

# Miniature X-Ray Source

# Mini-X2

**Mini-X2 is a miniature X-ray tube system, which includes the X-ray tube, high voltage power supply and USB controller. It is designed for X-ray fluorescence analysis applications (XRF).**



### Features

- USB controlled
- Stable output
- Fast
- Low power
- Small

### Applications

- X-Ray Fluorescence (XRF) analysis
- Portable systems
- OEM
- Process Control
- Research
- Teaching

### Options

- Power: 4 W or 10 W
- HV: 50 kV or 70 kV
- Target: Ag, Au, Rh, or W

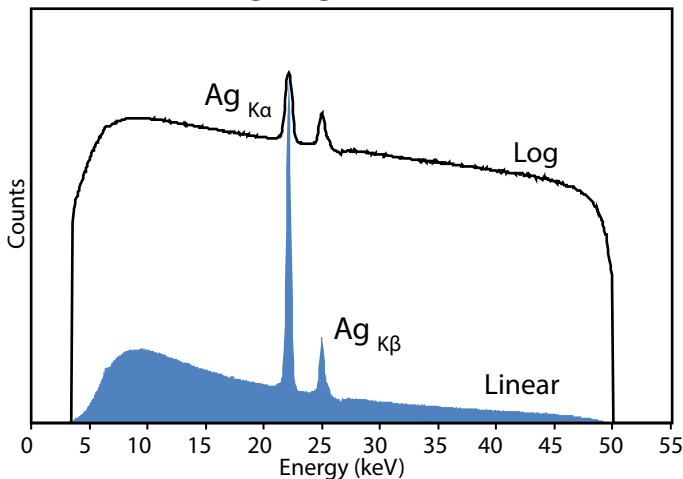
The Mini-X2 is a miniature X-ray tube system which includes the X-ray tube, the power supply, the control electronics, and the USB communications to the computer. It is optimized for compact X-ray fluorescence (XRF) applications.

The Mini-X2 consists of two components: the Mini-X2 X-ray tube module and the Mini-X2 Controller. The X-ray tube module includes the tube and HVPS. Several different options are available: 1) maximum power can be 4W or 10W; 2) maximum HV can be 50 kV or 70 kV; and 3) the anode can be Ag, Au, Rh, or W and several custom variations can be provided ([www.amptek.com](http://www.amptek.com)). The Controller includes the USB communications and software control. It can be configured, via software, to support any of the X-ray tube modules. A 10 pin flex cable connects the Controller and the X-ray tube module. Connections to the Controller are 12VDC power, USB for command and control, and an AUX connector with a safety interlock and a driver for a warning light.

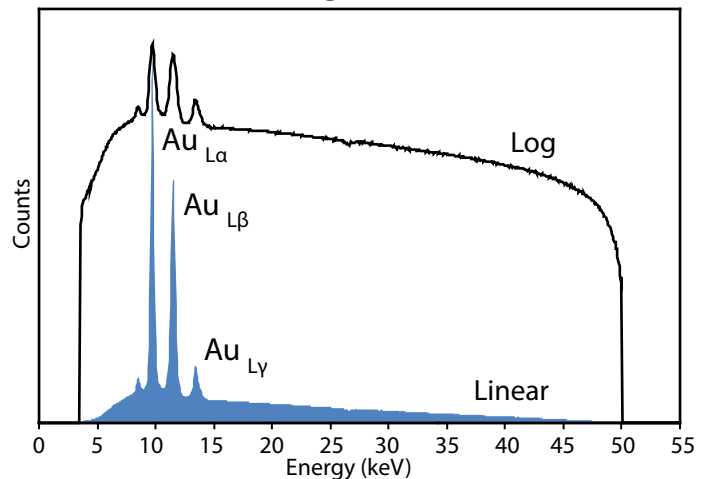
The Mini-X2 is a replacement for Amptek's previous Mini-X product family. The X-ray Tube Module is similar to the previous Mini-X-OEM. The Controller has significantly improved control features, including software configurability and faster control and readback. It utilizes a completely different software interface, based upon the FW6 protocol used with Amptek's digital pulse processors.

