

60kV 12W MagPro X-ray Imaging Source Manual

TUB-MAN-1007, Rev A

Introduction

The MagPro x-ray source is small, lightweight, and can be packaged into custom enclosures. The MagPro x-ray source includes an x-ray tube and a high voltage power supply that operates at up to a maximum of 12W at 60kV or 1000 μ A. The MagPro source is designed for bench top applications where higher flux reduces measurement times. The tube anode is grounded allowing placement close to the sample.

Figure 1 - MagPro X-ray Source

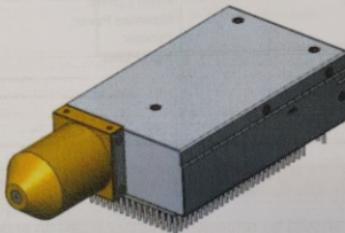


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X-ray Source Characteristics

The MagPro x-ray tube is small, lightweight, and can be packaged into custom enclosures. The MagPro x-ray tube package includes an x-ray tube and a high voltage power supply that operates at up to 12 Watts at 60kV or 1000 μ A.

Components	Quantity Required
TUB0014X-XX – X-ray Source	1
Power Supply – 24VDC @ 1.7A	1
2.1 mm x 5.5 mm x 9.5 mm Barrel Connector	1
Cable – USB Type A-B 2.0	1

Mechanical Specifications		X-ray Tube Characteristics	
Tube Type:	Metal-ceramic	HV Polarity:	Grounded anode
Cathode Type:	Tungsten filament	High Voltage:	4kV to 60kV
Operating Temp:	-10° C to +50° C	Beam Current:	0 μ A to 1000 μ A
Storage Temp	-40° C +85° C	Maximum Power:	12 Watts
Cooling:	Air	Window:	Beryllium
HV Insulation:	Silicone potting	Input Power:	25W max (24 VDC \pm 1.5VDC)
Weight:	\leq 1.6 lbs. (745 g)		
Available Targets:	Tungsten, Silver, Rhodium		
Max Case Temp:	\leq 65° C		
Max Anode Shield Temp	\leq 110° C		

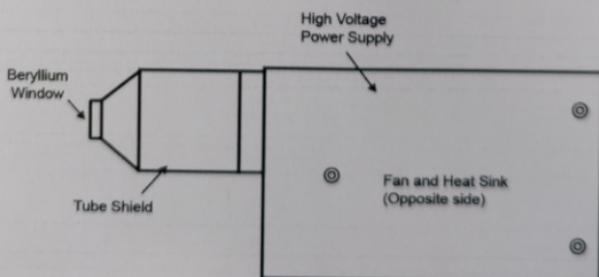
Initial Inspection

When a MagPro tube is received, it should be unpacked and inspected as soon as possible. A standard MagPro tube is encased in a brass shield. This shield is connected directly to a high voltage power supply. Inspect the high voltage power supply and the tube shield assembly for any damage that may have occurred during shipping. If a tube has been damaged, please contact Moxtek immediately. The serial number is located on the high voltage power supply. Please do not touch the beryllium window.

Handling

Care should be taken when handling the tube and the high voltage power supply. Do not drop or strike the tube on any surface. Care must be taken to not damage the beryllium window.

