TPC CATHODE HV

1. Introduction

The TPC cathode high voltage is supplied by a Glassman 100 kV power supply Model # PS/WK100N6CTS30. In the model number, 100N means 100 kV negative polarity, CT means an optional current trip capability and S30 means “slow turn on” with a ramp to maximum of 30 seconds. The power supply in use is mounted in Rack Row 2A3 on the platform. The VME control crate for the cathode is mounted directly below the power supply. The canbus address for this crate is 57.

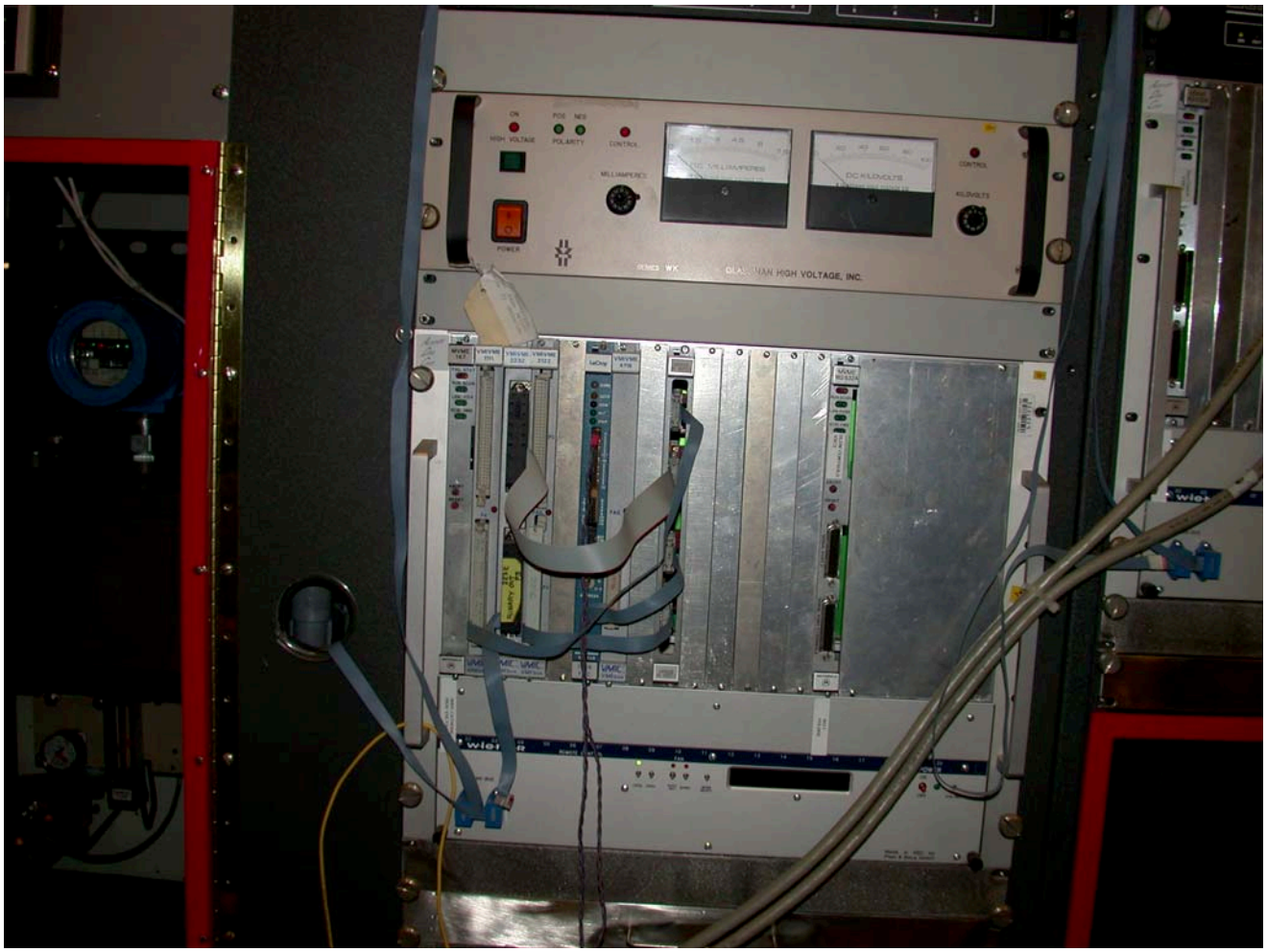


Figure 1

The back of the power supply is shown below:

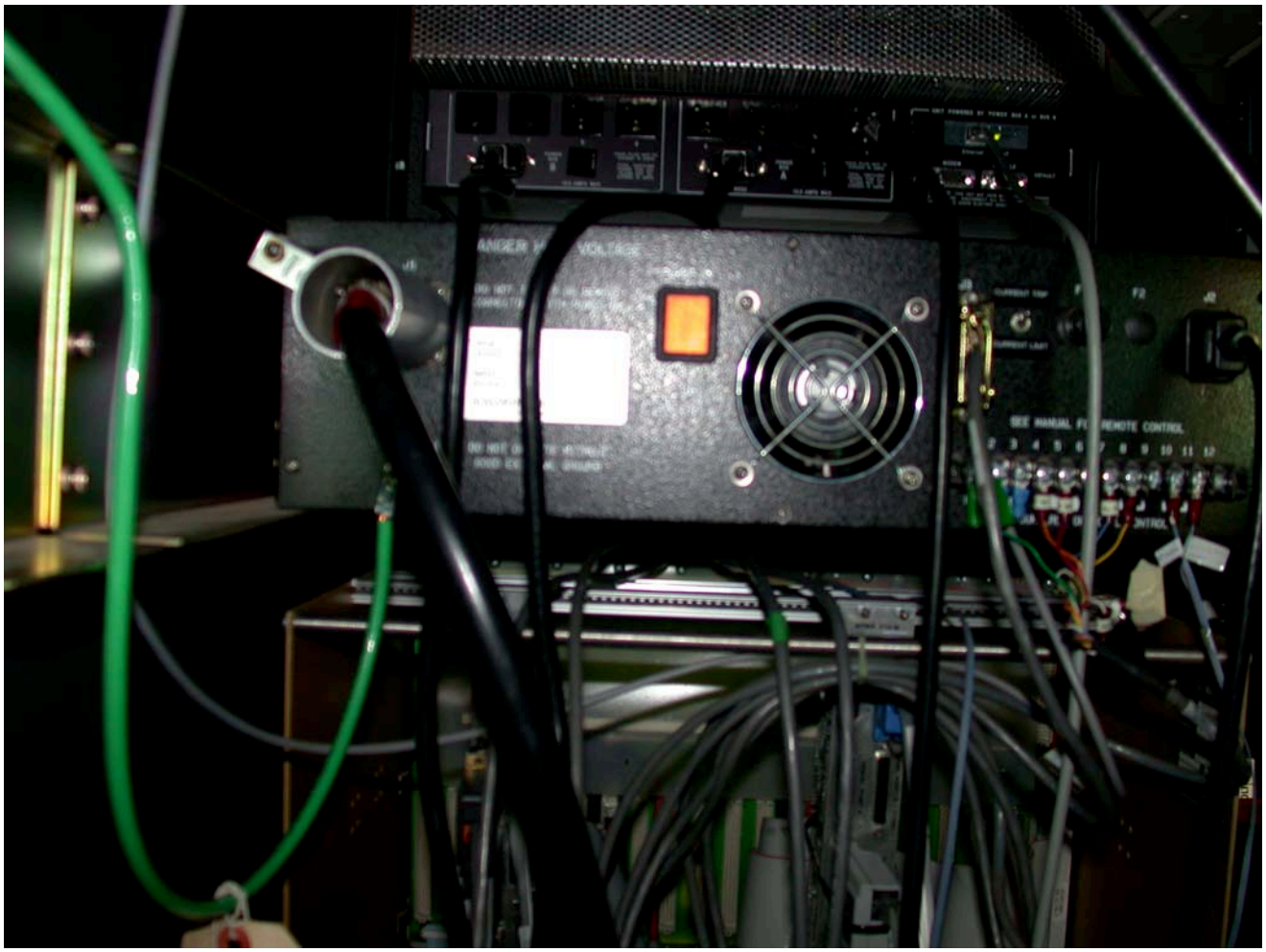


Figure 2

The slow controls for the power supply were developed by Tom Trainor and Greg Harper at the University of Washington. The power supply has been modified slightly to provide some control signals – the modifications are well documented in the schematic that is kept with the manual. We have one spare power supply that is identical to the one in use. It is kept on the platform in Rack row 2B5. The spare was used briefly a few years ago when we were checking for the source of some noise on the field cage, so it is known to work properly.

