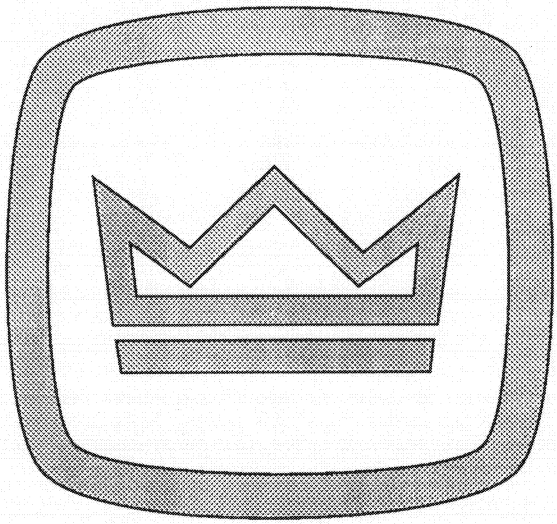

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POWER AMPLIFIER

SERVICE MANUAL

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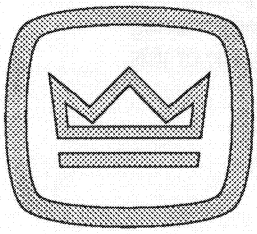

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SERVICE MANUAL

Mailing Address:
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Elkhart, IN 46515-1000

Shipping Address:
57620 C.R. 105
Elkhart, IN 46517-4095

KMR
4/92

The information furnished in this manual does not include all of the details of design, production, or variations of the equipment. Nor does it cover every possible situation which may arise during installation, operation or maintenance. If you need special assistance, beyond the scope of this manual, please contact the Crown International Customer Service Department.

Crown International, Inc.
Shipping:
57620 C.R. 105
Elkhart, Indiana 46517-4095
Mailing:
P.O. Box 1000
Elkhart, Indiana 46515-1000
Phone: (219) 294-8200
(800) 342-6939
Fax: (219) 294-8301

WARNING

TO PREVENT SHOCK OR FIRE HAZARD, DO NOT EXPOSE TO RAIN OR MOISTURE!

CAUTION

TO PREVENT SHOCK DO NOT USE THE POLARIZED AC PLUG OF THIS UNIT WITH AN UNPOLARIZED EXTENSION CORD, RECEPTACLE OR OTHER OUTLET WHERE THE BLADES CANNOT BE FULLY INSERTED.

ATTENTION

POUR PREVENIR LES CHOCS ELECTRIQUES NE PAS UTILISER CETTE FICHE POLARISEE AVEC UN PROLONGATEUR. UNE PRISE DE COURANT OU UNE AUTRIE SORTIE DE COURANT, SAUF SI LES LAMES PEUVENT ETRE INSEREES A FOND SANS EN LAISSER AUCUNE PARTIE A DECOUVERT.

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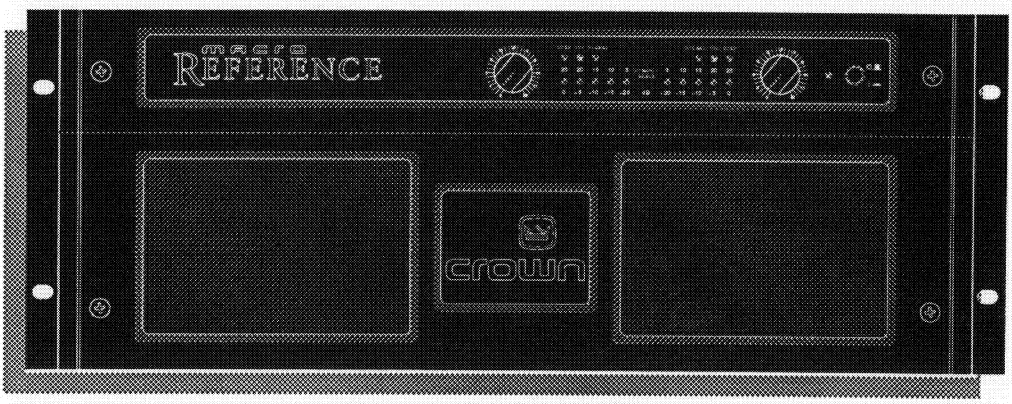


Fig. 1.1 Macro Reference

1 Introduction

This manual contains service information on the Crown Macro Reference power amplifier. It is designed to be used in conjunction with the Macro Reference Instruction Manual. However, some important information is duplicated in this Service Manual in case the Instruction Manual is not readily available.
NOTE: THE INFORMATION IN THIS MANUAL IS INTENDED FOR USE BY AN EXPERIENCED TECHNICIAN ONLY!

1.1 The Macro Reference

The Macro Reference amplifier is a compact, audio power amplifier designed for professional use. Providing high power amplification from 20Hz-20KHz with minimum distortion, the unit features balanced 1/4" phone and XLR inputs, bridged and parallel monophonic capability and a means for isolating signal shield ground from circuit ground.

1.2 Warranty

Each Instruction Manual contains basic policies as related to the customer. However, under questionable circumstances, please contact the Technical Service Department or Director of Customer Service at:

Crown International, Inc.
Shipping:
57620 C.R. 105
Elkhart, Indiana 46517-4095
Mailing:
P.O. Box 1000
Elkhart, Indiana 46515-1000
Phone: (219) 294-8200
(800) 342-6939
Fax: (219) 294-8301
BBS: (219) 294-8284

2 MAINTENANCE

2.1 Introduction

Section 4 contains technical information required to effectively and efficiently service and repair the Crown Macro Reference. Included are disassembly and reassembly procedures, required test equipment lists, checkout procedures and basic troubleshooting tips.

This information is intended for use by an ***experienced*** technician only!

Use this information in conjunction with the Instruction Manual, schematic/board layout diagrams, parts lists and exploded view drawings (the latter located in Sections 6, 7 and 8 of this manual).

2.2 Basic Troubleshooting

As is well know, time is an important factor in providing efficient service repair. Therefore, several time-saving troubleshooting steps are listed below. These hints may or may not already be implemented in your service work. If not, you may wish to experiment with them in order to help improve your efficiency. After all, time is money!

2.2.1. Establishing Problems

User complaints about defective operation may not always be clear or simple. Furthermore, the trouble the user has experienced may be due to the system and not the unit itself. If possible, talk to the user about this problem. This will usually be simpler than trying to understand written complaints. A first hand account of the problem can help in:

1. Getting the problem to re-occur on the service bench.
2. Getting an understanding of the probable cause. Some troubles will be obvious upon visual inspection. When the trouble (or its symptoms) is not so obvious ask:

a) Exactly what was the problem: how was it noticeable?
b) How was the unit being used?
c) Has the system as a whole been carefully examined for possible external problems?
d) How long had the unit been operating when the problem occurred? Was it heat related?

If the user is unavailable or unable to explain the trouble the next step is a thorough visual inspection.

2.2.2. Visual Inspection

A good visual inspection may often save hours of tedious troubleshooting. Make a habit of proceeding in an orderly manner to insure that no vital part of the following procedure is omitted. The visual inspection can be performed in 10 to 15 minutes. It is recommended both as a preventative maintenance procedure and also for its value in determining cause of malfunction

1. Check that all external screws are tight and that none are missing.
2. Check all fuses/circuit breakers.
3. Check for smooth and proper operation of switches, etc.
4. Inspect line cord for possible damage to cap, jacket and conductors.
5. Remove protective covers.
6. Check that all attaching parts for internal circuits are tight and that none are missing.
7. Inspect all wiring for charred insulation, or discoloration as evidence of previous overheating.
8. Check that all electrical connections are secure. This includes wire terminals, screw and stud type terminals, and all soldered connections.
9. Check for obvious destruction of internal structural parts. Distortion in any of these parts could mean that the unit has been dropped or subjected to severe shock.

2.3 Troubleshooting

The three steps to effective troubleshooting and repair were mentioned earlier. They can be summarized in the three following questions: What is the problem (effect)? What is causing the problem (cause)? What can be done to eliminate the cause (repair)? The purpose of this section is to help you answer these questions in an orderly manner.

Finding and fixing the problem(s) is not the end of maintenance. The final step is to thoroughly test the amplifier to be certain that it meets the factory specifications after it has been repaired. The test procedures in section 2.5.2 will help you do this as well as aid you in locating the cause of problem(s).

2.3.1 Identifying Symptoms

Why was the amplifier brought in for repair? Can you get it to malfunction again? (Some problems can be intermittent and difficult to find.) If you don't observe anything wrong with the amplifier, tactfully inquire how the owner used it and try to determine if it was misused or some other component in their system could have been at fault.

2.3.2 Macro Reference Electrical Checkout and Adjustment Procedures

The following instructions outline an orderly checkout and troubleshooting procedure. The purpose and arrangement of this procedure is to determine the cause of the trouble as quickly as possible; leading to a detection of which component part(s) must be replaced or repaired.

WARNING!!

Most adjustments are made with protective covers removed. This means prior to any non-ac-powered testing, discharge all power capacitors. Also, use extreme caution while making any internal adjustments when the unit is powered.

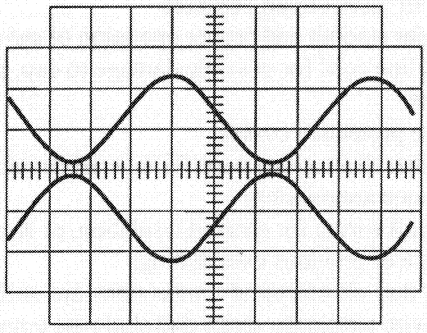


Fig. 2.1 Bridged MONO

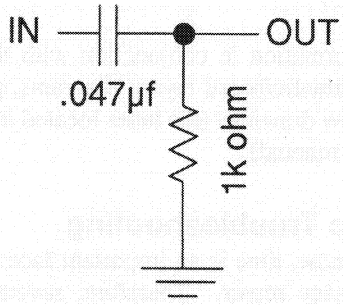


Fig. 2.2 Differenciated RC Circuit

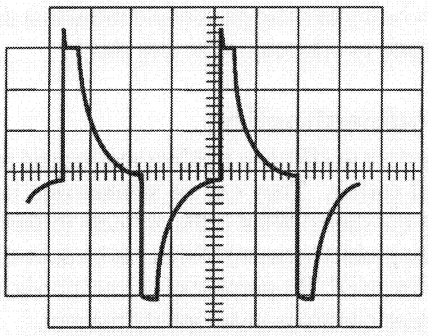


Fig. 2.3 Differentiated Square Wave

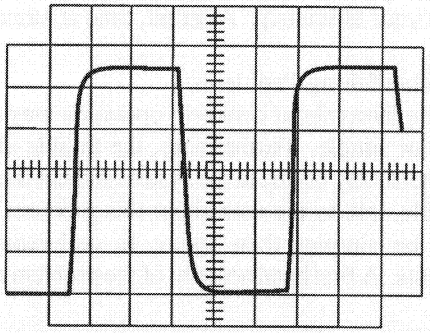


Fig. 2.4 10kHz Square Wave

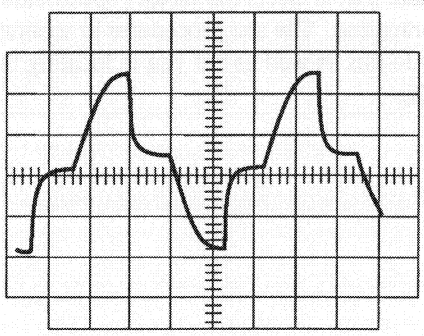


Fig. 2.5 Inductive Load

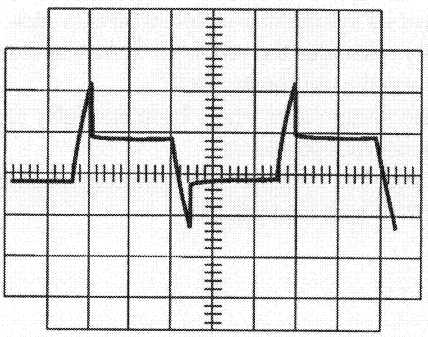


Fig. 2.6 ODEP Protection

Type of Test or Adjustment	Input Signal Characteristics	Comments
1. Bias	None	With a quiescent power of less than 90 watts measure the voltage across R302 and R402. The bias voltage should equal .350 VDC + .05 V - .000 V. If the bias voltage needs to be adjusted, adjust R326 and R426 for the correct bias voltages. Next measure the voltage across R321 and R421. This voltage should equal .35 VDC ± .025 V. If the bias voltage needs to be adjusted, adjust R323 and R423 for the correct bias voltage. Check the voltage across R309, R409, R322 and R422 to make sure it is between .500 to .600 VDC.
2. DC Output Offset	None	With the input level controls (R100 and R200) turned fully clockwise, the DC offset for both channels should be no more than +/- 10 millivolts. Note: There is no output offset adjustments for the Macro-Reference.
3. O.D.E.P Null	None	With the amplifier cool pin 1 of S100/S200, should measure -10VDC (+/-.1V). If needed adjust R121 and R221 for the correct voltages. Pin 3 of S100/S200, should measure +11.1VDC +/-.1V. If needed adjust R132 and R232 for the correct voltages.
4. Input C.M.R.	1kHz sq. wave; .775V	Using a balanced 1/4 inch input jack with the tip and ring shorted together insert a 5Vp-p 1 kHz square wave signal into the amplifier input. For amplifiers with 2.2 volt sensitivity use a 2.2 VAC signal. While monitoring the outputs of channel one and channel two with an oscilloscope adjust R512 and R612 for an output null.
5. Monophonic	1kHz sine wave; .415V	-Parallel Mono Tests With the stereo/mono switch in the parallel mono position insert a .775 VAC 1 kHz signal into channel one. There should be a two inphase signals present, equal in amplitude, at the outputs of channels one and two. Both of these signals will be controlled by channel one input level control. Switch the stereo/mono switch to stereo. There should be signal present only on channel one output. -Bridge Mono Tests With the stereo/mono switch in the bridge mono position, set the channel two input level control to full CCW. Insert a .775 VAC 1 kHz signal into channel one input. There should be signal present on both channel outputs, equal in amplitude, with channel two 180 degrees out of polarity from channel one (see Fig. 4.1 : page 4-8). Channel one input level control should control the output level for both channels. Return the amplifier to stereo operation.

Type of Test or Adjustment	Input Signal Characteristics	Comments
		THE FOLLOWING CHECKS ARE DONE BY USING A LOAD. PLEASE USE CAUTION AND FOLLOW THE CHECK OUT PROCEDURES CAREFULLY TO INSURE CORRECT RESULTS. **NOTE:** The following tests are done assuming that the amplifier is configured for .775 V input sensitivity. Input voltages will need to be greater if the amplifier is in the 26 dB gain position sensitivity. **CAUTION: THE FOLLOWING TESTS WILL REQUIRE A RESISTIVE LOAD CAPABLE OF 1500 WATTS INTO TWO OHMS.**
6. Current Limit Tests	1kHz sq. wave; 1 ohm	NOTE: The current limit tests require a differentiated square wave input. See Fig. 4.2 (page 4-8) for a circuit to create a differentiated square wave. On the channel under test insert a 1 kHz differentiated square wave. With a one ohm load on the output, monitor the output waveform with an oscilloscope. Slowly increase the input signal until the output signal starts to clip as shown in Fig. 4.3 (page 4-8). Current limiting should take place when the output reaches a 40 volt peak which would produce 40 amps of output current.
7. 10 kHz Square Wave	10kHz sq. wave; 8 ohm	With an 8 ohm load on each channel insert a 10 kHz square wave to produce a 20 VAC output (Fig. 4.4 : page 4-8). Observe the rise time of the signal which should be 13 volts per microsecond. The output waveform should be stable with no ringing. Some overshoot may occur with peak output voltages greater than 20 volts.
8. 20 kHz Sine Wave	20kHz sine wave; 8 ohm	With an 8 ohm load on each channel insert a 20 kHz sine wave on both inputs. Vary the amplitude of the input signal and observe where clipping takes place. The amplifier should produce at least 73 VAC on the output before clipping occurs.
9. 1 kHz Power Checks	1kHz sine wave; 8 ohm 1kHz sine wave; 4 ohm	With both channels operating, insert a 1 kHz signal into the inputs. Observe the following output voltages with the various output loads. **8 Ohm Load** Minimum output voltage before clipping should be 78 VAC (760 watts). **4 Ohm Load** Minimum output voltage before clipping should be 68.1 VAC (1160 watts).

Type of Test or Adjustment	Input Signal Characteristics	Comments
	1kHz sine wave; 2 ohm	**2 Ohm Load** Minimum output voltage before clipping should be 54 VAC (1458 watts).
10 Inductive Load	1kHz sine wave; .415V;159µh coil	Insert a 1 kHz sine wave, .415 VAC into both channels and connect a 159 microhenries inductive load (paralleled with an 8 ohm resistor) on the output of each channel. Observe the output waveform (Fig. 4.5 : page 4-8).
11. ODEP Limiting	60Hz sine wave; .415V	For the following tests, the cooling fan blade must be removed to allow the heatsinks to heat up. With a 2 ohm load per channel, insert a .415 VAC, 60 Hz input signal to both channels. Allow the heatsinks to heat up until the ODEP protection circuit starts to limit the output signal. The waveform in Fig. 4.6 (page 4-8) should be observed. On the Macro-Reference check to see that the amber LED is not lit when ODEP is activated. Next configure the amp for parallel mono operation . With the input signal now present on channel one only, load channel one output with 8 ohms and channel two with 2 ohms. Observe that channel two ODEP protection circuit is limiting both channel one and channel two outputs. Next load channel one with 2 ohms and channel two with 8 ohms. Observe that channel one ODEP protection circuit is limiting both channel one and channel two outputs. Reinstall the cooling fan blade after this test has been completed.
12. I.M. Distortion	60Hz/7kHz (4:1 ratio); 8 ohm	Using a 60 Hz / 7 kHz input signal summed in a 4:1 ratio with 8 ohm loads on both channels measure the I.M. distortion at the rated output of 760 watts for each channel. Readings should be less than .05% from 28 milliwatts to 760 watts.
13. T.H.D.	20kHz sine wave; 8 ohm	Using a 20 kHz input signal with 8 ohm loads on both channels measure the T.H.D. distortion at the rated output of 666 watts (73 VAC) for each channel. The rated RMS sum total harmonic distortion should be less than .1% of the fundamental output voltage
14. Signal To Noise	Input sensitivity switch to 26 dB	With input jacks shorted insure that each channel has a signal-to-noise ratio greater than -120 dB below the rated power of 760 watts into 8 ohms. Be sure to use a 20 Hz to 20 kHz bandpass filter ahead of the voltmeter.
15. IOC® Operation	1kHz sine wave; 8 ohm	With no load on the amplifier apply a 1 VRMS, 1 kHz signal to the input of each channel. Note that the green LED is brightly lit to indicate clipping. Now turn the level down and note that the green LED dims to indicate normal signal presence. Check both channels.

