

LOW CURRENT POWER SUPPLY

the digital group

po box 6528 denver, colorado 80206 (303) 777-7133

298-038-A-8+1

Digital Group Low Current Power Supply

General Design

The low current power supply is designed to provide -5 volts, +12 volts, and -12 volts for the various circuits in the Digital Group systems. Up to 1 amp of current may be drawn from each supply, depending on the power transformer provided, although the current required by most systems is in the low milliamperage range. The three outputs are protected from overvoltage, over current, and over temperature.

Specific Design

The centertapped output of the power transformer is rectified to + and - voltages to ground by D1 & D2, and D3 & D4 respectively. C2 and C1 filter the pulsating DC to provide +18 to 21 volts and -18 to 21 volts. The +18 to 21 volts is then dropped and regulated to the desired voltage by one of the three regulators. The LM340K-12 and LM320K's are preset to the desired voltages, +5%. The LM340K-12 provides the +12 volt output, as long as 1 amp or less is drawn, and the minimum + input voltage of 14.5 volts (including any ripple) exists. Similarly, the LM320K-5 and LM320K-12 are tied to the -18 to 21 volt supply to provide -5 and -12 volts. A number of 1 mfd and 4.7 mfd tantalums have been provided. These are used to suppress oscillations, particularly in the LM320K's.

Three C106B Silicon Controlled Rectifiers (SCR) are provided to clamp out any dangerously high voltage that may occur due to noise, transients, or a shorted regulator. The resistors and zeners set the clamping voltage to about 15% higher than the nominal supply voltage.

Light Emitting Diodes (LED) are used to indicate that the voltages are running properly. A +5 volt monitoring LED is also provided. A quick glance will tell the power supply status. The four diodes could also be brought out to the front of the system, if desired.

Changes

The actual amount of power available is dependent on the power transformer used. A 24 volt centertapped transformer with normal line voltages will provide about 1/2 amp at each output voltage before excessive ripple results. Higher currents up to 1 amp are possible by using a 28 or 30 volt centertapped transformer. High currents will result in the regulators getting warm. The -5 regulator will get very hot if current in excess of 1/2 amp is drawn from it. A small heat sink on the LM320K-5 is then advisable.

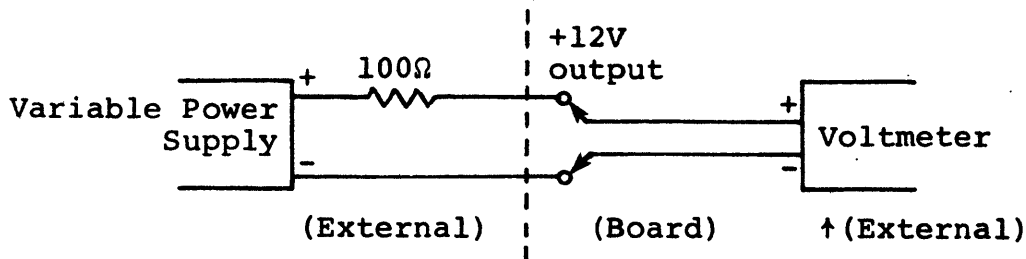
The combination of high current drain from the +12 supplies and low line voltage will generally first show up as "hum" on cassettes recorded from the Digital Group cassette interface. Measure the +12 volt outputs with an oscilloscope. Greater than 1/4 volt of ripple at any output indicates an overloaded supply.

