

# X-RAY DETECTOR

# XR-100CR

**No Liquid Nitrogen  
Solid State Design**

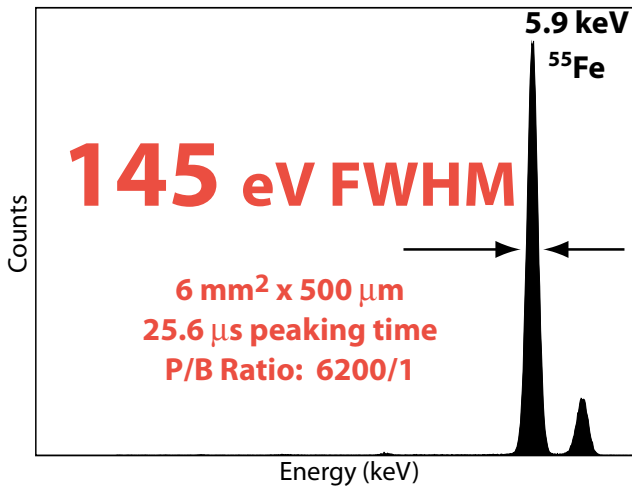
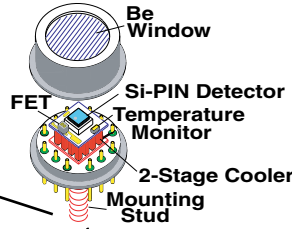
**High Performance at  
Low Cost**

### FEATURES

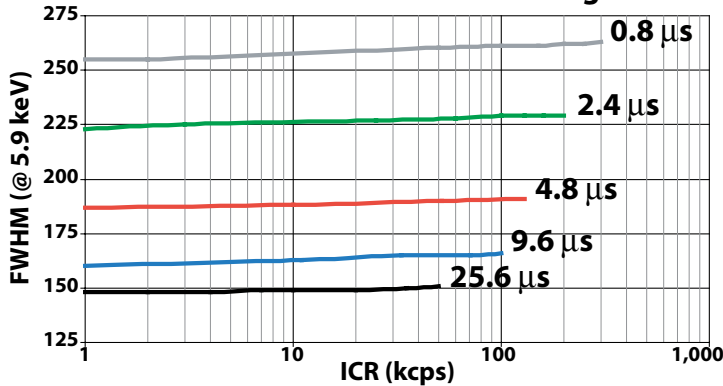
- Si-PIN Photodiode
- Thermoelectric Cooler
- Beryllium Window
- Hermetic Package (TO-8)
- Wide Detection Range
- Easy to Operate

### APPLICATIONS

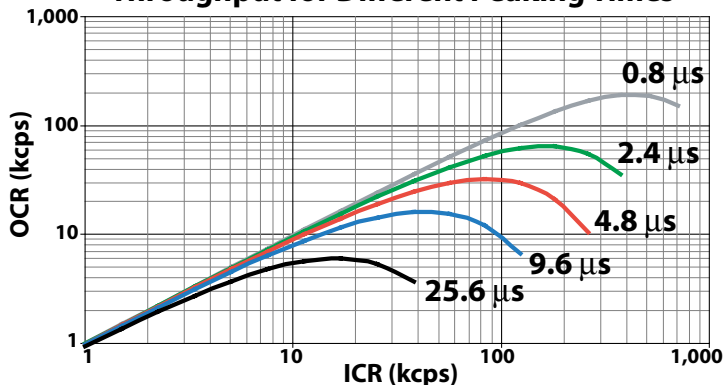
- X-Ray Fluorescence
- OEM
- Process Control
- RoHS / WEEE Compliance
- Portable Instruments
- Art & Archaeology
- Teaching & Research
- Lead Detectors
- Space and Astronomy
- Environmental Monitoring
- Nuclear Plant Monitoring
- Heavy Metals in Plastic
- Semiconductor Processing
- Plating Thickness
- Sulfur in Oil & Coal Detection
- Smoke Stack Analysis
- Coal & Mining Operations
- Jewelry Analysis
- Forensic Investigations



### Resolution vs. ICR for Different Peaking Times



### Throughput for Different Peaking Times



Model *XR-100CR* is a high performance X-Ray Detector, Preamplifier, and Cooler system using a thermoelectrically cooled Si-PIN Photodiode as an X-Ray detector. Also mounted on the 2-stage cooler are the input FET and a novel feedback circuit. These components are kept at approximately -55°C, and are monitored by an internal temperature sensor. The hermetic TO-8 package of the detector has a light tight, vacuum tight thin Beryllium window to enable soft X-Ray detection.