2. Hardware Connections

The main HV cable runs from the power supply through the platform cable tray up to the TPC wheel near sector 13 on the east side of STAR. The cable is a large diameter black HV cable with a red tape stripe every few feet. The cable travels down a channel at the outer radius of the field cage and makes the connection to the central membrane via a banana plug connector – the cable also has a connector that screws onto a fitting at the TPC wheel to secure it. At the power supply (see Fig 2) the cable screws into the connector on the back of the supply. The connector is covered with an aluminum tube that is also screwed to a bracket on the power supply – this is an extra safety measure which was imposed by RHIC – the theory being that it takes a "tool" to actually unplug the connector. (Don't ask me why…). There is also a sealed transition fitting that connects the supplied Glassman cable to the long cable that goes to the TPC face. This transition piece is in the cable tray under the third floor of the platform. It is visible if you stand looking at the back of the Glassman and look up.

In addition to the power cable, a large ground return cable is bolted to the TPC face on the east side and run to the inside of the Rack 2B3. The rack is then bonded to the ground post of the power supply.

Also visible in Fig 2 are the remote control cables for the power supply: a terminal strip at the lower right, and above that a DB25? connector with a bronze hood. Just to the right of the connector is a small toggle switch – this is the selector for the current trip option (it should be up!)

To allow for a remote AC power cycle of the Glassman it is plugged into a remote power switch accessible via telnet. The RPS is mounted in Rack 2A3. The internet address is

rps2.starp.bnl.gov and the Glassman is in plug #1.

See the section on RPS for the instructions and password.

3. VME controls

The VME crate for controlling the cathode HV is shown in Fig 1. From left to right, the modules are:

1. VME processor – scserv port 9005
2. VMIVME-1111 64-Bit Differential Digital Input
3. VMIVME-2232 32 Channel Relay Output Board
4. VMIVME-3122 16 Bit A to D Converter
5. Lecroy 1176 TDC
6. VMIVME-4116 8 Channel 16 Bit Analog Output
7. Homemade connection interface board

Figure 2 also shows a second VME processor in the crate, but that has been removed to become a spare. It was for the pulser originally.

We have manuals and one spare module each for all these boards. The connections from these modules to the Glassman are well documented in the paper work that came from Greg Harper (U of Washington). In addition, the hookup of the terminal strip on the back of the Glassman is as follows: (plus see pg 54 of my notebook 1)

Terminal connector TB1 on back of Glassman:

