

INSTRUCTION MANUAL  
**MODEL 166**  
**50 MHz PULSE/  
FUNCTION GENERATOR**

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**WAVETEK**  
**SAN DIEGO**

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9045 BALBOA AVENUE, SAN DIEGO, CALIFORNIA

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**MODEL 166**  
**50 MHz PULSE/  
FUNCTION GENERATOR**

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**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.

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

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

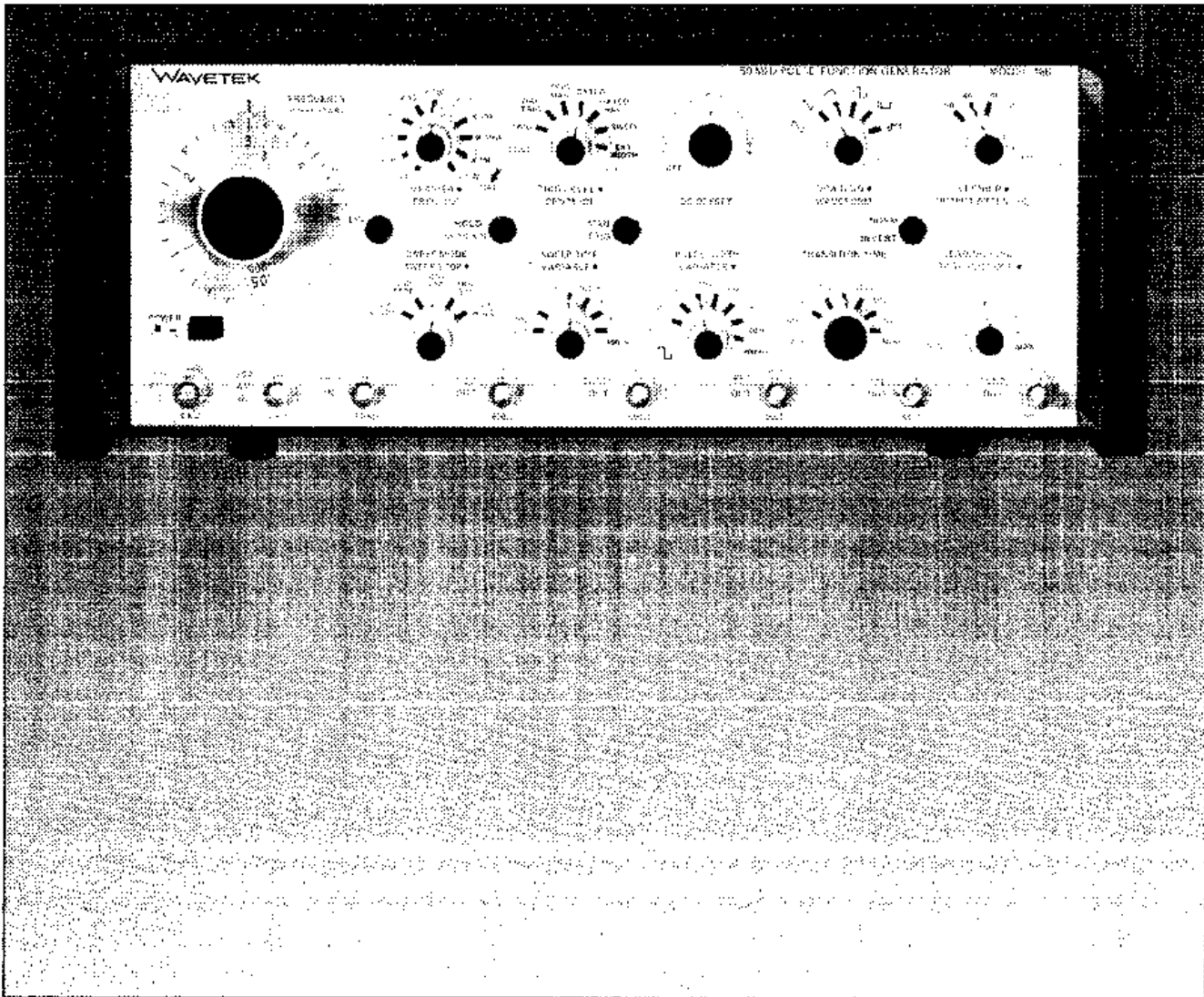


Figure i -- Model 166 50 MHz Pulse/Function Generator

## SECTION 1

### GENERAL DESCRIPTION

#### 1.1 MODEL 166

The Model 166 Pulse/Function Generator is a combination sweep, function and pulse generator with a full complement of features in all modes of operation. The frequency range is from 0.0001 Hz (2.8 hours per cycle) to 50 MHz. Waveforms are sine, triangle, ramp, square, pulse, positive pulse and negative pulse. The waveforms may be amplitude controlled, dc offset and inverted (complemented).

Pulse versatility includes variable width and independently variable leading and trailing edge transition times. The generator can be used to generate an output pulse whose width and frequency are dependent upon an external signal input.

Sweep can be logarithmic, as well as linear. The output can be stopped at the start and stop frequencies for accurate setting. Besides continuous sweep, a sweep may be triggered from the quiescent start frequency. The frequency can sweep to the upper (stop) frequency, then return to start frequency, or it can be held at the upper frequency. The duration of the sweep can be set to be from 100 seconds to 100 micro-seconds.

The generator can give a continuous output, be triggered for one cycle, or a double cycle, or gated for many cycles. The output waveform can be presented in haverwave mode; i.e., the selected waveform starts and stops at a positive or negative peak voltage.

