

CARVER

M240

Mobile Magnetic Field Amplifier

SERVICE MANUAL

WARNING

Any person performing the procedures described in this manual will be exposed to hazardous voltages and risk of electric shock.

Carver Corporation assumes that any person who removes the cover from the unit has been properly trained in protecting against avoidable injury. Therefore, the procedures described herein are to be performed by qualified electronics service personnel only.

Specifications

Power Output Stereo Mode: (continuous RMS power output per channel, both channels driven, at 13.8 VDC input)	120 W into 4 Ω ohms 20 Hz to 20 kHz, with no more than 0.15% THD (switcher noise removed)
Power Output Bridged Mono Mode: (Referenced to 13.8 VDC input)	150 W, into 4 Ω 240 W, into 8 Ω 20 Hz to 20 kHz, with no more than 0.15% THD
Signal to Noise Ratio: (Referenced to 120 W, A weighted into 4 Ω)	Greater than 100 dB
Frequency Response:	20 Hz - 20 kHz
Input Sensitivity:	250 mV - 4 V
Input Level Control Attenuation Range:	13 dB
Subsonic Filter:	-3 dB at 15 Hz
Crossover:	115 Hz, 18 dB/octave
DC Power Supply Voltage:	11 - 15 V
Fuse:	20 A chassis mount
Dimensions (w x h x d)	12.45" x 6.0" x 2.3"
Protection Circuits:	Output Short Circuit Internal Fault DC Offset High Frequency
Input Impedance: Low level in High level in	10 k Ω 1.3 k Ω

CARVER CORPORATION
SERVICE BULLETIN

Service Bulletin # M-240-2

Model M-240

Serial #

Reason: Parts MJE4340 and MJE4350 are no longer available.

Procedure: If these transistors need to be replaced:

Replace Q207, Q307 MJE4340 with TIP35B transistors.

Replace Q206, Q306 MJE4350 with TIP36B transistors.

Delete:

Qty-2 321-80001-00
MJE4340

Qty-2 321-80002-00
MJE4350

Add:

Qty-2 321-80000-00
TIP35B

Qty-2 321-80003-00
TIP36B

SERVICE APPROVAL _____
ENGINEERING APPROVAL _____

2/19/87

DATE

M240 Mobile Magnetic Field Amplifier

Service Manual

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Introduction

This manual is designed to provide qualified service personnel with all of the technical information needed to test and to repair malfunctioning M240 Mobile Magnetic Field Amplifiers.

The rationale behind the design of this manual is that experienced service personnel are better served by detailed technical information, rather than by step-by-step fault isolation procedures, which may or may not apply in any given situation. As such, this manual describes the theoretical operation of the unit, then lists a series of performance verification tests.

Further background information is provided in the form of service bulletins, parts lists, mechanical assembly instructions, and supporting illustrations.

This manual is a companion document to the Carver Car Amplifier M240 *Owner's Manual*. Refer to the *Owner's Manual* for detailed

information and recommendations for installing the M240 amplifier.

Technical Description

The M240 Mobile Magnetic Field Amplifier consists of five basic circuit elements:

- Input Buffers and Crossover Filters
- Input Muting and Protection Circuits
- Audio Power Amplifiers
- Power Supply Commutating Circuits
- 20 kHz Pulse Width Modulating Switching Supply

Input Buffers and Crossover Filters

The input buffers and crossover filters are described in detail in the following paragraphs.

Input Sensitivity

The M240 accommodates both high- and low-level inputs ranging between 240 mV and 4 V. The Hi-Level Select Switch on the front panel controls the type of input. Press the switch in for high level inputs; leave the switch out for low level inputs.

The input sensitivity of the M240 amplifier is further controlled by two potentiometers. RP1 controls the sensitivity of both high- and low-level inputs to the left channel; RP2 controls the sensitivity of both inputs to the right channel. Sensitivity can be adjusted over a range of 13 dB.

Input Buffers

Both left and right inputs pass through buffers with infrasonic filters (-3 dB point at 15 Hz). The buffered output is at U1-12 for the left channel and

U2-12 for the right channel. During normal operation, the outputs from the input buffers drive the internal power amplifiers.

Crossover Filters

A built-in crossover network allows for the use of additional amplifiers at different frequencies in Biamplication applications. The filter network consists of high- and low-pass filters with a crossover frequency of 115 Hz, 18 dB/octave. The crossover frequency is illustrated in Figure 3.

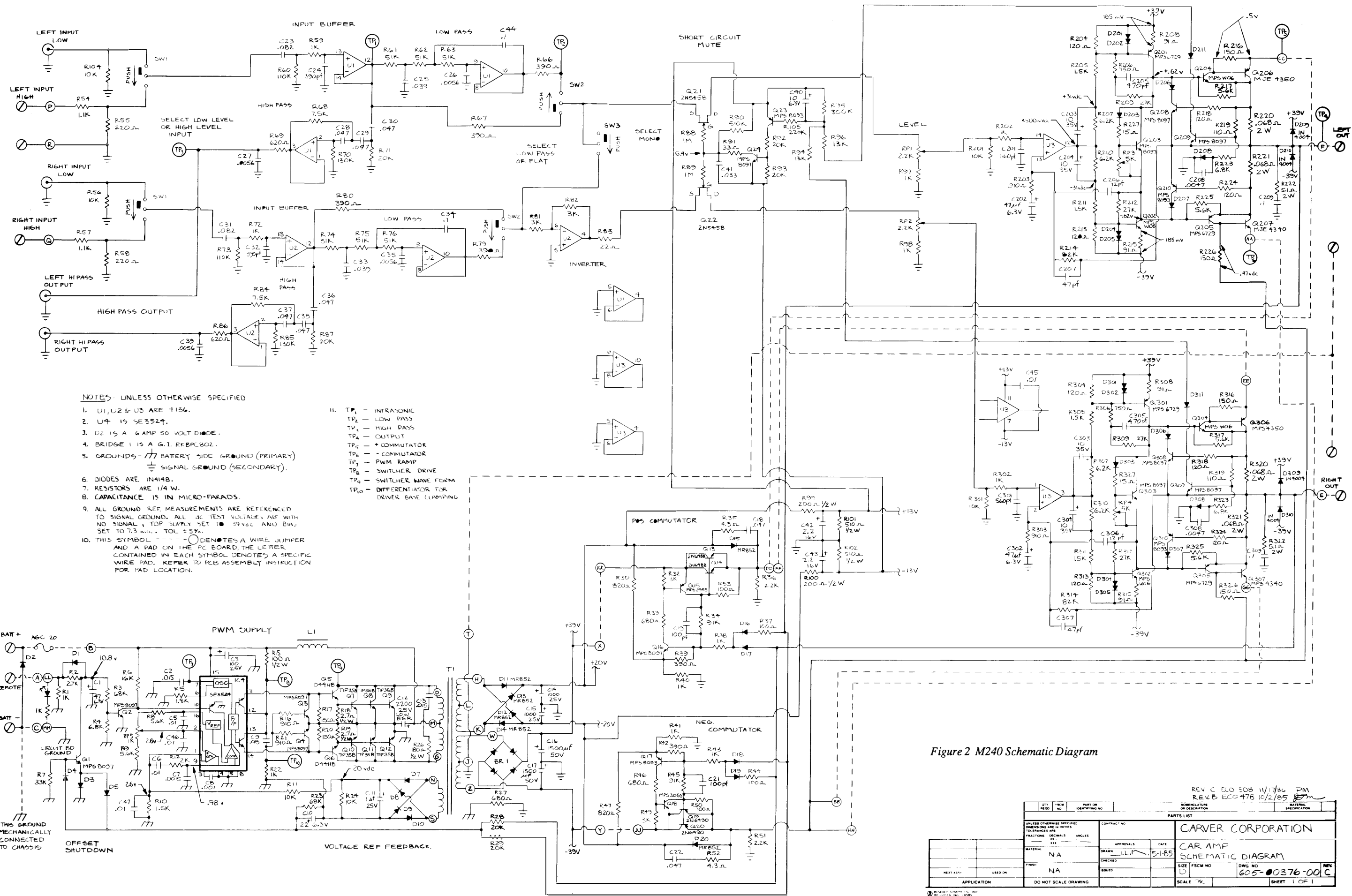
During Biamplication operation, frequencies below 115 Hz pass through a low-pass filter (U1-10 and U2-10) to drive the internal amplifiers. In addition, frequencies above 115 Hz pass through a high-pass filter to form LEFT and RIGHT HIPASS OUTPUTs. These low-level outputs are intended for amplification by an external power amplifier.

NOTE: The low-level outputs from the high-pass filters are available regardless of the position of the Biamp Switch.

Refer to the Carver Car Amplifier M-240 *Owner's Manual* for the switch settings and wiring required for Biamplication applications.

Mono/Stereo Operation

The Mono Switch (SW3) controls whether or not the M240 will operate in mono or stereo mode. Depress the switch for bridged mono operation; leave the switch out for stereo. In mono mode, the M240 serves as a high power, single-channel amplifier. Refer to the Carver Car Amplifier M-240 *Owner's Manual* for the switch settings and wiring required for mono applications, especially for use in Biampified systems.



