CARVER

C-9 SERVICE MANUAL

WARNING

Any person performing these procedures will be exposed to

HAZARDOUS VOLTAGES AND THE RISK OF ELECTRIC SHOCK

It is assumed that any person who removes the cover from the unit has been properly trained in precautions for avoiding risk of shock or injury. Therefore, the procedures described herein are to be performed by

QUALIFIED ELECTRONICS SERVICE PERSONNEL ONLY

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LIST of FIGURES and TABLES

Note: This is a technical manual intended for service personnel use. It is a companion document to the Model C-9 Owner's Manual. For information on set-up and use of the Model C-9, please refer to the Owner's Manual for detailed instructions and recommendations.

1.0 INTRODUCTION:

This manual is designed to address two primary areas of concern encountered when a Model C-9 is brought in for repair:

A. The manual contains those critical test procedures and expected results necessary to determine whether or not the unit is functioning as intended by design.

B. The manual provides diagnostic methods for locating the offending circuit element(s) once a valid malfunction has been detected.

The Model C-9 is unusual from the service perspective because of the highly critical, yet almost totally subjective, nature of its function. Obvious problems such as gross distortion, hum, noise or lack of an output signal are, of course, easy to recognize and categorize as true malfunctions. Unfortunately (from the service person's perspective), these kinds of problems are relatively rare in the Model C-9. In fact, about half of the units received at the factory repair center exhibit absolutely no malfuntion whatsoever!

This is because several essential elements necessary to achieve the optimum experience of Sonic Holography are external to the C-9 itself. A cursory reading of the C-9 Owner's Manual reveals that the C-9 hardware is simply one element of a total psycho-acoustic system responsible for providing the exciting, yet subtle and extremely subjective perception of Sonic Holography. Some C-9 owners have been premature in assuming fault with the unit when problems with the Hologram Effect are perceived.

More often than not, a thorough reading of the C-9 Owner's Manual and conscientious adherence to its recommendations will resolve most problems a customer might have in achieving the ultimate experience Sonic Holography can produce.

Since no piece of test equipment has been designed that is capable of perceiving and quantifying Sonic Holography effects in terms of Volts, Ohms, Amperes, decibels, percentages or Hertz, the Carver Corporation has developed a series of simple and straightforward test procedures which will absolutely verify or deny the proper operation and correct alignment of the critical Sonic Holography processing circuitry. These verification procedures require only common items of test equipment found on any professional audio test bench and a basic level of technical skill.

2.0 IDENTIFYING THE PROBLEM:

Before beginning any bench work, identify the general category of the customer's complaint and use the following outline to locate the reported problem in terms of three categories, each of which leads to a specific set of tests designed to determine whether or not the C-9 is at fault and then, if it is, to help locate the offending circuitry.

FIGURE 2.0 PROBLEM CATEGORY/PROCEDURE GUIDE:

I. Obvious Malfunctions --- see "GENERAL TROUBLESHOOTING"

A. Power On LED does not light or is extremely dim
B. One or both channels have no output signal
C. A loud tick, pop or thump on turn-on or turn-off
D. Grossly audible hum, noise or distortion
E. Intermittent operation (audibly cuts in and out)

II. Specification Shortfalls --- see "IC REPLACEMENT"

A. One or both channels fail to meet distortion specs
B. One or both channels fail to meet noise specs
C. One or both channels "squeal" or oscillate

III. Hologram Image Complaints---see "FUNCTIONAL VERIFICATION"

A. C-9 causes "crosstalk" between channels
B. Can't hear any Hologram effects on some program material
C. Hologram effect alters the harmonic content of instruments
D. Can't find the Holographic "sweet spot"
E. Just doesn't sound like it used to anymore

2.1 REQUIRED TOOLS and EQUIPMENT

The following list of equipment indicates which tools will be needed to address each of the problem categories and perform the related tests.

FIGURE 2.1 PROBLEM/EQUIPMENT MATRIX

CATEGORY of PROBLEM I	II	III	TOOLS AND EQUIPMENT REQUIRED
yes	yes	yes	Phillips Screwdriver
yes	no	no	DC Volt/ohm Meter
opt	no	yes	Dual Trace Triggered Oscilloscope & probes
opt	yes	yes	Low Distortion Tuneable Audio Oscillator
yes	yes	yes	AC Voltmeter, low noise
no	yes	no	Low Residual Distortion Analyser (distortion only)
no	yes	no	Two Phono Input Shorting Plugs (noise only)
no	yes	no	IHF "A" Weighting Filter (noise only)

3.0 UNIVERSAL PROCEDURES:

The following procedures apply to all internal service work on the C-9 unit regardless of which category the complaint fits.

3.1 Remove the cover from the unit
3.2 Verify that the AC line voltage selector is set for the local voltage
3.3 Verify that the proper value line fuse is installed for that voltage
3.4 Apply AC line power to the unit
3.5 Set INJECTION RATIO and LISTENING ANGLE buttons OUT; HOLOGRAM IN

The information regarding 3.2 and 3.3 (line voltage & fuse) is found in the section entitled "115/230 VOLT CONVERSION" (SECTION 7.0).

