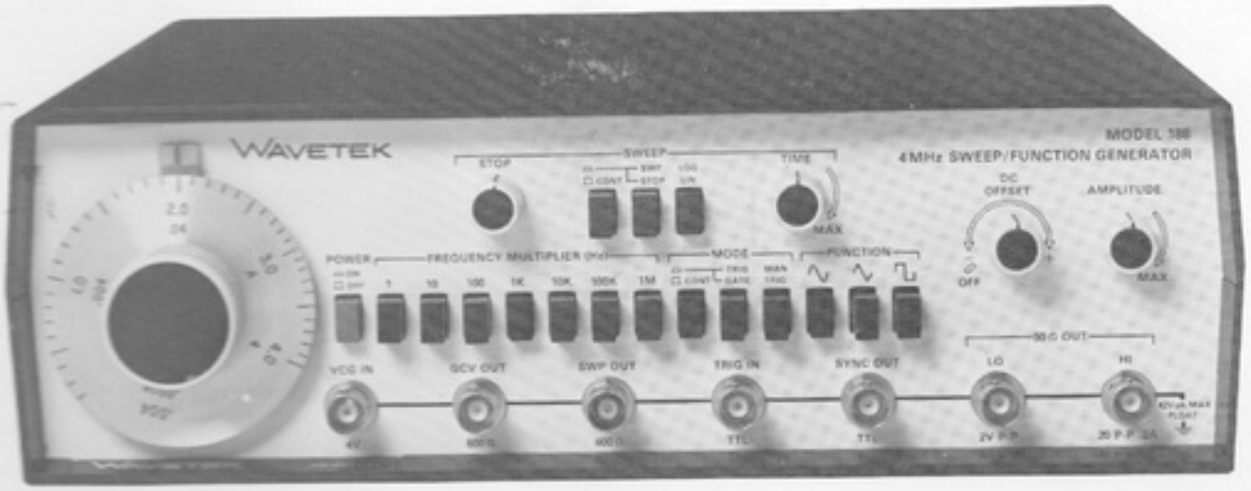
MODEL 188
4 MHz SWEEP/ FUNCTION GENERATOR



WAVETEK

INSTRUCTION MANUAL

MODEL 188
4 MHz SWEEP/ FUNCTION GENERATOR

WAVETEK®
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Manual Revision: 1/82
Instrument Release: D

WARRANTY

All Wavetek instruments are warranteed against defects in material and workmanship for a period of one year after date of manufacture. Wavetek agrees to repair or replace any assembly or component (except batteries) found to be defective, under normal use, during this period. Wavetek's obligation under this warranty is limited solely to repairing any such instrument which in Wavetek's sole opinion proves to be defective within the scope of the warranty when returned to the factory or to an authorized service center. Transportation to the factory or service center is to be prepaid by purchaser. Shipment should not be made without prior authorization by Wavetek.

This warranty does not apply to any products repaired or altered by persons not authorized by Wavetek, or not in accordance with instructions furnished by Wavetek. If the instrument is defective as a result of misuse, improper repair, or abnormal conditions or operations, repairs will be billed at cost.

Wavetek assumes no responsibility for its product being used in a hazardous or dangerous manner either alone or in conjunction with other equipment. High voltage used in some instruments may be dangerous if misused. Special disclaimers apply to these instruments. Wavetek assumes no liability for secondary charges or consequential damages and, in any event, Wavetek's liability for breach of warranty under any contract or otherwise, shall not exceed the purchase price of the specific instrument shipped and against which a claim is made.

Any recommendations made by Wavetek for use of its products are based upon tests believed to be reliable, but Wavetek makes no warranty of the results to be obtained. This warranty is in lieu of all other warranties, expressed or implied, and no representative or person is authorized to represent or assume for Wavetek any liability in connection with the sale of our products other than set forth herein.

SAFETY

This instrument is wired for earth grounding via the facility power wiring. Do no bypass earth grounding with two wire extension cords, plug adapters, etc.

BEFORE PLUGGING IN the instrument, comply with installation instructions.

MAINTENANCE may require power on with the instrument covers removed. This should be done only by qualified personnel aware of the electrical hazards.

The instrument power receptical is connected to the instrument safety earth terminal with a green/yellow wire. Do not alter this connection. (Reference: ⏚ or ⚠ stamped inside the rear panel near the safety earth terminal.)

WARNING notes call attention to possible injury or death hazards in subsequent operations.

CAUTION notes call attention to possible equipment damage in subsequent operations.

CONTENTS

SECTION 1
GENERAL DESCRIPTION

1.1 THE MODEL 188

The Wavetek Model 188, 4 MHz Sweep/Function Generator, is a precision source of sine, triangle and square waveforms plus dc voltage. All waveforms are front panel variable from 4 mHz to 4 MHz and can be internally or externally modulated. Frequencies are variable linearly or logarithmically within a frequency range. When used as a sweep generator, an internal ramp generator provides a recurring sweep over a 1000:1 (linear) frequency range or 10,000:1 (logarithmic) frequency range. Output can be continuous or the generator can be triggered or gated by an external signal or a front panel switch. Amplitude of the waveforms is variable form 10V peak-to-peak into 50Ω down to 15 mV peak-to-peak. DC reference of the waveform can be offset positively or negatively.

The two selectable waveform outputs are a 20V peak-to-peak maximum and a 2V peak-to-peak maximum (20 dB down from 20 Vp-p); both may be varied over a 30 dB range. Auxiliary outputs are a TTL level sync, a 600Ω sweep ramp and a 600Ω generator control voltage signal whose level is proportional to the main generator frequency.

1.2 SPECIFICATIONS

1.2.1 Versatility

Waveforms
Sine ∿ , triangle △ , square ⊓ , TTL pulse ⊓ and dc.

Operational Modes
Continuous: Generator runs continuously at selected frequency.

Triggered: Generator is quiescent until triggered by external signal or manual trigger, then generates one complete waveform cycle at selected frequency.

Gated: As triggered mode, except output continues for duration of gate signal. Last waveform started is completed.

Sweep: An internal ramp generator will sweep the main generator from a lower, start frequency to a higher stop frequency, linearly (3 decades) or logarithmically (4 decades).

Sweep Stop: Frequency switches to high sweep limit. Used to set high frequency limit.

Frequency Range
0.004 Hz linear (0.0004 Hz log) to 4 MHz in 7 overlapping decade ranges:

×1	0.004 (0.0004) to 4 Hz
×10	0.04 (0.004) to 40 Hz
×100	0.4 (0.04) to 400 Hz
×1K	4 (0.4) Hz to 4 kHz
×10K	40 (4) Hz to 40 kHz
×100K	400 (40) Hz to 400 kHz
×1M	4 (0.4)kHz to 4 MHz

Function Output
∿ , △ , ⊓ selectable and variable to 20 Vp-p (10 Vp-p into 50Ω) HI output, and to 2 Vp-p (1 Vp-p into 50Ω) LO output. Both outputs varied with a 30 dB vernier. Peak output current is 100 mA maximum (HI output) into 50Ω (200 mA peak into a short circuit). Source impedance is 50Ω.

DC Offset and DC Output
Waveform offset and dc output selectable and variable through HI and LO BNC outputs. DC output selectable by not selecting a waveform function. HI output is ±10V max (±5V into 50Ω) as offset or Vdc output. Signal-peak plus offset limited to ±10V (±5V into 50Ω). LO output is ±1V max (±0.5V into 50Ω) as is signal-peak plus offset limit. DC offset plus waveform attenuated proportionately at LO (−20 dB) output.

TTL Sync Output
TTL pulse (50% duty cycle) at generator frequency. Drives up to 20 TTL loads.

GCV — Generator Control Voltage
0 to 4.0V open circuit output from 600Ω source impedance. Proportional to frequency of main generator. For use as a horizontal drive signal.

VCG — Voltage Controlled Generator
Up to 1000:1 frequency change (linear mode) or up to 10,000:1 change (logarithmic mode) with external 0 to ±4V signal. Upper and lower frequencies limited to maximum and minimum of selected range.

Slew Rate: 2% of range per μs (linear); 0 to 100% of range in 20 ms (logarithmic).

Linearity: ±0.5% through × 100K range; ±2% on ×1M range.

Input Impedance: 2 kΩ.

Sweep
Main generator is frequency modulated by internal sweep generator. Main generator frequency repeatedly rises from frequency set by dial and range button to frequency set by sweep stop knob.

Sweep Mode: Linear (3 decades max) or logarithmic (4 decades max).

Sweep Rate: 30 ms to 1 min. (nominal) continuously adjustable.

Sweep Width: Up to 1:1000 (linear) or 1:10,000 (logarithmic) continuously adjustable.

Sweep Output
Ramp waveform output with 4V peak into open circuit. Source impedance 600Ω. For use as a horizontal drive signal.

Trigger and Gate
Input: TTL compatible levels.
Pulse Width: 50 ns minimum.
Repetition Rate: 4 MHz maximum.

1.2.2 Frequency Precision

Dial Accuracy
±5% of full scale.

Time Symmetry
Square wave variation from 0.2 to 4.0 on dial less than: ±1% to 100 kHz; ±5% to 4 MHz.

1.2.3 Amplitude Precision

Sine variation with frequency less than: ±0.2 dB on all ranges through ×100K; ±1.0 dB to 4 MHz.

1.2.4 Waveform Characteristics

Sine Distortion
Less than: 0.5% on ×1K and ×10K ranges; 1% on ×1, ×10, ×100 and ×100K ranges. All harmonics 25 dB below fundamental on ×1M range.

Triangle Linearity
Greater than 99% to 200 kHz.

Square Wave Rise and Fall Time
At HI output, less than 50 ns for 10 Vp-p output into 50Ω termination.

1.2.5 General

Environmental
Specifications apply at 25°C ±5°C. Instrument will operate from 0°C to 50°C ambient temperatures.

Dimensions
28.6 cm (11¼ in.) wide; 8.9 cm (3½ in.) high; 26.7 (10½ in.) deep.

Weight
2.7 kg (6 lb) net; 4.5 kg (10 lb) shipping.

Power
90 to 128V or 198 to 264V (specify); 48 to 66 Hz; less than 15 watts.

NOTE

All specifications apply for dial between 0.2 and 4.0; amplitude at 10 Vp-p from HI output into 50Ω termination.

SECTION 2
INSTALLATION

2.1 MECHANICAL INSTALLATION

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

2.2 ELECTRICAL INSTALLATION

2.2.1 Power Connection

WARNING

To preclude injury or death due to shock, the third wire earth ground must be continuous to the facility power outlet. Before connecting to the facility power outlet, examine extension cords, autotransformers, etc., between the instrument and the facility power outlet for a continuous earth ground path. The earth ground path can be identified at the plug on the instrument power cord; of the three terminals, the earth ground terminal is the nonmatching shape, usually cylindrical.

CAUTION

To prevent damage to the instrument, check for proper match of line and instrument voltage and proper fuse type and rating.

NOTE

Unless otherwise specified at the time of purchase, this instrument was shipped from the factory for operation on a 90 to 128 Vac line supply and with a 1/4 amp slow blow fuse. Instruments configured for 180 to 256 Vac have a 1/8 amp slow blow fuse. Select the appropriate fuse and 115 or 230 switch position at the rear panel when changing power sources.

2.2.2 Signal Connections

Use 3 foot RG58U 50Ω shielded cables equipped with BNC connectors to distribute all input and output signals.

2.3 ELECTRICAL ACCEPTANCE CHECK

This checkout procedure is a general verification of generator operation. Should a malfunction be found, refer to the warranty in the front of this manual.

A two channel oscilloscope, four 3 foot 50Ω coax cables with BNC connectors, a coax tee connector and an additional function generator are required for this procedure.

Preset the generator front panel controls as follows:

Control	Position
Dial	2.0
MODE	CONT (released)
FUNCTION	⌐¬
DC OFFSET	OFF (ccw)
AMPLITUDE	MAX (cw)
FREQUENCY MULTIPLIER	× 1K
SWEEP	CONT (released)

Set up the oscilloscope, Model 188 and external function generator as shown in figure 2-1 and perform the steps in table 2-1.

2.4 CHANGING THE OUTPUT IMPEDANCE

The output impedance is normally:

HI 10V p-p (50Ω source) into 50Ω.
LO 1V p-p (50Ω source) into 50Ω.

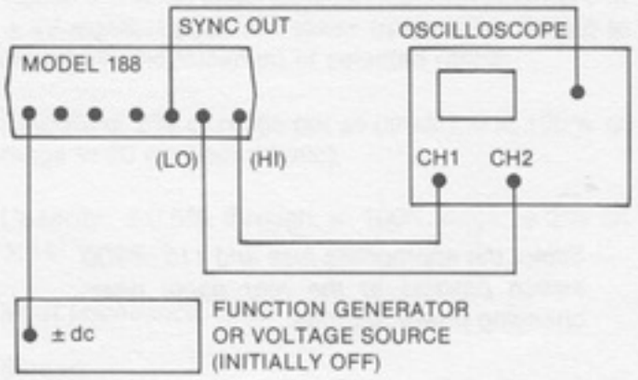


Figure 2-1. First Setup

Amplitude is normally variable over 30 dB for each output with a 50 dB amplitude range available by utilizing both outputs.

If simultaneous 600Ω and 50Ω output impedances are desired:

1. Change value of R148 from 499Ω to 604Ω.
2. Remove R149.

The result is:

HI 10V p-p (50Ω source) into 50Ω.
LO 10V p-p (600Ω source) into 600Ω.

Amplitude is variable over 30 dB. Square wave rise and fall time is less than 150 ns. Any value greater than 600Ω may also be substituted for the value of R148 for other output impedances.

To increase the range of the variable amplitude control in a modified unit beyond 30 dB, decrease the value of R124 as necessary. Waveform quality relative to the standard unit is not guaranteed below −30 dB and above 20 kHz.

Table 2-1. Initial Checkout

Step	Control	Position/Operation	Observation
1	POWER	ON	±10V square wave on CH1 and ±1V on CH2. Return to CH1 only.
2	Dial	Rotate in both directions. Return to 2.0.	Rotation ccw increases frequency of ⊓ ; rotation cw decreases frequency.
3	FREQUENCY MULTIPLIER	Press each switch sequentially; return to ×1K.	Frequency increases in decade steps, left to right.
4	AMPLITUDE	Rotate ccw.	Amplitude decreases.
5	DC OFFSET	Rotate cw. Return to OFF.	Output immediately offset negative, then moves positive. OFF return it to original level.
6	AMPLITUDE	Rotate cw.	Square returns to original amplitude.
7	Function Generator or DC Voltage Source	Vary input dc voltage; then disconnect VCG IN input.	Frequency increases with positive voltage and decreases with negative voltage.
8	FUNCTION	Press ∿ , ⊓ , ◺ .	Observe ∿ , ⊓ , ◺ waveforms.
9	MODE	Gate (CONT depressed, TRIG/GATE released).	A dc level near zero volts (except ⊓ function).
10	MANUAL TRIGGER	Press and hold.	Continuous ◺ .

Table 2-1. Initial Checkout (Continued)

Step	Control	Position/Operation	Observation
	Set up trigger source as shown in figure 2-2. Set trigger source for 100 Hz TTL signal.		
11	——	———	∿ gated on during positive portion of TTL signal on CH2.
12	TRIG/GATE	Trigger (depressed)	One cycle per trigger cycle.
13	MODE	Main generator continuous (CONT released)	Setup connectors as shown in figure 2-3. Sync scope on channel 2 input.
14	Dial	Full cw	
15	SWEEP Controls	Linear sweep (CONT depressed, SWP/STOP depressed, LOG/LIN extended, STOP full cw, TIME centered)	Output varies from low frequency to high frequency
16	LIN/LOG Button	Press	Logarithmic distributed sweep when compared to step 15 linear sweep.

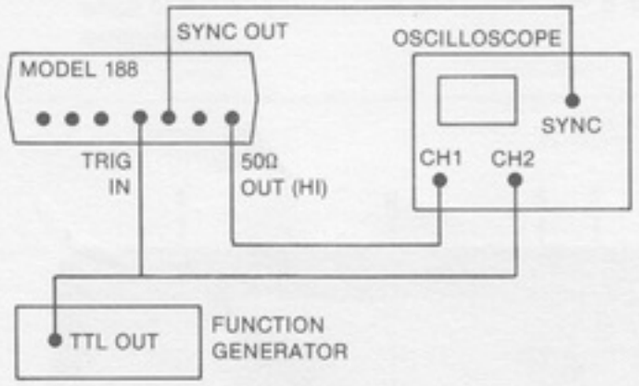


Figure 2-2. Second Setup

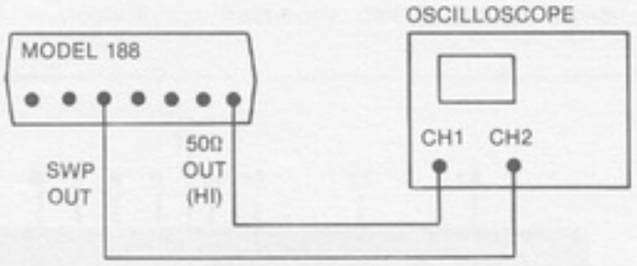


Figure 2-3. Third Setup

SECTION 3
OPERATION

3.1 CONTROLS AND CONNECTIONS

The generator front panel controls and connectors are shown in figure 3-1 and keyed to the following descriptions.

1 **Frequency Dial** — Settings under the dial index mark summed with **21** and multiplied by **4** determine the output signal frequency and the sweep start frequency in sweep mode. The dial is engraved with both linear and logarithmic scales: outer scale linear and inner scale logarithmic.

2 **POWER Button** — Turns generator ON and OFF.

3 **STOP Knob** — Sets the upper frequency limit when CONT **5** is depressed and SWP/STOP **6** is extended.

4 **FREQUENCY MULTIPLIER Controls** — Selects one of seven frequency multipliers for dial **1** setting.

5 **CONT Button** — Selects sweep submode to main generator's continuous mode. Extended is continuous (nonsweep) mode while depressed is sweep mode. Sweep is from a low frequency set by **1** to a high frequency set by **3**. Main generator mode control **8** must be in continuous mode (extended).

6 **SWP/STOP Button** — When button is depressed (and **5** depressed and **8** extended) selects repetitive sweep of the main generator frequency. When button is extended, the frequency is stopped at the upper sweep limit with upper frequency being set by STOP control **3**.

7 **LIN/LOG Button** — Selects linear or logarithmic frequency distribution of sweep,

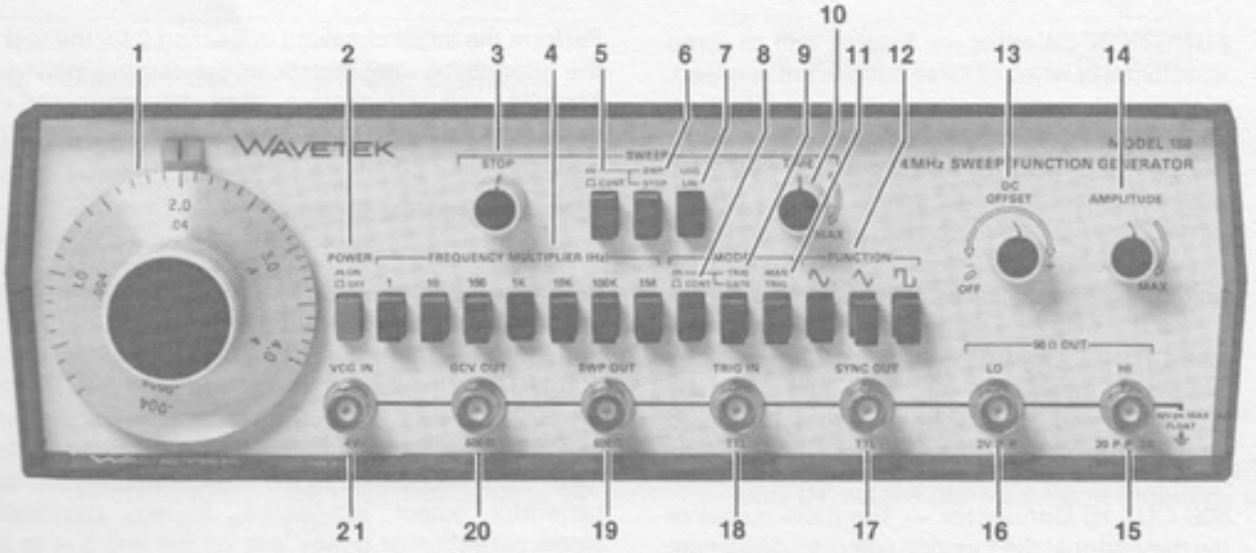


Figure 3-1. Controls and Connectors

VCG and main dial within a frequency range. Linear operation is selected when the button is extended. Logarithmic operation is selected when the button is depressed.

8, 9 **Generator MODE Controls** — Selects one of the following three modes:

CONT — **8** released. Continuous output at 50Ω OUT **15** and **16** and SYNC OUT (TTL) **17** connectors.

TRIG — **8** and **9** pressed. DC level output until generator triggered by the MAN TRIG **11** or with a signal at the TRIG IN connector **18** . When triggered, the generator output is one cycle of waveform followed by a dc level.

GATE — **8** pressed and **9** released. As for TRIG except the output is continuous for the duration of the manual or external trigger signal. The last cycle started is always completed.

10 **TIME Knob** — Sets the sweep time by controlling the period of the sweep ramp generator.

11 **Manual Trigger Button** — Triggers or gates the output signals when generator mode is TRIG or GATE (**8** pressed). In trigger mode, one waveform cycle is output when the button is pushed. In gate mode, waveform cycles are continuously output as long as the button is held in.

12 **FUNCTION Selector** — Selects one of three waveforms or when all three buttons are released, a dc level.

13 **DC OFFSET Control** — Offsets the 50Ω OUT waveforms or gives dc levels from −10V to +10V (−5V to +5V into 50Ω) at **15** and from −1V to +1V (−0.5V to +0.5V into 50Ω) at **16**. An OFF position ensures no offset.

14 **AMPLITUDE Control** — Ccw rotation reduces waveform amplitudes at **15** and **16** by 30 dB. DC and offset voltages are not affected by this control.

15 **50Ω OUT HI Connector** — The main output of the generator at the function selected. Maximum 20 Vp-p (10 Vp-p into 50Ω) with 30 dB continuous amplitude control. 50Ω source impedance.

16 **50Ω OUT LO Connector** — Same as **15** except 20 dB (1/10) lower in amplitude.

17 **TTL OUT Connector** — A TTL square for each cycle of the generator. To be used for synchronization or as a TTL signal capable of driving 20 TTL loads.

18 **TRIG IN Connector** — Accepts a TTL signal to trigger or gate the generator. Triggers on the rising (low to high) transition and gates during the positive (high) portion of the triggering signal.

19 **SWP OUT Connector** — Supplies a ramp waveform with an approximate 4V peak into an open circuit. For use as a horizontal drive signal. Source impedance is 600Ω.

20 **GCV OUT Connector** — Provides a 0 to 4V open circuit output proportional to the frequency of the main generator. For use as a horizontal drive signal. Source impedance is 600Ω.

