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MODEL SR440

FAST PREAMPLIFIER

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INTRODUCTION

The Model SR440 Fast Preamp contains four wide bandwidth, dc coupled amplifiers designed to be used independently or cascaded to provide gains of 5, 25, 125 and 625.

The fast rise time, low noise and dc accuracy of the SR440 make it the ideal instrument for amplifying outputs of fast photomultiplier tubes and photodiodes.

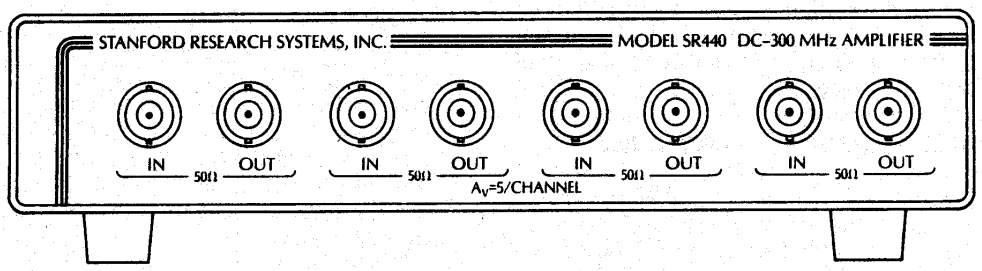


Figure 1 - SR440 Front Panel

TYPICAL SPECIFICATIONS

INPUTS	50Ω impedance, dc coupled, BNC connectors.
OUTPUTS	dc coupled, BNC connectors (terminate into 50Ω.)
VOLTAGE GAIN	5.0 per channel, ± 3%, cascadable to 625.
BANDWIDTH	dc to 300 MHz.
OPERATING RANGE	inputs ± 250 mV.
OVERSHOOT	±5%
NOISE	<25 μV rms referenced to the input.
STABILITY	10 μV/°C referenced to the inputs (0 - 50°C.)
OFFSET	input ± 50 μV adjustable.
RISE / FALL TIME	1.5 ns
PROPAGATION DELAY	2.2 ns
RECOVERY TIME	< 4 ns for a times 20 overload.
PROTECTION	± 3.5V dc, ± 50V transient.
MECHANICAL	7.7" x 6.7" x 2".
POWER	16W, 100/120/ 220/240 V, 50/60 Hz
WARRANTY	One year parts and labor on materials and workmanship.

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OPERATION

The SR440 Fast Preamplifier is useful for amplifying small signals to levels that allow processing by other instruments such as the SR400 Gated Photon Counter. The four channels may be used independently or cascaded as desired. The following table gives the maximum input voltage for linear operation as a function of gain for 1 to 4 channels,

Channels	Gain	Maximum Input
1	5	250 mV
2	25	50 mV
3	125	10 mV
4	625	2 mV

TROUBLESHOOTING

WARNING: Dangerous voltages are present on the printed circuit board. Always turn the power off and disconnect the line cord before removing the cover or changing components.

The diodes in the overload protection circuit can be damaged by excessive voltages at the input of any stage. To check for damage measure for 0.6 Volts across both diodes in D1. D2 and D3 can be tested by simply removing them from the circuit and then checking for degradation of the amplifiers pulse response as each diode is reconnected. Replacement diodes are available from the factory.

CALIBRATION

There are two rows of 4 holes in the cover to access the offset calibration pots. The first row is the input offset adjust, and the second row the output offset adjust.

Allow at least 30 minutes for the unit to warm up before calibrating. To calibrate the input offset, connect a voltmeter to the input and adjust the pot at front hole in line with that channel for a reading of 0 ± 10 μV. To calibrate the output offset, connect a voltmeter to the output and adjust the pot at the back hole in line with that channel for a reading of 0 ± 50 μV.

REDUCING INPUT OFFSET DRIFT

SR400 amplifiers are protected against input overloads. This input protection serves two puposes: 1) It allows for quick recovery from large overloading signals and 2) It prevents damage to the front end transistor. However, this protection network also introduces an input offset drift with temperature. If very low offset drift with temperature is required and the input signal does not overload the amplifier, the protection circuit may be bypassed. This will virtually eliminate the input offset drift of the amplifier. If many amplifiers are being cascaded to provide a large gain, only the first amplifier needs to be modified to improve the drift.

