

Xinray Tube Operation Procedure

The purpose of this operation procedure is to assist the user to make connections and operating the Xinray linear tube properly. If there is any question, please let Sigen know.

1. To make electrical connections

1.1 Connect the gate to a PS350 power supply using SHV cables and 10 kOhms series resistor box. Ground the power supply to the tube housing. Establish a GPIB connection between the power supply and the PC.

1.2 Connect one of the Varian Ion pump controllers to a Keithley 2000 Multimeter using BNC cables. The Multimeter must be set to read DC voltage. Ground the Multimeter to the tube housing. Establish a GPIB connection so tube pressure can be monitored.

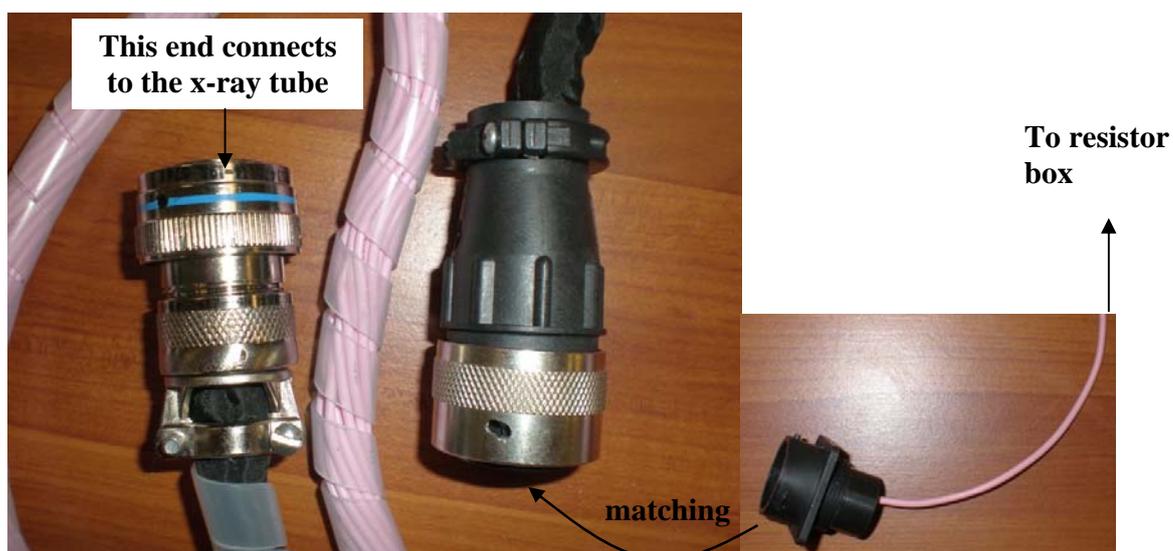
1.3 Connect a BNC cable from the IMON on the SPE to an Oscilloscope, or a Keithley 2000 Multimeter. If using a Keithley 2000 Multimeter, ground the Multimeter to the tube housing. Establish a GPIB connection so tube current can be monitored.

1.4 Connect anode power supply to R24 FT on the tube using R24 cables. Ground the power supply to the tube housing. Establish a connection for the PC to control the anode power supply (optional).

1.5 Ground the tube housing to the in-house grounding bar.

1.6 Connect the desired source to a 10 kOhm resistor box with SHV or MHV cable. For tubes with a 19-pin feedthrough, see the following for instructions to connect to the cathode.

Connect one end of the white 19-conductor cable as shown in the left picture below to one of the feedthroughs (FT1-4) depending on which source to be tested. Leave the other end of the cable open at this step.



Insert the metal pin of the white single-conductor wire assembly into the back of the black plastic connector as shown in the picture above. Choose correct source for testing

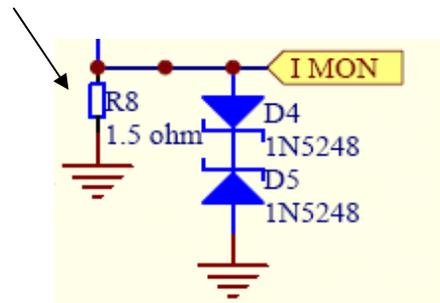
and push pin into hole until a small click is heard and the pin cannot be pulled out. (Use the contact extraction tool provided to extract the pin if it's inserted to the wrong hole). The other end is connected to the resistor box with a MHV connector.

