Pixie-4

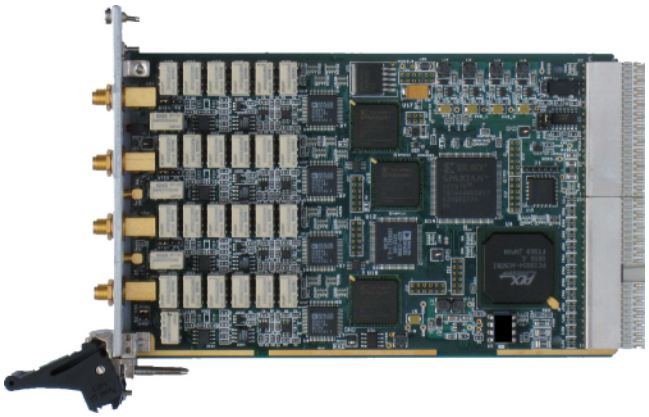
Instruments That Advance The Art

Pixie-4

Four-channel 75 MHz PXI Express Digital Processor

FEATURES

- **Four channel 14 bit, 75 MSPS pulse processor.**
- **32K MCA spectrum per channel.**
- **Waveform capture and Pulse Shape Analysis.**
- **Sophisticated pile-up inspection.**
- **Front and back panel digital I/O signals.**
- **Customizable GUI and DSP.**

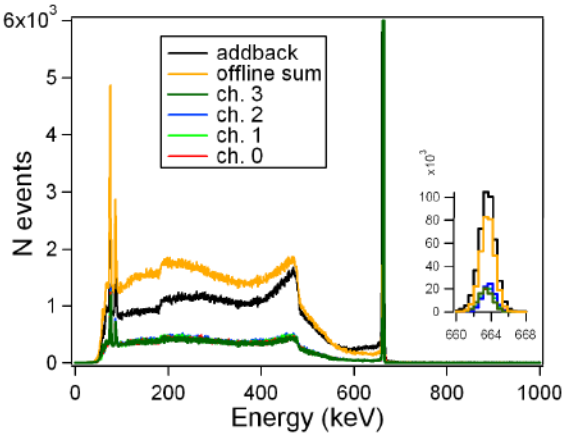


OVERVIEW

The Pixie-4 is a 4-channel all digital pulse processor on a single 3U CompactPCI/PXI card. It has been designed for fast high-precision coincidence gamma-ray spectroscopy using HPGe detectors. It is well suited to work with 4-fold Clover detectors and with a large variety of other radiation detectors such as scintillators and silicon detectors. The Pixie-4 not only offers waveform acquision but also high precision pulse height measurements and time stamping for event reconstruction.

Incoming signals are digitized at a rate of 75 MSPS with a 14-bit ADC. The digital data stream is used for triggering, pile-up inspection and filtering in real time. Waveforms with 13.3 ns sampling intervals and up to 13 µs in length can be stored in an on-board FIFO. Pulse height reconstruction, accumulation of a 32K MCA spectrum for each channel, and optional pulse shape analysis are performed on an event-by-event basis by a digital signal processor and a FPGA. Waveforms and spectra can be read out through the PCI data interface at rates of ~100 MBytes/s.

Multiple Pixie-4 modules can share clocks and triggers through the PXI chassis backplane, which implements bussed and nearest neighbor lines between slots. A 4-slot CompactPCI/PXI crate can house a data acquisition computer with a hard disk, a Pixie-4 card, a HV card and a preamplifier power supply card to create a very compact read-out system, weighing less than 6 kg with largest dimension 26 cm (10 inch).



Spectra from a Clover HPGe detector, illustrating the increased peak efficiency and lower Compton background using the online add-back spectrum.

APPLICATIONS

- **HPGe, including Clover detectors.**
- **Scintillator detectors, including Phoswich.**
- **Silicon strip detectors.**
- **Single and Multi-detector systems.**
- **Real-time Pulse-Shape Discrimination.**
- **Waveform analysis.**
- **Time dependent spectroscopy.**

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SPECIFICATIONS

Front Panel I/O
- 4 analog signal inputs. Impedance 50 Ω or 5 kΩ.
- 2 digital inputs / ouputs for triggers or veto signals.

Backplane I/O
- Low skew system clock distributed to all modules.
- Configurable LVTTL lines for veto, run synchronization, multiplicity, and trigger distribution.

PXI Express Platform
- 3U CompactPCI form factor with PCI data interface.
- Data rates of ~100 MBytes/s from single module to host PC.