Figure 2 – Part Locations

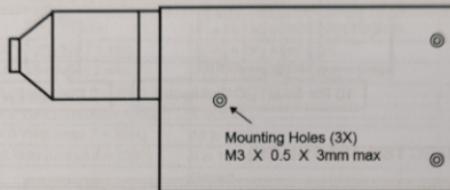


Source Setup

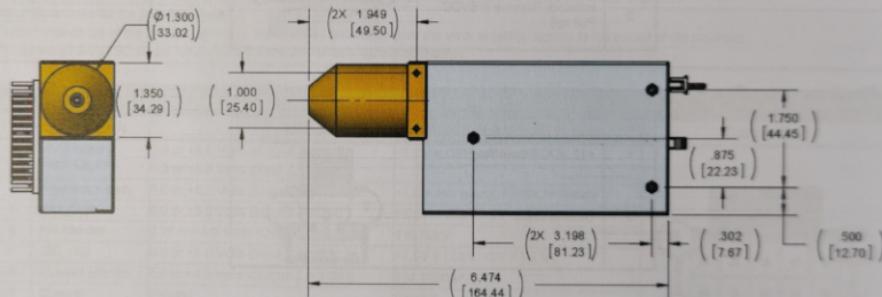
Mechanical

Mounting

The shielded MagPro source may be mounted with the exit collimator facing any direction. Care should be taken not to support the power supply by the shield alone. The high voltage power supply has three M3-0.5 threaded holes on both sides of the metal case. These holes may be used for mounting (see Physical Layout). Maximum screw thread insertion length is 3mm.



Dimensions

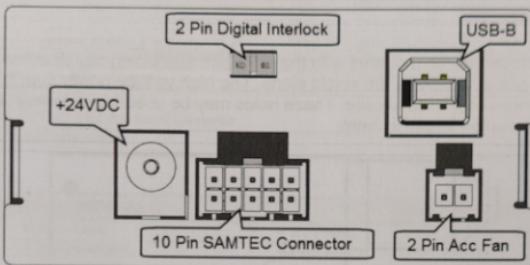


Cooling

The MagPro tube utilizes a fan and heat sink for a combination of forced-air convection and conduction cooling. The tube should be operated in an environment that allows convection and conduction to secondary parts. Operating Temperature is -10° C to +50° C. Maximum case temperature, as measured at the surface of the power supply, is +65°C.

Electrical Connector Locations and Pinouts

Figure 3 - X-Ray Tube Electrical Connectors



2-Pin Digital Interlock (SAMTEC TSM-102-01-L-SH)

Pin	Function	Connector
1	Interlock Send (GND)	
2	Interlock Receive (+5VDC Pull up)	

2-Pin Accessory Fan

Pin	Function	Connector
1	+12 VDC Power Red	
2	Ground Black	

+24 VDC

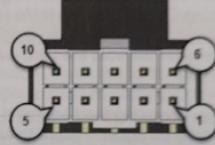
Power Jack	Function	Connector
Center Pin	+24 VDC ± 5% Input Power	
Sleeve	Ground	

USB Type B Connector

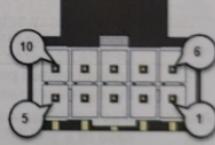
The USB-B connector conforms to the USB standards for communication to a peripheral device. USB is master control; other connectors will be disabled when the USB is connected.

USB Connector	Connector
Standard USB Type B Connector. Device not powered by USB.	

10-Pin SAMTEC Connector (IPL-105-01-L-D-RA-K)

Analog Control Pinouts				
Pin	Function	I/O Value	Response/Description	Connector
1	HV Enable	0.0 or +5.0 Volts (Input Z = 10k)	<1.0V = OFF, >4V = ON	
2	Filament Ready	0.0 or +5.0 Volts (Output Z = 1k)	<1.0 = Not ready, +5VDC = Ready	
3	HV Control	0.27 to +4.0 Volts (Input Z = 100k)	4 to 60kV	
4	HV Monitor	0.27 to +4.0 Volts (Output Z = 1000)	4 to 60kV	
5	Current Control	0.04 to +4.0 Volts (Input Z = 100k)	10 to 1000μA	
6	Current Monitor	0.0 to +4.0 Volts (Output Z = 1000)	0 to 1000μA	
7	Ground	Ground	Ground	
8	Ground	Ground	Ground	
9	Filament Enable	0.0 or +5.0 Volts (Input Z = 10k)	<1.0V = OFF, >4V = ON	
10	Input Power	+24 Volts DC ± 5%	Input Power	

Input impedance for the program signals is 100 kΩ to ground.
Output impedance of the monitor signals is 100 Ω series resistance from the error amplifier signals to the output of the monitors.
Recommend SAMTEC 10 pin connector IPD1-05-D-K-M as a mating connector.