Type of Test or Adjustment	Input Signal Characteristics	Comments
16. Input Sensitivity	1kHz sine wave; .775 V	Adjust the input level controls (R100 and R200) fully CW and set the sensitivity switch (S3) to the 26dB gain position. With an input level of .775V at 1kHz amplifier output level should measurement 15.2 - 15.8 Vrms. Return sensitivity switch to .775 position. Output level should measure 76 - 79 Vrms.
17. Display Calibration	1 KHz sine wave: Sensitivity switch in high gain (.775) position	**Level Verification:** While viewing the amplifier upside down and from the front switch S-1 (on the display board) to the right or Level position. Apply a 1 KHz input signal to both channels. Slowly increase the input amplitude until the -10dB LED begins to pulse. Adjust R78 on the display board until the channel 1 and channel 2 indicators pulse at the same frequency. Indicators should illuminate within the tolerances specified below:

LEVEL INDICATOR	OUTPUT LEVELS (RMS) REQUIRED TO ILLUMINATE
-20 dB	6.95 - 8.75
-15 dB	12.36 - 15.56
-10 dB	21.9 - 27.67
-5 dB	39.09 - 49.21
0 dB	69.51 - 87.51

3 Voltage Conversion

The Macro Reference can be wired for 100VAC, 120VAC, 200VAC, 220VAC or 240VAC operation. This is made possible by use of a multitap transformer for the high energy power supplies. Follow the table shown with the schematic, and the drawing below:

CAUTION: Because there is a risk of electric shock, only a competent technician should attempt to alter the line voltage configuration.

1. Remove the top cover of the Macro Reference (held on by 8 screws).
2. With the front panel toward you, locate the control module where all pwer connections are made to the power transformers.
3. Make the appropriate change in jumpers for the desired operating voltage. See Fig. 3.1 and Fig. 3.2.
4. Replace the 30 amp circuit breaker with a 20 circuit breaker, for all connections 200V and above.
5. Change the line cord tag to read the correct voltage.

Note: Use only a 30 amp circuit breaker for 100VAC or 120VAC operation. Use only a 20 amp circuit breaker for 200VAC, 220VAC or 240VAC operation.

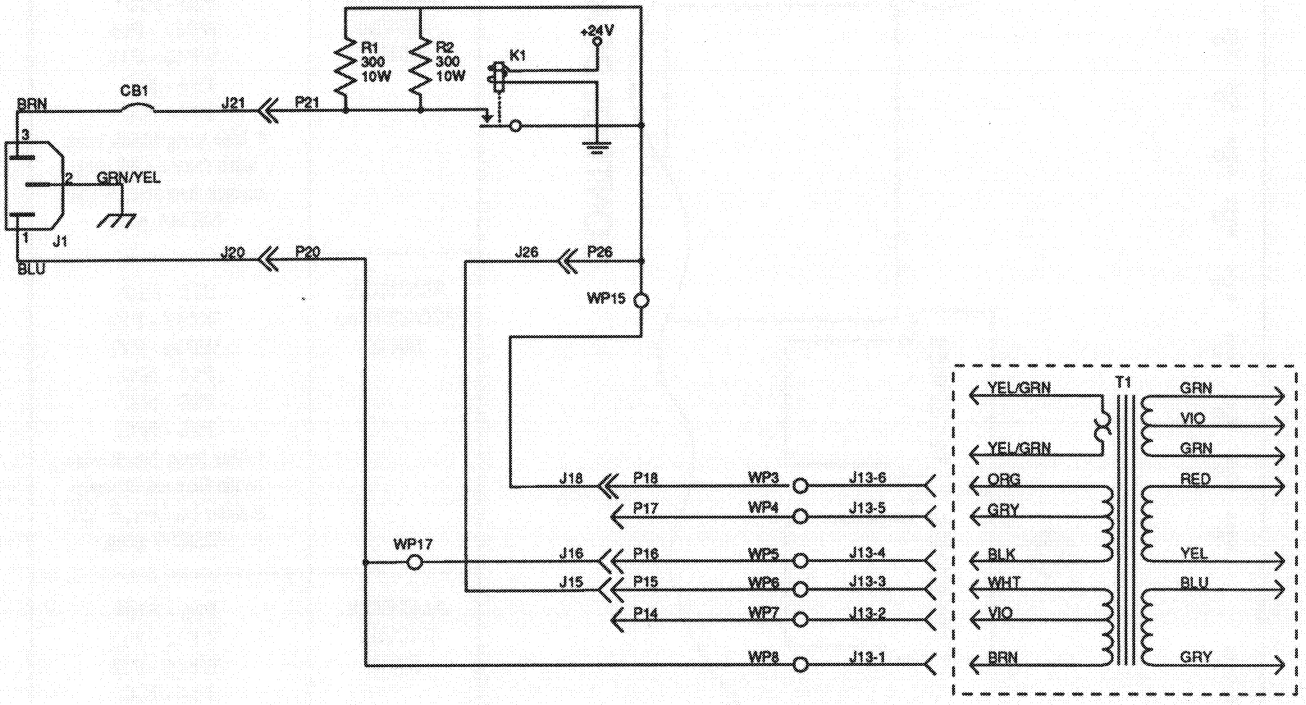
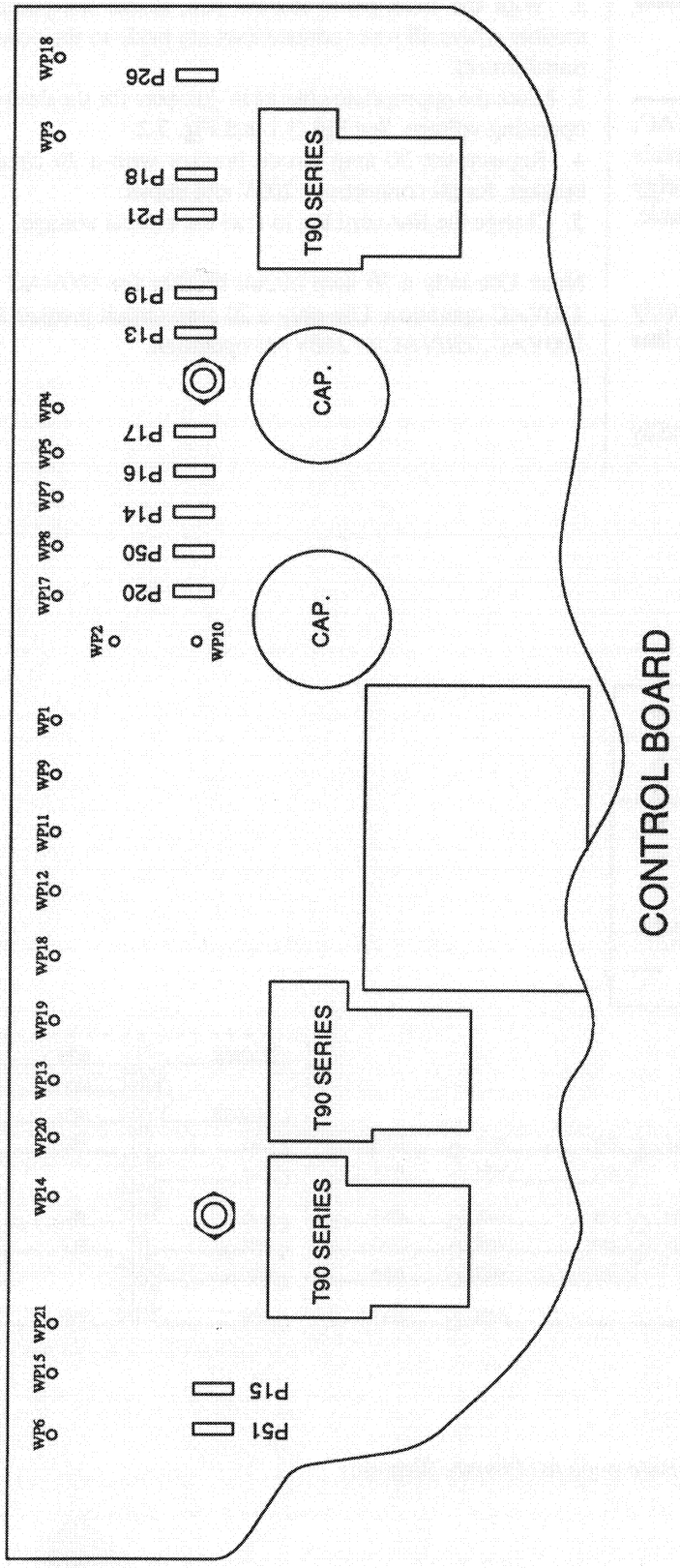


Fig. 3.1 Macro Reference AC Primary Diagram



VOLTAGE & FREQUENCY	JUMPER REQUIREMENTS
Crown 120Vac 60Hz	P26 - P15* WP17 - P16 WP16 - P18 P14 - N.C. P17 - N.C. * Use long black wire with fastons 30 amp circuit breaker, 5-15P NEMA plug
AMCRON 100Vac 50/60Hz	P26 - P14* WP17 - P16 WP16 - P17 P15 - N.C. P18 - N.C. * Use long black wire with fastons 30 amp circuit breaker, 5-15P NEMA plug
AMCRON 120Vac 60Hz	P26 - P15* WP17 - P16 WP16 - P18 P14 - N.C. P17 - N.C. * Use long black wire with fastons 30 amp circuit breaker, 5-15P NEMA plug
AMCRON 220/230Vac 50Hz	P15 - P16* WP17 - P13 WP16 - P17 P14 - N.C. P18 - N.C. P26 - N.C. * Use long black wire with fastons 20 amp circuit breaker, 5-15P CEE7-7 plug
AMCRON 240Vac 50Hz	P15 - P16* WP17 - P13 WP16 - P18 P14 - N.C. P18 - N.C. P26 - N.C. * Use long black wire with fastons 20 amp circuit breaker, 5-15P CEE7-7 plug

Fig. 3.2 Macro Reference Line Voltage Change Chart

4 Circuit Theory

4.1 Overview

The MR amplifier incorporates several new technological advancements including real-time computer simulation, low-stress output stages, and an advanced heatsink embodiment. Extra circuitry is incorporated to limit temperature and current to safe levels—making it highly reliable and tolerant of faults. Unlike many lesser amplifiers, it can operate at its voltage and current limits without self-destructing.

Real-time computer simulation is used to create an analog of the junction temperature of the output transistors (herein referred to as the output devices). Current is limited only when the device temperature becomes excessive—and just by the minimum amount necessary. This patented approach maximizes the available output power and eliminates overheating—the major cause of device failure.

The topology used in the MR amplifier grounded output stages is called the "grounded bridge," and makes full use of the power supply. This patented topology also provides peak-to-peak voltages available to the load that are twice the voltage the output devices are exposed to. The grounded bridge topology is ground-referenced. Composite devices are constructed to function as gigantic NPN and PNP devices, since the available currents exceed the limits of available devices. Each output stage has two of these composite NPN devices and two composite PNP devices.

The devices connected to the load are referred to as "high-side NPN and PNP" and the devices connected to ground are referred to as "low-side NPN and PNP." Positive current is delivered to the load by increasing conductance simultaneously in the high-side NPN and low-side PNP stage, while decreasing conductance of the high-side PNP and low-side NPN in synchrony. The two channels may be used together to double the voltage (bridge-mono) or the current (parallel-mono) presented to the load. This feature gives the user flexibility in maximizing the power available to the load.

A wide-bandwidth multiloop design is used for state-of-the-art compensation. This produces ideal behavior and results in ultra-low distortion values.

Aluminum extrusions have been widely used for heatsinks in power amplifiers due to their low cost and reasonable performance. However, measured on a watts per pound or watts per volume basis, the extrusion technology doesn't perform nearly as well as the heatsink technology developed for the MR power amplifier.

Our heatsinks are fabricated from custom convoluted fin stock that provides an extremely high ratio of area to volume, or area to weight. All power devices are mounted directly to massive heat spreaders that are electrically hot. Making the heat spreaders electrically hot allows improved thermal performance by eliminating the insulating interface underneath the power devices. The chassis itself is used as part of the thermal circuit, and this maximizes utilization of the available resources.

4.2 Circuit Theory

Power is provided by low-field torroidal power transformer T1. The secondaries of T1 are full-wave rectified by D22 D23, D1-4 and filtered by large computer-grade capacitors. A thermal switch embedded in the transformer protects it from overheating.

Monolithic regulators provide a regulated ±15 volts.

4.2.1 Stereo Operation

For simplicity, the discussion of stereo operation will refer to channel one only. Mono operations will be discussed later.

Please refer to the schematics provided at the back of this manual.

The input signal at the phone jack passes directly into the balanced gain stage (U104-A). Use of a P.I.P. module for input signal causes the input signal to pass through the P.I.P. and then to the balanced gain stage. The balanced gain stage (U104-A) causes balanced-to-single-ended conversion to take place using a difference amplifier. From there, gain is controlled with the front-panel level controls and the internal input sensitivity switch. (The input sensitivity switch is located through the P.I.P. opening in the rear panel. See figure 4.2.) The error amp (U104-C) amplifies the difference between the output signal and the input signal from the gain stage, and drives the voltage-translator stage.

The voltage-translator stage channels the signal to the Last Voltage Amplifiers (LVA), depending on the signal polarity, from the error amp U104-C. The +LVA (Q105) and the –LVA (Q110), with their push-pull effect through the bias servo Q318, drive the fully complementary output stage.

The bias servo Q318 is thermally coupled to the heat sink, and sets the quiescent bias current in the output stage to lower the distortion in the crossover region of the output signal.

With the voltage swing provided by the LVAs, the signal then gains current amplification through the triple Darlington emitter-follower output stage.

The bridge-balanced circuit (U104-D) receives a signal from the output of the amplifier, and differences it with the signal at the VCC supply. The bridge-balanced circuit then develops a voltage to drive the bridge-balanced output stage. This results in the VCC supply having exactly one-half of the output voltage added to their quiescent voltage. D309, D310, D311 and a trimmer resistor in parallel with D312 set the quiescent current point for the bridge-balanced output stage.

The protection mechanisms that affect the signal path are implemented to protect the amplifier under real-world conditions. These conditions are high instantaneous current, excessive temperature, and operation of the output devices outside safe conditions.

Q107 and Q108 act as a conventional current limiter, sensing current in the output stage. When current at any one instant exceeds the design criteria, the limiters attenuate the drive from the LVAs, thus limiting current in the output stage to a safe level.

To further protect the output stages, a specially developed ODEP circuit is used (Output Device Emulator Protection). It produces an analog output proportional to the always-changing safe operating area margin of the output transistor. This output controls the translator stage previously mentioned, removing any further drive that may exceed the safe operating area of the output stage.

Thermal sensor S100 gives the ODEP circuits vital information on the operating temperature of the heat sink on which the output devices are mounted.

Should the amplifier fail in such a way that would cause DC across the output lead, the DC protection circuit senses this and shuts down the power supply until the DC is removed.

4.2.2 Bridge-Mono Operation

By setting the rear panel Stereo-Mono switch to BRIDGE-MONO, the user can convert the MR into a bridge-mono amplifier. With a signal applied to the Channel 1 input jack, and the load between the red banana posts on the back panel, a double-voltage output occurs.

The Channel 1 output feeds the Channel 2 error amp U204-C. Since there is a net inversion, Channel 2 output is opposite polarity of Channel 1. This produces twice as much voltage across the load. Each of the channel's protection mechanisms work independently if a fault occurs.

4.2.3 Parallel-Mono Operation

With the Stereo-Mono switch set to PARALLEL-MONO, the output of Channel 2 is paralleled with that of Channel 1. A suitable high-current-handling jumper must be connected across the red banana posts to gain the benefits of this mode of operation.

The signal path for Channel 1 is the same as previously discussed, except that Channel 1 also drives the output stage of Channel 2. The balanced input, error amp, translators, and LVAs of Channel 2 are disconnected and no longer control the Channel 2 output stage. The Channel 2 output stage and protection mechanisms are also coupled through S1 and function as one.

In PARALLEL-MONO mode, twice the current of one channel alone can be obtained. Since the ODEP circuit of Channel 2 is coupled through S1, this gives added protection if a fault occurs in the Channel 2 output stage. The ODEP circuit of Channel 2 will limit the output of both output stages by removing the drive from the Channel 1 translator stages.

4.3 Control Circuitry

The channel one relay, K2, is energized by PNP transistor Q1. The control voltage needed to bias on Q1 comes from pin 13 of U102D and [UOIC) . On initial turn on the capacitor C110 begins to charge. This charging action brings the inverting input (pin 10) low. This causes a high output on pin 13 of (U102D) and Q1 is held off (approximately 3 seconds). After C110 is charged Pin 10 is high causing U102D to change states placing a low on pin 13. This low turns on Q1 causing the relay K2 to turn on. There are four control mechanisms that can cause K2 to de-energize:

4.3.1 Low Frequency Protection

U102A and U102B are arranged as a window comparator with a window level of ±10V. During normal operation pins 1 and 2 are at a logic high allowing Q1 to remain on. R184, R184, C119 and C107 for a filter action that allows frequencies from below seven hertz down to DC to change the state of U102A and U102B. Any signal with a level above 10V and from seven hertz down to DC will cause U102A and U102B to switch states. This action ultimately will cause Q1 to Turn off de-energizing K2.

4.3.2 Common Mode Detector (High Side of Bridge)

U101C and U101D use as a window voltage through a resistor dropping network (R163 and R164) the amplifier

output waveform. This window voltage is found on pins 9 and 10. The high side of bridge current is sensed across R304 and R307. This voltage as related to current is placed, through resistor dropping networks onto the input pins 9 and 10. As common mode current increases the potential of pins 9 and 10 eventually will overcome the reference voltage set up by pins 8 and 11. When this output voltage window is exceeded the two comparator sections switch states and Q1 is ultimately switched off.

4.3.3 Common Mode Detector (Low Side of Bridge)
U101A and U101B form a window comparator circuit with a window of ±.4V. Pins 7 (through R143) and 4 (through R144) receive a signal level that is related to the low side of bridge emitter current. When this level exceeds .4 volts, on both input pins (pin4 and pin 7), the logic level of the two sections switch states from a normally low level to a logic high. This logic change results in the turning off of Q1 which de-energizes K2.

4.3.4 Over Voltage Protection
U1D serves as a window comparator for the purpose of over line voltage control. In the event the line voltage exceeds 10% (132VAC) the high energy power supplies are disabled. R7 and R8 form a resistor dropping network from the regulated +15V supply to ground The voltage drop across R8 is 11.3VDC and serves as the window level and is applied to pin 10 (inverting input). With pin 10 in control of U1D pin 13 has a logic low which is placed across D13 and D14. This prevents conduction and allows Q1 to remain on which allows K2 to remain energized.

Resistors R3, R4, R5 and R6 serve as a resistor dropping network from the unregulated +24VDC supply to ground. As the line voltage increases the unregulated supply will become increasingly more negative. The voltage level on the wiper of R4 is applied to pin 11 (non-inverting input). When this level exceeds the window level of pin 10 the circuit switches states. This allows D13 and D14 to conduct placing a logic high on to the base of Q1. This, in turn, biases off Q1 and de-energizes K2.

4.3.5 Fan Control
The fan control signal is the ODEP waveform taken from the ODEP protection circuit. U1D is an inverting amplifier with a gain of three (20log -(5.1MΩ/1MΩ + 510kΩ)). As the output transistors/heatsink increase in temperature the ODEP voltage level will drop from 11.1VDC to near ØVDC. The product of U1D will be an inversion of this ODEP protection voltage and multiplied by a times of three. Because of the dc bias, on pin 13 of U1D, the anplified signal begins at -15V and after coplete ODEP limiting ends up at +15V. This intial high negative voltage causes D5 to cut off. The inverting input on U1B, on the Control Module, being negative is inverted and biases off the opto-triac and in turn keeps the fan off. As the ODEP protection voltage decreases in dc value the voltage output of U1D on the display module will become progressively less negative and eventually becoming positive in polarity. As this fan control voltage becomes positive conduction of D5 will increases. As conduction of D5 increases the signal on pin 6 of U1B on the control module becomes less negative. The output of U1B on the control module eventually switches and the opto-triac is biased on. This in turn biases Q4 into conduction and allows the fan to begin turning.