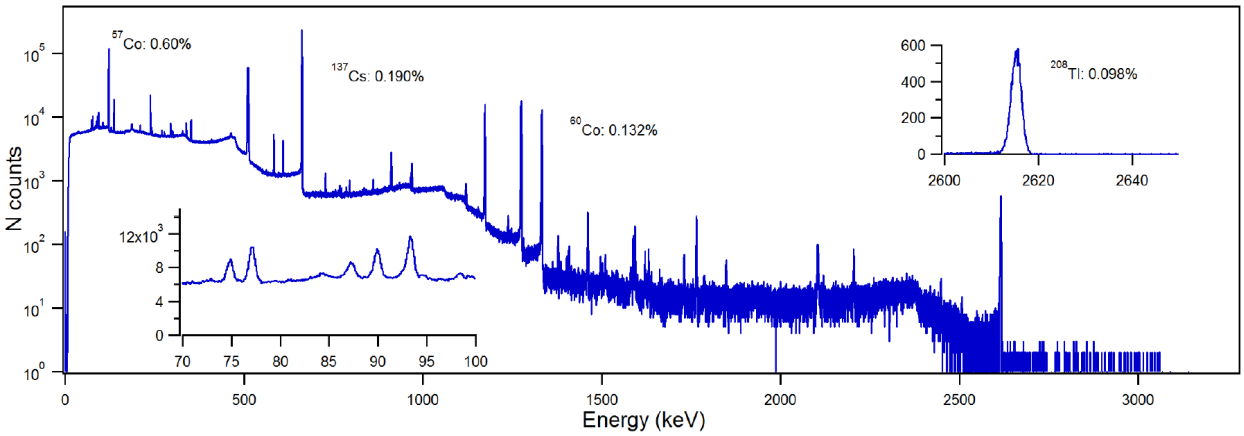
Data Reported
- Energy spectra, including Clover add-back spectrum.
- List mode data, (energies, timestamps, and waveforms).
- Run statistics.

Pulse Processing
- Signal digitized at 75 MSPS, 14 bit.
- Waveform capture at 13.3 ns sampling.
- 16 bit DSP operating at 75 MHz, processing limit 200k - 400k pulses/s combined for 4 channels.

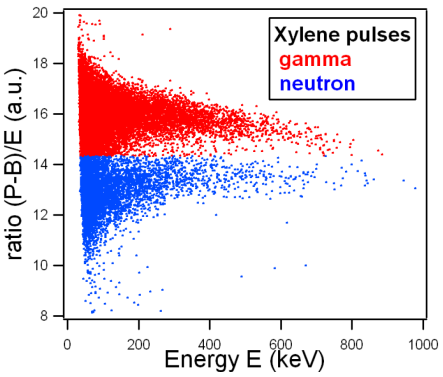
Digital Controls
- Gain: 10:1 range in 64 steps.
- Offset: -2.5V to 2.5V in 65536 steps.
- Energy filter: Rise time and flat top: 0.080 - 106 µs.
- Acquisition: Coincidence pattern and window.
- Digital oscilloscope and FFT for health-of-system analysis.

Customization
- Users can add code to DSP processing.
- Multi-module coincidence test can be programmed using XIA's PXI PDM module.
- Customized firmware upon request.

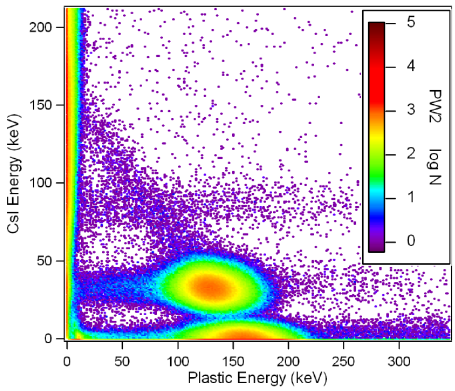
SAMPLE PERFORMANCE



Multi-source spectrum collected with a Pixie-4 and 40% HPGe detector, (~8 kcps)



The result of Pulse Shape Discrimination applied to signals from a liquid scintillator exposed to a mixed neutron/gamma field.



Beta-Gamma coincidence spectrum from a Phoswich detector using real-time pulse shape analysis in a Pixie-4.

SOFTWARE

The Pixie-4 is operated through a GUI based on Wavemetrics' Igor Pro. ROOT or LabVIEW demo interfaces are also available. The C library is largely compatible with Linux, and source code is available to users who plan to integrate PIXIE modules into a custom data acquisition system. A firmware variant for general purpose pulse shape analysis is available.

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