The CS14100, a 14 bit, 100 MS/s digitizer card for the PCI bus can monitor signals onboard an aircraft

Airborne deep memory

Imagine the speed, memory, and precision required to monitor communications signals aboard an aircraft in flight. A military engineering support group searched for a solution capable of continuously capturing a communications signal at 100 MegaSamples per second (MS/s) for 30 seconds. The application required a minimum of 12 bits of vertical digitizer resolution in order to provide sensitivity to the high dynamic range communications signal. The raw communications signal with a GHz frequency carrier is mixed-down to a lower Intermediate Frequency (IF) on the order of 50MHz.

While a minimum of 12 bits of resolution was required, the customer requested as much resolution as possible. In fact, while captured signal fidelity generally improves with nominal digitizer resolution, the dynamic performance is best specified by two parameters measured on the digitizer. These parameters are the Signal-to-Noise-Ratio (SNR), and the Spurious Free Dynamic Range (SFDR).

Communications signals are usually analyzed in the frequency domain. Frequency spectra are obtained by performing a Fourier transform on the raw time domain signal captured by the digitizer. The SNR is the measure of how low the random background noise floor is in the frequency spectrum of a captured signal. The SFDR sets the limit on the maximum amplitude of any sharp spurious frequency component. Consequently, high SNR and SFDR provide high sensitivity to low amplitude communications signal frequency components.

Gage suggested the CS14100, a 14 bit, 100 MS/s digitizer card for the PCI bus, because it features an 70dB SFDR and 63dB SNR. In order to capture and store the required 30 seconds of uninterrupted data, the minimum amount of on-board acquisition memory required is 100 MS/s, 30 seconds = 3,000MS, or three GigaSamples (GS). The maximum amount of on-board memory available on a high-resolution digitizer card was, and still is, 1GS. Gage, however, will soon launch a series of high-resolution digitizer cards with up to 2GS of acquisition memory.

Gage produced a custom turnkey Gage Measurement System consisting of three CS14100 digitizer cards, each with the maximum-available 1G of on-board memory, all housed into a chassis. The housing chassis was a Gage Instrument Mainframe computer, running Windows 2000, with forced-air ventilation and a card-retention mechanism for the rugged airborne environment.

The three CS14100s were arranged in a Domino configuration, where triggering and clocking signals were cascaded among the three digitizer cards so that each card's on-board memory was filled in succession. Usually, Gage multi-card digitizer systems are configured as a Master/Slave set for true simultaneous sampling and triggering on all channels. For other applications, however, multiple CompuScope cards can be operated independently so that different cards may sample and trigger independently. GageScope®, an easy-to-use Windows-based oscilloscope software, automatically opens multiple display windows and controls for each independent CompuScope card.

Using three independent CS14100 cards proved to be perfect for the Domino configuration since each of the cards could start capturing at different times. External triggering connections were made so that the end of capture on one card initiated capture on the next card in the Domino chain. A common shared clock was distributed to all three cards to ensure an exactly identical sampling rate. No custom programming was required and GageScope alone was used to control the three digitizers and display their signals.

Custom software was also provided in order to correct for the slight misalignment of the seam separating each of the three data sets from the three digitizers due to small internal fixed timing delays. Although the misalignment was only a few points, the customer required perfect seam matching for signal features that straddled the seams.

Gage's solution was to make minimal software modifications and to use straightforward external cabling to integrate three off-the-shelf products in order to deliver a complete turnkey solution to solve the customer's application.

Sandy Luk, Marketing Associate
Gage Applied Technologies Inc
Tel: +1 (514) 633 7007, ext. 3060
Fax: +1 (514) 633 1414
Email: sandy.luk@gage-applied.com
Web: www.gage-applied.com

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