4.0 GENERAL TROUBLESHOOTING:

These procedures apply to the "dead" unit and/or units which exhibit severe hum, noise or distortion that is audible and/or units which function intermittently in terms of passing a signal or exhibit a turn-on thump.

4.1 Double check the AC power source and line fuse. Make sure the unit is plugged in.
4.2 Verify that the POWER ON LED is illuminated. If not, and step 4.3 is completed successfully, replace the LED or its series resistor.
4.3 Measure the bipolar DC supplies. A positive voltage of 12.8 plus or minus 1.5 should appear at every IC's pin #11 and a negative voltage within the same limits should appear at every IC's pin #7.
4.4 If step 4.3 yields unacceptable results, troubleshoot and repair the power supply and/or locate the offending shorted component(s).
4.5 If the supply voltages are within limits and a gross malfunction persists, try the following suggestions:

A. One channel dead...suspect bad solder connections and/or a short or crack in the PCB or a non-functioning IC section.
B. Gross hum on one or both channels...check the power supplies for excessive AC ripple components (>50 millivolts). If this is not the cause, look for open ground connections.
C. Gross distortion on one or both channels...can be caused by a near short on the output of any IC section but is more likely to be a bad IC. Moving from input to output while passing a 1 kHz test signal, look at each successive IC output until the guilty device is located.

4.6 If the unit functions properly except for a loud pop or thump upon power-up, suspect the turn-on mute circuitry. With a 2.5V 1kHz output signal present, power the unit down for 5 seconds. Upon turn-on, both outputs should be attenuated at least 20dB for about one second. If both channels fail this test, suspect the FET drive circuitry surrounding IC3. IC3 pin 12 should exhibit a positive signal upon power-up, suddenly switching to a negative level after a second or two. If the FET gate drive is correct, suspect the FET(s).

5.0 IC REPLACEMENT

Subtle yet excessive levels of noise or distortion are invariably caused by "below-spec" ICs. Prior to replacing any IC for these reasons, however, run the noise and distortion tests below:

5.1 Install shorting plugs in both inputs. Connect an IHF "A" weighted filter at the input of an AC voltmeter. All switches should remain in the positions described earlier (INJ. RATIO & LIST. ANGLE are OUT, HOLOGRAM is IN). The raw noise output of either channel should measure less than 30 microvolts. If an "A" weighting filter is not available, the noise may be measured "flat". A good rule of thumb in the case of the ICs used in the C-9 is to expect about three times the noise reading between an "A" weighted measurement and a "flat" one. Any reading below 100 microvolts (flat) is considered acceptable.

5.2 If output noise exceeds the specification, probe the outputs of each successive stage's ICs until the offending chip(s) are located and replace them.

5.3 Distortion is to be measured at the "rated" output of 2V rms. All the front panel pushbuttons are to be engaged (in) and the bandwidth of the distortion analyser should be limited by use of an 80kHz filter to suppress RFI since the cover is removed. Under these conditions, the THD readings should fall below 0.05% for any frequency between 20Hz and 20kHz.

5.4 If THD exceeds the specification, probe the outputs of each successive stage's ICs until the offending chip(s) are located and replace them.

5.5 It is our experience that if noise and THD specifications are met, the IM distortion will always fall below the specified level. If you wish to measure it, be sure to use the standard SMPTE frequency mix and signal ratios. The resulting measurement should be below .05% at the rated (2 Volt) output.

5.6 If oscillation (self-sustained ringing) is the problem, locate the earliest IC output node in the circuitry at which it is present and replace the offending part.

6.0 FUNCTIONAL VERIFICATION

Once the basic circuitry is functioning without obvious problems, tests may be completed to determine the critical alignment of the primary Holographic circuits. Since these circuits purposely cross-feed portions of the stereo signal, expect a considerable amount of "crosstalk" between channels. This is normal and well controlled. Begin with all pushbuttons in their OUT positions.

6.1 Drive both inputs with a 1kHz signal at 0dBm (.775 Vrms) and verify the presence of identical signals at each output. Switch the HOLOGRAM function to its on (IN) position.

6.2 Using a dual-trace oscilloscope, connect one probe to IC2, pin 4 and set the scope's triggering to activate and lock on that signal.

6.0 FUNCTIONAL VERIFICATION, cont.

6.3 While driving both channels (at the previously-established reference level), adjust the frequency upward while alternately probing IC5, pin 4 and IC4, pin 4 on the scope's second channel. Compare the phase angles between scope traces until a precise 360 degree phase shift is exhibited, first at IC5 and then IC4. The phase shift networks are tuned correctly if this 360 degree shift occurs at a frequency between 8.0kHz and 8.8kHz on both channels and if both channels' phase shift alignment frequencies track within 400 Hz of each other. The nominal frequency is 8.4kHz @ 360 degrees; 119 microseconds of signal delay. If this test results in acceptable findings, proceed to step 6.6.

6.4 As a further test of the delay networks, their frequency responses may be measured. Because the delay networks are preceeded by circuitry with its own frequency response variations, each measurement at a new frequency must be "zeroed" by driving both inputs to the level required to achieve a 0dBm (.775Vrms) level at the phase shift network input node, IC2 pin 4. The relative responses of the shifters may then be noted at IC4 and IC5 pins 4, and should correspond within 1.5 dB to the chart and check-points described by Figure and Table 6.4.

