Synchronized, Triggered Automotive Data Gathering Using Measure Foundry and DT9836 Hardware

Imagine that you need to capture multiple channels of high-speed, high-resolution, simultaneous data in real time with absolutely no missed samples. Now imagine that your data acquisition system has to perform flawlessly in a moving vehicle at 160 miles per hour on a test track, or in the same vehicle over distressed road surfaces. Your components under test will be subject to multiple G forces of stress. How would you design such a system? How could you ensure that the test equipment and computer capturing the data would not fail under these harsh conditions? Finally, how would you do all this at significant savings, reducing the cost of the test system by up to 30%?

A large automotive component manufacturer that supplies equipment to major car manufacturers faced this challenge. During their product development, the manufacturer performs a number of test drives under these conditions to acquire live data to characterize their components. They formed a partnership with Data Translation to design the solution.

To acquire the data in a moving vehicle during the test drives, they use an industrial notebook computer running Windows XP. Hard drive failure was a real concern in this scenario. To avoid hard disk problems, the data is saved in flash memory on a USB 2.0 memory stick, and the hard disk is switched off during measurement. Although USB is commonly thought of as a peripheral bus for keyboards, mice, and similar low-demand devices, USB 2.0 provides the necessary high data throughput, at 40 Megabytes per second, for rapid data storage. With the addition of a battery backup, the manufacturer has a rugged, robust, yet lightweight computing platform.

Next they needed data acquisition hardware and software. Because they are using a notebook computer, card bus solutions such as PCI were out of the question. But there was another problem: They needed 24 isolated, simultaneous channels of analog input data at 200 kHz per channel. Additionally, a minimum of 8 digital inputs, synchronized and simultaneous with the analog input data stream, and one counter/timer with results in the streaming data were required. Phase information is a high priority, and multiplexer delays are not acceptable for their data gathering. Simultaneous-sampling data acquisition hardware products with this many channels are not common, nor are they inexpensive.

Data Translation application engineers proposed a unique answer that the manufacturer would not have thought of: Use two DT9836-12 high performance, isolated simultaneous data acquisition USB modules in tandem. The modules use the USB 2.0 bus, which is readily available on the notebook computer and provides the necessary throughput. At 225 kHz and 16-bit resolution per channel, they provide the high speed and high accuracy that are required. Their 16 digital inputs each met that requirement with channels to spare.

The question remained, how could two separate sets of channels be truly simultaneous? While each DT9836 module performs simultaneous sampling, how could they be configured to work as one? The solution was that both systems use the same external master clock and the same external trigger. Both modules are configured to run with an external trigger and with a single external clock, so that they run at the exact same sample rate. One digital output is used as the external trigger so that both modules are started at exactly the same time by software. One of the DT9836 modules generates the external clock on one of its counter/timer outputs.

The solution was that both systems use the same external master clock and the same external trigger. Both modules are configured to run with an external trigger and with a single external clock, so that they run at the exact same sample rate. One digital output is used as the external trigger so that both modules are started at exactly the same time by software. One of the DT9836 modules generates the external clock on one of its counter/timer outputs. With this configuration, digital input starts at the exact same nanosecond for both modules. The digital inputs are controlled by Measure Foundry, to pulse on an external trigger input to the modules.