21 **VCG IN Connector** — Accepts ac or dc voltages to proportionately control frequency within the range determined by the FREQUENCY MULTIPLIER **4** . Positive voltage increases the frequency set by the dial **1** ; negative voltage decreases the frequency. The VCG IN will not drive the generator frequency beyond the normal dial limits of a range. Input impedance is 2 kΩ.

3.2 OPERATION

Perform the initial checkout in Section 2 for the feel of the instrument. Any questions concerning individual controls and connectors may be answered in paragraph 3.1.

3.2.1 Signal Termination

Proper signal termination, or loading, of the generator connectors is necessary for its specified operation. For example, the proper termination of either of the 50Ω OUT connectors is shown in figure 3-2. Placing the 50Ω terminator, or 50Ω resistance, in parallel with a higher impedance, matches the receiving instrument input impedance to the coax characteristic and generator output impedance, thereby minimizing signal reflection or power loss on the line due to impedance mismatch.

The input and output impedances of the generator connectors are listed below.

Connector	Impedance
50Ω OUT (HI)	50Ω
50Ω OUT (LO)	50Ω
SYNC OUT (TTL)	*
TRIG IN	*
VCG IN	2 kΩ
SWP OUT	600Ω
GCV OUT	600Ω

*The TTL OUT connector is diode protected and can drive up to 20 Transistor-Transistor-Logic (TTL) loads (low level between 0V and 0.4V, and high level between 2.4V and 5V). It should not be connected to resistive load less than 600Ω. The TRIG IN connector accepts TTL logic levels, is diode protected, and requires 500 μA drive from a high level output.

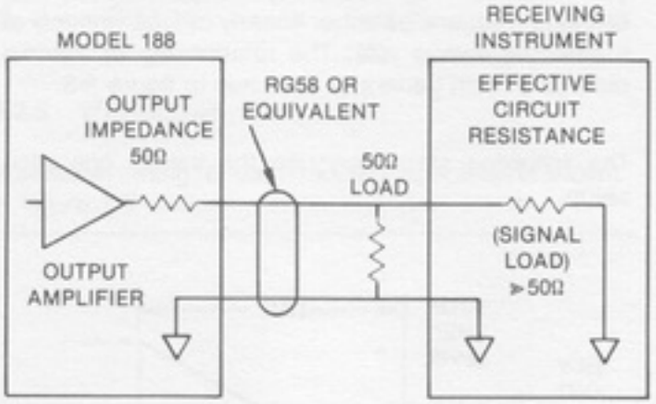


Figure 3-2. Signal Termination

3.2.2 Manual Function Generator Operation

For basic operation, select the waveform frequency and amplitude. The following steps demonstrate manual control of the function generator. (Bold numbers are keyed to figure 3-1.)

Step	Control/Connector	Setting
1	50Ω OUT **15** **16**	Connect circuit to either output (refer to paragraph 3.2.1).
2	FREQUENCY MULTIPLIER **4**	Set to desired range of frequency.
3	Frequency Dial **1**	Set to desired frequency within the range.
4	SWEEP's CONT **5**	Extended.
5	FUNCTION **12**	Set to desired waveform.
6	DC OFFSET **13**	Set as desired. Limit waveform amplitude to prevent clipping (see figure 3-3).
7	AMPLITUDE **14**	Set for desired amplitude.

3.2.3 Voltage Controlled Function Generator Operation

Operation as a voltage controlled function generator (VCG) is as for a manually controlled function generator, only the frequency within a particular range is additionally controlled by an external voltage (±4V excursions) injected at the VCG IN connector. Perform the steps given in paragraph 3.2.2, only set the frequency dial to determine a reference from which the frequency is to be voltage controlled:

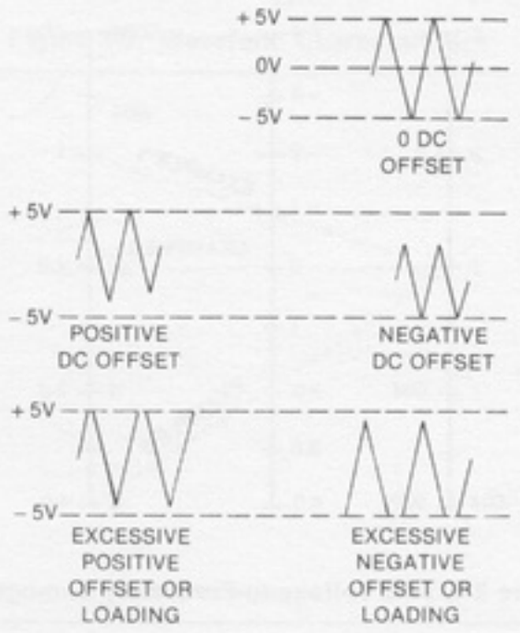


Figure 3-3. DC OFFSET Control

1. For frequency control with positive dc inputs at VCG IN, set the dial for a lower frequency limit.
2. For frequency control with negative dc inputs at VCG IN, set the dial for an upper frequency limit.
3. For modulation with an ac input at VCG IN, set the dial at the desired center frequency. Do not

exceed the limits of the selected frequency range.

Figure 3-4 is a nomograph with examples of dial and voltage effects. Example 1 shows that with 0V VCG input, frequency is determined by the main dial setting, 2 (linear mode) or .04 (logarithmic mode) in this example. Example 2 shows that with a positive VCG input, output frequency is increased. Example 3 shows that with a negative VCG input, output frequency is decreased. (Note that the Output Frequency Factor column value must be multiplied by a frequency range multiplier to give the actual output frequency.)

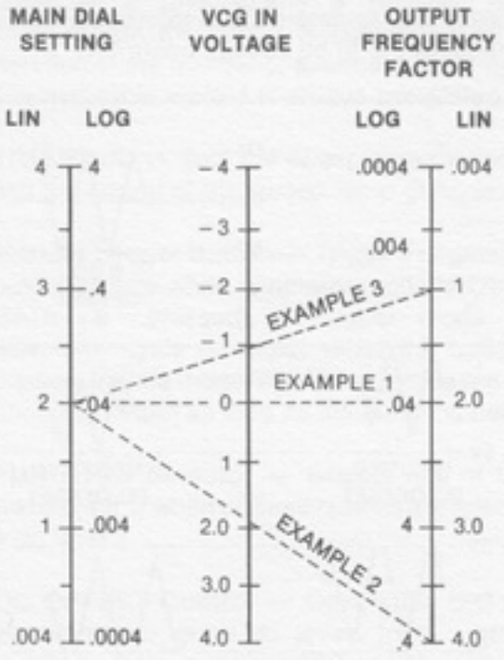


Figure 3-4. VCG Voltage-to-Frequency Nomograph

NOTE

Nonlinear operation may result when the VCG input voltage is excessive; that is, when the attempted generator frequency exceeds the range limits. The upper limit is four times the multiplier setting, and the lower limit is 1/1000th (linear) or 1/10,000 (logarithmic) of the upper limit.

The up to 1000:1 (linear) or 10,000:1 (logarithmic) VCG sweep of the generator frequencies available in each range results from a 4V excursion at the VCG IN connector. With the frequency dial set to 4.0, excursions between −4V and 0V at VCG IN provide the up to 1000:1 (lin) or 10,000:1 (log) frequency sweep. With the dial set to .004 (linear) or .0004 (logarithmic), excursions between 0V and +4V at the VCG IN provide up to 1000:1 (linear) or 10,000:1 (logarithmic sweep within the set frequency range.

3.2.4 Sweep Generator Operation

Operation as a sweep generator is similar to manually controlled generator operation except the main generator can be repetitively swept between two selected frequencies either linearly or logarithmicly at a selected sweep rate. The relationship of internal ramp and main generator is shown in figure 3-5.

The following steps describe the sweep operation setup.

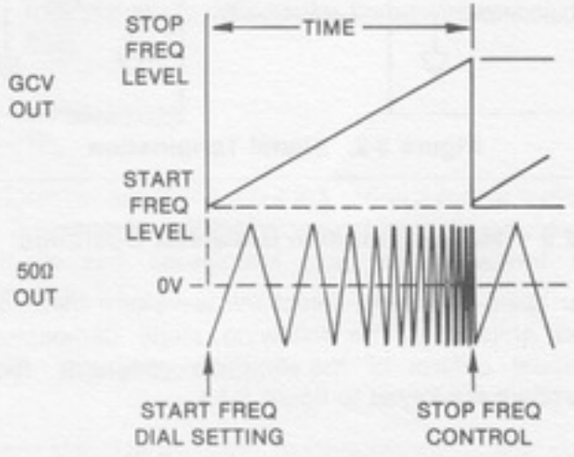


Figure 3-5. Effect of Sweep Time and Width on Output Frequency

Step	Control	Setting
1	MODE: CONT **8**	Press to release. (Continuous mode of main generator is necessary for sweep.)

Step	Control	Setting
2	Frequency dial **1**	Select sweep start frequency.
3	SWEEP's CONT **5**	Depressed. (Selects sweep submode of main generator's continuous operation.)
4	SWP/STOP **6**	Press to release. (Extended allows setting of stop frequency.)
5	STOP **3**	Select the stop frequency. (The stop frequency will always be higher than the start frequency.)
6	Time **10**	Sets the internal sweep rate.

3.2.5 Waveforms

Waveform timing for each mode of operation is shown in figure 3-5.

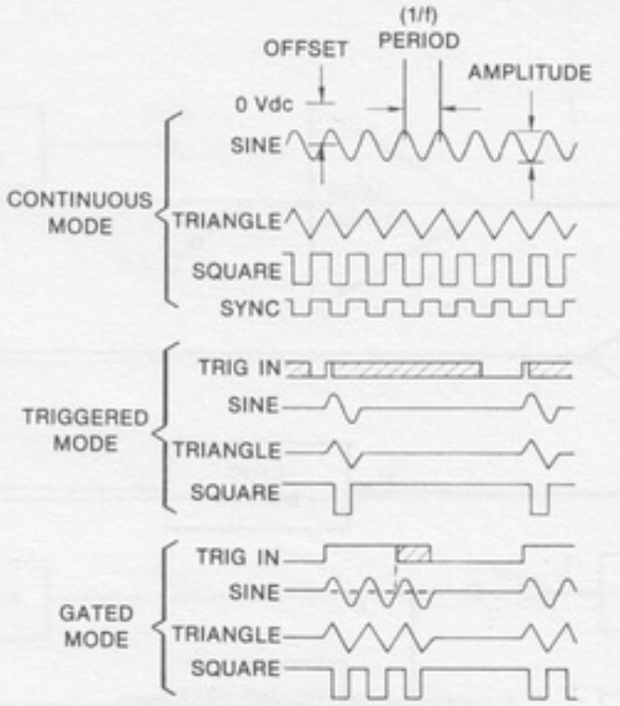


Figure 3-5. Waveform Characteristics

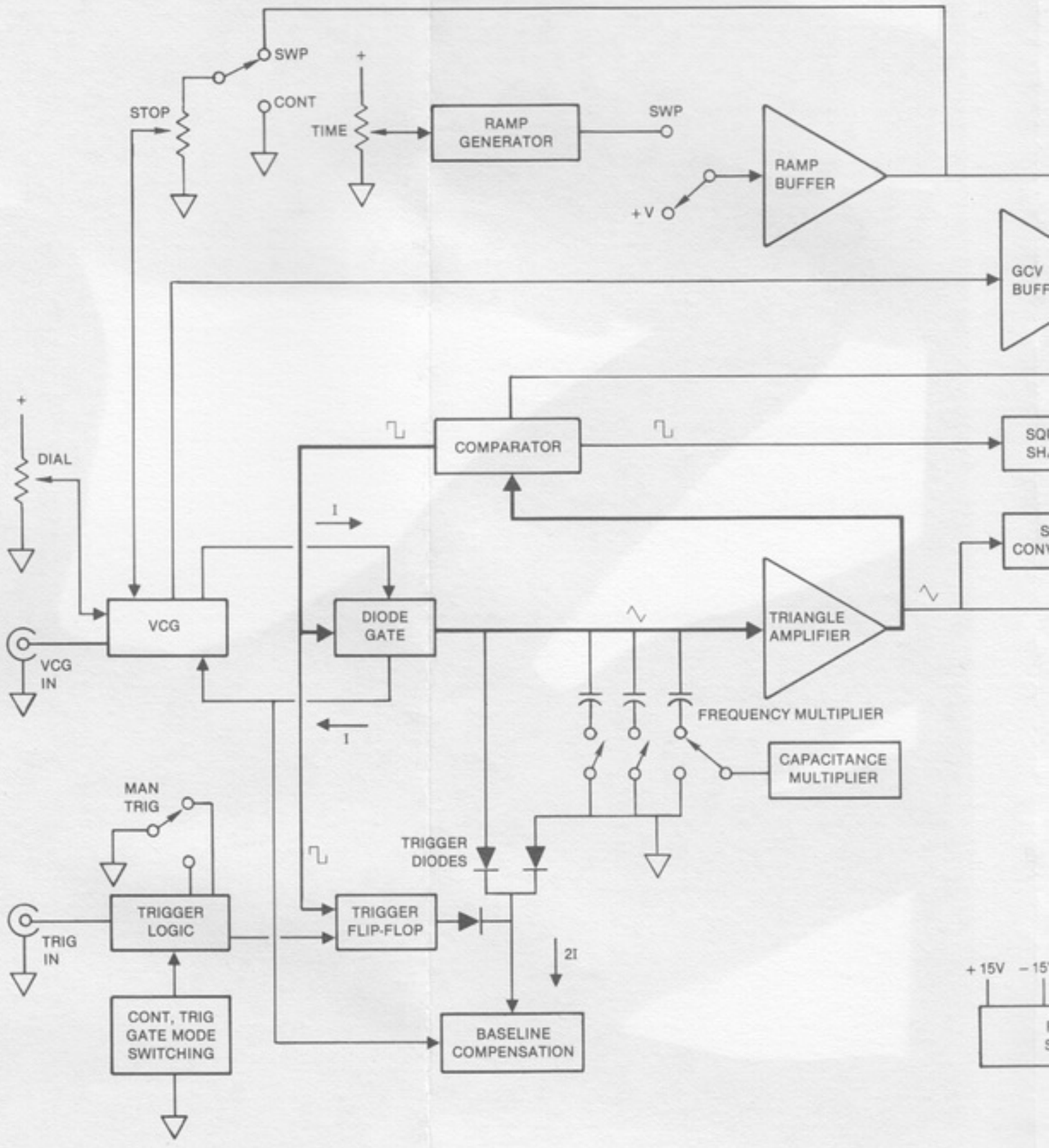
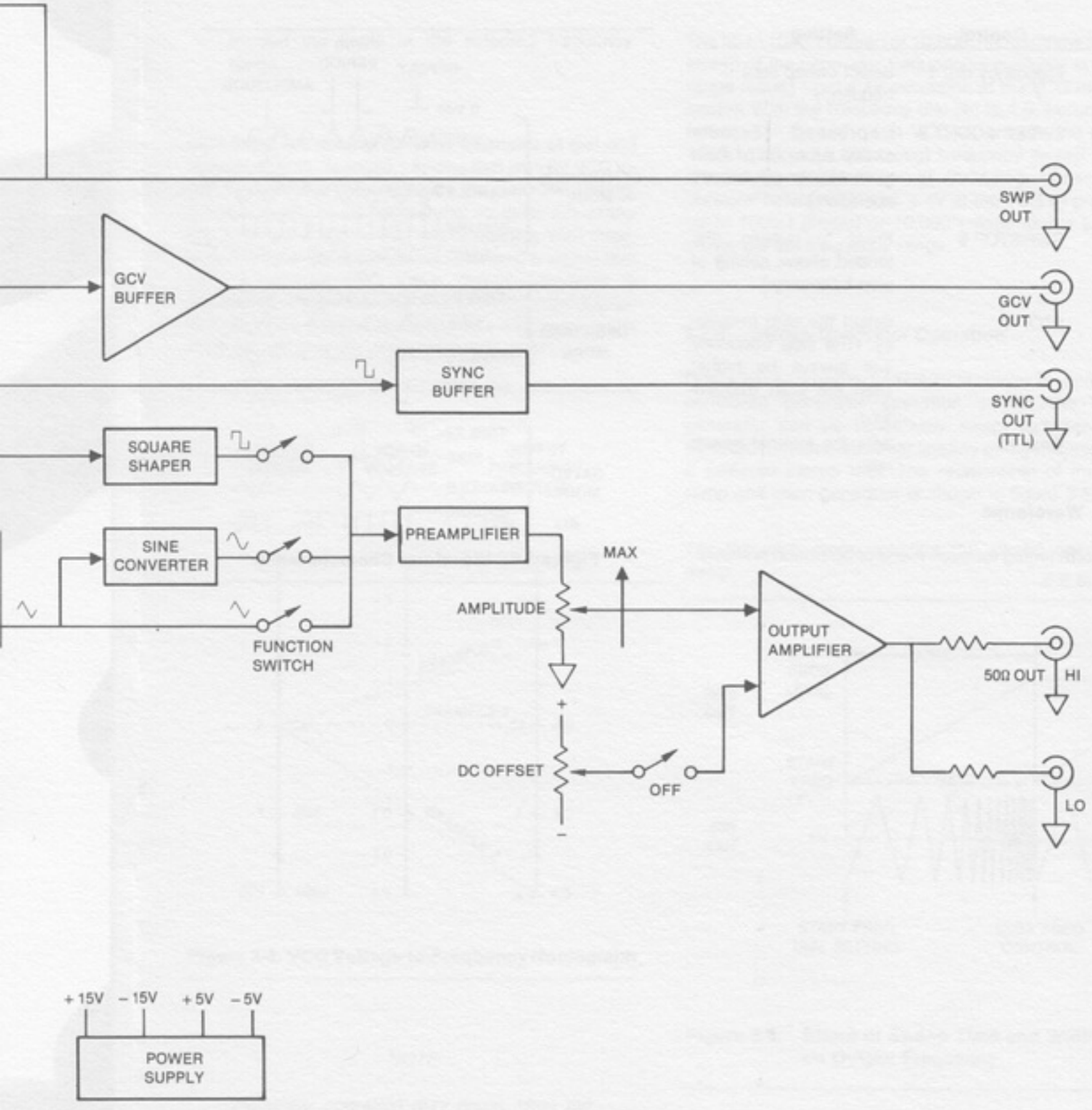


Figure 4-1. Function Block Diagram


SWP OUT
GCV BUFFER
GCV OUT
SYNC BUFFER
SYNC OUT (TTL)
SQUARE SHAPER
SINE CONVERTER
PREAMPLIFIER
MAX
AMPLITUDE
OUTPUT AMPLIFIER
50Ω OUT
HI
FUNCTION SWITCH
DC OFFSET
OFF
LO

+ 15V
– 15V
+ 5V
– 5V
POWER SUPPLY

SECTION 4
CIRCUIT DESCRIPTION

This section describes the functions of major circuit elements and their relationships to one another as shown in figure 4-1, functional block diagram. The following sections in this manual provide more detailed information for maintaining the instrument.

As shown in figure 4-1, the VCG (Voltage Control of Generator) sums voltage inputs from the frequency dial and the VCG IN connector. This sum voltage controls the magnitude of a complementary current source and current sink. This current varies linearily from approximately 2 mA to 2 μA over a 1000:1 (4.0 to .004) range or logarithmically from approximately 2 ma to 0.2 μa over a 10,000:1 (4.0 to .0004) range of each frequency multiplier. The VCG also controls the trigger baseline compensation circuit, which consists of another current sink at twice the current magnitude.

The diode gate, controlled by the comparator output, connects either the current source or the current sink to the timing capacitor selected by the frequency multiplier. When the current source is switched in, the charge on the timing capacitor will rise linearily, producing the positive-going triangle slope. Likewise, the current sink produces the negative-going triangle slope.

The triangle amplifier is a unity gain amplifier whose output is fed to the comparator and to the output circuits. The comparator operates as a window detector with limit points set to the triangle peaks. The ± 2V output is sent back to the diode gate and to the output circuits. When the output is $+2$V, the triangle is positive-going until the $+1.25$V limit is reached and the comparator output switches to -2V. When the output is -2V, the triangle is negative-going until the -1.25V limit is reached and the comparator output switches back to $+2$V, repeating the process. In this manner, the basic function generator loop, the bold path in figure 4-1, produces simultaneous generation of triangle and square waves at the same frequency.

The output frequency is determined by the magnitude of the timing capacitor selected by the frequency multiplier switches and by the magnitude of the currents supplied to and removed from it. Since the currents are linearily proportional to the sum of the VCG inputs, so will be the output frequency.

To extend the lower frequency capability of the generator, a capacitance multiplier circuit divides VCG currents by 10 (effectively multiplying the timing capacitor by 10) for each of the lower 3 multiplier ranges.

The TTL square from the comparator is buffered and sent to the SYNC OUT TTL connector. The other side is sent to the trigger flip-flop and to a level shifter to produce the ± 2V bipolar square for the diode gate and the square shaper circuits. The square shaper converts the square into a current signal and applies it to the ⎍ FUNCTION switch. The buffered triangle is applied to the ∿ FUNCTION switch and to the sine converter input. The sine converter, using the nonlinear characteristics of its diodes, converts the triangle into a sinusoidal current for the ∿ FUNCTION switch.

The selected function is sent to the preamplifier, where it is inverted and buffered. The preamplifier output goes to the output amplifier through the AMPLITUDE control where it is summed with offset voltage from the DC OFFSET control. Here, waveform and offset are inverted and amplified to a ± 10V peak signal which can drive a 50Ω termination from a 50Ω source impedance. The output amplifier drives the 50Ω OUT HI connector and a resistor divider producing the 50Ω OUT LO output.

Noncontinuous modes of operation (trigger and gate) result from allowing or preventing the VCG current source from charging the timing capacitor. Whenever the trigger flip-flop output is low, each of the two trigger diodes conduct a current I, sourcing 2I to the baseline compensation circuit. This removes the current I from the VCG current source and forces a 0V baseline at the triangle amplifier input.

When the CONT switch is released, trigger logic is inhibited from passing any trigger signals and the trigger flip-flop output is held high. This prevents the trigger diodes from conducting and the generator loop operates continuously.

When the CONT switch is pressed, the generator loop is held at the 0V baseline. Pressing the TRIG/GATE switch puts the instrument in triggered mode and any external or manual trigger signals at the trigger logic input will be transformed into a narrow pulse corresponding to the low-to-high transition of the trigger input. This pulse sets the trigger flip-flop high and allows the generator loop to run. When the triangle negative peak is reached, the comparator low-to-high transition clocks the trigger flip-flop low and, when the 0V baseline level is reached, the generator loop again stops. The result is a single cycle generated after the triggering signal corresponding to 0 to 360° of phase. Successive triggered waveforms always start at the same 0° point.

Releasing the TRIG/GATE switch puts the instrument in the gated mode. This is identical to the triggered mode, except the trigger flip-flop is held high for the full duration of the triggering signal. The generator produces continuous waveforms during the time the external signal is high or the manual trigger switch is held in. The last triggered cycle started is always completed and successive gated bursts always start at the 0° point.

