



SERVICE MANUAL

D-150A SERIES II DUAL-CHANNEL POWER AMPLIFIER

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TABLE OF CONTENTS

SECTION 1: GENERAL INFORMATION	1-1
1.1 Introduction	1-1
1.2 General Operation	1-1
SECTION 2: SPECIFICATIONS	2-1
2.1 General Specifications	2-1
2.2 Monaural Specifications	2-1
2.3 Stereo Specifications	2-2
SECTION 3: OPERATING CONTROLS AND ADJUSTMENTS	3-1
3.1 Operating Precautions	3-1
3.2 Amplifier Controls	3-1
3.3 Circuit Board Modification	3-2
SECTION 4: REPAIR AND MAINTENANCE	4-1
4.1 Introduction	4-1
4.2 Required Test Equipment	4-1
4.3 Basic Troubleshooting	4-3
4.3.1 Establishing the Problem	4-3
4.3.2 Visual Inspection	4-3
4.4 Disassembly	4-4
4.4.1 Front Panel Removal	4-4
4.4.2 Main Board Cover Removal	4-4
4.4.3 Main Board Replacement	4-4
4.4.4 Power Switch Removal	4-4
4.4.5 Filter Capacitor Removal	4-4
4.4.6 Power Transformer Removal	4-4
4.4.7 Output and Driver Transistor Replacement	4-5
4.5 Reassembly	4-5
SECTION 5: GENERAL CIRCUIT THEORY	5-1
5.1 Input Stage	5-1
5.2 Voltage Amplification	5-1
5.3 Output Stage	5-1
5.4 Protection Circuitry Stage	5-2
5.5 Bootstrap Supply	5-2
5.6 Temperature Compensation/Offset Circuitry	5-3
5.7 Input-Output Comparator (IOC)	5-3

SECTION 6: TEST PROCEDURES	6-1
6.1 Electrical Checkout	6-1
6.1.1 Quiescent DC Offset	6-1
6.1.2 Bias Level Adjustment	6-1
6.1.3 Power Tests	6-1
6.1.4 Protection Circuit Tests	6-2
6.1.5 Intermodulation Distortion	6-3
6.1.6 IOC Circuit	6-3
6.1.7 Signal to Noise	6-3
6.1.8 Quiescent AC Power	6-3
6.1.9 Mono Operation	6-3
6.2 Troubleshooting Chart	6-3
6.3 .775 V RMS Conversion	6-8
6.4 Voltage Conversion	6-8
6.5 Controls and Adjustments	6-9
6.5.1 Power Switch/Indicator	6-9
6.5.2 Input Level Controls	6-9
6.5.3 IOC Indicators	6-9
6.5.4 Input Phone Jacks	6-9
6.5.5 Mono/Dual Switch	6-9
6.5.6 Fuse	6-9
6.5.7 AC Line Cord	6-10
6.5.8 Main Output Jacks	6-10
 SECTION 7: ILLUSTRATED PARTS LIST	 7-1
7.1 General Information	7-1
7.2 Standard and Special Parts	7-1
7.3 Ordering Parts	7-1
7.4 Shipment	7-1
7.5 Terms	7-1
7.6 Parts Lists, Exploded Views and Schematics	7-2

LIST OF ILLUSTRATIONS AND TABLES

Illustration 2-1	Nominal Output Impedance
Illustration 3-1	Front Panel Controls
Illustration 3-2	Rear Panel Connectors
Illustration 6-1	Correct Square Wave Operation
Illustration 6-2	Test Limiting Wave Form
Illustration 6-3	Protection Circuit Memory Waveform
Illustration 6-4	Voltage Conversion
Illustration 7-1	Chassis Assembly
Illustration 7-2	Internal Exploded View
Illustration 7-3	IOC Component Board Layout
Illustration 7-4	IOC Foil Board Layout
Illustration 7-5	Main Module Q41603J3 Component Board Layout
Illustration 7-6	Main Module Q41603J3 Foil Board Layout
Illustration 7-7	Main Module Q41603J3 Schematic
Illustration 7-8	Main Module Q42531-6 Component Board Layout
Illustration 7-9	Main Module Q42531-6 Foil Board Layout
Illustration 7-10	Main Module Q42531-6 Schematic
Illustration 7-11	Jumper Locations

TABLES

Table 2-1	Performance Chart
Table 4-1	Required Test Equipment
Table 6-1	Troubleshooting

SECTION 1: GENERAL INFORMATION

1.1 Introduction

This manual contains service information on the D-150A II. The "II" designation indicating the second series of this popular Crown offering.

Caution:

This manual is produced to support the work of experienced and qualified service technicians at authorized Crown Repair Centers. It does not provide the type of detailed information that an inexperienced person would require to work on this unit.

Schematic diagrams, exploded view drawings, parts listing and checkout procedures are provided for the disassembly, inspection and repair of the amplifier. For complete installation and operation procedures, refer to the D-150A II Instruction Manual.

1.2 General Operation

The D-150A II is a single or dual channel power amplifier designed for use in medium power systems which demand high accuracy and wide frequency response. The D-150A II provides precision amplification of frequencies from DC to 20kHz, with extremely low harmonic and intermodulation distortion, low noise, and high "damping factor".

Output capability is 75 watts per channel minimum RMS into an 8 ohm load. When the amplifier is bridged and operating as a mono channel unit, output power reaches 250 watts minimum RMS into an 8 ohm load.

SECTION 2: SPECIFICATIONS

2.1 General Specifications

Hum and Noise (20Hz - 20kHz): 110dB below rated output.

Phase Response: +0, -15 degrees, DC-15kHz at 1 watt.

Input Impedance: 25K ohms, +/- 30%.

Amplifier Output Protection: Short, mismatched, and open circuit proof. Limiting is instantaneous with no flyback pulses, thumps, cutouts, etc. No premature limiting on transients.

Overall Protection: AC line fused. Thermal switch in AC line protects against overheating caused by insufficient ventilation. Controlled slewing-rate voltage amplifiers protect overall amplifier against RF burnouts. Input overload protection is furnished by an internal resistor at inputs of amp.

DC Output Offset (Shorted Input): 10 millivolts or less, internally adjustable to zero.

Turn-On: Instantaneous, with minimum thumps and no program delay.

Power Supply: Massive computer-grade filter capacitors store over 20 joules of energy. Two regulated supplies for complete isolation and stability.

Power Requirements: Requires 50 - 400Hz AC on 100, 120, 200, 220, or 240V +/-10% operation. Draws 30 watts or less on idle. Maximum AC power requirement: 750 watts.

Heatsinking: The entire amplifier is used as a heatsink. 3/16" thick chassis acts as a heatsink along with auxiliary fins.

Chassis: All aluminum construction for maximum heat conduction and minimum weight.

Controls: Independent level controls are mounted on the front panel. Power switch with associated pilot light is on front panel. Non-interacting DC balance controls are mounted on main PC board under electronics cover. A mono-stereo channel switch is located next to the input jacks on the rear panel.

Connectors: Input - 1/4 inch phone jacks. Output - color coded binding posts. AC line - 3-wire (grounded) male connector on 5 foot cable.

Dimensions: 19" (48.3cm) inches long, 5-1/4" (13.3cm) inches high, 8-3/4" (22.2cm) inches deep (from mounting surface of front panel).

Weight: 24 pounds (10.9 kg).

Finish: Polyester vinyl coated front panel with Lexan insert.

2.2 Monaural Specifications

Output Power: 250 watts minimum RMS into an 8 ohm load over a bandwidth of 1Hz - 20kHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage (both channels operating).

Frequency Response 1kHz Power: +/- .15dB DC - 20kHz at 1 watt into 16 ohms; +/- 1dB DC - 60kHz.

Harmonic Distortion: Less than 0.001% from 20 - 400Hz and increasing linearly to 0.05% at 20kHz at 160 watts into 16 ohms.

I.M. Distortion S.M.P.T.E. (60Hz - 7kHz 4:1): Less than 0.05% from 0.01 watts to 0.25 watts and less than 0.01% from 0.25 watts to 160 watts into 16 ohms, per channel.

Slewing Rate: 12 volts per microsecond.

Damping Factor: Greater than 400, DC-400Hz into 16 ohms.

Output Impedance: Less than 30 milliohms in series with less than 6 microhenries.

Load Impedance: Rated for 8 ohm usage; safely drives any load including completely reactive loads.

Voltage Gain: 41.2 +/-2% or 32.3 +/- 0.2dB at maximum gain. (See Section 6.3 for possible modifications)

Input Sensitivity: 1.19 volts +/- 2% for 250 watts into 8 ohms. (Might be modified to .775 volts with RMS conversion. See Section 6.3)

Output Signal: Balanced, single channel.

Damping Factor: Greater than 400, DC - 400Hz into 8 ohms.

Output Impedance: Less than 15 milliohms in series with less than 3 microhenries.

Load Impedance: Rated for 8 ohm usage; safely drives any load, including completely reactive loads.

Voltage Gain: 20.6 +/-2% or 26.3 +/- .2dB at maximum gain. (See Section 6.3 for possible modifications)

Input Sensitivity: 1.19 volts +/-2% for 80 watts into 8 ohms. (Might be modified to .775 volts with RMS conversion. See Section 6.3)

Output Signal: Unbalanced, dual channel.

2.3 Stereo Specifications

Output Power: 75 watts per channel minimum RMS (both channels operating) into an 8 ohm load over a bandwidth of 1Hz - 20kHz at a rated RMS sum total harmonic distortion of 0.05% of the fundamental output voltage.

Frequency Response: +/-1dB DC - 20kHz at 1 watt into 8 ohms; +/-1dB DC - 100kHz.

1kHz Power: 90 watts RMS into 8 ohms, per channel, both channels operating. 0.1% total harmonic distortion.

Harmonic Distortion: Less than 0.001% from 20Hz - 400Hz, and increasing linearly to 0.05% at 20kHz at 80 watts RMS per channel into 8 ohms.

IM Distortion S.M.P.T.E. (60Hz - 7kHz 4:1): Less than 0.05% from 0.01 watts to 0.25 watts and less than 0.01% from 0.25 watts to 80 watts into 8 ohms, per channel.

Slewing Rate: 6 volts per microsecond (slewing rate is the maximum value of the first derivative of the output signal, or the maximum slope of the output signal).

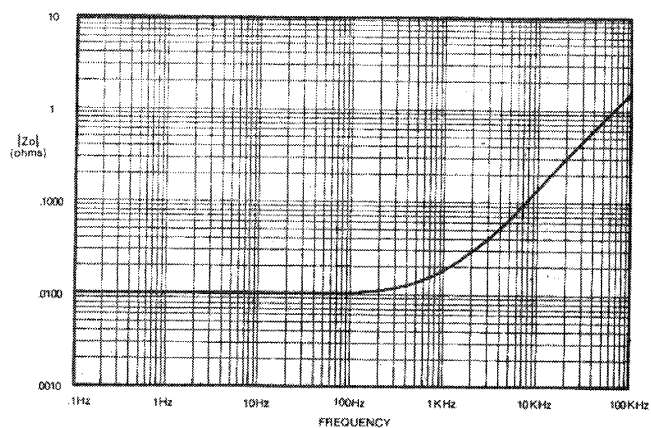


Illustration 2-1
Nominal Output Impedance

D-150A II										
Configuration and Load \ Type of test	FTC Continuous Average Power at .1% THD (see note 1)		Single Cycle Tone Burst Watts at <0.05% THD (see note 2)			40mS Tone Burst Watts at <0.05% THD (see note 3)			EIA Watts +/- 1db 1% THD (see note 4)	
	20Hz-20KHz	80Kz	20Hz	60Hz	80Hz	20Hz	60Hz	80Hz	80Hz	
Stereo per CHL (both chl powered)	4	150	115	155	205	115	150	145	160	
	8	75	90	75	95	110	75	90	85	95
	16	50	50	45	50	55	45	50	50	55
Bridged Monaural (Balanced output)	8	305	285	340	415	285	310	295	320	
	16	160	185	185	195	215	185	185	180	195

Notes:

1. Continuous power in the context of Federal Trade Commission testing is understood to be minimum of five minutes of operation. Harmonic distortion is measured as the RMS sum total as a percentage of the fundamental output voltage. This distortion specification applies for all wattage greater than 0.25 watts.
2. A single cycle of sine wave is presented to the amplifier and monitored for non-linear distortion. The average power during the burst is reported. Speakers must be able to withstand this level if they are to be safely used with this amplifier.
3. A 40 millisecond burst or two cycles of sine wave (whichever is of greater duration) is used and the power computed as the average power during the burst. The duty cycle of this test is 10 percent. This power level is a measure of how loud an amplifier is perceived by the hearing process.
4. EIA standard RS-490 (both channels driven)

**Table 2-1
Performance Chart**

SECTION 3: OPERATING CONTROLS AND ADJUSTMENTS

This section is a summary of D-150A II controls and adjustments along with a number of important precautions for proper operation.

3.1 Operating Precautions

The following operating precautions must be followed to both protect the amplifier against damage and to obtain optimum service performance.

Connections. Use care in making connections, selecting signal sources and controlling the output level. Crown is not liable for damage to loads.

Parallel Operation. Never parallel the output with any other amplifier output or parallel the two channels of the D-150A II. Damage incurred by such operation is not covered under warranty.

Transformer-Coupled Devices. Never drive a transformer-coupled device or any other device which appears as a low frequency short (less than 3 ohms at DC) without a series isolating capacitor. Such operation may damage the device and/or needlessly waste output power.

Grounding. Do not connect the ground lead of the output cable to the input signal ground as oscillations may result from forming such a loop.

Improper Outputs. Never connect the output to a power supply, battery or power main.

AC Mains. Always operate the amplifier from AC mains of not more than 10% above or below the selected line voltage and only within the frequency range of 50 - 60Hz AC. Failure to comply with these frequency limits voids the warranty.

Circuit Modifications. Tampering in the circuitry by unqualified personnel or the making of unauthorized circuit modifications may seriously degrade the performance of the amplifier and possibly invalidate the warranty.

3.2 Amplifier Controls

Illustrations 3-1 and 3-2 are front and rear panel diagrams that show the controls described below.

Power Switch/Indicator. This button activates the D-150A II. The amber LED lights if proper power requirements are met.

Input Level Controls. Two controls channel the input signal through 25K ohm audio taper potentiometer.

IOC Indicators. The IOC (Input Output Comparator) displays are the two red front panel LED's that indicate such conditions as input signal overload, improper load impedance, or even an amplifier based problem. Intermittent flashing with music program peaks is normal. However, continuous illumination indicates a problem that requires attention.

Input Phone Jacks. Input signal hook-up is through conventional unbalanced 1/4" phone jacks. Refer to the Instruction Manual for complete information on connecting input lines to the unit.

Mono/Dual Switch. This rear panel switch sets operation as a single (mono) or dual (stereo) channel amplifier.

Fuse. Improper AC voltage or a variety of internal amplifier problems will blow the protective fuse. Fuse replacement is also required when converting to another AC main voltage. (See Section 6.5.6)

AC Line Cord. A three-wire, heavy duty AC cord and plug are standard equipment. Use caution with the third wire ground since it may introduce a ground loop in the system. A three-to-two plug adapter may be needed to prevent ground loop problems. Contact Crown Technical Service Department for further information if grounding problems are suspected in a particular system hook-up.