To modify an amplifier, **first unplug the power cord from the unit.** Unscrew the four rubber feet from the bottom and remove the lid from the chassis. The input protection circuit is located directly behind the input BNC connector for the amplifier. The components are shown in figure 2 as they appear on the circuit board. Desolder and remove D1, D2, D3, R2 and R3 (4.99k) from the board. Store these components in a safe place. Insert a jumper made of bent wire or component lead into the socket as shown and solder. This jumpers the input BNC directly to the input transistor.

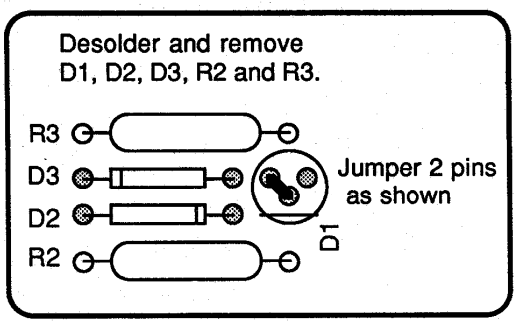


Figure 2 - Input offset drift modification

Using caution, connect the power cord and turn the amplifier on. Connect the amplifier output to a DVM and adjust the potentiometer which is at the back of the amplifier section to null the output.

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Turn off the unit and remove the power cord. Replace the lid and feet. It is a good idea to mark which amplifier has been modified on the front panel so that it is always the first amplifier in a cascaded configutation.

NOTE: The amplifier is no longer protected from overloading signals. Large overloading signals will saturate the amplifier and it will not recover quickly from overload. Also, very large signals will damage the front end. Make sure that the input signal never exceeds ±5 Volts.

CIRCUIT DESCRIPTION

R2, R3, R4, P1, D1, D2 and D3 comprise an overload protection circuit which clamps the inputs to the ac and dc amplifiers at ± .35 Volts. This prevents Q1 and Q2 from saturating and yields fast recovery from overloads. Ac gain is provided by Q1 and Q2 and is compensated by C7. U1 sets the amplifier's dc gain. P2 nulls the dc offset at the amplifier's output. Q2 sums the ac and dc signals and can drive 50Ω loads to ±1.5 Volts. U2, D5 and Q3 provide a temperature stable bias voltage for the overload protection circuits which are individually adjusted by P1A, P1B, P1C and P1D to null dc offset at the input.

LINE VOLTAGE SELECTION

The SR440 operates from a 100, 120, 220 or 240 Volt ac nominal, 50 or 60 Hz power source. Before applying power, verify that the line selector card (located in the power entry module) is in the correct position. The selected voltage is indicated by the white dot on the voltage list.

To change the line voltage selection, disconnect the line cord and remove the fuse module with a small screwdriver. Pull out the voltage selection card (located at the right of the power entry module) with a pair of needle nose pliers. Rotate the plastic indicator until it lines up with the correct voltage indicated on the fuse holder and reinsert the card. Install the correct fuse, reinsert the fuse holder and replace the line cord.

LINE FUSE

Verify that the correct line fuse is installed before connecting the line cord. The rear pannel indicates the correct fuse size, 1/4 Amp @ 100/120 Volts or 1/8 Amp @ 220/240 Volts. If necessary the fuse can be changed as indicated in the line voltage selection section.

PARTS LIST

C 1A	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 1B	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 1C	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 1D	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 2A	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 2B	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 2C	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 2D	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 3A	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 3B	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 3C	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 3D	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 4A	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 4B	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 4C	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 4D	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 5A	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 5B	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 5C	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 5D	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 6A	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 6B	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 6C	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 6D	47U	Capacitor, Electrolytic, 16V, 20%, Rad
C 7A	20P	Capacitor, Variable, 250V, 5mm
C 9A	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 9B	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 9C	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 9D	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 10	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 11	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 12	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 13	2.2U	Capacitor, Tantalum, 35V, 20%, Rad
C 14A	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 14B	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 14C	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 14D	.1U	Capacitor, Ceramic Disc, 50V, 20%, Z5U
C 15	3300U	Capacitor, Electrolytic, 16V, 20%, Rad
C 16	3300U	Capacitor, Electrolytic, 16V, 20%, Rad
C 17A	10U	Capacitor, Electrolytic, 16V, 20%, Rad
C 17B	10U	Capacitor, Electrolytic, 16V, 20%, Rad
C 17C	10U	Capacitor, Electrolytic, 16V, 20%, Rad
C 17D	10U	Capacitor, Electrolytic, 16V, 20%, Rad
C 20	10U	Capacitor, Tantalum, 35V, 20%, Rad
C 21	10U	Capacitor, Tantalum, 35V, 20%, Rad
D 1A	MSD6100	Diode
D 1B	MSD6100	Diode
D 1C	MSD6100	Diode
D 1D	MSD6100	Diode
D 2A	5082-2800	Diode
D 2B	5082-2800	Diode
D 2C	5082-2800	Diode
D 2D	5082-2800	Diode