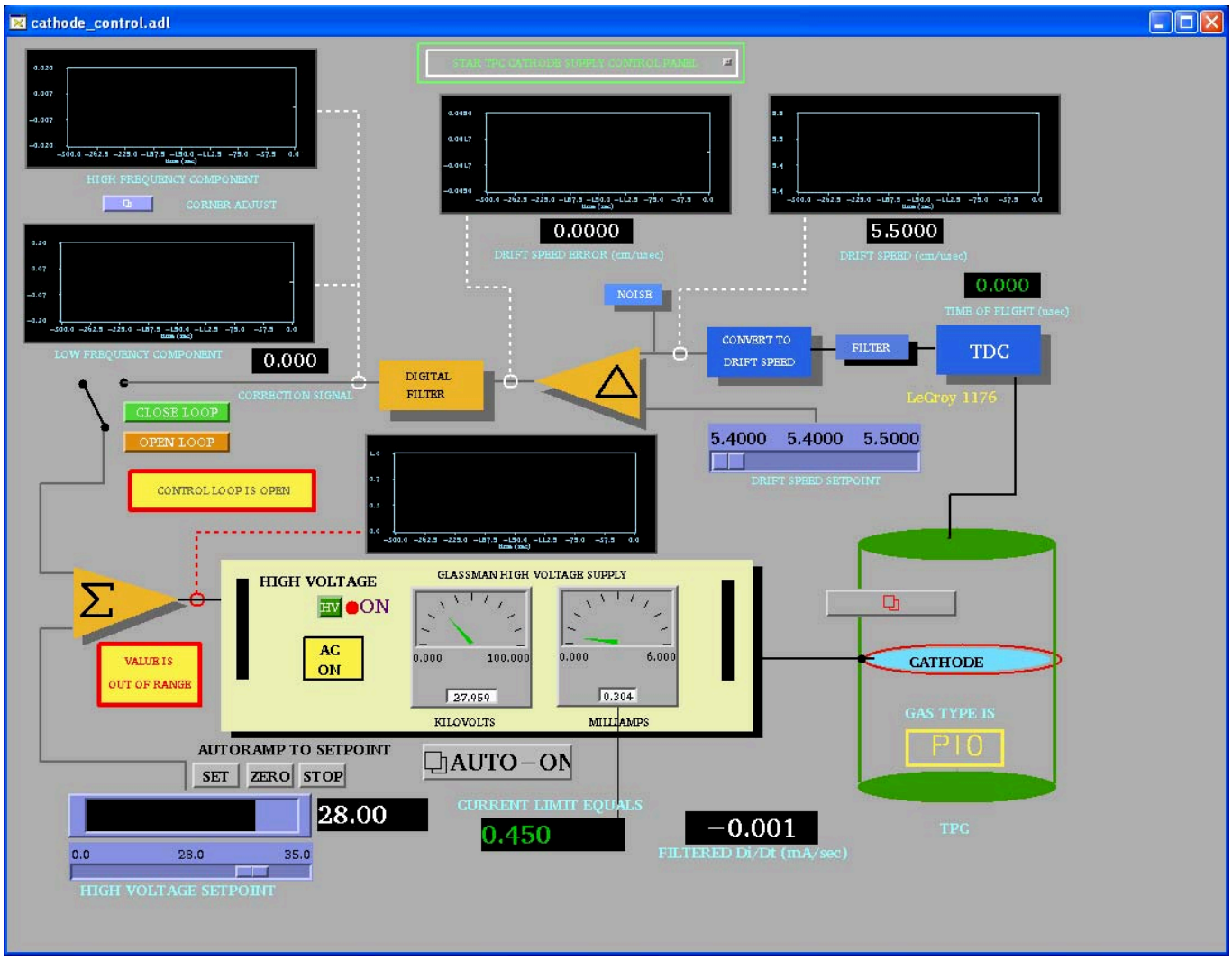
Terminal	Cable
1	#1 Green
2	Red from TPC interlock
3	Black (common) from interlock
4	#4 Orange
5	#5 Red
6	Not connected
7	#7 Blue
8	#8 Yellow
9	Not connected
10	HV enable
11	HV enable common

2 & 3 are the interlock permissive cable from the TPC AB interlock system in rack 2A8. This signal will turn off the HV in case of a STAR global alarm, or in case of a gas system problem.

10 & 11 were added by Mike Cherney and me in 1999 to allow for a remote reset of the Glassman (see below for slow controls interface.)

4. Slow Controls GUI

The main control GUI for the cathode is available from the TPC top level GUI. The cathode GUI looks like:



The picture shows the Glassman set to the canonical value of 28 kV. Note that the voltage readback shows 27.959 kV – this difference has always been there and varies between -30 and -40 volts and is probably due to a mis-calibration of the slow controls. We have run this way for many years. Note also that the total current draw for the supply is .305 milliamps and reflects the ~76 microamps down the 4 resistor chains. The current trip limit is .450 milliamps (see below for where this is set). Note also that the AC is on and the HV is “ON” as indicated by the red light. (This is really a HV enabled light.)

The rest of the graphs and indicators on the GUI are no longer used. They were developed to run the TPC in a constant drift velocity mode, not a constant voltage mode. The theory was to turn the laser on automatically every ~ hour and use a signal from the anode wires that came from the laser flash off the central membrane. This “stop” signal went to the TDC in the VME crate and the program would raise or lower the HV to bring the measured drift time back to the desired drift time (and hence velocity). The laser was then turned off automatically. This was a very elegant way of running in theory (and actually worked a few times) but it was ultimately defeated by all the other “background” signals in the chamber.

Under normal running conditions, the Glassman stays on and enabled – the detector operators merely ramp the HV up to the final value using the autoramp program after the RHIC beams are ready for physics running. The autoramp program is also used to turn the HV off before the beams are dumped. The autoramp program is a separate GUI available by clicking on the “AUTO-ON” button on the Glassman GUI:

The autoramp program ramps the HV to 10 kV, checks the four field cage currents, then ramps to 20 kV, checks the currents, and then ramps to 28 kV and checks the currents one more time. If the currents are all equal, within specs, the cathode is declared ready for physics.

If the autoramp program detects a problem with the currents it will automatically ramp the voltage back to 0 and put up a “trouble” message for the operator. They should then call an expert. The autoramp program runs in a separate VME processor from the cathode processor. It currently runs in a processor in the DAQ room (stargate.starp.bnl.gov).