When sweep mode is selected by a combination of the main generator in continuous mode and the ramp generator switches set to SWP, the ramp generator is enabled and a ramp voltage becomes part of the control voltage in the VCG circuit to control the main generator frequency. Ramp period, variable from 30 ms to 1 minute, is set by the TIME Control. Ramp generator output is buffered to drive the sweep output and VCG circuit. The ramp magnitude suppling the VCG input is controlled by the STOP potentiometer.

Selecting the stop switch position biases the buffer amplifier to a level equal to the positive peak of the ramp (+V). In this static mode the upper sweep limit can be set by the STOP Control.

When the CONT position of the SWEEP switch is selected the ramp generator is disabled and the buffered ramp is disconnected from the VCG input.

The GCV (Generator Control Voltage) from the VCG circuit is a resultant voltage from the three VCG inputs: dial, VCG IN and sweep ramp. This voltage is buffered and made available at the GCV BNC.

SECTION 5
ALIGNMENT

5.1 FACTORY REPAIR

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 alignment or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

5.2 REQUIRED TEST EQUIPMENT

Voltmeter	Millivolt dc measurement (1% accuracy)
Oscilloscope	≥60 MHz bandwidth
Counter	4 MHz (0.1% accuracy)
50Ω Feedthru	±1% accuracy, 2W
Distortion Analyzer	To 400 kHz
RG58U Coax Cable	3 ft length BNC male contacts

5.3 REMOVING GENERATOR COVERS

1. Invert the instrument and remove the four screws in the bottom cover.

2. Turn the instrument upright; remove the top cover for access to generator alignment controls.

3. When alignment is complete, secure the bottom cover with four screws.

NOTE

Remove the cover only when it is necessary to make adjustments or measurements.

5.4 ALIGNMENT

After referring to the following preliminary data, perform alignment, as necessary, per table 5-1. If performing partial alignment, check previous settings and adjustments for applicability. See figures 5-1 and 5-2 for alignment control location.

1. All measurements made at the FUNCTION OUT connector must be terminated into a 50Ω (±1%) load.

2. Start the alignment by connecting the unit to an appropriate ac power source and setting the front panel switches as follows.

POWER	ON
Frequency Dial	4.0
FREQ MULT (Hz)	×1K
MODE CONT	CONT (released)
FUNCTION	⊓
DC OFFSET	OFF
AMPLITUDE	MAX
LIN/LOG	LIN (released)
SWEEP's CONT	CONT (released)
SWP/STOP	STOP (released)

3. Allow the unit to warm up at least 30 minutes for final alignment. Keep the instrument cover on to maintain heat. Remove cover only to make adjustments or measurements.

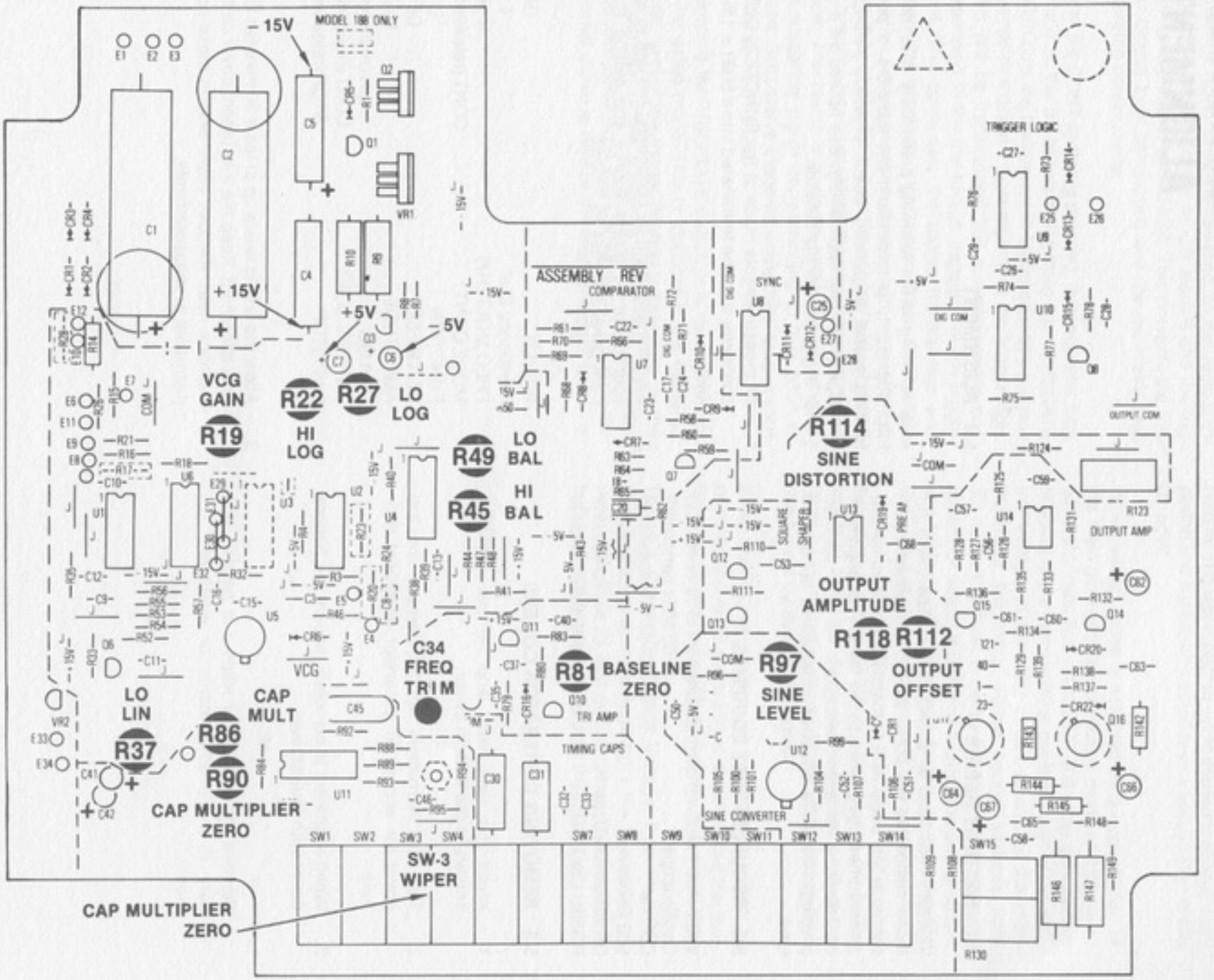


Figure 5-1. Alignment Point Location, Generator Board

Table 5-1. Alignment Procedure

Step	Check	Tester	Test Point	Control Setting	Adjust	Result	Remark
1	Power Supply	Voltmeter	C4 +	Paragraph 5.4, Step 2		+ 15 ± .75V	Verify ± 15V should track within 30 mV
2			C5 –			– 15 ± .75V	
3			C7 +			+ 5 ± .25V	Verify
4			C6 –			– 5 ± .25V	
5	Capacitor Multiplier Zero		SW3 - B Wiper		R90 CAP MULT ZERO	0 ± 2V	
6	Approximate Bottom of the Dial Frequency	Counter	50Ω OUT HI (terminate into 50Ω	Dial: .004 FREQ MULT: 10K	R37 LO LIN	20 to 25 ms period	
7	Bottom of the Dial Symmetry	Scope			R49 LO BAL	Equalize (+) and (–) half cycles	Set scope to (–) trigger; display one full cycle. Align positive transition to center of screen. Multiply the horizontal display × 10. Set scope to (+) trigger; adjust R49 to align negative transition with center of screen
8	Bottom of the Dial Frequency (Lin)	Counter		FREQ MULT: × 1K	R37 LO LIN	350(± 50) ms period	
9	Top of the Dial Symmetry	Scope		Dial: 4.0	R45 HI BAL	Equalize (+) and (–) half cycles	See step 7
10	Top of the Dial Frequency (Lin)	Counter		Dial: 4.0 FREQ MULT: × 1K	R19 VCG GAIN	4 ± .2 kHz	
11				FREQ MULT: × 10K		40 ± .8 kHz	Verify
12				FREQ MULT: × 1M	C34 FREQ TRIM	4 ± .02 MHz	
13				FREQ MULT: × 100K		400 ± 8 kHz	Verify. If necessary, trim by changing value of C33
14				FREQ MULT: × 100	R86 CAP MULT	2.5 ± .05 ms	

Table 5-1. Alignment Procedure (Continued)

Step	Check	Tester	Test Point	Control Setting	Adjust	Result	Remark
15				FREQ MULT: ×10		25 ±.5 ms	Verify
16				FREQ: ×1		250 ±5 ms	
17	Bottom of the Dial Frequency (Log)			Dial: .0004 FREQ MULT: ×100K SWEEP: CONT, STOP, LOG	R27 LO LOG	40 ±2 Hz	Allow 1 hour warm-up
18	Top of the Dial Frequency (Log)			Dial: 4.0 FREQ MULT: ×100K	R22 HI LOG	400 ±10 kHz	Repeat steps 17 and 18 once.
19	Sine Distortion (Lin)	Distortion Analyzer		FUNCTION: ∿ FREQ MULT: ×1K	R97 SINE LEVEL R114 DISTOR-TION	Adjust for minimum distortion	It may be necessary to reduce amplitude to 5V peak.
20	Output Amplitude	Scope		FUNCTION: ∿	R118 OUTPUT AMPL	10 Vp-p (+.3V/−0V)	
21	Output Offset	Voltmeter		FUNCTION: ∿	R112 OFFSET	0 ±50 mV	
22	Baseline Zero	Scope		MODE: Trigger	R81 B A S E - LINE ZERO	0 ±75 mV	It may be necessary to trim the baseline with R80
23	Sweep Offset	Voltmeter	SWP OUT (Unter-minated)	SWEEP: CONT, SWP, LIN	R9 (Sweep board) SWEEP OFFSET	0 ±2 mV	

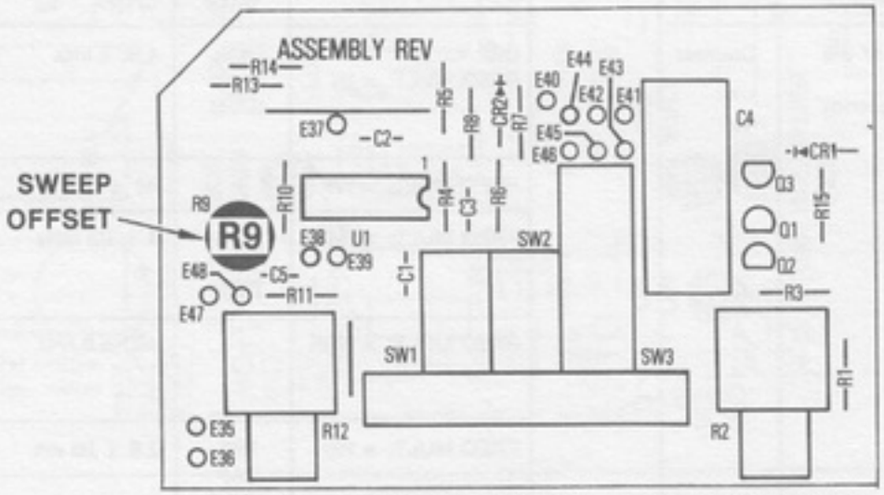


Figure 5-2. Alignment Point Location, Sweep Board

SECTION 6
TROUBLESHOOTING

6.1 FACTORY REPAIR

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 alignment or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

6.2 TROUBLESHOOTING TABLES

Table 6-1 gives an index of the troubleshooting tables by indications of common problems. The tables do not cover every possible trouble, but, when used in conjunction with circuit descriptions and schematics, will be an aid in systematically isolating faulty components.

6.3 TROUBLESHOOTING INDIVIDUAL COMPONENTS

6.3.1 Transistor

1. A transistor is defective if more than one volt is measured across its base-emitter junction in the forward direction.

2. A transistor when used as a switch may have a few volts reverse bias voltage across base-emitter junction.

3. If the collector and emitter voltages are the same, but the base emitter voltage is less than 500 mV forward voltage (or reversed bias), the transistor is defective.

4. A transistor is defective if its base current is larger than 10% of its emitter current (calculate currents from voltage across the base and emitter series resistors).

5. In a transistor differential pair (common emitter stages), either their base voltages are the same in normal operating condition, or the one with less forward voltage across its base emitter junction should be off (no collector current); otherwise, one of the transistors is defective.

6.3.2 Diode

A diode (except a zener) is defective if there is greater than one volt (typically 0.7 volt) forward voltage across it.

6.3.3 Operational Amplifier

1. The "+" and "–" inputs of an operational amplifier will have less than 15 mV voltage difference when operating under normal conditions.

2. When the output of the amplifier is connected to the "–" input (voltage follower connection), the output should be the same voltage as the "+" input voltage; otherwise, the operational amplifier is defective.

3. If the output voltage stays at maximum positive, the "+" input voltage should be more positive than the "–" input voltage, or vice versa; otherwise, the operational amplifier is defective.

6.3.4 FET Transistor

1. No gate current should be drawn by the gate of an FET transistor. If so, the transistor is defective.

2. The gate-to-source voltage is always reverse biased under a normal operating condition; e.g., the source voltage is more positive than the gate voltage for 2N5485, and the source voltage is more negative than gate voltage for a 2N5462. Otherwise, the FET is defective.

3. If the device supplying gate voltage to an FET saturates, the FET has too large a Vgs (pinch off) for the circuit and should be replaced.

6.3.5 Capacitor

1. Shorted capacitors have zero volts across their terminals.

2. Opened capacitor can be located (but not always) by using a good capacitor connected in parallel with the capacitor under test and observing the resulting effect.

6.4 GENERAL INSTRUCTIONS

When encountering a problem, it is advisable to return as many of the front panel controls as possible to their initial settings and still retain the problem. The troubleshooting tables in this section generally begin at these initial settings and specify all subsequent setups. Preset the front panel controls as follows.

Control	Position
Frequency Dial	4.0
POWER	ON
FREQ MULT (Hz)	1K
FUNCTION	∿
DC OFFSET	OFF
AMPLITUDE	MAX
SWEEP	CONT, STOP, LIN

CAUTION

To prevent damage to components, turn unit off while removing or replacing components, connectors or pc boards.

The suspected malfunctioning condition should be double checked to eliminate the possibility of improper settings or connections. Before attempting fault isolation, the unit should be checked for proper line voltage selection (refer to Section 2). A good visual inspection of the boards and chassis wires for damage or overheating often saves much time.

Once the malfunction is defined, begin the isolation procedure by selecting an indication in table 6-1 which best describes the malfunction and proceed to the referenced troubleshooting table.

Follow through the checks in the troubleshooting table, using schematics and assemblies as a guide. When positive results are not obtained, perform the indicated corrective procedure.

Table 6-1. Fault Isolation

Indication	Table
1. Fuse blown, no power indication or no outputs.	6-2
2. Function outputs missing or clipped when TTL sync OK. Triangle problem.	6-3
3. Sine waveform problem.	6-4
4. Square waveform problem.	6-5
5. TTL sync output problem.	6-6
6. Generator frequency does not respond correctly to dial and VCG input.	6-7
7. Waveform symmetry problem.	6-8
8. Problem on bottom three ranges only.	6-9
9. Generator trigger and gate mode problem.	6-10
10. Sweep problem.	6-11

Table 6-2. Power Supplies and Generator Loop

Indication: Fuse blown, no power indication or no outputs.

Check	Corrective Procedure
1. Set all controls in their initial positions (refer to paragraph 6.4).	
2. Ensure line voltage matches instrument configuration (refer to Section 2). Check fuse.	Replace fuse; check for normal operation.
3. Check C1 (+) and C2 (−) for ±20 to 26V unregulated dc.	a. CR1 - CR4. b. C1, C2. c. SW1. d. T1, RV1, F1 (bracket assembly).

Table 6-2. Power Supplies and Generator Loop (Continued)

Indication: Fuse blown, no power indication or no outputs.	
Check	**Corrective Procedure**
4. Check indicator lamp.	DS1 and VR2, wiring E34 and E33.
5. Check C4 (+) for +15 Vdc.	a. VR1. b. Excessive loading; use board jumpers to isolate cause.
6. Check C5 (−) for −15 Vdc.	a. Q2. b. U2, Q1. c. Excessive loading; use board jumpers to isolate cause.
7. Check U7 pin 14 for +5 Vdc and U7 pin 13 for −5 Vdc.	a. Q4, Q3, U2. b. Excessive loading; use board jumpers to isolate cause.
8. Check U4 pin 6 for a dc shift from approximately +10V to +15V as the frequency dial is rotated from 4.0 to .004. Check U6 pin 8 for a dc shift from −10Vto −15V as the frequencydial is rotated from 4.0 to .004.	Go to table 6-7.
9. Check anode CR6 for approximately +3.5 Vdc.	Go to table 6-10.
10. If emitter Q11 has a 4 kHz, ±1.25V triangle, go to table 6-3.	
11. Check for the same voltage at the gate of Q9 as at the emitter of Q11, within saturation limits of the amplifier.	Q9 - Q11 and associated circuitry.
12. If the voltage at the emitter of Q11 is ≥ +1.25V, check cathode CR10 for approximately −2.5V. If the voltage at the emitter of Q11 is ≤ −1.25V, check cathode CR10 for approximately +2.5V.	U7, Q7 and associated circuitry.
13. Check U5.	

Table 6-3. Output Circuits

Indication: Function outputs missing or clipped when TTL sync output OK. Problem with triangle waveform.

Check	Corrective Procedure
1. Set controls to initial positions (refer to paragraph 6.4).	Check for normal operation.
2. Check emitter Q11 for a 4 kHz, ±1.25V triangle.	Go to table 6-2.
3. Select triangle function, rotate AMPLITUDE ccw, and check U13 pin 10 for a ±1.25V triangle.	a. R114 R118 adjustments. b. U13. c. SW13.

Table 6-3. Output Circuits (Continued)

Indication: Function outputs missing or clipped when TTL sync output OK. Problem with triangle waveform.

Check	Corrective Procedure
4. Rotate AMPLITUDE cw (MAX), DC OFFSET to OFF, and check 50Ω OUT (HI) for a 20V p-p (open circuit) triangle.	a. Output amplifier circuit. b. E15, E16 wiring.
5. Check for excessive discontinuities at the triangle peaks near the bottom of a frequency range (other than ×1 to ×100).	a. U5. b. SQR signal at cathode CR10 not ±2.5V.
6. Check for nonlinearities in the triangle slopes near the bottom of a frequency range (other than ×1 to ×100).	a. Associated timing capacitor or C36. b. U5, CR6. c. Q9, Q10.
7. Check for a waveform symmetry problem.	Go to table 6-8.

Table 6-4. Sine Conversion

Indication: Sine waveform problem.

Check	Corrective Procedure
1. Set controls to initial positions (refer to paragraph 6.4).	Check for normal operation.
2. Check emitter Q11 for a 4 kHz, ±1.25V triangle.	Go to table 6-2.
3. Verify that the ±1.25 triangle peaks at the emitter of Q11 agree within 3%.	a. R62, R63, R64, R65, R67, R68, R70. b. CR8, CR9, U7. c. ±15V supplies.
4. Select triangle function; check for ±1.25V triangle at U13 pin 10.	Go to table 6-3, step 3.
5. Select sine function; check for ±1.25V sine at U13 pin 10.	a. U12 circuitry. b. SW12.
6. Check sine distortion 50Ω OUT (HI) per calibration procedure (refer to table 5.1).	a. R97, R114 adjustments. b. Waveform symmetry, R45 adjustment and table 6-8. c. U12 circuitry.
7. Check sine amplitude vs frequency per specifications (refer to section 1).	C47, C55, C56, C57.

Table 6-5. Square Function

Indication: Square waveform problem.

Check	Corrective Procedure
1. Set controls to initial positions (refer to paragraph 6.4).	Check for normal operation.
2. Check CR10 cathode for a 4 kHz, approximately ±2V square wave.	Go to table 6-2.
3. Select a triangle function; check U13 pin 10 for a ±1.25V triangle.	Go to table 6-3.
4. Select square function; check U13 pin 10 for a ±1.25V square.	a. Q12, Q13 circuitry. b. SW14.
5. Check square wave at 50Ω OUT (HI) for the same 20V p-p (open circuit) amplitude as the triangle and sine.	R106, R110, R111.
6. Check rise/fall times of 4 MHz square (50Ω terminated) for <50 ns.	C51, C55, C56, C57.

Table 6-6. TTL Sync Output

Indication: TTL sync output problem.

Check	Corrective Procedure
1. Set controls to initial positions (refer to paragraph 6.4).	Check for normal operation.
2. Check U8 pin 1 for a TTL level, 4 kHz square.	Go to table 6-2.
3. Check U8 pin 8 for a TTL level, 4 kHz square.	a. U8. b. CR11, CR12.
4. Check SYNC OUT TTL.	E27, E28, E19 wiring.
5. Check SYNC OUT waveform at 4 MHz, using a TTL load termination or a ≥600Ω resistive termination and ≤3 foot RG58U coax.	a. U8. b. E19 ground connection.

Table 6-7. VCG Circuit

Indication: Generator does not respond correctly to dial and VCG input.

Check	If Faulty, Check
1. Set controls to initial positions (refer to paragraph 6.4).	Check for normal operation.
2. Check for approximately +15V at E11.	a. E10, E11 and E12 wiring. b. +15V supply. c. Dial potentiometer.
3. Check for 0 ±5 mV at U1 pin 13.	U1.
4. Check U1 pin 14 for approximately −5V.	U1.
5. Check that as the dial is rotated from 4.0 to .004, the voltage at U1 pin 14 varies from approximately −5 to 0V.	U1.
6. Ensure that U1 pin 5 remains at a constant 0V ±40 mV as the dial is varied.	U1, U4, and U6 circuits.
7. Check that, as the dial is rotated from .004 to 4.0, the voltage at U1 pin 1 does not saturate near −15V or +15V (typical range is between −10V and +10V) and stops varing with the dial.	Q6, U1, and U6 circuits.
8. Check that as the dial is rotated from .004 to 4.0, U6 pin 8 varies from approximately −15V to −10V.	U6, U1, and Q6 circuits.
9 Check that, as the dial is rotated from .004 to 4.0, the voltage at U1 pin 7 does not saturate near +15V or −15V (typical range is between +10V and −10V) and stops varying with the dial.	U4 and U1 circuits.
10 Check that, as the dial is rotated from .004 to 4.0, U4 pin 13 varies from approximately +15V to +10V.	U4 and U1 circuits.
11. Check for nonlinearity in the ±1.25V triangle at the emitter of Q11 near the bottom of the ×1K through ×1M ranges.	a. Associated timing capacitors or C36. b. U5, CR6. c. Q9, Q10.
12. Check frequencies of ×1K, ×10K and 100K ranges.	a. Adjust R19. b. C30, 31 and 32 (trimmed by C20).
13. Check frequency and linearity of ×1M range.	a. C34. b. C36 nominal value. c. C18, 19, 20 and 21.
14. Check frequencies of ×1, ×10 and ×100 ranges.	R86 and table 6-9.
15. Select log mode. Check that as the frequency dial is rotated from 4.0 to .0004, U3 pin 4 varies from approximately −.65V to −.45V.	a. U3. b. U1 circuit.

Table 6-8. Symmetry

Indication: Waveform symmetry problem.