Power to the XR-100CR is provided by the PX5 Digital Pulse Processor and Power Supply. The PX5 is DC powered by an AC adaptor and provides a variable Digital Pulse Processing Amplifier (0.200 µs to 100 µs peaking time), the MCA function, and all power supplies for the detector.

The XR-100CR/PX5 systems ensures stable operation in less than one minute from power turn-on.

The resolution for the 5.9 keV peak of <sup>55</sup>Fe is 145 eV FWHM to 230 eV FWHM depending on the detector type and shaping time constant (see next page for selection guide).

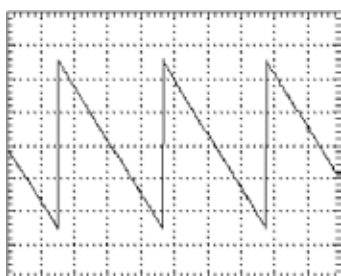
# SPECIFICATIONS

GENERAL	
Detector Type	Si-PIN
Detector Size	6 mm <sup>2</sup> to 25 mm <sup>2</sup> . See Selection Guide.
Silicon Thickness	300 μm and 500 μm
Collimator	Multilayer
Energy Resolution @ 5.9 keV, <sup>55</sup> Fe	145 eV FWHM to 230 eV FWHM depending on detector type and shaping time constant. See Selection Guide.
Background counts	<3 x 10 <sup>3</sup> /s, 2 keV to 150 keV for 7 mm <sup>2</sup> / 300 μm detector
Be Window	1 mil (25 μm) or 0.5 mil (12.5 μm) thick
Charge Sensitive Preamplifier	Amptek custom design with reset through the H.V. connection
Gain Stability	<20 ppm/°C (typical)
Case Size	3.00 x 1.75 x 1.13 in (7.7 x 4.4 x 2.9 cm)
Weight	4.9 ounces (139 g)
Total Power	<1 Watt
Warranty Period	1 year
Typical Lifetime	5 to 10 years, depending on use
Storage Time	10+ years in dry environment
Operation Conditions	0°C to +40°C
Shipping and Storage	Long term storage: 10+ years in dry environment Typical Storage & Shipping: -20°C to +50°C, 10 to 90% humidity non condensing
TUV Certification	Certificate #: CU 72072412 01 Tested to: UL 61010-1: 2004 R7 .05 CAN/CSA-C22.2 61010-1: 2004

INPUTS	
Preamp Power	±8 to 9 V @ 15 mA with <50 mV peak-to-peak noise.
Detector Power	+100 to +200V @ 1 μA depending on detector type; <0.1% variation.
Cooler Power	Current = 350 mA maximum Voltage = 4 V maximum with <100 mV peak-to-peak noise Internal temperature controller

### OUTPUTS

**Reset Output Waveform**  
The output of the XR100CR swings from +5 V to -5 V. The reset period will vary with detector type and count rate.



Preamplifier Sensitivity	1 mV/keV typical (may vary for different detectors)
Polarity Feedback	Negative Signal Out, 1 kΩ max. load Reset through the detector capacitance
Temperature Monitor Sensitivity	PX5: direct reading in K through software PX2CR: 770 mV = -50 °C

### CONNECTORS

Preamp Output	BNC coaxial connector
Power and Signal	6-Pin LEMO connector
Interconnect Cable	To PX5: 6-Pin LEMO to 6-Pin LEMO, 5 ft length To PX2CR: 6-Pin LEMO 9-Pin D, 5 ft length

### 6-PIN LEMO CONNECTOR

Pin 1	Temperature monitor diode
Pin 2	+ H.V. Detector Bias, +100 - 200 V max.
Pin 3	-9 V Preamp Power
Pin 4	+9 V Preamp Power
Pin 5	Cooler Power Return
Pin 6	Cooler Power: 0 to +4 V @ 350 mA
CASE	Ground and Shield

### OPTIONS

- Other Beryllium window thicknesses are available on special order (0.3 mil - 7.5 μm).
- Collimator Kit for high flux applications.
- Accessories for vacuum applications.
- See also XR-100SDD specifications using Silicon Drift Detectors.
- See also XR-100T-CdTe specifications using Cadmium Telluride (CdTe) diode detectors for high efficiency and high resolution Gamma Ray detection (<1 keV FWHM @ 122 keV, <sup>57</sup>Co).