Note that if the cathode voltage is on and it is necessary to reboot the autoramp processor, the voltage will reset to zero.

The autoramp GUI also has a “stop” button if the operator wants to interrupt the ramp, and a reset button to bring the program back to a known state.

5. Initial turn-on of the Glassman

After a long shutdown, the cathode HV system should be turned on as follows:

1. Make sure the RPS2 is on – log into RPS2 and check that plug 1 is on.

2. Turn on the AC rocker switch on the Glassman. (Note – this AC switch can only be turned on at the Glassman. The GUI button that shows AC off or on is only an indicator, not a switch.)

3. Turn on crate 57 and wait for the processor to boot up. To be sure the boot process finished, you can watch the boot by telneting to scserv 9005.

4. Check the status of the TPC interlock – cathode HV enabled output should be green (OK) or flashing green (override OK).

5. Using the GUI or the button on the front of the Glassman push the HV on button. Check that the red “HV on” light is on.

6. Check that the green negative polarity light is on and that the red control led above the kilovolts pot is lit. (The power supply must not be in current control mode.)

7. Use the slider on the GUI to set 1 kV and push the “set” button – the supply should ramp to 1.0 kV and show some current on the readback. Set the slider back to 0 and push set. The supply should ramp to 0.

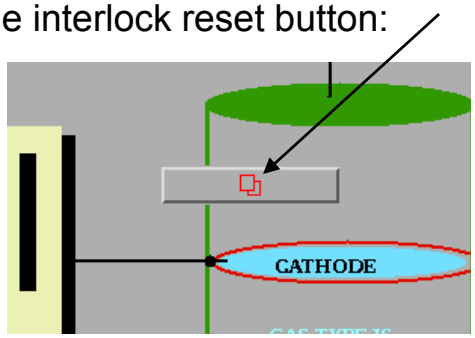
6. Interlocks and Trips

The Glassman HV is enabled by an output from the TPC Allen-Bradley interlock system. The main AB system and indicator panel are in the gas mixing room. There is also a readout of the panel available via slow controls from the top level TPC GUI. The HV enable can be dropped for multiple reasons: smoke or fire on the platform, methane detected by the platform methane sniffer, no air flow through the IFC region, TPC gas system problems or shutdown, or methane detected in the outer TPC insulation volume. In this case the green “Cathode HV enable” indicator on the AB panel will go out and the red “Cathode HV off” button will light and the HV will be disabled. To restore the HV:

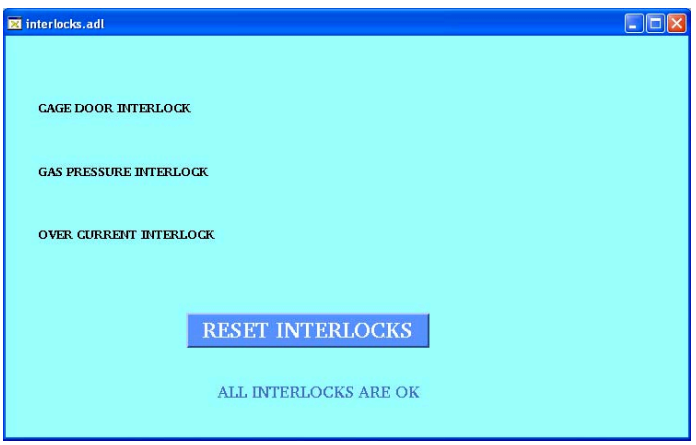
1. Find the source of the alarm and clear the problem.

2. Once the alarm condition has been cleared, go to the gas mixing room and push the green “Cathode HV Enabled” button – it should light if the reason for the alarm has been cleared. Note that the interlock will NOT clear by itself – interlocks stay latched off until operator action is taken.

3. On the Glassman GUI click on the interlock reset button:

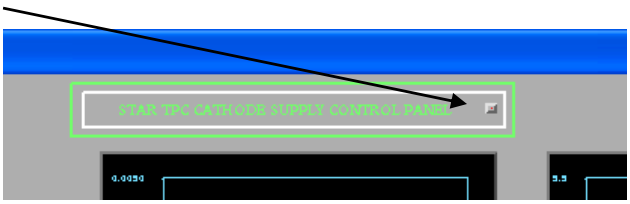


4. This brings up the interlock panel – sometimes a red box will pop up also telling you to “check the interlocks”. Click on “Reset Interlocks” and kill the window.

