Keysight Technologies

Simplify Complex High-Speed Multichannel Acquisition Systems in Big Physics Experiments

Application Brief

KEYSIGHT TECHNOLOGIES

Abstract

Your job is to expand knowledge at the galactic or nanometer scale. You need to be confident that the results of your big physics experiments – whether plasma and inertial confinement fusion, particle acceleration, microwave and RF astrophysics, or x-ray imaging in hydrodynamics – are accurately captured by dependable measurement solutions that provide exceptional speed and measurement fidelity.

Simplifying the data acquisition system within these experiments can be a non-negligible task. Achieve successful complex multichannel big physics experiments with the Keysight Technologies multichannel digitizers which contain all the timing and synchronization technologies needed to create synchronous sampling across 10s or 100s of channels at a time.

Introduction

Big physics experiments form the backbone for some of the world's most crucial projects such as fusion research for the development of clean sustainable energy, the research into the origins of the universe and the investigation and discovery of sub-atomic particles.

The instrumentation of these experiments often relies upon the use of multiple transducers and arrays of devices that must be integrated into the lab environment.

High-speed digitizers provide the crucial data capture component in these systems and the quality of the measurement often relies on the performance of these devices.

Application Overview

As a scientist, you must define cost effective solutions for complex measurement tasks.

Typically you want to model an event or a process obtaining as much information as possible. This often includes an array of fast detectors of differing characteristics whether photomultiplier tubes (PMT), beam current transformers, spectrometers, fast diodes, or other detectors.

To correctly recreate the event or process from captured data, you need confidence in the triggering and synchronization of 10s or 100s of channels used in the experimental setup.

Often, the challenge for the scientist is the integration of the various transducer and digitizer components into the complex environment of the experiment. Triggering and timing data of multichannel systems must be known across all of the channels to allow faithful data reconstruction. The data acquisition system must be integrated not only into the hardware environment of the experimental machine, but also into the software environment.

Traditional solutions can be power hungry and bulky, leading to further requirements in laboratory space and even additional power and climate control to house the instrumentation system.

Solution

In laboratories around the world, Keysight instrumentation has become an integral part of advanced experimental systems. Our instruments are used in two major areas that require high-speed measurements: real-time applications, and single-shot or event-based applications. We provide the extreme speed and precision needed for system monitoring and control, and for capturing data from the interactions and events in the experiments themselves.

The Keysight M9703A multichannel AXIe digitizer module is an 8 channel, DC coupled, 12-bit digitizer for the capture of fast signals. The hardware is supported with a range of API's in Windows and LINUX environments. It integrates state of the art ADC technology in a standard modular form factor (AXIe), to simplify system development.

Solution Details

The M9703A integrates 8 high-speed, high-resolution digitizer channels into a single card allowing the capture of fast transient signals from PMTs, spectrometers and other fast detectors. The low noise and high dynamic range of the analog-to-digital conversion enables the observation of the finest details in the signals. On-board FPGA processing in the form of four Virtex-6 FPGA provides real-time processing capability for data reduction.

Multiple units of the M9703A can be integrated into a single AXIe chassis. Keysight's M9505A chassis can hold 5 units, providing 40 channels of data acquisition in a desktop system.

Synchronization of the system can be achieved using a choice of external or system reference clock inputs. Timing and triggering signals available from the AXIe backplane include: a system 100 MHz clock, the 100 MHz PCIe clock, point-to-point star trigger from the embedded system module ESM, bi-directional point-to-point star trigger, and a 12-lane parallel trigger bus.

The flexibility in the AXIe infrastructure enables complex triggering from one device to the others. The embedded system module then allows the breakout of the synchronization signals through additional external clock and trigger in/out connections.

