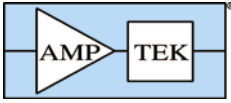


RoHS / WEEE Compliance X-ray Detector



Complete X-Ray Spectrometer

X-123

The X-123 is a complete X-Ray Detector System in one small box that fits in your hand.

INCLUDES

- 1 X-Ray Detector and Preamplifier
- 2 Digital Pulse Processor and MCA
- 3 Power Supply and Interface with PC

Features

- Compact integrated system
- Simple to operate
- Small size (2.7 x 3.9 x 1 in or 7 x 10 x 2.5 cm)
- Low power (1.2 W)
- Light weight (6.3 oz or 180 g)

Applications

- X-Ray Fluorescence Instrumentation
- RoHS / WEEE Compliance
- Process Control
- Art and Archaeology

Detector

- Si-PIN for X-ray detection
- Thermoelectrical cooler
- Area: 5 to 25 mm²
- Thickness: 300 to 680 μm

Typical Performance

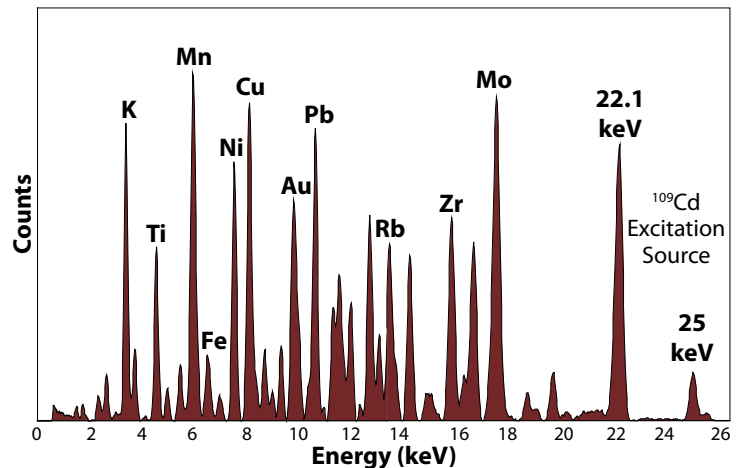
- Resolution: 145 to 260 eV FWHM at 5.9 keV
- Optimum energy range: 1 keV to 40 keV
- Max count rate: Up to 2 x 10⁵ cps

Detailed performance depends on detector and configuration, which can be optimized for specific applications.



No Liquid Nitrogen
Accommodates all Amptek detectors

X-Ray Fluorescence from ¹⁰⁹Cd



OEM's #1 Choice

Overview

The X-123 represents the culmination of 14 years of X-ray detector development at Amptek. Our philosophy has always been to create small, low power, high performance instruments while keeping them simple to operate. The X-123 exemplifies this philosophy by providing in a single package the XR-100 Detector and its Charge Sensitive Preamplifier; the DP4 Digital Pulse Processor with pulse shaper, MCA, and interface; and the PC4 Power Supply. *All that is needed is a 5 Volts DC input and a USB or RS232 connection to your computer.*

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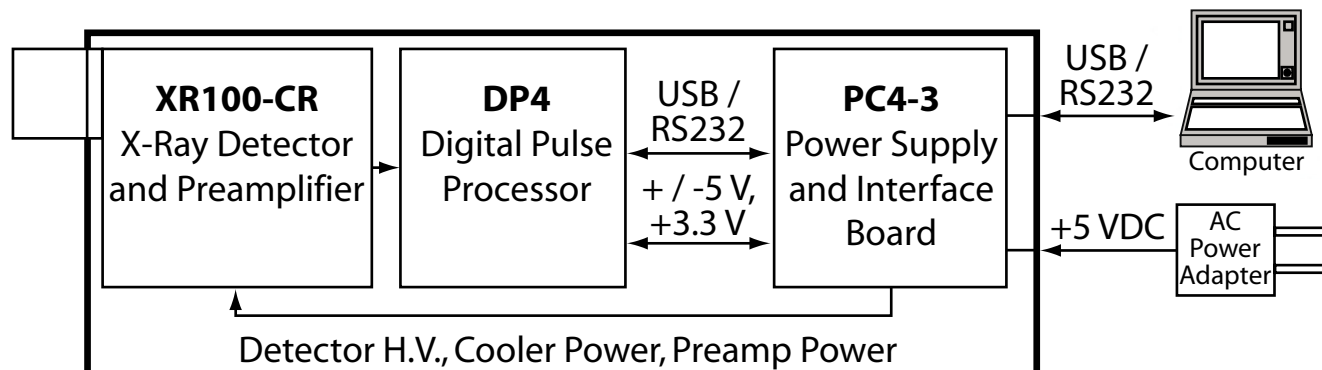
X-123 Specifications