Caution:

Crown assumes no liability whatsoever for operation of ungrounded auxiliary equipment, nor for violation of UL or local electrical codes.

Main Output Jacks. Main output jacks are standard MDP banana style. Refer to the D-150A II Instruction Manual for complete information on connecting output lines and loads.

3.3 Circuit Board Modification

D-150A units with serial numbers 59429 and higher carry a circuit board with a number of modifications from earlier units. See Section 6.3 for a discussion of these modifications.

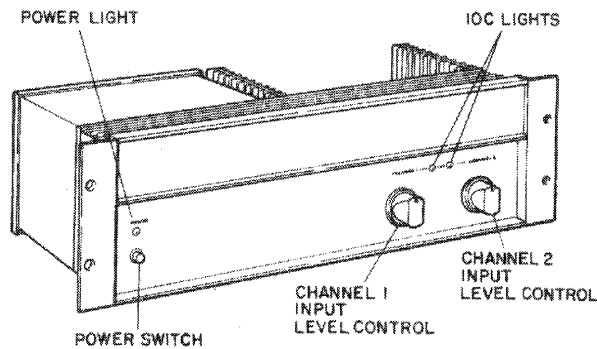


Illustration 3-1
Front Panel Controls

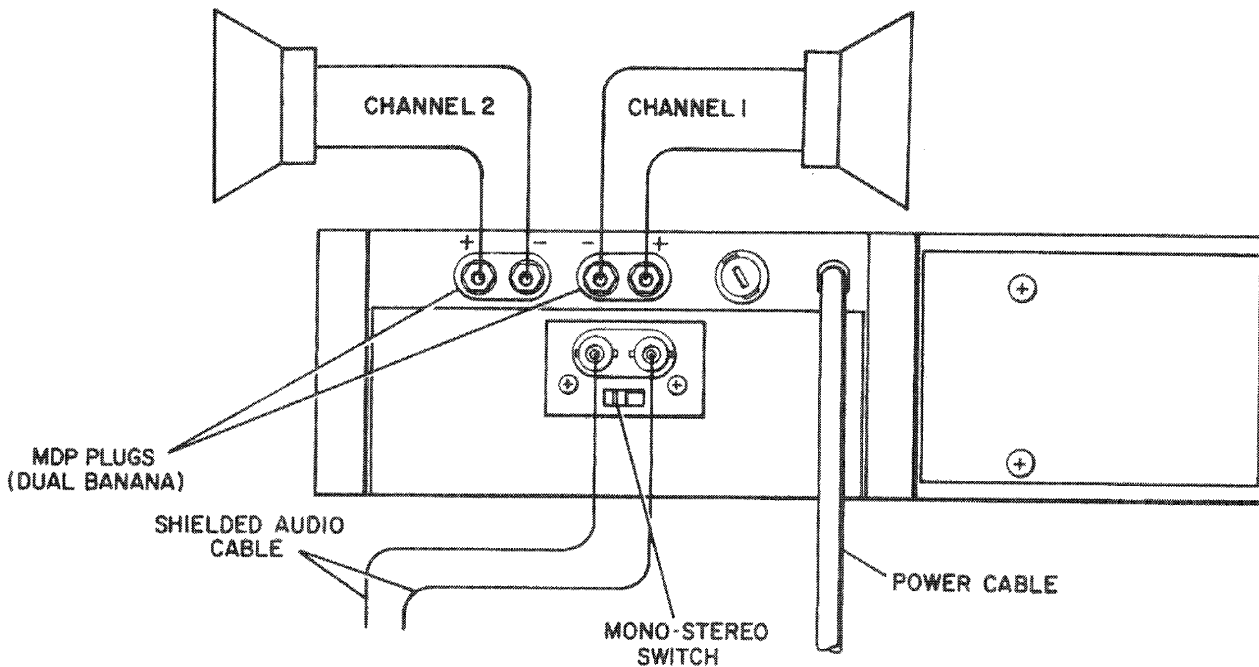


Illustration 3-2
Rear Panel Connectors

SECTION 4: REPAIR AND MAINTENANCE

4.1 Introduction

This section contains information for proper servicing of the D-150A II amplifier including disassembly and reassembly procedures, required test equipment lists, repair procedures, and basic troubleshooting tips.

Two other sections will be of assistance in D-150A II service: **Section 5** covers General Circuit Theory that could aid a technician in investigating an unusual problem. **Section 6** covers Test Procedures that are required following component replacement.

NOTE: The information in this section is intended for use by a qualified electronics technician. We have made no effort to provide the general background information that is essential for the proper servicing of any complex piece of electronic equipment.

4.2 Required Test Equipment

Routine service work on the D-150A II can be performed with a minimum amount of test equipment. However, to insure that the unit is maintained in accord with "factory specifications", we provide the following list of required test equipment. The "Requirements" column provides information for selecting test equipment from various manufacturers.

REQUIRED TEST EQUIPMENT			
EQUIPMENT	REQUIREMENTS	APPLICATIONS	SUGGESTED MODEL
Oscilloscope	Capable of displaying a 10M Hz signal	Monitoring output during service and testing	Tektronics or equivalent
Volt-ohmmeter (VOM)	Low-voltage resistance probe (100mv range). High voltage resistance probe. (1.5V range)	Check resistance values (low voltage probe). Check semi-conductor junctions for opens or shorts (high voltage probe) Check DC voltages	Fluke 8020, 8024, 8060 or equivalent
Signal Generator	Sine/Square wave available; flat frequency response. THD. 1% maximum	Provide test signals for service and checkout	Wavetek 130-Series or equivalent
Circuit Breaker	15 ampere rating	In AC line to unit; protects circuitry from overload if power supply has shorted	
AC Line Voltage Monitor	Peak reading meter (displays rms equivalent to a sinusoidal peak for any wave form)	Monitor line voltage	Information available from CROWN
AC Voltmeter	100mv low range, flat frequency response to 100K Hz	Set output level for testing; check noise level	Hewlett-Packard 400F or equivalent
Filter	20-20K Hz bandpass, low noise 20Hz-20K Hz	Between preamplifier and voltmeter in noise test	Information available from CROWN
Intermodulation	Residual (.002% or lower)	Check IM distortion	Information available from CROWN

Table 4-1
Required Test Equipment

4.3 Basic Troubleshooting

Troubleshooting of electronic equipment is a unique blend of art and science. Most of the following suggestions would apply equally well in the repair of any electronic gear. The underlying principle is an obvious one: You want to get the unit back in service with a minimum of time and effort. By making an initial, methodical review of the service problem, you may be able to avoid chasing down time-consuming dead ends.

4.3.1 Establishing the Problem

User complaints about effective 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 gaining an understanding of the probable cause and in getting the problem to re-occur on the service bench.

Some troubles will be obvious upon visual inspection. But when the trouble or its symptoms are not so obvious, you need answers to such questions as:

- a. Exactly what was/is the problem?
- b. How was it noticed?
- c. How was the unit being used?
- d. Has the system as a whole been carefully examined for possible problems?
- e. 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.

4.3.2 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 preventive maintenance procedure and also as a valuable tool 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 and other external controls.
4. Inspect line cord for possible damage to plug, jacket and conductors.
5. Remove protective covers as outlined in "Disassembly" in Section 4.4.2
6. Verify 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. Verify that all electrical connections are secure including 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.

4.4 Disassembly

Complete disassembly of the D-150A II should rarely, if ever, be required. Disassemble the unit only as far as is necessary to make a full inspection and to perform repairs, testing, and adjustment.

To aid in matching part numbers with the assembly illustrations, each part is identified with a reference number matching its illustration number. The same number system is used throughout the manual.

WARNING

WHEN CONNECTED TO AC POWER MAINS, THE UNIT IS A POTENTIALLY LETHAL HAZARD, PARTICULARLY DURING INITIAL INSPECTION. UNTIL YOU HAVE IDENTIFIED THE SOURCE OF THE TROUBLE OR HAVE DETERMINED THAT THE UNIT IS SAFE TO POWER UP, MAKE SURE IT IS DISCONNECTED FROM AC MAINS.

(Refer to **Illustration 7-1** and **7-2** for the following steps.)

4.4.1 Front Panel Removal

To remove the front panel (4), loosen the two hex screws (1) behind each rack mount bracket (2) and remove the six phillips screws (3) that secure the front panel to the amplifier chassis. Gently pull the front panel straight off. Avoid straining the cables connected to the input level controls, power switch or IOC board.

4.4.2 Main Board Cover Removal

To remove the main board cover (15), remove the two screws (14) that secure the dress plate (13). Remove the dress plate and gently pull the main board cover off. Most main board components are now easily accessible for testing and replacement.

4.4.3 Main Board Replacement

Remove the front panel (4) and main board cover (15) as described above. Note the routing and placement of the various wires connected to the main circuit board. To avoid errors in reassembly, a simple, hand drawn diagram could be very helpful.

Unsolder and remove the wires connected to the main board. Remove the two screws (81) that mount the main board to the amplifier chassis and remove the main board.

4.4.4 Power Switch Removal

Remove the front panel as described in 4.4.1. Remove AC wires from the power switch (5) by gently pulling them off. Remove the screw (6) that secures the switch mounting bracket (14) to the front panel. The switch can now be removed from the mounting bracket for replacement.

4.4.5 Filter Capacitor Removal

Remove the front panel as described in 4.4.1. Remove the two screws (11) that secure the transformer cover (9) to the power transformer (28). Lift off the transformer cover and the transformer wraparound (8). With the front of the amplifier facing upward, remove screws and mounting hardware from the filter capacitors (38) and (39). It should not be necessary to unsolder any of the wires connected to the capacitor.

4.4.6 Power Transformer Removal

Remove the front panel as described in 4.4.1. Remove the two screws (11) that secure the transformer cover (9) to the power transformer (28). Lift off the transformer cover and the transformer wraparound (8). Note location and routing of all wires coming from the power transformer (a diagram would be helpful).

Unsolder and remove the following wires:

- a. the green wire to the main circuit board (83);
- b. the yellow wire to the power supply capacitors (38) and (39);
- c. the primary wires to terminal strips (26) and (27);
- d. the red wires to the bridge rectifier (41) by pulling the Faston connectors straight away from the rectifier.

Gently pull all the wires through the hole in the chassis. Finally, remove all the mounting hardware that secures the transformer to the chassis and remove the power transformer.

4.4.7 Output and Driver Transistor Replacement

Remove the front panel (4) and main board cover (15) as described above. Unsolder the wires going to the transistor to be replaced and remove the hardware securing the transistor to the chassis. Gently pull it away from the chassis. When installing the new transistor, insure that the insulator has new heat-sink compound applied to it for proper thermal conduction. Install the transistor and hardware making sure that the transistor is snugly mounted to the chassis to insure good thermal conduction is maintained.

4.5 Reassembly

Reassembly is essentially the reverse of disassembly. To check the type of size of attaching parts, refer to the appropriate illustration in Section 6.

SECTION 5: GENERAL CIRCUIT THEORY

This section is a summary of D-150A II theory of operation. For schematic reference, use diagram JO23-0 in the Appendix.

Model D-150A II units with serial numbers 59428 and above incorporate some engineering improvements in the input stage; however, the circuitry described here applies to all units.

For simplicity, the circuit description which follows refers to channel 1 only; the operating principles are identical for channel 2.

5.1 Input Stage

The input signal enters the unbalanced 1/4" input jack. After the signal level is adjusted to a desired amplitude through R105, it is applied to the dual IC operation amplifier U100. The direct input signal is applied to the non-inverting input (U100 pin 3) and the feedback signal is applied to the inverting input (pin 2).

Because of the feedback path, both signals entering U100 will have a common polarity and will thus produce a near-zero output (pin 6). The IC op amp will always try to keep a zero potential difference between both inputs. Any type of non-linearity will cause the op amp to produce a large output, and therefore, a substantial size correction signal in order to retain the small output level.

5.2 Voltage Amplification

D-150A II front end circuitry consisting of IC op amp through Q105 provides voltage amplification. The signal translator transistor Q101 provides no voltage amplification itself, but rather converts the ground referenced input signal to a signal with a reference to the negative supply (-45V). The result is higher voltage swing capabilities from the final voltage amplification transistor Q105. Q105 is the main source of voltage amplification.

R116 in the base circuit of Q105 serves two purposes:

1. To provide collector current for Q101.
2. To amplify the signal thus developed across the collector of Q101.

As this development is in process, Q105 emitter voltage is developed across R124. When this voltage reaches a positive 0.6V, Q106 turns on and "pulls" the drive away from the last voltage amplifier, thus acting as a current limiter for Q105.

5.3 Output Stage

The output of the final voltage amplifier provides the signal drive to the predriver (Q107, Q112), driver (Q109, Q113), and the output transistors (Q110, Q114) in order to amplify the current for final output power.

The correct bias transistor (Q111) collector-emitter voltage of 2.15VDC is distributed throughout the current amplification stages in the following manner:

1. Base-to-emitter junction of negative predriver (Q112) is .6V.
2. Base-to-emitter junction of positive driver (Q109) and predriver (Q107) is .6V.
3. Negative driver (Q113) and output transistor (Q114) have a fixed base-emitter bias in reference to the negative supply and are not involved with the bias servo circuitry.
4. .315V is present across the positive output base-to-emitter resistor (R131).

As noted above, the predrivers and drivers are biased at .6V. But also, the output transistors have a .315VDC voltage from base-emitter and are therefore at a "sub turn-on" voltage. This form of biasing is known as class AB+B where the driver transistors carry the bias current while the output transistors serve only as boosters. The output transistors sense when the driver transistors are developing significant current drawn from the load and thus take over and deliver the needed current.

The result of this format is maximum efficiency with minimum crossover notch distortion and idling amplifier heat.

5.4 Protection Circuitry Stage

The D-150A II protection circuitry is the Crown-developed SPACE (Signal Programmed Automatic Current Executor) control circuit.

R132 and R134 are current sensing resistors which carry the output current from the output transistors to the positive and negative limiting transistors (Q103, Q104). Before the output current becomes dangerously high, the limiting transistor is activated which in turn limits the drive voltage at the base of the predriver. When the predriver current and the limiter current are equal to the current available from Q102, a limit point is reached and the protection circuitry remains in this state until the overload is removed.

5.5 Bootstrap Supply

The bootstrap supply is a voltage doubler network consisting of C4, C5, D1 and D2. From the 33VAC, C4 is charged through D1 during one-half of the AC cycle. During the next half cycle, C5 is charged to approximately twice the voltage of C4 through D2. This provides a constant current source for the predriver, bias, and voltage amplifier sections of the D-150A II.

A 10V zener diode (D3) is primarily responsible for providing a constant 10V distribution across the combination R110 and Q102. This allows Q102 to provide a constant current path to the predriver, bias, and voltage amplifier sections.

The constant current source is necessary to attain maximum voltage swing from the voltage amplifier stage as well as to help isolate the front-end input stage supply from the rail supply. This, in turn, helps prevent front-end overload.

5.6 Temperature Compensation/Offset Circuitry

The output offset adjustment (R100) provides a bias voltage for the inverting (pin 2) input of op amp U100. The output offset adjustment is set with the level control fully CCW so there is zero DC voltage across the output of the amplifier. With the level control either open or closed, the non-inverting input is at 0 volts. The output offset adjustments (R100) then can vary the bias voltage on the inverting input to match this for zero output.

