Pixie-16

Instruments That Advance The Art

16-Channel 100/250/500 MHz PXI Digital Processor

FEATURES

- Accepts input signals directly from detector preamplifier outputs or scintillator/PMT combinations.
- Signals digitized with 100-500 MSPS, 12-16 bit ADC.
- Synchronous acquisition of waveforms up to 163µs in length.
- Spectrum from 1K to 32K bins, up to 4.3 billion counts per bin.
- Onboard CFD trigger with adjustable parameters.
- List mode data buffered to allow zero dead-time acquisition.
- PXI backplane trigger distribution and run synchronization.
- Full speed 32-bit, 33 MHz PCI interface to host computer, up to 109 MBytes/s readout sustained.

OVERVIEW

The Pixie-16 is a 16-channel all digital signal processor on a single 6U CompactPCI/PXI card. Designed for fast coincidence gamma-ray spectroscopy with segmented detectors or detector arrays, it offers both high speed waveform acquisition and MCA anaysis at a low per-channel cost.

Each channel of the Pixie-16 accepts signals from virtually any radiation detector that has an exponential decay output. Incoming signals are digitized with 12 or 14 or 16-bit, 100 or 250 or 500 MSPS ADCs. The digital data stream is used for triggering, pile-up inspection and filtering in real time. Waveforms with 10 or 4 or 2ns sampling intervals, up to 163µs in length, can be stored in a FIFO. Pulse height reconstruction, incrementing a 32K spectrum for each channel and optional pulse shape anlaysis is performed on an event-by-event basis by a 32-bit floating point digital signal processor (DSP). Waveforms and spectra can be read out at up to 109 Mbyte/s.

Multiple Pixie-16 modules can be synchronized and share basic triggers through the PXI section of the back-plane. More than 160 additional backplane connections can be configured to distribute triggers, share multiplicity or coincidence information, or link the DSPs of different modules.

The Pixie-16 is operated through a simple graphical user interface running on Windows. A C driver library, compatible with Linux, is provided for users who plan to integrate Pixie-16 modules into a custom data acquisition system.
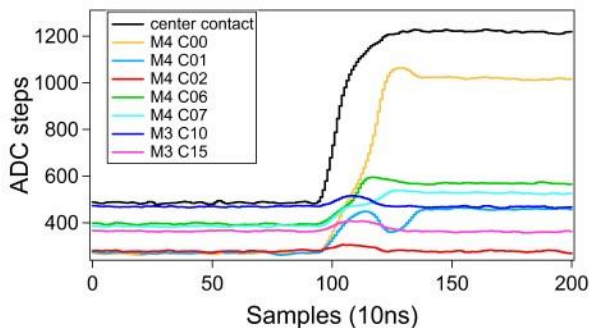
Synchronous waveforms acquired from a highly segmented HPGe detector. The center contact signal gives the energy, while segment signals can be used for gamma-ray tracking by pulse shape analysis.

APPLICATIONS

- Segmented germanium detectors.
- Silicon Strip Detectors.
- Arrays of scintillation detectors.
- Synchronous waveform capture for gamma-ray tracking.
- Sub-nanosec timing measurements.
- Mixed systems with different detector types. All Pixie-16 variants (12-16 bit, 100-500 MSPS) can be operated simltaneously within the same crate with the same software interface.

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SPECIFICATIONS

Front Panel I/O

- 16 analog signal inputs, (SMB). Impedance 50 Ω or 1 kΩ or 4kΩ with jumper selectable 50 Ω input termination.
- 28 digital inputs/ouputs, including 4 high speed LVDS input/output connections, 16 LVDS inputs for channel specific gating, LVTTL inputs and outputs for general purpose.
- Option for external clock through front panel input.

Backplane I/O

- Low skew system clock distributed to all modules.
- Trigger, run synchronization, and global veto lines.
- ~150 configurable connections for complex trigger logic, multiplicity information, or data transfers between modules.

Data Reported

- Energy spectra.
- List mode data: Energies, timestamps (48-bit), QDC sums and waveforms.
- Run statistics.

Pulse Processing

- Signal digitized at 100, 250 or 500 MSPS, 12,14 or 16 bit.
- Broad range of peaking times, (varies with digitization rate).
- Differential Non-Linearity < 0.5 LSB.
- Integral Non-Linearity < 0.57 LSB/14-bit or <0.38 LSB/12-bit for a dynamic range of 3 MeV.
- Waveform capture at full ADC rate. (10, 4 or 2 ns sampling).

