

Single and Four Channel USB2 Digital X-ray Processors

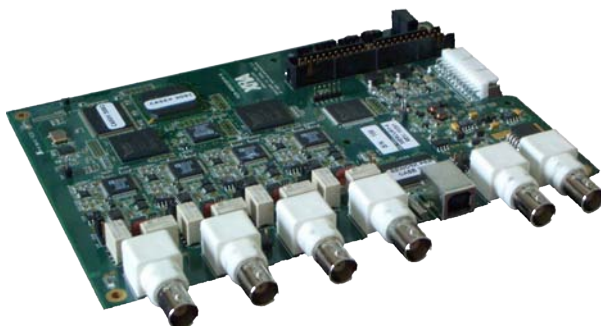
OVERVIEW

The DXP Mercury-1 and Mercury-4 processors package either one or four high speed digital spectrometers into a compact desktop box with built-in power supply. Each spectrometer offers a peaking time range of 0.1 - 160 μ s, and can output up to 1,000,000 cps into the spectrum. The DXP-Mercury has excellent noise performance, which suits it for energy dispersive x-ray measurements over the extended energy range 0.1-100 keV and beyond, using either a single detector or multi-element detector arrays. The Mercury processors offer computer control over all amplifier and spectrometer settings including gains, peaking times, and pileup inspection criteria. The DXP's trapezoidal digital FIR filters achieve significantly enhanced throughputs at comparable energy resolutions when compared to analog systems, but at a lower cost per detector. Energy resolution is nearly independent of count rate up to maximum throughput. The full computer interface allows all data taking and calibration operations to be automated, greatly reducing the possibility of human error. Data can be collected either into a full spectrum of up to 16K channels or into up to 32 regions of interest (ROI's) and passed to the host without stop-

ping data collection. The full spectrum allows peak fitting and/or deconvolution to be done on a detector by detector basis, leading to more accurate intensity extractions, particularly where scatter peaks are changing rapidly with energy. The DXP Mercury operates easily with a very wide range of common detector/preamplifier systems of either polarity, including pulsed optical reset, transistor reset, and resistive feedback varieties. The DXP Mercury offers several timing modes, including fast scanning with full MCA readout or multiple ROI's, as well as list mode readout, where time and energy are stored for each event. The onboard memory manager gives full access to the data even during data collection. For deadtimeless operation with fast scanning, the memory can be organized into two completely independent banks, allowing readout of one bank while the other is filled. Peak readout speeds across the high-speed USB2 interface exceed 16 MB/sec.

FEATURES

- Single module contains either 1 or 4 channels of pulse processing electronics with full MCA per channel.
- Peaking time range: 0.1 to 160 μ sec
- Maximum throughput up to 1,000,000 counts/sec/channel.
- Digitization: 14 bits at 50 MHz
- Low noise front end offers excellent resolution, and provides excellent performance in the soft x-ray region (110 - 1500 eV).
- Operates with virtually any x-ray detector. Preamplifier type is computer controlled.
- 16 bit gain DAC and input offset are computer controlled.
- Pileup inspection criteria are computer selectable.
- Accurate ICR and livetime for precise deadtime correction and count rate linearity.



FEATURES (CONTINUED)

- Multi-channel analysis for each channel allows optimal use of data.
- Facilitates automated gain setting and calibration to simplify tuning array detectors.
- External Gate allows data acquisition on all channels to be synchronized.
- 16 (M-1) or 32 (M-4) auxiliary digital lines available to support special applications. By default, these are used as ROI outputs (up to 14 for M-1, 6 per ch for M-4), plus Trigger and Live Time outputs.
- 4 MB of high-speed memory allows ample storage for timing applications such as mapping with full spectra or multiple ROI's. Memory can be read at the full USB2 speed.
- Peak USB2 transfer rates exceed 16 MB/sec.

SPECIFICATIONS

INPUTS

Analog: BNC Connector. One or four preamplifier inputs, jumper-selectable input gain. 0dB (x1): 10 kohm impedance, +/- 4V range or 6dB attenuation (1/2 gain): 600 ohm, +/- 8V range. Works with common reset or resistive feedback preamplifiers of either polarity.

Digital: (TTL) Each module has a pair of BNC connectors used for any of the following functions:

Gate: Logic input for externally timed data collection. Suppresses collection when asserted. The polarity is programmable to match external systems.

Sync: Logic input to control time resolved data collection, such as scanning.

DATA I/O

Software Interface: High-Speed USB2

Digital Controls:

Gain: 100x range, controlled by 16-bit DAC. Preamplifier gain range 0.1 to 10 mV/keV at standard settings.

Filtering: Peaking times 0.1 - 160 μ s. Adjustable flat top to eliminate ballistic deficit effects.

Pileup: Fast channel filter time, pulse detection threshold, and fast channel pileup inspection test limits may be set independently to achieve best results in every x-ray energy regime.

Data collection: MCA limits, bin widths, ROI's

Data Outputs:

Spectrum: Up to 16384 (16K) channels (32 bits deep).

ROI's : Up to 32 ROI regions can be defined in software per channel.

Timing: Multiple spectra or sets of ROI's can be stored; continuous operation is possible using memory in dual-bank configuration.

Statistics: All values required for pileup correction are available: livetime, realtime, input events, output events.

Diagnostics: ADC trace, baseline distribution, baseline history

Hard-wired Data Outputs:

Front panel 25-way connector with ROI, ICR and Live-Time TTL outputs.

Single 25-way connector for M-1

Two 25-way connectors for M-4.

SOFTWARE

XIA provides *ProSpect*, a software package for setting up and optimizing the Mercury processor and generating configuration files for use by other control packages. Handel, a comprehensive set of C libraries, simplifies integration of DXP-Mercury control into existing data collection packages. Several complete control packages are available, either commercially or as open-source from National Laboratory groups.

PERFORMANCE

Resolution: state of the art, detector dependent.

Count Rate: OCR to 1 Mcps max (at ICR > 2 Mcps)

Throughput: The output count rate (OCR) approaches theoretical values based on input count rate (ICR) and deadtime T_d , where T_d equals 2 times peaking time plus dwell time: $OCR = ICR * \exp(-ICR * T_d)$.

Integral Non-linearity: $\leq 0.1\%$ over full scale output range.

Pileup Inspection: Pulse-pair resolution typically better than 100 ns unless limited by signal risetime.

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