Figure 6.4 Delay Network Frequency Response Curve

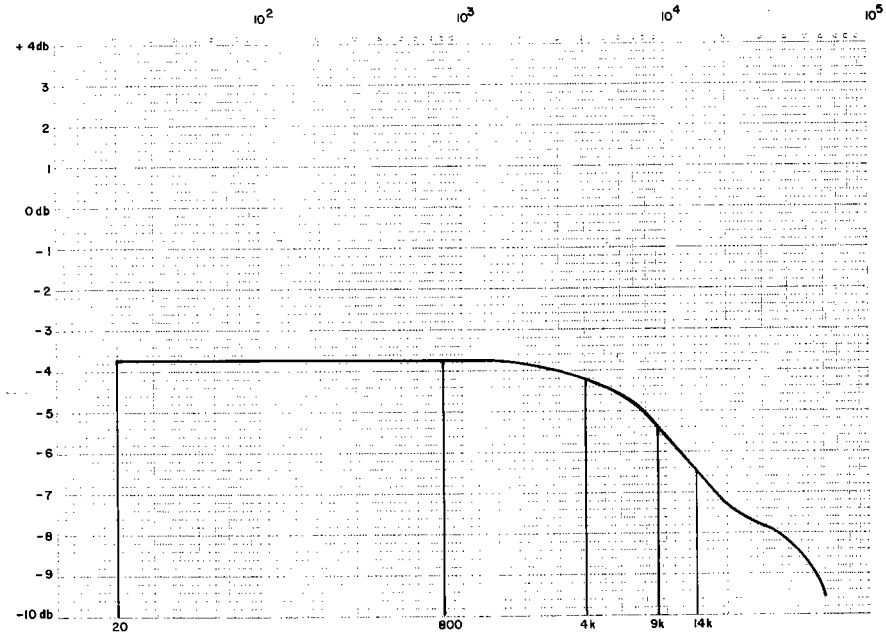


Table 6.4 Delay Network Test Points/Results

Test Frequency	IC2 pin 4	IC4/IC5 pin 4	Delay Time
20 Hz	0dBm	-3.7dB	IC2 pin 4 to either
800 Hz	0dBm	-3.8dB	IC4 or IC5 pin 4:
4000 Hz	0dBm	-4.2dB	360 degrees 8.4kHz
9000 Hz	0dBm	-5.4dB	(i.e. 119 uSec)
14000 Hz	0dBm	-6.5dB	

6.0 FUNCTIONAL VERIFICATION, cont.

6.5 There is no provision for adjustment of the phase networks. However, if they deviate from the performance as described in 6.3 & 6.4, a stage-by-stage comparison between channels (IC4/5 pins 3, 12, 10 & 4) should reveal the detuned element(s). Replacement of the .001 mFd phase shift capacitors with known close-tolerance parts is the fix.

6.6 Proceed to verify the overall frequency response and cross-channel feed characteristics per Figure 6.6 and Table 6.6, below Please note that the frequencies of interest are in the smoother portion of the overall response curves...we have already dealt with the alignment of the critical phase shift networks which are responsible for the "comb" filter effect above 4kHz. Test conditions are as follows:

A. Input signal is 0dBm (.775Vrms) @ 20Hz, 800Hz & 4kHz
B. INJECTION RATIO & LISTENING APERTURE switched OUT (NORMAL/NARROW)
C. HOLOGRAM switched IN (ENGAGE)

Drive one channel alone to measure the "DRIVEN" and "UNDRIVEN" (cross-feed) responses. Drive both channels simultaneously to measure the composite "BOTH CHANNELS DRIVEN" response. Measured results must be within 1.5dB (plus or minus) of the values in Table 6.6.