2. To make the SPE box connections

2.1 Connect the cathode using MHV cable and 10 kOhm series resistor box to the CATHODE input.

2.2 This step is only to verify the trigger signal is operational and stable. Connect the Digital output of the USB NI-DAQ card to the TRIG input of the SPE box via a BNC cable. Use a T-connector to connect this to channel 2 of the Oscilloscope. Also make sure the Oscilloscope is triggered to channel 2, and the trigger level is between 2-3 V.

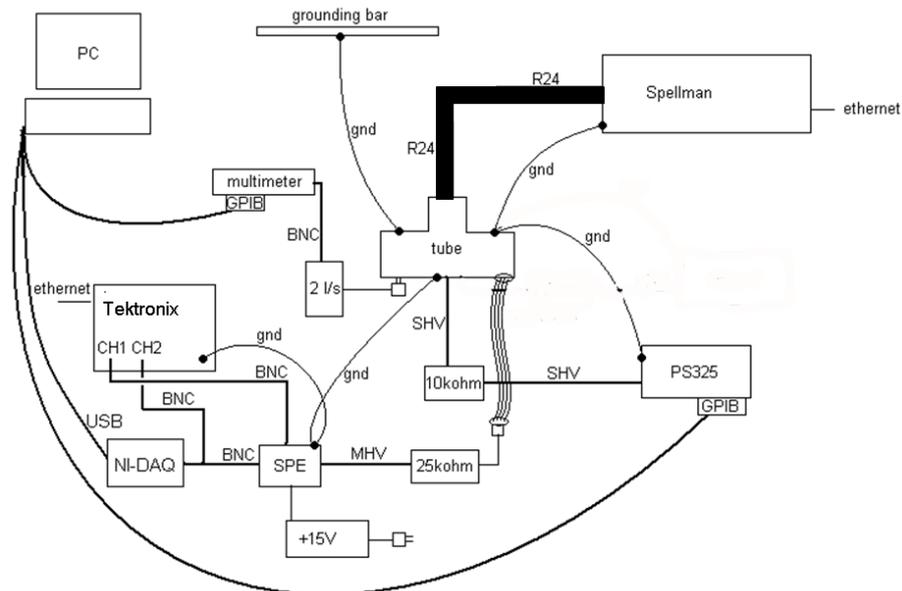
2.3 Or connect the I MON (0.67 A/V) output to the Keithley 2000 Multimeter and make sure it is triggered. BE SURE the 1.5 Ohm resistor in SPE must be removed from the SPE if using a Keithley 2000 Multimeter to monitor the current.



2.4 Plug in the DC 15V power supply for the SPE and turn it on.

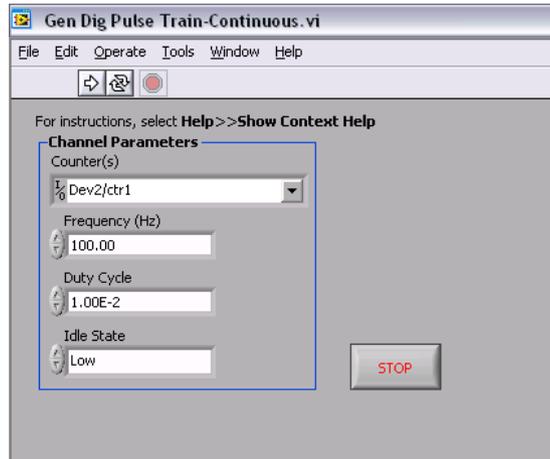
2.5 Ground the housing of the SPE box to the tube, as well as the ground input of the Keithley 2000 (if used). Ensure all other ground connections are still intact.

