Keysight Technologies

Oscilloscope in Medical Imaging Applications – Measuring Power Integrity and Current Measurement

Measuring electrical signals is a challenge in medical applications. Users need to measure electrical signals during troubleshooting, installation and maintenance, verification of IO digital transmission, power integrity, power management and validation of DDR memory. Many designers know that they need an oscilloscope for their design work but many oscilloscope users have unwittingly caused themselves trouble by ignoring the importance of the prosaic oscilloscope probe. The challenge is to find a suitable probe to work with the oscilloscope to address all these applications.

This application brief explores how Keysight's oscilloscope probe helps designers measure the power integrity of DC power supply noise in digital integrated circuit (IC) and current measurement for medical battery-powered devices and IC.

Figure 1. The Keysight N7020A power rail probe for power integrity measurements.

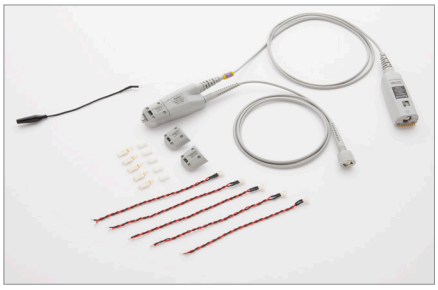

Figure 2. The Keysight N2820A 2-channel high-sensitivity current probe.

Keysight Solutions

Power Integrity Analysis of DC Power Supply in Digital IC

Power supply induced jitter (PSIJ) can be one of the largest sources of clock and data jitter in digital systems. Similarly, noise on DC power supplies is often caused by switching currents from the transitions of clock and data in these systems. Many designers would like a relatively easy method of determining how much of their systems data jitter is PSIJ and how much of the noise on the DC supplies is coming from specific clocks, data lines or other toggling sources.

The common question medical equipment designers ask is if it is worth trying to clean up the supply more--how much margin will it buy back? Another common question is which of these data lines or toggling signals is causing the noise on the DC supply, and how much. Designers in diagnostic medical imaging such as magnetic resonance imaging (MRI) concerned about the DC supply noise as it will impact the FPGA serial data, which later impacts the image reconstruction process and quality of the image.

Keysight offers the N7020A power rail probe and N8846A power integrity analysis application for those who are looking for answers to solve the DC supply noise issue. The power integrity analysis application lets users define a DC supply as either a victim of or an aggressor to other periodic transitioning signals, and predicts the amount of adverse interaction involved. This way, designers can see what their DC supply and toggling signals look like if they were immune to the negative effects of each other. With this insight, users can make informed decisions about what, if any, next steps they would take to clean up the DC supplies.

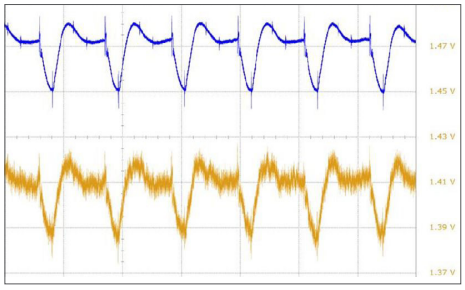

Figure 3. Comparison between N7020A power rail probe (blue trace) versus conventional active probe (yellow trace) when measuring the DC power supply noise. The yellow trace shows large trace noise when compared to the blue trace, which shows small traces of noise (about 1 mVpp).

Figure 4. Results from the N8846A power integrity analysis application showing the eye diagram of the FPGA serial data before and after the effects of the DC supply noise are removed. Notice that the results are nearly identical to the previous results when the DC supply was physically changed to reduce noise.

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High Sensitivity Currrent Measurements

As modern medical battery-powered devices and integrated circuits become more 'green' and energy efficient, there is a growing need to ensure that the current consumption of these devices is within acceptable limits.

Some of the key test needs for current measurement include: (a) precision at low currents and measuring very low power quiescent states accurately, because so much time is spent there, (b) wide dynamic range current measurement, to measure wide variations between high and low currents with precision and accuracy, (c) fast data acquisition, to be able to catch short transients associated with high bandwidth current measurements that require low resistance, impedance and capacitance, and (d) to be intrusive but not interrupt the circuit as you change probe location.

The Keysight N2820A Series high-sensitivity current probes address the need for high-sensitivity current measurements with a wide dynamic range and sensitivity down to sub-milliampere. These probes also offer the advantage of small physical connections to the device under test because today's application environments require an extremely small form factor.

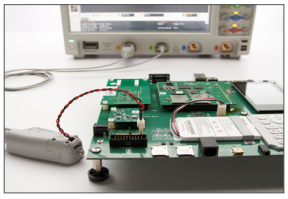

Figure 5. Keysight's ultra sensitive N2820A/21A current probes (with resolution as low as 50 µA) excel at measuring small current levels typically found in battery-powered devices

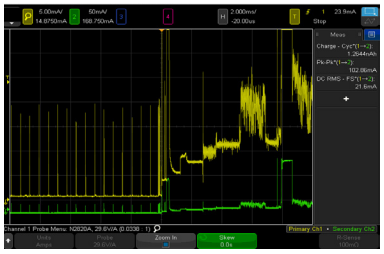

Figure 6. A Keysight InfiniiVision 3000 X-Series or 4000 X-Series oscilloscope can also be paired with the N2820A/21A current probes to provide the same simultaneous low- and high-gain views for wider dynamic range current measurement.

Specification at a Glance

Features	Keysight Oscilloscope Probe
N7020A Power Rail Probe	
Probe Bandwidth (-3dB)	2 GHz (with N7022A main cable and N7021A pigtail cable); 350 MHz (with N7023A browser)
Offset range	± 24 V
Input impedance at DC	± 850 mV
Probe noise	10% of the noise of the oscilloscope that it is attached to
N2820A/21A Current Probe	
Probe Bandwidth (-3dB)	Zoom-out channel: DC to 3 MHz; Zoom-in channel: DC to 500 kHz
Minimum measurable current	250 µA (with N2822A 20 mΩ, 500 mW) 50 µA (with N2824A 100 mΩ, 500 mW) 5 mA (with N2825A user-defined 1 mΩ, 500 mW) 500 nA (with N2825A user-defined 1 kΩ, 500 mW)
Maximum measurable current	5 A (with N2822A 20 mΩ, 500 mW) 2.2 A (with N2824A 100 mΩ, 500 mW) 5 A 2 (with N2825A user-defined 1 mΩ, 500 mW) 1.2 mA 2 (with N2825A user-defined 1 kΩ, 500 mW)

Literature

Managing Wireless Medical Applications	Publication Number
N7020A Power Rail and N8846A Power Integrity Application Data Sheet	5992-0141EN
N2820A/21A High Sensitivity, High Dynamic Range Current Probes Data Sheet	5991-1711EN
Solving Design and Test Challenges for Medical Devices Brochure	5991-2240EN

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