparison with a current probe, the CX3300A can more clearly and precisely visualize current waveform measurements.

### Example-1: Low power device measurement

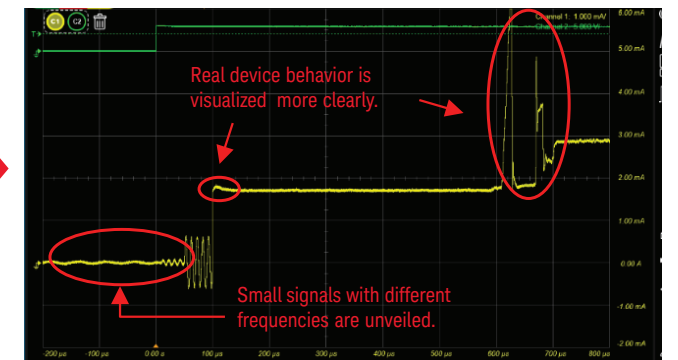
This is an example of a BLE (Bluetooth Low Energy) device advertising event measurement. Although a conventional current probe allows you to observe the current waveform shape, the CX3300 unveils more precise never before seen current waveform in the circuit. For the CX3300, the CX1101A sensor is selected, because it has similar bandwidth to the current probe.

Current probe (DC - 100 MHz, 1mA min)  
with oscilloscope (12 bit, 350 MHz BW, 2.5 GSa/s)

The CX3300A with the CX1101A current sensor  
(DC - 100 MH, 40 MHz BW@20 mA range)



(1) Zoom into sleep and wake-up mode



(2) Zoom into active mode

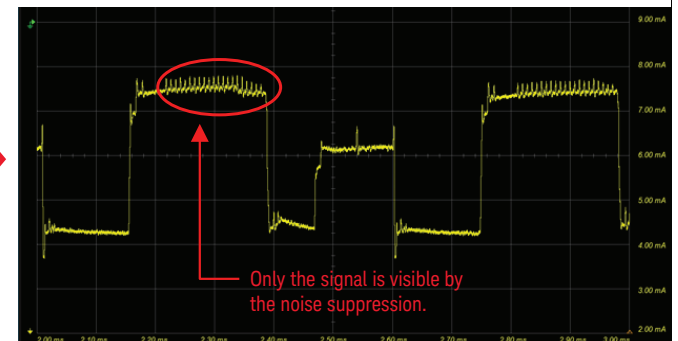
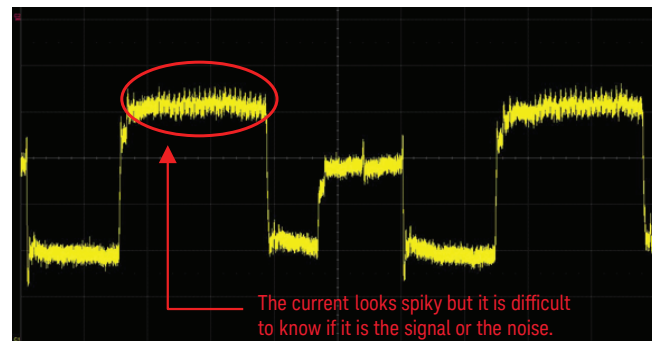


Figure 3. Example of a low power device measurement

## Example-2: Pulsed I/V measurement

The CX3300A's current measurement capability is not limited to circuit board applications, but also available for any current waveform measurement applications.

An example application is a pulsed I/V measurement. It is important to prevent self-heating, study non-volatile memory behavior, or characterize time varied device parameters for material and device characterization. The semiconductor technology evolution demands higher speeds and higher levels of sensitivity.

In this pulsed I/V measurement example, the pulse steps are applied to 1 k $\Omega$ , and the current waveform is measured as follows.