5.7 Input-Output Comparator (IOC)

The IOC display is a window comparator circuit using two operational amplifiers (U1C, D) and LED indicator (D108). Any small non-linearity in the amplifier causes a feedback loop error at the inverted input of the main IC op amp (U100). The main IC output (pin 6) will rise above its normal value in an attempt to correct the problem. This signal is then responsible for raising the bias voltage on U1 and, in turn, activating Q116 which lights D108.

SECTION 6: TEST PROCEDURES**6.1 Electrical Checkout**

The following outlines an orderly checkout and adjustment procedure for the D-150A II. Refer to Section 4.2 for the test equipment required for these procedures.

6.1.1 Quiescent DC Offset

Using a DC voltmeter, measure the voltage at the output of the amplifier. It should not exceed +/- 10MV. Should the offset need to be adjusted use the following procedure.

(For units with serial numbers 51024 through 59428)

- a. Allow amplifier to warm-up for 15 minutes.
- b. Set input level control, located on the front panel, fully CCW.
- c. Adjust Output Offset R100 or R200 for 0 (zero) reading on the DC voltmeter.
- d. Slowly rotate the input level control CW until the reading on the DC voltmeter peaks in value.
- e. Adjust Input Offset R102 or R202 for 0 (zero) reading on the DC voltmeter.

(For units with serial numbers 59429 and higher)

- a. Allow amplifier to warm-up for 15 minutes.
- b. Set input level control, located on the front panel, fully CW.
- c. Adjust Output Offset R100 or R200 for 0 (zero) reading on the DC voltmeter.

6.1.2 Bias Level Adjustment

With the amplifier power on and no input signal present, check the base-emitter bias voltage using a DC voltmeter. It should fall between .31VDC to .35VDC. To adjust use the following procedure.

(For units with serial numbers 51024 through 59428)

- a. Bias voltage is varied by changing the value of select resistors R128 and R228. If bias voltage is high, increase the value of the resistor. If bias voltage is low, decrease the value of the resistor. The select resistor should have a value between 30 to 300 ohms.

(For units with serial numbers 59429 and higher)

- a. Adjust bias pot R128 and R228 for correct bias voltage.

6.1.3 Power Tests (one channel driven)

- a. Inserting a 1kHz sine wave signal into the channel under test, the 8 ohm power rating of 98 watts (28.0VRMS) and the 4 ohm power rating of 175 watts (26.5VRMS) should be obtained before clipping occurs.
- b. Inserting a 20kHz sine wave signal into the channel under test, an 8 ohm power rating of 90 watts (27.0VRMS) should be obtained before clipping occurs.

- c. Inserting a 10kHz square wave input signal with an 8 ohm load on the output of the amplifier, adjust the input level for a 30V peak to peak output level. The output waveform should be clean with no overshooting or ringing occurring (see **Illustration 6-1**).

6.1.4 Protection Circuit Tests

- a. Insert a 1kHz sine wave signal into the channel under test and adjust the output level for 28VRMS.
- b. Place a 2 ohm load on the output of the amplifier and observe the output. It should clip the sign waveform signal evenly on both the positive and negative portion of the waveform (see **Illustration 6-2**).

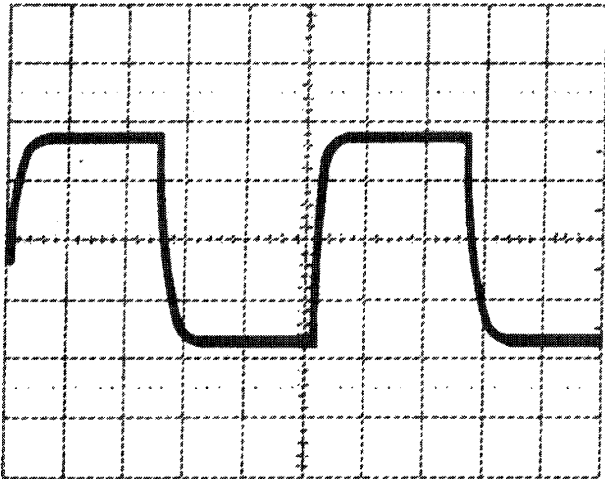


Illustration 6-1
Correct Square
Wave Operation

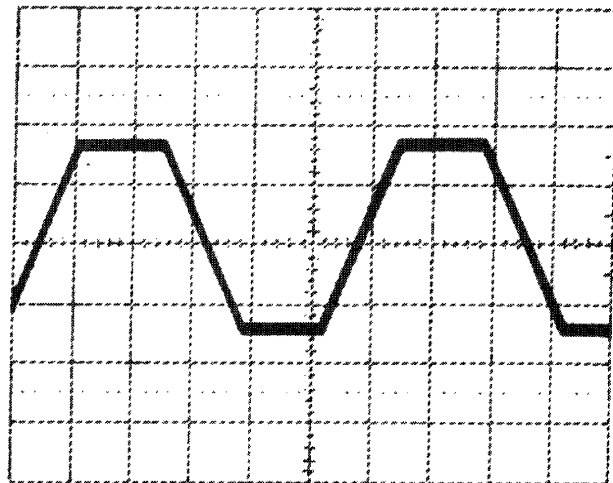


Illustration 6-2
Test Limiting
Waveform

- c. Remove the 2 ohm load and place a 159 microhenry inductive load on the output. Observe the output waveform. It should be similar to that in **Illustration 6-3**.

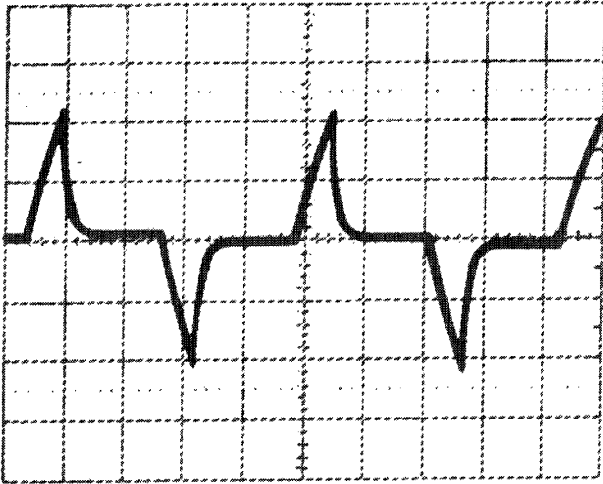


Illustration 6-3
Protection Circuit
Memory Waveform

6.1.5 Intermodulation Distortion

- a. Using a 60Hz - 7kHz signal summed in a 4:1 ratio (S.M.P.T.E. method) on the input of the amplifier with an 8 ohm load on the output, insure that the following specs are within tolerance at a rated power output of 80 watts. 0dB through -25dB less than .01% -30dB through -40dB less than .03%

6.1.6 IOC Circuit

The IOC indicator should illuminate when the output signal is driven into clip.

6.1.7 Signal to Noise

- a. With the input level controls fully CCW, use a 20Hz to 20kHz bandpass filter on the output of the amplifier to measure the signal to noise ratio. Insure that it's greater than 110dB below the rated output power.

6.1.8 Quiescent AC Power

Quiescent power should be less than 30 watts with a line voltage of 120VAC. 20 watts is typical.

6.1.9 Mono Operation

Using only channel one for an input signal, insert a 1kHz sine wave with the dual/mono switch in the mono position. Observe that channel two is 180 degrees out of polarity from channel one. Channel one input level control should vary both channel one and two output signal.

6.2 Troubleshooting Chart

The following chart will be helpful in identifying symptoms and possible defects in the operation of model D-150A. For more detailed troubleshooting contact the Crown engineering.

Symptom	Defect
Blows Fuse	<ol style="list-style-type: none"> 1. Rectifier block shorted, DM 1 2. C1 shorted 3. Leaky or shorted filter capacitors C2, C3 4. Bootstrap supply AC wire frayed and shorts to positive supply trace on Main Board 5. Shorted power transformer TI 6. A shorted power device in both positive and negative output stage Q301, Q303, Q401, Q403 7. Fuse blown due to external problem -- wrong size fuse inserted 8. Pinched wires in power supply
No Output Stage Bias	<ol style="list-style-type: none"> 1. No bias resistor R128, R228 2. Bias resistor connector to circuit board not soldered 3. L100, L200 open 4. C-E short of bias transistor Q111, Q211
High Bias (amplifier heats up)	<ol style="list-style-type: none"> 1. Amplifier instability-high frequency oscillation (check Q106, Q206) 2. Shorted output terminal post 3. DC offset (see offset section) 4. Leaky output device (may pass signal and show okay with continuity test) Q110, Q210, Q114, Q214
Negative Offset -Both Channels-	<ol style="list-style-type: none"> 1. Defective IC op amp 2. D5 shorted 3. Q101, Q201 leaky or shorted
Positive Offset -Both Channels-	<ol style="list-style-type: none"> 1. Defective IC op amp 2. D4 shorted
Positive Offset -Single Channel-	<ol style="list-style-type: none"> 1. Defective IC op amp 2. Q100, Q200 leaky or shorted 3. Q101, Q201 open 4. Q106, Q206 open, leaky or shorted 5. Q105, Q205 open, leaky or shorted 6. Positive predriver, driver or output device leaky or shorted Q107, Q207, Q109, Q209, Q110, Q210 7. Q111, Q211 shorted

Table 6-1
Troubleshooting

Symptom	Defect
Negative Offset -Single Channel-	<ol style="list-style-type: none"> 1. Defective IC op amp 2. Mono switch hot wire shorted to ground 3. Negative predriver, driver or output device leaky or shorted Q112, Q212, Q113, Q213, Q114, Q214 4. Q101, Q201 base to collector leakage
Small DC Offsets	<ol style="list-style-type: none"> 1. Broken Ground on input level control (R105, R205) 2. Input jack hot lead and ground pin not shorted together (level controls full up with no input jack) 3. D100, D200 leaky or shorted
Negative half of Signal missing	<ol style="list-style-type: none"> 1. Q112, Q212 open 2. Violet/white wire from main board to output board open or not soldered
Positive half of Signal missing	<ol style="list-style-type: none"> 1. Bootstrap supply <ol style="list-style-type: none"> a. C4 open b. D1 or D2 shorted c. Green AC wire not soldered correctly 2. Q102, Q202 open 3. Loss of positive supply voltage (+45V) 4. D3 shorted 5. Q108, Q208 open, leaky or shorted 6. Q107, Q207 open 7. R300, R400 open 8. Yellow/white wire from main board to output board open or not correctly soldered
Oscillation (Full waveform)	<ol style="list-style-type: none"> 1. R106, R206 open 2. C116, C216 open
Oscillation (Positive half)	<ol style="list-style-type: none"> 1. Defective IC op amp 2. Defective driver, Q300, Q400 3. C113, C213 open
Oscillation (Negative half)	<ol style="list-style-type: none"> 1. Defective IC op amp 2. C112, C212 defective 3. Defective driver, Q113, Q213

**Table 6-1 (cont.)
Troubleshooting**

Symptom	Defect
Protection Circuit -No current limiting	<ol style="list-style-type: none"> 1. Current limiting transistor open <ol style="list-style-type: none"> a. Positive (Q103, Q203) b. Negative (Q104, Q204) 2. D101, D201, D107, D207 open 3. D118, R218, R119, R219 open 4. C108, C208, C109, C209 open
-Excessive limiting	<ol style="list-style-type: none"> 1. D101, D201, D107, D207 shorted 2. Q103, Q203, Q104, Q204 shorted 3. Loose output hardware
-Current limiting oscillation-	<ol style="list-style-type: none"> 1. Negative feedback capacitor, in limiting transistor circuit defective, positive C107, C207, negative C110, C210
-Flyback pulses from inductive loads	<ol style="list-style-type: none"> 1. C108, C208, C109, C209 open
Clipping (negative) Both Channels	<ol style="list-style-type: none"> 1. D5 open or leaky 2. D2 open or leaky 3. Defective IC op amp
Clipping (positive) Both Channels	<ol style="list-style-type: none"> 1. D4 open or leaky 2. D3 open or leaky 3. Defective IC op amp 4. D1 or D2 open (positive portion of signal will clip at a 60 Hz rate) 5. C4 open or changed in value
Clipping (negative) Single Channel	<ol style="list-style-type: none"> 1. Open or leaky predriver Q112, Q212 2. Shorted or leaky limiting transistor Q104, Q204 3. L100, L200 open 4. Open output emitter resistor R303, R403 5. Q115, Q215, Q116, Q216 on IOC board defective
Clipping (positive) Single Channel	<ol style="list-style-type: none"> 1. Open or leaky predriver, Q107, Q207 2. Shorted or leaky limiting transistor Q103, Q203 3. Open output emitter resistor R301, R401 4. Defective IC op amp 5. Q102, Q202 defective

**Table 6-1 (cont.)
Troubleshooting**

Symptom	Defect
High IM (Load Related)	<ol style="list-style-type: none">1. R9 (1 ohm) open2. Defective IC op amp3. C101, C201 open4. C114, C214 open5. Q106, Q206 defective6. Defective predriver or driver device Q107, Q207, Q112, Q212, Q300, Q400, Q302, Q402
Low dB IM	<ol style="list-style-type: none">1. Low output Bias2. C102, C202 open3. C104, C204 open
High IM (Not Load Related)	<ol style="list-style-type: none">1. R115, R215 changed in value2. R109, R209 changed in value3. C105, C205 changed in value4. C106, C206 changed in value
120 Hz in output waveform	<ol style="list-style-type: none">1. Power Supply filter capacitor(s) open, C2, C32. C5 open3. Power Supply filter capacitor mounting hardware loose
High noise	<ol style="list-style-type: none">1. Input jacks not isolated from chassis ground2. Noisy zener diode, D33. Broken ground on input jack, in input cable or on input level control (R105, R205)4. Oscillation (C101, C201 open)

Table 6-1 (cont.)
Troubleshooting

6.3 .775 V RMS Conversion

D-150A II models with serial numbers 59429 and higher carry a main circuit board with the Crown part number Q42531-6. This board incorporates several modifications from earlier models:

- a. New dual LF 357H operational amplifiers in the front end.
- b. New IOC circuitry.
- c. An option of having a 0 dB (.775 V RMS) input sensitivity.

Note that this later version of the D-150A II main circuit board is not interchangeable with earlier types of boards. The Appendix includes the layout parts lists and schematic for both board versions.

Here are the procedures to convert the Q42531-6 main board to the .775 V RMS input sensitivity:

- 1. Disconnect AC Power.
- 2. Remove dress plate and perforated main circuit board cover.
- 3. Solder #22 buss wire jumpers at locations R146 and R246.

This conversion will result in the changes to operating specifications:

Stereo Voltage Gain: 21.6 +/-2% or 26.7dB +/- .02dB.

Monaural Voltage Gain: 43.2 +/- 2% or 32.7Db +/- .02dB.

Input Sensitivity: .775 +/- 2% for 80 watts into 8 ohms stereo or 160 watts into 16 ohms mono.

6.4 Voltage Conversion

Often Crown products are purchased in one country and later moved to another requiring an AC mains conversion. For this reason, the following procedure and chart as well as a world-wide voltage map is provided.

The D-150A II power supply may be connected for any of five voltages. Converting from one to the other is accomplished by unsoldering and reconnecting wire jumpers between terminal connectors.

