Pixie Hybrid

Instruments That Advance The Art

Pixie Hybrid

Four channel 16-bit 250 MHz PXI Digital Processor

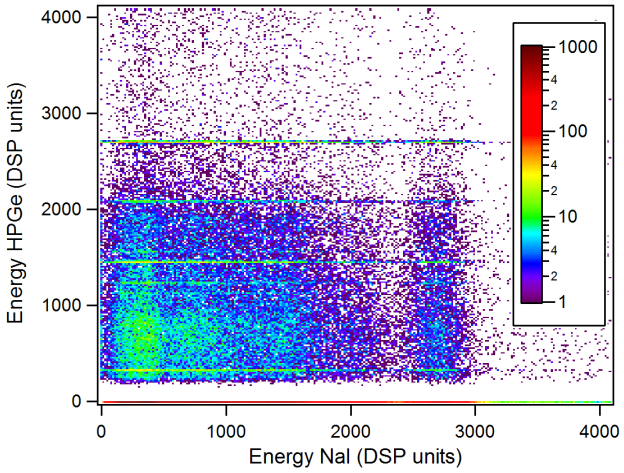
FEATURES

- **Four channel 16 bit, 250 MSPS pulse processor.**
- **32K MCA spectrum per channel.**
- **Processor peaking times adjustable from 0.048 - 63.4µs.**
- **Programmable gain, input offset, and pileup inspection criteria.**
- **Triggered synchronous waveform acquisition.**
- **Simultaneous amplitude and Pulse Shape Analysis.**
- **Sub-nanosec Timing Resolution.**
- **Configurable front and back panel digital I/O signals.**
- **Customizable GUI, DSP, FPGA, and Hardware.**

OVERVIEW

Designed for fast high-precision coincidence gamma-ray spectroscopy using HPGe detectors, scintillators, and silicon detectors, the Pixie Hybrid offers both high speed waveform acquisition, pulse height measurements and time stamping for event reconstruction. The digital stream is used for triggering, pile-up inspection and filtering in real time. Pulse height reconstruction, accumulation of a 32K MCA spectrum for each channel, and optional pulse shape analysis is performed on an event-by-event basis.

The Pixie Hybrid is backwards compatible to, and combines the best features of, the Pixie-4 and Pixie-4 Express, but with added functionality and flexibility for future expansion. The Pixie Hybrid can be customized on many levels for specific applications, either by XIA or an experienced end user. This includes the top level GUI, the C driver library, the DSP, the FPGA, and the hardware (ADC model and analog front end). The flexible front-end daughter-card design allows future application of alternative digitization speeds up to 500 MSPS. Other planned upgrades include the addition of a White Rabbit compatible SFP Ethernet port (IEEE 1588 High Accuracy Profile).



2D energy histogram of coincident energies from HPGe and NaI detector

APPLICATIONS

- **High precision gamma-spectroscopy with HPGe**
- **Timing with fast scintillators**
- **Multi-element & multi-detector systems**
- **Coincidence acquisition**
- **Real-Time Pulse Shape Analysis –**
  - **Segmented or strip detectors**
  - **Phoswich detectors**
  - **Neutron detectors**

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SPECIFICATIONS

Front Panel I/O

- 4 analog signal inputs, SMB connectors. Impedance 50 Ω or 2 kΩ. Optional 1/8 attenuation. Pulse amplitudes up to (2.0V) / (gain * attenuation)
- General Purpose digital I/O connected to programmable logic. 2 MMCX coaxial connectors.

Backplane I/O

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

PXI Platform

- 3U CompactPCI/PXIe form factor.
- Requires PXIe Hybrid slot

Digital Controls

- Coarse gain 2 or 5 for 250 MSPS version
- Fine gain ± 20% digital adjustment.
- DC offset compensation: ± 2.5V (before gain)
- Energy filter: Rise time and flat top: 0.048 - 63.4 µs.
- Acquisition: Local and shared trigger, hit pattern, coincidence window.

