Product Feature

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Current Analyzers Go Where No Instrument Has Gone Before

These two- and four-channel device current analyzers, along with their associated current probes, make it possible to accurately measure the lowest levels of current in analog and digital devices.

CURRENT CONSUMPTION AND energy conservation are real concerns for many present and future wireless applications, both for analog and digital devices. Measuring current has long been a task "left" to a general-purpose instrument (such as a multimeter) or to an instrument nominally designed for some other function (such as a digital storage oscilloscope or spectrum analyzer).

Unfortunately, for the low current levels expected in low-power devices for many emerging wireless applications, which must run for extended periods on battery power—like wearable electronics, embedded medical devices, machine-to-machine (M2M) devices, and Internet of Things (IoT) sensors—such measurement tools fall short of sensitivity and resolution.

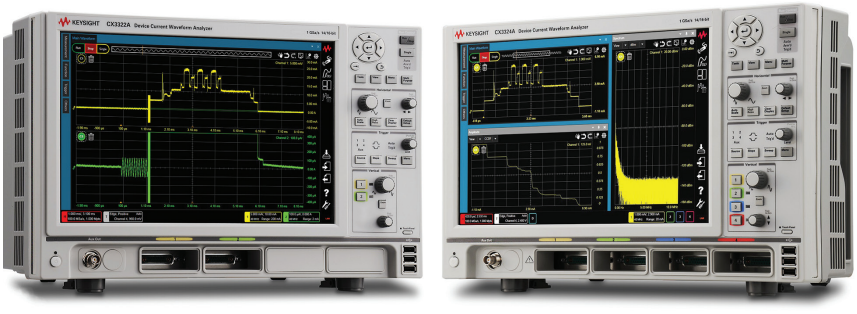
Fortunately, a series of instruments has been developed specifically for measuring low current levels, the CX3300 series of device current waveform analyzers from Keysight Technologies (www.keysight.com). When armed with the appropriate current sensor, the analyzers can characterize device currents as low as 10 pA and as large as 10 A. The current waveform analyzers receive signals from the current sensor and digitize them at a rate of 1 Gsample/s and 14- and 16-b dynamic-range settings with bandwidths of either 100 or 200 MHz, providing measurements of current levels previously undetectable and unmeasurable.

The analyzers are candidates for research laboratories; analog, digital, and mixed-signal semiconductor device designers; and semiconductor device users. They provide the analysis capability to develop that next-generation wireless device that will run almost forever on battery power.

The CX3300 series *(Fig. 1)* consists of two instruments with various options, current probes, and a variety of accessories. The benchtop instruments are the model CX3322A with two input channels and the model CX3324A with four input channels. Both perform measurements with a maximum sampling rate of 1 Gsample/s, offering 14-b resolution in high-speed mode and 16-b resolution in high-resolution mode (better than 100 dB). The current analyzers are available with a choice of analog bandwidths—50, 100, or 200 MHz—and a choice of memory depth—16, 64, or 256 Mpoints. The bandwidth and memory depth options are upgradeable for future requirements.

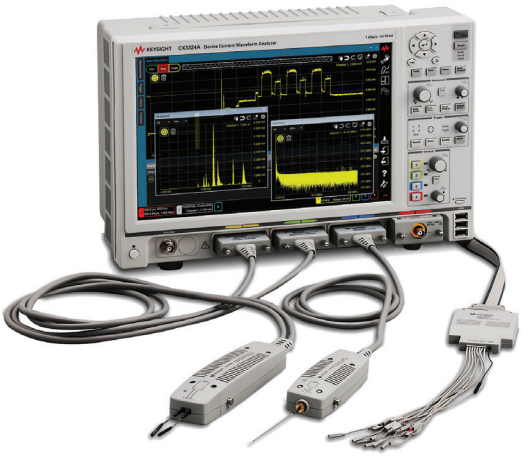
Although these instruments represent the first of their kind in terms of their capabilities in measuring low current levels with massive dynamic range, they will seem familiar to many users, since they adopt many of the traits of an oscilloscope. They feature intuitive graphical user interfaces (GUIs) that are relatively easy to learn and simple to use, aided by a striking 14.1-in. multitouch liquid-crystal-display (LCD) screen.

By touching a starting point on a displayed curve, for example, the instrument's "anywhere zoom" feature makes it possible with a touch of a finger to



1. The CX3300 Series of device current waveform analyzers includes the two-channel model CX3322A (left) and four-channel model CX3324A (right).