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D3A	5082-2800	Diode
D3B	5082-2800	Diode
D3C	5082-2800	Diode
D5	MSD6100	Diode
D6	BR-81D	Integrated Circuit
D7	GREEN	LED, T1-3/4 Package
J3	MINI 7 DI	Connector, Male
P1A	200	Pot, Multi-Turn Trim
P1B	200	Pot, Multi-Turn Trim
P1C	200	Pot, Multi-Turn Trim
P1D	200	Pot, Multi-Turn Trim
P2A	50K	Pot, Multi-Turn Trim
P2B	50K	Pot, Multi-Turn Trim
P2C	50K	Pot, Multi-Turn Trim
P2D	50K	Pot, Multi-Turn Trim
PC1	SR240	SR440 Printed Circuit Board
Q1A	MRF904	Transistor, TO-72 Package
Q1B	MRF904	Transistor, TO-72 Package
Q1C	MRF904	Transistor, TO-72 Package
Q1D	MRF904	Transistor, TO-72 Package
Q2A	MRF965	Transistor, TO-46 Package
Q2B	MRF965	Transistor, TO-46 Package
Q2C	MRF965	Transistor, TO-46 Package
Q2D	MRF965	Transistor, TO-46 Package
Q3	2N3906	Transistor, TO-92 Package
R1A	49.9	Resistor, Metal Film, 1/8W, 1%
R1B	49.9	Resistor, Metal Film, 1/8W, 1%
R1C	49.9	Resistor, Metal Film, 1/8W, 1%
R1D	49.9	Resistor, Metal Film, 1/8W, 1%
R2A	4.99K	Resistor, Metal Film, 1/8W, 1%
R2B	4.99K	Resistor, Metal Film, 1/8W, 1%
R2C	4.99K	Resistor, Metal Film, 1/8W, 1%
R2D	4.99K	Resistor, Metal Film, 1/8W, 1%
R3A	4.99K	Resistor, Metal Film, 1/8W, 1%
R3B	4.99K	Resistor, Metal Film, 1/8W, 1%
R3C	4.99K	Resistor, Metal Film, 1/8W, 1%
R3D	4.99K	Resistor, Metal Film, 1/8W, 1%
R4A	1.74K	Resistor, Metal Film, 1/8W, 1%
R4B	1.74K	Resistor, Metal Film, 1/8W, 1%
R4C	1.74K	Resistor, Metal Film, 1/8W, 1%
R4D	1.74K	Resistor, Metal Film, 1/8W, 1%
R5A	33K	Resistor, Carbon Film, 1/4W, 5%
R5B	33K	Resistor, Carbon Film, 1/4W, 5%
R5C	33K	Resistor, Carbon Film, 1/4W, 5%
R5D	33K	Resistor, Carbon Film, 1/4W, 5%
R6A	4.7K	Resistor, Carbon Film, 1/4W, 5%
R6B	4.7K	Resistor, Carbon Film, 1/4W, 5%
R6C	4.7K	Resistor, Carbon Film, 1/4W, 5%
R6D	4.7K	Resistor, Carbon Film, 1/4W, 5%
R7A	316	Resistor, Metal Film, 1/8W, 1%
R7B	316	Resistor, Metal Film, 1/8W, 1%
R7C	316	Resistor, Metal Film, 1/8W, 1%
R7D	316	Resistor, Metal Film, 1/8W, 1%
R8A	52.3	Resistor, Metal Film, 1/8W, 1%
R8B	52.3	Resistor, Metal Film, 1/8W, 1%
R8C	52.3	Resistor, Metal Film, 1/8W, 1%
R8D	52.3	Resistor, Metal Film, 1/8W, 1%
R9A	560	Resistor, Carbon Film, 1/4W, 5%
R9B	560	Resistor, Carbon Film, 1/4W, 5%
R9C	560	Resistor, Carbon Film, 1/4W, 5%
R9D	560	Resistor, Carbon Film, 1/4W, 5%
R10A	2.0M	Resistor, Carbon Film, 1/4W, 5%
R10B	2.0M	Resistor, Carbon Film, 1/4W, 5%