- 1. Remove front panel as described in Section 7.4.
- 2. Locate the voltage conversion terminal strips, (26) and (27) in **Illustration 7-2**. Unsolder and move the jumper wires as necessary by referring to **Illustration 6-5** for desired AC line voltage.
- 3. For all voltages 200V and higher, the fuse must be changed from a 6.25 amp to 3 amp.
- 4. Install the front panel.

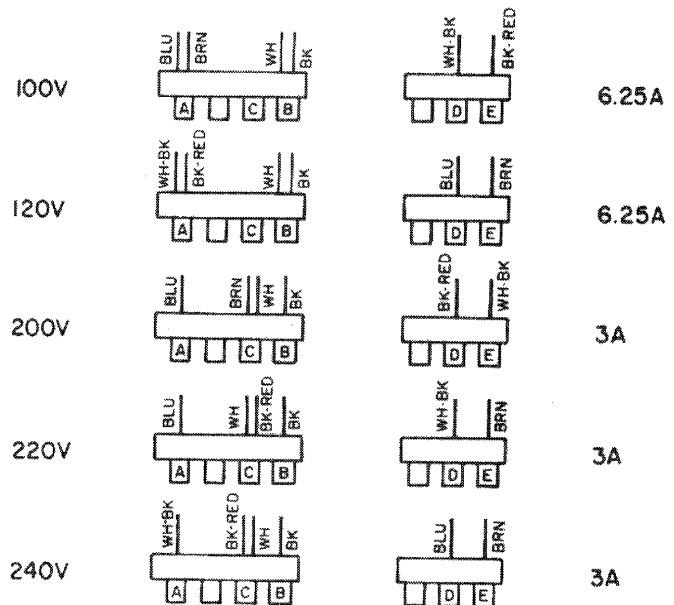


Illustration 6-4
Voltage Conversion

The following are a number of operating precautions given as an aid to understanding proper and improper amplifier usage.

1. Use care in making connections, selecting signal sources and controlling the output level. Crown is not liable for damage done to loads.
2. Never parallel the output with any other amplifiers output or parallel the two channels of the D-150A II amplifier. Damage incurred by such operation is not covered under warranty.
3. Never drive a transformer-coupled device or any other device which appears as a low frequency short (less than 3 ohms at DC) without a series isolating capacitor. Such operation may damage the device and/or needlessly waste output power.
4. Do not connect the ground lead of the output cable to the input signal ground as oscillations may result from forming such a loop.
5. Never connect the output to a power supply, battery, or power main.
6. Operate the amplifier from AC mains of not more than 10% above or below the selected line voltage and only 50/60Hz AC. Failure to comply with these frequency limits voids the warranty.
7. Tampering in the circuitry by unqualified personnel or the making of unauthorized circuit modifications may seriously degrade the performance of the amplifier and possibly invalidate the warranty.

6.5 Controls and Adjustments

The following paragraphs refer to the front and rear panel diagrams (**Illustration 3-1** and **Illustration 3-2**).

6.5.1 Power Switch/Indicator

This button, when depressed, will activate the D-150A II and also cause the amber LED indicator to illuminate if proper power requirements are met.

6.5.2 Input Level Controls

Both Input Level Controls provide control of the input signal level by channeling the input signal through 25K ohm audio taper potentiometer.

6.5.3 IOC Indicators

The IOC (Input Output Comparator) indicators are the two red LED indicators located on the front panel and help the user identify problems the unit may experience, such as input signal overload, improper load impedance, or even an amplifier based problem. Occasional flashing with music program peaks is normal, however, continuous illumination indicates a problem and should be investigated.

6.5.4 Input Phone Jacks

Input signal hook-up is through conventional unbalanced 1/4" phone jacks. Refer to the Instruction Manual for complete information on connecting input lines to the unit.

6.5.5 Mono/Dual Switch

This rear panel switch determines whether the unit is to perform as a single (mono) or dual (stereo) channel amplifier.

6.5.6 Fuse

Fuse replacement should not normally be necessary unless AC main voltage conversion is needed (see **Section 7.10**) or if the fuse has blown due to improper AC voltage or the amplifier develops an internal problem.

6.5.7 AC Line Cord

The D-150A II is furnished with a three wire, heavy duty AC cord and plug as standard equipment. Use caution with the third wire ground since it may introduce a ground loop in the system. A three-to-two plug adapter may be needed to prevent ground loop problems. Contact Crown Technical Service Department for further information if grounding problems are suspected in a particular system hook-up.

NOTE: Crown assumes no liability whatsoever for operation of ungrounded auxiliary equipment, nor for violation of UL or local electrical codes.

6.5.8 Main Output Jacks

The D-150A II main output jacks are of the standard MDP banana style. Refer to the D-150A II Instruction Manual for complete information on connecting output lines and loads to the unit.

SECTION 7: ILLUSTRATED PARTS LIST

7.1 General Information

This section contains illustrations and parts lists that are to be used in conjunction with the service, repair and adjustment procedures contained in **Section 4** of this manual.

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 schematic designation next to the illustration. Both the index number and the schematic designation are included in the parts list in separate columns. The schematic 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 on the component side. Schematic designations also appear on these diagrams.

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

7.2 Standard and Special Parts

Some electrical and electronic parts used 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.

7.3 Ordering Parts

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

7.4 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.

7.5 Terms

NOTE: Part prices are subject to change without notice.

1. Normal terms are C.O.D. The order may also be charged to your Visa or Master Charge account or 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. \$2.50 is average for an order under one pound.
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.

7.6 Parts Lists, Exploded Views and Schematics

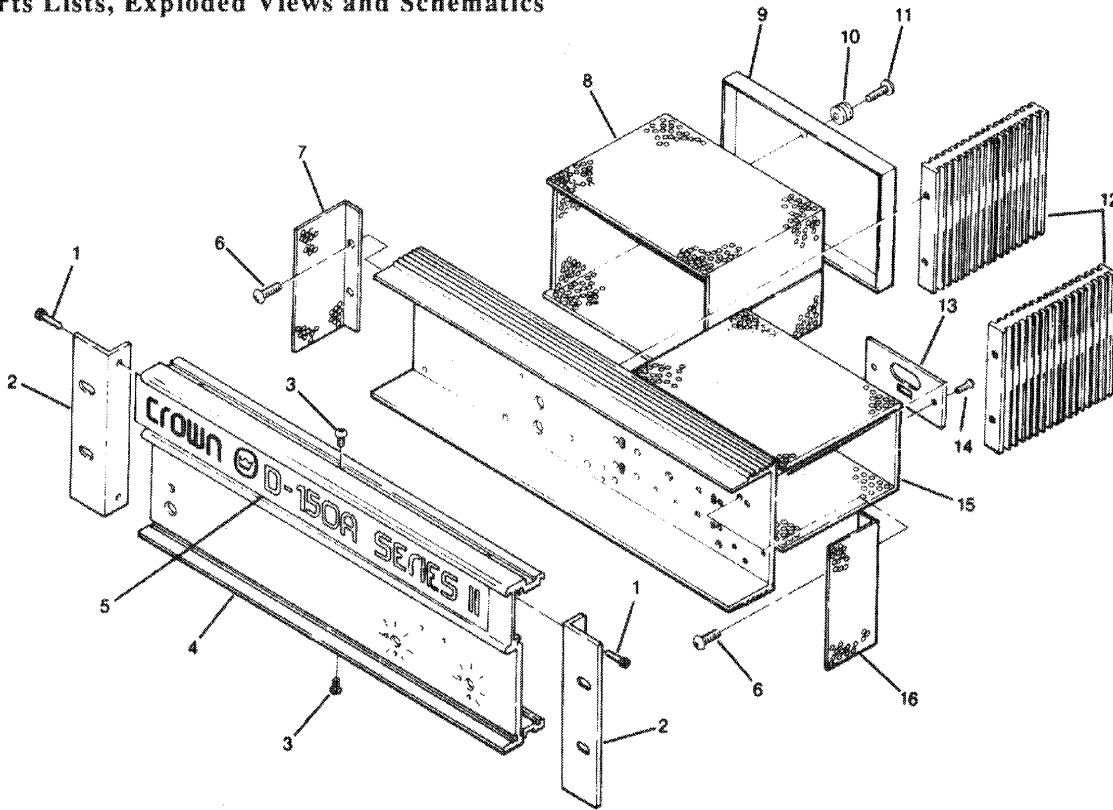


Illustration 7-1
Chassis Assembly

ITEM #	DESCRIPTION	PART #	REFERENCE
1	6-32 x .75 Hex Screw	C 1858-7	
2A	5 1/4" Rack Mount (Charcoal Grey)	D 5708J8	Serial #62738 and below
2B	5 1/4" Rack Mount (Carbide Black)	F10940J8	Serial #62739 and above
3	6-32 x .25" Screw	C 4758-6	
4A	Front Panel (Charcoal Grey)	F10075-4	Serial #62738 and below
4B	Front Panel (Carbide Black)	F10926J7	Serial #62739 and above
5	Front Panel Overlay	F10074-7	
6	10-24 x .75 Self Tap Screw	C 4017-7	
7	End Cover	F 9565J6	Transformer End
8	Transformer Wraparound	F 9952K3	
9	Transformer Cover	F10159J5	
10	Rubber Gromet	C 6915-0	
11	10-32 x .5" Screw	C 2049-2	
12	Heat Sink	D 3956-6	
13	Dress Plate	F 9594K3	
14	8-32 x .37 Screw	C 5297-4	
15	PC Board Cover	F 9564K6	
16	End Cover	F 9566K1	PC Board End

INTERNAL PARTS LIST

<u>ITEM #</u>	<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>	<u>REFERENCE</u>
1		Flag Housing	C 3297-6	
2		Flag Terminal	C 3901-3	
3		6-32 Hex Nut	C 1889-2	
4		#6 Internal Star Washer	C 5594-4	
5	S501	SPST Power Switch	D 5699A8	
6		6-32 x .37 Hex Screw	C 3322-2	
7		.5 x .195 Fiber Washer	C 3575-5	
8		Power LED Board	P10068B4	
9		Amber Power LED	C 4342-9	
10		6-32 x .25" Screw	C 4758-6	
11		PB Switch Collar	D 4108-3	
12		Pushbutton	D 5954J8	
13		Plunger	D 4808A6	
14		Switch Bracket	F10042A2	
15		6-32 x .37 Self Tap Screw	C 4320-6	
16		6-32 x .1" Screw	C 2138-3	
17	E301, E401	Red LED	C 5905-2	
18		IOC LED Board	P 9988-0	
19		Level Control Knob	D 5953J0	
20		.375 Hex Nut	C 1288-7	
21		Cable Strain Relief	D 2828-8	
22	R400 (shown); R300	Level Control	D 5696-6	
23		5 1/4" Rack Mount	D 5952J2	
24		6-32 x .75 Socket Cap Screw	C 1858-7	
25		10-24 x .75 Self Tap Screw	C 4017-7	
26		Terminal Strip G2	D 5366-6	
27		Terminal Strip 2G1	D 3323-9	
28	T500	Power Transformer	D 4380-8	
29		Rubber Gromet	C 1566-7	
30		#10 Flat Washer	C 2101-1	
31		#10 Internal Star Washer	C 2279-5	
32		10-32 Hex Nut	C 2170-6	
33	R500, R502	1.2K ohm 2W	C 3649-8	
34		10-32 x .5" Screw	C 2049-2	
35		Solder Lug .218	D 2934-4	
36		.312 Fiber Shoulder Washer	C 3320-6	
37		.3 x .525 x .125 Nylon Washer	C 1657-3	
38	C501	9300uf Filter Capacitor	C 5888-0	
39	C502	9300uf Filter Capacitor	C 5888-0	
40	C500	.1uf	C 2938-6	

INTERNAL PARTS LIST (cont'd)

<u>ITEM #</u>	<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>	<u>REFERENCE</u>
41	D500	Bridge Rectifier	C 4305-6	
42		Strain Relief	C 2803-2	
43		AC Line Cord	D 6505-8	
44		Fuse Holder	C 5597A5	
45	F500	6.25A MDX Fuse	C 4307-2	100-120V AC
--	F500	3A Fuse	C 4384-1	200-240V AC
46	R303	.1 ohm 5W	C 4761-0	
--		2.7 ohm .5W 5% (in parallel with R303)	C 2857-8*	
47		6-32 x .62 Screw	C 3879-1	
48		#6 Solder Lug	C 3163-0	
49	Q303	MJ15003 NPN	C 7064-6	
50	Q301	MJ15003 NPN	C 7064-6	
51		Anodized TO3 Insulator	D 4039-1	
52		Plastic TO3 Insulator	D 4071-3	
53		TO220 Torque Spreader	C 654104	
54	Q300	TO220 MJE15028	C 5890-6	
55		TO220 Mica Insulator	C 6067-0	
56		1.1" Jumper Lug	D 5587-7	
57	Q302	TO220 MJE15028	C 5890-6	
58		TO66 Plastic Insulator	D 4113-3	
59	R301	.1 ohm 5W	C 4761-0	
--		2.7 ohm .5W 5% (in parallel with R301)	C 2857-8*	
60	C402	.1uf Capacitor	C 2938-6	
61		8-32 Hex Nut	C 1986-6	
62		.87 x .18 Fiber Washer	D 3609-1	
63	L300	3uh Coil	M43121-9	
64	L400	3uh Coil	M43121-9	
65		#8 Internal Star Washer	C 1951-0	
66		8-32 x 1.75" Stud	C 3324-8	
67		#8 Solder Lug	D 2935-1	
68		4.1" Hex Standoff	D 3961-6	
69		2 Conductor Phone Jack	C 3423-8	
70		.375 Fiber Shoulder Washer	C 1306-7	
71		Control Assembly	M20105-9	Incl. 71, 76-79
72		.62 x .375 Fiber Washer	C 1646-6	
73		8-32 x .25 Screw	C 2136-7	
74		.62 x .375 Bright Washer	C 2189-6	
75		.375 Bright Nut	C 1288N7	

INTERNAL PARTS LIST (cont'd)

<u>ITEM #</u>	<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>	<u>REFERENCE</u>
76		Steel Eyelet	C 3529-2	
77		Foam Tape	S 2859-7	Specify length
78	S502	DPDT Slide Switch	C 4110-0	
79		Solder Lug .130	C 6818-6	
80	R501	1 ohm .25W	C 6392-2	
81		6-32 x .37 Screw	C 4329-6	
82		Board Mount Bracket	F 9562-4	
83		Main Board	Q42531-6	
84	C300	4.7uf @ 100V Axial Capacitor	C 5050-7	
85	C400	4.7uf @ 100V Axial Capacitor	C 5050-7	
86	S500	160° Thermal Switch	C 2799-2	
87	Q402 MJE15028	TO220 Power Transistor	C 5890-6	
88	Q400 MJE15028	TO220 Power Transistor	C 5890-6	
89	R403	.1 ohm 5W	C 4761-0	
--		2.7 ohm .5W 5%	C 2857-8*	
		(in parallel with R403)		
90	Q401	MJ15003 NPN	C 7064-6	
91	Q403	MJ15003 NPN	C 7064-6	
92	R401	.1 ohm 5W	C 4761-0	
--		2.7 ohm .5W 5%	C 2857-8*	
		(in parallel with R401)		
93	R302	2.7 ohm 1W	C 1001-4	
94	C301	.1uf	C 2938-6	
95	C401	.1uf	C 2938-6	
96	R402	2.7 ohm 1W	C 1001-4	
97		Dual Binding Post	C 2823-0	
98		IOC Module Assy	Q41880J7	

* 2.7 ohm .5W 5% resistor is deleted on S/N 59665 and above.