Check	If Faulty, Check
1. Set controls to initial positions (refer to paragraph 6.4).	Check for normal operation.
2. If symmetry problem appears on ×1, ×10, ×100 ranges only, problem may be R90 adjustment or go to table 6-9.	
3. Perform steps 5 through 12 of table 6-7, then return to this table.	a. R49 adjustment. b. R45 adjustment.
4. Verify RUN signal at cathode CR6 is approximately +3.5V.	Go to table 6-10.
5. Verify U6 pin 4 and U6 pin 15 vary from approximately −10 to −15V as dial is rotated from 4.0 to .004.	U1, U6, R52, R53.
6. Verify amplitude of SQR signal at cathode CR10 is approximately ±2V.	a. Q7 circuit. b. U7 circuit. c. +5V supply.
7. Check U5, CR6.	

Table 6-9. Capacitance Multiplier

Indication: Problem on bottom frequency ranges only.

Check	Corrective Procedure
1. Set controls to initial positions (refer to paragraph 6.4).	Check for normal operation on ×1K range.
2. Check for 0 Vdc at U11 pins 2 and 6.	SW2 - SW4.
3. Check for approximately 0 Vdc at U11 pin 12.	U11 circuitry.
4. Check for 0 Vdc ±5 mV at U11 pin 10.	a. R90 adjustment. b. U11 circuitry.
5. Select ×100 range; check U11 pin 10 for heavy oscillations.	C46, U11.
6. Check that the signal at U11 pin 2 is amplified by approximately 6 at pin 12 (within saturation limits).	U11 circuitry.
7. Check for the same signal at U11 pins 6 and 7 as at the emitter of Q11.	SW4, U11 circuitry.
8. Ensure that R93 and R94 are shorted in the ×100 range.	SW4.

Table 6-9. Capacitance Multiplier (Continued)

Indication: Problem on bottom frequency ranges only.

Check	Corrective Procedure
9. Check 400 Hz frequency (2.0 × 100).	a. R86 adjustment. b. R89, R95, C45.
10. Check 40 Hz frequency (2.0 × 10).	R93, SW3.
11. Check 4 Hz frequency (4.0 × 1).	R94.
12. Check symmetry at 0.2 × 100; ensure triangle is linear.	a. R90 adjustment. b. U11. c. Leaky C30, C36, C45, C46, CR6, U5, Q9.

Table 6-10. Trigger Logic

Indication: Generator trigger and gate mode problems.

Check	If Faulty, Check
1. Set controls to initial positions (refer to paragraph 6.4).	Check for normal continuous operation.
2. If generator operates normally in continuous mode, go to step 7.	
3. Check for 0V at U9 pins 2 and 5.	SW9.
4. Check for a TTL low at U10 pin 10.	U9, +5V supply.
5. Check for +5V at U10 pin 9.	a. U10. b. CR6, CR15, Q8. c. U6.
6. Check for approximately +3.5V at anode CR6. Check for normal continuous mode operation.	a. CR6, U6, Q8. b. Go to table 6-2.
7. Check that U6 pin 4 and U6 pin 15 vary from approximately −10V to −15V as dial is rotated from 4.0 to .004.	a. U6, R52, R53. b. Go to table 6-7.
8. Go to gated mode (CONT depressed, TRIG/GATE released). Check U9 pin 2 for a TTL high.	a. U10. b. SW9, SW11, +5V supply.

Table 6-10. Trigger Logic (Continued)

Indication: Generator trigger and gate mode problems.

Check	Corrective Procedure
9. Check U9 pin 1 for a TTL high.	a. U9. b. R73, −5V supply.
10. Check U10 pin 10 for a TTL high.	a. U9. b. U10.
11. Check U10 pin 9 for TTL low.	a. U10. b. Q8.
12. Check anode CR6 for approximately −1.5V.	a. CR15, Q8, R78. b. CR6.
13. Check cathode CR6 for approximately −0.7V.	a. U5. b. U6.
14. Check emitter Q11 for 0 Vdc ±100 mV.	a. R81 adjustment. b. Q9 - Q11 circuitry.
15. Connect an external TTL signal to TRIG IN connector; check for the inverse of that signal at U10 pin 10.	a. E25, E26. b. CR13, CR14. c. U9, SW10.
16. Press TRIG/GATE switch and check for an approximate 20 ns negative pulse at U10 pin 10 following the low-to-high transition of the external signal (increasing the frequency of the external generator makes this pulse more visible).	a. U9, SW10. b. C29.
17. Remove the external signal and verify that U10 pin 5 goes from high to low when the MAN TRIG switch is held depressed.	a. SW11. b. U10.
18. Release the TRIG/GATE switch (gated) and check that U10 pin 10 goes from high to low when the MAN TRIG switch is pressed.	SW9.
19. Monitor 50Ω OUT, triangle function, for 0 Vdc baseline.	R81, R112 adjustments.
20. Press MAN TRIG switch and check 50Ω OUT for a continuous triangle while the switch is held. Depress TRIG/GATE switch (triggered) and verify a single cycle output each time the MAN TRIG switch is depressed.	a. U10 or clock signal to U10 from U7. b. C29 (pulse too narrow).

Table 6-11. Sweep Circuit

Indication: Sweep or Ramp problems.

Check	Corrective Procedure
1. Depress CONT (Sweep). Extend SWP/STOP. Check E48 for +4V.	a. U1. b. SW2.
2. Depress SWP/STOP. Check collector of Q3. 4V peak ramp. If ramp amplitude is >4V peak. If ramp amplitude is <4V peak.	 U1, Q3. Q1, Q2.
4. At SWP OUT check for period change of approximately 30 ms to 60s as the TIME control is rotated from full ccw to full cw.	Q2, R22.
5. At SWP OUT check for ramp period drift.	C4.
6. At E39 with STOP control full cw, ramp amplitude is 4V peak, with STOP control full ccw, ramp amplitude is 0V.	R12, SW1, SW2.

SECTION 7
PARTS AND SCHEMATICS

7.1 DRAWINGS

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

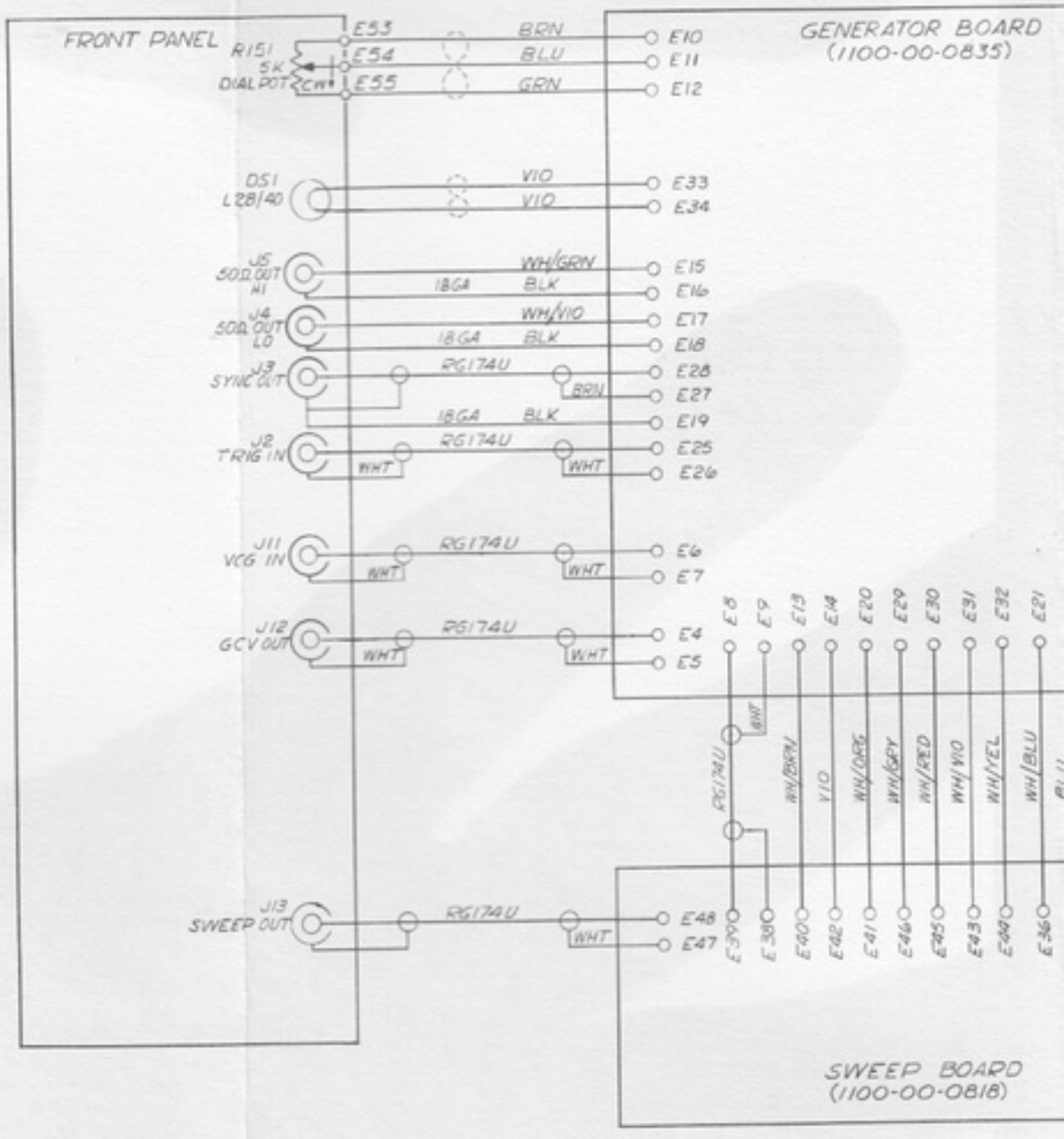
7.2 ORDERING PARTS

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

7.3 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.

Drawing	Drawing No.
Instrument Schematic	0004-00-0166
Chassis Assembly	0102-00-0837
Chassis Parts List	1101-00-0837
Generator Board Schematic	0103-00-0835
Generator Board Assembly	1100-00-0835
Generator Board Parts List	1100-00-0835
Sweep Board Schematic	0103-00-0818
Sweep Board Assembly	1100-00-0818
Sweep Board Parts List	1100-00-0818



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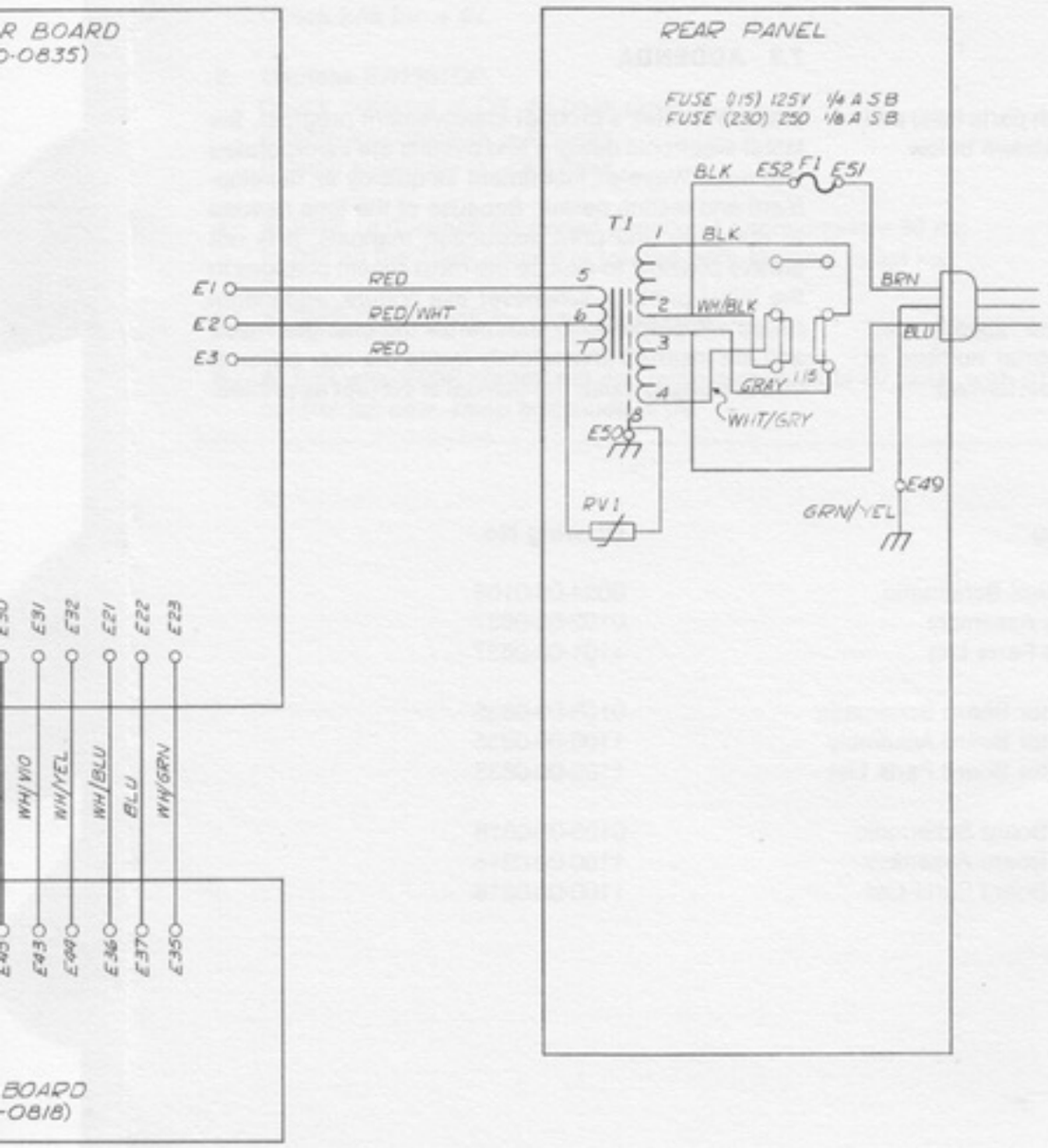
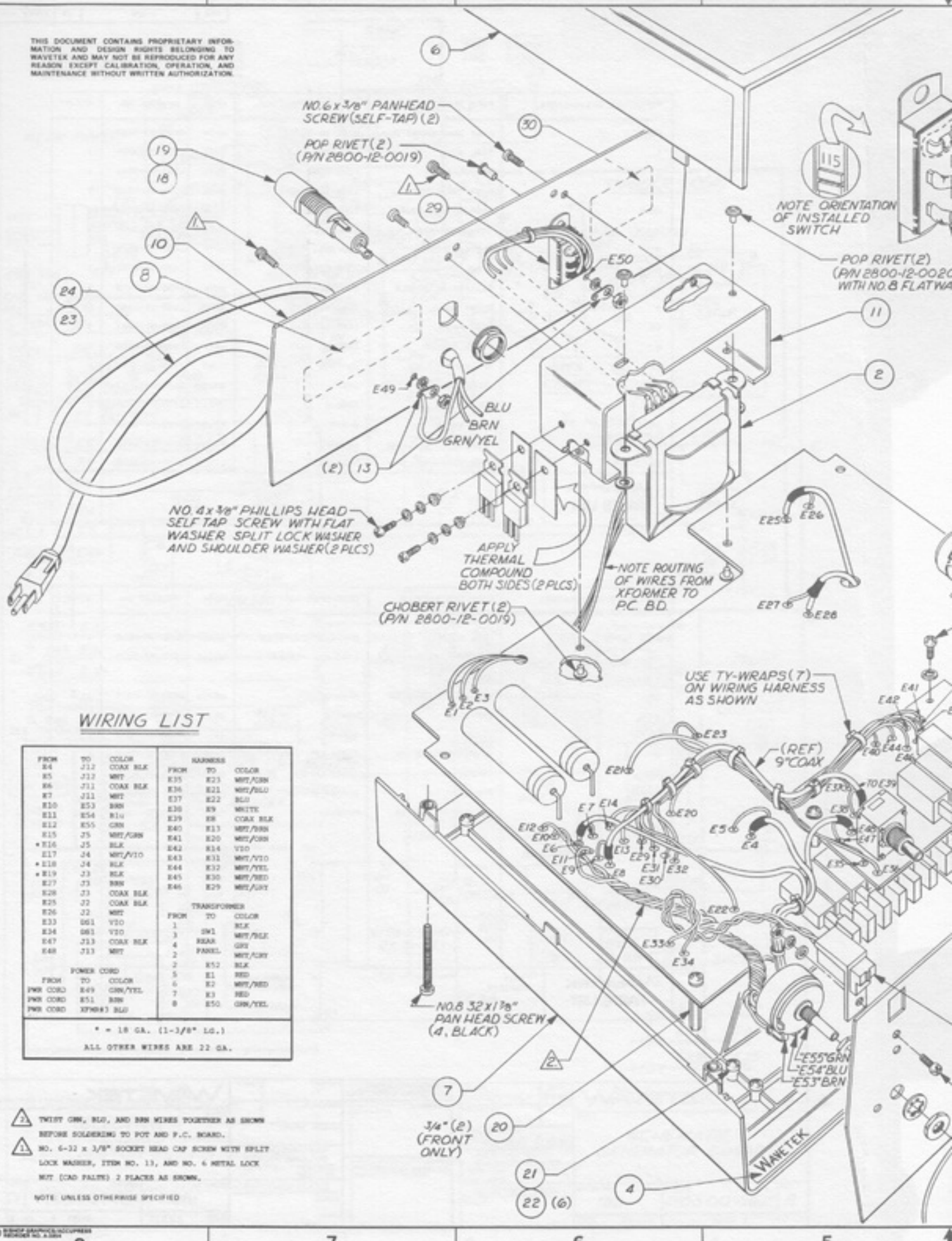


REV	ECN	BY	DATE	APP

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN RO FIFER	DATE 5-8-80	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	ENGINEER		TITLE SCHEMATIC, INSTRUMENT
FINISH WAVETEK PROCESS	RELEASE APPROVAL C. Kuida 6-10-80		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1° XX ±.030		
	DO NOT SCALE DWG		MODEL NO. 188
	SCALE		DWG NO. 0004-00-0166 REV
			CODE IDENT 23338 SHEET / OF /



WIRING LIST

FROM	TO	COLOR
E4	J12	COAX BLK
E5	J12	WHT
E6	J11	COAX BLK
E7	J11	WHT
E10	E53	BRN
E11	E54	BLU
E12	E55	GRN
E15	J5	WHT/GRN
* E16	J5	BLK
E17	J4	WHT/VIO
* E18	J4	BLK
* E19	J3	BLK
E27	J3	BRN
E28	J3	COAX BLK
E25	J2	COAX BLK
E26	J2	WHT
E33	D61	VIO
E34	D61	VIO
E47	J13	COAX BLK
E48	J13	WHT

POWER CORD

FROM	TO	COLOR
PWR CORD	E49	GRN/YEL
PWR CORD	E51	BRN
PWR CORD	XF9@#3	BLU

HARNESS

FROM	TO	COLOR
E35	E23	WHT/GRN
E36	E21	WHT/BLU
E37	E22	BLU
E38	E9	WHITE
E39	E8	COAX BLK
E40	E13	WHT/BRN
E41	E20	WHT/GRN
E42	E14	VIO
E43	E31	WHT/VIO
E44	E32	WHT/YEL
E45	E30	WHT/RED
E46	E29	WHT/GRY

TRANSFORMER

FROM	TO	COLOR
1	SW1	BLK
3	REAR PANEL	WHT/BLK
4		GRN
2		WHT/GRY
2	E52	BLK
5	E1	RED
6	E2	WHT/RED
7	E3	RED
8	E50	GRN/YEL

* = 18 GA. (1-3/8" LG.)

ALL OTHER WIRES ARE 22 GA.

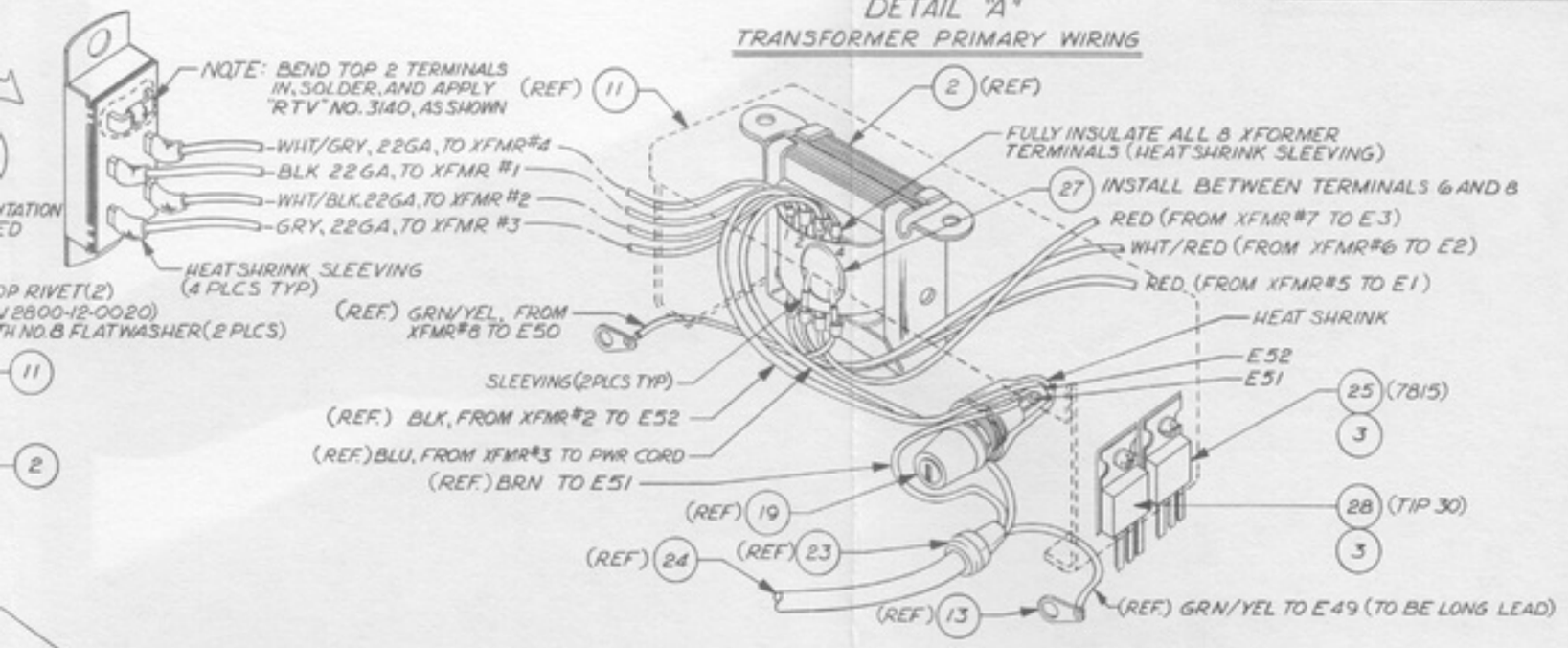
⚠2 TWIST GRN, BLU, AND BRN WIRES TOGETHER AS SHOWN BEFORE SOLDERING TO POT AND P.C. BOARD.

⚠1 NO. 6-32 x 3/8" SOCKET HEAD CAP SCREW WITH SPLIT LOCK WASHER, ITEM NO. 13, AND NO. 6 METAL LOCK NUT (CAD PALTE) 2 PLACES AS SHOWN.

