

INSTRUCTION MANUAL
MODEL 154
PROGRAMMABLE
WAVEFORM GENERATOR

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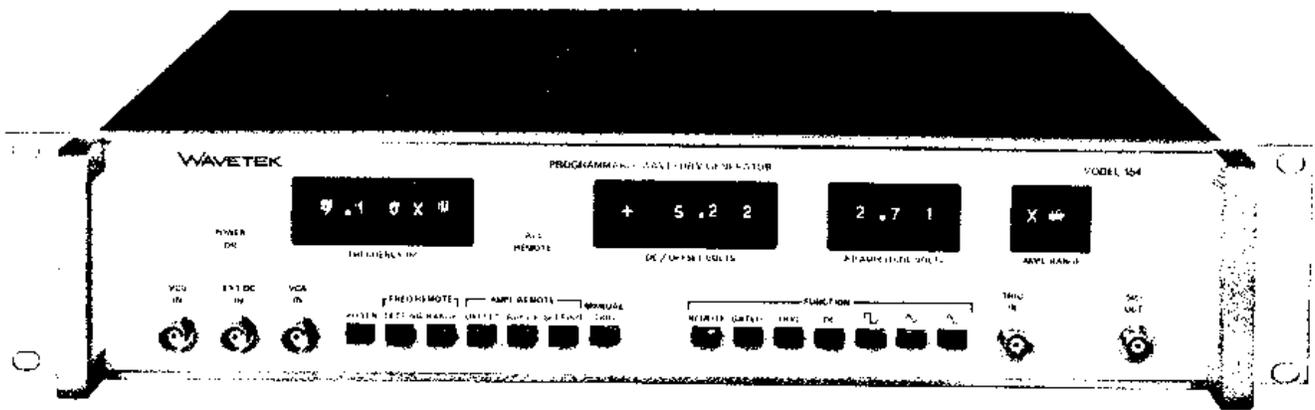


Figure i – Model 154 Programmable Waveform Generator

SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance, and repair of this instrument. Wavetek's product improvement program ensures that the latest electronic developments are incorporated in all Wavetek instruments by the addition of circuit and component changes as rapidly as development and testing permit. Due to the time required to document and print instruction manuals, it is not always possible to incorporate the more recent changes in the released manual. In this case, data will be found on engineering change sheets at the rear of the manual. If no change sheets are included, the manual is correct as printed.

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SECTION 1

INTRODUCTION

1.1 GENERAL CAPABILITIES

The Model 154 Programmable Waveform Generator is a precision source of sine, square and triangle waveforms covering a frequency range from 0.001 Hz to 10 MHz. In addition, a calibrated, programmable dc voltage output is provided. Amplitude, frequency and dc level may be digitally programmed with three digit resolution. Amplitude, frequency and dc level may also be modulated by an analog control voltage. The generator may be operated in continuous, triggered or gated modes. All controls may be locally or remotely programmed. All programming is DTL/TTL compatible.

1.2 PHYSICAL AND ELECTRICAL SPECIFICATIONS

1.2.1 Versatility

Output Signals

DC voltage, Sine , Square  and Triangle  selectable, with auxiliary pulse output.

Frequency Range

0.001 Hz to 10 MHz in 10 decade ranges, with 3 digit resolution.

Main Output

DC voltage, ± 0.1 Vdc to 10 Vdc at 100 mA maximum. Output impedance less than 1Ω . , , , 0.001V peak to peak to 10 V peak to peak into 50Ω load. Output impedance 50Ω . All waveforms may be offset 5 V above or below ground level with 3 digit resolution and selectable polarity. Signal level plus offset voltage not to exceed ± 7.5 V peak into 50Ω load.

Auxiliary Output

50% duty cycle pulse at generator frequency. Fixed amplitude, 0 to +6 V peak into open circuit (0 to 3 V into 50Ω).

Operating Modes

Continuous, trigger, or gated mode, selectable. The generator may be triggered to produce single cycles by pushbutton trigger or external trigger command. Any discrete number of cycles will be produced by applying a gate signal for the desired burst width when in the gated mode. Minimum voltage required for trigger = +3 V, 50 V can be applied without damage.

Analog Modulation Control

The frequency, amplitude and dc offset level of the generator can be independently controlled by an external voltage. The control can be dc programming or wideband modulation.

1.2.2 Accuracy

Horizontal Precision

Frequency accuracy of the generator, whether programmed manually with front panel switches or remotely by external digital programming:

0.001 Hz to 100 kHz	$\pm(1\%$ of setting +1 digit)
100 kHz to 1 MHz	$\pm(1\%$ of full scale)
1 MHz to 10 MHz	$\pm(2\%$ of full scale)

Vertical Precision

and Waves

0.001 Hz to 100 kHz	$\pm(1\%$ of setting +1 digit)
100 kHz to 1 MHz	$\pm(2\%$ of setting +1 digit)
1 MHz to 10 MHz	$\pm(5\%$ of setting +1 digit)

Wave

0.001 Hz to 10 kHz	$\pm(1\%$ of setting +1 digit)
------------------------------	--------------------------------

Vertical precision stated is for X1 amplitude multiplier. For X0.1, X0.01 and X0.001 add 1% per step.

DC Voltage

$\pm(1\%$ of setting +1% of full scale).

DC Offset

$\pm(1\%$ of setting +1% of range).

1.2.3 Waveform Purity

Stability

Short term	$\pm 0.05\%$ for 10 minutes
Long term	$\pm 0.25\%$ for 24 hours

Percentages apply to frequency, amplitude and dc offset stability.

Time Symmetry

1% to 500 kHz.

Amplitude Symmetry

All waveforms to 500 kHz are symmetrical about ground within $\pm 1\%$ of range maximum p-p amplitude.

Sine Distortion

10 Hz to 100 kHz Less than 0.5%
 0.001 Hz to 1 MHz Less than 1.0%
 1 MHz to 10 MHz All harmonics at least -28 dB

Square Wave

Auxiliary output better than 5 nanosecond rise and fall time with less than 5% aberrations. Main output better than 35 nanosecond rise time with aberrations less than 5% ±10 mV.

Triangle Linearity

Greater than 99%, 0.01 Hz to 100 kHz.

DC Voltage

Ripple and noise less than 10 mV rms with generator idle.

1.2.4 Analog Control Characteristics

Voltage Control of Frequency (VCG)

Up to 1000:1 frequency change with an external voltage input of 5 volts. The upper frequency is limited to maximum of selected range. VCG input impedance 3.3 kΩ.

VCG Response

Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

VCG Linearity

1.0 Hz to 100 kHz ±0.2% of full scale
 0.001 Hz to 1 MHz ±0.5% of full scale

Voltage Control of Amplitude (VCA)

Full amplitude control with an external voltage input of ±5 volts. The control is bipolar, that is, the amplitude can be controlled from maximum through null to range maximum at inverted phase. VCA input impedance is 3.3 kΩ.

VCA Response

Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

VCA Linearity

1% of full scale.

Voltage Control of DC Offset

All waveforms may be offset above or below ground level by an external voltage. Sensitivity of the signal is +2 or -2 volts offset per volt input dependent on dc polarity selected. Input impedance is 3.3 kΩ. Signal level plus offset voltage not to exceed ±7.5 volts peak into 50Ω load.

DC Offset Response

Bandwidth 100 kHz limited by a slew rate of 2% of range per microsecond.

DC Offset Linearity

1% of full scale.

1.2.5 Environmental

Specifications apply at 25°C ±5°C. For operation from 0°C to +50°C, derate all specifications by a factor of 2. Instrument may be stored from -50°C to +80°C without damage.

1.2.6 Mechanical

Dimensions

19-inch rack mount panel, 3½ inches high, 16½ inches deep.

Weight

15 lb. net, 24 lb. shipping.

Power

105 V to 125 V or 200 V to 250 V; 50 to 400 Hz; less than 45 watts.

NOTES

All specifications apply for control settings from 1.00 to 9.99.

On 1 MHz range only X1 and X0.1 amplitude settings apply.

1.3 PROGRAMMING

Description

All functions may be remotely controlled by BCD logic level programming. Front panel push button switches can be used to select local (front panel) control or remote control. When all controls are in the remote position, a logic voltage output is enabled for computer verification as well as illumination of a front panel light for visual verification. Signal ground and program ground are isolated.

Program Requirements

Frequency	3 digits	12 lines
Frequency Range	10 ranges	4 lines
Amplitude	3 digits	12 lines
Amplitude Range	4 ranges	2 lines
DC Level	3 digits	12 lines
DC Polarity	0, + or -	2 lines
Function	∩, □, ∨ or dc	2 lines
Mode	Cont. Trig or Gate	2 lines
Output	Front or rear panel	1 line
Return	2 lines
All remote	Output for verification	1 line

Total No. of Lines for Complete Control 52 lines

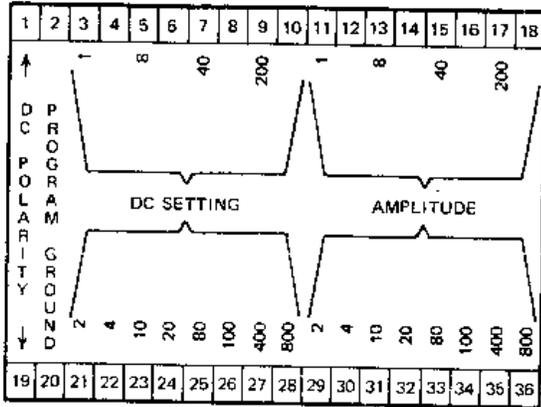
Program Transition Time

Frequency, amplitude and dc offset settings respond in less than 100 μs. Frequency range, function, offset polarity and attenuator respond in less than 3 ms.

CONTROL CONNECTOR PIN LAYOUT

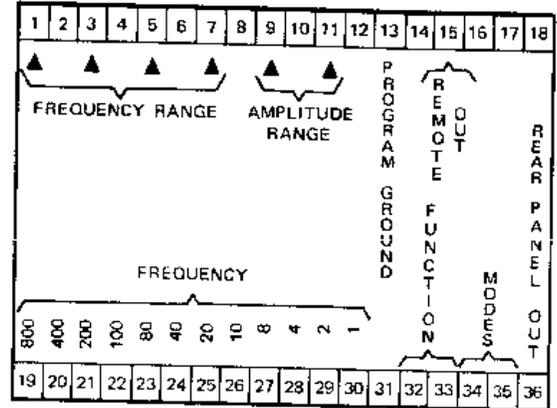
Plug J2

Mating Connector
Amphenol 57-30360



Plug J3

Mating Connector
Amphenol 57-30360



Standard Control Logic

Logic 1 = +2.4 V to +10 V, typical sink current 1.5 mA per line.

Logic 0 = -1 V to +1 V, open circuit voltage is approximately -0.7 V.

TRUTH TABLES WITH PIN ASSIGNMENTS

DC Polarity	Program (Pin No.) 19 1	Frequency Range	Program (Pin No.) 7 5 3 1	Amplitude Range	Program (Pin No.) 11 9	Function	Program (Pin No.) 33 32	Mode	Program (Pin No.) 35 34
+	0 0	0.001	0 0 0 0	0.001	0 0	 	0 0	Continuous	0 0
0	0 1	0.01	0 0 0 1	0.01	0 1		0 1	Gated	0 1
-	1 0	0.1	0 0 1 0	0.1	1 0		1 0	No Output	1 0
		1.0	0 0 1 1	1.0	1 1		1 1	Trigger	1 1
		10	0 1 0 0						
		100	0 1 0 1						
		1 K	0 1 1 0						
		10 K	0 1 1 1						
		.1 M	1 0 0 0						
		1 M	1 0 0 1						

2

SECTION

INSTALLATION AND OPERATION

2.1 MECHANICAL INSTALLATION

After unpacking the instrument, visually inspect all external parts for possible damage to switches, connectors, surface areas, etc. If damage is discovered, file a claim with the carrier who transported the unit. The shipping container and packaging material should be saved in case reshipment is required.

The front panel has been designed to allow this unit to be mounted in a standard 19-inch equipment rack. No mechanical installation is required when the instrument is to be used as a portable bench unit.

2.2 ELECTRICAL INSTALLATION

2.2.1 Power Connection

NOTICE

Unless otherwise specified at the time of purchase, all Wavetek Model 154 instruments are shipped from the factory with the power transformer connected for operation on a normal 115-volt ac line supply, and a ½ amp 115-volt slow blow line fuse.

To convert to 230 volts, set the slide switch at the rear of the instrument to 230, and replace the fuse with a slow blow fuse rated at ¼ amp at 230 volts.

Connect the ac line cord to the mating connector at the rear of the unit.

2.2.2 Signal Connections

Use 50Ω shielded cables equipped with female BNC connectors to distribute all RF signals when connecting this instrument to associated equipment.

2.3 OPERATING CONTROLS

The operating controls and electrical connections for the Model 154 are shown in Figures 2-1 and 2-2. Each of the following paragraph numbers corresponds to a number appearing in Figure 2-1, front panel, and Figure 2-2, rear panel.

1. **Power On Indicator** – The indicator is illuminated when the unit is on.

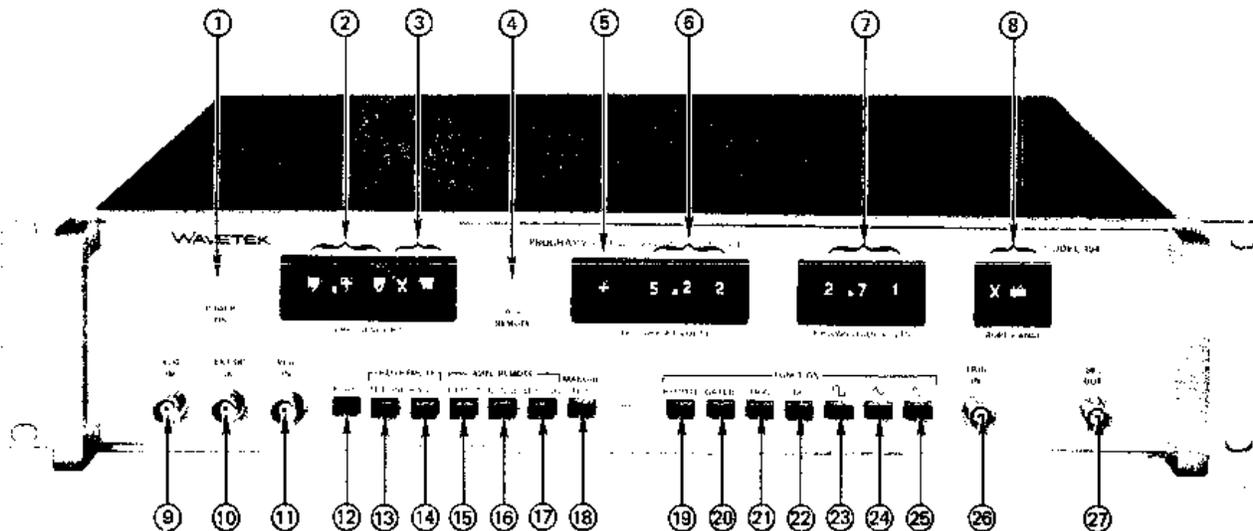


Figure 2-1. Operating Controls, Front Panel

2. **Frequency Hz Setting** – A three-digit thumbwheel switch is provided for output frequency selection. For the actual output frequency, this value is multiplied by the frequency Hz range multiplier (3).
3. **Frequency Hz Range Multiplier** – This thumbwheel switch has ten decade ranges from 1 millihertz to 1 megahertz. This value multiplied by the setting (2) gives the output frequency.
4. **All Remote Indicator** – When all the front panel remote push buttons are in (button Nos. 13, 14, 15, 16, 17 and 19, see Fig. 2-1), the indicator is illuminated. This means the generator is completely controlled by remote programming and independent of the front panel controls. In this condition a signal ($> +3$ Vdc) appears at pin 15 of plug J3 for computer notification.
5. **DC/Offset Polarity** – When in the dc mode, this switch determines the polarity of the dc level, either + or –. When in the “0” position, the dc level will always be zero. When in the , , or  function, this switch controls the polarity of the offset. When in the “0” position, the offset will always be zero.
6. **DC/Offset Volts** – This three-digit thumbwheel switch sets the dc level when in the dc mode, or the amount of dc offset into a 50Ω load for the waveform functions. The maximum voltage of the output amplifier is limited to ± 7.5 volts into 50 ohms; therefore, the peak signal amplitude plus the offset should not exceed this limit or a distorted waveform will be the result. When in the dc mode, the output dc voltage is dependent only on the setting of this switch and independent of the p-p amplitude volt and amplitude range settings and also independent of the load current up to 100 milliamps.
7. **P-P Amplitude Volts** – This three-digit thumbwheel switch is used to set the peak to peak signal level into a 50 ohm load. It controls the level for the sine, triangle and square waves, but has no control in the dc mode.
8. **Amplitude Range** – This switch has four ranges, 1.0, 0.1, 0.01, and 0.001, allowing output amplitudes from 9.99 volts to 1 millivolt.
9. **VCG IN (Voltage Controlled Generator)** – This connector allows external analog control of frequency. Up to a 1000:1 frequency change may be obtained. A positive voltage increases frequency and a negative voltage decreases frequency. See section under OPERATION for details.
10. **EXT DC IN (External DC Offset Control)** – This input allows external analog control of dc offset or of dc voltage output. Sensitivity of the input is +2 or –2 volts offset per 1 volt input dependent on dc polarity selected; i.e., a gain of two. The small signal bandwidth is 100 kHz and the slew rate is 2% of range per microsecond.

The EXT DC IN connector operates in conjunction with any manually or remotely programmed dc level or offset. The signals will be added or subtracted depending on the polarities. If the polarity switch (see 5) is in the “0” position, the EXT DC IN connector is disabled.
11. **VCA IN (Voltage Controlled Amplitude)** – The output amplitude can be modulated by an analog voltage input to this connector. This input signal is algebraically summed with the p-p amplitude setting on the front panel or with the remote program. This input may be used for studying most amplitude modulation techniques.
12. **Power** – Depressing this push button switch turns the unit on.
13. **Frequency Remote, Setting** – The frequency setting (see No. 2) will be controlled by the remote program when this switch is depressed. This does not affect the range multiplier. The setting is 0.00 if the control lines are open and the switch is depressed.
14. **Frequency Remote, Range** – Depressing this switch causes the frequency range to be selected by the remote program. The range will stay at X0.001 if the control lines are open and the switch is depressed.
15. **Amplitude Remote, Offset** – When this push button switch is depressed, the dc voltage output or signal dc offset, including the polarity, is controlled by the remote program. The setting will be +0.00 if the control lines are open and the switch is depressed.
16. **Amplitude Remote, Range** – The amplitude range is remotely controlled when the push button switch is depressed. The range will stay at X0.001 if the control lines are open and the switch is depressed.
17. **Amplitude Remote, Setting** – Depressing this switch causes the amplitude setting to be controlled by the remote program. The setting will be 0.00 with the button depressed and the control lines open.
18. **Manual Trigger** – The manual trigger button operates when the generator is in either triggered or gated mode (see Nos. 20 and 21). In the triggered mode,

one cycle of the selected waveform is generated each time the button is depressed. In the gated mode, the generator will continue to oscillate while the button is depressed. Upon releasing the trigger button, the generator will complete the last cycle and stop oscillating.

19. **Function Remote** – When this button is depressed, all of the modes under the function heading (Nos. 20 - 25) are under remote control. If this switch is depressed and the control lines are open, the output waveform will be a sine wave in the continuous running mode.
20. **Gated Mode** – When this switch is depressed, the generator may be started by applying a gating signal of at least 3 volts to the TRIG IN connector (see No. 26). Removing the gating signal causes the generator to complete the last cycle and stop. The generator may also be gated by depressing the manual trigger button (see No. 18).
21. **Trigger Mode** – In this mode the generator will produce one cycle of output for each trigger signal applied. The frequency of the trigger signal should be lower than the generator frequency. The trigger signal must be at least 3 volts. If both the gated and trigger switches are depressed, the generator will be in the triggered mode.
22. **DC** – Depressing this button causes a dc output to be present at the 50Ω output connector (see No. 27). The output impedance in the dc mode is 1 ohm. The maximum amount of dc is 10 volts and is set by the dc volts thumbwheel switch (see No. 6). The polarity is determined by the dc polarity switch (see No. 5).

The polarity must be + or – for an output. Neither the p-p amplitude (see No. 7) nor the amplitude range multiplier (see No. 8) control has any effect on the dc output. The loading current should not exceed 100 milliamps.

23.  **(Square Waveform)** – Depressing this button produces a square wave at the 50Ω output connector. Amplitude is controlled by the p-p amplitude volt and amplitude range switches (see Nos. 7 and 8), frequency by the frequency Hz setting and range multiplier switches (see Nos. 2 and 3).
24.  **(Triangle Waveform)** – This switch applies a triangle waveform to the 50Ω output connector.
25.  **(Sine Waveform)** – Depressing the button applies a sine wave to the 50Ω output connector.
26. **TRIG IN** – This connector accepts the trigger input signal for operation in either the trigger or gated mode (see Nos. 20 and 21). The trigger signal should be at least 3 volts. The input is dc coupled with 10K ohm impedance. Up to a 50 volt signal may be applied without damage.
27. **50Ω OUT** – This is the main output connector for all output signals. The signal will always be here unless the generator has been programmed to direct the output to the rear connector.
28. **AUX OUT** – This is an auxiliary pulse output. It is 0 to +6 volt pulse with 50% duty cycle. It can be used as a pulse, sync or squarewave output. It runs at the same frequency as the main generator. The rise and fall time is less than 5 nanoseconds.

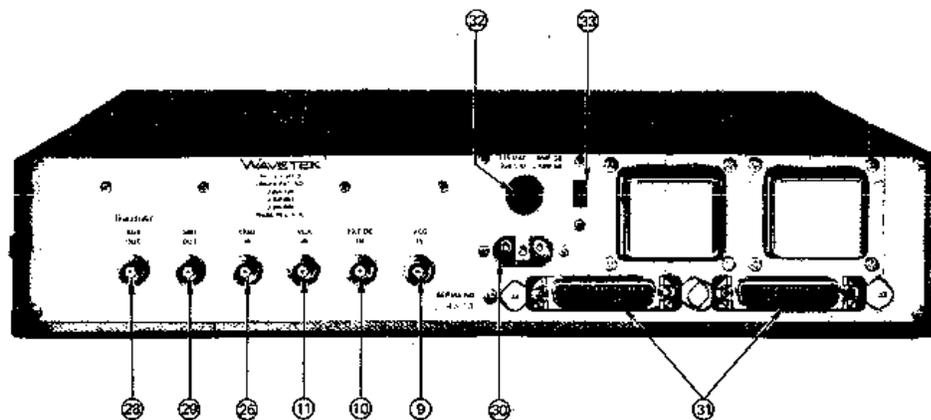


Figure 2-2. Operating Controls, Rear Panel

29. **50 Ω OUT** — The main output is shifted to the rear output connector when pin No. 36 of connector J3 is programmed with a +2.4 V to +10 V signal. (See Section 1.3.)
30. **Power In Receptacle** — This connector accepts a female power cord for applying 120 or 240 volts ac.
31. **Remote Programming Connectors** — Remote control signals are input to the generator through these connectors. All control logic is BCD. (See Section 1.3 for pin assignments.) The mating connector (Part No. 57-30360) is manufactured by Amphenol.
32. **Line Fuse** — This fuse protects the instrument from ac line transients as well as shorts within the instrument. For 115 Vac operation, use a ½ amp slow blow fuse. For 230 Vac, use a ¼ amp slow blow fuse.
33. **115 - 230 Volt Switch** — This switch selects the power input voltage used. The instrument is normally shipped for 115 Vac and a ½ amp fuse. To convert to 230 Vac, set slide switch to 230 and install a ¼ amp slow blow fuse.

2.4 INSTALLATION CHECKS

This paragraph outlines a quick checkout procedure to determine if the instrument is operating properly. Field calibration and checkout instructions are given in Section 4 to determine compliance with electrical specifications. If electrical deficiencies exist, refer to the warranty on the back of the title page.

Use a Tektronix Model 454 oscilloscope (or equivalent) and a 10 MHz counter-timer with 4-digit resolution when performing these installation checks.

1. Connect the line cord to the ac line.
2. Connect the 50 Ω OUT BNC to oscilloscope with 50 ohm cable terminated with 50 ohms.
3. Set frequency Hz to 1.00 X 1K.
4. Set DC/OFFSET VOLTS to 0 0.00.
5. Set P-P AMPLITUDE VOLTS to 1.00.
6. Set AMPL RANGE to X1.0.
7. Set generator up for complete manual control; that is, see that none of the remote buttons is depressed.
Depress  push button.
9. Depress POWER push button.
10. Observe a 1 volt p-p square wave at 1 kHz on the oscilloscope.
11. Depress  and then  push buttons. Observe triangle and sine waveforms, respectively.
12. Depress TRIG push button. Press MANUAL TRIG button several times and observe single cycle generation. Return TRIG button to out position.
13. Depress GATED push button. The generator should run as long as the MANUAL TRIG button is depressed. Return GATED button to out position.
14. With FUNCTION still on  and amplitude at 1.00 X 1.0, set DC/OFFSET VOLTS to +5.00. Rotate most significant decade from 5 to 0. Change polarity to -. Rotate same switch from 0 to 5. Observe sine waveform being offset, first positively, then decreasing to zero and then increasing negatively over the range of ± 5 volts. See Section 2.3, number 6, for signal plus offset limitations on the output amplifier. Return DC/OFFSET VOLTS to 0 0.00.
15. Set P-P AMPLITUDE VOLTS to 9.99. Rotate most significant decade from 9 to 0 and note proper operation of amplitude setting control.
16. Return P-P AMPLITUDE VOLTS to 9.99. Rotate AMPL RANGE control through all positions and note 20 dB change in amplitude per step. Return AMPL RANGE control to X1.0.
17. Remove 50 ohm terminator. Reconnect scope. Depress DC push button. Set DC/OFFSET VOLTS to +9.00. Observe 9 volt dc level. Rotate most significant decade of DC/OFFSET VOLTS thumbwheel switch from 9 to 0 and observe dc level decrease. Set polarity to - and rotate the same digit from 0 to 9. Observe dc level increasing negatively. Return DC/OFFSET VOLTS to 0 0.00.
18. Disconnect output BNC cable to oscilloscope and reconnect to a counter with 50 ohm terminator.
19. Rotate frequency setting and range multiplier switches and observe counter to verify proper frequency calibration.
20. Remote programming may be checked by applying dc levels (+2.4 to +10 V) to the appropriate pins of plugs J2 and J3 to verify that the output is correct. Use the Truth Tables with Pin Assignments in Section 1.3 to

determine which pins must receive a signal for a specified output.

2.5 OPERATING PROCEDURE

No preparation for operation is required beyond completion of the initial installation checks given in paragraph 2.4 of this manual. It is recommended that a one-half hour warm-up period be allowed for the associated equipment to reach a stabilized operating temperature and for the Model 154 to attain stated accuracies.

2.5.1 Operation as a Function Generator

1. Properly terminate the 50Ω OUT connector with 50Ω ±1% termination.
2. Select the desired waveform either from the front panel push buttons or by the remote program. If the remote mode is used, the FUNCTION REMOTE push button must be depressed.
3. Set FREQUENCY HZ setting and range multiplier for desired output frequency. If a remote program is used, be sure FREQ REMOTE SETTING and/or RANGE push buttons are depressed as required.
4. Set P-P AMPLITUDE VOLTS and AMPL RANGE multiplier for desired output amplitude. If a remote program is used, depress either or both AMPL REMOTE RANGE and SETTING push buttons as desired.
5. A positive or negative dc offset may be applied to the waveform by setting the DC/OFFSET VOLTS to the desired level. The peak signal value plus the offset cannot exceed ±7.5 volts. If it is desired to control the offset by the remote program, the AMPL REMOTE OFFSET push button must be depressed.

2.5.2 Operation as a Voltage Controlled Generator

The VCG input connector can be used to externally control the frequency of the generator. If a positive voltage is applied to the VCG input terminal, the frequency will increase from the dial setting. A negative voltage will cause the frequency to decrease from the dial setting. The VCG range of the Model 154 is 1000:1. The nomograph of Figure 2-3 shows the characteristics of the VCG circuit. Column A gives the frequency setting, column B, the VCG voltage and column C, the resultant frequency of the generator.

The following are examples of setting up the generator for several ranges of frequency change.