I2C Bus Digital Control Pinout				
Pin	Function	I/O Value	Response/Description	Connector
1	HV Enable / Hard Disable	0.0 or +5.0 Volts (Output Z = 1k) 0.0 or +5.0 Volts (Input Z = 10k)	<1.0V = OFF, >4V = ON	
2	Filament Ready	0.0 or +5.0 Volts (Output Z = 1k)	<1.0 = Not ready, +5VDC = Ready	
3	I2C_SDA	0.0 or +5.0 Volts (Input Z = 100k)	<1.0V = LOW, >2V = HIGH	
4	HV Monitor	0.27 to +4.0 Volts (Output Z = 1000)	4 to 60kV	
5	I2C_SCL	0.0 or +5.0 Volts (Input Z = 100k)	<1.0V = LOW, >2V = HIGH	
6	Current Monitor	0.0 to +4.0 Volts (Output Z = 100Ω)	0 to 1000μA	
7	Ground	Ground	Ground	
8	Ground	Ground	Ground	
9	Filament Enable	0.0 or +5.0 Volts (Output Z = 1k)	<1.0V = OFF, >4V = ON	
10	Input Power	+24 Volts DC ± 5%	Input Power	

Input impedance for the digital signals is 100 kΩ to ground.
Output impedance of the monitor signals is 100 Ω series resistance from the error amplifier signals to the output of the monitors.
Recommend SAMTEC 10 pin connector IPD1-05-D-K-M as a mating connector.

Safety

The MagPro comes with a digital interlock connection. The MagPro cannot emit x-rays if the two interlock pins are open; the x-ray source can emit x-rays if the two pins are shorted.

This does not apply under analog control, in which case the customer is responsible for designing and creating their own interlock. In practice, the two interlock pins should be connected to a normally open switch. This switch should be integrated into a radiation enclosure such that if the radiation enclosure is open, the switch is open and the x-ray source is turned off. The radiation enclosure design is a customer decision; customers are

required to design their instrument to be "radiation" safe. The interlock circuit provides a means for the customer to achieve a radiation safe instrument.

For CE Compliance, use the provided Ferrite Cable Filter (Steward Part Number 28A2024-0A2) with 3 wraps through the core and an AC/DC wall adapter (ETSA240170UDC-P5P-SZ or equivalent) with 20 AWG cable to provide the necessary filtration and shielding of input power.

Operating Conditions

MagPro tube anodes are grounded to the brass metal shield. The shield is grounded to the power supply. Damage to the tube and/or power supply may result if a ground wire is not provided from the case ground to an appropriate equipment ground. Note that the Shield is potted directly to the HVPS and may not be removed!

When operating the 60kV MagPro x-ray tube in analog mode, adhere to the maximum settings listed in the Analog Control Pinouts table (above). Do not exceed 200 μ A at 60 kV, and 12 kV at 1000 μ A. Failure to adhere to these limits may cause damage to the x-ray tube and/or high voltage power supply. Failure to adhere to this parameter will void the tube warranty. Internal memory records operation outside established limits for failure analysis.

When operating the MagPro x-ray tube, wait 2 seconds after the tube has been powered off before powering the tube on again. Failure to wait 2 seconds may damage the filament. Failure to adhere to this parameter will void the tube warranty.

Operating Precautions - Warnings

CAUTION: Verify that the tube and the high voltage power supply are properly grounded before plugging in the 24VDC supply cord connector.

CAUTION: MagPro X-ray sources contain Beryllium. If the Beryllium window is broken, a very small amount of dust might be generated. If this occurs follow the instructions on the MSDS for cleanup.

WARNING: MagPro X-ray sources may become very hot during operation resulting in serious burns if touched. If so equipped confirm that the heat sink fan is operating correctly when source is powered on.

WARNING: MagPro X-ray sources produce x-ray radiation. MagPro tubes are shielded with a metal shield and high-Z potting materials. Extra shielding may be required depending on the application. **ONLY OPERATE X-RAY SOURCE IN PROPERLY SHIELDED ENCLOSURES** preferably with the safety lockout switch preventing operation when shielding has been removed. It is the responsibility of the operator to ensure that all applicable safety precautions are taken and observed.