2.6 Double-check all connections according to the following schematic:

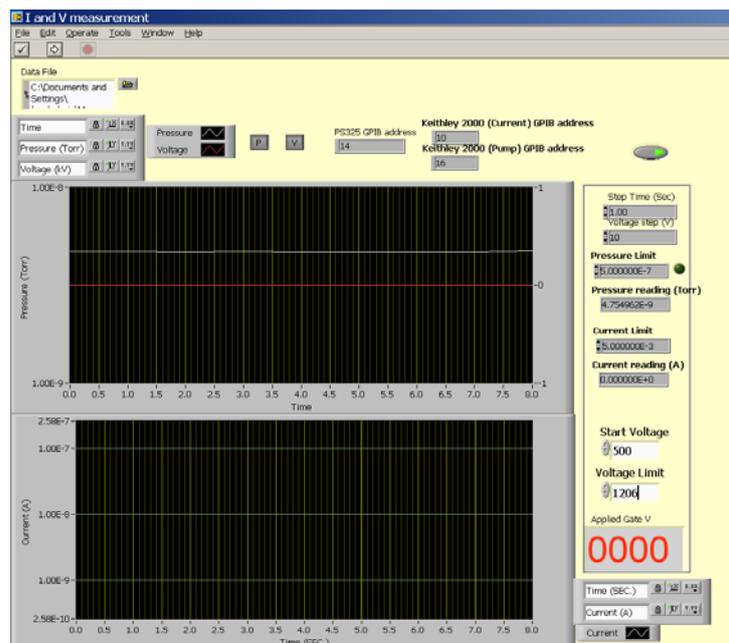


3. To setup the controlling Labview programs:

3.1 Below is a screenshot of **Gen_Dig_Pulse_Train_continuous.exe**, the program used for generating a continuous pulse. Open the program and fill in the parameters according to the snapshot below. If the frequency and/or duty cycle are altered for testing, PLEASE BE AWARE that this tube is ONLY specified to run at $\leq 5\text{mA}$ cathode current, 100kV anode voltage, 100 μs pulse durations & 1% duty cycle per emitter. Please consult with Sigen or XinRay engineer prior to running the tube at parameters that exceed these settings.



3.2 Below is a screenshot of the Labview controlling program of **SPE_PS325_DMM2000.exe**, the program used for controlling the emitter gate voltage and monitor the pressure. Open the program and fill in the parameters according to the snapshot below. PLEASE refer to 3.11 of IV_data.xls to determine the "Voltage Limit" for each emitter up to 5mA (100us pulsed, 1% duty cycle operation). Once again, PLEASE BE AWARE that this tube is ONLY specified to run at $\leq 5\text{mA}$ cathode current, 100kV anode voltage, 100 μs pulse durations & 1% duty cycle per emitter. Please consult with Sigen or XinRay engineer prior to running the tube at parameters that exceed these settings.



3.3 **PS325 GPIB Address:** Enter the address for the gate power supply under “PS GPIB address” and that for the Multimeter reading pressure under “Pump GPIB address”.

3.4 **Keithley 2000 GPIB Address:** Enter the address for the Ion Pump and Current measurement devices.

