

Figure 1: Fan Beam/Cone Beam

Introduction

Moxtek manufactures low-power miniature X-ray sources for a variety of applications including handheld XRF, Security, NDT and benchtop instruments. Moxtek sources are small, lightweight and can be packaged into customer enclosures. MOX140G is ideally configured for backscatter and traditional imaging. MOX140G is capable of running up to 140kV and 7W.

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X-ray Source Characteristics

Table 1: Mechanical Specifications

Mechanical Specifications	
Tube Type	Metal-Ceramic
Window	0.001in Tungsten
Operating Temp	-10° to +50° C
Storage Temp	-30° to +65° C
Cooling	Forced air (as needed)
Weight	1.9kg/ 4.2lbs
Available Targets:	Tungsten

Table 2: X-ray Tube Characteristics

X-ray Tube Characteristics	
HV Polarity	Bi Polar
High Voltage	140kV (max)
Beam Current	25uA - 50uA
Maximum Power	7W (50% Duty Cycle)
Focal Spot Size	1.00mm max FWHM
Maximum Exposure	30sec
Standard Warranty	1 year with typical usage

Cooling

Active or passive cooling will be needed depending on the application. Adhering to the limits specified in the X-ray Source Characteristics will prevent any damage. Internal memory records operating temperature to facilitate failure analysis. Operation outside of the permitted limits will void the warranty.

Operating Conditions

140kV tube anodes are grounded to the sheet metal and 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 sheet metal is potted directly to the HVPS and should never be removed.

When operating the 140kV x-ray tube, adhere to the maximum settings as shown in Table 1 and 2. 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.

Mounting Information

Side screws are M2.5-0.45 THD and can be put in at a depth of 2mm. The front has 4 studs with dimensions M2 X 8mm. Mox140G, has four dual purpose screws at the front of the device. The studs are used for mounting purposes, and for grounding. Removal of more than two studs will void the warranty. Once removed, studs cannot be added back due to a risk in puncturing potting and harming electronic components.

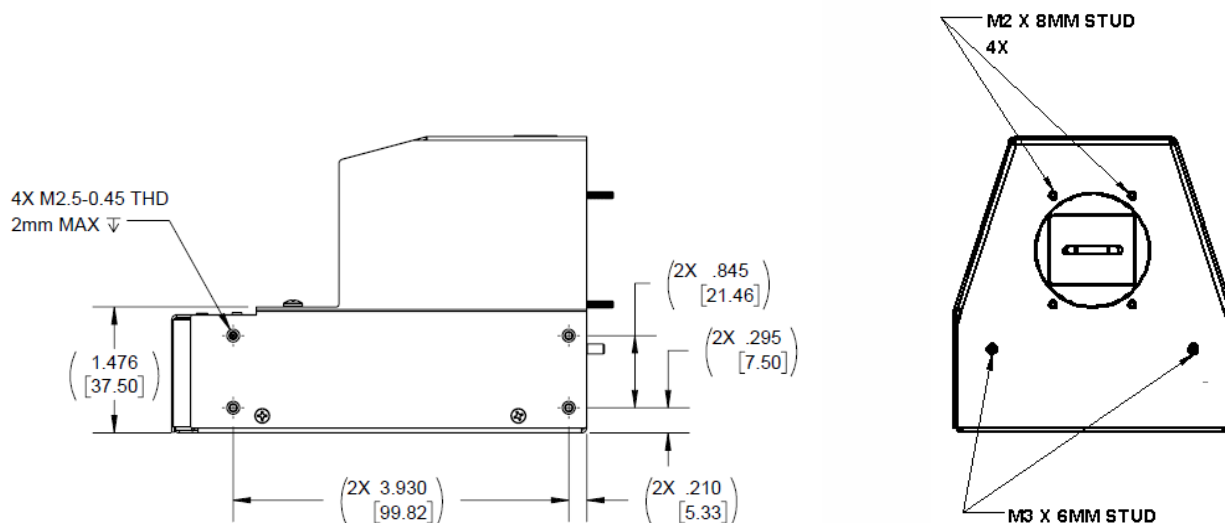


Figure 2: Mounting Points Diagram

Initial Inspection

Please Inspect Contents
**Optional items to purchase*

Table 3: Components, Quantities

Components	Quantity Required
TUB0020X-W08	1
Molex 12 pin Picoblade connector # 53398-1271*	1
Cable – USB Type A-B 2.0*	1
12V power supply*	1