Figure 6.6 Composite Frequency Response Curves

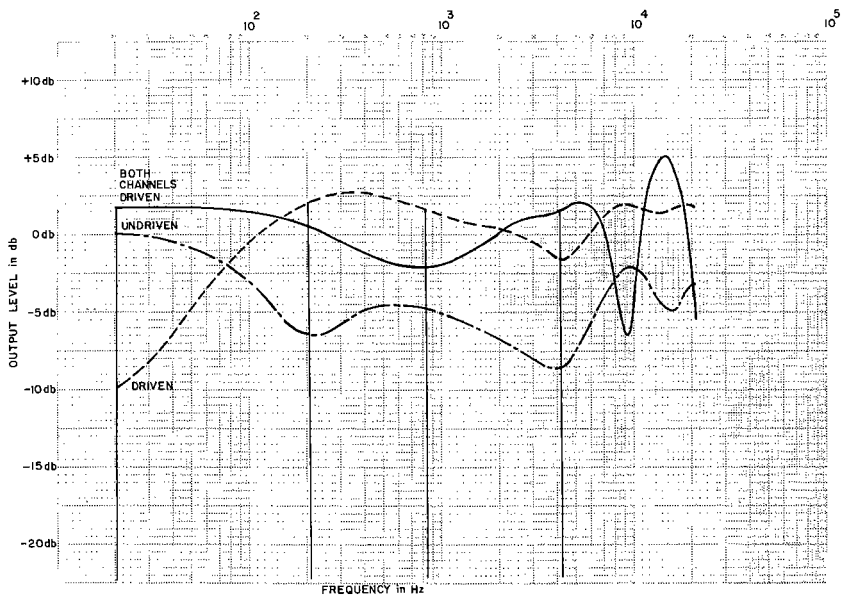


Table 6.6 Composite Test Points/Results

Test Frequency (Hz)	One Channel Driven		Both Channels Driven
	Driven Ch.	Undriven Ch.	
20	-10.2dB	+.1dB	+1.8dB
800	+1.5dB	-5.0dB	-2.2dB
4K	-1.8dB	-8.6dB	+1.4dB

6.0 FUNCTIONAL VERIFICATION, cont.

6.7 If the frequency response tests show errors, it is adviseable to disconnect the phase networks temporarily and repeat the frequency response tests. This is accomplished by de-soldering and lifting one end of resistors R45 and R105. With the "comb" filtering defeated in this way, troubleshooting of the remaining input circuitry is much more straightforward. Test conditions are the same as before, except that two new frequencies have been added at the upper end.

6.8 Drive each channel alone and then both channels together. Use the block diagram to pinpoint the location of any error sources in the response if the curves deviate from the values given in Table 6.8 and shown in Figure 6.8. As before, the acceptable deviation from the nominal values is 1.5dB (plus or minus).