The signal being generated may be frequency or amplitude modulated by external signals.





#### 1.2 SPECIFICATIONS

##### 1.2.1 Versatility

Instrument operates as a sweep/function generator or a pulse generator.

##### 1.2.2 Sweep/Function Generator

###### Selectable Waveforms

Sine , triangle , ramp  and square . All can be inverted 180°. Ramp up-down ratio can be as large as 1:1000. All can be amplitude and frequency modulated.

###### Operational Modes

**Continuous:** Generator oscillates continuously at selected frequency.

**Triggered:** Generator quiescent until triggered by external signal or manually, then generates one cycle.

**Double Triggered:** As triggered mode, except two cycles are generated.

**Triggered Haverwave:** As triggered mode. Output is one cycle starting at  $-90^\circ$  (or  $+90^\circ$ ).

**Gated:** As triggered, except output continues for duration of gate.

**Gated Haverwave:** As gated. Output is a burst of cycles starting at  $-90^\circ$  (or  $+90^\circ$ ).

**Continuous Sweep:** Generator frequency continuously sweeps up from start to stop frequency.

**Triggered Sweep:** Generator oscillates at sweep start frequency until triggered, then generates one sweep to the stop frequency and returns to the start frequency.

**Sweep and Hold:** As triggered sweep mode, except the generator remains at stop frequency until the trigger signal falls, then returns to start frequency.

###### Frequency Range

0.0001 Hz to 50 MHz in 11 ranges. Maximum sweep 1000:1 in linear or logarithmic mode.

###### Sweep Time Range

100s to 100  $\mu$ s in 6 ranges.

###### Function Output

Variable to 30V p-p into open circuit (15V p-p into 50 $\Omega$ ). DC offset of waveform is adjustable to  $\pm 10$ V open circuit ( $\pm 5$ V into 50 $\Omega$ ). Voltage attenuation 0 to 80 dB: to 60 dB in 20 dB steps, plus 20 dB continuous vernier.

**Low Frequency Hold**

Function output will hold at the instantaneous voltage level when the hold switch is depressed. Effective in the X 0.001 Hz to X 10 Hz ranges.

Amplitude Drift: Less than 0.2% of amplitude per minute.

**DC Offset**

DC offset of all waveforms is adjustable to  $\pm 10\text{V}$  open circuit ( $\pm 5\text{V}$  into  $50\Omega$ ). Waveform plus offset is limited to  $\pm 15\text{V}$  open circuit ( $\pm 7.5\text{V}$  into  $50\Omega$ ).

**GCV Output**

0 to 5V (nominal, open circuit) proportional to the frequency of the main generator. Output impedance is  $600\Omega$ .

**Sweep Output**

0 to +5V (nominal, open circuit) ramp. Output impedance is  $600\Omega$ . Sweep time is 100s to 100  $\mu\text{s}$ .

**VCG (FM) – Voltage Controlled Generator**

Up to 1000:1 frequency change with external 0 to +5V signal.

Mode: Linear or logarithmic.

Slew Rate: 2% of range per  $\mu\text{s}$ .

VCG Linearity: 0.0005 Hz to 50 kHz  $\pm 0.5\%$  of range.

**Voltage Controlled Amplitude (AM)**

0 to  $\pm 5\text{V}$  gives 0 to 30V amplitude change. AC input allows 0 to 200% modulation (suppressed carrier).

AC Input Range: 5V minimum for 100%, 10V minimum for 200% AM.

Input Impedance: 4.99 to 10 k $\Omega$ , depending on gain control.

Input Bandwidth: 10 kHz.

**Trigger Input**

Trigger Signal: 1V p-p minimum.

Trigger Level:  $\pm 5\text{V}$ .

Input Impedance: 1.5 k $\Omega$ , 30 pF.

Maximum Repetition Rate: 25 MHz.

**1.2.3 Frequency Precision****Dial Accuracy (For  $\sim$ ,  $\wedge$ ,  $\square$  and linear dial settings of 0.5 to 5)**

$\pm 2\%$  of full scale for 0.0005 Hz to 5 MHz.

+ 15%, - 6% of full scale for 5 to 50 MHz.

**1.2.4 Amplitude Precision****Amplitude Change With Frequency**

Sine and square variations less than:

$\pm 0.1$  dB to 100 kHz;

$\pm 0.2$  dB to 1 MHz;

$\pm 3$  dB to 50 MHz.

**Step Attenuator Accuracy**

$\pm 0.3$  dB per 20 dB step to 100 kHz.

**1.2.5 Waveform Characteristics****Sine Distortion (Test at 10V p-p normal sine wave)**

Less than 0.5% for 10 Hz to 100 kHz.

All harmonics greater than:

30 dB down for 100 kHz to 5 MHz;

20 dB down for 5 to 50 MHz.

**Triangle Linearity**

Greater than 99% for 0.005 Hz to 100 kHz.

**Square Wave Aberrations (Test at 10Vp-p)**

Less than 5% of p-p voltage.

**1.2.6 Pulse Generator****Pulses**

Variable amplitude positive or complementary pulses  $\square$ ,  $\square$ . Pulse amplitude, width and rise/fall times are independently adjustable and independent of frequency. TTL and  $\overline{\text{TTL}}$  pulse widths are simultaneous with main pulse. AM and FM modulation. All pulses can drive  $50\Omega$  terminations.

**Operational Modes**

Continuous, Triggered, Double Triggered, Gated and Continuous Sweep. (See Sweep/Function Generator.)