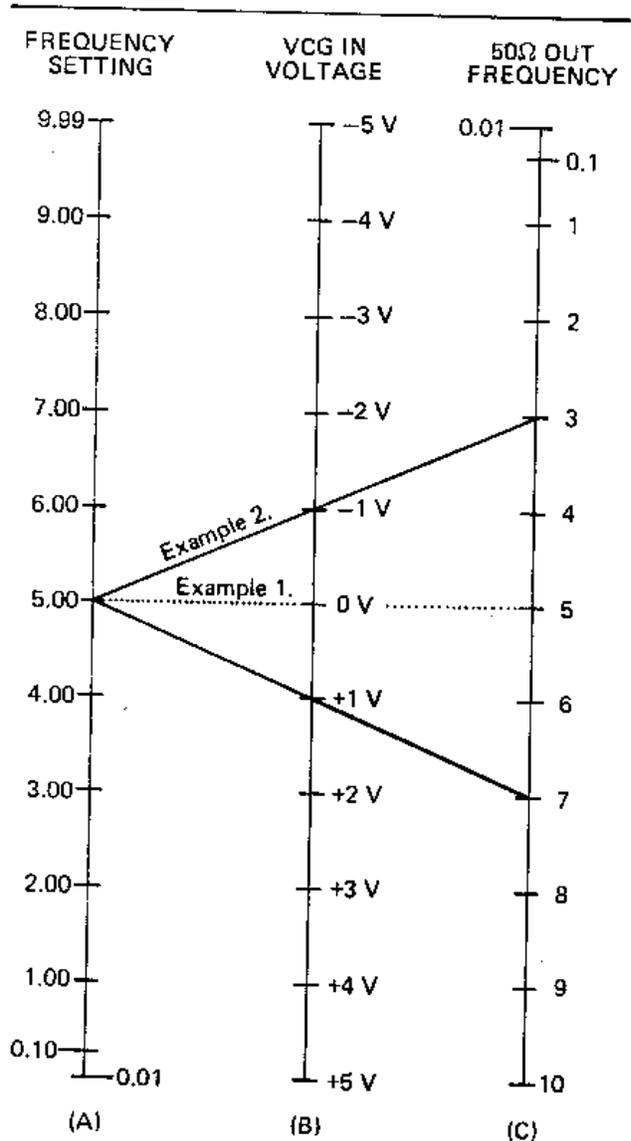


Figure 2-3. VCG Voltage-to-Frequency Nomograph

In example 1, the frequency setting is 5.00 and 0 volts VCG input voltage is applied. Extend a straight line from 5.00 (frequency setting) through 0 volts (VCG voltage). The result is an output frequency of 5 (multiplied by the range multiplier).

In example 2, the frequency setting is 5.00 and a varying VCG voltage of -1 V to +1 V is applied. By extending straight lines through the appropriate position it can be seen that the frequency will vary from 3 to 7 (multiplied by the range multiplier).

To obtain a maximum frequency change of 1000:1 the low frequency must have a setting of 0.01 X the multiplier. The maximum top frequency will then be 9.99 X the multiplier, thus giving a 1000:1 change.

For example, suppose an increasing sweep from 10 kHz to 10 MHz is desired. The VCG input must be a 0 to +5 volt ramp. The frequency setting must be $0.01 \times 1\text{M}$ which equals 10 kHz (the low frequency). At a +5 volt input the generator will be at the full scale output ($9.99 \times 1\text{M}$) or 10 MHz.

As another example, sweep down from 1 kHz to 1 Hz. The VCG input must be a 0 to -5 volt ramp. The frequency setting must be 9.99×100 which equals 1 kHz, the high frequency. At a -5 volt input the generator will be at the minimum allowed output for the X100 range (0.01×100) or 1 Hz. These examples may be verified by using the nomograph in Figure 2-3.

2.5.3 Operation as a Triggered Generator

1. Select the desired waveform by depressing the corresponding FUNCTION push button. If remote control is used, depress the FUNCTION REMOTE push button and program the remote connector as required.
2. Set or program generator to the desired frequency.
3. Depress the TRIG push button. If remote control is used, depress FUNCTION REMOTE. Apply +2.4 to +10 volt logic levels to pins 34 and 35 of plug J3. (See the Truth Tables in Section 1.3.)
4. Apply an external trigger signal of at least +3 volts to the TRIG IN connector or depress the MANUAL TRIG push button for generation of one cycle of the selected waveform. One cycle output will be generated for each input signal, providing the frequency of the trigger signal is lower than the generator frequency.

2.5.4 Operation as a Gated or Tone Burst Generator

1. Select the desired waveform by depressing the corresponding FUNCTION push button. If remote control is used, depress the FUNCTION REMOTE push button and program the remote connector as required.
2. Set or program generator to the desired frequency.
3. Depress the GATED push button. If remote control is used, depress FUNCTION REMOTE. Apply +2.4 to +10 volt logic level to pin 34. No signal is applied to pin 35.
4. Apply an external gating signal of at least +3 V to the TRIG IN connector or depress the MANUAL TRIG button. A gated or tone burst signal will be generated as long as gating signal is applied to TRIG IN or MANUAL TRIG is depressed.

2.5.5 Operation as a DC Voltage Source

Model 154 may be used as a calibrated dc voltage source not to exceed 100 mA of current as follows:

1. Set the generator in the triggered mode either by depressing the TRIG push button or by the remote program. See 2.5.3, Step 3. This inhibits the generator from running which minimizes the noise content of the dc.
2. Set the function to DC either locally or by remote program. The output impedance at the 50Ω OUT connector is now less than 1 ohm.
3. Connect the 50Ω OUT connector to the device under test.
4. Set or program the DC/OFFSET VOLTS to the desired value, either positive or negative. The dc voltage ranges from 9.99 to 0.01. The ripple and noise is less than 10 mV with the generator idle.

2.5.6 Operation as an Amplitude Modulated Generator

The VCA IN connector provides an input for amplitude modulation. In using the VCA capability of the generator, refer to Figure 2-4.

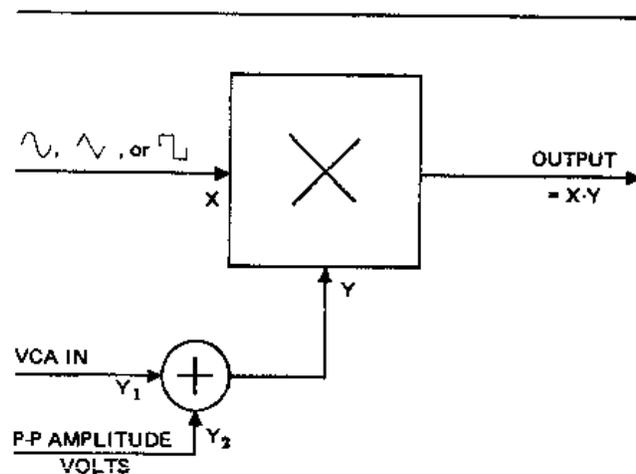


Figure 2-4. X-Y Multiplier Block Diagram

The output of the generator is the product of the X and Y inputs; that is, the generator signal times the sum of the VCA IN plus the p-p amplitude, or $\text{output} = X(Y_1 + Y_2)$. Y_2 is always a positive dc level, internal to the generator, which controls the output amplitude, if there is no VCA IN signal. Any VCA input, whether dc or ac, adds to Y_2 . If the sum of Y_1 and Y_2 exceeds the output capabilities of the generator, a clipped waveform will result.

The modulated output of the generator with several different VCA input conditions is shown in Figure 2-5. The P-P AMPLITUDE VOLTS control is assumed to be 0.00.

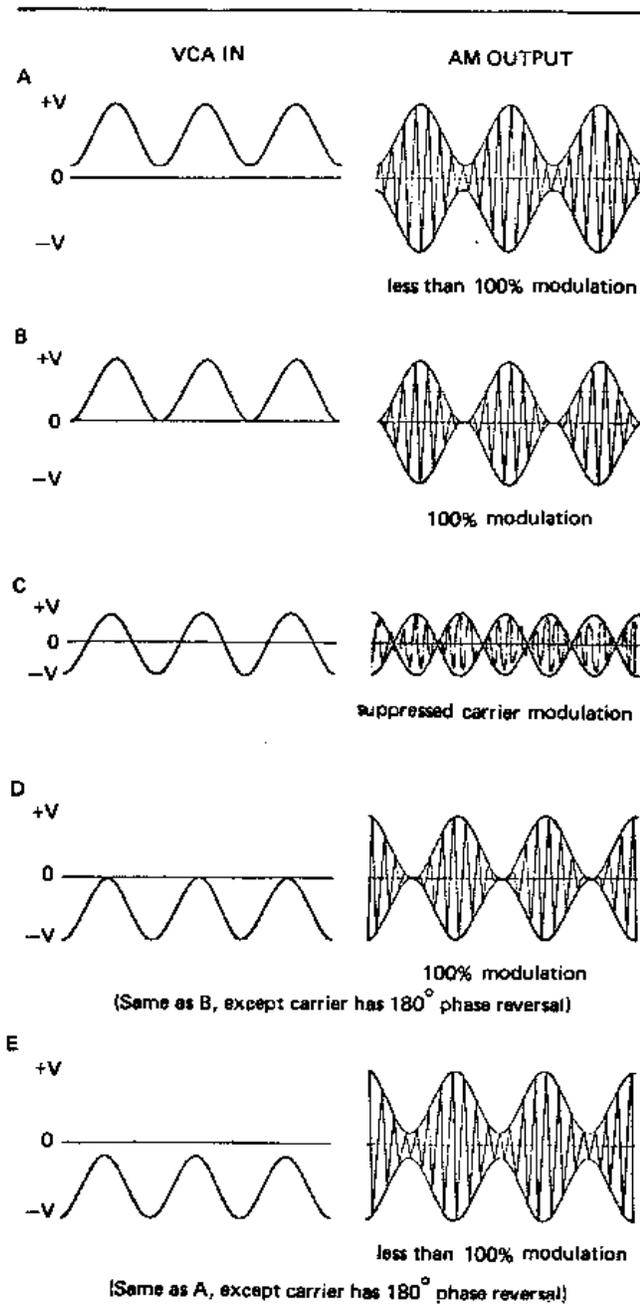


Figure 2-5. Amplitude Modulation Input and Resultant Output

The nomograph in Figure 2-6 is provided to determine the peak limits of the amplitude modulated output.

Example 1 displays suppressed carrier modulation. See Figure 2-5, Diagram C, for a display of the VCA input waveform and the resultant modulated output.

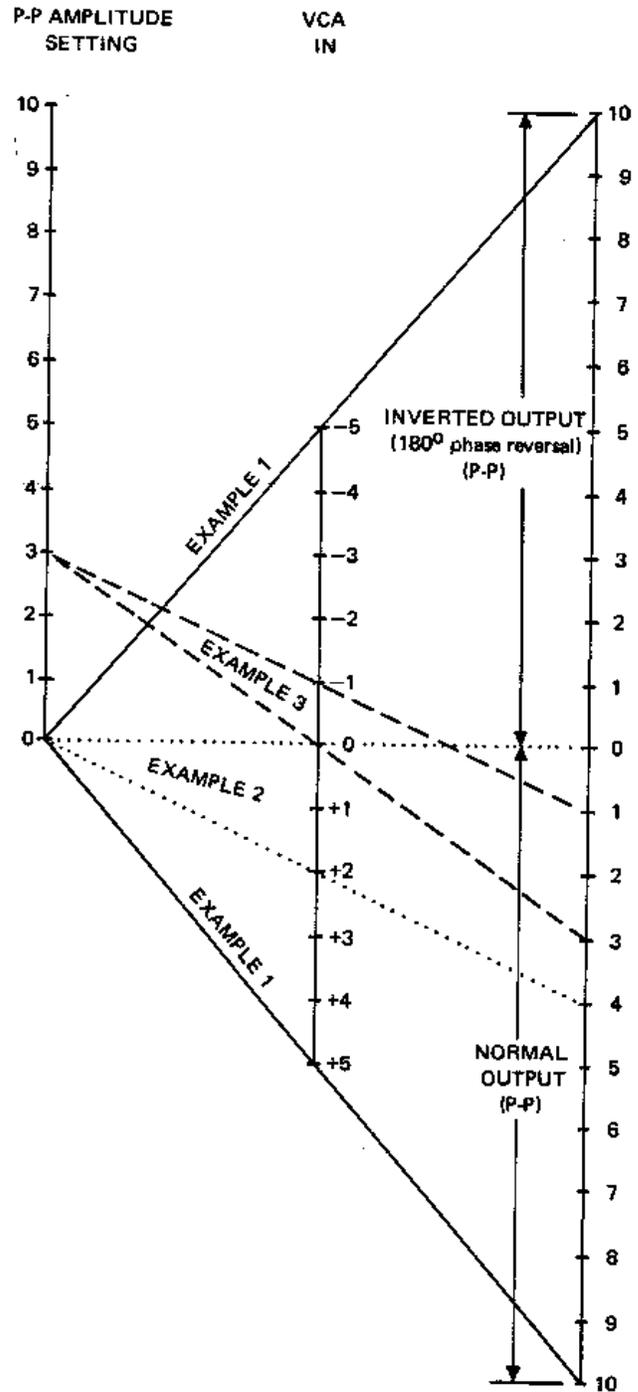


Figure 2-6. Amplitude Modulation Nomograph

Example 2 shows 100% modulation. The envelope is 4 volts peak to peak. The input sine wave is 2 volts p-p with the negative peak equal to zero as referenced to signal ground of the Model 154. See Figure 2-5, Diagram B, for waveform display.

Example 3 shows the effect of using the p-p amplitude control together with a VCA input. The result is less than 100% modulation, since the p-p amplitude control has offset the VCA input above signal ground. The effect is shown in Diagram A of Figure 2-5.

2.5.7 Remote Operation

The Model 154 may be partially or totally operated in the remote mode. Refer to Figure 2-1.

All of the following should be noted when using a remote program.

1. Be sure logic levels are compatible with those stated in Section 1.3.
2. Be sure plugs J2 and J3 are wired correctly according to the pin layout in Section 1.3.
3. Some or all functions may be programmed at any one time. See Section 2.3, paragraphs 13 through 19.

4. When the generator is completely under remote control, a front panel light will be illuminated as well as a signal generated at pin 15 of J3.
5. The analog program applied to the VCG IN, VCA IN and/or EXT DC IN are additive to the digital program.
6. The 50 Ω OUT is normally at the front panel, but may be programmed to appear at the rear panel connector by applying a signal to pin 36 of connector J3. The waveform quality at high frequencies will be better at the front panel output.

CAUTION

At no time should voltage be applied to the instrument that will cause the potential between signal ground and program ground to exceed 10 Vdc.

CIRCUIT DESCRIPTION

3.1. GENERAL DESCRIPTION

3.1.1 VCG Generator

A simplified block diagram of the VCG generator is shown in Figure 3-1. Triangle and square signals are generated simultaneously in the triangle generator circuit. The triangle is then applied to a sine converter and amplified.

The frequency is controlled by the current from the VCG amplifier which in turn is controlled by the voltage from the VCG D/A converter.

One of the signals, square, triangle, sine or DC, is fed into the X-Y multiplier and the amplitude is controlled by the VCA D/A converter.

The signal is then fed into the output amplifier. The amount of dc offset is controlled by the voltage from the dc offset D/A converter. The square wave from the triangle generator circuit is also fed into a fast switching circuit, a pulse amplifier, to generate a fixed amplitude fast square wave output.

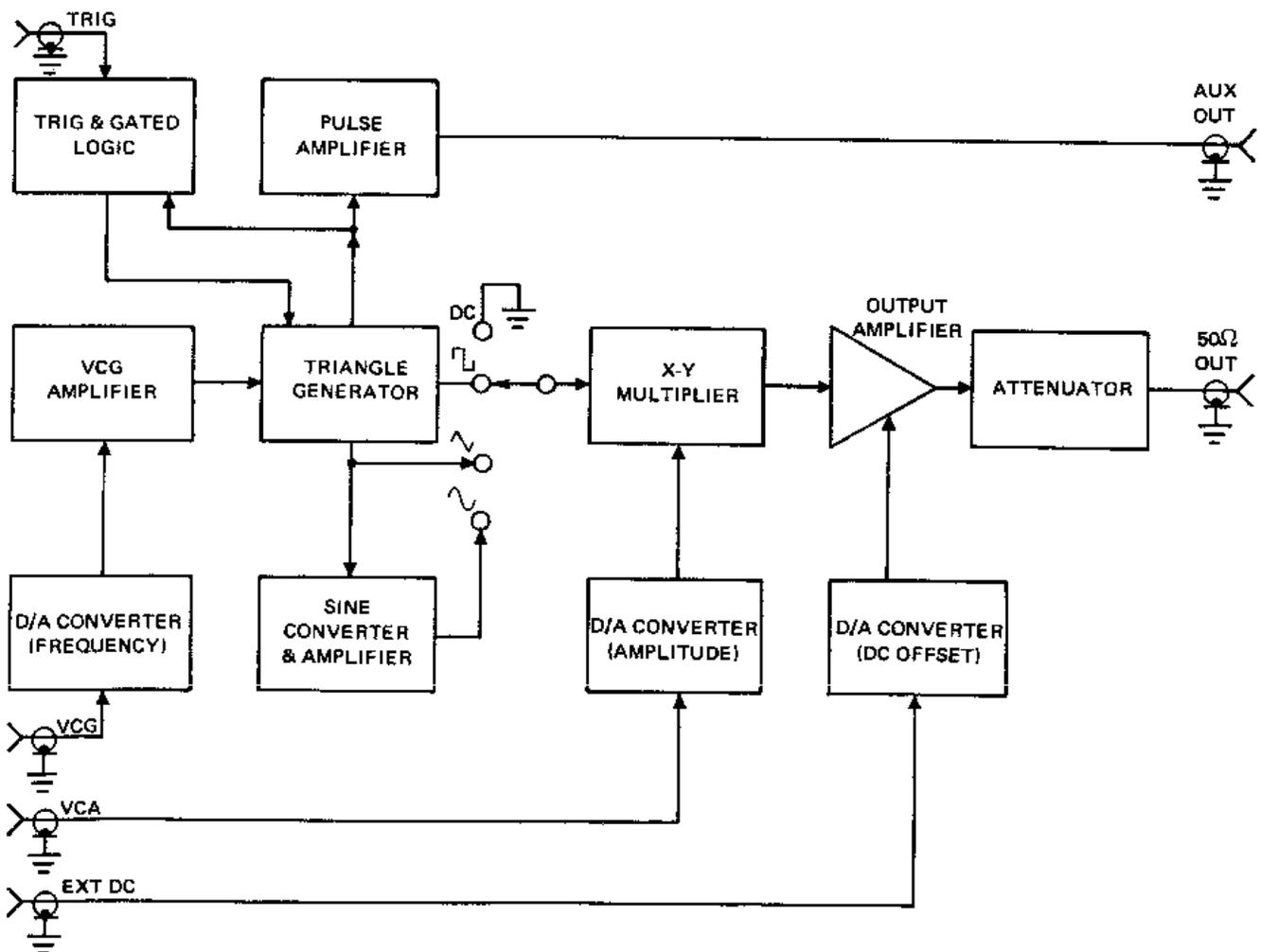


Figure 3-1. VCG Generator Block Diagram

3.2 THEORY OF OPERATION

3.2.1 Triangle Generator

When the voltage at point D is positive, the diodes CR15 and CR16 are reverse biased and CR14 and CR17 are forward biased. See Figure 3-2. Therefore, the current $I+$ is charging the capacitor C which causes the voltage at points A and B to rise. As soon as the voltage at point B reaches +1.25 V, the output of the hysteresis switch will switch negative and thus reverse the current flow. The current $I-$ is drawn from capacitor C. Again, the hysteresis switch will switch positive when the voltage at B is below -1.25 V. Thus, triangle and square signals are generated simultaneously.

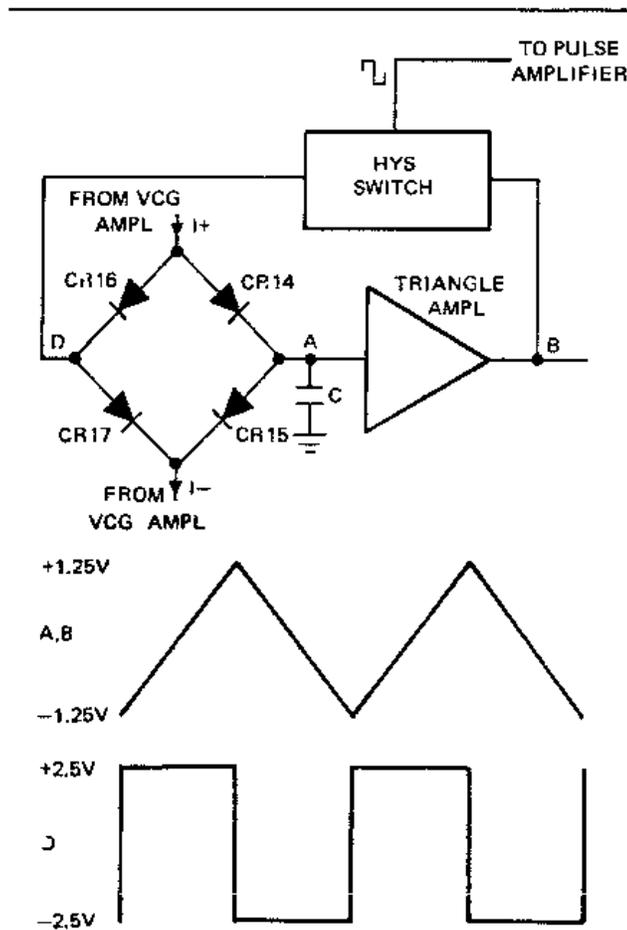


Figure 3-2. Triangle Generator Block Diagram

The output frequency depends on the size of the capacitor selected and the amount of currents, $I+$ and $I-$, charging the capacitor. The currents are controlled by the VCG amplifier which in turn is controlled by the voltage from the D/A amplifier and VCG input.

3.2.2 VCG Amplifier and Current Sources

The voltage used to control the output frequency from the D/A amplifier is applied to point A of the VCG amplifier. See Figure 3-3. Two ICs are used to shift the control voltage ground reference to the power supply reference. The other two ICs are the current source generators. The two current outputs are fed to the triangle generator.

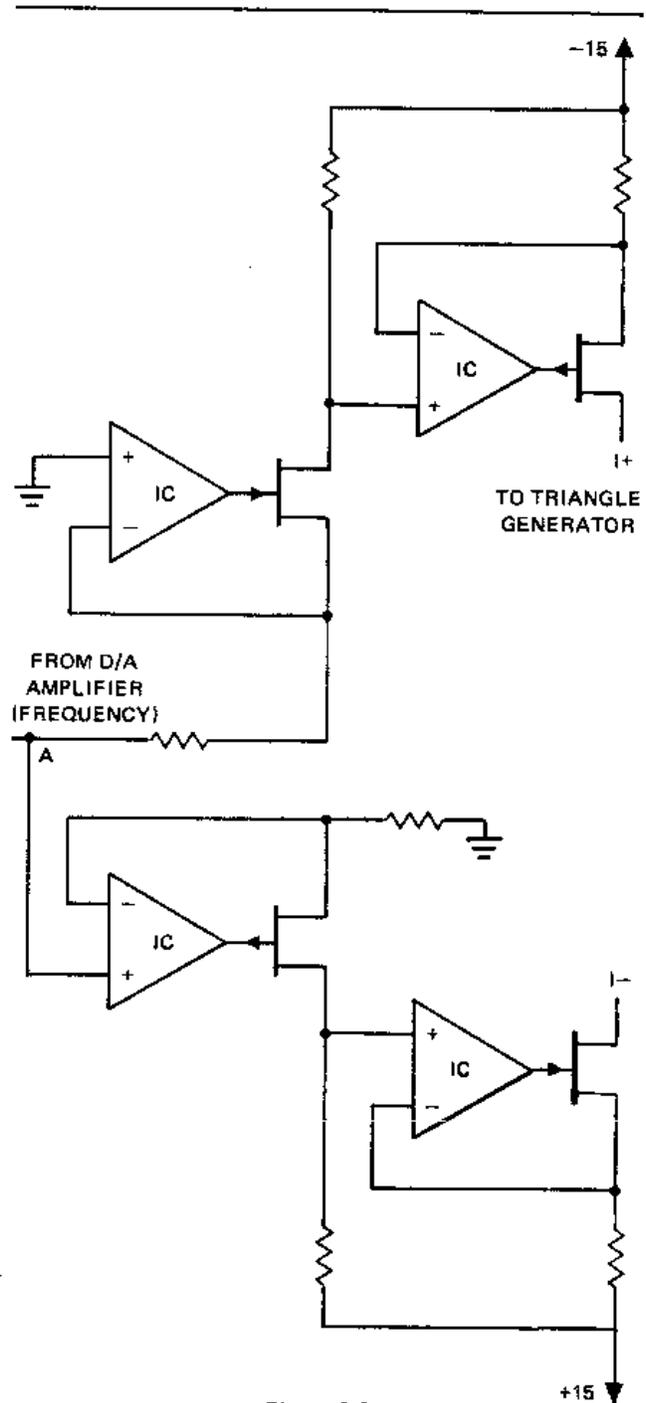


Figure 3-3.

VCG Amplifier and Current Source Simplified Circuit

3.2.3 Capacitance Multiplier

Frequency ranging is achieved by selecting different capacitors. For frequency ranges at X1 Hz or below, large capacitors are necessary and, therefore, impractical. Instead, a capacitance multiplier circuit is used, and ranging is achieved by changing the multiplication factor which is equivalent to the ranging resistors. The simplified circuit is shown in Figure 3-4.

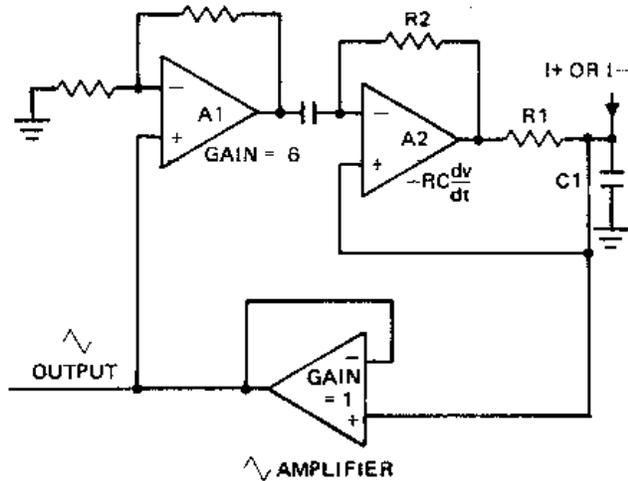


Figure 3-4. Capacitance Multiplier Simplified Circuit

Because of the nature of the feedback loop connection, A1 and A2, most of the current, I_+ and I_- , will be drawn by A2 through R1. Only a very small percentage of current is changing and discharging capacitor C1. Therefore, the output frequency will appear much slower. The percentage of current drawn by A2 is precisely controlled by the loop gain and time constant of the capacitance multiplier circuit. Frequency ranging is achieved by changing R2.

3.2.4 X-Y Multiplier and Output Amplifier

One of the signals is selected and fed into one input of the X-Y multiplier, and a control voltage from the D/A amplifier is fed to the other input. Refer to Figure 3-5. The differential output from the X-Y multiplier is directly proportional to the product of two inputs.

The signal is then fed into the output amplifier which consists of two inverting amplifiers. The combined operation of the two amplifiers is exactly equal to one differential amplifier. Because of the large common mode rejection of this amplifier, the output amplifier ground, " ∇ ", can be floated from all other grounds, " \perp ". A separate power supply would be required in this case.

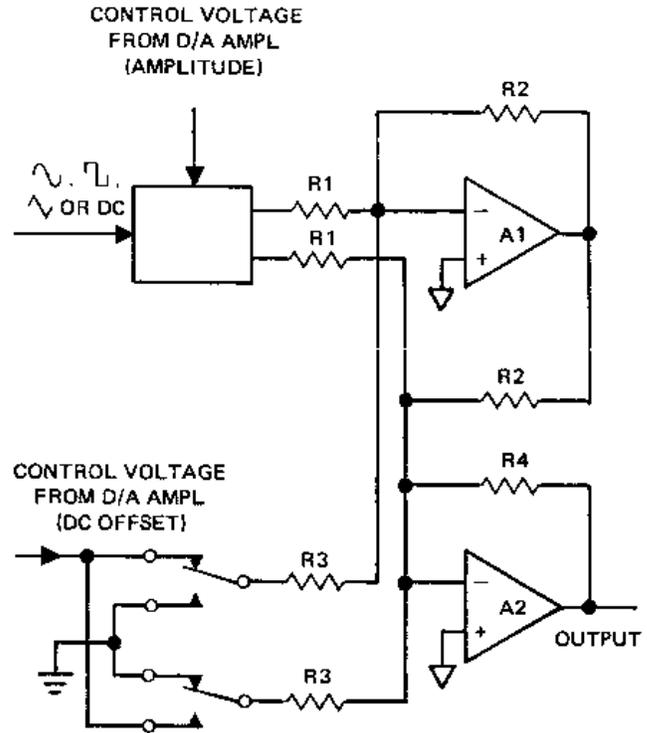


Figure 3-5.

X-Y Multiplier and Output Amplifier Simplified Circuit

3.2.5 Trigger Gated Modes

The triangle generator will oscillate continuously only if the voltage at G is negative which reverse biases CR11. Refer to Figure 3-6. This requires that the voltage at E or F be negative. If both voltages at E and F are positive, then so is the voltage at G. The current through CR11 will keep the voltage of C from falling below zero, because CR12 is clamped at zero. This stops the generator from oscillating.

The JK flip-flop is used to control the timing so that the triangle will always stop at the end of the cycle. The triangle will stop at time t_3 , if the trigger signal is reset between times t_1 and t_3 as shown in the timing diagram.

If the signal at B is differentiated before it is applied to the JK flip-flop, only one cycle of the triangle signal will be generated for each trigger input.

3.2.6 D/A Converter

Diode gates are used to switch the voltage through weighting resistors into the summing node of an amplifier. Refer to the D/A Converter Schematic.

