

Miniature X-Ray Source

Mini-X

Mini-X is a self-contained, miniature X-ray tube system, which includes the X-ray tube, high voltage power supply and USB controller. Designed for X-ray fluorescence analysis applications - XRF.



Features

- 50 kV / 80 μ A
- Ag or Au target
- USB controlled
- Stable output
- Fast
- Low power
- Small

Applications

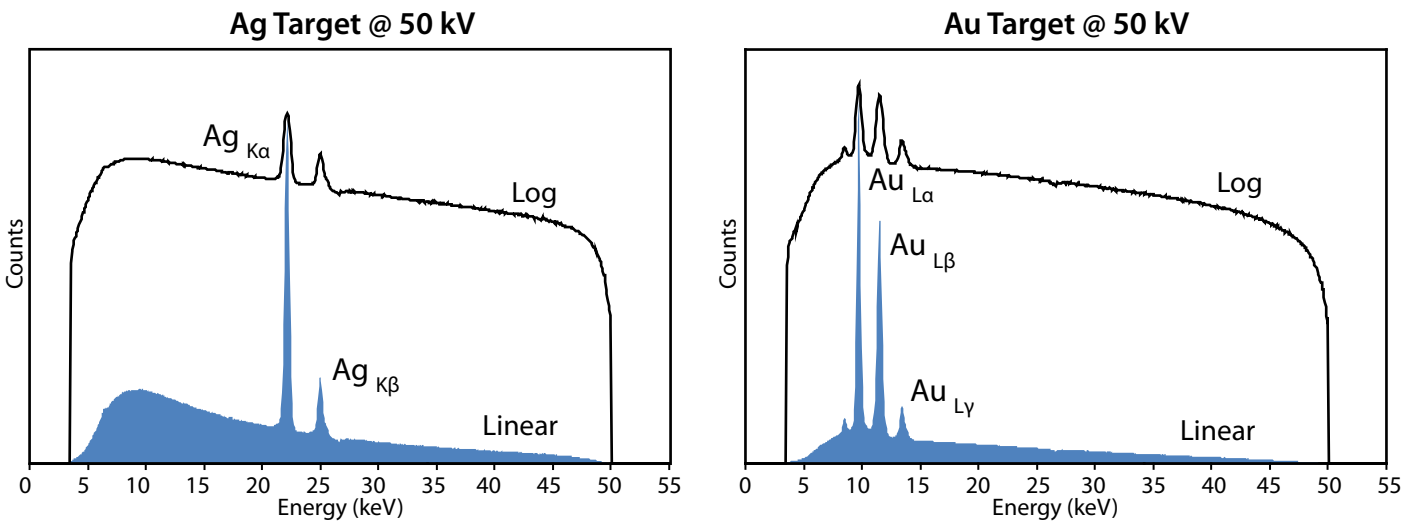
- X-Ray Fluorescence (XRF) analysis
- Portable systems
- OEM
- Process Control
- Research
- Teaching

Mini-X is the first of its kind; a self-contained, packaged, miniature X-ray tube system, which includes the X-ray tube, the power supply, the control electronics and the USB communication to the computer. It is designed to replace radioisotopes in X-ray fluorescence analysis applications.

Mini-X has been designed to simplify the XRF process by providing a grounded anode, variable current and voltage controlled via USB and ease of operation. It features a 50 kV/80 μ A power supply, a gold (Au) or silver (Ag) transmission target, and a beryllium end window. It is designed for continuous operation in industrial environments.

To further simplify the use of Mini-X an AC adaptor is provided to supply the 12 VDC needed to power the system. The only connections needed to operate the tube are a USB cable and AC adaptor. A flashing red LED and a beeper warns the user when x-rays are present.

