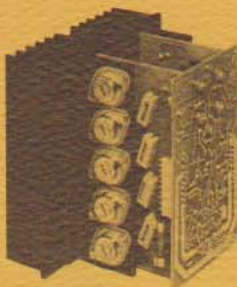
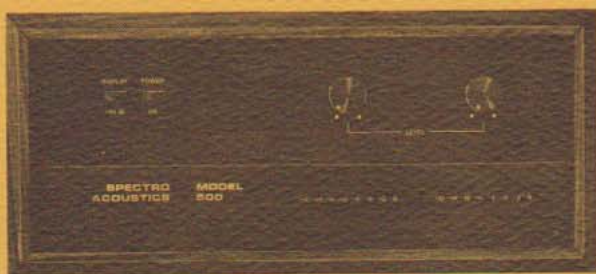


SPECTRO ACOUSTICS **GOLD**



POWER AMPLIFIER
MODEL 500

AMPLIFICATION EXCELLENCE SPECTRO ACOUSTICS MODEL 500



The Spectro SCAMP*

If your concern is for the utmost in high fidelity performance, Spectro Acoustics has designed the power amplifier you need.

The Spectro 500 series Power Amplifiers are the second generation of power amplifiers using unique SCAMP construction. This modular construction technique, used in all Spectro Acoustics power amplifiers, contains all of the electronic circuitry for a complete 250 watt monaural amplifier from the balanced differential input stage right through the rugged, multiple emitter, epitaxial silicon power output devices. Designed as a class AB quasi complimentary audio power amplifier, each SCAMP module contains 22 silicon transistors, 10 silicon diodes and an assortment of the finest close tolerance resistors and capacitors.

The SCAMP's rugged construction utilizes the absolute minimum of distortion prone hard wiring, replacing that wire with military grade printed circuit boards whenever possible in the circuit design. The results:

- greater consistency unit to unit
- less possibility of distortion caused by improper lead dress
- greater reliability
- ease of service
- Each power transistor uses multiple emitter type construction for higher thermal reliability and extended safe operating area.
- VI or load line limiters to protect the output transistors from operating outside of their safe operating area by eliminating the drive current.
- Low pass filter on the input to prevent RF energy from getting into the input of the power amplifier.
- Extremely large and effective heat sink surface areas to provide maximum thermal stability.

The Spectro Acoustics Model 500 series Power Amplifier is a 500 watt package of performance; an engineering accomplishment that looks the part with gold accents against a black anodized front panel making an elegant statement about the quality within. Construction of the Spectro 500 is modular and uses self contained amplifier (SCAMP*) units. Incredible head room is achieved by Spectro's massive unregulated power supply for the neutrality and definition demanded by discriminating audiophiles. Internal protection from RF interference is provided and each SCAMP module has load line limiters built into monitor both the voltage across the output transistors and the current through them. These techniques are used in all Spectro Power Amplifiers.

The SCAMP modules are designed to be fully interchangeable and can be replaced for instant action warranty service with a screw driver as the only required tool. Should your Spectro Model 500 ever fail to perform to its specifications your dealer will be able to, in many cases, replace the defective SCAMP module the same day.

The Spectro Acoustics Model 500 Series Power Amplifiers utilize a massive unregulated power supply (plus and minus 92 volts) greater than most power amplifiers of comparable size. The result is:

- Increased head room
- Sharper transient response
- Greater dynamic range

The combination of an unregulated power supply and features of Spectro's unique SCAMP system provide deep, well defined bass response; crystalline, concise, high frequencies and mid-range depth heretofore not thought possible from a solid state amplifier.

Two models, the 500 and 500SR, are equipped with eight segment, dual channel, LED peak power display with switchable sensitivity.

Available in three models, the 500R is designed primarily for professional sound reinforcement and eliminates all unnecessary control functions, the 500SR (Super Rack) which is designed for the professional who requires gain control and output monitoring and the 500, designed for the audiophiles home high fidelity listening system.

Spectro Acoustics Model 500 Power Amplifier offers amplification excellence and is dedicated to performance, reliability and value.

*A trade mark of Spectro Acoustics Inc.

0 POWER AMPLIFIER



Spectro Acoustics Model 500R for professional sound reinforcement



Spectro Acoustics Model 500SR (Super Rack) for professionals who need gain control and output monitoring.

SPECIFICATIONS

POWER OUTPUT: 250 watts RMS per channel.
FTC Rating Both channels driven, 8 ohms, 20Hz to 20KHz, with less than .25% THD.

TYPICAL POWER AT CLIPPING: 325 watts RMS per channel.
Each channel driven, 8 ohms, musical program material.

DISTORTION: THD, less than .25% at any frequency between 20Hz and 20KHz and at any power level from 250mW to 250W into 8 ohms.

IM, less than .25% standard SMPTE test frequencies, 60Hz and 7000Hz mixed 4 to 1, at any power level from 250mW to 250W into an 8 ohm load.