External Width: An external signal at the trigger input determines the output pulse width and frequency.

**Pulse Period Range**

Pulse period is selectable from 20 ns to 10,000s (50 MHz to 0.0001 Hz) with approximately 1% vernier.

**Pulse Width**

10 ns to 100 ms in 7 ranges. Maximum duty cycle is 70% for periods to 200 ns, decreasing to 50% for 20 ns periods. Control has nominal 50% duty cycle detent.

**Transition Time**

7 ns to 50 ms in 7 ranges, independently variable for leading and trailing edges.

**Function Output**

0 to  $\pm 15\text{V}$  into open circuit and 0 to  $\pm 7.5\text{V}$  into  $50\Omega$ . Voltage attenuation 0 to 80 dB: to 60 dB in 20 dB steps, plus 20 dB continuous vernier.

**TTL and  $\overline{\text{TTL}}$  Pulses**

Transition times less than 4 ns into  $50\Omega$  termination.

## 1.2.7 General

### Stability

Amplitude, dc offset and frequency in linear mode to 500 kHz.

Short Term:  $\pm 0.05\%$  for 10 minutes.

Long Term:  $\pm 0.25\%$  for 24 hours.

### Environmental

Specifications apply at  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$  after 30 minute warm-up.

Instrument will operate from  $0^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$ .

### Dimensions

36.2 cm (14¼ in.) wide; 13.3 cm (5¼ in.) high; 38.1 cm (15 in.) deep.

### Weight

9.8 kg (21½ lb) net; 12.5 kg (27½ lb) shipping.

### Power

108 to 132V or 216 to 250V; 50 to 400 Hz; 50 watts nominal.

# 2

## SECTION 2

### INITIAL PREPARATION

#### 2.1 MECHANICAL PREPARATION

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 with the power transformer connected for operation on a 108 to 126 Vac line supply and with a 0.5 amp slow blow fuse.*

Conversion to other input voltages requires a change in rear panel fuse-holder voltage card position and fuse according to the following table and procedure.

Card Position	Input Vac	Fuse (Slow Blow, 3 AG)
100	90 to 105	0.5 amp
120	108 to 126	0.5 amp
220	198 to 231	0.25 amp
240	216 to 250	0.25 amp

1. Disconnect the power cord at the instrument, open fuse holder cover door and rotate FUSE PULL to left to remove the fuse (figure 2-1).

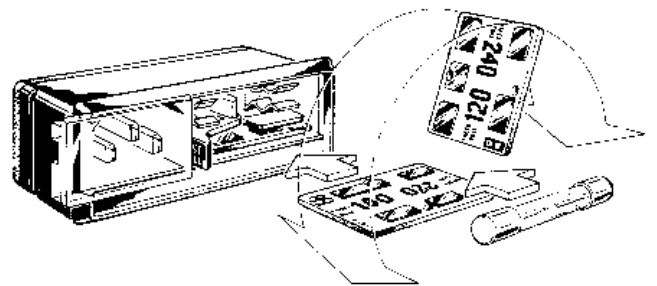


Figure 2-1. Fuse Holder on Rear of Instrument

2. Remove the small printed circuit board and select operating voltage by orienting the printed circuit board to position the desired voltage on the top left side. Push the board firmly into its module slot.
3. Rotate the FUSE PULL back into the normal position and insert the correct fuse into the fuse holder. Close the cover door.
4. Connect the ac line cord to the mating connector at the rear of the unit and the power source.

## 2.2.2 Signal Connections

Use RG58U 50Ω shielded cables equipped with female BNC connectors to distribute input and output signals when connecting this instrument to associated equipment.

## 2.3 ELECTRICAL ACCEPTANCE CHECK

This checkout procedure verifies the generator operation. If a malfunction is found, refer to the Warranty in the front of this manual. A 2 channel oscilloscope, a 50Ω load, a tee fitting and 50Ω coax cables are needed for this procedure (see figures 2-2 through 2-5).

Preset the pulse generator controls as follows:

Control	Position
FREQUENCY Dial	1
FREQ Range	X 1K
FREQ VERNIER	cw
GEN MODE	CONT
TRIG LEVEL	10 o'clock
LIN/LOG	LIN
DC OFFSET	OFF
VCA GAIN	ccw
WAVEFORM	~
OUTPUT ATTEN	0
OUTPUT ATTEN VERNIER	cw
NORM/INVERT	NORM
SWEEP MODE	CONT SWP
SWEEP STOP	cw
SWEEP TIME	10s   1s
SWEEP TIME VARIABLE	12 o'clock
PULSE WIDTH	⌏
PULSE WIDTH VARIABLE	cw
TRANSITION TIME	7 ns   50 ns
LEADING EDGE	cw
TRAILING EDGE	cw
POWER	ON