Figure 6.8 Disconnected Response Curves

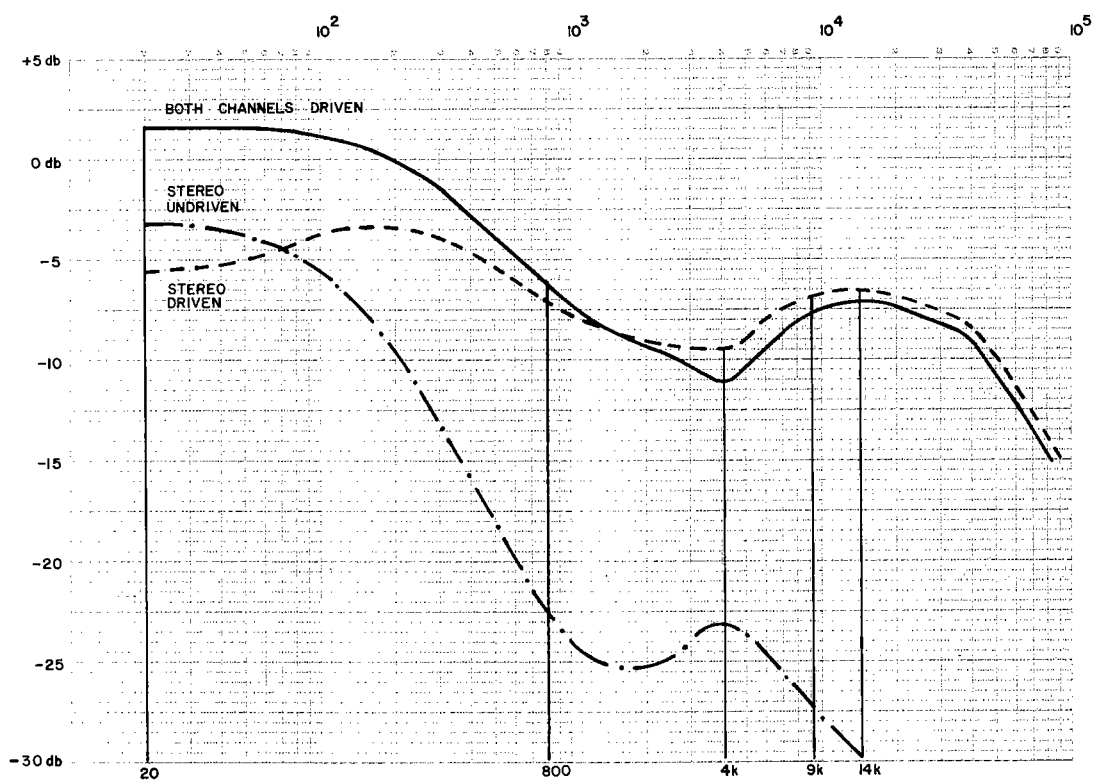


Table 6.8 Disconnected Test Points/Results

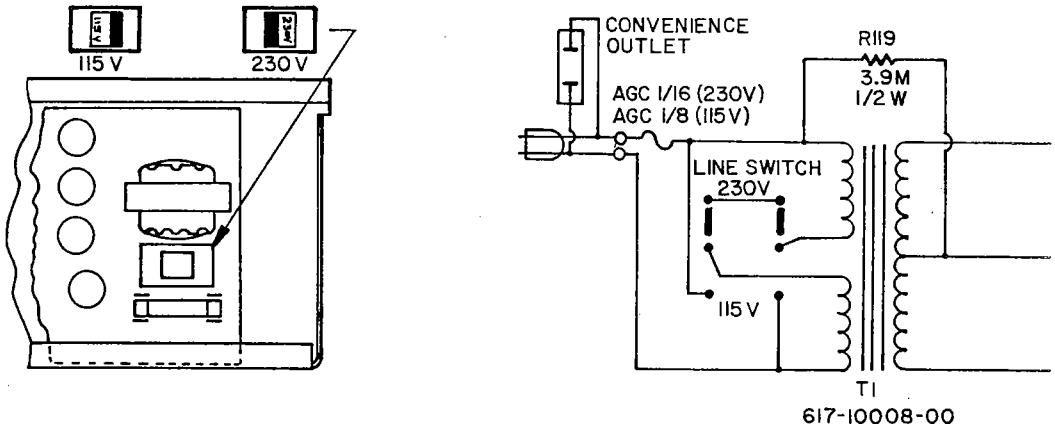
Test Frequency (Hz)	One Channel Driven		Both Channels Driven
	Driven Ch.	Undriven Ch.	
20	-5.6dB	-3.1dB	+1.8dB
800	-7.0dB	-22.8dB	-6.2dB
4K	-9.4dB	-23.3dB	-11.1dB
9K	-7.0dB	-27.5dB	-7.8dB
14K	-6.8dB	-30.0dB	-7.3dB

7.0 115/230 LINE VOLTAGE CONVERSIONS

Some units are equipped with AC LINE VOLTAGE conversion switches. These are typically those which are shipped to European countries and/or sales outlets dealing with military personnel. Standard USA domestic units and those destined for Canada (CSA approval label on rear) do not feature such a switch and cannot be converted without exchanging the line power transformer. The schematic diagram shows a non-convertible type.