FREQUENCY RESPONSE: 20Hz to 20KHz ± 0.1 dB
10Hz to 40KHz ± 1 dB
5Hz to 80KHz ± 3 dB

Measured at 1 watt output level into 8 ohms.

HUM & NOISE: Better than 100 dB below full output, unweighted. Better than 108 dB below full output, "A" weighted.

SENSITIVITY: 1.5V RMS input for 250 watts into 8 ohm load.

INPUT IMPEDANCE: Greater than 16K ohms.

OUTPUT CAPABILITIES: Voltage at Clipping--51 to 36 volts RMS, depending on load and duty cycle.

Minimum Recommended Load -- 4 ohms.

Damping Factor --150+.

Stability--Unconditionally stable under any load, including electrostatic speakers.

DIMENSIONS: Model 500:
17" wide x 7" high x 12" deep
Model 500R and Model 500SR:
19" wide x 7" high x 12" deep

WEIGHT: 40 pounds.

Specifications subject to change without notice

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INTRODUCTION

The Spectro Acoustics Model 500 Stereo Power Amplifier is designed with removable self contained amplifier (Scamp*) modules for easy repair or replacement.

SCAMP* DESCRIPTION

Each 500 Scamp* is divided into three separate circuit boards, connected together by 10 pin molex connectors. One board (referred to through out this manual as the "input board") contains all input, pre-driver, and protection circuitry which plugs into the two output boards, one for the negative and one for the positive half of the signal contain the output and driver transistors, fuses, flyback diodes and associated output device resistors.

The dotted lines in the schematic diagram separate input board circuitry from output assembly circuitry.

CIRCUIT DISCRIPTION

Input signal is applied to the base of Q2. Q1 supplies a constant current to the differential voltage amplifier Q2 and Q3.

Out of phase signals appearing at the collectors of Q2 and Q3 are fed to the bases of voltage amplifiers Q7 and Q4. Q4 drives inverter Q5, which is in series with Q6 and Q7. Output predrivers Q10 and Q11, driven by Q5 and Q7, supply base current to output drivers Q12 and Q13. Q12 and Q13 supply the final current drive for the output transistors Q14 thru Q21.

Bias transistor Q6, controls the forward bias to the output and current drivers to reduce crossover distortion. Trimpot R43 is for bias adjustment. NOTE: Read "Biasing Prodecure" before turning R43!!!

Negative feedback is applied to the base of Q3 from the output through R13 and R14. R14 is connected to the speaker terminal side of the speaker fuse.

Flyback diodes CR9 and CR10 short out excessive inductive kick-back voltages that could damage the output devices.

The output protection circuit serves to short out base drive

to Q10 and Q11 through the collector-emitter junctions of Q8 and Q9 when they are turned on by increasing voltage across R34 and R42 indicating excessive current in the outputs. The protection circuit will normally operate only when the amplifier is connected to a very low output impedance (less than 2 ohms).

LED CIRCUIT

The LED circuit consists of a series of comparitors each with a reference voltage on its + input determined by the voltage divider network R1 thru R20.

The output of each channel amplifier goes to its LED circuit and is rectified and divided by CR17, CR18, R21 thru R24. When the audio signal is greater or equal to the voltage reference on the comparitors + input, the comparitor turns on its LED indicating power level.

The power supply for this board starts with the LED winding (green wires on power transformer) going to the bridge rectifier (CR19 thru CR 22). After filtering, C4, the voltage is regulated by Darlington Q1, 27 volt Zener diode DR23 and its limiting resistor R41. The typical problems of this board are the comparator IC's and transistor Q1.

POWER SUPPLY

The Model 500's power supply is common to both channels and supplies around \pm 90 volts, unloaded with a 120 volt line voltage.

The power transformer secondary has a center tapped winding for Scamps* and a 30 volt winding to power the pilot lights and LED display for the regular Model 500, just the LED display on the Model 500SR and the single pilot LED on the Model 500R.

Export units are provided with a dual primary winding transformer which comes wired for 240 volt A.C. operation (primaries wired in series) but can be re-strapped at any time for 120 volt A.C. operation (primaries wired in parallel). When re-strapping be sure to observe phasing of the windings as shown on the schematic diagram.

The unit has "user accessible" speaker and power fuses. The

speaker fuses are factory supplied as 5 amp AGC. The power fuses are supplied with 10 amp AGC for 120 volt A.C. operation and 5 amp AGC for 240 volt operation. Under no event should the power fuses be replaced with higher than the rated values.