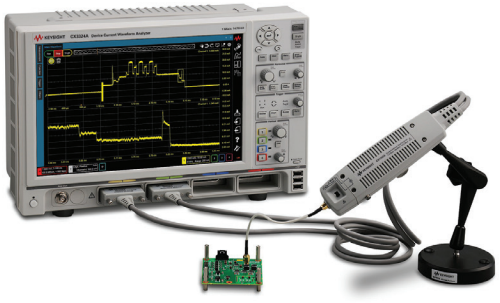
expand or shrink the view for the selected portion of a waveform. For those who prefer an "old-fashioned" display screen, a front-panel switch allows the touch function to be deactivated. As an added feature, both analyzers can function as spectrum analyzers, showing results on the full screen or on a window of the screen.



2. Three current sensors are available for the CX3300 series analyzers—models CX1101A, CX1102A, and CX1103A.

DON'T FORGET THE SENSORS

The device current waveform analyzers work with different sensors to provide a choice of measurement capabilities and measurement sensitivity. At present, three types of sensors are available for the analyzers: models CX1101A, CX1102A, and CX1103A *(Fig. 2)*. Model CX1101A is a single-channel current sensor capable of working with the highest voltages, with a maximum input voltage of ±40 V dc. It operates with 100-MHz bandwidth to measure minimum current of 40 nA and maximum current of 10 A with ±0.9% dc measurement accuracy when working with one of the device current waveform analyzers.



3. Six probe-tip connections and connector interfaces simplify measurements on many different devices under test (DUTs).

Model CX1102A is a dual-channel current sensor with 100-MHz standalone bandwidth. It operates with maximum input voltage of ±12 V dc and can measure current from 40 nA to 1 A, also with ±0.9% measurement accuracy with one of the analyzers. This dual-channel current sensor offers a great deal of flexibility—for example, studying device current at two different current settings or measurement resolutions.

For truly low-current-level measurements, the third current sensor, model CX1103A, enables measurements of current levels as low as 150 pA to a maximum current level of 20 mA, with ±0.9% measurement accuracy. This sensitive tool features a standalone measurement bandwidth of 200 MHz and can be specified with maximum input voltage of ±0.5 V dc.

Current measurements may be performed by means of coaxial connections to a test fixture or using probe-tip connection additions to the current sensors to probe device leads and other points in a circuit *(Fig. 3)*. A total of six detachable probe-tip connections are available for the sensors. These connections offer endless possibilities for experimentation—for example, to study how current changes as a result of different factors in a circuit, such as the variations in dielectric constant of a substrate material, or even the conductivity of microstrip transmission lines.

In addition, using a model CX1151A passive probe interface adapter, power consumption can also be calculated and displayed on either of the CX3300 series device current waveform analyzers. The CX1151A has a maximum input voltage rating of 100 V peak and 200-MHz bandwidth.

Neither the CX3322A nor the CX3324A device current waveform analyzer include a dedicated digital trigger input for analysis of digital devices. But the added channels in the CX3324A enable the use of one of the accessories, the CX1152A digital channel interface cable, in support of digital measurements (with maximum input voltages of ±25 V dc). The interface cable, combined with the measurement capabilities of the CX3324A, make it possible to examine the logic status of digital devices.

Both analyzers are relatively easy to use, with controls intelligently laid out for manual operation, knobs for horizontal and vertical settings, and navigation keys for ease of finding values on different parts of a captured waveform. Three Universal Serial Bus (USB) ports are including for saving and moving measurement results as needed.

For ease of analysis, the device current waveform analyzers have a number of analysis capabilities, including an Automatic Power and Current Profiler, a Power Measurement Wizard, a fast-Fourier-transform (FFT) analyzer, and Statistical Analysis functions. These built-in functions provide analysis power without adding external computers and programs. In addition, the analyzers include simple user calibration functions to allow an operator to quickly calibrate the analyzer and a connected sensor for a zero-current setting.

The CX3322A and CX3324A analyzers, along with their sensors and accessories, reach uncharted territory for engineers seeking to understand the current consumption of their circuits and devices. Their wide measurement bandwidths make it possible to capture even the briefest transient current events to fully understand device behavior. With picoampere sensitivity and better than ±1% accuracy, they provide the insights needed to understand the effects of active devices on battery power.

With the growing number of wireless devices that will depend on battery power, this is invaluable measurement data that was previously unavailable at these low current levels. MW