INSTRUCTION MANUAL

MODEL 187
4 MHz PULSE/ FUNCTION GENERATOR

WAVETEK

WAVETEK SAN DIEGO, INC.

9045 Balboa Ave., San Diego, CA 92123

WARRANTY

All Wavetek instruments are warranted 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.

CONTENTS

CONTENTS (Continued)

SAFETY

This instrument is wired for earth grounding via the facility power wiring. Do not 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.

SECTION 1
GENERAL DESCRIPTION

1.1 THE MODEL 187

The Wavetek Model 187, a 4 MHz Pulse/Function Generator, is a precision source of sine, triangle, square and pulse waveforms plus dc voltage. All waveforms are front panel variable from 4 mHz to 4 MHz and can be frequency modulated and swept with an external signal. Variable width and delay, single or double pulses can be output inverted or normal. Amplitude of the waveforms is variable from 10V peak-to-peak into 50Ω down to 30 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. A TTL level signal at generator frequency is simultaneous with the waveform outputs for synchronization.

1.2 SPECIFICATIONS

1.2.1 Versatility

Instrument operates as either a function generator or pulse generator.

Functions
Sine ∿ ; triangle ⋀⋁ ; square ⊓⊔ ; fixed baseline normal pulses ⎍ , ⎍ , ⎍ and inverted pulses ⊔ , ⊔ , ⊔ 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.

Frequency Range
0.004 Hz to 4 MHz in 7 overlapping decade ranges:

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

Main Outputs (50Ω OUT)
∿ , ⋀⋁ , ⊓⊔ , ⎍ 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. ⎍ , ⎍ , ⊔ , ⊔ selectable and variable from fixed baseline to 10 Vp-p (5 Vp-p into 50Ω) HI output, and to 1 Vp-p (0.5 Vp-p into 50Ω) LO output. Both outputs varied with a 30 dB vernier. Peak output current is 100 mA maximum (HI output). Source impedance is 50Ω.

DC Offset and DC Output
Function baseline offset and dc output selectable and variable through HI and LO BNC outputs. DC only output selected by not selecting a 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.

Pulse Modes
Square ⊓⊔ : 50% duty cycle.

Pulse: Adjustable width pulse in phase with sync signal.

Delayed Pulse: Pulse delayed with respect to sync out. Pulse delay and pulse width adjustable.

Double Pulse: Time between pulses and time of pulse width adjustable. Second pulse not generated if delay less than width.

Pulse Period Range
250 ns to 250s in 7 overlapping decade ranges.

Pulse Width
100 ns to 100 ms in 3 ranges with vernier control. Has no effect in ⊓⊔ mode.

Pulse Delay
100 ns to 100 ms in 3 overlapping ranges with vernier control.

Sync Output
TTL pulse (50% ±10% duty cycle at generator frequency. Drives up to 20 TTL loads.

VCG—Voltage Controlled Generator
Up to 1000:1 frequency change 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.

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

Input Impedance: 2 kΩ.

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
Duty cycle variation in ⊓⊔ mode, 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, referenced to 1 kHz;
±1.0 dB to 4 MHz.

1.2.4 Function 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.

Pulse 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; 13.3 cm (5¼ in.) high; 26.7 cm (10½ in.) deep.

Weight
3.5 kg (7.7 lb) net; 5 kg (11.2 lb) shipping.

Power
90 to 128V or 180 to 256V, 48 to 66 Hz; less than 30 watts.

NOTE

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

SECTION 2
INITIAL PREPARATION

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 female 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 female BNC connectors, two 50Ω terminations, 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
FREQUENCY MULTIPLIER	×1K
MODE	CONT (released)
FUNCTION	⎍
DC OFFSET	OFF
AMPLITUDE	MAX
DELAY	12 o'clock
DELAY RANGE	10 μs-1 ms
WIDTH	12 o'clock
WIDTH RANGE	10 μs-1 ms
PULSE MODE	⊓⊔
PULSE/SQUARE OUTPUT	NORM ⎍

Set up the oscilloscope, Model 187 and external function generator as shown in figure 2-1 and perform the steps in table 2-1.

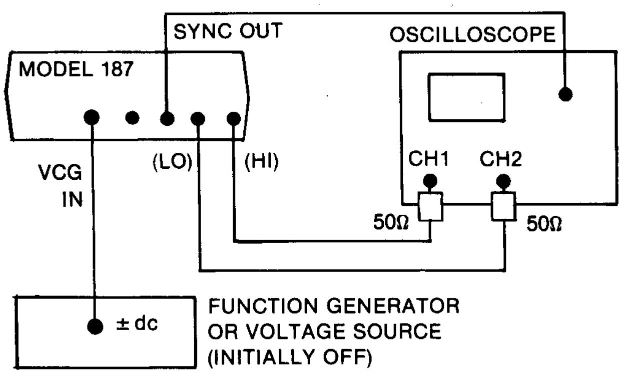


Figure 2-1. First Setup

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.

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 with −30 dB lowest possible amplitude. 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 returns 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 ∿ and ∿ .	Observe ∿ and ∿ waveforms.
9	MODE	Gate (depress CONT, release TRIG/GATE).	A dc level near zero volts.

Table 2-1. Initial Checkout (Continued)

Step	Control	Position/Operation	Observation
10	MANUAL TRIGGER	Press and hold.	Continuous ∿ .
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	MODE	Trigger (depress TRIG/GATE)	One ∿ cycle during positive portion of TTL signal on CH2.
13		Continuous (release CONT)	
14	FUNCTION	Pulse (depress).	Square wave.
15	PULSE MODE	Depress DLY OFF	
16	WIDTH	Vary, return to 12 0'clock	Pulse width varies.
17	AMPLITUDE	Vary, return to MAX.	Upper and lower levels vary.
18	PULSE/SQUARE OUTPUT	Invert pulse (depress NORM/INV)	Phase inversion of pulse relative to sync signal.
19		Release NORM/INV	
20		Depress ⎍	Positive offset pulse.
21	AMPLITUDE	Vary, return to MAX.	Upper level varies, lower level remains fixed.
22	PULSE/SQUARE OUTPUT	Depress ⎍	Negative offset pulse.

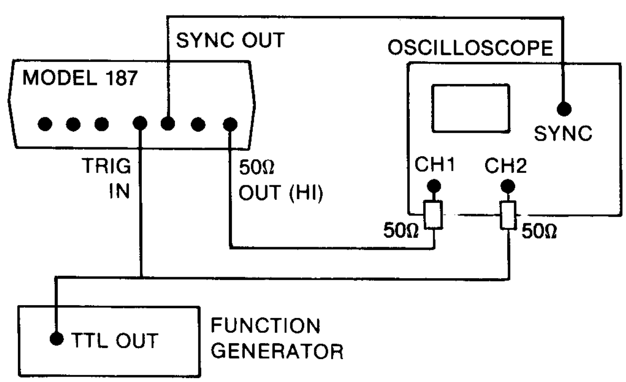


Figure 2-2. Second Setup

Table 2-1. Initial Checkout (Continued)

Step	Control	Position/Operation	Observation
23	AMPLITUDE	Vary, return to MAX.	Lower level varies, upper level remains fixed.
24	PULSE MODE	Depress DLY ON	Pulse position shifts relative to sync signal.
25		Depress DBL PULSE	
26	WIDTH	Decrease (ccw) *NOTE: Pulse width must be less than pulse delay.*	Double pulses displayed.
27	DELAY Vernier	Vary, return to 12 o'clock.	Double pulse separation varies.
28	WIDTH	Vary.	Width of all pulses vary.

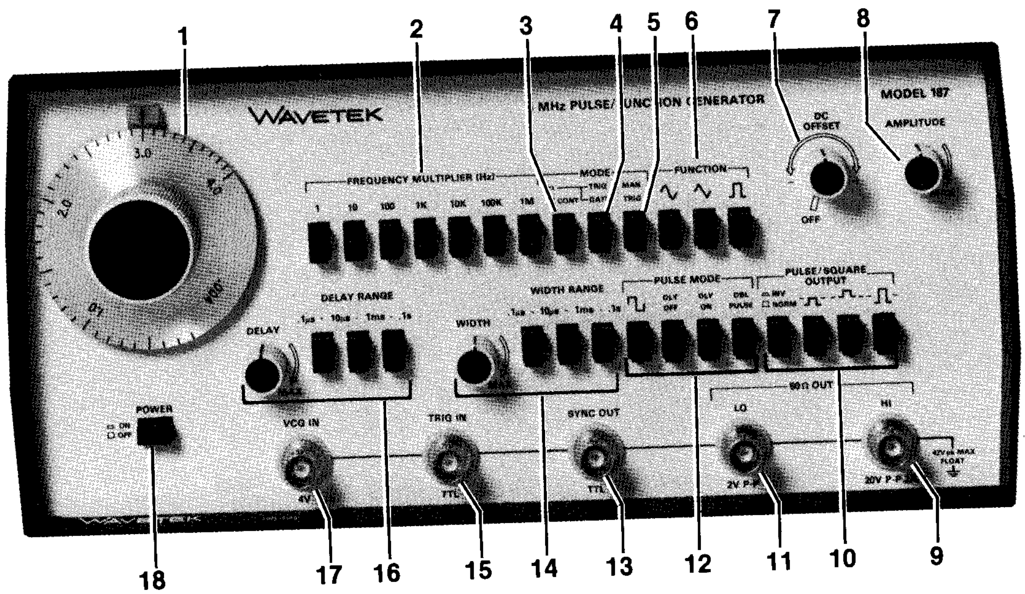


Figure 3-1 Controls and Connectors

SECTION 3
OPERATION

3.1 CONTROLS AND CONNECTORS

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 voltage at **17** and multiplied by **2** to determine the output signal frequency.

2 **Frequency Multiplier**—Pushbutton selects one of seven frequency multipliers for **1** and voltage input at **17**.

3,4 **Mode Pushbuttons**—Select one of the following three modes:

Continuous—3 released, selects continuous output at 50Ω OUT **9** and **11** and SYNC OUT (TTL) **13** connectors.

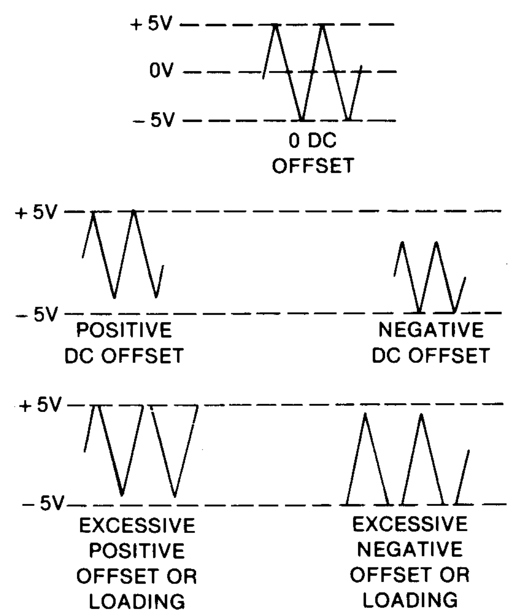
Trigger—3 and **4** depressed. A dc level output until the generator is triggered by MAN TRIG **5** or with a signal at TRIG IN connector **15**. When triggered, the generator output is one cycle of waveform followed by a dc level.

Gate—3 depressed and **4** released. Same as trigger except the output is continuous for the duration of the manual or external trigger signal. The last cycle is always completed.

5 **MAN TRIG Pushbutton**—Triggers or gates the output signals when **4** is depressed or released respectively. In the trigger mode, one waveform cycle is output when **5** is pressed. In gate mode, waveform cycles are continuously output as long as **5** is held in.

6 **FUNCTION Pushbuttons**—Select sine ∿ , triangle ⋀ or pulse ⎍ waveform. When all three FUNCTION buttons are released the output is a dc level. Pulse waveform parameters are controlled by the second row of controls.

7 **DC OFFSET Knob**—Offsets the 50Ω OUT waveform or gives a dc level (all function switches released) from −10V (ccw, not off) to +10V (cw) (−5V to +5V into 50Ω) at the HI output **9** and from −1V to +1V (−0.5V to +0.5V into 50Ω) at the LO output **14**. An OFF position ensures no dc offset. See figure 3-2.



NOTE: Example is HI output into a 50Ω load.

Figure 3-2. DC OFFSET Control

8 **AMPLITUDE CONTROL**—CCW rotation reduces waveform amplitude at 50Ω OUTPUTS **9** and **11** by 30 dB while CW increases amplitude. DC and offset voltages are not affected by this control.

9 **50Ω OUT HI Connector**—Output for the selected function. Maximum 20 Vp-p (10 Vp-p into 50Ω) with 30 dB continuous amplitude control. 50Ω source impedance. 100 mA peak current for required waveform; 200 mA short circuit current.

10 **PULSE/SQUARE OUTPUT Pushbuttons**—Select the pulse amplitude symmetry relative to the baseline. With DC OFFSET **7** OFF, the baseline is 0V. With DC OFFSET, the baseline is varied by the DC OFFSET control.

(full pulse symbol)—Selects a pulse that maintains amplitude symmetry about the baseline. AMPLITUDE control **8** adjusts the peak-to-peak level of the pulse. See figure 3-3.

(positive pulse symbol)—Selects the positive pulse. AMPLITUDE control **8** adjusts the positive peak while the negative peak remains fixed at the baseline. See figure 3-3.

(negative pulse symbol)—Selects the negative pulse. Amplitude control **8** adjusts the negative peak while the positive peak remains fixed at the baseline. See figure 3-3.

NORM/INV Pushbutton—Selects normal or inverted pulse output. Inverted pulse is a reversal of the active and inactive levels of the pulse. The net result for a square pulse would be a 180° phase shift with respect to sync pulse. See figure 3-3.

11 **50Ω OUT LO Connector**—Output for the selected function. Maximum 2 Vp-p (1 Vp-p into 50Ω) with 30 dB continuous amplitude control. 50Ω source impedance.

12 **PULSE MODE Pushbuttons**—Select a pulse synchronous with the sync pulse, a pulse delayed with respect to the sync pulse, double pulse (two pulse per pulse period) or a 50% duty cycle pulse.

DBL PULSE Pushbutton—Selects two pulses for each pulse period. In double pulse, DELAY

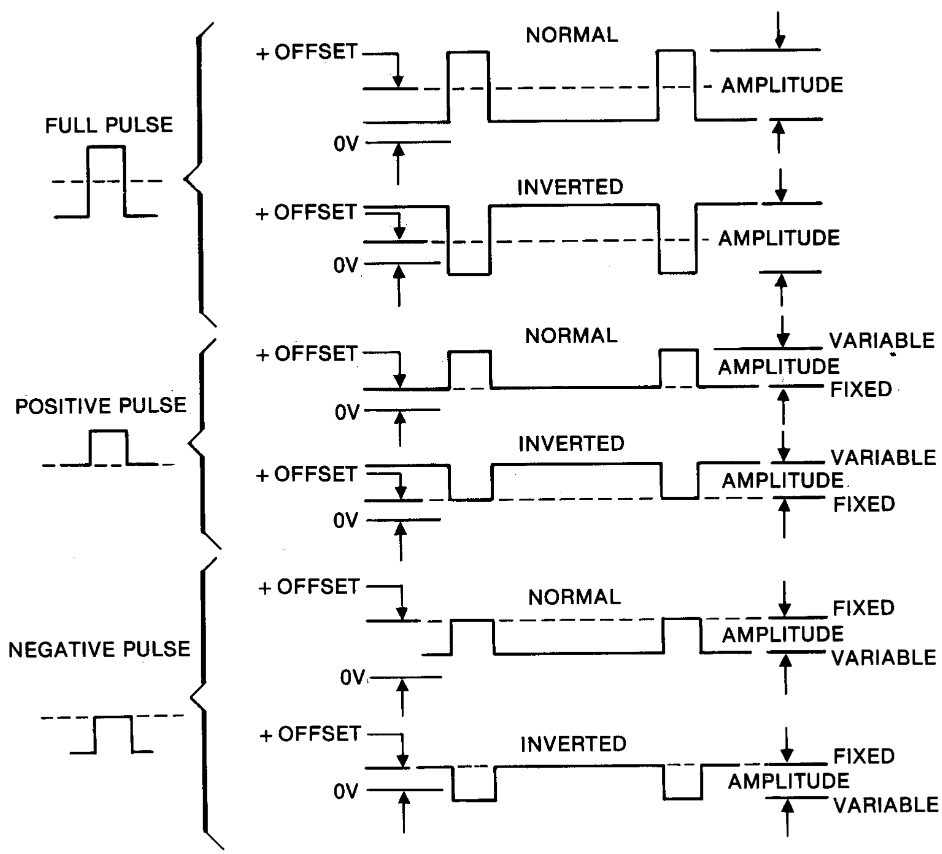


Figure 3-3. PULSE/SQUARE OUTPUT Amplitude/Offset Relationship

RANGE and vernier 16 set the period between the two pulses. WIDTH RANGE and vernier 14 control the pulse width of both pulses. See figure 3-4.

DLY ON Pushbutton—Initiates the DELAY RANGE and vernier **16** to delay the pulse relative to sync output **13.**

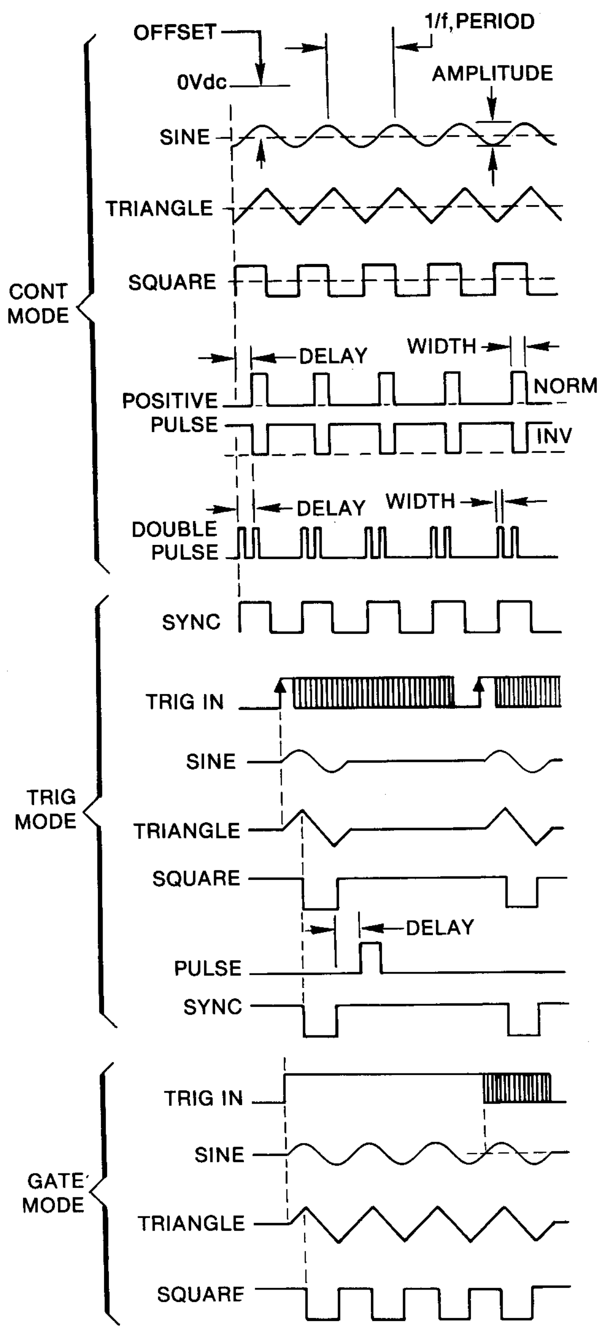


Figure 3-4. Waveform Characteristics

DLY OFF Pushbutton—Inhibits the DELAY RANGE and vernier.

⊓⊔ **Pushbutton**—Selects a square wave. WIDTH RANGE and vernier have no effect on the square wave.

13 **SYNC OUT TTL Connector**—Output for a TTL square wave for each generator cycle. To be used for synchronization or as a TTL signal capable of driving 20 TTL loads. SYNC OUT provides reference for pulse delay.

14 **WIDTH Controls**—Sets pulse width in all pulse modes except ⊓⊔.

WIDTH RANGE Pushbutton—Select one of three pulse width ranges (0.1 μs to 10 μs, 10 μs to 1 ms, 1 ms to 0.1s) for use with WIDTH vernier.

WIDTH Vernier—Varies the width period within the selected WIDTH RANGE. CW increases pulse width, ccw decreases pulse width.

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

16 **DELAY CONTROLS**—Set pulse delay in delay and double pulse modes.

DELAY RANGE Pushbuttons—Select one of three pulse delay ranges (0.1 μs to 10 μs, 10 μs to 1 ms, 1 ms to 0.1s) for use with the DELAY vernier. Pulse delay is relative to sync output. In double pulse mode, delay controls the period between the two pulses.

DELAY Vernier—Varies the delay period of the selected DELAY RANGE. CW increases pulse delay and ccw decreases pulse delay.

17 **VCG IN Connector**—Accepts ac or dc voltage to proportionately control frequency within the range determined by the FREQUENCY MULTIPLIER **2**. Positive voltage increases the frequency set by the dial **1**; negative voltage decreases the frequency.

18 **POWER Pushbutton**—Applies line power to the generator circuits.

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 3-5. 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:

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

*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.

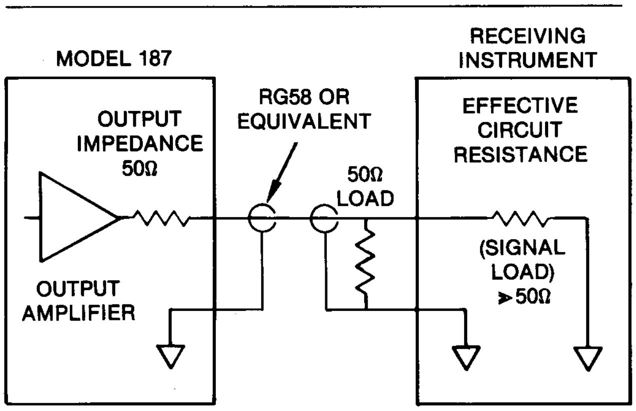


Figure 3-5. Signal Termination

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 keys to figure 3-1.)

Step	Control/Connector	Setting
1	50Ω OUT **9, 11**	Connect circuit under test to either output (refer to paragraph 3.2.1)
2	FREQUENCY MULTIPLIER **2**	Set to desired range of frequency.
3	Frequency Dial **1**	Set to desired frequency within the range.
4	FUNCTION **6**	Set to desired waveform. (To select a square wave, depress ⎍ **6**, ⎍ **10** and ⎍ **12**.
5	DC OFFSET **7**	Set as desired. Limited waveform amplitude to prevent clipping (see figure 3-2).
6	AMPLITUDE **8**	Select 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 particular ranges 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.

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 maximum range (determined by dial end points and frequency multiplier.)

Figure 3-6 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. 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.)

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 of the upper limit.

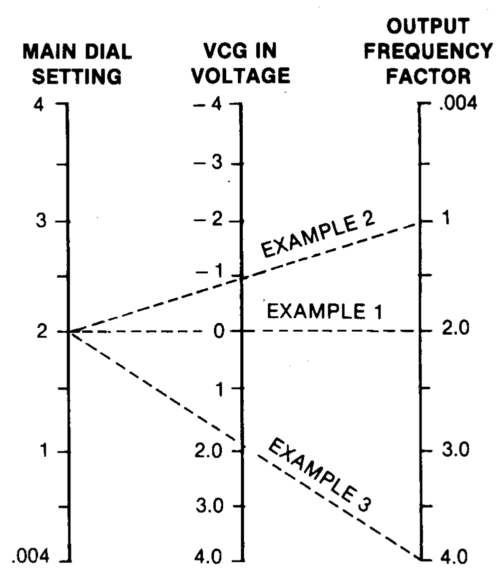


Figure 3-6. VCG Voltage-to-Frequency Nomograph

The up to 1000:1 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 frequency sweep. With the dial set to .004, excursions between 0V and +4V at the VCG IN provide up to 1000:1 within the set frequency range.

3.2.4 Pulse Generator Operation

Operation as a pulse generator is similar to the manual and VCG controlled generator except a single pulse, double pulse or square wave may be selected.

The following steps describe the pulse operation setup:

Step	Control/Connector	Setting
1	MODE: CONT **3**	Release CONT.
2	Frequency dial **1**	Select pulse repetition rate.
3	FREQUENCY MULTIPLIER **2**	Select pulse repetition rate.
4	FUNCTION **6**	Depress ⎍ .
5	PULSE/SQUARE OUTPUT **10**	Depress desired pulse output.
6	PULSE MODE **12**	Depress desired pulse mode.
7	WIDTH **14**	Depress desired pulse width range and select desired pulse width. (Not applicable if 50% duty cycle pulse, ⎍ , was selected.)
8	DELAY **16**	Depress desired pulse delay range and select desired pulse delay. (Not applicable if DLY OFF was selected.)
9	DC OFFSET **7**	Set as desired. Limit pulse amplitude as necessary to prevent clipping (see figure 3-2).
10	AMPLITUDE **8**	Select desired amplitude.