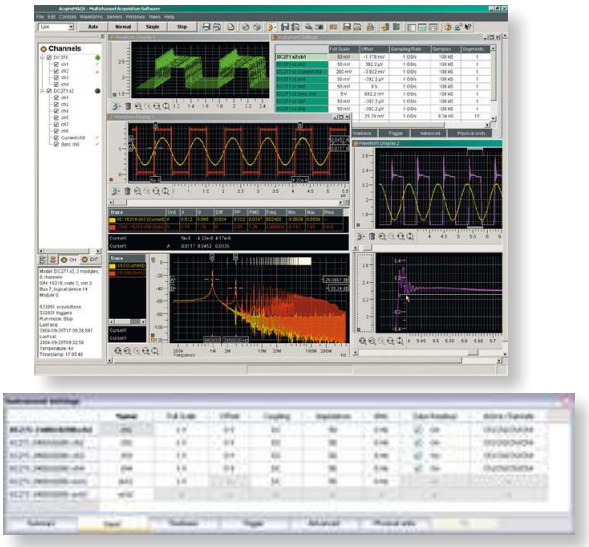
Connection to a controlling PC can be made via a cabled PCIe connection to the ESM. Alternatively an embedded processor, such as the M9536A, can be used to control the acquisition system from one of the AXIe slots.

Turnkey software for the capture and control of data across 10s or 100s of channels is possible using the Keysight's U1092A-S01 AcqirisMAQS software. This powerful software was designed and developed specifically for control and monitoring of advanced data acquisition systems. It allows remote Ethernet operation of multiple systems at various networked locations.

The user-friendly interface provides drag and drop functions and a familiar multiple-window workspace for multiple waveform display, and cursors for simple and rapid measurement.

Figure 1. Five Keysight M9703A AXIe 12-bit digitizers installed in the Keysight M9505A 5-slot AXIe chassis to form a 40-channel, 12-bit acquisition system.

Figure 2. One Keysight M9703A AXIe 12-bit digitizer and one M9536A embedded AXIe controller installed in the Keysight M9502A 2-slot AXIe chassis.



Conclusion

Using the M9703A helps you get more synchronized channels on your desktop. A single 5-slot AXIe M9505A chassis integrates five M9703A units, providing 40 channels of high-speed data acquisition, with 1.6 GS/s, or 20 channels at 3.2 GS/s. The M9703A provides DC to 1 GHz analog bandwidth, for capture of fast transients, and fast measurement throughput, with 4 GB onboard memory, four lane PCIe Gen 2 backplane link, and four onboard Xilinx Virtex-6 FPGAs providing real-time processing capabilities.

With the M9703A, Keysight provides the extreme speed and precision needed for system monitoring and control, and for capturing data from the interactions and events in the experiments themselves.

Ordering Information

Model	Description
M9703A	AXIe 12-bit digitizer
M9703A-SR1	1 GS/s sampling rate
M9703A-SR2	1.6 GS/s sampling rate
M9703A-INT	Interleaved channel sampling functionality
M9703A-F05	650 MHz maximum analog bandwidth
M9703A-F10	1 GHz bandwidth additional path
M9703A-M10	1 GB (64 MS/ch) acquisition memory
M9703A-M20	2 GB (128 MS/ch) acquisition memory
M9703A-M40	4 GB (256 MS/ch) acquisition memory

Related products	
M9502A	2-slot AXIe chassis
M9505A	5-slot AXIe chassis
M9536A	Embedded AXIe controller
U1092A	AcqirisMAQS multichannel acquisition software

Want to know more

- Product information
  www.Keysight.com/find/m9703a
- Advanced Research at Keysight.com
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  publication number 5990-5420EN
  http://cp.literature.Keysight.com/litweb/pdf/5990-5420EN.pdf

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A personalized view into the information most relevant to you.

www.axiestandard.org
AdvancedTCA® Extensions for Instrumentation and Test (AXIe) is an open standard that extends the AdvancedTCA for general purpose and semiconductor test. Keysight is a founding member of the AXIe consortium.

www.lxistandard.org
LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Keysight is a founding member of the LXI consortium.

www.pxisa.org
PCI eXtensions for Instrumentation (PXI) modular instrumentation delivers a rugged, PC-based high-performance measurement and automation system.

For more information on Keysight Technologies' products, applications or services, please contact your local Keysight office. The complete list is available at:
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