



Instruments That Advance The Art

# Pixie-Net

## 4 channel 250 MHz Desktop Digital Spectrometer

### FEATURES

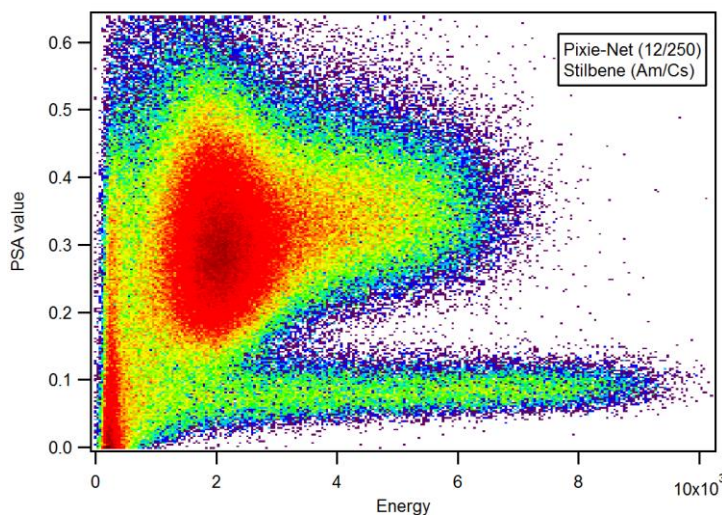
- Compact standalone detector readout electronics.
- 4 channels, 12 bit, 250 MSPS pulse processor.
- 32K on-board MCA spectrum per channel.
- Waveform capture and Pulse Shape Analysis.
- Sub-nanosec Timing Resolution.
- Embedded Linux platform.
- Front and back panel digital I/O signals.
- Gbit Ethernet, local USB storage, web interface.
- Approx. 8x8x14cm, 1 kg, 18 W
- Low cost



### OVERVIEW

The Pixie-Net is a multi-channel digital spectrometer for radiation detectors in desktop format with integrated networking and USB resources. Designed for high-precision coincidence gamma-ray spectroscopy using HPGe detectors, scintillators, or silicon detectors, the Pixie-Net offers not only waveform digitization and capture but also pulse height measurements, on-board energy histograms, time stamping and constant fraction timing, pileup inspection, external gating and online pulse shape analysis. Besides nuclear spectroscopy, the Pixie-Net can be used for neutron/gamma discrimination, time-of-flight measurements, and coincidence/anti-coincidence measurements.

The Pixie-Net combines an embedded Linux system with XIA's digital pulse processing developed on the Pixie PXI spectrometer series. Incoming signals are digitized at 250 MSPS with 12 bit ADCs. Using a ZYNQ All Programmable SoC with programmable logic (FPGA) and dual-core ARM<sup>®</sup> processor on the same chip, the ADC data stream is captured and processed in the FPGA section and the ARM processor writes the results to a removable USB drive or makes them available on a web server. Multiple units can share signals through GPIO.



*Pulse shape analysis (alpha/gamma discrimination) using crystal Stilbene*

### APPLICATIONS

- Scintillator, HPGe, Si detectors
- Real-time Pulse-Shape Discrimination
- Clover detectors
- Distributed Data Acquisition
- Homeland Security
- OEM systems
- Remote monitoring

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## SPECIFICATIONS

### Front/Rear Panel I/O

- 4 analog signal inputs. Impedance 50  $\Omega$  or 2 k $\Omega$ .
- 10 digital inputs / outputs for triggers or veto signals
- 5V power supply and control for active PMT bases
- Simple pulser for system check and diagnostics
- RJ45 Ethernet
- USB type A (for peripherals)
- USB type micro-B (for UART control from PC)

### Zynq “System on Chip” Platform

- Dual-core ARM<sup>®</sup> Cortex™-A9 with Xilinx 7-series FPGA section
- Gigabit Ethernet, 1GB RAM, USB2.0, 16GB SD
- PMOD expansion port (for Wi-Fi, GPS, GPIO, I2C, SDI, LEDs)
- Linux based on Ubuntu 15
- Local file storage
- IEEE 1588 timing compatible