## Mini-X Output X-Ray Spectra

**Ag Target @ 50 kV**



**Au Target @ 50 kV**



The Mini-X2 is based on the Newton Scientific Inc. miniature X-ray sources.

OEM's #1 Choice

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# Specifications

## Mini-X2 X-Ray Tube Module

X-Ray Tube Performance	
Target Material	Silver (Ag), Gold (Au), Rhodium (Rh), Tungsten (W)
Target Type	Transmission
Tube Voltage	10 to 50 kV or 35 to 70 kV
Tube Power	4 W or 10 W available
Tube Current	5 $\mu$ A to 200 $\mu$ A (Fold back for power limit)
Typical Dose Rate Ag & Rh	1 Sv/hr (100 rem/hr) @ 30 cm on axis, at 50 kV and 80 $\mu$ A (4 W)
Au & W	2.2 Sv/hr (220 rem/hr) @ 30 cm on axis, at 50 V and 80 $\mu$ A (4 W)
Typical Flux Ag & Rh	1 x 10 <sup>6</sup> cps/mm <sup>2</sup> @ 30 cm on axis, at 50 kV and 1 $\mu$ A
Au & W	2.2 x 10 <sup>6</sup> cps/mm <sup>2</sup> @ 30 cm on axis, at 50 kV and 1 $\mu$ A
Leakage Radiation	< 5 $\mu$ Sv/hr (0.5 mrem/hr) at 5 cm with safety plug installed
Tarket Thickness Ag & Rh	0.75 $\pm$ 0.1 $\mu$ m
Au & W	1 $\pm$ 0.1 $\mu$ m
Window	125 $\mu$ m Be (window grounded)
Focal Spot	Approx. 2 mm
Settling Time	0.5 s (typical)
Cathode Type	Tungsten filament
HV Polarity	Grounded anode
HV Stability	< 0.1%
Environmental & Physical	
Operating Temp	-10 to +50 $^{\circ}$ C
Storage Temp	-25 to +60 $^{\circ}$ C
Humidity	30 to 90% non-condensing
Cooling	Air cooled
Weight	< 400 g

## Mini-X2 Controller

Connectors	
Power	3 pos receptacle, 0.031" (Hirose)
USB	Standard Mini-USB
Interlock	4 pos terminal block, female sockets, 0.15" pitch
Mini-X2	10 pos latching ribbon, male, 0.10" pitch
Power	
Input Voltage	11.5 to 12.5 V
Input Current	1.5 A max
Power Consumption	4 W Tubes: 9 W @ full power 10 W Tubes: 18 W @ full power
Safety	
Controls	1) Safety interlock (with fail-safe lamp driver) 2) USB enable command Tube shuts off if USB is lost
Indicators	1) Flashing LED 2) Beeper 3) External lamp driver
Physical	
Dimensions	2.270 x 2.770 x .770 in
Weight	85 g

## Radiation Precautions

**The Mini-X2 generates x-ray radiation during normal operation. The Mini-X2 has been designed to focus radiation in the designated output direction, however radiation in other directions is possible and should be addressed with shielding and/or monitoring in the final application.**

**Radiation Levels** external to the X-ray tube housing with the brass safety plug ON do not exceed 25  $\mu$ S/h (2.5 mrem/h) measured 5 cm from the surface of the housing in accordance with Requirements 5.2.2.2.2 of the American National Standard N43.2.

**Examples of shielding the 4 W, 50 kV, Ag anode tube (that comply with the above standard)**

- 1 mm (0.040 inch) of Pb will result in radiation levels of 0.5 mrem/h.
- 6.35 mm (0.250 inch) of Fe will result in radiation levels of 0.5 mrem/h.
- 3.18 mm (0.125 inch) of Brass will result in radiation levels of 2.5 mrem/h.

