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PS27 Tube Power Supply. Installation Instructions.

General

The PS27 is a power supply for tube circuits. It has a dual regulated +/- 150 VDC high voltage supply and a 12.6VDC regulated filament supply. The supply has a heavy duty toroidal power transformer with a dual 120V/ 240V line input. The supply is specifically designed for powering the XM26 electronic crossover network. The XM26 has a total of 8 12AX7 tubes. The supply can also be used for other purposes.

The PS27 regulators are fully short circuit protected and are current limited. The 12.6V output is current limited to 1.5 A and the 150 V supplies are limited to 70 mA each.

A relay driver is included for driving a signal relay that enables the outputs of the equipment to be powered. Drivers for Light Emitting Diodes are provided that can drive 3 LED Indicator lights.

Power Supply Sequencing

The power supply sequencing has a dual purpose. The tubes are protecting from power turn on and turn off transients by delayed application of anode voltage. The time delay relay driver enables the delayed turn-on of the output. The output thus becomes active after the tubes are warmed up!

After the power to the PS27 is turned on the 12.6V filament power will become active immediately, but the HV plate supply is not active yet. This prevents damage to the tube cathodes caused by hot spots. After a 10 S delay the HV power is turned on. The internal voltages in the tube circuits take some time to stabilize. After another 10 S delay the output relay will be activated.

At each stage in the sequence the LED indicators will indicate the state of the power supply.

When the power supply is turned off the output relay will be deactivated immediately, and after a time of approx. one tenth of a second the HV supply will be turned off. This gives the relay time to settle, avoiding bad signal transients at the output of the tube equipment.

Parts List

| | | |
|-----|--------------|------------------------|
| R1 | 10K | Cermet trimpot |
| R2 | 100K | 1% Metal film resistor |
| R3 | 1.00K | 1% Metal film resistor |
| R4 | 1M | 1% Metal film resistor |
| R5 | 47K | 1W Power Resistor |
| R6 | 10.0 Ohm | 1W Power Resistor |
| R7 | 1.00K | 1% Metal film resistor |
| R8 | 100K | 1% Metal film resistor |
| R9 | 100K | 1% Metal Film |
| R10 | 47K | 1W Power Resistor |
| R11 | 10.0 Ohm | 1W Power Resistor |
| R12 | 100 Ohm | 1% Metal film resistor |
| R13 | 100 Ohm | 1% Metal film resistor |
| R14 | 100 Ohm | Cermet trimpot |
| R15 | 100K | 1% Metal Film |
| R16 | 1.00K | 1% Metal Film |
| R17 | 1.00K | 1% Metal Film |
| R18 | 1.00K | 1% Metal Film |
| R19 | 100K | 1% Metal Film |
| R20 | 1.00M | 1% Metal Film |
| R21 | 1.00M | 1% Metal Film |
| R22 | 1.00M | 1% Metal Film |
| R23 | 1.00M | 1% Metal Film |
| R24 | 100K | 1% Metal Film |
| R25 | 100K | 1% Metal Film |
| R26 | 100K | 1% Metal Film |
| R27 | 1.00K | 1% Metal Film |
| C1 | 220 uF,200V | Aluminum Electrolytic |
| C2 | 220 uF,200V | Aluminum Electrolytic |
| C3 | 0.22 uF,250V | Polypropylene Film |
| C4 | 33 uF,250V | Aluminum Electrolytic |
| C5 | 0.22 uF,250V | Polypropylene Film |
| C6 | 33 uF,250V | Aluminum Electrolytic |
| C7 | 0.22 uF,250V | Polypropylene Film |
| C8 | 6800 uF,50V | Aluminum Electrolytic |
| C9 | 1000 uF,50V | Aluminum Electrolytic |
| C10 | 1000 uF,50V | Aluminum Electrolytic |
| C11 | .22 uF,100V | Polyester Film |
| C12 | .22 uF,100V | Polyester Film |
| C13 | 22 uF,25V | Tantalum Electrolytic |
| D1 | 1N4004 | Diode,1A 400V |
| D2 | 1N4004 | Diode,1A 400V |
| D3 | 1N4004 | Diode,1A 400V |
| D4 | 1N4004 | Diode,1A 400V |
| D5 | 1N5232 | Zener Diode, 5.6V |
| D6 | 1N5232 | Zener Diode, 5.6V |
| D7 | 1N5232 | Zener Diode, 5.6V |