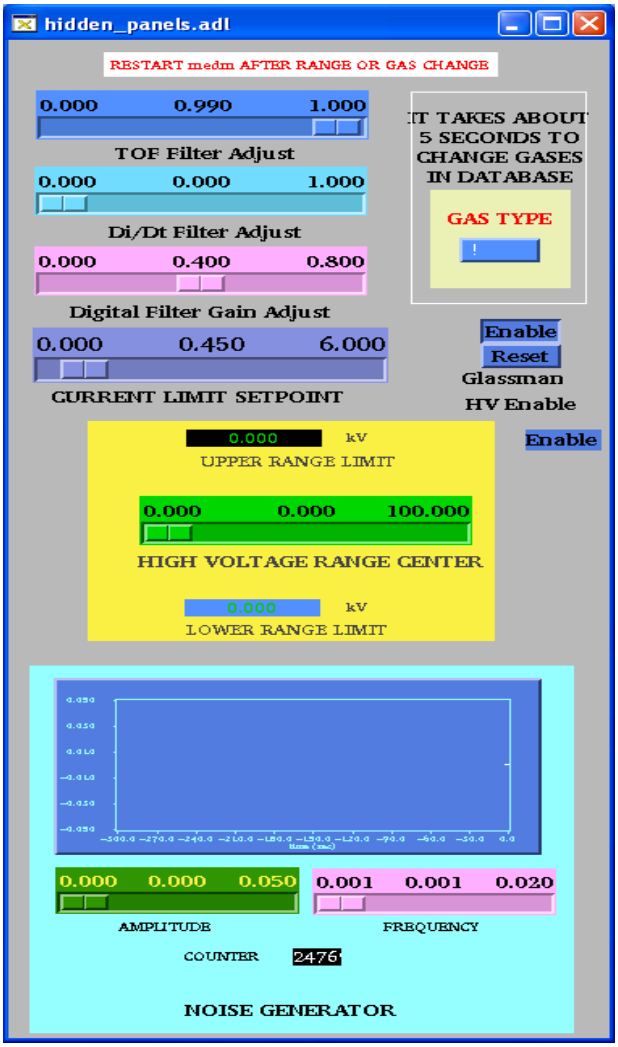


5. On the main Glassman GUI check if the High Voltage indicator is off or on – if off, click on the green HV button to re-enable the HV. You should then be able to raise the HV again.

Rarely, usually due to a bad RHIC abort, the cathode HV will trip on current overload. (Recall the trip limit is .450 milliamps). To clear this trip you need to bring up the super secret, operators only GUI. On the main Glassman GUI find the small button labeled “STAR TPC Cathode Supply Control Panel” near the top of the main GUI:



This brings up the settings page:



Most of the settings on this page refer to the unused feedback mode. The one setting that might be used is for the current limit set point (set at 0.450). To reset a current trip, push the Glassman HV Enable “Reset” button and then push the “Enable” button.

Close this window and check the main Glassman GUI. If the HV indicator is off click the green HV button to re-enable the HV. You should then have control again. After a current trip I usually check the field cage currents at 2 kV to make sure there was no damage to the structure.

6. Troubleshooting

In general the cathode HV has been a very reliable system. I rarely have to reboot the processor during a run. Usually operator problems are connected with the autoramp processor rebooting or crashing, but for run 8 it seemed very stable. We think this may be because ITD has not scanned our systems during the run. I recall one strange episode where the Glassman got into a funny state – see pages 123 & 124 in Notebook 1.

If the cathode voltage seems to be dead, try the following:

1. Check the TPC interlock system to make sure the Cathode HV is enabled. Note that one subtle problem occurs when the methane content in the insulation gap goes above 18% LEL – the AB interlock system will drop the permissive, but there will be no alarm like when the main gas system alarms. The permissive will stay latched off until it gets reset – even if the methane goes back down. This has happened multiple times.

2. If the AB interlock is enabled, check the HV status on the GUI. If it is off, first clear the interlock on the sub-GUI and then click on the HV button.

3. If it still won't come on, go to the super secret sub-GUI and use the reset and then enable buttons. Try to turn on the HV again on the main GUI.

4. If still no, log into RPS2 and power cycle the Glassman.

5. If still no, power cycle crate 57 - wait for the processor to reboot and try again.