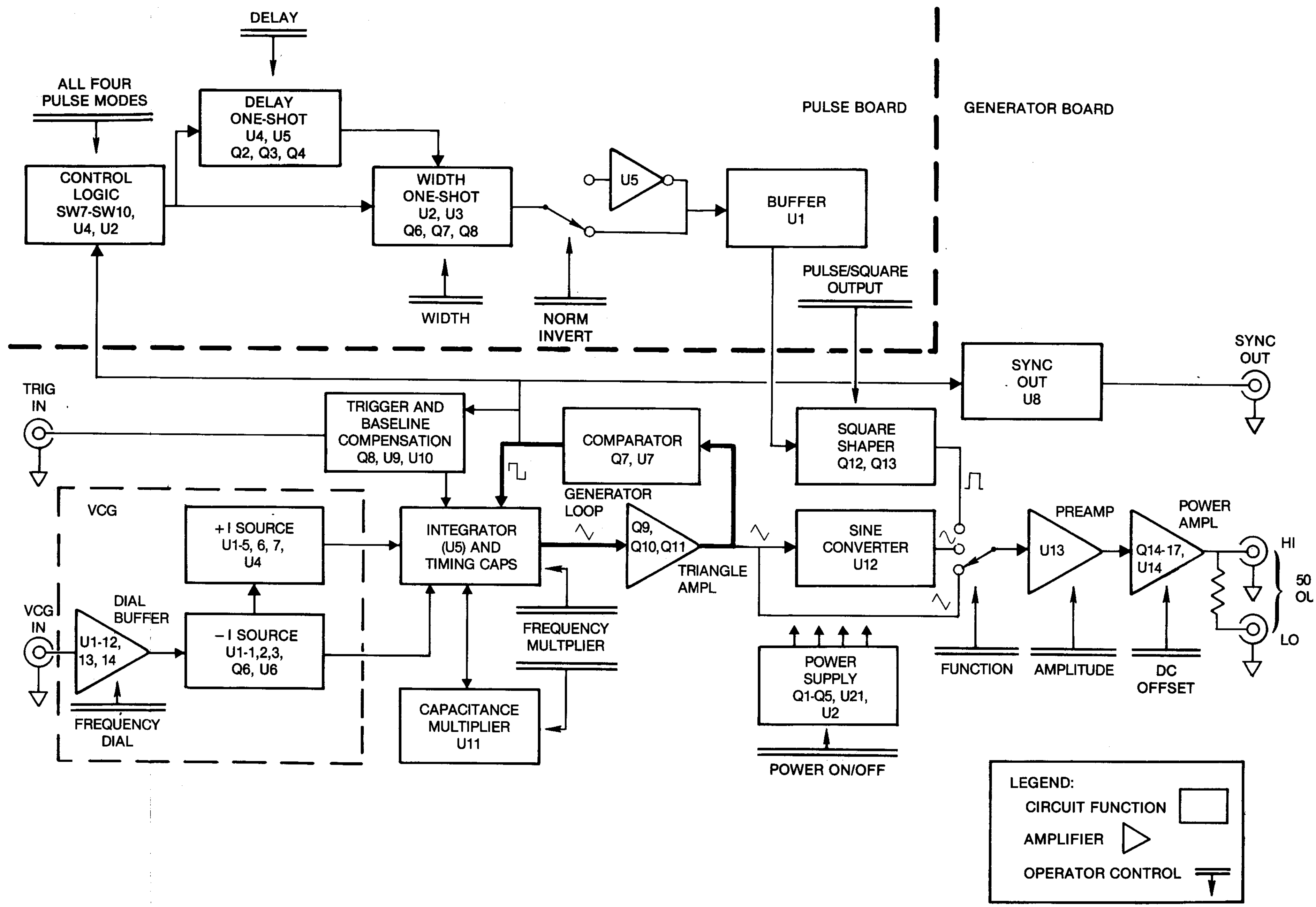


Figure 4-1. Function Block Diagram

SECTION 4
CIRCUIT DESCRIPTION

4.1 INTRODUCTION

This section describes the functions of major circuit elements and their relationships to one another as shown in figure 4-1, functional block diagram.

4.2 GENERATOR BOARD

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 linearly from approximately 2 mA to 2 μA over a 1000:1 (4.0 to .004) range of each frequency multiplier.

The integrator, consisting of the bridge diodes and timing capacitors, is switched by the comparator output. This switching causes either the current source or current sink to charge the timing capacitor selected by the frequency multiplier.When the current source is switched in, the charge on the timing capacitor will rise linearly, 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 $\pm$2V output is sent back to the integrator and timing capacitor.When the output is +2V, the triangle is positive-going until the +1.25V 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 +2V, 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 linearly 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 sent to the trigger flip flop, the intergrator and the pulse board one-shots. The one-shot pulse (or square) is sent to the square shaper input. When the ⎍ FUNCTION switch is selected, the square shaper is enabled and converts the pulse into a current signal.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 to produce 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 2 I 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 th 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 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.

4.3 PULSE BOARD

The pulse generator circuitry (figure 4-1) consists of the control logic, delay one-shot, width one-shot, buffer and square shaper.

Selecting ⎍ of the main board, enables the square shaper and allows the signals of one the four pulse modes to be sent to the preamplifier. The square shaper on the main board and the pulse/square output switching on the pulse board determines whether the output pulse will be unipolar (positive or negative pulse) or bi-polar (negative and positive pulse).

The pulse mode switches select one of the four pulse modes. This pulse system uses two one-shots and control logic combinations to generate the desired pulse output. The logic, which is a part of the one-shots, determines the function of the one-shot (delay) or width), selects the proper combination of one-shots needed, and determines how the comparator output of the main board is to be used and shaped for triggering purposes. Since both one-shots function the

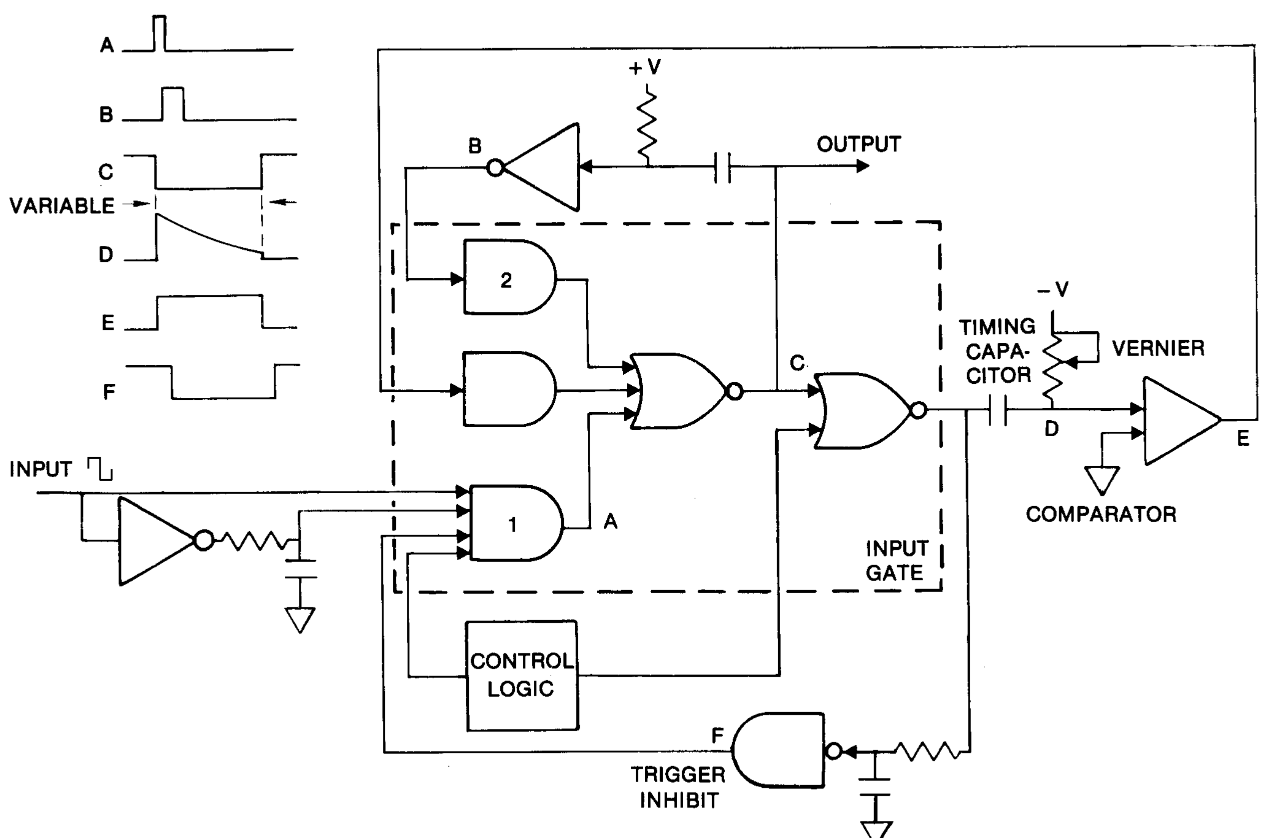


Figure 4-2. One Shot Schematic

same, (figure 4-2) a simplified drawing illustrating one-shot principle of operation is applicable to both one-shots.

An input waveform of any duration is received at two inputs of AND gate 1. Since the signal at one input is inverted and has a RC delay network, the output of gate 1 will have a constant pulse width as shown in waveform (A). The transient spike of pulse (A) is felt at the timing capacitor where the vernier and capacitor create a variable time constant to discharge the pulse as shown by waveform (D). As long as the comparator input (D) is positive, the comparator output (E) will remain positive. This output pulse waveform (E) is fedback, buffered, and inverted before being fed to the output to generate waveform (C). The purpose of AND gate 2, inverter and RC network, is to generate a delayed pulse (B) to latch the output and prevent any spikes. The output of trigger inhibit pulse (F) insures that no other incoming pulse will retrigger the timing capacitor until the capacitor times out.

Once the square or desired pulse has been generated, it is sent to the norm/invert switch where the signal can be inverted relative to the sync out. The signal after being buffered is sent on to the square shaper.

The square shaper is involved in all four pulse modes; refer to sheet 1 of the main generator schematic 0103-00-0850. The square shaper is activated by placing a reverse bias on either CR31 for positive pulse or CR30 for negative pulse. Both are reversed bias for bipolar operation. By pressing ⎍ of the pulse board, a negative voltage is removed from cathode of CR31, causing it to become reverse biased. Since CR31 removes the positive output pulse from emitter of Q12 while forward biased, the pulse is now forced to travel through CR17 which shapes the output pulse before sending it to the preamplifier. Similarly, pressing ⊔ removes a positive forward bias voltage on the anode of CR30 which shorts the negative pulse. CR30 thus becomes reverse biased and the output of emitter Q13 is allowed to pass through square shaping diode CR18. Output switching for ⌐⌙ simply causes CR30 and CR31 to be reversed simultaneously. Refer to appendix A for voltage values of CR31 cathode and CR30 anode for all output modes and waveform possibilities.

4.3.1 Square

Now refer to pulse board schematic 0103-00-0843 sheet 1. Selecting square causes the control logic to inhibit the delay and width one-shots. This is done by placing a ground on U2 pin 10 and a +5 volts on U3 pin 3 to disengage the width one-shot and by leaving a ground on U4 pin 2 and U5 pin 2, to disengage the delay one-shot.

The comparator output is fed through U4 AND gate pin 6 since pins 4 and 5 are high, to pin 8 of U4 where the signal is inverted. From U4 pin 8 the square goes to U3 pin 8.

The signal is passed through U3 pin 10 (because pin 9 is low) to U2 pin 6. Since AND gate pin 4 and 5 are high, the signal is fed out NOR gate pin 8 and inverted. Here the signal travels on to buffer U1.

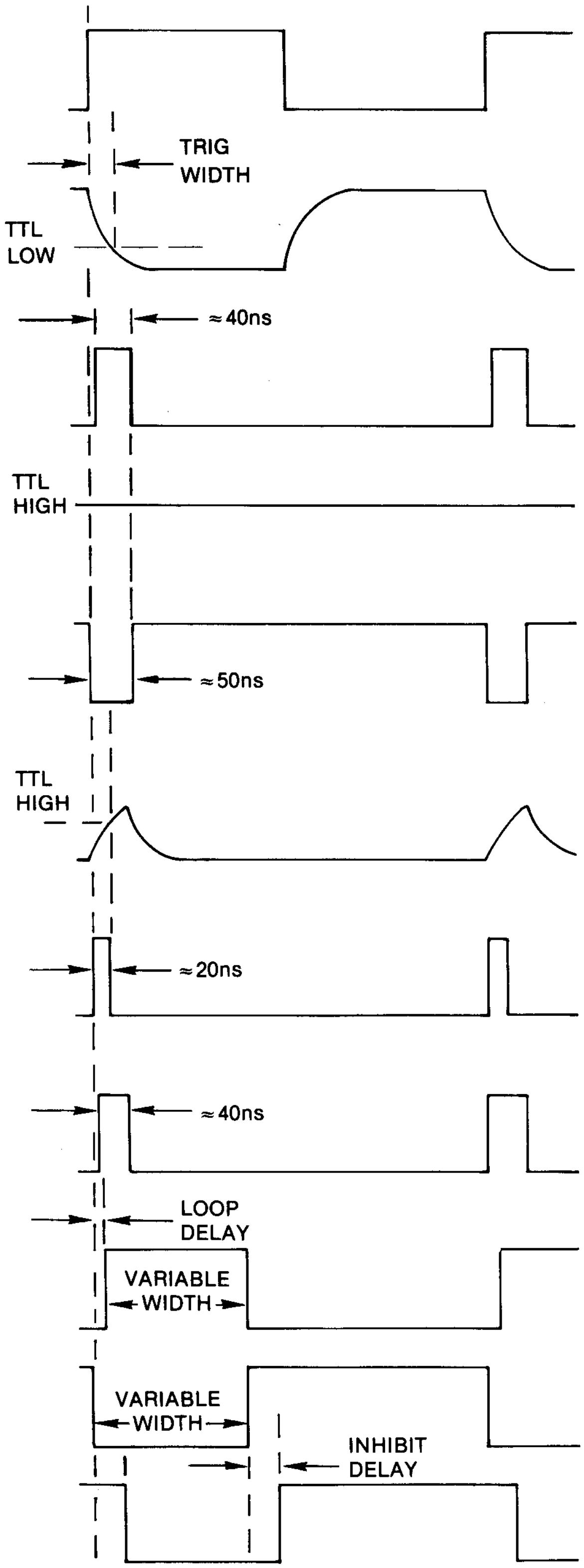
Two points can be observed about the control logic for this mode. First, for NOR gates of U4 and U2 to pass any signal, three of the unsused inputs need to be at a logic low. Hence, the control logic must cause three of the AND gates feeding one of the NO gates to be low, and must cause the AND gate which will pass the signal to have all inputs high other than the signal input. Tracing from the square switch to the AND gates of U4 and U2 will reveal how this is accomplished. Note that these criteria must be met in the other modes also. Second, the circuitry which generates a one-shot triggering pulse (A) as illustrated in figure 4-2, is not needed when in square mode. Hence, the control logic effectively disables U4 pins 1 and 11 triggering input signal by grounding pin 13 of U4 and disables U2 11 and 12 by placing a +5 volts on U3 pin 5 (thus placing a low on U2 pin 12).

4.3.2 Delay Off

In DLY OFF mode the control logic inhibits the delay one-shot and enables the width one-shot. The delay one-shot is inhibited in the same manner as described for square mode. The width one-shot is enabled by placing a high on U2 pin 10 and placing a low on U3 pin 3. U4 AND gate pins 1 and 11 are enabled by placing a high on U2 pin 10 and placing a low on U3 pin 3. U4 AND gate pins 1 and 11 are enabled which causes a trigger pulse of constant duration from NOR gate pin 8. The negative transition of this pulse is fed to U3 pin 8 and is inverted and delayed before being fed to pin 9 of U3. The resulting output of U3 pin 10 is a smaller pulse width than that observed at pin 8 of U4 and a pulse which is positive. This pulse then triggers the one-shot in a manner as described for figure 4-2. Added to this one-shot are the timing capacitors for greater width variation. Refer to appendix B for voltage values of Q6, Q7 and Q8. Refer to figure 4-3 for timing and detailed point by point tracing of DLY OFF.

4.3.3 Delay On

In DLY ON mode the input control logic enables both one-shots. The width one-shot is enabled as described for DLY OFF and the pulse delay one-shot is enabled by placing a +5 volts on U4 pin 2 and U5 pin 2. The positive transition of the square wave triggers the delay one-shot. This results in an output at U4 pin 8 that has a variable low because of pulse width one-shot. Again this works as described for figure 4-2 with added capactitors to increase the delay pulse. The width one-shot is now set to trigger on the positive transition of the delay pulse. This is done by disabling U2 AND gate pin 5 to process the positive transition from U4 pin 8. The resulting triggering pulse corresponds to pulse (A) of figure4-2. This trigger pulse will be felt at U2 pin 8 and will trigger the width one-shot. The width pulse will be variable as in DLY OFF. Refer to figure 4-4 for a more complete examination of this mode.



U4-11. Input Square.

U4-1. Input Square Inverted and Delayed by R11, C3. Anded with Square for Trigger Pulse.

U4-9,10. Trigger Regeneration.

U4-12. Inhibit Signal.

U4-8. U4 Output (Constant Width Since Delay One-Shot Disabled). Fed to Width One-Shot.

U3-9. Previous Signal Inverted and Delayed by R27, C13.

U3-10. Previous Two Signals Nored together to Give Short Positive Trigger.

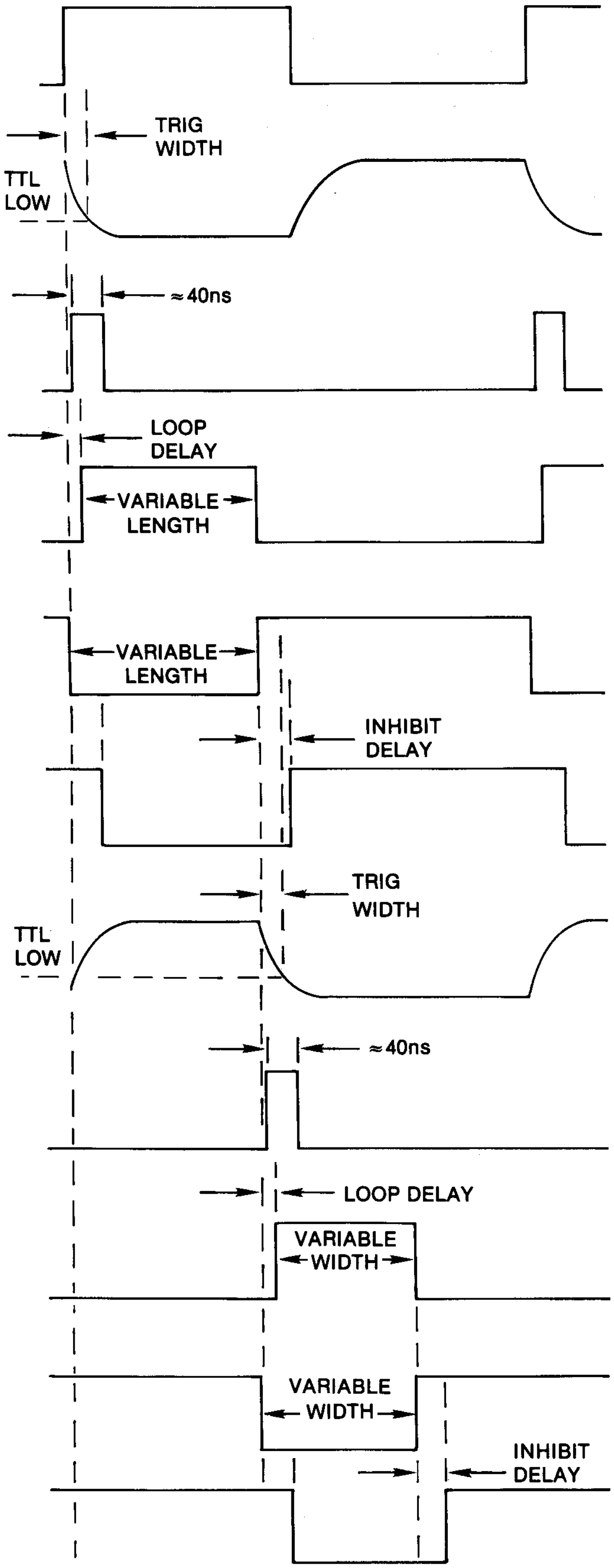
U2-2,3. Trigger Regeneration. Latches One-Shot to Allow Time for Feedback to U2-9 to Arrive.

U2-9. Loop Feedback. Width Governed by C17, R22 (WIDTH Vernier).

U2-8. Variable Width Pulse. Fed to Output.

U2-4. Inhibit. Delayed by R31, C16 to Allow One-Shot Time to Reset before next Trigger.

Figure 4-3 Delay Off Mode Timing Chart



U4-11. Input Square.

U4-1. Input Square Inverted and Delayed by R11, C3. Anded with Square for Trigger Pulse.

U4-9,10. Trigger Regeneration. Latches One-Shot to Allow Time for Loop Feedback to Arrive.

U4-3. Loop feedback. Width determine by C6, R6 (DELAY vernier)

U4-8. Variable Length Delay Pulse. Positive Transition Will Trigger Output Pulse.

U4-12. Inhibit. Delay by R12, C5 to Allow One-Shot Time to Reset before Next Trigger.

U2-12. Variable Delay Pulse Inverted and Delayed by R28, C14. Anded with Delay Pulse for Trigger.

U2-2,3. Trigger Regeneration. Latches One-Shot to Allow Time for Loop Feedback to Arrive.

U2-9. Loop Feedback. Width Governed by C17, R22 (WIDTH Vernier).

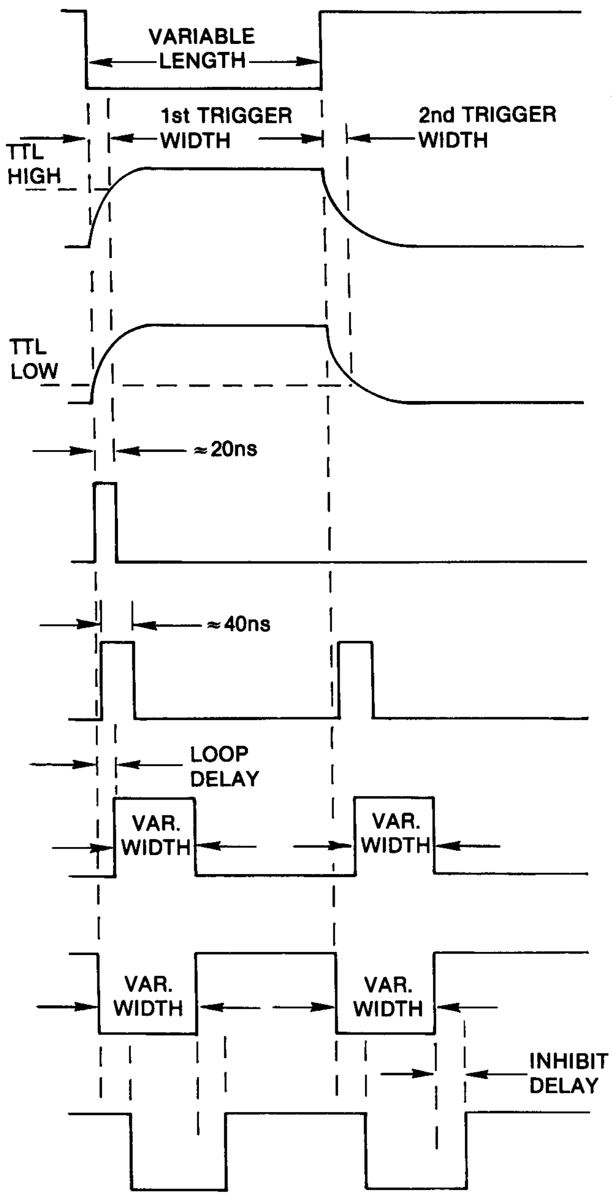
U2-8. Variable Width, Delayed Pulse. Fed to Output.

U2-1. Inhibit. Delayed by R31, C16 to Allow One-Shot Time to Reset before Next Trigger.

Figure 4-4. Delay On Mode Timing Chart

4.3.4 Double Pulse

DBL PULSE works exactly as the delayed pulse except that the logic low on U2 pin 5 is changed to a logic high. This allows the width one-shot to be triggered on the negative transition for U4 pin 8 via U3 pins 8, 9 and 10 and on the positive transition via U3 pins 6, 5 and 4 with AND gate U2 pin 12. For analysis refer to figure 4-5.



U4-8. Delay Pulse (same as Generated in DLY ON Mode).

U3-9. Delay Pulse Inverted and Delayed by R27, C13. Nored with Delay Pulse to Give First Trigger.

U2-12. Delay Pulse Inverted and Delayed by R28, C14. Anded with Delay Pulse to Give Second Trigger.

U2-6. First Trigger Pulse.

U2-2,3. Trigger Regeneration. Latches One-Shot to Allow Time for Loop Feedback to Arrive. Occurs for Both Triggers.

U2-9. Loop Feedback. Widths Governed by C17, R22 (WIDTH Vernier). Both Pulses Have Equal Width.

U2-8. Double Pulse with Variable Width and Delay. Fed to Output.