| | | |
|-----|---------|----------------------------|
| D8 | 1N4004 | Diode,1A 400V |
| D9 | 1N5232 | Zener Diode, 5.6V |
| D10 | 1N5232 | Zener Diode, 5.6V |
| D11 | 1N4004 | Diode,1A 400V |
| D12 | 1N4004 | Diode,1A 400V |
| D13 | 1N4004 | Diode,1A 400V |
| D14 | 1N4004 | Diode,1A 400V |
| D15 | 1N4004 | Diode,1A 400V |
| D16 | 1N4004 | Diode,1A 400V |
| D17 | 1N5232 | Zener Diode, 5.6V |
| D18 | 1N4004 | Diode,1A 400V |
| Q1 | ZVNL120 | N-Channel mosfet |
| Q2 | IRF630 | N-Channel mosfet |
| Q3 | 2N2222A | NPN transistor |
| Q4 | ZVNL120 | N-Channel mosfet |
| Q5 | IRF9630 | P-Channel mosfet |
| Q6 | ZVP2120 | P-Channel mosfet |
| Q7 | 2N5087 | PNP transistor |
| Q8 | 2N5087 | PNP transistor |
| Q9 | IRF630 | N-Channel mosfet |
| IC1 | LM7805 | Voltage regulator |
| IC2 | LM339 | Comparator |
| T1 | | Toroidal power transformer |

The following parts are supplied with each board kit:

| Quantity | Description | |
|----------|---------------------------------|------------------------|
| 2 | 47K | 1W Power Resistor |
| 2 | 10.0 Ohm | 1W Power Resistor |
| 1 | 10K | Cermet trimpot |
| 1 | 100 Ohm | Cermet trimpot |
| 2 | 100 Ohm | 1% Metal film resistor |
| 6 | 1.00K | 1% Metal film resistor |
| 8 | 100K | 1% Metal film resistor |
| 5 | 1.00M | 1% Metal Film |
| 3 | 0.22 uF,250V | Polypropylene Film |
| 2 | .22 uF,100V | Polyester Film |
| 2 | 33 uF,250V | Aluminum Electrolytic |
| 2 | 220 uF,200V | Aluminum Electrolytic |
| 2 | 1000 uF,50V | Aluminum Electrolytic |
| 1 | 6800 uF,50V | Aluminum Electrolytic |
| 1 | 22 uF,25V | Tantalum Electrolytic |
| 12 | 1N4004 | Diode,1A 400V |
| 6 | 1N5232 | Zener Diode, 5.6V |
| 2 | ZVNL120 | N-Channel mosfet |
| 2 | IRF630 | N-Channel mosfet |
| 1 | 2N2222A | NPN transistor |
| 1 | ZVP2120 | P-Channel mosfet |
| 1 | IRF9630 | P-Channel mosfet |
| 2 | 2N5087 | PNP transistor |
| 1 | LM7805 | Voltage regulator |
| 1 | LM339 | Comparator |
| 5" | Bare Hookup wire | |
| 1 | 16 pin DIP Socket | |
| 1 | 2 Pos terminal block | |
| 4 | 3 Pos terminal block | |
| 3 | TO220 insulator + 4/40 hardware | |

| | |
|---|--------------------------------|
| 1 | small bag of heatsink compound |
| 2 | 6/32 machine screw |
| 2 | 6/32 nut |
| 1 | PS27 Circuit board |

Assembly Instructions

Most parts are installed in the usual way. Insert the part at the location on the circuit board as indicated by the silk screen identification and solder on the solder side of the board.

Jumpers: Two jumper wires need to be installed. They are indicated with a white line running between two holes in the circuit board. One is located near label D8 and the other one is near IC2.

