FEATURES

- Compatible with all Amptek XR100 Si-PIN and CdTe-diode detectors
- Use with detectors from other manufacturers
- Trapezoidal shaping with wide range of shaping time settings to optimize performance
- High count rate capability with excellent baseline stability, throughput, and pile-up rejection
- Up to 8 k output MCA channels
- USB interface to personal computer, with software to support instrument control, data acquisition, and analysis
- Oscilloscope mode - DAC output for pulse monitoring and adjustment
- Eight (8) single channel analyzer outputs

Power

- High voltage bias adjustable 100V to 1.5 kV
- Thermoelectric cooler with feedback
- Operates from +5 V DC supply (AC power adapter included)

Physical

- Low Power: 2 W typical
- Small Size: 6.5 x 5.5 x 1.5 inches / 165 x 135 x 40 mm
- Light Weight: 1.6 lbs / 750 g

INCLUDES

- Digital pulse shaping amplifier
- Integrated multichannel analyzer
- Power supplies

Front

Back

Photograph of the front and back of the PX4

OVERVIEW

The Amptek PX4 is an interface between Amptek's XR100 series of X-ray and γ-ray detectors and a personal computer with data acquisition, control, and analysis software. The PX4 includes three major components: (1) a shaping amplifier, based on a state of the art, high performance, low power DP4 digital pulse processor, (2) a multichannel analyzer, and (3) power supplies. It replaces both the previous generation PX2 shaping amplifier and power supply and the separate MCA.

The pulse processing and MCA function of the PX4 are based on Amptek's DP4 digital pulse processor. The PX4 offers several performance advantages over traditional analog systems, including higher energy resolution, reduced ballistic deficit, higher throughput, better pile-up rejection, enhanced stability, and the ability to adjust shaping time parameters over a wide range to optimize performance. The PX4 includes a USB interface. The power supply portion of the PX4 provides all of the power necessary for the detector, preamplifier, and the PX4.

The PX4 offers several advantages over the previous generation PX2: (1) a single unit interfaces with all XR100 variants; (2) many parameters may be adjusted to optimize performance, such as shaping time constant and HV bias; (3) the pulse processor offers enhanced baseline stability, throughput, pile-up rejection, and Rise Time Discrimination (RTD); and (4) the MCA is integrated with the complete system.

SPECIFICATIONS

GENERAL

Gain Settings	28 user selectable coarse gain settings from 4x to 560x. Fine gain is adjustable between 0.75 and 1.25.
Pulse Shape	Trapezoidal. A semi-gaussian amplifier with shaping time t has a peaking time of 2.2t and is comparable in performance with the trapezoidal shape of the same peaking time.
Peaking and Flat Top Times	24 programmable peaking times between 0.8 and 102 µs. For each peak time, 16 flat top durations are available, >0.2 µs.
Rise Time Discrimiator (RTD)	Programmable to select input pulses based on their rise time properties.
Troughput	Cycle time = 1 µs. 0.8 µs peaking time = 1 MHz periodic signal. Dead time = 1.25x peaking time.
Pile-Up Reject	Pulses separated by more than the fast channel resolving time, 600 ns, and less than 1.25x peaking time are rejected.
Channels	Commandable to 256, 512, 1k, 2k, 4k, or 8k channels
Analog Input (BNC)	Accepts pulses from the Amptek XR100 or any other detector with preamplifier reset or resistive feedback.
XR100 Power (6-Pin LEMO)	Provides power to preamp and detector. Includes HV bias, thermoelectric cooler power, and preamp power.
USB and RS-232 Serial Interface	Standard USB 1.1 (USB 2.0 compatible) and RS-232 interface to personal computer. Used for data acquisition and hardware control. Maximum USB cable length 5 m (defined by USB specification). To increase the length use a USB hub every 5 m.
DAC Output (BNC)	Used in oscilloscope mode to view the shaped pulse and other diagnostic signals. Range: 0 to 1 V.
Input Power	5 VDC (500 mA max) via power jack. Mates with a center positive 5.5 mm x 2.1 mm power plug.
UL Certified	Certificate #: CU 72072412 01 Tested to: UL 61010-1: 2004 R7 .05 CAN/CSA-C22.2 61010-1: 2004

ANALOG OUT BNC CONNECTOR

Analog output used in oscilloscope mode to view the shaped pulse and other diagnostic signals. Range: 0 to 1 V.