U2-1,4. Inhibit. Delay by R31, C16 to Allow One-Shot Time to Reset before Next Trigger.

Figure 4-5. Double Pulse Mode Timing Chart

SECTION 5
ALIGNMENT

5.1 FACTORY REPAIR

Wavetek maintains a factory department for those cusstomers 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	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 (ref: drawing 0102-00-0844 in section 7).
2. Turn the instrument upright; remove the top cover for access to generator alignment controls.
3. For access to the pulse board, remove the screws securing the bottom cover to the generator board, replace the top cover invert the instrument and remove the bottom cover.
4. When alignment is complete, secure both covers.

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.

The completion of these alignment procedures returns the instrument to correct calibration. All limits and tolerances given in these procedures are alignment guides and should not be interpreted as instrument specifications. Instrument specifications are given in section 1 of this manual.

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 COUNT	CONT (released)
FUNCTION	⎍
DC OFFSET	OFF
AMPLITUDE	MAX
PULSE MODE	⎾⏌
PULSE/SQUARE OUTPUT	NORM (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.

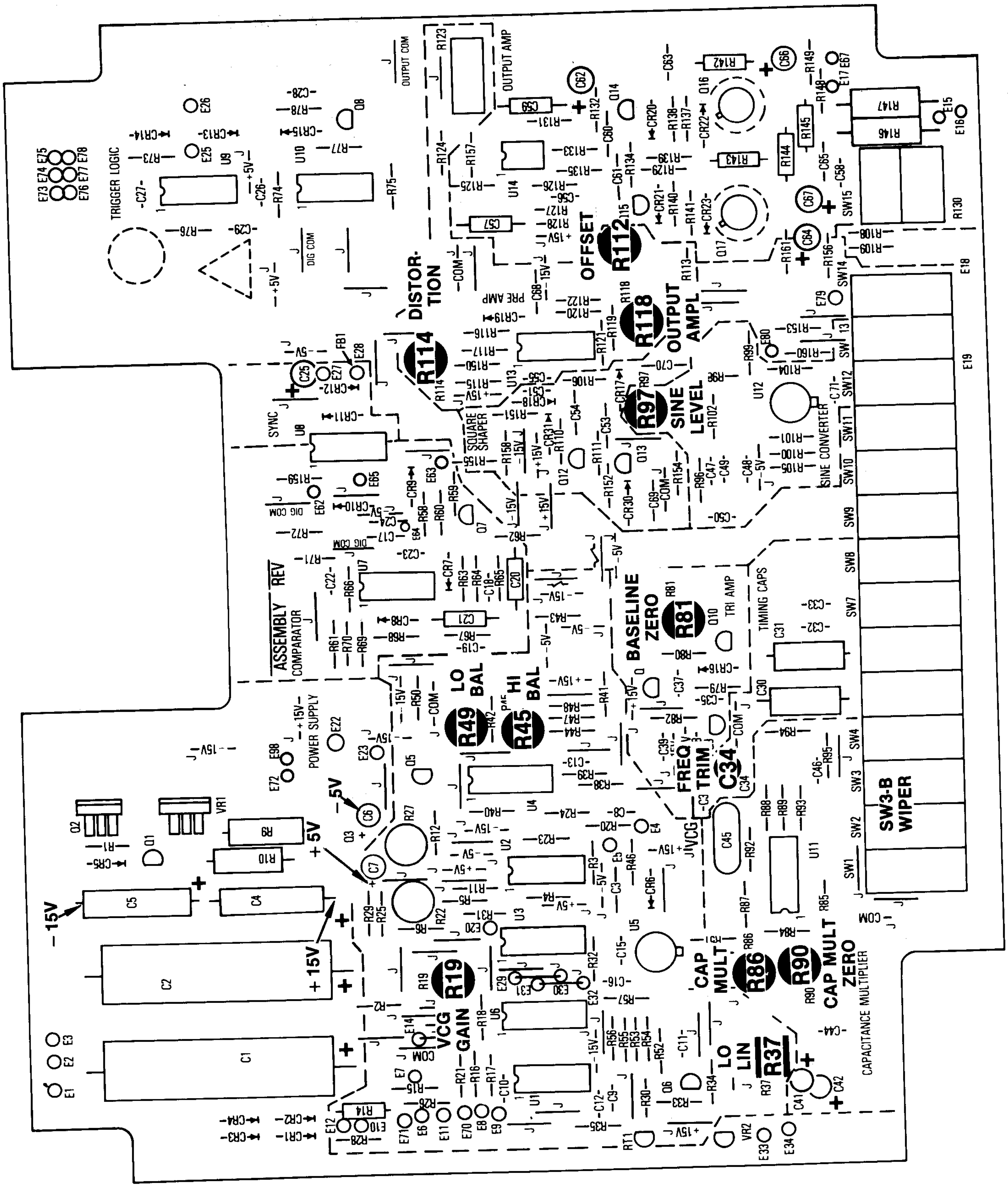


Figure 5-1. Generator Board Alignment Points

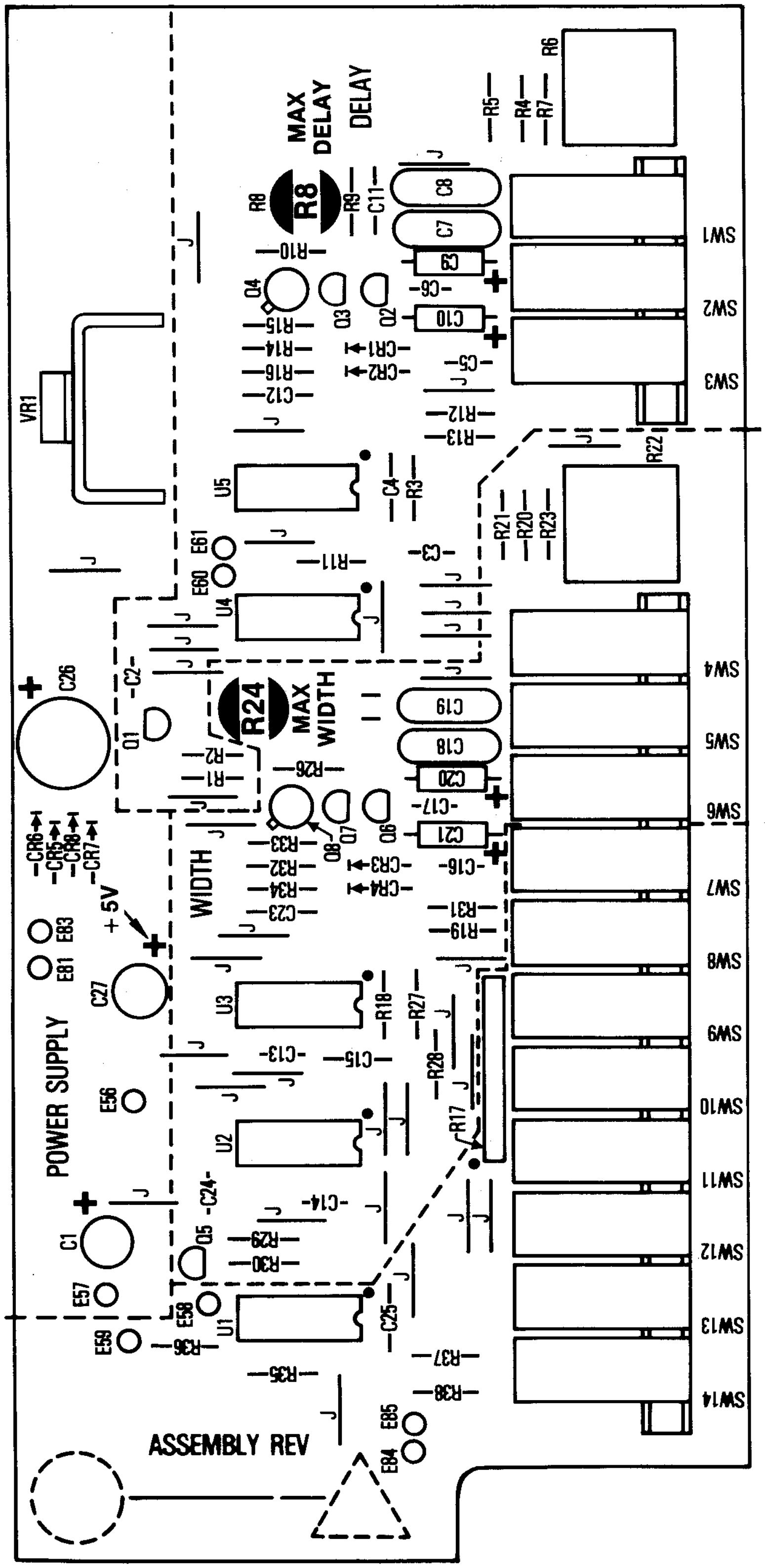


Figure 5-2. Pulse Board Alignment Points

Table 5-1. Alignment Procedure

NOTE: Open columns indicate previous entry remains applicable.

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	
Replace top cover, turn the instrument over and remove the bottom cover, make check of step 5 and replace the cover, turn the instrument over again and continue with step 6.							
5			C27 +			+ 5 ± .25V	
6	Capacitor Multiplier Zero		SW3-B		R90 CAP MULT ZERO	0V ± 2mV	
7	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	
8	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
9	Bottom of the Dial Frequency	Counter		FREQ MULT: × 1K	R37 LO LIN	350 ± 50 ms period	
10	Top of the Dial Symmetry	Scope		Dial: 4.0	R45 HI BAL	Equalize (+) and (–) half cycles	Same method as step 8, except adjust R45.
11	Top of the Dial Frequency	Counter		Dial: 4.0 FREQ MULT: × 1K	R19 VCG GAIN	4 + .02 kHz	
12				FREQ MULT: × 10K		40 ± .8 kHz	Verify
13				FREQ MULT: × 1M	C34 FREQ TRIM	4 ± .02 MHz	
14				FREQ MULT: × 100K		400 ± 8 kHz	Verify. If necessary, trim by changing value of C33
15				FREQ MULT: × 100	R86 CAP MULT	2.5 ± .05 ms	
16				FREQ MULT: × 10		25 ± .5 ms	Verify

Table 5-1. Alignment Procedure (Continued)

Step	Check	Tester	Test Point	Control Setting	Adjust	Result	Remark
17				FREQ: ×1		250 ±5 ms	Verify
18	Sine Distortion	Distortion Analyzer		FUNCTION: ∿ FREQ MULT: ×1K	R97 SIN LEVEL R114 DISTORTION	Adjust for minimum distortion	It may be necessary to reduce amplitude to 5V peak
19	Output Amplitude	Scope		FUNCTION: ∿	R118 OUTPUT AMPL	10 Vp-p (+.3V/−0V)	
20	Output Offset	Voltmeter		FUNCTION: ∿	R112 OFFSET	0 ±50 mV	
21	Baseline Zero	Scope		MODE: Trigger	R81 BASELINE ZERO	0 ±75 mV	It may be necessary to trim the baseline with R80

Replace top cover, turn the instrument over and remove the bottom cover. The following adjustments will be on the pulse board.

Step	Check	Tester	Test Point	Control Setting	Adjust	Result	Remark
22	Pulse Width			MODE: CONT FREQ MULT: 10K FUNCTION: ⎍ PULSE MODE: DLY OFF WIDTH RANGE: .1μs-10μs WIDTH Vernier: MAX PULSE/SQUARE: ⎍	R24 MAX WIDTH	12 (−0/+1) μs pulse width as shown in fig. 5-3.	Scope horizontal: 2 μs/div Scope trigger. External Trigger Source: 187 SYNC OUT.
23	Pulse Delay			PULSE MODE: DLY ON DELAY RANGE: .1μs-10μs DELAY Vernier: MAX	R8 MAX DELAY	12 (−0/+1) μs pulse delay as shown in fig. 5-4.	Pulse delay is relative to sync output.

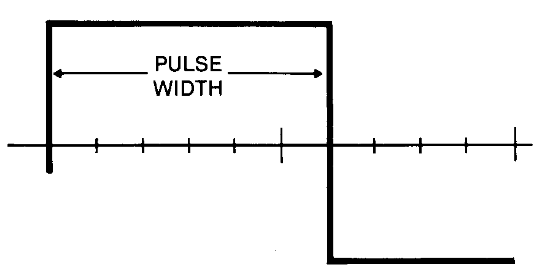


Figure 5-3. Pulse Width

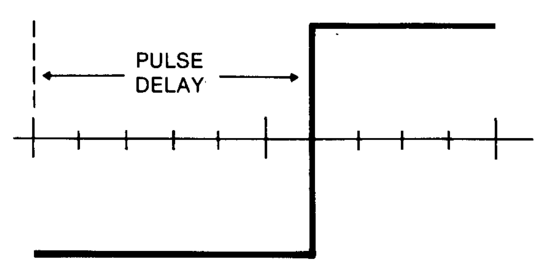
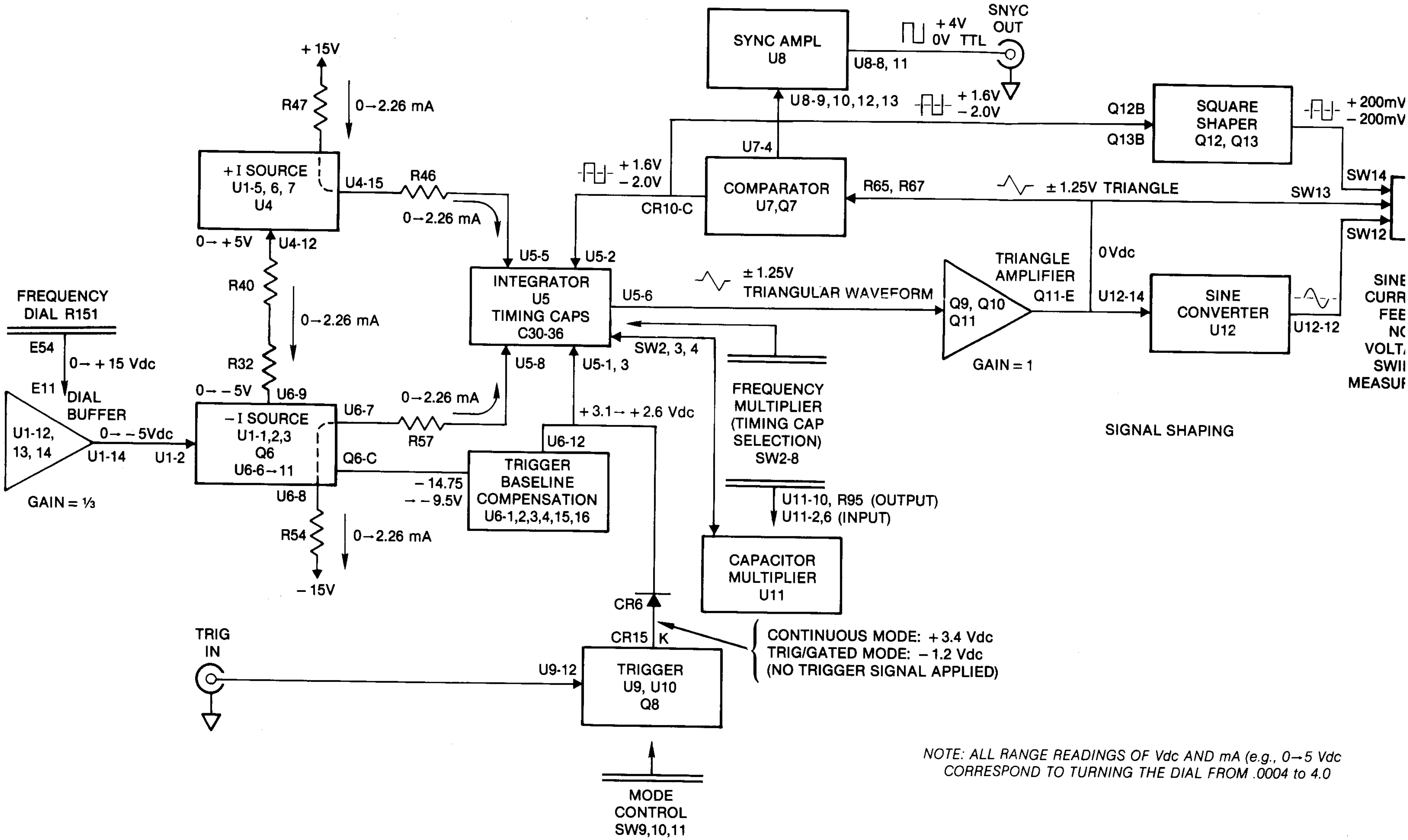


Figure 5-4. Pulse Delay



NOTE: ALL RANGE READINGS OF Vdc AND mA (e.g., 0→5 Vdc CORRESPOND TO TURNING THE DIAL FROM .0004 to 4.0

Figure 6-1. Generator Board Troubleshooting Block Diagram

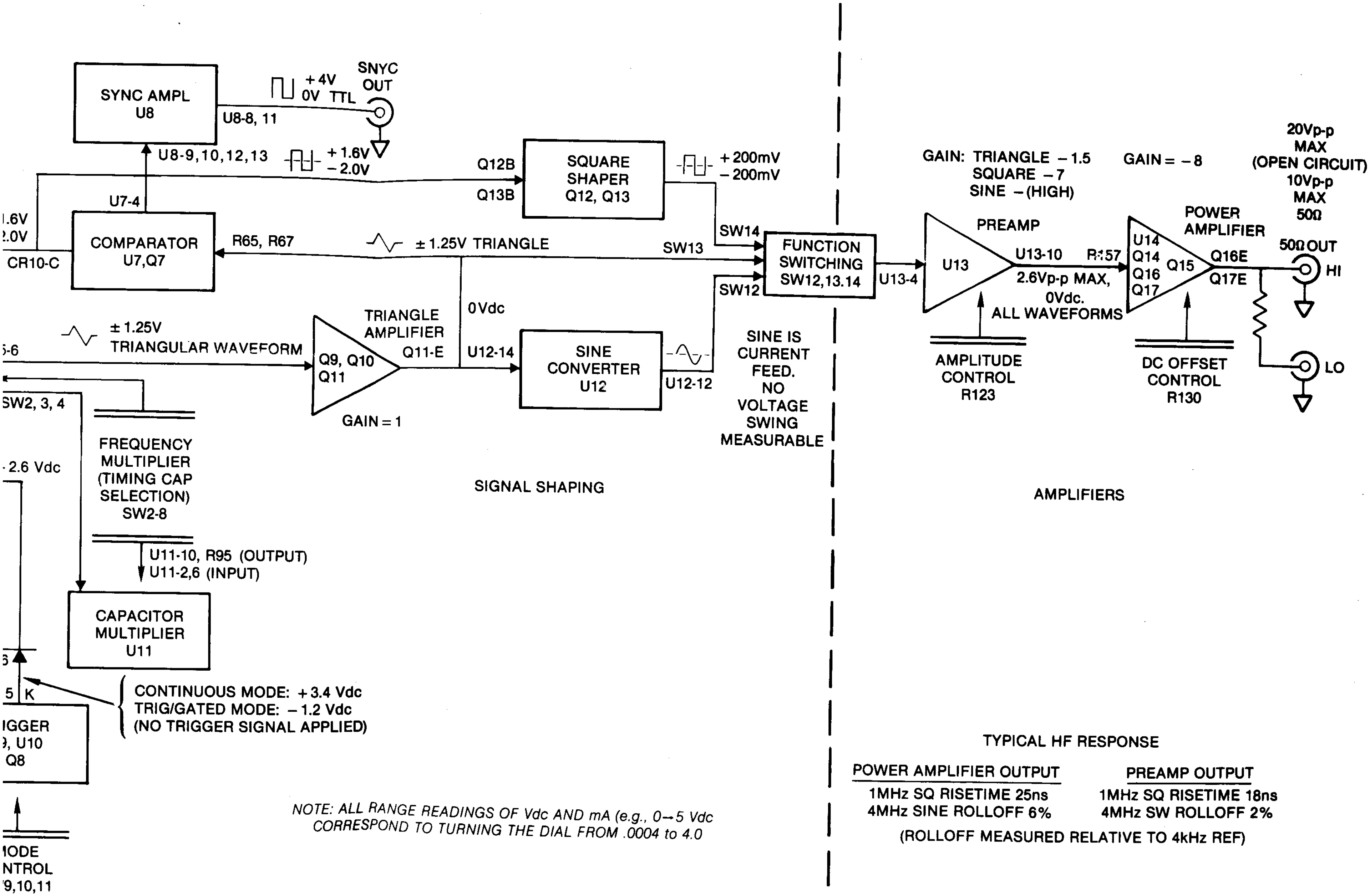


Figure 6-1. Generator Board Troubleshooting Block Diagram

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 BEFORE YOU START

CAUTION

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

Since no troubleshooting guide can possibly cover all the potential problems, the aim of this guide is to give a methodology which if applied consistently will lead to the problem area.

This troubleshooting guide is arranged to aid you in meeting the following goals.

1. Symptom recognition (listing of possible problem).
2. Symptom elaboration (front panel manipulation to isolate problems).
3. Isolation to the faulty function.
4. Isolation to the faulty circuit.
5. Isolation to the faulty component.

The functional blocks and their purpose are listed in table 6-1 as a supplement to figures 4-1 and 6-1. All information presented will revolve around this list. Figure 6-1 is the generator board portion of figure 4-1 annoted with troubleshooting data.

Table 6-1. Purpose of Each Circuit

Functional Block	Purpose
Power Supply	Supply regulated ±15 Vdc and ±5 Vdc to all circuits.
Dial Buffer	Buffer amplifier (voltage gain = −⅓). For isolation between the frequency dial pot and the following circuits.
−I Source	Constant current source (negative). The output level of which can be set from 0 to approximately 2.26 mA by the output of the dial buffer. The current output, applied to the integrator, results in the linear negative-going triangle slope. The −I source also outputs a second 0 to 2.26 mA to the +I source.
+I Source	Constant current source (positive). The output level of which can be set from 0 to approximately 2.26 mA by the output (U6-9) of the −I source. The current output, applied to the integrator, results in the linear positive-going triangle slope.

Table 6-1. Purpose of Each Circuit (continued)

Functional Block	Purpose
Integrator	Forms a linear triangular waveform as a result of alternate application of + and − charging current to a timing capacitor. Alternation is controlled by a square-wave signal applied from the comparator. This is accomplished through the use of a diode bridge, timing capacitors and appropriate range switching.
Triangle Buffer	Unity-gain FET-input noninverting buffer amplifier. Provides sufficient drive for the following circuits.
Comparator	Monitors the output of the triangle buffer and provides a control signal to the integrator that results in the generation of alternate positive- and negative- going linear ramps. The input of the comparator contains peak detection circuits that determine the ±1.25V peak levels of the resultant triangular Waveform. The input circuits also contain R-C lead networks which "roll off" the triangle peaks during high frequency operation. The networks compensate for normal circuit delays, thus maintaining good dial tracking in the X100K and X1M frequency ranges. The control signal output to the integrator takes the form of a square wave which is also applied to trigger, sync and square shaper circuits.
Capacitor Multiplier	Used only in X1, X10 and X100 frequency multiplier ranges, this circuit shunts 90% (in X100), 99% (in X10) or 99.9% in (X1) of the current available from the ± I sources away from the timing capacitor, effectively "multiplying" the value of the timing capacitor by 10, 100 or 1000.
Sync Amplifier	Provides TTL level square wave (fan-out of 20) at the generator frequency to the front panel.
Trigger	Provides non-continuous generator operation by controlling application of the ± charging currents to the timing capacitor. In triggered mode, one cycle of waveform is generated each time the trigger input is driven to a TTL high level. In gated mode, the generator continues to run as long as the trigger input is held at a TTL high.
Trigger Baseline Compensation	Ensures that the output of the integrator remains at 0Vdc in triggered/gated operation with no trigger input.

Table 6-1. Purpose of Each Circuit (continued)

Functional Block	Purpose
Square Shaper	Conditions the square wave from the comparator to proper amplitude and waveshape by clipping the top and bottom of the waveform.
Sine Coverter	Inputs triangular waveform and, through the use of nonlinear resistor-diode circuitry, outputs a sinusoidal current.
Preamp	Inputs selected waveform and amplifies it to 2.6Vp-p for input to the power amplifier. Gain is -1.5 in triangle, -7 in square. It is current fed.
Power Amplifier	Complementary symmetry amplifier. Capable of delivering 10Vp-p into 50Ω. Gain is -8 (open circuit) -4 (into 50Ω)
Width One-shot	Variable Width.
Delay One-shot	Variable Delay
Control Logic	Control.

6.3 STARTING

When confronted with a problem, intially check the power supplies (figure 6-2). Once the power supplies are determined to be good, use the front panel manipulation to isolate the problem and refer to table 6-2, an index of the troubleshooting tables by indications of common problems. Table 6-2 and referenced figures 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.

Once the problem is isolated to the smallest possible number of components, test individual components. Paragraph 6.4 suggests methods of testing many of the commonly used components.

6.4 TROUBLESHOOTING INDIVIDUAL COMPONENTS

6.4.1 Transitor

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 500mV forward voltage (or reversed bias), the transitor 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.