Initial Setup

Ensure proper ground connection to the shell.
Ensure all pinouts are correct.
Confirm everything is powered off when connecting to source.
If using the adapter board, proceed to software section.

Electrical Interface

The Samtec 10-pin FLE-105-01-G-DV connector is not used. This is for Moxtek use only. See Figure 3 below. The Moxtek uses a Molex Picoblade connector # 53398-1271 (12-pins) is used to interface with MOX140G.

Table 4: Pins Defined

Pin #	Name	Description
1	VDC	Main power, 12V +/- .5V
2	VDC	Main power, 12V +/- .5V
3	VDC	Main power, 12V +/- .5V
4	SCL	I2C clock line
5	SDA	I2C data line
6	ENABLE	+5V to enable x-rays
7	GND	Ground return
8	GND	Ground return
9	GND	Ground return
10	GND	Ground return
11	+5V	Aux power
12	+3.3 OR +5V	I2C power*

*Pin 12 should be powered with the same voltage used on the host's I2C pull-up. If +3.3V I2C bus, is used +3.3V should be used for pin 12. If +5V I2C bus is used, +5V should be used for pin 12.

Electrical Interface cont.

To interface with the Molex Picoblade connector, use a Molex 0510211200 connector housing and a Molex 28AWG jumper lead socket to socket wires. (Molex 0006660013 is a good example). Power on the cable should be off when connecting or disconnecting to the source.

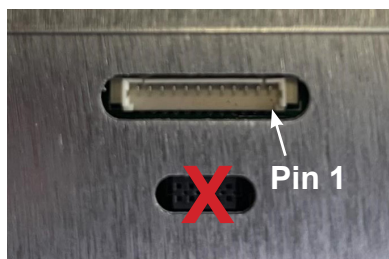


Figure 3: Ribbon cable connection

I2C Information

The master I2C bus requires 1K ohm to close to blue ribbon resistors for the pull-up voltage because of the nature of the level shifter used.

Table 5: Addresses and Lengths of Various Data

Name	Type	Size (bits)	Address (hex)	Description
ctrl_Interlock	unsigned	8	0x00	Status of pin 6 above, the enable signal
ctrl_Enable	unsigned	8	0x01	Enable status
errorFlags	unsigned	8	0x02	All errors are registered here
ctrl_vHWREV	unsigned	8	0x03	hardware revision number
ctrl_vFWREV	unsigned	8	0x04	firmware revision number
ctrl_cMFGYEAR	unsigned	8	0x06	manufactured year
ctrl_cMFGMONTH	unsigned	8	0x07	manufactured month
ctrl_cMFGDAY	unsigned	8	0x08	manufactured day
ctrl_cTUBESN	unsigned	24	0x09,0A,0B	tube serial number
ctrl_cPSSN	unsigned	24	0x0C,0D,0E	power supply serial number
ctrl_vBrdTemp	unsigned	16	0x0F,10	current board temperature
ctrl_vMaxTemp	unsigned	16	0x11,12	maximum recorded board temperature
ctrl_vMinTemp	unsigned	16	0x13,14	minimum recorded board temperature
ctrl_vHVSet	unsigned	16	0x1B,1C	high voltage set point
ctrl_vUASet	unsigned	16	0x1D,1E	beam current set point
ctrl_vnegHVMon	unsigned	16	0x1F,20	negative high voltage monitor
ctrl_vUAMon	unsigned	16	0x21,22	beam current monitor
ctrl_vposHVMon	unsigned	16	0x23,24	positive high voltage monitor

Reading and Writing Voltage/Current and Temperature Values

To read or write to the registers, the code must read or write a byte at a time and convert them to their full values (if they are larger than 1 byte). So for example, on ctrl_vBrdTemp, user would read the two bytes starting at 0x0F. Because data is stored little-endian format, byte 0x10 is the most significant byte (MSB), so it is shifted up by 8 and added to byte 0x0F.