NOTE: The DAC output will roll over if the voltage is greater or less than the permissible range. For this reason, an output offset of 100 mV or so is recommended (may be set via software on the Misc. tab).

Shaped	Most common setting and displays the shaped output, which should be trapezoidal.
Decimated	Displays the input to the ADC, which should be a simple exponential decay with a 3.2 µs time constant. The input to the ADC should not go below zero, and so a DC offset of 100 to 200 mV is recommended. This can be verified using the decimated output, but note the additional offset introduced by the DAC.
Test	Used for Amptek factory calibration and setup.
Fast	Output of the fast channel shaper.

AUX BNC CONNECTOR

Digital output set via software to show various diagnostic signals. It is commonly used to gate an oscilloscope or is input to a counter.

ICR (Incoming Count Rate)	Output of a discriminator at the fast threshold. It is HIGH whenever the fast channel signal exceeds its threshold. If set above the noise, it triggers on all incoming counts.
PILE-UP	Output pile-up indicator,
MCS Timebase	Toggles every time the MCS time base increments.
ONESHOT	Period during which a 2nd event would be considered piled-up.
DET_RES	Active-Low detector reset lockout period, i.e., indicates when a preamplifier reset is detected.
MCA_EN	High = MCA Enabled, Low = MCA Disabled.
TRIGGER	Peak detect fired
SCA8	Single Channel Analyzer output #8.

XR100 POWER: 6-PIN LEMO CONNECTOR

1	Temperature
2	Bias (up to 1500 V)
3	-8.5 or -5 VDC
4	+8.5 or +5 VDC
5	Cooler – (grounded)
6	Cooler +

Ground on Shield

DIGITAL I/O: 15-PIN D CONNECTOR (FEMALE)

1	Gound
2	RS232 - TX
3	RS232 - RX
4	SCA 6 Out
5	SCA 5 Out
6	Ground
7	Gate (input)
8	Buffer Sel (input)
9	SCA 8 Out
10	External Power On
11	SCA 7 Out
12	SCA 1 Out
13	SCA 2 Out
14	SCA 3 Out
15	SCA 4 Out

Notes:
1) The RS232 - TX and - RX can be used to implement a conventional serial interface
2) "External power on" may be used to turn the PX4 off or on remotely (by bringing this pin to ground momentrily). It functions like the front panel sweitch (i.e., holding it to ground for >3 seconds returns the unit to its prior configuration).

For full specifications, please see http://www.amptek.com

SPECIFICATIONS (con't)

USB CONNECTOR

Standard USB 1.1 type B connector.

MULTICHANNEL ANALYZER (MCA)

The MCA portion of the PX4 supports 256, 512, 1024, 2048, 4096 or 8192 channels. The PX4 uses 3 bytes per channel, which allows up to 16.7 M counts per channel. The MCA has two spectral buffers available, A and B, which can be selected either via software, or by a hardware signal on the Digital I/O connector (BUFFER_SEL).

The GATE input on the Digitial I/O connector can also control the MCA. It can be used with external logic to control when events are counted. It can be set active high, active low, or disabled via software. When counts are gated off, the clock is also gated off so that an accurate count rate can be determined. Amptek recommends that the gate input duration be equal to or greater than the sum of the peaking and flat top durations.

GATE and BUFFER_SEL inputs are: V_{IL} (logic low): -0.5 to + 0.7 V, V_{IH} (logic high): +2.4 to +5.5 V.

SINGLE CHANNEL ANALYZERS (SCA)

The PX4 contains eight (8) single channel analyzers (SCAs). Each SCA has an upper and a lower threshold. If an event occurs with a shaped output within the range defined by these thresholds, then a logic pulse is generated and is output to the I/O connector on the PX4, where it can be connected to external hardware.

The upper and lower limits of the 8 SCAs can be set independently in the software. SCA8 serves a dual purpose – not only does it operate like the other SCAs, but it is also used to set the Region-of-Interest (ROI) for the "Preset Count" mode of MCA operation. That is, when a Preset Count is selected, the MCA will stop after the programmed number of counts occurs in the SCA8 ROI.

All SCA outputs on the Digital I/O connector are 50 ns wide
V_{OL} (logic low): 0.1 V @ 100 µA
V_{OH} (logic high): +3.1 V @ 100 µA

SOFTWARE

The PX4 is provided with the ADMCA display and acquisition software application. This software controls and sets all acquisition parameters and plots the data. It also sets all of the power supplies. This software has an integrated interface to the XRF-FP quantitative analysis software.