6.4.2 Diode

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

Table 6-2. Fault Isolation

Note: Return as many of the front panel controls as possible to their initial settings and still retain the problem. The troubleshooting tables 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
MODE	CONT
FREQ. MULT	1K
FUNCTION	
PULSE MODE	
PULSE/SQUARE OUTPUT	NORM,
DC OFFSET	OFF
AMPLITUDE	MAX

Problem	Figure
Power Supply	6-2
Symmetry or Frequency (Power Supplies OK)	6-3
Improper Amplitude or Waveshape of Any Function	6-5
No Output (Power Supplies OK)	6-6
No Square and Pulse Output Only (Power Supplies OK)	6-7

6.4.3 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 "−" input voltage, or vice versa; otherwise, the operational amplifier is defective.

6.4.4 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.

6.4.5 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.

6.4.6 Digital TTL IC's (e.g. 7400 Series)

1. The device is operating correctly if the output high state is > +2.4V and low state is < +0.5V.

2. The input must show the same two levels as in step 1. If the levels are between +0.8V and +2.0V, the connection to the driving circuit output is open.

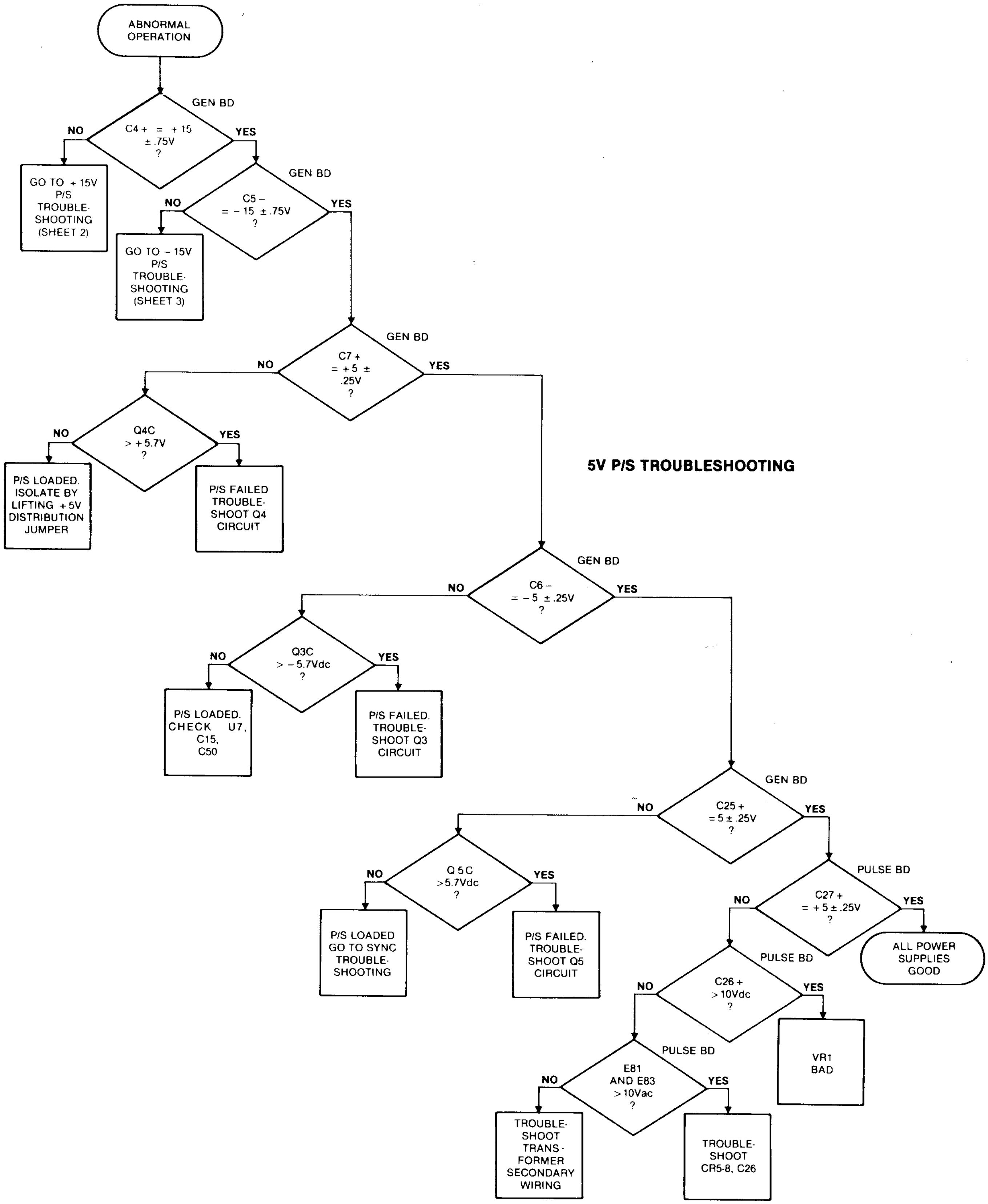


Figure 6-2. Power Supply Troubleshooting (Sheet 1)

+ 15V P/S TROUBLESHOOTING

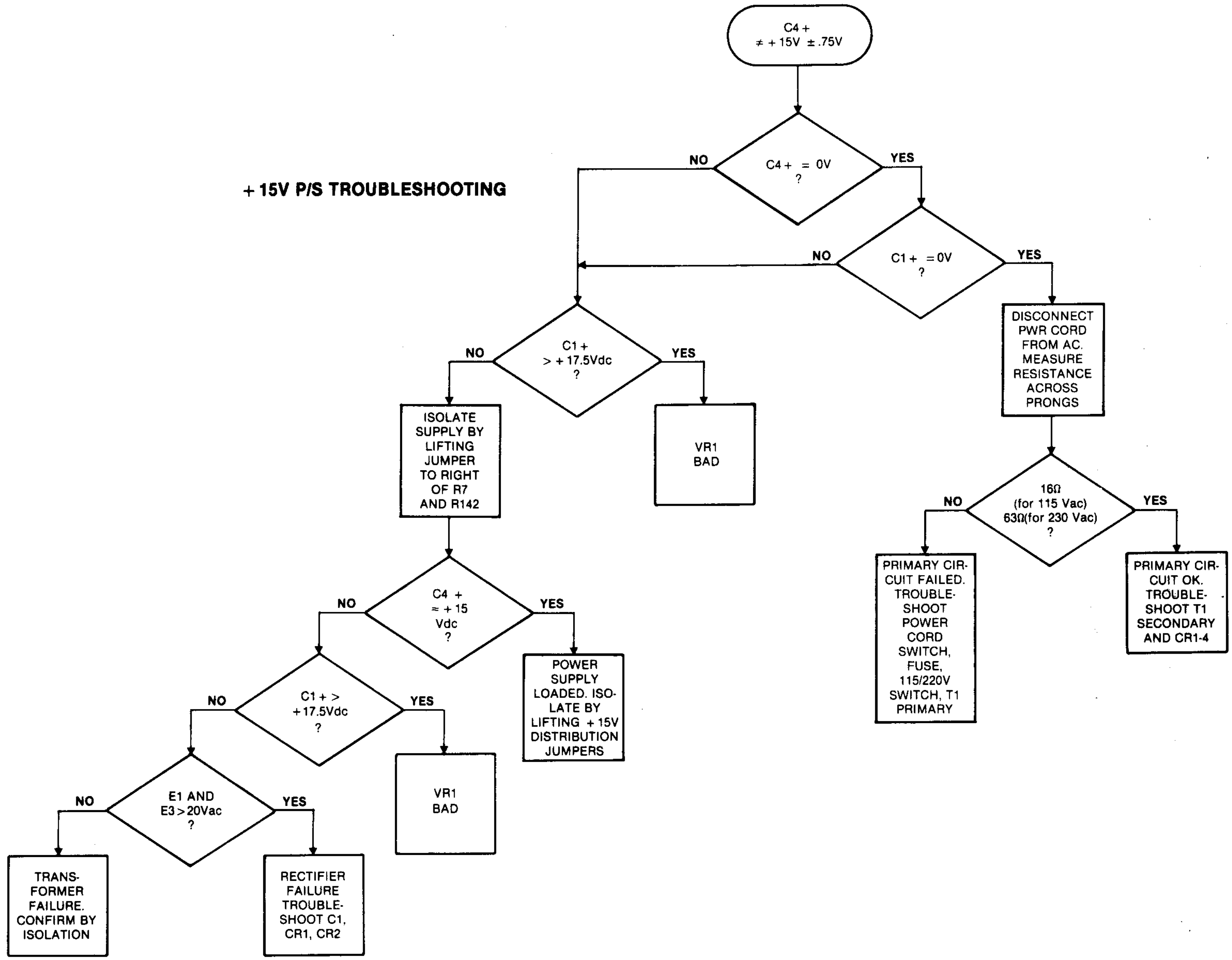


Figure 6-2. Power Supply Troubleshooting (Sheet 2)

– 15V P/S TROUBLESHOOTING

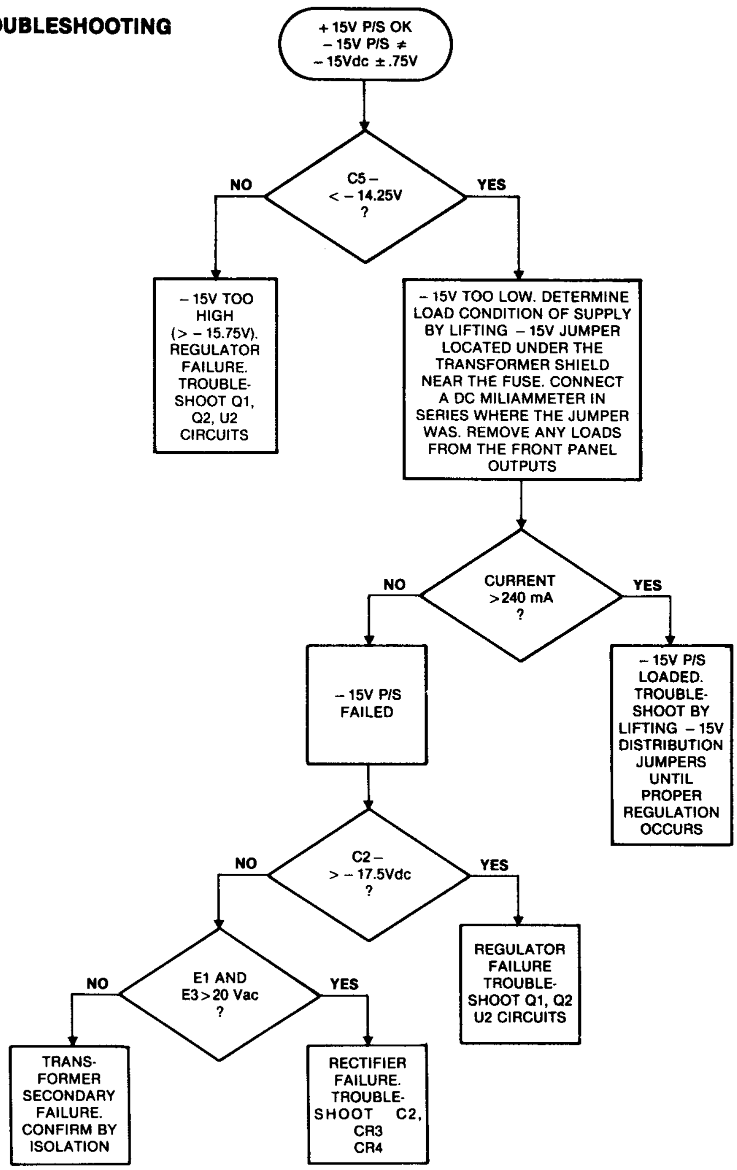


Figure 6-2. Power Supply Troubleshooting (Sheet 3)

NOTES ON BOTTOM-OF-DIAL (BOD) FAILURES

If BOD symmetry will not adjust, go to triangle mode and inspect linearity of the waveform.

Curvature of both sides of the triangle indicates a leak on line or in U5. Check BOD on X1K through X1M to check timing capacitors C30-C33. Measure voltage drop across R51: If any current is flowing, problem is in Q9, C34, C35, C36. If no current is flowing, problem is in U5.

A non-symmetrical triangle with or without curvature on one side only is an indication of failure in one current source or a leaky diode in U5. Determination of the failed circuit can be made by the following steps:

1. Measure voltage drop across R32 or R40. These drops should be equal and be in the 2 to 20 mV range.
2. Measure drops across R47 and R54. If either of these voltages is different from that measured in step 1, the problem lies in the circuit which shows the different voltage; that is, if the drop across R47 is different, problem is U4. If the voltage across R54 is different, the problem is U6. If all drops appear good, the problem is probably in U5. If changing U5 yields no improvement, the problem may still be a very small leak on the triangle generation line Q9, C34, C35, C36.

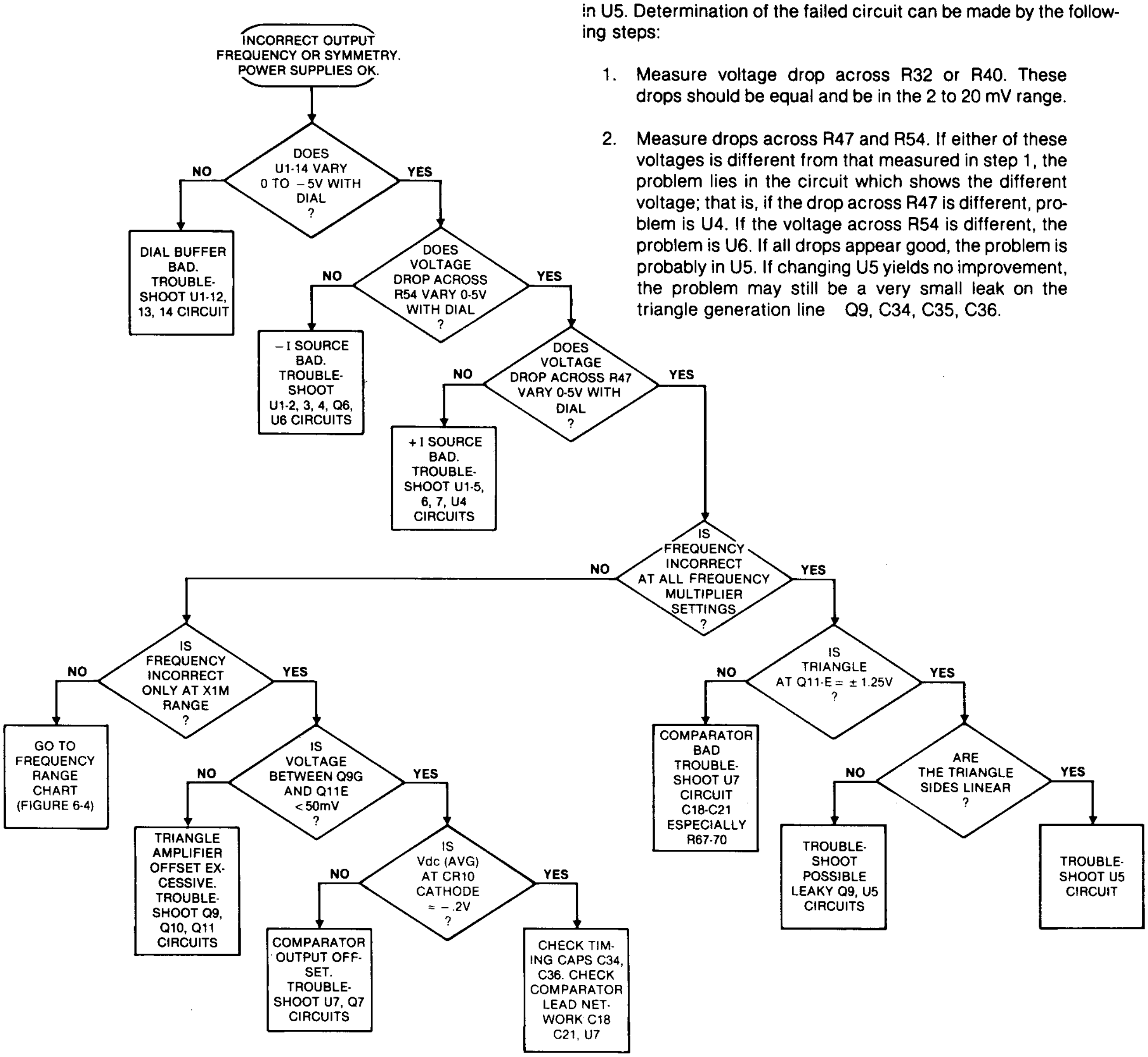


Figure 6-3. Symmetry or Frequency Problems

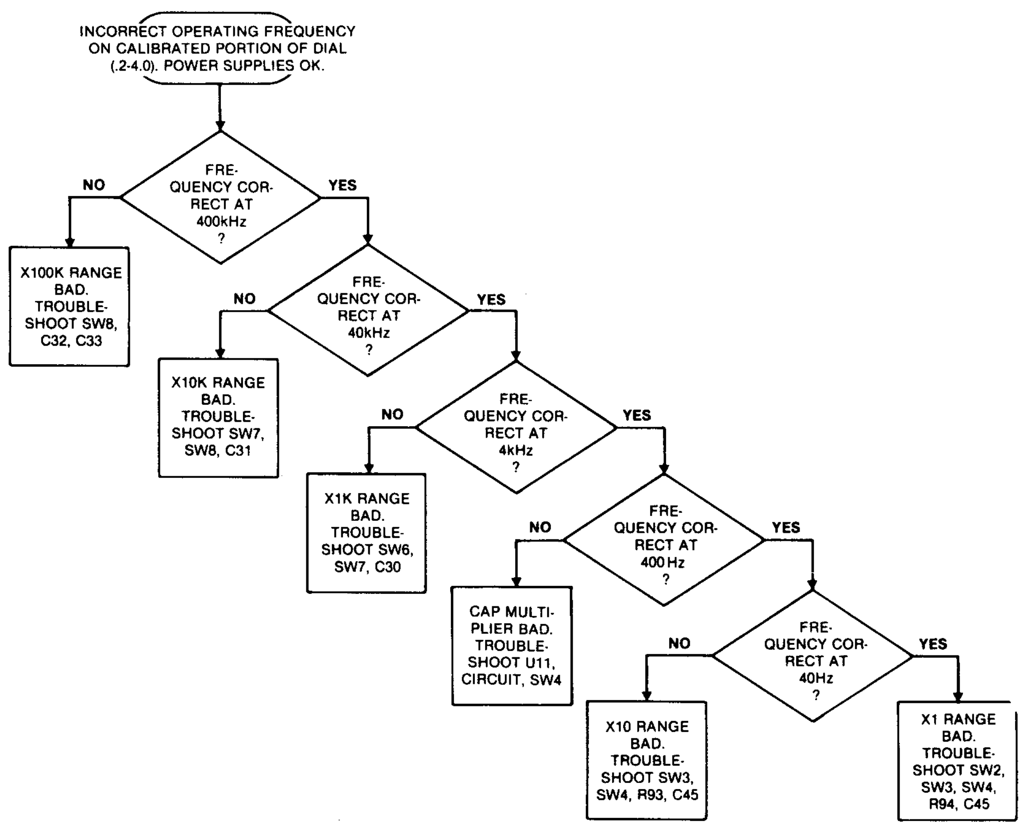


Figure 6-4. Frequency Calibration Problems

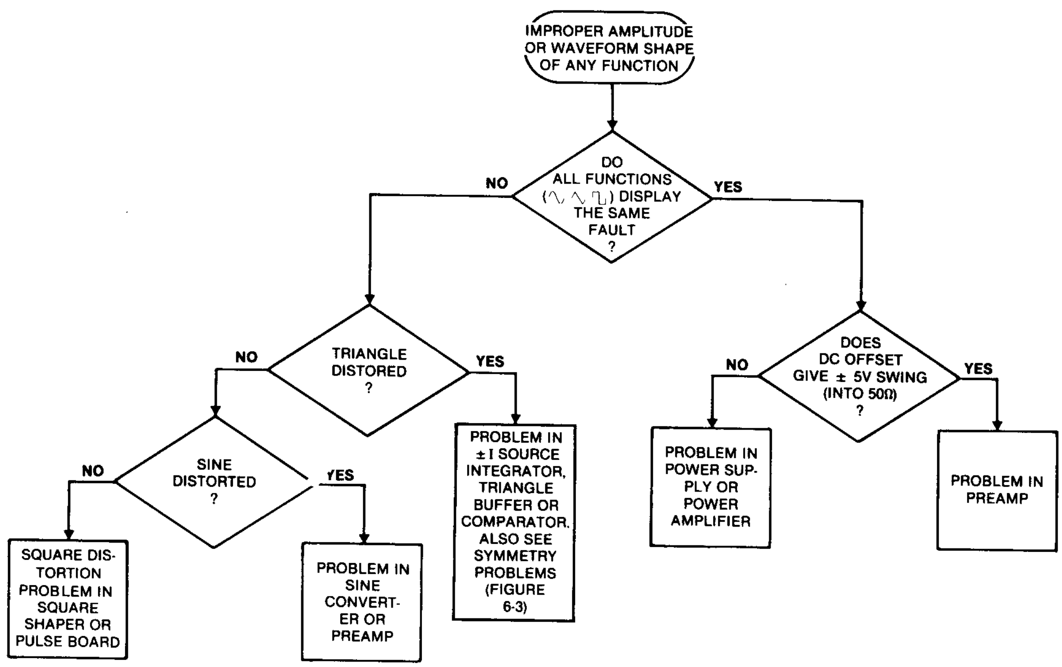


Figure 6-5. Improper Amplitude or Waveshape

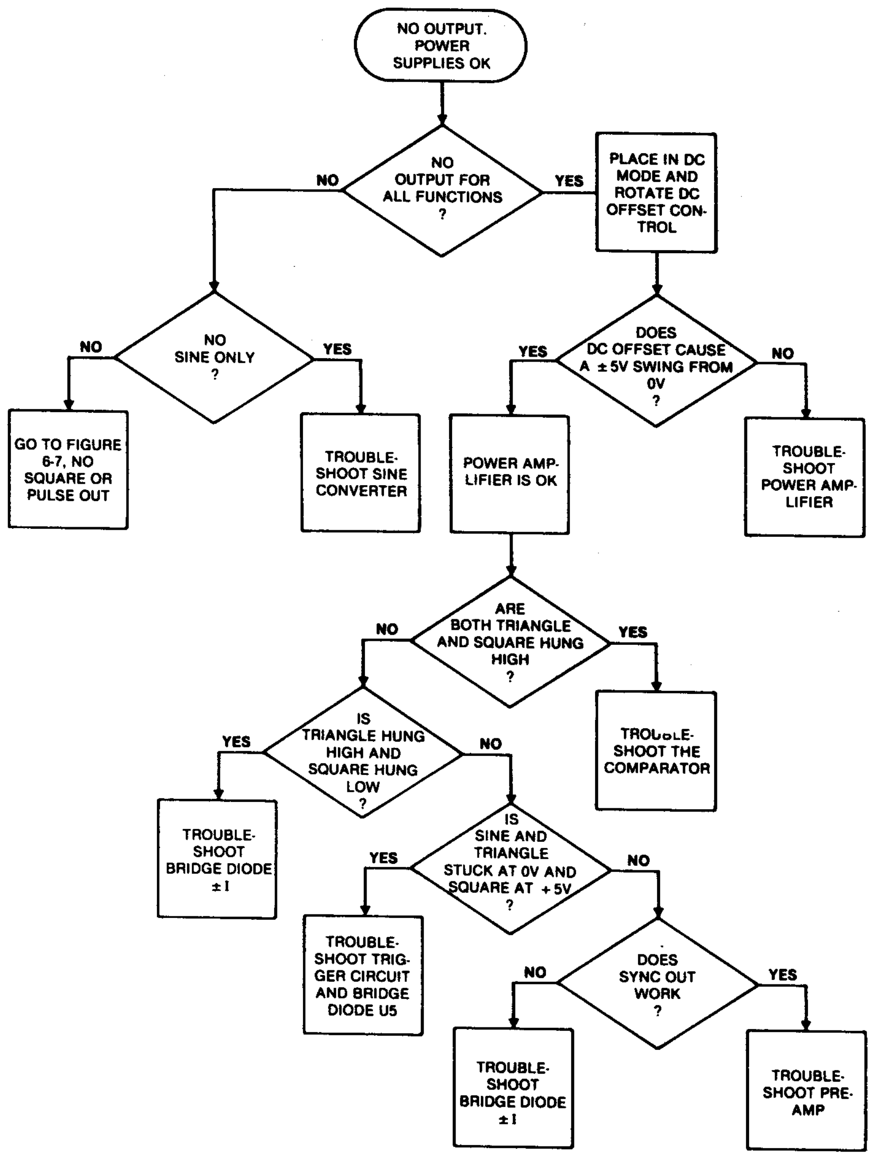


Figure 6-6. No Output

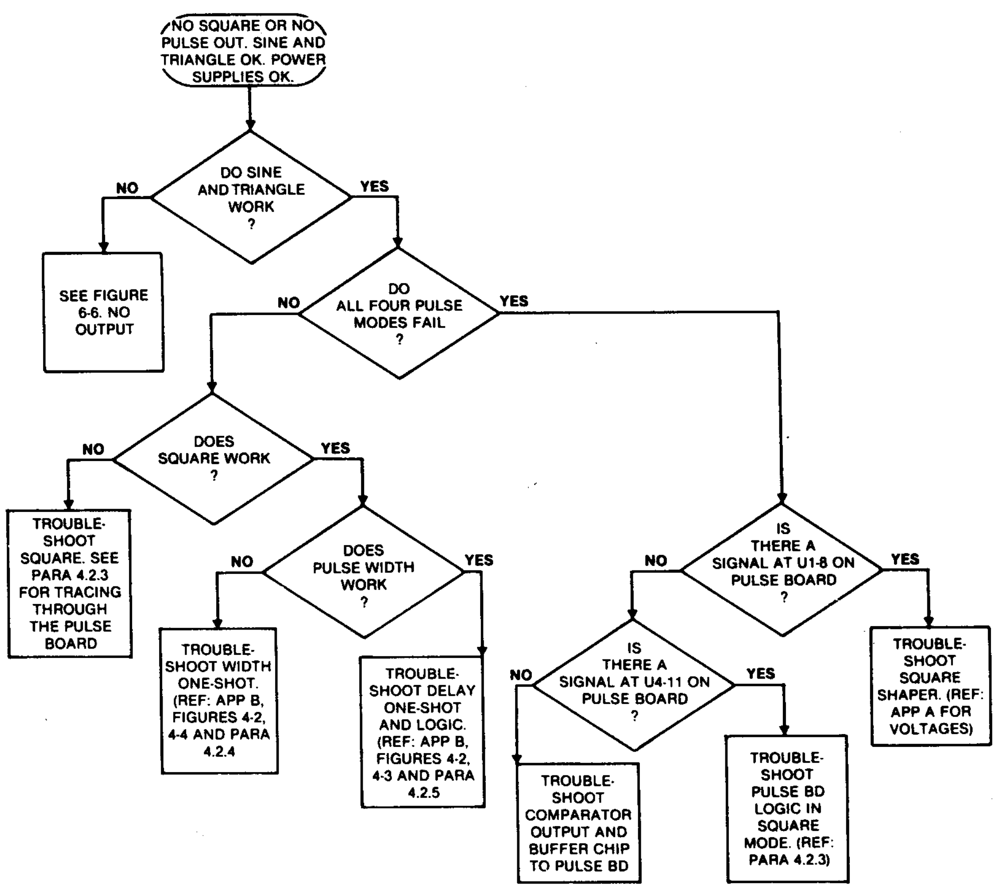


Figure 6-7. No Square or No Pulse Output Only

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 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as develop ment 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 sumarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

7.3 ORDERING PARTS

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

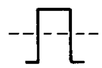
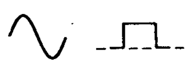
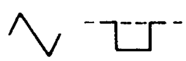
NOTE

An assembly drawing number is not necessarily the assembly part number. However, the assembly parts list number is the assembly part number.