### RoHS / WEEE Solutions Spectrum of Chromium, Lead and Cadmium

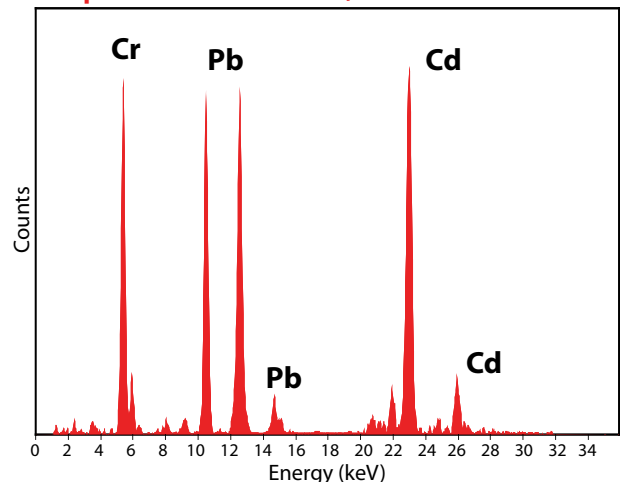


Figure 1. Chromium (Cr), Lead (Pb), and Cadmium (Cd).

## AMPTEK XR-100 Selection Guide

Detector Type Area/Thickness Be Window Thick- ness Options	Guaranteed Energy Resolution eV FWHM @ 5.9 keV* Peak to Background Ratio**
The following detectors are fully depleted and contain a Multilayer (ML) Internal Collimator.	
<b>Si-PIN</b> 6 mm <sup>2</sup> / 500 μm 0.5 or 1.0 mil Be	145 - 165 eV 32 μs Peaking Time P/B Ratio: 6200/1
<b>Si-PIN</b> 13 mm <sup>2</sup> / 500 μm 1.0 mil Be	180 - 205 eV 32 μs Peaking Time P/B Ratio: 4100/1
<b>Si-PIN</b> 25 mm <sup>2</sup> / 500 μm 1.0 mil Be	190 - 225 eV 32 μs Peaking Time P/B Ratio: 2000/1
<b>SUPER SDD</b> 25 mm <sup>2</sup> / 500 μm 0.5 mil Be	125 - 140 eV 11.2 μs Peaking Time P/B Ratio: 8200/1

\*Peaking Time is approximately 2.4x shaping time.  
\*\*The Peak to Background (P/B) Ratio is the ratio of the counts at the 5.9 keV to 2 keV.



Figure 2. X-123 X-Ray Spectrometer and OEM configurations.