A gating signal is placed across pin 7 of U1B on the control module. This gating signal is a product of U1A, Q3, R19 and the fan enable signal from the display module. C12 and R19 form an RC timing circuit that from the +15V supply begin to charge. U1A monitors the Line voltage wave form and is a ØV crossing detector. Everytime the line waveform crosses ØV Q3 is turned on and discharges C12. This developes a ramping type waveform. The higher positive portion of the waveform is used to turn off the opto-triac even when the fan control signal is of a value by itself to turn on the fan. The fan control current therefore has a duty cycle to it.

4.4 Display Circuitry

4.4.1 IOC
U3A and U3B serve as a voltage comparator with R13, R15 and R17 as the resistor dropping network. Pin 7 has a window level of +7V and pin 4 has a window of -7V. U3A and U3B have a logic high which turns off Q1 and the IOC LED E1. When the error signal from the error amp appears the ±7V window is overcome and switches the state of U3A and U3B. Q1 then is biased on and the IOC LED E1 illuminates.for the duration of the error signal.

4.4.2 ODEP
U5C on the display module is the current sourse for the ODEP LED E15. Under normal operating conditions U5C and D7 conduct allowing current to flow through the LED 15. As the fan control signal

4.4.3 Signal Indication
Incorporated on the display module of the Macro Reference amplifier are three modes of signal indication:

SPI (Signal Presence Indication)
U1A and U1B serve as a full wave rectifying network. On the output of U2B is the SPI LED E4 which illuminates anytime signal is present.

Dynamic Range/Signal Level Indication
With the switch S1 in the Dynamic position this rectified audio signal is placed on the inverting inputs of a sequence of window comparators. U3C, U3D, U5A, U5B and U5D serve as the current sources for the five Dynamic Range LEDs. This signal is rectified but unfiltered containing, therefore, the peak value of the audio waveform. R29, R31, R33, R35, R37 and R39 provide a resistor dropping network for the inverting inputs to the Dynamic Range current sources. This same rectified signal is placed on the non-inverting inputs via the filtering function of C3. The signal applied to the non-inverting inputs is of an RMS value. With the non-inverting input receiving the RMS value and the inverting input receiving the peak value the output of each LED comparator is the dynamic range of the signal.

With the switch S1 in the Level position the peak signal is still placed on the inverting inputs of the comparator drivers. A small DC level is placed on all of the non-inverting inputs. The LED illumination is, in this mode, peak responding instead of signal Dynamic Range.

5 Specifications

5.1 Performance

Note: 8 ohm loads were used unless specified otherwise.

Frequency Response: 3 Hz to 100 kHz bandwidth. ± 0.1 dB 20 Hz to 20 kHz at 1 watt.

Signal to Noise Ratio: 120 dB (A-weighted) below rated output at 26 dB gain.

IM Distortion: Less than 0.005% from 760 watts through -10 dB, increasing smoothly to a maximum of 0.025% at -40 dB, measured at 26 dB gain.

Damping Factor: Greater than 20,000 from 10 Hz to 200 Hz. 1,800 at 1 kHz.

5.2 Power

Power Bandwidth:

10 Hz to 25 kHz -1.0 dB.

7 Hz to 27 kHz -1.5 dB.

5 Hz to 28 kHz -2.0 dB.

4 Hz to 30 kHz -3.0 dB.

Output Power:

Note: The following power specifications are for STEREO (two-channel) operation with a THD of 0.02% or less while both channels are driven.

760 watts per channel into 8 ohms.

1,160 watts per channel into 4 ohms.

1,500 watts per channel into 2 ohms.

Load Impedance: Rated for 16, 8, 4, and 2 ohm usage only. Safe with all types of loads, even reactive ones.

Required AC Mains: 50/60 Hz, at 100, 120, 200, 220/230, 240 VAC.) Draws 90 watts or less at idle. With a continuous 1 kHz sinewave output of 760 watts into 8 ohms in STEREO mode, as many as 26 amps are drawn from a 120 VAC source.

It is extremely important to have adequate AC power available to the amplifier. Power amplifiers can not create energy—they must have the required **voltage and current** to deliver the undistorted rated wattages you expect.

The amp is provided with the correct line cord for the rated line voltage.

5.3 Controls

Enable: A pushbutton located on the front panel to turn the amplifier on and off.

Level: A signal level control with 31 detents for each channel, located on the front panel..

Stereo-Mono: A three-position switch located on the back panel which selects between STEREO, BRIDGE-MONO, and PARALLEL-MONO modes of operation.

Input: A two-position switch located inside the amplifier selects between two input sensitivities. (A voltage gain of 26 dB or a sensitivity of .775 V for full rated output.)

Level / Dynamic Range Meter: A two-position switch located behind the front panel sets the display meter on the front panel as either a dB level meter or a Dynamic Range power meter.

5.4 Indicators

Enable: This amber indicator is on while the amplifier is on to show that the low-voltage power supply is operating.

ODEP: Two amber multifunction indicators which show the reserve energy status of each channel. Normally they are brightly illuminated to show that reserve energy is available. In the rare event there is no energy reserve, they will dim in proportion to ODEP limiting. They remain off if a tripped breaker, blown fuse or thermal shutdown occurs. (In the case of a thermal shutdown, the amplifier will return to normal operation after cooling down to a safe operating temperature.)

IOC: Two yellow indicators which are normally off. In the unlikely event the output waveform differs from that of the input by 0.05% or more, they will flash. In this way, they act as sensitive distortion indicators to provide proof of performance. **Note: It is normal for the Channel 2 IOC indicator to remain in PARALLEL-MONO mode.**

Signal: Two green Signal presence indicators flash in sync with the input signal to show its presence.

Dynamic Range / Level Meter: Two green five-segment meters (one per channel) display either the output dynamic range in dB or the output level in dB. (Your unit comes factory-set to display dynamic range.) As dynamic range meters they show the ratio of the peak to average power of each channel. As output level meters they show how high the output levels are relative to full power.

5.5 Input/Output

Input Connector: Balanced phone jacks on chassis and internal P.I.P. connector. (Balanced 3-pin XLR connectors are provided on P.I.P.-FX which is a standard feature.)

Input Impedance: Nominally 20 K ohms, balanced. Nominally 10 K ohms, unbalanced.

Input Sensitivity: Switchable between .775 V (unbalanced) for rated output or a voltage gain of 26 dB. (See section 4.5, Input Sensitivity Adjustment.)

Output Connector: Color-coded dual binding posts (banana jacks).

DC Output Offset: (Shorted input) ±10 millivolts.

Output Signal

Stereo: Unbalanced, two-channel.

Bridge-Mono: Balanced, single-channel. Channel 1 controls are active; Channel 2 controls are inactive but not removed from operation.

Parallel-Mono: Unbalanced, single-channel. Channel 1 controls are active; Channel 2 controls are inactive but not removed from operation.

5.6 Protection

If unreasonable operating conditions occur the protection circuitry limits the drive level to protect the output transistor stages, particularly in the case of elevated temperature. Transformer overheating will result in a temporary shutdown of that particular channel. Controlled slew-rate voltage amplifiers protect the unit against RF burnouts. Input overload protection is furnished at the amplifier input to limit current.

Turn On: No dangerous transients. Four second turn-on delay. **Note:** This may be changed by resistor substitution. Contact Amcron Technical Services Department for details.

5.7 Construction

Black splattered-coat steel chassis and black powder-coated front panel for maximum durability. Chassis utilizes specially designed "flow-through" ventilation from front to side panels.

Cooling: Convection cooling with custom heat diffusers and infinitely variable on-demand forced air assistance.

Dimensions: 19 in. standard rack mount (EIA Std. RS-310-B), 7 in. height, 16 in. depth behind mounting surface, 2.75 in. in front of mounting surface.

Weight: 56.5 lbs. Center of gravity is approximately 6 in. behind front mounting surface.

6 Schematic Diagrams

J 0410-1 Display Circuit Schematic
J 0411-9 Power Supply/Control Circuitry Schematic
J 0412-7 Main Circuit Schematic

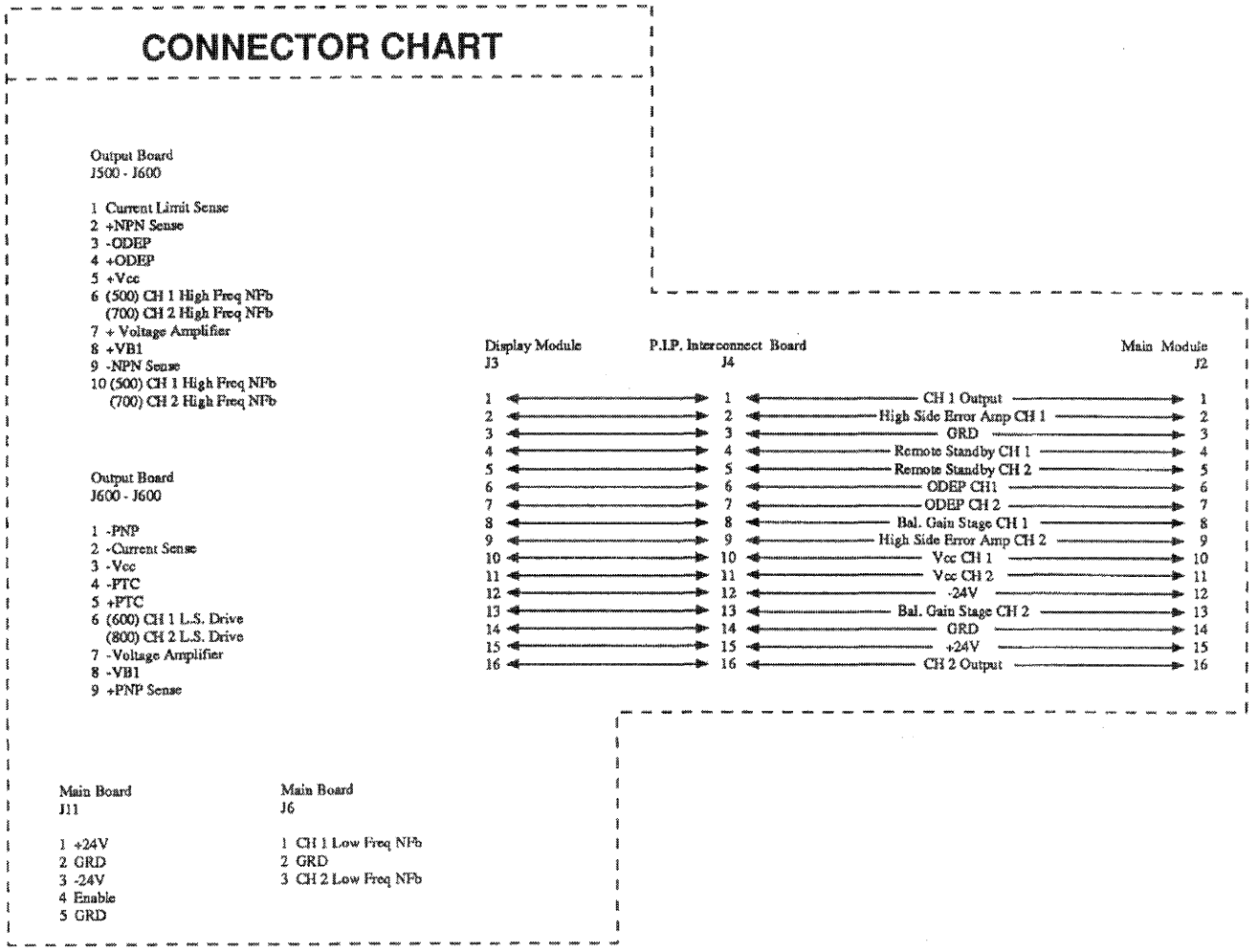


Fig. 6.1 Amplifier Interconnection Chart

PART II
Component Documentation

Parts

General Information

Sections 7 and 8 contain illustrations and parts lists for the Macro Reference power amplifier. This information should be used with the service, repair and adjustment procedure in Section 2.

Most of the mechanical and structural type parts are illustrated and indexed on exploded view drawings. Electrical and electronic parts on these illustrations are also identified by the circuit reference designation next to the illustration. Both the index number and the reference designation are included in the parts list in separate columns. The reference designations correspond to those shown in schematic diagrams.

Electrical and electronic parts located on printed circuit boards are illustrated by schematic symbols on the trace side and by component shape symbols on the component side. Reference designations also appear on these diagrams.

The quantity of each part used in each location is also shown in the parts listing.

Standard and Special Parts

Many electrical and electronic parts used in the Macro Reference are standard items stocked by and available from electronic supply houses. However, some electronic parts that appear to be standard, are actually special. A part ordered from Crown will assure an acceptable replacement. Structural items, covers and panels are available from Crown only.

Ordering Parts

When ordering parts, be sure to give the amplifier model and serial number and include the part description and Crown Part Number (CPN) from the parts list. Price quotes are available upon request.

Shipment

1. Shipment will be made by UPS or best method unless you specify a preferred method.
2. Shipments are made F.O.B. Elkhart, Indiana only.
3. Established Crown accounts will be freight prepaid and billed unless shipped by truck or air freight.
4. All others will be shipped freight collect.

Terms

1. Normal terms are C.O.D. unless the order is prepaid.
2. Net 30 days terms apply only to those firms who have an established line of credit with Crown.
3. If prepaying please add an amount for the freight charge. $2.00 is average for an order under one pound.
NOTE: Part prices are subject to change without notice.
4. New parts returned for credit are subject to a 10% restocking charge.
5. You must receive authorization from the Parts Dept. before returning parts for credit.
6. We are not a general parts warehouse! Parts are available for servicing Crown products only.

Illustrated Parts Lists

Contained within this section are the illustrated parts lists for the Macro Reference amplifier. Most of the mechanical and structural parts are illustrated and indexed in the main chassis illustration. The electrical and electronic parts in the assembly drawings are also shown in the circuit schematics (Figures 8.1 and 8.2) and are labeled in the parts list with both the schematic component number and the Crown Part Number (CPN).

Electric and electronic parts which are located on printed circuit boards are illustrated by schematic symbols on the trace side of the boards and by their component shape symbol on the component side of the boards. Schematic component numbers also appear on these drawings.

The quantity of each part used in each location is also shown in the parts list.

7 EXPLODED VIEW DRAWINGS

The ***Exploded Views*** section of this service manual is the compilation of drawings of chassis parts and components found within the Macro Reference amplifier. For schematic drawings see section 6 and for circuit board layouts along with parts lists see section 8.

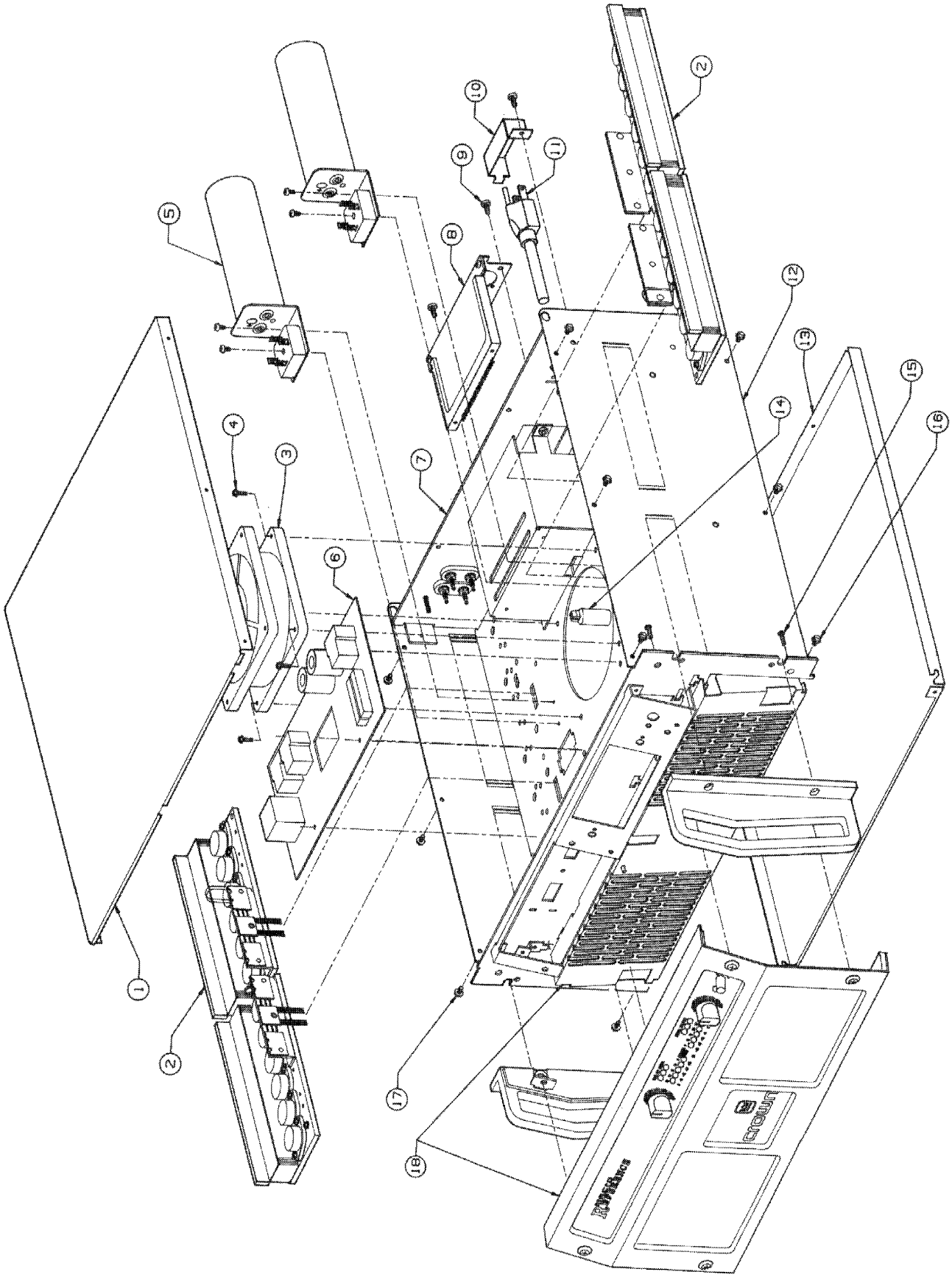


Fig. 7.1 Chassis Assembly (Top)

CHASSIS ASSEMBLY (TOP)

ITEM#	DESCRIPTION	PART #	QTY	NOTES
1	Top Cover	F11705J4	1	
2	Heatsink Assembly	————	2	See Page 7-7
3	Fan	C 7858-1	1	
4	6-32 x .625 Screw	C 7864-9	16	
5	Capacitor Assembly	————	2	See Page 7-11
6	Control Module	Q42834-4	1	See Page 8-2
7	Back Panel Assembly	————	1	See Page 7-14
8	P.I.P. Card Assembly	————	1	See Page 7-12
9	6-32 x .437 Screw	C 7601-5	24	
10	Circuit Breaker Cover	F 11624J7	1	
11	Power Cord	D 7538-8	1	
12	Chassis	M20752J7	1	
13	Bottom Cover	F11705J4	1	
14	.875" Toggle Nut	C 6873-1	2	
15	6-32 x .625 Screw	C 7864-9	2	
16	6-32 x .437 Screw	C 7601-5	6	
17	6-32 x .437 Screw	C 7601-5	6	
18	Front Panel Assembly	————	1	See Page 7-9