Drawing	Drawing No.
Instrument Schematic	0004-00-0174
Chassis Assembly	0102-00-0844
Chassis Parts Lists	1101-00-0844
Generator Board Schematic	0103-00-0850
Generator Board Assembly	1100-00-0850
Generator Board Parts List	1100-00-0850
Pulse Board Schematic	0103-00-0843
Pulse Board Assembly	1100-00-0843
Pulse Board Parts List	1100-00-0843

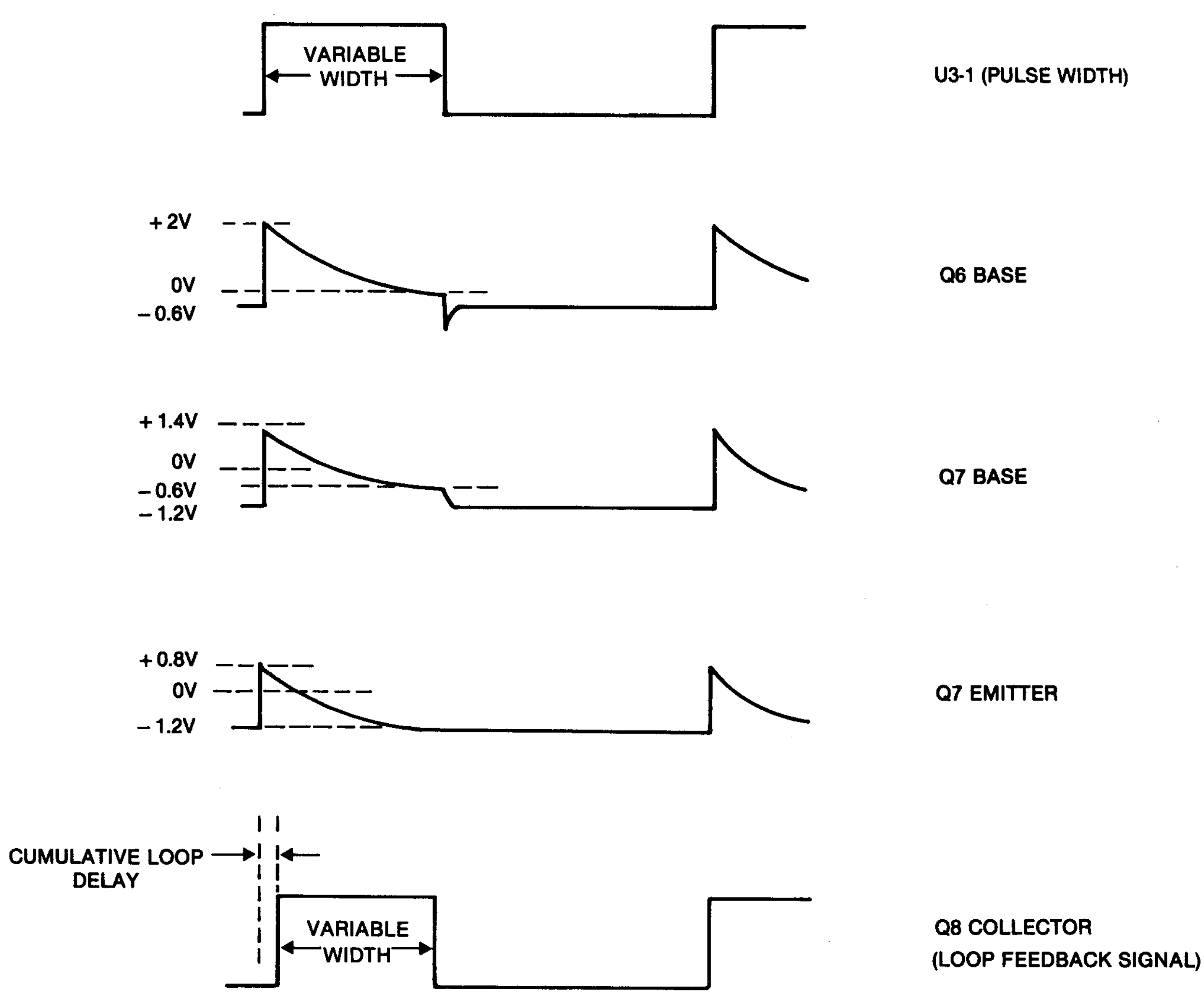
APPENDIX A

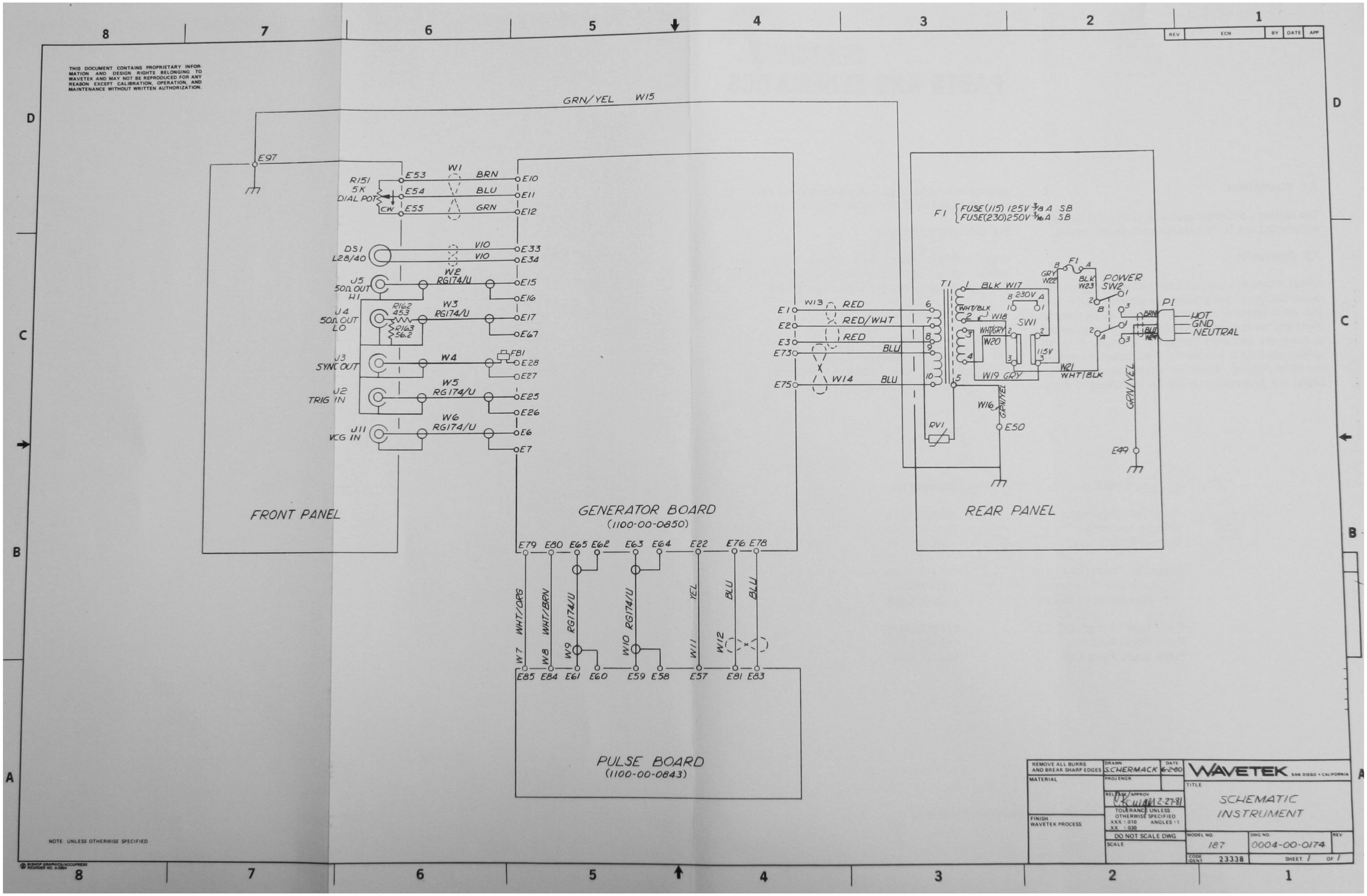
SQUARE SHAPER CONTROL VOLTAGES (MAIN BOARD)

	CR31 Cathode	CR30 Anode
	+ 15V	− 3.4V
	+ 15V	+ 2.4V
	− 2.5V	− 3.4V
	− 2.5V	+ 2.5V
	− 2.5V	+ 2.5V
	− 2.5V	+ 4.3V
	− 2.5V	+ 4.3V

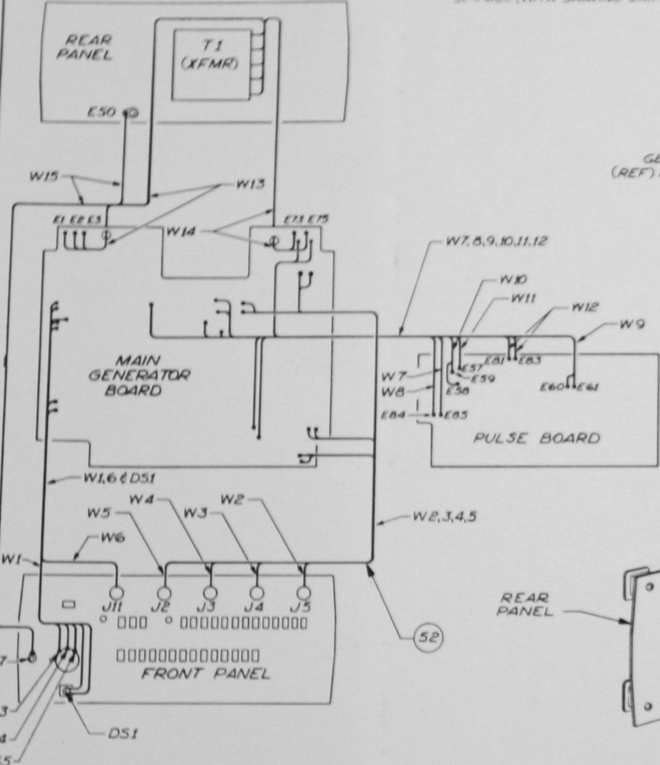
APPENDIX B

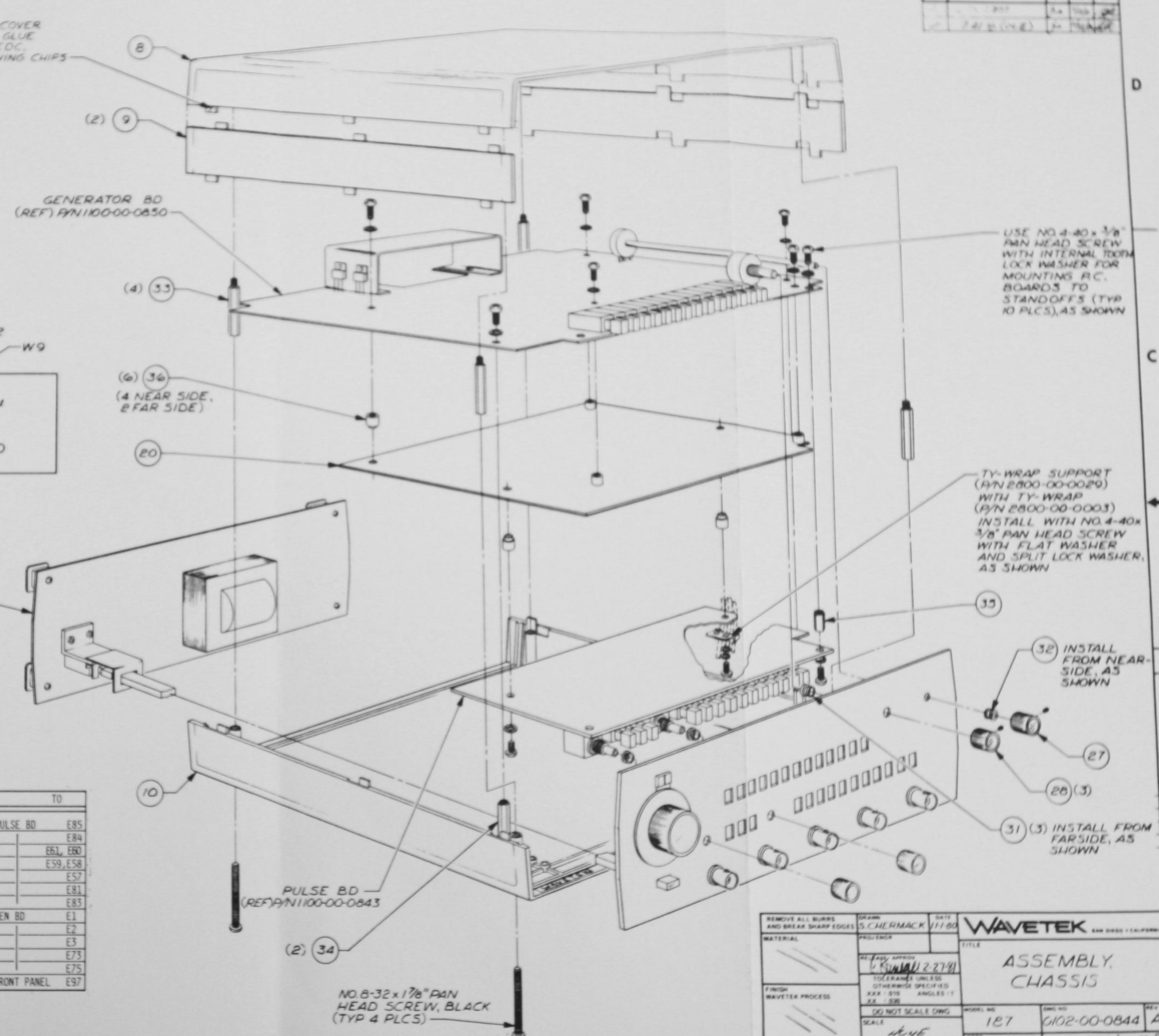
WIDTH ONE-SHOT WAVEFORMS (BOTH ONE-SHOTS IDENTICAL)




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.
GRN/YEL W15
E97
R151 5K DIAL POT
CW
E53
E54
E55
W1
BRN
BLU
GRN
E10
E11
E12
DS1 L28/40
V10
V10
E33
E34
J5 50Ω OUT HI
W2 RG174/U
E15
E16
J4 50Ω OUT LO
R162 453
R163 56.2
W3 RG174/U
E17
E67
J3 SYNC OUT
W4
FB1
E28
E27
J2 TRIG IN
W5 RG174/U
E25
E26
J11 VCG IN
W6 RG174/U
E6
E7
FRONT PANEL
GENERATOR BOARD
(1100-00-0850)
E79 E80 E65 E62 E63 E64 E22 E76 E78
W7 WHT/ORG
W8 WHT/BRN
W9 RG174/U
W10 RG174/U
W11 YEL
W12 BLU BLU
E85 E84 E61 E60 E59 E58 E57 E81 E83
PULSE BOARD
(1100-00-0843)
E1 E2 E3 E73 E75
W13 RED
RED/WHT
RED
BLU
W14 BLU
F1 FUSE(115) 125V 3/8A SB
FUSE(230) 250V 3/16A SB
T1
BLK W17
WHT/BLK
W18
WHT/GRY
W20
W19 GRY
230V
115V
SW1
GRY W22
F1
BLK W23
POWER SW2
W21 WHT/BLK
P1
BRN
BLU
HOT
GND
NEUTRAL
GRN/YEL
W16
E50
RV1
E49
REAR PANEL
NOTE: UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DRAWN S.CHERMACK
DATE 6-2-80
PROJ ENGR
RELEASE/APPROV
12-27-81
TOLERANCE UNLESS OTHERWISE SPECIFIED
XXX ±.010 ANGLES ±1
XX ±.030
DO NOT SCALE DWG
SCALE
WAVETEK SAN DIEGO • CALIFORNIA
TITLE
SCHEMATIC
INSTRUMENT
MODEL NO. 187
DWG NO. 0004-00-0174
REV
CODE IDENT 23338
SHEET 1 OF 1

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.





CHASSIS WIRING LIST

REF DES.	COLOR	FROM	TO
W1	BRN	GEN BD - E 10	FRONT PANEL - E53
	BLU	E 11	E54
	GRN	E 12	E55
W2	COAX	E15, E 16	J 5
W3		E17, E 62	J 4
W4		E28, E 27	J 3
W5		E25, E 26	J 2
W6		E 6, E 7	J11

REF DES.	COLOR	FROM		TO	
W7	W/ORN	GEN BD	E79	PULSE BD	E85
W8	W/BRN		E80		E84
W9	COAX		E65, E62		E61, E60
W10	COAX		E63, E64		E59, E58
W11	YEL		E22		E57
W12	BLU		E76		E81
	BLU		E78		E83
W13	RED	REAR PANEL	T1-6	GEN BD	E1
	RED/WHT		T1-7		E2
	RED		T1-8		E3
W14	BLU		T1-9		E73
	BLU		T1-10		E75
W15	GRN/YEL		E50	FRONT PANEL	E97

NOTE: UNLESS OTHERWISE SPECIFIED

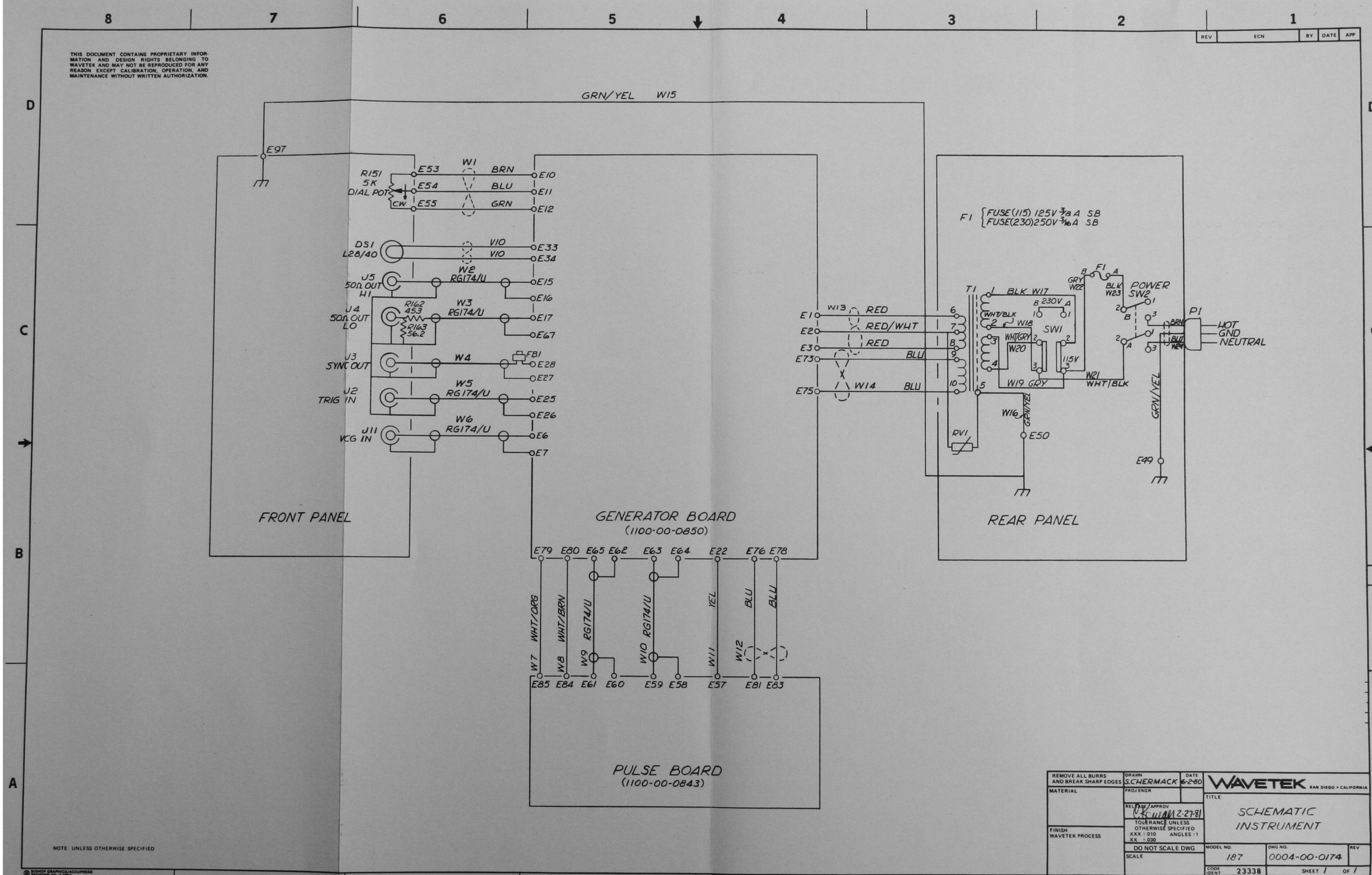
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN S. CHERMACK	DATE 11/80
MATERIAL	PROJ ENGR	
FINISH WAVETEK PROCESS	REL ENG APPROV 2-27-81	
	TOLERANCES UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES ± 1° XX ± .030	
	DO NOT SCALE DWG	
	SCALE NONE	

