

## Notes on Glassman High Voltage Power Supply Model PS/NV-20PN15

The following applies directly to the PS/NV-20PN15 which according to Glassman was an OEM model used in an ion implanter. It has a dual output of 0 to +/-20 kVDC at up to 15 mA. As configured for the original application, it runs in tracking mode whereby the positive and negative outputs are controlled by a single 0 to 10 VDC input without an adjustable current limit. But the two supplies can be separately controlled with fully variable output voltage and current requiring only very minor wiring changes. Much of the information should also apply to other similar OEM models and with obvious modifications, to Glassman's standard ER series of high voltage power supplies.

Note that the top and bottom views are virtually identical. Flipping between them shows almost no change for the driver boards and polyethylene HV box (though of course, they are set up for opposite polarities).

I found some stickers inside:

**Driver Board:** (Assembly, Power Supply Driver) - APD-ER-1-C1-HV.

**HV Board:** (Assembly, High Voltage) - AHV-ER-20P15-HV.

**HV Box:** (Enclosure) - ENCL-ER-02.

So, the PS/NV-20PN15 is really a combination of slightly modified versions of the PS/ER-20P15 and PS/ER-20N15 in one cabinet.

While they have rear panel wiring information for the standard ER series power supply, it doesn't apply to this OEM model which has a strange connector rather than a terminal strip for external control.

### Safety and Disclaimer

This equipment is potentially lethal both from the high voltage output as well as the off-line switching power supply(s) inside. It is imperative that all high voltage safety guidelines be followed when using the power supply and in addition, all line voltage safety guidelines be followed if working inside for testing or repair. See the document: Safety for more information.

The author of this page and Glassman High Voltage will not be held liable for any direct or consequential damage, injury, or death that might occur as the result of the use or misuse of the information in this document.

## Control Connections

These have been determined by educated guesswork with confirmation where possible.

### Positive output high voltage supply (top in cabinet):

J3 (top)	J1 (rear)	Color	Description
1	Not used		Goes to J5-12, for front panel V-Pot
2	Not used		Goes to J5-11, for front panel I-Pot
3	Not used		Enable (Leave open)
4	Multiple	Black	Signal Common (Gnd)
5	C	Orange	Voltage Monitor: 0-10 V for 0-20 kV
6	NC		
7	Not used		Current Control: 0-10 V for 0-15 mA
8	F	Yellow	Voltage Control: 0-10 V for 0-20 kV
9	M	Brown	Current Monitor: 0-10 V for 0-15 mA
10	R	Green	10 V Reference for External Controls
11	d	Red	Interlock Relay (24 V): Gnd to Enable HV
12	Not used		Goes to via near J3, function unknown

### Negative output high voltage supply (bottom in cabinet):

J3 (bottom)	J1 (rear)	Color	Description
1	Not used		Goes to J5-12, for front panel V-Pot
2	Not used		Goes to J5-11, for front panel I-Pot
3	Not used		Enable (Leave open)
4	Multiple	Black	Signal Common (Gnd)
5	W	Orange	Voltage Monitor: 0-10 V for 0-20 kV
6	NC		
7	Not used		Current Control: 0-10 V for 0-15 mA
8	F	Yellow	Voltage Control: 0-10 V for 0-20 kV
9	f	Brown	Current Monitor: 0-10 V for 0-15 mA
10	Not used		10 V Reference
11	d	Red	Interlock Relay (24 V): Gnd to Enable HV
12	Not used		Goes to via near J3, function unknown

### Notes:

1. Black goes to rear connector J1 pins H, I, L, S, V, a, j. There are also a pair of green wires on E and Y which go to Earth ground.
2. R34 on driver PCB must be removed to enable the Current Control to function. This resistor was added specifically for the 20PN15 to force the current limit to be at the maximum without external wiring. A 330K ohm 1/4 watt resistor should be installed for R30 keep this signal from floating but as long as there is a pot permanently attached to J3-7, it won't matter (and installing that resistor requires removing the driver PCB. This is only really necessary for the HV power supply restorer purist!).

3. “NC” means nothing appears to be connected to the pin - An ohmmeter check shows open to anyplace tried on the PCB but this is not 100 percent confirmed as there could be a high impedance connection via isolation diodes or something. I did not check the underside of the PCB.

4. “Not used” means there is no connection to the rear J1 connector but there is a connection to the PCB.

There are no other external connections to either of the J3s or any other internal connector, or interconnections between the two power supplies besides the common power input.

However, there is a jumper between J5-9 and J5-10. This is part of the interlock chain which also goes to J3-11.

## **Conversion from 208/230 VAC to 115 VAC**

This procedure has been confirmed to work at low power. It requires very few changes to the AC wiring, all easily reversible. However, it does require replacing the fan with one rated for 115 VAC. The original 208/230 VAC fan does run at 115 VAC but doesn't move much air (it's very quiet though!). There's a possibility that fan replacement could be avoided by using the primaries of one of the low voltage power transformers as a stepup winding to power the fan but I haven't tried this.

Note that I have not yet tested 115 VAC operation to the rated specifications of the power supply.