For users who wish to write custom applications, an Application Programming Interface (API) is provided.

To download PX4 software, please see our web site: http://www.amptek.com/mcasoft.html.

OPERATING NOTES

The signal input to the PX4 is the preamplifier output. The PX4 digitizes the preamplifier output, applies real-time digital processing to the signal, detects the peak amplitude (digitally), and bins this value in its histogramming memory, generating an energy spectrum. The use of digital signal processing offers several important performance advantages compared to previous systems. The spectrum is then transmitted over the PX4's USB interface to the user's computer. The PX4 hardware is controlled over the USB interface, permitting the user not only to start and stop acquisition but to select shaping times, select the HV bias, etc.

The PX4 complete pulse processing system and power supply
1) Digitizes the preamp signal
2) Implements trapezoidal shaping
3) Creates a multichannel analyzer (MCA) type output spectrum
4) Provides all necessary power for Amptek XR100 detectors.

1) DP4 Input (Preamp Output)
5 mV/div   20 µsec/div

2) Prefilter Output (ADC Input)
3) DP4 Shaped Output
Both traces: 200 mV/div   20 µsec/div


4) Multichannel Analyzer Output
Mn
Pb
Mo
K

For full specifications, please see http://www.amptek.com
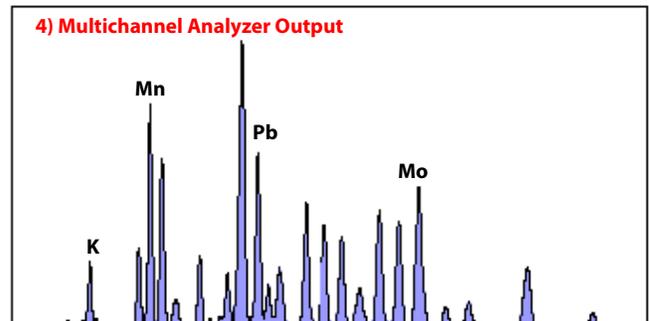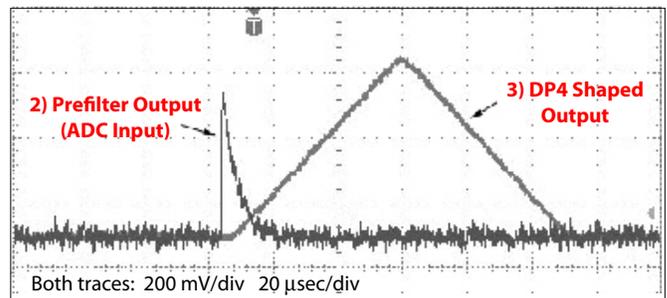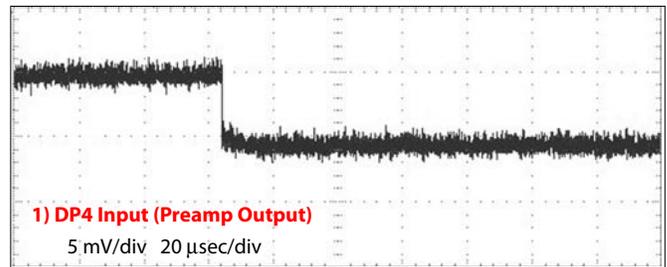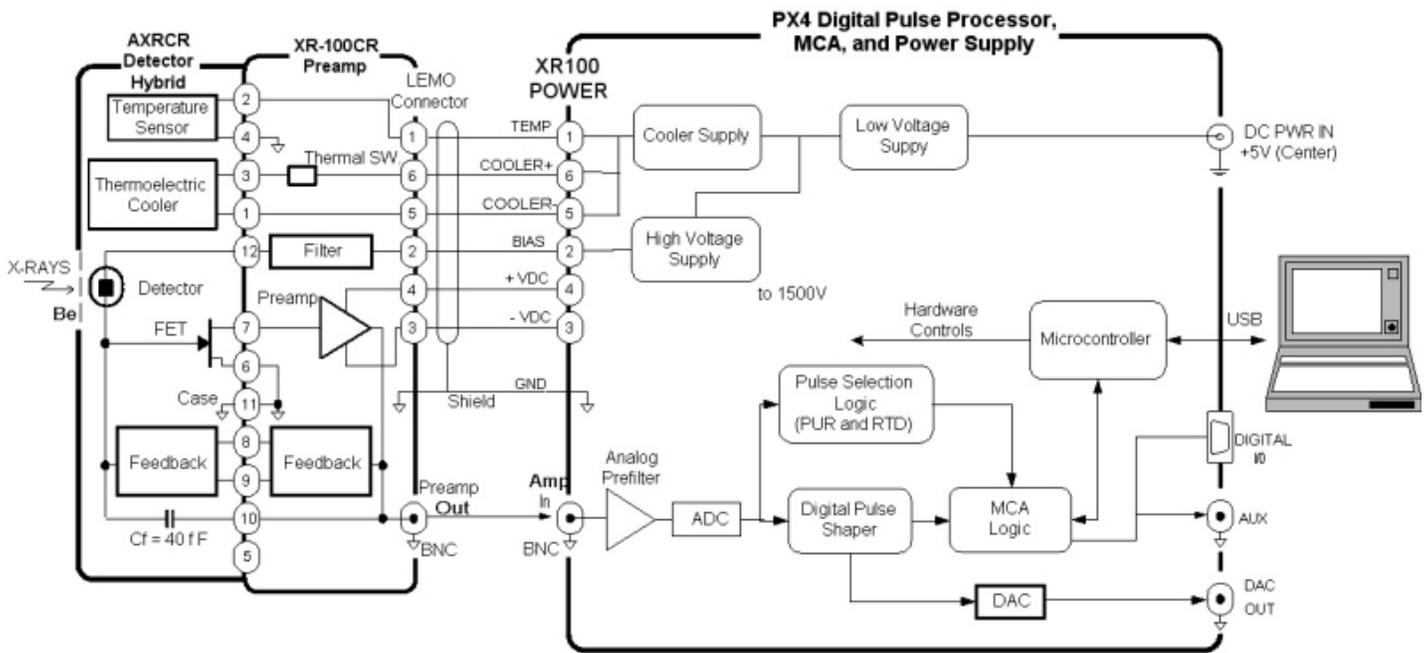
Block Diagram

