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CARVER

M-200t

SERVICE MANUAL

TABLE OF CONTENTS

	Page
Specifications	I
Schematic Diagram (fold-out)	III
Part Locator (with overlay)	IV
Wiring Diagram	V
Assembly Drawing (fold-out)	VI
List of Figures	VII
Figures	VIII
240V/110V Conversion	X
Introduction	1
The Power Supply	1
Triac-Controlled Transformer	1
Primary Regulator Circuit	2
Protection Circuits	3
- Over Current	3
- High Frequency	4
- DC Offset	4
- Over Voltage	4
- Integrator	4
- $\pm 12V$ Fault	5
Amplifier Circuits	5
Test Procedure	8
Parts List	10

M-200t SPECIFICATIONS

FREQUENCY RESPONSE:

@ 3vrms 1w out into 8 ohms---
20 Hz--- left channel -0.1db
 right channel -0.1db
200 Hz-- left channel -0.0db
 right channel -0.0db
2 kHz--- left channel -0.0db
 right channel -0.0db
20 kHz-- left channel -0.0db
 right channel -0.6db

THD:

@1w out into 8 ohms---
20 Hz--- left channel .015%
 right channel .019%
2 kHz--- left channel .019%
 right channel .07%
20 kHz-- left channel .15%
 right channel .4%

@100w out into 8 ohms---
20 Hz--- left channel .005%
 right channel .03%
2 kHz--- left channel .022%
 right channel .04%
20 kHz-- left channel .09%
 right channel .17%

POWER OUTPUT:

Line @ 120 vac (held)
Into 8 ohms;
left channel only 128w
right channel only 128w
both channels driven 120w (each channel)
Into 4 ohms; (will not run with continuous rms waveform @ full power)
left channel only 203w
right channel only 205w
both channels driven 182w (each channel)

LOW VOLTAGE SUPPLY REG.:

Line @ 100vac----+12.1v -12.1v
Line @ 120vac----+12.7v -12.5v
Zener Dissipation---- 300mw

LINE REGULATION:

Top rail set @ 55vdc @ 120vac line
Top rail ---- 50.5v @ 100vac line
Top rail ---- 56.8v @ 140vac line

POWER SUPPLY THERMAL CONSIDERATION:

Top dc rail varies ± 1.0 volts with extreme temp. variations

LOW VOLTAGE FAULT:

Amp will shut down immediately if either 12 volt supply fails

DC OFFSET FAULT:

+2.2V dc will shut amp down

-3.1V dc will shut amp down

LOW FREQUENCY TRIP:

Right ch. will trip @ 4Hz @ clipping

Right ch. will not trip @ 7Hz

Left ch. will trip @ 1.5Hz @ clipping

Left ch. will not trip @ 3Hz

Right and left ch. driven amp will trip @ 2Hz @ clipping

Right and left ch. driven amp will not trip @ 4Hz

HIGH FREQUENCY TRIP:

Both ch. will trip @ 30kHz before clipping

Integrator Shut-down:

trip threshold = 25V rms

trip time @ 30Vrms is 40 sec. min. and 70 sec. max.

OVER VOLTAGE TRIP:

63 volts min.

67 volts max.

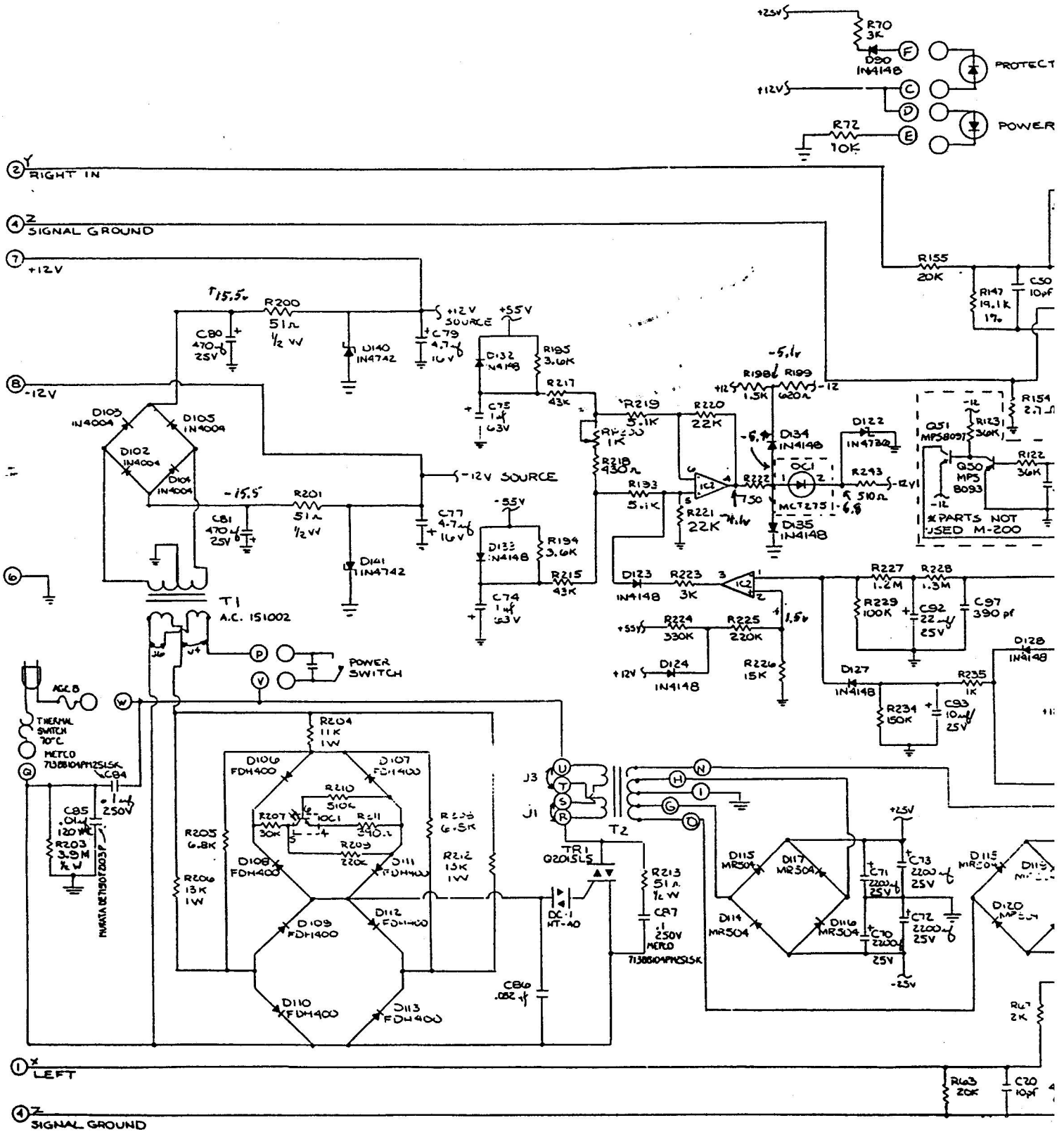
OVER CURRENT TRIP:

should trip immediately when shorted

should limit current to 9 amps

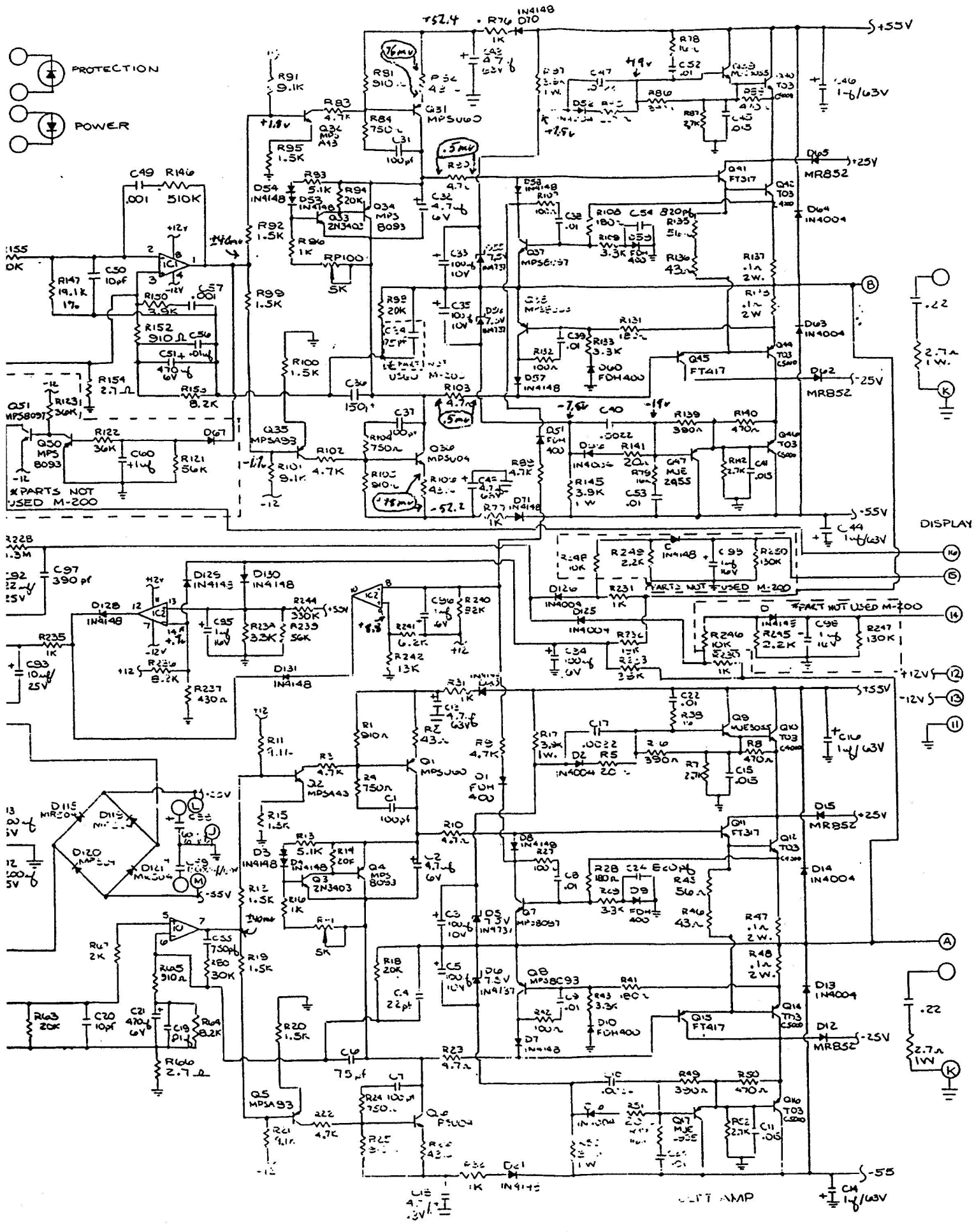
TURN OFF THUMPS --- TURN ON THUMPS

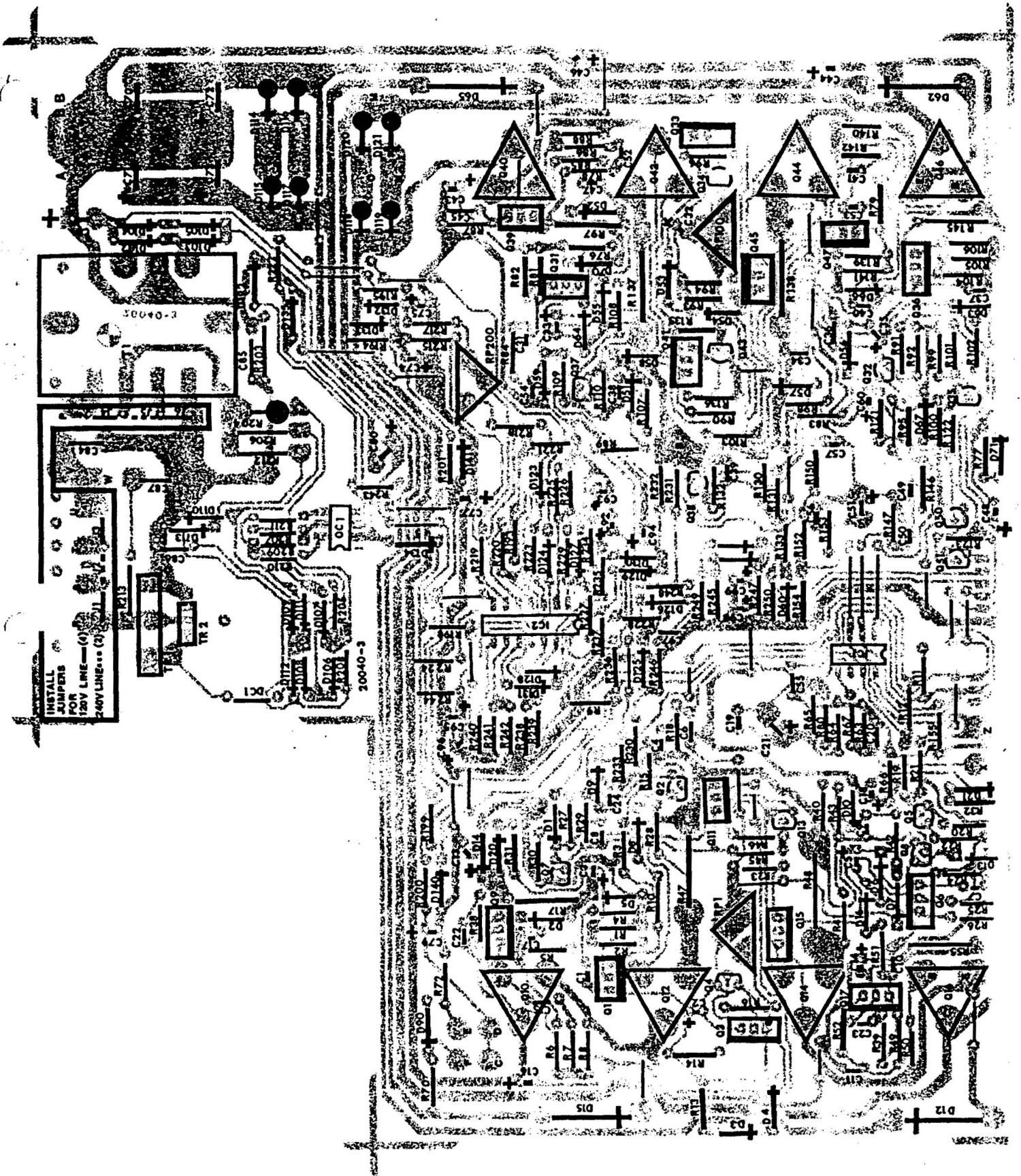
should not exceed 2V peak max.