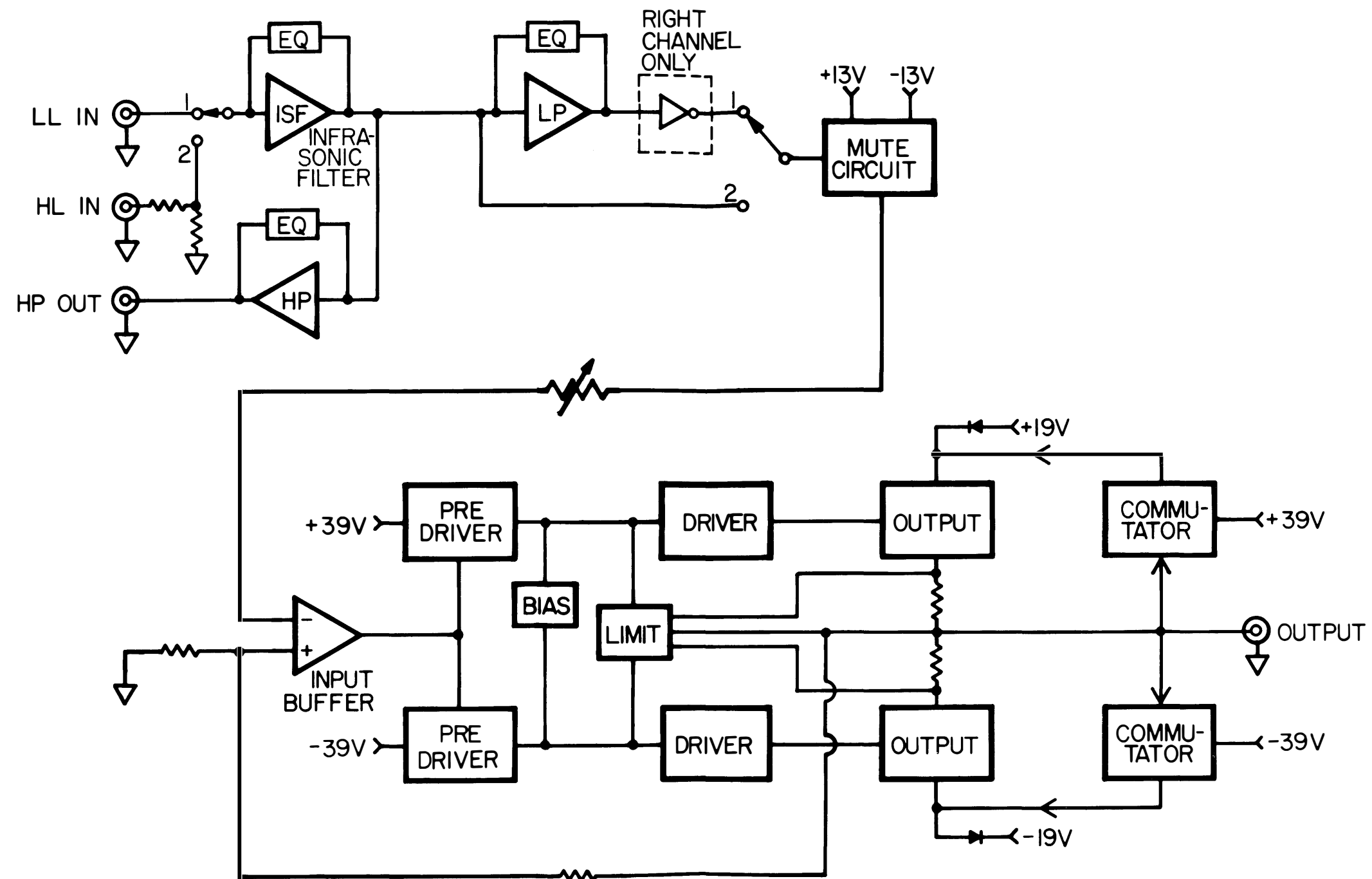


Figure 1 M240 Block Diagram

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APPROVALS	DATE	CAR AMP SERVICE MANUAL			
DRAWN P. MCGUIRE	11/18/86				
CHECKED		SIZE C	FSCM NO.	DWG. NO.	REV.
ISSUED		SCALE NONE		SHEET	

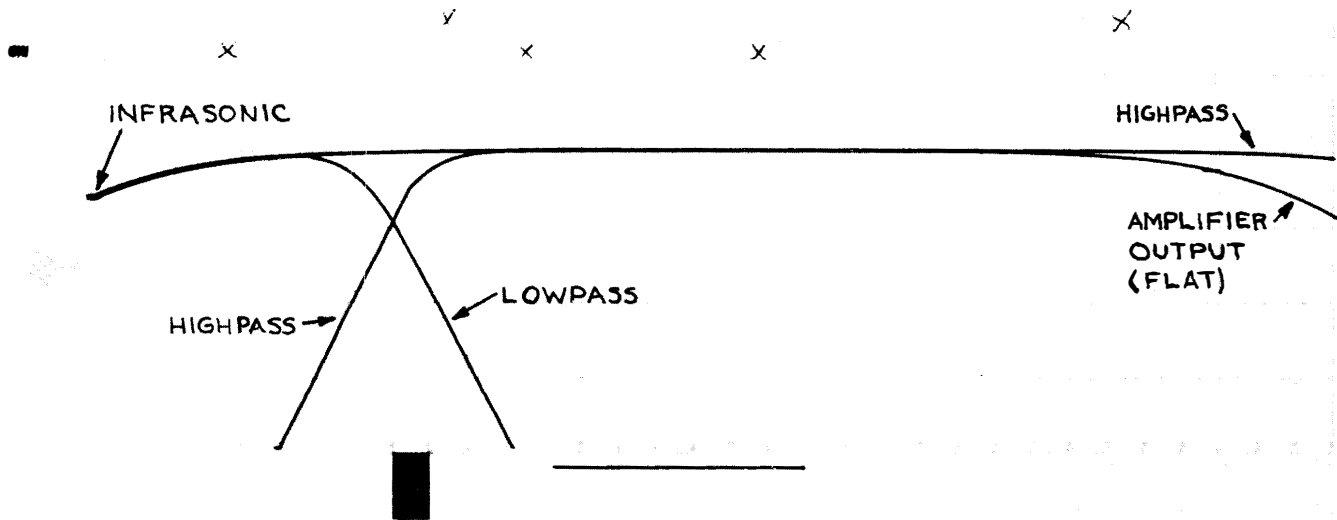


Figure 3 Frequency Response Graph

Input Muting and Protection Circuits

Muting of the amplifier circuits occurs during the following situations:

- Power Up
- Excessive current on the amplifier outputs
- Excessive high frequencies on the amplifier outputs

Each of these situation is described in detail below.

Power Up

A five-second delay between the time the amplifier is turned on and the time the amplifier is fully powered protect the amplifier circuit from electrical surges. The power-up protection circuit causes muting by enabling the shutdown input to the 3524 Pulse-Width Modulating Switching

Supply. The circuit is described in detail below under the heading *Peripheral Circuitry*.

Excessive Current

Excessive current is detected by monitoring the voltage drop across R220 and R221. When the voltage drop exceeds 0.65 V (with an output of 11 amps), the amplifier circuit is muted in two ways:

- Q209 is turned on and the mute sense transistor, Q23, is activated through R96 and D211 (left channel) or R94 and D311 (right channel). Q23 and Q24 control the bias of FETs Q21 and Q22. When the FETs are biased positive, the amplifier circuit is muted. C40 provides hysteresis and noise immunity to Q23.
- Q208 and Q210 are turned on, thereby diverting current from the bases of the drivers, Q204 and Q205.

High Frequencies

The amplifier is protected from oscillations above 20 KHz by D208, C208, and R223. D208 normally prevents muting during negative transitions of the audio signal. Bypassing D208 with C208 allows Q209 to turn on during negative transitions at high frequencies.

- Q209 is turned on and the mute sense transistor, Q23, is activated through R96 and D211 or R94 and D311. (Refer to *Excessive Current* above for a description of the muting circuit.)

Power Amplifiers

The essential elements of the power amplifiers include:

- Input buffers
- Predrivers
- Bias network
- Output drivers
- Power supply commutators

Each channel is served by a separate amplifier circuit. The single difference between the two channels is an inverter (U2-4) in the right channel. This inverter allows smaller filter capacitors to be used in the circuit, and allows for bridging of the amplifier without the use of an external inverter. The capacitor size can be reduced because most low frequency signals are monoral. With the right channel inverted, one channel uses the positive filter capacitor while the other is using the negative filter capacitor.

Given the similarities between the two amplifier circuits, only the left channel is described below. In general, reference designators for the right channel can be calculated by adding "100" to the corresponding left channel reference designator.

Input Buffers

When the low-level input is used and the input sensitivity control (RP1) is turned up, the gain of the amplifier is approximately 40 dB. With the sensitivity control turned down, the gain is reduced to approximately 27 dB. When the high-level input is used, the input is attenuated by 15.0 dB giving an overall gain range of 11.5 dB to 40 dB or 28.5 dB overall adjustment.

The input sensitivity control (RP1) is followed by a 3 dB/octave single-pole low-pass filter (R202 and C201) which prevents slew limiting of the amplifier.

U3-12 is a buffer amplifier with 2 inputs:

- the audio input signal (U3-14)
- the feedback signal from the amplifier output (U3-13)

Predrivers

The output of U3-12 is level-shifted and amplified by the predrivers, Q201 and Q202.

The diode pairs D201/D202 and D204/D205 provide current limiting for predrivers Q201 and Q202, respectively.

Bias Network

D203, Q203, and RP3 regulate the bias current for the drivers (Q204 and Q205). D203 and Q203 are thermally connected to the heatsink to provide thermal feedback. Thus, as Q204, Q205, Q206, and Q207 heat up, the bias current decreases.

Output Drivers

Current limiting for the output drivers (Q206 and Q207) is provided by D206, Q208, and D207, Q210. (Refer to Input Muting and Protection Circuits above for a discussion of how the

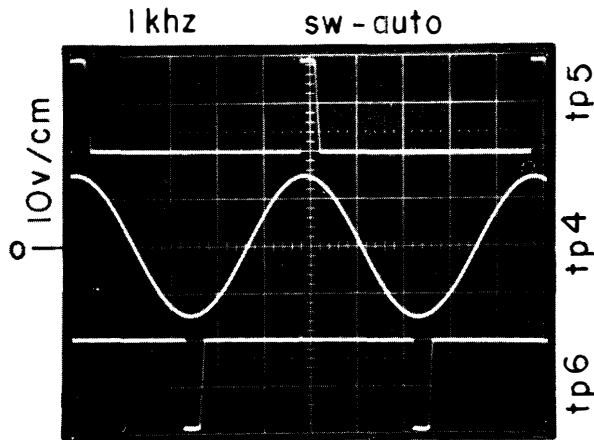


Figure 4 Commutator Threshold

amplifier circuit is protected from excessive current and excessive high frequencies).

Clamp diodes, D209 and D210, prevent the audio output from exceeding +39 V or dropping below -39V.

Power Supply Commutating Circuits

To increase the efficiency of the amplifiers, a commutating circuit controls the voltage supplied to the output drivers. The voltage supplied to the output drivers is switched between ± 19 vdc and ± 39 vdc as required. See Figures 4, 5, and 6 for details.

Since the commutator circuit is common to both channels, if one amplifier requires additional voltage, that voltage is supplied to both channels. Since the positive and negative components of the circuit are identical, only the positive comutator is discussed below.

Commutator waveforms are received at the emitter of the output drivers, Q206 and Q207. (Testpoints TP5 and TP6 are at Pads CC and AA, respectively. Refer to Figure 2 for the location of the testpoints.)