LOW CURRENT POWER SUPPLY - CONSTRUCTION

1. Solder in D1 - D4 making sure of polarities. Clip leads.
2. Mount transformer with two #6 bolts. Put nuts, lockwashers, and washers on component side. Solder black (ac) wires to pads marked "ac" on foil side. Solder either of the two common-colored wires in proper positions near ends of diodes (see parts layout). Solder the remaining wire to the hole between the diodes.
3. Mount C6. Mount C1 and C2 by bolting through the board. Make sure of polarities and that bolts are snug.
4. Apply power to AC side of transformer. (It would be wise to install a 1 Amp fuse in the AC line.) There should be a voltage of greater than 18V across each capacitor with the + side of the capacitor being more positive. There should be approximately 40 volts measured from minus of C1 to plus of C2. If this is so, continue. If not, see troubleshooting #1.
5. Next install C7 through C12. Make sure of polarities. (Vertical stripe along one side indicates +.)
6. Install C3, C4, C5. Install R1 through R3. Install R4 through R8. Install R9 and R10.
7. Install Z1, Z2, Z3. Make sure of polarities. Bar indicates cathode. (Be careful not to overheat. Use needle nose pliers or alligator clip to heatsink lead.)
8. Install SCR1, SCR2, SCR3. Heatsink during soldering. Bend leads to fit. Install so chamfer is aligned properly.

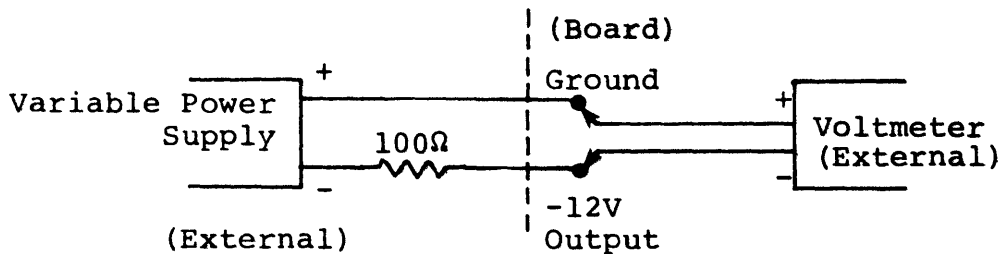
Note: Steps 9, 10, and 11 test overvoltage protection circuits. If steps do not check out, refer to troubleshooting #2.)

9. Apply a variable voltage through a 100 ohm resistor to +12 volt output. Starting at a low voltage (near zero), slowly increase the voltage while monitoring with a voltmeter as shown:



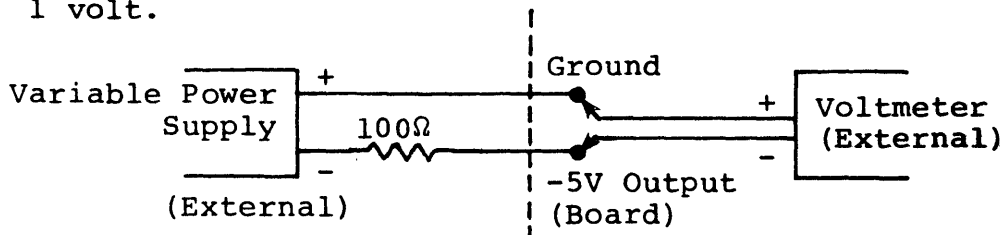
At around 13 volts the voltage should suddenly drop to approximately 1 volt. Reduce the voltage to 10 volts and temporarily disconnect the power supply. Reconnect the power supply. The voltmeter should then read around 10 volts.

10. Apply variable voltage through a 100 ohm resistor to -12 volt output. Slowly increase voltage from zero while monitoring voltage as shown (make sure of polarities!):



At around 13 volts the voltage should stop increasing and drop to approximately 1 volt. Reduce the variable voltage to 10 volts and temporarily disconnect the power supply. Reconnect and the voltmeter should read 10V.

11. Apply variable voltage through a 100 ohm resistor to -5 output. Follow the same procedure as in step 10. At about 6 volts the voltage will stop increasing and drop to around 1 volt.



Reduce the variable voltage to 3 volts and temporarily disconnect the power supply. Reconnect and the voltmeter should read 3 volts. Remove power supply and voltmeter.