Before any conclusions regarding the condition of the power supply are drawn, it is wise to remove both Scamp* modules and re-measure the voltages. If the power supply is still inoperative, or supplying other than the correct D.C. voltages, then check the power supply. By disconnecting the two big red wires going to the bridge rectifier from the transformer, the transformers secondary voltage can be measured across these two wires. An A.C. voltage of around 124 volts should exist if the transformer is good and is receiving proper voltage on its primary winding. If you measure incorrect voltages or none at all, it could be the power transformer, the on-off switch, or a broken connection. If the secondary voltages are alright then suspect the bridge rectifier next. Disconnect the wires from the bridge and with your ohmmeter on low ohms, check the bridge diodes the following way:

To test for shorted diodes, connect the ohmmeters positive (red) lead to the + terminal of the bridge. Touching the negative ohmmeter lead to any of the remaining three leads should yield a very high resistance reading, (greater than 50K ohms). Measuring across the two A.C. terminals (in either direction) should also yield a high resistance reading. To test for open diodes, connect the ohmmeter's positive lead to the - terminal, then connect the negative lead to the + terminal and measure for low resistance at both A.C. terminals again. If any reading does not yield proper results, replace the bridge rectifier (Spectro Acoustics, Inc. Part Number 105-0031). This is a 25 amp rated 200PIV unit.

If both the power transformer and bridge tests alright, but the power supply still does not operate properly replace one or both filter capacitors depending on which one yields improper readings.

If the main D.C. supply is alright, but the small secondary winding (two green wires) that run the pilot lights, LED indicator

board is inoperative, replace the power transformer. (Spectro Acoustics, Inc. Part Number 104-0013 standard 120 volt, Model or Part Number 104-0014, export Model with dual primaries 120/240 volt.)

After repairing the power supply, be sure that the proper line fuse is installed.

OUTPUT FAILURE

In our experience at the factory, by far the most common warranty problem in the Model 500 is that of output transistor failure. This is generally true in all power amplifiers, regardless of expense or quality of design, because of all the components in a power amplifier, the output transistors are exposed to the most abuse. Thermal stress caused by constant heating and cooling of these devices during the operation combines with the high current and voltage (hence power dissipation) to torture these devices during normal (and sometimes ab-normal) use.

The fuses on each Scamp* are readily visible without removing the modules, and offer a very good indication of blown output devices. If one or both of these fuses on each module are open, chances are good that one or more output devices are destroyed. Of course, the initial breakdown occurs in only one device, but, in some cases, the instantaneous current surge that accompanies a device failure will take an otherwise "healthy" device to rest along with the initial weak transistor.

The procedure for removing a Scamp* module is quite simple if the following sequence of events is adhered to. In some cases, where down time is critical, or simply as a general policy, we recommend that the repair facility have an extra Scamp* module (available from Spectro Acoustics, Inc. to authorized warranty stations and dealers on an exchange basis) so that, rather than causing the customer to wait for the repair of his unit, the repair station can simply install a new module and either fix or exchange the defective Scamp* at their convenience. This also applies to Scamps* which for one reason or another seem to defy repair or have chronic problems.

SCAMP* REMOVAL AND REPLACEMENT

- 1) Unplug the unit.
- 2) Remove the top cover by removing the 12 retaining screws (8 on top and 4 on the bottom), spreading the top cover corner lips and lifting the top cover up and off the unit.
- 3) Remove the 4 Scamp* retaining screws and their associated nuts.
- 4) Remove the Scamp* by pulling it straight out the back of the unit.
- 5) Do not replace the Scamp* fuses without first checking the output transistors, since these fuses tend to give an indication of blown outputs.
- 6) When installing the new or repaired Scamp*, make sure the molex connector pins are aligned properly, or else the Scamp* could be damaged when the unit is turned on.

SCAMP* REPAIR

Once the Scamp* has been removed, visually inspect it for fried or charred components. As mentioned before, a blown Scamp* fuse is a good indication of output device failure.

In older units, the Scamp* fuses were 8 amp and sometimes blow under heavy load conditions. Replace these with 10 amp fuses.

When outputs fail, or Scamp* fuses blow, R29 and or R30 will open up because they have to carry the full load of Q10 and Q11 after the outputs go. These are flame proof, so it may not be visually apparent that these are open. These resistors should also be replaced with flame proof ones. Also check protection transistors Q8 and Q9.

In nearly every case a blown power transistor (Q12 thru Q21) will exhibit a short circuit between all three of its terminals, or at least from collector to emitter, so it is often possible to check these devices without removing them from the board. In order to test these without removing them, it is suggested that the resistors that are connected to the emitters of these devices (R34 thru R41, 1.5 ohms/5watt) be lifted at one end before measurements are made. Once this has been done, it is a simple task to test for

shorted output transistors. Using a standard V.O.M. in its medium resistance range, connect the meter across the transistors case (collector) and its emitter lead from which you disconnected the .51 ohm resistor (negative lead to case/positive lead to emitter). Measurement should show an open circuit (or greater than 50K ohms) if the particular device is not shorted. The base/emitter junctions should also be tested on devices that do not show a C/E short. This can be done by touching the meter's positive lead to the base terminal circuit board trace while the negative probe is touched to each devices emitter pin. The forward biased junctions should show a low resistance reading under these conditions. To test the base/emitter junctions for reverse bias conditions, simply reverse the test leads which (on a good device) will render a high reading (greater than 50K) due to the "off" condition of the junction.