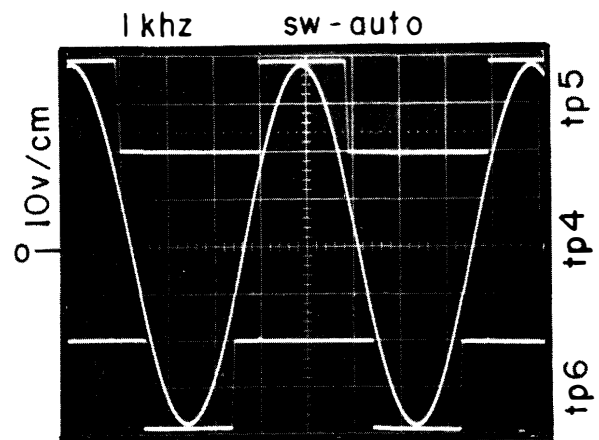


Figure 5 Commutator Maximum Output @ 1 KHz

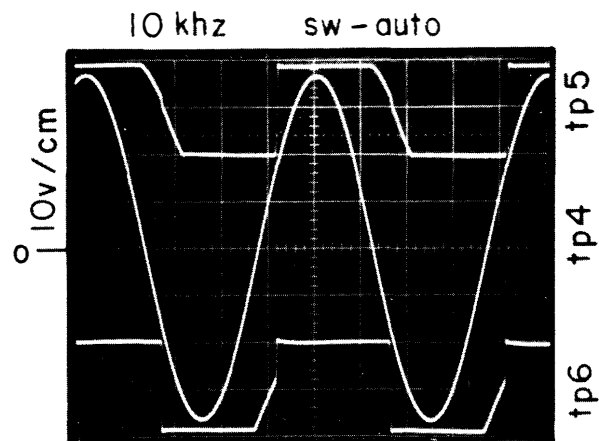
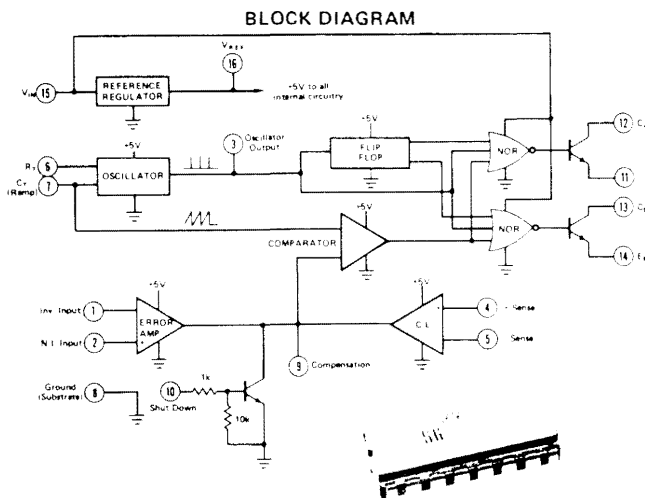


Figure 6 Commutator Maximum Output @ 10 KHz

The audio output signal is fed to the positive commutator circuit through D16 (left channel) and D17 (right channel). Q16 is biased with respect to the +20v supply by R30 and R40. Q16 is turned on only when additional voltage is required by the power amplifiers to reproduce the audio waveform.

Q15, Q14, and Q13 amplify the output of Q16 to provide the necessary current for the output drivers of the amplifiers. D15 prevents current from the



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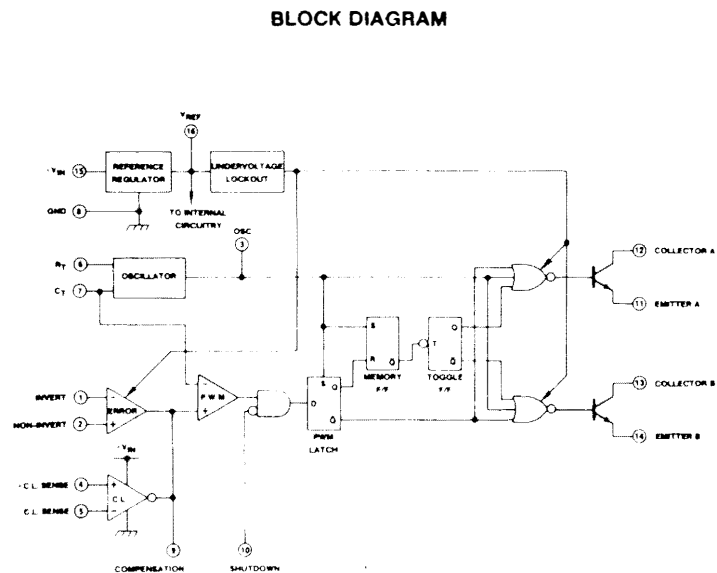


Figure 7 3524 Block Diagrams (SE3524 is shown at top; SG3524B is shown at bottom)

+20V main supply from flowing back into the commutator circuit.

Pulse Width Modulating Power Supply

The M240 amplifier is designed for use in a 12 vdc negative ground system. It converts +12 vdc

to the ± 39 vdc and ± 20 vdc required by the two 120W power amplifiers using a push-pull pulse width modulating (PWM) switching supply.

An SE3524 Pulse Width Modulating Regulator controls the operation of the switching supply. (Refer to the section titled *Service Bulletins* for

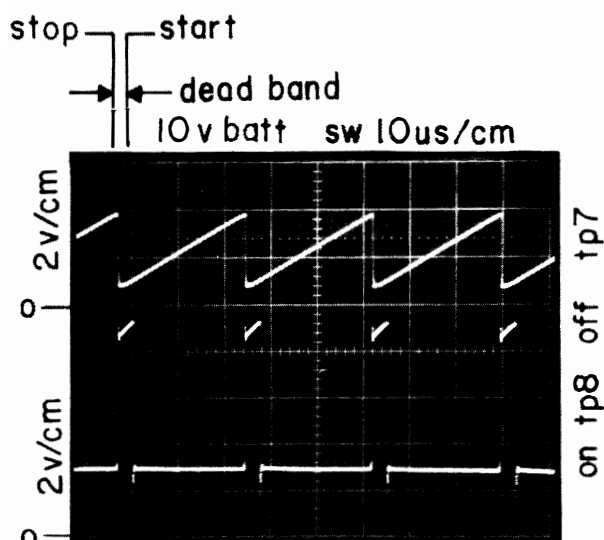


Figure 8 Ramp and 3524 Output, Maximum Duty Cycle

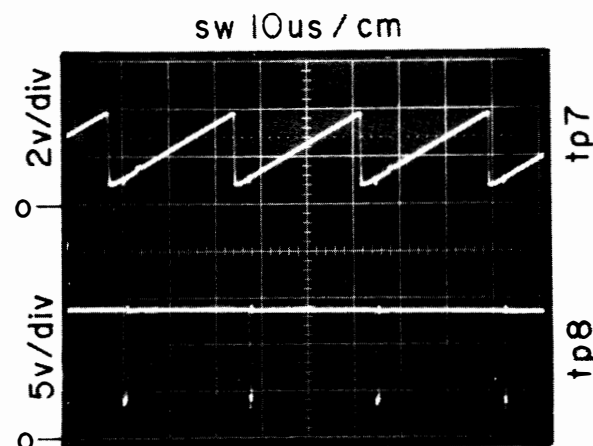


Figure 9 Ramp and 3524 Output, Minimum Duty Cycle

information on the substitution of the pin-for-pin compatible SG3524B for the SE3524.)

3524 Pulse Width Modulating Regulator

The 3524 contains all the control circuitry for a switching regulator. An internal 5V reference, capable of supplying up to 50 mA to external loads, provides an on-board operating standard.

An external RC network adjusts the oscillator frequency and duty cycle. Regulation is controlled by an error amplifier which, combined with the sense amplifier, also allows current limiting and remote shutdown functions. The outputs of the 3524 are two identical NPN transistors with both emitters and collectors uncommitted.

The relationships between the various components of the 3524 are illustrated in Figure 7.

Voltage Reference Section. The internal voltage reference and regulator section provides a 5-volt reference output at pin 16. This voltage also serves as a regulated voltage source for the internal timing and control circuitry.

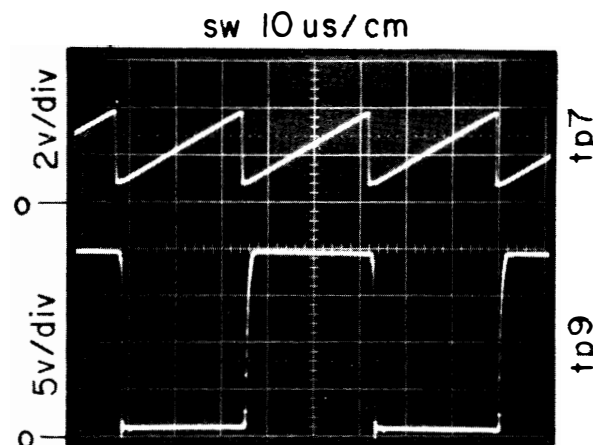


Figure 10 Switcher Driver, Maximum Duty Cycle

Oscillator Section. The oscillator section in the 3524 uses an external resistor to establish a constant charging current into an external capacitor. While this uses more current than a series connected RC, it provides a linear ramp voltage on the capacitor which is also used as a reference for the comparator. Refer to Figures 8 and 9 for the ramp waveforms.

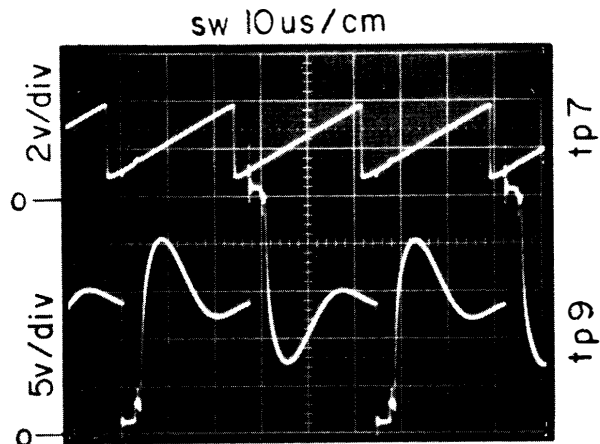


Figure 11 Switcher Driver, Minimum Duty Cycle

Error Amplifier. The error amplifier is a simple differential-input, transconductance amplifier. The output is the compensation terminal, pin 9, which is a high-impedance node (approximately 5 M).

Output Circuits. The outputs of the 3524 are two identical NPN transistors with both collectors and emitters uncommitted. Each output transistor has antisaturation circuitry for fast response. Current limiting is set for a maximum output current of approximately 100 mA.