R10C	2.0M	Resistor, Carbon Film, 1/4W, 5%
R10D	2.0M	Resistor, Carbon Film, 1/4W, 5%
R11A	365	Resistor, Metal Film, 1/8W, 1%
R11B	365	Resistor, Metal Film, 1/8W, 1%
R11C	365	Resistor, Metal Film, 1/8W, 1%
R11D	365	Resistor, Metal Film, 1/8W, 1%
R12A	180	Resistor, Carbon Comp, 1/2W, 5%
R12B	180	Resistor, Carbon Comp, 1/2W, 5%
R12C	180	Resistor, Carbon Comp, 1/2W, 5%
R12D	180	Resistor, Carbon Comp, 1/2W, 5%
R13A	10.0	Resistor, Metal Film, 1/8W, 1%
R13B	10.0	Resistor, Metal Film, 1/8W, 1%
R13C	10.0	Resistor, Metal Film, 1/8W, 1%
R13D	10.0	Resistor, Metal Film, 1/8W, 1%
R14A	1.0K	Resistor, Carbon Film, 1/4W, 5%
R14B	1.0K	Resistor, Carbon Film, 1/4W, 5%
R14C	1.0K	Resistor, Carbon Film, 1/4W, 5%
R14D	1.0K	Resistor, Carbon Film, 1/4W, 5%
R15A	1.0K	Resistor, Carbon Film, 1/4W, 5%
R15B	1.0K	Resistor, Carbon Film, 1/4W, 5%
R15C	1.0K	Resistor, Carbon Film, 1/4W, 5%
R15D	1.0K	Resistor, Carbon Film, 1/4W, 5%
R16A	4.99K	Resistor, Metal Film, 1/8W, 1%
R16B	4.99K	Resistor, Metal Film, 1/8W, 1%
R16C	4.99K	Resistor, Metal Film, 1/8W, 1%
R16D	4.99K	Resistor, Metal Film, 1/8W, 1%
R17A	1.24K	Resistor, Metal Film, 1/8W, 1%
R17B	1.24K	Resistor, Metal Film, 1/8W, 1%
R17C	1.24K	Resistor, Metal Film, 1/8W, 1%
R17D	1.24K	Resistor, Metal Film, 1/8W, 1%
R18	2.49K	Resistor, Metal Film, 1/8W, 1%
R19	1.82K	Resistor, Metal Film, 1/8W, 1%
R20	3.3K	Resistor, Carbon Film, 1/4W, 5%
R21	1.0K	Resistor, Carbon Film, 1/4W, 5%
R22	121	Resistor, Metal Film, 1/8W, 1%
R23	845	Resistor, Metal Film, 1/8W, 1%
R24	845	Resistor, Metal Film, 1/8W, 1%
R25	121	Resistor, Metal Film, 1/8W, 1%
R26	1.5K	Resistor, Carbon Film, 1/4W, 5%
T1	12 VA LOW	Transformer
U1A	LT1007	Integrated Circuit
U1B	LT1007	Integrated Circuit
U1C	LT1007	Integrated Circuit
U1D	LT1007	Integrated Circuit
U2	LT1007	Integrated Circuit
U3	LM317T	Integrated Circuit
U4	LM337T	Integrated Circuit
Z0	4-40 KEP	Nut, Kep
Z0	1" #26	Wire #26
Z0	3-1/2" #24	Wire #24
Z0	TO-18 HAT	Heat Sinks
Z0	TO-18	Insulators
Z0	4-40X1/4P	Screw, Panhead Phillips
Z0	4-40X3/8P	Screw, Flathead Phillips
Z0	4-40X3/8P	Screw, Panhead Phillips
Z0	POWERBL	Power Entry Hardware
Z0	SR440FOO	Hardware, Misc.
Z0	NYLON SH	Washer, nylon
Z0	FILM	Insulators
Z0	T0-18 CLIP	Heat Sinks
Z0	INS	Connector, BNC, Panel Mount
Z0	USA	Line Cord
Z0	MINI 7 DIF	Connector, Female
Z0	SR440-1	Fabricated Part
Z0	SR440-2	Fabricated Part
Z0	SR440-5	Front Panel