Resistors: The 4 big 1W power resistors and 21 1/4W metal film resistors are mounted onto the circuit board as indicated. R18 is not labeled: it is the resistor next to Q9. The resistors are color coded as follows:

| | |
|----------|--------------------------------|
| 47K | yellow purple orange gold |
| 10.0 Ohm | brown black black gold |
| 1.00K | brown black black brown brown |
| 10.0K | brown black black red brown |
| 100K | brown black black orange brown |
| 1.00M | brown black black yellow brown |

The 10 K trimpot (marked 103) is inserted at location R1 and the 100 Ohm trimpot (marked 101) is inserted at location R14.

Diodes: Install the 12 1N4004 rectifier diodes and the 6 1N5232 zener diodes as indicated. Make sure the band on the diode that indicated the cathode matches the white band on the identification. Some diodes have a black body and white band (1N4004) and some have a white body with black band (1N5232 usually). It is very important that the orientation is done correctly. **IMPORTANT NOTE:** Mount D12, D13, D14 and D15 so there is a 0.1" to 0.2" gap between the diodes the circuit board. This will improve the cooling of the diodes.

Small Capacitors: Install the 2 0.22 uF polypropylene capacitors (marked .22K) at locations C5, C7. Install the two 0.22uF polyester film capacitors (marked 224) at locations C11 and C12. Install the 22uF Tantalum capacitor at location C13.

Terminal Blocks: The terminal blocks are supplied in units of two and three. Make up a 5 position unit by joining a 2-pos unit and a 3-pos unit. Install the 3 3-position terminal block and the 5-position unit as indicated at one of the long sides of the circuit board. Orient so that the wire entry is at the edge of the board.

C3 and R27: These two parts are installed at location marked C3. The two parts are connected in series. Solder one lead of a 10.0K resistor to one lead of a 0.22uF polypropylene capacitor. Insert the free leads into the mounting holes marked C3. Solder.

Small Transistors: Install the 6 small transistors Q1,3,4,6,7,8 as indicated on the circuit board. Make sure the flat side of each transistor is oriented as indicated.

Large Electrolytic Capacitors: Install the 5 large electrolytic capacitors C1,2,4,6,8 as indicated on the circuit board. Make sure the plus and minus side are oriented correctly. The plus side is marked on the circuit board (+). The white band on the capacitors indicates the minus (-) side.

IC socket: install a 14 pin IC socket at location IC2. Note the orientation. Pin 1 of the socket is nearest C13, the tantalum capacitor. Insert the LM339 voltage comparator into the socket. Make sure the pin 1 orientation is correct.

Heatsink: Install the heatsink by placing the circuit board onto the two tabs and fasten with 6/32 hardware. Note that the tabs will rest on the solder side of the board and the side with the 6 mounting holes is on the component side of the circuit.

Power Semiconductors: Install one IRF630 power MOSFET at location Q9. Observe the orientation of the heatsink tab. The other 3 power semiconductor are mounted on the heatsink. Bend the leads so that they will fit into the holes in the circuit board when mounted. Install IC1, Q2 and Q5 with the 4/40 hardware insulating wafer. Use a small amount of heatsink compound on both sides of the insulating wafer. Place between heatsink and transistor tab. Put the insulating shoulder washer into the hole of the transistor and fasten with 4/40 screw and nut. Check with a multimeter that the transistor tab is insulated from the heatsink

Assembly is now complete. Please double check all parts for proper insertion and soldering.

Installation.

Transformer connection: The toroidal power transformer has a dual 120 V primary, a dual 120 V secondary and a 15 V secondary. For 120VAC line operation the two primary windings are connected in parallel. Connect the blue and violet wires together to one side of the line and connect the gray and brown

wires together to the other side of the line. For 240 VAC line voltage the two primaries are connected in series. Connect the violet wire to the gray wire. Connect one side of the line to the blue wire and the other side of the line to the brown wire.

The secondary 120VAC windings are connected as a VA center tap. See Table 1. The red and orange wires go to the COM terminal on terminal block 1, the black wire goes to one of the terminals marked AC and the yellow wire goes to the other terminal marked AC.