Table 6: Variables Defined

Variable	Definition	Related Equation
KV_{SET}	Desired KV	$ctrl_vHVSet = KV_{SET} * 416.5$
UA_{SET}	Desired Current	$ctrl_vUASet = UA_{SET} * 518.4$
KV_{MONP}	KV monitor positive	$KV_{MONP} = ctrl_vnegHVMon / 169$
KV_{MONN}	KV monitor negative	$KV_{MONN} = ctrl_vposHVMon / 169$
UA_{bc}	Monitor beam current	$UA_{bc} = ctrl_vUAMon * 0.0094$
T_K	Temperature (Kelvin)	$T_K = ctrl_vBrdTemp / 16$
T_C	Temperature (Celsius)	$T_C = T_K - 273.15$

Table 7: Bit Description

Bit Number	Decimal Value	Error	Description
1	1	Low HV	Will throw an error if +/- KV is 5KV or lower than the set KV
2	2	High HV	Will throw an error if +/- KV is 5KV or higher than the set KV
3	4	Low UA	Will throw an error if uA is 5uA or lower than the set uA
4	8	High UA	Will throw an error if uA is 5uA or higher than the set uA. If uA is set to 0, will throw an error if uA is 10uA or higher
5	16	High Temperature	Will throw an error if the internal temperature is 75°C or higher (Will be adjusted based on environmental testing)
6	32	Low Temperature	Will throw an error if the internal temperature is -7°C or lower (Will be adjusted based on environmental testing)

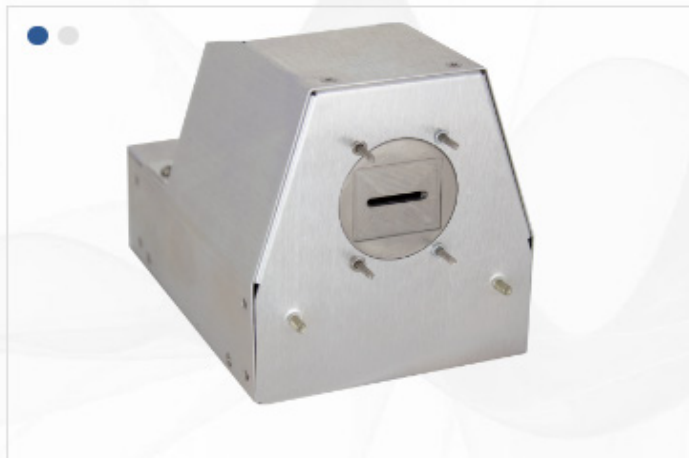
Operating Precautions and Warnings

The X-ray source should be ramped up to 140KV to avoid arcing within the tube. If the source has been sitting idle for a few hours or more, 3 seconds is recommended to ramp up to full voltage and power for the first cycle. The suggested procedure is to turn the source on at 70KV and 20uA. At 70KV, then take 10KV steps up to 140KV. Finally turn the filament power up to full output. This should take about 3 seconds. If the source has been running, the ramp rate time can be decreased to 0.5 seconds. The suggested procedure is to turn the source on at 70KV and 20uA, then take 10KV steps up to 140KV. Finally turn the filament power up to full output. This should take about 0.5 seconds.