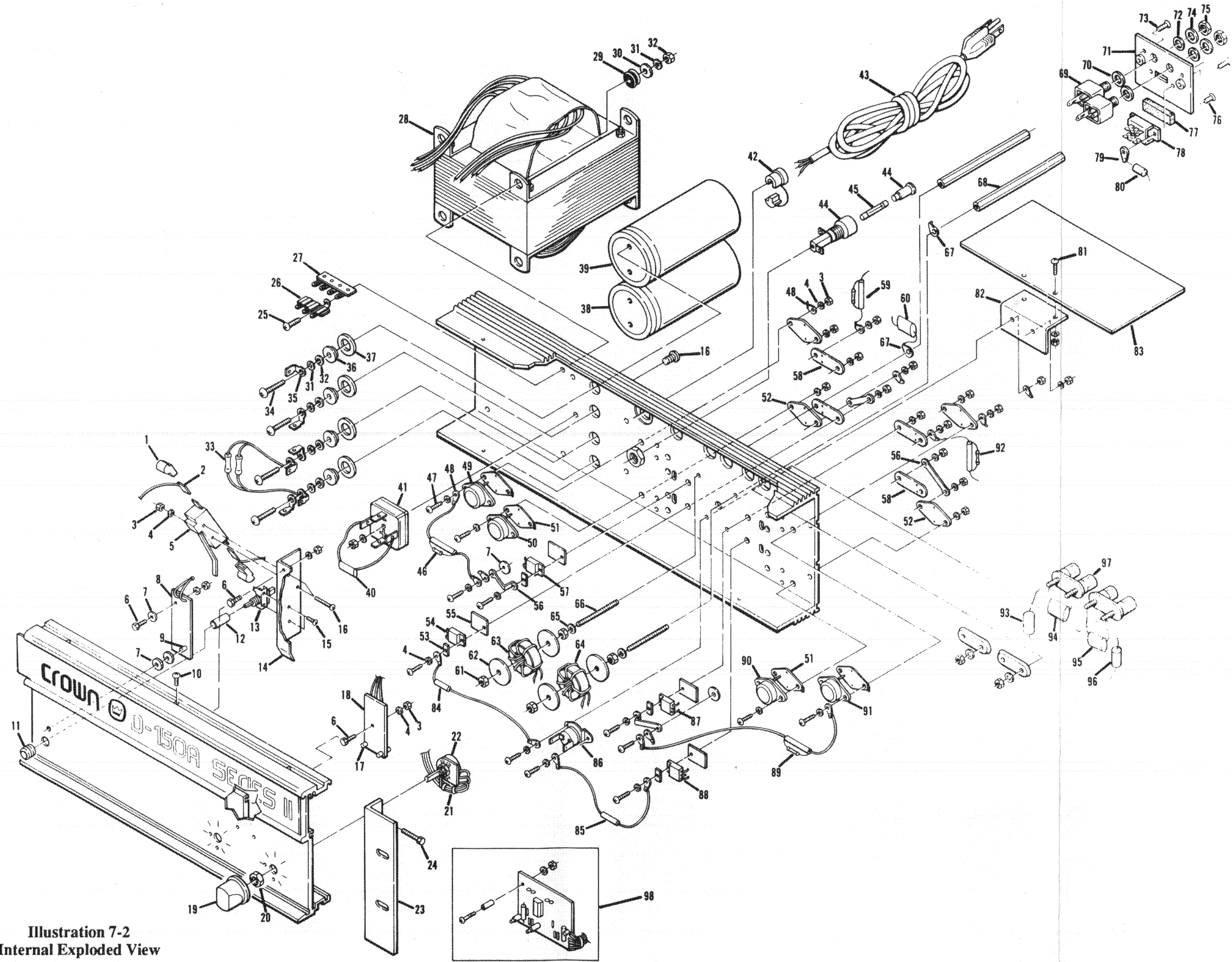


Illustration 7-2
Internal Exploded View

IOC MODULE (Serial #59664 and below)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>CAPACITORS</i>		
C8	2.2MF 50V Vertical	C 5362-6
C118	.22MF 100V Film	C 3218-2
C218	.22MF 100V Film	C 3218-2
<i>DIODES</i>		
D107	1N4148	C 3181-2
D108	MV5053 Red LED	C 4341-1
D207	1N4148	C 3181-2
D208	MV5053 Red LED	C 4341-1
<i>TRANSISTORS</i>		
Q115	Selected 2N3859A NPN	D 2961-7
Q116	Selected 2N3859A NPN	D 2961-7
Q215	Selected 2N3859A NPN	D 2961-7
Q216	Selected 2N3859A NPN	D 2961-7
IC2A,B,C,D	LM 339 Voltage Comparator	C 4345-2
<i>RESISTORS</i>		
R14	33K ohm .25W 5% CF	C 4346-0
R15	150K ohm .25W 5% CF	C 4216-5
R16	33K ohm .25W 5% CF	C 4346-0
R138	1.6M .25W 5% CF	C 4235-5
R139	2.7K ohm 1W 10%	C 1079-0
R140	27K ohm .5W 5% CF	C 1056-8
R141	18K ohm .25W 5% CF	C 2633-3
R144	10K ohm .25W 5% CF	C 2631-7
R238	1.6M .25W 5% CF	C 4235-5
R239	2.7K ohm 1W 10%	C 1079-0
R240	27K ohm .5W 5% CF	C 1056-8
R241	18K ohm .25W 5% CF	C 2633-3
R244	10K ohm .25W 5% CF	C 2631-7
<i>MISCELLANEOUS</i>		
	14 Pin IC Socket	C 3450-1

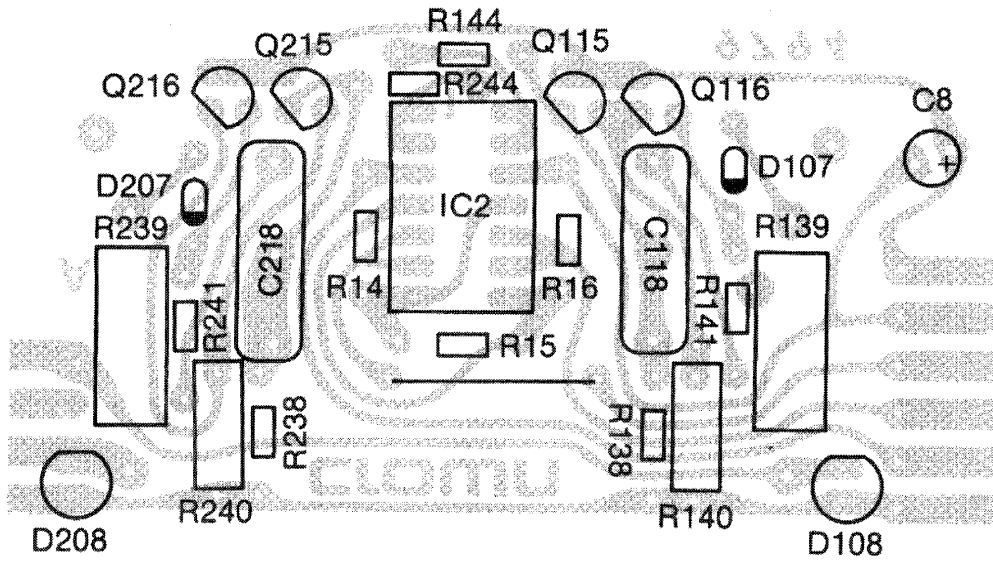


Illustration 7-3
IOC Component Board Layout
 (S/N 59664 and below)

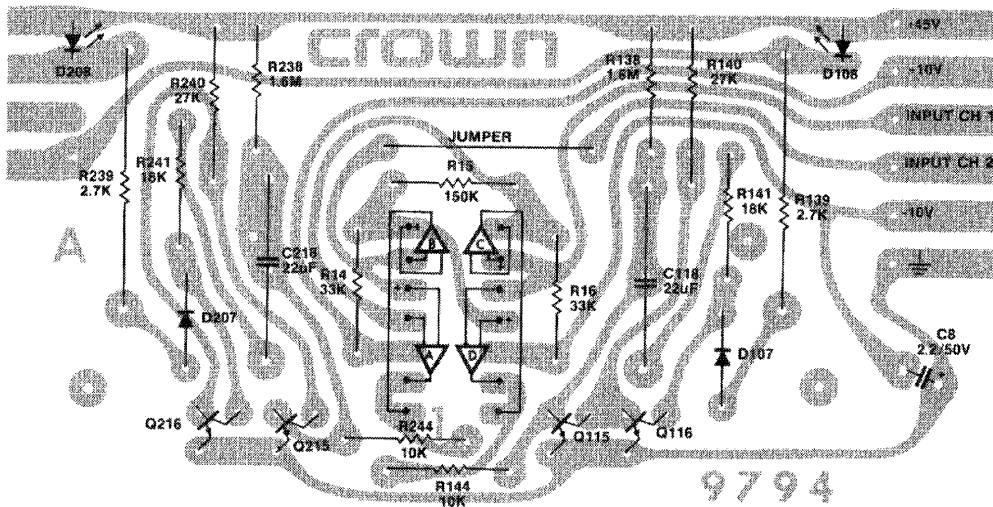


Illustration 7-4
IOC Foil Board Layout
 (S/N 59664 and below)

**D150A SERIES II MAIN MODULE Q41603J3
FOR UNITS WITH SERIAL NUMBERS 51024 THROUGH 59428**

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>CAPACITORS</i>		
C4	10MF 160V	C 2796-8
C5	10MF 50V Vertical	C 3728-0
C6	.01MF Disc	C 1751-4
C9	.1MF Disc	C 5639-7
C105	100PF Mica	C 3410-0
C101	.001MF 200V Film	C 3480-8
C102	200PF Mica	C 3411-3
C103	200PF Mica	C 3411-3
C104	47PF Mica	C 3409-7
C105	120PF Mica	C 3290-1
C106	100PF Mica	C 3410-5
C107	200PF Mica	C 3411-3
C108	10MF 50V Vertical	C 3728-0
C109	10MF 50V Vertical	C 3728-0
C110	.0027MF 200V Film	C 3481-6
C111	470PF Mica	C 2511-1
C112	.001MF 200V Film	C 3480-8
C113	.01MF Disc	C 1751-4
C114	200PF Mica	C 3411-3
C117	47PF Mica	C 3409-7
C200	100PF Mica	C 3410-5
C201	.001MF 200V Film	C 3480-8
C202	200PF Mica	C 3411-3
C203	200PF Mica	C 3411-3
C204	47PF Mica	C 3409-7
C205	120PF Mica	C 3290-1
C206	100PF Mica	C 3410-5
C207	200PF Mica	C 3411-3
C208	10MF 50V Vertical	C 3728-0
C209	10MF 50V Vertical	C 3728-0
C210	.0027MF 200V Film	C 3481-6
C211	470PF Mica	C 2511-1
C212	.001MF 200V Film	C 3480-8

D-150 MAIN MODULE Q41603J3 (cont'd)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>CAPACITORS (cont.)</i>		
C213	.01MF Disc	C 1751-4
C214	200PF Mica	C 3411-3
C217	47PF Mica	C 3409-7
<i>DIODES</i>		
D1	1N4004	C 2851-1
D2	1N4004	C 2851-1
D3	1N961B 10V Zener	C 3549-0
D4	1N961B 10V Zener	C 3549-0
D5	1N961B 10V Zener	C 3549-0
D100	1N4148	C 3181-2
D101	1N4148	C 3181-2
D102	1N4004	C 2851-1
D103	1N4148	C 3181-2
D104	1N4148	C 3181-2
D105	1N4148	C 3181-2
D106	1N4004	C 2851-1
D107	1N270	D 6212-1
D200	1N4148	C 3181-2
D201	1N4148	C 3181-2
D202	1N4004	C 2851-1
D203	1N4148	C 3181-2
D204	1N4148	C 3181-2
D205	1N4148	C 3181-2
D206	1N4004	C 2851-1
D207	1N270	D 6212-1
<i>INTEGRATED CIRCUITS</i>		
IC1	UA739PC	C 3231-5
L100	.5 Microhenry Coil	C 3510-2
L200	.5 Microhenry Coil	C 3510-2
<i>RESISTORS</i>		
R2	2.2K ohm .5W 5%	C 1036-0
R3	1.5K ohm 2W 10%	C 3303-2
R5	8.2K ohm .25W 5%	C 2877-6
R8	1.5K ohm 2W 10%	C 3303-2
R9	1 ohm .5W 5%	C 3612-6

D-150A II MAIN MODULE Q41603J3 (cont'd)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
R10	390 ohm .5W 5%	C 2609-3
R11	10K ohm .5W 1%	C 2343-9
R13	100 ohm .25W 5%	C 2872-7
R100	100K ohm Trim Pot	C 5062-2
R101	2M ohm .25W 5%	C 3199-4
R102	250K ohm Trim Pot	C 3087-1
R103	1K ohm .25W 5%	C 2627-5
R104	240K ohm .25W 5%	C 4220-7
R106	4.7K ohm .25W 10%	C 3939-3
R107	56 ohm .25W 10%	C 3511-0
R108	3.3K ohm .25W 10%	C 2629-1
R109	510 ohm .5W 1%	C 3304-0
R110	2.4K ohm .25W 5%	C 3616-7
R111	56K ohm .25W 5%	C 2882-6
R112	8.2K ohm .25W 5%	C 2877-6
R113	5.6K ohm .25W 5%	C 3220-8
R114	1K ohm .25W 5%	C 2627-5
R115	10K ohm .5W 1%	C 2343-9
R116	820 ohm .25W 5%	C 3301-6
R117	33K ohm .5W 5%	C 3137-4
R118	120 ohm .5W 5%	C 3837-9
R119	82 ohm .25W 5%	C 3960-9
R120	5.1K ohm 1W 5%	C 2808-1
R121	22.1K ohm .5W 1%	C 3855-1
R122	82 ohm .25W 5%	C 3960-9
R123	120 ohm .5W 5%	C 3837-9
R124	82 ohm .25W 5%	C 3960-9
R125	2.2K ohm .5W 5%	C 1036-0
R125	2.2K ohm .25W 5%	C 3152-3
R126	750 ohm .25W 5%	C 3803-1
R127	15 ohm .25W 5%	C 3614-2
R128	500 ohm Trim Pot	C 6048-0
R129	100 ohm .25W 5%	C 2872-7
R130	180 ohm .25W 5%	C 2873-5
R131	5.6 ohm .5W 5%	C 3299-2
R135	180 ohm .25W 5%	C 2873-5
R136	5.6 ohm .5W 5%	C 3299-2
R137	180K ohm .25W 5%	C 4218-1
R142	13K ohm .25W 5%	C 4300-7
R143	13K ohm .25W 5%	C 4300-7