Figure 3. XR-100CR Taking an X-Ray Fluorescence Spectrum of Michelangelo's David

## APPLICATIONS

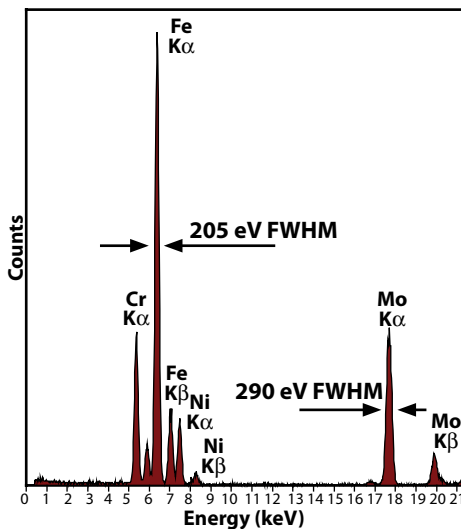


Figure 4. SS316 Fluorescence from <sup>109</sup>Cd

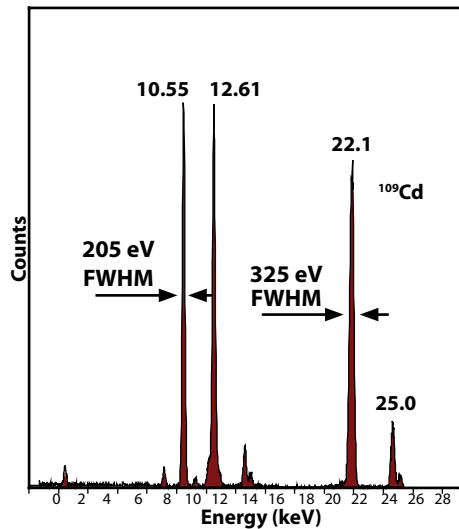


Figure 5. Lead (Pb) Fluorescence from <sup>109</sup>Cd

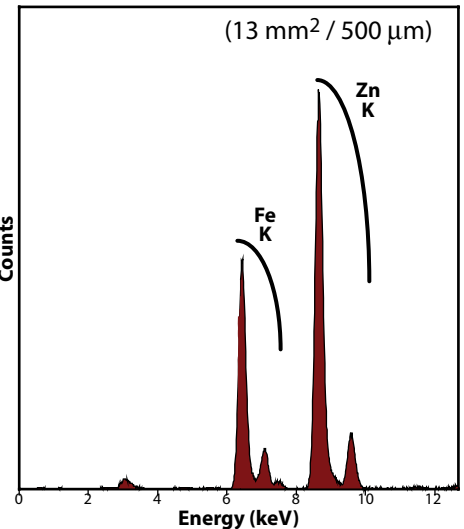


Figure 6. Process Control. Galvanized Steel: Zinc (Zn) plating on Iron (Fe)

For full system specifications, please see <http://www.amptek.com/xr100cr.html>

# APPLICATIONS

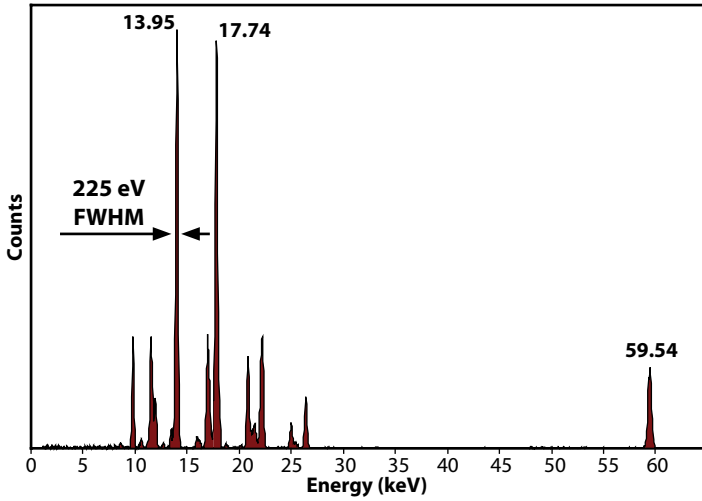


Figure 7.  $^{241}\text{Am}$  Spectrum

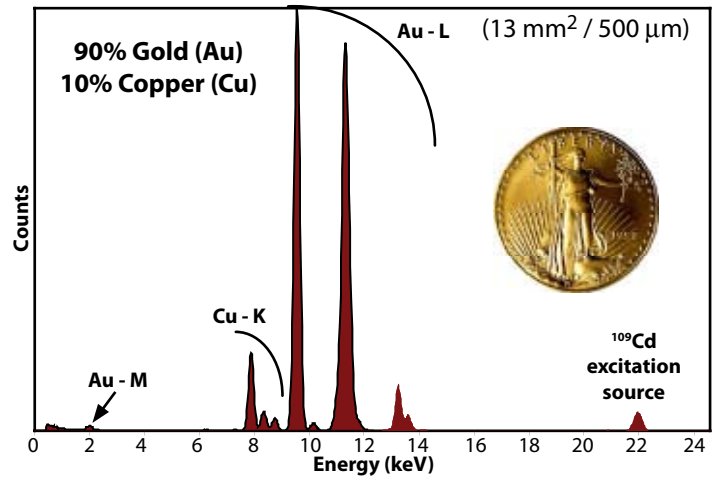


Figure 8. Saint Gaudens US \$20 gold coin with 90% Gold (Au) and 10% Copper (Cu).

