PulseCore Semiconductor Turns to Tektronix USB Test Solution and Spectrum Analyzers to Enable USB 2.0 Chip Development

Customer Solution Summary

September 2008

Challenge

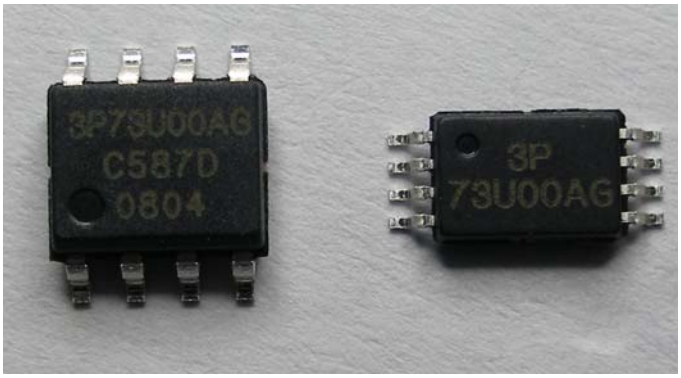
Develop a new IC that enables USB applications, reduce peak-power USB 2.0 radiated EMI, prove USB 2.0 signal integrity remains unchanged, and maintain stable USB 2.0 high speed compliance.

Solution

A suite of Tektronix instrumentation including a DPO7254 oscilloscope, RSA6114A Real-Time Spectrum Analyzer, USB-Certified test fixture, and TDSUSB2 automated USB compliance software were used to fully perform and document USB 2.0 compliance and signal integrity, and for measuring on-cable and radiated USB 2.0 EMI power reduction.

Benefits

- The use of a real-time spectrum analyzer helped PulseCore to push its silicon to the limit of its functionality and EMI radiation, giving hardware designers more design choices.
- Repeatable, automated tests made it easy for PulseCore to verify USB 2.0 industry compliance at the touch of a button.



First in the world, the PulseCore 3P73U00AG ICs provides SSC for a variety of USB 2.0 ASIC input clock frequencies (12MHz, 15MHz, 24MHz, 25MHz, 30MHz, 48MHz, etc). The SSC function maintains USB 2.0 compliance and attenuates the 480MHz fundamental USB 2.0 radiated frequency by 4dB.

Reducing EMI in USB 2.0

PulseCore Semiconductor recently introduced a new USB 2.0 integrated circuit (IC) that is the industry's first to use spread spectrum technology as a way to reduce electromagnetic interference emissions (EMI) while still achieving USB compliance. Until now, spread spectrum clocking (SSC) was thought to be impossible in USB devices because of the exceptionally tight timing and frequency domain limits imposed by USB compliance standards and tests.

Drawing from its more than 10 years experience in developing spread spectrum EMI reduction devices, PulseCore saw an opportunity to help its customers simplify EMI reduction for USB 2.0 and reduce or eliminate the need for expensive shielding, ferrite beads, conductive paint, filtering networks and other costly, space-consuming alternatives. PulseCore's patent-pending USB 2.0 Peak EMI Reduction IC overcomes these obstacles through extremely fine spread spectrum granularity and control.

EMI is a growing problem as smaller, high-resolution LCD displays are used in a variety of applications Today's state of the art in EMI reduction is spread spectrum clocking, so called because it slowly varies or "spreads," the frequency of a central timing device, such as a PLL clock, over a "spectrum" of frequencies. The resulting diffusion of electromagnetic pulses, which would otherwise be concentrated in a single frequency, reduces the peak power of the signal and thus helps ensure FCC compliance.

PulseCore Semiconductor Turns to Tektronix Instrumentation

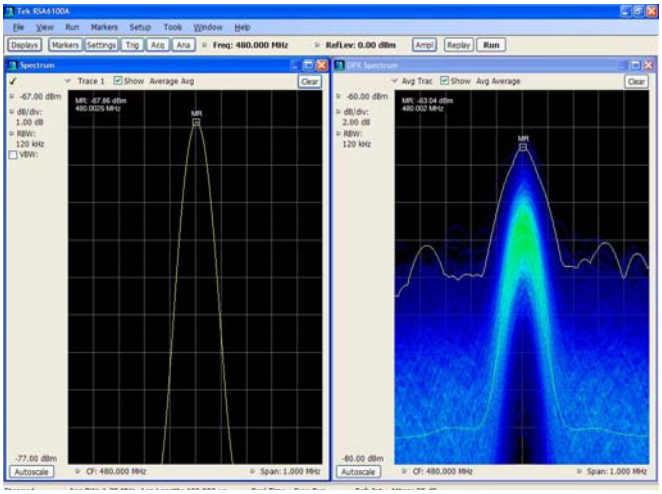


Figure 1

SSC is off as measured at USB port #3 (480MHz radiated EMI, antenna)

