Application	*Materials Science -Big Physics*
Product	*DN6.221-12 Digitizer* *12 Channel 1.25 GS/s 8 Bit*

Case Study

Solid State Materials Science using High Magnetic Fields

Introduction

The University of Tokyo
The Institute for Solid State Physics

The International MegaGauss Science Laboratory is part of the Institute Solid State Physics (ISSP) at the University of Tokyo. The objective of the laboratory is to study the physical properties of solid-state materials (such as semiconductors, magnetic materials, metals, insulators, superconducting materials) as they are subjected to ultra-high magnetic fields. The fields are also used for researching new materials and controlling their phase and functionality. The laboratories pulse magnets can currently generate up to 87 Tesla (T) by non-destructive methods, and from 100 T up to 760 T (currently the world record for the strongest field generated in-doors) by a destructive process.

The Requirement

As part of a major push to optimize the magnetic fields generated by the laboratories MegaGauss machine it is important to synchronize the trigger events that fire banks of large capacitors (figure 1). Ideally, the capacitors all need to be triggered within 10 ns of each other. As such, the laboratory must examine the trigger signals for each capacitor to determine their key characteristics and timing relationships. The MegaGauss machine also requires careful control as physical parameters restrict its firing to just a few shots per day.

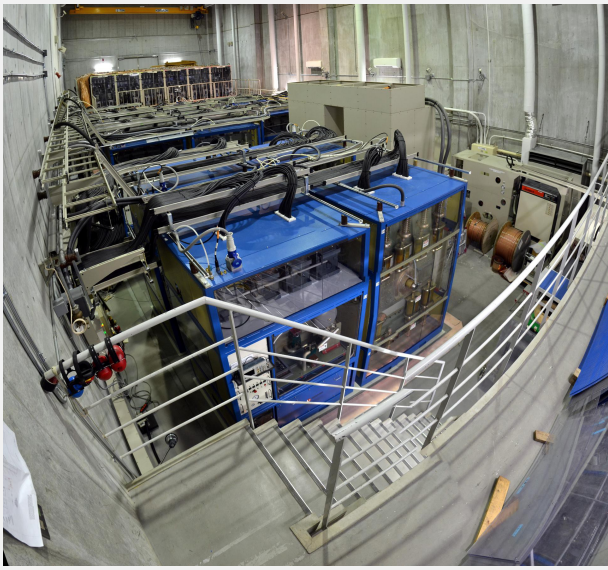

Figure 1. Shows the large capacitor banks that are used to generate the ultra-high magnetic fields of the MegaGauss machine.

In order to capture and analyze the trigger signals ISSP required a fully synchronous 10 channel digitizer system that delivers a single shot sampling rate in excess of 1 gigasamples per second (GS/s). The high sampling rate allows the shape and frequency content of individual trigger pulses to be revealed, while fully synchronous sampling ensures inter-channel timing measurements can be consistently made with sub-nanosecond precision.

A further complication is the fact that the Megaguass machine generates dangerously high magnetic fields that are potentially unsafe and can easily interfere with the measuring instrumentation. Great care needs to be taken to shield both equipment and operators. The measurement system needs to be located in the laboratory while the operator adjusts and monitors the experiments from the safety of a control room (figures 2 and 3). As such, the digitizer system must be able to operate remotely and controlled over the laboratories network.