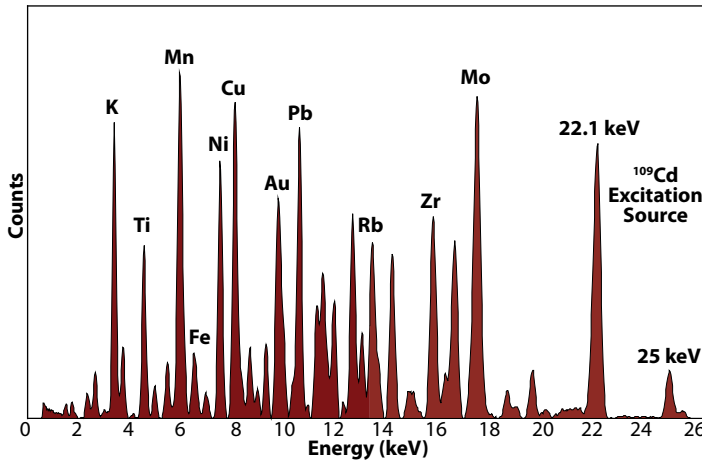


Figure 9. Multi-Element Fluorescence from  $^{109}\text{Cd}$

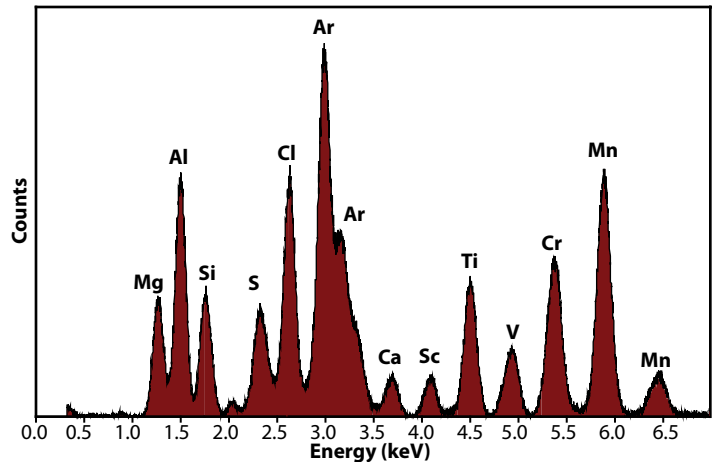


Figure 10. Low Element Fluorescence with 6 mm<sup>2</sup>/500 mm Detector

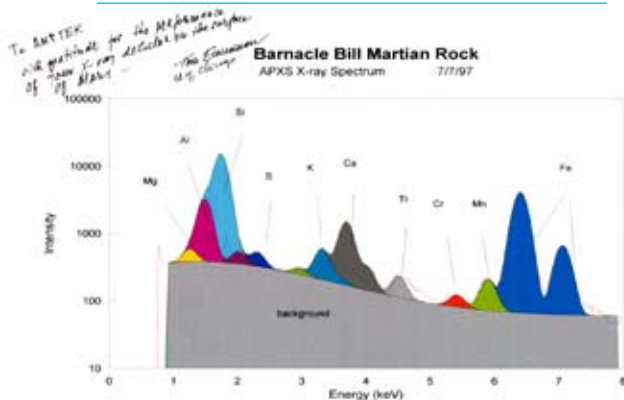


Figure 11. First Rock Spectrum from Mars

For its unique design and reliability, the XR-100 was selected for the Pathfinder Mission to perform rock and soil analysis using X-ray fluorescence techniques. Spectrum courtesy of the University of Chicago.

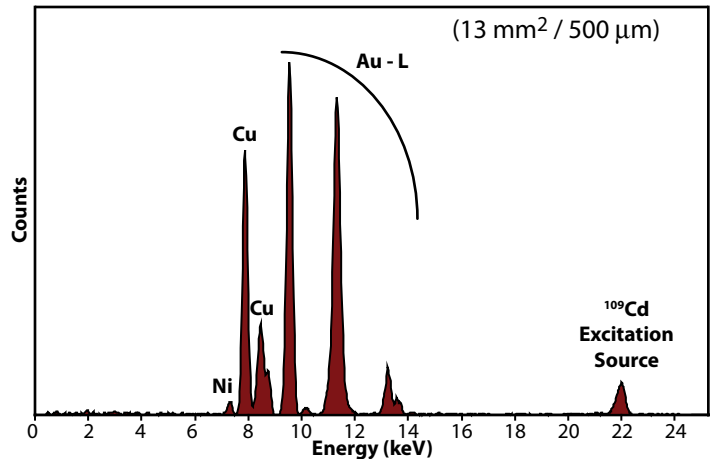
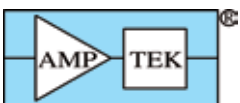


Figure 12. Jewelry analysis of a 14k Gold/White Gold (Au) chain containing Copper (Cu) and Nickel (Ni).



Figure 13 (left). Complete XRF System: XR-100CR, PX5 Digital Pulse Processor and MCA, Mini-X X-Ray Generator System, and XRF-FP Quantitative Analysis Software (not shown)



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