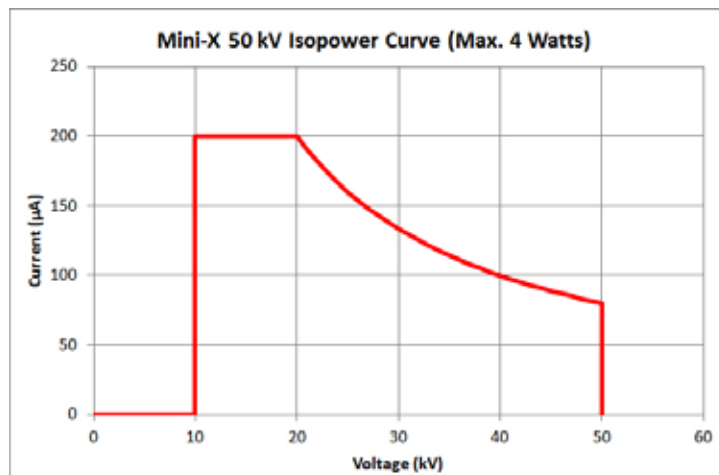
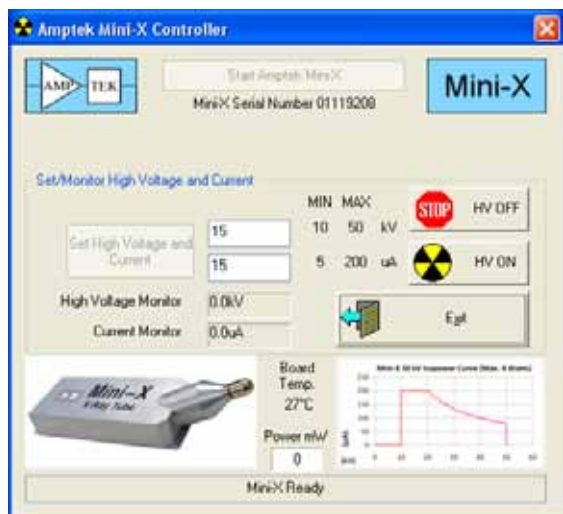
Mini-X Output X-Ray Spectra



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

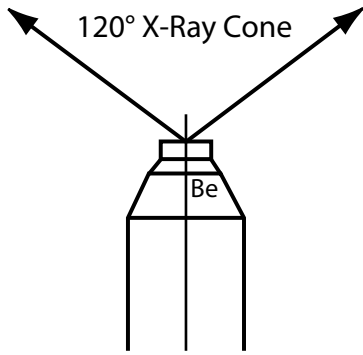
Mini-X Specifications

Target Material	Silver (Ag)	Gold (Au)
Target Thickness	0.75 μm ($\pm 0.1 \mu\text{m}$)	1 μm ($\pm 0.1 \mu\text{m}$)
Tube Voltage	10 to 50 kV	10 to 50 kV
Tube Current	5 μA min. / 200 μA max.	5 μA min. / 200 μA max.
Approximate Dose Rate	1 Sv/h (100 Rem/hr) @ 30 cm on axis, 50 kV and 80 μA	2.2 Sv/h (220 Rem/hr) @ 30 cm on axis, 50 kV and 80 μA
Approximate Flux	10^6 counts per second/ mm^2 on the axis at a distance of 30 cm (50 keV/1 μA)	2.2×10^6 counts per second/ mm^2 on the axis at a distance of 30 cm (50 keV/1 μA)
Continuous Output Power	4 W max. @ 100% duty cycle	4 W max. @ 100% duty cycle
Window Material	Beryllium (Be); window at ground	Beryllium (Be); window at ground
Window Thickness	127 μm	127 μm
Focal Spot Size	Approximately 2 mm	Approximately 2 mm
Output Cone Angle	120°	120°
Cooling	Air cooled	Air cooled
High Voltage Stability	< 0.1%	< 0.1%
Leakage Radiation	<5 $\mu\text{Sv/h}$ (0.5 mrem/h) at 5 cm with safety plug installed	<5 $\mu\text{Sv/h}$ (0.5 mrem/h) at 5 cm with safety plug installed
Power Consumption	9 W at 50 kV and 80 μA	9 W at 50 kV and 80 μA
Input Voltage	12 VDC (AC adapter included)	12 VDC (AC adapter included)
Control	USB, mini-USB connector (cable included)	USB, mini-USB connector (cable included)
Setting Time	Typical < 1 s	Typical < 1 s
Weight	360 g	360 g
Humidity	30 to 90% non condensing	30 to 90% non condensing
Operating Temperature	-10 °C to +50 °C	-10 °C to +50 °C
Storage Temperature	-25 °C to +60 °C	-25 °C to +60 °C
Safety Controls and Indicators	1) External hardware interlock 2) Flashing LED 3) Beeper	1) External hardware interlock 2) Flashing LED 3) Beeper
Software	Mini-X Control Software controls voltage and current Mini-X API for custom programming applications	Mini-X Control Software controls voltage and current Mini-X API for custom programming applications
Warranty	One year or 2000 hours, whichever comes first	One year or 2000 hours, whichever comes first