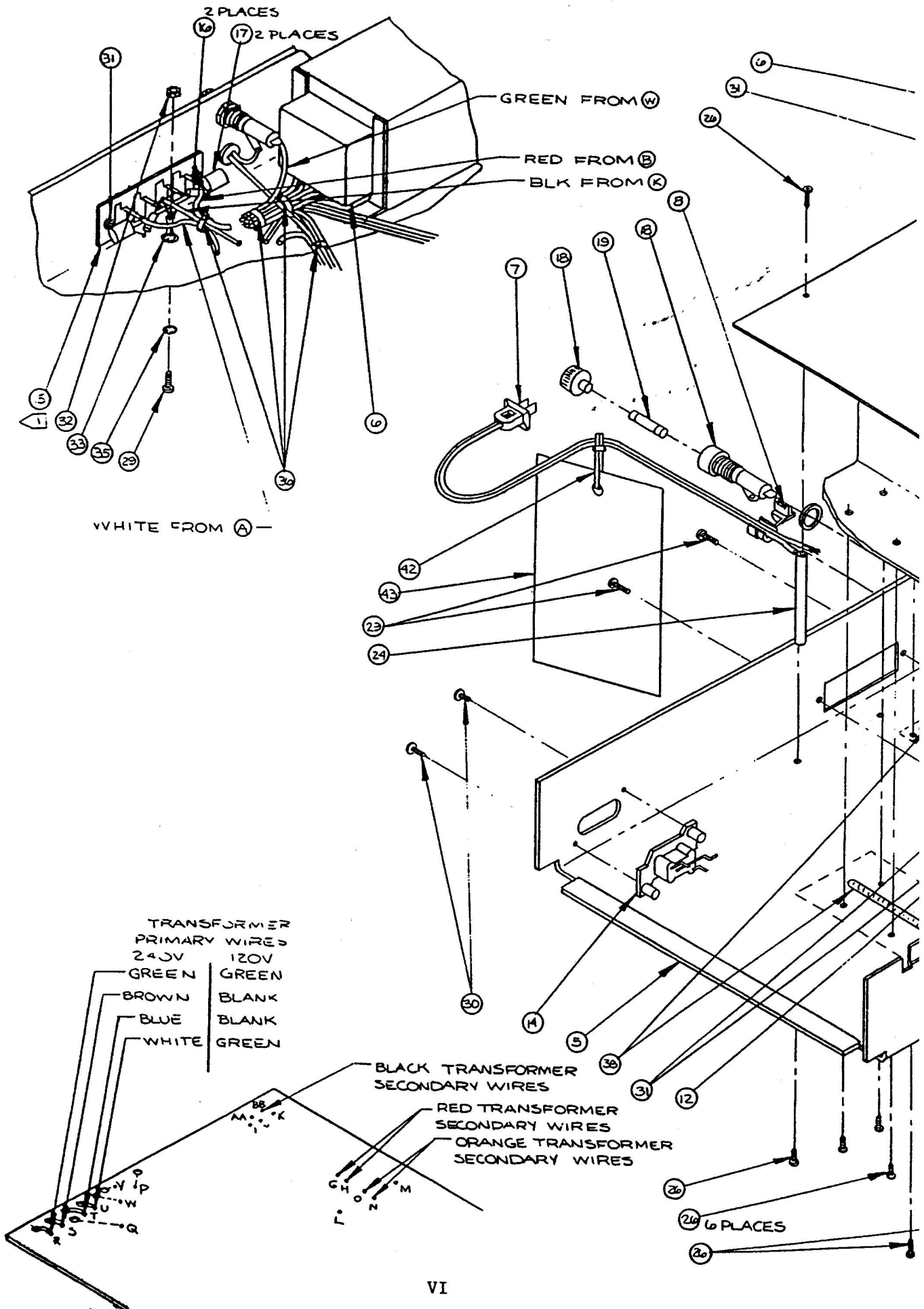


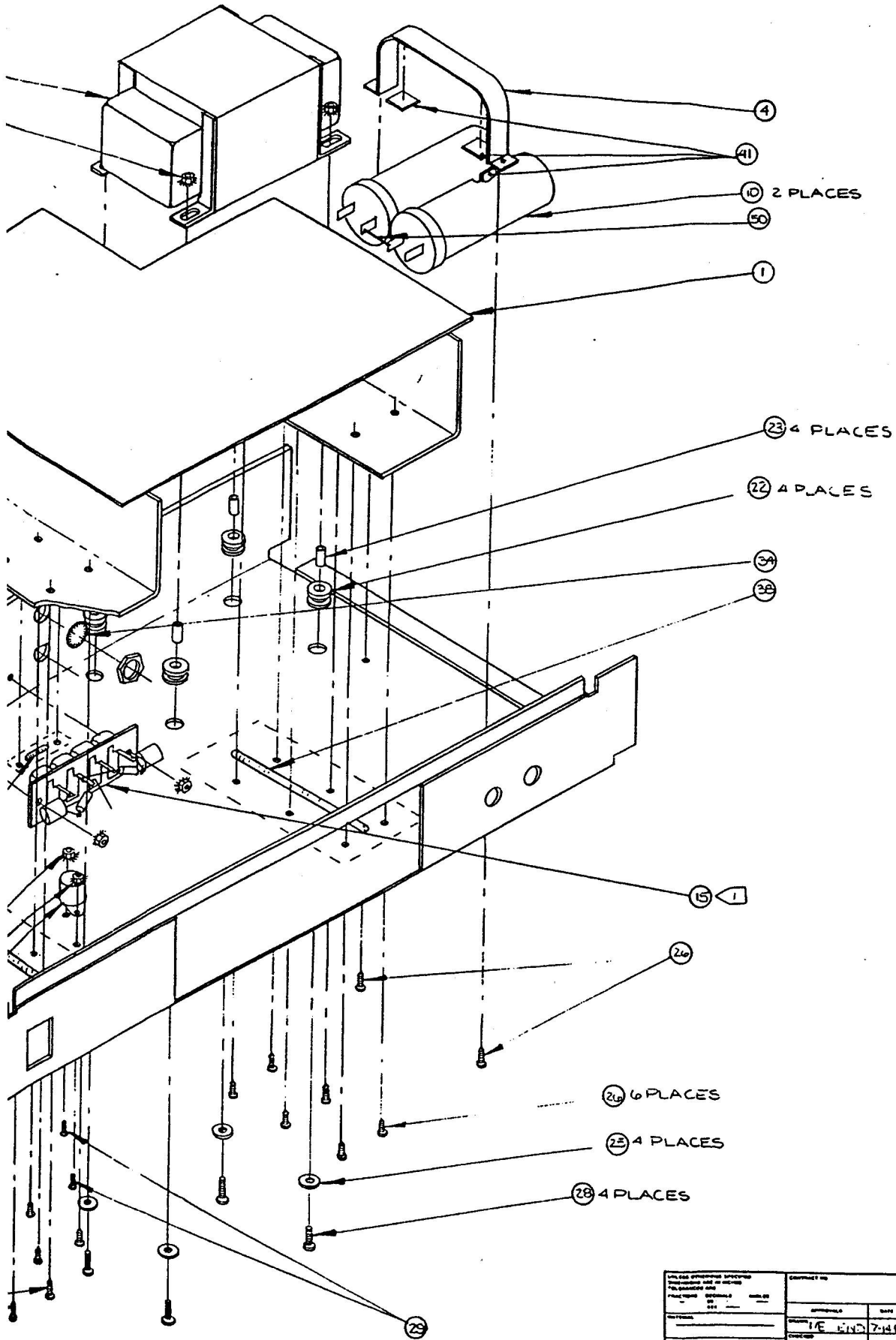
NOTES -
 IC1 IS A TL072.
 IC2 IS A 4136.
 UNLESS OTHERWISE SPECIFIED -
 ALL CAPACITANCE IS IN MICRO-FARADS.
 ALL RESISTORS ARE 1/4W.

CARVER CORPORATION
 M-200t
 ME LENO 4-12-83
 20040-3 REV 3 11 6-30-83









<small> UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS AND DECIMALS TO BE USED AS SHOWN </small>	<small> CONTRACT NO. APPROVALS DATE </small>		CARVER CORPORATION	
	<small> DRAWN BY CHECKED BY DATE </small>		M 200c FINAL ASSY.	
<small> PART NO. REV. DATE </small>	<small> DRAWN BY CHECKED BY DATE </small>	<small> SIZE D </small>	<small> PART NO. 00777 </small>	<small> SHEET 1 OF 2 </small>
<small> DO NOT SCALE DRAWING </small>	<small> SCALE NONE </small>		<small> SHEET 1 OF 2 </small>	

DESCRIPTION OF FIGURES 1 THROUGH 8

Fig. 1 Diac triggering at idle

Fig. 2 Voltage across triac at idle

Fig. 3 Voltage across triac at full power into 8 ohms

Fig. 4 Voltage across C 86 when amp is into shutdown

Fig. 5 Pos. commutator at 1 kHz full power into 8 ohms

Fig. 6 Neg. Commutator at 1 kHz full power into 8 ohms

Fig. 7 Positive commutator at 6 kHz full power into 8 ohms

Fig. 8 Negative commutator at 6 kHz full power into 8 ohms

*NOTE: All primary waveforms must be checked with a floating scope with no secondary ground reference!