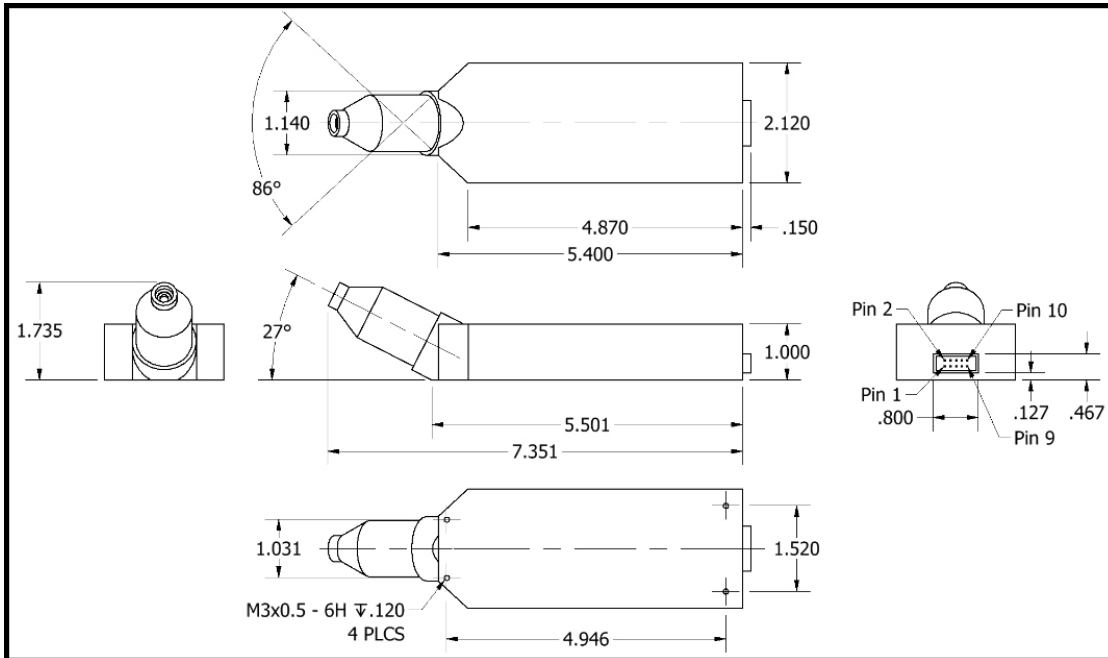
The inside of the housing can also be lined with 3.18 mm (0.125 inch) of aluminum (Al) in order to absorb the XRF from the shielding material.

## Caution

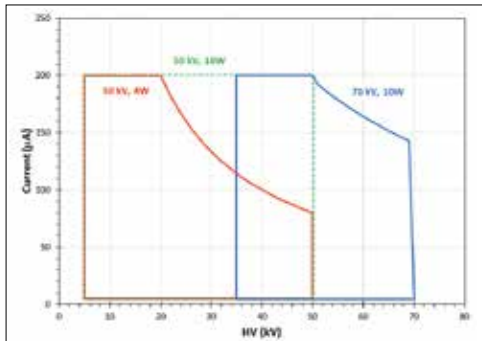
**This device produces X-Rays when energized. To be operated only by qualified personnel.**

# Mini-X2 Mechanicals

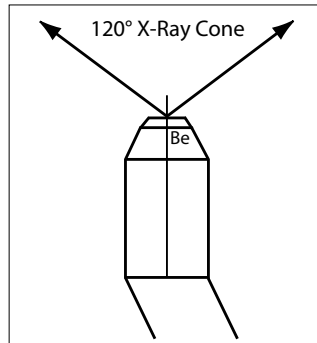
## Mini-X2 Mechanical Dimensions



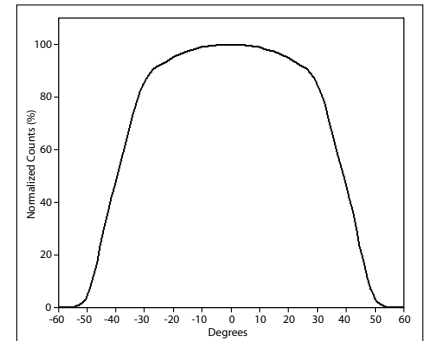
**Mini-X2 50 kV Isooper Curve (Max. 4 Watts)**