WARNING: MagPro X-ray sources operate at high voltages. Do not operate HVPS if there is any damage to the case or a grounding wire is not securely attached.

USB Driver and Software Installation

Download the following *.zip files from the 12Watt google drive folder (link below).

- USBDrivers.zip
- 12WattControllerVer039.zip

The USBDrivers.zip contains an *install.bat* file that will load the necessary USB drivers for the 12 Watt Tube. You may need to run the *install.bat* file in admin mode.

<https://drive.google.com/folderview?id=0B8ohU6HRQShkRnVFNURuRElpRWM&usp=sharing>

Windows 7, Windows 8 and Windows 10 32 and 64 Bit

In Windows 8 and 10 there is a Driver Signature Enforcement that needs to be disabled in order for the USB drivers to complete installation. See this web site on how to do that: <http://www.isunshare.com/windows-8/how-to-disable-or-enable-driver-signature-enforcement-in-windows-8-and-8.1.html>.

1. Extract the USBDrivers.zip and run the *install.bat* file.
2. Connect the 12 Watt to the PC using a USB cable and then power up the 12 Watt.

Note: You should receive a notification that the USB device is looking for its associated driver. You should then be notified that the device is ready to use.

3. Extract and install the 12WattControllerVer039.zip.

Note: This will automatically install and run the application which will search for a connected 12 Watt.

Software Application Operation

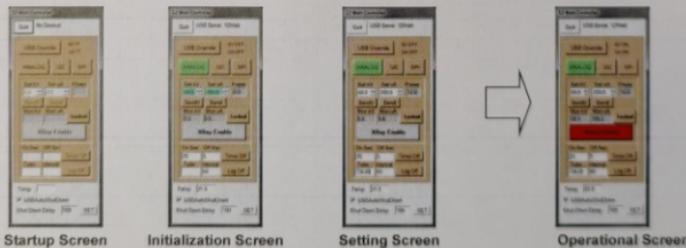
When installation is complete, locate the new "Moxtek" folder in your program directory, open the folder and double-click on the 12WControllerVer001 program to launch the application. Multiple instances of the program can be initiated, to control multiple sources simultaneously, by launching multiple interface panels.

Panel Layout

On startup, the control panel will look similar to the "Startup Screen" shown below. Once a USB cable is plugged into the controlling computer, the program will recognize and display the controller version at the top of the panel as well as the MagPro source firmware (FW Vers:) and USB Serial number.

Clicking on and entering the KV and emission current settings in the "Set KV" and "Set μ A" windows respectively will turn the windows green, indicating that new values have been entered. Clicking on the "Send" button below the windows will transmit that value to the source, turning the window from green to white as shown in the "Setting Screen" panel. Source KV may be set between a minimum of 4 and maximum of 60kV. μ A may be set between a minimum of 0 and maximum of 1000 μ A. If the μ A setting exceeds the 12W source capability it will automatically be reduced to a 12W maximum setting. The calculated tube power is displayed in the "Power" window.

Figure 1 Power Window



Clicking on the Gray "XRay Enable" button will energize the tube to begin emitting X-Rays. The button will turn Red and display "XRay Disable" button indicating tube is operating normally. Clicking on "XRay Disable" button will toggle back to the Gray "XRay Enable" button de-energize the tube turning the x-rays off. This function is

disabled if the "Locked" button is Red indicating that the mechanical safety interlock switch described in the Safety section is open due to an enclosure safety switch not being closed.

Selecting and setting the timer "On Sec" and "Off Sec" windows and then clicking on the "Timer ON" button will override the "XRay Enable" button turning the source on and off for the periods (Seconds) described in the windows respectively. When the timer is active the button will toggle from Brown to Green and then back to Brown when disabled.

Lastly, to record source life data, toggling the "Log ON" button will record a CSV operational text data file to a pre-set folder C:\lifetesting under a number entered in the "Tube" window on an interval (Seconds) set in the "Interval" window. Repeatedly starting and stopping this function will automatically increment the file name.