140kV Software Guide

1. Click on [link](#) to access the 140kV folder. See below page for location of software downloads.
2. Download the MOX140G Software folder
3. Unzip the downloaded file “MOX140G Software” onto desktop
4. Navigate to the “Drivers” folder
5. Open the “Moxtek 2.12.28-Signed” folder
6. Right click the “dp-chooser.exe” and select “Run as administrator”
7. Follow the prompts to install the driver
8. Once complete, run the “CDM21228_Setup.exe” file to install the FTDI driver
9. Follow the prompts to install the driver
10. Once complete, navigate to the main 140kV folder
11. Run the “140kV PC Controller.application” file
12. Once the 140kV PC Controller software is installed, run the program
13. A taskbar search for “140kV PC Controller” can locate the new file if needed

X-Ray Products > X-Ray Sources > MOX140G



Mox140G Fan Beam

MOX140G







High energy imaging in a compact package. MOX140G is a complete X-ray source that is ideally configured at:

High energy imaging applications (140kV) compact (3.5in x 3.5in x 5in) lite weight 1.55kg (3.4 lb) package.

Side window tubes have approximately 30% higher x-ray flux compared to end window tubes, which helps in applications that rely on counting low numbers of photons, such as X-Ray Diffraction (XRD).

For more information, please view our [datasheet](#) or contact one of our experts.

Resources

 Downloads	<h4>Related Downloads</h4> <p> MOX140G Datasheet</p>
 FAQ	<h4>Related FAQs</h4> <p>What power supply controller do you recommend for Moxtek tubes?</p> <p>Does Moxtek offer the power supply for x-ray tubes?</p> <p>What are the dimensions of MOXTEK X-ray sources?</p> <p>Does Moxtek offer any sources with imaging capabilities?</p> <p>Does Moxtek manufacture tubes with higher voltage than 40kV?</p>
 Videos	<h4>Related Videos</h4> <p>Extreme X-ray Source Testing</p> <p>Performance Improvements in Miniature X-ray Tubes</p>
 Downloads	<h4>Software</h4> <p> MOX140G Software</p>

Running the 140kV PC Controller Application

1. Start by ensuring the adapter board switch is in the off position
2. Connect the red cable to the adapter board, and then the 140KV source (as seen below)
3. Plug in the 12V power supply provided to both a wall outlet and the adapter board
4. Connect the provided USB cable to the adapter board, and to a PC that has the provided software installed.

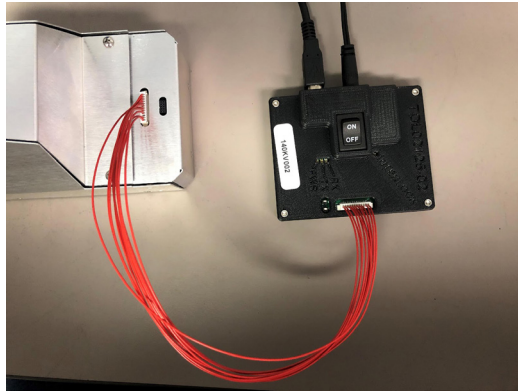


Figure 5: USB cable to the adapter board

5. Connect the interlock pins of the adapter board to a shielded safety interlock. It requires an open or short condition. If the two pins are shorted together, the interlock is closed and the unit is safe to run. If the two pins are open, or not connected to each other, the interlock is open and the unit will cease to emit any X-rays.



Figure 6: Interlock Pins

6. Power on the adapter board. Turn the switch from “OFF” to “ON”.
7. A green light should turn on, which confirms power is being provided, and a red light, meaning the safety interlock is closed. The unit is ready to run.



Figure 7: Safety Interlock Closed

Running the 140KV PC Controller Application cont.

8. Go to the PC connected via USB to the adapter board, and start the “140KV PC Controller” application.
9. In the program, go to the Communication Port section and click the drop-down box. The program will recognize the adapter board’s serial number. Click it. If nothing shows up, click out of the drop-down box and try again. Communication can stall, and may take multiple attempts.

