Keysight Technologies
Oscilloscope in Medical Imaging Applications – IO Interface Validation

There are various types of serial communication-based medical equipment in the healthcare industry, ranging from bedside patient monitors, neo-natal and intensive care equipment, magnetic resonance imaging (MRI) and lab equipment. Equipment designers face various challenges in the IO board design, such as balancing the type of serial communication bus needed against the cost of design.

This application brief explores how Keysight oscilloscopes help designers validate the medical instrument's IO interface for data processing in image reconstruction.

Keysight Oscilloscope

– Three instruments in one: oscilloscope, logic analyzer and protocol analyzer
– Wide range of application-specific software for debug, analysis and compliance testing

Figure 1. Keysight Infiniium 9000 Series oscilloscope

Keysight Solutions

Verification on Serial Digital Transmission of Controller Unit Interface

Medical imaging designers normally focus on testing imaging hardware and sensors. For the control board and controller unit interface, they often rely on the board supplier or controller supplier to perform all the testing. Designers tend to forget that there could be compatibility issues when the boards are installed into the overall system. By not testing or performing verification on the control board upfront, the designers may need to troubleshoot the issue at a later stage of an assembly line, costing them more time and money. Additionally, they may not have sufficient knowledge on how to test all bus protocols.

Keysight's Infiniium 9000 Series oscilloscopes are not just signal debugging instruments. They incorporate a protocol analyzer, allowing users to quickly drill and move between protocol and physical layers testing or debugging. The Infiniium 9000 Series supports most of the current and frequently used protocol testing in medical imaging equipment, such as PCIe Gen1, Gen2, SATA Gen2, HDMI1.4, USB3.0 and Ethernet.

As for high-speed digital transmission using Electro-Optical/Optical-Electro, the Keysight N7004A optical-to-electric converter directly converts optical signals for convenient analysis on Keysight's oscilloscopes. This converter is used to test system boards with an embedded optical transceiver in scenarios where there is no clock signal.

The incorporation of the protocol analyzer into the oscilloscope provides a one-box solution to meet the full range of designer needs.
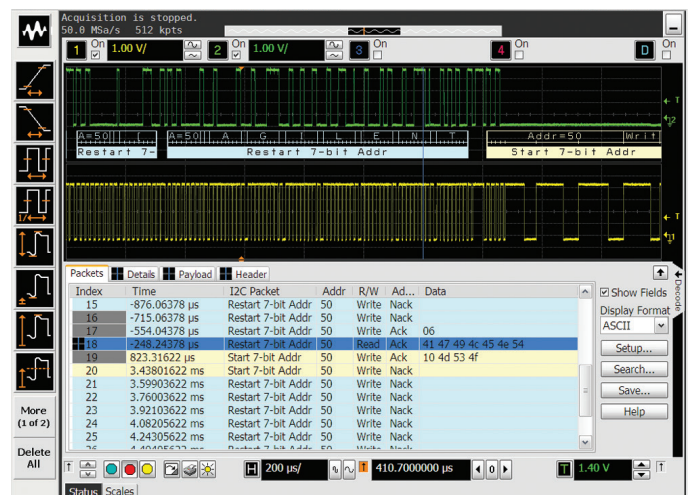

Figure 2. Extend your oscilloscope's capability with protocol analysis. The tracking marker/bar shows precise time alignment between protocol viewer and analog waveforms.

Figure 3. The Keysight N7004A is connected to the oscilloscope

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Validation of DDR Memory

Many medical device designers are experts on the medical portion of their product, but what about the compute engine? This is the part of the medical device that does not touch the patient but makes the decisions based on collected data. Many medical device manufacturers use off-the-shelf DDR3 or DDR4 embedded motherboards as part of their overall system. But what do they know about those motherboards? In most cases, the manufacturers just assume that proper validation was done and that there is nothing to fear! Well, they are not entirely correct.

Medical device designers often complain of intermittent memory failures that cause their medical device to malfunction or crash. These failures are troublesome but random and are difficult to isolate to find root cause of. In addition to that, intermittent memory issues can impact the overall image reconstruction process in the controller for medical imaging system.

Using Keysight's Infiniium 9000 Series oscilloscope with the N5459A DDR compliance software option, designers can quickly and easily evaluate and characterize memory designs. Automated testing based on Joint Electronic Devices Engineering Council (JEDEC) specifications saves time. The N5459A application software also includes additional debug and compliance capabilities.
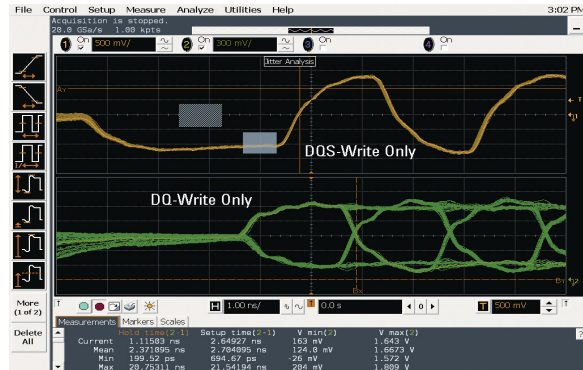
Figure 4. N5459A software application for DDR memory test.

Specification at a Glance

Features	Keysight InfiniiVision 9000 Series Oscilloscopes
Bandwidth	600 MHz, 1 GHz, 2.5 GHz and 4 GHz models
Channels	2 or 4 analog channels (DSO) + 16 digital channels (MSO)
Max sample rate	10 GSa/s (20 GSa/s on 2-ch) (600 MHz is 5 GSa/s on 4-ch and 10 GSa/s on 2-ch)
Applications	N5464B USB triggering and decode N5463B PCI Express 1.1 triggering and decode N5391B I²C/SPI triggering and decode N5397A Xilinx FPGA dynamic probe application N5392A Ethernet compliance application N5416A USB 2.0 compliance application U7233A DDR1 validation application N5413B DDR2 validation application
N7004A Optical-to-Electrical Converter	
Bandwidth (electrical, -3 dBe)	32 GHz (with Brickwall filter); 21.3 GHz (with 4th order Bessel Thomson filter)
Wavelength range	750 to 1650 nm
Connector type	FC/PC to 50/125 µm fiber, compatible with single-mode or multimode fiber

Literature

Managing Wireless Medical Applications	Publication Number
Infiniium 9000 Series Oscilloscope Data Sheet	5990-3746EN
N7004A 33GHz Optical-to-Electrical Converter Data Sheet	5992-1767EN
U7231A DDR3 Compliance Test Application for Infiniium Series Oscilloscopes Data Sheet	5989-7243EN
Solving Design and Test Challenges for Medical Devices Brochure	5991-2240EN

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