The switching waveform appears in Figures 8 and 9.

Deadband Control. The 3524 pulse width modulating regulator provides two outputs which alternate in turning on. The internal oscillator sends a momentary blanking pulse to both outputs at the end of each period to provide a "deadband," a period in which neither input is on. The deadband is illustrated in Figure 8, Peripheral Circuitry.

Peripheral Circuitry. D2 and a 20-Amp fuse (fast-blo AGC type) protect the unit from excessive current draw or reversed polarity.

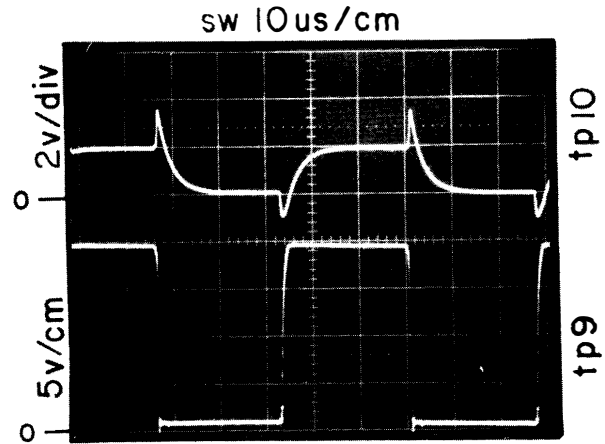


Figure 12 Differentiator Waveform

The Remote Turn On terminal allows the M240 Car Amplifier to be turned on by the car radio. Power up is delayed by R1, R2, R3, R4, C1, D1, Q2, thereby allowing a "soft" start of the amplifier. Activation of the Remote Turn On terminal pulls the Shutdown pin (IC4-10) low, thereby enabling the 3524.

Protection against DC offset on the audio outputs is provided by summing the two outputs by R28 and R29 and filtering the audio signal with C10. When negative offset is present, D5 is forward biased, turning on Q1, and subsequently turning off Q2. The Shutdown input of the 3524 (IC4-10) is forced high, thereby disabling the supply. When positive offset is present, D4 is forward biased, turning on Q1, forcing IC4-10 high and disabling the supply.

CAUTION: If DC offset is present, you may need to ground the cathode of D5 to allow the supply to turn on. If you do this, be sure that there is no load on the amplifier outputs.

The outputs of the 3524 alternately turn on and turn off transistors Q5 and Q6. Refer to Figures 10 and 11 for the switcher driver waveforms.

When Q5 is turned on, Q7, Q8, and Q9 turn on, allowing current to flow through primary winding D-M of the transformer. When Q6 is turned on, Q10, Q11, and Q12 turn on and current flows through winding G-M in the opposite direction.

Q3 and Q4 decrease the turn-off times of Q5 and Q6 by momentarily clamping their bases to ground at each transition, as shown in Figure 12.

Voltage feedback from winding N-S of the transformer is rectified, filtered, and fed back to the error amplifier (IC4-1) of the 3524 switching supply. The voltage is compared to the reference voltage and the pulse width is adjusted as required.

The secondary consists of two separate windings :

- H-K. The outputs are rectified by D11, D12, D13, and D14. C14 and C15 provide capacitive filtering. Outputs from this winding provide 20 V, the main supply for the power amplifiers
- W-Z. The outputs pass through bridge rectifier BR1 to create 39 V for the commutator supply. These voltage are delivery to the power amplifier only as required.

Calibration and Performance Testing

Use the tests described in the following pages to determine the overall performance of the amplifier.

Before running the test procedures, read the service bulletins for help on common service problems.

Required Equipment

In addition to standard audio electronic test equipment, you will need a power Supply either an Astron RS50 or an equivalent model.

CAUTION: The power supply must meet the following requirements.

Since the turn-on transient is 44 amps, the power supply must be rated for a minimum of 44 amps without current limiting. Both the current and the voltage should be monitored at all times. If the voltage drops below 7.5 V, turn the supply off and restart. If the power supply limits during turn-on and voltage folds back, the switchers may lock on one side and cause thermal damage to switcher transistors Q7 and Q12.

NOTE: This is not a problem with the SG3524B. See the section titled *Service Bulletin* for details.

CAUTION: Do not run the amplifier PCB into a load unless it is installed in the heat-sink/chassis and properly torqued.

The mechanical assembly of the amplifier is critical. Consult Figures 14 through 18 and the service bulletins before attempting reassembly. In particular, refer to Figure 18 to verify that all components on the back of the PCB have been properly prepared.

Power Supply

1. Unless otherwise instructed, adjust the power supply voltage for 13.8 V at the amplifier terminals for each test.
2. With the amplifier turned off, connect the main power supply cables.
 - a. Connect B+ to remote terminal and verify that the Power On LED lights and the

amp draws less than 500 mA after a 5-second delay.

- b. Adjust the power supply for $39.0\text{ V} \pm 0.2\text{V}$ on BR1, Pad X. (See Figure 13 for the location of Pad X.)
- c. Verify that the waveform on IC4-12 matches that of Figure 8 when the supply is set to 10 V and matches Figure 9 when the supply is set to 13.8 V.

Bias Adjustment

1. With no load and no signal, adjust RP4 for 1 mV across the series pair of R320 and R321.
2. Adjust RP3 for 1 mV across the series pair of R220 and R221. These two adjustments set the idle current to 7.3 mA for each amplifier.

See Figure 13 for test point locations.

Frequency Response

Refer to Figure 3 during the following test.

Set Up Conditions

- Leave Hi-Level Select Switch out
- Provide $8\ \Omega$ load on speaker outputs
- Set input level controls (RP1 and RP2) at maximum
- Set reference to 0 dBv at 1 kHz at output

Test Procedure

1. Verify $-3\text{ dB} \pm 1\text{ dB}$ @ 18 Hz
2. Verify $-3\text{ dB} \pm 1\text{ dB}$ @ 30 kHz
3. Verify high level input is down 15.5 dB $\pm 1\text{dB}$
4. Verify signal level is down 6 dB $\pm 1\text{ dB}$ with

Mono Switch in and either channel driven.

5. Verify level controls RP1 and RP2 give 13dB ± 1 dB of range.

Low Pass Crossover

Refer to Figure 3 during the following test.

Set Up Conditions

- Leave Hi-Level Select Switch out
- Press Biamp Switch in
- Monitor speaker outputs
- Provide $8\ \Omega$ load on speaker outputs
- Set input level controls (RP1 and RP2) at maximum.
- Set reference to 0 dBv at 1 kHz on output

Test Procedure

1. Verify $-3\text{ dB} \pm 1\text{ dB}$ @ 110 Hz.

High Pass Crossover

Refer to Figure 3, the Frequency Response Graph during the following test.

Set Up Conditions

- Leave Hi-Level Select Switch out
- Monitor HIPASS OUTPUT
- No load on output
- Set reference to -10 dBV @ 1 kHz

Test Procedure

1. Verify $-3\text{ dB} \pm 1\text{ dB}$ @ 127 Hz.

Commutator Threshold

Refer to Figure 4 during this test.

Set Up Conditions:

- Leave Hi-Level Select Switch out
- Monitor speaker outputs
- Provide $8\ \Omega$ load on outputs
- Set reference frequency to 1 kHz

Test Procedure

1. Connect the scope probe to the emitter of Q306 (Pad EE) and verify that the positive commutator turns on at 10 V RMS \pm 1 V with either channel driven.
2. Repeat Step 1 for the emitter of Q307 (Pad GG) to test the performance of the negative commutator.

See Figure 13 for test point locations.

Power and Distortion

Refer to Figures 5 and 6 during this test.

Set Up Conditions

- Leave Hi-Level Select Switch out
- Monitor speaker outputs
- Provide $8\ \Omega$ load on outputs
- Set reference frequency to 1 kHz

Test Procedure

1. Verify a minimum of 74 watts on the speaker outputs with less than 0.25% distortion using a 30 kHz filter. (This figure includes switcher noise.)

2. Verify that the commutator waveforms on Pads EE and GG match those of Figure 5.
3. Repeat Steps 1 and 2 at 20 Hz. Refer to Figure 5 for the appropriate waveforms.
4. Repeat Steps 1 and 2 at 10 kHz. Refer to Figure 6 for the appropriate waveforms.
5. Verify the presence of at least 120 watts on the speaker outputs (supply held at 13.8 V at terminals of amplifier) with less than 0.25% distortion into $4\ \Omega$.

NOTE: Supply limitations may require that one channel be tested at a time.

Protection Circuits

Short Circuit Test

1. 7 V RMS out into $8\ \Omega$ @ 1 KHz. (Note the supply current.)
2. Short the output and verify that the supply current decreases

DC Offset

1. 7 V RMS out into $8\ \Omega$ @ 1 KHz. (Note the supply current.)
2. Short pins 1 and 2 of IC3 to offset the amplifier.
3. Verify that the supply current decreases and the switcher cycles on and off.
4. Repeat Steps 2 and 3, shorting pins 13 and 14 of IC3.

High Frequency Shutdown

1. No load 20 KHz
2. Verify that the signal is muted when either right or left channel is run into clipping.

CAUTION: Do not run the amplifier at full output voltage at 20 KHz for prolonged periods of time.

Noise

1. Short the inputs with shorting plugs.
2. Verify that noise is less than 500 uV RMS JIS "A" weighted.

Service Bulletins

The following bulletins describe changes in the original design of the M240 amplifier, as well as suggestions on repairing common malfunctions.

Mechanical Installation of PCB

Some changes have been made in mounting screw type and hole size. See items 7 and 10 on Figure 14 for details.

Because tolerances are critical, we recommend the use of a torque driver to be sure that exactly 12in/lbs of torque is applied to all mounting screws. If you are unable to tighten screws without bending, breaking, or stripping, contact the factory.

Mechanical PCB Changes

Transistors ⑥ and ⑦ must be installed so that they do not interfere with center mounting holes. Refer to Figure 15.

In some defective boards, a copper trace leads up to the edge of the mounting screw which clamps transistors ⑥ and ⑦ to the heatsink. (See the mounting hole between Q20 and Q19 in Figure 13.) This defect caused the 39 V supply to be shorted to chassis ground. Some of these boards were repaired with sleeving.

If you have a defective board, remove the board from the chassis, then remove copper trace 0.030 inches from the edge of the mounting hole.

Phono Jacks

Refer to Detail A in Figure 15 for information on replacing the phono jacks.