The X-123 combines Amptek's standard XR-100CR detector and preamplifier, DP4 pulse processor and MCA, and PC4-3 power supply into a single package. This page summarizes the most critical specifications. For more details, see the specification sheets and web pages for the individual components.

SYSTEM PERFORMANCE				
Energy Resolution	145 to 260 eV FWHM @ 5.9 keV. Depends on detector, peaking time, and temperature.			
Energy Range	Efficiency is >25% for X-rays from 1.5 to 25 keV. May be used outside this range with lower efficiency.			
Maximum Count Rate	Depends on peaking time. Recommended maxima for 50% dead time with pile-up rejection enabled are shown below:			
DP4 Peaking Time (μs)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td>2.4 μs</td> <td>6.4 μs</td> <td>25.6 μs</td> </tr> </table>	2.4 μ s	6.4 μ s	25.6 μ s
2.4 μ s	6.4 μ s	25.6 μ s		
Shaping Time (μs)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td>1.0 μs</td> <td>2.9 μs</td> <td>11.6 μs</td> </tr> </table>	1.0 μ s	2.9 μ s	11.6 μ s
1.0 μ s	2.9 μ s	11.6 μ s		
Recommended Max Rate (s^{-1})	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <td>1.2×10^5</td> <td>4.6×10^4</td> <td>1.2×10^4</td> </tr> </table>	1.2×10^5	4.6×10^4	1.2×10^4
1.2×10^5	4.6×10^4	1.2×10^4		
DETECTOR AND PREAMPLIFIER				
Detector Type	Si-PIN			
Detector Size	5 mm ² to 25 mm ²			
Silicon Thickness	300 μ m, 500 μ m, or 680 μ m			
Be Window Thickness	1 mil (25 μ m) or 0.5 mil (12.5 μ m)			
Thermoelectric Cooler	2-stage			
Preamplifier Type	Amptek custom design with reset through HV connection.			
PULSE PROCESSOR				
Coarse Gain	Four software selectable settings: x11, x21, x55, and x106.			
Fine Gain	Software selectable from 0.75 and 1.25, 10 bit resolution.			
System Conversion Gain	At 1k channels, 7 to 110 eV/channel, so 7 to 110 keV full scale.			
Gain Stability	<100 ppm / deg C (typical)			
Pulse Shape	Trapezoidal			
Peaking Time	Twenty four software selectable peaking times between 0.8 and 102 μ s, approximately log spaced, corresponding to semi-gaussian shaping times of 0.4 to 45 μ s.			

PULSE PROCESSOR (CON'T)	
Dead Time	Total dead time is 1.25 times the peaking time. No conversion time.
Fast Channel Pulse Pair Resolving Time	600 ns
MCA	
Number of Channels	Commandable to 8k, 4k, 2k, 1k, 0.5k, or 0.25k channels
Presets	Time, total counts, counts in an ROI, counts in a channel
COMMUNICATIONS	
USB	1.1 (2.0 compatible) at full-speed (12 mbps)
Serial	Standard RS232 at up to 57.6 Kbaud
POWER	
Nominal Input	+5 VDC at 250 mA (1.2 W)
Input Range	4 V to 6 V (300 to 200 mA)
High Voltage Supply	Internal multiplier, adjustable to 400 V
Cooler Supply	Closed loop controller with $\Delta T_{max} = 85^{\circ}C$
GENERAL and ENVIRONMENTAL	
Operating Temperature	0°C to 40°C
Total Power	<1 Watt
Warranty Period	1 year
Typical Device Lifetime	5 to 10 years, depending on use
Storage Time	10+ years in dry environment
INTERFACE SOFTWARE	
Amptek's ADMCA software can be used for data acquisition and control. Running under Windows98™ or later on PC compatible computers, this software controls all of Amptek's systems: the MCA8000A, the DP4, the PX4, the X-123, and others. This software permits control of all X-123 functions, including acquiring and storing data. Amptek also provides a DLL library of routines, with sample programs, for users who want to develop their own interfaces.	