It is also wise to check the .51 ohm/ 5 watt output resistors that you lifted while checking the outputs.

Once the faulty device(s) have been located, remove its two screws, and then the transistor. Notice that under each transistor is a mica washer, which serves to insulate the cases of these devices (which are live electrical contacts) from the grounded heatsink fins. This washer is coated with silicon thermal compound on both sides, and when installing new output transistors it is extremely important that the washer be used and that it receives a fresh coating of thermal compound (Wafefield type 120 or equivalent).

In the first production units, this washer was a gray "sill" pad that did not need silicon compound. If at all possible these should be replaced with TO-3 Mica washers and thermal compound.

The screws should be tightened with a reasonable amount of torque applied to insure a good thermal path from device to heatsink. Transistors should be replaced one at a time so that the circuit board does not come loose from the heatsink. Once the transistors have been checked and replaced, it is wise to check for shorts between the output transistor cases and the heatsink due to burrs poking through the mica washers.

TESTING THE INPUT BOARD

It is a good idea to test the Scamp* input board separately from the output-heatsink assembly to insure that when they are connected together, improper operation of the input board will not cause failure of the output devices.

- 1) Turn the unit off and disconnect all input and output connections from the amp.
- 2) Turn the bias control down (fully counter-clockwise).
- 3) Plug the Scamp* input board (without the output assembly) into its normal 10 pin molex connector.
- 4) Set your voltmeter to D.C. volts.
- 5) Connect the voltmeter's common lead to amplifiers negative supply rail.
- 6) Connect the voltmeter's positive lead to the collector (case) of the negative predriver Q11 (1E03).
- 7) Turn the power on and observe the voltage. It should read between .2 and .4 volts. Turn the bias control up (fully clockwise). It should read between 1.0 and 1.2 volts. Turn bias control down.

To test the positive drive voltage:

- 8) Connect the voltmeter's common lead to chassis ground. Connect the voltmeter's positive lead to the emitter lead of positive predriver Q10 (1E02).
- 9) Repeat the test in Step 7 above. Results should be approximately the same as in Step 7.

If the voltages measured are correct then it should be safe to connect the input board and output heatsink assembly together.

If the drive voltages just measured have little or no change while rotating the bias trimpot, but read within those voltages specified in Step 7, replace the bias transistor Q6 (1A18).

You may also want to check the limiter circuit components, especially the transistors Q8 and Q9.

If the drive voltages measure close to that of the supply voltages (\pm 90 volts), test or replace all transistors on the input board. Also check R29 and R30 for opens.

BIAS ADJUSTMENT

For absolute best reliability, the bias trimpot (RL13) should be turned fully counter-clockwise.

For the best compromise between thermal stability and distortion follow this procedure:

- 1) Remove all input and output load connections.
- 2) Let the unit warm up for at least five minutes before attempting to adjust bias!
- 3) Set your voltmeter on its most sensitive D.C. volt range. Connect its leads between the bases of output transistors Q14 thru Q20, and the hot (red) speaker terminal for that channel.
- 4) Adjust the bias trimpot for a .10 volt (100 millivolts) reading on your voltmeter.

This completes the bias adjustment.

FINAL TEST PROCEDURE

Before hooking up a load to the amplifier, connect an A.C. voltmeter, and oscilloscope across the speaker terminals. Check the output for D.C. offset (should be less than .1 volt), and oscillations. Now connect an 8 ohm resistor of at least 250 watt capabilities across the speaker terminals along with the meter and oscilloscope. Also connect a sine wave generator to the input of the amplifier, set the generator at 1K Hz and slowly bring up the level until your meter reads 45 volts A.C. (250 watts across 8 ohms). You should see a clean and undistorted sine wave. Check amplifiers frequency response from 20 Hz to 20K Hz (may read just slightly under 250 watts at 20K Hz).