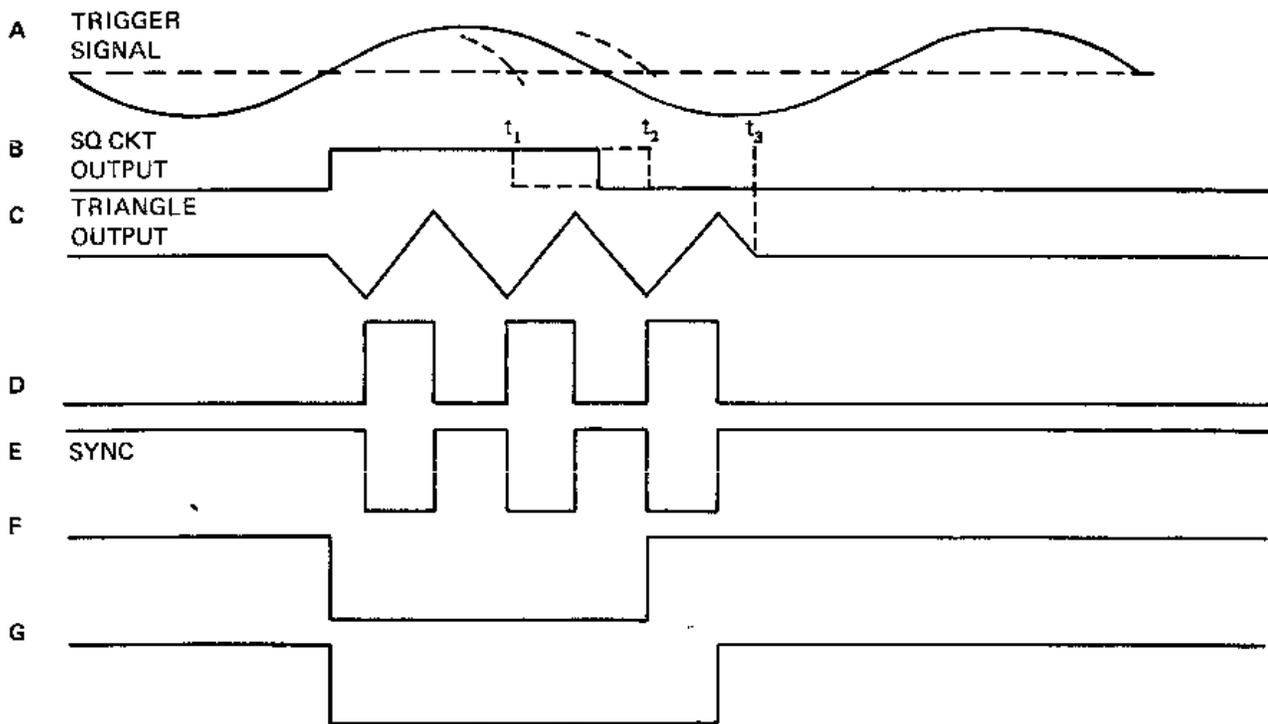
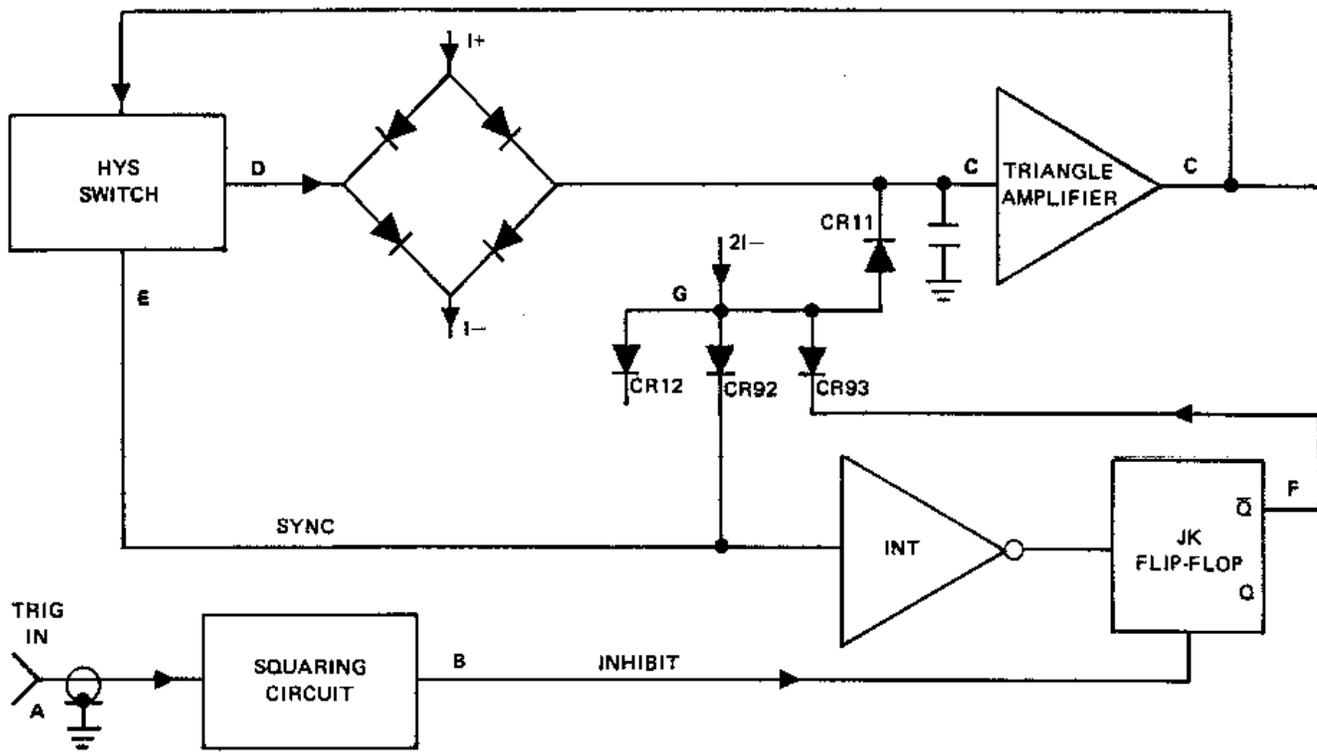


Figure 3-6. Trigger Gated Block and Timing Diagrams

4

SECTION 4

CALIBRATION AND MAINTENANCE

4.1 INTRODUCTION

This section provides instructions for testing, calibrating, troubleshooting, and repairing the Model 154 generator. The instructions are concise and written for the experienced electronics technician or field engineer. Wavetek maintains a factory-repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to facilitate the turnaround time. The main board test point and adjustment locations are shown on the board itself, and all points are illustrated in the data package.

4.2 ACCESS INSTRUCTION

Removal of the top dust cover affords quick access to all the components within the unit. However, it may be necessary to remove the bottom dust cover to replace the components.

An extender board (located in the front left corner) is provided to allow testing and repair of individual boards while still in the circuit. To remove the extender board, remove the two screws located on the side panel.

4.2.1 Removing the Dust Cover

1. Unplug the power cord.
2. Unscrew two captive screws on top cover.
3. Remove top cover.
4. Follow same procedure for bottom cover removal.

4.3 RECOMMENDED TEST EQUIPMENT

Table 4-1 contains a list of recommended test equipment. Any test equipment having equivalent accuracies may be substituted for those listed.

Table 4-1. TEST EQUIPMENT

Type	Required Characteristics	Recommended	
		Manufacturer	Model
Oscilloscope	To 250 MHz	Tektronix	454
Oscilloscope	To 30 MHz	Tektronix	544
Plug-In	Dual Channel	Tektronix	1A1
Plug-In	Peak mV measuring capability	Tektronix	1A5
Distortion Analyzer	To 600 kHz	Hewlett-Packard	334A
Spectrum Analyzer Display	To 50 MHz	Hewlett-Packard	141S
IF Section		Hewlett-Packard	8552A
RF Section		Hewlett-Packard	8553L
Differential Voltmeter	Microvolt dc measurement		
Counter-Timer	To 10 MHz 0.1% of reading accuracy		

4.4 CALIBRATION INSTRUCTIONS

The following paragraphs provide complete sequential calibration procedures for the Model 154 generator.

NOTE

The entire calibration procedure must be read first to determine initial control settings and test equipment connections required before attempting recalibration. The steps of this procedure should be performed in the sequence given, and the parts within each step should also be performed in the same sequence given. Fold out page 4-21 for Adjustment and Test Point Locations.

NOTE

Unless otherwise noted, all measurements made at the 50Ω OUT connector should be terminated into a 50Ω load when in \sim , \wedge , or \sqcup modes and unterminated when in DC.

4.4.1 Preliminary Procedures

Allow the unit to warm up for at least 30 minutes. Start the calibration by setting the front panel switches and controls as follows:

POWER Switch ON (IN)
 FUNCTION Switch \sim
 All other push button switches should be in the OFF (OUT) position.
 FREQUENCY 9.99 X 100
 DC/OFFSET 0 0.00
 AMPLITUDE 5.00 X 1.0

4.4.2 Power Supply Regulation

1. Connect a voltmeter to R5 (marked "+15 V" in \wedge AMPL section of the main board), and ground at TP1 (C15).
2. Adjust voltage to +15 Vdc \pm 20 mV, using R21 on the 15 V power supply board.
3. Check for approximately -15 volts at R7 (marked "-15 V" in \wedge AMPL section of the main board).
4. Check for approximately +24 volts at R4 and -24 volts at R3 in \wedge AMPL section of the main board. Test points are marked "+24 V" and "-24 V".
5. Connect a voltmeter to +23 volts across C72 (OUTPUT AMPL section of main board). Adjust voltage to +23 Vdc \pm 20 mV using R21 on the 23 V power supply board.
6. Check voltage across C70 for -23 Vdc \pm 400 mV.
7. Check the +6 volt supply in AUX AMPL section of main board and ground at TP1 (C15). Voltage should be +6 Vdc \pm 200 mV.

4.4.3 Triangle Amplitude Adjustment

1. Use a type W or 1A5 plug-in module with the scope for this calibration. Connect the oscilloscope probe (X1) to output of the triangle amplifier at TP2 and ground at TP1 on the main board. Make sure the frequency setting is at 9.99 X 100 Hz.

2. Adjust the positive peak of the triangle to +1.25 V \pm 5 mV using R21 on the main board.
3. Adjust the negative peak of the triangle to -1.25 V \pm 5 mV using R11 on the main board.

4.4.4 Frequency Calibration

1. Set function to \sqcup and connect the main output to the scope.
2. Set frequency to 0.09 X 0.1M. Alternately short and open VCG IN to ground and adjust R34 on the D/A amplifier board until no frequency shifting can be observed on the scope.
3. Connect the main output to a counter and verify that the shifting is less than 100 Hz.
4. Set frequency to 0.01 X 10K. Adjust R29 on the D/A amplifier board for 100 Hz \pm 15 Hz. (VCG should not be shorted to ground.)
5. Connect the output to an oscilloscope. Adjust the time symmetry to within 1% using R7 on the VCG board. A dual channel counter set in the B-A mode may also be used for this calibration. By alternately changing the slopes from positive to negative on both channels, the asymmetry may be measured.
6. Set frequency to 9.99 X 10 kHz. Adjust output frequency to 99.9 kHz \pm 100 Hz using R40 on D/A amplifier board.
7. Set frequency to 8.99 X 1 MHz. Adjust frequency to 8.99 MHz \pm 25 kHz using C4 on main board. Trim C2 if necessary.
8. Set frequency to 9.99 X 10K. Re-adjust frequency to 99.9 kHz \pm 100 Hz using R40 on D/A amplifier board. Trim R31 on D/A amplifier board if necessary.
9. Set frequency to 0.01 X 10 kHz. Re-adjust output frequency to 100 Hz \pm 15 Hz using R29 on D/A amplifier board.
10. Check frequency accuracy from 1.00 X 1M to 9.99 X 1M. All frequencies should be within \pm 2.0% of full scale. If not, re-adjust C4. If adjusting C4 does not help, try to trim capacitors C16, C17, C22 and C23 on the main board. Add 5 to 10 pF capacitance at locations C16 and C23, if frequency at the 9.99 X 1 MHz setting is too low. Reduce 5 to 10 pF of capacitance at both C17 and C22, if frequency at the 9.99 X 1 MHz setting is too high.

11. Set frequency to $9.99 \times 0.1\text{M}$. Adjust frequency to $999 \text{ kHz} \pm 1 \text{ kHz}$ using C6 on the main board. Trim C8 if necessary.
12. Set frequency to $9.99 \times 1\text{K}$. Adjust output frequency to $9.99 \text{ kHz} \pm 10 \text{ Hz}$ using R39 on D/A amplifier board.
13. Set frequency to 9.99×100 . Adjust output frequency to $999 \text{ Hz} \pm 1 \text{ Hz}$ (or period to $1001 \mu\text{s} \pm 1 \mu\text{s}$) using R38 on the D/A amplifier board.
14. Set frequency to 9.99×10 . Adjust output frequency to $99.9 \text{ Hz} \pm 0.1 \text{ Hz}$ (or period to $10.01 \text{ ms} \pm 10 \mu\text{s}$) using R37 on the D/A amplifier board.
15. Connect a scope probe to the output of the triangle amplifier at TP2 and ground at TP1 on the main board.
16. Set generator to TRIG mode with front panel switch. Set frequency to $9.99 \times 10 \text{ Hz}$. Adjust the dc level to $0 \text{ Vdc} \pm 3 \text{ mV}$ using R2 on the main board.
17. Set generator back to continuous running, frequency to $0.50 \times 1.0 \text{ Hz}$, and function to \square . Adjust the time symmetry at the 50Ω OUT connector to less than 0.2% using R47 on the VCG board. In addition to using sweep magnifier on scope for this calibration, a dual channel counter may be used as described in Step 5 of Section 4.4.4.
18. Set frequency to $9.99 \times 1.0 \text{ Hz}$. Adjust output frequency to $9.99 \text{ Hz} \pm 0.01 \text{ Hz}$ (or period to $100.1 \text{ ms} \pm 0.1 \text{ ms}$) using R15 on the VCG board.

4.4.5 X-Y Multiplier Adjustment

1. Set function to DC, frequency to $2.00 \times 100 \text{ Hz}$, and DC/OFFSET to 0 0.00.
2. Make sure the 50Ω output ground is not shorted to program ground by measuring the voltage between the two grounds; i.e., the grounds of 50Ω OUT and TRIG IN.
3. Connect the 50Ω OUT to an oscilloscope. Alternately short and open the 50Ω ground to the TRIG IN ground. Adjust R153 on the main board at the same time until the dc level at the output changes less than 5 mV.

NOTE

In case the voltage across the two grounds is too small and the effect is not obvious, an external voltage less than 10 Vdc can be applied momentarily between the two grounds for the above calibration. R153 should be adjusted for a dc shift of less than 5 mV.

4. Adjust R117 on the main board so that the output dc level stays within 10 mV at the 0.00 and 9.00 settings of the P-P AMPLITUDE VOLTS control.
5. Set DC/OFFSET to $0 \text{ Vdc} \pm 20 \text{ mV}$ using R132 on the main board.
6. Set function to \wedge (frequency remains at $2.00 \times 100 \text{ Hz}$) and P-P AMPLITUDE to 0.00.
7. Adjust the voltage between TP3 and TP1 (GND) on main board to $0 \text{ Vdc} \pm 5 \text{ mV}$ using R8 on the D/A amplifier board. TP3 is located at one end of R110 in the X-Y multiplier section on the main board.
8. Adjust the 50Ω OUT signal to minimum using R118 on the main board.
9. Set P-P AMPLITUDE to 0.05 V. Adjust R124 on main board for the most linear waveform.
10. Reset P-P AMPLITUDE to 0.00. Repeat Step 8.
11. Set function to DC with P-P AMPLITUDE and DC/OFFSET still at 0.00. Adjust dc voltage at 50Ω OUT to $0 \text{ Vdc} \pm 20 \text{ mV}$ into open circuit using R132 on the main board.
12. Set function to \wedge and P-P AMPLITUDE to 0.00. Repeat Step 8.

4.4.6 Sine Distortion Adjustment

1. Set function to \wedge , frequency to $9.99 \times 100 \text{ Hz}$, and P-P AMPLITUDE to 9.99.
2. Connect a scope probe (X1) to the output of the sine amplifier at TP4 and ground at TP1. Connect the other end to a low frequency sine distortion analyzer.
3. Adjust sine distortion for minimum using R85, R86 and R88 on the main board. These pots interact so several adjustments of each pot may be necessary for minimum distortion.

4. Adjust for minimum sine distortion at 50Ω OUT using R120 on the main board.
5. Check sine distortion at 9.99 X 1 kHz. Re-adjust R85, R86 and R88, if necessary, to obtain optimum sine distortion at 999 Hz and 9.99 kHz.
6. Set function to DC, frequency to 2.00 X 100 Hz and DC/OFFSET to 0 0.00. Repeat Steps 4 and 11 in Section 4.4.5 (X-Y Multiplier Adjustment).

4.4.7 Output Amplitude and DC Offset Adjustment

1. Set function to DC and P-P AMPLITUDE to 0.00. Adjust R18 on the D/A amplifier board so that the dc level at the 50Ω OUT connector changes less than 10 mV at different dc polarity settings: “-”, “0” and “+”.
2. Set P-P AMPLITUDE to 9.99 V, function to  and frequency to 9.99 X 100 Hz.
3. Adjust output amplitude to 9.99 V p-p ±10 mV into a precision 50Ω load using R10 on the D/A amplifier board.

Set function to . Adjust the amplitude to 9.99 V p-p ±10 mV using R108 on the main board.
5. Adjust the dc offset of  output to less than ±10 mV using R93 on the main board.
6. Set function to . Adjust the peak voltage to ±4.995 V ±5 mV using R57 and R54 on the main board for positive and negative peaks, respectively.

NOTE

If calibration cannot be achieved, trim R44 (on main board) so that the  signal at the emitter of Q13 is symmetrical about ground within 200 mV.

7. Set function to DC and DC/OFFSET VOLTS to +9.99. Adjust the output voltage at 50Ω OUT connector to +9.99 V ±10 mV using R22 on the D/A amplifier board without a load.
8. Switch DC/OFFSET VOLTS to -9.99. The output voltage should be -9.99 V ±60 mV. If not, re-adjust R22 to obtain optimum calibration.
9. Set function to , P-P AMPLITUDE to 0.00 and DC/OFFSET VOLTS to +4.99.

10. Adjust the dc offset at the 50Ω OUT connector to +4.99 V ±5 mV into a precision 50Ω load using R24 on the D/A amplifier board.
11. Switch the DC/OFFSET VOLTS to -4.99. The output voltage should be -4.99 V ±30 mV. If not, re-adjust R24 to obtain optimum calibration.

4.4.8 High Frequency Amplitude Response Adjustment

1. Set frequency to 1.00 X 1 MHz, DC/OFFSET to 0 0.00, P-P AMPLITUDE to 9.99 V, and function to . Make sure that the output is loaded with a precision 50Ω load.
2. Adjust C75 and C77 on the main board for best looking square waveform.
3. Set function to . Adjust for best amplitude flatness to 10 MHz with 1 kHz as reference using C49 on the main board.

4.4.9 Trigger Baseline Adjustment

1. Set function to , frequency to 9.99 X 100 Hz, DC/OFFSET to 0 0.00, and P-P AMPLITUDE to 9.99 V. Generator should be in TRIG mode. Adjust output voltage to 0 Vdc ±10 mV using R2 on the main board.
2. Change frequency to 0.01 X 100 Hz. Adjust output voltage to 0 Vdc ±30 mV using R34 on the VCG board.
3. Change function to . Adjust output voltage to 0 Vdc ±10 mV using R93 on the main board.

4.5 CORRECTIVE MAINTENANCE

This portion of the manual presents a systematic approach to trouble-shooting. It is composed of two parts. Part one (see 4.5.1) is a quick guide for locating the area of the problem. Part two (see 4.5.2) contains 12 tables which are given as detailed supplements to part one.

The following abbreviations are used:

Symbol	Meaning
B	Base (transistor)
C	Collector (transistor)
E	Emitter (transistor)
G	Gate (FET)
S	Source (FET)
D	Drain (FET)
CR	Diode
Qn	Transistor number (n)
V _{GS}	Voltage between gate and source (FET)
Q	Output terminal (flip-flop)
\bar{Q}	Inverting output terminal (flip-flop)

4.5.1 Quick Trouble-Shooting Guide

Symptom	Corrective Action
Blown Line Fuse	<p>Replace fuse. If it blows again, check the following:</p> <ol style="list-style-type: none"> 1. Solder bridge or wire connection shorted. 2. Q45 and/or Q46 shorted in output amplifier. 3. One of the 7 transistors mounted on the rear panel is shorted to itself or to another transistor through the chassis. 4. Follow Table 4-2 to locate the short in a particular supply. 5. By-pass capacitors for power supply are shorted. 6. Relay in -24 V supply is shorted.
+15 V Power Supply Malfunctions	<ol style="list-style-type: none"> 1. Voltage low: <ol style="list-style-type: none"> a. Transformer output low. b. Extra current loading. Check for overheated and defective component in the circuit. c. Q2 or Q3 is shorted. d. Q1 is open. e. CR2 is shorted. f. IC1 is defective. 2. Voltage high: <ol style="list-style-type: none"> a. Power transistor TIP29 or Q1 is shorted. b. Q3 is open. c. IC1 is defective. 3. High frequency oscillation (MHz): <ol style="list-style-type: none"> a. C4 or C5 at IC1 is defective. b. One of the semiconductors in another part of the circuit is oscillating. Locate by using hand to touch the most sensitive area of the circuit boards. 4. Large 60 cycle noise: <ol style="list-style-type: none"> a. Dirty contact. Unplug the power board and clean the contact. b. Defective filter capacitor, C1 or C9.
Other Power Supply Malfunctions	<ol style="list-style-type: none"> 1. Follow Table 4-2 to locate the problem to a particular power supply. 2. Use similar procedure for trouble-shooting as in the +15 V power supply malfunctions.
No Output Signals	<ol style="list-style-type: none"> 1. If no \surd signal is present at output of \surd AMPL, follow Table 4-3 for trouble-shooting. 2. If no signal is present at pin 4 of IC2 in the X-Y multiplier on main board, follow Table 4-7 to check out relay logic. 3. If no signal is present at both emitters of Q31 and Q32 with the \surd function selected, follow Table 4-12 to check out the X-Y multiplier. 4. If signal is seen at emitter of Q31 and Q32, follow Table 4-5 to check out the output amplifier.
No \surd , \square or SYNC Output	Follow Table 4-12 to check out the corresponding circuit.
\square Rise/Fall Time Abnormally Slow	<ol style="list-style-type: none"> 1. Malfunctioning \square amplifier. 2. One of the capacitors in the output amplifier is open. 3. C75 and C77 (output amplifier) are not calibrated. 4. C50, C53 or C52 in X-Y multiplier is open.

Quick Trouble-Shooting Guide (continued)

Symptom	Corrective Action
Frequency Accuracy Out of Specification	<ol style="list-style-type: none"> 1. Check frequency calibration. 2. Check for defective C10, C16 to C23, CR18 and/or CR20 on main board, if problem is in X10K to X1 MHz ranges. 3. Check capacitance multiplier, if problem appears in X0.001 to X1 ranges only, using Table 4-6. 4. Check digit switch, D/A converter of frequency section, if problem appears to be in frequency setting, using Table 4-9. 5. Check VCG and D/A amplifier for frequency linearity problem in all ranges, using Table 4-4. 6. Follow Table 4-10 for frequency ranging problem.
High Frequency Output Has Abnormal Ringing	<ol style="list-style-type: none"> 1. C69 or output amplifier is open. 2. Defective capacitor in output amplifier.
High Sine Distortion at Low Frequency	<ol style="list-style-type: none"> 1. \sphericalangle amplitude and time symmetry calibration is off. 2. Defective sine converter. 3. Sine converter or X-Y multiplier calibration is off. 4. Dirty contact on power supply board.
High Sine Distortion at High Frequency	<ol style="list-style-type: none"> 1. \square also looks bad, if problem is in the output amplifier. 2. Defective capacitors C10 and C16 to C23 in \sphericalangle amplifier. 3. Defective C29 to C36 in sine amplifier. 4. Defective sine converter.
Unsymmetrical \sphericalangle	Follow Table 4-4 to check out the VCG circuit.
Amplitude Accuracy Out of Specification	<ol style="list-style-type: none"> 1. Check calibration. 2. Check for defective C25, C31 and C67 for frequency linearity problem over 1 kHz. 3. Check digit switch and D/A converter for amplitude setting problem, using Table 4-9. 4. Follow Table 4-8 for amplitude ranging problem. 5. Check X-Y multiplier, using Table 4-12.
DC Offset Accuracy Out of Specification	<ol style="list-style-type: none"> 1. Check calibration. 2. Check digit switch and D/A converter for offset setting problem, using Table 4-9. 3. Check for zero offset of X-Y multiplier and output amplifier.
TRIG and GATED Mode Inoperative	<ol style="list-style-type: none"> 1. Check trigger and gated control switches. 2. Check for correct signals in the trigger circuit, using Table 4-11.

4.5.2 Trouble-Shooting Guide Tables

one or two seconds at a time to prevent it from blowing fuses and further damage circuit components.

4.5.2.1 POWER SUPPLIES

Use Table 4-2 to localize the problem to a particular power supply and associated loading circuitry. In some cases, it is necessary to turn on the power of the unit no more than

NOTE

Be sure to use the correct ground in the following voltage checks.