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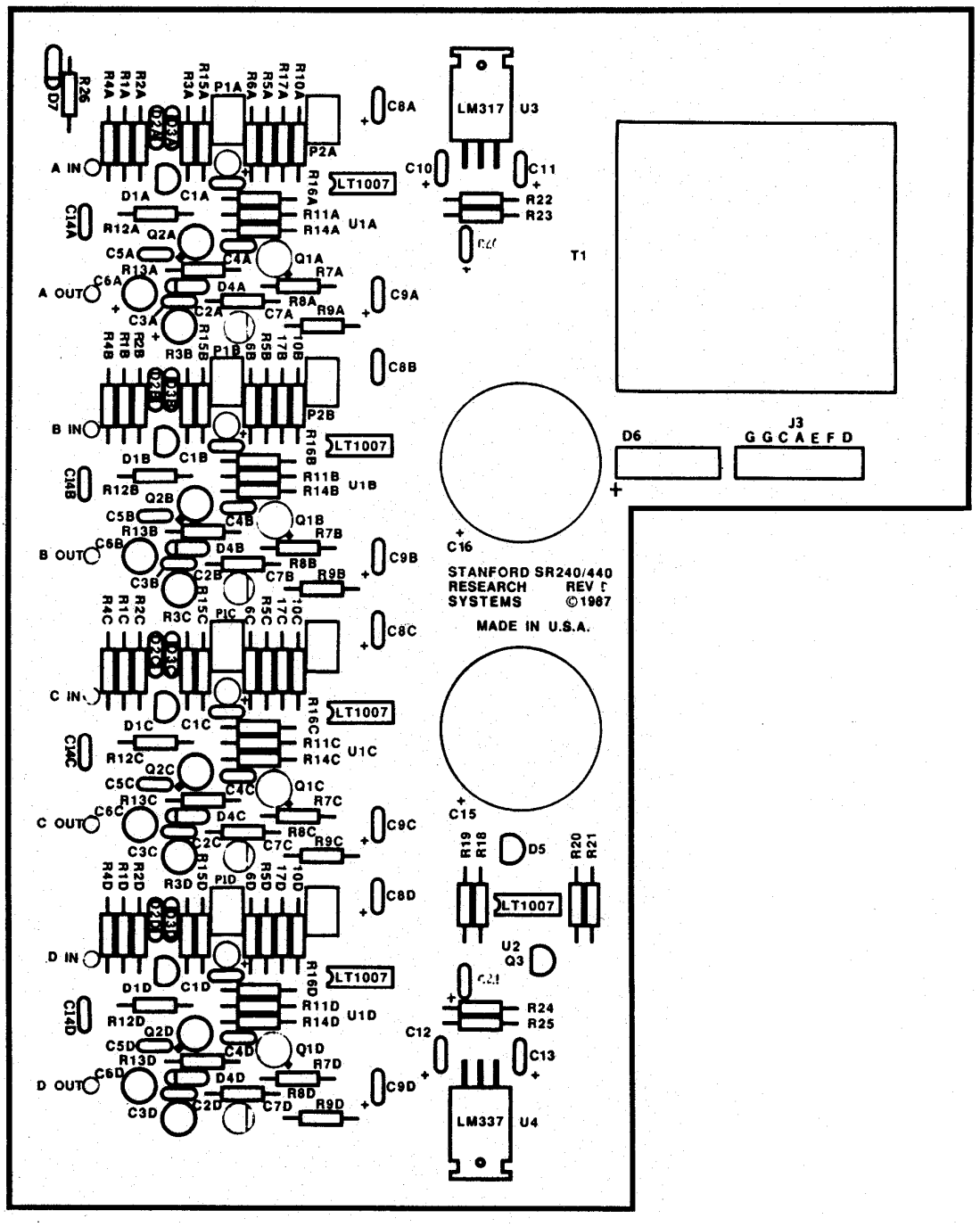


