Keysight Technologies

New Probing Technology Enables High Sensitivity, Wide Dynamic Range Current Measurement

Application Note

KEYSIGHT TECHNOLOGIES

Introduction

As modern battery-powered devices and integrated circuits become more green and energy efficient, there is a growing need to make high sensitivity, low level current measurements to ensure these devices' current consumption is within acceptable limits. The key applications calling for accurate power consumption measurement are battery-powered applications such as wireless mobile devices and consumer electronics. To maximize the battery life, engineers need to minimize the power consumption over the life of the product. Power is defined as P = V x I. The key enabler of reducing the power consumption of a device is to lower the average current consumption for a fixed supply voltage level.

A primary challenge in measuring the current consumption of battery-powered mobile devices, such as a cell phone or a tablet computer, is that the dynamic range of the current signal is very wide. The mobile device typically switches back and forth between active states, where it draws very high and fast peak currents, and an idle or standby current mode, where it draws very small DC and AC currents.

Figure 1 shows the current drain measured on a GSM cell phone when making a call. The active current peaks as high as ~2 A, and at idle mode, the current drain is extremely small.

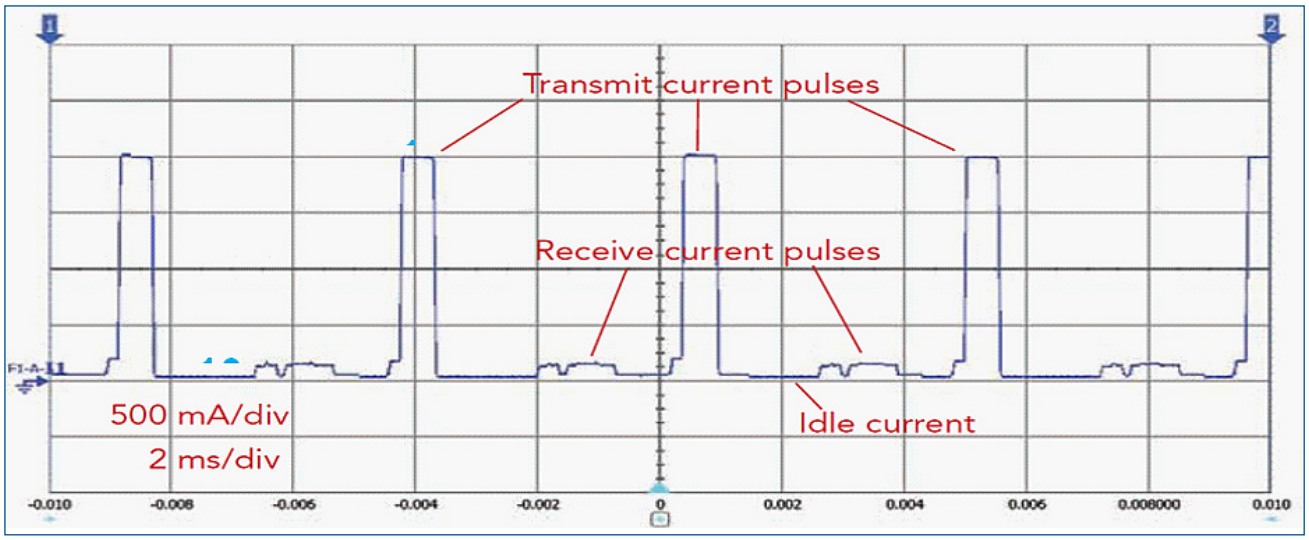

Figure 1 The current drain measured on a GSM cell phone when making a call.

A simple way to measure a current with an oscilloscope is to use a clamp-on type current probe such as the Keysight Technologies, Inc. 1147B or N2893A to directly monitor the current going into the device.

Unfortunately, this approach is not appropriate for measuring small currents that rapidly change between sub-milli amps and several amps because of the limited dynamic range and sensitivity of the clamp-on type current probe, which is limited to a few milli amps. In the example for measuring the current consumption of a mobile phone, the idle state current is not quite measurable because it is buried in the probe noise.

Also, for a more accurate measurement, one would occasionally degauss the probe to remove residual magnetism from the probe core and compensate for any DC offset of the clamp-on current probe. This extra calibration procedure makes the clamp-on current probe cumbersome to use.

Figure 2 A simple way to measure a current with an oscilloscope is to use a clamp-on type current probe such as Keysight's 1147B or N2893A.

The new N2820A Series high-sensitivity current probes from Keysight Technologies address the need for high-sensitivity current measurements with a wide dynamic range. These probes also offer the advantage of physically small connections to the device under test (DUT) since today's application environments require an extremely small form factor. The new N2820A/21A AC/DC current probes offer the industry's highest sensitivity among oscilloscope current probes, going all the way down to 50 uA with a maximum current range of 5 A.