Table 4-2. POWER SUPPLIES

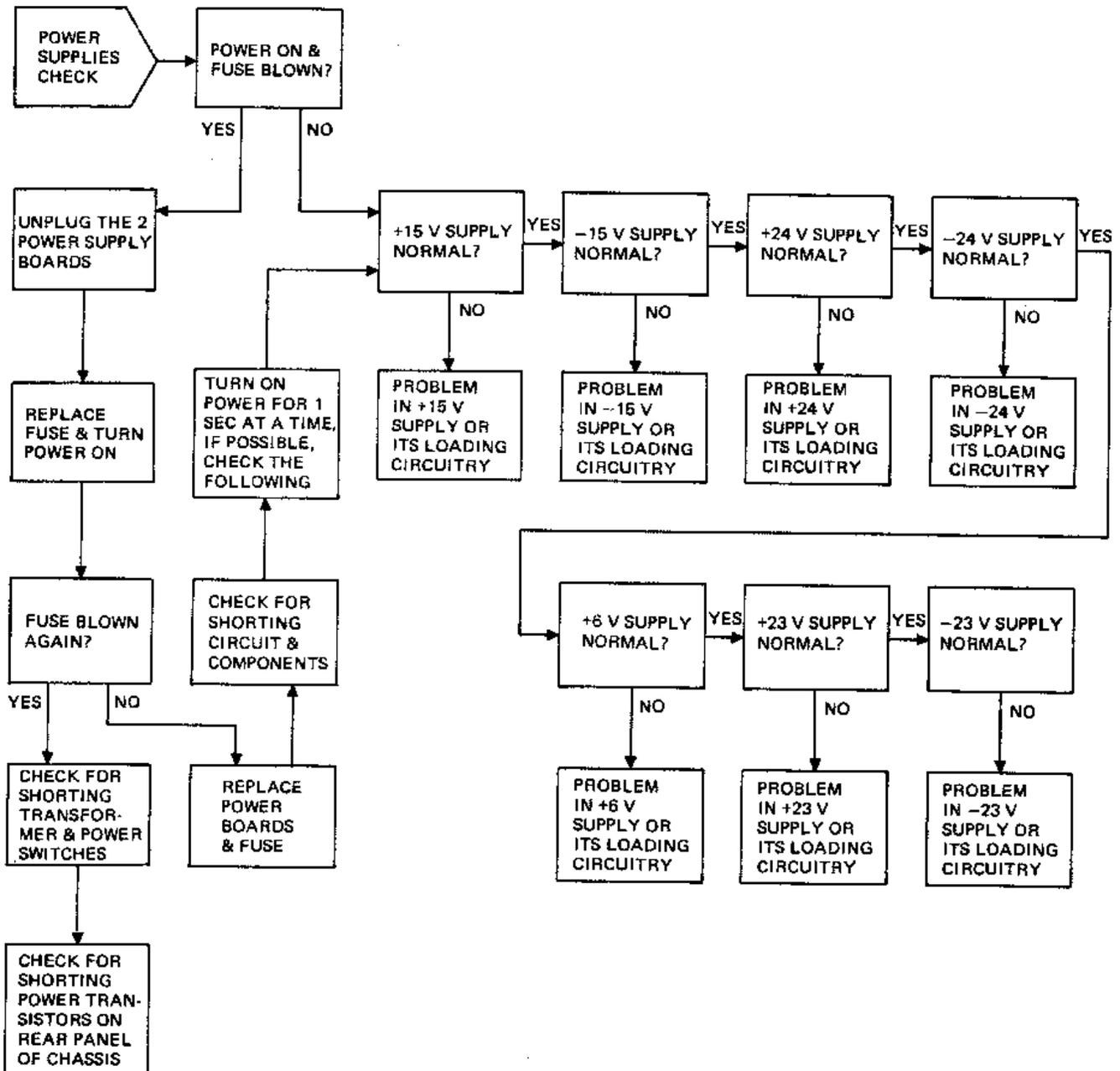


Table 4-3. TRIANGLE AMPLIFIER, COMPARATOR, AND HYSTERESIS SWITCH

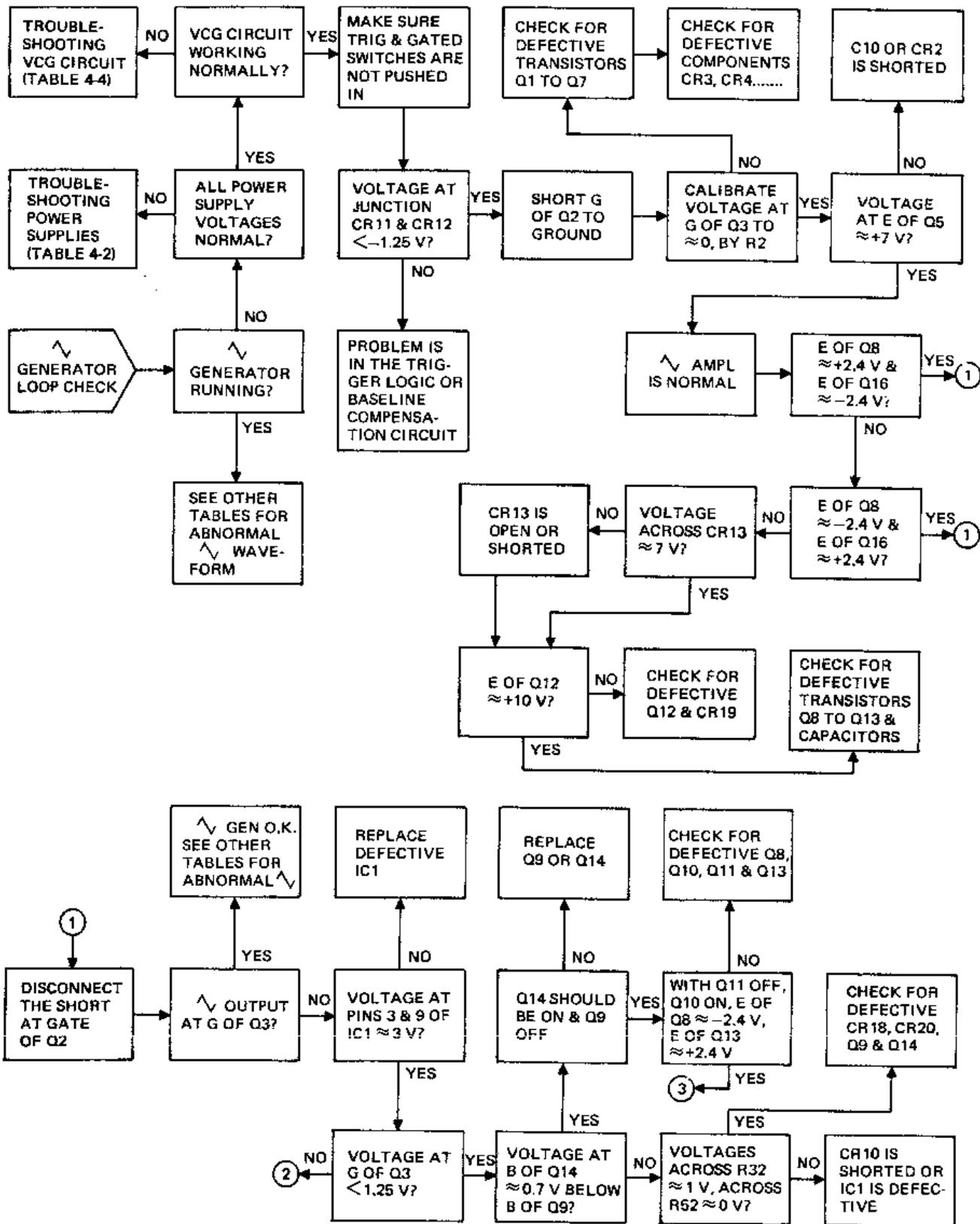


Table 4-3. TRIANGLE AMPLIFIER, COMPARATOR, AND HYSTERESIS SWITCH (Continued)

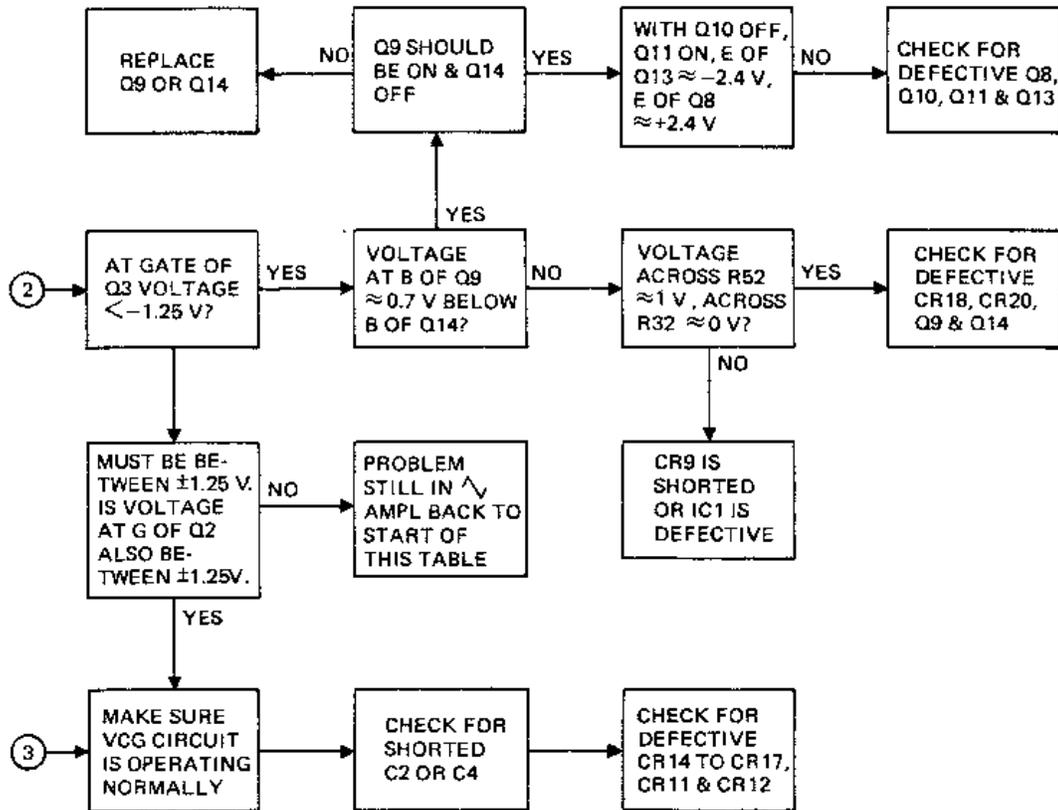


Table 4-4. VCG AND CURRENT SOURCE

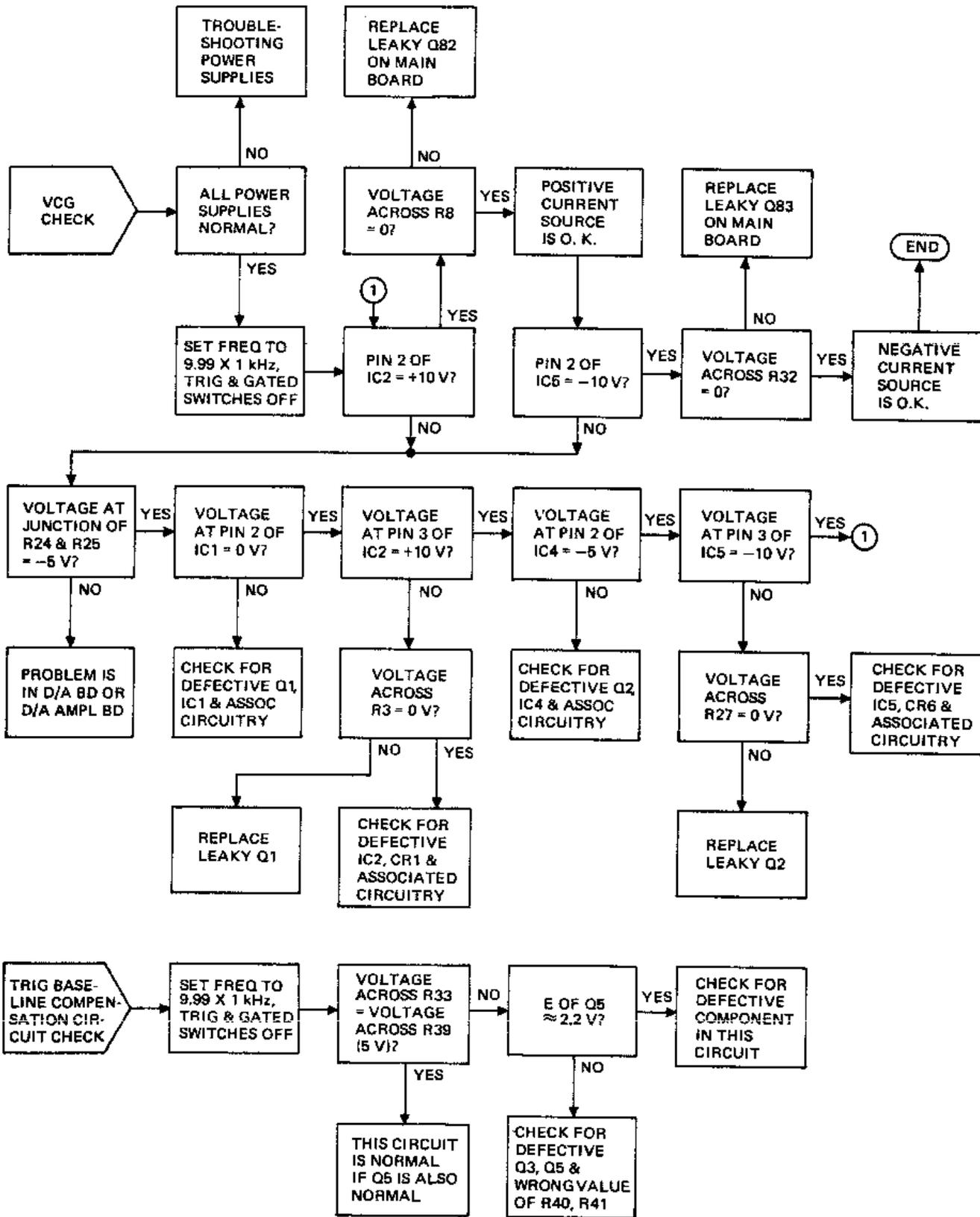


Table 4-5. OUTPUT AMPLIFIER

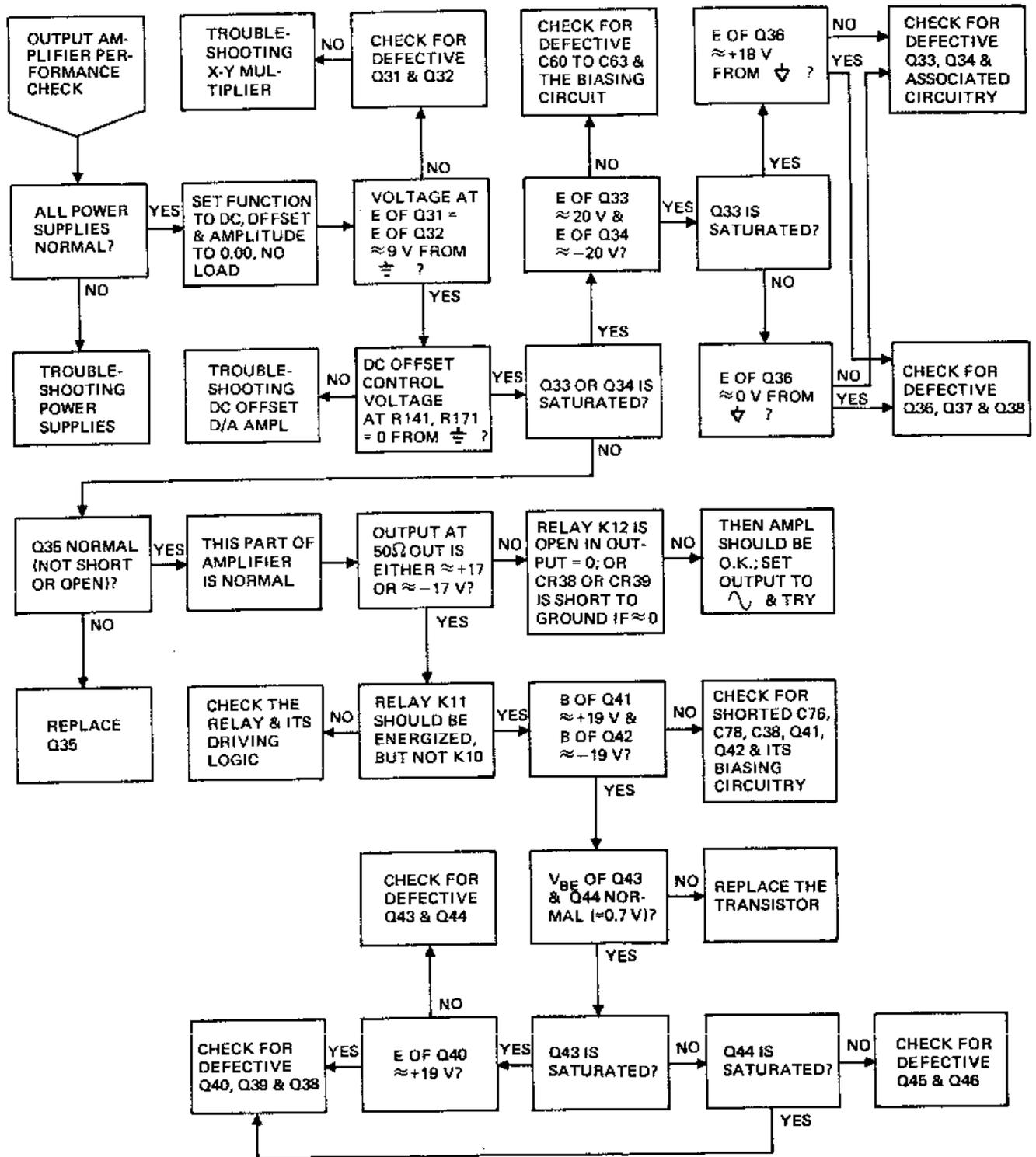


Table 4-6. CAPACITANCE MULTIPLIER

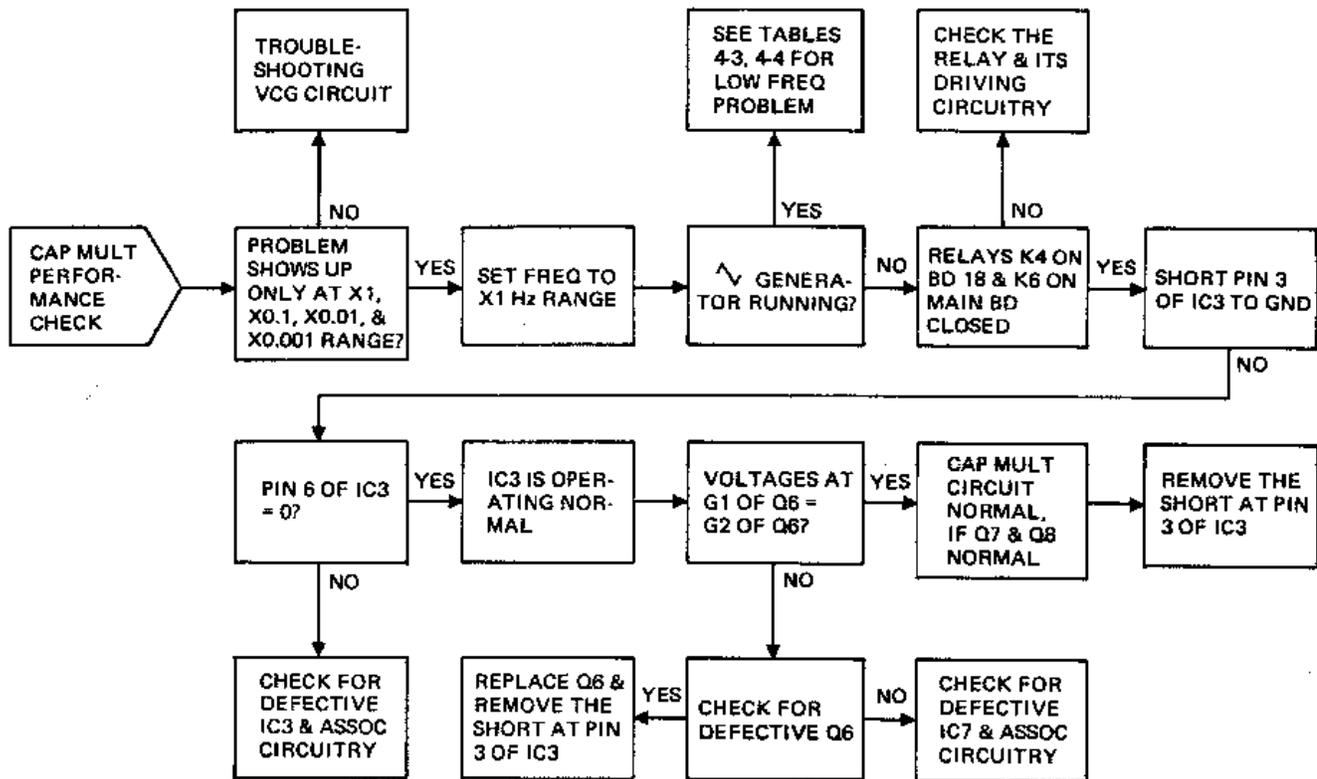


Table 4-7. FUNCTION LOGIC

COMPONENTS FUNCTION	Q58 Q59		Q60 Q61		Q62 Q63 Q64			K7 K8 K9		
	~	X		X						
~	X			X	X			X		
⌋		X		X		X			X	X
DC (Also see Table 4-8)		X	X				X			X

- NOTES: 1. For standard logic only. For inverse logic, interchange Q58 with Q59 and Q60 with Q61.
 2. For TRIG and GATED logic, see Timing Diagram, Table 4-11.
 3. The transistor or relay with "X" is in an "ON" state.

4.5.2.2 AMPLITUDE RANGING CONTROL LOGIC

Table 4-8 is provided as a hint for trouble-shooting amplitude ranging control logic.

1. At X0.1 range, only Q48, Q49, Q51, Q56 and K13 are "ON" and all other transistors and relays should be "OFF".
2. Relay K12 should never be "ON" when K13, K14 or K15 is "ON".

Table 4-8. AMPLITUDE RANGING CONTROL LOGIC

COMPONENTS AMPL RANGE		ALL COMPONENTS ARE ON MAIN CIRCUIT BOARD										
		STANDARD LOGIC ONLY, FOR INVERSE LOGIC, INTERCHANGE Q47 WITH Q48 AND Q49 WITH Q50				RELAY OR LOGIC DRIVER (ON)	(K1, D/A AMPL BOARD)					
		Q47	Q48	Q49	Q50		K10	K11	K12	K13	K14	K15
X1		X		X	Q54 Q55		X	X				
X0.1		X	X		Q51 Q56				X			
X0.01	X			X	Q52 Q56					X		
X0.001	X		X		Q53 Q56						X	
DC output (Also see Table 4-7)	Not Applicable		Not Applicable		Q57 Q55	X	X	X				

NOTE: The transistor or relay with "X" is in an "ON" state.

4.5.2.3 D/A CONVERTER

The D/A converter can easily be checked out by comparing the voltage level at the cathode of each switching diode according to Table 4-9. If the voltage level is not in agreement

with the table, check for correct voltage at the connector and the associated circuitry.

Pin No. 1 at the connector is the summing node of the D/A amplifier and should be 0 Vdc. If not, the problem is in the D/A amplifier.

Table 4-9. D/A CONVERTER

COMPONENTS FREQ AMPL OR OFFSET SETTINGS	PIN NUMBER AT CONNECTOR D/A CONVERTER BOARD												DIODE (CR) NUMBER (VOLTAGE AT CATHODE)											
	3	4	5	6	7	8	9	11	12	13	14	15	40	37	34	30	27	24	21	17	14	11	8	4
0.00	0	0	0	0	0	0	0	0	0	0	0	0	L	L	L	L	L	L	L	L	L	L	L	L
1.11	1	0	0	0	1	0	0	0	1	0	0	0	H	L	L	L	H	L	L	L	H	L	L	L
2.22	0	1	0	0	0	1	0	0	0	1	0	0	L	H	L	L	L	H	L	L	L	H	L	L
3.33	1	1	0	0	1	1	0	0	1	1	0	0	H	H	L	L	H	H	L	L	H	H	L	L
4.44	0	0	1	0	0	0	1	0	0	0	1	0	L	L	H	L	L	L	H	L	L	L	H	L
5.55	1	0	1	0	1	0	1	0	1	0	1	0	H	L	H	L	H	L	H	L	H	L	H	L
6.66	0	1	1	0	0	1	1	0	0	1	1	0	L	H	H	L	L	H	H	L	L	H	H	L
7.77	1	1	1	0	1	1	1	0	1	1	1	0	H	H	H	L	H	H	H	L	H	H	H	L
8.88	0	0	0	1	0	0	0	1	0	0	0	1	L	L	H	H	L	L	H	H	L	L	H	H
9.99	1	0	0	1	1	0	0	1	1	0	0	1	H	L	H	H	H	L	H	H	H	L	H	H

NOTE: H = +6 V.
 L = 0 V.
 1 is > 2.4 V for standard logic, < 1 V for inverting logic.
 0 is < 1 V for standard logic, > 2.4 V for inverting logic.

4.5.2.4 FREQUENCY RANGING LOGIC

Table 4-10 is provided as a hint for trouble-shooting frequency ranging and calibration problems. A few typical examples are listed below to clarify the use of this table.

1. Defective Q16, C12, K3, R39 or K6 will cause abnormal frequency output at X1K range. Shorted C3 will have 0 Vdc output. Inoperative K4 will have frequency output as at X1 MHz range, etc.
2. Frequency stays the same at all ranges from X0.001 to X10 Hz, if relay K6 is not energized or is open.
3. Frequency out of specification at X10K, X0.1M and X1M ranges indicates that R40 is not properly calibrated.
4. Each pair of transistors, Q1 and Q2, Q3 and Q4, Q5 and Q6, and Q7 and Q8, should never be "ON" or "OFF" simultaneously. If this occurs, all frequency ranging is wrong, or there is no ranging control at all.

Table 4-10. FREQUENCY RANGING LOGIC

COMPONENTS	TRANSISTORS ON FREQ RANGING BOARD (See Note 1)						MAIN BD						VCG BD			D/A AMPL BD					
							RELAY OR LOGIC DRIVER (ON)	C6 C7 C8		C11	C12	C13	C14 CAP C15 MULT		R20 R21	R22 R23	R16 R17	R37	R38	R39	R40
	Q1	Q2	Q3	Q4	Q5	Q6		Q7	Q8	K1	K2	K3	K4	K5	K6	K2	K3	K4	K4	K5	K6
FREQ RANGING							Q9, Q13, Q21, Q14						X	X							X
X0.001	X		X		X								X	X							X
X0.01		X	X		X		Q10, Q13, Q21, Q14						X	X	X						X
X0.1	X			X	X		Q11, Q13, Q21, Q14						X	X		X					X
X1		X		X	X		Q12, Q13, Q21, Q14						X	X			X				X
X10	X		X			X	Q14						X								X
X100		X	X			X	Q15					X									X
X1K	X			X		X	Q16			X											X
X10K		X		X		X	Q17, Q18, Q20	X													X
X0.1M	X		X			X	Q18, Q19, Q20	X													X
X1M		X	X			X	Q18, Q20														X

- NOTES: 1. For standard control logic only (for inverse logic, interchange each pair of transistors).
 2. The transistor or relay with "X" is in its "ON" state.

4.5.2.5 TRIGGER AND GATED LOGIC TIMING

For trouble-shooting the trigger, set the generator at GATED mode. Refer to Table 4-11. Draw a vertical line on the timing diagram along t_1 or t_2 , depending on whether the

TRIG IN signal is low or high, and check for correct voltage levels according to the timing diagram.

After the GATED mode has been checked out and is working normally, the TRIG mode can be checked in the same way but concentrated in the Q78, Q77 area.

Table 4-11. TRIGGER AND GATED LOGIC TIMING DIAGRAM

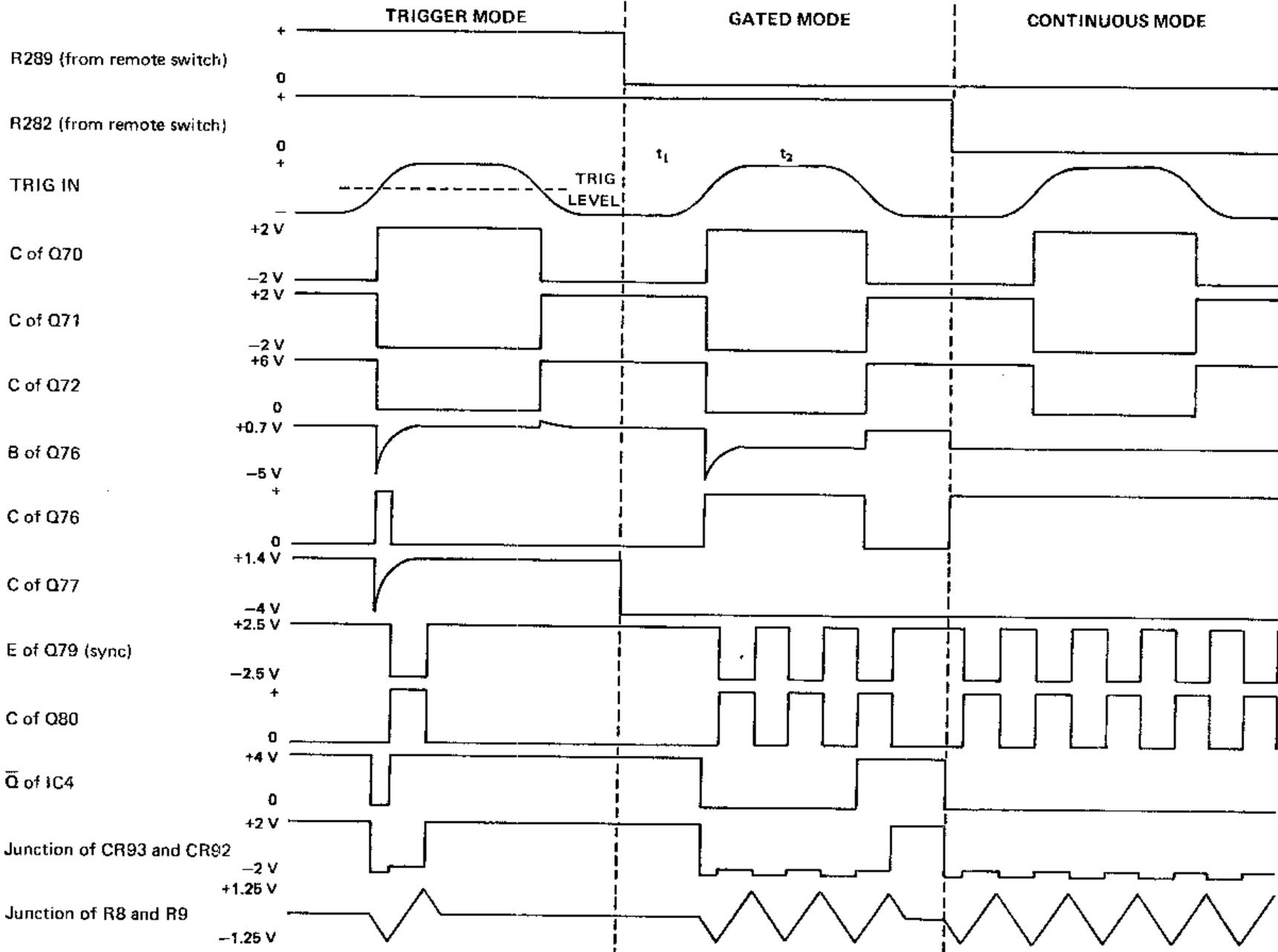


Table 4-12. KEY SIGNAL AND VOLTAGE

~ AMPLIFIER, COMPARATOR AND HYSTERESIS SWITCH

Test Point	Typical Voltage
G of Q2	2.5 V p-p  , 0 Vdc offset
G of Q3	2.5 V p-p  , 0 Vdc offset
E of Q5	2.5 V p-p  , ≈ +7 Vdc offset
Pins 1 and 4 of IC1	See Table 4-13
Pins 2 and 8	-3 V
Pins 3 and 9	-3.7 V
E of Q14	+6.8 Vdc
B of Q14 and Q9	See Table 4-13
E of Q8 and Q13	See Table 4-13
E of Q12	+10 V
R42 and R45 junction	-3 V
S of Q82	+10 V to +15 V, dependent on frequency setting
S of Q83	-10 V to -15 V, dependent on frequency setting

X-Y MULTIPLIER

Test Point	Typical Voltage
R111	Selected signal ( ,  , or DC)
R110	VCA input, voltage dependent on amplitude setting
Pins 8 and 12 of IC2	0 Vdc
Pin 5 of IC2	Same signal as at pin 4, but -1.4 V offset
Pins 6 and 11 of IC2	-1.4 V
Pin 10 of IC2	-1.4 V below pin 9
Pins 3 and 13	-13.5 V
Pin 1 of IC2	+5 V
E of Q32	Selected signal output, +9 Vdc offset, amplitude dependent on setting
E of Q31	Inverted output of Q32

~ CONVERTER AND AMPLIFIER

Test Point	Typical Voltage
Pin 2 of A1	See Table 4-13
Pin 4 of A1	+14 V
Pin 1 of A1	-14 V
Pin 5 of A1	250 mV p-p  , 0 Vdc offset
R75 and R76 junction	2.5 V p-p  , 0 Vdc offset
B of Q17 and Q18	+8 V