Figure 3 - SR440 PC Layout

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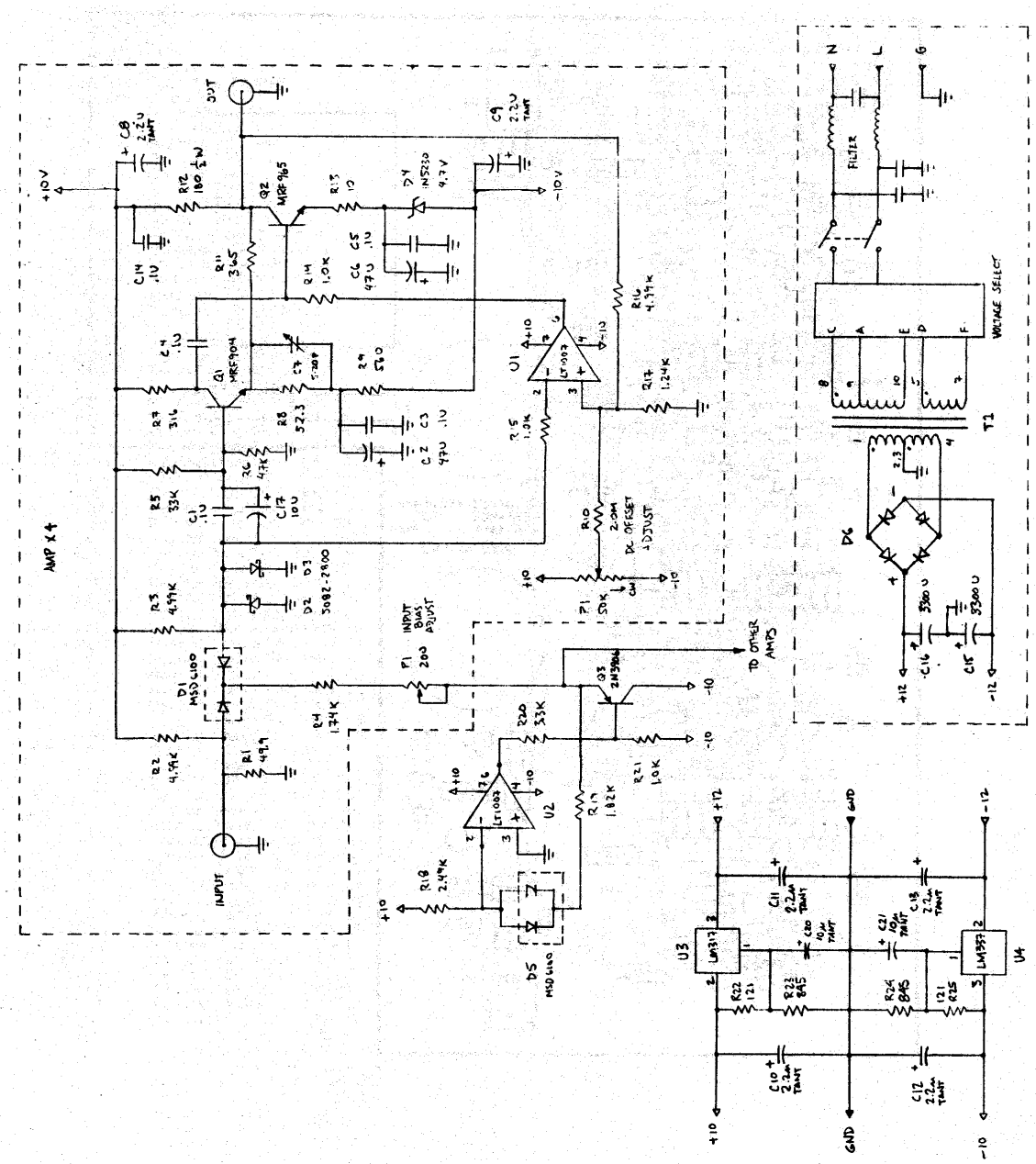


Figure 4 - SR440 Schematic

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