7.1 If the unit is equipped with a switch, it may be converted by following the instructions, below. Refer to Figure 7.1 for the locations of the fuse and switch, and the schematic detail.

Figure 7.1 115/230 Line Voltage Conversion Switch & Fuse



7.2 CONVERSION FROM 115 TO 230

A. Remove AGC 1/8 Amp fuse from fuseholder
B. Install AGC 1/16 Amp fuse in fuseholder
C. Change line voltage switch to 230V position so that the legend "230" appears visibly
D. Apply "240V" label (Carver P/N 530-10001-00) over "120" silk-screen designation on rear panel near line cord entry

7.3 CONVERSION FROM 230 TO 115

A. Remove AGC 1/16 Amp fuse from fuseholder
B. Install AGC 1/8 Amp fuse in fuseholder
C. Change line voltage switch to 115V position so that the legend "115" appears visibly
D. Remove the "240V" label from the rear panel near line cord entry point, exposing original "120V" silkscreen designation

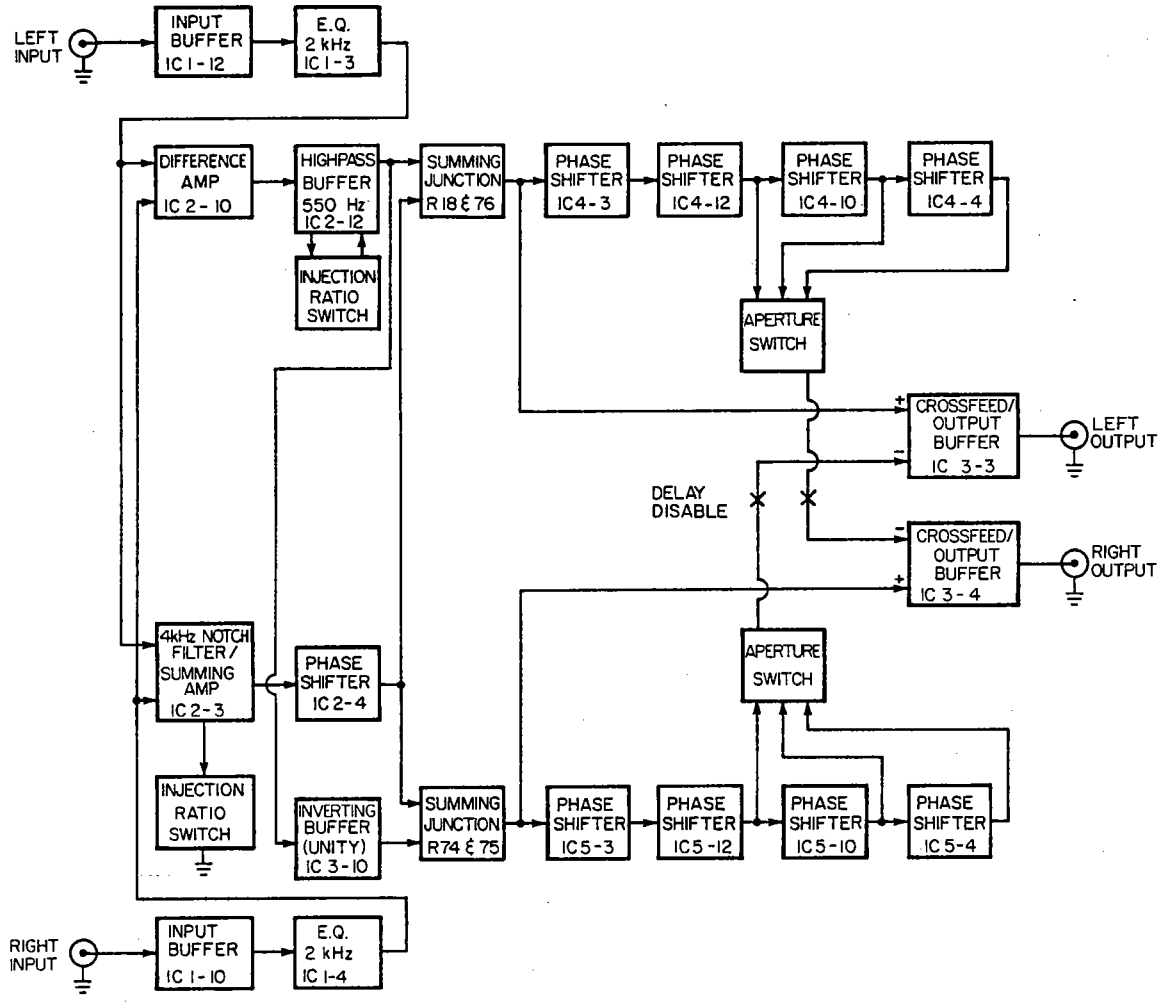
8.0 PRODUCT SPECIFICATIONS (verifiable):