12. Install RG1, RG2, and RG3. Be sure to bolt down regulators securely with washers and nuts on component side. Apply power to transformer. There should be $+12 \pm .5$ volts at +12 output, $-12 \pm .5$ volts at -12 output, and $-5 \pm .5$ volts at -5 volt output. If not, see troubleshooting #3. (Make sure voltmeter is not at fault - measure all voltages to ground.)
13. Install L1, L2, L3, L4. Make sure polarities are correct. Apply power to transformer. L1, L2, L3 should light. Apply +5 volts to +5 input on board. L4 should light. If not, see troubleshooting #4.

Troubleshooting

1. a. Check transformer to see if approximately 24 volts AC appears across red leads and approximately 12 volts AC from each red lead to brown lead.
 - b. Check capacitors to see if shorted or open. (Must be removed for this test.) Check polarity.
 - c. If a & b check, then a diode (or diodes) is bad or has been inserted backwards. Check and replace bad ones.
2. If step 9 fails, check SCR3, Z2, R3, R8, C5. Check for proper polarity and solder joints.

If step 10 fails, check SCR1, Z1, R1, R4, C3.

If step 11 fails, check SCR2, Z3, R2, R5, C4.

If measured voltage never increases above 1 volt, check the zener for short. If at given voltage the measured voltage does not drop, check the zener for open and check SCR. Check resistors for correct value. Check disc capacitor for short. If all else fails, replace resistors and disc, then zener, then SCR. Also check C6 through C10 for shorts or opens.

3. If +12 does not work, check RG1 for bad solder joints and loose mounting bolts. Bolt on ground line must make contact with regulator case and ground line. If good, then RG1 may be defective. (Do C1 and C2 still have correct voltage levels?)

If -12 does not work, check RG2 in the same manner as RG1 above. Bolts must contact case and foil.

If -5 does not work, check RG3 as RG1 & RG2 above.

If -5, -12, and +12 all do not work, problem is probably in C1, C2, D1, D2, D3, D4, or transformer.

Also check C6 through C10 for short or open.

4. If LED does not light up, check its orientation first. Measure the voltage drop across the LED. IF zero, the LED is shorted or the supply is inoperative. If about .6 volts, the LED is backwards. If above 4 volts, the LED is open. Correct operating voltage will be in the range of 2.5 volts.

LOW CURRENT POWER SUPPLY - PARTS LIST

C1 - C2 2900 mfd 25V electrolytic
C3 - C5 .1 mfd disc
C6, C7,
C9,C10,C12 1 mfd tantalum
C8,C11 4.7 mfd tantalum
D1 - D4 2 Amp power diodes (MR501 typ.)
L1 - L4 LED - MV5020 typical
R1 - R3 10 ohm 1/4W
R4 - R8 220 ohm 1/4W
R9 - R10 750 ohm 1/4W
RG1 +12V Regulator LM340-12 or 7812
RG2 -12V Regulator LM320-12 or 7912
RG3 -5V Regulator LM320-5.0 or 7905
SCR1 - 3 SCR C106B
Z1 - Z2 13V 1W Zener 1N4743
Z3 5.6V 1W Zener 1N4734
1 Transformer 24-26V CT 1 Amp
1 Heatsink
8 #6 bolts, nuts, lockwashers

NOTE: C9 and C12 are optional.
 The heatsink included goes on the -5V regulator.

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POWER SUPPLY INFORMATION: Information presented is about the three different sizes of power supplies. Use the information that pertains to your supply.

PWR-0

Note on the PWR-0 schematic that the capacitors for the negative portion of the supply are shown with + polarity on the wrong side. The component layout is correct. If your kit has been supplied with a black transformer with solder tabs, then the two tabs at the bottom are for AC line input. Don't worry if the transformer covers the four holes labelled ac. The three tabs on top are the secondary and the center tab is wired to the CT WIRE position on the component layout. The other two go to either side on the component layout sheet. Ground and voltage outputs at the other end of the board are spaced to accept a connector on .156" centers. Leads from large diodes could be used as pins and moxex female bodies would plug into the pins.

A PWR-6 is a PWR-0 and a 5V 6 AMP supply. A PWR-12 is a PWR-0 and a 5V 12 AMP supply. Likewise, a PWR 18 is a PWR 0 and a 5V 18 AMP.