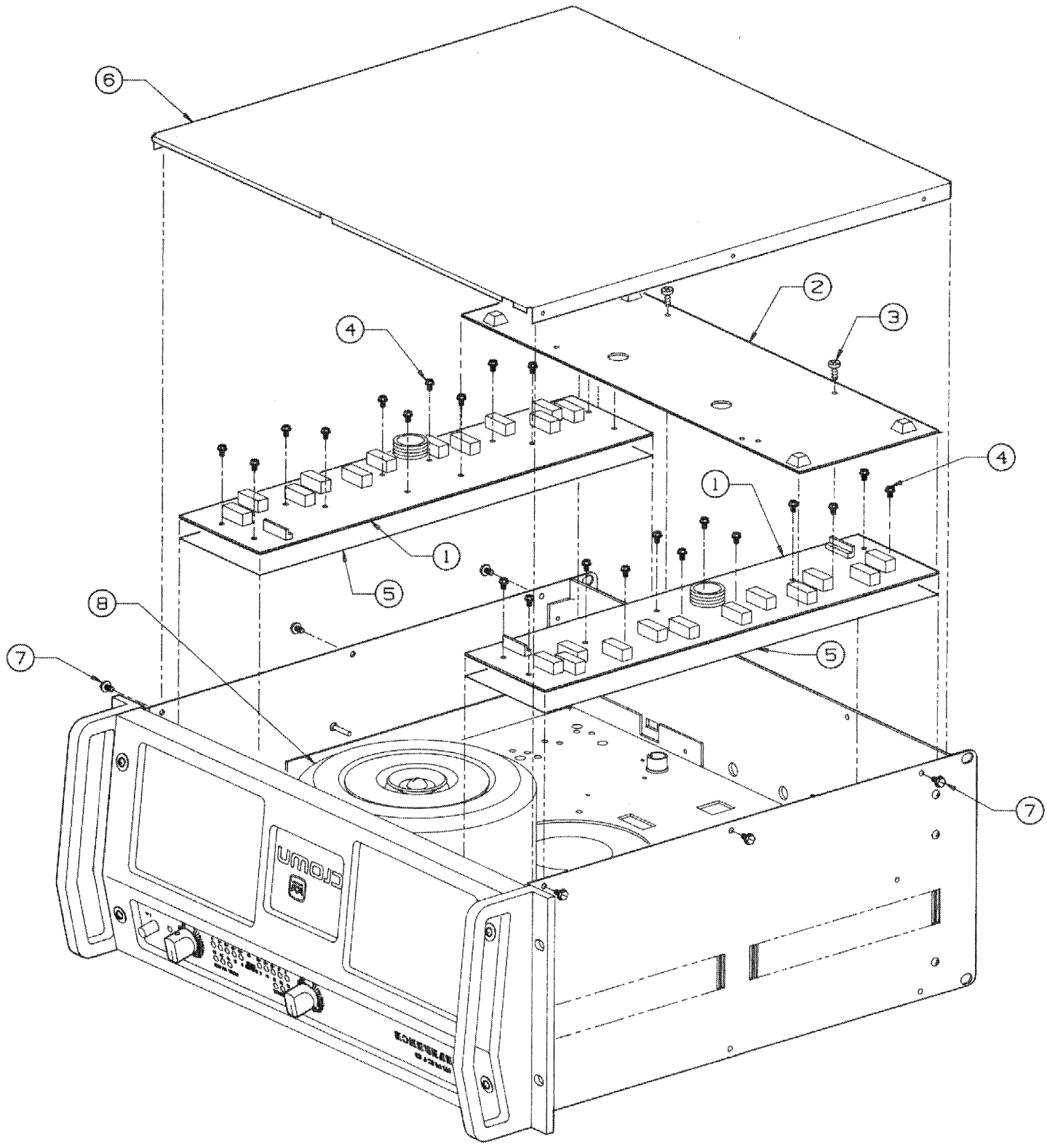


Fig. 7.2 Chassis Assembly (Bottom)

CHASSIS ASSEMBLY (BOTTOM)

ITEM#	DESCRIPTION	PART #	QTY	NOTES
1	*Output Module*	----------	2	See Page 8-16
2	*Main Module*	----------	1	See Page 8-22
3	6x32 1.25	D 6291-5	2	
4	Torx Screw	D 6315-2	24	
5	Output Pad	D 7060-3	2	
6	Bottom Cover	F11705J4	1	
7	Screw	D 7601-5	6	
8	Transformer	D 7102-3	1	

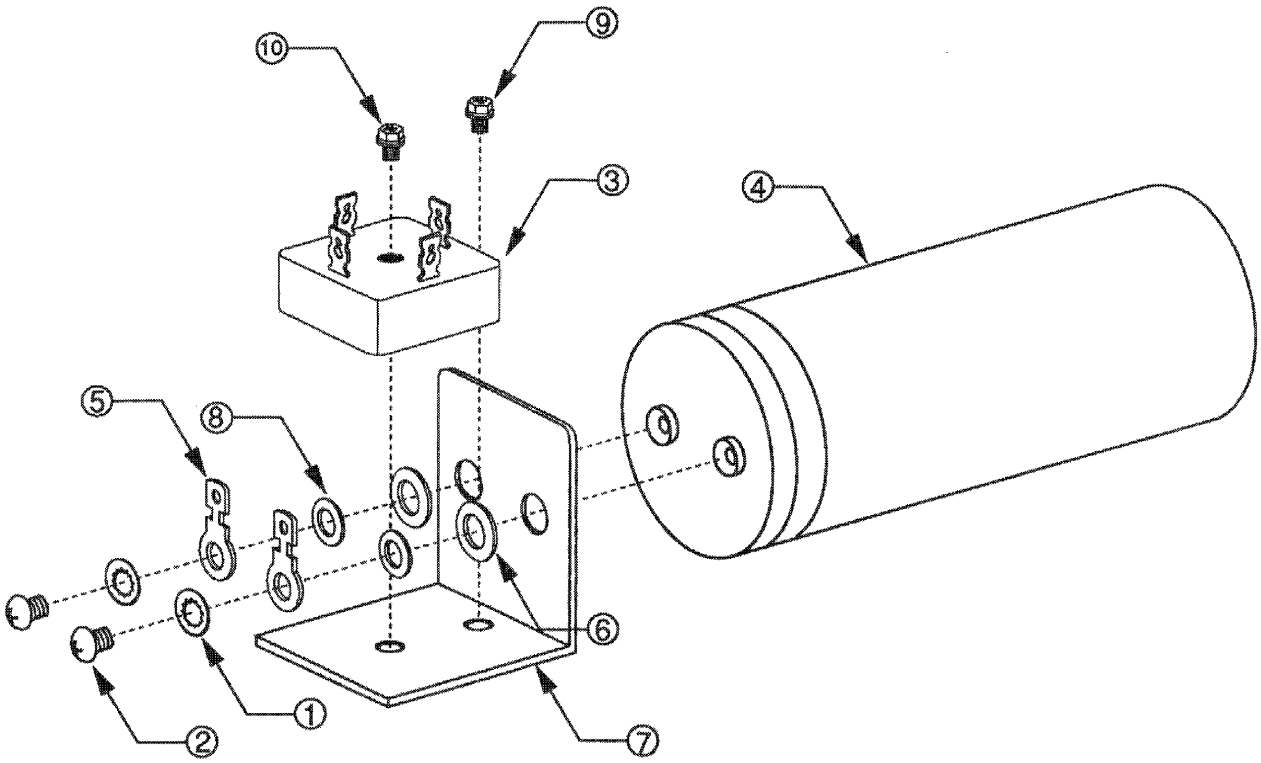


Fig. 7.3 Capacitor Assembly

CAPACITOR ASSEMBLY

ITEM#	DESCRIPTION	PART #	QTY	NOTES
1	Lockwasher	C 6860-8	2	
2	10-32 X .37 TRHD	C 4013-6	2	
3	35A Bridge Rectifier	C 4305-6	1	
4	6300µFD 150V	C 7068-7	1	
5	Solder Lug	D 2934-4	2	
6	Shoulder Washer	D 6764-1	2	
7	Capacitor Bracket	F10866-6	1	
8	Fiber Washer	D 7142-9	2	
9	.320 Hex Tri-Lob	D 6291-5	1	
10	6 x 32 x .75 Hex	C 6964-8	1	

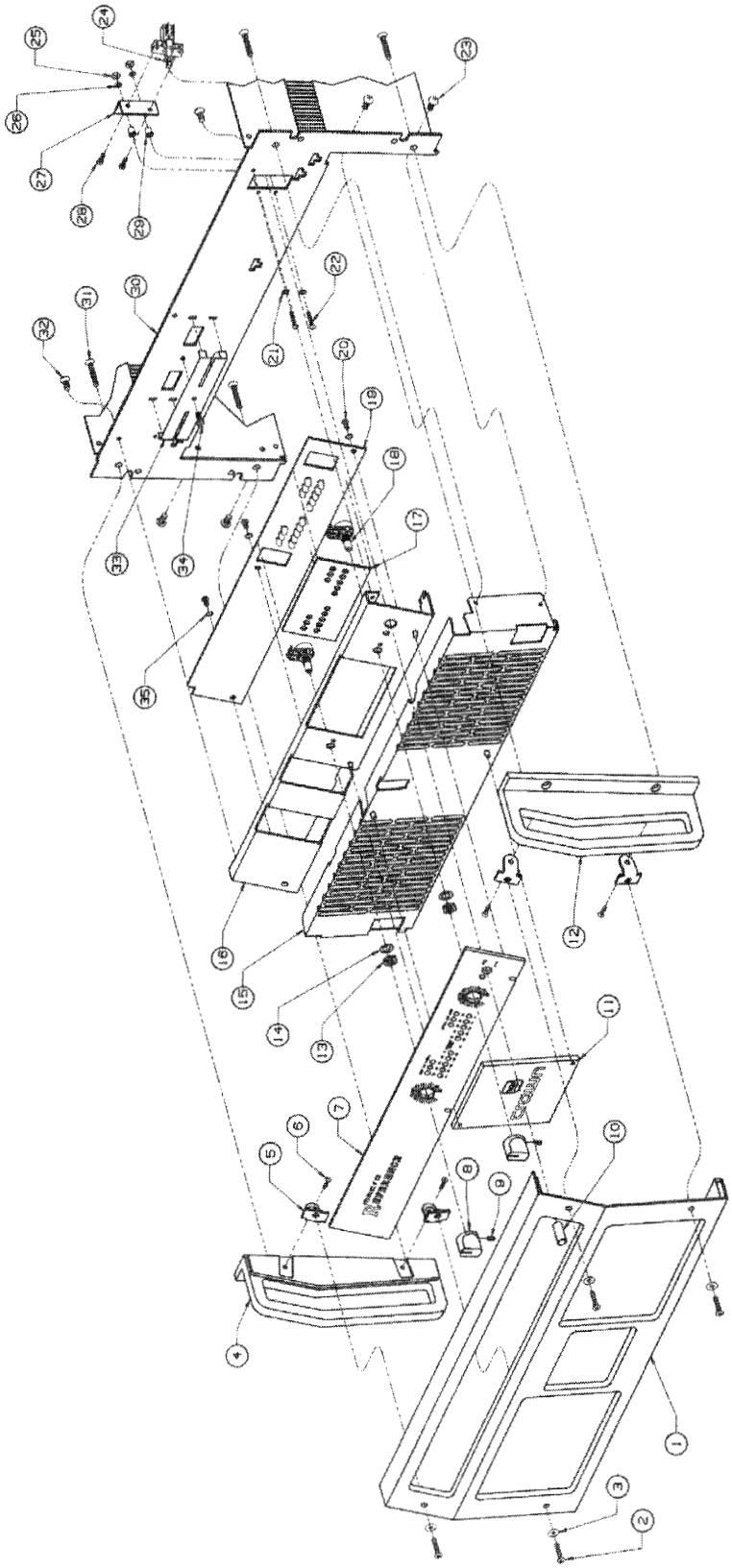


Fig. 7.4 Front Panel Assembly

FRONT PANEL ASSEMBLY

ITEM#	DESCRIPTION	PART #	QTY	NOTES
1	Front Panel	F11712J0	1	
2	8-32X.625 Screw	C 7828-4	4	
3	Nylon Washer	D 7317-7	4	
4	MR Left Handle	F11796J3	1	
5	Handle Mounting Bracket	M20921J8	2	
6	8-32 X .25 Fthd Ph	C 2136-7	2	
7	Front Panel Inset	D 7430-8	1	
8	MR Level Control Knob	F11736J9	2	
9	6/32 x .18 Slug	C 6005-0	2	
10	On/Off Pushbutton	F11738J5	1	
11	Lower Front Panel Insert	H43122-3	1	
12	MR Right Handle	F11795J51	1	
13	Level Control Hardware		2	Comes with Level Control
14	Level Control Hardware		2	Comes with Level Control
15	7" Finger Guard	M20881J4	1	
16	Display Board Bracket	M20971-4	1	
17	Display Board Insulator	F11787-3	1	
18	Level Control (5K ohm)	C 8401-9	2	
19	Display Module	Q42835-1	1	
20	6-32 x .3125 Screw	C 7009-1	3	
21	Lockwasher	C 1824-9	2	
22	4-40 x .62 Screw	C 3334-7	2	
23	6-32 x ..437 Screw	C 7601-5	4	
24	On/Off Switch	C 5958-1	1	
25	4 x 40 Nut	C 1938-7	2	
26	Lockwasher	C 1824-9	2	
27	Power Switch Bracket	F11907-7	1	
28	4-40 x .375 Screw	C 5961-5	2	
29	6-32 x .625 Screw	C 8094-2	2	
30	MR Chassis	M20876J4	1	
31	8-32 x .5 Screw	C 8238-5	4	
32	6-32 x .437 Screw	C 7601-5	2	
33	Fishpaper Holder	F11787-3	1	
34	6-32 x ..437 Screw	C 7601-5	1	
35	Star Washer	C 5594-4	3	

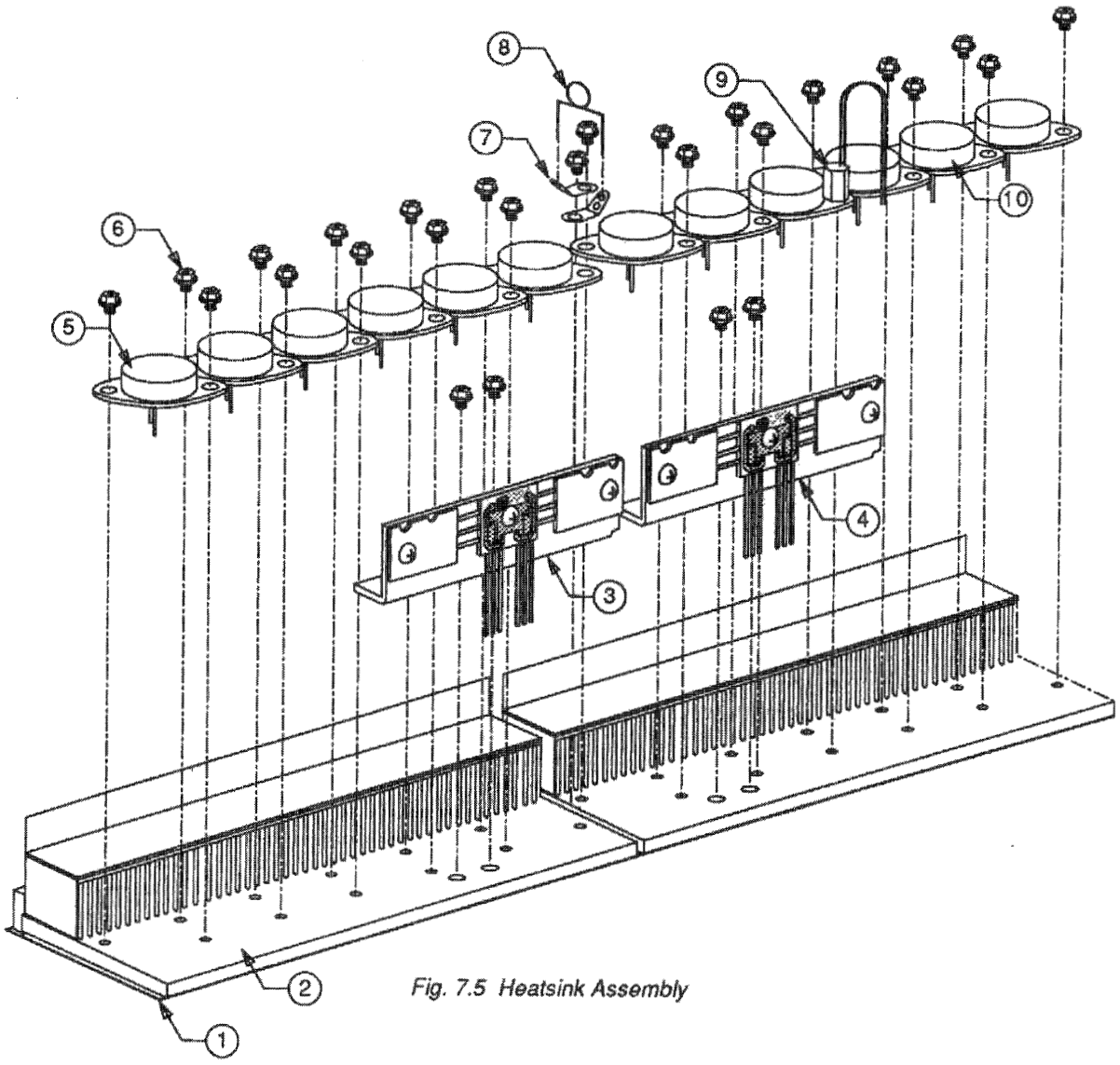


Fig. 7.5 Heatsink Assembly

HEATSINK ASSEMBLY

ITEM#	DESCRIPTION	PART #	QTY	NOTES
1	Silpad	D 6280-8		
2	Heatsink	M20538-1		
3	NPN Driver Assembly	M44629-0		See Page 7-8
4	PNP Driver Assembly	M44630-8		See Page 7-8
5	NPN Output Device	D 6729-4		(MJ15003)
6	6-32 X.235 Torx	D 6315-2		
7	Solder Lug	C 3163-0		
8	.01 MF 500V	C 7697-3		
9	PTC 95° C	D 6591-8		
10	PNP Output Device	C 7065-3		(MJ15004)

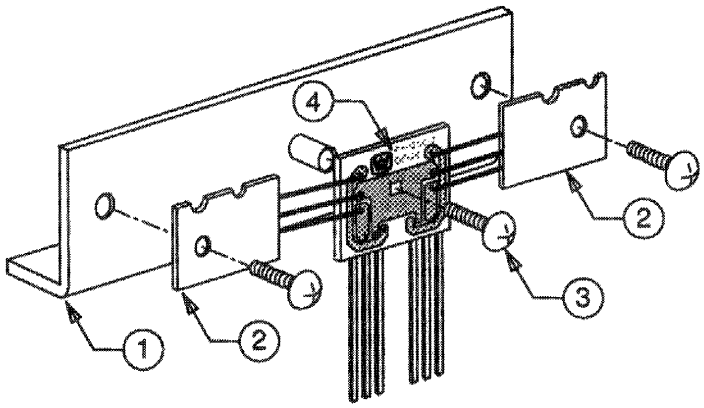


Fig. 7.6 Driver Transistor Assembly

DRIVER TRANSISTOR ASSEMBLY

ITEM#	DESCRIPTION	PART #	QTY	NOTES
	NPN Driver Assembly	**M44629-0**	**1**	
1	Driver Adapter Plate	M20840-1	1	
2a	2SC4029 NPN	C 8159-3	2	
3	6-32 X .3125	C 7009-1	3	
4	Driver Adapter #2	P10264-3	1	
	PNP Driver Assembly	**M44630-8**	**1**	
1	Driver Adapter Plate	M20840-1	1	
2b	2SA1553 PNP	C 8186-6	2	
3	6-32 X .3125	C 7009-1	3	
4	Driver Adapter #2	P10264-3	1	
	* Driver assembly is the same for both NPN and PNP stages. Only the transistor types differ.			