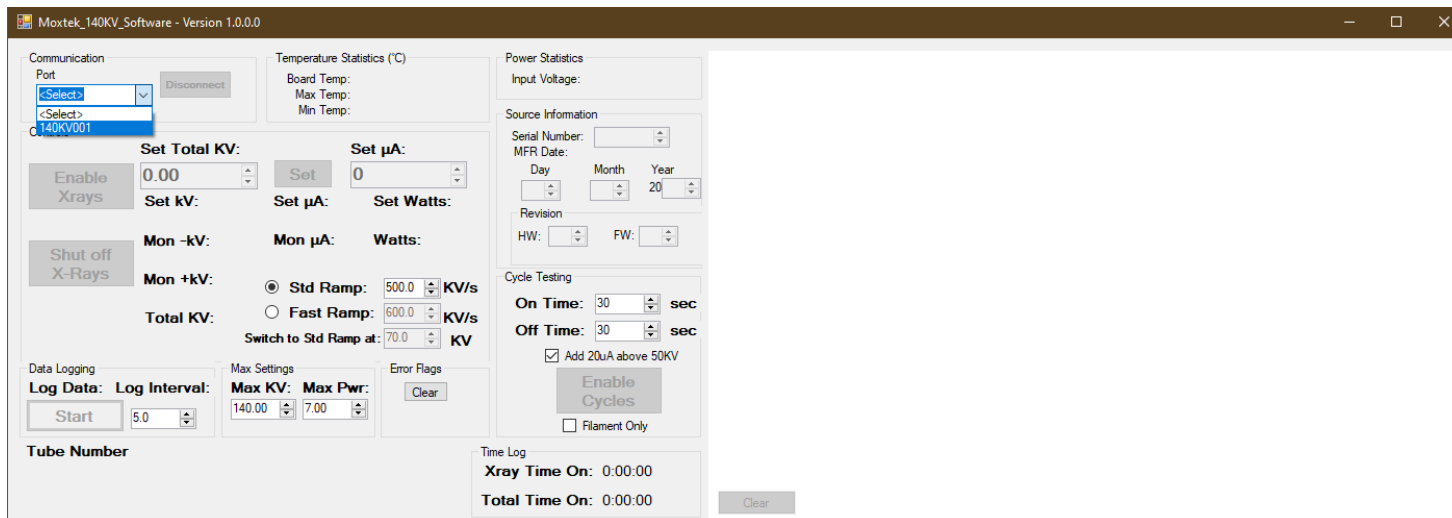


Figure 8: Communication Port Section

10. Once the connection is successful, it will populate certain fields with information about the connected source.

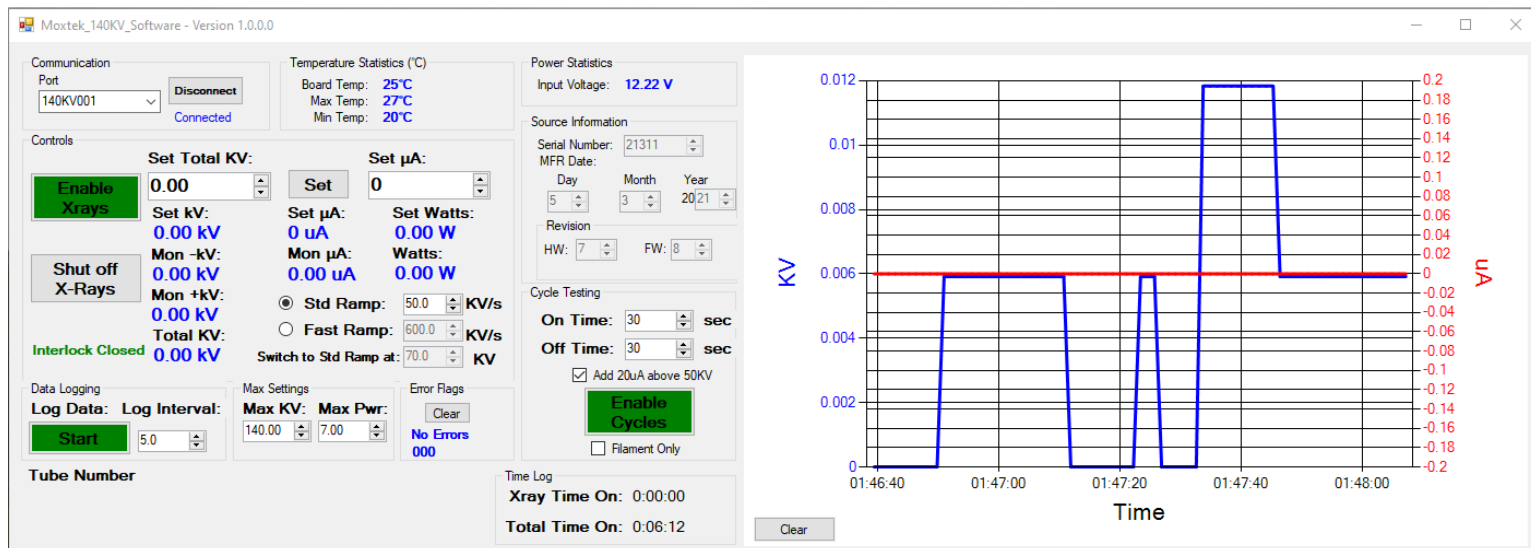


Figure 9: Successful Connection

11. To run the source, click the “Enable Xrays” button, and put the desired values in the “Set Total KV” and “Set uA” boxes. For the first run of