**Mini-X2 120° Cone**



**Mini-X2 Angular Response**



## How does the Mini-X2 differ from Amptek's existing Mini-X products?

The Mini-X2 provides many additional control parameters and much better hardware monitoring than the first generation Mini-X. It provides a much faster readback and assessment that the tube is operating nominally. It allows one to easily reconfigure, via software rather than hardware, different tube parameters. The safety interlock includes a failsafe lamp driver and software configurability. It provides more complete fault monitoring and the ability to over-ride defaults.

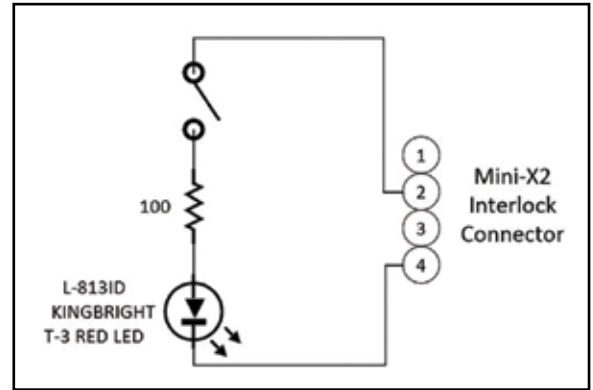
The Mini-X2 controller has the same physical form factor as the MX-50, operates on the same voltages, draws the same current, and still communicates via USB. The INTERLOCK connector has a different pinout. The software interface is completely different: new USB drivers, new command set, new parameter set, etc. A new version of the application software is required; all of the existing operations will still exist, with little change, but a menu of advanced settings will be added. For customers writing their own software, their code will need to be replaced using a new set of subroutines.



# APPLICATION NOTES

## Safety Interlock

The AUX connector on the Mini-X2 Controller contains a safety interlock, designed for use with a failsafe warning lamp. A typical application circuit is sketched below. The controller applies a configurable voltage across the external interlock circuit and monitors the current; the tube is only enabled if the current is within a programmable range. It turns off if the switch is open or if the lamp fails.

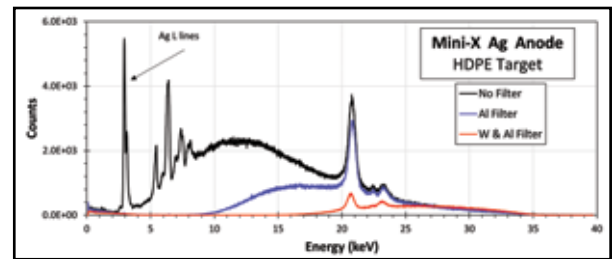


## Warning lamp and beeper

The Mini-X2 controller includes an LED and a beeper which indicate that the tube's HV and current are enabled. They flash/beep at about 1 Hz. The safety interlock drives a lamp with a failsafe circuit. See the Mini-X2 User Manual for warning lamp technical specifications.

## Filters and Collimators

In XRF, the characteristic X-rays of a given element (the analyte) are only stimulated by incident X-rays with energy above the analyte's absorption edge (and most efficiently by those between 1.5 and 2 times the absorption edge). An X-ray tube produces X-rays across a broad continuum (bremsstrahlung spectrum) extending below the absorption edge; these contribute to spectral background and degrade the precision, accuracy, and detection limits of an analyte. Filters (and HV settings) are used to reduce the background for a particular analyte and are key to high quality XRF measurements. See the Mini-X2 User Manual for more information.



## Software

The Mini-X2 is provided with software which allows the user to set the HV and current, enable or disable the tube, to set various configuration parameters, and to read back the unit's status. Amptek also provide a software developer's kit (SDK) for customers who need to write their own control software. The Mini-X2 software interface is based on Amptek's FW6 communication protocol, via USB. It is completely different from the software interface on the original Mini-X.



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