X-123 Architecture and Connection Diagram



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

X-123 Description

Amptek's specialty is X-ray spectrometers, which are small, low power, high performance, and simple to operate. The X123 combines in a single package Amptek's standard, high performance X-ray spectroscopy components: the XR-100CR detector and preamplifier, DP4 digital pulse processor and MCA, and PC4-3 power supply. The result is a complete integrated system which can fit in your hand. In many commercially available systems, the preamplifier alone has more size, mass, and power than this integrated system. It requires only 2 connections to run: +5 VDC power and a standard RS-232 or USB bus. With the X-123, anyone can rapidly obtain high quality X-ray spectra.

The typical detector is a Si-PIN photodiode: X-rays interacting in the silicon create an average of one electron/hole pair for every 3.62 eV of energy lost in the silicon, which is the input signal.

The detector is mounted on a thermoelectric cooler along with the input FET and coupled to a custom charge sensitive preamplifier. The thermoelectric cooler reduces the electronic noise in the detector and preamplifier, but the cooling is transparent to the user: it operates like a room temperature system. The charge-sensitive preamplifier uses a novel feedback technique, injecting reset pulses through the high voltage connection to the detector.

The pulse processor is the DP4, a digital pulse processor which replaces both the shaping amplifier and multichannel analyzer (MCA) found in most analog systems. The use of digital technology improves several key parameters: (1) better performance, specifically better resolution and operation at higher count rates; (2) greater flexibility since more configura-

tion options are available and they are selected by software over a RS-232 interface, and (3) improved stability and reproducibility. The DP4 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 spectrum is then transmitted over the DP4's interface to the user's computer. The Amptek DP4 has 6 main function blocks to implement these functions: (1) an analog prefilter; (2) an ADC; (3) a digital pulse shaper; (4) pulse selection logic; (5) histogram logic, and (6) interfacing hardware (which includes a micro-controller) and software.

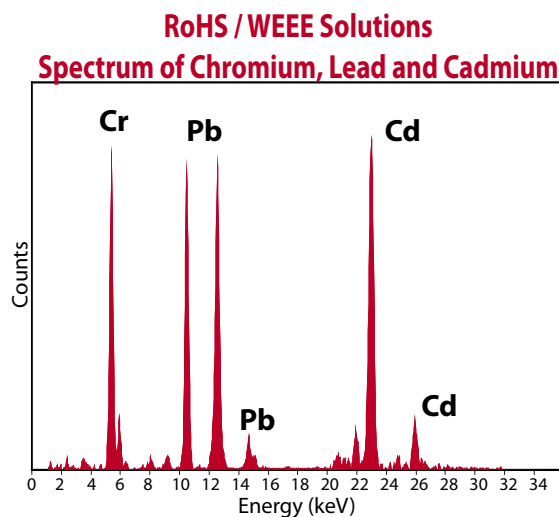
The power supply is Amptek's PC4-3, a single board. The input is approximately 5 VDC with a current of about 250 mA. The PC4-3 uses switching supplies to produce all the low voltages required for the digital processor and the preamplifier. It also includes a high voltage multiplier to produce the detector bias voltage, up to 400 V, and supply for the thermoelectric cooler which provides closed loop control with a maximum temperature differential of 85°C. Both of these supplies are adjusted at the factory for a particular detector.

The complete system is packaged in 7 x 10 x 2.5 cm³ aluminum box, with the detector mounted on an extender. In its standard configuration, only two connections are required: power (+5 VDC) and serial (either USB or RS232). The DP4 board supports several additional inputs and outputs, if the X123 will be integrated with other equipment. This includes an MCA gate, a memory buffer select signal, timing outputs, and SCA outputs. Please contact Amptek Inc. or see the DP4 specifications for further information.