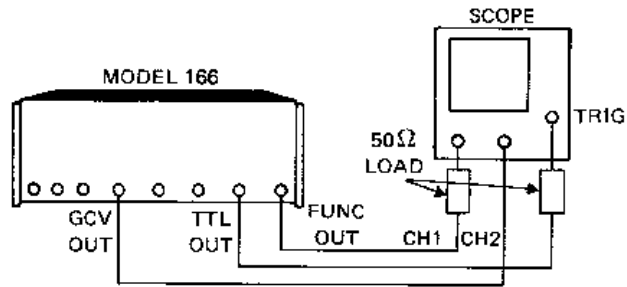


Figure 2-2. Initial Setup

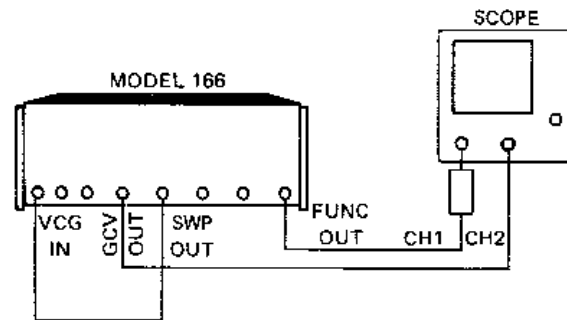


Figure 2-3. VCG Setup

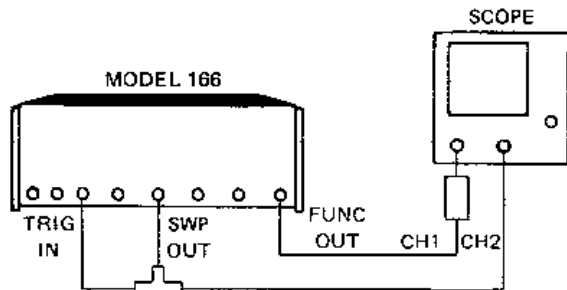


Figure 2-4. Trigger Setup

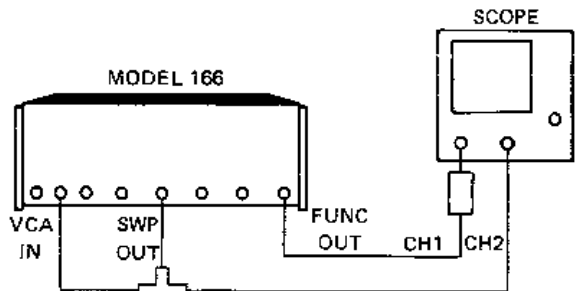





Figure 2-5. VCA Setup


Table 2-1. Initial Checkout

Step	Control	Position/Operation	Observation
1		Connect instrument as shown in figure 2-2 and sync scope to TTL output.	CH1: 1 kHz sine wave, 15V p-p. CH2: dc signal. Approximately 1V.
2	FREQ VERNIER	Rotate ccw, then cw.	CH1: A small change in frequency (1% of range).
3	FREQ Range	Check each position. Return to X 1.	CH1: Frequency increases from ccw to cw positions.
4	HOLD	Press and hold. Release.	Waveform stops and holds at a dc level. Waveform continuous when switch is released.
5	FREQ Range	X 1K.	
6	OUTPUT ATTEN VERNIER	Rotate ccw. Return to cw.	Amplitude of waveform decreases for ccw change.
7	OUTPUT ATTEN	Check each position. Return to 0.	Amplitude of waveform decreases in decade steps as attenuation increases.
8	OUTPUT ATTEN VERNIER	Rotate to 9 o'clock.	
9	DC OFFSET	Rotate cw thru -, 0 to +. Return to OFF.	Waveform moves to a negative offset, then to a positive offset, as the control is rotated cw. Waveform clipping may occur at - and + ends of control.
10	OUTPUT ATTEN VERNIER	Vernier cw.	
11	WAVEFORM	Check each position. Return to  .	Each waveform is present;  and  are both positive going 0V to +7.5V, but complementary to each other.



*NOTE: For proper waveform output in steps 12 through 16, the pulse period must be several times longer than the pulse width and transition time. Change the FREQ range whenever necessary.*

12	PULSE WIDTH	Rotate to each position. Return to 10 $\mu$ s   100 $\mu$ s.	Pulse width is <u>narrow at ccw positions</u> and <u>wider at cw positions</u> .
13	PULSE WIDTH VARIABLE	Rotate ccw. Return to cw.	Pulse width becomes narrow, returns to wide
14	TRANSITION TIME	Rotate to each position. Return to 500 ns   5 ns.	Transition time decreases ccw and increases cw.
15	LEADING EDGE	Rotate ccw.	Waveform rise time increases, then returns to original time.

## Initial Checkout (Continued)

Step	Control	Position/Operation	Observation
16	TRAILING EDGE	Rotate ccw.	Waveform fall time increases, then returns to original time.
17	FREQ Range	X 1K	
18	NORM/INVERT	INVERT, then NORM	Waveform changes from positive pulse to negative pulse.
19	WAVEFORM		
20	NORM/INVERT	INVERT, then NORM.	Waveform phase shifts 180°, from one switch position to the other.
21		Connect instrument as shown in figure 2-3.	
22	FREQUENCY Dial	Full cw. Sync the scope to CH1 (FUNC OUT).	CH1: Waveform is swept from a low frequency to a high frequency. CH2: 0 to 5V ramp for each burst of swept waveforms.
23	GEN MODE	SWEEP.	Waveform is swept from a low frequency to a high frequency.
24	SWEEP TIME	Check each position. Return to 100 ms I 10 ms.	As the switch is rotated cw, the sweep duration decreases. (Observe CH2 on fast times.)
25	LIN/LOG	LOG. Return to LIN.	CH1: Waveform has longer low frequency sweep in LOG mode. CH2: Logarithmic ramp in LOG mode.
26	SWEEP TIME VARIABLE	Rotate ccw. Return to cw.	Ccw increases sweep duration.
27	SWEEP MODE	SWP START.	CH1: Frequency approximately 50 Hz. CH2: 0 Vdc.
28	FREQUENCY Dial	Rotate from cw to ccw. Return to cw.	CH2: DC level increases from 0 to 5V, returns to 0V.
29	SWEEP MODE	SWP STOP.	CH2: Approximately 5V.
30	SWEEP STOP	Rotate ccw. Return to cw.	CH2: DC level decreases, returns to 5V.
31	SWEEP MODE	TRIG SWP.	CH1: Frequency approximately 50 Hz. CH2: 0V.
32	MAN TRIG	Press and release (try several times).	One burst of swept waveform, then returns to start frequency.