Keysight's N2820A 2-channel high sensitivity current probe comes with two parallel differential amplifiers inside the probe with different gain settings, where the low gain side allows you to see the entire waveform or the "zoom out" view of the waveform and the high gain amplifier provides a "zoom in" view to observe extremely small current fluctuations, such as a mobile phone's idle state. The N2820A/21A current probes are optimized for measuring the current flow within the DUT to characterize sub-circuits, allowing the user to see both large signals and details on fast and wide-dynamic current waveforms.

Figure 3 The new N2820A/21A AC/DC current probes offer the industry's highest sensitivity among oscilloscope current probes.

The probe offers an innovative method of connecting the probe to your DUT. The supplied Make-Before-Break (MBB) connectors allow you to quickly probe multiple locations on your DUT without having to solder or unsolder the leads. The MBB header may be mounted on your target board or wired out of the DUT. It fits into standard 0.1" spacing thru-holes for 0.025" square pins. Users should plan their PCB layouts accordingly. The MBBs are a great way to easily connect and disconnect across multiple locations on the target board without interrupting the circuit under test.

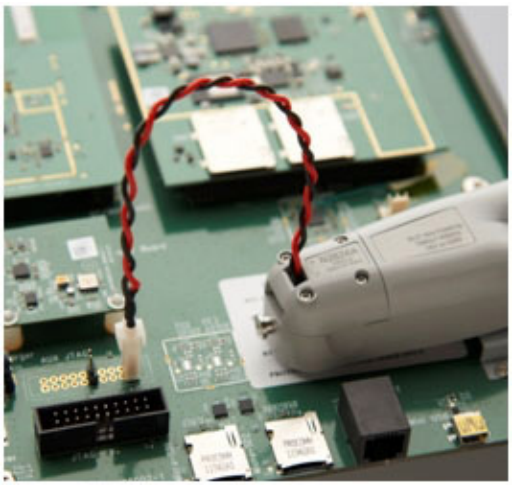

Figure 4 The supplied Make-Before-Break (MBB) connectors allow you to quickly probe multiple locations on your DUT without having to solder or unsolder the leads.

The innovation hasn't stopped there. With current waveforms captured, you now want to calculate the average current consumption of the system over time. Keysight's Infiniium and InfiniiVision oscilloscopes provide an area under the curve measurement (Charge), where you can easily calculate the integrated current consumptions in Ah (Ampere x Hour) over time. The 'Ah' is a unit of measurement of a battery's electrical storage capacity. One Ah is equal to a current of one ampere flowing for one hour.

Now with the N2820A/21A current probes, engineers in battery-powered product testing are able to see the details and the big picture on dynamic current waveforms like never before with traditional clamp on probes.

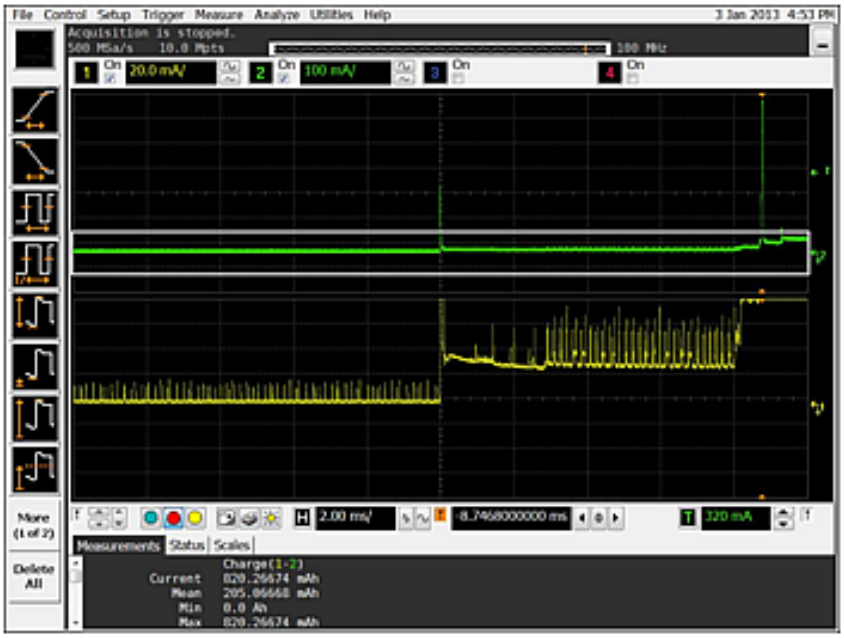

Figure 5 Keysight's Infiniium and InfiniiVision oscilloscopes provide an area under the curve measurement (Charge), where you can easily calculate the integrated current consumptions in Ah (Ampere x Hour) over time.

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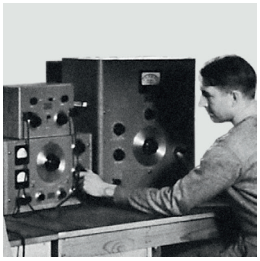

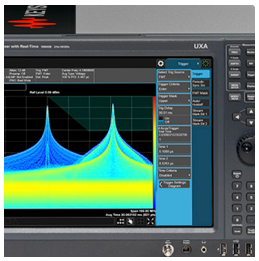

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