Focus on the job in hand

When USB 2.0 technology is employed in test and measurement signal analyzer hardware, life can become so much more simple

by Charles Birdsong, Dave Galyardt & James Zhuge

Recent trends in test and measurement hardware show a movement from standalone monolithic devices to PC-based systems that use the PC as the user interface, and some dedicated hardware to perform the advanced computations. While some solutions offer hardware that fits inside the PC enclosure, many systems require an external front-end to contain PCBs, LED indicators, cable connectors, and various other hard switches and knobs. When the front-end is separated from the PC, communication technology must be used to link the two.

Many communication technologies have been used in the past, but now USB 2.0 technology has emerged, offering the best features and potential. This technology offers high bandwidth data transfer, plug and play Windows support, robust communication, and backward compatibility with USB 1.1 technology. USB 2.0 technology has also been adopted by all major PC manufacturers, with plans to replace many older, competing communication technologies. This widespread market acceptance means that USB 2.0 is here to stay, and will be widely available for some time to come.

Market acceptance is an important consideration in developing test and measurement hardware. Test and measurement manufacturers must invest time and resources into developing new hardware platforms, and must be sure that the communications technology they choose will be successful in the future. There are examples of products that adopted the wrong technology that were never accepted in the market place, or of manufacturers who failed to upgrade to the latest technology, leaving them stuck with a platform that is difficult to support or replace. USB 2.0 promises to be a powerful standard for all PC peripheral devices with a bright future. The Certified Hi-Speed USB logo signifies that a USB 2.0 device meets industry standard specifications.

Dactron has adopted USB technology and developed the first USB 2.0-based signal analyzer, named Focus. This analyzer includes many state-of-the-art features such as 24-bit A/D converters on input and outputs, ICP and TEDS support, and compatibility with a DC power supply. But the feature that makes the Focus standalone is the USB 2.0 communication.

Besides general signal analysis needs, the Focus is well-suited for applications that require high bandwidth and portability. Measurements that require as much as 42kHz bandwidth with up to 20 channels can easily be made. Also, with its high bandwidth the Focus can

transfer data to disk while processing data in real-time. The benchmark throughput rate is 16 channels, with each channel sampling at 96kHz, meaning that data is measured by the analyzer and then streamed to the hard disk on the PC with no gaps or drop outs.

The user can view frequency spectra or octave data on the screen as the raw unprocessed data is recorded on the PC in order to verify that the recorded data captures the event, guaranteeing that after the measurement is completed and the data is post processed, the results will be captured. In addition, some measurements require real-time data processing and only use the throughput to disk as a backup (a function that was previously performed with digital recorders).

Data throughput requires high bandwidth communication because of the high demands of throughput data integrity. Some analyzers stream data to the internal memory of the analyzer, and after the measurement is complete, slowly transfer the data to the PC. The disadvantage of this design is that storage space is limited by the amount of memory in the analyzer. When the memory – typically only 256 megabytes – is filled, the recording stops. When data is truly streamed to disk, then the only limit to the length of the recording is the size of the disk drive. However, this setup requires the communication technology to move all the data from the front-end to the PC in real-time.

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The bandwidth requirement is a function of the number of channels times the sampling rate. USB 2.0 supports a maximum data transfer rate of 480Mbits per second, or 15Msamples per second with 32-bit data. For applications using data streaming to the PC's hard disk, the throughput rate is influenced by factors such as disk-write

Left: A tracking measurement of a steam turban
Above: Military ordinance case shaker test

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speed and the CPU's interrupt latency. In a data acquisition system, the software and hardware modules each handle many different tasks in addition to data throughput. In such a complex environment it is not possible to realize the maximum USB data transfer rate of 15Msamples/second. On the Focus, the transfer speed has been benchmarked at a maximum rate of over 1.6Msamples/second, and disk drive write-speed can be significantly improved using a USB 2.0-compliant disk drive. USB 2.0 disk drives bypass the PC CPU when writing data, increasing the write speed, and eliminating delays due to PC interrupts.

An industry survey has shown that USB will soon be the most popular PC peripheral interface, and USB 2.0 has gained growing momentum in 2001 and 2002. The following are quotes from CNET news published on 20 June 2002:

USB 2.0 "is the one technology that finally meets all the requirements we've had up until now," said Brian Zucker, a technology evangelist at Dell Computer. "Dell, for one, will make USB 2.0 High-Speed its standard method for connecting devices to its desktop PCs. Over time, it plans to eliminate a number of specialized ports such as those used specifically to connect a PC's keyboard, mouse and printer, replacing them with six or so USB 2.0 ports," he said.

Gateway plans to move over completely by the end of the year, a representative said. EMachines, a major player in retail sales, particularly at the lower end, has begun selling USB 2.0.

"By the end of this year, 80 to 90 per cent of Intel desktop platform shipping will have integrated USB 2.0," said Jason Ziller, chairman of the USB Implementer's Forum, and Intel's technology initiatives manager.

For older PCs that do not have USB 2.0 on-board, bridge cards are widely available to make any PC USB 2.0 compatible. For desktop PCs, PCI-based USB 2.0 bridge cards are available for about US$50. The PCI-USB card has four USB 2.0 ports, and each port provides connection for either a USB 2.0 or USB 1.1 client device. For laptop users, a PCMCIA-based USB 2.0 bridge card can be used, also costing about US$50.

A PC-based signal analyzer with USB 2.0 communication presents a powerful solution for many applications in vehicle testing. The portability (4.53kg and 9-32V DC power supply) and plug-and-play interface means that a laptop and analyzer can easily fit in the passenger seat and be monitored during testing. Since USB 2.0 is a popular interface, there are no special hardware needs for the PC – only on-board USB 2.0 ports or a PCI-to-USB 2.0 bridge card is needed. The high channel-count means that up to 20 signals can be measured simultaneously, and time, frequency, and amplitude data can be computed and saved. The simultaneous throughput to disk option allows all channels to be recorded to disk during real-time analysis, ensuring that the event of interest was recorded so that valuable track time is not wasted repeating tests.

Brake testing is an ideal application for such a system. The high bandwidth capability allows simultaneous acoustic and vibration monitoring and recording to disk. Real-time processing allows triggered measurements to be started, based on advanced test conditions such as a narrow-band spectra or octave spectra exceeding some limit, or using simple triggers from digital signals. Other applications include modal analysis data acquisition, acoustics testing, order analysis, transient captures, and more.

USB 2.0 peripheral communications provide fast and easy plug-and-play communication with unmatched bandwidth, and promises to become an industry standard in the PC market. New peripheral devices are being released every day, taking advantage of the bandwidth capabilities. Test and measurement devices such as the Dactron Focus Dynamic Signal Analyzer will emerge using this technology, bringing new advances to the market.

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