Pulse Width Modulating Supply

An engineering order has been issued to prevent the 3524 from entering a disallowed state when the supply voltage is low and to reduce the inrush current during power up. Drop out was 9V and is now 6.5V.

The following parts have been replaced:

1. R2
30K 1/4W
P/N 251-00121-00

Replaced by:

27k 1/4W
P/N 251-00104-00

2. R4
16K 1/4W
P/N 251-00099-00

Replaced by:

6.8K 1/4W
P/N 251-00090-00

3. R6
36K 1/4W
P/N 251-00107-00

Replaced by:

16K 1/4W
P/N 251-00099-00

To install new potentiometers in existing boards, enlarge the lead holes to 0.046 inches.

Part Substitutions

Motorola MPS2979 has been used as a substitute for Motorola MPS 6729, P/N 321-10001-00. (See Q201, 205, 301, and 305.)

Replacement of the SE3524 Chip

The SE3524 Pulse Width Modulating Regulator has been replaced by the pin-for-pin compatible SG3524B. The latter provides low voltage "lock up" protection. The SG3524B allows the amplifier to be turned and run with power supplies which cannot handle the turn-on surge of 45 amps.

Mechanical Design of Level Controls

The original trim potentiometers (RP1 and RP2) were open, with exposed carbon, and easily damaged. The replacement part is sealed and protected.

1. RP1 and RP2
Trim Pot 2.2K 1/10W PCB Mount
P/N 259-20010-00

Replaced by:

Trim Pot 2.0K 1/10W PCB Mount
P/N 259-20010-00

2. R97 and R98
Res Cfilm 820 Ω 1/4W Prep .4"
P/N 251-00068-00

Replaced by:

Res Cfilm 1K 1/4W Prep .4"
P/N 251-00070-00

Parts

The following pages contain a complete parts list for the M240 Mobile Magnetic Field Amplifier. The parts are grouped by type : resistors, capacitors, diodes, transistors, integrated circuits, hardware, miscellaneous items, and shipping kit. Within groups, parts are listed in order by part number.

Resistors

Part Number	Description	Reference Designators
251-00013-00	RES CFILM 4.3 Ω 1/4W PREP .4	R35,52
251-00026-00	RES CFILM 15 Ω 1/4W PREP .4	R227,327
251-00030-00	RES CFILM 22 Ω 1/4W PREP .4	R83
251-00034-00	RES CFILM 33 Ω 1/4W PREP .4	R91
251-00045-00	RES CFILM 91 Ω 1/4W PREP .4	R208,215,308,315
251-00046-00	RES CFILM 100 Ω 1/4W PREP .4	R37,44,50,53
251-00047-00	RES CFILM 110 Ω 1/4W PREP .4	R219,319
251-00048-00	RES CFILM 120 Ω 1/4W PREP .4	R204,215,218,224, 304,315,318,324
251-00050-00	RES CFILM 150 Ω 1/4W PREP .4	R17,20,216,226,316,326
251-00054-00	RES CFILM 220 Ω 1/4W PREP .4	R55,58
251-00060-00	RES CFILM 390 Ω 1/4W PREP .4	R39,42,66,67,79,88
251-00065-00	RES CFILM 620 Ω 1/4W PREP .4	R69,86
251-00066-00	RES CFILM 680 Ω 1/4W PREP .4	R27,33,46
251-00067-00	RES CFILM 750 Ω 1/4W PREP .4	R206,306
251-00068-00	RES CFILM 820 Ω 1/4W PREP .4	R30,47
251-00069-00	RES CFILM 910 Ω 1/4W PREP .4	R16,21,203,303
251-00070-00	RES CFILM 1 K 1/4W PREP .4	R1,22,38,40,41,43,59,72,97,98,202,302
251-00071-00	RES CFILM 1.1 K 1/4W PREP .4	R54,57
251-00074-00	RES CFILM 1.5 K 1/4W PREP .4	R10,205,211,305,311
251-00076-00	RES CFILM 1.8 K 1/4W PREP .4	R5
251-00077-00	RES CFILM 2 K 1/4W PREP .4	R12
251-00078-00	RES CFILM 2.2 K 1/4W PREP .4	R36,51
251-00081-00	RES CFILM 3 K 1/4W PREP .4	R32,49,81,82
251-00088-00	RES CFILM 5.6 K 1/4W PREP .4	R8,9,217,225,317,325
251-00089-00	RES CFILM 6.2 K 1/4W PREP .4	R207,210,307,310
251-00090-00	RES CFILM 6.8 K 1/4W PREP .4	R4,223,323
251-00091-00	RES CFILM 7.5 K 1/4W PREP .4	R68,84
251-00094-00	RES CFILM 10 K 1/4W PREP .4	R11,24,56,104,201,301
251-00097-00	RES CFILM 13 K 1/4W PREP .4	R94,96
251-00099-00	RES CFILM 16 K 1/4W PREP .4	R6
251-00101-00	RES CFILM 20 K 1/4W PREP .4	R28,29,71,87,92,93
251-00104-00	RES CFILM 27 K 1/4W PREP .4	R2,209,212,309,312
251-00106-00	RES CFILM 33 K 1/4W PREP .4	R7
251-00111-00	RES CFILM 51 K 1/4W PREP .4	R61-63,74-76

Resistors (Continued)

Part Number	Description	Reference Designators
251-00116-00	RES CFILM 82 K 1/4W PREP .4	R214,314
251-00117-00	RES CFILM 91 K 1/4W PREP .4	R34,45
251-00119-00	RES CFILM 110 K 1/4W PREP .4	R60,73
251-00121-00	RES CFILM 130 K 1/4W PREP .4	R70,85
251-00126-00	RES CFILM 220 K 1/4W PREP .4	R105
251-00129-00	RES CFILM 300 K 1/4W PREP .4	R95
251-00135-00	RES CFILM 510 K 1/4W PREP .4	R90
251-00142-00	RES CFILM 1 M 1/4W PREP .4	R88,89
251-10008-03	RES CFILM 2.7 Ω 1/2W BULK	R18,19
251-10046-03	RES CFILM 100 Ω 1/2W UNPREP	R15
251-10052-00	RES CFILM 180 Ω 1/2W PREP .5	R26
251-10053-00	RES CFILM 200 Ω 1/2W PREP .5X	R99,100
251-10063-03	RES CFILM 510 Ω 1/2W UNPREP	R101,102
253-20003-00	RES, WIRE WOUND .068 Ω 2 WATT	R220,221,320,321
253-20030-00	RES WIRE WOUND 5.1 Ω 2W	R222,322

Capacitors

Part Number	Description	Reference Designators
201-00007-00	CAP CERAMIC DISC 47 PF 10% 1000V	C207,307
201-00012-00	CAP CER DISC 100PF 10% 1000V	C19,21
201-00022-00	CAP CER DISC 390PF 10% 1000V	C24,32
201-00023-00	CAP CER DISC 470PF 10% 1000V	C205,305
201-00025-00	CAP CER DISC 560PF 10% 1000V	C201,301
201-00045-00	CAP CER DISC 12PF 10% 1000V	C206,306
204-00003-00	CAP MYLAR .001UF	C8
204-00005-00	CAP MYLAR .0015UF	C7
204-00011-00	CAP MYLAR .0047UF	C208,308
204-00012-00	CAP MYLAR .0056UF	C26,27,35,39
204-00015-00	CAP MYLAR .01UF	C5,6,46,47
204-00017-00	CAP MYLAR .015UF	C2,9,13
204-00022-00	CAP MYLAR .033UF	C41 2
204-00023-00	CAP MYLAR .039UF	C25,33
204-00024-00	CAP MYLAR .047UF	C18,22,28-30,36-38
204-00026-00	CAP MYLAR .082UF	C23,31
204-00027-00	CAP MYLAR .1UF	C34,44,209,309
205-00001-00	CAP ELECTROLYTIC 1UF 50V RAD	C11
205-00002-00	CAP LYTIC 2.2UF 35V RADIAL	C42,43
205-00010-00	CAP LYTIC 10 μ F 35V RADIAL	C40,203,204,303,304

Capacitors (Continued)

Part Number	Description	Reference Designators
205-00011-00	CAP LYTIC 22UF 16V RADIAL	C10
205-00013-00	CAP LYTIC 47UF 16V RADIAL	C1,202,302
205-00025-00	CAP LYTIC 1000UF 25V RAD 1"H	C14,15
205-00046-00	CAP LYTIC 1500UF 50V C16,17	
205-00047-00	CAP LYTIC 2200UF 25V RAD .98 HT C12	
205-00048-00	CAP LYTIC 100UF/25V RADIAL C3	

Diodes

Part Number	Description	Reference Designators
320-20001-00	DIODE IN 4148 75V PREP	D1,3-5,7-10,16-19,201-208,211,301-308,31
320-20004-00	DIODE IN 4004 400V PREP	D209,210,309,310
320-20007-00	DIODE MR 852 UNPREP	D11,12,13,14,15,20
320-20009-00	DIODE 6A05 6AMP 50V	D2

Transistors

Part Number	Description	Reference Designators
321-10000-00	XISTOR 152 NPN 5M SG MPS W06	Q202,204,302,304
321-10001-00	XISTOR 152 PNP SM SG MPS 6729	Q201,025,301,305
321-40000-00	XISTOR T092 NPN SM SG MPS 8097	Q1-4,15,24,203,208,209,303,308,309
321-40003-00	XISTOR T092 MPS 8093 (SUB FPN4)	Q17,23,207,307
321-40005-00	XISTOR T092 JFET SM SG 2N 5458	Q21,22
321-60000-00	XISTOR T0220 NPN POWER MJE3055	Q18
321-60002-00	XISTOR T0220 PNP POWER MJE2955	Q15
321-60005-00	XISTOR T0220 NPN D44H8	Q5,6
321-60004-00	XISTOR T0220 NPN 2N6488	Q13,14
321-60006-00	XISTOR T0220 PNP 2N6490	Q19,20
321-80000-00	XISTOR T0218AA NPN TIP 35B	Q7,8,9,10,11,12
321-80001-00	XISTORT0218AA NPN MJE 4340	Q207,307
321-80002-00	XISTOR T0218AA PNP MJE 4350	Q206,306

Integrated Circuits

Part Number	Description	Reference Designators
330-30003-00	IC QUAD OP AMP (4136)	U1,2,3
330-60004-00	VOLTAGE REG. SWITCHING SE3524	IC4

Hardware

Part Number	Description	Reference Designators
101-00002-00	BARRIER STRIP 3 POS 90 DEG MNT 1	
152-10002-00	KEPNUT 6-32X5/16 ZC	
152-10001-00	KEPNUT 440 ZC	
151-20053-00	SCREW MACH PP BLK 6-32 X 1/2	
151-20053-05	SCREW MACH PP SS 6-32X1/2	
151-30051-00	SCREW SHT MTL PP BLK 6X1/4 "B"	
151-30002-00	SCREW SHT MTL PP BLK 4X3/8 "A"	
151-30003-00	SCREW SHT MTL PP BLK 4X1/2 "B"	
151-30102-00	SCREW SHT MTL PP BLK 8X3/8 "A"	
151-20009-01	SCREW MACH PP ZC 4-40X1 1/8	
111-20051-00	SOLDER LUG #6	
154-10001-00	WASHER FLAT SAE BLK #4	
154-10051-00	WASHER FLAT SAE BLK #6	
154-20351-02	WASHER INT LOCK CAD PLTD 1/2ID	
154-40005-01	WASHER,SHLDR NYL .2155D X .125	

Miscellaneous Items

The following items are listed alphabetically.