1. Replace the plug on the power cord with one rated for 115 VAC, 15 A (normal 3 prong plug). Brown or black is Hot (brass screw), blue or white is Neutral (silver screw), green or green/yellow is Ground (green screw).

2. Replace the fuse in the Hot (F2, brown or brown/white wires) with 12 A slo-blo type. (A normal fuse will likely blow upon power-on due to the charging surge of the main filter capacitors on the driver boards.)

3. Remove and bypass the fuse in the Neutral (F1, blue or blue/white). (Installing a 30 A slow blow fuse is also probably just about as safe since F2 would always blow long before F1 but wouldn't meet the NEC Code.)

4. Replace the fan with a similar model rated for 115 VAC. Air should blow in.

5. Move the 2 jumpers on each driver board from the 230 to the 115 V position. This changes the input to the main MOSFET drive from a bridge rectifier to a doubler and also puts 115 VAC across one primary of the low voltage power transformer. There is also a fuse on the driver board probably to the low voltage power supply transformer that might also need to be replaced (though I've been testing with the original fuse and had no problems so far).

6. Rewire the main power switch to put the indicator lamps in parallel instead of series. On the switch:

- Interchange the blue wire with the brown wire.
- Interchange the blue/white wire with the brown/white wire.
- Add lugs to enable the white wire and brown/white wire to be jumpered together.

7. Make a note on the model sticker that the supply is wired for 115 VAC. VERY IMPORTANT!!!

## Initial Testing

It's probably best to test only one supply at a time. Unplug the power and control connectors from the power supply not being tested to eliminate any possibility of damage to it. Only two connections are required to enable the supply to power up as originally set up. These are on the rear connector (J1) or more directly to the driver board connector (J3):

- A 10K pot between J3-10 (CW-end) and J3-4 (CCW-end) with its wiper to J3-8 for the Voltage Control.
- J3-11 to J3-4 to enable the supply.

If R34 has been removed to enable the Current Control to function, then in addition:

- A 10K pot between J3-10 (CW-end) and J3-4 (CCW-end) with its wiper to J3-7 for Current Control.

No special load is needed to just check for basic operation but a high voltage probe or stack of high voltage resistors to extend the range of your VOM or DMM should be used for both personal safety and that of the meter. If the original HV cable isn't available, a well insulated wire or the stack of resistors can be inserted into the HV connector - it needs to go in about 6 inches to make contact. A multimeter can be put on the voltage monitor output (J3-5).

## Without Current Control:

1. Make sure the pot is fully counterclockwise so that the output voltage should be 0 and apply 115 VAC power. The fan and indicator lights should come on.

2. Turn the pot *\*slowly\** to see if there is any output - it should respond immediately. If there is no change, turn off power and check your connections. The pot should vary the voltage smoothly from 0 V to the maximum rated voltage of the supply, 20 kV (with appropriate polarity) for the model PS/NV-20PN15 (or PS/ER-20P15 or PS/ER-20N15).

3. The voltage monitor output should track the actual high voltage output on a scale of 0 to 10 V for 0 to 20 kV.

To check the current monitor and Current Control, turn off the supply and replace the HV probe or resistor stack with a high voltage load. Just to see if these are working at all, a load that will allow a small current to flow with some modest voltage is all that's needed. A pair of 500K, 5 W resistors in series with the voltage set for 1.5 kV will result in 1.5 mA.

4. Put the multimeter on J3-9. 0 to 10 V corresponds to 0 to 15 mA. 1.5 mA should read out as 1 V. Set the pot to 0 and turn on the supply.

5. Adjust the Voltage Control for a reading of 1 V. Check that the output voltage is 1.5 kV (either with a high voltage probe or via J3-5).

## **With Current Control:**

1. Make sure both pots are fully counterclockwise so that the output voltage should be 0 and apply 115 VAC power. The fan and indicator lights should come on.
2. Turn each pot *\*slowly\** to see if there is any output - there should be little or none because the current limit will keep the voltage from rising much above 0.
3. Set the Current Control to about 10 percent (1 mA).
4. *\*Slowly\** turn the Voltage Control. The output voltage should respond immediately. If there is no change, turn off power and check your connections. The pot should vary the voltage smoothly from 0 V to the maximum rated voltage of the supply, 20 kV (with appropriate polarity) for the model PS/NV-20PN15 (or PS/ER-20P15 or PS/ER-20N15).
5. The voltage monitor output should track the actual high voltage output on a scale of 0 to 10 V for 0 to 20 kV.
6. To check the current monitor and Current Control, turn off the supply and replace the HV probe or resistor stack with a high voltage load. Just to see if these are working at all, a load that will allow a small current to flow with some modest voltage is all that's needed. A pair of 500K, 5 W resistors in series with the voltage set for 1.5 kV will result in 1.5 mA.
7. Put the multimeter on J3-9. 0 to 10 V corresponds to 0 to 15 mA. 1.5 mA should read out as 1 V. Set both pots to 0 and turn on the supply.
8. Set the Current Control to 2 or 3 mA. Adjust the Voltage Control for a reading of 1 V. Check that the output voltage is 1.5 kV (either with a high voltage probe or via J3-5).
9. Back off the Current Control. When it goes below 1.5 mA, the output voltage should automatically reduce to maintain the current specified by the Current Control.