HIGH DYNAMIC RANGE CURRENT MEASUREMENTS ON IoT DEVICES

Simultaneously measure various current levels from µA to A in all phases of IoT device activity – from sleep to receive and transmit mode

Current measurement with nine-figure dynamic range

A long battery lifetime is crucial for modern IoT and mobile devices. In order to keep energy consumption as low as possible, these devices typically work with special sleep modes that consume very little power and are only interrupted by very short activity phases of normal or high power consumption. For a device to succeed, its power consumption has to be optimized in the early development phase. It needs to be measured accurately, which requires sophisticated probing solutions. The probe must be able to simultaneously measure very small currents in the µA or even nA range as well as currents up to several amperes. Handling such a high dynamic range of 10^6 or even up to 10^9 is a challenge for every measurement device and may even be impossible for digital multimeters, current probes or source meter units (SMU).

Multi-channel power probe

The R&S®RT-ZVC02/-ZVC04 multi-channel probes are ideal for battery lifetime measurements on low power consumption devices. They simultaneously measure current with high dynamic range and high resolution in all mobile device activity phases. To operate the multi-channel probe, an R&S®RTE1000, R&S®RTO2000 or R&S®RTP oscilloscope is required. With up to four current and four voltage input channels, each with 18 bit ADC resolution, the R&S®RT-ZVC02/-ZVC04 multi-channel power probes provide the dynamic range needed to analyze current consumption. Three built-in shunts and an external shunt mode in combination with switchable gain factors help optimize the input current range.

Current measurement range	Shunt
±4.5 µA; ±45 µA	10 kΩ
±4.5 mA; ±45 mA	10 Ω
±4.5 A; ±10 A	10 mΩ
±45 mV [1]; ±450 mV [1]	external

The external shunt mode is beneficial for simultaneous measurement of different current levels. It supports very high dynamic range as well as highest vertical resolution. In shunt mode, two current measurement channels of the R&S®RT-ZVC02/-ZVC04 multi-channel power probe are connected to the same shunt resistor (see figure on next page).

[1] Current range depends on shunt value.

Application Card
Version 01.00

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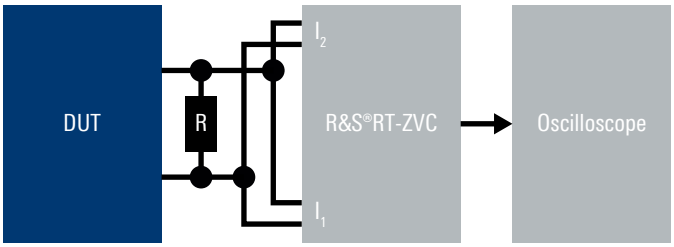
By operating the two channels at different sensitivities, it is possible to detect the general current characteristics over all activity phases (zoomed out) as well as small details of an individual phase with highest accuracy (zoomed in).

Setup of measurement with external shunt



Zoomed in and zoomed out in one acquisition

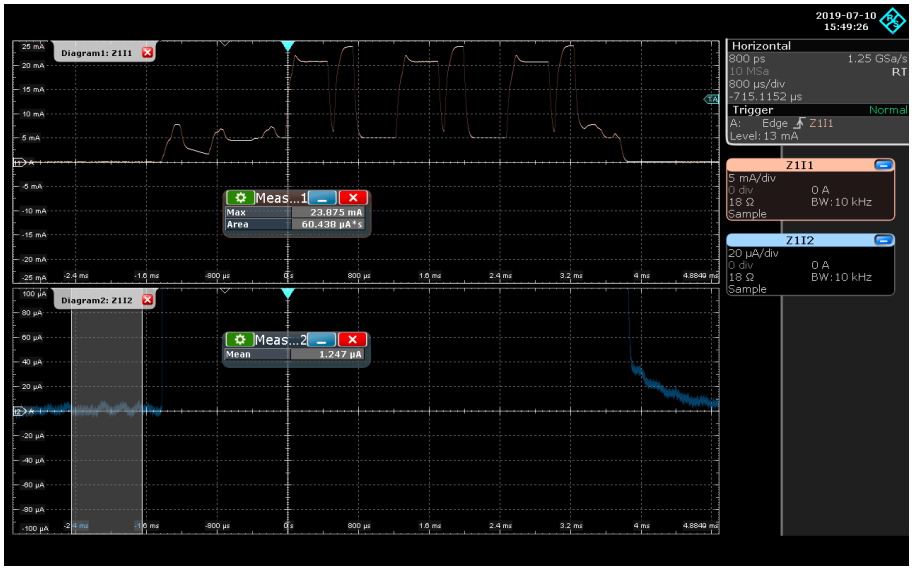
The results in the screenshot were achieved by performing a high-side current measurement on a Bluetooth® Low Energy device with an 18 Ω external shunt. The upper trace shows the current during the full advertising event (zoomed out), the measured maximum current (Max) and the consumed charge (Area). It was recorded using the low sensitivity setting (450 mV) of the external shunt mode of the R&S®RT-ZVC04. The lower trace was acquired simultaneously using the same shunt resistor and the high sensitivity setting (45 mV) of the R&S®RT-ZVC04. This zoomed in view helps users observe the smallest details in the current trace. Although the current peaks extend the measurement range of the device in this setting, the small sleep current can be resolved and determined to be about 1.2 µA in a gated measurement (Mean).

Summary

The R&S®RT-ZVC02/-ZVC04 multi-channel probes detect smallest currents with high dynamic range. In external shunt mode, the same measurement can be performed with different sensitivities, making it possible to observe both the general current trend as well as detailed behavior. The probes come with a set of high-quality pin connector cables and solder-in leads for connecting the probes in typical embedded electronics measurement scenarios. Available options include 4 mm connector cables with different lengths as well as BNC type connector cables for connecting standard oscilloscope voltage and current probes to extend the voltage and current measurement range.

Ordering information

Designation	Type	Order No.
Multi-channel probe with 2 voltage, 2 current channels	R&S®RT-ZVC02	1326.0259.02
Multi-channel probe with 4 voltage, 4 current channels	R&S®RT-ZVC04	1326.0259.04
Oscilloscope with up to 2 GHz bandwidth	R&S®RTE1000	1326.2000.24
Oscilloscope with up to 6 GHz bandwidth	R&S®RTO2000	1329.7002.04
Oscilloscope with up to 16 GHz bandwidth	R&S®RTP	1320.5007.04



Zoomed in and zoomed out view of the same current signal by using two different sensitivities at Z1I1 and Z1I2

Rohde&Schwarz GmbH&Co. KG
Europe, Africa, Middle East | +49 89 4129 12345
North America | 1 888 TEST RSA (1 888 837 87 72)
Latin America | +1 410 910 79 88
Asia Pacific | +65 65 13 04 88
China | +86 800 810 82 28 | +86 400 650 58 96
www.rohde-schwarz.com
customersupport@rohde-schwarz.com

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