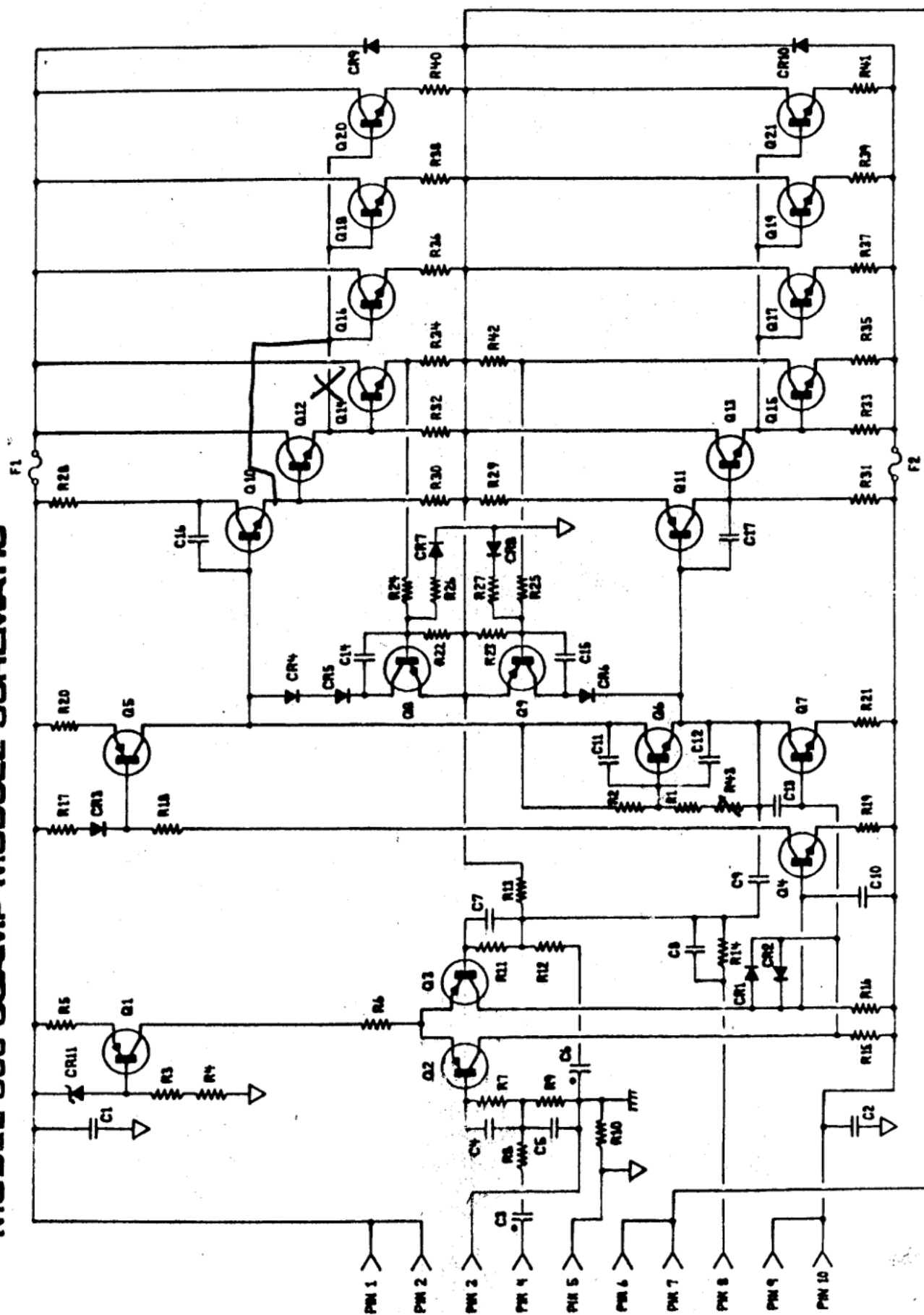
To test the protection circuit, set frequency at 20Hz and full power output. Then short the speaker output to ground from the input terminal of the fuse holder to prevent blowing the speaker fuse.

After about 5 seconds, remove the short and make sure the amplifier resumes operation.