WAVETEK SAN DIEGO / CALIFORNIA

TITLE: ASSEMBLY, CHASSIS

MODEL NO. 187 — DWG NO. 0102-00-0844 — REV A

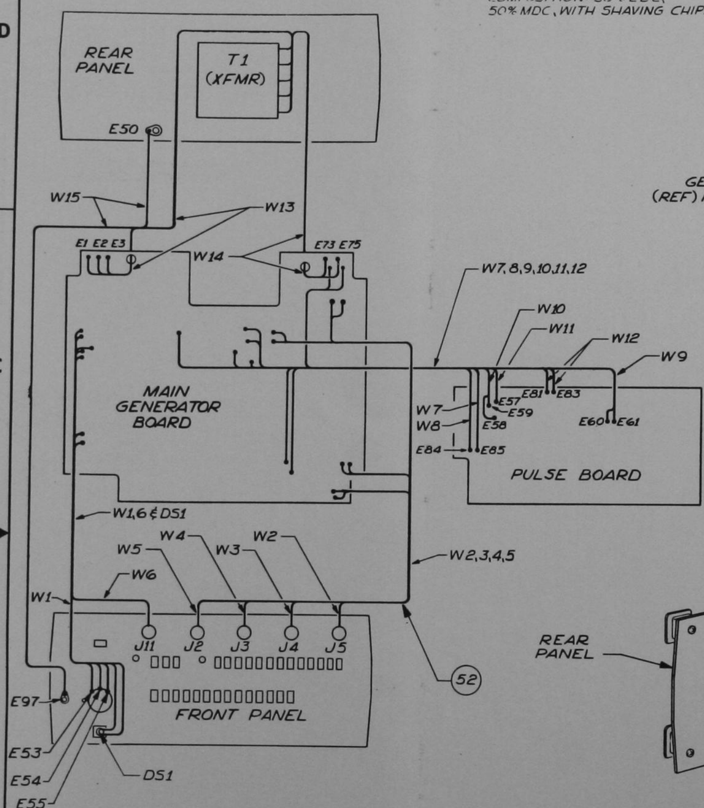
CODE IDENT 23338 — SHEET 1 OF 2

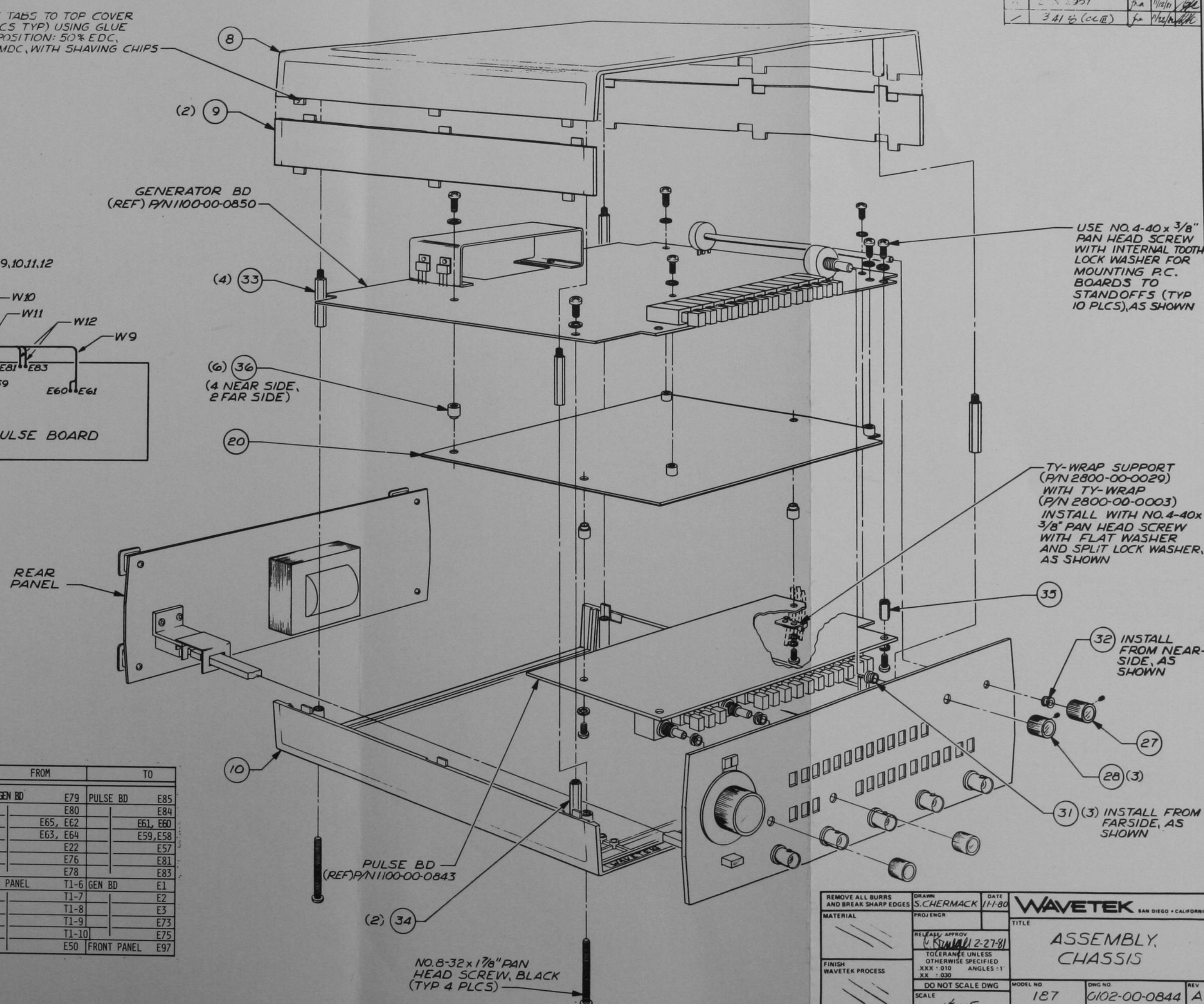


THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.
GRN/YEL W15
E97
R151 5K DIAL POT
CW
E53 E54 E55
W1 BRN BLU GRN
E10 E11 E12
DS1 L28/40
VIO VIO
E33 E34
J5 50Ω OUT HI
W2 RG174/U
E15 E16
J4 50Ω OUT LO
R162 453
R163 56.2
W3 RG174/U
E17 E67
J3 SYNC OUT
W4
FB1
E28 E27
J2 TRIG IN
W5 RG174/U
E25 E26
J11 VCG IN
W6 RG174/U
E6 E7
FRONT PANEL
GENERATOR BOARD
(1100-00-0850)
E79 E80 E65 E62 E63 E64 E22 E76 E78
W7 WHT/ORG
W8 WHT/BRN
W9 RG174/U
W10 RG174/U
W11 YEL
W12 BLU BLU
E85 E84 E61 E60 E59 E58 E57 E81 E83
PULSE BOARD
(1100-00-0843)
E1 E2 E3 E73 E75
W13 RED RED/WHT RED BLU
W14 BLU
F1 FUSE(115) 125V 3/8A SB
FUSE(230) 250V 3/16A SB
T1
BLK W17
WHT/BLK
W18
WHT/GRY
W20
W19 GRY
230V
115V
SW1
GRY W22
F1
BLK W23
POWER SW2
W21 WHT/BLK
BRN
BLU
P1
HOT
GND
NEUTRAL
W16 GRN/YEL
E50
RV1
GRN/YEL
E49
REAR PANEL
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH
WAVETEK PROCESS
DRAWN S.CHERMACK
DATE 6-2-80
PROJ ENGR
RELEASE APPROV
2-27-81
TOLERANCE UNLESS OTHERWISE SPECIFIED
XXX ±.010 ANGLES ±1
XX ±.030
DO NOT SCALE DWG
SCALE
WAVETEK SAN DIEGO • CALIFORNIA
TITLE
SCHEMATIC
INSTRUMENT
MODEL NO. 187
DWG NO. 0004-00-0174
REV
CODE IDENT 23338
SHEET 1 OF 1
REV ECN BY DATE APP
NOTE: UNLESS OTHERWISE SPECIFIED

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.

REV	ECN	BY	DATE	APP
/	3414 (CC III)			





CHASSIS WIRING LIST

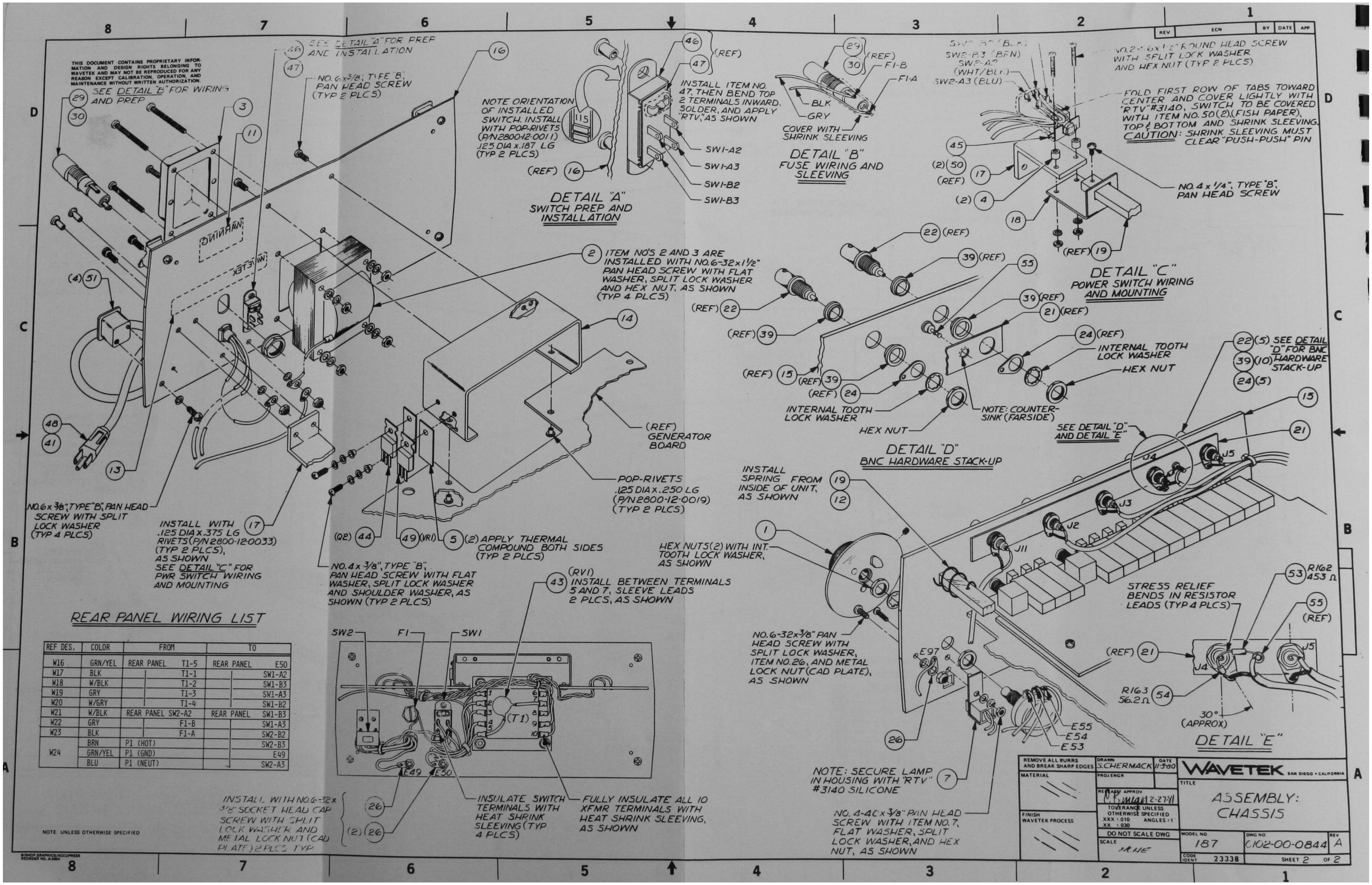
REF DES.	COLOR	FROM	TO
W1	BRN	GEN BD - E 10	FRONT PANEL - E53
	BLU	E 11	E54
	GRN	E 12	E55
W2	COAX	E15, E 16	J 5
W3		E17, E 67	J 4
W4		E28, E 27	J 3
W5		E25, E 26	J 2
W6		E 6, E 7	J11

REF DES.	COLOR	FROM		TO	
W7	W/ORN	GEN BD	E79	PULSE BD	E85
W8	W/BRN		E80		E84
W9	COAX		E65, E62		E61, E60
W10	COAX		E63, E64		E59, E58
W11	YEL		E22		E57
W12	BLU		E76		E81
	BLU		E78		E83
W13	RED	REAR PANEL	T1-6	GEN BD	E1
	RED/WHT		T1-7		E2
	RED		T1-8		E3
W14	BLU		T1-9		E73
	BLU		T1-10		E75
W15	GRN/YEL		E50	FRONT PANEL	E97

NOTE: UNLESS OTHERWISE SPECIFIED

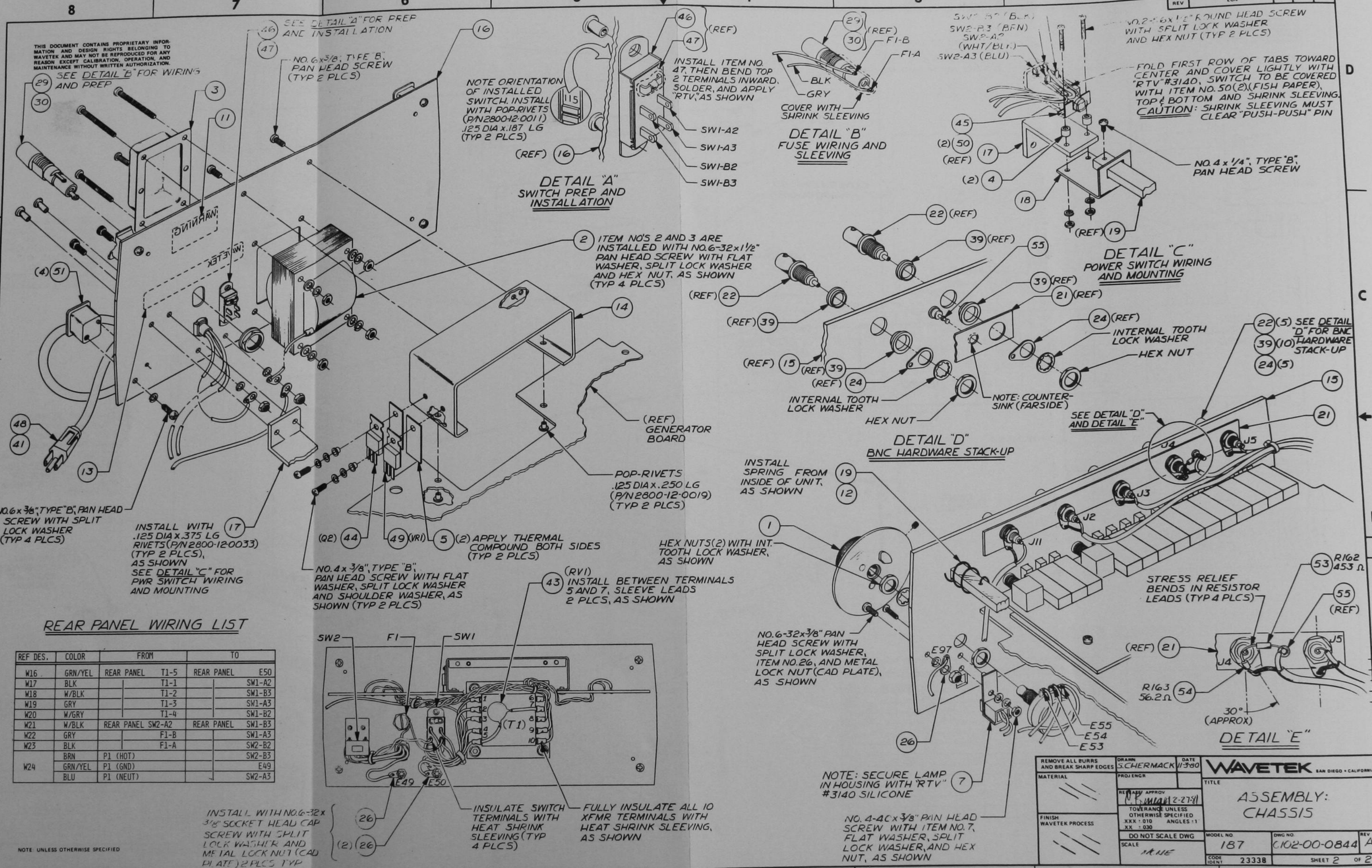
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN S. CHERMACK	DATE 11-1-80	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE ASSEMBLY, CHASSIS
FINISH WAVETEK PROCESS	RELEASE APPROV 2-27-81		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 XX ± .030 ANGLES ± 1°		
	DO NOT SCALE DWG		MODEL NO 187
	SCALE NONE		DWG NO 0102-00-0844 REV A
			CODE IDENT 23338 SHEET 1 OF 2

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-3894



REAR PANEL WIRING LIST

REF DES.	COLOR	FROM		TO	
W16	GRN/YEL	REAR PANEL	T1-5	REAR PANEL	E50
W17	BLK		T1-1		SW1-A2
W18	W/BLK		T1-2		SW1-B3
W19	GRY		T1-3		SW1-A3
W20	W/GRY		T1-4		SW1-B2
W21	W/BLK	REAR PANEL	SW2-A2	REAR PANEL	SW1-B3
W22	GRY		F1-B		SW1-A3
W23	BLK		F1-A		SW2-B2
W24	BRN	P1 (HOT)			SW2-B3
	GRN/YEL	P1 (GND)			E49
	BLU	P1 (NEUT)			SW2-A3



REAR PANEL WIRING LIST

REF DES.	COLOR	FROM		TO	
W16	GRN/YEL	REAR PANEL	T1-5	REAR PANEL	E50
W17	BLK		T1-1		SW1-A2
W18	W/BLK		T1-2		SW1-B3
W19	GRY		T1-3		SW1-A3
W20	W/GRY		T1-4		SW1-B2
W21	W/BLK	REAR PANEL	SW2-A2	REAR PANEL	SW1-B3
W22	GRY		F1-B		SW1-A3
W23	BLK		F1-A		SW2-B2
W24	BRN	P1 (HOT)			SW2-B3
	GRN/YEL	P1 (GND)			E49
	BLU	P1 (NEUT)			SW2-A3

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.

REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG, CHASSIS	N	0102-00	0102-00-0844	1
1	DIAL ASSY	182A-0028	WVTK	1201-00-0028	1
2	TRANSFORMER	5600-00-0025	WVTK	1204-00-0046	1
52	CHASSIS CABLE KIT	187-0877	WVTK	1207-00-0877	1
3	END BELL	110-333	WVTK	1400-00-0174	1
4	SPACER	8480	WVTK	1400-00-0653	2
36A	PLATE, NAME	139-305	WVTK	1400-00-2180	1
7	INDICATOR, DIAL	180-303	WVTK	1400-00-4970	1
1A	COVER, TOP	180-300-1	WVTK	1400-00-5000	1
9	EXPANDER	180-301	WVTK	1400-00-5010	2
51	POST	180-302	WVTK	1400-00-5020	4
2A	COVER, BOTTOM	180-300-2	WVTK	1400-00-5030	1
11	LABEL, WARNING	1400-00-6940	WVTK	1400-00-6940	1
12	SPRING, POWER ROD REF: 3200-01-0001	1400-00-8280	WVTK	1400-00-8280	1
50	INSULATOR, PWR SWITCH REF: 1600-99-0001	1400-00-8370	WVTK	1400-00-8370	2
14	BRACKET, AC SHIELD	1400-00-9473	WVTK	1400-00-9473	1
15	PANEL, FRONT	1400-01-1900	WVTK	1400-01-1900	1

WAVETEK PARTS LIST — TITLE: CHASSIS — ASSEMBLY NO. 1101-00-0844 — PAGE: 1 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
16	PANEL, REAR	1400-01-3253	WVTK	1400-01-3253	1
17	BRACKET, SWITCH MNTG	1400-01-3263	WVTK	1400-01-3263	1
18	BRACKET, POWER ROD	1400-01-3273	WVTK	1400-01-3273	1
19	POWER ROD	1400-01-3280	WVTK	1400-01-3280	1
20	SHIELD PLATE	1400-01-3293	WVTK	1400-01-3293	1
21	GROUNDING PLATE	1400-01-3303	WVTK	1400-01-3303	1
13	LABEL, RATING	1400-01-4610	WVTK	1400-01-4610	1
22	BNC CONN	KC-7946	KING	2100-01-0002	5
24	SOLDER LUG	1497	SMITH	2100-04-0012	5
26	SOLDER LUG	11A144	ZIER	2100-04-0025	4
55	TERMINAL, INSULATED	014-2001-00-0-479	SLTRO	2100-05-0054	1
27	KNOB, SMALL	0-M-9	ROGAN	2400-01-0010	1
28	KNOB, 1/4IN BUSHING	RB-67-0-M-9	ROGAN	2400-01-0017	3
29	FUSE, 3/8A, 250V, S-B	313.375	LITFU	2400-05-0009	1
30	FUSE HOLD	031.1653/031.1666	SCHUR	2400-05-0012	1
31	BUSHING NYLINER	4L2FF	THOMN	2800-01-0002	3
32	BUSHING(NYLINER)1/8	2L2FF	THOMN	2800-01-0005	1

WAVETEK PARTS LIST — TITLE: CHASSIS — ASSEMBLY NO. 1101-00-0844 — PAGE: 2 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
33	STANDOFF, MALE/FEMALE 1.750 H., .250 HEX 8-32	1475-M03-F05-832	UNICP	2800-02-0010	4
34	STANDOFF, MALE/FEMALE 2.50H., .250 HEX, 4-40	1499-M03-F05-440	UNICP	2800-02-0031	2
35	STANDOFF .625H., .250 HEX, 4-40	8835	SMITH	2800-02-0033	1
36	STANDOFF, SWAGE .281 H., .250 DIA 4-40, .062 MAT'L	BR6911B-0.281-3A	LYNTR	2800-03-0011	6
6	BAIL ASSY W/FT	180-500	WVTK	2800-08-0010	1
61	SPEEDNUT, SELF RETAIN	C7494-632-4	TINN	2800-09-0003	6
39	WASHER, SHOULDER	2668	SMITH	2800-27-0004	10
41	STRAIN RELIEF BUSH	SR6W-1	HEYCO	2800-37-0003	1
NONE	INSULATOR, MICA	64-21-023-106	ASHVL	3100-00-0006	3
53	RES, MF, 1/8W, 1%, 453	RN55D-4530	TRW	4701-03-4530	1
54	RES, MF, 1/8W, 1%, 56.2	RN55D-56R2F	TRW	4701-03-5629	1
43	VARISTOR	V56ZA8	GE	4799-00-0048	1
44	TRANS	TIP-30	TI	4902-00-0300	1
45	SWITCH ASSY PB	5103-00-0020	WVTK	5102-00-0005	1

WAVETEK PARTS LIST — TITLE: CHASSIS — ASSEMBLY NO. 1101-00-0844 — PAGE: 3 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
46	SWITCH ASSY SLIDE	46256-LF	SWCFT	5105-00-0002	1
47	SOLDER GUARD	46256-LF-SG	SWCFT	5105-09-0001	1
48	PWR CORD	0-7789-008-GY	PACRD	6001-80-0004	1
49	VOLTAGE REGULATOR	MC7815	MOT	7000-78-1500	1

WAVETEK PARTS LIST — TITLE: CHASSIS — ASSEMBLY NO. 1101-00-0844 — PAGE: 4 — REV C

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES

MATERIAL

FINISH: WAVETEK PROCESS

DRAWN | DATE

PROJ ENGR

RELEASE APPROV

TOLERANCE UNLESS OTHERWISE SPECIFIED: XXX ±.010, XX ±.030, ANGLES ±1°

DO NOT SCALE DWG

SCALE

WAVETEK SAN DIEGO • CALIFORNIA

TITLE: PARTS LIST CHASSIS

MODEL NO. 187 — DWG NO. 1101-00-0844 — REV C

CODE IDENT 23338 — SHEET 1 OF 1

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-5894

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.