Digital Controls

- Input: Choice of two termination/attenuation options. Full scale range ± 2V pp.
- Gain: Fixed analog voltage gain; digital adjustement ±10%.
- Offset: -1.5V to 1.5V in 65536 steps.
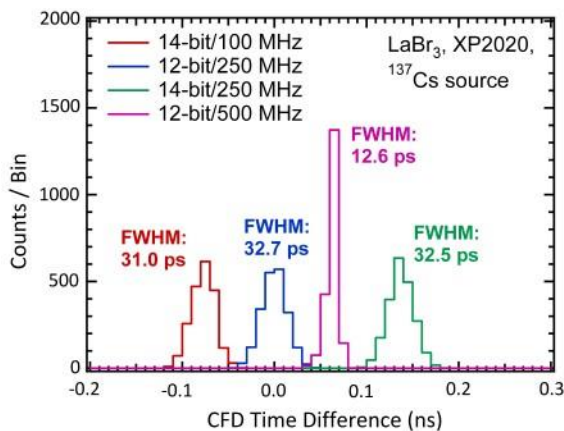- Filter: Rise time and flat top: 0.02 - 80µs in small steps.

CompactPCI/PXI System

- 6U form factor with standard 3U cPCI/PXI 32-bit, 33 MHz interface.
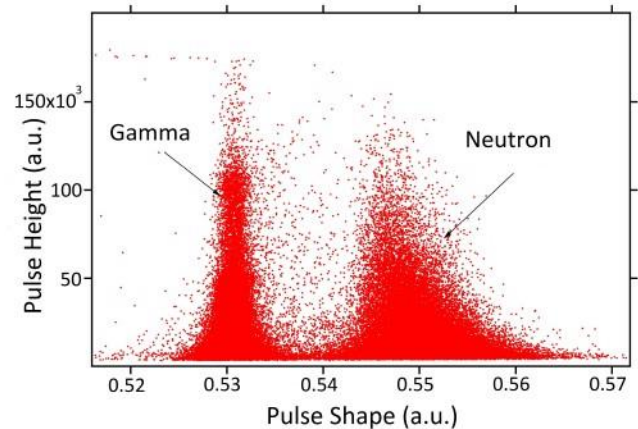- Customized power supplies and backplane I/O.

SAMPLE PERFORMANCE
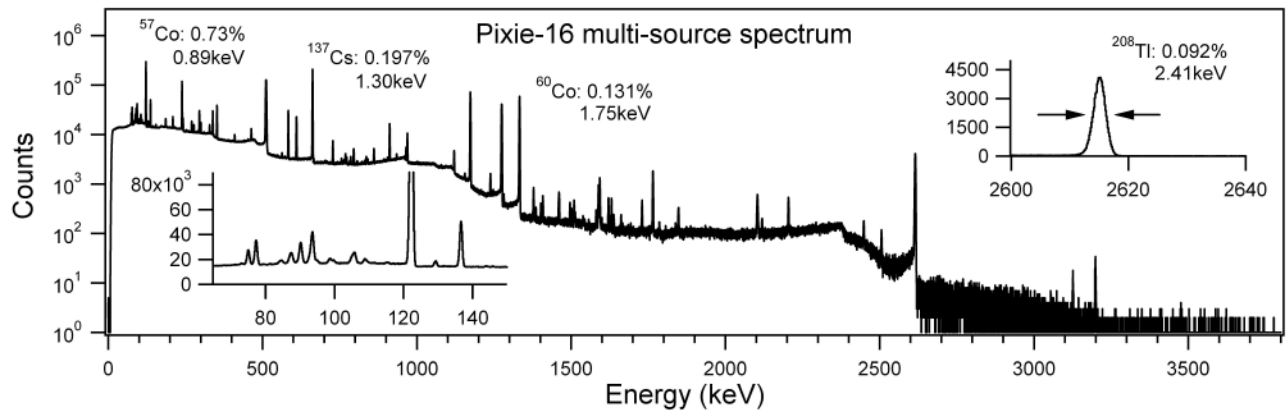
Multi-source spectrum acquired with Pixie-16 and a 40% HPGe detector

Histogram of measued time difference ΔT between two channels, (common signal divided with 50Ω splitters,- essentially the ADC's intinsic resolution).

Neutron Gamma discrimination by pulse shape analysis using the Pixie-16

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