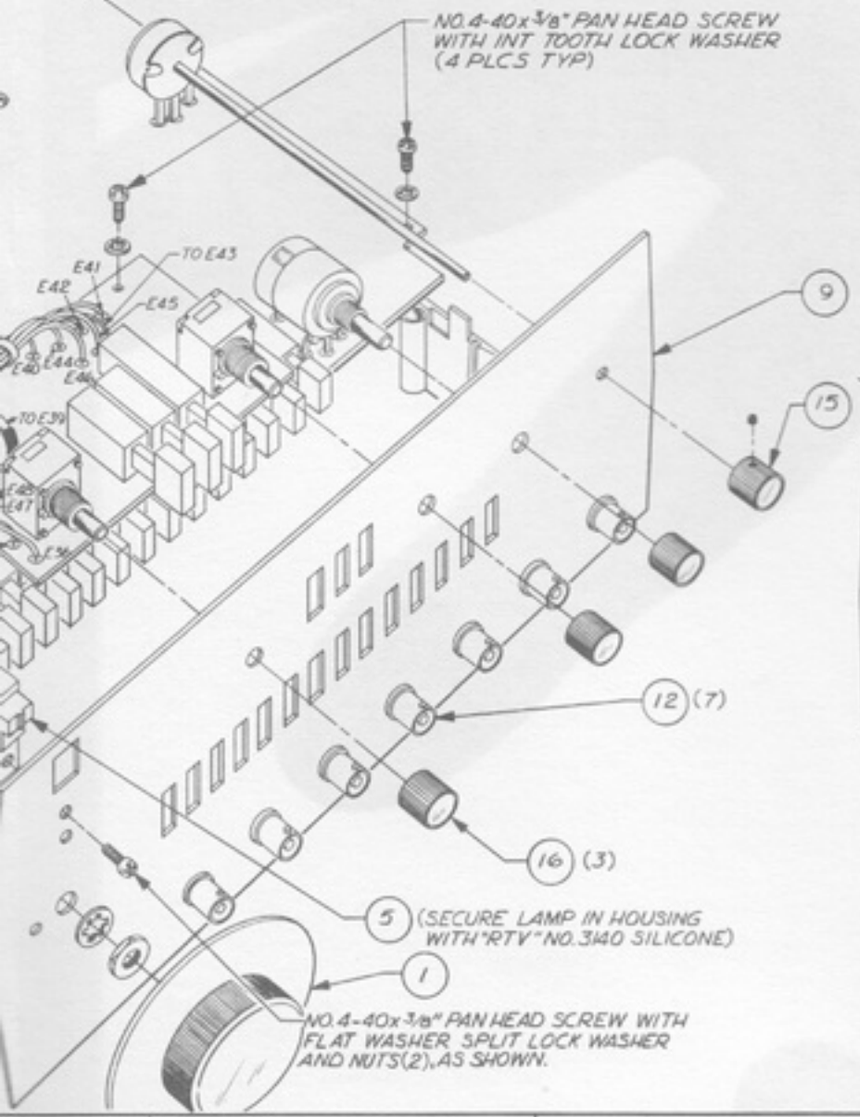
NOTE: UNLESS OTHERWISE SPECIFIED

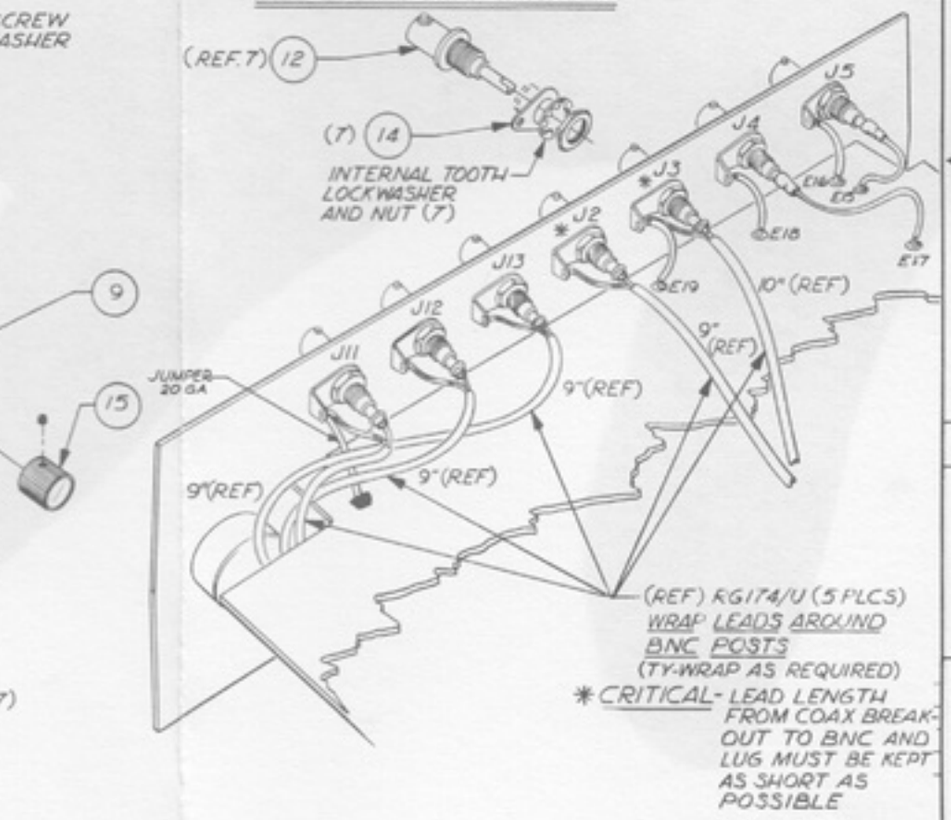
REV	ECN	BY	DATE	APP
A	#2429-CHNG ITEM 8 ADD ITEM 30	[illegible]	[illegible]	[illegible]
B	#2908	[illegible]	11/5/90	

DETAIL "A"
TRANSFORMER PRIMARY WIRING



TYP. BNC HARDWARE STACK-UP





REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN S. CHERMACK	DATE 5/5/80	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	ENGINEER		TITLE: CHASSIS ASSEMBLY
FINISH WAVETEK PROCESS	APPROVED [illegible] 6-13-80		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ±1° XX ± .030		
	DO NOT SCALE DWG		MODEL NO. 188 / DWG NO. 0102-00-0837 / REV B
	SCALE		CODE IDENT 23338 / SHEET 1 OF 1

NOTE: UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP

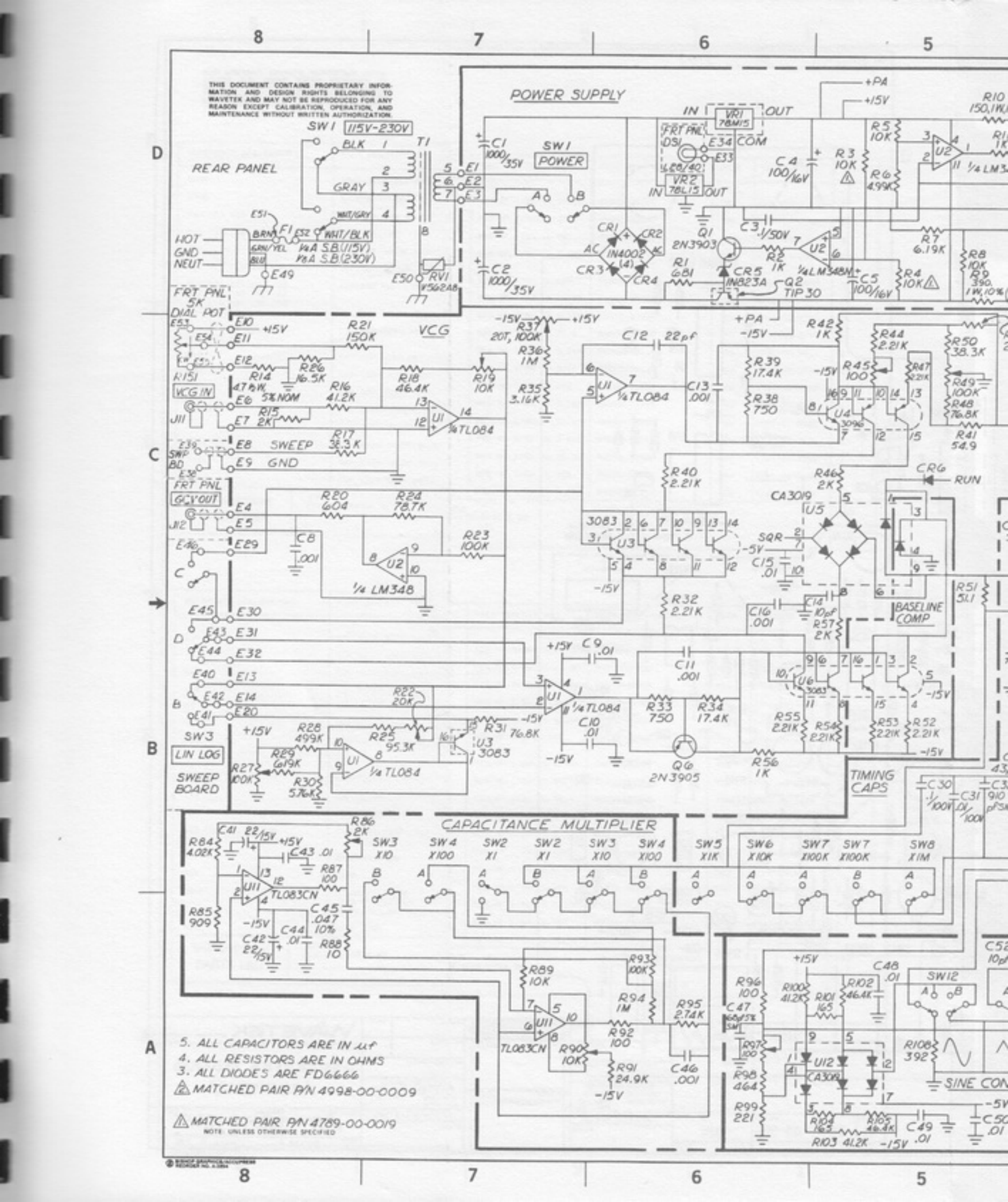
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG. CHASSIS	0102-00-0837	WVTK	0102-00-0837	1
1	DIAL ASSY	188-0029	WVTK	1201-00-0029	1
2	TRANSFORMER	182A-0041	WVTK	1204-00-0041	1
NONE	ASSY. TOP COVER	1206-00-1013	WVTK	1206-00-1013	1
NONE	ASSY. BOTTOM COVER	1206-00-1014	WVTK	1206-00-1014	1
3	INSULATOR. MICA	142-311	WVTK	1400-00-2080	2
5	INDICATOR. DIAL	180-303	WVTK	1400-00-4970	1
NONE	LABEL. WARNING	1400-00-6940	WVTK	1400-00-6940	1
11	BRACKET. AC SHIELD	1400-00-9473	WVTK	1400-00-9473	1
9	FRONT PANEL	1400-01-1440	WVTK	1400-01-1440	1
10	REAR PANEL	1400-01-1843	WVTK	1400-01-1843	1
0	LABEL. RATING	1400-01-4610	WVTK	1400-01-4610	1
12	BNC CONN	KC-7946	KING	2100-01-0002	7
14	SOLDER LUG	1497	SMITH	2100-04-0012	7
13	SOLDER LUG	1485-6	SMITH	2100-04-0028	2
15	KNOB. SMALL	0-M-9	ROGAN	2400-01-0010	1
16	KNOB. 1/4IN BUSHING	RB-67-0-M-9	ROGAN	2400-01-0017	3
18	FUSE. 1/4A. 250V. S-B	313.250	LITFU	2400-05-0008	1

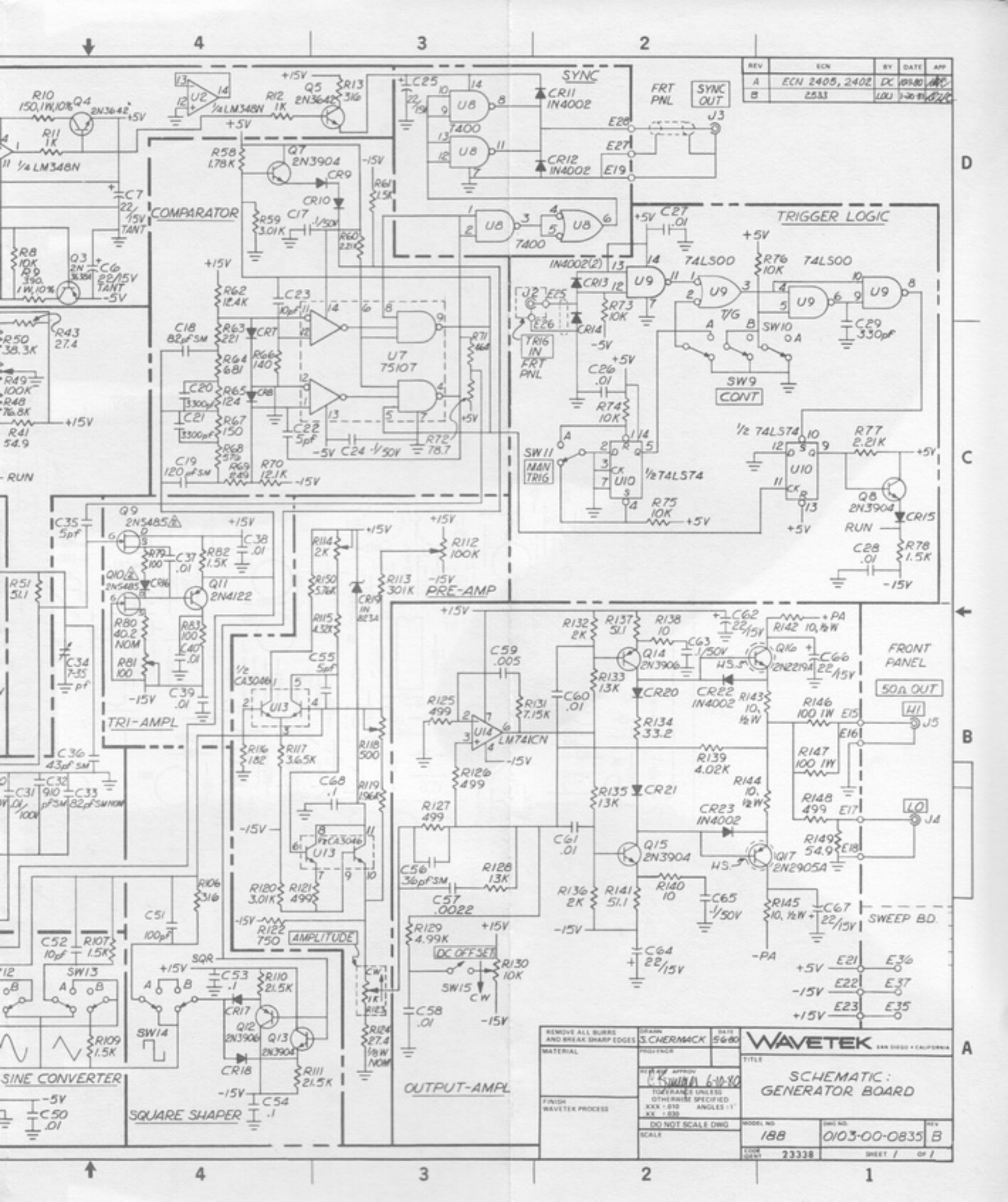
WAVETEK PARTS LIST	TITLE CHASSIS	ASSEMBLY NO. 1101-00-0837 PAGE 1	REV C

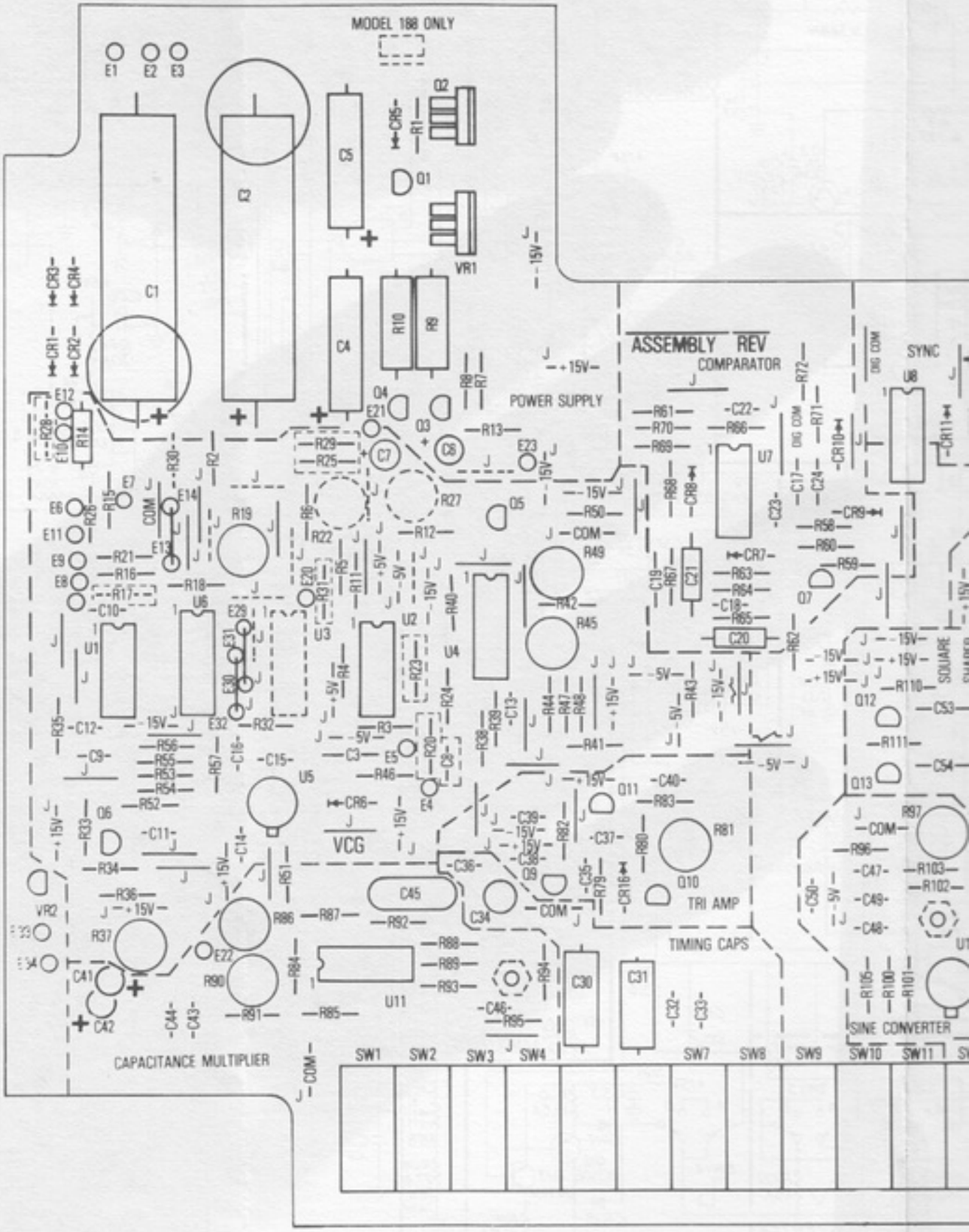
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
19	FUSE HOLD	031.1653/031.1666	SCHUR	2400-05-0012	1
20	STANDOFF. MALE/FEMALE .750 H. .250 HEX. 4-40	1443-M03-F05-440	UNICP	2800-02-0009	2
23	STRAIN RELIEF BUSH	SR6W-1	HEYCO	2800-37-0003	1
27	VARISTOR	V56ZA8	GE	4799-00-0048	1
28	TRANS	TIP-30	TI	4902-00-0300	1
29	SWITCH ASSY SLIDE	46256-LF	SWCFT	5105-00-0002	1
29A	SOLDER GUARD	46256-LF-SG	SWCFT	5105-09-0001	1
24	PWR CORD	0-7789-008-GY	PACRD	6001-80-0004	1
25	VOLTAGE REGULATOR	MC7815	MOT	7000-79-1500	1

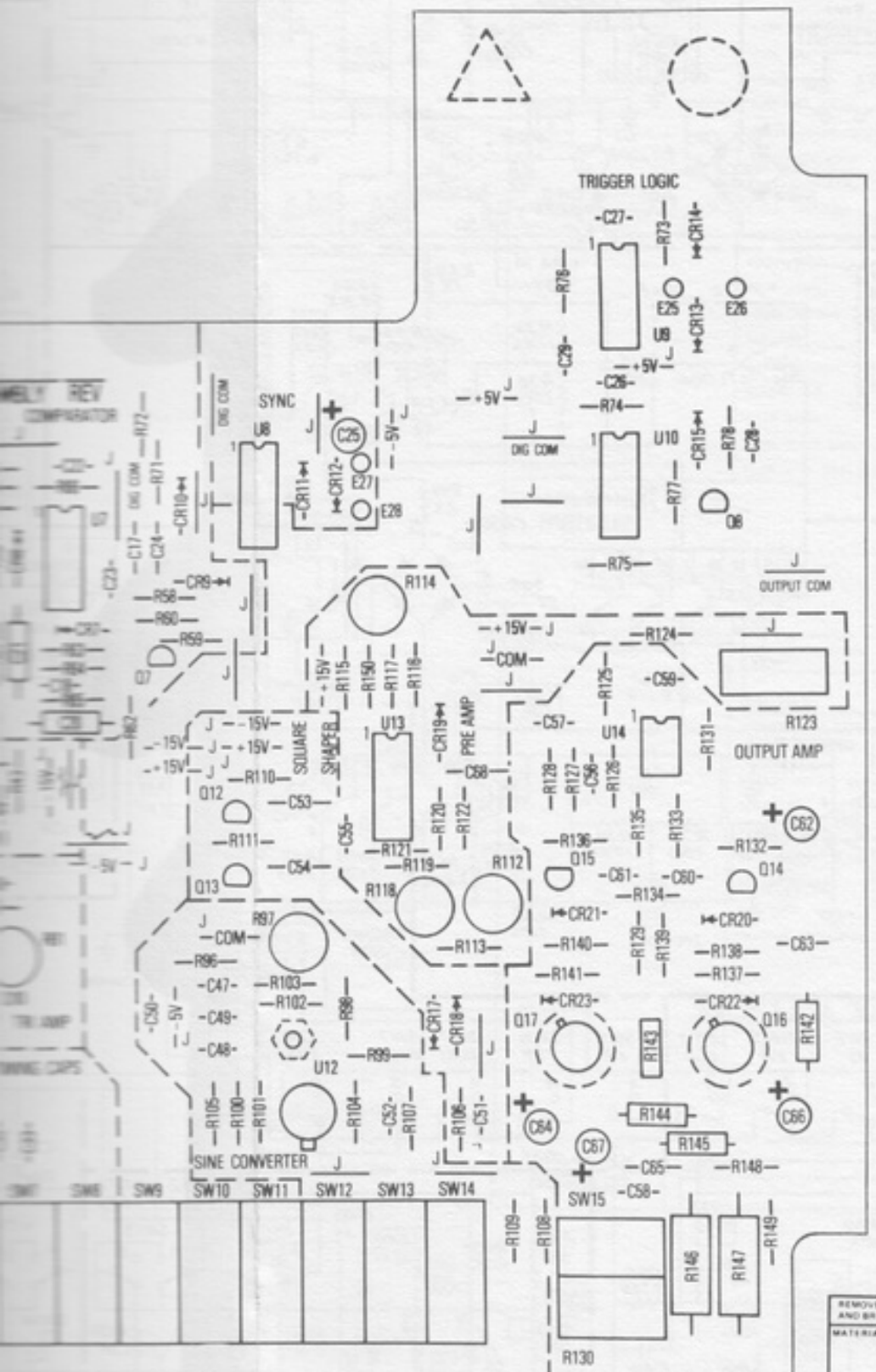
WAVETEK PARTS LIST	TITLE CHASSIS	ASSEMBLY NO. 1101-00-0837 PAGE 2	REV C