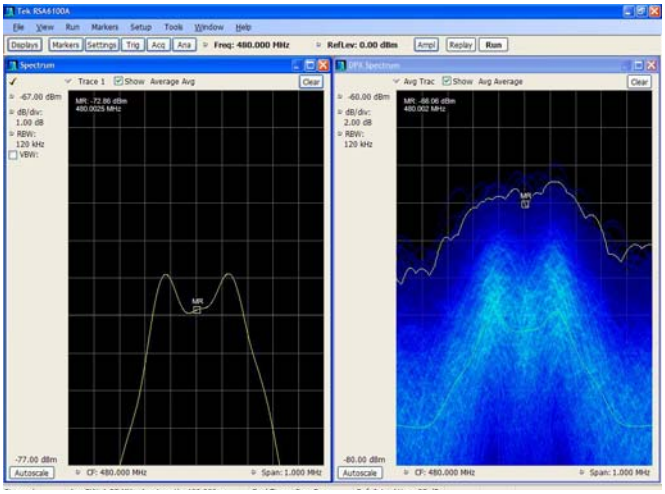


Figure 2

SSC is on as measured at USB port #3 (480MHz radiated EMI, antenna), showing 4dB average EMI attenuation

"We faced a difficult test challenge of fully performing and documenting measurements on two diametrically opposed and mutually exclusive objectives," said Dan Hariton, Director of Engineering at PulseCore. "On one hand we had to measure and prove USB 2.0 compliance and signal integrity, while on the other we had to measure on-cable and radiated USB 2.0 EMI peak-power reductions from our designs."

Full USB 2.0 Test Solution

To meet this challenge and demonstrate both the compliance and effectiveness of the new chip design, PulseCore turned to a full suite of Tektronix instruments, probe adapter, test fixture and compliance software. "Tektronix is a leader in the USB design and compliance testing, giving us a lot of confidence that our designs would be certified," Hariton commented. "The Tektronix Real-Time Spectrum Analyzers with DPX provided the fastest, most effective way to identify low-level spurious signals over wide frequency spans."

For measuring USB 2.0 compliance and USB 2.0 signal integrity, PulseCore combined a DPO7254 oscilloscope with the TDSUSB2 software option, the TDSUSBF test fixture and a P7360A 6 GHz differential active probe.

For measuring on-cable and radiated USB 2.0 EMI power reduction, PulseCore opted for a RSA6114A Real-Time Spectrum Analyzer (RTSA) with DPX, RTPA2A Real-Time Spectrum Analyzer TekConnect probe adapter, P7360A 6GHz differential active probe with probe tips and an antenna with antenna preamplifier. DPX waveform image-processing technology provides a live-RF view of the spectrum, enabling unprecedented capability for viewing RF signals.

Using this setup, Hariton and his team were able to fully prove time-domain USB 2.0 compliance. The TDSUSB2 software eliminated the tedium of manually setting up the oscilloscope by providing predefined oscilloscope setups for various tests. This enabled PulseCore to quickly perform all USB-IF recommended tests, such as eye diagram and parametric testing for low-speed, full-speed and high-speed hosts, devices and hubs with the results displaying automatically. The equipment used identified and differentiated between the USB ports present on the notebook motherboard and singled out pre-existing minor differences between seemingly identical USB 2.0 ports.

On the EMI testing side, the RTSA provided PulseCore with real-time analyses of the SSC on/off transitions and their spectrum signatures and allowed the team to monitor critical SSC parameters to ensure they remained within the specification. While USB 2.0 compliant, an average of 4dB EMI attenuation is demonstrated between Figure 1 with SSC turned off and in Figure 2 where it is turned on.

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Dan Hariton
Director of Engineering, PulseCore Semiconductor

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Push the Limit

But beyond documenting the new ICs performance, the speed, repeatability and flexibility of the instrumentation and software also proved useful during the design phase by giving PulseCore's engineering team valuable insights.

"Without the Tektronix equipment and the software, we would not have been able to push our silicon to the limit, and determine the functionality restrictions of our silicon," Hariton explained. "Visualize USB compliance as being a measurement of one that gives both USB compliance and USB functionality. We were able to prove with a combination of RTSA and software that we could go to a factor of two, twice as much in terms of frequency deviation. Compliance gradually becomes intermittent as we increase the frequency deviation, but USB 2.0 functionality is maintained."

The result of this intensive testing effort pays off for PulseCore customers. "There is value-add for the end-user or the system designer because now he has a choice. If his USB system is radiating too much, he has a tradeoff between USB compliance and EMI attenuation. So he may say I am going to give up USB compliance but I will make it radiation, FCC-compliant," Hariton said. "We could not have determined this without the test equipment we used."

The device shown on page one (3P73U00AG) is the first to provide SSC for a variety of USB 2.0 ASIC input clock frequencies. By working closely with designers and standards bodies such as the USB IF (Implementers Forum), Tektronix provides the instrumentation and software to enable this level of breakthrough innovation for customers around the world.

Tektronix DPO7000 with TDSUSB2 automated USB compliance software

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