## Initial Checkout (Continued)

Step	Control	Position/Operation	Observation
33	SWEEP MODE	SWP HOLD.	
34	MAN TRIG	Press and hold, then release.	Waveform sweeps up to high frequency and remains while switch is held, returns to start frequency when switch is released.
35	SWEEP MODE	CONT SWP	
36	FREQUENCY	1	
37		Connect instrument as shown in figure 2-4.	
38	GEN MODE	TRIG. (Trigger scope on CH2.) Adjust scope for several triggered cycles.	CH1: Each waveform is one complete cycle. CH2: 0 to 5V ramp.
39	GEN MODE	DBL TRIG.	Each waveform is two complete cycles.
40	GEN MODE	TRIG HAV.	Each waveform is one cycle starting and ending at $-90^\circ$ .
41	GEN MODE	GATED. Adjust scope for several bursts of waveforms.	Waveforms are in bursts of approximately 100 ms.
42	GEN MODE	GATED HAV.	Burst of waveforms start at $-90^\circ$ and end at $-90^\circ$ .
43	WAVEFORM		
44	GEN MODE	EXT WIDTH.	Pulse waveform.
45	TRIG LEVEL	Rotate slowly. Return to 10 o'clock.	Pulse varies in width. Returns to original width.
46		Connect instrument as shown in figure 2-5.	
47	GEN MODE	CONT.	
48	OUTPUT VERNIER	12 o'clock.	
49	WAVEFORM		CH1: Low to high amplitude bursts of waveforms.
50	VCA GAIN	Rotate from ccw to cw.	Amplitude modulation increases from 0 to maximum.

# SECTION 3

## OPERATION

### 3.1 CONTROLS AND CONNECTORS

The controls and connectors for the Model 166 are shown in figure 3-1. The listing below discusses each control and its function.

**1 FREQUENCY/SWEEP START Dial** — The main frequency control. The setting on this dial multiplied by the frequency range (FREQ) setting is the basic output frequency of the generator. The dial sets the sweep start frequency when SWEEP mode (5) is selected. (The FREQ VERNIER and VCG IN also affect the generator frequency.) The outer scale has linear distribution; the inner has logarithmic (2). The dial index mark lights when power is on.

**2 LIN/LOG Switch** — This switch selects a linear change in frequency or a logarithmic change in frequency when sweeping (20), frequency modulating (23) or using the frequency dial (1).

**3 FREQ Range Switch** — The 11 position outer switch selects the generator frequency range, which, when multiplied by the frequency dial setting (1), determines the basic output frequency of the generator.

**VERNIER Control** — The inner knob allows fine control over the output frequency. A complete turn of this vernier is equivalent to approximately one half of the smallest division on the main frequency dial (1). When in the full clockwise position (CAL), the settings on the main dial will be accurate.