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST CHASSIS
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1° XX ±.030		MODEL NO. 188 / DWG NO. 1101-00-0837 / REV C
	DO NOT SCALE DWG		CODE IDENT 23338 / SHEET 1 OF 1
	SCALE		

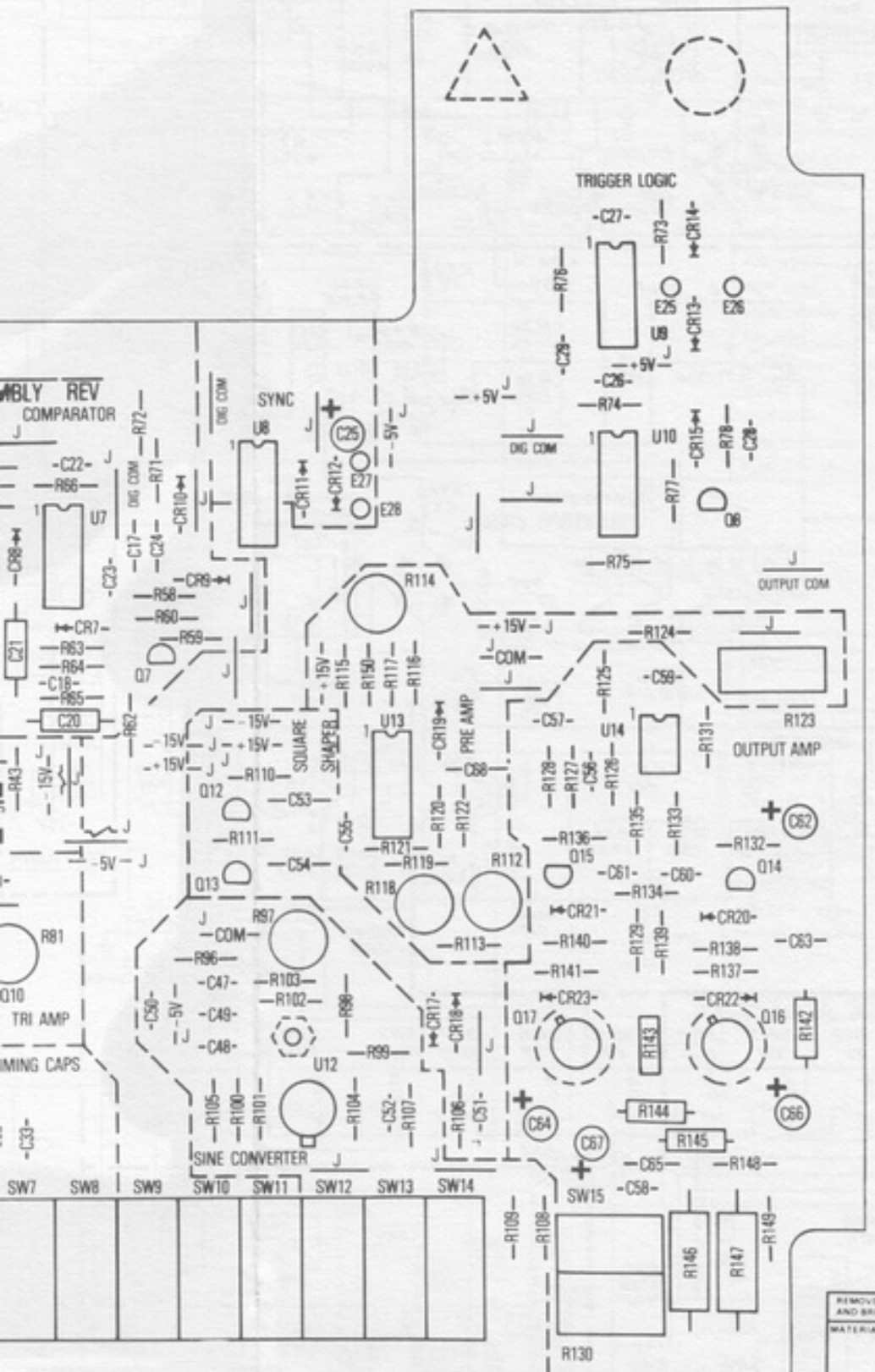

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.
POWER SUPPLY
REAR PANEL
SW1 115V-230V
T1
F1
HOT
GND
NEUT
SW1 POWER
VR1 78M15
VR2 78L15
CR1 CR2 CR3 CR4 IN4002 (4)
CR5 IN823A
Q1 2N3903
Q2 TIP 30
U2 1/4 LM348N
FRT PNL 5K DIAL POT
VCG
VCG IN
SWEEP
GND
FRT PNL GEN OUT
SWEEP BD
SW3
LIN LOG
SWEEP BOARD
U1 1/4 TL084
U2 1/4 LM348
U3 3083
U4 3096
U5 CA3019
U6 3083
Q6 2N3905
BASELINE COMP
TIMING CAPS
CAPACITANCE MULTIPLIER
U11 TL083CN
U12 CA3019
SW12
SINE CON
5. ALL CAPACITORS ARE IN uf
4. ALL RESISTORS ARE IN OHMS
3. ALL DIODES ARE FD6666
MATCHED PAIR P/N 4998-00-0009
MATCHED PAIR P/N 4789-00-0019
NOTE: UNLESS OTHERWISE SPECIFIED


SYNC
FRT PNL
SYNC OUT
J3
CR11 IN4002
CR12 IN4002
E28
E27
E19
U8
7400
COMPARATOR
TRIGGER LOGIC
74LS00
U9
T/G
SW10
SW9
CONT
SW11
MAN TRIG
TRIG IN FRT PNL
E25
E26
J2
CR13
CR14
IN4002(2)
1/2 74LS74
U10
R76 10K
R73 10K
R74 10K
R75 10K
R77 2.21K
Q8 2N3904
CR15
RUN
C27 .01
C28 .01
C29 330pf
U7 75107
Q9 2N5485
Q10 2N5485
Q11 2N4122
TRI-AMPL
PRE-AMP
CR19 IN823A
R112 100K
R113 301K
R114 2K
R115 4.32K
R116 182
R117 3.65K
R118 500
R119 196
R120 3.01K
R121 499
R122 750
AMPLITUDE
U13
1/2 CA3046
SQUARE SHAPER
SQR
SW13
SW14
CR17
CR18
Q12 2N3906
Q13 2N3904
SINE CONVERTER
R109 1.5K
R110 21.5K
R111 21.5K
OUTPUT-AMPL
DC OFFSET
SW15
R129 4.99K
R130 10K
U14 LM741CN
R125 499
R126 499
R127 499
R128 13K
R131 7.15K
R132 2K
R133 13K
R134 33.2
R135 13K
R136 2K
R137 51.1
R138 10
R139 4.02K
R140 10
R141 51.1
R142 10, ½W
R143 10, ½W
R144 10, ½W
R145 10, ½W
Q14 2N3906
Q15 2N3904
Q16 2N2219A
Q17 2N2905A
CR20
CR21
CR22 IN4002
CR23 IN4002
FRONT PANEL
50Ω OUT
HI
LO
J5
J4
E15
E16
E17
E18
R146 100 1W
R147 100 1W
R148 499
R149 54.9
SWEEP BD.
E21
E22
E23
E36
E37
E35
+PA
-PA
+5V
-5V
+15V
-15V
C59 .005
C60 .01
C61 .01
C62 22/15V
C63 .1/50V
C64 22/15V
C65 .1/50V
C66 22/15V
C67 22/15V
C68 .1
C69 .01
C51 100pf
C52 10pf
C53 .1
C54 .1
C55 5pf
C56 36pf SM
C57 .0022
C58 .01
C35 5pf
C36 43pf SM
C37 .01
C38 .01
C39 .01
C34 7-35 pf
C18 82pf SM
C19 120pf SM
C20 3300pf
C21 3300pf
C22 5pf
C23 10pf
C24 .1/50V
R10 150, 1W, 10%
R11 1K
R12 1K
R13 316
R58 1.78K
R59 3.01K
R60 2.21K
R61 1.5K
R62 12.4K
R63 221
R64 681
R65 124
R66 140
R67 150
R68 576
R69 649
R70 12.1K
R71 464
R72 78.7
R79 100
R80 40.2 NOM
R81 100
R82 1.5K
R83 100
R106 316
R107 1.5K
R108 1.5K
R124 27.4 1/8W NOM
CW1 1K
R43 27.4
R50 38.3K
R49 100K
R48 76.8K
R41 54.9
R51 51.1
C7 22/15V TANT
C6 82/15V TANT
R8 10K
R9 390, 1W, 10%
Q3 2N3638A
Q4 2N3642
Q5 2N3642
Q7 2N3904
CR9
CR10
REV
ECN
BY
DATE
APP
A
ECN 2405, 2402
DC
1-29-80
B
2533
LOU
1-30-80
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DRAWN S. CHERMACK 5-6-80
ENGINEER
APPROV 6-10-80
TOLERANCES UNLESS OTHERWISE SPECIFIED
XXX ± .010 ANGLES ± 1°
XX ± .030
DO NOT SCALE DWG
SCALE
WAVETEK SAN DIEGO, CALIFORNIA
TITLE
SCHEMATIC: GENERATOR BOARD
MODEL NO. 188
DWG NO. 0103-00-0835
REV B
CODE IDENT 23338
SHEET 1 OF 1





REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJENGR		TITLE: GENERATOR BOARD ASSEMBLY
	RELEASE APPROV		
FINISH: WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED: XXX ± .010 ANGLES ± 1; XX ± .030		
	DO NOT SCALE DWG		MODEL NO: 188 — DWG NO: 1100-00-0835 — REV
	SCALE		CODE IDENT NO: 23338 — SHEET 1 OF 1



REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJECT		TITLE: GENERATOR BOARD ASSEMBLY
	RELEASE APPROV		
FINISH: WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED: XXX ±.010 ANGLES ±1 XX ±.030		
	DO NOT SCALE DWG		MODEL NO: 188 DWG NO: 1100-00-0835 REV:
	SCALE		CODE IDENT NO: 23338 SHEET 1 OF 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG, GEN BD	0101-00-0835	WVTK	0101-00-0835	1
NONE	SCHEMATIC, GEN BD	0103-00-0835	WVTK	0103-00-0835	1
C22 C35 C55	CAP, CER, 5PF, 1KV	DD-050	CRL	1500-00-5011	3
C14 C23 C52	CAP, CER, 10PF, 1KV	DD-100	CRL	1500-01-0011	3
C51	CAP, CER, 100PF, 1KV	DD-101	CRL	1500-01-0111	1
C11 C13 C16 C46 C8	CAP, CER, .001MF, 1KV	DD-102	ARCO	1500-01-0211	5
C10 C15 C26 C27 C28 C37 C38 C39 C40 C40 C44 C48 C49 C50 C58 C60 C61 C9	CAP, CER, MN, .01MF, 50V	CAC02Z5U103Z100A	CORNG	1500-01-0310	18
C17 C24 C3 C53 C54 C63 C65 C68	CAP, CER, MON, .1MF, 50V	CAC03ZU104Z050A	CORNG	1500-01-0409	8
C12	CAP, CER, 22PF, 1KV	DD-220	ARCO	1500-02-2011	1
C57	CAP, CER, .0022, 1KV	DD-222 LONG LEAD	CRL	1500-02-2201	1
C29	CAP, CER, 330PF, 1KV	DD-331	ARCO	1500-03-3111	1
C20 C21	CAP, C, MN, 3300PF, 50V	1801X7R050A332J	VRDYN	1500-03-3205	2
C59	CAP, CER, .005MF, 50V	CK-502	CRL	1500-05-0210	1
C33T	CAP, MICA, 100PF, 500V	DM15-101J	ARCO	1500-11-0100	1
C19	CAP, MICA, 120PF, 500V	DM15-121J	ARCO	1500-11-2100	1
C56	CAP, MICA, 36PF, 500V	DM15-360J	ARCO	1500-13-6000	1

WAVETEK PARTS LIST	TITLE PCA, GENERATOR BD	ASSEMBLY NO. 1100-00-0835 PAGE: 1	REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG
NONE	TRANSIPAD	10160
R45 R81 R97	POT, TRIM, 100	91AR100
R19 R90	POT, TRIM, 10K	91AR10K
R112 R27 R49	POT, TRIM, 100K	91AR100K
R114 R86	POT, TRIM, 2K	91AR2K
R22	POT, TRIM, 20K	91AR20K
R118	POT, TRIM, 500	91AR500
R130	POT, SWITCH, 10K	GH-1879
R123	POT, CONT, 1K FROM: 4600-01-0207	4609-71-1
R37	POT, TRIM, 20T, 100K	6BWR100K
R142 R143 R144 R145	RES, C, 1/2W, 5%, 10	RC20GF-1
R14	RES, C, 1/2W, 5%, 4.7	RC20GF-4
R10	RES, C, 1W, 10%, 150	RC32GF15
R9	RES, C, 1W, 10%, 390	RC32GF39
R79 R83 R87 R92 R96	RES, MF, 1/8W, 1%, 100	RN55D-10
R11 R12 R2 R42 R56	RES, MF, 1/8W, 1%, 1K	RN55D-10
R5 R73 R74 R75 R76 R8	RES, MF, 1/8W, 1%, 10K	RN55D-10

WAVETEK PARTS LIST	TITLE PCA, GENERATOR BD

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C36	CAP, MICA, 43PF, 500V	DM15-430J	ARCO	1500-14-3000	1
C47	CAP, MICA, 68PF, 500V	DM15-680J	ARCO	1500-16-8000	1
C18	CAP, MICA, 82PF, 500V	DM15-820J	ARCO	1500-18-2000	1
C32	CAP, 910PF, 100V, 1%	DM15-911F	ARCO	1500-19-1101	1
C4 C5	CAP, ELECT, 100MF, 16V	500D1079016DC7	SPRAG	1500-31-0101	2
C1 C2	CAP, ELECT, 1000MF, 35V	39D10890350L6	SPRAG	1500-31-0212	2
C31	CAP, POLYC, .01MF, 100V TTT TTT	PA28103F	ELCUS	1500-41-0304	1
C30	CAP, POLYC, .1MF, 100V	PA28104F	ELCUS	1500-41-0404	1
C45	CAP, MYLAR, .047MF100V	225P47391WD3	SPRAG	1500-44-7314	1
C34	VAR1, 7-35PF, 250V	7S-TRIKO-02 7/35 PF	TRIKO	1500-53-5000	1
C25 C41 C42 C6 C62 C64 C66 C67 C7	CAP, TANT, 22MF, 15V	196D226X9015KA1	SPRAG	1500-72-2601	9
1	GENERATOR BD	1700-00-0817	WVTK	1700-00-0817	1
DS*	LAMP	L28/40	MURA	2400-02-0017	1
NONE	STANDOFF, SWAGE .875 H, .250 HEX 4-40, .062 MAT'L	6926-7/8-2C	LYNTR	2800-05-0003	2
NONE	HEAT SINK	NF-207	WAKE	2800-11-0001	2

WAVETEK PARTS LIST	TITLE PCA, GENERATOR BD	ASSEMBLY NO. *100-00-0835 PAGE: 2	REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR
R89		
R23 R93	RES, MF, 1/8W, 1%, 100K	RN55D-100
R138 R140 R88	RES, MF, 1/8W, 1%, 10	RN55D-10
R70	RES, MF, 1/8W, 1%, 12.1K	RN55D-121
R65	RES, MF, 1/8W, 1%, 124	RN55D-124
R62	RES, MF, 1/8W, 1%, 12.4K	RN55D-124
R120 R133 R135	RES, MF, 1/8W, 1%, 13K	RN55D-130
R66	RES, MF, 1/8W, 1%, 140	RN55D-140
R67	RES, MF, 1/8W, 1%, 150	RN55D-150
R107 R109 R61 R78 R82	RES, MF, 1/8W, 1%, 1.5K	RN55D-150
R21	RES, MF, 1/8W, 1%, 150K	RN55D-150
R101 R104	RES, MF, 1/8W, 1%, 165	RN55D-165
R26	RES, MF, 1/8W, 1%, 16.5K	RN55D-165
R34 R39	RES, MF, 1/8W, 1%, 17.4K	RN55D-174
R58	RES, MF, 1/8W, 1%, 1.78K	RN55D-178
R116	RES, MF, 1/8W, 1%, 182	RN55D-182
R119	RES, MF, 1/8W, 1%, 1.96K	RN55D-196
R132 R136 R15 R46 R57	RES, MF, 1/8W, 1%, 2K	RN55D-200

WAVETEK PARTS LIST	TITLE PCA, GENERATOR BD

NOTE: UNLESS OTHERWISE SPECIFIED

REV	ECN	BY	DATE	APP

ESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
PAD	10160	METRS	2800-11-0004	2
IM. 100	91AR100	BECK	4600-01-0103	3
IM. 10K	91AR10K	BECK	4600-01-0315	2
IM. 100K	91AR100K	BECK	4600-01-0402	3
IM. 2K	91AR2K	BECK	4600-02-0201	2
IM. 20K	91AR20K	BECK	4600-02-0301	1
IM. 500	91AR500	BECK	4600-05-0104	1
ITCH. 10K	GH-1879	CTS	4602-01-0300	1
NT. 1K 600-01-0207	4609-71-0201	WVTK	4609-71-0201	1
IM. 20T. 100K	6BWR100K	BECK	4609-90-0001	1
1/2W. 5%. 10	RC20GF-100	STKPL	4700-25-0100	4
1/2W. 5%. 4.7	RC20GF-4R7	STKPL	4700-25-0479	1
W. 10%. 150	RC32GF151K	AB	4700-36-1500	1
W. 10%. 390	RC32GF391K	AB	4700-36-3900	1
1/8W. 1%. 100	RN55D-1000F	TRW	4701-03-1000	5
1/8W. 1%. 1K	RN55D-1001F	TRW	4701-03-1001	5
1/8W. 1%. 10K	RN55D-1002F	TRW	4701-03-1002	7

R BD	ASSEMBLY NO. 1100-00-0835 PAGE: 3	REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R110 R111	RES. MF. 1/8W. 1%. 21.5K	RN55D-2152F	TRW	4701-03-2152	2
R124T	RES. MF. 1/8W. 1%. 21.5	RN55D-21R5F	TRW	4701-03-2159	1
R63 R99	RES. MF. 1/8W. 1%. 221	RN55D-2210F	TRW	4701-03-2210	2
R32 R40 R44 R47 R52 R53 R54 R55 R60 R77	RES. MF. 1/8W. 1%. 2.21K	RN55D-2211F	TRW	4701-03-2211	10
R69	RES. MF. 1/8W. 1%. 249	RN55D-2490F	TRW	4701-03-2490	1
R91	RES. MF. 1/8W. 1%. 24.9K	RN55D-2492F	TRW	4701-03-2492	1
R95	RES. MF. 1/8W. 1%. 2.74K	RN55D-2741F	TRW	4701-03-2741	1
R43	RES. MF. 1/8W. 1%. 27.4	RN55D-27R4F	TRW	4701-03-2749	1
R120 R59	RES. MF. 1/8W. 1%. 3.01K	RN55D-3011F	TRW	4701-03-3011	2
R113	RES. MF. 1/8W. 1%. 301K	RN55D-3013F	TRW	4701-03-3013	1
R106 R13	RES. MF. 1/8W. 1%. 316	RN55D-3160F	TRW	4701-03-3160	2
R35	RES. MF. 1/8W. 1%. 3.16K	RN55D-3161F	TRW	4701-03-3161	1
R134	RES. MF. 1/8W. 1%. 33.2	RN55D-33R2F	TRW	4701-03-3329	1
R117	RES. MF. 1/8W. 1%. 3.65K	RN55D-3651F	TRW	4701-03-3651	1
R17 R50	RES. MF. 1/8W. 1%. 38.3K	RN55D-3832F	TRW	4701-03-3832	2
R108	RES. MF. 1/8W. 1%. 392	RN55D-3920F	TRW	4701-03-3920	1
R139 R84	RES. MF. 1/8W. 1%. 4.02K	RN55D-4021F	TRW	4701-03-4021	2

WAVETEK PARTS LIST	TITLE PCA. GENERATOR BD	ASSEMBLY NO. 1100-00-0835 PAGE: 5	REV D

SCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
1/8W. 1%. 100K	RN55D-1003F	TRW	4701-03-1003	2
1/8W. 1%. 10	RN55D-10R0F	TRW	4701-03-1009	3
1/8W. 1%. 12.1K	RN55D-1212F	TRW	4701-03-1212	1
1/8W. 1%. 124	RN55D-1240F	TRW	4701-03-1240	1
1/8W. 1%. 12.4K	RN55D-1242F	TRW	4701-03-1242	1
1/8W. 1%. 13K	RN55D-1302F	TRW	4701-03-1302	3
1/8W. 1%. 140	RN55D-1400F	TRW	4701-03-1400	1
1/8W. 1%. 150	RN55D-1500F	TRW	4701-03-1500	1
1/8W. 1%. 1.5K	RN55D-1501F	TRW	4701-03-1501	5
1/8W. 1%. 150K	RN55D-1503F	TRW	4701-03-1503	1
1/8W. 1%. 165	RN55D-1650F	TRW	4701-03-1650	2
1/8W. 1%. 16.5K	RN55D-1652F	TRW	4701-03-1652	1
1/8W. 1%. 17.4K	RN55D-1742F	TRW	4701-03-1742	2
1/8W. 1%. 1.78K	RN55D-1781F	TRW	4701-03-1781	1
1/8W. 1%. 182	RN55D-1820F	TRW	4701-03-1820	1
1/8W. 1%. 1.96K	RN55D-1961F	TRW	4701-03-1961	1
1/8W. 1%. 2K	RN55D-2001F	TRW	4701-03-2001	5