5V 6 AMP

Connect AC to two tabs on transformer. These are labelled 1 and 2. DC out is labelled + and - and is located at the edge of the board.

5V 12 AMP

Connect power to the leads on the transformer labelled COM and 5V. The 6V lead should not be used. DC output is from the bolts labelled + and -. Don't remove the bars between s+ and + or between s- and -. These are for sensing purposes.

5V 18 AMP

Connect AC power to leads 1 and 4 on the transformer. Connect a jumper between 3 and 4. Connect a jumper between 1 and 2. (If you plan to use 230V AC then connect power to leads 1 and 4. Jumper 2 and 3 together) DC output is from the bolts labelled + and -. Do not remove jumper bars They are for sense purposes.

FUSING

Fuse the AC line to the supply.

PWR-0 fuse for 1 amps. 5V 6 AMP fuse for 1 amp.

5V 12 AMP fuse for 2 amps. 5V 18 AMP fuse for 3 amps.

Use HEAVY guage wire to run power connections. Make sure that full voltage is getting to the system. Especially true for 5 volts and ground. Don't install fuses in ground lines. For safety use 3 prong grounding plugs for your equipment and ground your case.

POWER SUPPLY WIRING
PRECAUTIONS

Assembly of digital circuits involves little hazard; either during assembly or during operation. Voltages are low and chips are likely to be the only victim.

Assembling and using a power supply involves line voltage which can easily zap you. Thus a few precautions are in order.

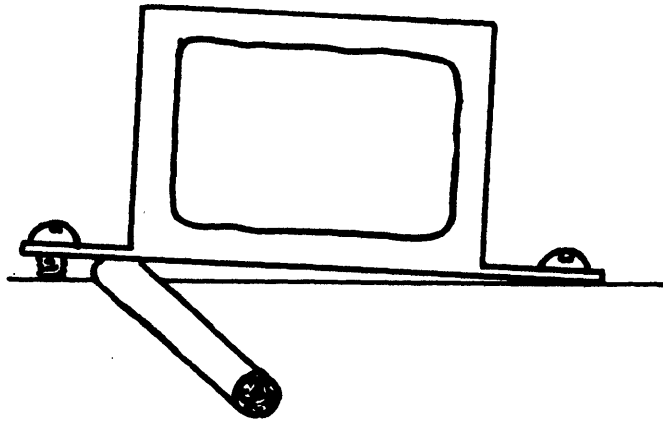
Most important is to make sure your connections are secure. One should double wrap wire on tabs or posts that are to be soldered. Wires soldered into a board should be pushed in till the insulation is tight against the board and the wire should be soldered thoroughly. Strain relief should be used on all AC connections to prevent a live wire from working loose.

Also make sure that wires have no chance of shorting and causing damage. (This includes your body) All wires feeding thru a metal wall should be protected by a rubber grommet. Nothing should ever be installed so that it puts pressure on a wire carrying power. Don't lash things up on a temporary basis and plan to fix it later. Many times it never gets fixed.