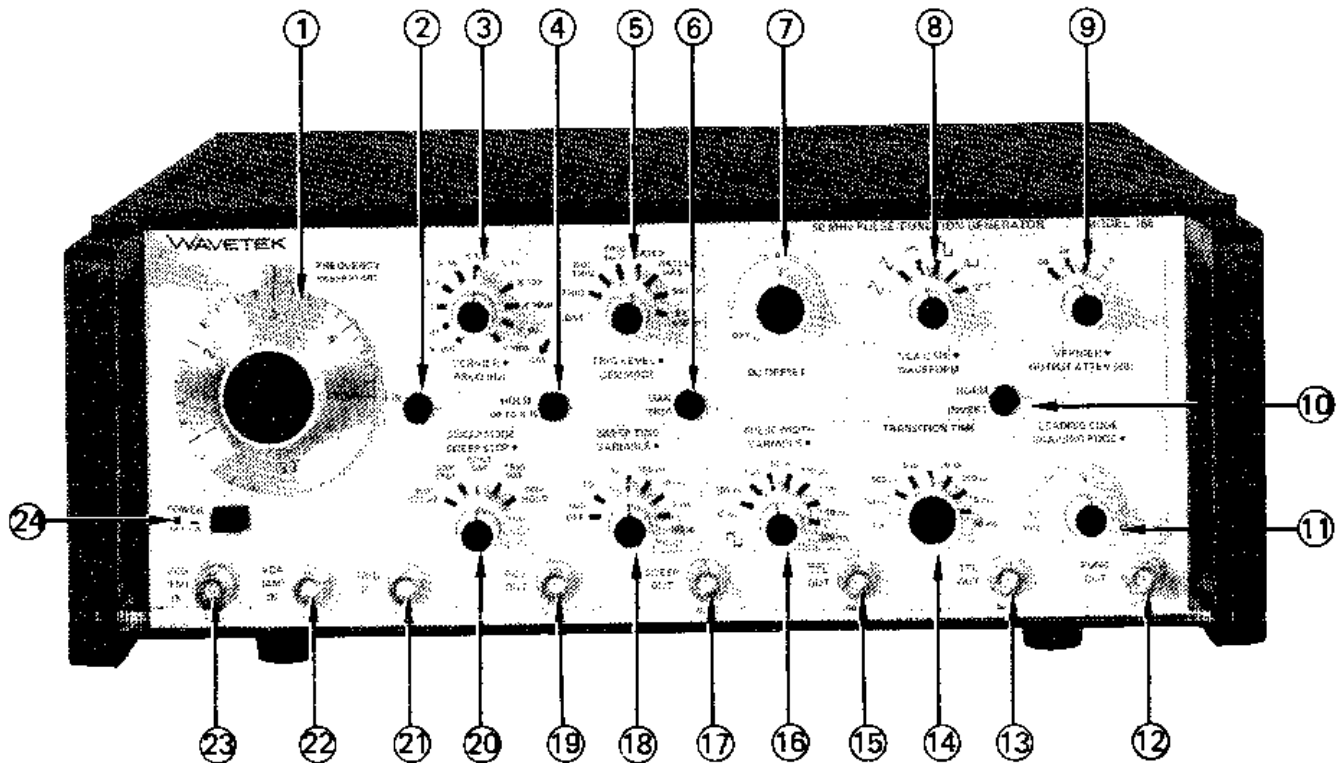








Figure 3-1. Controls and Connectors









8 **WAVEFORM Selector** – The six position outer switch selects the waveform that appears at the FUNC OUT BNC (12). The waveforms are sine , triangle , ramp , square , positive going pulse  and positive going complementary pulse .

**VCA GAIN Control** – When amplitude modulating with a signal at the VCA (AM) IN BNC (22), the inner knob determines the level of modulation by attenuating the input signal.

9 **OUTPUT ATTEN (dB) Control** – The four position outer knob attenuates the FUNC OUT waveform and offset (12) from 0 dB (15V<sub>p-p</sub> max into 50Ω LOAD) to -60 dB (15 mV p-p into 50Ω) in 20 dB steps. The inner VERNIER knob varies the attenuation over an additional 0 to approximately 20 dB. Maximum attenuation is 80 dB (1.5 mV p-p into 50Ω).



10 **NORM/INVERT Switch** – This switch inverts waveform output from FUNC OUT (12). Inversion is about the 0 volt axis of the non-offset waveform.





11 **LEADING EDGE Control** – For ,  and  waveforms only. The outer knob varies the leading edge transition time throughout the range indicated by the TRANSITION TIME switch (14). Transition time should not exceed the pulse width.

**TRAILING EDGE Control** – For ,  and  waveforms only. The inner knob varies the trailing edge transition time throughout the range indicated by the TRANSITION TIME switch (14). Transition time should not exceed the “off” time of the pulse period.








12 **FUNC OUT, 50Ω Connector** – This BNC connector is the selected waveform output of the main generator. Output level is 30V p-p maximum into an open circuit or 15V p-p maximum into a 50Ω load.

13 **TTL OUT Connector** – This BNC connector is a source of TTL level pulses at the main generator frequency. Pulse width, but neither amplitude nor transition time are controllable. Amplitude is fixed at an inactive level of 0.0 volts and an active level of approximately 2.4 volts when loaded with 50Ω. TTL pulse width is controllable regardless of the waveform selected.

14 **TRANSITION TIME Switch** – This seven position switch selects the range of pulse leading and trailing edge transition times. Actual in-range time is set by the LEADING EDGE control (11). Affects , 

and  waveforms at FUNC OUT (12). It has no effect on TTL and  $\overline{\text{TTL}}$  outputs or on ,  and  waveforms. Transition time should not exceed the “off” time of the pulse period.

15  **$\overline{\text{TTL}}$  OUT Connector** – This BNC connector is a source of  $\overline{\text{TTL}}$  level pulses at the main generator frequency. Pulse characteristics are the same as for TTL pulses (13) except amplitude is fixed at an inactive level of approximately 2.4 volts and an active level of 0 volts when loaded with 50Ω.

16 **PULSE WIDTH Switch** – The outer eight position switch selects the pulse width range. The  position ensures a 50% duty cycle pulse. The inner VARIABLE knob varies the pulse width throughout the range selected by the outer knob. This knob is inactive when the outer switch is in the  position. The PULSE WIDTH switch affects ,  and  output at FUNC OUT (12) and the TTL (13) and  $\overline{\text{TTL}}$  (15) outputs. The  and  waveforms are not affected. Pulse width cannot exceed 70% of pulse period.

17 **SWEEP OUT, 600Ω Connector** – This BNC connector provides a fixed 0 to nominal +5 volts sawtooth waveform whose period is determined by the SWEEP TIME control (18); there is no output when SWEEP TIME is OFF. Output also depends on the SWEEP MODE control (20):

Position	SWP OUT
SWP START	0V
SWP STOP	Approximately +5V
CONT SWP	Sawtooth
TRIG SWP	0V until triggered, then sawtooth and return to 0V
SWP HOLD	0V until triggered, then ramp to +5V and hold for duration of trigger, then return to 0V

18 **SWEEP TIME Switch** – The seven position outer knob provides a sweep duration range. The inner VARIABLE knob selects the actual sweep time. An OFF position ensures that the sweep generator is off and has no effect on the frequency of the main generator.

19 **GCV Out Connector** — This BNC connector provides the Generator Control Voltage, a nominal 0 to +5 volts proportional to the main generator frequency.