BD	ASSEMBLY NO. 1100-00-0835 PAGE: 4	REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R80	RES. MF. 1/8W. 1%. 40.2	RN55D-40R2F	TRW	4701-03-4029	1
R100 R103 R16	RES. MF. 1/8W. 1%. 41.2K	RN55D-4122F	TRW	4701-03-4122	3
R115	RES. MF. 1/8W. 1%. 4.32K	RN55D-4321F	TRW	4701-03-4321	1
R71 R98	RES. MF. 1/8W. 1%. 464	RN55D-4640F	TRW	4701-03-4640	2
R102 R105 R18	RES. MF. 1/8W. 1%. 46.4K	RN55D-4642F	TRW	4701-03-4642	3
R121 R125 R126 R127 R140	RES. MF. 1/8. 1%. 499	RN55D-4990F	TRW	4701-03-4990	5
R129 R6	RES. MF. 1/8W. 1%. 4.99K	RN55D-4991F	TRW	4701-03-4991	2
R137 R141 R51	RES. MF. 1/8W. 1%. 51.1	RN55D-51R1F	TRW	4701-03-5119	3
R149 R41	RES. MF. 1/8W. 1%. 54.9	RN55D-54R9F	TRW	4701-03-5499	2
R60	RES. MF. 1/8W. 1%. 576	RN55D-5760F	TRW	4701-03-5760	1
R150 R30	RES. MF. 1/8W. 1%. 5.76K	RN55D-5761F	TRW	4701-03-5761	2
R20	RES. MF. 1/8W. 1%. 604	RN55D-6040F	TRW	4701-03-6040	1
R7	RES. MF. 1/8W. 1%. 6.19K	RN55D-6191F	TRW	4701-03-6191	1
R1 R64	RES. MF. 1/8W. 1%. 681	RN55D-6810F	TRW	4701-03-6810	2
R131	RES. MF. 1/8W. 1%. 7.15K	RN55D-7151F	TRW	4701-03-7151	1
R122 R33 R38	RES. MF. 1/8W. 1%. 750	RN55D-7500F	TRW	4701-03-7500	3
R31 R48	RES. MF. 1/8W. 1%. 76.8K	RN55D-7682F	TRW	4701-03-7682	2

WAVETEK PARTS LIST	TITLE PCA. GENERATOR BD	ASSEMBLY NO. 1100-00-0835 PAGE: 6	REV D

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST GENERATOR BD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030		
	DO NOT SCALE DWG		MODEL NO. 188 DWG NO. 1100-00-0835 REV D
	SCALE		CODE IDENT 22238 SHEET 1 OF 8

REV	ECN	BY	DATE	APP

ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
RN55D-7872F	TRW	4701-03-7872	1
RN55D-7879F	TRW	4701-03-7879	1
RN55D-9090F	TRW	4701-03-9090	1
RN55D-9532F	TRW	4701-03-9532	1
RN60D-1004F	TRW	4701-13-1004	2
RN60D-4993F	TRW	4701-13-4993	1
RN60D-6193F	TRW	4701-13-6193	1
RN70D-1000F	TRW	4701-33-1000	2
142-501-64A	WVTK	4789-00-0019	1
1N823A	NPC	4801-01-0823	2
3CE-1	SEMT	4801-02-0001	10
FD-6666	FAIR	4807-02-6666	11
2N2219A	NSC	4901-02-2191	1
2N2905A	NSC	4901-02-9051	1
2N3638A	CARTR	4901-03-6381	1

	ASSEMBLY NO. 1100-00-0835 PAGE 7	REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
U7	IC	SN75107AN	TI	7007-51-0700	1
U8	IC	7400	TI	8000-74-0000	1
U9	IC	74LS00	TI	8000-74-0010	1
U10	IC	74LS74	TI	8000-74-7410	1

WAVETEK PARTS LIST	TITLE PCA GENERATOR BD	ASSEMBLY NO. 1100-00-0835 PAGE 9	REV D

ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
2N3642	FAIR	4901-03-6420	2
2N3903	NSC	4901-03-9030	1
2N3904	FAIR	4901-03-9040	4
2N3905	ITT	4901-03-9050	1
2N3906	FAIR	4901-03-9060	2
2N4122	NSC	4901-04-1220	1
142-501-53	WVTK	4998-00-0009	1
5103-00-0026	WVTK	5103-00-0026	1
TL083CN	TI	7000-00-8300	1
TL084CN	TI	7000-00-8400	1
LM348N	NSC	7000-03-4800	1
MA-741	FAIR	7000-07-4100	1
CA-3019	FAIR	7000-30-1900	2
CA-3046	RCA	7000-30-4600	1
CA3083	FAIR	7000-30-8300	2
CA-3096AE	RCA	7000-30-9600	1
78L15	TI	7000-78-1501	1

	ASSEMBLY NO. 1100-00-0835 PAGE 8	REV D

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST GENERATOR BD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1° XX ±.030		
	DO NOT SCALE DWG		MODEL NO. 188 / DWG NO. 1100-00-0835 / REV D
	SCALE		CODE IDENT 23338 / SHEET 2 OF 2

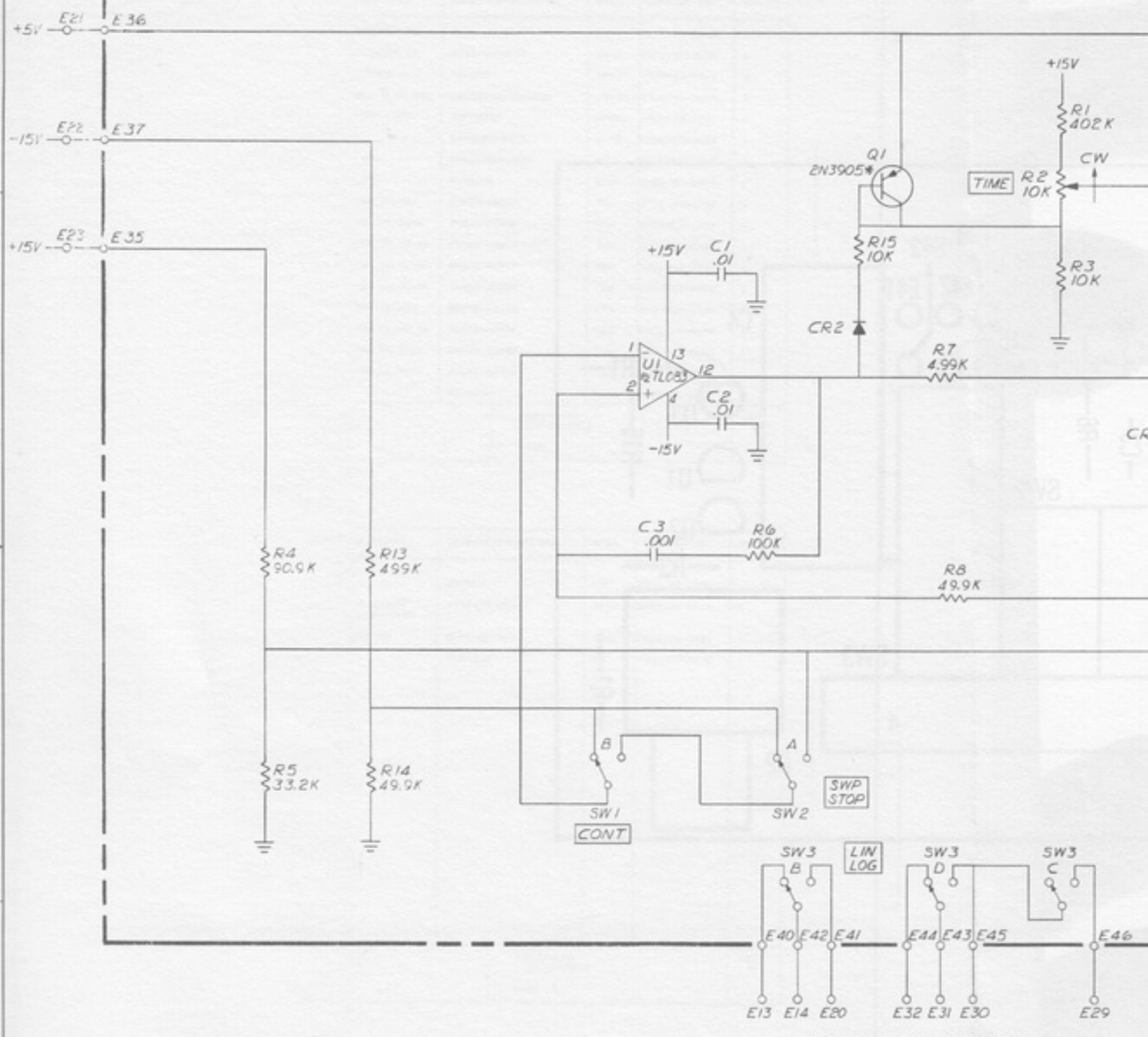
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO
R24	RES. MF. 1/8W. 1%. 78.7K	RN55D-7872F
R72	RES. MF. 1/8W. 1%. 78.7	RN55D-78R7F
R85	RES. MF. 1/8W. 1%. 909	RN55D-9090F
R25	RES. MF. 1/8W. 1%. 95.3K	RN55D-9532F
R36 R94	RES. MF. 1/4W. 1%. 1M	RN60D-1004F
R28	RES. MF. 1/4W. 1%. 499K	RN60D-4993F
R29	RES. MF. 1/4W. 1%. 619K	RN60D-6193F
R146 R147	RES. MF. 1W. 1%. 100	RN70D-1000F
R3 R4	RES. SET. 2-10K. 1/8W QTY: 2: 4701-03-1002	142-501-64A
CR19 CR5	DIODE. ZENER 6.2V	1N823A
CR1 CR11 CR12 CR13 CR14 CR2 CR22 CR23 CR3 CR4	DIODE	SCE-1
CR10 CR15 CR16 CR17 CR18 CR20 CR21 CR6 CR7 CR8 CR9	DIODE	FD-6666
Q16	TRANS	2N2219A
Q17	TRANS	2N2905A
Q3	TRANS	2N3638A

WAVETEK PARTS LIST | TITLE PCA. GENERATOR 8D | ASSEMBLY NO 1100-00- | PAGE 7

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO
Q4 Q5	TRANS	2N3642
Q1	TRANS	2N3903
Q13 Q15 Q7 Q8	TRANS	2N3904
Q6	TRANS	2N3905
Q12 Q14	TRANS	2N3906
Q11	TRANS	2N4122
Q10 Q9	TRANS. M/PR. 2N5405 QTY: 2: 4901-05-4850	142-501-53
S	SWITCH ASSY PB	5103-00-0026
U11	IC	TL083CN
U1	IC	TL084CN
U2	IC	LM340N
U14	IC	MA-741
U12 U5	IC	CA-3019
U13	IC	CA-3046
U3 U6	IC	CA3083
U4	IC	CA-3096AE
VR2	IC	78L15

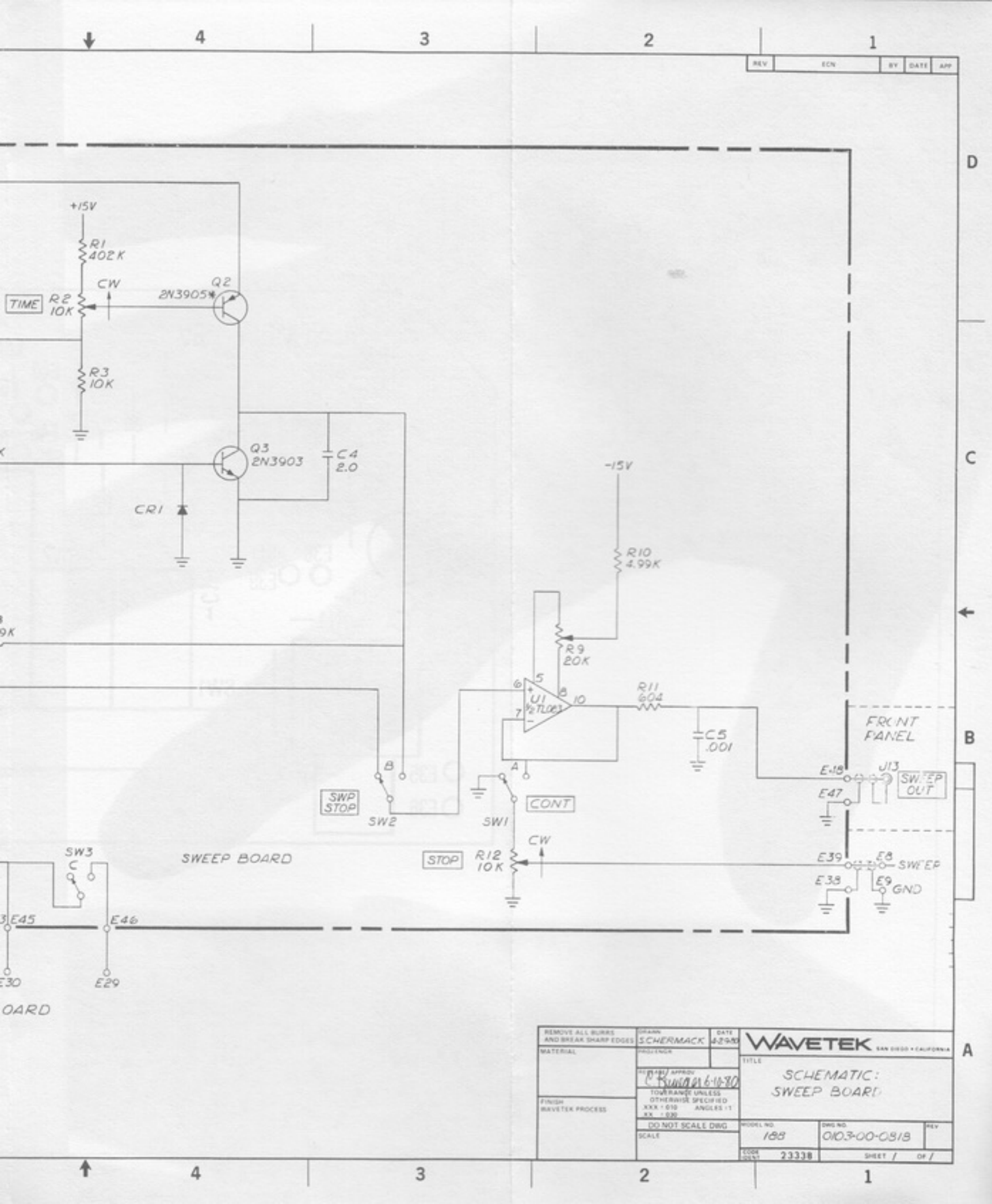
WAVETEK PARTS LIST | TITLE PCA. GENERATOR 8D | ASSEMBLY NO 1100-00- | PAGE 8

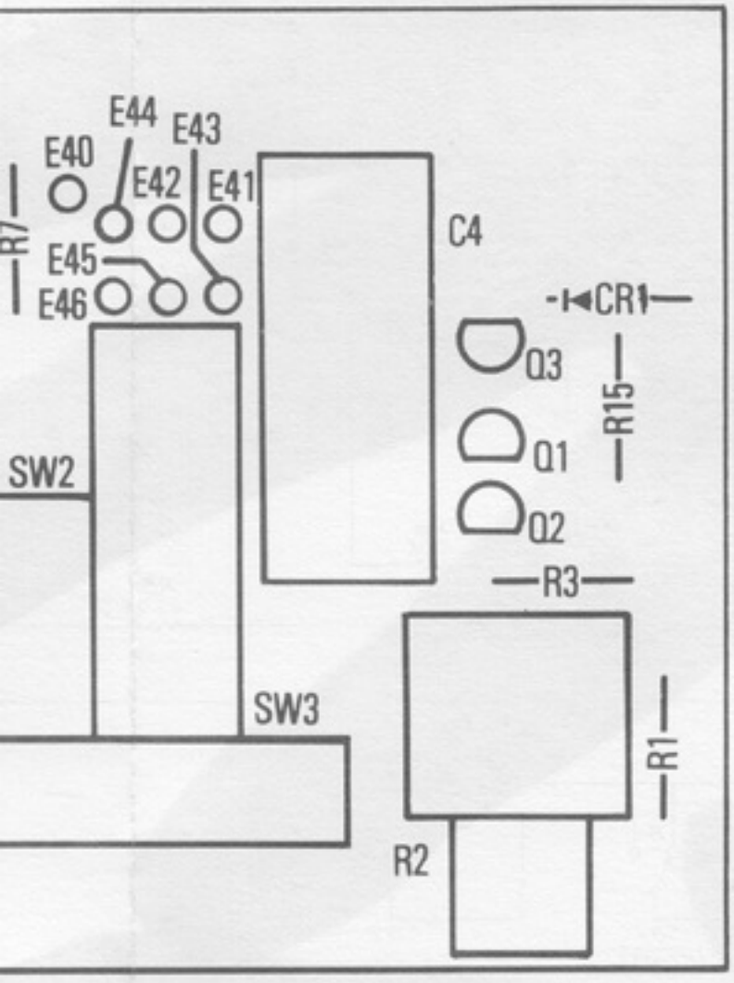
NOTE: UNLESS OTHERWISE SPECIFIED



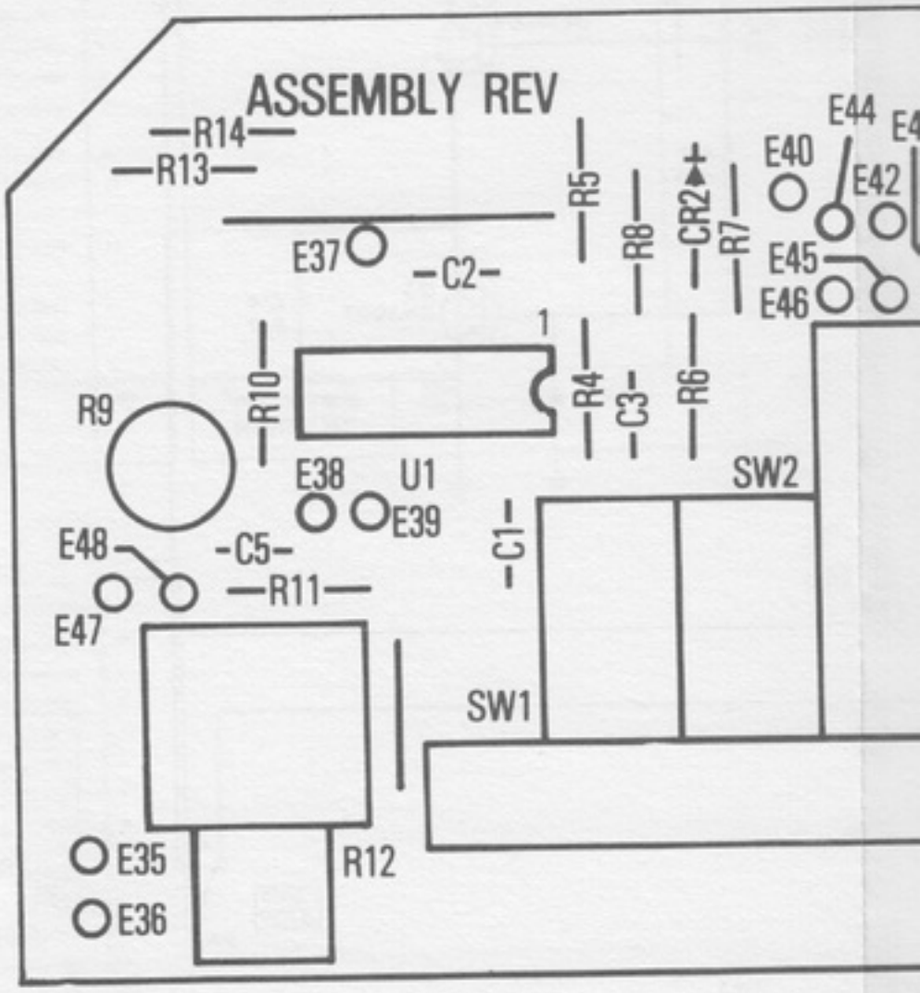
GENERATOR BOARD

6. SWITCHES SHOWN IN "CONT", "STOP", AND "LIN" MODE
5. * = MATCHED PAIR P/N 4998-00-0049
4. LAST REF DES'S USED:
   R15, C5, CR2, Q3, SW3, E48
3. ALL CAPACITORS ARE IN μf
2. ALL RESISTORS ARE IN OHMS
1. ALL DIODES ARE FD666
NOTE: UNLESS OTHERWISE SPECIFIED


+15V
R1
402K
TIME
R2
10K
CW
Q2
2N3905
R3
10K
Q3
2N3903
C4
2.0
CR1
-15V
R10
4.99K
R9
20K
U1
1/2 TL083
R11
604
C5
.001
FRONT
PANEL
E-18
J13
SWEEP
OUT
E47
SWP
STOP
SW2
SW1
CONT
CW
STOP
R12
10K
E39
E8
SWEEP
E38
E9
GND
SW3
SWEEP BOARD
E45
E46
E30
E29
OARD
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH
WAVETEK PROCESS
DRAWN
SCHERMACK
DATE
4-29-80
TOLERANCE UNLESS OTHERWISE SPECIFIED
XXX ± 010 ANGLES ± 1
XX ± 030
DO NOT SCALE DWG
SCALE
WAVETEK SAN DIEGO, CALIFORNIA
TITLE
SCHEMATIC:
SWEEP BOARD
MODEL NO.
188
DWG NO.
0103-00-0918
REV
CODE IDENT
23338
SHEET 1 OF 1



REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: SWEEP BOARD ASSEMBLY
	RELEASE APPROV		
FINISH: WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED: XXX ± .010 ANGLES ± XX ± .030		
	DO NOT SCALE DWG		MODEL NO: 188 / DWG NO: 1100-00-0818 / REV
	SCALE		CODE IDENT NO: 23338 / SHEET 1 OF 1



REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG. SWEEP BD	0101-00-0818	WVTK	0101-00-0818	1
NONE	SCHEMATIC. SWEEP BD	0103-00-0818	WVTK	0103-00-0818	1
C3 C5	CAP. CER., 001MF. 1KV	DD-102	ARCO	1500-01-0211	2
C1 C2	CAP. CER. MN., 01MF. 50V	CAC0225U103Z100A	CORNG	1500-01-0310	2
C4	CAP. MYLR. 2MF. 200V	2MFW205K	AMRAD	1500-42-0504	1
NONE	SWEEP BD	1700-00-0818	WVTK	1700-00-0818	1
R12 R2	POT. CONT. 10K	72MIN05A5103U	AB	4400-01-0322	2
R9	POT. TRIM, 20K	91AR20K	BECK	4400-02-0301	1
R15 R3	RES. MF. 1/8W. 1%. 10K	RN55D-1002F	TRW	4701-03-1002	2
R6	RES. MF. 1/8W. 1%. 100K	RN55D-1003F	TRW	4701-03-1003	1
R5	RES. MF. 1/8W. 1%. 33.2K	RN55D-3322F	TRW	4701-03-3322	1
R10 R7	RES. MF. 1/8W. 1%. 4.99K	RN55D-4991F	TRW	4701-03-4991	2
R14 R8	RES. MF. 1/8W. 1%. 49.9K	RN55D-4992F	TRW	4701-03-4992	2
R11	RES. MF. 1/8W. 1%. 604	RN55D-6040F	TRW	4701-03-6040	1
R4	RES. MF. 1/8W. 1%. 90.9K	RN55D-9092F	TRW	4701-03-9092	1
R1	RES. MF. 1/4W. 1%. 402K	RN60D-4023F	TRW	4701-03-4023	1
R13	RES. MF. 1/4W. 1%. 499K	RN60D-4993F	TRW	4701-03-4993	1
CR1 CR2	DIODE	FD-6000	FAIRI	4601-03-0001	2