The two green wires from the transformer are the filament winding. They should be connected to the two terminals marked FF.

Adjustments: Two adjustments have to be performed. A small screwdriver and a voltmeter are needed for making these adjustments. Turn the unit on and wait approx. 30 s for the power sequencing to be completed. Connect the voltmeter to terminals 12.6 and GAD and adjust the reading to 12.6 Volts with trimpot R14. Connect the voltmeter to terminals V++ and GAD and adjust the reading to 150 Volts with trimpot R1. Check that the voltage between V-- and GAD also reads V.

Filament power: The tube filaments are connected to terminals 12.6 and GAD. The current rating of this output is 1.A. This supply can supply filament power to up to 8 12AX7 tubes, or equivalent.

High Voltage Supply: The dual tracking 150 volt regulated DC supply is available at pins V--, GAD and V++. The current capacity is 70 mA on each output. The supply is current limited at this value.

Relay Power: The coil of a standard V relay can be connected to pins labelled RELAY and 12.6. This relay should not draw more than m. The relay will be activated approx. 20 seconds after power is applied to the PS27. This relay can be used to enable the outputs of the equipment.

LED: Three LED driver outputs are provided. L1, L2 and L3. Standard 10 mA LED's can be connected between each of these outputs and the 12.6 terminal. L1 will be active as soon a power is applied. L2 will be active when HV power becomes available and L3 will be active when the relay is activated.

Circuit description

See table 1 for connecting power and signals to the PS27. Circuit diagrams are shown in figures ps27.p01 and ps27.p02. The HV dual power regulator is shown in ps27.p01. Raw DC power is provided by diodes D1,2,3,4 and capacitors C1,2. Power MOSFET Q2 is the series regulator transistor for the positive supply. A current limit of 70 mA is set with resistor R6 and Q3. Q1 is the feedback controller. When Q4 is activated

by the sequencer the power supply will be shut down. The output voltage can be set with R1. The tracking negative supply operates in the same fashion. The output voltage of the negative supply equals that of the positive supply.

The filament supply has rectifier diodes D12--15 and capacitor C8. Voltage regulator IC1 provides 12.6V DC at 1.A. The regulator has a current limit of approximately 1.5A, depending on temperature. The output voltage is set with R14.

The power supply sequencing is done with voltage comparator IC2. After power up the RC network R20, C13 will control the timing. After C13 charges up to 1/3 of the power supply voltage the HV shutdown will be turned off and the dual V power supply comes on. LED is also derived from the shutdown signal. When the voltage on capacitor C13 reaches 2/3 of the power supply voltage the output relay driver Q9 will be activated. This will also turn on LED.

When AC power is turned off capacitor C13 will be discharged immediately because C11 and R19 have a time constant of only 22mS, slightly more than one cycle of the AC power. Discharge will cause LED and LED to turn off and the relay to be deactivated. After a 100ms delay caused by R26 and C12 the HV power will also be shut down.

| Terminal Block location | Terminal | signal |
|-------------------------|----------|--|
| 1 | AC | 240 VAC transformer secondary, side 1, Black |
| 1 | AC | 240 VAC transformer secondary, side 2, Yellow |
| 1 | COM | 240 VAC transformer center tap, Red, Orange |
| 2 | V-- | +150 VDC regulated output |
| 2 | GND | HV ground |
| 2 | V++ | +150 VDC regulated output |
| 3 | L3 | Cathode of LED, relay indicator light |
| 3 | L2 | Cathode of LED, HV indicator light |
| 3 | L1 | Cathode of LED1, power indicator light |
| 4 | FF | 15 VAC transformer secondary, side 1, green |
| 4 | FF | 15 VAC transformer secondary, side 2, green |
| 4 | 12.6 | 12.6V DC @1.A regulated filament supply, Anode of LED1,2,3, relay coil 1 |
| 4 | GND | Ground for filament supply |
| 4 | RELAY | relay coil 2 |

Table 1: Terminal block signals