Case Study

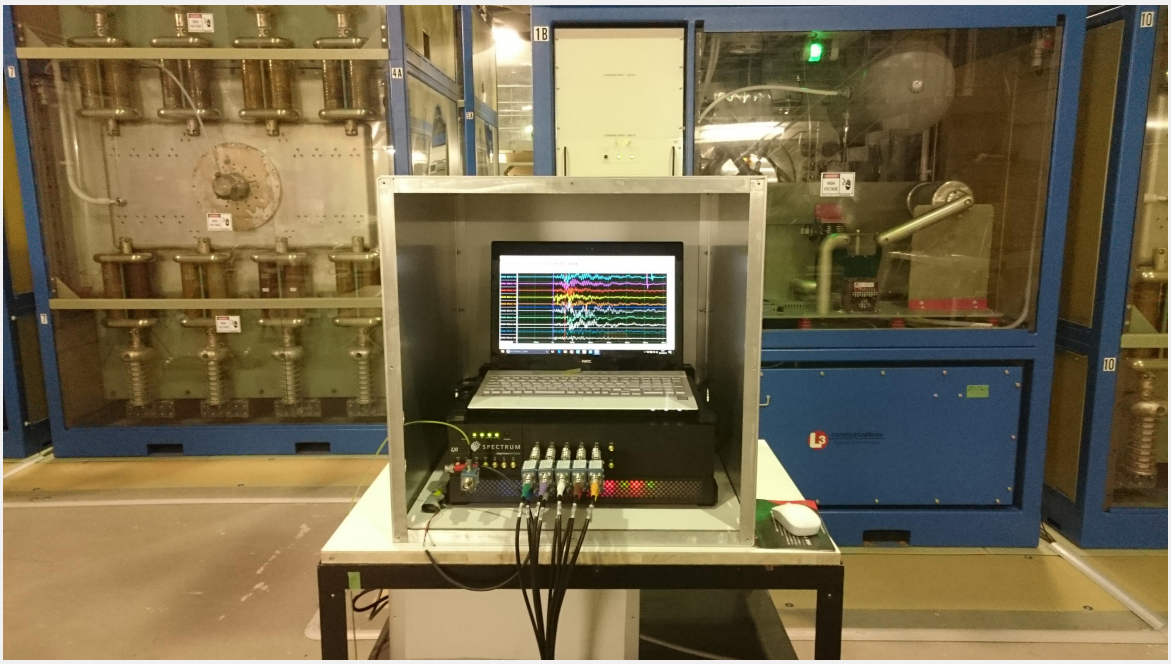

Figure 2. The digitizerNETBOX is located close to the large capacitors and housed in a shielded enclosure to avoid EMI. LXI control allows easy operation with a Notebook PC or via a connection to the laboratory network.

Figure 3. The MegaGauss machine is safely operated from the main control room.

Case Study

The solution

The solution from Spectrum was the DN6.221-12 digitizerNETBOX system. This unit met all the necessary technical requirements offering 12 fully synchronous channels, each sampling at 1.25 GS/s. As digitizerNETBOX units are LXI compliant instruments they allow full remote control and data transfer over a Gbit Ethernet connection. The units also come with SBench 6-Pro software which allows the user to quickly setup the system and start making measurements. SBench 6-Pro features an easy-to-use, graphical user interface that allows multi-channel waveform display, data analysis and documentation. Acquired and analyzed signals can be stored and exported to other devices, or other software programs, in a number of formats such as MATLAB, ASCII, binary and wave (figure 4). The digitizerNETBOX systems offer significant advantages over other digitizers as they provide a turn-key solution to multi-channel acquisition. Users can select the desired number of digitizer channels as well as fundamental specifications such as the sampling rate, resolution and on-board acquisition memory.

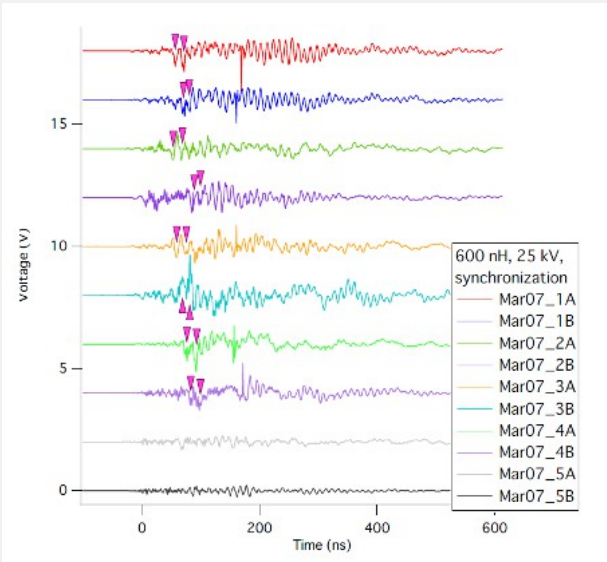

Figure 4. An acquisition showing 10 independent trigger signals (used to fire the capacitors) but captured synchronously by the DN6-221-12 digitzerNETBOX. Signal characteristics are easily identified and critical timing measurements can be made. Data is also exported for further analysis and documentation.

Conclusion

The Spectrum digitizerNETBOX provides an easy-to-use multi-channel data acquisition system that is well matched to the requirements of ISSP. The system was quickly installed and integrated into the MegaGauss machine so that trigger timing measurements and analysis could be made with improved precision and detail. The laboratory is now able to further optimize the performance of the Megagauss machine with the expectation that they will be able to generate the worlds highest ever in-door magnetic fields later in 2017.

Article written in collaboration with the International MegaGauss Science Laboratory, Institute Solid State Physics (ISSP) at the University of Tokyo