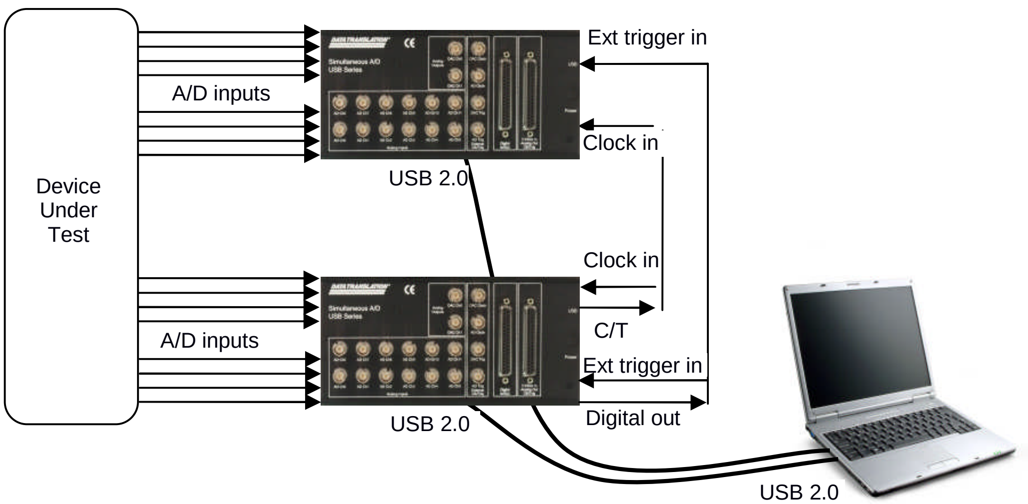


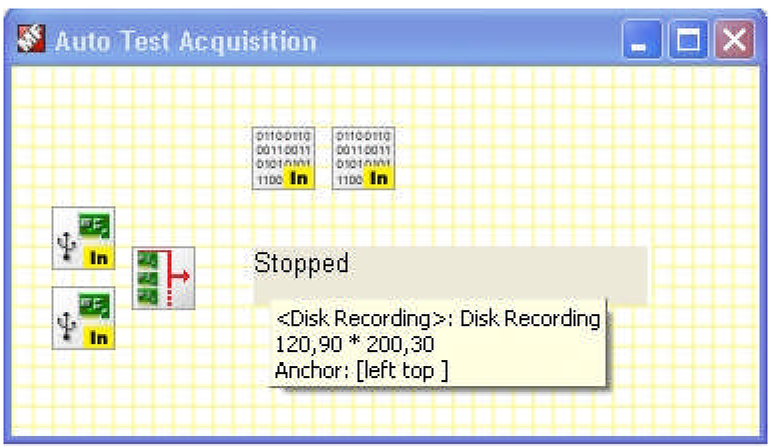
Figure 1: Synchronizing two modules

The application engineers showed the manufacturer how to use Measure Foundry to develop the data acquisition application. This decision was based in part upon the speed with which they could develop a real-time streaming application with flexible trigger conditions and a graphical user interface. But it also provided the opportunity to combine the simultaneous channels from the two data acquisition modules.

In the Measure Foundry solution, two analog input components are configured to bring in data from the modules. The data streams from the two DT9836 modules are merged into one using a signal synchronizer software component, creating one new data source for the rest of the application, providing synchronized data as if it were from a single device.

Because of their familiarity with our products, the Data Translation application engineers were able to identify the key features of components such as the signal synchronizer that would provide the manufacturer with a fast, flexible solution.

The manufacturer also required pre- and post-triggering, using two digital inputs (streamed along with the analog input channels) as trigger channels. The application allows pre-trigger definition at run time. If a rising edge is detected on one of the two trigger channels, all 24 channels of data are stored in a file on the host computer.



Signal Figure 1: In Measure Foundry design mode, two Analog Input components, left, combine data in a Synchronizer component. Data is captured with the Disk Recording component (shown with tool tip). The two Digital Input components provide triggering. Components are connected through configuration on property pages. During runtime, only the Disk Recording component will appear.

Measure Foundry's fast file writing is a key feature in conjunction with the triggering, saving the data in 16-bit binary format to achieve high throughput rates – the continuous data rate is 11.25 Megabytes per second. The manufacturer required that the solution save data in real time with no missed samples, even at high speed, and be fault tolerant. Measure Foundry's High-Performance File format (.HPF) is used with the Disk Recording component to save the acquired data. A file converter is used to convert the binary files to other formats for post-analysis in standard software applications.

The final hardware and software solution is portable to any automobile, and the manufacturer can put the sensors, data acquisition hardware, and computer platform where they are needed. It is also cost-effective, at 30% lower cost than a competitive solution, while delivering better specifications, signal speed, and accuracy. The manufacturer uses three complete systems to handle a high volume of testing work quickly and efficiently.

Working together, Data Translation's application engineers and the automotive component manufacturer's test team were able to design and create a test & measurement data acquisition solution just as robust as the automotive equipment it was designed to test.