D-150A II MAIN MODULE Q41603J3 (cont'd)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>RESISTORS (cont'd)</i>		
R200	100K ohm Trim Pot	C 5062-2
R201	2M ohm .25W 5%	C 3199-4
R202	250K ohm Trim Pot	C 3087-1
R203	1K ohm .25W 5%	C 2627-5
R204	240K ohm .25W 5%	C 4220-7
R206	4.7K ohm .25W 10%	C 3939-3
R207	56 ohm .25W 10%	C 3511-0
R208	3.3K ohm .25W 10%	C 2629-1
R209	510 ohm .5W 1%	C 3304-0
R210	2.4K ohm .25W 5%	C 3616-7
R211	56K ohm .25W 5%	C 2882-6
R212	8.2K ohm .25W 5%	C 2877-6
R213	5.6K ohm .25W 5%	C 3220-8
R214	1K ohm .25W 5%	C 2627-5
R215	10K ohm .5W 1%	C 2343-9
R216	820 ohm .25W 5%	C 3301-6
R217	33K ohm .5W 5%	C 3137-4
R218	120 ohm .5W 5%	C 3837-9
R219	82 ohm .25W 5%	C 3960-9
R220	5.1K ohm 1W 5%	C 2808-1
R221	22.1K ohm .5W 1%	C 3855-1
R222	82 ohm .25W 5%	C 3960-9
R223	120 ohm .5W 5%	C 3837-9
R224	82 ohm .25W 5%	C 3960-9
R225	2.2K ohm .5W 5%	C 1036-0
R225	2.2K ohm .25W 5%	C 3152-3
R226	750 ohm .25W 5%	C 3803-1
R227	15 ohm .25W 5%	C 3614-2
R228	500 ohm Trim Pot	C 6048-0
R229	100 ohm .25W 5%	C 2872-7
R230	180 ohm .25W 5%	C 2873-5
R231	5.6 ohm .5W 5%	C 3299-2
R235	180 ohm .25W 5%	C 2873-5
R236	5.6 ohm .5W 5%	C 3299-2
R237	180K ohm .25W 5%	C 4218-1
R242	13K ohm .25W 5%	C 4300-7
R243	13K ohm .25W 5%	C 4300-7

D-150A II MAIN MODULE Q41603J3 (cont'd)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>TRANSISTORS</i>		
Q1	SEL 2N3859 NPN	D 2961-7
Q2	2N4250A PNP	C 3786-8
Q100	SEL 2N3859 NPN	D 2961-7
Q101	PN4250A PNP	C 3786-8
Q102	MPS93 PNP	C 3578-9
Q103	SEL 2N3859 NPN	D 2961-7
Q104	2N4125 PNP	C 3625-8
Q105	MPSL01 NPN	C 3232-3
Q106	SEL 2N3859 NPN	D 2961-7
Q107	D40P3 NPN	C 5065-5
Q108	2N4125 PNP	C 3625-8
Q111	SEL 2N3859 NPN	D 2961-7
Q112	SS 7304	D 2923-7
Q200	SEL 2N3859 NPN	D 2961-7
Q201	PN4250A PNP	C 3786-8
Q202	MPS93 PNP	C 3578-9
Q203	SEL 2N3859 NPN	D 2961-7
Q204	2N4125 PNP	C 3625-8
Q205	MPSL01 NPN	C 3232-3
Q206	SEL 2N3859 NPN	D 2961-7
Q207	D40P3 NPN	C 5065-5
Q208	2N4125 PNP	C 3625-8
Q211	SEL 2N3859 NPN	D 2961-7
Q212	SS 7304	D 2923-7
<i>MISCELLANEOUS</i>		
	14 Pin IC Socket	C 3450-1
	Heatsink T0-92	C 3493-1
	D-Clips T0-92	C 3953-4
	PC Board Mount	F 9562-4

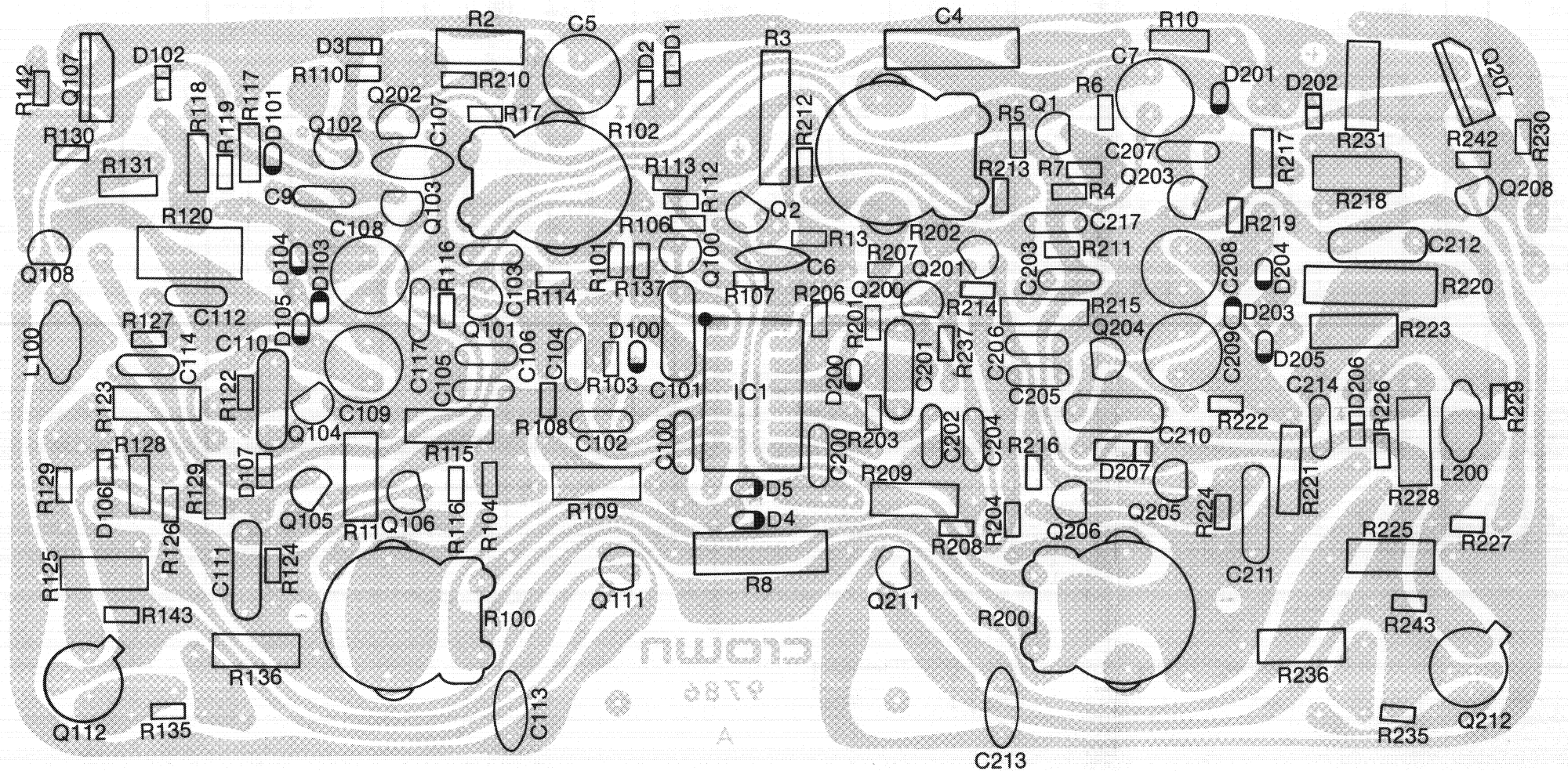


Illustration 7-5
Main Module Q41603J3 Component Board Layout
(S/N 51024 through 59428)

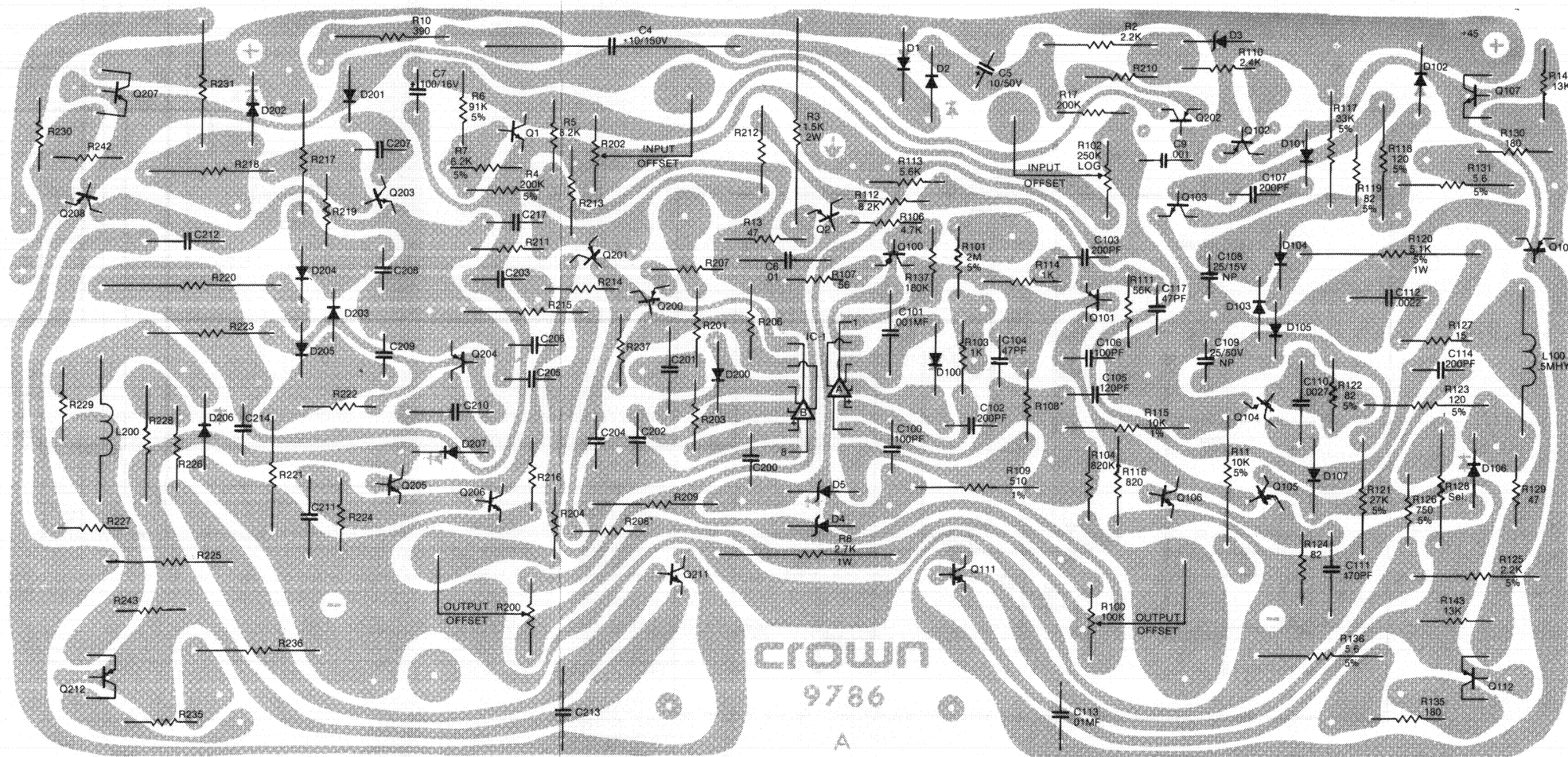


Illustration 7-6
Main Module Q41603J3 Foil Board Layout
(S/N 51024 through 59428)

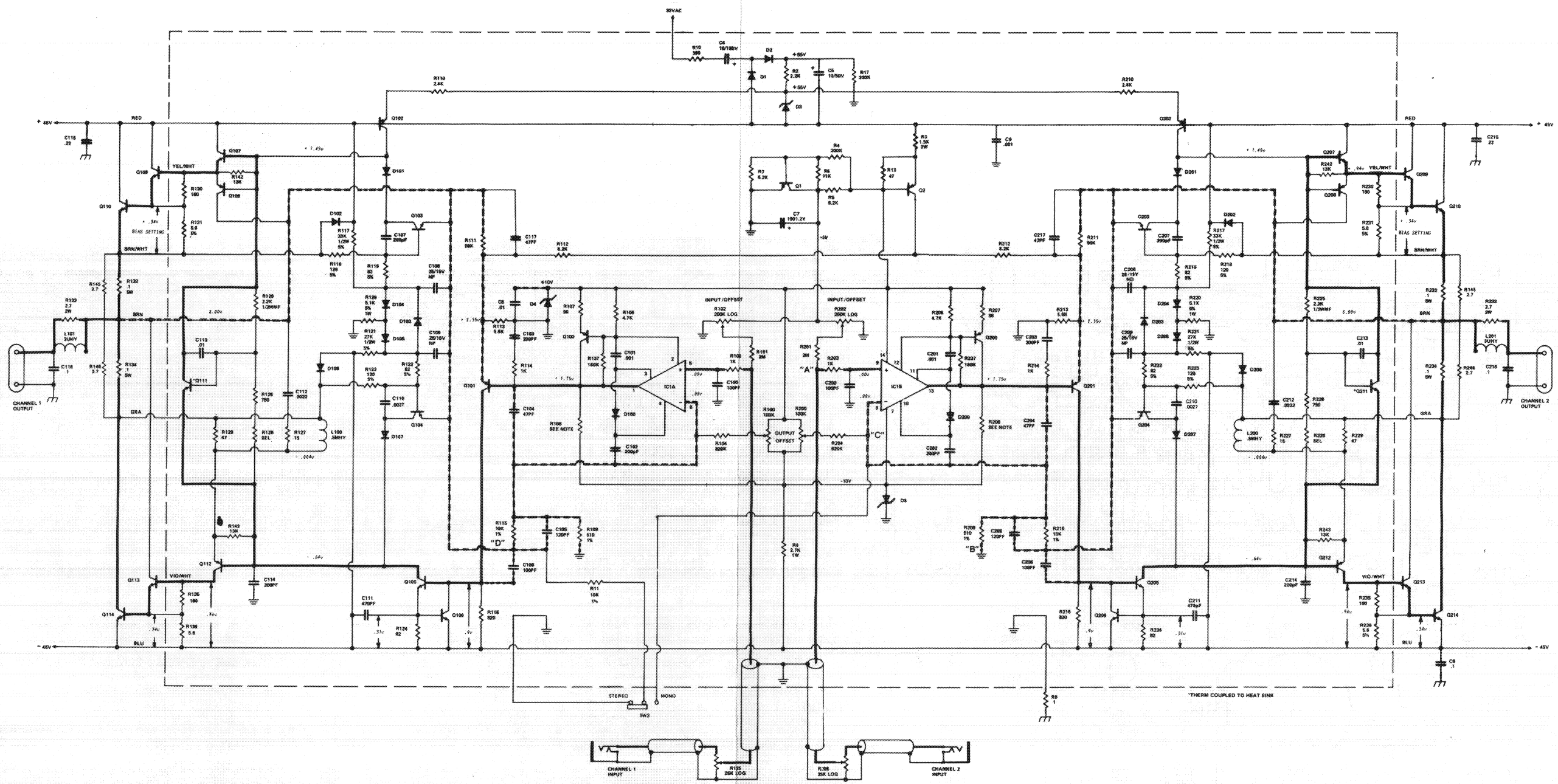
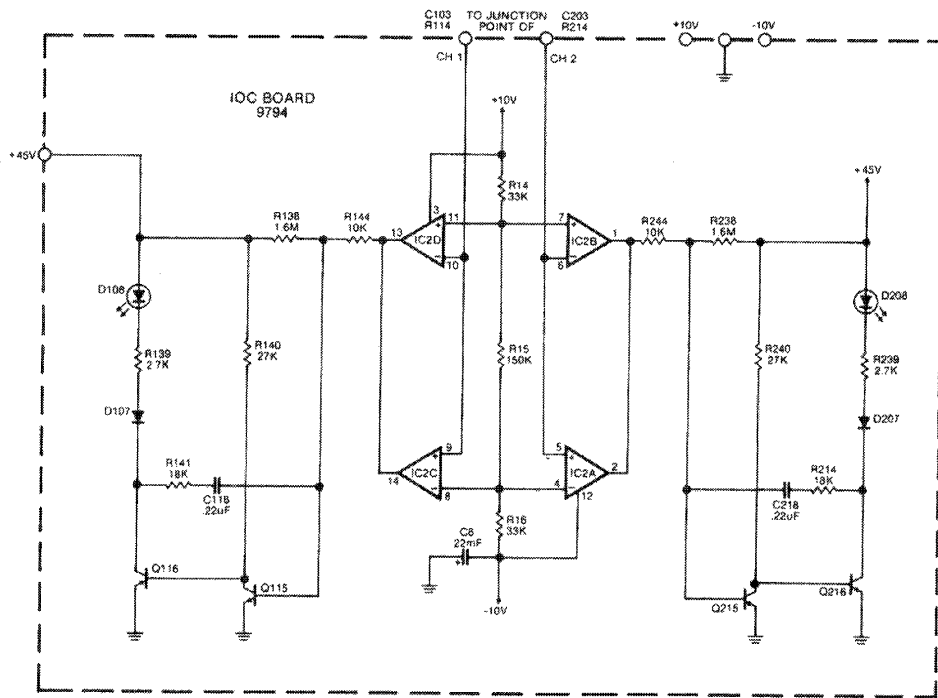
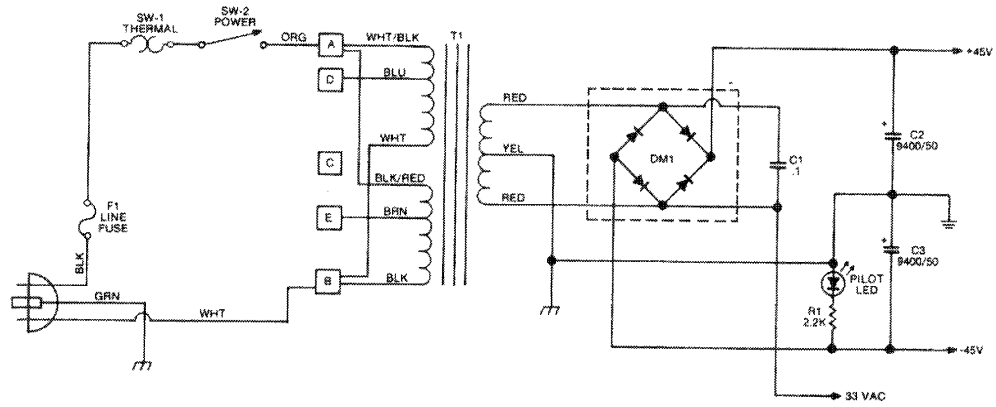