**NOTE: All commutator wave forms are measured on the collectors of the appropriate output devices.

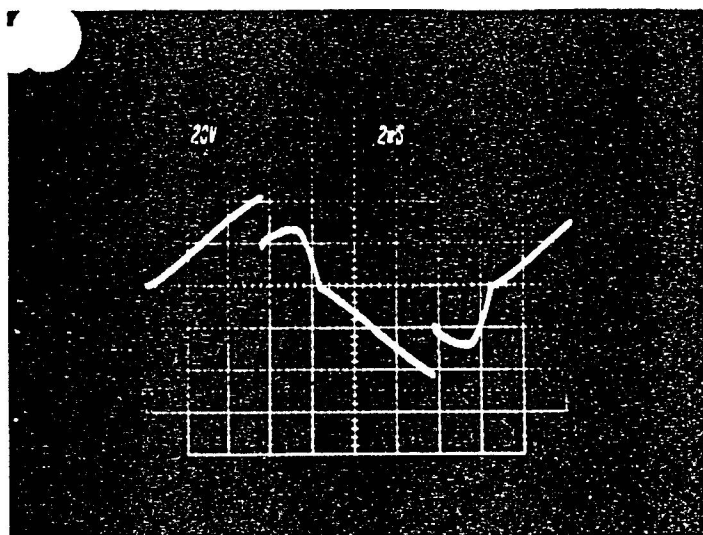


FIG. 1

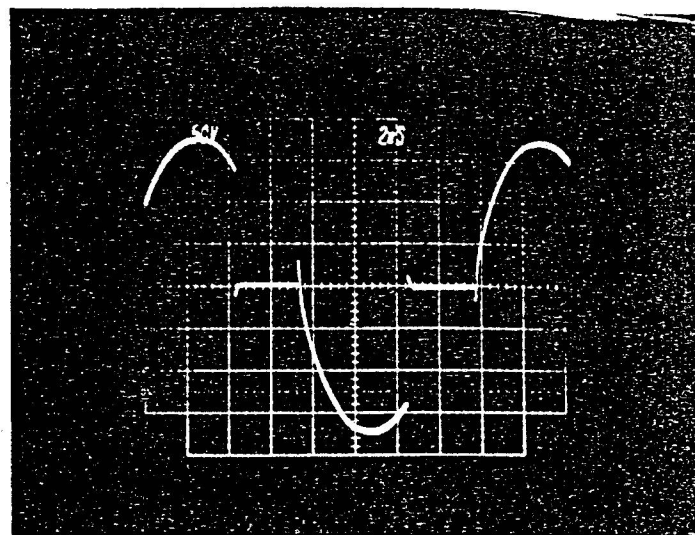


FIG 2

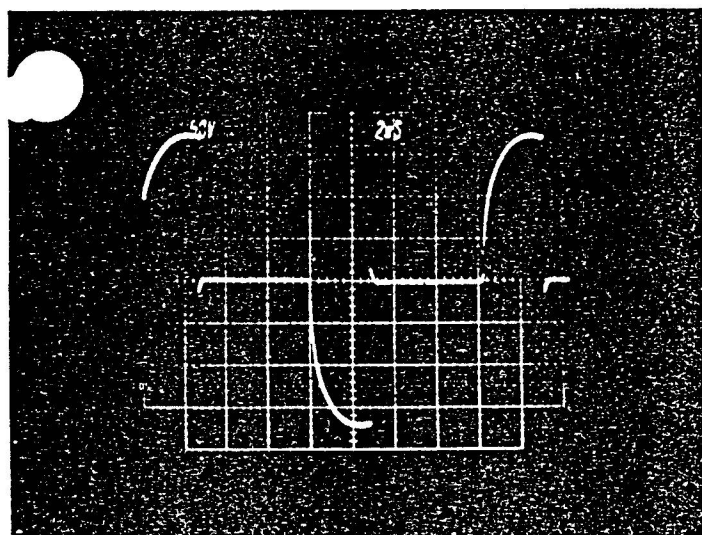


FIG 3

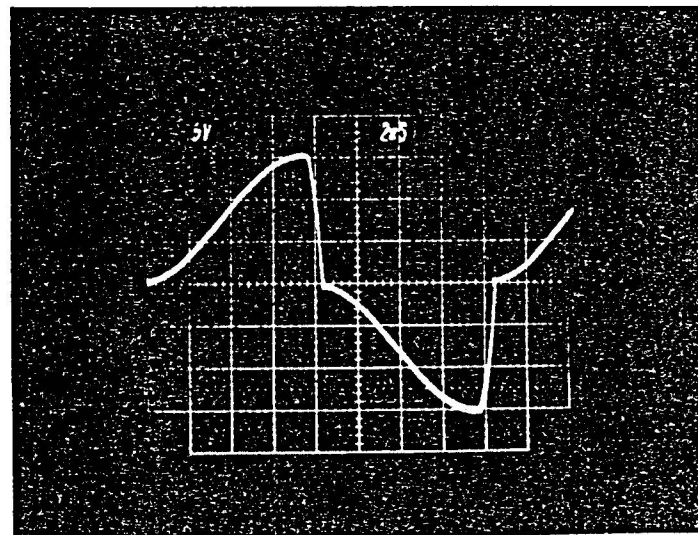


FIG 4

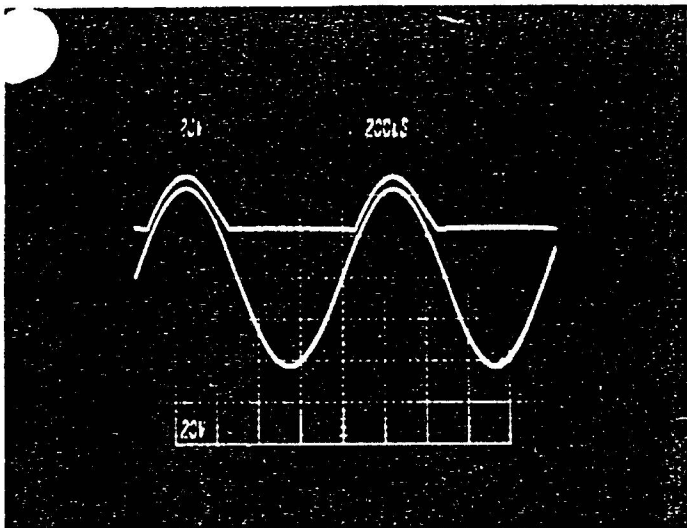


FIG 5

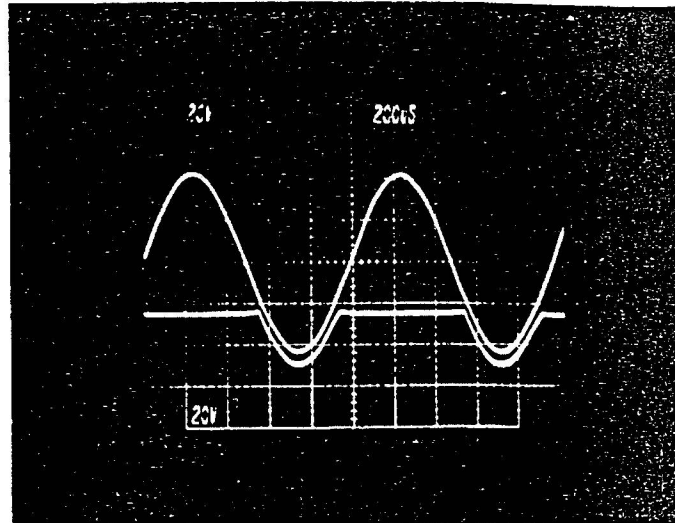


FIG 6

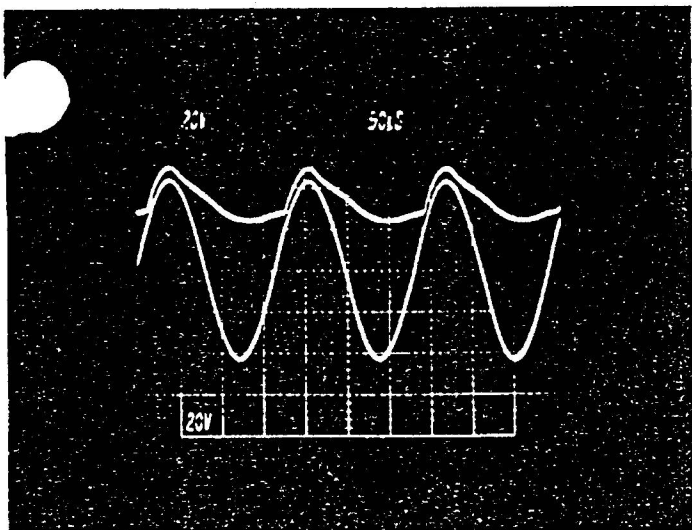


FIG 7

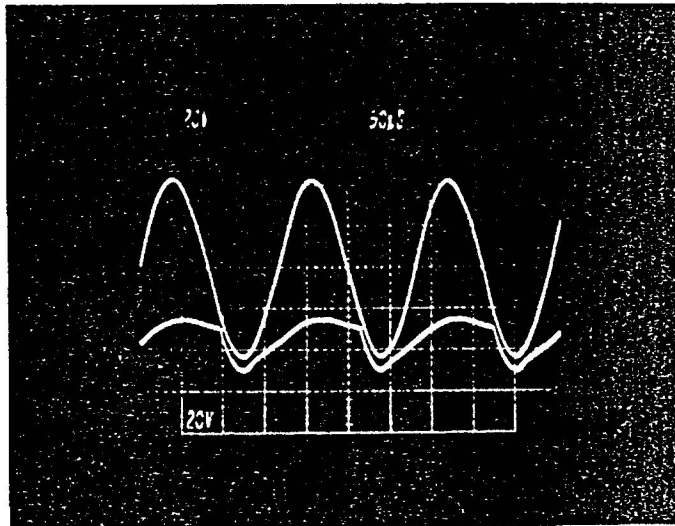
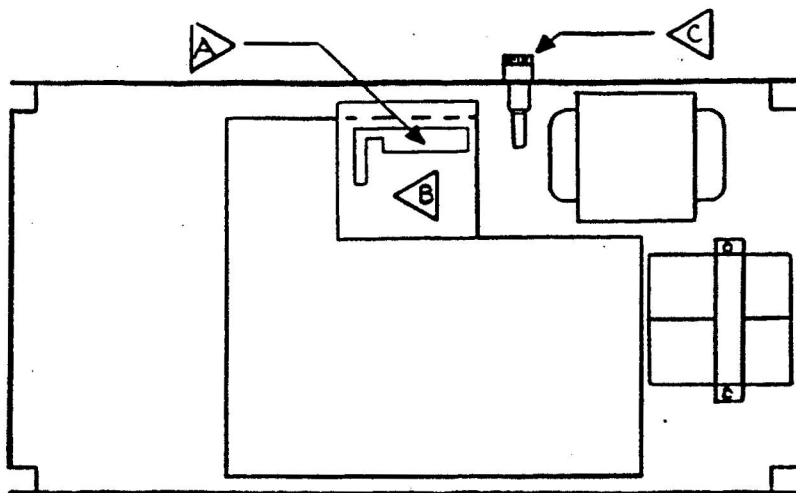






FIG 8







SHOCK HAZARD- DISCONNECT LINE CORD

CONVERSION FOR 120V OPERATION

- 1) LOCATE JUMPER DESIGNATION LABEL ON CIRCUIT SIDE OF PRINTED CIRCUIT BOARD .
- 2) REMOVE RAG PAPER COVERING JUMPERS , SET ASIDE.
- 3) USING JUMPER DESIGNATION LABEL, LOCATE SPECIFIED JUMPERS ON CIRCUIT BOARD. REMOVE JUMPERS J2 AND J5.
- 4) INSTALL JUMPERS J1, J3, J4 AND J6. CAUTION - INCORRECTLY REMOVED OR INSTALLED JUMPERS MAY CREATE SERIOUS SHOCK OR FIRE HAZARD!
- 5) REPLACE RAG PAPER , USING DOW-CORNING 732 RTV SILICONE, OR EQUIVALENT.
- 6) LOCATE FUSE HOLDER MOUNTED IN REAR PANEL . REMOVE ABC 5 FUSE FROM FUSE HOLDER, REPLACE WITH AGC B.
- 7) REMOVE 240V LABEL AND ABC 5 FUSE LABEL FROM REAR PANEL.
- 8) REPLACE TOP COVER.

CONVERSION FOR 240V OPERATION

- 1) LOCATE JUMPER DESIGNATION LABEL ON CIRCUIT SIDE OF PRINTED CIRCUIT BOARD .
- 2) REMOVE RAG PAPER COVERING JUMPERS , SET ASIDE.
- 3) USING JUMPER DESIGNATION LABEL, LOCATE SPECIFIED JUMPERS ON CIRCUIT BOARD. REMOVE JUMPERS J1, J3, J4 AND J6.
- 4) INSTALL JUMPERS J2 AND J5. CAUTION - INCORRECTLY REMOVED OR INSTALLED JUMPERS MAY CREATE SERIOUS SHOCK OR FIRE HAZARD!
- 5) REPLACE RAG PAPER , USING DOW-CORNING 732 RTV SILICONE, OR EQUIVALENT.
- 6) LOCATE FUSE HOLDER MOUNTED IN REAR PANEL . REMOVE AGC B FUSE FROM FUSE HOLDER, REPLACE WITH ABC 5.
- 7) APPLY 240V AND ABC 5 LABELS OVER VOLTAGE AND FUSE LABELS SILK SCREENED ON REAR PANEL.
- 8) REPLACE TOP COVER.

00763-0

M-200t CIRCUIT DESCRIPTION

INTRODUCTION

The M-200t is a magnetic field power amplifier which utilizes unique electronic control as a substitute for large quantities of bulk copper, iron and aluminum which are required by conventional designs. This high degree of electronic control and efficiency is made possible by the M-200t's power supply, which provides power to the amplifiers on demand rather than on a constant basis. This greatly reduces power dissipation in the output devices and reduces the required size of filter capacitors, transformers and heatsinks.

THE POWER SUPPLY