the day, please ensure that the “Std Ramp” rate is set to 50 KV/s or less. Once the unit is warmed up, go ahead and set the “Std Ramp” to 140 KV/s for a 1 second ramp time to full power, or check the “Fast Ramp” option, with 600 KV/s and 70 KV for the “Switch” value, and it will ramp to full power in 0.5 seconds.

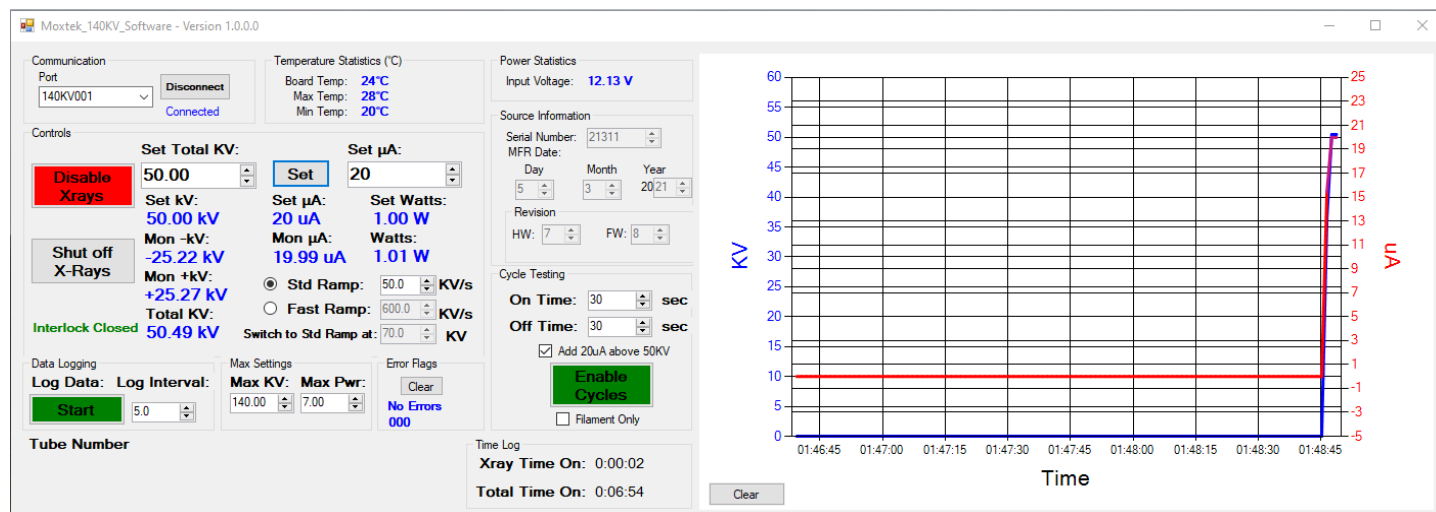


Figure 10: Enable X-rays

(Initial check and warm-up settings)