X-123 Application: RoHS / WEEE Compliance

The RoHS / WEEE directive requires the electronics industry to certify that products comply with maximum concentration amounts of particular elements and compounds (Cr VI, Pb, Cd, Hg, Br PBB/PBDE) by July 2006. The X-123 provides OEMs and end users with a powerful X-Ray Spectrometer system in one convenient, small, easy to use instrument that can be quickly implemented to minimize time to market. No additional engineering is required on the spectrometer end since all the connections have been made internally. All that is needed is a +5 Volts DC input power and a USB or RS232 connection to a computer.

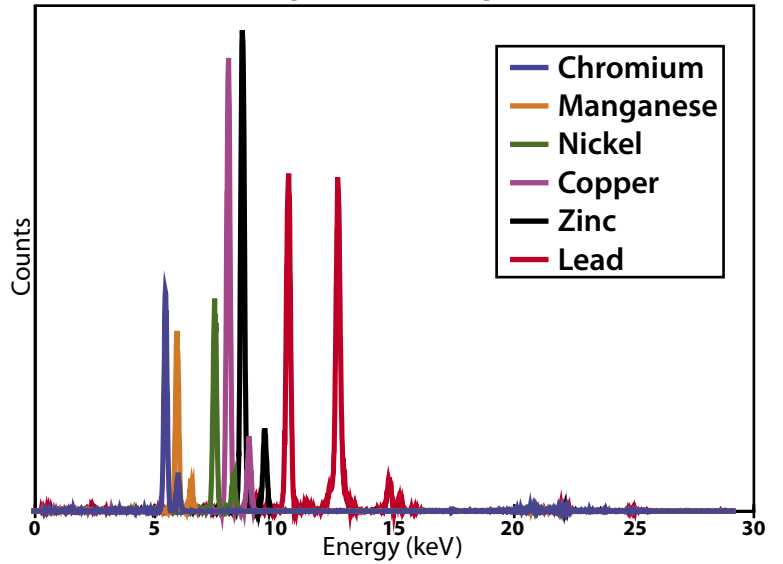
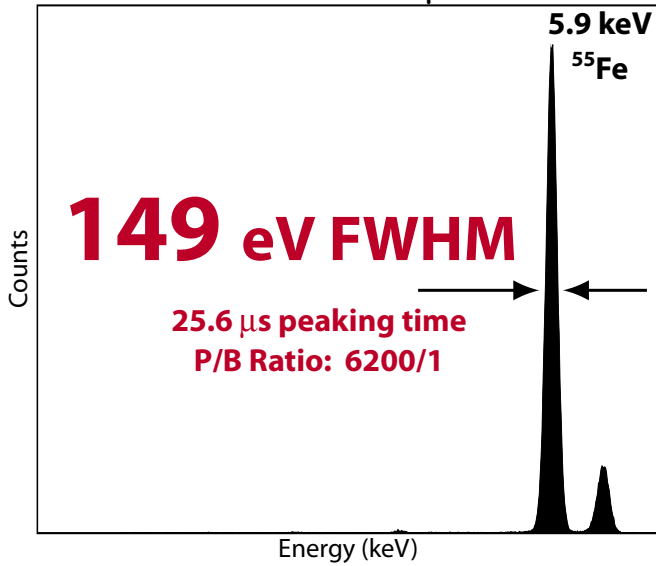
The X-123 does not sacrifice performance for size. The resolution for the 5.9 keV peak of ⁵⁵Fe is 145 eV FWHM to 260 eV FWHM depending on detector type and shaping time constant. Since the X-123 is a complete packaged spectrometer, it is the perfect choice for fast-track product development and will provide the OEM with the quickest time to market.