The M-200t utilizes two supplies. A conventional ± 12 volt "house-keeping" supply which drives the Magnetic Field regulator circuitry, the protection circuitry, and the front-end buffer amplifiers for the right and left channel amplifiers. This supply is always active as long as the M-200t is turned on, regardless of the protection circuitry or triac firing angle. The housekeeping supply uses a conventional transformer (T-1) with a split primary for 240V or 110V, 50/60 Hz operation. The power switch interrupts only the primary winding of (T-1). The triac phase control circuitry, which drives the Magnetic Field transformer (T-2), is driven by the voltage developed across one half of the split primary of (T-1). This arrangement makes it possible to maintain a constant voltage for the phase-shift network at 240V or 110V RMS of line and also provides low power switching for the main power supply (T-2). The Magnetic Field Supply provides the main amplifier supply voltages of ± 25 and ± 55 volts.

TRIAC CONTROLLED TRANSFORMER

Using phase controlled triac switching on the split primary of (T-2), makes it possible to obtain full control of load regulation, line regulation, and to turn the supply off during major faults.

This feature allows power to be delivered to the amplifier only as required, and provides a means of full amplifier and speaker protection without excessive or interfering circuitry being added directly in the signal path.

The firing angle of triac TR₁, which controls the power delivered to (T-2), is determined by the variable current source of OC₁. D₁₀₆, D₁₀₇, D₁₀₈, and D₁₁₁ provide voltage "steering" for OC₁ which makes it possible to use the bi-polar device for AC control.

When the voltage on C₈₆ reaches 40 volts, diac DC₁ will trigger (see fig. 1) and fire triac TR₁, which will remain on until zero crossing and then turn off. TR₁ will remain off until DC₁ is again triggered (see fig. 2).

If sufficient current flows through OC₁ to trigger diac DC₁ before or at 90° (see fig. 3), then maximum power will be delivered to the primary of (T-2). If the current through OC₁ is insufficient to charge C₈₆ to 40 volts before zero crossing, then no power will be delivered to the primary of (T-2) (see fig. 4). The normal operating range of TR₁ is demonstrated by figures 2 and 3 which indicate the minimum and maximum firing angles.

Opto-coupler OC₁ is used to provide electrical isolation between the primary and secondary circuits. The current through the LED portion of OC₁ is proportional to the power available to the primary of (T-2).