OUTPUT AMPLIFIER

Test Point	Typical Voltage
Voltage between  and 	-1 to +1 V (when floating)
E of Q33	+19 Vdc
E of Q34	-19 Vdc
R157 and R158 junction	+0.7 Vdc
E of Q35	Selected waveform, 0 to 1 V p-p
E of Q36	+10 V ±5 V
B of Q41	+19 Vdc
E of Q43	+19 Vdc
B of Q42	-19 Vdc
E of Q44	-19 Vdc
R166 and R168 junction	+0.7 Vdc
E of Q37 and Q39	+19 Vdc
E of Q40	+2 V to +18 V
R192 and R193 junction	Main output, ±15 V maximum

SYNC AND SQUARE AMPLIFIER

Test Point	Typical Voltage
R84 and R56 junction	±2.4 V 
CR27 cathode	±1.25 V 
R95 and R96 junction	±1.25 V 

AUX AMPLIFIER

Test Point	Typical Voltage
E of Q26	0 to +6 V 
E of Q27	+3.5 V
C of Q29	0 to +6 V  , < 5 ns RF time

D/A AMPLIFIER

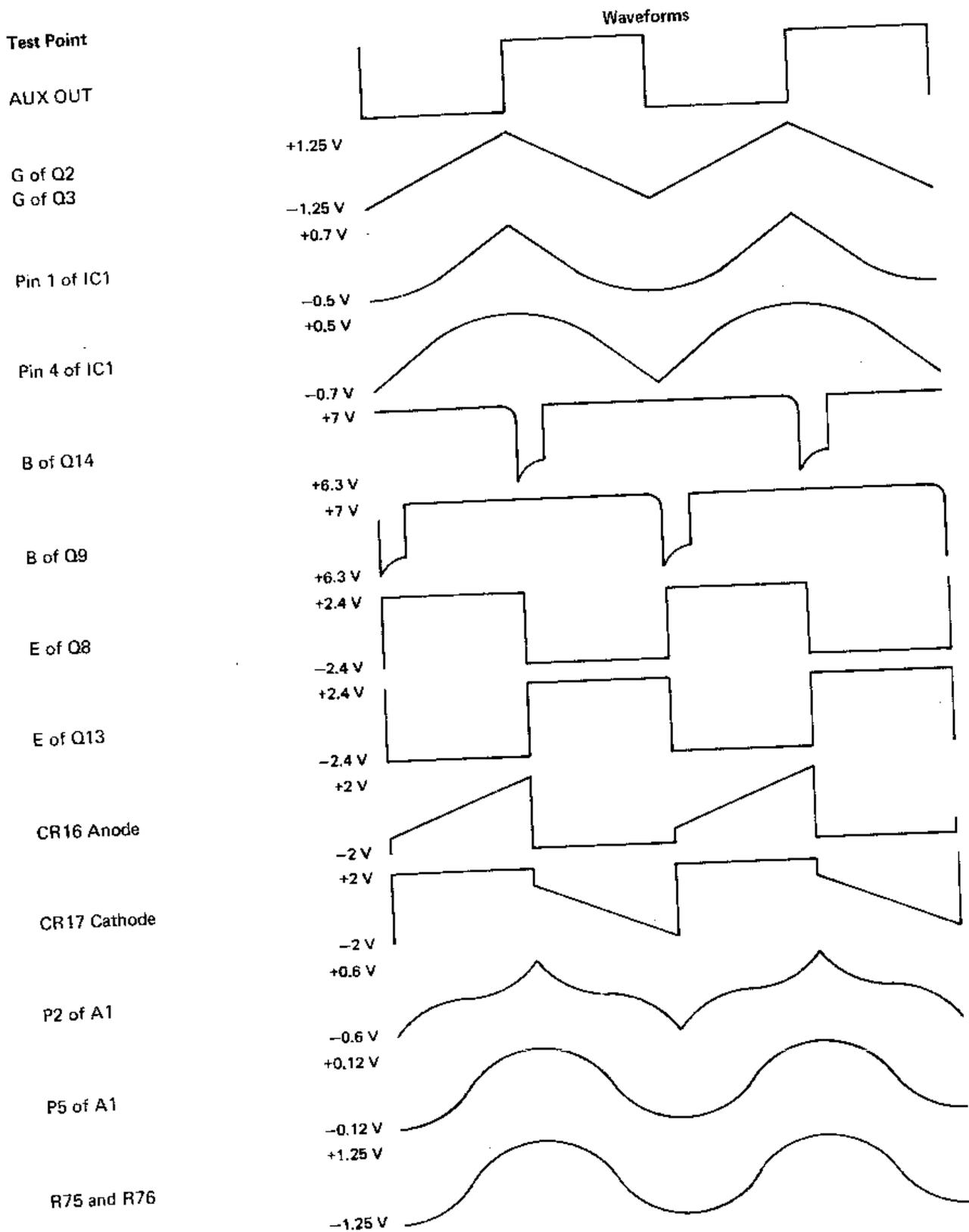
Pins 2 and 3 of all D/A amplifiers (IC1, IC2 and IC3) are 0 Vdc. Their output voltages are dependent on front panel and remote control settings. The gain of IC2 will decrease to 1/2 when dc output is selected and K1 is closed.

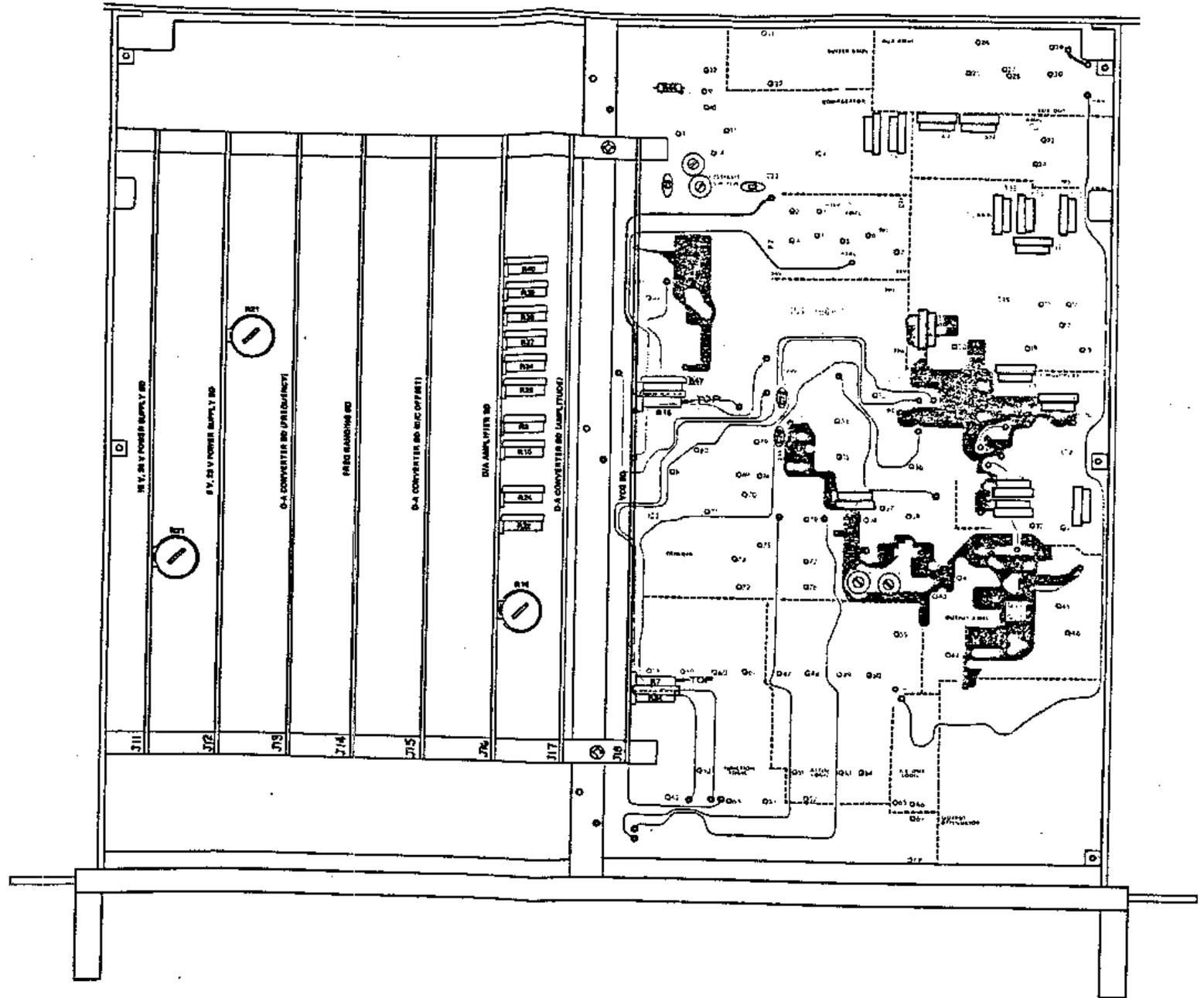
Table 4-12. KEY SIGNAL AND VOLTAGE (Continued)

VCG AMPLIFIER AND TRIGGER BASELINE COMPENSATION		CAPACITANCE MULTIPLIER*	
Test Point	Typical Voltage	Test Point	Typical Voltage
R24 and R25 junction	0 to -5 V*	G1 and G2 of Q6	±1.25 V
S of Q1	0 V	Pin 6 of IC7	, amplitude dependent on frequency setting
Pins 2 and 3 of IC2	+15 to +10 V*	Pins 2 and 3 of IC3	±1.25 V
S of Q2	0 to -5 V*	Pin 6 of IC3	±7.50 V
Pins 2 and 3 of IC5	-15 to -10 V*		
V _{GS} of Q3	V _{G1,S1} = V _{G2,S2}		
R36 and R37	Voltage across both are equal		
E of Q5	+2.2 V		
R36	Voltage across R39 and R29 are equal		

*Voltage is dependent on a frequency setting of 0.00 to 9.99.

Table 4-13. KEY WAVEFORMS





ADJUSTMENT AND TEST POINT LOCATIONS

SECTION 5

DIAGRAMS, ADDENDA AND PARTS LISTS

5.1 DRAWINGS

The following assembly drawings (with parts lists) and schematics are in the arrangement shown below.

5.2 ORDERING PARTS

When ordering spare parts, please specify part number, circuit reference, board, serial number of unit and, if applicable, the function performed.

5.3 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

CROSS REFERENCE FOR DRAWING NUMBERS

Drawings	Old Number	New Number	Drawings	Old Number	New Number
Chassis Schematic	154-200	0004-00-0041	D-A Converter Schematic	154-213	0103-00-0083
Chassis Assy	154-000	0002-00-0300	D-A Converter Assy	154-013	0101-00-0083
Chassis Parts List	"	1101-00-0041	D-A Converter Parts List	"	1100-00-0083
Main Board Schematic	154-215	0103-00-0085	Frequency Range Schematic	154-212	0103-00-0082
Main Board Assy	154-015	0101-00-0085	Frequency Range Assy	154-012	0101-00-0082
Main Board Parts List	"	1100-00-0085	Frequency Range Parts List	"	1100-00-0082
Patch Block Assy	154-024	1205-00-0489	D-A Amplifier Schematic	154-214	0103-00-0084
Patch Block Parts List	"	"	D-A Amplifier Assy	154-014	0101-00-0084
			D-A Amplifier Parts List	"	1100-00-0084
Mother Board Assy	154-010	0101-00-0080	VCG Board Schematic	154-216	0103-00-0086
Mother Board Parts List	"	1100-00-0080	VCG Board Assy	154-016	0101-00-0086
			VCG Board Parts List	"	1100-00-0086
15V, 24V Power Supply Schematic	154-211	0103-00-0081	Transistor Mounting Board	154-017	0101-00-0087
15V, 24V Power Supply Assy	154-011	0101-00-0081	Assy	"	1100-00-0087
15V, 24V Power Supply Parts List	"	1101-00-0081	Transistor Mounting Board Parts List	"	1100-00-0087
6V, 23V Power Supply Schematic	154-221	0103-00-0088	Rear Panel Assy	154-001	0102-00-0331
6V, 23V Power Supply Assy	154-021	0101-00-0088	Rear Panel Parts List	"	1101-00-0072
6V, 23V Power Supply Parts List	"	1100-00-0088	Extender Board Assy	154-018	0101-00-0088
			Extender Board Parts List	"	1100-00-0088

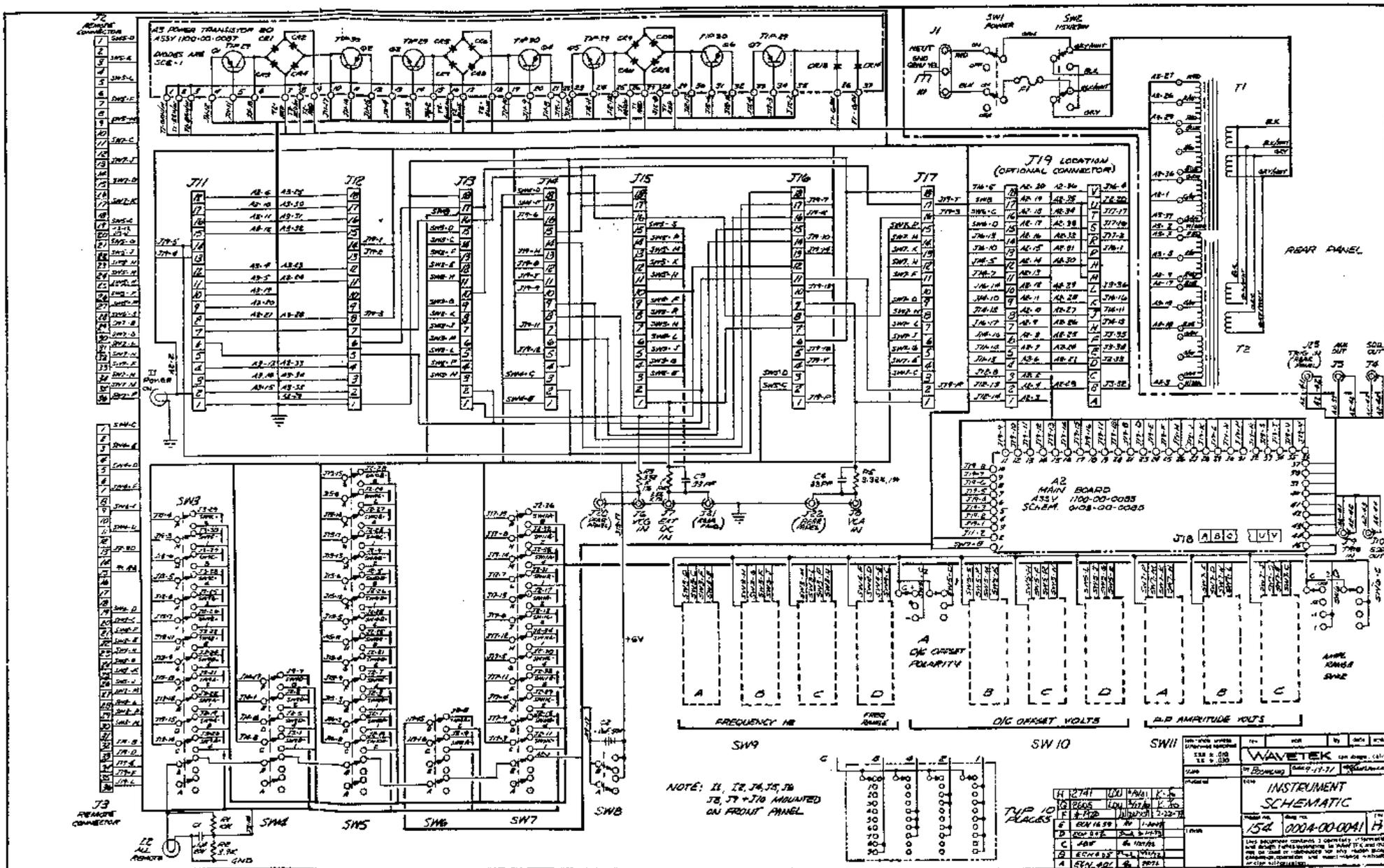
*Same as assembly number

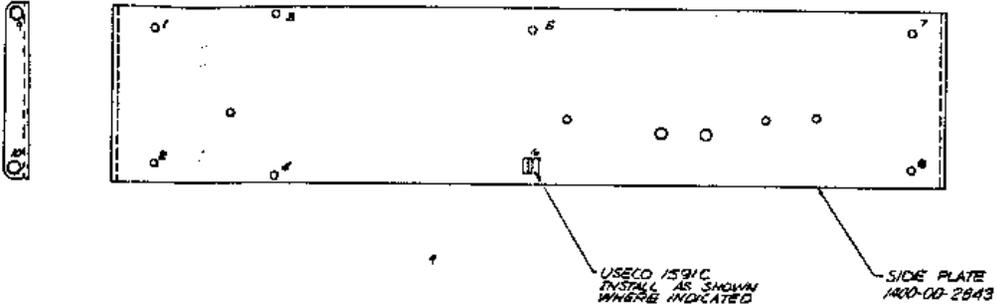
5.4 RECOMMENDED SPARE PARTS LIST

Information is provided to maintain the instrument on a board or component level. Price and delivery information should be obtained from the Wavetek representative in your area or directly from the factory.

DESCRIPTION	MFG	PART NO.	QTY
BOARD LEVEL			
15 V, 24 V POWER SUPPLY BOARD	WAVETEK	154-011	1
FREQ RANGING BOARD	WAVETEK	154-012	1
D/A CONVERTER BOARD	WAVETEK	154-013	1
D/A AMPLIFIER BOARD	WAVETEK	154-014	1
VCG BOARD	WAVETEK	154-018	1
6 V, 23 V POWER SUPPLY BOARD	WAVETEK	154-021	1
COMPONENT LEVEL			
DIODE TUNNEL	GE	1N3716	1
DIODE	SEMTECH	SCE-1	2
DIODE	FAIRCHILD	FD777	1
DIODE	FAIRCHILD	FD6666	8
*DIODE -69	FAIRCHILD	FD6668	2
DIODE ZENER	WAVETEK	130-506	2
FUSE 1/4 115 V	LITTELFUSE	313-500	
FUSE 1/4 230 V	LITTELFUSE	313-250	1
*INTEGRATED CKT -13	FAIRCHILD	μA708C	2
*INTEGRATED CKT -14	FAIRCHILD	μA708C	2
INTEGRATED CKT	RCA	CA3028A	1
INTEGRATED CKT	RCA	CA3049	1
INTEGRATED CKT	MOTOROLA	MC1595L	1
INTEGRATED CKT	MOTOROLA	MC3050P	1
LAMP	MURA	BP 23/40	2
RELAY	JENCO	RR30-1023	2
RELAY	JENCO	RR30-1024	2
SINE MODULE	WAVETEK	B142-011	1
TRANSISTORS	FAIRCHILD	2N3638	8
TRANSISTORS	FAIRCHILD	2N3842	2
TRANSISTORS	FAIRCHILD	2N3848	8
TRANSISTORS	FAIRCHILD	2N4248	2
TRANSISTORS	MOTOROLA	MPS L08	1
TRANSISTORS	MOTOROLA	2N2906A	1
*TRANSISTORS -52	MOTOROLA	2N3663	2
*TRANSISTORS -53	MOTOROLA	2N5485	2
*TRANSISTORS -54	MOTOROLA	2N5485	1
*TRANSISTORS -55	MOTOROLA	2N6482	1
*TRANSISTORS -66	MOTOROLA	2N2219A	2
TRANSISTORS	TEXAS INST	TIP 29	2
TRANSISTORS	TEXAS INST	TIP 30	2
TRANSISTORS	TECH PROD	TP 308	1

* Denotes special selected parts and should be ordered from Wavetek.





FILE	LEFT	RIGHT
1	X	
2		X
3	X	X
4	X	X
5	X	
6		X
7	X	
8		X
9	INSTALL BOOTTS FASTENERS TYPED FOR LEFT & RIGHT	

X INDICATES INSTALL BLOCK

1 LEFT REQD/UNIT
1 RIGHT

SEE SHEET 1			
REV	BY	DATE	APP
A	ECN 401	10/1/77	WV
WAVESTEK FULL SERVICE 1500 WASHINGTON ST. #11-171 BOSTON, MA 02118			
CHASSIS ASSEMBLY LEFT + RIGHT SIDE PLATES DATE: 10/1/77			
MODEL NO. 1591C DATE: 10/1/77 0002-00-0300 H			
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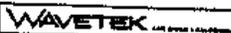
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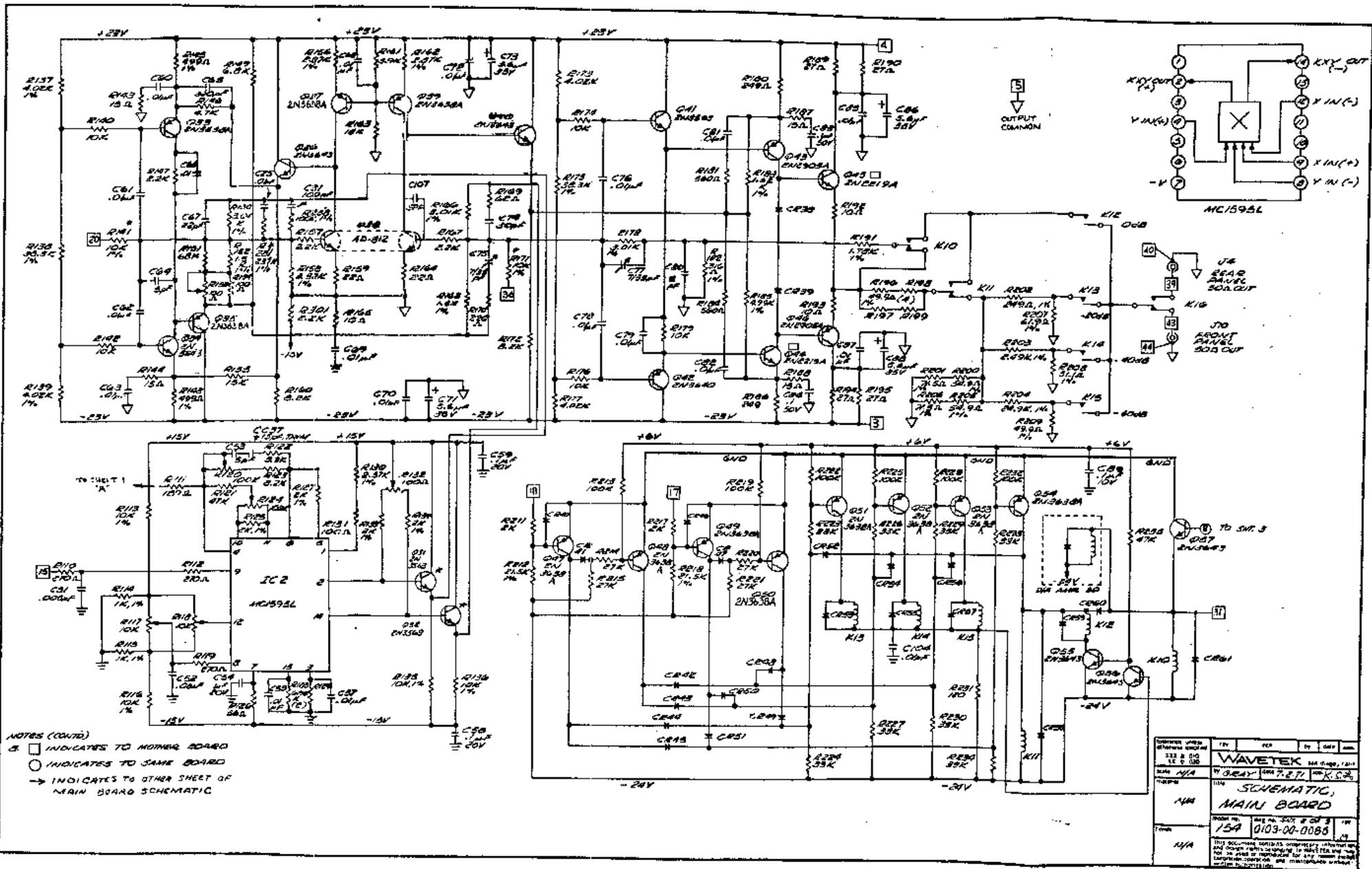
REFERENCE DESIGNATOR	PART DESCRIPTION	ORIG-IPOR-PART-NO	MPN	WAVETEK NO.	QTY/PT
NONE	ASSY DRAG CHASSIS	0102-00-0200		0102-00-0200	1
20	D.B. PANEL ASSEMBLY	124-004		1201-00-0020	1
29	BRACER	144-305		1400-00-2113	2
31	PANEL, PT	124-300		1400-00-2810	1
38	RAIL, STDE	184-202		1400-00-2842	2
14	RAIL, SUP	184-204		1400-00-2843	1
15	RAIL, SUP, TOP	184-202		1400-00-2843	1
57	GUIDE, RD	184-210		1400-00-2840	2
10	LENS, INDICATOR	184-211		1400-00-2870	2
23	COVER	134-219		1400-00-2972	2
14	HANDLE REF: 3200-00-0001	184-028		1400-00-2990	2
NONE	SHIELD, INDICATOR REF: 3200-00-0004	194-324		1400-00-3360	1
NONE	ID LABEL SPECIAL INSTRUMENT	1400-01-0998		1400-01-0990	1
J10 J8 J7 J6 J5	INC CONN	80-7946	KING	2100-01-0002	3
NONE	CONN	57-20240	AMPH	2100-03-0438	2
31	BOLDER LID	1997	SMITH	2100-04-0413	1

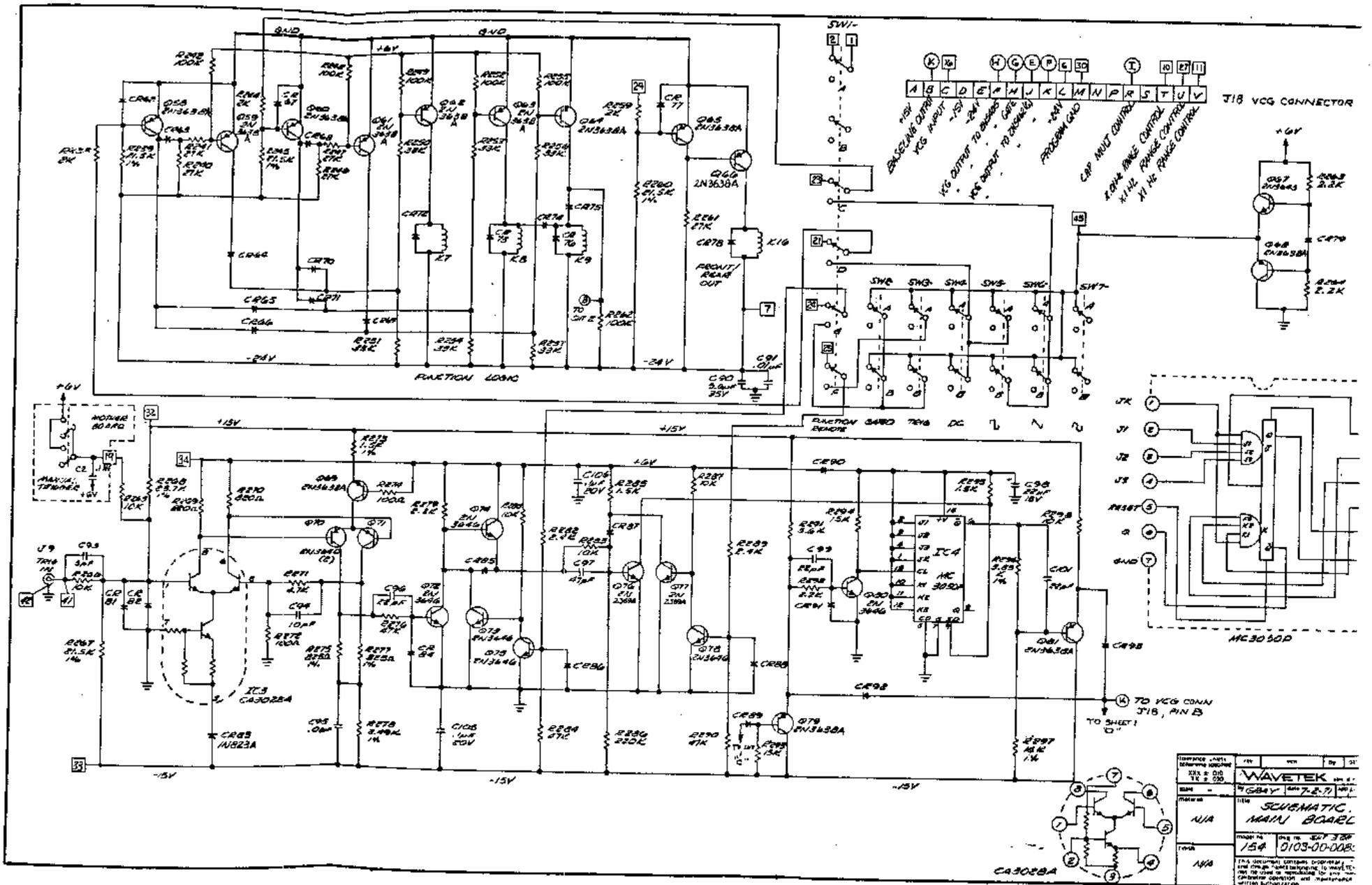
WAVETEK PARTS LIST TITLE STD CHASSIS ASSEMBLY NO. 1101-00-0041 PAGE: 1 REV. K

REFERENCE DESIGNATOR	PART DESCRIPTION	ORIG-IPOR-PART-NO	MPN	WAVETEK NO.	QTY/PT
46	INSERT, BANG. LOC	780100-AL3	BOOTS	2800-09-0012	4
41	PART, CHASSIS	1891-C11	LABCO	4000-09-0022	10
42	WASHER, SPACER	2446	SMITH	2800-27-0002	2
33	WASHER, RADIAL	2446	SMITH	2800-27-0004	1
35	W/LEM PLAT WASHER	22444-385	WATSON	2800-28-0005	1
34	RETAINING RING	3209-31		2800-28-0005	1
SWP	SWITCH ASSEMBLY D101	154-400	FRANK	400-34-0002	2
SW10	SWITCH ASSEMBLY D102	154-401		3107-00-0001	1
SW11	SWITCH ASSEMBLY D103	154-402		3107-00-0002	1
SW12	SWITCH ASSEMBLY D104	154-403		3107-00-0003	1
NONE	PWR CORD	4001-80-0005	SMITH	4001-80-0005	1