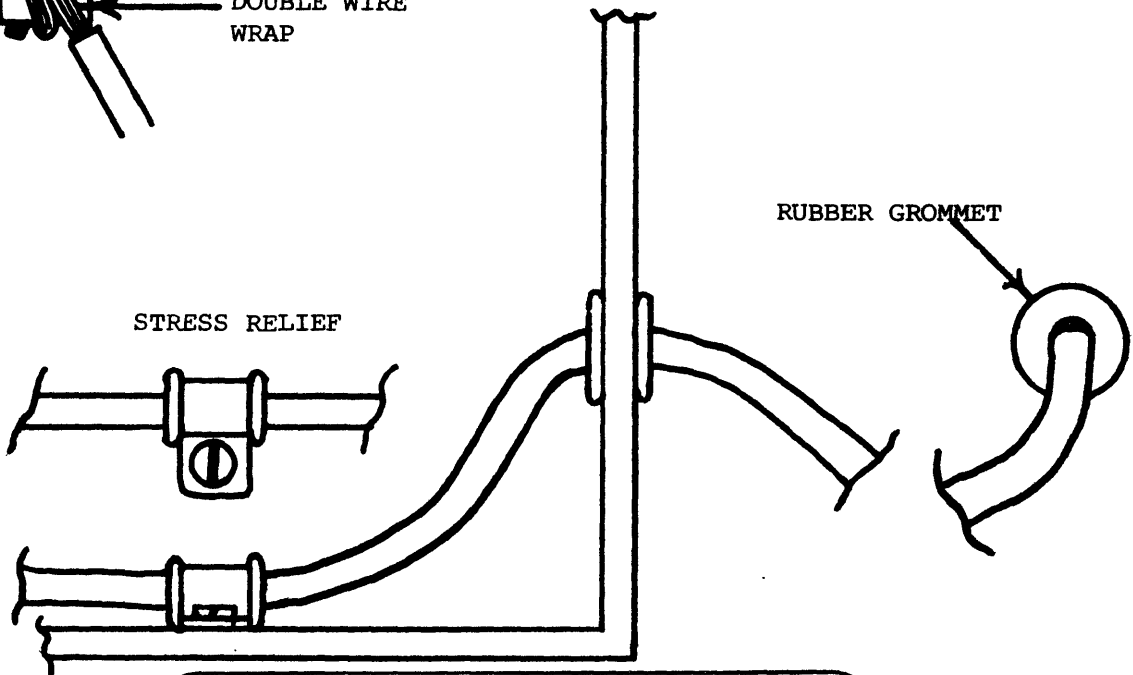
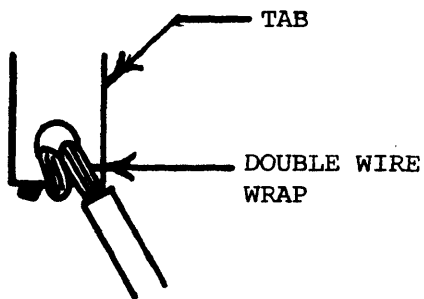
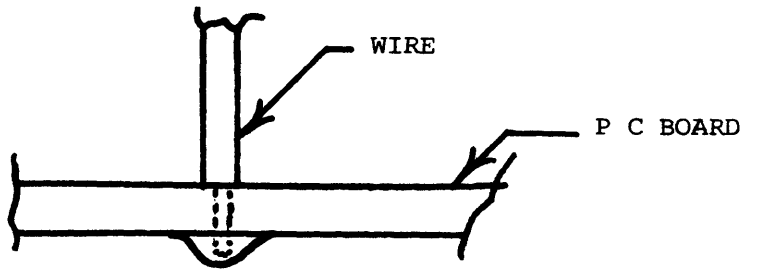
Items connected to AC power should always be fused to prevent catastrophe in the event of a short. Any exposed connections should be insulated. All connections should be as snug as possible.

Use of a three terminal grounding plug is strongly advised. The third wire which is indicated by a green conductor should be attached to the case ground of your system. (The ground conductor may be indicated by some other method than the green conductor; Possibly by a silver wire with two copper colored wires.)