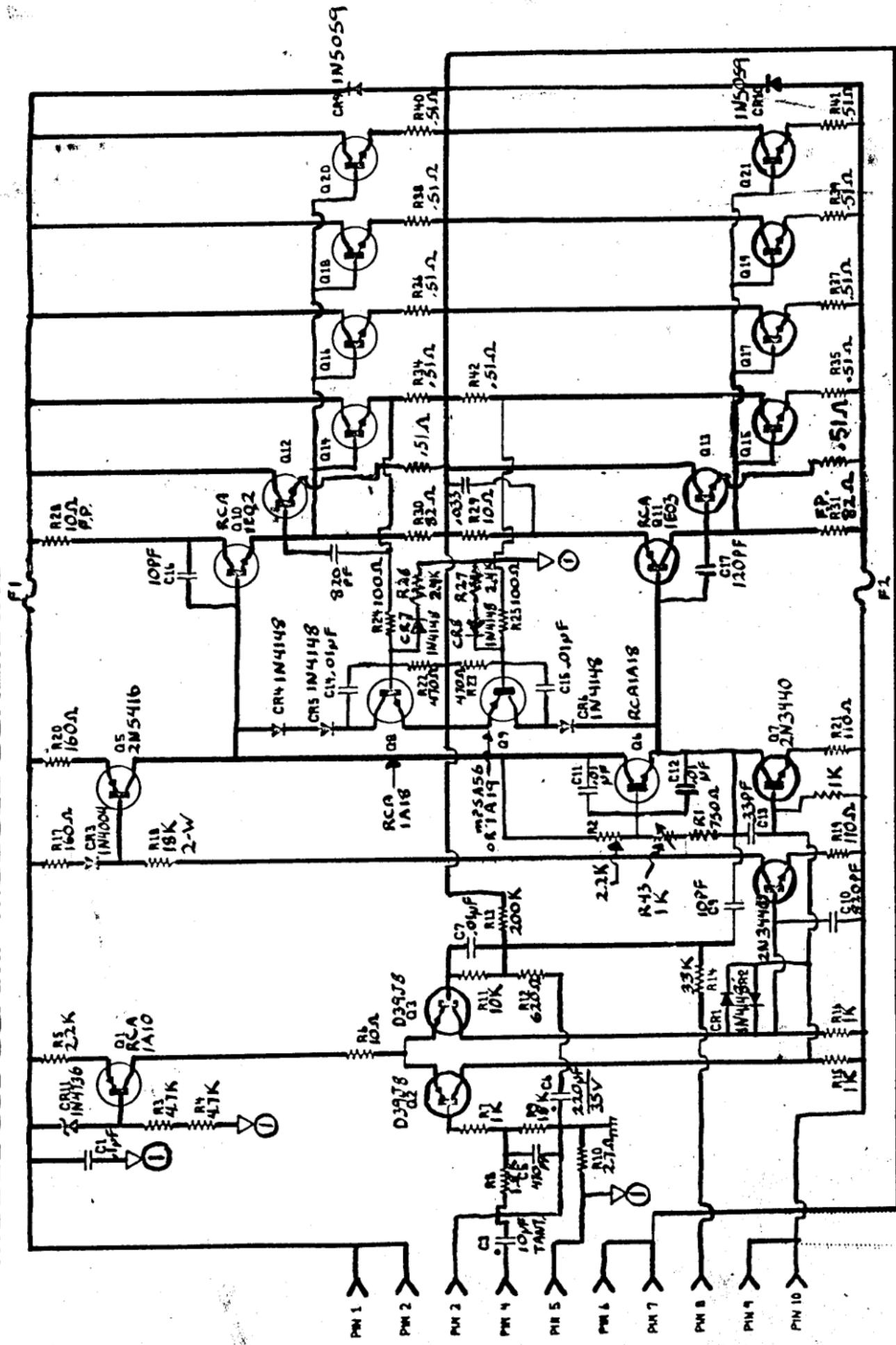
*TRADEMARK

SPECTRO ACOUSTICS

MODEL 500 SCAMP MODULE SCHEMATIC



SPECTRO ACoustics MODEL 800 SCAMP MODULE SCHEMATIC



REV. BY P.C. GOODWIN

PART NUMBER

SEMICONDUCTORS:

CR1, CR2, CR4	Diode, signal, type 1N4148 or 1N914	105-0019
CR5, CR6, CR7, CR8	Diode, rectifier, type 1N4003 or 1N4004	105-0002
CR3	Diode, power rectifier, type 1N5059	105-0021
CR9, CR10	Zener diode, 6.8V 1 W, type 1N4736	105-0032
CR11	Transistors, PNP high voltage, type RCA1A10	105-0027
Q1	Transistor, PNP high voltage, type D39J8	105-0030
Q2, Q3	Transistor, NPN high voltage, type 2N3440	105-0028
Q4, Q7	Transistor, PNP high voltage, type 2N5416	105-0029
Q5	Transistor, NPN small signal, type RCA 1A18	105-0025
Q6, Q8	Transistor, PNP small signal, type RCA 1A19	105-0026
Q9	Transistor, NPN H.V. Power, type TCA 1E02	105-0023
Q10	Transistor, PNP H.V. Power, type RCA 1E03	105-0024
Q11	Transistor, NPN H. V. Power, type RCA 1B05	105-0017
Q12, Q13, Q14, Q15		
Q16, Q17, Q18, Q19		
Q20, Q21		

CAPACITORS:

C1, C2	Mylar .1uf/100V10%	106-0012
C3	Electrolytic 10uf/25V/20%	106-0005
C4, C7, C11	Mylar .01uf/100V/10%	106-0023
C12, C14, C15		
C5	Ceramic 470pf/100V20%	106-0054
C6	Electrolytic 220uf/35V/20%	106-0059
C8, C9, C16	Ceramic 10pf/100V/10%	106-0019
C10	Ceramic 820pf/100V/20%	106-0060
C13	Ceramic 33pf/100V/20%	106-0018
C17	Ceramic 120pf/100V/10%	106-0057

RESISTORS:

R1	Carbon Film	910	ohms	1/2 watt	5%	109-0006
R2, R5	Carbon Film	2.2K	ohms	1/2 watt	5%	109-0010
R3, R4	Carbon Film	4.7K	ohms	1/2 watt	5%	109-0011
R6, R28, R29	Carbon Film	10	ohms	1/2 watt	5%	109-0075
R7, R15, R16	Carbon Film	1K	ohms	1/2 watt	5%	109-0007
R8, R26, R27	Carbon Film	1.8K	ohms	1/2 watt	5%	109-0009
R9, R14, R18	Carbon Film	18K	ohms	1/2 watt	5%	109-0037
R10	Carbon Film	2.7	ohms	1/2 watt	5%	109-0039
R11	Carbon Film	10K	ohms	1/2 watt	5%	109-0015
R12	Carbon Film	620	ohms	1/2 watt	5%	109-0081
R13	Carbon Film	200K	ohms	1/2 watt	5%	109-0086
R17, R19, R20, R21	Carbon Film	160	ohms	1/2 watt	5%	109-0078
R22, R23	Carbon Film	470	ohms	1/2 watt	5%	109-0004
R24, R25	Carbon Film	100	ohms	1/2 watt	5%	109-0038
R30, R31	Carbon Film	82	ohms	1/2 watt	5%	109-0077
R32, R33	Carbon Film	56	ohms	1/2 watt	5%	109-0076
R34, R35, R36, R37	Wire Wound	.51	ohms	5 watt	10%	109-0074
R38, R39, R40, R41						
R42						
R43	Trim Pot	1K	ohms	1/2 watt	10%	111-0023

SEMICONDUCTORS:

CR1 - CR4	Diode, Rectifier, type 1N4003, 1N4001	105-0002
CR5	Bridge Rectifier, type 25A, 200V	105-0031
CR6	LED (Red) .128 Dia. (Model 500R ONLY)	105-0001
CR7	Diode, Signal, type 1N4148 or 1N914 (Model 500R ONLY)	105-0019

CAPACITORS:

C1, C2	Electrolytic, 13,000uf/100V/20%	106-0058
C3, C4	Mylar .22/100V/10%	106-0016
C5, C6	Mylar .1/100V/10%	106-0012

RESISTORS:

R1, R2	Carbon Film 3.3K ohms 1/2 watt 5% (Model 500R ONLY)	109-0012
R3, R4	Wire Wound 10 ohms 5 watt 10%	109-0073
R5, R6	Pot 100K ohms 1/2 watt 10% (Model 500 & 500SR ONLY)	111-0021
	Carbon Film 100K ohms 1/2 watt 10% (Model 500R ONLY)	109-0058

MISCELLANEOUS:

F1	120V Units: Fuse, 10A 3AB	108-0062
	240V Units: Fuse, 5A AGC	108-0037
F2, F3	Fuse, 5A AGC	108-0037
L1, L2	Inductors, 10uH	104-0009
PL1 - PL12	Pilot Lamps, 28V 40mA (Model 500 ONLY)	108-0031
T1	Power Transformer, 120V Units	104-0013
	Power Transformer, 240V Units	104-0014

CIRCUIT BOARDS:

Lamp Board	Model 500 ONLY	103-0011
LED Board	Model 500R ONLY	103-0023
Connector Board		103-0035
Switch Board	Model 500 and 500SR ONLY	103-0037

ICAMP MODULE PARTS LISTING (Page 2)

PART NUMBER

HEAT SINKS:

Heat sink for Q1, Q4, Q5, Q7	TO-39 heatsink, press-on type	108-0042
Heat sink for Q10, Q11	TO-66 heatsink	108-0068
Heat sink for Q12, Q21	TO-3 heatsink, extrusion type	101-0038

