



Instruments That Advance The Art

Pixie-16 x1 and Pixie-16 x2

16- or 32-Channel 125/250 MHz PXI Digital Processor

FEATURES

- Accepts input signals directly from detector preamplifier outputs or scintillator/PMT combinations.
- Signals digitized with 125 or 250 MSPS, 14-bit ADC.
- Synchronous acquisition of waveforms up to 32.7 μ s in length (at 125 MSPS).
- MCA spectrum from 1K to 32K bins, up to 4.3 billion counts per bin.
- Onboard CFD, PSA, QDC 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.



OVERVIEW

The Pixie-16 x1 and the Pixie-16 x2 are 16- and 32-channel, respectively, all-digital signal processors on a single-width 6U CompactPCI/PXI card. Designed for fast coincidence gamma-ray spectroscopy with segmented detectors or detector arrays, they offer both high-speed waveform acquisition and MCA analysis at a low cost per channel.

Each channel of either model accepts signals from virtually any radiation detector that has an exponential decay output. Rectangular and Gaussian pulse shapes can be accommodated with specific energy filter settings. Incoming signals are digitized with 14-bit, 125-250 MSPS ADCs, with more options on the way. The digital data stream is used for triggering, pile-up inspection, and filtering in real time. Waveforms with 8 or 4 ns sampling intervals, up to 4096 samples, can be stored in a FIFO. Pulse height reconstruction, incrementing a 32K spectrum for each channel, and optional further processing are performed on an event-by-event basis by a 32-bit floating point digital signal processor (DSP). A user-configurable constant fraction discriminator (CFD), continuously computing scaled minus delayed signal, can be used to refine trigger timing and report sub-cycle time of arrival. Up to 8 QDC sums add a user-defined number of waveform samples relative to the trigger point and can be used for pulse shape analysis (PSA), including particle identification and neutron/gamma discrimination.

Multiple Pixie-16 x1 or Pixie-16 x2 modules can be synchronized and share basic triggers through the PXI section of the backplane. More than 160 additional backplane connections can be configured to distribute triggers or share multiplicity or coincidence information. All Pixie-16 variants can be operated simultaneously within the same crate with the same software interface.

Both models are operated through the Pixie SDK, a C/C++ driver library compatible with Windows and Linux.

APPLICATIONS

- Segmented germanium detectors
- Silicon Strip Detectors
- Arrays of scintillation detectors
- Synchronous waveform capture for gamma-ray tracking
- Sub-nanosecond timing measurements
- Mixed systems with different detector types

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SPECIFICATIONS

Front Panel I/O

- Pixie-16 x1: 16 analog inputs (SMB)
- Pixie-16 x2: 32 analog inputs (0.1in headers)
- 2 digital inputs/outputs (MMCX)

PXI Backplane I/O

- 6U form factor with standard 3U cPCI/PXI interface
- 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
- Requires PXIE-CRATE-P16X14 with high current power supplies and custom backplane

Data Reported

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

Digitally Controlled Input Stage

- Pixie-16 x1: Two analog voltage gains
- Pixie-16 x2: Fixed analog gain
- Digital adjustment $\pm 10\%$
- Offset: -1.5V to 1.5V in 65536 steps

User-Configurable Pulse Processing

Standard Firmware

- Signal digitized at 125 or 250 MSPS, 14 bit
- Trapezoidal trigger filter with programmable rise time and flat top
- Trapezoidal energy filter with programmable rise time and flat top: 0.02 - 80 μ s in small steps
- Pileup inspection: reject, pause, invert
- Waveform capture at full ADC rate 32-4096 samples with programmable delay
- 8 QDC sums of programmable length
- Online CFD (scaled minus delayed signal) with programmable scale and delay
- Basic trigger distribution and coincidence logic

Custom Firmware

XIA has a long history of customizing pulse processing firmware to the specific needs of particular applications on an NRE basis

Examples include

- Multiplicity distribution across modules
- External signal for trigger or timing
- Time-gated data acquisition into multiple spectra

FLEXIBLE ARCHITECTURE

The Pixie-16 x1 and Pixie-16 x2 are based on a 6U PXI main board with 4 ADC daughtercards. These daughtercards come in various channel densities and digitization/input options. For large systems, cabling input format can be matched to detector output on an NRE basis. Current standard configurations are

Pixie-16 x1

- Total 16 channels
- 4 channels per daughtercard
- SMB input connectors
- Impedance 50 Ω or 2k Ω
- Optional 1/8 attenuation
- Variable gain and offset for each channel
- 14-bit, 125 or 250 MSPS digitization

Pixie-16 x2

- Total 32 channels
- 8 channels per daughtercard
- 0.1in headers or other high density inputs
- Impedance 50 Ω
- Fixed gain, variable offset for each channel
- 14-bit, 125 or 250 MSPS digitization