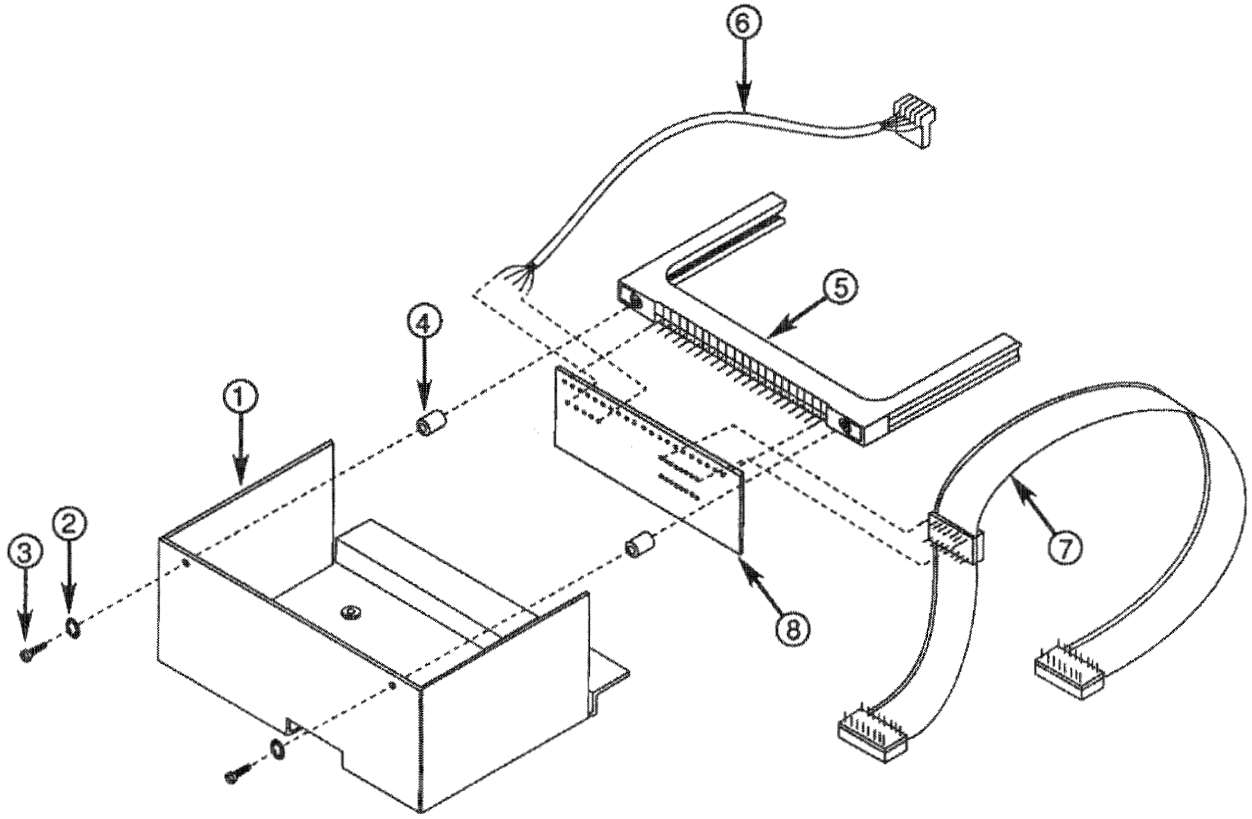


Fig. 7.7 P.I.P. Cage Assembly

P.I.P. CAGE ASSEMBLY

ITEM#	DESCRIPTION	PART #	QTY	NOTES
1	P.I.P. Card Shield Asm	F10777J3	1	
2	#4 Int.Star Lock Washer	C 1824-9	2	
3	4-40 X .62	C 3334-7	2	
4	.25X.14X.375 RD SPC	C 6431-8	2	
5	22 Contact Edge Connector	C 6821-0	1	
6	P.I.P. Cable Assembly	D 6626-2	1	
7	P.I.P. Ribbon Conn.	D 6899-5	1	
8	P.I.P. Brd. Intercon.	P10094B0	1	

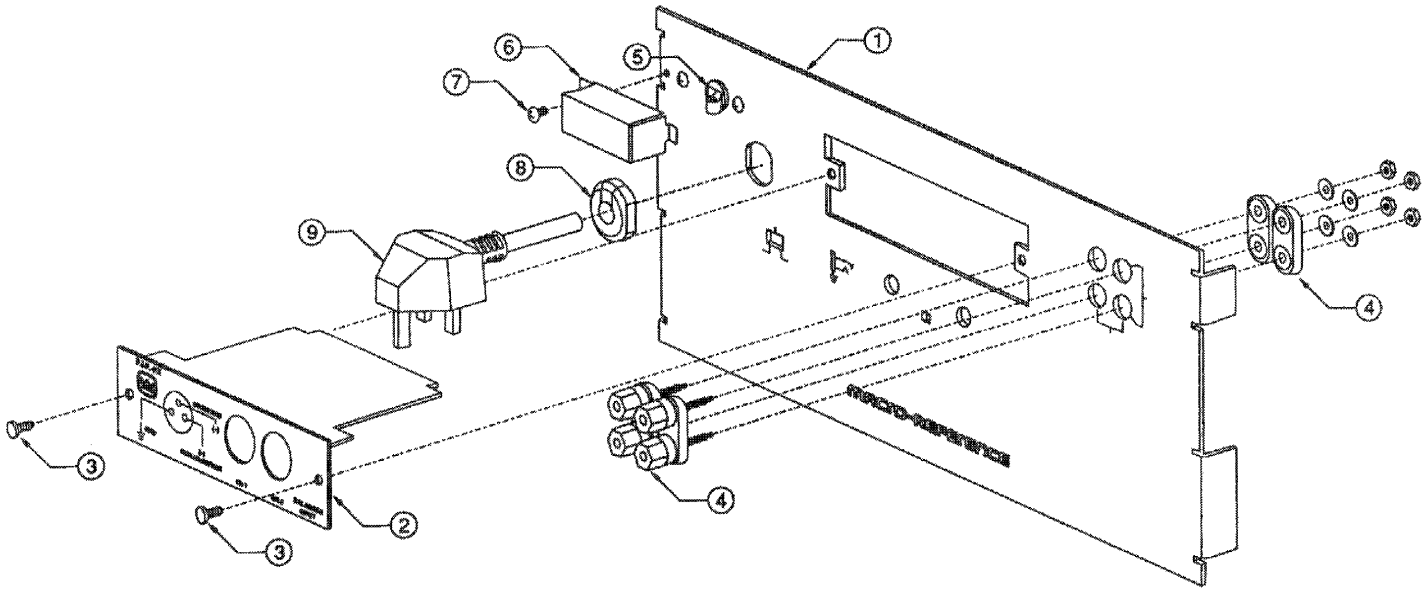


Fig. 7.8 Back Panel Assembly

BACK PANEL ASSEMBLY

ITEM#	DESCRIPTION	PART #	QTY	NOTES
1	Back Panel	M20803J8	1	
2	P.I.P.-FX Card	M44018-6	1	
3	6-32 x .437 Screw	C 7601-5	2	
4	Dual Binding Post	C 8013-2	2	
5	30A Circuit Breaker	C 7756-7	1	
6	Circuit Breaker Cover	F 11624J7	1	
7	6-32 x .437 Screw	C 7601-5	1	
8	Strain Relief	C 7315-2	1	
9	Power Cord	D 7538-8	1	

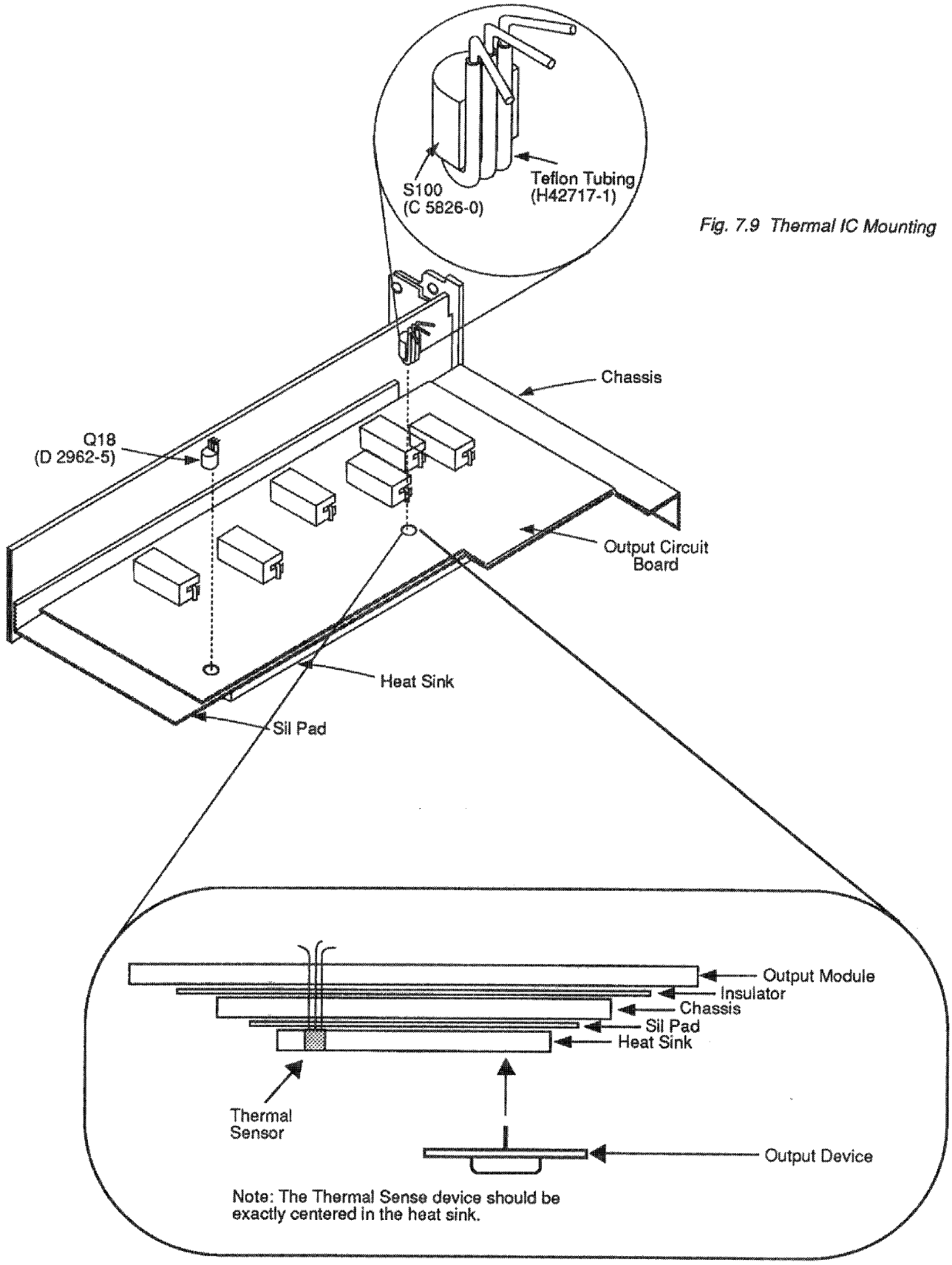
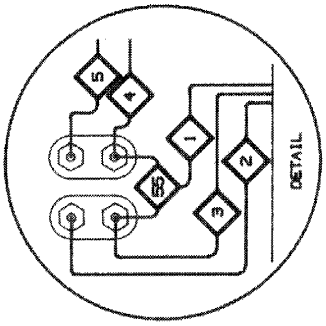


Fig. 7.9 Thermal IC Mounting



LEGEND																													
	1	BLACK	29	BLACK
	2	RED	30	RED-WHITE
	3	BLACK	31	RED
	4	BLACK	32	BLUE
	5	RED	33	BLACK
	6	GREEN	34	BLUE
	7	BROWN	35	RED
	8	BLUE	36	WHITE
	9	BLACK	37	ORANGE
	10	RED	38	BLUE
	11	BLUE	39	WHITE
	12	RED	40	BLUE
	13	BLUE	41	BLACK
	14	RED	42	BLUE
	15	ORANGE	43	BLACK
	16	RED-WHITE	44	BLACK
	17	RED	45	BLACK
	18	BLACK	46	BLACK
	19	BLACK	47	BLUE
	20	BLUE	48	RED
	21	BLUE-WHITE	49	BLUE
	22	ORANGE	50	BLUE-WHITE
	23	YELLOW	51	RED
	24	RED-WHITE	52	GREY
	25	GREEN	53	GREY
	26	WHITE	54	GREY
	27	GREY	55	BLACK
	28	BLACK		

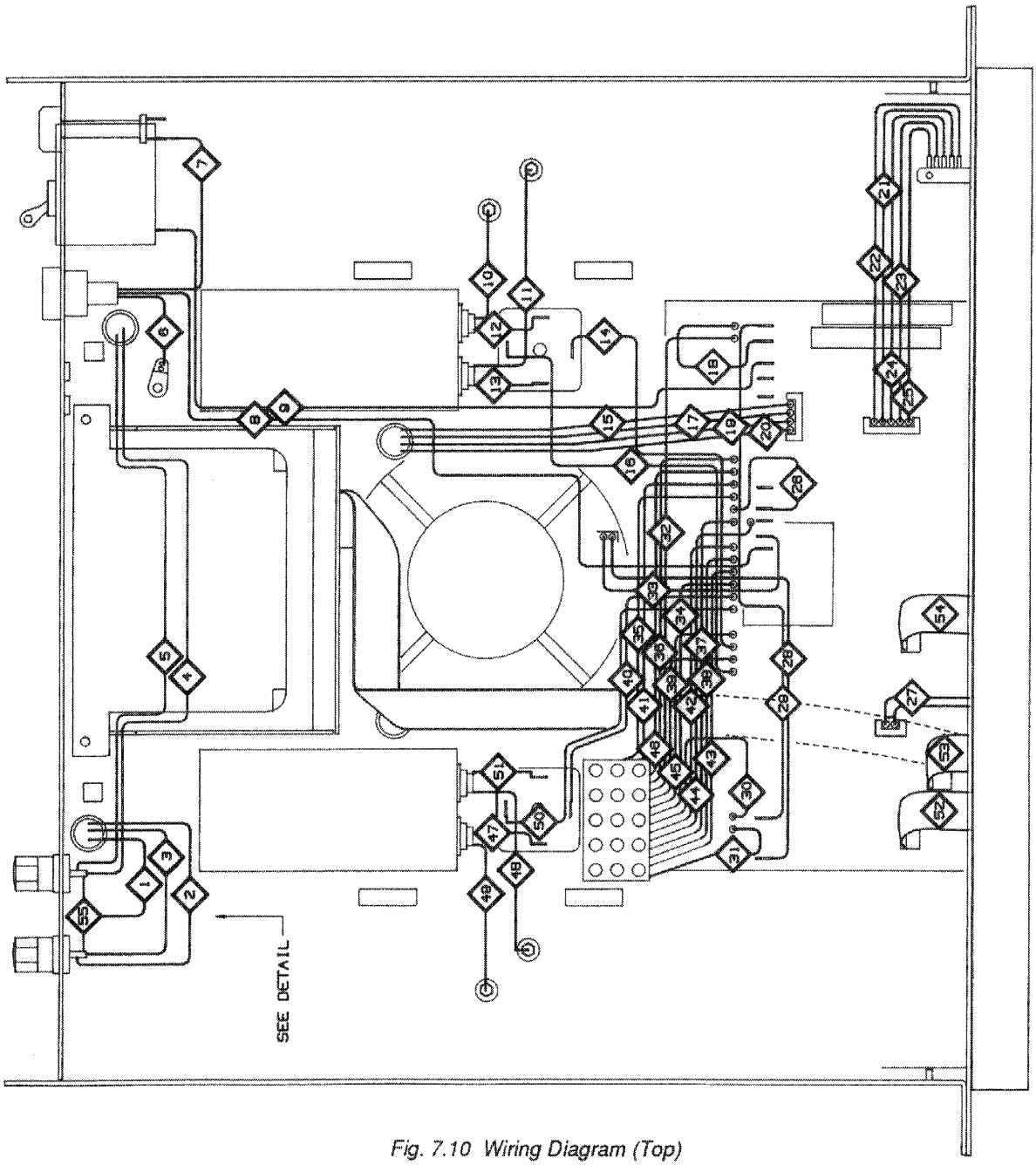


Fig. 7.10 Wiring Diagram (Top)

LEGEND	GREY	GREY	GREY	BLACK	RED	GREY	GREY	GREY	BLUE	RED	BLACK	ORANGE	GREY	BLACK	RED	GREY	GREY	BLACK	BLACK	BLACK	BLACK	BLACK	GREY	GREY	GREY	BLACK	RED	GREY	GREY	BLACK	RED-WHITE	RED-WHITE
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