POWER SUPPLY WIRING
PRECAUTIONS



MASHED WIRE

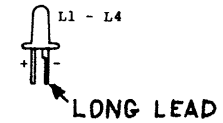
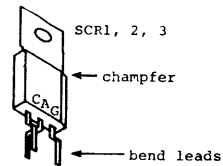
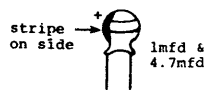
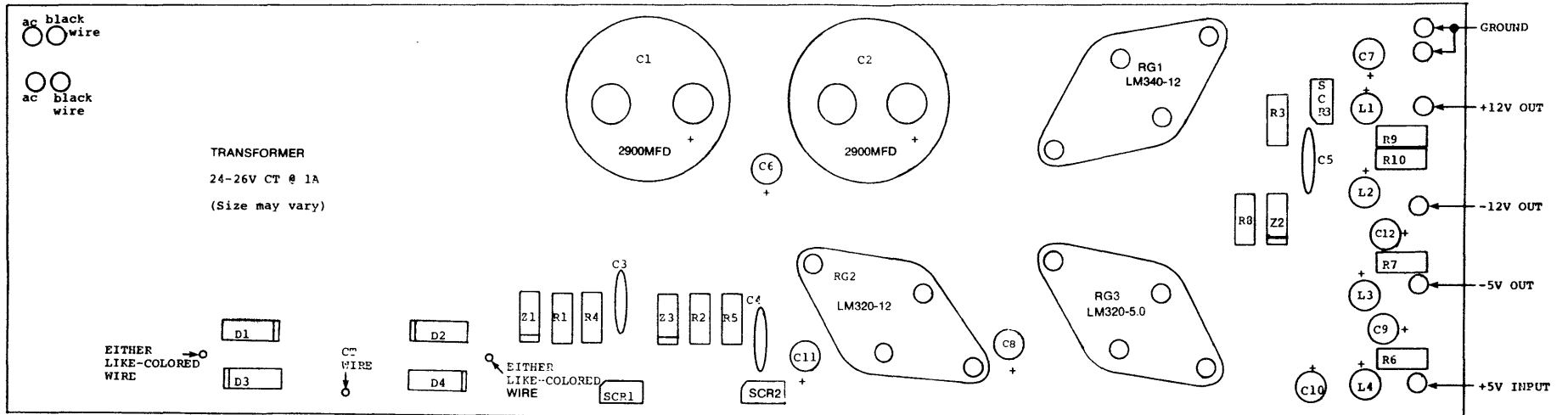


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LOW CURRENT POWER SUPPLY — COMPONENT LAYOUT



115VAC, ±10%
47-63 HZ

A
B
COM

T1

BRI
PH2002A

OVP TABULATION				
MODEL	R21	R22	R24	R25
3,5,9	470Ω	---	1.5K	1.2K
12	1.2K	47Ω	1K	2.2K
24,28	1.5K	390Ω	1K	4.7K

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 1/2W, 5% CARBON FILM.

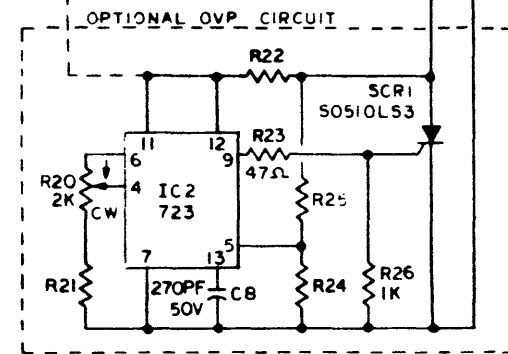
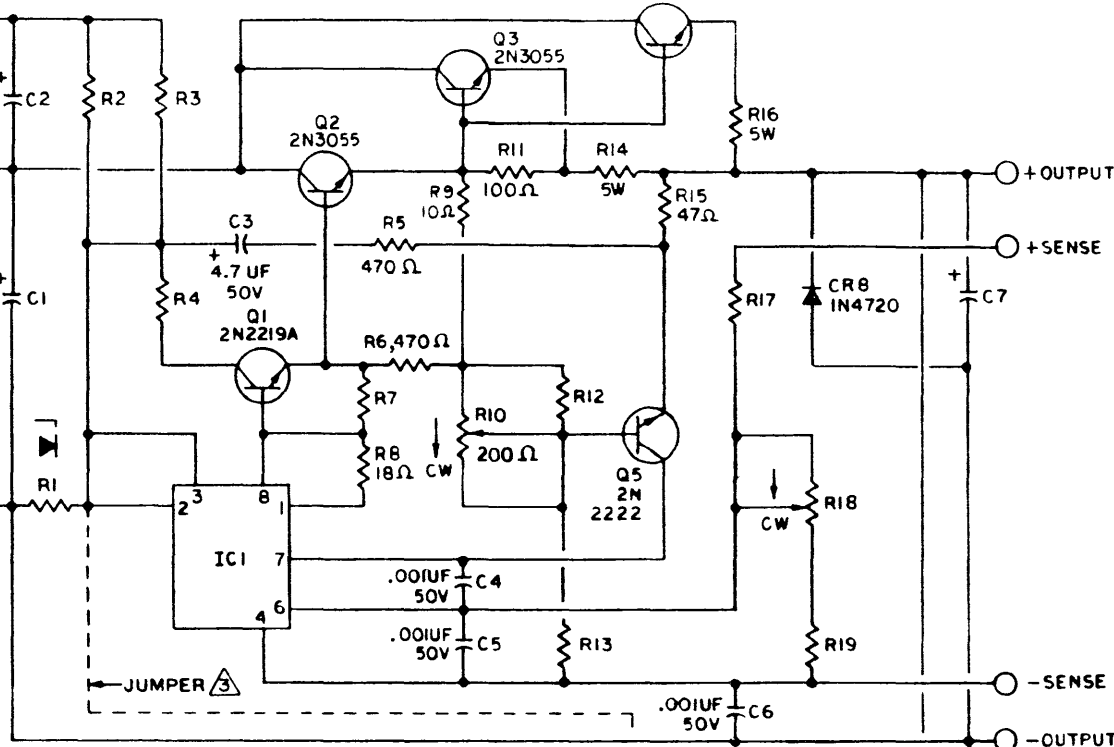
⚠ R4 AND Q1 NOT USED. R7 IS JUMPERED ON PC BOARD ETCH.