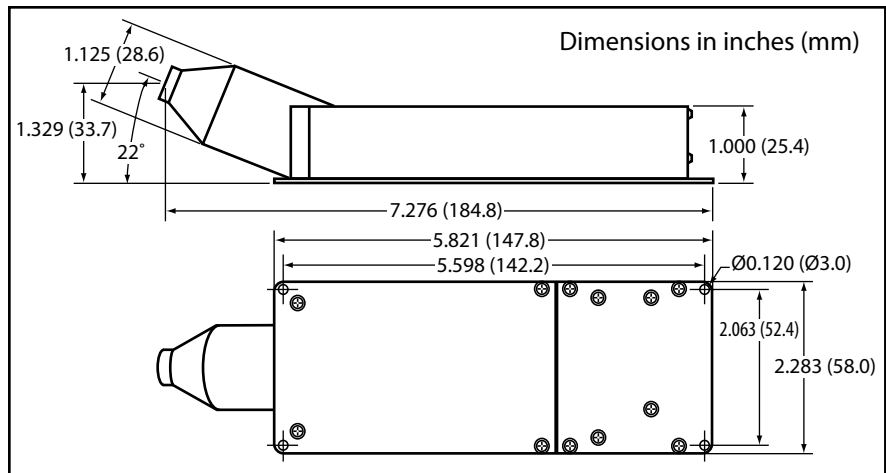
USB Software Interface. Allows the user to set the voltage and current as well as monitor both parameters.

Mini-X Mechanical Dimensions

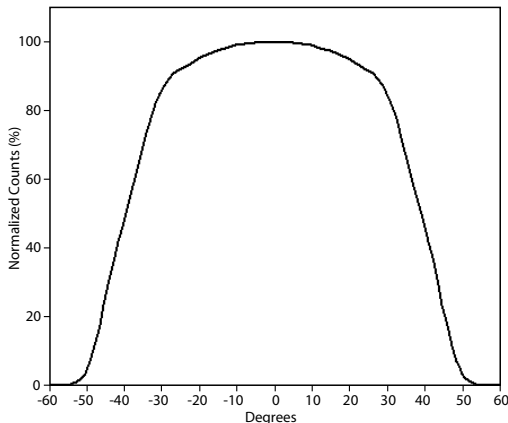


Mini-X 120° cone.

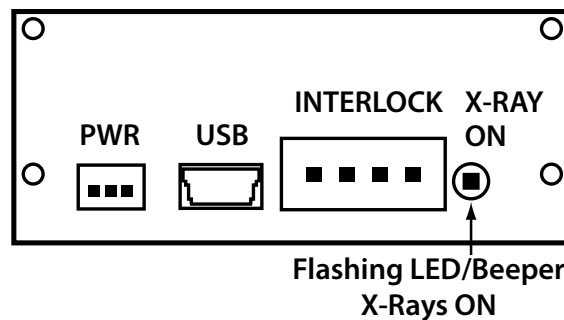
NOTE: When using the 2 mm collimator, the X-ray cone is 5°.