REV	ECN	BY	DATE	APP

WAVETEK PARTS LIST — TITLE: CHASSIS — ASSEMBLY NO. 1101-00-0844 — PAGE: 1 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG, CHASSIS	N	0102-00	0102-00-0844	1
1	DIAL ASSY	182A-0028	WVTK	1201-00-0028	1
2	TRANSFORMER	5600-00-0025	WVTK	1204-00-0046	1
52	CHASSIS CABLE KIT	187-0877	WVTK	1207-00-0877	1
3	END BELL	110-333	WVTK	1400-00-0174	1
4	SPACER	8480	WVTK	1400-00-0653	2
36A	PLATE, NAME	139-305	WVTK	1400-00-2180	1
7	INDICATOR, DIAL	180-303	WVTK	1400-00-4970	1
1A	COVER, TOP	180-300-1	WVTK	1400-00-5000	1
9	EXPANDER	180-301	WVTK	1400-00-5010	2
51	POST	180-302	WVTK	1400-00-5020	4
2A	COVER, BOTTOM	180-300-2	WVTK	1400-00-5030	1
11	LABEL, WARNING	1400-00-6940	WVTK	1400-00-6940	1
12	SPRING, POWER ROD REF: 3200-01-0001	1400-00-8280	WVTK	1400-00-8280	1
50	INSULATOR, PWR SWITCH REF: 1600-99-0001	1400-00-8370	WVTK	1400-00-8370	2
14	BRACKET, AC SHIELD	1400-00-9473	WVTK	1400-00-9473	1
15	PANEL, FRONT	1400-01-1900	WVTK	1400-01-1900	1

WAVETEK PARTS LIST — TITLE: CHASSIS — ASSEMBLY NO. 1101-00-0844 — PAGE: 2 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
16	PANEL, REAR	1400-01-3253	WVTK	1400-01-3253	1
17	BRACKET, SWITCH MNTG	1400-01-3263	WVTK	1400-01-3263	1
18	BRACKET, POWER ROD	1400-01-3273	WVTK	1400-01-3273	1
19	POWER ROD	1400-01-3280	WVTK	1400-01-3280	1
20	SHIELD PLATE	1400-01-3293	WVTK	1400-01-3293	1
21	GROUNDING PLATE	1400-01-3303	WVTK	1400-01-3303	1
13	LABEL, RATING	1400-01-4610	WVTK	1400-01-4610	1
22	BNC CONN	KC-7946	KING	2100-01-0002	5
24	SOLDER LUG	1497	SMITH	2100-04-0012	5
26	SOLDER LUG	11A144	ZIER	2100-04-0025	4
55	TERMINAL, INSULATED	014-2001-00-0-479	SLTRO	2100-05-0054	1
27	KNOB, SMALL	O-M-9	ROGAN	2400-01-0010	1
28	KNOB, 1/4IN BUSHING	RB-67-0-M-9	ROGAN	2400-01-0017	3
29	FUSE, 3/8A, 250V, S-B	313.375	LITFU	2400-05-0009	1
30	FUSE HOLD	031.1653/031.1666	SCHUR	2400-05-0012	1
31	BUSHING NYLINER	4L2FF	THOMN	2800-01-0002	3
32	BUSHING(NYLINER)1/8	2L2FF	THOMN	2800-01-0005	1

WAVETEK PARTS LIST — TITLE: CHASSIS — ASSEMBLY NO. 1101-00-0844 — PAGE: 3 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
33	STANDOFF, MALE/FEMALE 1.750 H., .250 HEX 8-32	1475-M03-F05-832	UNICP	2800-02-0010	4
34	STANDOFF, MALE/FEMALE 2.50H, .250 HEX, 4-40	1499-M03-F05-440	UNICP	2800-02-0031	2
35	STANDOFF .625H, .250 HEX, 4-40	8835	SMITH	2800-02-0033	1
36	STANDOFF, SWAGE .281 H., .250 DIA 4-40, .062 MAT'L	BR6911B-0.281-3A	LYNTR	2800-03-0011	6
6	BAIL ASSY W/FT	180-500	WVTK	2800-08-0010	1
61	SPEEDNUT, SELF RETAIN	C7494-632-4	TINN	2800-09-0003	6
39	WASHER, SHOULDER	2668	SMITH	2800-27-0004	10
41	STRAIN RELIEF BUSH	SR6W-1	HEYCO	2800-37-0003	1
NONE	INSULATOR, MICA	64-21-023-106	ASHVL	3100-00-0006	3
53	RES, MF, 1/8W, 1%, 453	RN55D-4530	TRW	4701-03-4530	1
54	RES, MF, 1/8W, 1%, 56.2	RN55D-56R2F	TRW	4701-03-5629	1
43	VARISTOR	V56ZA8	GE	4799-00-0048	1
44	TRANS	TIP-30	TI	4902-00-0300	1
45	SWITCH ASSY PB	5103-00-0020	WVTK	5102-00-0005	1

WAVETEK PARTS LIST — TITLE: CHASSIS — ASSEMBLY NO. 1101-00-0844 — PAGE: 4 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
46	SWITCH ASSY SLIDE	46256-LF	SWCFT	5105-00-0002	1
47	SOLDER GUARD	46256-LF-SG	SWCFT	5105-09-0001	1
48	PWR CORD	0-7789-008-GY	PACRD	6001-80-0004	1
49	VOLTAGE REGULATOR	MC7815	MOT	7000-78-1500	1

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DRAWN / DATE
PROJ ENGR
RELEASE APPROV
TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030
DO NOT SCALE DWG
SCALE

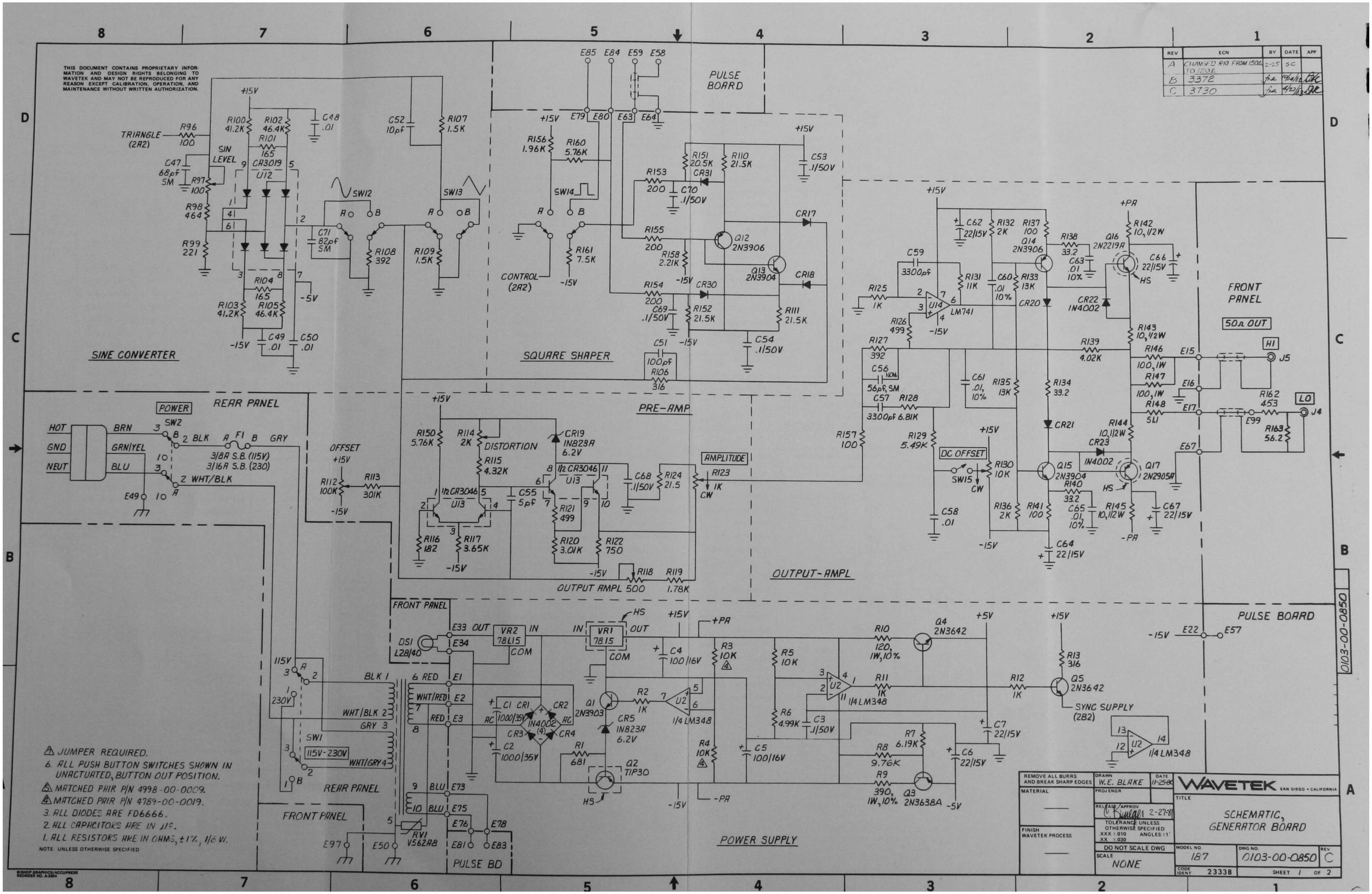
WAVETEK SAN DIEGO • CALIFORNIA

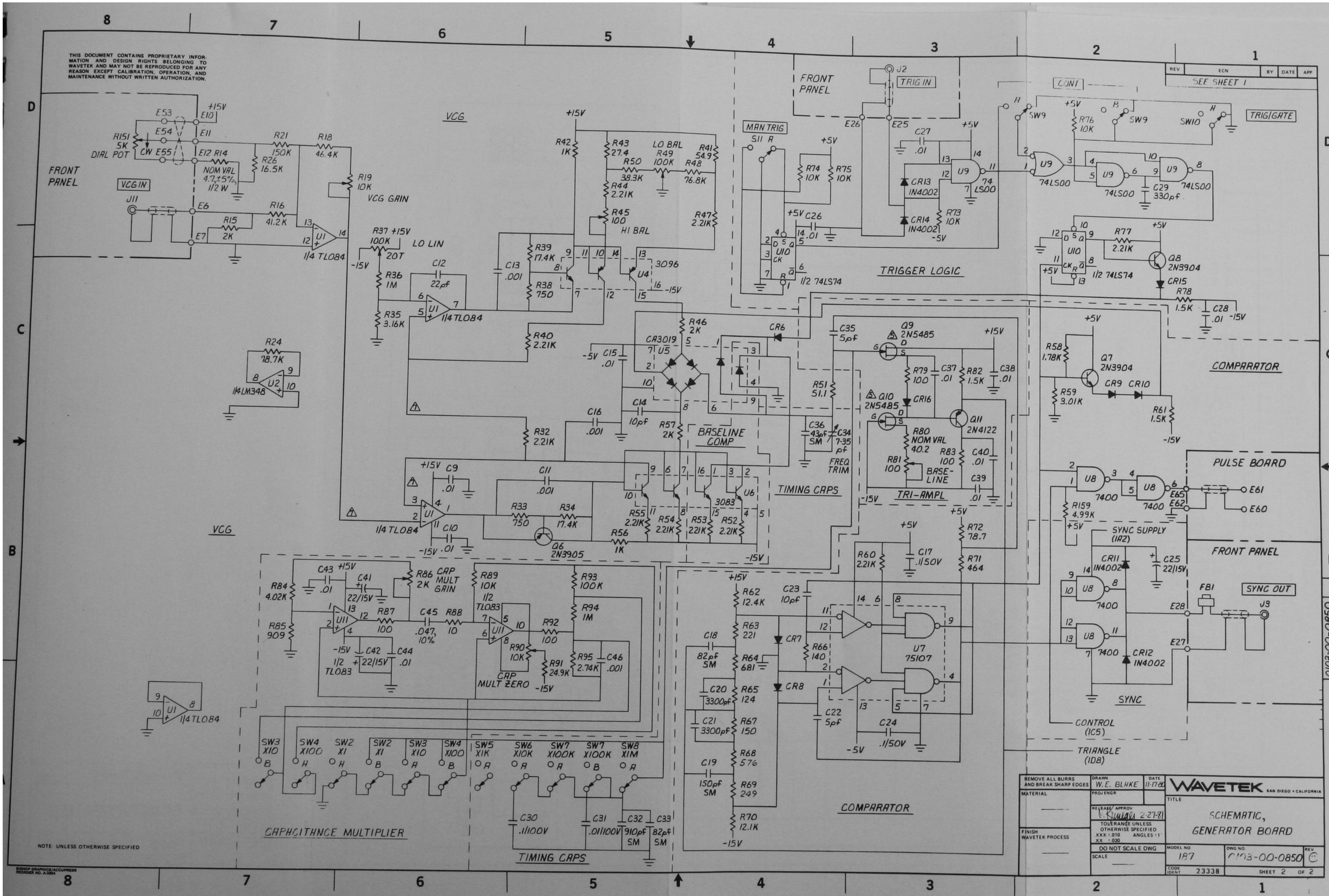
TITLE: PARTS LIST CHASSIS

MODEL NO. 187 — DWG NO. 1101-00-0844 — REV C

CODE IDENT 23338 — SHEET 1 OF 1

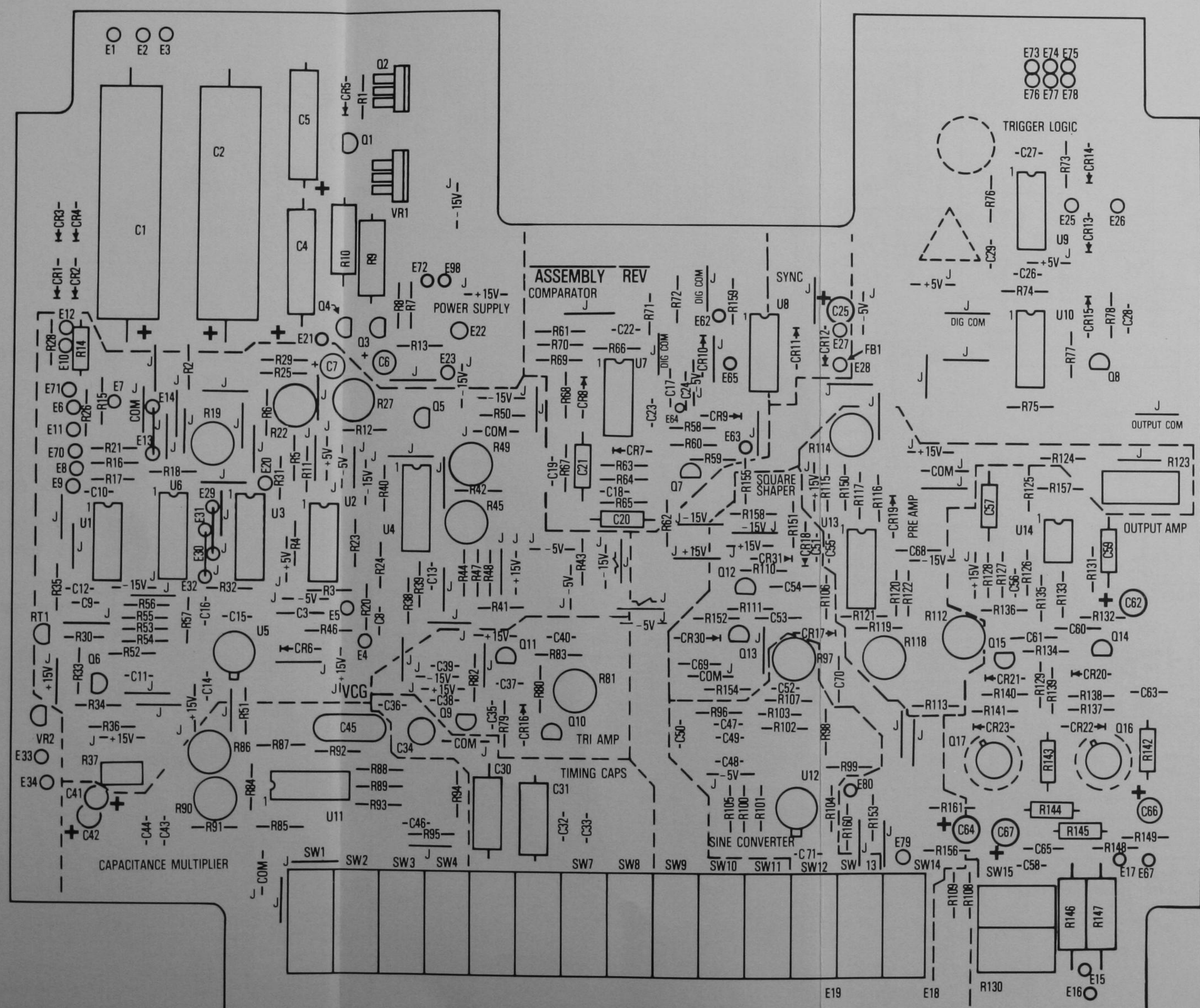
BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-3884


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.
SINE CONVERTER
SQUARE SHAPER
PULSE BOARD
PRE-AMP
OUTPUT-AMPL
FRONT PANEL
50Ω OUT
HI
LO
REAR PANEL
POWER
POWER SUPPLY
PULSE BD
TRIANGLE (2A2)
CONTROL (2A2)
SYNC SUPPLY (2B2)
OFFSET
DISTORTION
AMPLITUDE
DC OFFSET
OUTPUT AMPL 500
SIN LEVEL
HOT
GND
NEUT
BRN
GRN/YEL
BLU
115V-230V
⚠ JUMPER REQUIRED.
6. ALL PUSH BUTTON SWITCHES SHOWN IN UNACTUATED, BUTTON OUT POSITION.
⚠ MATCHED PAIR P/N 4998-00-0009.
⚠ MATCHED PAIR P/N 4789-00-0019.
3. ALL DIODES ARE FD6666.
2. ALL CAPACITORS ARE IN μF.
1. ALL RESISTORS ARE IN OHMS, ±1%, 1/8 W.
NOTE: UNLESS OTHERWISE SPECIFIED
REV | ECN | BY | DATE | APP
A | CHANGED R10 FROM 150Ω TO 120Ω
B | 3372
C | 3730
REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DRAWN W.E. BLAKE
TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 XX ±.030 ANGLES ±1°
DO NOT SCALE DWG
SCALE NONE
WAVETEK SAN DIEGO • CALIFORNIA
TITLE SCHEMATIC, GENERATOR BOARD
MODEL NO. 187
DWG NO. 0103-00-0850
REV C
CODE IDENT 23338
SHEET 1 OF 2
0103-00-0850



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.
FRONT PANEL
VCG IN
VCG
VCG GAIN
LO LIN
LO BAL
HI BAL
TRIGGER LOGIC
TRIG IN
MAN TRIG
CONT
TRIG/GATE
COMPARATOR
BASELINE COMP
TIMING CAPS
FREQ TRIM
TRI-AMPL
PULSE BOARD
SYNC SUPPLY (IR2)
SYNC OUT
SYNC
CONTROL (IC5)
TRIANGLE (ID8)
CAP MULT GAIN
CAP MULT ZERO
CAPACITANCE MULTIPLIER
NOTE: UNLESS OTHERWISE SPECIFIED
SEE SHEET 1
REMOVE ALL BURRS AND BREAK SHARP EDGES
DRAWN W.E. BLAKE 11-17-80
WAVETEK SAN DIEGO • CALIFORNIA
SCHEMATIC, GENERATOR BOARD
DO NOT SCALE DWG
MODEL NO. 187
DWG NO. 0103-00-0850
CODE IDENT 23338
SHEET 2 OF 2
0103-00-0850

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.



REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE GENERATOR BD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030		
	DO NOT SCALE DWG		MODEL NO 187
	SCALE		DWG NO 1100-00-0850 REV
			CODE IDENT 23338 SHEET 1 OF 1

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.

REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG, GENERATOR	0101-00-0850	WVTK	0101-00-0850	1
NONE	SCHEMATIC, GENERATOR	0103-00-0850	WVTK	0103-00-0850	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	CAP, CER, .001MF, 1KV	DD-102	CRL	1500-01-0211	4
C10 C15 C26 C27 C28 C37 C38 C39 C40 C43 C44 C48 C49 C50 C58 C60 C61 C63 C65 C9	CAP, CER, MN, .01MF, 50V	CAC02Z5U103Z100A	CORNG	1500-01-0310	20
C17 C24 C3 C53 C54 C68 C69 C70	CAP, CER, MON, .1MF, 50V	CAC03Z5U104Z050A	CORNG	1500-01-0405	8
C12	CAP, CER, 22PF, 1KV	DD-220	CRL	1500-02-2011	1
C29	CAP, CER, 330PF, 1KV	DD-331	CRL	1500-03-3111	1
C20 C21 C57 C59	CAP, C, MN, 3300PF, 50V	1801X7R050A332J	VRDYN	1500-03-3205	4
C19	CAP, MICA, 150PF, 500V	DM15-151J	ARCO	1500-11-5100	1
C36	CAP, MICA, 43PF, 500V	DM15-430J	ARCO	1500-14-3000	1
C56T	CAP, MICA, 56PF, 500V	DM15-560J	ARCO	1500-15-6000	1
C47	CAP, MICA, 68PF, 500V	DM15-680J	ARCO	1500-16-8000	1
C18 C33T C71	CAP, MICA, 82PF, 500V	DM15-820J	ARCO	1500-18-2000	3

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 1 — REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C32	CAP, 910PF, 100V, 1%	DM15-911F	ARCO	1500-19-1101	1
C4 C5	CAP, ELECT, 100MF, 16V	500D107G016DC7	SPRAG	1500-31-0101	2
C1 C2	CAP, ELECT, 1000MF, 35V	39D108G035GL6	SPRAG	1500-31-0212	2
C31	CAP, POLYC, .01MF, 100V	PA2B103F	ELCUB	1500-41-0304	1
C30	CAP, POLYC, .1MF, 100V	PA2B104F	ELCUB	1500-41-0404	1
C45	CAP, MYLAR, .047MF100V	225P47391WD3	SPRAG	1500-44-7314	1
C34	VARI, 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, 20V	202A2002226M3	MATSO	1500-72-2621	9
NONE	GENERATOR BOARD	1700-00-0850	WVTK	1700-00-0850	1
DS1	LAMP	L28/40	MURA	2400-02-0017	1
NONE	HEAT SINK	207	WAKE	2800-11-0001	2
NONE	TRANSIPAD	10160	METRS	2800-11-0004	2
FB1	FERRITE BEAD	56-590-65/3B	FERRX	3100-00-0001	1
R45 R81 R97	POT, TRIM, 100	91AR100	BECK	4600-01-0103	3
R19 R90	POT, TRIM, 10K	91AR10K	BECK	4600-01-0315	2
R112 R49	POT, TRIM, 100K	91AR100K	BECK	4600-01-0402	2
R114 R86	POT, TRIM, 2K	91AR2K	BECK	4600-02-0201	2

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 2 — REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R118	POT, TRIM, 500	91AR500	BECK	4600-05-0104	1
R130	POT, SWITCH, 10K	4602-01-0300	WVTK	4602-01-0300	1
R123	POT, CONT, 1K FROM: 4600-01-0207	4609-71-0201	WVTK	4609-71-0201	1
R37	POT, TRIM, 20T, 100K	68WR100K	BECK	4609-90-0001	1
R142 R143 R144 R145	RES, C, 1/2W, 5%, 10	RC20GF-100	STKPL	4700-25-0100	4
R14	RES, C, 1/2W, 5%, 4.7	RC20GF-4R7	STKPL	4700-25-0479	1
R10	RES, C, 1W, 10%, 120	RC32F-121K	AB	4700-36-1200	1
R9	RES, C, 1W, 10%, 390	RC32GF391K	AB	4700-36-3900	1
R137 R141 R157 R79 R83 R87 R92 R96	RES, MF, 1/8W, 1%, 100	RN55D-1000F	TRW	4701-03-1000	8
R11 R12 R125 R2 R42 R56	RES, MF, 1/8W, 1%, 1K	RN55D-1001F	TRW	4701-03-1001	6
R5 R73 R74 R75 R76 R89	RES, MF, 1/8W, 1%, 10K	RN55D-1002F	TRW	4701-03-1002	6
R93	RES, MF, 1/8W, 1%, 100K	RN55D-1003F	TRW	4701-03-1003	1
R36 R94	RES, MF, 1/8W, 1%, 1M	RN55D-1004F	TRW	4701-03-1004	2
R88	RES, MF, 1/8W, 1%, 10	RN55D-10R0F	TRW	4701-03-1009	1
R131	RES, MF, 1/8W, 1%, 11K	RN55D-1102F	TRW	4701-03-1102	1

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 3 — REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R70	RES, MF, 1/8W, 1%, 12.1K	RN55D-1212F	TRW	4701-03-1212	1
R65	RES, MF, 1/8W, 1%, 124	RN55D-1240F	TRW	4701-03-1240	1
R62	RES, MF, 1/8W, 1%, 12.4K	RN55D-1242F	TRW	4701-03-1242	1
R133 R135	RES, MF, 1/8W, 1%, 13K	RN55D-1302F	TRW	4701-03-1302	2
R66	RES, MF, 1/8W, 1%, 140	RN55D-1400F	TRW	4701-03-1400	1
R67	RES, MF, 1/8W, 1%, 150	RN55D-1500F	TRW	4701-03-1500	1
R107 R109 R61 R78 R82	RES, MF, 1/8W, 1%, 1.5K	RN55D-1501F	TRW	4701-03-1501	5
R21	RES, MF, 1/8W, 1%, 150K	RN55D-1503F	TRW	4701-03-1503	1
R101 R104	RES, MF, 1/8W, 1%, 165	RN55D-1650F	TRW	4701-03-1650	2
R26	RES, MF, 1/8W, 1%, 16.5K	RN55D-1652F	TRW	4701-03-1652	1
R34 R39	RES, MF, 1/8W, 1%, 17.4K	RN55D-1742F	TRW	4701-03-1742	2
R119 R58	RES, MF, 1/8W, 1%, 1.78K	RN55D-1781F	TRW	4701-03-1781	2
R116	RES, MF, 1/8W, 1%, 182	RN55D-1820F	TRW	4701-03-1820	1
R156	RES, MF, 1/8W, 1%, 1.96K	RN55D-1961F	TRW	4701-03-1961	1
R153 R154 R155	RES, MF, 1/8W, 1%, 200	RN55D-2000F	TRW	4701-03-2000	3
R132 R136 R15 R46 R57	RES, MF, 1/8W, 1%, 2K	RN55D-2001F	TRW	4701-03-2001	5
R151	RES, MF, 1/8W, 1%, 20.5K	RN55D-2052F	TRW	4701-03-2052	1

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 4 — REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R110 R111 R152	RES, MF, 1/8W, 1%, 21.5K	RN55D-2152F	TRW	4701-03-2152	3
R124	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
R158 R32 R40 R44 R47 R52 R53 R54 R55 R60 R77	RES, MF, 1/8W, 1%, 2.21K	RN55D-2211F	TRW	4701-03-2211	11
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 R138 R140	RES, MF, 1/8W, 1%, 33.2	RN55D-33R2F	TRW	4701-03-3329	3
R117	RES, MF, 1/8W, 1%, 3.65K	RN55D-3651F	TRW	4701-03-3651	1
R50	RES, MF, 1/8W, 1%, 38.3K	RN55D-3832F	TRW	4701-03-3832	1
R108 R127	RES, MF, 1/8W, 1%, 392	RN55D-3920F	TRW	4701-03-3920	2

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 5 — REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R139 R84	RES, MF, 1/8W, 1%, 4.02K	RN55D-4021F	TRW	4701-03-4021	2
R80T	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 R126	RES, MF, 1/8, 1%, 499	RN55D-4990F	TRW	4701-03-4990	2
R159 R6	RES, MF, 1/8W, 1%, 4.99K	RN55D-4991F	TRW	4701-03-4991	2
R148 R51	RES, MF, 1/8W, 1%, 51.1	RN55D-51R1F	TRW	4701-03-5119	2
R129	RES, MF, 1/8W, 1%, 5.49K	RN55D-5491F	MEPCO	4701-03-5491	1
R41	RES, MF, 1/8W, 1%, 54.9	RN55D-54R9F	TRW	4701-03-5499	1
R68	RES, MF, 1/8W, 1%, 576	RN55D-5760F	TRW	4701-03-5760	1
R150 R160	RES, MF, 1/8W, 1%, 5.76K	RN55D-5761F	TRW	4701-03-5761	2
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
R128	RES, MF, 1/8W, 1%, 6.81K	RN55D-6811F	TRW	4701-03-6811	1
R122 R33 R38	RES, MF, 1/8W, 1%, 750	RN55D-7500F	TRW	4701-03-7500	3

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 6 — REV F

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: PARTS LIST PCA, GENERATOR BD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 .XX ±.030 ANGLES ±1		MODEL NO. 187 — DWG NO. 1100-00-0850 — REV F
	DO NOT SCALE DWG		CODE IDENT 23338 — SHEET 1 OF 2
	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.