Illustration 7-7
 Main Module Q41603J Schematic
 (S/N 51024 through 59428)

**D150A SERIES II
 POWER AMPLIFIER
 MI 261F**



NOTES:

- THIS IS A REPRESENTATIVE SCHEMATIC ONLY AND DOES NOT NECESSARILY REFLECT THE EXACT CIRCUITRY OF YOUR UNIT. REFER TO SERVICE MANUAL FOR FURTHER TECHNICAL INFORMATION.
- THIS SCHEMATIC APPLIES TO AMPLIFIERS NUMBERED 51024 AND ABOVE.
- CIRCUIT SHOWN APPLIES TO PC BOARDS #9786 (MAIN BOARD) AND #9794 (IOC BOARD).
- DC VOLTAGES ARE SHOWN FOR VARIOUS POINTS. THESE ARE NORMAL OPERATING VOLTAGES FOR ZERO INPUT.
- WIRE COLOR CODES ARE GIVEN FOR THE MAIN POWER SUPPLY AND SOME BOARD WIRES.
- ALL RESISTORS IN OHMS UNLESS OTHERWISE STATED.
- ALL CAPACITORS IN MICRO-FARADS UNLESS OTHERWISE STATED.
- COMPONENTS COMMON TO BOTH CHANNELS ARE NUMBERED FROM 1 TO 99.
- CHANNEL ONE COMPONENTS ARE NUMBERED FROM 100 TO 199.
- CHANNEL TWO COMPONENTS ARE NUMBERED FROM 200 TO 299.
- R108, R208 ARE OMITTED WHEN IC-1 IS μ A739; 3.3K WHEN μ A749 IS USED.

MAIN MODULE Q42531-6 (Serial #59665 and above)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
CAPACITORS		
C4	10MF 160V	C 2796-8
C5	10MF 50V Vertical	C 3728-0
C6	.01MF Disc	C 1751-4
C9	.1MF Disc	C 5639-7
C10	.01MF Disc	C 1751-4
C100	100PF Mica	C 3410-5
C104	47PF Mica	C 3409-7
C105	120PF Mica	C 3290-1
C106	100PF Mica	C 3410-5
C107	200PF Mica	C 3411-3
C108	10MF 50V Vertical	C 3728-0
C109	10MF 50V Vertical	C 3728-0
C110	.0027MF 200V Film	C 3481-6
C111	470PF Mica	C 2511-1
C112	.001MF 200V Film	C 3480-8
C113	.01MF Disc	C 1751-4
C114	200PF Mica	C 3411-3
C117	47PF Mica	C 3409-7
C118	.1MF	C 5639-7
C200	100PF Mica	C 3410-5
C204	47PF Mica	C 3409-7
C205	120PF Mica	C 3290-1
C206	100PF Mica	C 3410-5
C207	200PF Mica	C 3411-3
C208	10MF 50V Vertical	C 3728-0
C209	10MF 50V Vertical	C 3728-0
C210	.0027MF 200V Film	C 3481-6
C211	470PF Mica	C 2511-1
C212	.001MF 200V Film	C 3480-8
C213	.01MF Disc	C 1751-4
C214	200PF Mica	C 3411-3
C217	47PF Mica	C 3409-7
C218	.1MF	C 5639-7

MAIN MODULE Q42531-6 (Serial #59665 and above) (cont'd)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>DIODES</i>		
D1	1N4004	C 2851-1
D2	1N4004	C 2851-1
D3	1N961B 10V Zener	C 3549-0
D4	1N961B 10V Zener	C 3549-0
D5	1N961B 10V Zener	C 3549-0
D7	1N4148	C 3181-2
D101	1N4148	C 3181-2
D102	1N4004	C 2851-1
D103	1N4148	C 3181-2
D104	1N4148	C 3181-2
D105	1N4148	C 3181-2
D106	1N4004	C 2851-1
D107	1N270	D 6212-1
D201	1N4148	C 3181-2
D202	1N4004	C 2851-1
D203	1N4148	C 3181-2
D204	1N4148	C 3181-2
D205	1N4148	C 3181-2
D206	1N4004	C 2851-1
D207	1N270	D 6212-1
<i>INTEGRATED CIRCUITS</i>		
U1	LM339N	C 4345-2
U100	LF357N	C 6527-3
U200	LF357N	C 6527-3
L100	.5 Microhenry Coil	C 3510-2
L200	.5 Microhenry Coil	C 3510-2
<i>RESISTORS</i>		
R1	2.2K ohm .5W 5%	C 1036-0
R2	2.2K ohm .5W 5%	C 1036-0
R3	1.5K ohm 2W 10%	C 3303-2
R8	1.5K ohm 2W 10%	C 3303-2
R10	390 ohm .5W 5%	C 2609-3
R11	10K ohm .5W 1%	C 2343-9
R14	33K ohm .25W 5%	C 4346-0
R15	150K ohm .25W 5%	C 4216-5
R16	33K ohm .25W 5%	C 4346-0
R17	200K ohm .25W 5%	C 3622-5

MAIN MODULE Q42531-6 (Serial #59665 and above) (cont'd)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>RESISTORS (cont'd)</i>		
R100	100K ohm Trim Pot	C 5062-2
R101	2M ohm .25W 5%	C 3199-4
R103	1K ohm .25W 5%	C 2627-5
R104	240K ohm .25W 5%	C 4220-7
R109	510 ohm .5W 1%	C 3304-0
R110	2.4K ohm .25W 5%	C 3616-7
R111	56K ohm .25W 5%	C 2882-6
R112	8.2K ohm .25W 5%	C 2877-6
R113	5.6K ohm .25W 5%	C 3220-8
R115	10K ohm .5W 1%	C 2343-9
R116	820 ohm .25W 5%	C 3301-6
R117	33K ohm .5W 5%	C 3137-4
R118	120 ohm .5W 5%	C 3837-9
R119	82 ohm .25W 5%	C 3960-9
R120	5.1K ohm 1W 5%	C 2808-1
R121	22.1K ohm .5W 1%	C 3855-1
R122	82 ohm .25W 5%	C 3960-9
R123	120 ohm .5W 5%	C 3837-9
R124	82 ohm .25W 5%	C 3960-9
R125	2.2K ohm .5W 5%	C 1036-0
R126	750 ohm .25W 5%	C 3803-1
R127	15 ohm .25W 5%	C 3614-2
R128	500 ohm Trim Pot	C 6048-0
R129	100 ohm .25W 5%	C 2872-7
R130	180 ohm .25W 5%	C 2873-5
R131	5.6 ohm .5W 5%	C 3299-2
R135	180 ohm .25W 5%	C 2873-5
R136	5.6 ohm .5W 5%	C 3299-2
R138	150K ohm .25W 5%	C 4216-5
R139	2.7K ohm 1W 10%	C 1079-0
R140	56K ohm .25W 5%	C 2882-6
R142	13K ohm .25W 5%	C 4300-7
R143	13K ohm .25W 5%	C 4300-7
R144	4.7K ohm .25W 5%	C 3939-3
R145	825 ohm .25W 1%	C 6556-2

MAIN MODULE Q42531-6 (Serial #59665 and above) (cont'd)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>RESISTORS (cont'd)</i>		
R146	FOR .775VRMS SENSITIVITY JUMPER	
R200	100K ohm Trim Pot	C 5062-2
R201	2M ohm .25W 5%	C 3199-4
R203	1K ohm .25W 5%	C 2627-5
R204	240K ohm .25W 5%	C 4220-7
R209	510 ohm .5W 1%	C 3304-0
R210	2.4K ohm .25W 5%	C 3616-7
R211	56K ohm .25W 5%	C 2882-6
R212	8.2K ohm .25W 5%	C 2877-6
R213	5.6K ohm .25W 5%	C 3220-8
R215	10K ohm .5W 1%	C 2343-9
R216	820 ohm .25W 5%	C 3301-6
R217	33K ohm .5W 5%	C 3137-4
R218	120 ohm .5W 5%	C 3837-9
R219	82 ohm .25W 5%	C 3960-9
R220	5.1K ohm 1W 5%	C 2808-1
R221	22.1K ohm .5W 1%	C 3855-1
R222	82 ohm .25W 5%	C 3960-9
R223	120 ohm .5W 5%	C 3837-9
R224	82 ohm .25W 5%	C 3960-9
R225	2.2K ohm .5W 5%	C 1036-0
R226	750 ohm .25W 5%	C 3803-1
R227	15 ohm .25W 5%	C 3614-2
R228	500 ohm Trim Pot	C 6048-0
R229	100 ohm .25W 5%	C 2872-7
R230	180 ohm .25W 5%	C 2873-5
R231	5.6 ohm .5W 5%	C 3299-2
R235	180 ohm .25W 5%	C 2873-5
R236	5.6 ohm .5W 5%	C 3299-2
R238	150K ohm .25W 5%	C 4216-5
R239	2.7K ohm 1W 10%	C 1079-0
R240	56K ohm .25W 5%	C 2882-6
R242	13K ohm .25W 5%	C 4300-7
R243	13K ohm .25W 5%	C 4300-7
R244	4.7K ohm .25W 5%	C 3939-3
R245	825 ohm .25W 1%	C 6556-2
R246	FOR .775 V RMS SENSITIVITY JUMPER	

MAIN MODULE Q42531-6 (Serial #59665 and above) (cont'd)

<u>LOCATION #</u>	<u>DESCRIPTION</u>	<u>PART #</u>
<i>TRANSISTORS</i>		
Q101	PN4250A PNP	C 3786-8
Q102	MPS93 PNP	C 3578-9
Q103	SEL 2N3859 NPN	D 2961-7
Q104	2N4125 PNP	C 3625-8
Q105	MPSL01 NPN	C 3232-3
Q106	SEL 2N3859 NPN	D 2961-7
Q107	D40P3 NPN	C 5065-5
Q108	2N4125 PNP	C 3625-8
Q111	SEL 2N3859 NPN	D 2961-7
Q112	NDS206 PNP	C 4116-7
Q115	SEL 2N3859 NPN	D 2961-7
Q116	SEL 2N3859 NPN	D 2961-7
Q201	PN4250A PNP	C 3786-8
Q202	MPS93 PNP	C 3578-9
Q203	SEL 2N3859 NPN	D 2961-7
Q204	2N4125 PNP	C 3625-8
Q205	MPSL01 NPN	C 3232-3
Q206	SEL 2N3859 NPN	D 2961-7
Q207	D40P3 NPN	C 5065-5
Q208	2N4125 PNP	C 3625-8
Q211	SEL 2N3859 NPN	D 2961-7
Q212	NDS206 PNP	C 4116-7
Q215	SEL 2N3859 NPN	D 2961-7
Q216	SEL 2N3859 NPN	D 2961-7
<i>MISCELLANEOUS</i>		
	14 Pin IC Socket	C 3450-1
	8 Pin IC Socket	C 3451-9
	Heatsink T0-92	C 3493-1
	D-Clips T0-92	C 3953-4
	PC Board Mount	F 9562-4
	0 ohm Jumpers	C 5868-9