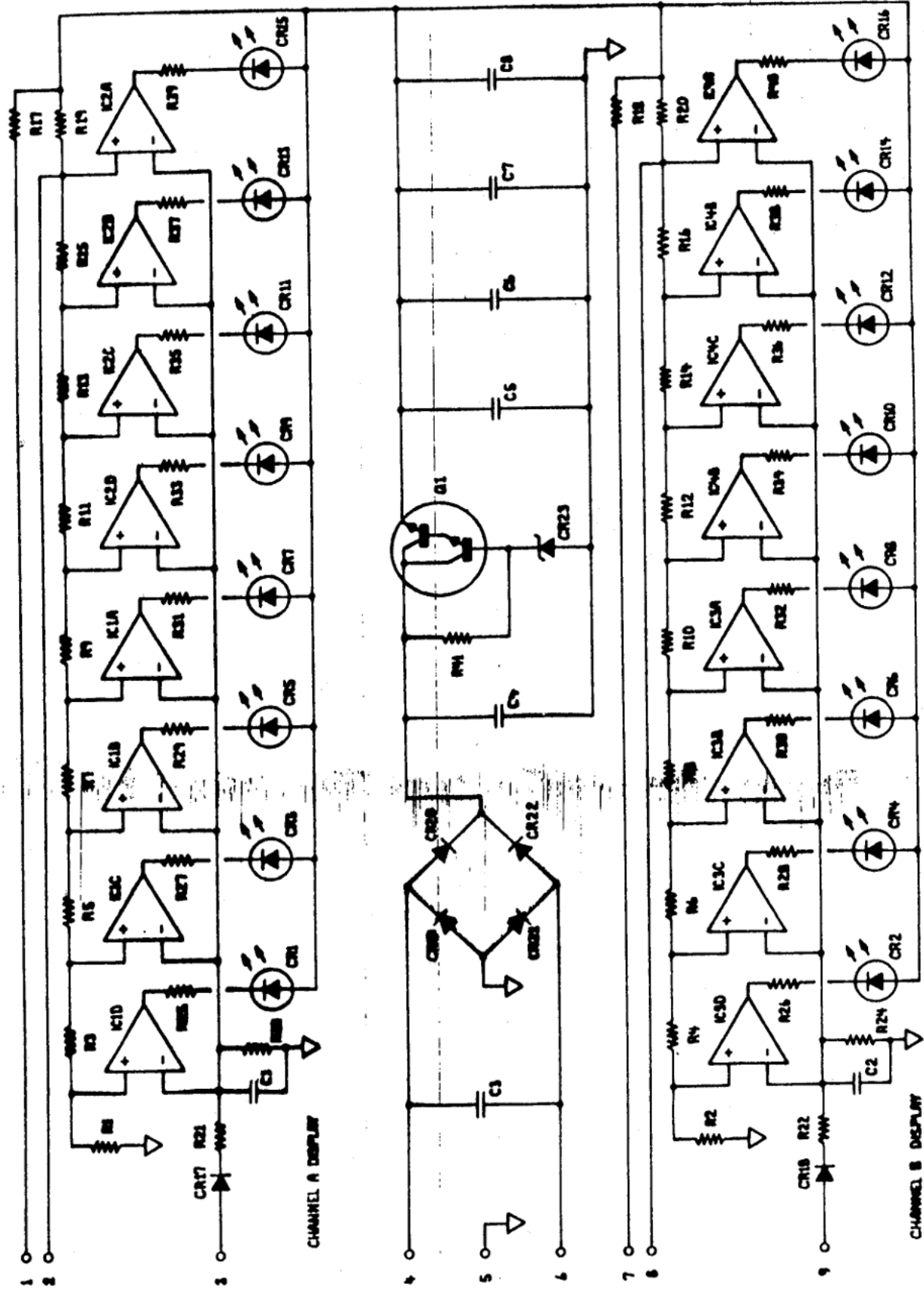
CIRCUIT BOARDS:

Positive Side Output Stage Board	103-0032
Negative Side Output Stage Board	103-0033
Input Stage Board	103-0039

MISCELLANEOUS:

F1, F2	AGC 5 Amp	108-0037
Transistor Sockets for Q12 - Q21		108-0063

SPECTRU ALUMINUM MODEL 500 LED POWER LEVEL DISPLAY SCHEMATIC



LED POWER LEVEL DISPLAY PARTS LISTING

REVISION A 8-77

PART NUMBER

SEMICONDUCTORS:

CR1 - CR16 Model 500 LED (Red) .120 Dia.
 Model 500SR LED (Red) .180 Dia.
 CR17 - CR22 Diode, Rectifier, type 1N4003, 1N4001
 CR23 Zener Diode, 27V 1W, type 1N4750
 IC1 - IC4 Quad Comparator, type 3302
 Q1 Transistor, Darlington Power, Type D40K2

105-0037
 105-0036
 105-0002
 105-0035
 105-0034
 105-0033

CAPACITORS:

C1, C2, C3, C7, C8 Mylar .01uf/100V/10%
 C4, C5, C6 Electrolytic 50uf/63V/20%

106-0012
 106-0034

RESISTORS:

R1, R2	Carbon Film	160	ohms	1/2 watt	5%
R3, R4	Carbon Film	200	ohms	1/2 watt	5%
R5, R6	Carbon Film	390	ohms	1/2 watt	5%
R7, R8	Carbon Film	820	ohms	1/2 watt	5%
R9, R10	Carbon Film	680	ohms	1/2 watt	5%
R11, R12, R41	Carbon Film	1K	ohms	1/2 watt	5%
R13, R14	Carbon Film	1.3K	ohms	1/2 watt	5%
R15, R16	Carbon Film	1.8K	ohms	1/2 watt	5%
R17, R18, R21, R22	Carbon Film	2.2K	ohms	1/2 watt	5%
R19, R20	Carbon Film	20K	ohms	1/2 watt	5%
R 23, R24	Carbon Film	1.5K	ohms	1/2 watt	5%
R25 - R40	Carbon Film	1.6K	ohms	1/2 watt	5%

109-0078
 109-0079
 109-0080
 109-0082
 109-0065
 109-0007
 109-0083
 109-0009
 109-0010
 109-0048
 109-0084
 109-0085

CIRCUIT BOARDS:

LED Power Level Display Boards

103-0035