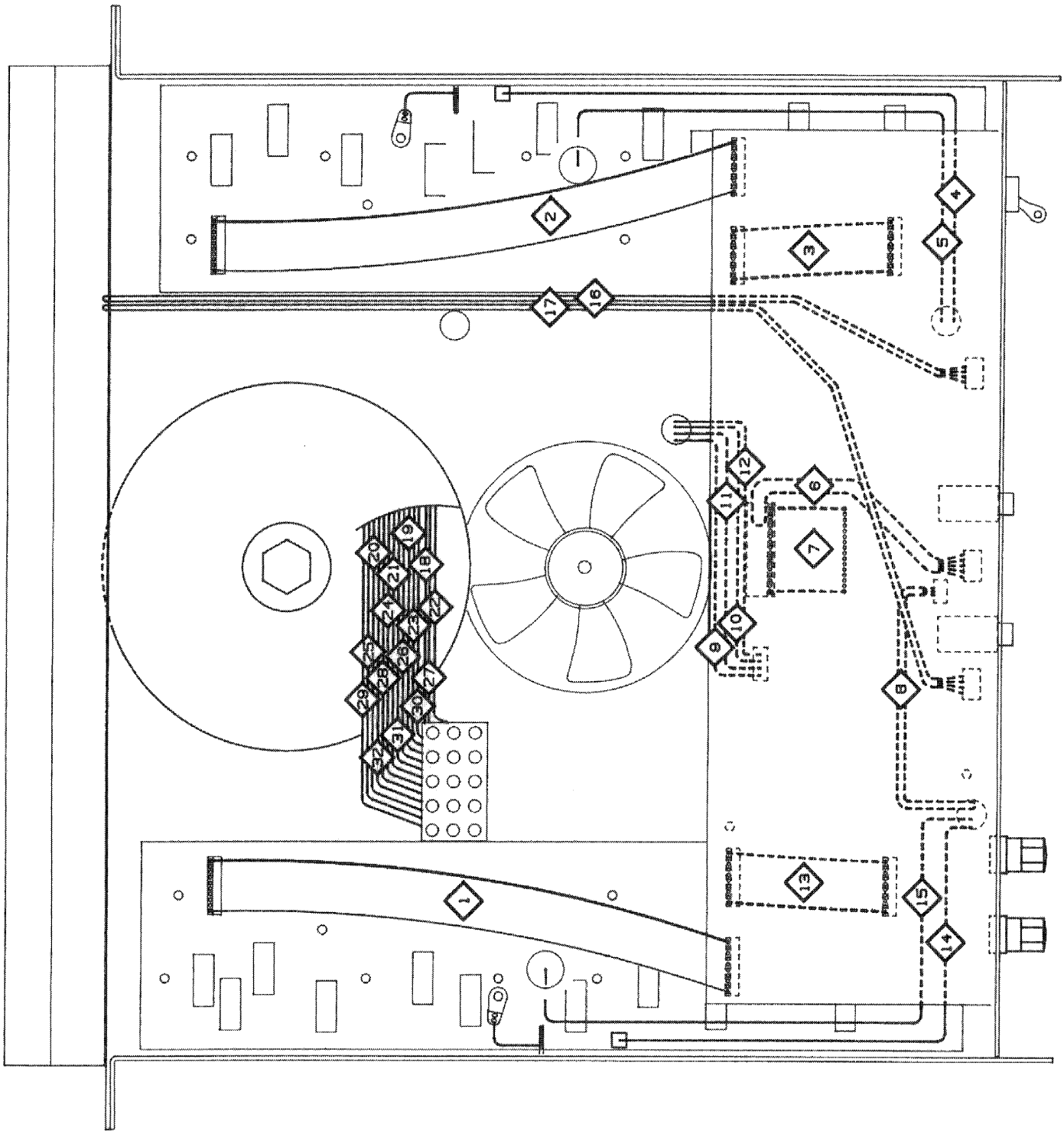
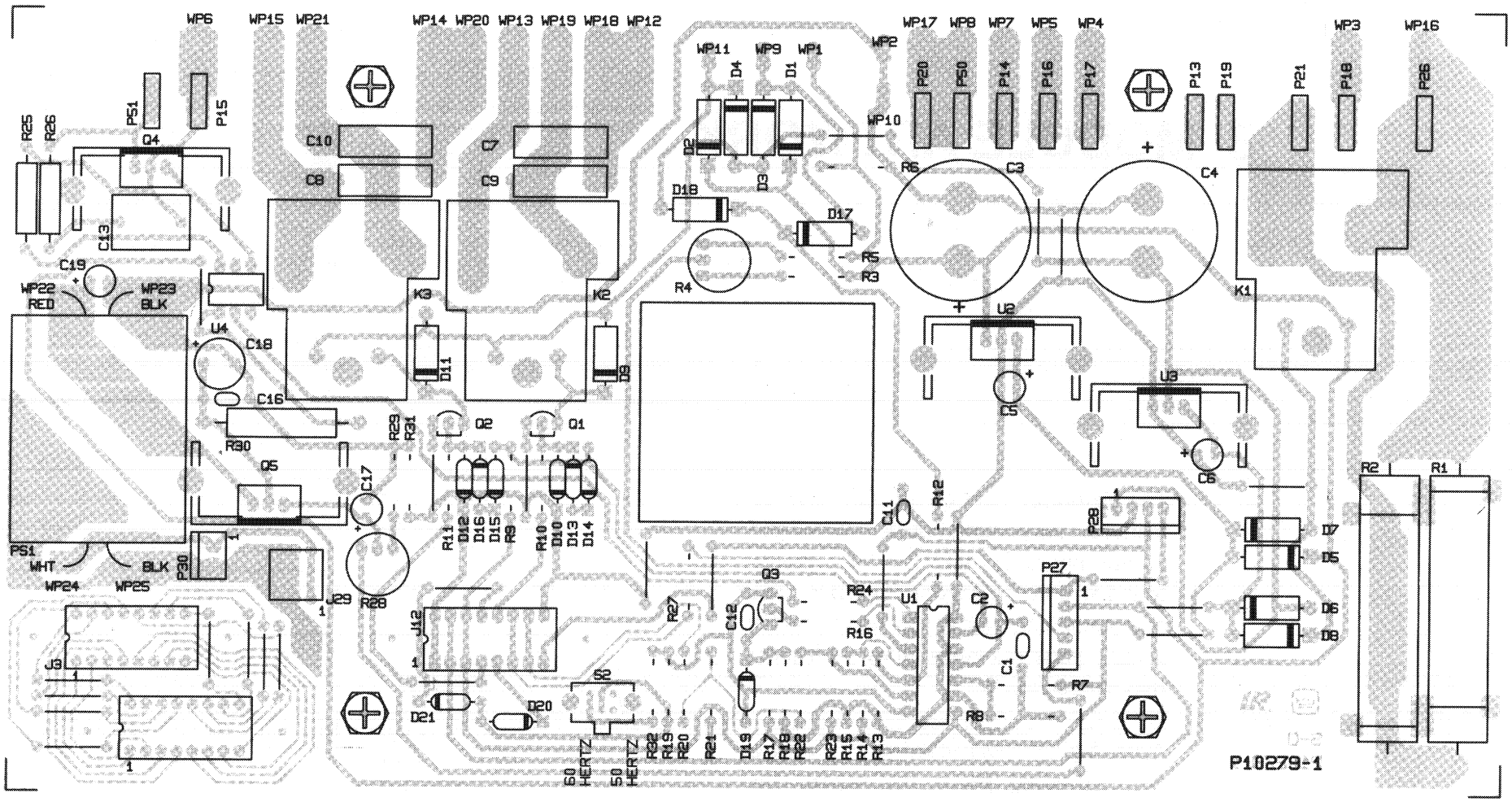


Fig. 7.11 Wiring Diagram (Bottom)

8 MODULE ARTWORK

The ***Modules*** section of this service manual is the compilation of artwork and circuit board layouts for the module found within the Model amplifier. For schematic diagrams see section 6 and for chassis parts drawings along with parts lists see section 7.

Note: A blank space in the right column of the following parts list means the component is the same as on the module listed immediately to the left!



** Darker tracework indicates parts side of module foil layout.*
*** Lighter tracework indicates bottom side of module foil layout.*

Fig. 8.1 Control Module (Q42834-4)

CONTROL MODULE

Circuit Designation	Q42834-4			
	Description	Part #	Description	Part #
Resistors				
R1	300 Ohm 10W	C 7669-2		
R2	300 Ohm 10W	C 7669-2		
R3	150 K Ohm .25W	C 4216-5		
R4	10 K Ohm Trim Pot	C 3093-9		
R5	150 K Ohm .25W	C 4216-5		
R6	100 K Ohm .25W	C 2883-4		
R7	33. K Ohm .25W	C 4346-0		
R8	100 K Ohm .25W	C 2883-4		
R9	3.9 K Ohm .25W	C 2630-9		
R10	2.2 K Ohm .25W	C 2628-3		
R11	2.2 K Ohm .25W	C 2628-3		
R12	47 K Ohm .25W	C 2880-0		
R13	20 K Ohm .25W	C 5046-5		
R14	47 K Ohm .25W	C 2880-0		
R15	1 K Ohm .25W	C 2627-5		
R16	47 K Ohm .25W	C 2880-0		
R17	3.3 K Ohm .25W	C 2629-1		
R18	12 K Ohm .25W	C 2878-4		
R19	91 K Ohm .25W	C 3621-7		
R20	4.7 K Ohm .25W	C 3939-3		
R21	4.7 K Ohm .25W	C 3939-3		
R22	470 K Ohm .25W	C 4225-6		
R23	470 K Ohm .25W	C 4225-6		

CONTROL MODULE (CONT)

Circuit Designation	Q42834-4			
	Description	Part #	Description	Part #
R24	2.2 K Ohm .25W	C 2628-3		
R25	180 Ohm .5W	C 1006-3		
R26	36 Ohm .5W	C 2988-1		
R27	3.0 K Ohm .25W	C 3805-6		
R28	5K Ohm Trim Pot	C 3670-4		
R29	4.7 K Ohm .25W	C 3939-3		
Capacitors				
C1	.1µf 50V	C 6130-6		
C2	2.2µf 50V	C 5362-6		
C3	1800µf 35V	C 7819-3		
C4	1800µf 35V	C 7819-3		
C5	2.2µf 50V	C 5362-6		
C6	2.2µf 50V	C 5362-6		
C7	.1µf 200V	C 2938-6		
C8	.1µf 200V	C 2938-6		
C9	.1µf 200V	C 2938-6		
C10	.1µf 200V	C 2938-6		
C11	.1µf 50V	C 6130-6		
C12	.1µf 50V	C 6130-6		
C13	.47µf 250V	C 7502-5		
C16	.1µf 50V	C 6130-6		
C17	.01µf 100V	C 3161-4		
C18	100µf 35V	C 8026-4		

CONTROL MODULE (CONT)

Circuit Designation	Q42834-4			
	Description	Part #	Description	Part #
Transistors				
Q1	2N4125 PNP	C 3625-8		
Q2	2N4125 PNP	C 3625-8		
Q3	2N4125 PNP	C 3625-8		
Q4	MAC218A6 (TRIAC)	C 7662-7		
Q5	MJE15028 NPN	C 5890-6		
Integrated Circuits				
U1	LM339N	C 4345-2		
U2	MC7815CT	C 5095-2		
U3	MC7915CT	C 5096-0		
U4	MOC3011	C 7665-0		
Diodes				
D1	1N4004	C 2851-1		
D2	1N4004	C 2851-1		
D3	1N4004	C 2851-1		
D4	1N4004	C 2851-1		
D5	1N4004	C 2851-1		
D6	1N4004	C 2851-1		
D7	1N4004	C 2851-1		
D8	1N4004	C 2851-1		
D9	1N4004	C 2851-1		
D10	1N4004	C 2851-1		
D11	1N4004	C 2851-1		
D12	1N4148	C 3181-2		

CONTROL MODULE (CONT)

Circuit Designation	Q42834-4			
	Description	Part #	Description	Part #
D13	1N4148	C 3181-2		
D14	1N4148	C 3181-2		
D15	1N4148	C 3181-2		
D16	1N4148	C 3181-2		
D17	1N4004	C 2851-1		
D18	1N4004	C 2851-1		
D19	1N961B 10V Zener	C 3549-0		
D20	1N4148	C 3181-2		
D21	1N4148	C 3181-2		
Misc.				
	Relay (Cover)	C 7890-4		
CB1	Relay 30A	C 7891-2		
	6 X 32 Hex Nut	C 1889-2		
	14 Pin IC Socket	C 3450-1		
	16PIN IC Socket	C 4508-5		
	#6 INT.Star Washer	C 5594-4		
	T0220 Heat Sink	C 6510-9		
	Torque Spreader	C 6541-4		
	6-32 X .3125 RDHD	C 7009-1		
	4 Pos 1 Center Header	C 7592-6		
	5 Pos 1 Center Header	C 7593-4		
	.25 PC Mount	C 7817-7		
	Low Noise PWR Supply	C 8333-4		
	Connector 14-16 Ga	C 7352-5		

CONTROL MODULE (CONT)

Circuit Designation	Q42834-4			
	Description	Part #	Description	Part #
	Mate-N-Lock	C 7832-6		
	Mate-N-Lock Socket	C 7833-4		
	MR Control Bd (Blank)	P10279-1		

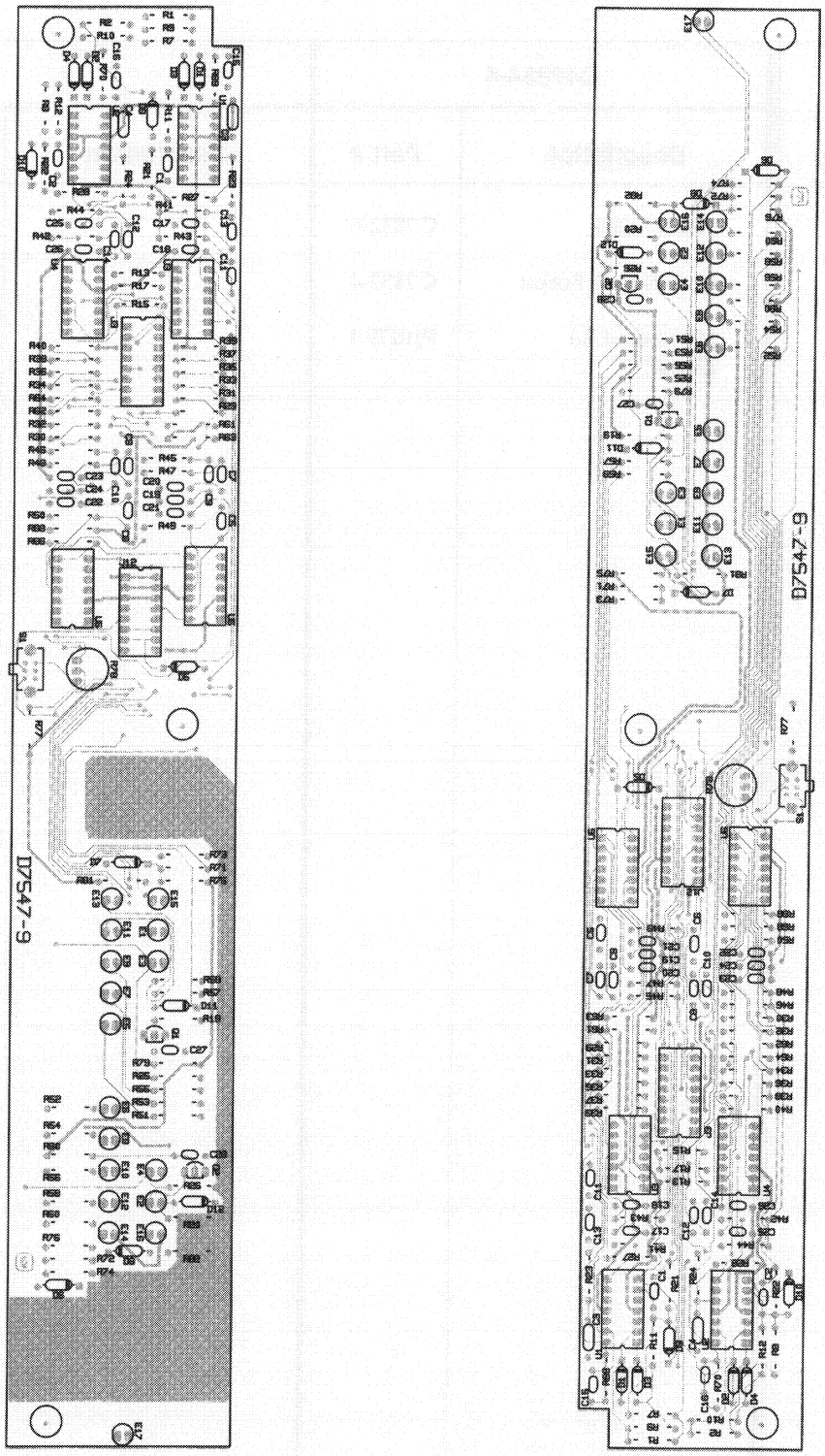


Fig. 8.2 Display Module (Q42835-1)

DISPLAY MODULE

Circuit Designation	Q42835-1			
	Description	Part #	Description	Part #
Resistors				
R1	100 K Ohm .25W 1%	C 5707-2		
R2	100 K Ohm .25W 1%	C 5707-2		
R7	100 K Ohm .25W 1%	C 5707-2		
R8	100 K Ohm .25W 1%	C 5707-2		
R9	10 K Ohm .25W 1%	C 4859-2		
R10	10 K Ohm .25W 1%	C 4859-2		
R11	4.99K Ohm .25W 1%	C 3686-0		
R12	4.99K Ohm .25W 1%	C 3686-0		
R13	8.25 K Ohm .25W 1%	C 7810-2		
R15	14.3 K Ohm .25W 1%	C 6165-2		
R17	8.25 K Ohm .25W 1%	C 7810-2		
R19	820 Ohm .25W	C 3301-6		
R20	820 Ohm .25W	C 3301-6		
R21	10 K Ohm .25W 1%	C 4859-2		
R22	10 K Ohm .25W 1%	C 4859-2		
R23	1.5 K Ohm .25W	C 2876-8		
R24	1.5 K Ohm .25W	C 2876-8		
R25	820 Ohm .25W	C 3301-6		
R26	820 Ohm .25W	C 3301-6		
R27	1.8 M Ohm .25W	C 4236-3		
R28	1.8 M Ohm .25W	C 4236-3		
R29	6.81 K Ohm .25W 1%	C 6104-1		
R30	6.81 K Ohm .25W 1%	C 6104-1		

DISPLAY MODULE (CONT)

Circuit Designation	Q42835-1			
	Description	Part #	Description	Part #
R31	1.69 K Ohm .25W 1%	C 7434-1		
R32	1.69 K Ohm .25W 1%	C 7434-1		
R33	953 Ohm .25W 1%	C 6317-9		
R34	953 Ohm .25W 1%	C 6317-9		
R35	536 Ohm .25W 1%	C 5044A8		
R36	536 Ohm .25W 1%	C 5044A8		
R37	300 Ohm .25W	C 3801-5		
R38	300 Ohm .25W	C 3801-5		
R39	390 Ohm .25W	C 6495-3		
R40	390 Ohm .25W	C 6495-3		
R41	22 K Ohm .25W	C 3302-4		
R42	22 K Ohm .25W	C 3302-4		
R43	22 K Ohm .25W	C 3302-4		
R44	22 K Ohm .25W	C 3302-4		
R45	22 K Ohm .25W	C 3302-4		
R46	22 K Ohm .25W	C 3302-4		
R47	22 K Ohm .25W	C 3302-4		
R48	22 K Ohm .25W	C 3302-4		
R49	22 K Ohm .25W	C 3302-4		
R50	22 K Ohm .25W	C 3302-4		
R51	390 Ohm .25W	C 6495-3		
R52	390 Ohm .25W	C 6495-3		
R53	390 Ohm .25W	C 6495-3		
R54	390 Ohm .25W	C 6495-3		

DISPLAY MODULE (CONT)

Circuit Designation	Q42835-1			
	Description	Part #	Description	Part #
R55	390 Ohm .25W	C 6495-3		
R56	390 Ohm .25W	C 6495-3		
R57	390 Ohm .25W	C 6495-3		
R58	390 Ohm .25W	C 6495-3		
R59	390 Ohm .25W	C 6495-3		
R60	390 Ohm .25W	C 6495-3		
R61	1.0 M Ohm .25W	C 3198-6		
R62	1.0 M Ohm .25W	C 3198-6		
R63	3.3 M Ohm .25W	C 4237-1		
R64	3.3 M Ohm .25W	C 4237-1		
R66	47 K Ohm .25W	C 2880-0		
R68	1 K Ohm .25W	C 2627-5		
R69	5.1 M Ohm .25W	C 4126-6		
R70	5.1 M Ohm .25W	C 4126-6		
R71	820 Ohm .25W	C 3301-6		
R72	820 Ohm .25W	C 3301-6		
R73	1.8 K Ohm .25W	C 3807-2		
R74	1.8 K Ohm .25W	C 3807-2		
R75	3.3 K Ohm .25W	C 2629-1		
R76	3.3 K Ohm .25W	C 2629-1		
R77	20 K Ohm .25W	C 5046-5		
R78	5K Ohm Helipot Trim	C 3670-4		
R79	470 K Ohm .25W	C 4225-6		
R80	470 K Ohm .25W	C 4225-6		

DISPLAY MODULE (CONT)

Circuit Designation	Q42835-1			
	Description	Part #	Description	Part #
R82	1.5 K Ohm .25W	C 2876-8		
R83	1.5 K Ohm .25W	C 2876-8		
Capacitors				
C1	27PF 100V	C 6813-7		
C2	27PF 100V	C 6813-7		
C3	.47µf 50V	C 6802-0		
C4	.47µf 50V	C 6802-0		
C5	.1µf 50V	C 6804-6		
C6	.1µf 50V	C 6804-6		
C7	.1µf 50V	C 6804-6		
C8	.1µf 50V	C 6804-6		
C9	.1µf 50V	C 6804-6		
C10	.1µf 50V	C 6804-6		
C11	.1µf 50V	C 6804-6		
C12	.1µf 50V	C 6804-6		
C13	.1µf 50V	C 6804-6		
C14	.1µf 50V	C 6804-6		
C15	.47µf 50V	C 6802-0		
C16	.47µf 50V	C 6802-0		
C17	.001µf 100V	C 6807-9		
C18	.001µf 100V	C 6807-9		
C19	.001µf 100V	C 6807-9		
C20	.001µf 100V	C 6807-9		
C21	.001µf 100V	C 6807-9		