⚠ JUMPER USED ON 3,5,9 MODELS WITH OVP.

PROPRIETARY INFORMATION

NO INFORMATION GIVEN HEREIN MAY BE DISSEMINATED TO ANY PERSON OR COMPANY WITHOUT THE EXPRESS PERMISSION OF XENTEK INC.

TABULATION															
MODEL	INPUT TAP A	INPUT TAP B	IC1	C1	C2	C7	CR1,2	R1	R2,3	R12	R13	R14,16	R17	R18	R19
XP60-3	2-3V, 12A	4V, 12A	LM300	56K UF 15V	100UF 16V	2.2K UF 10V	IN4001	-	100Ω	270Ω	220Ω	.1Ω	220Ω	2K	100Ω
XP60-5	5V, 12A	6V, 10A	LM305	56K UF 15V	100UF 16V	2.2K UF 10V	IN4001	3.3K	470Ω	100Ω	270Ω	.1Ω	5.6K	2K	1.8K
XP60-9	7V, 9A 8V, 8.6A	9V, 8.2A 10V, 7.8A	LM305	29K UF 25V	100UF 25V	1K UF 25V	IN4001	4.7K	1K	470Ω	1K	.1Ω	10K	2K	1.5K
XP60-12	11V, 6.8A 12V, 6.5A 13V, 6.1A	14V, 6.4A 15V, 6.0A 16V, 5.6A	LM305	22K UF 35V	100UF 35V	1K UF 25V	IN4002	12K	3.9K	470Ω	1.5K	.22Ω	18K	2K	1.8K
XP60-24	17±18V, 5.2A 19±20V, 5A	21±22V, 5.2A 23±24V, 5A	LM305A	18K UF 50V	47UF 63V	470UF 35V	IN4002	1N 4751A	8.2K	-	3.9K	.22Ω	15K	1K	1K
XP60-28	25±26V, 3.2A 27±28V, 2.6A	29±30V, 2.4A 31±32V, 1.8A	LM305A	18K UF 50V	47UF 63V	470UF 35V	IN4002	1N 4753A	10K	390Ω	5.6K	.22Ω	27K	1K	1.3K



XENTEK INC. SAN MARCOS CALIF.		DRAWN BY GM	
SCALE: —	APPROVED BY:	REVISED	
DATE: 8-3-74			
POWER SUPPLY SCHEMATIC			REV. A
MODEL XP60 SERIES			DRAWING NUMBER C3012-S01