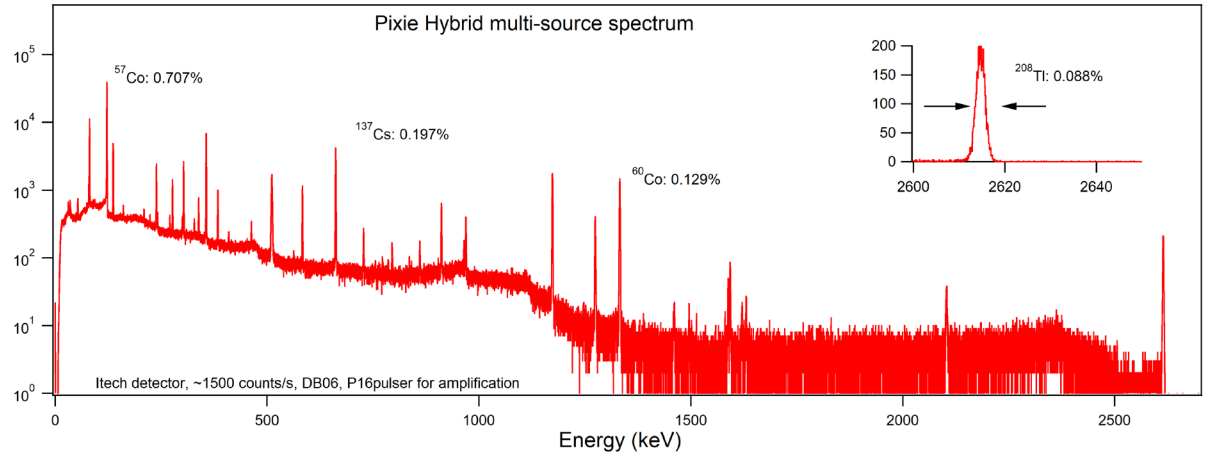
Pulse Processing

- Signal digitized at 250 MSPS, 16 bit.
- Waveform capture at full ADC rate.
- Energy filter operated at 125 MHz.
- Real time pulse shape analysis (charge integration)
- Real time constant fraction timing

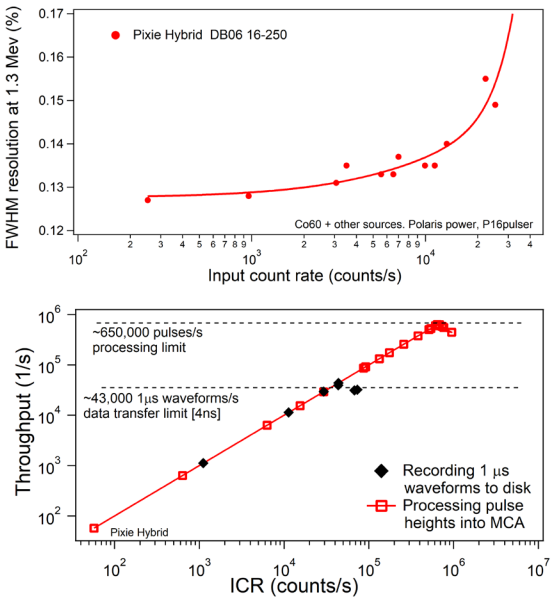
Data Reported

- Energy spectra (32K per channel).
- List mode data (energies, timestamps, and waveforms).
- Run statistics.

SAMPLE PERFORMANCE



Multi-source spectrum from a HPGe detector, using 16bit, 250 MSPS ADC variant



SOFTWARE

The Pixie Hybrid software is operated through a graphical user interface based on Wavemetrics' Igor Pro. The interface calls functions from the same C driver library, which handles conversion of physical parameters (e.g. filter times) into numbers used by the firmware. All parameters can be saved to disk for easy switching between applications.

The C library is largely compatible with Linux and code is available to users who plan to integrate Pixie modules into a custom data acquisition system. All host software is provided as open source. Users can also add their own functions to the DSP events processing code. Blocks of the FPGA have been reserved for custom user logic.

Energy resolution with HPGe detector as a function of input count rate (top) and throughputs of energies to on-board MCA and of 1µs waveforms to host PC's disk for short filter as a function of input count rate (bottom) [256 samples per waveform].

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