DISPLAY MODULE (CONT)

Circuit Designation	Q42835-1			
	Description	Part #	Description	Part #
C22	.001µf 100V	C 6807-9		
C23	.001µf 100V	C 6807-9		
C24	.001µf 100V	C 6807-9		
C25	.001µf 100V	C 6807-9		
C26	.001µf 100V	C 6807-9		
C27	.1µf 50V	C 6804-6		
C28	.1µf 50V	C 6804-6		
Diodes				
D1	1N4148	C 3181-2		
D2	1N4148	C 3181-2		
D3	1N4148	C 3181-2		
D4	1N4148	C 3181-2		
D5	1N4148	C 3181-2		
D6	1N4148	C 3181-2		
D7	1N4148	C 3181-2		
D8	1N4148	C 3181-2		
D9	1N4148	C 3181-2		
D10	1N4148	C 3181-2		
D11	1N4148	C 3181-2		
D12	1N4148	C 3181-2		
LEDs				
E1	Yellow LED	C 4431-0		
E2	Yellow LED	C 4431-0		
E1	Green LED	C 7863-1		

DISPLAY MODULE (CONT)

Circuit Designation	Q42835-1			
	Description	Part #	Description	Part #
E2	Green LED	C 7863-1		
E3	Green LED	C 7863-1		
E4	Green LED	C 7863-1		
E5	Green LED	C 7863-1		
E6	Green LED	C 7863-1		
E7	Green LED	C 7863-1		
E8	Green LED	C 7863-1		
E9	Green LED	C 7863-1		
E10	Green LED	C 7863-1		
E11	Green LED	C 7863-1		
E12	Green LED	C 7863-1		
E13	Green LED	C 7863-1		
E14	Green LED	C 7863-1		
E15	Green LED	C 7863-1		
E16	Green LED	C 7863-1		
E17	Amber LED	C 4342-9		
Integrated Circuits				
U1	MC33079P	C 7558-7		
U2	MC33079P	C 7558-7		
U3	LM339N	C 4345-2		
U4	LM339N	C 4345-2		
U5	LM339N	C 4345-2		
U6	LM339N	C 4345-2		

DISPLAY MODULE (CONT)

Circuit Designation	Q42835-1			
	Description	Part #	Description	Part #
Misc.	16Pin Dip Cable	D 6990-2		
	Display Brd (Blank)	D 7547-9		

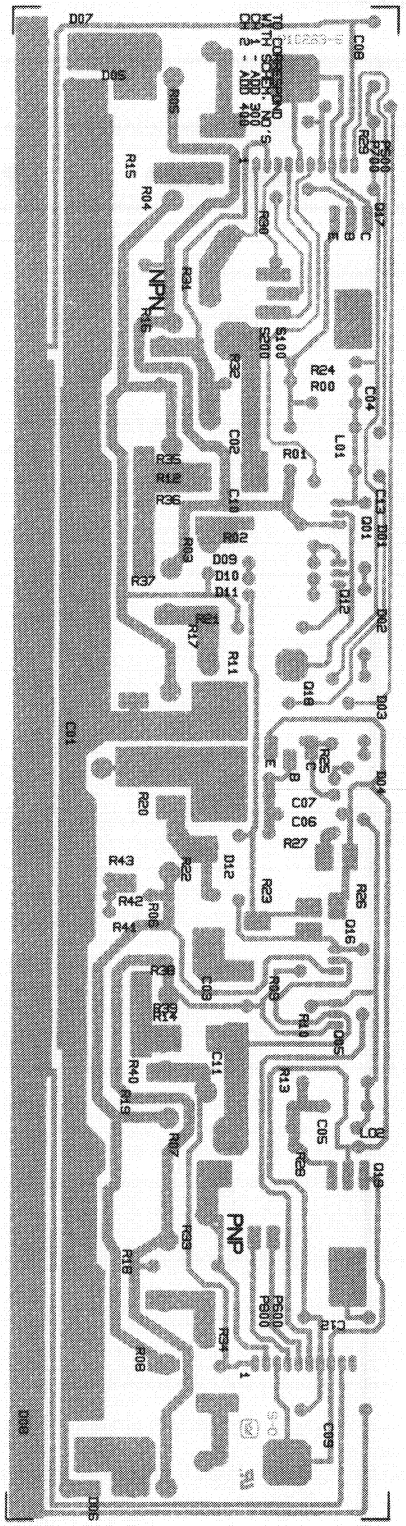


Fig. 8.3 Output Module (Q42822-9)

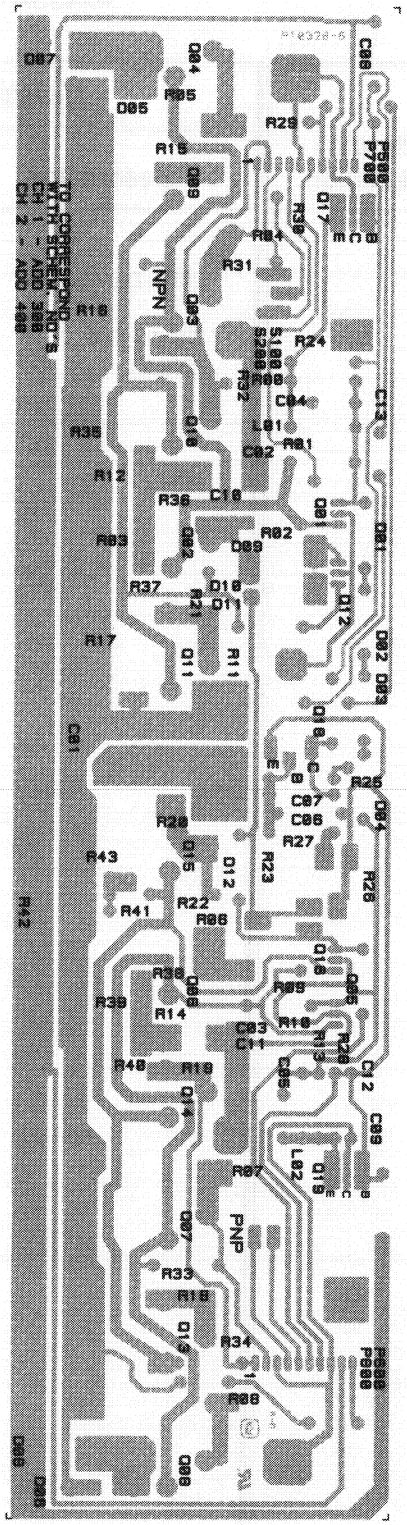


Fig. 8.4 Output Module (Q428941-7)

OUTPUT MODULE

Circuit Designation	Q42822-9		Q42941-6	
	Description	Part #	Description	Part #
Resistors				
R300 R400	68 Ohm .25W	C 6079-5		
R301 R401	100 Ohm .25W	C 2872-7		
R302 R402	5.6 Ohm .5W	C 7778-1		
R303 R403	.2 Ohm 5W	C 6486-2		
R304 R404	.2 Ohm 5W	C 6486-2		
R305 R405	.2 Ohm 5W	C 6486-2		
R306 R406	.2 Ohm 5W	C 6486-2		
R307 R407	.2 Ohm 5W	C 6486-2		
R308 R408	.2 Ohm 5W	C 6486-2		
R309 R409	22 Ohm .25W	C 7779-9		
R310 R410	100 Ohm .25W	C 2872-7		
R311 R411	2.7 Ohm 10W	C 5862-5		
R312 R412	2.7 Ohm 1W	C 1001-4		
R313 R413	68 Ohm .25W	C 6079-5		
R314 R414	2.7 Ohm 1W	C 1001-4		

OUTPUT MODULE (CONT)

Circuit Designation	Q42822-9		Q42941-6	
	Description	Part #	Description	Part #
R315 R415	.2 Ohm 5W	C 6486-2		
R316 R416	.2 Ohm 5W	C 6486-2		
R317 R417	.2 Ohm 5W	C 6486-2		
R318 R418	.2 Ohm 5W	C 6486-2		
R319 R419	.2 Ohm 5W	C 6486-2		
R320 R420	.2 Ohm 5W	C 6486-2		
R321 R421	5.6 Ohm .5W	C 7778-1		
R322 R422	22 Ohm .25W	C 7779-9		
R323 R423	250 Ohm Lin Trimpot	C 6844-2		
R324 R424	13 K Ohm .25W	C 4300-7		
R325 R425	2.2 K Ohm .25W	C 2628-3		
R326 R426	250 Ohm Lin Trimpot	C 6844-2		
R327 R427	390 Ohm .25W	C 6495-3		
R328 R428	13 K Ohm .25W	C 4300-7		
R329 R429	51 Ohm .25W	C 6402-9		
R330 R430	102 Ohm .25W 1%	C 6626-3		

OUTPUT MODULE (CONT)

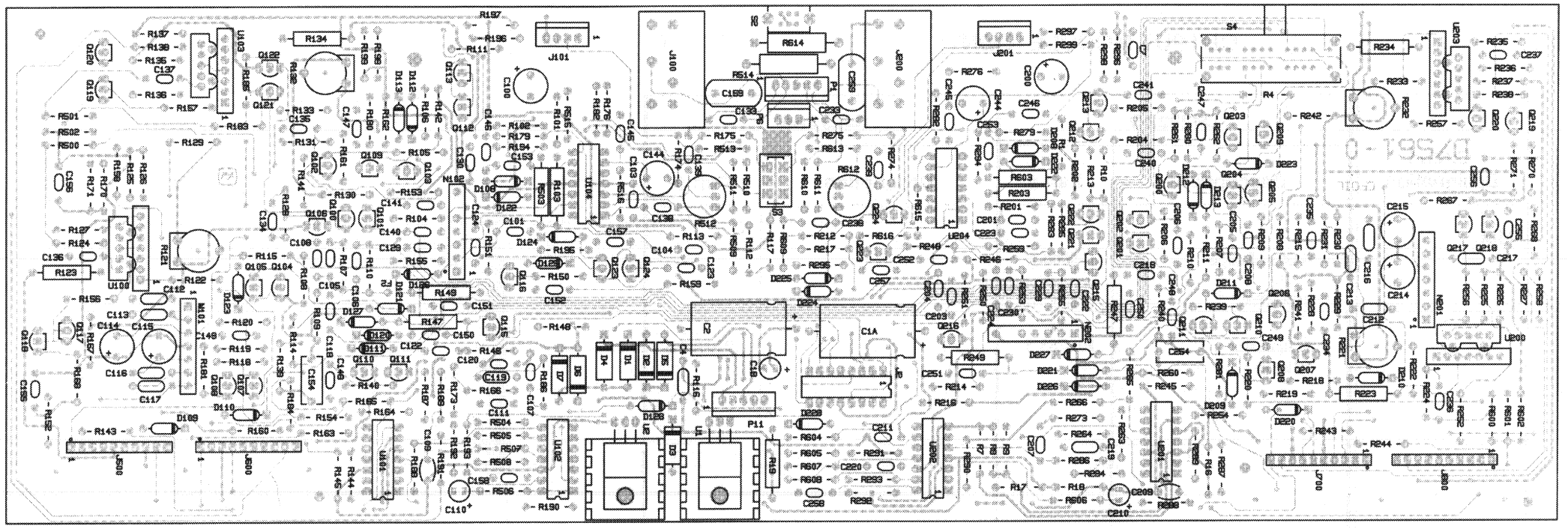
Circuit Designation	Q42822-9		Q42941-6	
	Description	Part #	Description	Part #
Capacitors				
C301 C401	.047µf 200V	C 3978-1		
C302 C402	.1µf 200V	C 2938-6		
C303 C403	.1µf 200V	C 2938-6		
C304 C404	.0022µf 100V	C 3285-1		
C305 C405	.0027µf 200V	C 3481-6		
C306 C406	.01µf 100V	C 6806-1		
C307 C407	.001µf 100V	C 6807-9		
C308 C408	180pF 100V	C 6810-3		
C312 C412	470pF 100V	C 6808-7		
C313 C413	.47µf 250V	C 7502-5		
Inductors				
L300 L400	2.5 µH Coil	D 7407-6		
L301 L401	.470 µH	C 3510-2		
L302 L402	.470 µH	C 3510-2		
Diodes				
D301 D401	1N4004	C 2851-1		

OUTPUT MODULE (CONT)

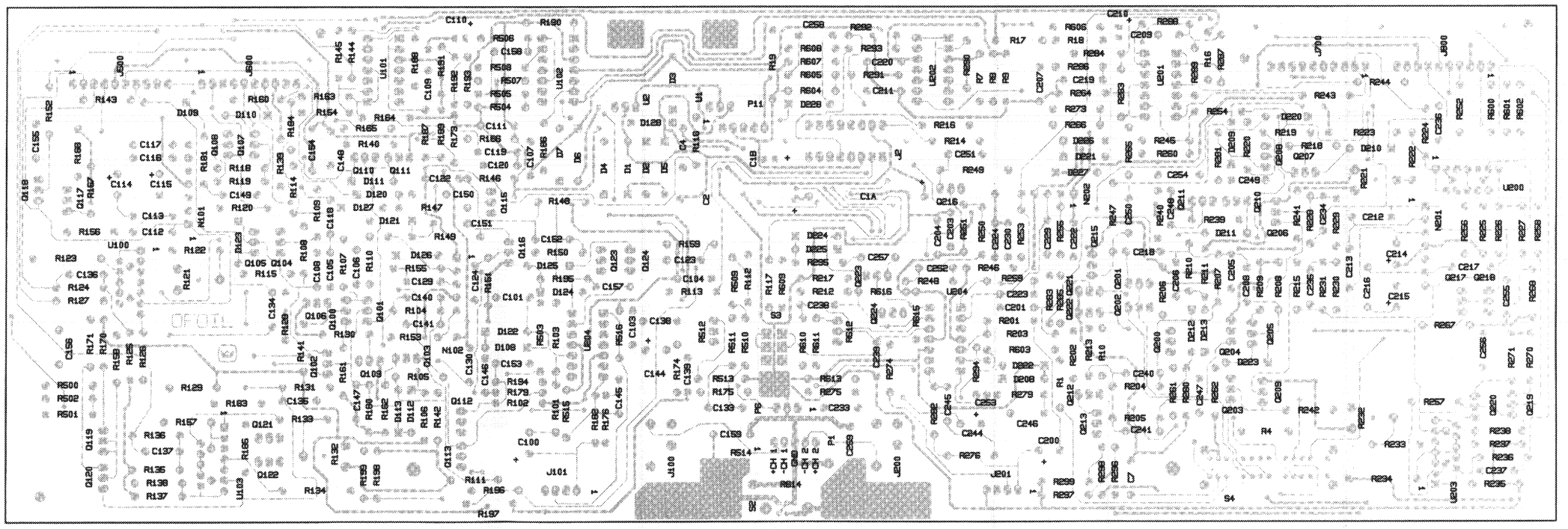
Circuit Designation	Q42822-9		Q42941-6	
	Description	Part #	Description	Part #
D302 D402	1N4004	C 2851-1		
D303 D403	1N4004	C 2851-1		
D304 D404	1N4004	C 2851-1		
D305 D405	MR822 Pwr Rect	C 8383-9		
D306 D406	MR822 Pwr Rect	C 8383-9		
D307 D407	MR822 Pwr Rect	C 8383-9		
D308 D408	1N4004	C 2851-1		
D309 D409	1N4004	C 2851-1		
D310 D410	1N4004	C 2851-1		
D311 D411	1N4004	C 2851-1		
Transistors				
Q317 Q417	MPS-U10 NPN	C 7271-7		
Q318 Q418	MPS8097 NPN	~~D 2962-5~~	C 8813-5	
Q319 Q419	MPSU60 PNP	C 7318-6		

OUTPUT MODULE (CONT)

Circuit Designation	Q42822-9		Q42941-6	
	Description	Part #	Description	Part #
Misc.				
	0 Ohm Jumper	C 5868-2		
	10P HDR	C 7057-0		
	Output Brd (Blank)	P10263-5		P10328-6



Component Side



Foil Side

Fig. 9.5 Main Module (Q42837-7)