The network formed by D₁₀₉, D₁₁₀, D₁₁₂, D₁₁₃, R₂₀₆, R₂₀₅, R₂₀₈, and R₂₁₂ is used to prevent hysteresis by pulling the voltage on C₈₆ down after DC₁ has stopped conducting.

THE REGULATOR

Linear supply regulation is maintained by the differential amplifier formed by IC₂ pins 4, 5, and 6. This stage monitors the ±55 volt supply rails. Since the positive supply is fed to the negative port and the negative supply to the positive port, an increase in voltage across RP₂₀₀ and R₂₁₈ will cause the output of the differential amplifier to go negative. This in turn will decrease OC₁ LED current and increase the charge time on C₈₆, reducing (T-2) primary voltage. The inverse will hold true if the supply rails should decrease. RP₂₀₀ is used to adjust the secondary voltage of (T-2).

R_{243} and D_{122} provide a stable reference voltage, other than ground, allowing the output of the differential amplifier to determine OC_1 , LED current without having to level-shift its output.

The network of D_{132} , R_{195} , and C_{75} allows the regulator to rapidly respond to decreases in positive rail voltage while slowing its response to rail voltage increase. D_{133} , R_{194} , and C_{74} perform the same function for the negative rail. This action improves the stability of the regulator.

PROTECTION CIRCUITS

Full active shutdown is provided for the following faults:

1) over current; 2) excessive high frequency; 3) D-C offset - subsonic frequency; 4) over voltage; 5) integrator shutdown; 6) ± 12 volt supply failure.

All shutdown conditions (except ± 12 volt supply failures) are sensed by the comparator formed by IC_2 pins 1, 2, and 3. Under normal operation, the reference voltage on pin 2 is 1.5 volts (divided down from the positive 55 volt rail via R_{224} , R_{225} , R_{226}). After shutdown has occurred, D_{124} becomes forward biased and the reference voltage becomes .8 volts (divided down from the positive 12 volt supply via R_{225} and R_{226}). When the voltage on pin 1 exceeds that on pin 2, then the output of pin 3 will go negative and forward bias D_{123} . This in turn will cause the output of IC_2 pin 4 to go negative which will reverse-bias the LED portion of OC_1 and turn the Magnetic Field Supply (T-2) off.

THE SHUTDOWN SENSORS OPERATE AS FOLLOWS

1) Over Current Shutdown - Operation of the positive current limiters is sensed by IC_2 pins 8, 9, and 10. Under normal operation D_1 and D_{51} are reverse biased and there is no current flow through R_{240} . With no current flowing through R_{240} , the voltage on pin 8 will be twelve volts. If limiter transistors Q_{37} or Q_7 are turned on, then current will flow through R_{240} , pulling the voltage on pin 9 below 8.4 volts. This will forward bias D_{131} and D_{127} , driving IC_2 pin 1 positive, and shut the main supply off.

*NOTE: The R.C. network of R_{234} and C_{93} , prevents false triggering and determines the sample rate of the shutdown cycle.

2) High Frequency Protection - This feature prevents common mode conduction at the clip point at high frequencies and prevents ultrasonic oscillations from damaging speakers. Under normal operation D_{59} and D_9 prevent the positive current limiters from turning on during negative audio excursions. Bypassing D_{59} and D_9 with C_{54} and C_{24} allows abnormally high frequencies to turn the positive limiters on during negative excursions. This will initiate the same shutdown cycle as over-current.

3) DC Offset - Subsonic Frequency Protection - The output of the right and left channels is summed via R_{232} and R_{233} . These resistors have different values so that shutdown will occur even if right and left channels offset in opposite directions at the same potential (i.e. R.Ch. +6, L.Ch. -6). C_{94} rolls off all audio frequencies and allows only DC offset or subsonic frequencies to reach the shut-down sensor. DC offset is sensed by IC_2 pins 12, 13, and 14. A positive .6 volt reference on pin 14 holds the output of the comparator at -10.4 volts during normal operation. Negative offset will pull pin 14 low via D_{129} and positive offset will drive pin 13 positive via D_{130} . Either condition will drive pin 12 positive, forward biasing D_{128} and D_{127} , driving IC_2 pin 1 positive, and turn the main supply off.

4) Over-voltage Protection - Since (T-2) secondary voltage is determined by an active regulator, it is necessary to protect supply capacitors and amplifier circuitry against regulation failure. The comparator formed by IC_2 pins 12, 13, and 14 samples a portion of the positive 55 volt supply which has been divided down by R_{244} , R_{239} , and R_{243} . C_{95} prevents transient or false triggering. If the voltage on pin 13 exceeds the .6 volt reference voltage on pin 14, then pin 12 will go positive, forward biasing D_{128} and D_{127} , and drive IC_2 pin 1 positive, turning the main supply off.

5) Integrator Shutdown Protection - The output of the right and left channels is summed and rectified by D_{126} and D_{125} . This voltage is integrated by the R.C. network formed by C_{97} , R_{228} , C_{92} , and R_{227} . If the long term power output exceeds 78 watts (25 VRMS) for an excessive period of time, then abnormally low dynamic content and/or excessive clipping are indicated. Both of these conditions are very hard on speaker systems. If the power level fails to drop below 78 watts

This manual is provided free, courtesy of CARVERaudio.com over a reasonable length of time, then IC₂ pin 1 will exceed the 1.5 volt reference on pin 2 and turn the main supply off. When pin 1 drops below the standby reference of .8 volts, then the amp will restart.

6) ± 12 Volt Supply Failure Protection - All of the shutdown modes that have been discussed so far have depended on the correct operation of comparators that require a ± 12 volt supply. Therefore it is necessary to provide a means of turning (T-2) off during ± 12 volt supply failures that are independent of the operation of the analog logic formed by IC₂.

Positive 12 volt supply failure protection is achieved by the network formed by R₁₉₈, R₁₉₉, and D₁₃₄. During normal operation D₁₃₄ is reverse biased and the network has no effect on regulation. If, however, the positive 12 volt supply should fail, then D₁₃₄ is forward biased, which in turn will reverse bias OC₁ LED and turn (T-2) off.

If the -12 volt supply should fail, then IC₂ pin 4 will go positive. This will forward bias D₁₃₅ and claim the voltage on OC₁ pin 1 at positive .6 volts. Since the negative 12 volt supply is absent, OC₁ pin 2 is about zero volts. This condition limits the current through the OC₁ LED and turns (T-2) off.

Although the supply tracking transistors or commutators are actually part of the power supply, they will be discussed in the amplifier section as their operation is closely related to the audio signal.

AMPLIFIER CIRCUITS

For this discussion we will be looking at the non-inverting left channel with mention of the inverting right channel only when specific differences apply. Each channel of the M-200t uses one half of a TL072 operational amplifier as an input buffer for low noise and distortion. The right channel input feeds an inverting or negative port, and the left channel input feeds a noninverting or positive port.

The output of the left channel input buffer drives a pair of DC level shifters, Q₂ and Q₅, which reference the audio to the two top DC supply rails. These two devices also operate as a current source which provides the DC biasing current necessary to operate subsequent stages in a low distortion class AB configuration.

The output of the DC level shifter drives a class AB common emitter stage (Q₁ and Q₆) which provides the necessary voltage gain and pre-driver current.

The bias network of Q_3 and Q_4 has two basic functions. Being located between the base of driver Q_{11} and the base of driver Q_{15} , it sets up the VBE of the drivers and outputs (Q_{12} and Q_{14}). This determines the DC idle current through the outputs. The idle current is adjusted with RP_1 (RP_{100} in the right channel). Q_3 is mounted on the heatsink and provides thermal feedback to prevent output current drift with temperature change. D_3 and D_4 track local ambient temperature change to improve the stability of the stage.

The pre-drive stage of Q_1 and Q_6 provides full output swing to drivers Q_{11} and Q_{15} . This driver stage provides the necessary current gain to drive the output devices Q_{12} and Q_{14} , which in turn provide full voltage swing and current to the load.

Q_{13} is located between the bases of output devices Q_{12} and Q_{14} . Its purpose is to help prevent common mode conduction and to decrease the turn-off time of the output devices. It operates by lowering its impedance as the difference between the two bases increase.