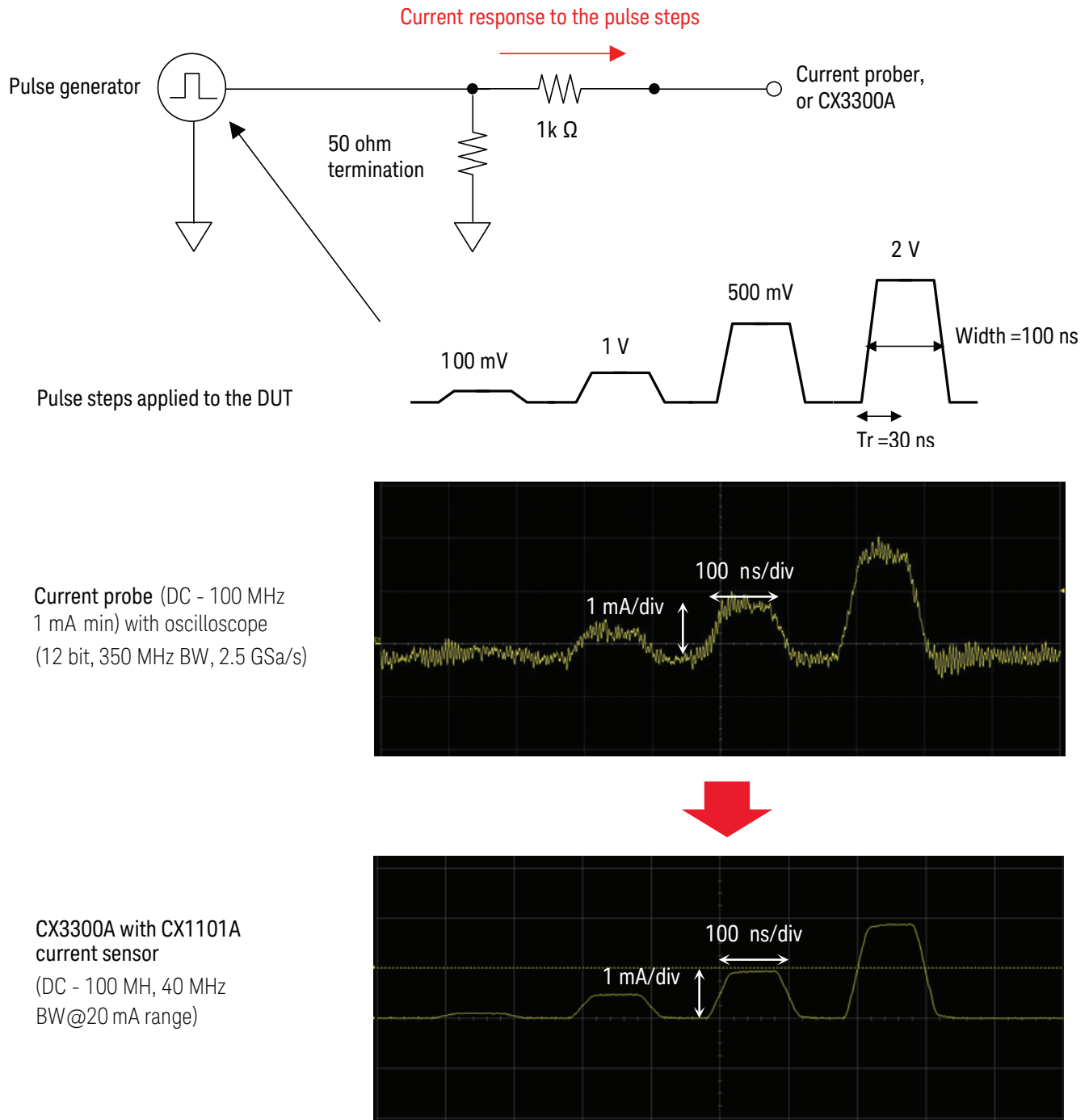


Figure 4. Pulsed I/V measurement setup and measurement result comparison

## A Breakthrough Solution for Precision Current Waveform Measurement

As shown in the measurement examples, the CX3300A's low noise design and ultra-wideband low current sensing technology enables you to precisely and accurately visualize never before seen current waveform. The CX3300A's measurement capabilities can complement and enhance existing measurement solutions and benefit a broad range of applications with the following features:

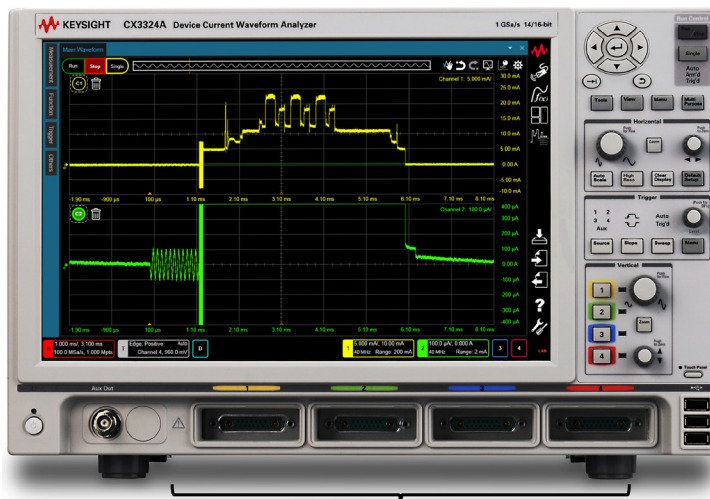
### Benefits:

- The ability to precisely visualize never before seen current waveform
- Accurate and reliable measurement without the core saturation effect of a current probe
- No maximum current and frequency derating limitation
- No time loss for degauss operation
- Enabling explorative measurements and debugging in a similar way as using an oscilloscope

### Key Features:

- Ultra-wideband low current sensing technology based current sensors (CX1101A, CX1102A, CX1103A)
- Max. 200 MHz bandwidth (50 MHz, 100 MHz and 200 MHz options)
- Max. 1 GSa/s sampling rate
- Max. 256 Mpts memory depth (16 M, 64 M and 256 M options)
- 2ch/4ch mainframe model. (Digital channel is available only for 4ch model)
- WGXA 14.1" LCD with multi touch screen that is helpful for interactive measurement and debugging

CX3300 mainframe



Sensor connector inputs (2ch or 4ch)

#### CX1101A Single channel current sensor

20  $\mu$ A to 10 A range  
25 kHz to 100 MHz  
40 V max



#### CX1102A Dual channel (range) current sensor

20  $\mu$ A to 1 A range  
25 kHz to 100 MHz  
12 V max



#### CX1103A Low side current sensor

200 nA to 20 mA range  
100 kHz to 200 MHz  
0.5 V/1 V max



#### CX1151A Passive Probe Interface Adapter (for voltage monitor)

80 V max (with 1/10 probe)  
8 V max (without 1/10 probe)



Figure 5. CX3300 Product Overview

## Ordering Information

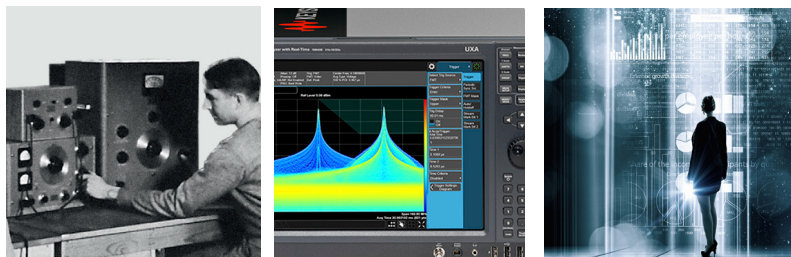
Category	Model Number	Description
2 channel mainframe	CX3322A	Device Current Waveform Analyzer, 1 GSa/s, 14/16-bit, 2 Channel
	CX3322A-B05	Bandwidth – 50 MHz
	CX3322A-B10	Bandwidth – 100 MHz
	CX3322A-B20	Bandwidth – 200 MHz
	CX3322A-016	Memory – 16 Mpts/ch
	CX3322A-064	Memory – 64 Mpts/ch
	CX3322A-256	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
4 channel mainframe	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
Sensors and accessories	CX1101A	Current Sensor, Single Channel, $\pm 40$ V, 100 MHz, 40 nA – 1 A
	CX1102A	Current Sensor, Dual Channel, $\pm 12$ V, 100 MHz, 40 nA – 1 A
	CX1103A	Current Sensor, Low Side, 200 MHz, 100 pA – 20 mA
	CX1151A <sup>1</sup>	Passive Probe Interface Adapter
	CX1152A	Digital Channel, 10 Mohm Input, $\pm 25$ V, 8 Channel
	CX1201A	Sensor Head, Coaxial Through
	CX1202A	Sensor Head, Coaxial Through with V Monitor
	CX1203A <sup>2</sup>	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
	CX1903A	Rack Mount Kit for CX3300 Series
	CX1905A <sup>3</sup>	Attachment for 3D Probe Positioner

1. Recommended passive probe: Keysight N2843A
2. CX1203A is furnished for CX1101A and CX1102A.
3. Recommended 3D positioner: Keysight N2787A



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