### Digital Controls

- Analog gain and digital gain adjustment
- Energy filter (0.048 - 63.4  $\mu$ s).
- Trigger filter and threshold
- Waveform length and delay
- Event acceptance: Hit pattern, external gating, coincidence window, input delays

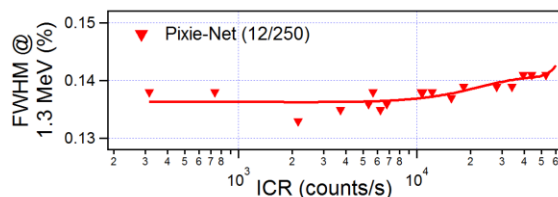
### Pulse Processing

- Signal digitized at 250 MSPS, 12 bit. (inquire for higher rate/precision, or more channels)
- Energy filter operated at 125 MHz.
- Real time pulse shape analysis (charge integration)
- Real time constant fraction timing

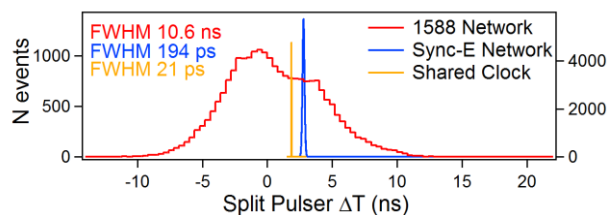
### Data Reported

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

## PERFORMANCE



Energy resolution as a function of input count rate.



Timing resolution within a Pixie-Net (shared clocks) and between two Pixie-Nets (network synchronization).

## SOFTWARE

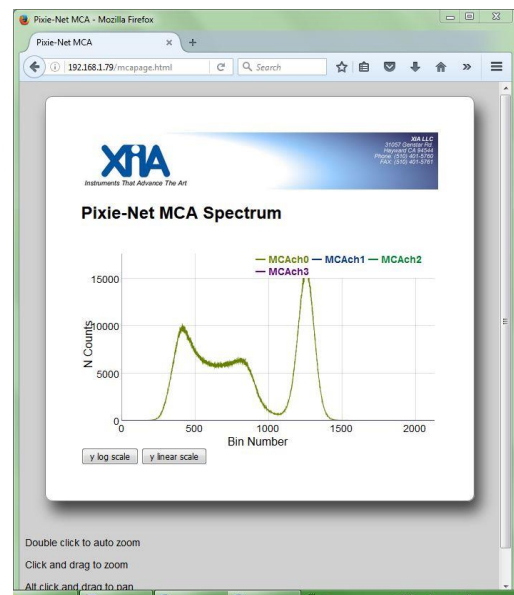
The Pixie-Net runs a customized version of Ubuntu 15. Many applications from the Linux universe are installed (gcc, ftp, http, ssh, etc); more can be added by the user. A number of simple programs read results and waveforms from the FPGA section, format and store them to file, and make them available on a web server. Settings and results can be managed through a web interface provided by XIA, or with plug-ins for common acquisition/analysis tools (LabVIEW, MATLAB, Igor Pro, etc). All parameters can be saved to disk for easy switching between applications.

The Pixie-Net is a standalone data acquisition system, eliminating the need for a host PC and software drivers to control and readout a USB or PXI peripheral. Data acquisition can be set up, started/stopped, and monitored over the network, with data saved to local storage or shared over the network.

Options for operation include:

- Remote login to the embedded Linux system via a UART/SSH terminal program or via Remote Desktop
- Monitor MCA spectra and run statistics via a web page hosted by the Pixie-Net Linux system
- Save data to mounted network drive or local USB drive
- Download MCA spectra, run statistics, and list mode data files from web server
- Integrate web API into front end GUI built on analysis software

Multiple Pixie-Net units can form a distributed data acquisition system synchronized over the data network. Each Pixie-Net can locally collect data with timestamps synchronized to sub-microsecond (or even sub-nanosecond) precision using IEEE 1588 clock synchronization or synchronous Ethernet, implemented in the Zynq Ethernet controller or a secondary Ethernet PHY.



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