A.	Total Harmonic Distortion	less than .05% 20Hz-20kHz @ 2Vrms
B.	IM Distortion	less than .05% SMPTE
C.	Noise @ Output (input shorted)	less than 30uV ("A" weighted)
D.	Output @ Clipping	more than 6Vrms @ 1kHz
E.	Size (excluding buttons, panel)	1.68" x 3.88" x 17.75"
F.	Power Supply	120VAC, 60Hz or 220VAC, 50Hz 10W

Note: Specifiacations are subject to change without notice

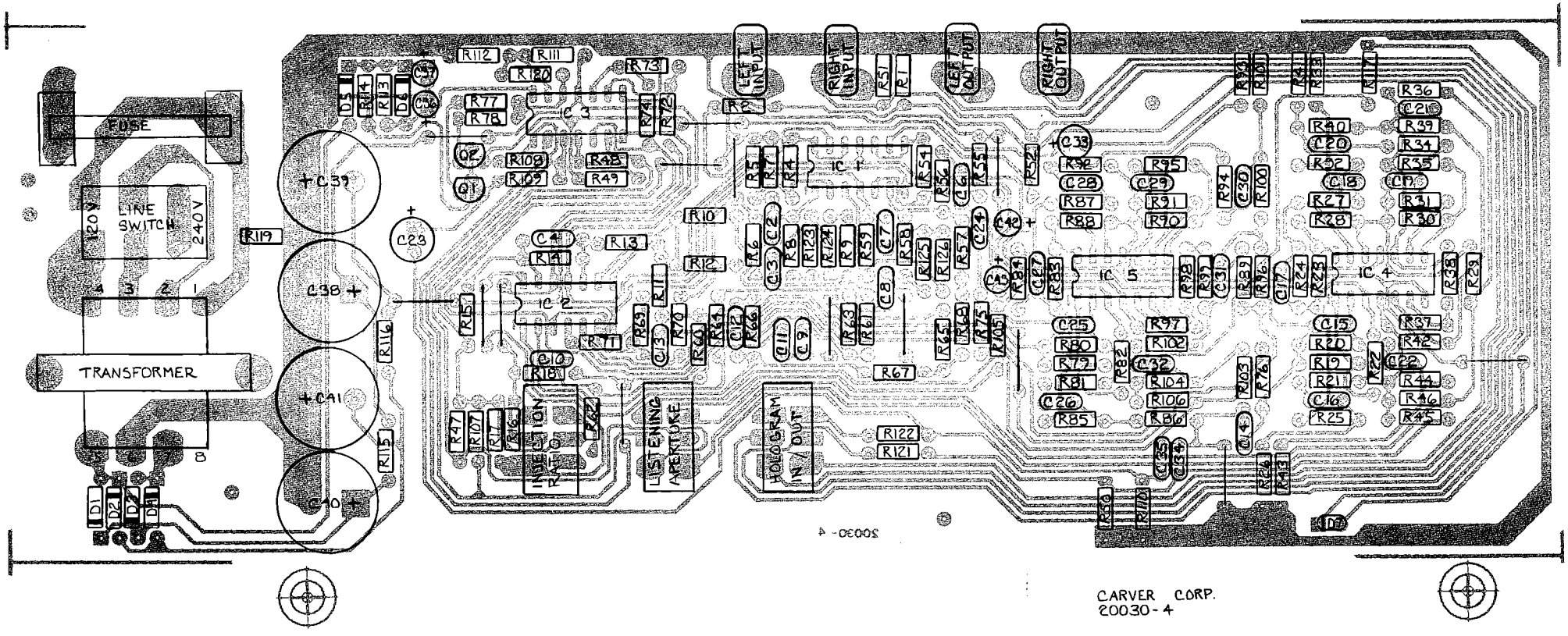
9.0 ELECTRONIC DIAGRAMS

Figure 9.1 Block Diagram



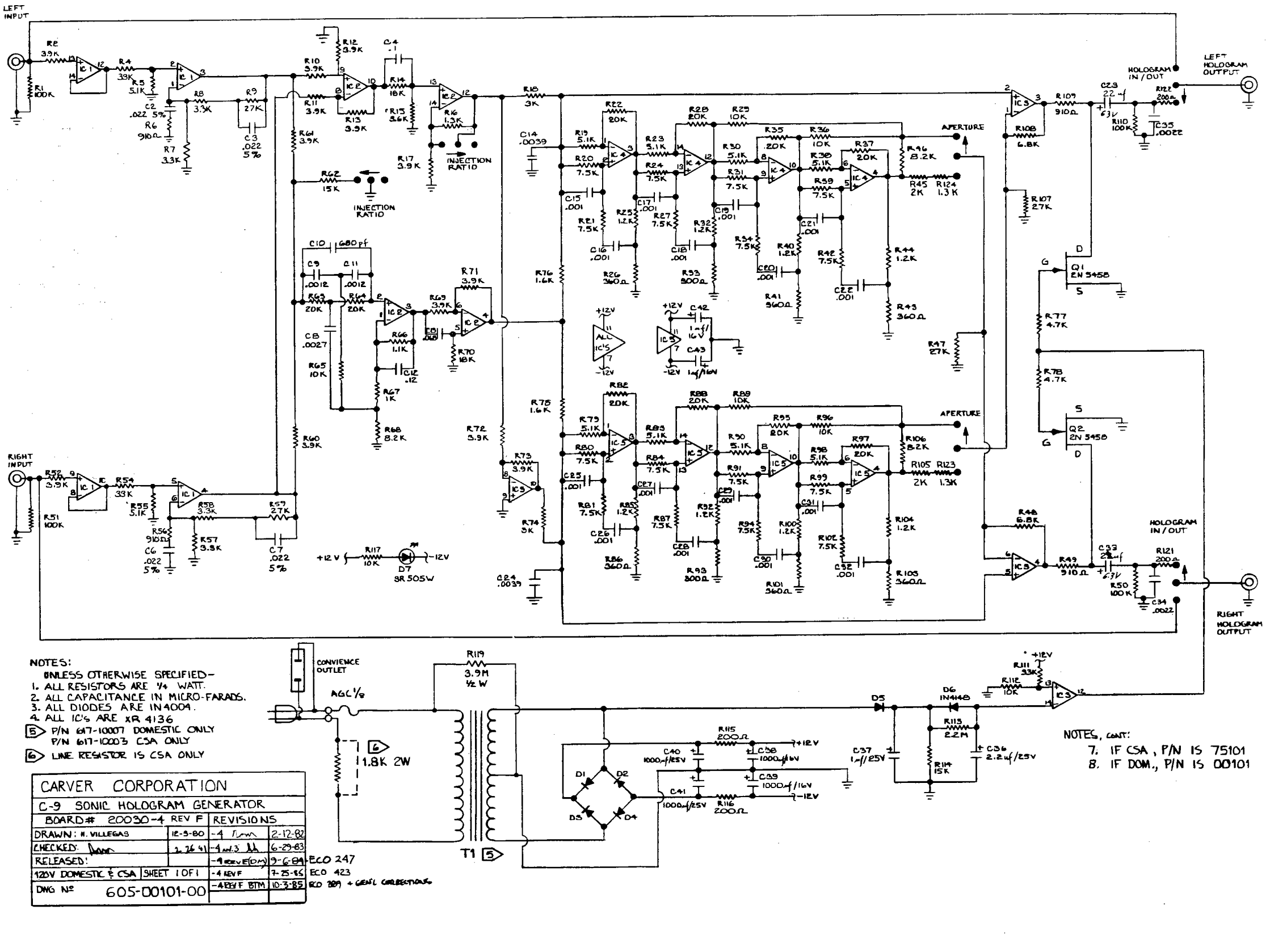
9.0 ELECTRONIC DIAGRAMS, cont.