The current through the outputs is monitored by sampling the voltage drop across emitter resistors R_{47} and R_{48} . We will look at only the positive limiter circuit. As the current through Q_{12} increases, the voltage across R_{47} also increases. The emitter-base junction of limiter transistor Q_7 is located across this resistor and when the voltage drop reaches about .9 volts, Q_7 begins to conduct and diverts current away from the base of driver Q_{11} . D_8 allows only the positive signal component to be fed to limiter transistor Q_7 . When Q_7 conducts, D_1 is forward biased and sends a trip signal to the over current shutdown sensor.

Normally, outputs Q_{12} and Q_{14} operate off of a $\pm 25V$ supply, however this rail voltage may be increased to $\pm 55V$ on demand. Commutation transistors Q_{10} and Q_{16} allow the supply voltage to "track" the audio between ± 25 and ± 55 volts. We will look at only the positive commutator circuit. The output signal of the amplifier is bootstrapped via C_3 and D_5 to the base of Q_9 which provides the necessary current gain for commutator Q_{10} . D_5 sets up a constant bootstrap voltage and determines the amount of lead voltage the commutator has over the output signal (see fig. 5 and fig. 6). The network formed by C_{17} , D_2 , and R_5 blocks the bias voltage on the base of Q_9 from the bootstrap network and provides additional voltage lead at higher frequencies (see fig. 7 and fig. 8).

MISCELLANEOUS

D_{20} , R_{31} , and C_{13} filter supply noise from the +55 volt supply to reduce noise in the predrivers.

The output pole of C_{12} and R_{53} operates as an ultra-sonic output filter and phase compensator.

Overall negative feedback is provided to the negative port of the input buffer via R_{18} . The amount of feedback is determined by R_{18} , R_{65} , C_{21} and R_{64} . In the right channel the feedback is determined by R_{98} , R_{153} , C_{51} , R_{152} , and R_{147} .

The front panel of the M-200t has a power on/off switch, a power indicator LED and a fault LED which indicates when the supply i into protection.

The amplifier may be operated in stereo or bridged for mono operation, with no special adaptor. Minimum recommended impedance of 4 ohms nominal for stereo and 8 ohms nominal for bridged mode.

The amplifier is protected with an eight amp AGC fuse and 70°C thermal breaker both in series with the line.

M-200t TEST PROCEDURE

1. INSPECT AMP FOR GROSS WIRING ERRORS AND POOR SOLDER ON PCB.
2. SET RP1 AND RP100 BIAS CONTROLS FOR MINIMUM IDLE CURRENT.
SET RP200 FOR MINIMUM SECONDARY VOLTAGE.
3. BRING VARIAC UP SLOWLY UNTIL TRIAC FIRES (approximately 87V line).
POWER LED WILL LIGHT.
 - A) Check for excessive current draw.
 - B) Make sure both channels pass a signal (1V rms).
 - C) Rails should be about (± 25 , ± 9.5 , ± 11.5).
4. INCREASE LINE TO 120V AC.
 - A) Check for excessive current draw.
 - B) Fault LED should be off.
 - C) Both channels pass a clean 2 kHz, 1V rms signal with small crossover notch.
 - D) Rails should be about (± 30 , ± 11 , ± 12.5).
5. SET TOP DC RAIL TO $\pm 56.0V$ (middle rail should be approximately $\pm 25V$).
6. ADJUST IDLE CURRENT.
 - A) Adjust RP1 for (3.0 mV " ± 0.5 mV" across R47) with loads out.
This will set the left channel (idle current at 25 \rightarrow 35 mA).
 - B) Repeat step "A" for RP100 on right channel. Measure across R137.
 - C) Engage loads.
7. CHECK TRIAC FIRING FOR GOOD SYMMETRY. [Fig. 2]
8. CHECK BOTH CHANNELS @ 1 kHz FULL POWER @ 3V rms (128W) @ 120V line.
 - A) Verify symmetrical clipping.
 - B) Check commutators [Fig. 5 & 6].
 - C) Check distortion (.05% A-weighted) @ 2 kHz full power.
9. CHECK POWER BAND-WIDTH (@ full 120V line).
 - A) Verify 32V rms @ 20 Hz for 4 sec. without taking fuse.
 - B) Verify 32V rms @ 20 kHz.

10. CHECK HIGH-FREQUENCY TRIP

- A) Check both channels independently.
- B) Trips into clipping @ 20 kHz.
- C) Trips before clipping @ 30 kHz (25V → 26V).

11. CHECK LOW-FREQUENCY TRIP

- A) Check both channels independently.
- B) Right channel should trip @ (4 Hz @ the clip point).
Right channel (should not trip @ 7 Hz).
- C) Left channel should trip @ (2 Hz @ the clip point).
Left channel should not trip @ 4 Hz.
- D) If generator will not operate @ low frequencies, then 3 -6V dc may be used @ the input.

12. OVER CURRENT TRIP

- A) Drive both channels @ 1 kHz approximately 20V rms.
- B) Short left channel and observe shutdown.
- C) Short right channel and observe shutdown.

13. INTEGRATOR SHUTDOWN

- A) Drive both channels @ 6 kHz, 32 rms.
- B) Check commutators [Figs. 7 & 8].
- C) Verify shutdown in approximately 50 sec.
- D) Engage - 20 dB SW and verify restart in approximately 20 sec (± 20%).
- E) *Release -20 dB SW.

14. FREQUENCY RESPONSE

- A) Drive both channels @ a +20 dBm ref. @ 2 kHz.
- B) Left channel (-0.2 dB @ 20 Hz), (-0.2 dB @ 30 kHz).
- C) Right channel (-0.2 dB @ 20 Hz), (-0.5 dB @ 20 kHz).
- D) Both channels should be within 0.5 dB of each other @ 2 kHz.

15. NOISE

- A) Shorted input - should be less than 0.8 mV.

16. CHECK OVER VOLTAGE TRIP

- A) Approximately 65V ±2V on top dc rail.
- B) Be sure to reset rail to 56.0 after test.

17. CHECK TURN-OFF THUMPS (1V rms output into 8 ohms)

- A) Left channel ±2V peak.
- B) Right channel ±2V peak.

PARTS LIST

PART	ASSY DESCRIPTION
601-00176-00	ASSEMBLY, PCB M-200 110V
201-00002-00	CAP CERAMIC DISC 10PF 10% 1000V
201-00004-00	CAP CERAMIC DISC 22PF 10% 1000V
201-00010-00	CAP CERAMIC DISC 75PF 10% 1000V
201-00012-00	CAP CER DISC 100PF 10% 1000V
201-00015-00	CAP CER DISC 150PF 10% 1000V
201-00022-00	CAP CER DISC 390PF 10% 1000V
201-00027-00	CAP CER DISC 750PF 10% 1000V
201-00028-00	CAP CER DISC 820PF 10% 1000V
201-00035-00	CAP CER DISC .01UF 125V UL APR
204-00003-00	CAP MYLAR .001UF
204-00007-00	CAP MYLAR .0022UF
204-00015-00	CAP MYLAR .01UF
204-00017-00	CAP MYLAR .015UF
204-00026-00	CAP MYLAR .082UF
205-00001-00	CAP ELECTROLYTIC 1UF 50V RAD
205-00005-00	A CAP LYTIC 4.7UF 35V RADIAL
205-00008-00	CAP LYTIC 4.7UF 63V RADIAL
205-00010-00	CAP LYTIC 10UF 35V RADIAL
205-00012-00	CAP LYTIC 22UF 35V RADIAL
205-00015-00	CAP LYTIC 100UF 10V RADIAL
205-00019-00	CAP LYTIC 470UF 6.3V RADIAL
205-00027-00	CAP LYTIC 2200UF 25V RADIAL
205-00032-00	CAP ELECTROLYTIC 1UF 63V RAD
205-00035-00	CAP LYTIC 100UF 6.3V RADIAL
205-00036-00	CAP LYTIC 470UF 25V RADIAL