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R161	RES, MF, 1/8W, 1%, 7.5K	RN55D-7501F	TRW	4701-03-7501	1
R48	RES, MF, 1/8W, 1%, 76.8K	RN55D-7682F	TRW	4701-03-7682	1
R24	RES, MF, 1/8W, 1%, 78.7K	RN55D-7872F	TRW	4701-03-7872	1
R72	RES, MF, 1/8W, 1%, 78.7	RN55D-78R7F	TRW	4701-03-7879	1
R85	RES, MF, 1/8W, 1%, 909	RN55D-9090F	TRW	4701-03-9090	1
R8	RES, MF, 1/8W, 1%, 9.76K	RN55D-9761F	TRW	4701-03-9761	1
R146 R147	RES, MF, 1W, 1%, 100	RN70D-1000F	TRW	4701-33-1000	2
R3 R4	RES, SET, 2-10K, 1/8W QTY: 2: 4701-03-1002	142-501-64A	WVTK	4789-00-0019	1
CR19 CR5	DIODE, ZENER 6.2V	1N823A	MOT	4801-01-0823	2
CR1 CR11 CR12 CR13 CR14 CR2 CR22 CR23 CR3 CR4	DIODE	1N4002	FAIR	4801-02-0001	10
CR10 CR15 CR16 CR17 CR18 CR20 CR21 CR30 CR31 CR6 CR7 CR8 CR9	DIODE	1N4148	FAIR	4807-02-6666	13
Q16	TRANS	2N2219A	NSC	4901-02-2191	1
Q17	TRANS	2N2905A	NSC	4901-02-9051	1
Q3	TRANS	2N3638A	CARTR	4901-03-6381	1
Q4 Q5	TRANS	2N3642	FAIR	4901-03-6420	2

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 7 — REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q1	TRANS	2N3903	NSC	4901-03-9030	1
Q13 Q15 Q7 Q8	TRANS	2N3904	FAIR	4901-03-9040	4
Q6	TRANS	2N3905	ITT	4901-03-9050	1
Q12 Q14	TRANS	2N3906	FAIR	4901-03-9060	2
Q11	TRANS	2N4122	NSC	4901-04-1220	1
Q10 Q9	TRANS, M/PR, 2N5485 QTY: 2: 4901-05-4850	142-501-53	WVTK	4998-00-0009	1
NONE	SWITCH ASSY PB	5103-00-0039	WVTK	5103-00-0039	1
U11	IC	TL083CN	TI	7000-00-8300	1
U1	IC	TL084CN	TI	7000-00-8400	1
U2	IC	LM348N	NSC	7000-03-4800	1
U14	IC	LM741CN	NSC	7000-07-4100	1
U12 U5	IC	CA-3019	FAIR	7000-30-1900	2
U13	IC	CA-3046	RCA	7000-30-4600	1
U6	IC	CA3083	FAIR	7000-30-8300	1
U4	IC	CA-3096AE	RCA	7000-30-9600	1
VR2	IC	78L15	TI	7000-78-1501	1
U7	IC	SN75107AN	TI	7007-51-0700	1

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 8 — REV F

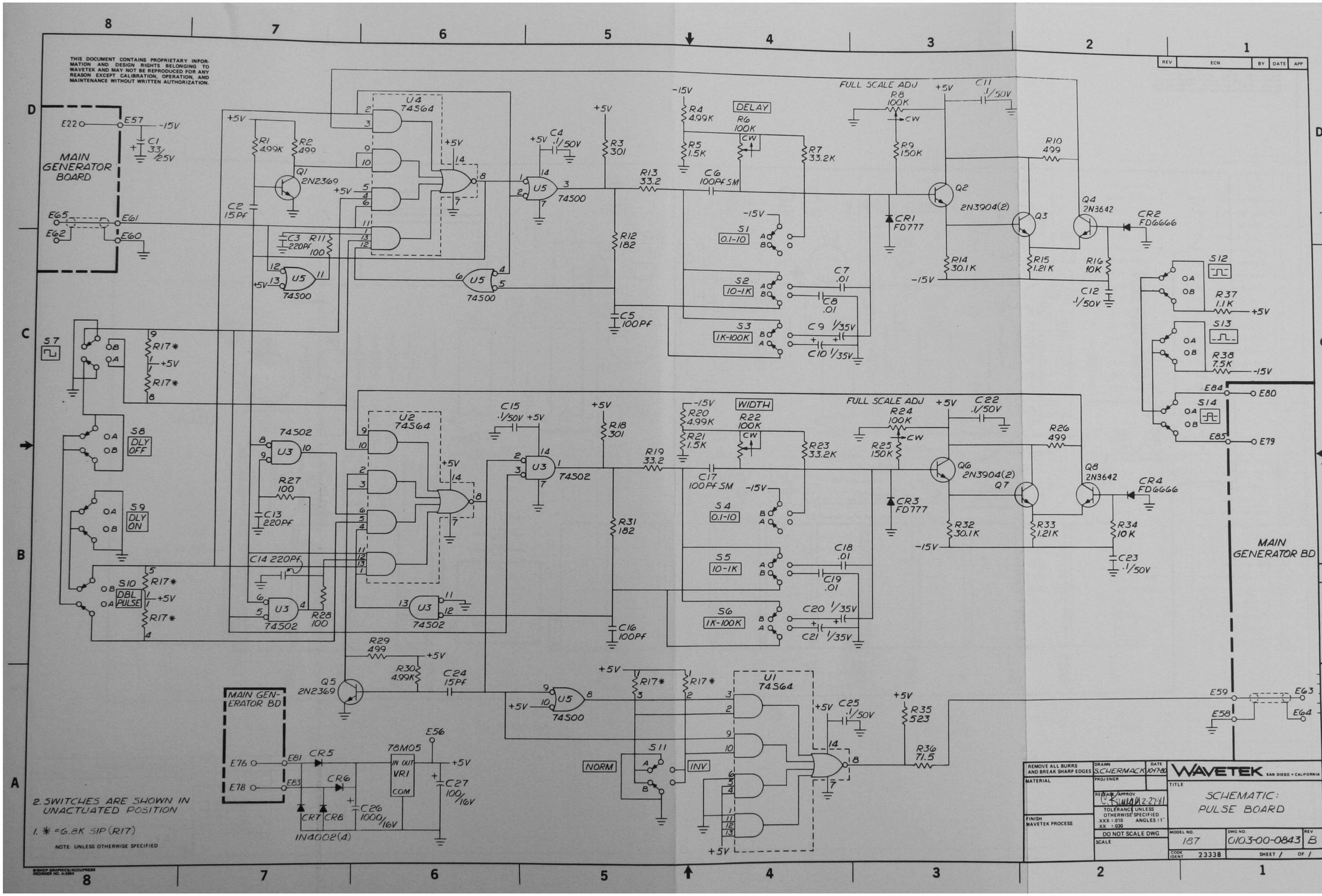
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
U8	IC	7400	TI	8000-74-0000	1
U9	IC	74LS00	TI	8000-74-0010	1
U10	IC	74LS74	TI	8000-74-7410	1

WAVETEK PARTS LIST — TITLE: PCA, GENERATOR BD — ASSEMBLY NO. 1100-00-0850 — PAGE: 9 — REV F

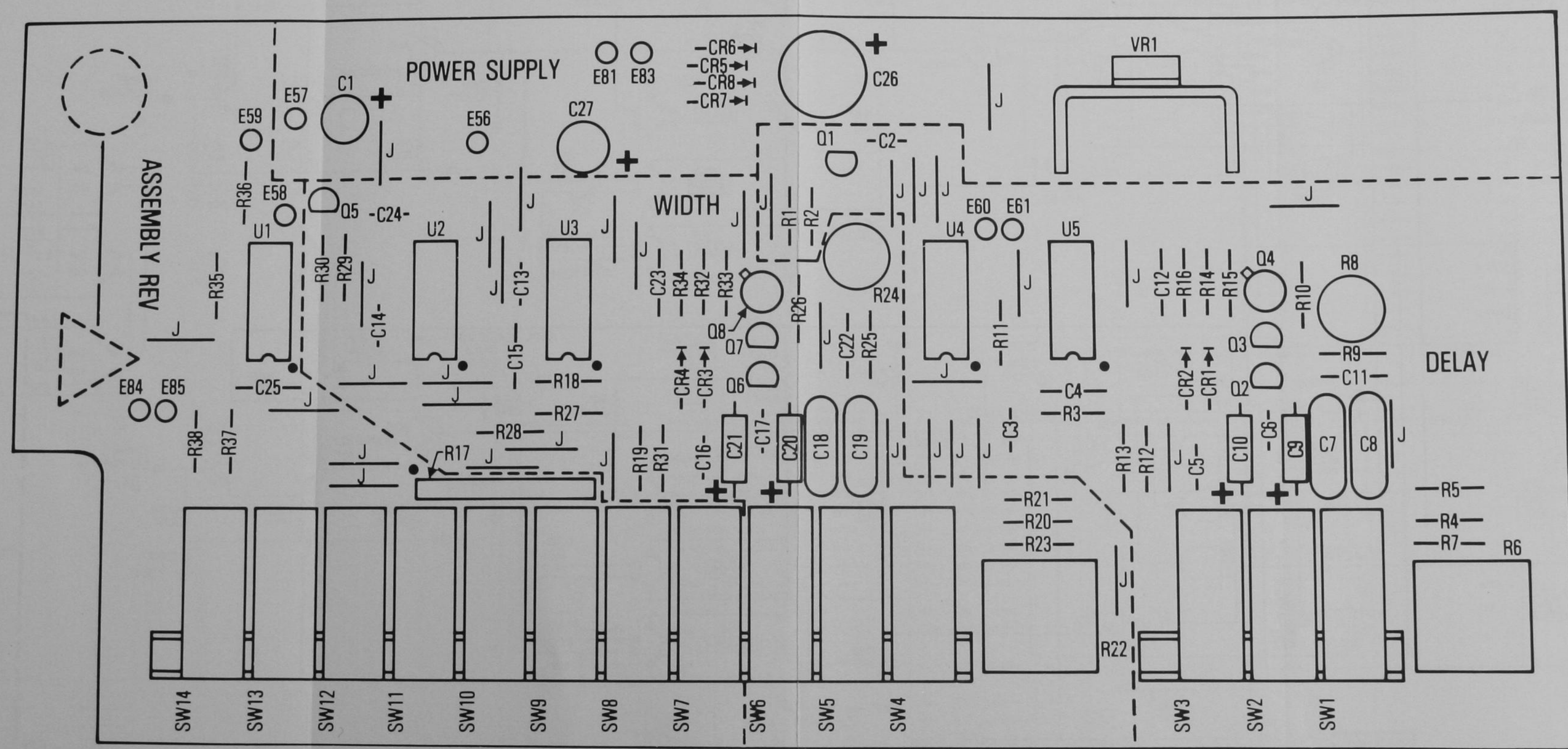
NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: PARTS LIST PCA, GENERATOR BD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX ±.010 ANGLES ±1° .XX ±.030		
	DO NOT SCALE DWG		MODEL NO. 187 — DWG NO. 1100-00-0850 — REV F
	SCALE		CODE IDENT 23338 — SHEET 2 OF 2

REV	ECN	BY	DATE	APP


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.
MAIN GENERATOR BOARD
MAIN GENERATOR BD
MAIN GEN-ERATOR BD
DELAY
WIDTH
FULL SCALE ADJ
DLY OFF
DLY ON
DBL PULSE
NORM
INV
2. SWITCHES ARE SHOWN IN UNACTUATED POSITION
1. ✱ =6.8K SIP (R17)
NOTE: UNLESS OTHERWISE SPECIFIED
REMOVE ALL BURRS AND BREAK SHARP EDGES
DRAWN S.CHERMACK
WAVETEK SAN DIEGO • CALIFORNIA
SCHEMATIC: PULSE BOARD
TOLERANCE UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DWG
FINISH WAVETEK PROCESS
MODEL NO. 187
DWG NO. 0103-00-0843
REV B
CODE IDENT 23338
SHEET 1 OF 1

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.



REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE PULSE BD
	RELEASE APPROV		
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX · 010 ANGLES · 1 XX · 030		
	DO NOT SCALE DWG		MODEL NO 187
	SCALE		DWG NO 1100-00-0843
			REV
			CODE IDENT 23338
			SHEET 1 OF 1

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.

REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG, PULSE	0101-00-0843	WVTK	0101-00-0843	1
NONE	SCHEMATIC, PULSE	0103-00-0843	WVTK	0103-00-0843	1
C16 C5	CAP, CER, 100PF, 1KV	DD-101	CRL	1500-01-0111	2
C11 C12 C15 C22 C23 C25 C4	CAP, CER, MON, .1MF, 50V	CAC03Z5U104Z050A	CORNG	1500-01-0405	7
C2 C24	CAP, CER, 15PF, 1KV	DD-150	CRL	1500-01-5011	2
C13 C14 C3	CAP, CER, 220PF, 1KV	DD-221	CRL	1500-02-2111	3
C17 C6	CAP, MICA, 100PF, 500V	DM15-101J	ARCO	1500-11-0100	2
C27	CAP, ELECT, 100MF, 25V RADIAL LEAD, SP .20	CRE SERIES 100/25	CAPAR	1500-31-0102	1
C26	CAP, ELECT, 1000MF/16V RADIAL LEAD, SP .20	CRE SERIES 1000/16	CAPAR	1500-31-0211	1
C1	CAP, ELECT, 33MF, 25V RADIAL LEAD, SP .14	CLE-L SERIES 33/25	CAPAR	1500-33-3002	1
C18 C19 C7 C8	CAP, MYLAR, .01MF, 100V	225P10391WD3	SPRAG	1500-41-0314	4
C10 C20 C21 C9	CAP, TANT, 1MF, 35V	150D105X9035A2	SPRAG	1500-71-0502	4
NONE	PULSE BOARD	1700-00-0843	WVTK	1700-00-0843	1
NONE	SUPPORT, TYRAP	RAMS-S3-M	PANDT	2800-00-0029	1
NONE	HEATSINK	371	AHAM	2800-11-0016	1
R24 R8	POT, TRIM, 100K	91AR100K	BECK	4600-01-0402	2

WAVETEK PARTS LIST — TITLE: PCA, PULSE BOARD — ASSEMBLY NO. 1100-00-0843 — PAGE: 1 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R22 R6	POT, CONT, 100K	72MIN056S104A	AB	4600-01-0406	2
R11 R27 R28	RES, MF, 1/8W, 1%, 100	RN55D-1000F	TRW	4701-03-1000	3
R16 R34	RES, MF, 1/8W, 1%, 10K	RN55D-1002F	TRW	4701-03-1002	2
R37	RES, MF, 1/8W, 1%, 1.1K	RN55D-1101F	TRW	4701-03-1101	1
R15 R33	RES, MF, 1/8W, 1%, 1.21K	RN55D-1211F	TRW	4701-03-1211	2
R21 R5	RES, MF, 1/8W, 1%, 1.5K	RN55D-1501F	TRW	4701-03-1501	2
R25 R9	RES, MF, 1/8W, 1%, 150K	RN55D-1503F	TRW	4701-03-1503	2
R12 R31	RES, MF, 1/8W, 1%, 182	RN55D-1820F	TRW	4701-03-1820	2
R18 R3	RES, MF, 1/8W, 1%, 301	RN55D-3010F	TRW	4701-03-3010	2
R14 R32	RES, MF, 1/8W, 1%, 30.1K	RN55D-3012F	TRW	4701-03-3012	2
R23 R7	RES, MF, 1/8W, 1%, 33.2K	RN55D-3322F	TRW	4701-03-3322	2
R13 R19	RES, MF, 1/8W, 1%, 33.2	RN55D-33R2F	TRW	4701-03-3329	2
R10 R2 R26 R29	RES, MF, 1/8, 1%, 499	RN55D-4990F	TRW	4701-03-4990	4
R1 R20 R30 R4	RES, MF, 1/8W, 1%, 4.99K	RN55D-4991F	TRW	4701-03-4991	4
R35	RES, MF, 1/8W, 1%, 523	RN55D-5230F	TRW	4701-03-5230	1
R38	RES, MF, 1/8W, 1%, 7.5K	RN55D-7501F	TRW	4701-03-7501	1
R36	RES, MF, 1/4W, 1%, 71.5	RN60D-71R5F	TRW	4701-13-7159	1

WAVETEK PARTS LIST — TITLE: PCA, PULSE BOARD — ASSEMBLY NO. 1100-00-0843 — PAGE: 2 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R17	RES MODULE	4310R-101-682	BOURN	4770-00-0016	1
CR5 CR6 CR7 CR8	DIODE	1N4002	FAIR	4801-02-0001	4
CR1 CR3	DIODE	FD777	FAIR	4807-02-0777	2
CR2 CR4	DIODE	1N4148	FAIR	4807-02-6666	2
Q4 Q8	TRANS	2N3642	FAIR	4901-03-6420	2
Q2 Q3 Q6 Q7	TRANS	2N3904	FAIR	4901-03-9040	4
Q1 Q5	TRANS	MPS-2369	FAIR	4902-02-3690	2
NONE	SWITCH ASSY	5103-00-0034	WVTK	5103-00-0034	1
NONE	SWITCH ASSY PB	5103-00-0040	WVTK	5103-00-0040	1
U5	IC	74S00	TI	8000-74-0001	1
U3	IC	74S02	SIG	8000-74-0201	1
U1 U2 U4	IC	74S64	TI	8000-74-6401	3
VR1	VOLTAGE REGULATOR	MA7805UC	FAIR	8000-78-0500	1

WAVETEK PARTS LIST — TITLE: PCA, PULSE BOARD — ASSEMBLY NO. 1100-00-0843 — PAGE: 3 — REV C

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	PROJ ENGR		TITLE: PARTS LIST PCA, PULSE BD
FINISH WAVETEK PROCESS	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030		
	DO NOT SCALE DWG		MODEL NO. 187 — DWG NO. 1100-00-0843 — REV C
	SCALE		CODE IDENT 23338 — SHEET 1 OF 1

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-3884

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.

REV	ECN	BY	DATE	APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG, PULSE	0101-00-0843	WVTK	0101-00-0843	1
NONE	SCHEMATIC, PULSE	0103-00-0843	WVTK	0103-00-0843	1
C16 C5	CAP, CER, 100PF, 1KV	DD-101	CRL	1500-01-0111	2
C11 C12 C15 C22 C23 C25 C4	CAP, CER, MON, .1MF, 50V	CAC03Z5U104Z050A	CORNG	1500-01-0405	7
C2 C24	CAP, CER, 15PF, 1KV	DD-150	CRL	1500-01-5011	2
C13 C14 C3	CAP, CER, 220PF, 1KV	DD-221	CRL	1500-02-2111	3
C17 C6	CAP, MICA, 100PF, 500V	DM15-101J	ARCO	1500-11-0100	2
C27	CAP, ELECT, 100MF, 25V RADIAL LEAD, SP .20	CRE SERIES 100/25	CAPAR	1500-31-0102	1
C26	CAP, ELECT, 1000MF/16V RADIAL LEAD, SP .20	CRE SERIES 1000/16	CAPAR	1500-31-0211	1
C1	CAP, ELECT, 33MF, 25V RADIAL LEAD, SP .14	CLE-L SERIES 33/25	CAPAR	1500-33-3002	1
C18 C19 C7 C8	CAP, MYLAR, .01MF, 100V	225P10391WD3	SPRAG	1500-41-0314	4
C10 C20 C21 C9	CAP, TANT, 1MF, 35V	150D105X9035A2	SPRAG	1500-71-0502	4
NONE	PULSE BOARD	1700-00-0843	WVTK	1700-00-0843	1
NONE	SUPPORT, TYRAP	RAMS-S3-M	PANDT	2800-00-0029	1
NONE	HEATSINK	371	AHAM	2800-11-0016	1
R24 R8	POT, TRIM, 100K	91AR100K	BECK	4600-01-0402	2

WAVETEK PARTS LIST — TITLE: PCA, PULSE BOARD — ASSEMBLY NO. 1100-00-0843 — PAGE: 1 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R22 R6	POT, CONT, 100K	72MIN056S104A	AB	4600-01-0406	2
R11 R27 R28	RES, MF, 1/8W, 1%, 100	RN55D-1000F	TRW	4701-03-1000	3
R16 R34	RES, MF, 1/8W, 1%, 10K	RN55D-1002F	TRW	4701-03-1002	2
R37	RES, MF, 1/8W, 1%, 1.1K	RN55D-1101F	TRW	4701-03-1101	1
R15 R33	RES, MF, 1/8W, 1%, 1.21K	RN55D-1211F	TRW	4701-03-1211	2
R21 R5	RES, MF, 1/8W, 1%, 1.5K	RN55D-1501F	TRW	4701-03-1501	2
R25 R9	RES, MF, 1/8W, 1%, 150K	RN55D-1503F	TRW	4701-03-1503	2
R12 R31	RES, MF, 1/8W, 1%, 182	RN55D-1820F	TRW	4701-03-1820	2
R18 R3	RES, MF, 1/8W, 1%, 301	RN55D-3010F	TRW	4701-03-3010	2
R14 R32	RES, MF, 1/8W, 1%, 30.1K	RN55D-3012F	TRW	4701-03-3012	2
R23 R7	RES, MF, 1/8W, 1%, 33.2K	RN55D-3322F	TRW	4701-03-3322	2
R13 R19	RES, MF, 1/8W, 1%, 33.2	RN55D-33R2F	TRW	4701-03-3329	2
R10 R2 R26 R29	RES, MF, 1/8, 1%, 499	RN55D-4990F	TRW	4701-03-4990	4
R1 R20 R30 R4	RES, MF, 1/8W, 1%, 4.99K	RN55D-4991F	TRW	4701-03-4991	4
R35	RES, MF, 1/8W, 1%, 523	RN55D-5230F	TRW	4701-03-5230	1
R38	RES, MF, 1/8W, 1%, 7.5K	RN55D-7501F	TRW	4701-03-7501	1
R36	RES, MF, 1/4W, 1%, 71.5	RN60D-71R5F	TRW	4701-13-7159	1

WAVETEK PARTS LIST — TITLE: PCA, PULSE BOARD — ASSEMBLY NO. 1100-00-0843 — PAGE: 2 — REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R17	RES MODULE	4310R-101-682	BOURN	4770-00-0016	1
CR5 CR6 CR7 CR8	DIODE	1N4002	FAIR	4801-02-0001	4
CR1 CR3	DIODE	FD777	FAIR	4807-02-0777	2
CR2 CR4	DIODE	1N4148	FAIR	4807-02-6666	2
Q4 Q8	TRANS	2N3642	FAIR	4901-03-6420	2
Q2 Q3 Q6 Q7	TRANS	2N3904	FAIR	4901-03-9040	4
Q1 Q5	TRANS	MPS-2369	FAIR	4902-02-3690	2
NONE	SWITCH ASSY	5103-00-0034	WVTK	5103-00-0034	1
NONE	SWITCH ASSY PB	5103-00-0040	WVTK	5103-00-0040	1
U5	IC	74S00	TI	8000-74-0001	1
U3	IC	74S02	SIG	8000-74-0201	1
U1 U2 U4	IC	74S64	TI	8000-74-6401	3
VR1	VOLTAGE REGULATOR	MA7805UC	FAIR	8000-78-0500	1

WAVETEK PARTS LIST — TITLE: PCA, PULSE BOARD — ASSEMBLY NO. 1100-00-0843 — PAGE: 3 — REV C

REMOVE ALL BURRS AND BREAK SHARP EDGES
MATERIAL
FINISH WAVETEK PROCESS
DRAWN / DATE
PROJ ENGR
RELEASE APPROV
TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES ±1 XX ±.030
DO NOT SCALE DWG
SCALE

WAVETEK SAN DIEGO • CALIFORNIA

TITLE: PARTS LIST PCA, PULSE BD

MODEL NO. 187 — DWG NO. 1100-00-0843 — REV C
CODE IDENT 23338 — SHEET 1 OF 1

NOTE: UNLESS OTHERWISE SPECIFIED

BISHOP GRAPHICS/ACCUPRESS REORDER NO. A-3894