Figure 9.2 Parts Locator



9.0 ELECTRONIC DIAGRAMS, cont.

Figure 9.3 Detailed Schematic Diagram



10.0 REPLACEABLE PARTS LIST

C-9 PARTS

REFERENCE DESIGNATOR	CARVER PART NUMBER	DESCRIPTION
C 10	201-00026-00	CAP CER DISC 680PF 10% 1000V
C11 C9	204-00004-00	CAP MYLAR .00012UF
C34 C35	204-00007-00	CAP MYLAR .0022UF
C8	204-00008-00	CAP MYLAR .0027UF
C24 C14	204-00010-00	CAP MYLAR .0039UF
C2 C3 C6 C7	204-00019-00	CAP MYLAR .0022UF %5
C13	204-00025-00	CAP MYLAR .068UF
C4	204-00027-00	CAP MYLAR .1UF
C12	204-00028-00	CAP MYLAR .12UF
C15 C22 C25 C32	204-00040-00	CAP MYLAR .001UF
C37 C42 C43	205-00001-00	CAP ELECTROLYTIC 1UF 50V RAD
C36	205-00002-00	CAP LYTIC 2.2UF 35V RADIAL
C23 C33	205-00011-00	CAP LYTIC 22UF 16V RADIAL
C38 C39	205-00023-00	CAP LYTIC 1000UF 16V RADIAL
C40 C41	205-00025-00	CAP LYTIC 1000UF 25V RAD 1"H
R115 R116 R121 R122	251-00053-00	RES CFILM 200 OHM ¼W PREP .4
R33 R93	251-00057-00	RES CFILM 300 OHM ¼W PREP .4
R26 R41 R43 R86 R101 R103	251-00059-00	RES CFILM 360 OHM ¼W PREP .4
R6 R49 R56 R109	251-00069-00	RES CFILM 910 OHM ¼W PREP .4
R67	251-00070-00	RES CFILM 1 K ¼W PREP .4
R66	251-00071-00	RES CFILM 1.1 K ¼W PREP .4
R25 R32 R40 R44 R85 R92 R100 R104	251-00072-00	RES CFILM 1.2 I ¼W PREP .4
R16 R45 R105	251-00073-00	RES CFILM 1.3 K ¼W PREP .4
R75 R76	251-00075-00	RES CFILM 1.6 K ¼W PREP .4
R45 R105	251-00077-00	RES CFILM 2 K ¼W PREP .4
R18 R74	251-00081-00	RES CFILM 3 K ¼W PREP .4
R7 R8 R57 R58	251-00082-00	RES CFILM 3.3 K ¼W PREP .4
R15	251-00083-00	RES CFILM 3.6 K ¼W PREP .4
R2 R10 R11 R12 R13 R17 R52 R60 R61 R69 R71 R72 R73	251-00084-00	RES CFILM 3.9 K ¼W PREP .4
R77 R78	251-00086-00	RES CFILM 4.7 K ¼W PREP .4
R5 R19 R23 R30 R38 R55 R79 R90 R98 R83	251-00087-00	RES CFILM 5.1 K ¼W PREP .4
R48 R108	251-00090-00	RES CFILM 6.8 K ¼W PREP .4
R20 R21 R24 R27 R31 R34 R39 R42	251-00091-00	RES CFILM 7.5 K ¼W PREP .4
R46 R68 R106	251-00092-00	RES CFILM 8.2 K ¼W PREP .4
R29 R36 R65 R89 R96 R112 R117	251-00094-00	RES CFILM 10 K ¼W PREP .4
R62 R114	251-00098-00	RES CFILM 15 K ¼W PREP .4
R14 R20	251-00100-00	RES CFILM 18 K ¼W PREP .4
R22 R28 R35 R37 R63 R64 R82 R88 R95 R97	251-00101-00	RES CFILM 20 K ¼W PREP .4
R9 R47 R59 R107	251-00104-00	RES CFILM 27 K ¼W PREP .4
R4 R111 R54	251-00106-00	RES CFILM 33 K ¼W PREP .4
R1 R50 R51 R110	251-00118-00	RES CFILM 100 K ¼W PREP .4
R113	251-00150-00	RES CFILM 2.2 M ¼W PREP .4
R119	251-10156-00	RES CFILM 3.9 M ½W PREP .5
06	320-20001-00	DIODE IN 4148 75V PREP
01 02 03 04 05	320-20004-00	DIODE IN 4004 400V PREP
Q1 Q2	321-40005-00	XISTOR TO92 JFET SM SG 2N 5458
IC1 IC2 IC3 IC4 IC5	330-30003-00	IC QUAD OP AMP (4136)

10.0 REPLACEABLE PARTS LIST, cont.

CARVER PART NUMBER	DESCRIPTION
105-40001-00	FUSEHOLDER CLIP PCB MOUNT
109-10001-00	PHONO JACK SINGLE PC MOUNT
315-10502-00	FUSE AGC 1/8
315-10501-00	FUSE AGC 1/16
318-10003-00	SWITCH PUSH 3 KEY
318-00001-00	SWITCH LINE VOLTAGE SELECTOR
601-00101-00	ASSY, PCB OUTBDHOLOGRAM C9 110V
617-10007-00	TRANSFORMER 110V C9
617-10008-00	TRANSFORMER 110/220V C9
101-30002-00	BUMPONS, RUBBER ROUND SMALL
118-90001-00	STRN RE MCT.062 WS.15X.28 18/2
151-20001-00	SCREW MACH PP BLK 440X1/4
160-00001-00	CONVENIENCE OUTLETS
401-90001-00	LINECORD 18 GAGE 2 WIRE SPT 2
502-30016-01	CHASSIS SCREEN C-9
508-20001-01	BUTTON MOLDED & PAINTED BLK
151-30051-00	SCREW SHT MTL PP BLK 6X1/4 "B"
504-20008-01	COVER TOP PAINT BLK C-9
506-20051-01	STRIP, APPEARANCE END PNT BLK
532-10003-00	BAG PLASTIC 7"X24"
532-20004-00	BX C9/DTL 19 7/8X3 1/8X5 15/16
532-30006-00	FOAM END C-9/DTL
990-00003-00	CARD, WARRANTY REGISTRATION
990-00004-00	CARD, LIMITED WARRANTY
990-20004-00	MANUAL C-9