MAIN MODULE

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
Resistors				
R2	10 K Ohm 1%	C 8260-9		
R4	10.5K Ohm 1%	C 4497-1		
R7	43 K Ohm	C 4167-0		
R8	75 K Ohm	C 5702-3		
R9	3.3K Ohm	C 2629-1		
R16	3.3K Ohm	C 2629-1		
R17	75 K Ohm	C 5702-3		
R18	43 K Ohm	C 4167-0		
R10	N/A			
R19	2.7 Ohm .5W	C 2857-8		
R101 R201	1.02 K Ohm 1%	C 6086-0		
R102 R202	510 Ohm	C 4226-4		
R103 R203	20.5 K Ohm 1%	C 8416-7		
R104 R204	2.7K Ohm	C 5168-7		
R105 R205	2.7K Ohm	C 5168-7		
R106 R206	12K Ohm	C 2878-4		
R107 R207	68 K Ohm	C 3620-9		
R108 R208	820 K Ohm	C 3301-6		
R109 R209	68 K Ohm	C 6079-5		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
R110 R210	68 K Ohm	C 3620-9		
R111 R211	12K Ohm	C 2878-4		
R112 R212	51 K Ohm	C 2881-8		
R113 R213	4.7K Ohm	C 3939-3		
R114 R214	4.7K Ohm	C 3939-3		
R115 R215	510 K Ohm	C 4226-4		
R116 R216	3.3 M Ohm	C 4237-1		
R117 R217	47 K Ohm	C 2880-0		
R118 R218	270 Ohm .25W	C 7780-7		
R119 R219	634 Ohm ..25W	C 6298-1		
R120 R220	270 Ohm ..25W	C 7780-7		
R121 R221	100K Ohm Trim Pot	C 5062-2		
R122 R222	270 K Ohm	C 2885-9		
R123 R223	20 K Ohm	C 5057-2		
R124 R224	6.8K Ohm	C 5166-1		
R125 R225	100 Ohm	C 7782-3		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
R126 R226	100 Ohm	C 7782-3		
R127 R227	6.8K Ohm	C 5166-1		
R128 R228	10 K Ohm	C 2631-7		
R129 R229	100 K Ohm	C 2883-4		
R130 R230	100 K Ohm	C 2883-4		
R131 R231	10 K Ohm	C 2631-7		
R132 R232	100K Ohm Trim Pot	C 5062-2		
R133 R233	270 K Ohm	C 2885-9		
R134 R234	20 K Ohm	C 5057-2		
R135 R235	100 Ohm	C 2872-7		
R136 R236	6.8K Ohm	C 5166-1		
R137 R237	100 Ohm	C 7782-3		
R138 R238	6.8K Ohm	C 5166-1		
R139 R239	820 Ohm	C 3301-6		
R140 R240	68 Ohm	C 6079-5		
R141 R241	150 K Ohm	C 4216-5		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
R142 R242	150 K Ohm	C 4216-5		
R143 R243	100 K Ohm	C 2883-4		
R144 R244	100 K Ohm	C 2883-4		
R145 R245	3.3 K Ohm	C 4237-1		
R146 R246	10 K Ohm	C 2631-7		
R147 R247	200 Ohm .5W	C 7781-5		
R148 R248	2.7K Ohm	C 5168-7		
R149 R249	200 Ohm .5W	C 7781-5		
R150 R250	2.7K Ohm	C 5168-7		
R151 R251	10 K Ohm	C 2631-7		
R152 R252	12K Ohm	C 2878-4		
R153 R253	Ø Ohm JMPR	C 5868-2		
R154 R254	121 K Ohm 1%	C 8261-7		
R155 R255	47 K Ohm	C 2880-0		
R156 R256	1.3K Ohm	C 3144-0		
R157 R257	1.3K Ohm	C 3144-0		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
R158 R258	9.1K Ohm	C 5878-1		
R159 R259	1 K Ohm	C 2627-5		
R160 R260	10 K Ohm 1%	C 4859-2		
R161 R261	47 Ohm	C 2528-5		
R162 R262	47 Ohm	C 2528-5		
R163 R263	121 K Ohm 1%	C 8261-7		
R164 R264	10 K Ohm 1%	C 4859-2		
R165 R265	121 K Ohm 1%	C 8261-7		
R166 R266	3.3 M Ohm	C 4237-1		
R167 R267	1K Ohm 1%	C 4850-1		
R168 R268	953 Ohm 1%	C 6317-9		
R170 R270	1K Ohm 1%	C 4850-1		
R171 R271	953 Ohm 1%	C 6317-9		
R173 R273	10 K Ohm 1%	C 4859-2		
R174 R274	24.9 K Ohm 1%	C 7155-2		
R175 R275	6.19 K Ohm 1%	C 3688-6		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
R176 R276	24.9 K Ohm 1%	C 7155-2		
R179 R279	1.3 K Ohm	C 3144-0		
R180 R280	470 Ohm	C 2626-7		
R181 R281	270 Ohm	C 2885-9		
R182 R282	22 Ohm	C 4479-9		
R183 R283	2.4K Ohm	C 3616-7		
R184 R284	470 K Ohm	C 4225-6		
R185 R285	2.4K Ohm	C 3616-7		
R186 R286	2.7 M Ohm ..25W	C 2634-1		
R187 R287	36 K Ohm	C 4865-9		
R188 R288	36 K Ohm	C 4865-9		
R189 R289	27 K Ohm	C 5165-3		
R190 R290	2 M Ohm	C 3199-4		
R191 R291	33K Ohm	C 4346-0		
R192 R292	10 K Ohm	C 2631-7		
R193 R293	10 K Ohm	C 2631-7		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
R194 R294	20 K Ohm	C 5046-5		
R195 R295	47 Ohm	C 2528-5		
R196 R296	4.7 K Ohm	C 3939-3		
R197 R297	10 K Ohm	C 2631-7		
R198 R298	4.7 K Ohm	C 3939-3		
R199 R299	10 K Ohm	C 2631-7		
R500 R600	100 K Ohm	C 4216-5		
R501 R601	100 K Ohm	C 4216-5		
R502 R602	100 K Ohm	C 4216-5		
R503 R603	47 Ohm	C 2528-5		
R504 R604	470 K Ohm	C 4225-6		
R505 R605	470 K Ohm	C 4225-6		
R506 R606	1.5 K Ohm	C 2876-8		
R507 R607	470 Ohm	C 2626-7		
R508 R608	1 M Ohm	C 3198-6		
R509 R609	4.99 K Ohm 1%	C 3686-0		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
R510 R610	4.99 K Ohm 1%	C 3686-0		
R511 R611	4.99 K Ohm 1%	C 3686-0		
R512 R612	100 Ohm CMR Adjust	C 6173-6		
R513 R613	4.99 K Ohm 1%	C 3686-0		
R514 R614	24 Ohm 5W	C 7340-0		
Resistor Networks				
N101 N201	Resistor Network	D 6081-0		
N102 N202	Resistor Network	D 6082-8		
Capacitors				
C1	1000µf 35V	C 4303-1		
C2	470µf 35V	C 3913-8		
C6	.01µf 100V	C 6806-1		
C100 C200	100µf 16V NP	C 4148-0		
C101 C201	47pf MICA	C 6812-9		
C103 C203	.022µf 100V	C 6805-3		
C104 C204	.022µf 100V	C 6805-3		
C105 C205	47pf 100V	C 6812-9		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
C106 C206	47pf 100V	C 6812-9		
C107 C207	.1µf 50V	C 6804-6		
C108 C208	12pf 100V	C 6814-5		
C109 C209	.002µf 100V	C 7613-0		
C110 C210	2.2µf 50V	C 5362-6		
C111 C211	.1µf 50V	C 6804-6		
C112 C212	.12µf 50V	C 6803-8		
C113 C213	.47µf 50V	C 6802-0		
C114 C214	100µf 16V VERT	C 3729-8		
C115 C215	100µf 16V VERT	C 3729-8		
C116 C216	.47µf 50V	C 6802-0		
C117 C217	.12µf 50V	C 6803-8		
C118 C218	12pf 100V	C 6814-5		
C119 C219	.47µf 50V	C 6802-0		
C120 C220	.1µf 50V	C 6804-6		
C122 C222	100pf 100V	C 6811-1		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
C123 C223	180 pf 100V	C 6810-3		
C124 C224	47pf 100V	C 6812-9		
C129 C229	47pf 100V	C 6812-9		
C130 C230	27pf 100V	C 6813-7		
C133 C233	12pf 100V	C 6814-5		
C134 C234	.022µf 100V	C 6805-3		
C135 C235	.022µf 100V	C 6805-3		
C136 C236	470pf 100V	C 6808-7		
C137 C237	470pf 100V	C 6808-7		
C138 C238	27 pf 100V	C 6813-7		
C139 C239	27 pf 100V	C 6813-7		
C140 C240	47pf 100V	C 6812-9		
C141 C241	47pf 100V	C 6812-9		
C144 C244	100µf 16V	C 4148-0		
C145 C245	47 pf 100V	C 6812-9		
C146 C246	47 pf 100V	C 6812-9		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
C147 C247	.01 µf 50V	C 6804-6		
C148 C248	180pf 100V	C 6810-3		
C149 C249	470pf 100V	C 6808-7		
C150 C250	.022 µf 100V	C 6805-3		
C151 C251	.01 µf 100V	C 6806-1		
C152 C252	220pf 100V	C 6809-5		
C153 C254	.1 µf 250V	C 5243-8		
C154 C255	.1 µf 50V	C 6804-6		
C156 C256	.1 µf 250V	C 5243-8		
C157 C257	27 pf 250V	C 6813-7		
C158 C258	.01 µf 50V	C 6804-6		
C159 C259	.1 µf 100V	C 7706-2		
Integrated Circuits				
U2	MC7815CT	C 5095-2		
U2	MC7915CT	C 5096-0		
U100 U200	UPA75HA	C 6911-9		
U101 U201	LM339N	C 4345-2		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
U102 U202	LM339N	C 4345-2		
U1203 U203	UPA76HA	C 6910-1		
U104 U204	MC34084P	C 6900-2		
Transistors				
Q100 Q200	2N3859A	D 2961-7		
Q101 Q201	MPSA93 PNP	C 3578-9		
Q102 Q202	MPSA43/A42	C 3810-6		
Q103 Q203	PN4250A	C 3786-8		
Q104 Q204	2N4125 PNP	C 3625-8		
Q105 Q205	MPSA93 PNP	C 3578-9		
Q106 Q206	2N4125 PNP	C 3625-8		
Q107 Q207	PN4250A	C 3786-8		
Q108 Q208	2N3859A	D 2961-7		
Q109 Q209	2N3859A	D 2961-7		
Q110 Q210	MPSA43/A42	C 3810-6		
Q111 Q211	2N3859A	D 2961-7		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
Q112 Q212	2N4125 PNP	C 3625-8		
Q113 Q213	2N4125 PNP	C 3625-8		
Q115 Q215	MPS8097 (ALT MPSA18)	D 2962-5		
Q116 Q216	PN4250A	C 3786-8		
Q117 Q217	2N3859A	D 2961-7		
Q118 Q218	2N3859A	D 2961-7		
Q119 Q219	2N4125 PNP	C 3625-8		
Q120 Q220	2N4125 PNP	C 3625-8		
Q121 Q221	2N4123	C 7458-0		
Q122 Q222	2N4123	C 7458-0		
Diodes				
D1	1N4004	C 2851-1		
D2	1N4004	C 2851-1		
D3	1N4004	C 2851-1		
D4	1N4004	C 2851-1		
D5	1N4004	C 2851-1		
D6	1N4004	C 2851-1		
D7	1N4004	C 2851-1		
D9	1N3070	C 5061-4		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
D108 D208	1N4148	C 3181-2		
D109 D209	1N4148	C 3181-2		
D110 D210	1N4148	C 3181-2		
D111 D211	1N3070	C 5061-4		
D112 D212	1N4148	C 3181-2		
D113 D213	1N4148	C 3181-2		
D120 D220	1N4148	C 3181-2		
D121 D221	1N4148	C 3181-2		
D122 D222	1N4148	C 3181-2		
D123 D223	1N3070	C 5061-4		
D124 D224	1N4148	C 3181-2		
D125 D225	1N4148	C 3181-2		
D126 D226	1N3070	C 5061-4		
D127 D227	1N3070	C 5061-4		
D128 D228	1N4148	C 3181-2		

MAIN MODULE (CONT)

Circuit Designation	Q42837-7			
	Description	Part #	Description	Part #
MISC.				
	6X32 Hex Nut	C 1889-2		
	6-32 X .50 RDHD	C 2176-3		
	IC Socket, 14Pin	C 3450-1		
	IC Socket,16Pin	C 4508-5		
	TO220 Heat Sink	C 5341-0		
	#6 INT.Star Washer	C 5594-4		
S2	Ground Lift Switch	C 7363-2		
S3	Sensitivity Switch	C 7363-2		
S4	Dual/Mono Switch	C 6781-6		
	3POS .Header	C 7526-4		
	10" Ribbon Cable	D 6619-7		
	6" Ribbon Cable	D 6620-5		
	Circuit Board	D 7561-0		
	.25 Phone Jack	C 6777-4		
	Phone Jack Cover	C 6778-2		

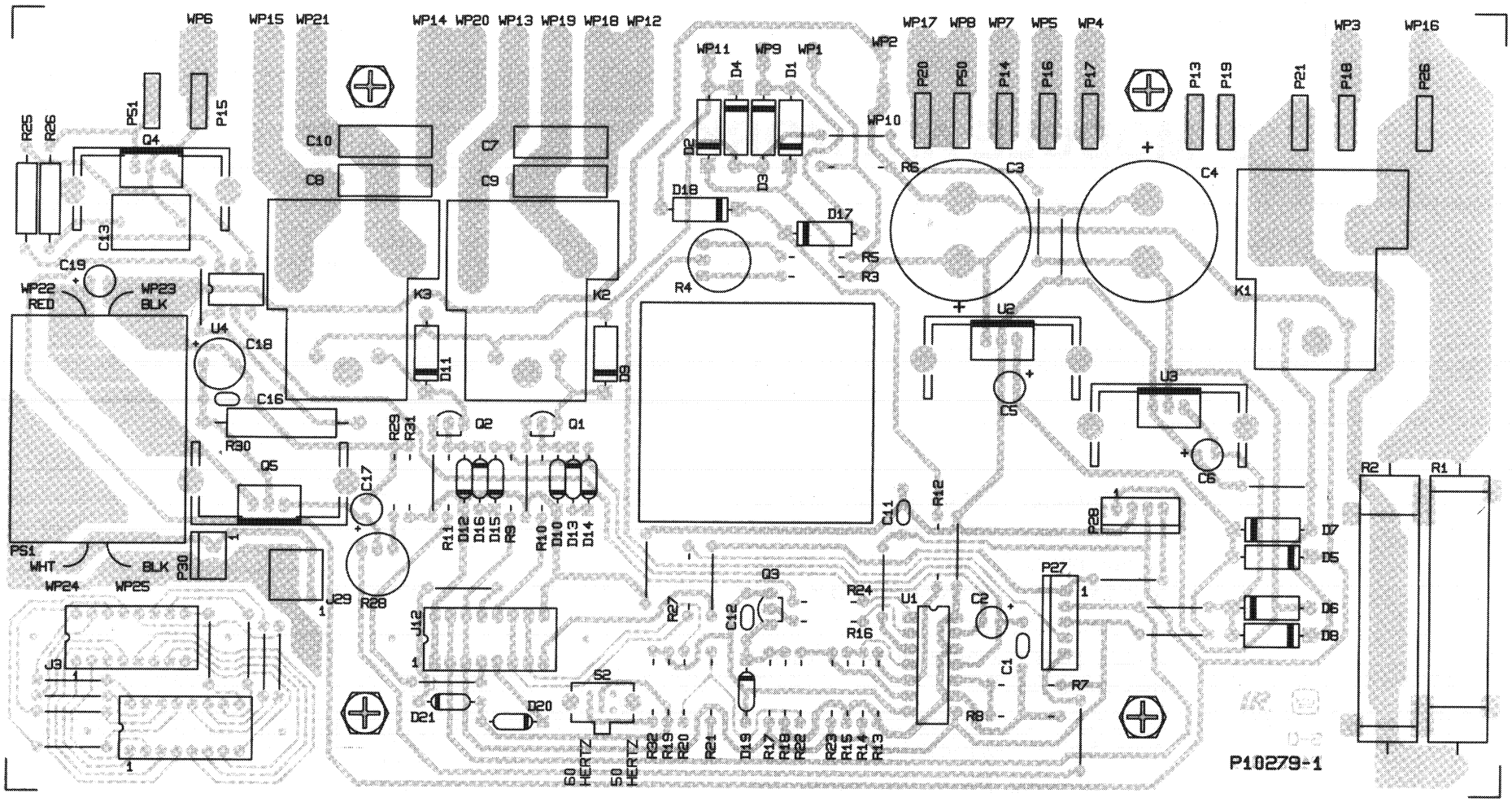
8 MODULE ARTWORK

The ***Modules*** section of this service manual is the compilation of artwork and circuit board layouts for the module found within the Model amplifier. For schematic diagrams see section 6 and for chassis parts drawings along with parts lists see section 7.

***Note**: A blank space in the right column of the following parts list means the component is the same as on the module listed immediately to the left!*

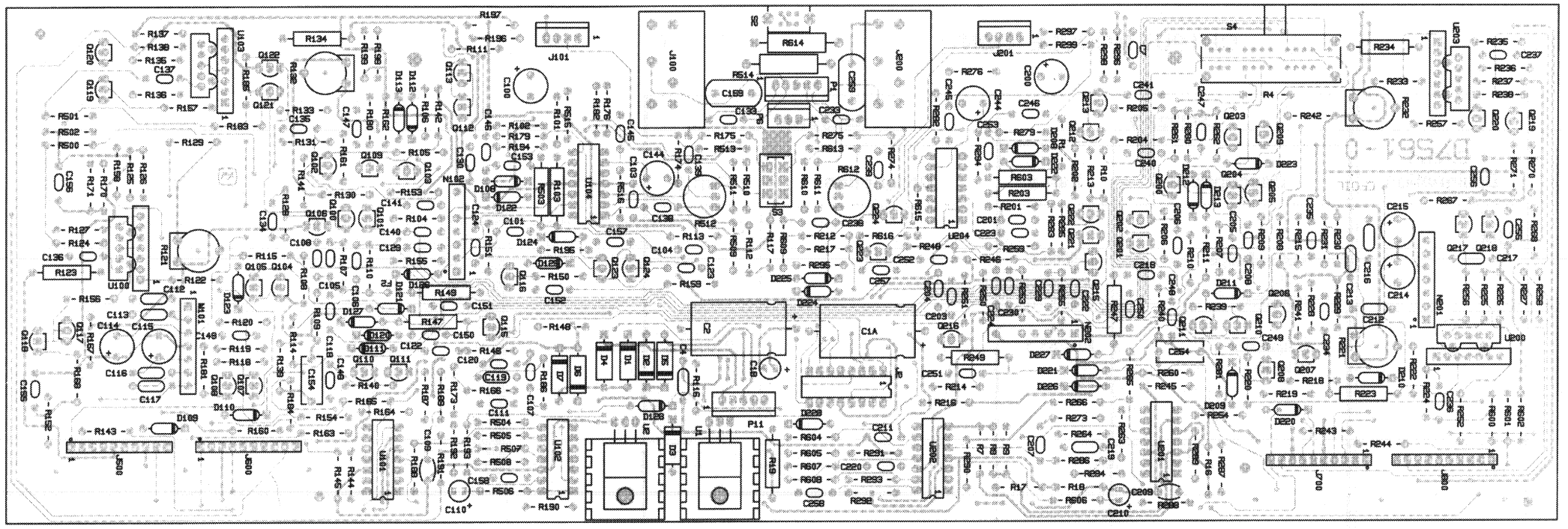
OUTPUT MODULE (CONT)

Circuit Designation	Q42822-9		Q42941-6	
	Description	Part #	Description	Part #
Misc.				
	0 Ohm Jumper	C 5868-2		
	10P HDR	C 7057-0		
	Output Brd (Blank)	P10263-5		P10328-6

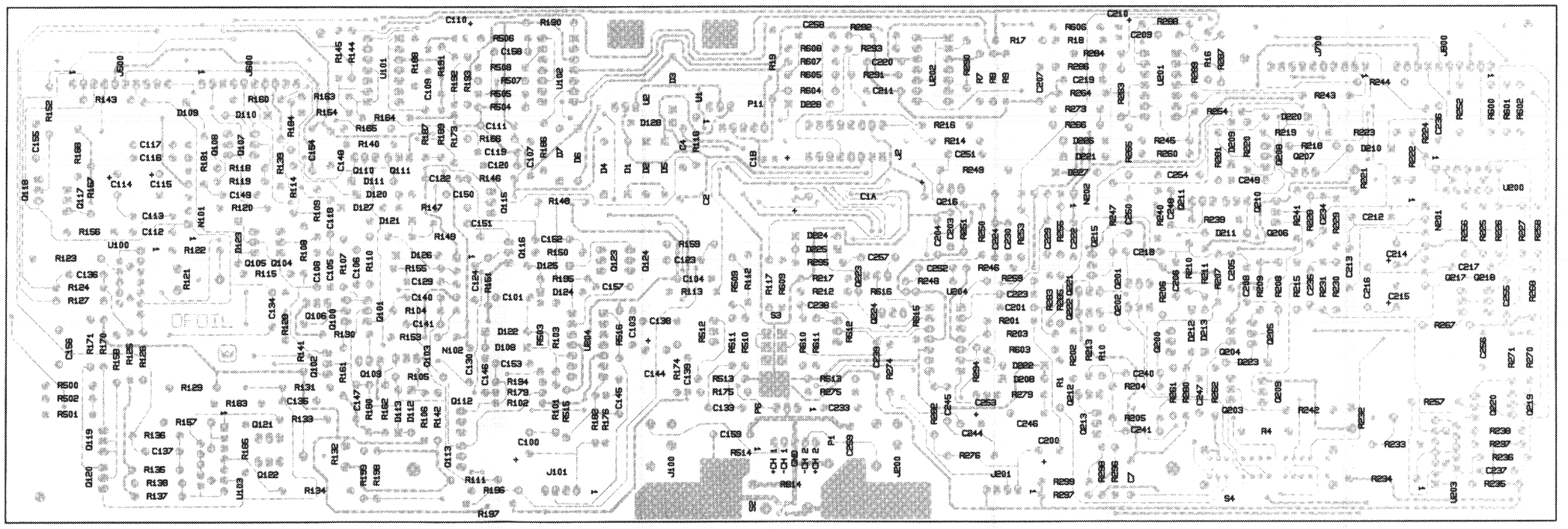


** Darker tracework indicates parts side of module foil layout.*
*** Lighter tracework indicates bottom side of module foil layout.*

Fig. 8.1 Control Module (Q42834-4)



Component Side



Foil Side

Fig. 9.5 Main Module (Q42837-7)