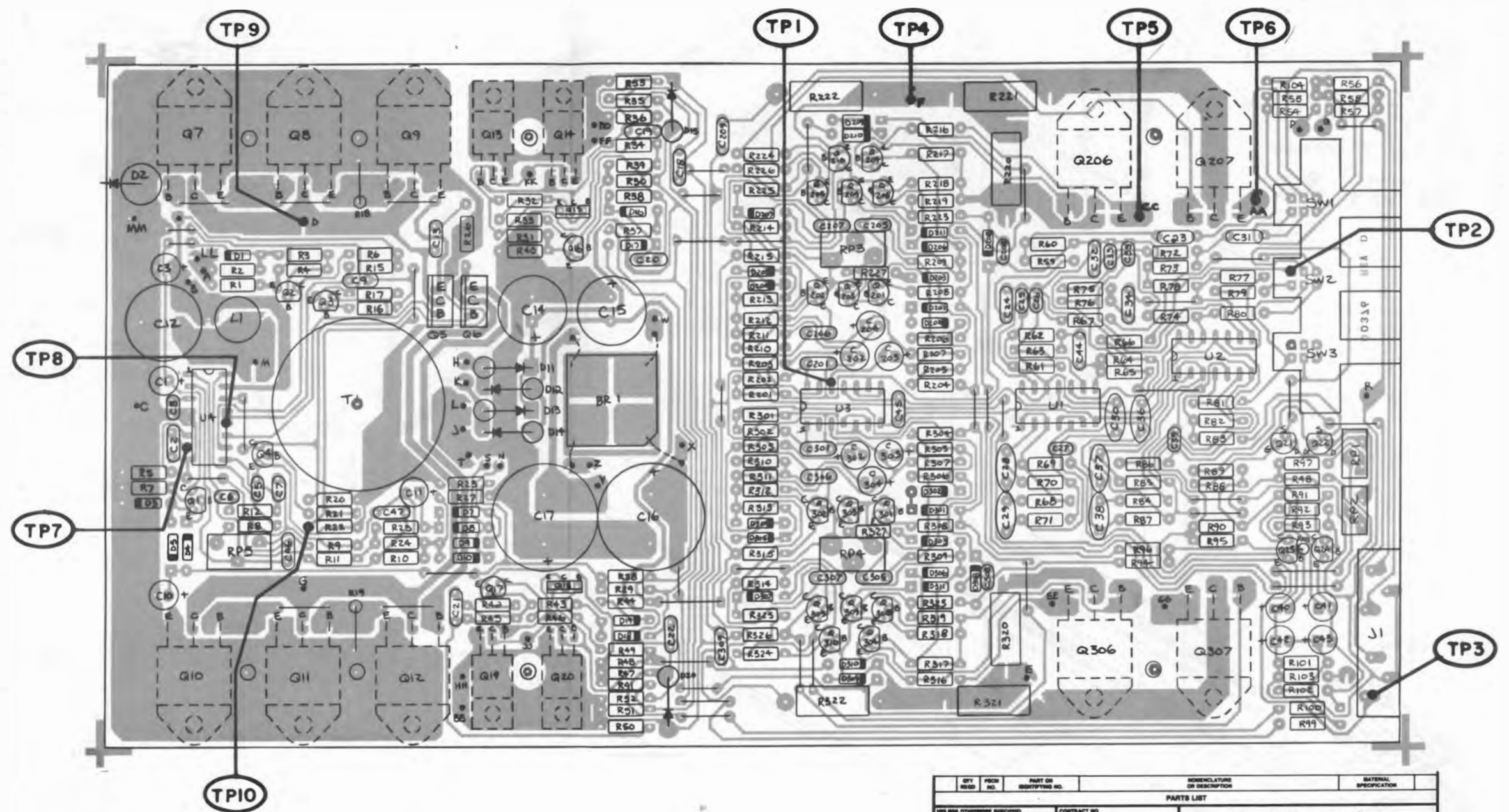
Part Number	Description	Reference Designators
601-00377-00	ASSY, PREP, LED CAR AMP	ITEM #
616-00004-00	COIL CAR AMP	L1
504-20020-01	COVER, BTM PNT BLK MBL MAG AMP	
315-10508-00	FUSE AGC 20	
105-40002-00	FUSEHOLDER PANEL MNT DOMESTIC	
511-10000-01	HEATSINK, ANO GRAY CAR AMP	
512-10604-00	LOGO GOLD CAR AMP	
512-10602-00	MICA INSULATOR	
512-10603-00	MICA WASHER MBL MAG AMP AMPLFR	
505-20003-01	PANEL, END (A) SCRNM MBL MAG AMP	
505-20004-01	PANEL, END (B) SCRNM MBL MAG AMP	
109-10005-00	PHONE JACK SM. QUAD PC MOUNT	
319-00028-00	RECT. BRIDGE 200V 8A FAST RECO	BR1
530-20017-00	STICKER (M-240)	
318-10009-00	SW PUSH 1 KEY NO FRAME MINI	SW1,2,3
403-40001-00	TAPE FOAM DOUBLE BACK 1/8HX1"W	
616-10001-00	TRANSFORMER POT CORE CAR AMP	TI
259-20010-00	TRIM POT 2.0K 1/10W PCB MOUNT	RP1,2
259-20001-00	TRIM POT 1 K PCB MOUNT	RP5
259-20003-00	TRIM POT 5 K PCB MOUNT	RP3,4

Miscellaneous Items (Continued)

Part Number	Description	Reference Designators
159-50001-00	TYRAP 3 3/8" L WHT	

Shipping Kit

Part Number	Description	Reference Designators
532-10002-00	BAG PLASTIC 4"X6"	
532-10011-00	BAG PLASTIC 10"X16" CAR AMP	
532-20017-00	BOX MBL MAG AMP	
532-30013-00	FOAM END BLOCK MBL MAG AMP	
990-20016-00	MANUAL CAR AMP	
990-20016-01	M240 MOBILE MAGNETIC FIELD AMPLIFIER SERVICE MANUAL	

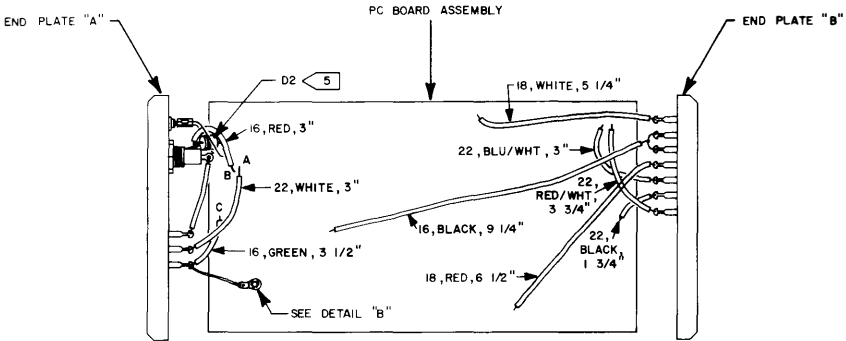
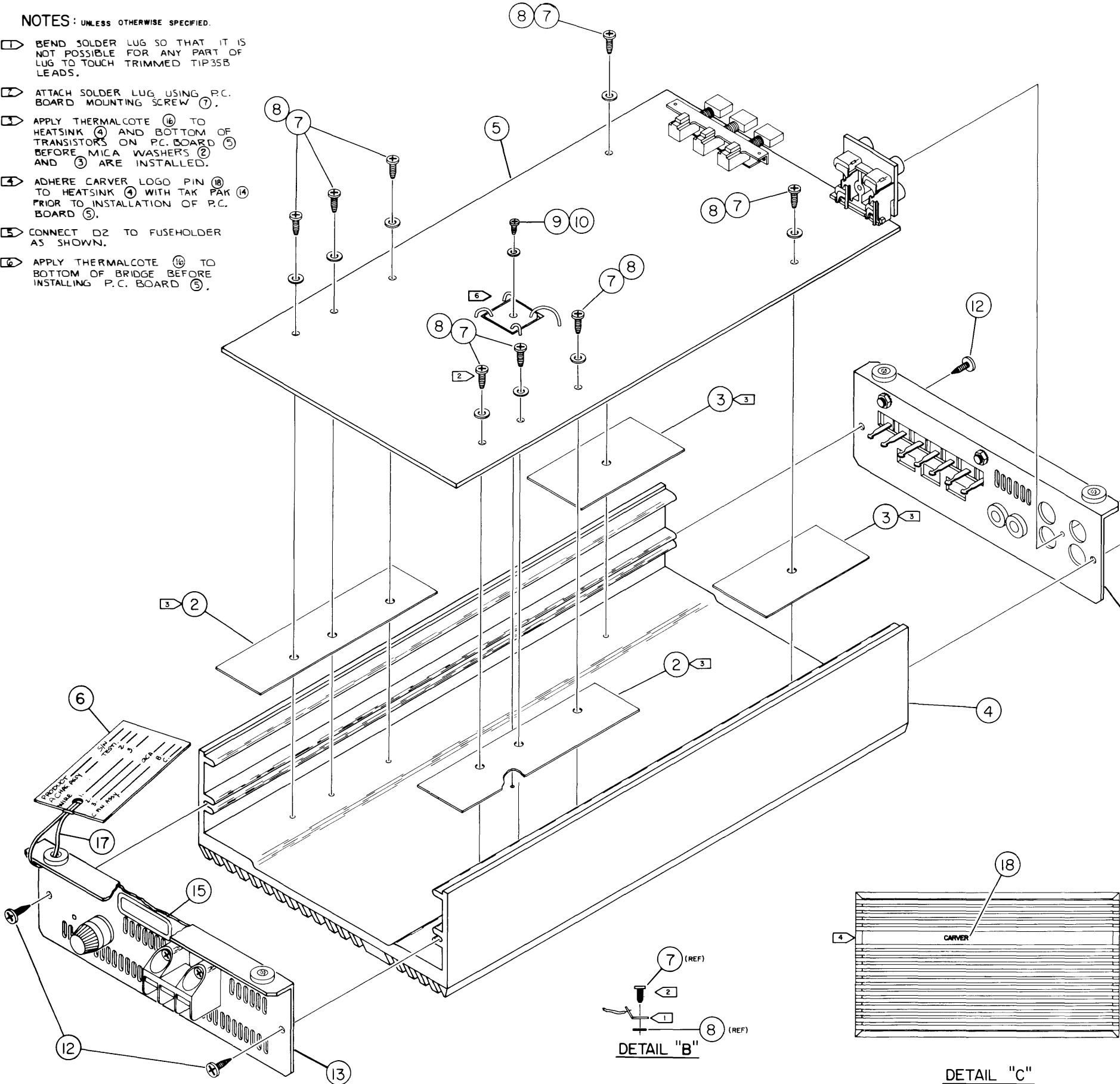