Block diagram of the PX4 in a complete system

PX4 Throughput vs. Peaking Time

Throughput with XR100CR and PX4
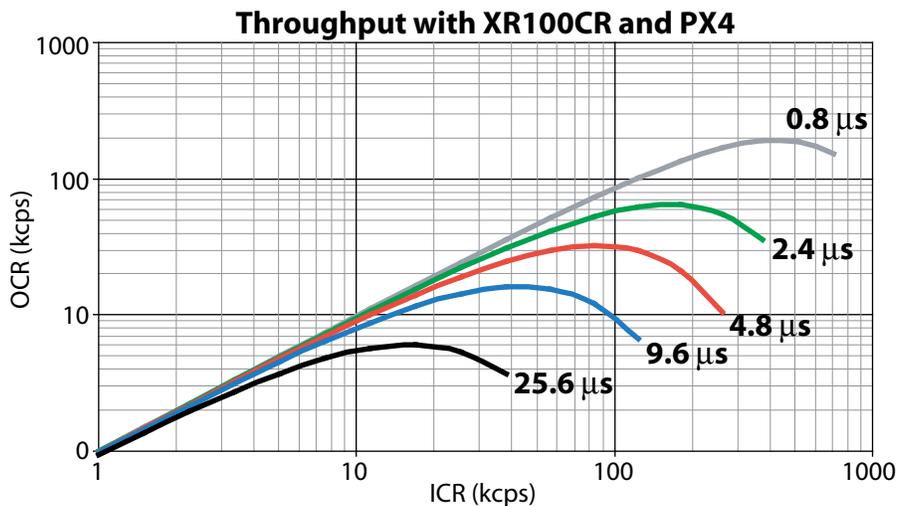
PX4 throughput for various peaking times. Taken with an Amptek XR100CR X-Ray Detector.

Complete XRF System

Complete XRF System Includes
- XR-100CR X-Ray Detector
- PX4 Digital Pulse Processor, MCA and Power Supply
- Mini-X USB Controlled X-Ray Tube
- XRF-FP Quantitative Analysis Software

Multi-Element Fluorescence from ^{109}**Cd**
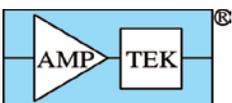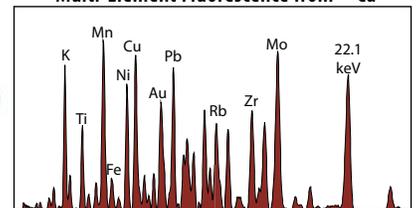
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