X-123 Typical Si-PIN Results

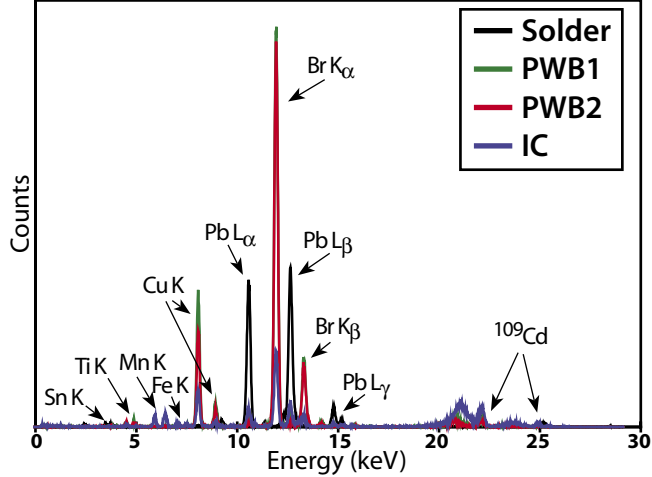
6 mm² x 500 μm

Multiple Element Spectra



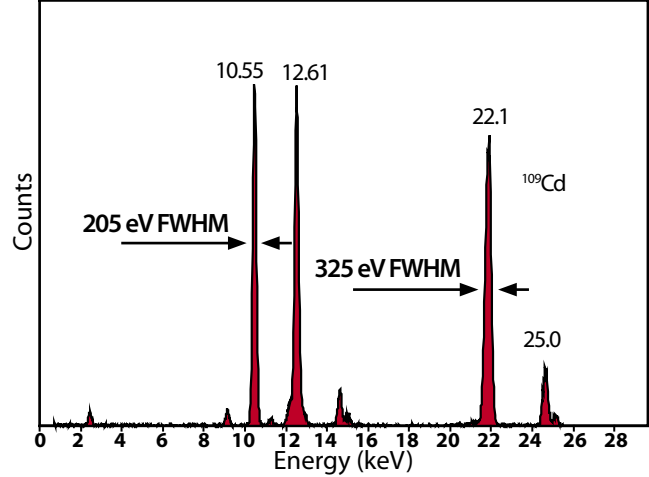
Electronics Industry Analysis

X-Ray Fluorescence of Solder, 2 Printed Circuit Boards and an Integrated Circuit

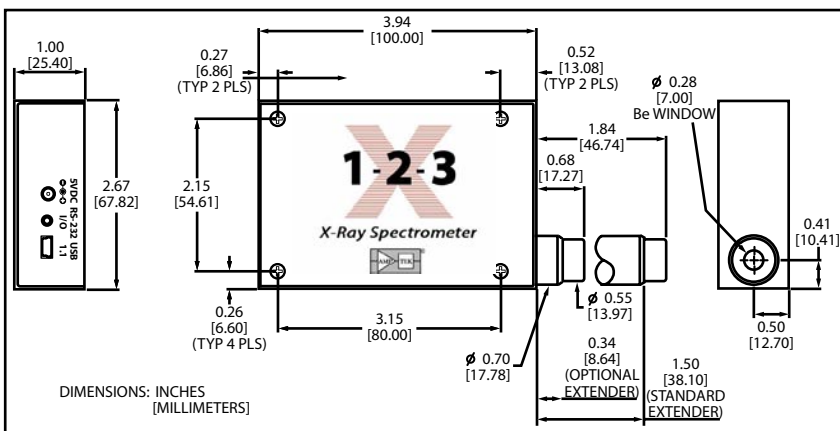


Lead Analysis

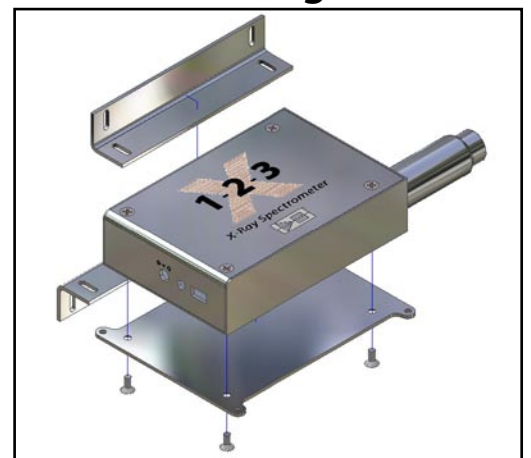
X-Ray Fluorescence of Pb from ¹⁰⁹Cd



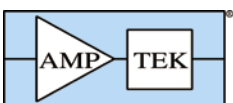
X-123 Mechanical Dimensions



Mounting Kit



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



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