QTY. REQD.	PCB NO.	PART OR IDENTIFYING NO.	DESCRIPTION OR DESCRIPTION	MATERIAL SPECIFICATION
PARTS LIST				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.		
FRACTIONS DECIMALS ANGLES		APPROVALS DATE		
MATERIAL		DRAWN <i>A. I. Carver</i> 1/30/85		
FINISH		CHECKED		
NEXT ASSY		REV.		
USED ON		SIZE PCB NO. DWG. NO. 601-00376-00		
APPLICATION		DO NOT SCALE DRAWING		
		SCALE 2:1 SHEET 1 OF 2		

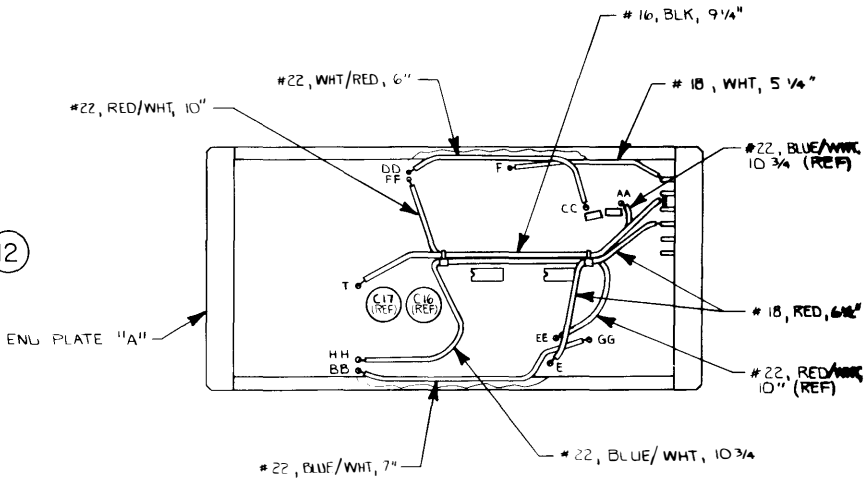
Figure 13 PCB Assembly Diagram, Sht 1

NOTES: UNLESS OTHERWISE SPECIFIED.

- 1 BEND SOLDER LUG SO THAT IT IS NOT POSSIBLE FOR ANY PART OF LUG TO TOUCH TRIMMED TIP35B LEADS.
- 2 ATTACH SOLDER LUG USING P.C. BOARD MOUNTING SCREW 7.
- 3 APPLY THERMALCOTE 16 TO HEATSINK 4 AND BOTTOM OF TRANSISTORS ON P.C. BOARD 5 BEFORE MICA WASHERS 2 AND 3 ARE INSTALLED.
- 4 ADHERE CARVER LOGO PIN 18 TO HEATSINK 4 WITH TAK PAK 14 PRIOR TO INSTALLATION OF P.C. BOARD 5.
- 5 CONNECT D2 TO FUSEHOLDER AS SHOWN.
- 6 APPLY THERMALCOTE 16 TO BOTTOM OF BRIDGE BEFORE INSTALLING P.C. BOARD 5.



DETAIL "A"

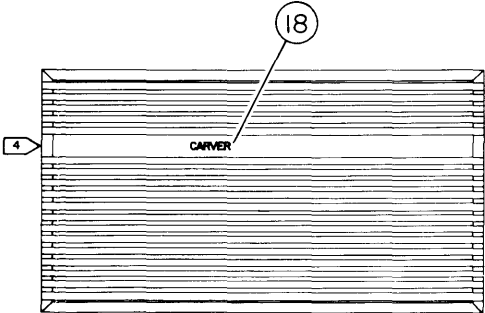


DETAIL "D"

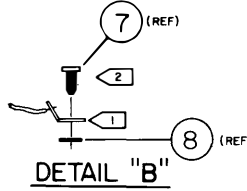
Figure 14 PCB Assembly Diagram, Sht 2

TORQUE 6 IN/LBS

TORQUE 12 IN/LBS



DETAIL "C"



DETAIL "B"

ITEM	P/N	DESCRIPTION	DES	QTY
18	512-10604-00	LOGO, GOLD, CAR AMP		1
17	403-00001-00	RUBBER BAND		1
16	403-20001-00	THERMALCOTE	AR	
15	530-20017-00	STICKER, SERIAL NO., CAR AMP		1
14	403-10009-00	LOCTITE, TAK PAK ADHESIVE	AR	
13	601-00379-00	ASSY, PREP END BRACKET "A", CAR AMP		1
12	151-30102-00	SCREW, SHT MTL PP BLK 8 X 3/8 "A"		4
11	151-30002-00	SCREW, SHT MTL PP BLK 4 X 3/8 "A"		1
10	154-10001-00	WASHER, FLAT SAE BLK NO.4		1
9	151-30003-00	SCREW, SHT MTL PP BLK 4 X 1/2 "B"		1
8	154-10051-00	WASHER, FLAT SAE BLK NO. 6		8
7	151-30053-00	SCREW, SHT MTL PP BLK 6 X 1/2 "B"		8
6	990-00005-00	CARD, TRAVEL WHITE		1
5	602-00376-00	ASSY, SUBTEST, CAR AMP (PRELIM)		1
4	511-10000-01	HEAT-SINK, ANO GRAY, CAR AMP		1
3	512-10603-00	MICA WASHER, CAR AMP (AMPLFR)		2
2	512-10602-00	MICA INSULATOR		2
1	601-00178-00	ASSY, PREP END BRACKET "B", CAR AMP		1

PARTS LIST		CONTRACT NO.		DATE	
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		J.A. LIVERS		5/28/85	
MATERIAL		APPROVALS		ASSY, FINAL TEST	
FINISH		CHECKED		CAR AMP	
NEXT ASSY		ISSUED		SIZE FROM NO.	
APPLICATION		DO NOT SCALE DRAWING		D	
				DWG. NO. 004-00301-00	
				SCALE	
				SHEET 1 of 1	

BISHOP GRAPHICS, INC.
REORDER NO. 1000

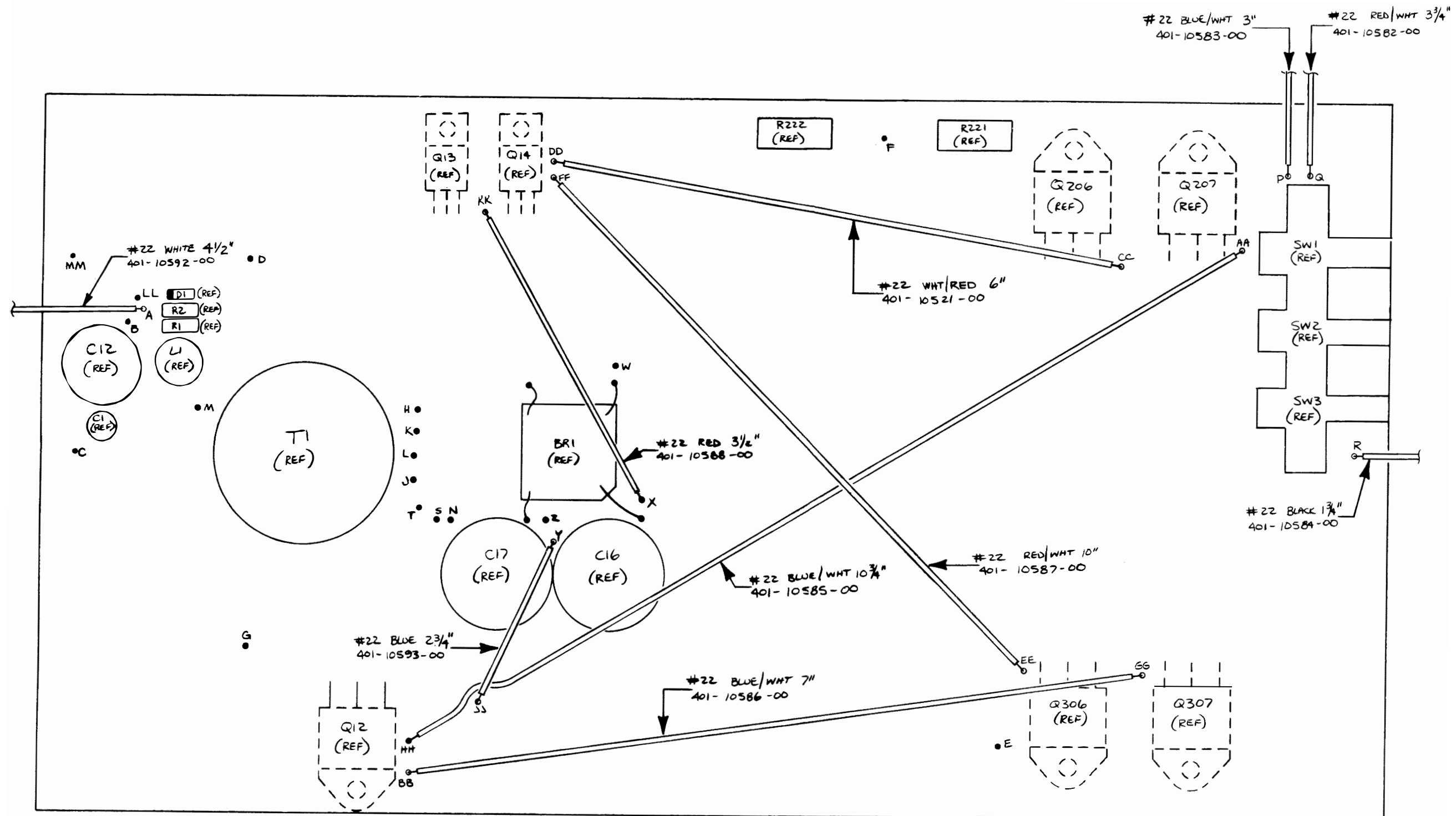


Figure 16 Assembly Instructions, Sht 1

QTY REQD	FSCM NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	MATERIAL SPECIFICATION
PARTS LIST				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES 1/16 .001 .001			CONTRACT NO.	
MATERIAL			APPROVALS DATE	
FINISH			DRAWN <i>[Signature]</i> 5/9/85	
APPLICATION			CHECKED	
DO NOT SCALE DRAWING			ISSUED	
			SIZE FSCM NO. DWG. NO. REV.	
			C C 601-00376-00	
			SCALE 2:1 SHEET 2 of 2	