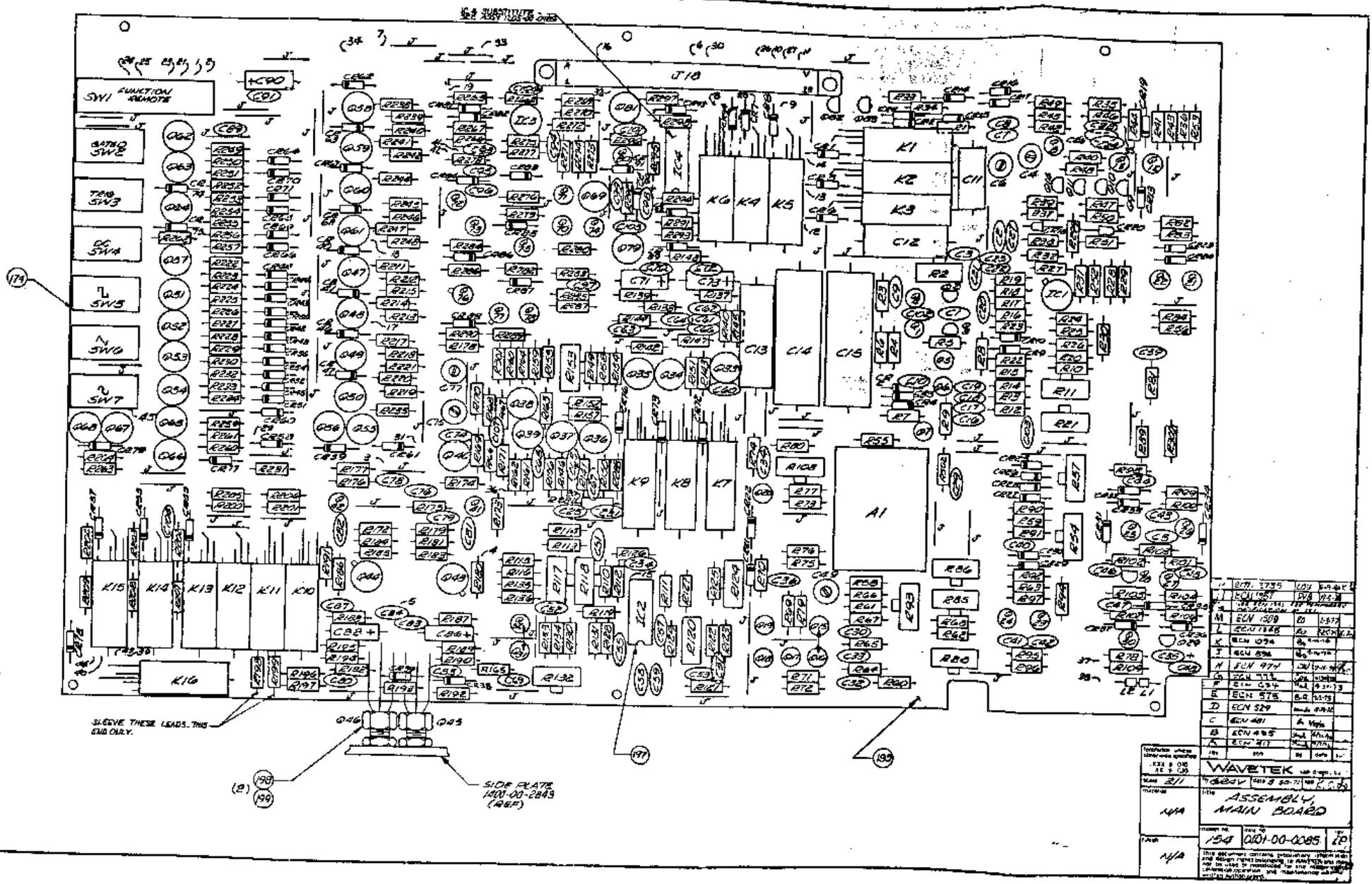
WAVETEK PARTS LIST TITLE STD CHASSIS ASSEMBLY NO. 1101-00-0041 PAGE: 2 REV. K

REMOVES ALL MARKS AND WEAR INDICATORS	REWORK	DATE	
MATERIAL	PREPARED BY	TITLE	
PAVING MACHINE	RELEASE APPROVED	DATE	PARTS LIST CHASSIS
	THE SPACE UNLESS OTHERWISE SPECIFIED IS IN INCHES AND DECIMALS THEREOF. ALL DIMENSIONS ARE TO BE TAKEN TO THE CENTER UNLESS OTHERWISE SPECIFIED. DO NOT SCALE DIMENSIONS.	REV. NO. 154 23338	
			1101-00-0041 REV. K





REV	DATE	BY	CHK
1	11/80	WAVETEK	
WAVETEK 150 0103-00-00B SCHEMATIC MAIN BOARD 150 0103-00-00B			



REV	DATE	BY	CHKD
1	08/11/77	WV	WV
2	09/15/77	WV	WV
3	10/15/77	WV	WV
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236	03/15/97	WV	WV

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN DETAILS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED OR ANY MANNER WITHOUT WAVETEK'S PERMISSION, AND WAVETEK'S PERMISSION IS LIMITED TO THE ORIGINAL OPERATIONS AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REV 100 87 5475 107

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-WFORM-PART-NO	WFORM	WAVETEK NO.	QTY/PT
R200 R205	RES. NP. 1/8W. 1%. 5A. 9	RN550-3489F	TRM	4701-03-3499	2
R124 R64 R71 R72	RES. NP. 1/8W. 1%. 5A. 2	RN550-3492F	TRM	4701-03-3429	4
R181 R184	RES. NP. 1/8W. 1%. 5A. 27A	RN550-3740F	TRM	4701-03-3740	2
R241	RES. NP. 1/8W. 1%. 5. 74W	RN550-3741F	TRM	4701-03-3741	1
R355 R357	RES. NP. 1/8W. 1%. 5A. 13W	RN550-3311F	TRM	4701-03-3191	2
R145 R307	RES. NP. 1/8W. 1%. 5A. 11W	RN550-4190F	TRM	4701-03-4190	2
R149	RES. NP. 1/8W. 1%. 5A. 81K	RN550-3481F	TRM	4701-03-3481	1
R120 R124	RES. NP. 1/8W. 1%. 5A. 70W	RN550-3481F	TRM	4701-03-3481	1
R131	RES. NP. 1/8W. 1%. 5A. 49. 8W	RN550-4492F	TRM	4701-03-4492	1
R14 R17	RES. NP. 1/8W. 1%. 7. 5K	RN550-7501F	TRM	4701-03-7501	2
R214 R270 R275 R277 R42	RES. NP. 1/8W. 1%. 5A. 22K	RN550-8230F	TRM	4701-03-8230	2
R122 R160 R172 R43 R22 R42 R42	RES. NP. 1/8W. 1%. 8. 25W	RN550-8231F	TRM	4701-03-8231	2
R302	RES. NP. 1/8W. 1%. 82. 3	RN550-3282F	TRM	4701-03-3282	1
R21 R30	RES. NP. 1/8W. 1%. 90. 8	RN550-3281F	TRM	4701-03-3281	1
R36	RES. NP. 1/8W. 1%. 19K	RN400-1620F	TRM	4701-13-1640	2
R47	RES. NP. 1/8W. 1%. 33K	RN400-3220F	TRM	4701-13-3220	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-WFORM-PART-NO	WFORM	WAVETEK NO.	QTY/PT
C808 C810 C810 C811 C878 C872 D811	DIODE. MET. 2-425-777 STY: 2 4807-02-0777	142-901-58	WVTR	4998-00-0002	1
R74 R77	TRANS	242349A	WGT	4901-03-3491	2
R42 R44	TRANS	242350A	NBC	4901-02-4081	2
R41 R45	TRANS	242351A	FAIR	4901-03-3430	2
R32 R33 R37 R39 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99	TRANS	242352A	CARTY	4901-03-4281	25
R1 R2 R3 R4 R5 R6 R7 R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99	TRANS	242353A	FAIR	4901-03-4100	4
R34 R35 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99	TRANS	242354A	FAIR	4901-03-4420	2
R19 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99	TRANS	242355A	NBC	4901-03-4440	15
R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99	TRANS	242356A	FAIR	4901-03-1390	4
R90	TRANS	242357A	WGT	4901-03-4840	1
R10 R11 R14 R15 R16 R17 R18 R19 R20 R21 R22 R23 R24 R25 R26 R27 R28 R29 R30 R31 R32 R33 R34 R35 R36 R37 R38 R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49 R50 R51 R52 R53 R54 R55 R56 R57 R58 R59 R60 R61 R62 R63 R64 R65 R66 R67 R68 R69 R70 R71 R72 R73 R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99	TRANS	242358A	NBC	4901-03-7710	4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-WFORM-PART-NO	WFORM	WAVETEK NO.	QTY/PT
R250 R251 R255 R254 R284 R257	RES. NP. 1/8W. 1%. 30. 2	RN550-3282F	TRM	4701-03-3229	4
R10 R20	RES. NP. 1/8W. 1%. 5. 43W	RN550-3481F	TRM	4701-03-3429	4
R37A	RES. NP. 1/8W. 1%. 5. 82K	RN550-3281F	TRM	4701-03-3281	1
R120 R178	RES. NP. 1/8W. 1%. 38. 3A	RN550-3282F	TRM	4701-03-3282	1
R108	RES. NP. 1/8W. 1%. 39K	RN550-3282F	TRM	4701-03-3282	1
R109 R141 R7	RES. NP. 1/8W. 1%. 3. 92W	RN550-3281F	TRM	4701-03-3281	3
R137 R139 R173 R177	RES. NP. 1/8W. 1%. 4. 02W	RN550-4021F	TRM	4701-03-4021	4
R447	RES. NP. 1/8W. 1%. 4. 02W	RN550-4021F	TRM	4701-03-4021	1
R70 R74	RES. NP. 1/8W. 1%. 4. 44A	RN550-4440F	TRM	4701-03-4440	1
R101 R102	RES. NP. 1/8W. 1%. 4. 4. 4	RN550-4440F	TRM	4701-03-4440	2
R144 R271	RES. NP. 1/8W. 1%. 4. 4. 7W	RN550-4741F	TRM	4701-03-4741	2
R121 R225 R274 R284 R290	RES. NP. 1/8W. 1%. 47. 5A	RN550-4752F	TRM	4701-03-4752	2
R148 R148 R41	RES. NP. 1/8W. 1%. 4. 49W	RN550-4940F	TRM	4701-03-4940	3
R165	RES. NP. 1/8W. 1%. 4. 4. 9W	RN550-4941F	TRM	4701-03-4941	1
R42 R43 R41 R42	RES. NP. 1/8W. 1%. 5. 81	RN550-5810F	TRM	4701-03-5810	1
R208	RES. NP. 1/8W. 1%. 5. 81. 1	RN550-5810F	TRM	4701-03-5810	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-WFORM-PART-NO	WFORM	WAVETEK NO.	QTY/PT
R109 R137 R138 R139 R139 R209	RES. NP. 1/8W. 1%. 49. 9	RN400-4999F	TRM	4701-13-4999	3
R301 R204	RES. NP. 1/8W. 1%. 21. 5	RN400-7130F	TRM	4701-13-7130	3
R311 R171	RES. DET. 2-10K. 1/8W STY: 2 4701-03-1002	142-501-04	WVTR	4998-00-0018	1
C812 C82 C83	DIODE. ZENER 4. 2V	14232A	NBC	4901-01-0822	3
C816 C820	DIODE	142716	FAIR	4802-01-2716	2
C810 C814 C818 C818 C817 C823 C826 C827 C828 C834 C84	DIODE	242327	FAIR	4807-02-0777	11
C81 C819 C821 C822 C822 C824 C824 C82 C820 C831 C822 C823 C823 C826 C827 C828 C825 C84 C840 C841 C842 C843 C844 C845 C846 C847 C848 C849 C83 C830 C831 C832 C832 C833 C835 C835 C835 C836 C837 C838 C839 C840 C841 C842 C843 C844 C845 C846 C847 C848 C849 C871 C872 C875 C878 C878 C878 C877 C878 C870 C88 C881 C882 C884 C885 C886 C887	DIODE	142448	FAIR	4807-02-4448	75

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-WFORM-PART-NO	WFORM	WAVETEK NO.	QTY/PT
R44 R45	TRANS. SEL. 242319A STY: 1 4901-02-2191	142-901-44	WVTR	4998-00-0001	2
R13 R14 R21 R22	TRANS. WFORM. 242343 STY: 2 4901-03-3430	142-801-32	WVTR	4998-00-0004	2
R83	TRANS. SEL. 242342 STY: 1 4901-03-3430	142-901-88	WVTR	4998-00-0008	1
R2 R3	TRANS. WFORM. 242342 STY: 2 4901-03-3430	142-801-53	WVTR	4998-00-0009	1
R4	SWITCH ASSEMBLY	188-404	WVTR	4809-00-0007	1
R46	J-32308-BLACK	ORL	5102-04-5003	7	
R47	AD DIR	ANDEV	7000-08-1200	1	
R48	AG157K	WGT	7000-15-0900	1	
R49	CA-3028A	RCA	7000-30-2800	1	
R50	CA3049T	RCA	7000-30-4900	1	

WAVETEK PARTS LIST TITLE MAIN

ASSEMBLY NO. 1100-00-0085 PAGE 7

WAVETEK PARTS LIST TITLE MAIN

ASSEMBLY NO. 1100-00-0085 PAGE 9

WAVETEK PARTS LIST TITLE MAIN

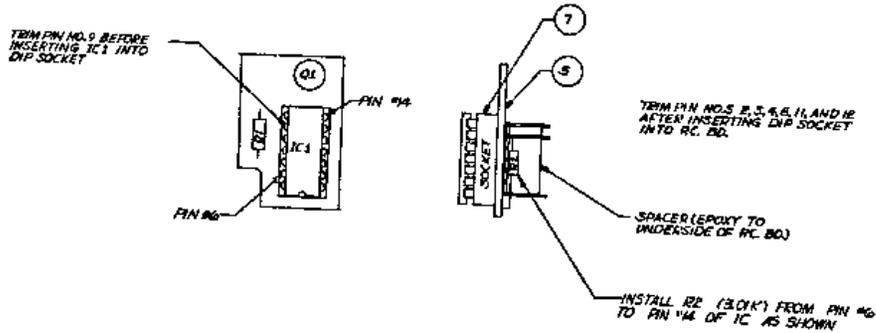
ASSEMBLY NO. 1100-00-0085 PAGE 11

REMOVE ALL SURF AND BRASS BRAGG LEGS		DATE	WAVETEK 1000 EAST 15TH AVENUE CALIFORNIA	
MATERIAL	QUANTITY	SCALE	PARTS LIST MAIN BOARD	
POWER	WAVETEK PROCURE	SCALE	154	1100-00-0085
SCALE	SCALE	SCALE	12238	8

WAVETEK PARTS LIST TITLE MAIN

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND IS NOT TO BE DISCLOSED TO ANY PERSON EXCEPT CALIBRATION, OPERATION AND MAINTENANCE AUTHORIZED PERSONNEL.

REV	REV	BY	DATE
A	ECN NO. 1472	RD	02/78
B	REDRAWN (NO CHANGES)	DC	10/78
C	# 1999	DC	7/79

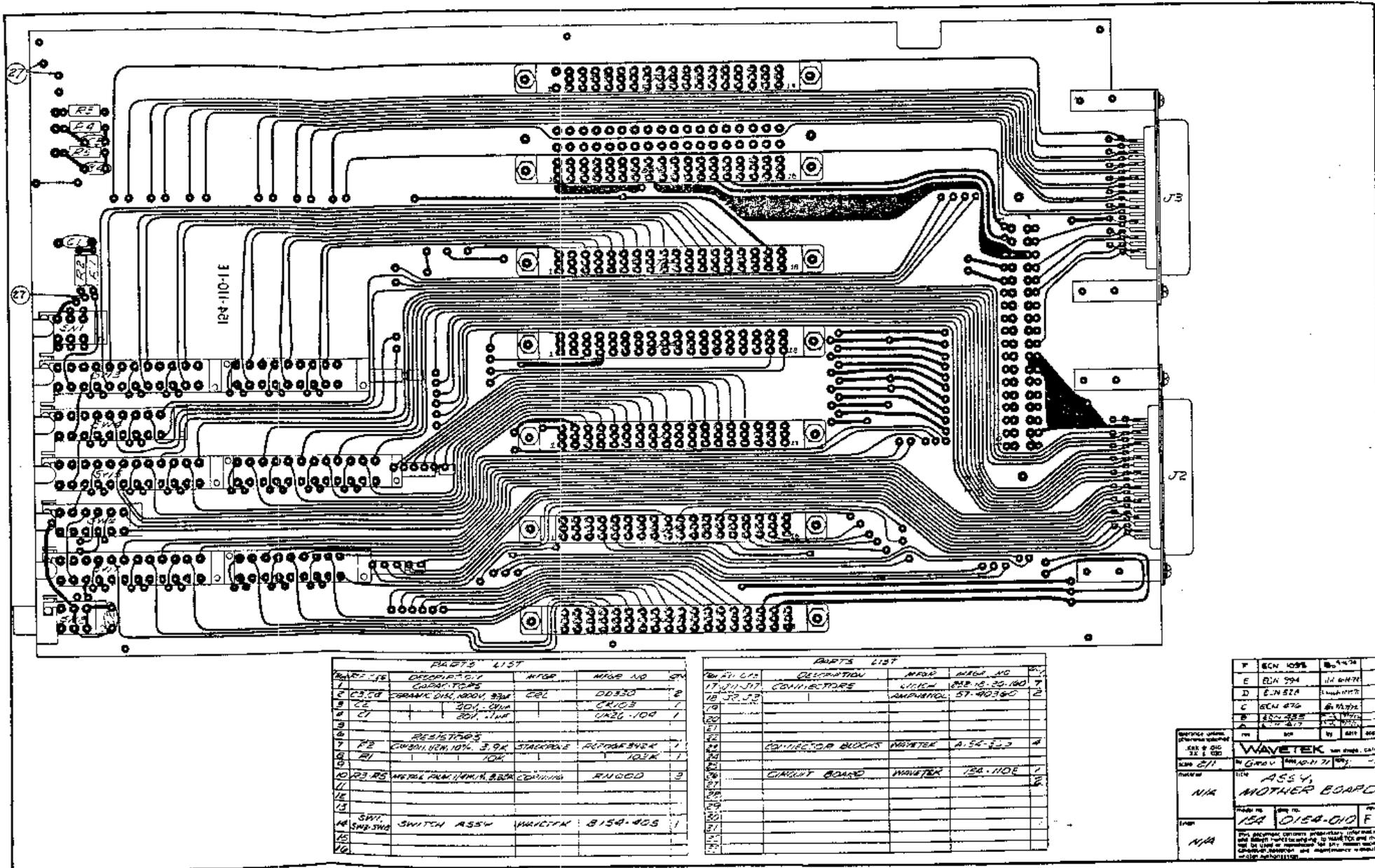


REFERENCE DESIGNATOR	PART DESCRIPTION	QTY-REQ-PART-NO	MRM	WAVETEX NO.	STV/PT
2	SPACER	1400-00-4441	WVTK	1400-00-4441	1
3	CHIP REPLACEMENT BR	156-124	WVTK	1700-00-0489	1
7	INT. ZC. 14P70-141	080200-1490	SAN	2100-00-0002	1
8E	RES. NP. 1/8W. 1%. 5.01K	80090-2011P	TW	4701-02-2011	1
8L	RES. NP. 1/8W. 1%. 5.01K	80090-2011P	TW	4701-02-2011	1
9E	TRAMP	20044A	WBC	0901-02-4440	1
10E	ZC	74L874	TE	0000-74-7410	1

WAVETEX PARTS LIST TITLE: PATCH BLOCK ASSEMBLY NO. 1205-00-0489 REV. C
PAGE: 1

WVTK, UNLESS OTHERWISE SPECIFIED

DRAWN BY: J. COOPER CHECKED BY: [] DATE: []	TITLE: PATCH BLOCK PART NO.: 1205-00-0489 REV: C	WAVETEX 154 1205-00-0489 C 13338
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PARTS LIST				
REF. ID	DESCRIPTION	QTY	WAVE NO	REV
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PARTS LIST				
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REV	ECN	ISSUE	DATE
E	ECN 594		11/04/78
D	ECN 514		11/04/78
C	ECN 476		08/13/78
B	ECN 438		07/13/78
A	ECN 417		07/13/78
REV	DATE	BY	APP
WAVETEK			
1000 GARDEN ST. BERKELEY, CALIF. 94702			
(415) 861-1000			
REV	DATE	BY	APP
ASSY, MOTHER BOARD			
REV	DATE	BY	APP
124-110-101E			
REV 1			
DATE 11/04/78			
BY N/A			
APP N/A			

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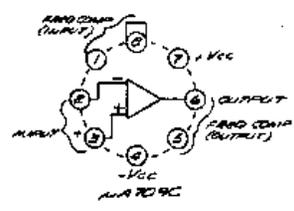
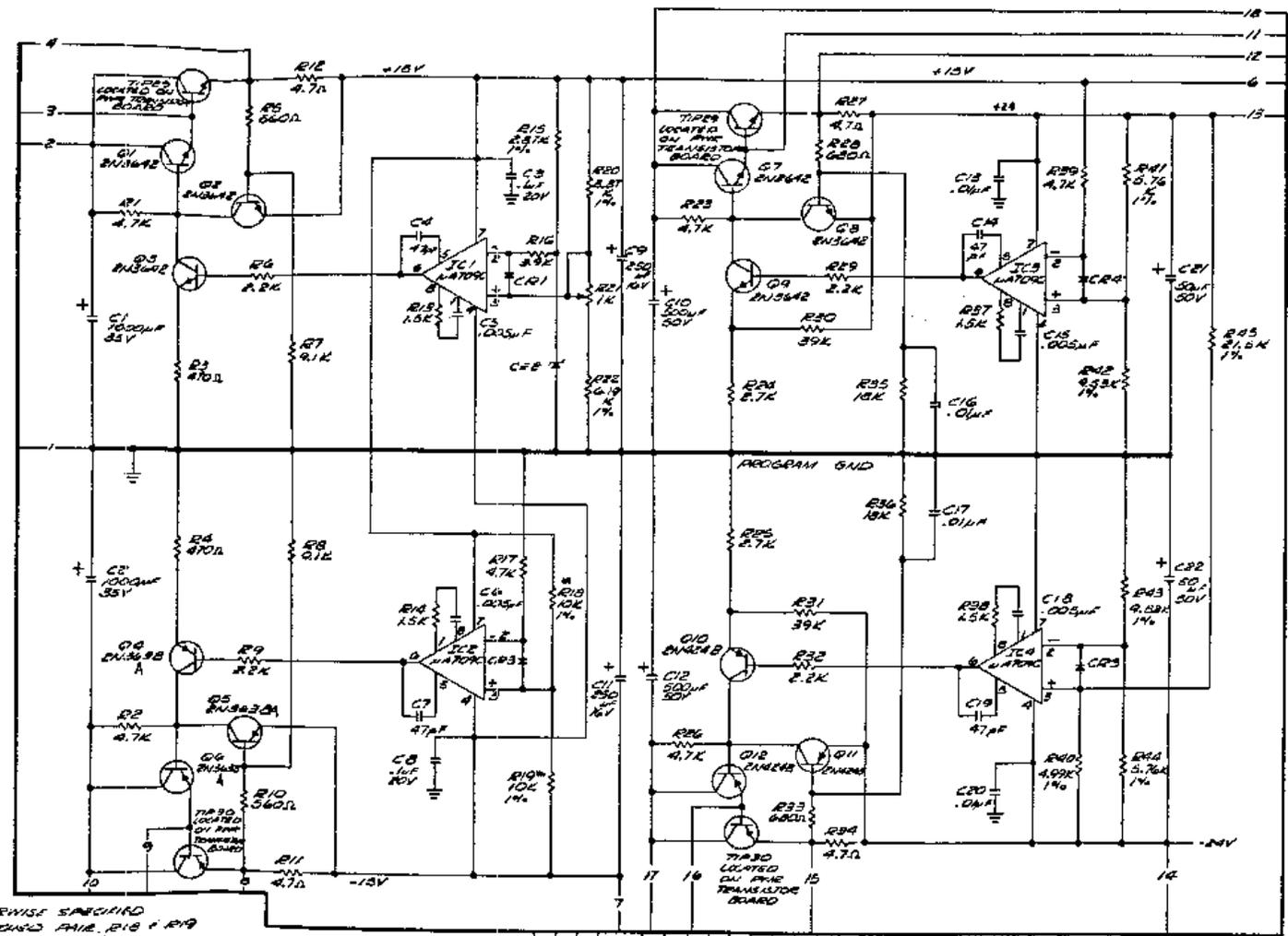
REV 301 97 DATE 01/97

REFERENCE DESIGNATOR	PART DESCRIPTION	QTY IN PWR-PART-NB	MPN	WAVETEK REL.	QTY/PT
None	ROBOMATIC 1407ELM001	0004-00-0041	WVTR	0004-00-0041	1
None	ARMY DRUM, MOTHER	0101-00-0080	WVTR	0101-00-0080	1
20	ALUCL. COBR	154-306	WVTR	1400-00-3870	4
D1 C1	CAP. CER. NON. LFP. 50V	640032N1604200A	COBWH	1500-01-0402	2
C3 C4	CAP. CER. 33PF. 16V	00-008	ORL	1900-00-2011	2
None	MOTHER	154-110	WVTR	1700-00-0080	1
J2 J3	CONN	57-A05A3	AMPN	2100-02-0040	2
J11 J12 J13 J14 J15 J16 J17	CONN. EDGE CARD	252-16-30-140	CINDA	2100-00-0013	7
S7	LAMP	7874	JGL	3400-02-0013	2
R1	RES. HP. 1/8W. 1K. 10%	RN350-1000P	YNS	4701-03-1002	1
R2 R4 R5	RES. HP. 1/8W. 1K. 3.3%	RN030-3301P	YNS	4701-03-3301	3
R6	RES. HP. 1/8W. 1K. 3.3%	RN500-0W50P	YNS	4701-03-3901	1
S4	SWITCH ARRY PS	134-005	WVTR	3100-00-0000	1
S5	BUTTON	J-03205-BLACK	ORL	3100-04-0003	7

WAVETEK PARTS LIST TITLE MOTHER ASSEMBLY NO. 1100-00-0080 PAGE: 1

WVTR 01/97 01/97 01/97

<input type="checkbox"/> SHOW ALL PARTS AND BREAK DOWN CODES <input type="checkbox"/> MATRNL. <input type="checkbox"/> FROM WAVETEK PROCESS	<input type="checkbox"/> REVISED <input type="checkbox"/> ALL CODES APPROV. <input type="checkbox"/> FOR CHANGE ORDER OR DRAWING REVISION <input type="checkbox"/> DATE: 1/15/97 <input type="checkbox"/> DO NOT SCALE COPY	DATE: 1/15/97 PART NO. 154 QTY: 23338 SHEET 1 OF 1	WAVETEK THE WORLD'S BEST MOTHER BOARD MODEL NO. 1100-00-0080 REV. G
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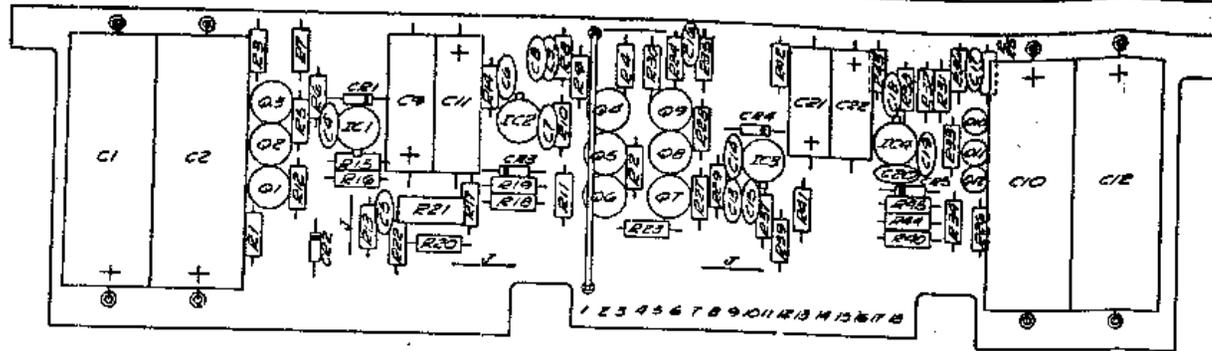


NOTES: UNLESS OTHERWISE SPECIFIED
 1. * INDICATES ANTI-STATIC PAIR. D18 & D19
 2. RESISTORS ARE CARBON, 1/8W, 1%
 3. DIODES ARE 1N4004

- 1 PROGRAM GND
- 2 TIP 27Y COIL
- 3 TIP 27Y BASE
- 4 TIP 27Y GND
- 5 15V OUTPUT
- 6 15V OUTPUT
- 7 TIP 27Y GND
- 8 TIP 27Y GND
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- 18 TIP 27Y GND

LAST REF DESIG
 R45 IOA
 C22 QIE
 C25

D	ECN 1857	REV	11-29-78
C	ECN 1599	REV	8-1-78
B	ECN 1381	REV	1-1-78
A	ECN 935	REV	1-1-78
REV	101	BY	WAV
WAVETEK INC. 10000 W. 10th St., Irvine, CA 92714			
Model	N/A	Part No.	154-003-00-0081
Rev	N/A	Rev	1
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NOTE: R5 & R10;
 WHEN USING 1/2 WATT RESISTORS
 THESE VALUES SHOULD BE ADJ.