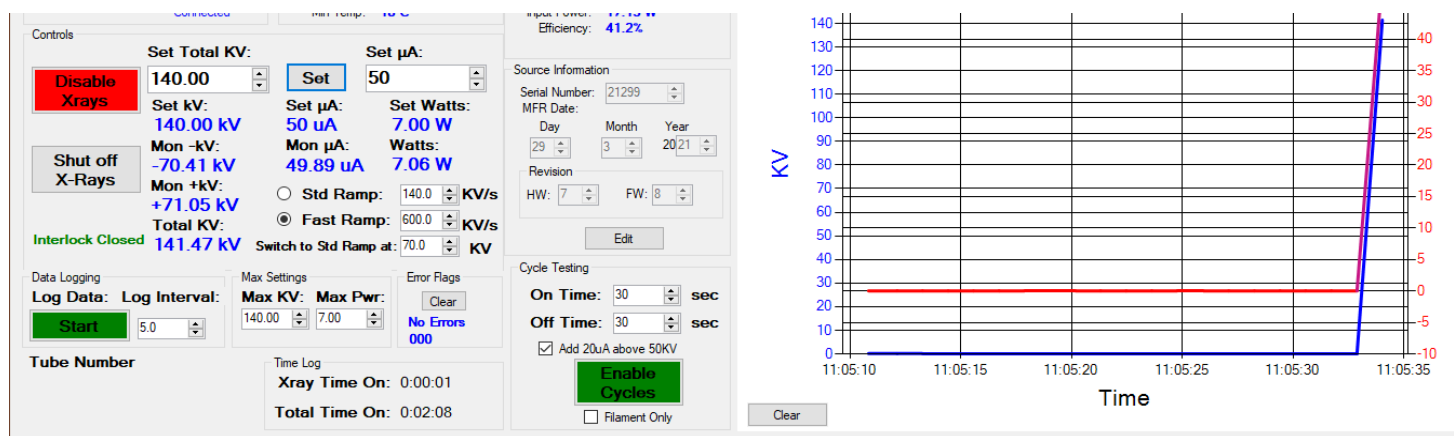


Figure 11: Initial Check and Warm-up Settings

(Full output with 0.5s ramp rate)

****NOTE**** There are additional software settings that are available.

The “Data Logging” section allows for creation of a text file that will populate with all the current settings and readings at chosen “Log Interval” you choose. Log periods are set to default to every 0.5s, but can be changed to any value between 0.5s to 3600s if desired.

The “Cycle Testing” section allows user to automatically turn the X-rays on and off at a specified duty cycle. The max “On Time” recommended is 30s. The corresponding minimum recommended “Off Time” is 30s. The “Add 20uA above 50KV” box should remain checked, and the “Filament Only” box should be blank.

If more details on these settings are needed, contact Moxtek.

Suggested Settings and Operation Parameters

- The source should be run between 10KV and 140KV.
- No beam current should be applied, unless the source is at 50KV or higher.
- 20uA should be the maximum current setting when below 100KV.
- If the source has been sitting overnight, or for about 24 hours, set the “Std Ramp” to 50 for the initial start-up. After it has been running, the “Std Ramp” can be set to 140.
- At full output, the source should be set to 140KV and 50uA. 50uA should be the maximum current setting for the source at any KV level.
- Active cooling is recommended to keep the temperature down on the source.