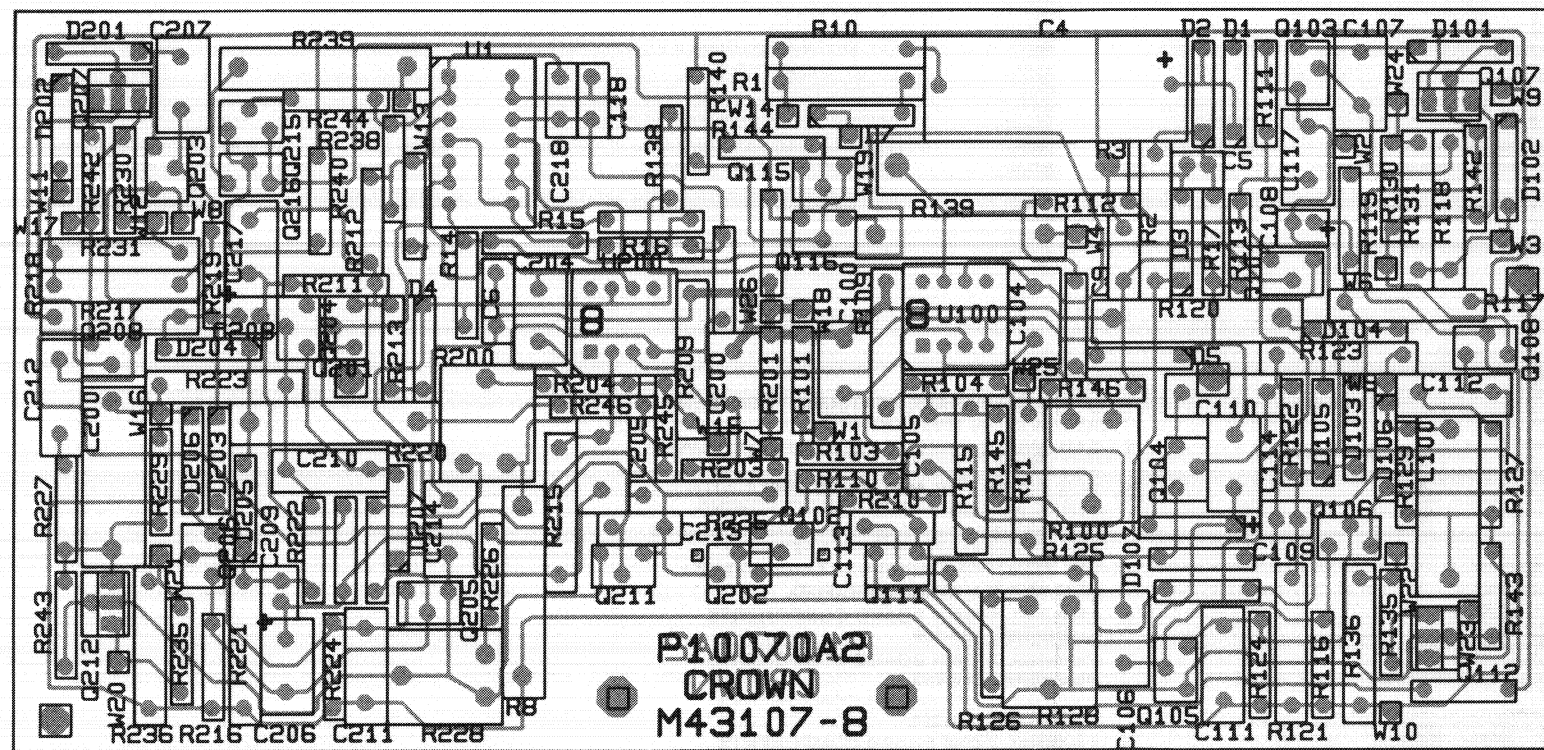


Illustration 7-8
Main Module Q42531-6 Component Board Layout
(S/N 59665 and above)

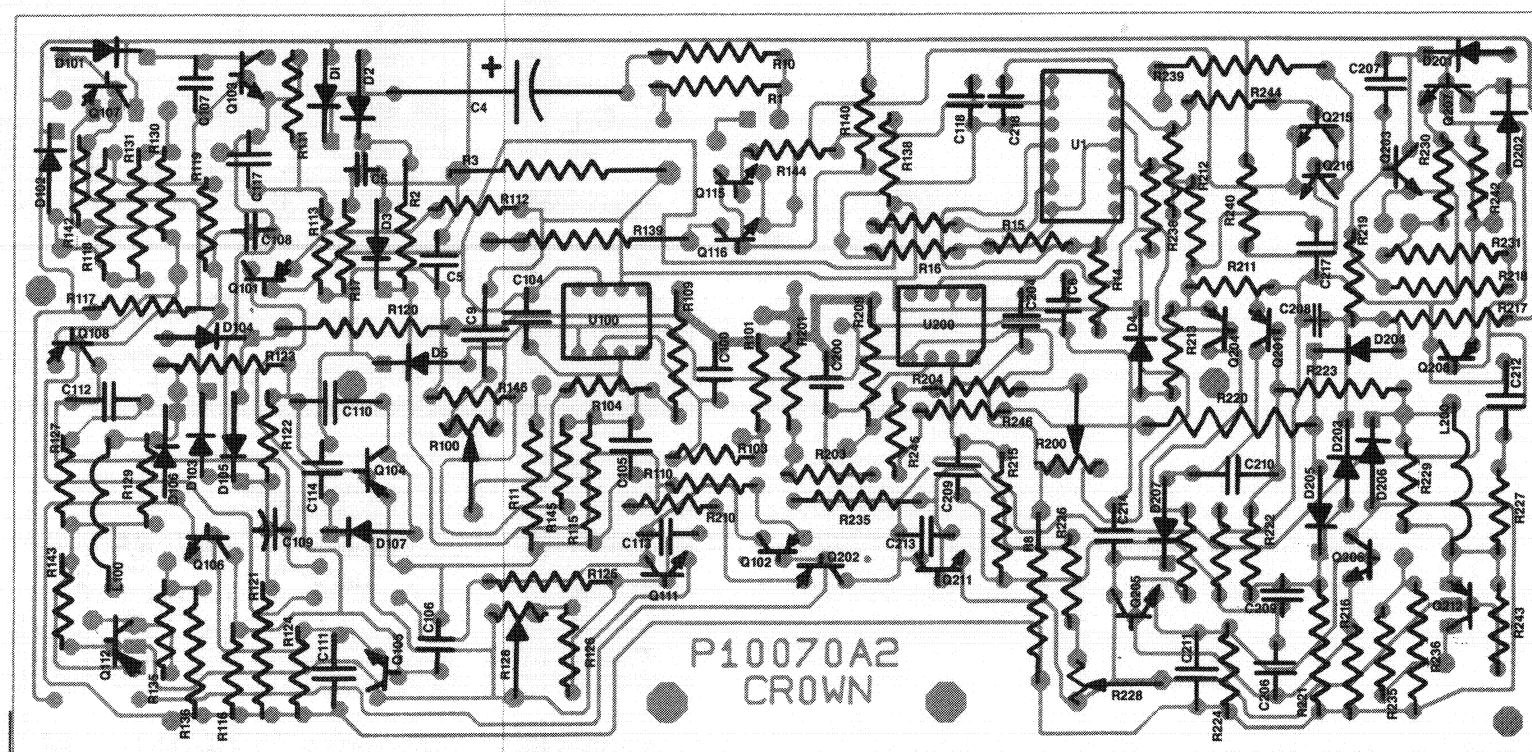
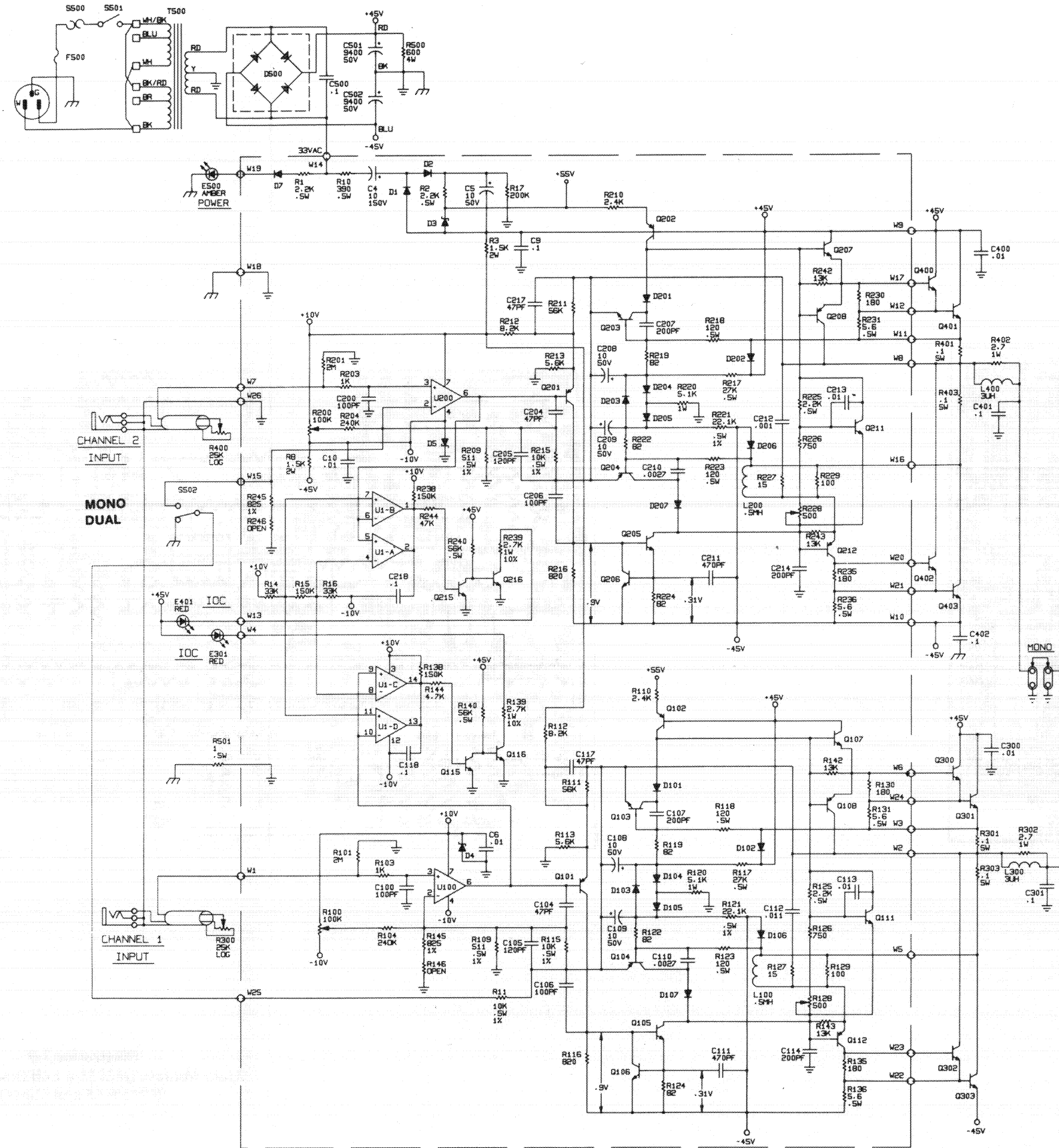


Illustration 7-9
Main Module Q42531-6 Foil Board Layout
(S/N 59665 and above)

D-150A SERIES II POWER AMPLIFIER



- NOTE:**
1. Q102 AND Q202 ARE HEATSUNK TOGETHER WITH A DUAL T092 COOLER.
 2. Q111 AND Q211 ARE HEATSUNK TO THE BOARD MOUNTING BRACKET.
 3. THIS SCHEMATIC APPLIES TO UNITS WITH SERIAL NUMBERS 59429 AND FOLLOWING.
 4. ALL RESISTORS ARE .25W, 5% WITH VALUES IN OHMS UNLESS OTHERWISE SPECIFIED.
 5. ALL CAPACITOR VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
 6. CHANNEL 1 MAIN BOARD COMPONENTS NUMBERED 100-199.
 7. CHANNEL 2 MAIN BOARD COMPONENTS NUMBERED 200-299.
 8. CHANNEL 1 OFF BOARD COMPONENTS NUMBERED 300-399.
 9. CHANNEL 2 OFF BOARD COMPONENTS NUMBERED 400-499.
 10. COMMON MAIN BOARD COMPONENTS NUMBERED 1-99.
 11. COMMON OFF BOARD COMPONENTS NUMBERED 1-99.
 12. DC VOLTAGES SHOWN APPLY TO NORMAL QUIESCENT OPERATING CONDITIONS.

Illustration 7-10
Main Module Q42531-6 Schematic
(S/N 59665 and above)

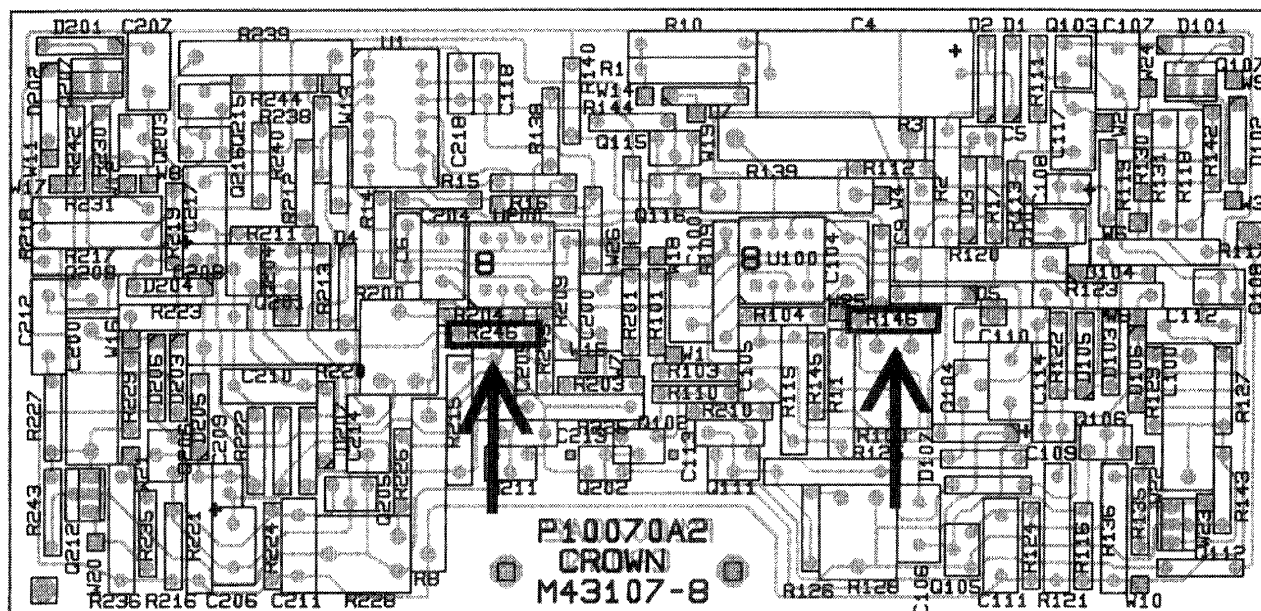


Illustration 7-11
Jumper Locations

The D-150A Series II amplifier comes with an optional feature that increases the input sensitivity of the amplifier to allow a 0dBm (.775Vrms) input signal to drive the amplifier to full rated power. The feature is set up to be easily field implemented by either a Crown Warranty Service Station or by the user without voiding the warranty.

Modification Instructions

1. Disconnect the amplifier from AC power.
2. Place the amplifier transformer end down on a flat surface. Remove the two black phillips head screws adjacent to the input jacks. The dress plate and perforated main board cover can now be easily removed. This will expose both sides of the main circuit board.
3. Solder #22 buss wire jumpers at the locations marked R146 and R246 on the main circuit board. A board layout with the jumpers locations indicated is provided for easy reference.
4. Reassemble the unit in reverse order of disassembly.

Specification Changes

Stereo Voltage Gain: 21.6 +/- 2% or 26.7dB +/- .02dB.

Monaural Voltage Gain: 43.2 +/- 2% or 32.7dB +/- .02dB.

Input Sensitivity: .775 volts +/- 2% for 80 watts into 8 ohms stereo or 160 watts into 16 ohms mono.