REV. 1	ECN 1857	2/8/79			
REV. 2	REV. 1381	26/12/78			
A	479	8/1/78			
DESCRIPTION	POWER SUPPLY	15V	20V	By	Auth
DATE	2/7	WAVETEK 100 Ave., CA, U.S.A.			
MANUFACTURED BY	WAVETEK	15V 20V POWER SUPPLY			
DATE	1/84	DIOI-00-0081			

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REV ECH DTG DATE APP

REFERENCE DESIGNATION	PART DESCRIPTION	QTY (MFG PART) (HU)	MFG	HAZ/14 NO.	QTY (PI)
WAVE	ASBY CRAG, PDR	0121-00-0001	WV7	1101-00-0001	1
WAVE	SCHEMATIC PDR	0121-00-0001	WV7	0107-00-0001	1
CS 116 C17 C28	CAP, CER, 01F, 50V	CR-103	LAL	1501-01-0010	6
C3 C4	CAP, CER, 11MF, 50V	LM20-100	DL	1501-01-0011	2
C14 C19 C4 C7	CAP, CER, 01F, 50V	W-170	ABC	1501-01-0011	4
C15 C20 C5 C4	CAP, CER, 005F, 50V	CR-102	LAL	1501-01-0010	4
C1 C2	CAP, ELECT, 1000PF, 50V	10010004350L	SPAG	1501-01-0012	2
C13 C6	CAP, ELECT, 2500PF, 50V	500251001007	SPAG	1501-01-0010	2
E21 C27	CAP, ELECT, 500PF, 50V	5005004350007	SPAG	1501-01-0010	2
E22 C22	CAP, ELECT, 1000PF, 50V	10010004350L	SPAG	1501-01-0012	2
WAVE	POWER	15A-111	WV7	1700-00-0001	1
WAVE	TRANSFORMER	15113	WV7	1700-00-0001	1
R21	RES, 10K, 1/4W	10K-10	WV7	0000-00-0001	1
R22 R27 R27 R34	RES, 1/4W, 50K, 1/4W	50K-005	WV7	0000-00-0001	4
R23 R24 R27 R28	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	4
R24 R30	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R25	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	1
R26 R27 R28 R29	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	4

WAVETEK PARTS LIST TITLE 15V PDRN ASSEMBLY NO. 1105-00-0001 PAGE 1 REV D

REFERENCE DESIGNATION	PART DESCRIPTION	WAVEFORM PART NO.	MFG	HAZ/14 NO.	QTY (PI)
WAVE	POWER	15A-111	WV7	1700-00-0001	1
WAVE	TRANSFORMER	15113	WV7	1700-00-0001	1
R21	RES, 10K, 1/4W	10K-10	WV7	0000-00-0001	1
R22 R27 R27 R34	RES, 1/4W, 50K, 1/4W	50K-005	WV7	0000-00-0001	4
R23 R24 R27 R28	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	4
R24 R30	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R25	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	1
R26 R27 R28 R29	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	4

WAVETEK PARTS LIST TITLE 15V PDRN ASSEMBLY NO. 1105-00-0001 PAGE 1 REV D

REFERENCE DESIGNATION	PART DESCRIPTION	QTY (MFG PART) (HU)	MFG	HAZ/14 NO.	QTY (PI)
R35 R26 R25	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	3
R36	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	1
R37 R38	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R39 R40	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R41 R17 R2 R23 W2 W3	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	6
R42	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	1
R43 R44	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R45	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	1
R46 R47 R48	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	3
R49	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	1
R50 R51 R52 R53	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	4
R54	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	1
R55 R56	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R57 R58	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R59 R60	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R61 R62	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R63 R64	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	2
R65 R66 R67 R68	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	4
R69 R70 R71 R72 R73	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	5
R74 R75 R76 R77 R78 R79 R80 R81 R82 R83 R84 R85 R86 R87 R88 R89 R90 R91 R92 R93 R94 R95 R96 R97 R98 R99 R100	RES, 1/4W, 10K, 1/4W	10K-010	WV7	0000-00-0001	100
CW2	DIODE	1N4001	WV7	0000-00-0001	1
CW3 CW4 CW5 CW6	DIODE	1N4001	WV7	0000-00-0001	4
RW D5 R4	TRANS	2N2219	WV7	0000-00-0001	1
R1 D2 W3 W4 W5 W6	TRANS	2N2219	WV7	0000-00-0001	6

WAVETEK PARTS LIST TITLE 15V PDRN ASSEMBLY NO. 1105-00-0001 PAGE 2 REV D

WAVE: 15V PDRN: 1105-00-0001

APPROVE ALL CHANGES AND SIGN REPAIR LOGS MULTISIGN	DATE RELEASE	TITLE 15V, 24V POWER SUPPLY
TOLERANCE (ALLS OTHERS UNLESS SPECIFIED) WAVE: 15V PDRN: 1105-00-0001	SCALE 1:1	MODEL NO. 154
PART NO. 1105-00-0001	REV. D	TOTAL COPIES 23338

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REV. 1000 87 DATE APP

REFERENCE DESIGNATOR	PART DESCRIPTION	QTY PER PART NO	UOM	WAVETEK NO.	UT/PT
None	FAST DSW. 200W	8101-11-100W	WVFN	8101-00-0340	1
None	SCHMPPFC. 200W	8102-00-0000	WVFN	8101-00-0000	1
C18 C19 C2 C3	CAP. 100V. 0.1M. 50V	CR-101	CM	1500-00-0310	4
C2 C4	CAP. 100V. 0.1M. 20V	CR-20-100	WVCO	1500-00-0311	0
C5	CAP. 50V. 0.001M. 10V	CR-021	CHL	1500-00-0311	1
C18 C15	CAP. 50V. 0.01M. 10V	CR-070	CHL	1500-00-0311	2
C11 C17 C9	CAP. 50V. 0.005M. 10V	CR-040	CHL	1500-00-0210	1
C1	CAP. ELECT. 1000P. 50V	3V010A635010	CHVAC	1500-11-0210	1
C6	CAP. ELECT. 2500P. 50V	500D250000P	SPHAG	1500-12-0510	1
C12 C16	CAP. ELECT. 500P. 50V	500D500000P	SPHAG	1500-14-0105	2
C13 C7	CAP. ELECT. 500P. 50V	5V0507605010	SPHAG	1500-14-0105	1
None	POWER	150-111	WVFN	1700-00-0001	1
R21	POT. 100K. 50	914010	WVCO	4000-00-0000	1
R13 R20 R3	RES. 1/4W. 1K. 0.7	RC200P-007	WVFN	4700-20-0070	1
R10 R11 R7	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1501	1
R18 R22	RES. 1/4W. 10K. 1.0K	WV50-1002P	THA	4701-00-1820	2
R41	RES. 1/4W. 10K. 1.0K	WV50-1003P	THA	4701-00-1510	1
R19 R17 C8	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1

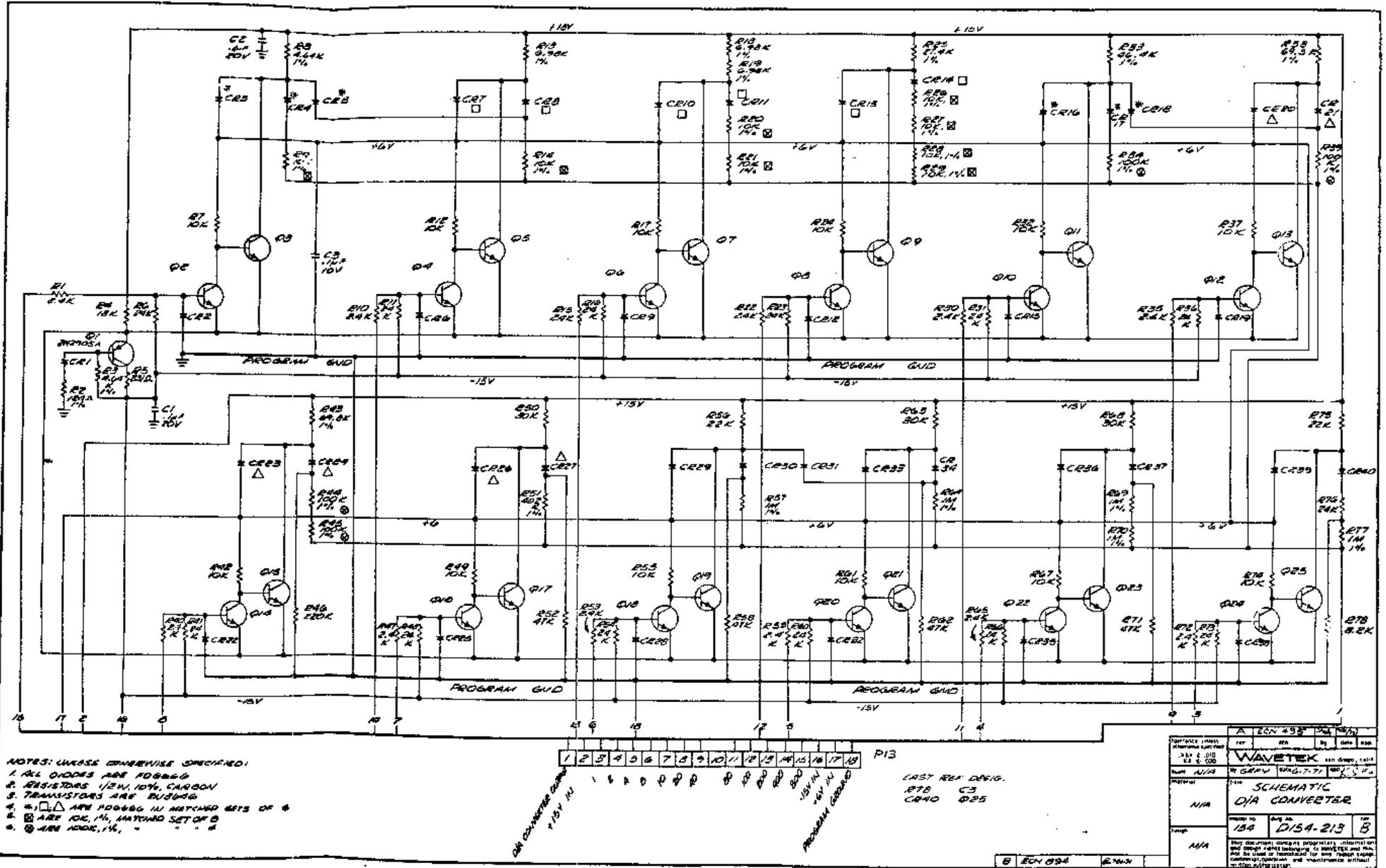
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 ASSEMBLY NO.: 1100-00-0000
 PAGE: 1
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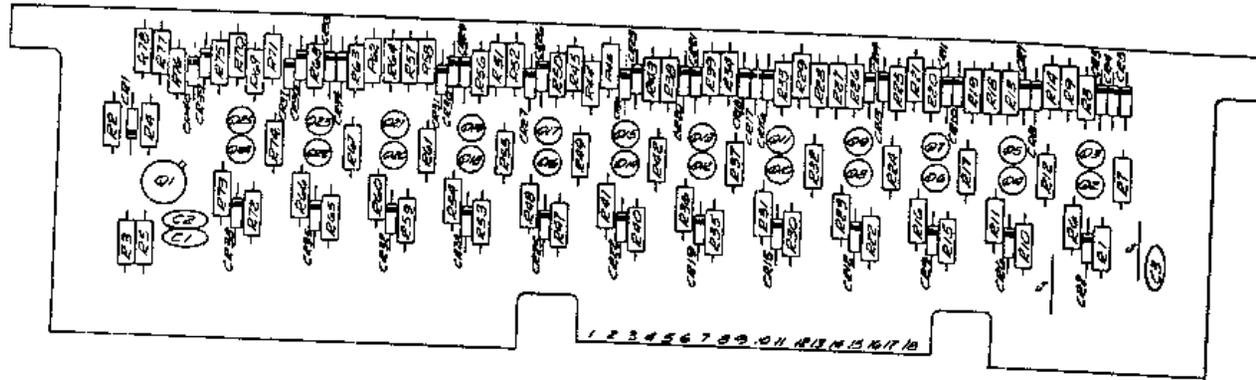
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R12 R25	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R15 R26	RES. 1/4W. 10K. 1.0K	WV50-1002P	THA	4701-00-1820	1
R16 R14	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R2	RES. 1/4W. 10K. 1.0K	WV50-1000P	THA	4701-00-0000	1
V1 R31 R20	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R30 R9	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R3	RES. 1/4W. 10K. 1.0K	WV50-1000P	THA	4701-00-0000	1
R28	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R19 R28	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R20	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R4	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R22 R23	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
R21 R24	RES. 1/4W. 10K. 1.0K	WV50-1001P	THA	4701-00-1511	1
CH2 CH3	DIODE	1N4001	WVCO	4000-00-0000	1
CN1 CN4 CN5	DIODE	70-0000	WVFN	4000-00-0000	1
U1 U2 U3 U4 U5 U6	TRANS	2N3040	WVFN	4701-00-0000	1
U7 U8 U9	TRANS	2N3040	WVFN	4701-00-0000	1
IC1 IC2 IC3	IC CLASS (E, PA, 200)	110-001-10	WVFN	1700-00-0000	1

WAVETEK PARTS LIST
 TITLE: 6V POWER
 ASSEMBLY NO.: 1100-00-0000
 PAGE: 2
 REV: A

NOTE: UNLESS OTHERWISE SPECIFIED

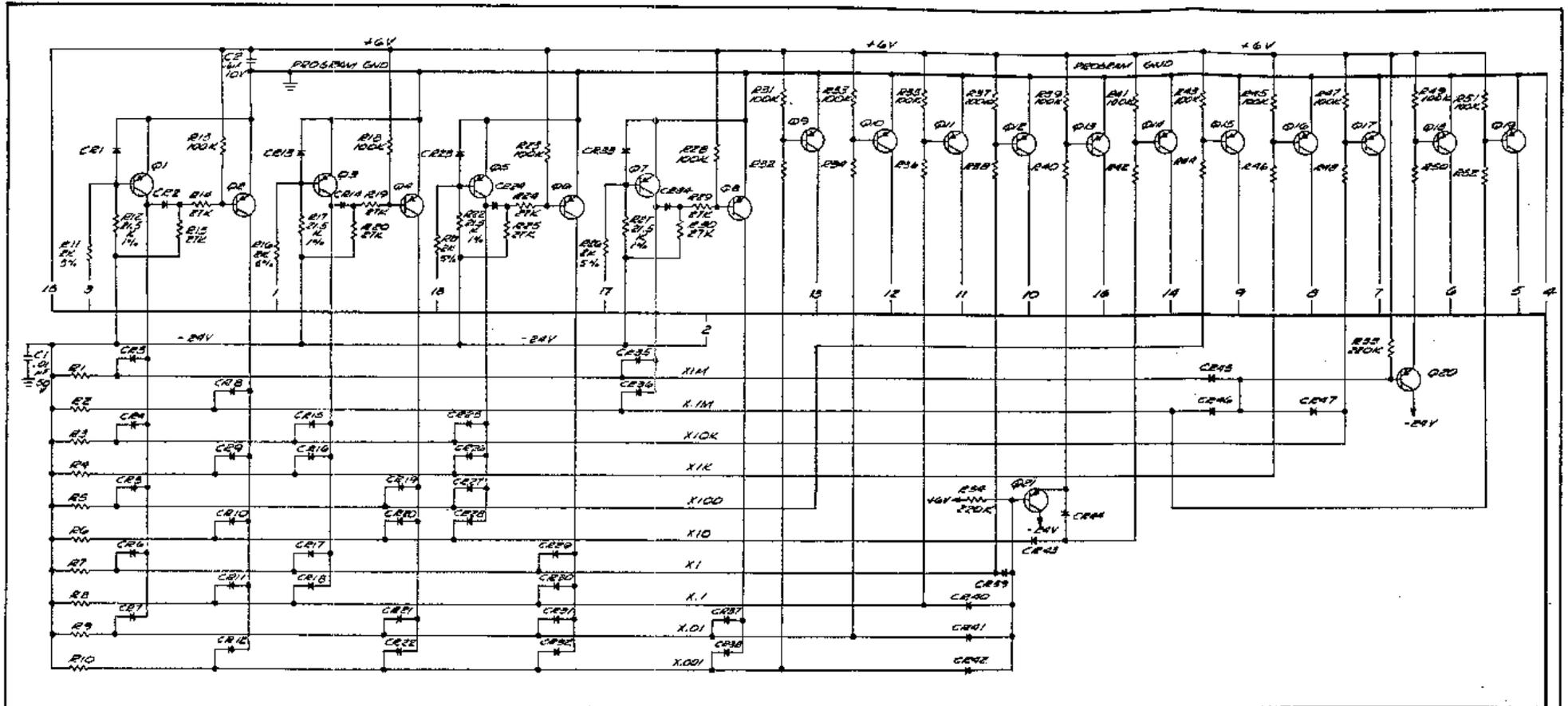
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MATERIALS	DESCRIPTION	
DESIGNED BY	DATE	TITLE
CHECKED BY	DATE	6V, 23V POWER SUPPLY
DATE	SCALE	1:50
REV. NO.	REV. DATE	100-00-0000
REV. DATE	REV. DATE	11/11/87



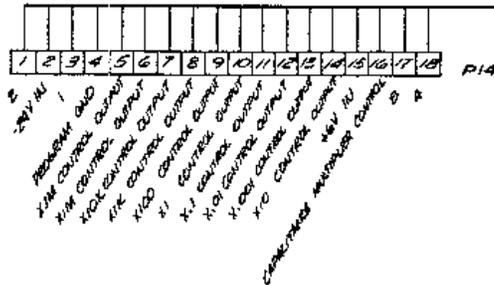


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REV. 002	REV. 002	6/75
REV. 003	REV. 003	8/75
REV. 004	REV. 004	9/75
REV. 005	REV. 005	10/75
REV. 006	REV. 006	11/75
REV. 007	REV. 007	12/75
REV. 008	REV. 008	13/75
REV. 009	REV. 009	14/75
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REV. 057	REV. 057	62/75
REV. 058	REV. 058	63/75
REV. 059	REV. 059	64/75
REV. 060	REV. 060	65/75
REV. 061	REV. 061	66/75
REV. 062	REV. 062	67/75
REV. 063	REV. 063	68/75
REV. 064	REV. 064	69/75
REV. 065	REV. 065	70/75
REV. 066	REV. 066	71/75
REV. 067	REV. 067	72/75
REV. 068	REV. 068	73/75
REV. 069	REV. 069	74/75
REV. 070	REV. 070	75/75

WAVETEK
 ASSEMBLY
 D/A CONVERTER
 159 10100-0089 C

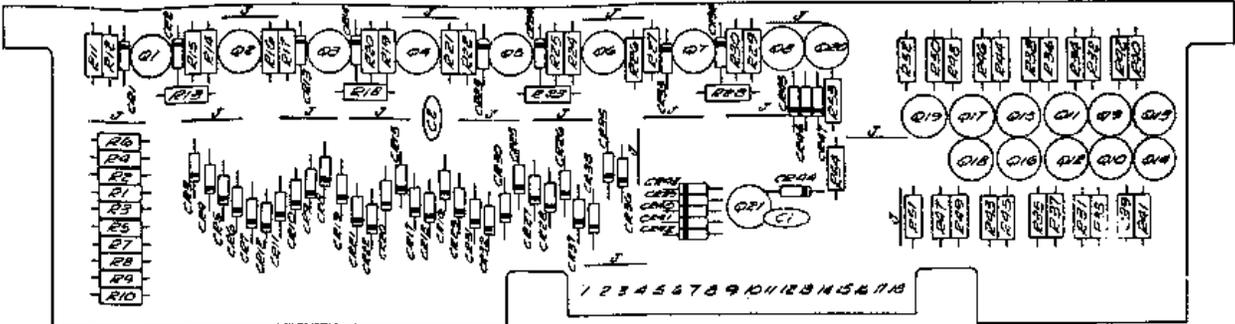


- NOTES: UNLESS OTHERWISE SPECIFIED
 1. ALL RESISTORS ARE 1/8W, 1% CARBON
 2. ALL RESISTORS ARE 5%
 3. ALL TRANSISTORS ARE EUC638A
 4. ALL DIODES ARE 1N4001



LAST REF DESIG
 854
 CR47
 CR1
 CR2

C	ECN	REV	D	DATE	1978
1	ECN	1595	10	1978	
A	ECN	982	10	1978	
WAVETEK					
154 0102-00-0092					
SCHEMATIC, FREQUENCY DIVIDER					
154 0102-00-0092					



REV	A	EQC	1871	1981	12-27
DATE		BY		DATE	APP
DESIGNER	WAVETEK				
DR	GARY [signature]				
NAME	ASSEMBLY FREQ BANGING				
PROJ	154	REV	0101-00-0082	REV	A
<small>THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND IS UNCLASSIFIED TO WAVE TEK. USE THIS FOR INTERNAL USE ONLY. FOR ANY OTHER USE, CONTACT WAVE TEK.</small>					

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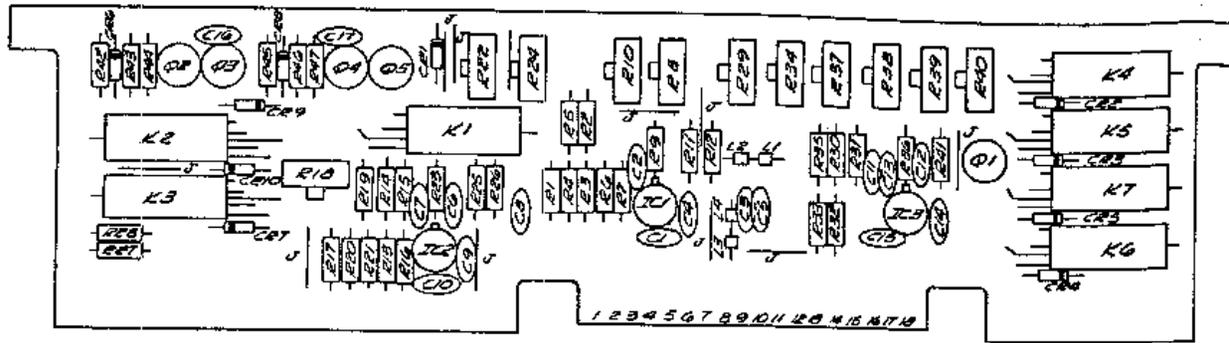
REV. 1000 BY DATE 1000

REFERENCE DESIGNATOR	PART DESCRIPTION	WAVE-TEK PART NO.	QTY	REV. 1000	QTY
None	ADPT. DRAG. MATRIZ	2180-00-0000	1	1000-00-0000	1
None	20-00-00-0000	0113-00-0000	1	0113-00-0000	1
CI	CON. CEN.	14-100	1	1500-00-0000	1
CA	CON. CEN.	1410-000	1	1500-00-0000	1
None	DRAG. MATRIZ	1500-000	1	1500-00-0000	1
None	FRONT PANEL	1500-000	1	1500-00-0000	1
R11 R10 R12 R13 R14	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R15 R16 R17 R18 R19	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R20 R21 R22 R23 R24	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R25 R26 R27 R28 R29	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R30 R31 R32 R33 R34	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R35 R36 R37 R38 R39	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R40 R41 R42 R43 R44	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R45 R46 R47 R48 R49	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R50 R51 R52 R53 R54	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R55 R56 R57 R58 R59	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R60 R61 R62 R63 R64	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R65 R66 R67 R68 R69	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R70 R71 R72 R73 R74	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R75 R76 R77 R78 R79	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R80 R81 R82 R83 R84	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R85 R86 R87 R88 R89	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R90 R91 R92 R93 R94	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
R95 R96 R97 R98 R99	RES. 10K 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C01 C02 C03 C04 C05	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C06 C07 C08 C09 C10	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C11 C12 C13 C14 C15	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C16 C17 C18 C19 C20	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C21 C22 C23 C24 C25	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C26 C27 C28 C29 C30	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C31 C32 C33 C34 C35	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C36 C37 C38 C39 C40	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C41 C42 C43 C44 C45	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C46 C47 C48 C49 C50	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C51 C52 C53 C54 C55	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C56 C57 C58 C59 C60	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C61 C62 C63 C64 C65	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C66 C67 C68 C69 C70	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C71 C72 C73 C74 C75	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C76 C77 C78 C79 C80	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C81 C82 C83 C84 C85	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C86 C87 C88 C89 C90	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C91 C92 C93 C94 C95	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C96 C97 C98 C99 C00	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15

REFERENCE DESIGNATOR	PART DESCRIPTION	WAVE-TEK PART NO.	QTY	REV. 1000	QTY
C01 C02 C03 C04 C05	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C06 C07 C08 C09 C10	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C11 C12 C13 C14 C15	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C16 C17 C18 C19 C20	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C21 C22 C23 C24 C25	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C26 C27 C28 C29 C30	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C31 C32 C33 C34 C35	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C36 C37 C38 C39 C40	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C41 C42 C43 C44 C45	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C46 C47 C48 C49 C50	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C51 C52 C53 C54 C55	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C56 C57 C58 C59 C60	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C61 C62 C63 C64 C65	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C66 C67 C68 C69 C70	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C71 C72 C73 C74 C75	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C76 C77 C78 C79 C80	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C81 C82 C83 C84 C85	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C86 C87 C88 C89 C90	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C91 C92 C93 C94 C95	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15
C96 C97 C98 C99 C00	COND. 0.001 1/2W 1% 0.25W	0100-0000	15	0100-00-0000	15

NOTE: UNLESS OTHERWISE SPECIFIED

WAVE-TEK 1100-00-0000 FREQUENCY RANGING	
PART NO. 154 QTY 23228	REV. 1000 DATE 1000



REV	BY	DATE	DESCRIPTION
A	ECN 834	8-1-64	
B	ECN 154	1-15-64	
WAVETEK DIVISION OF GENERAL ELECTRIC COMPANY			
ASSEMBLY D-A AMPLIFIER			
PROJECT NO.	DWG NO.	REV	
154	D101-00-0034	B	