3.6 **Step Time:** 1 Sec

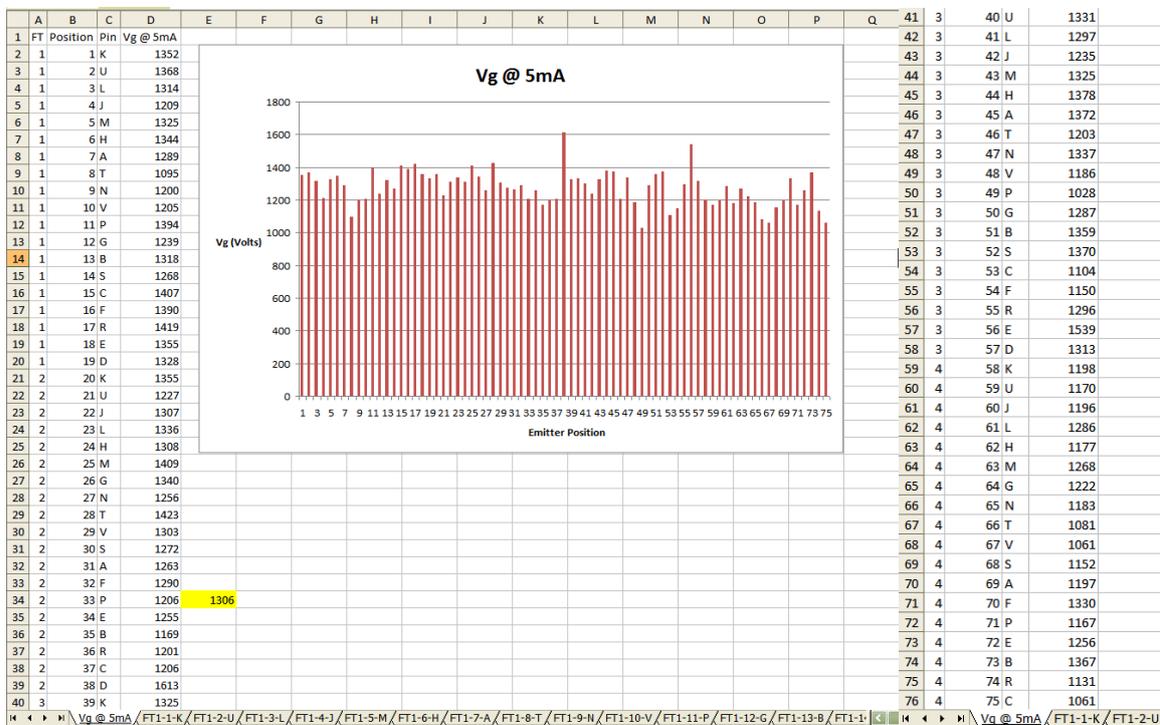
3.7 **Voltage Step:** 10-50 V

3.8 **Pressure Limit:** 5.0E-7 Torr

3.9 **Current Limit:** 5.0E-3A; Current (mA) = Reading in CH1 (mV) x 0.67 (A/V)

3.10 **Start Voltage:** 500 V

3.11 **Voltage Limit:** Refer to the following IV_data,



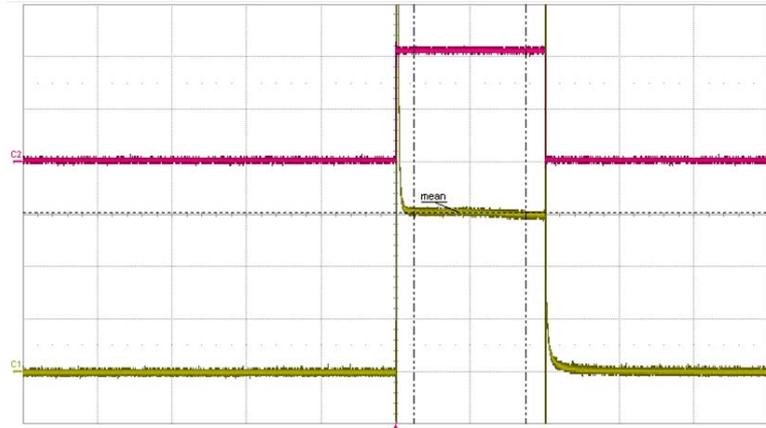
4 To run the programs

4.1 Start up the anode power supply and set the high voltage to $10 \leq x \leq 100$ kV.

4.2 Run the **Gen_Dig_Pulse_Train_continuous.exe** program. Ramp the anode to 100 kV and watch the ion pump controller to make sure the pressure is stable and below 5.0E-7 Torr. Once this is achieved, to proceed.

4.3 Run the **SPE_PS325_DMM2000.exe** program. The program will begin ramping the gate voltage to the set current level. Current (mA) = Reading in Ch1 of Oscilloscope (mV) x 0.67 (A/V). If using Multimeter 2000, please ensure at this time that the Multimeter is triggering properly and the current reading on the Keithley 2000 is reasonable. Please note: The best

way to verify the trigger width and pulse waveform of the emitter is to replace the 1.5OHM resistor on the SPE and connect IMON to Channel1 on an oscilloscope and TRIG to Ch2. Once the desired current has been reached, the oscilloscope should look like this:



4.4 Set the **Voltage Limit** to 0, and then stop the program. Please note: It may be helpful to save a screenshot of the SPE_PS325_DMM2000.exe program for future reference.

5. Appendix

(To define the cathode pixel positions)

As shown in the tube cross-section image below:

Cathode pixel 75 is located 38.50mm from the edge of the x-ray tube, and 30+38.50 mm from the edge of the stand. The 75 cathode pixel positions are numbered from 1 to 75 and the pitch between two adjacent cathodes is 4mm. Each cathodes focal spot position can be located by aligning the pinhole/collimator for each cathode pixel position directly along the center of the x-ray window. Please use the Combo Square to define each pixel position. And use the image detector to further define the pixel position.

If use a collimator, after roughly defining the pixel position using the Combo Square, adjust the collimator holder though using x, z, tilt and rotation stages, together with using a image detector to align the position of x-ray beam.