PARTS LIST - con't

PART	ASSY DESCRIPTION
207-10003-00	CAP MET POLY .1UF 250V 20% RAD
251-00008-00	RES CFILM 2.7 OHM 1/4W PREP .4
251-00014-00	RES CFILM 4.7 OHM 1/4W PREP .4
251-00027-00	RES CFILM 16 OHM 1/4W PREP .4
251-00029-00	RES CFILM 20 OHM 1/4W PREP .4
251-00037-00	RES CFILM 43 OHM 1/4W PREP .4
251-00040-00	RES CFILM 56 OHM 1/4W PREP .4
251-00046-00	RES CFILM 100 OHM 1/4W PREP .4
251-00052-00	RES CFILM 180 OHM 1/4W PREP .4
251-00060-00	RES CFILM 390 OHM 1/4W PREP .4
251-00061-00	RES CFILM 430 OHM 1/4W PREP .4
251-00062-00	RES CFILM 470 OHM 1/4W PREP .4
251-00063-00	RES CFILM 510 OHM 1/4W PREP .4
251-00065-00	RES CFILM 620 OHM 1/4W PREP .4
251-00067-00	RES CFILM 750 OHM 1/4W PREP .4
251-00069-00	RES CFILM 910 OHM 1/4W PREP .4
251-00070-00	A RES CFILM 1 K 1/4W PREP .4
251-00074-00	RES CFILM 1.5 K 1/4W PREP .4
251-00077-00	RES CFILM 2 K 1/4W PREP .4
251-00080-00	RES CFILM 2.7 K 1/4W PREP .4
251-00081-00	RES CFILM 3 K 1/4W PREP .4
251-00082-00	RES CFILM 3.3 K 1/4W PREP .4
251-00083-00	RES CFILM 3.6 K 1/4W PREP .4
251-00084-01	RES CFILM 3.9 K 1/4W PREP .5
251-00086-00	A RES CFILM 4.7 K 1/4W PREP .4
251-00087-00	A RES CFILM 4.1 K 1/4W PREP .4

PARTS LIST - con't

PART	ASSY DESCRIPTION
251-00089-00	RES CFILM 6.2 K 1/4W PREP .4
251-00090-00	RES CFILM 6.8 K 1/4W PREP .4
251-00092-00	RES CFILM 8.2 K 1/4W PREP .4
251-00093-00	RES CFILM 9.1 K 1/4W PREP .4
251-00094-00	RES CFILM 10 K 1/4W PREP .4
251-00097-00	RES CFILM 13 K 1/4W PREP .4
251-00098-00	RES CFILM 15 K 1/4W PREP .4
251-00100-00	RES CFILM 18 K 1/4W PREP .4
251-00101-00	A RES CFILM 20 K 1/4W PREP .4
251-00102-00	A RES CFILM 22 K 1/4W PREP .4
251-00105-00	RES CFILM 30 K 1/4W PREP .4
251-00108-00	RES CFILM 39 K 1/4W PREP .4
251-00109-00	RES CFILM 43 K 1/4W PREP .4
251-00112-00	RES CFILM 56 K 1/4W PREP .4
251-00116-00	RES CFILM 82 K 1/4W PREP .4
251-00118-00	RES CFILM 100 K 1/4W PREP .4
251-00122-00	RES CFILM 150 K 1/4W PREP .4
251-00126-00	RES CFILM 220 K 1/4W PREP .4
251-00130-00	RES CFILM 330 K 1/4W PREP .4
251-00135-00	RES CFILM 510 K 1/4W PREP .4
251-00144-00	RES CFILM 1.2 M 1/4W PREP .4
251-00145-00	RES CFILM 1.3 M 1/4W PREP .4
251-10039-00	RES CFILM 51 OHM 1/2W PREP .5
251-10156-00	RES CFILM 3.9 M 1/2W PREP .5
252-00412-00	RES CFILM 19.1K 1/4W 1% PREP .4
253-20001-00	RES WIRE WOUND .1 OHM 2W

PARTS LIST - con't

PART	ASSY DESCRIPTION
255-10118-00	RES MET OXIDE 3.9 K 1W
255-10129-00	RES MET OXIDE 11 K 1W
255-10131-00	RES MET OXIDE 13 K 1W
259-20001-00	TRIM POT 1 K PCB MOUNT
259-20003-00	TRIM POT 5 K PCB MOUNT
319-00001-00	DIAC 40V 1/8 WATT
320-20001-00	A DIODE PIV 75V 700 MA PREP
320-20004-00	A DIODE PIV 400V 1 AMP PREP
320-20005-03	DIODE PIV 400V 3 AMP UNPREP
320-20006-00	A DIODE PIV 400V 700 MA PREP
320-20007-03	DIODE PIV 200 FRT 3 AMP UNPREP
320-30001-00	DIODE ZENER 12V 1 WATT PREP
320-30004-00	DIODE ZENER 6.8V 1 WATT PREP
320-30005-00	DIODE ZENER 7.5V 1 WATT PREP
321-20000-00	XISTOR 202 NPN POWER MPS U04
321-20002-00	XISTOR 202 PNP POWER MPS U60
321-40000-00	XISTOR T092 NPN SM SG MPS 8097
321-40001-00	XISTOR T092 NPN SM SG MPS A43
321-40003-00	XISTOR T092 PMP SM SG MPS 8093
321-40004-00	XISTOR T092 PMP SM SG MPS A93
321-60000-00	XISTOR T0220 NPN POWER MJE3055
321-60001-00	XISTOR T0220 NPN POWER FT317B
321-60002-00	XISTOR T0220 PMP POWER MJE2955
321-60003-00	XISTOR T0220 PMP POWER FT417B
330-30001-00	IC DUAL OP AMP BIFET (TL072)
330-30003-00	A IC QUAD OP AMP (4136)

PARTS LIST - con't

PART	ASSY DESCRIPTION
330-40002-00	OPTOISOLATOR PHOTOTRANS.MCT275
501-00176-00	PCB MAIN M-200
602-00176-00	ASSEMBLY, TU M-200 110V
319-00050-00	TRIAC TO220 15 AMP 200 V
320-40001-00	A LED, RED
511-00002-00	HEATSINK TRIAC FAB M-200
601-00176-00	A ASSEMBLY, PCB M-200 110V
617-10007-00	TRANSFORMER 110V C-9
604-00081-00	ASSEMBLY, FINAL M-200 110V
101-30001-00	BUMPS, RUBBER ROUND MEDIUM
105-40002-00	FUSEHOLDER PANEL MNT DOMESTIC
106-30002-00	GROMMET, GUM
108-00001-00	INSULATOR MICA TO3
109-10002-00	PHONO JACK DUAL PC MOUNT
111-20051-00	SOLDER LUG #6
118-50002-00	TRANSISTOR SOCKET TO3 PCB MNT
118-90005-00	STRN RE MCT.100 WS.15X.28 18/2
119-20004-00	TERMINAL STRIP, SPEAKER 4 POS.
159-50001-00	A TYRAP 3 3/8"L WHT
204-00030-00	CAP MYLAR .22UF
205-00031-00	CAP FILTER (LYTIC) 6000/60V
253-20025-00	RES WIRE WOUND 2.7 OHM 2W
315-10509-00	FUSE AGC 8
318-50001-00	SWITCH THERMAL 70 DEG C
321-30003-00	XISTOR TO3 NPN POWER C 4000
321-30007-00	XISTOR TO3 PNP POWER C 5000
321-50000-00	XISTOR TO98 W/TAP SM SG 2N3403

PARTS LIST - con't

PART	ASSY DESCRIPTION
401-90001-00	LINECORD 18 GAGE 2 WIRE SPT 2
507-00007-00	BRACKET, 6000UF 60V CAP MNT, FAB
511-00003-00	HEATSINK TRANSISTOR FAB M-200
617-10009-00	TRANSFORMER 110V M-200T
607-00081-00	ASSY, BUTTON UP M-200 GRAY 110V
318-20001-00	SWITCH ROCKER SPDT BLK
503-40006-01	A PANEL FRONT SCREEN M-200 GRAY
504-20009-01	A COVER TOP PAINT BLK M-200
512-00202-03	STANDOFF 1/4ODX.109IDX2 1/8NYL
532-20012-00	BOX M-200
532-30009-00	FOAM END BLOCK (M-200)
990-00003-00	CAR, WARRANTY REGISTRATION
990-00004-00	CARD, LIMITED WARRANTY
990-20010-00	MANUAL M-200