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REV. 120 BY DATE APP

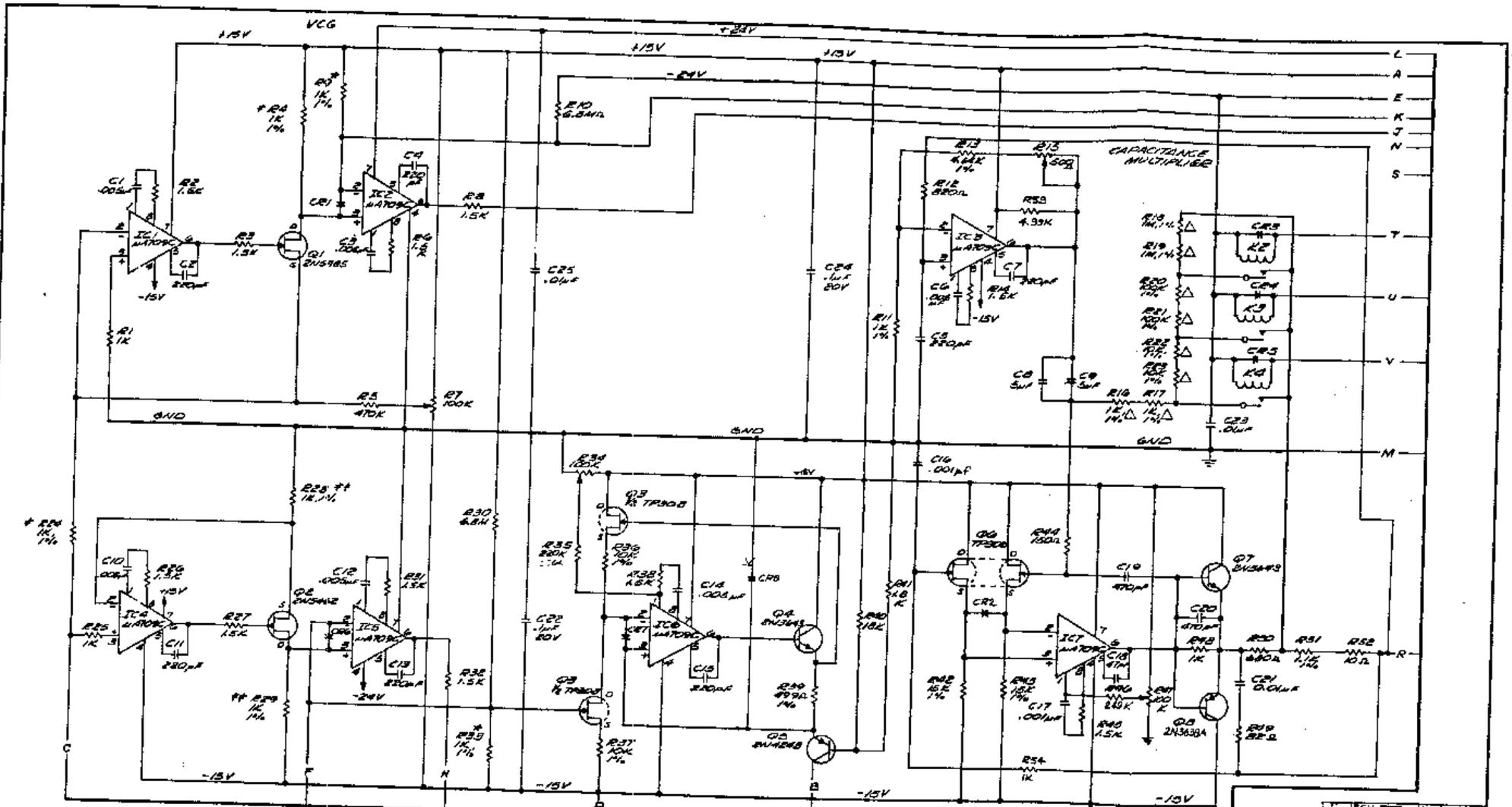
REFERENCE DESIGNATION	PART DESCRIPTION	UNIT-PPW-PAGE-NO	QTY	AVATAR NO.	QTY/PI
None	ASSY D-AMP, 100W, 150V	981-002-0004	1	7810-00-0004	1
None	ACMATIC, 100A AMP	100-00-0004	1	803-00-0004	1
C1	CAP, CER, 100P, 10V	07-100	1	150-01-0011	1
C1P	CAP, CER, 100P, 50V	07-100	1	150-01-0012	1
C1R C1T C1X C1Y C1Z	CAP, CER, 100P, 100V	1000-100	2	150-01-0013	2
C7	CAP, CER, 100P, 10V	00-100	1	150-02-0011	1
C1W C4 C8	CAP, CER, 200P, 10V	00-200	3	150-02-0111	3
C11	CAP, CER, 100P, 10V	00-100	1	150-02-0112	1
C12 C2 C4	CAP, CER, 100P, 100V	01-100	3	150-02-0210	3
None	004 AMP	150-114	1	150-03-0004	1
None	TRANSFORMER	100-100	1	150-03-0005	1
L1 L2 L3 L4	INDUCTOR	100-100	4	150-03-0006	4
R1 R2 R3 R4 R5 R7	RESISTOR	100-100	7	150-03-0007	7
R8 R9	RESISTOR	100-100	2	150-03-0008	2
R10 R11 R12 R13	RESISTOR	100-100	4	150-03-0009	4
R14 R15 R16 R17 R18	RESISTOR	100-100	5	150-03-0010	5
R19 R20 R21 R22	RESISTOR	100-100	4	150-03-0011	4
R23 R24 R25 R26 R27 R28	RESISTOR	100-100	6	150-03-0012	6
R29	RESISTOR	100-100	1	150-03-0013	1

WAVETEK PARTS LIST TITLE: D-AMP, 100W, 150V PART NO: 981-002-0004 PAGE: 1 REV: 1

REFERENCE DESIGNATION	PART DESCRIPTION	UNIT-PPW-PAGE-NO	QTY	AVATAR NO.	QTY/PI
J1 J2 J3	CONNECTOR	150-01-0011	3	150-01-0011	3

WAVETEK PARTS LIST TITLE: D-AMP, 100W, 150V PART NO: 981-002-0004 PAGE: 1 REV: 1

REFERENCE DESIGNATION	PART DESCRIPTION	UNIT-PPW-PAGE-NO	QTY	AVATAR NO.	QTY/PI
R19 R20 R21 R22	RESISTOR	100-100	4	150-03-0011	4
R23 R24 R25 R26	RESISTOR	100-100	4	150-03-0012	4
R27 R28 R29 R30	RESISTOR	100-100	4	150-03-0013	4
R31 R32 R33 R34	RESISTOR	100-100	4	150-03-0014	4
R35 R36 R37 R38	RESISTOR	100-100	4	150-03-0015	4
R39 R40 R41 R42	RESISTOR	100-100	4	150-03-0016	4
R43 R44 R45 R46	RESISTOR	100-100	4	150-03-0017	4
R47 R48 R49 R50	RESISTOR	100-100	4	150-03-0018	4
R51 R52 R53 R54	RESISTOR	100-100	4	150-03-0019	4
R55 R56 R57 R58	RESISTOR	100-100	4	150-03-0020	4
R59 R60 R61 R62	RESISTOR	100-100	4	150-03-0021	4
R63 R64 R65 R66	RESISTOR	100-100	4	150-03-0022	4
R67 R68 R69 R70	RESISTOR	100-100	4	150-03-0023	4
R71 R72 R73 R74	RESISTOR	100-100	4	150-03-0024	4
R75 R76 R77 R78	RESISTOR	100-100	4	150-03-0025	4
R79 R80 R81 R82	RESISTOR	100-100	4	150-03-0026	4
R83 R84 R85 R86	RESISTOR	100-100	4	150-03-0027	4
R87 R88 R89 R90	RESISTOR	100-100	4	150-03-0028	4
R91 R92 R93 R94	RESISTOR	100-100	4	150-03-0029	4
R95 R96 R97 R98	RESISTOR	100-100	4	150-03-0030	4
R99 R100 R101 R102	RESISTOR	100-100	4	150-03-0031	4
R103 R104 R105 R106	RESISTOR	100-100	4	150-03-0032	4
R107 R108 R109 R110	RESISTOR	100-100	4	150-03-0033	4
R111 R112 R113 R114	RESISTOR	100-100	4	150-03-0034	4
R115 R116 R117 R118	RESISTOR	100-100	4	150-03-0035	4
R119 R120 R121 R122	RESISTOR	100-100	4	150-03-0036	4
R123 R124 R125 R126	RESISTOR	100-100	4	150-03-0037	4
R127 R128 R129 R130	RESISTOR	100-100	4	150-03-0038	4
R131 R132 R133 R134	RESISTOR	100-100	4	150-03-0039	4
R135 R136 R137 R138	RESISTOR	100-100	4	150-03-0040	4
R139 R140 R141 R142	RESISTOR	100-100	4	150-03-0041	4
R143 R144 R145 R146	RESISTOR	100-100	4	150-03-0042	4
R147 R148 R149 R150	RESISTOR	100-100	4	150-03-0043	4
R151 R152 R153 R154	RESISTOR	100-100	4	150-03-0044	4
R155 R156 R157 R158	RESISTOR	100-100	4	150-03-0045	4
R159 R160 R161 R162	RESISTOR	100-100	4	150-03-0046	4
R163 R164 R165 R166	RESISTOR	100-100	4	150-03-0047	4
R167 R168 R169 R170	RESISTOR	100-100	4	150-03-0048	4
R171 R172 R173 R174	RESISTOR	100-100	4	150-03-0049	4
R175 R176 R177 R178	RESISTOR	100-100	4	150-03-0050	4
R179 R180 R181 R182	RESISTOR	100-100	4	150-03-0051	4
R183 R184 R185 R186	RESISTOR	100-100	4	150-03-0052	4
R187 R188 R189 R190	RESISTOR	100-100	4	150-03-0053	4
R191 R192 R193 R194	RESISTOR	100-100	4	150-03-0054	4
R195 R196 R197 R198	RESISTOR	100-100	4	150-03-0055	4
R199 R200 R201 R202	RESISTOR	100-100	4	150-03-0056	4
R203 R204 R205 R206	RESISTOR	100-100	4	150-03-0057	4
R207 R208 R209 R210	RESISTOR	100-100	4	150-03-0058	4
R211 R212 R213 R214	RESISTOR	100-100	4	150-03-0059	4
R215 R216 R217 R218	RESISTOR	100-100	4	150-03-0060	4
R219 R220 R221 R222	RESISTOR	100-100	4	150-03-0061	4
R223 R224 R225 R226	RESISTOR	100-100	4	150-03-0062	4
R227 R228 R229 R230	RESISTOR	100-100	4	150-03-0063	4
R231 R232 R233 R234	RESISTOR	100-100	4	150-03-0064	4
R235 R236 R237 R238	RESISTOR	100-100	4	150-03-0065	4
R239 R240 R241 R242	RESISTOR	100-100	4	150-03-0066	4
R243 R244 R245 R246	RESISTOR	100-100	4	150-03-0067	4
R247 R248 R249 R250	RESISTOR	100-100	4	150-03-0068	4
R251 R252 R253 R254	RESISTOR	100-100	4	150-03-0069	4
R255 R256 R257 R258	RESISTOR	100-100	4	150-03-0070	4
R259 R260 R261 R262	RESISTOR	100-100	4	150-03-0071	4
R263 R264 R265 R266	RESISTOR	100-100	4	150-03-0072	4
R267 R268 R269 R270	RESISTOR	100-100	4	150-03-0073	4
R271 R272 R273 R274	RESISTOR	100-100	4	150-03-0074	4
R275 R276 R277 R278	RESISTOR	100-100	4	150-03-0075	4
R279 R280 R281 R282	RESISTOR	100-100	4	150-03-0076	4
R283 R284 R285 R286	RESISTOR	100-100	4	150-03-0077	4
R287 R288 R289 R290	RESISTOR	100-100	4	150-03-0078	4
R291 R292 R293 R294	RESISTOR	100-100	4	150-03-0079	4
R295 R296 R297 R298	RESISTOR	100-100	4	150-03-0080	4
R299 R300 R301 R302	RESISTOR	100-100	4	150-03-0081	4
R303 R304 R305 R306	RESISTOR	100-100	4	150-03-0082	4
R307 R308 R309 R310	RESISTOR	100-100	4	150-03-0083	4
R311 R312 R313 R314	RESISTOR	100-100	4	150-03-0084	4
R315 R316 R317 R318	RESISTOR	100-100	4	150-03-0085	4
R319 R320 R321 R322	RESISTOR	100-100	4	150-03-0086	4
R323 R324 R325 R326	RESISTOR	100-100	4	150-03-0087	4
R327 R328 R329 R330	RESISTOR	100-100	4	150-03-0088	4
R331 R332 R333 R334	RESISTOR	100-100	4	150-03-0089	4
R335 R336 R337 R338	RESISTOR	100-100	4	150-03-0090	4
R339 R340 R341 R342	RESISTOR	100-100	4	150-03-0091	4
R343 R344 R345 R346	RESISTOR	100-100	4	150-03-0092	4
R347 R348 R349 R350	RESISTOR	100-100	4	150-03-0093	4
R351 R352 R353 R354	RESISTOR	100-100	4	150-03-0094	4
R355 R356 R357 R358	RESISTOR	100-100	4	150-03-0095	4
R359 R360 R361 R362	RESISTOR	100-100	4	150-03-0096	4
R363 R364 R365 R366	RESISTOR	100-100	4	150-03-0097	4
R367 R368 R369 R370	RESISTOR	100-100	4	150-03-0098	4
R371 R372 R373 R374	RESISTOR	100-100	4	150-03-0099	4
R375 R376 R377 R378	RESISTOR	100-100	4	150-03-0100	4
R379 R380 R381 R382	RESISTOR	100-100	4	150-03-0101	4
R383 R384 R385 R386	RESISTOR	100-100	4	150-03-0102	4
R387 R388 R389 R390	RESISTOR	100-100	4	150-03-0103	4
R391 R392 R393 R394	RESISTOR	100-100	4	150-03-0104	4
R395 R396 R397 R398	RESISTOR	100-100	4	150-03-0105	4
R399 R400 R401 R402	RESISTOR	100-100	4	150-03-0106	4
R403 R404 R405 R406	RESISTOR	100-100	4	150-03-0107	4
R407 R408 R409 R410	RESISTOR	100-100	4	150-03-0108	4
R411 R412 R413 R414	RESISTOR	100-100	4	150-03-0109	4
R415 R416 R417 R418	RESISTOR	100-100	4	150-03-0110	4
R419 R420 R421 R422	RESISTOR	100-100	4	150-03-0111	4
R423 R424 R425 R426	RESISTOR	100-100	4	150-03-0112	4
R427 R428 R429 R430	RESISTOR	100-100	4	150-03-0113	4
R431 R432 R433 R434	RESISTOR	100-100	4	150-03-0114	4
R435 R436 R437 R438	RESISTOR	100-100	4	150-03-0115	4
R439 R440 R441 R442	RESISTOR	100-100	4	150-03-0116	4
R443 R444 R445 R446	RESISTOR	100-100	4	150-03-0117	4
R447 R448 R449 R450	RESISTOR	100-100	4	150-03-0118	4
R451 R452 R453 R454	RESISTOR	100-100	4	150-03-0119	4
R455 R456 R457 R458	RESISTOR	100-100	4	150-03-0120	4
R459 R460 R461 R462	RESISTOR	100-100	4	150-03-0121	4
R463 R464 R465 R466	RESISTOR	100-100	4	150-03-0122	4
R467 R468 R469 R470	RESISTOR	100-100	4	150-03-0123	4
R471 R472 R473 R474	RESISTOR	100-100	4	150-03-0124	4
R475 R476 R477 R478	RESISTOR	100-100	4	150-03-0125	4
R479 R480 R481 R482	RESISTOR	100-100	4	150-03-0126	4
R483 R484 R485 R486	RESISTOR	100-100	4	150-03-0127	4
R487 R488 R489 R490	RESISTOR	100-100	4	150-03-0128	4
R491 R492 R493 R494	RESISTOR	100-100	4	150-03-0129	4
R495 R496 R497 R498	RESISTOR	100-100	4	150-03-0130	4
R499 R500 R501 R502	RESISTOR	100-100	4	150-03-0131	4
R503 R504 R505 R506	RESISTOR	100-100	4	150-03-0132	4
R507 R508 R509 R510	RESISTOR	100-100	4	150-03-0133	4
R511 R512 R513 R514	RESISTOR	100-100	4	150-03-0134	4
R515 R516 R517 R518	RESISTOR	100-100	4	150-03-0135	4
R519 R520 R521 R522	RESISTOR	100-100	4	150-03-0136	4
R523 R524 R525 R526	RESISTOR	100-100	4	150-03-0137	4



NOTES: UNLESS OTHERWISE SPECIFIED
 1. RESISTORS ARE 1/8W, 1%, CARBON
 2. * INDICATES MATCHED PAIR
 3. # INDICATES MATCHED PAIR
 4. M " " " SET
 5. D " " " SET

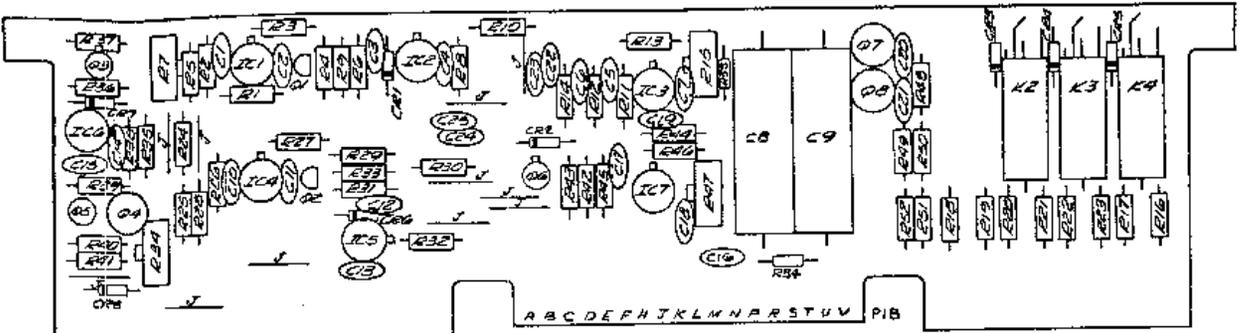
A B C D E F G H I J K L M N O P Q R S T U V P18

+15V
 +15V OUTPUT
 VCG INPUT
 -15V
 -24V
 NO OUTPUT TO BOARD
 NO OUTPUT TO BOARD
 NO OUTPUT TO BOARD
 NO OUTPUT TO BOARD
 PROGRAMMING GND
 CAN MUST GROUND
 X2014 100 Ohm Channel
 X114 100 Ohm Channel
 X17 10 Ohm Channel

LAST INF DIS.
 R54 OB
 C26 ICT
 C28 KA

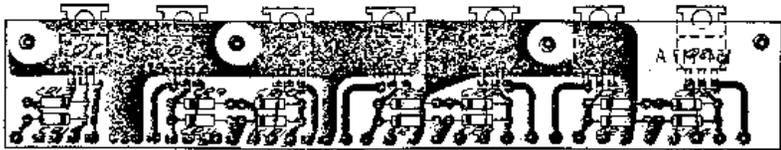
U	2555	FAH101	IC7A	F	ECN 1009	RT 2307	
H	ECN 1027	52A	100	B	ECN 1096	10-4-76	
S	25V	1599	21	D	ECN 894	8-4-76	

REV	1	DATE	10/2/76
BY	SEA	CHKD	SEA
APP'D		DATE	
WAVETEK			
DATE	10/2/76	REV	1
BY	SEA	CHKD	SEA
APP'D		DATE	
SCHEMATIC VCG BOARD			
MODEL NO.	154	REV	1
DATE	10/2/76	REV	1
BY	SEA	CHKD	SEA
APP'D		DATE	



F	ECN 357	EW 2-81
E	ECN 1309	EW 2-77
D	ECN 094	EW 1-76
C	ECN 1084	EW 1-74
B	ECN 875	EW 1-73
A	ECN 418	EW 1-72

DATE	REV	BY	CHK
1/24	010100-0380		F
WAVETEK 15800 SHAW BLVD. #200 IRVINE, CA 92614-1999 TEL: (714) 952-7000 FAX: (714) 952-7001			
ASSEMBLY VCG BOARD			
DATE	REV	BY	CHK
1/24	010100-0380		F
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PARTS LIST				
QTY	REF DES	DESCRIPTION	MANUFACTURER	WAVE NO.
1		DIODES		
2	CR-010	SCR-1	SEMTRON	1A
3				
4				
5		TRANSISTORS		
6	Q103 Q3, Q7	TIP 29	TEXAS INSTRUMENT	2
7	Q24A	TIP 30	TIP 30	3
8				
9				
10		CIRCUIT BOARD	WAVETEK	154-117A
11				
12				
13				

NOTES: UNLESS OTHERWISE SPECIFIED
 1 TRANSISTORS MOUNTED ON CIRCUIT SIDE

DATE OF REV. CHANGE	REV.	BY	DATE	DESC.
154-010 154-010				WAVETEK San Diego, Calif.
NAME	REV. NO.	REV. DATE	REV. BY	REV. DESC.
311	154-010	11-9-66		
PROJECT	TITLE			
N/A	ASSEMBLY TRANSISTOR MOUNTING BD			
FORM NO.	FORM NO.		REV.	
N/A	154-0154-017		1	
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 MANNER WITHOUT CALIBRATION OPERATIONS AND
 MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

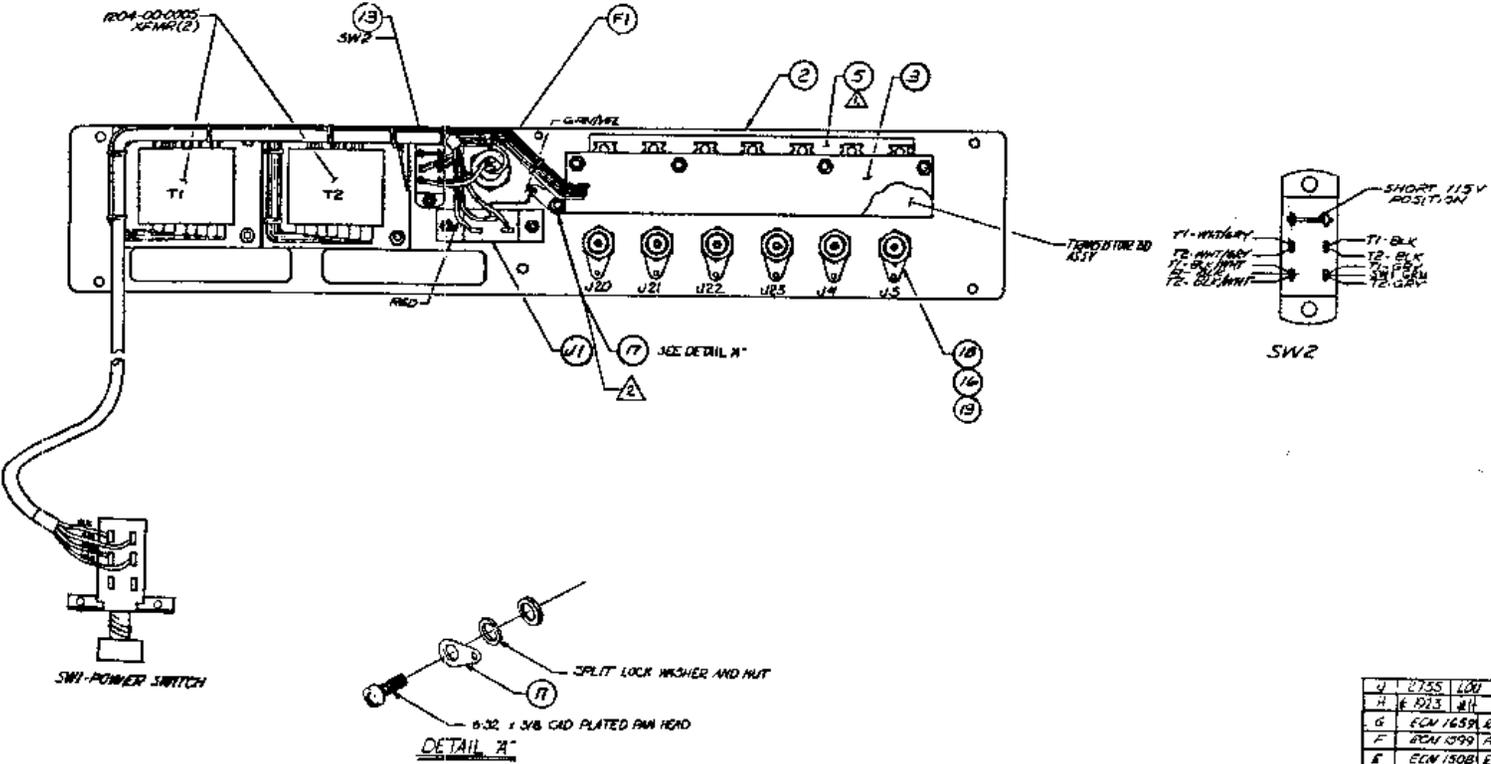
REV 000 BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	QTY PER PART NO	WFSW	WAVECORP NO.	QTY/PY
None	TRANS MOUNTING	150-107	WTH	1700-00-0087	1
CR1 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR21 CR22 CR23 CR24 CR25 CR26	SIZING	RCE-1	RETC	0001-02-0001	1A
R1 R2 R3 R4	TRANS	T1P-20	T1	0002-00-0200	0
R5 R6 R7	TRANS	T1P-30	T1	0002-00-0300	0

WAVETEK PARTS LIST	TITLE SIZING WTH 00	ASSEMBLY NO 1100-00-0087	REV
		PAGE 1	

NOTE UNLESS SHOWN OTHERWISE

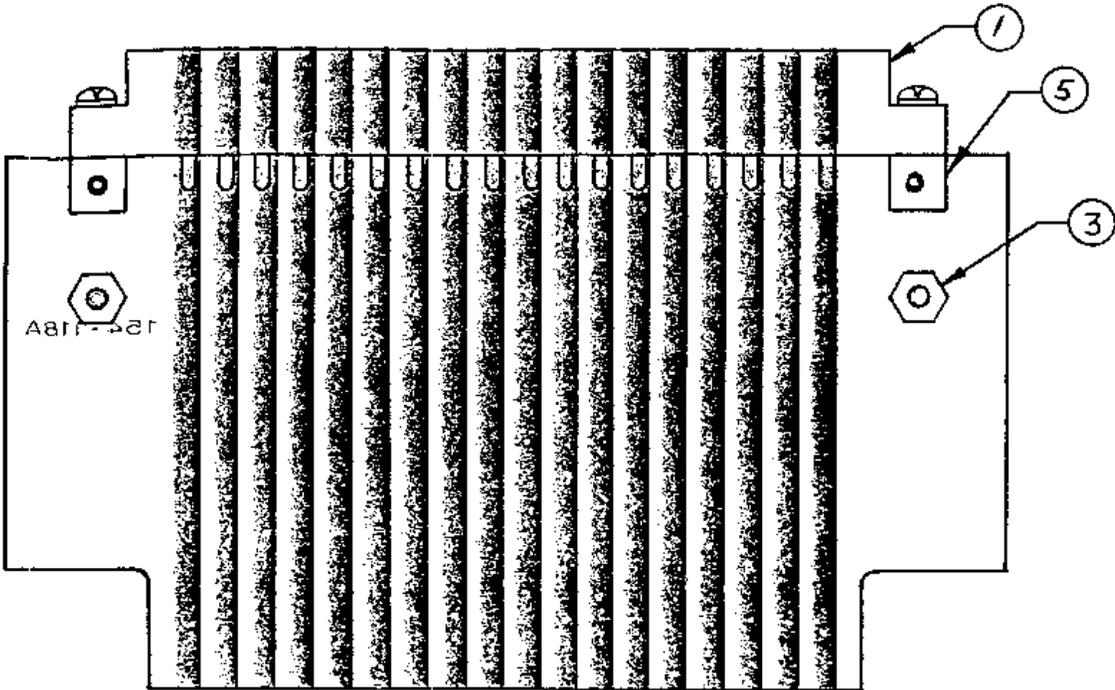
SEND ALL DIMENSIONS AND TOLERANCES TO: MATERIAL	FINISH	SCALE	DATE	WAVETEK SAN JOSE, CALIFORNIA
FINISH	RELEASE APPROV	TOLERANCE UNLESS OTHERWISE SPECIFIED SEE FIG 1 AND 2 UNLESS NOTED SCALE	DATE	TITLE TRANSISTOR MOUNTING BOARD
FINISH	DO NOT SCALE DIMS	SCALE	DATE	PROJ NO 154
			DATE	APP NO 1100-00-0087
			DATE	REV 23308



▲ APPLY THERMAL COMPOUND TO ITEM 5 (BETWEEN REAR PANEL AND INSULATOR)
 ▲ ALL CONNECTORS TO BE MECHANICALLY SECURE TO CHASSIS PRIOR TO SOLDERING
 NOTES: GROUND WIRES TO LUGS.

J	0755	100	6.984K7
H	0923	100	7.819K2
G	ECM 1659	20	1.80K
F	ECM 0999	20	0.90K
E	ECM 1508	20	0.917K
D	ECM 092	20	0.917K
C	ECM 102	20	0.917K
B	208	20	0.917K
A	401	20	0.917K

WAVETEK 154 0102-00-0331 J



PARTS LIST

ITEM	REF DES	DESCRIPTION	MFR	MFR NO.	QTY
1		CONNECTOR	CINCH	252-18-30-100	1
2					
3		STANDOFF	USECO	1531-B 3/8	2
4					
5		CHASSIS BLOCK	USECO	1591-B 11	2
6					
7					
8		P.C. BOARD	WAVETEK	154-118A	1
9					

DATE	REV	LEN	BY	DATE	APP
WAVETEK SAN DIEGO CALIF					
SCALE	BY <i>Gray</i> DATE <i>2/23/71</i> OFF				
MATERIAL	PART # <i>A334</i>				
	MODEL NO <i>EXTENDER BO</i>				
	DRAWING NO <i>154-118A-01A</i>				
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REV 100 #7 DATE 000

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-WPCW-PART-NO	WPCW	WAVETEK NO.	QTY
None	EXTENDER	100-110	WTK	1700-00-0000	1
1	CONN. EDGE CAP	250-10-10-100	CMCH	2100-00-0010	1
3 3A	STOPOFF	15210-100	USCC	2000-00-0000	3
5 5A	PART-KRABOZE	1501-011	USCC	2000-00-0001	2

WAVETEK PARTS LIST	TITLE EXTENDER	APPROVAL NO. 1000-11-0000 PAGE 1	REV
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NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BARRIERS AND BRASS BRIDGE PAGES	DATE	WAVETEK 1000 CALIFORNIA	
MATERIAL	REV	TITLE	
	000-000	EXTENDER BOARD	
DATE	0000-00-0000	TOLERANCES UNLESS SPECIFIED	
WAVETEK PROBAB	0000-00-0000	DIMENSIONS SPECIFIED	
		UNLESS OTHERWISE SPECIFIED	
		UNLESS OTHERWISE SPECIFIED	
		PROJ NO	DWG NO
		154	1100-00-0000
		REV	SHEET
		000	001