Mini-X Angular Response

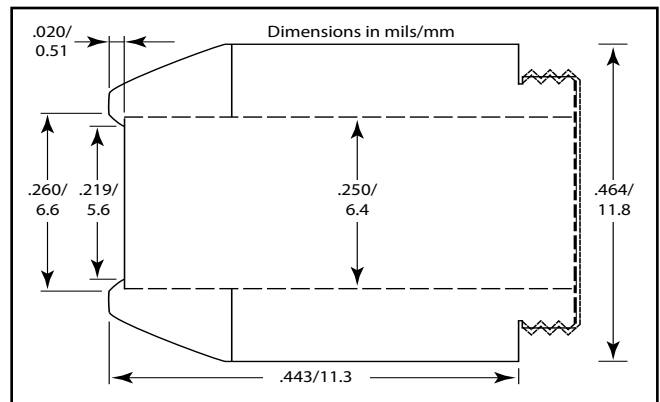


Back panel connectors



Collimator and Safety Plug

The Mini-X is provided with a collimator to facilitate its use in XRF applications. It consists of a brass collimator with an aluminum (Al) insert and a cover that screws into the Mini-X. The collimator has a 2 mm diameter hole. The brass safety plug when installed, reduces the flux from an operating tube to less than 2.5 mrem/h at 5 cm away in accordance with Requirements 5.2.2.2.2 of the NBS Handbook for Radiation Safety for X-Ray Diffraction and Fluorescence Analysis Equipment.



Collimator cover mechanical dimensions (mils/mm).

Filters

There are many reasons to use filters on the x-ray tube. They can help eliminate low energy photons to create a clean background and they can filter the characteristic lines of the tube's target. Keep in mind that when any filter is used it reduces the flux coming out of the tube. An Al filter reduces the flux much less than a Mo or Ag filter. The higher the Z of the filter or the thicker the filter, the less flux will be available. It is therefore necessary to raise the current of the x-ray tube to compensate.

Please see <http://www.amptek.com/minix.html> for output spectra with various filters.

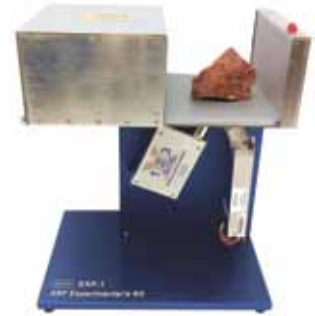
Filters Provided		
Material	Thickness (µm/mils)	# Provided
Al	1016 / 40	5
Al	254 / 10	5
Cu	25.4 / 1	3
Mo	25.4 / 1	2
Ag	25.4 / 1	1
W	25.4 / 1	1



The Mini-X shown with the Amptek XR-100CR X-Ray Detector and PX5 Digital Pulse Processor.



The Mini-X and X-123SDD shown with vacuum couplings.



The Mini-X mounted on Amptek Experimenter's XRF Kit

Mini-X-OEM X-Ray Tube for XRF



The Mini-X-OEM X-ray tube is not the same as the Mini-X.

The Mini-X has a USB interface to control the voltage and current through PC software. The Mini-X is an end-user, packaged device.

The Mini-X-OEM is controlled by user supplied analog voltages

Radiation Precautions

The Mini-X is intended to generate x-ray radiation during normal operation. The Mini-X 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 $\mu\text{S}/\text{h}$ (2.5 mrem/h) measured 5 cm from the surface of the housing in accordance with Requirements 5.2.2.2 of the National Bureau of Standards (NBS) Handbook for Radiation Safety for X-Ray Diffraction and Fluorescence Analysis Equipment.

Examples of Shielding (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.

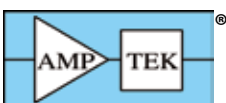
The inside of the housing can also be lined with 3.18 mm (0.125 inch) of aluminum (Al) in order to absorb the XRF from the shielding material.

Caution

The Mini-X is only one component of an X-ray instrument. It is the responsibility of the user, the OEM customer, or experimenter to provide a fail safe metal enclosure to prevent escaping radiation while using this product. The final product (turn-key system) must comply with local government regulations to protect personnel from exposure to radiation. Amptek Inc., bears no responsibility for the incorrect use of this product.

Caution

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



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