Carver Corporation

ASSY, PCB
CAR AMP

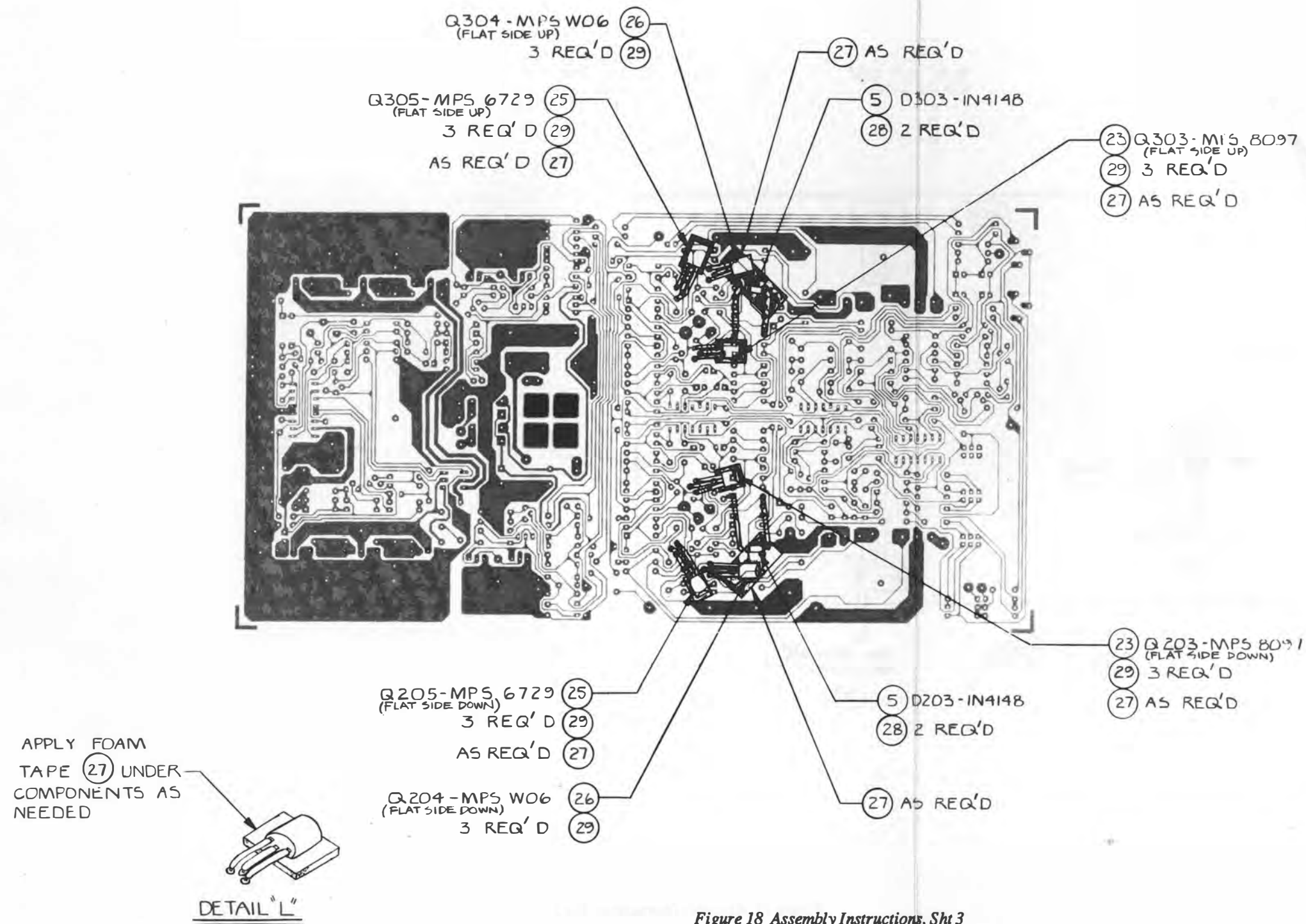
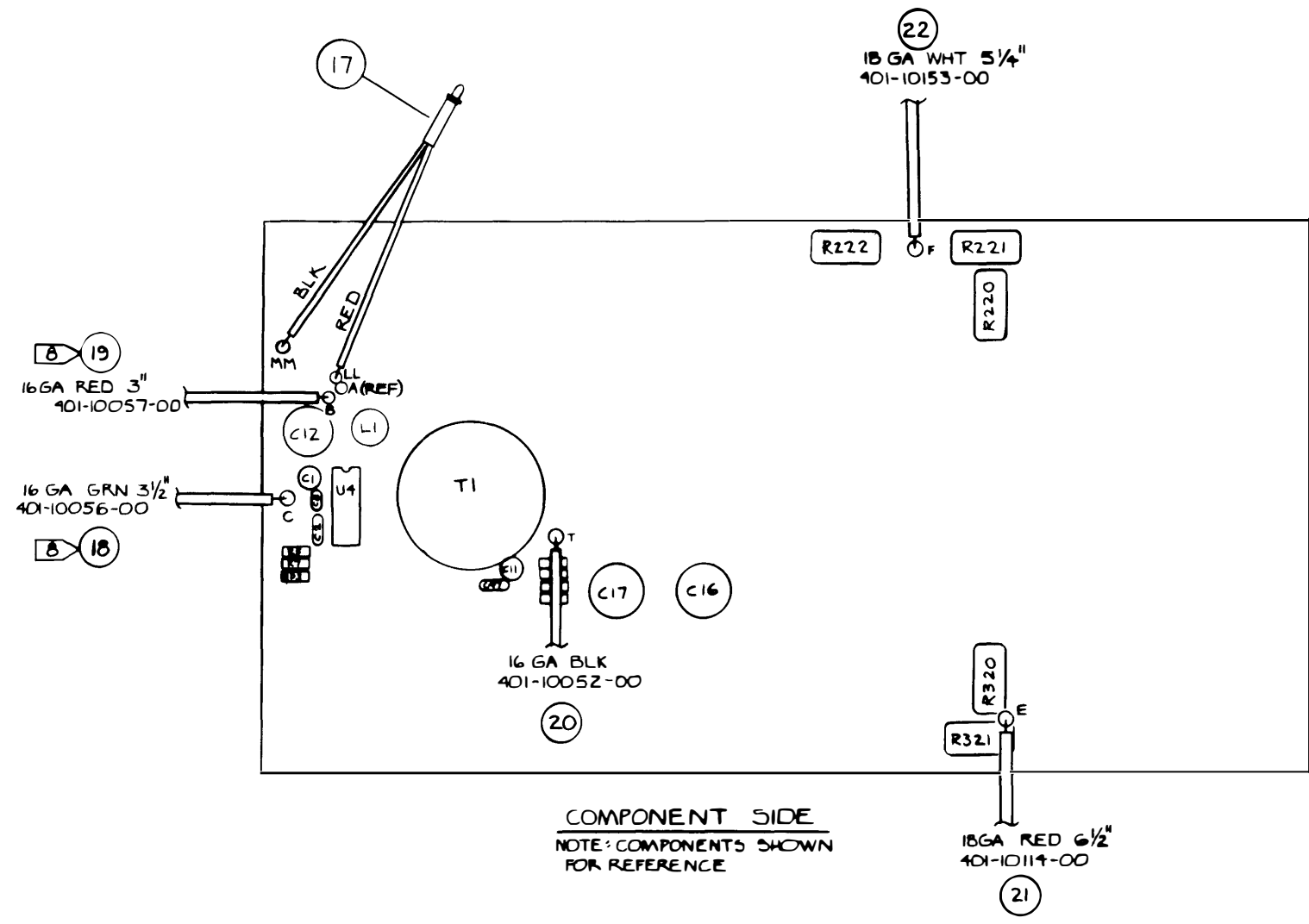


Figure 18 Assembly Instructions, Sht 3



- NOTES:
1. COMPONENTS SHOWN FOR REFERENCE
 2. [8] SEE PAGE 1 FOR NOTE AND DETAIL ON INSTALLING THESE WIRES.

Figure 17 Assembly Instructions, Sht 2

		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES XX . XXX .		CONTACT NO.		CARVER CORPORATION	
		MATERIAL		APPROVALS		DATE	
		FINISH		DRAWN JLM		7-26-85	
		NEXT ASSY		CHECKED		ASSEMBLY SUB TEST CAR AMP	
		USED ON				SIZE C CODE IDENT NO. DRAWING NO. 602-00376-00	
		APPLICATION		DO NOT SCALE DRAWING		SCALE 1/8" = 1"	
						SHEET 3 OF 3	

BISHOP GRAPHICS
REORDER NO. 1860 REV.

**CARVER CORPORATION
SERVICE BULLETIN**

Service Bulletin # M-240-2

Model M-240

Serial #

Reason: Parts MJE4340 and MJE4350 are no longer available.

Procedure: If these transistors need to be replaced:

Replace Q207, Q307 MJE4340 with TIP35B transistors.

Replace Q206, Q306 MJE4350 with TIP36B transistors.

Delete:

Qty-2 321-80001-00
MJE4340

Qty-2 321-80002-00
MJE4350

Add:

Qty-2 321-80000-00
TIP35B

Qty-2 321-80003-00
TIP36B

SERVICE APPROVAL _____
ENGINEERING APPROVAL _____

2/19/87