WAVETEK PARTS LIST

TITLE
PCA. SWEEP BD

1100-00-0818

REV
B

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q3	TRANS	2N3905	MOT	4901-03-9030	1
Q1 Q2	TRANS. M/PR. 2N3905 QTY: 2 4901-03-9050	4998-00-0049	WVTK	4998-00-0049	1
NONE	SWITCH ASSY PB	7103-00-0020	WVTK	7103-00-0020	1
U1	IC	TL082CN	TI	7000-00-8200	1

WAVETEK PARTS LIST

TITLE
PCA. SWEEP BD

1100-00-0818

REV
B

PAGE 2

WAVETEK SAN DIEGO • CALIFORNIA

PARTS LIST
SWEEP BD

MODEL NO.	DWG NO	REV
188	1100-00-0818	B
SCALE 23338	SHEET 1 OF 1	

REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG. SWEEP BD	0101-00-0818	WVTK	0101-00-0818	1
NONE	SCHEMATIC. SWEEP BD	0103-00-0818	WVTK	0103-00-0818	1
C3 C5	CAP. CER.. 001MF. 1KV	DD-102	ARCO	1500-01-0211	2
C1 C2	CAP. CER. MN. .01MF. 50V	CAC0223U103Z100A	CORNG	1500-01-0310	2
C4	CAP. MYLR. 2MF. 200V	2MFW205K	AMRAD	1500-42-0504	1
NONE	SWEEP BD	1700-00-0818	WVTK	1700-00-0818	1
R12 R2	POT. CONT. 10K	72MIN056S103U	AB	4600-01-0322	2
R9	POT. TRIM 20K	91AR20K	BECK	4600-02-0301	1
R15 R3	RES. MF. 1/8W. 1%. 10K	RN55D-1002F	TRW	4701-03-1002	2
R6	RES. MF. 1/8W. 1%. 100K	RN55D-1003F	TRW	4701-03-1003	1
R5	RES. MF. 1/8W. 1%. 33.2K	RN55D-3322F	TRW	4701-03-3322	1
R10 R7	RES. MF. 1/8W. 1%. 4.99K	RN55D-4991F	TRW	4701-03-4991	2
R14 R8	RES. MF. 1/8W. 1%. 49.9K	RN55D-4992F	TRW	4701-03-4992	2
R11	RES. MF. 1/8W. 1%. 604	RN55D-6040F	TRW	4701-03-6040	1
R4	RES. MF. 1/8W. 1%. 90.9K	RN55D-9092F	TRW	4701-03-9092	1
R1	RES. MF. 1/4W. 1%. 402K	RN60D-4023F	TRW	4701-13-4023	1
R13	RES. MF. 1/4W. 1%. 499K	RN60D-4993F	TRW	4701-13-4993	1
CR1 CR2	DIODE	FD-6666	FAIR	4807-02-6666	2

WAVETEK PARTS LIST	TITLE PCA. SWEEP BD	ASSEMBLY NO. 1100-00-0818 PAGE 1	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q3	TRANS	2N3903	MSC	4901-03-9030	1
Q1 Q2	TRANS. M/PR. 2N3905 QTY. 2 4901-03-9050	4998-00-0049	WVTK	4998-00-0049	1
NONE	SWITCH ASSY PB	5103-00-0030	WVTK	5103-00-0030	1
U1	IC	TL083CN	TI	7000-00-8200	1

WAVETEK PARTS LIST	TITLE PCA. SWEEP BD	ASSEMBLY NO. 1100-00-0818 PAGE 2	REV B

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO, CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PARTS LIST SWEEP BD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ± .010 ANGLES ±1 .XX ± .030		
	DO NOT SCALE DWG		MODEL NO. 188 DWG NO. 1100-00-0818 REV B
	SCALE		CODE IDENT 23338 SHEET 1 OF 1

WAVETEK®
SAN DIEGO
9045 Balboa Ave., San Diego, CA 92123
P. O. Box 651, San Diego, Calif. 92112
Tel 714/279-2200 TWX 910-335-2007

Amtsbl 153/1984

Anlage 7 zur Amtsbl

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daß der/die/das

Funktions-/Wobbelgenerator Modell 188

(Gerät, Typ, Bezeichnung)

in Übereinstimmung mit den Bestimmungen der

1046/1984

(Amtsblattverfügung)

funk-entstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

Name des Herstellers/Importeurs

WAVETEK
Electronics GmbH
PRODUCTION
Ruprechtsberg 11
D-8250 DORFEN
Tel. (08081) 2711

Bescheinigung des Herstellers/Importeurs

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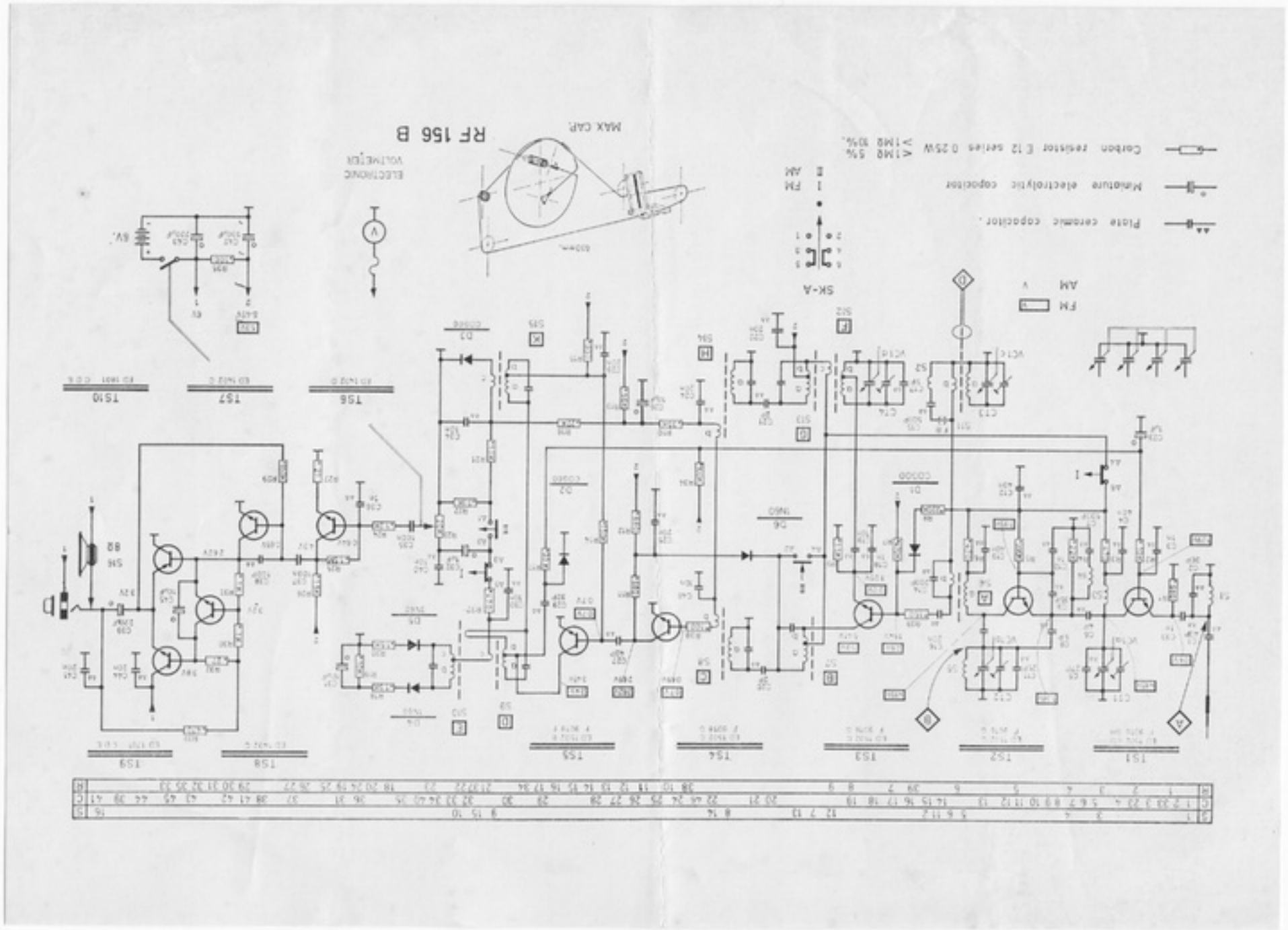
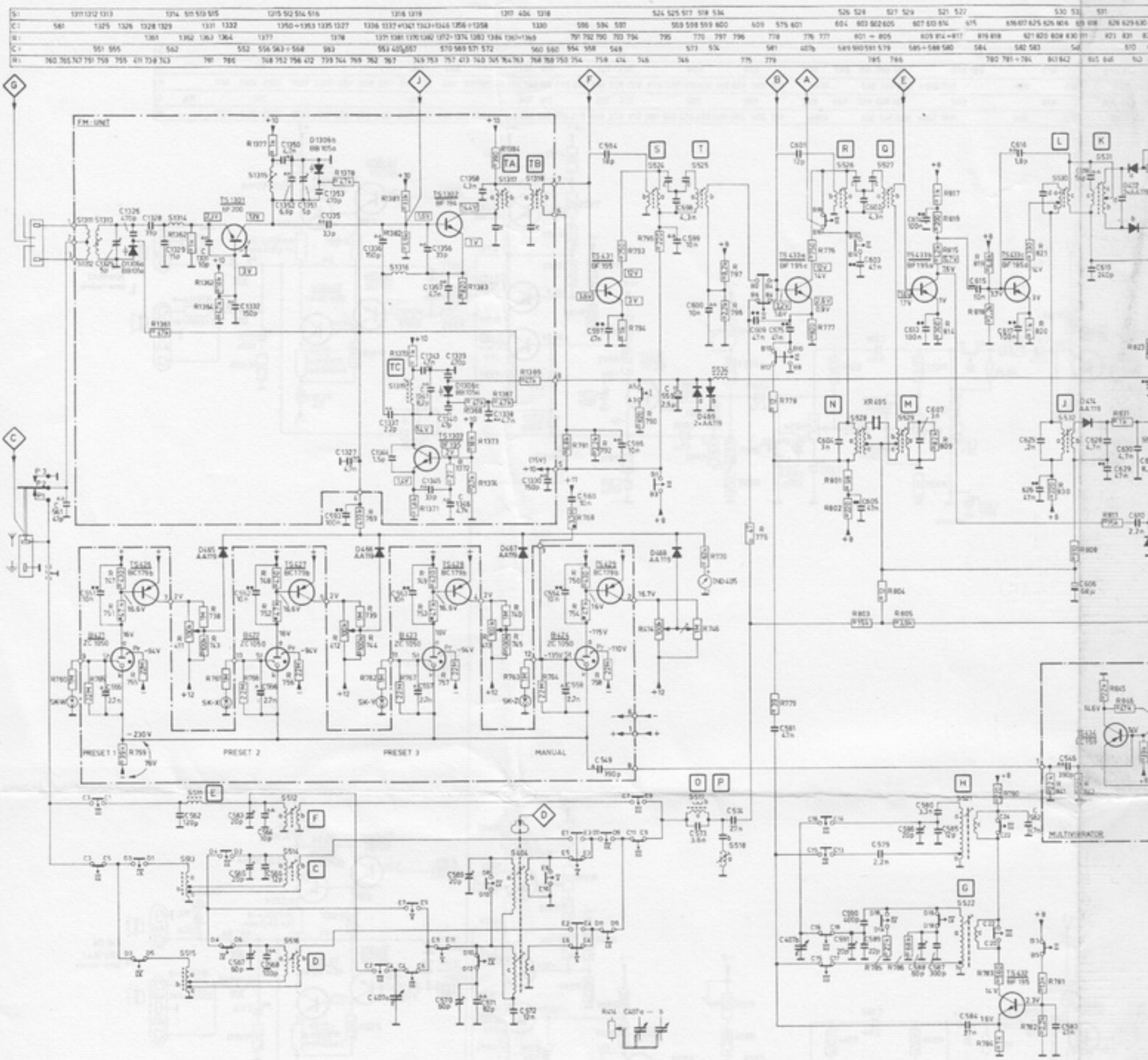

RF 156 B
MAX CAP.
ELECTRONIC VOLTMETER
Carbon resistor E 12 series 0.25W <1MΩ 5% >1MΩ 10%.
Miniature electrolytic capacitor
Plate ceramic capacitor.
FM
AM
SK-A
1 FM
2 AM
6V.
TS1
TS2
TS3
TS4
TS5
TS6
TS7
TS8
TS9
TS10



Carbon resistor E24 series	0.125 W 5%
Carbon resistor E12 series	0.25 W < 1 MΩ 5% / > 1 MΩ 10%
Carbon resistor E12 series	0.5 W < 1.5 MΩ 5% / > 1.5 MΩ 10%
Carbon resistor E12 series	1 W < 2.2 MΩ 5% / > 2.2 MΩ 10%
Tubular ceramic capacitor	500 V
Ceramic capacitor "Pin-up"	500 V
Plate ceramic capacitor	
Flat-foil polyester capacitor	

CS25896

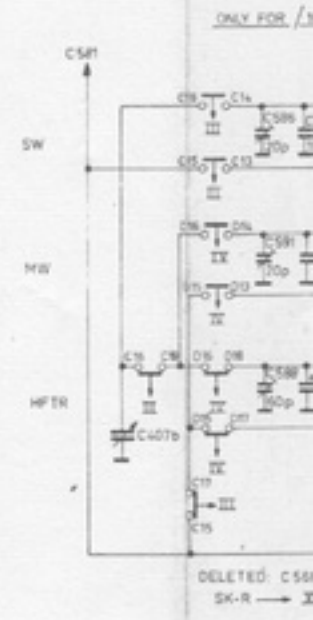
CIRCUIT DIAGRAM SHOWS POSITION LW

ONLY FOR /15/42/43/66

108 MHz tuner + detector

C1328 becomes 39 pF
C1329 becomes 12 pF
C1337 becomes 2.7 pF
C1340 becomes 270 pF
C1341 deleted
C1344 becomes 2.7 pF
C1352 becomes 3.9 pF
R1371 becomes 3.9 pF
R1383 becomes 1 kΩ

detector:
D472ab, C623, C624 and IND403 changed of polarity.



STEREO DECODER

MULTIVIBRATOR

ONLY FOR /16

DELETED: C568, C571 and R786.
SK-R → XX LW (HFTR)

TRA 2963

AERIAL

I AFC II FM III SW IV MW V LW

SK-A B C D E

ONLY FOR/42/66

TS 1101 BC 148 B

S1125 67 kHz

C1132 R1164

R789

C561 47p

R788

3 SK-C

S406 VL 503 2A 117V

R1035

XII

ELECTRONIC VOLTMETER

V → FM

V → MW

S527b

S528 KR 495 S529

XX - Small bandwidth

FM SW MW BW

ONLY FOR 42/43/46

2 SK-N 5 SK-N

L R1005 C711

R R1006 C712

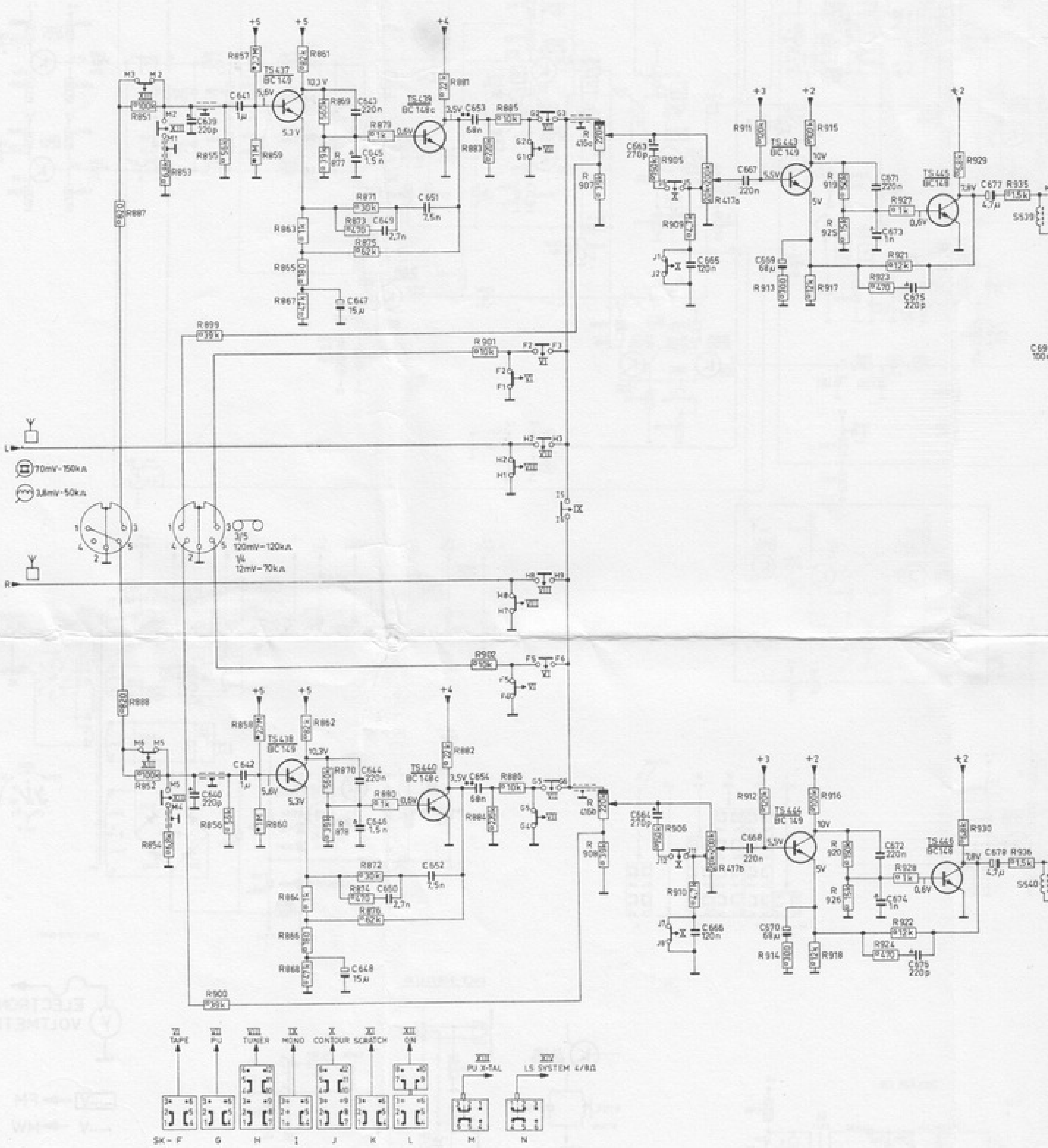
Earphone-socket

TRA 2962

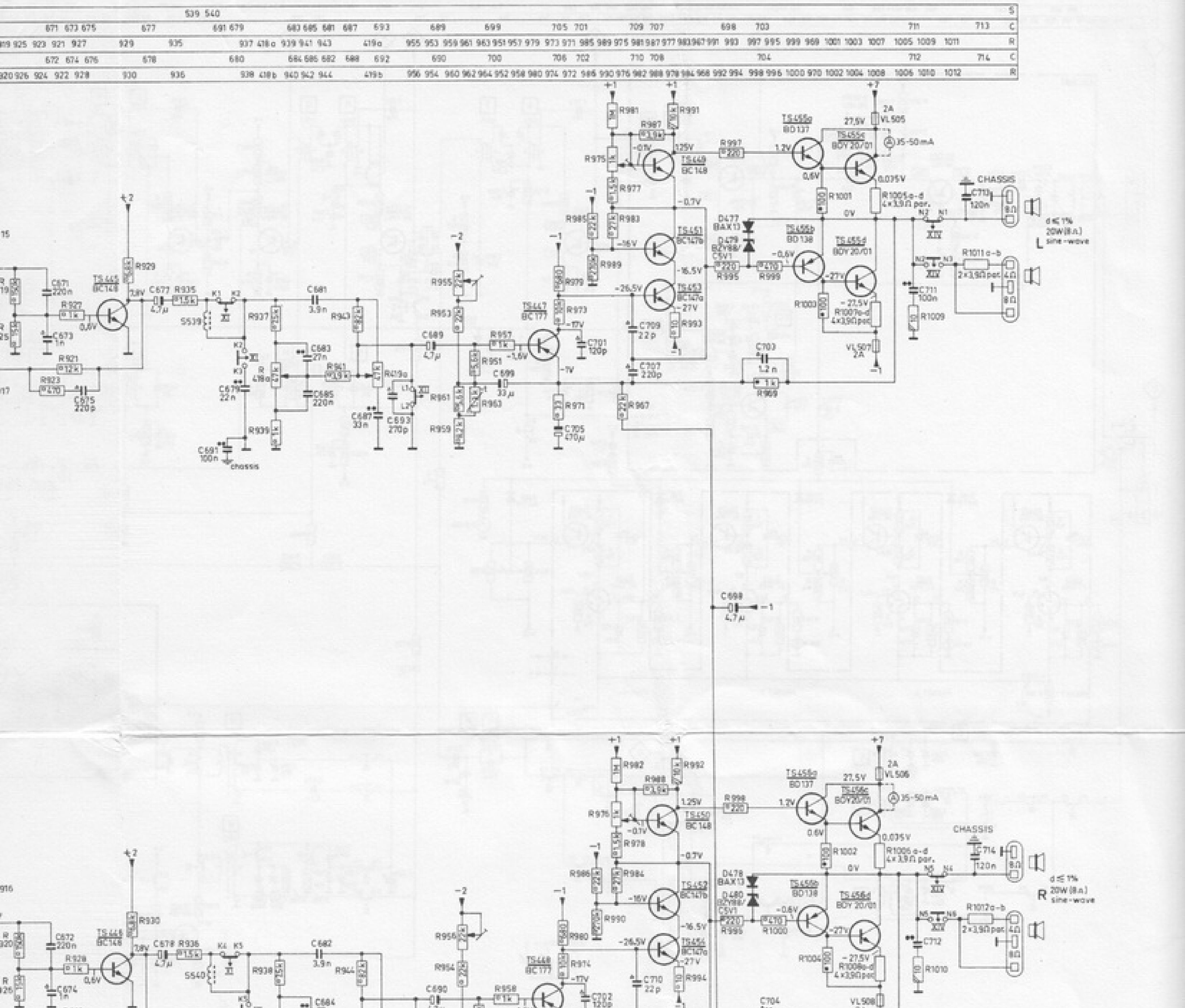
SUBJECT TO MODIFICATIONS

4822 725 15072

S: 539 54
C: 639 641 647 643 645 649 651 653 663 665 667 669 671 673 675 677
R: 887 851 853 899 855 857 859 861 863 865 867 869 877 871 879 873 875 881 901 883 885 416a 907 905 909 417a 911 913 915 917 919 925 923 921 927 929 935
C: 640 642 648 644 646 650 652 654 664 666 668 670 672 674 676 678
R: 888 852 854 900 856 858 860 862 864 866 868 870 878 872 880 874 876 882 902 884 886 416b 908 906 910 417b 912 914 916 918 920 926 924 922 928 930 936



CS25897



TRA 3650 B PART 2