20 **SWEEP MODE Switch** — The main generator frequency is controlled by the sweep generator when the GEN MODE switch (5) is in SWEEP position; otherwise, the two generators are independent. The outer five position switch selects the mode in which the internal sweep generator affects the main generator. The sweep start frequency is set by the FREQUENCY dial (1) and the sweep stop frequency is set by the inner SWEEP STOP knob (20). The sweep modes are:

- a. **SWP START Mode** — The main generator operates at the frequency set by the FREQUENCY dial (1) and in the range set by the FREQ switch (3). This mode is used to set the sweep start frequency.
- b. **SWP STOP Mode** — The main generator operates at the frequency set by the SWEEP STOP knob (20) and in the range set by the FREQ switch (3). This mode is used to set the sweep stop frequency.
- c. **CONT SWP Mode** — The main generator frequency is swept up from the sweep start frequency to the sweep stop frequency as preset in the SWP START mode and SWP STOP mode and in the time determined by the SWEEP TIME switch (18); the signal immediately drops to the start frequency and sweeps again.

21 **TRIG IN, 1.5 k $\Omega$  Connector** — This BNC connector is dc coupled with 1.5 k $\Omega$ , 30 pF input impedance. Trigger signals must be 1V p-p or greater but within the range of  $\pm 5V$ . The TRIG LEVEL control (5) adjusts the sensitivity of the generator to this input signal. Trigger signal width must be 25 ns or greater. Trigger frequency must be less than 25 MHz. The trigger signal can trigger the main generator and/or the sweep generator, depending on the mode of operation selected.

22 **VCA (AM) IN, 3 k $\Omega$  Connector** — This BNC connector has input impedance of 4.99 to 10 k $\Omega$  depending upon the VCA GAIN setting (8). With VCA GAIN fully cw, 0 to  $\pm 5$  volts gives a 0 to 30 volt amplitude change; 5 Vac gives 100% modulation; 10 Vac gives 200% modulation (suppressed carrier). Increased voltages are required when the VCA GAIN control is used. AM signal bandwidth is limited to 10 kHz.

23 **VCG (FM) IN, 6 k $\Omega$  Connector** — This BNC connector is the Voltage Controlled Generator signal input, a

signal that controls the main generator frequency. With 0 volts in, the main generator frequency is determined by the frequency range selected and the frequency dial setting. A positive VCG voltage will increase this frequency, and a negative voltage will decrease the frequency. Operation is limited by the FREQ range switch setting (3). A 5 volt excursion will vary the frequency up to 1000:1, linearly or logarithmically.

24 **POWER Switch** — Power is on when this pushbutton switch is in, and off when extended.

### 3.2 WAVEFORM TIMING

The relationship among waveforms for different modes is illustrated in figure 3-3.




### 3.3 OPERATING PROCEDURE

No preparation of the instrument is required beyond completion of the initial checkout given in paragraph 2.3. It is recommended that a one-half hour warm-up period be allowed for the associated equipment to reach a stabilized operating temperature, and for the Model 166 to attain stated accuracies. The operator should be familiar with the controls and connectors given in paragraph 3.1 and the waveform relationships given in figure 3-3.

There are almost unlimited ways to set up the generator and waveforms that may be obtained. The following sections describe basic configurations and how to set them up.

Notice the grouping of controls on the front panel:

- a. the waveform and amplitude group
- b. the pulse characteristics group
- c. the sweep group
- d. the frequency and operating mode group

Internally, the sweep group will be used only in sweep mode. In addition, the sweep generator can be used as an independent signal source with its own output. This is a convenient source of trigger and modulating signals for the main generator. The pulse group is used only for altered forms of the ,  and  waveforms.

The setup instructions given in the next paragraphs must necessarily be general. They are divided for five applications which can be combined as required:

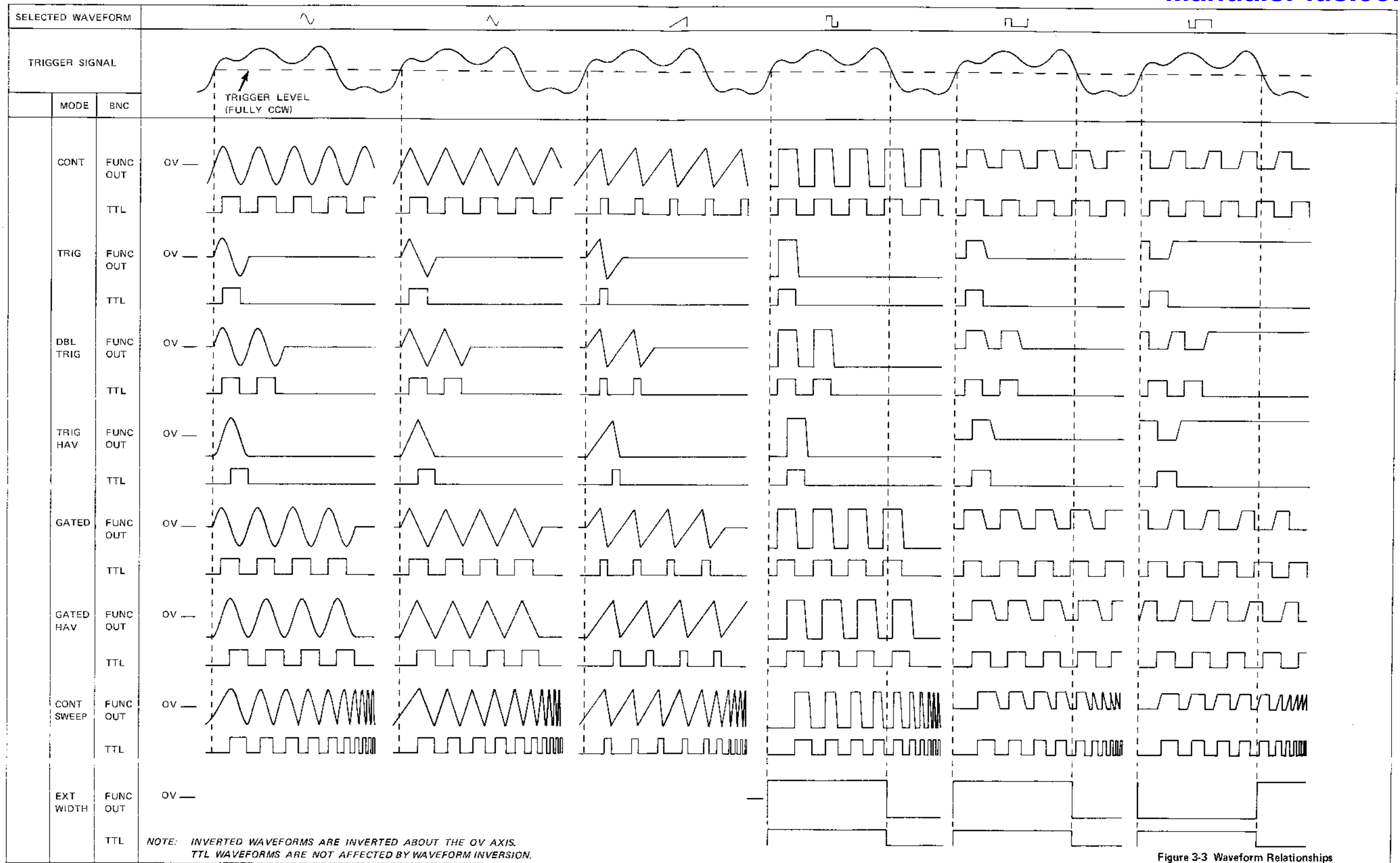


Figure 3-3 Waveform Relationships

- a. Continuous, triggered or gated operation
- b. Voltage controlled frequency (VCG) operation
- c. Sweep operation
- d. Pulse operation
- e. Voltage Controlled Amplitude (VCA) operation

### 3.3.1 Continuous, Triggered and Gated Operation

Operation in these modes is set up using standard waveforms. After getting results with a standard waveform, refer to paragraph 3.3.4 for pulse setup, if desired.

1. For most accurate results, place the generator in continuous mode and monitor the setup of the controls with an oscilloscope. Connect FUNC OUT to the oscilloscope and sync to this signal. It is best to use an oscilloscope with greater than 250 MHz band width or a sampling oscilloscope. To view the high frequency performance with a real-time scope, use a 50Ω, 10:1 attenuator at the scope input to reduce the capacitive loading due to the scope.
2. Set the frequency controls for the desired frequency.
3. Select the waveform, attenuation and offset. This completes the setup for continuous mode.
4. If one of the triggered or gated modes is desired, select the mode. If triggering is manual, rotate the TRIG LEVEL fully ccw. This completes the setup for manual triggering or gating.
5. If an external trigger signal is to be used, connect a qualified trigger source (paragraph 3.1) to the TRIG IN BNC and to the oscilloscope trigger input. Set the scope to trigger on the external signal. Rotate the Model 166 TRIG LEVEL control fully ccw, then rotate cw until the desired triggering occurs.

### 3.3.2 Voltage Controlled Frequency (VCG) Operation

Set up the controls as given in paragraph 3.3.1 for continuous operation. The frequency selected will be the reference frequency. A voltage at the VCG BNC will cause the frequency to deviate from the reference frequency.

1. For frequency control with positive dc inputs at VCG IN, set the dial for a lower limit from which frequency is to be increased.

2. For frequency control with negative dc inputs at VCG IN, set the dial for an upper limit from which frequency is to be decreased.
3. For modulation with an ac input at VCG IN, set the dial at the desired center frequency. Do not exceed the maximum dynamic range of the selected frequency range.

Figure 3-4 is a nomograph with examples of the frequency dial effect as a reference for VCG IN voltages. Example 1 shows that with 0V VCG input (2nd column), frequency (3rd column) is as determined by the frequency dial setting of 2 (1st column). 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 Factor of 50Ω OUT Frequency column must be multiplied by the frequency range in order to give the actual 50Ω OUT frequency.) For full 1000:1 linear mode VCG sweep of the generator frequencies, set the FREQ VERNIER full ccw.

#### NOTE

*The FREQ VERNIER must be rotated full ccw for 1000:1 linear or logarithmic range.*

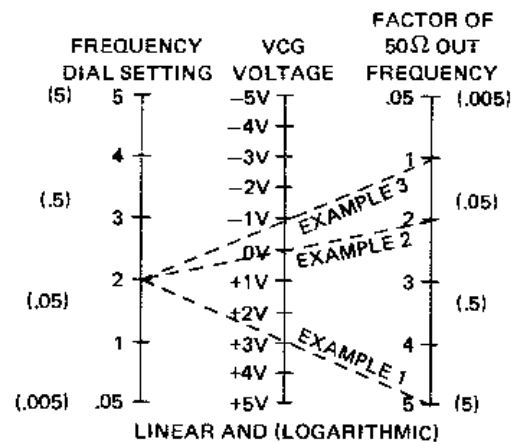
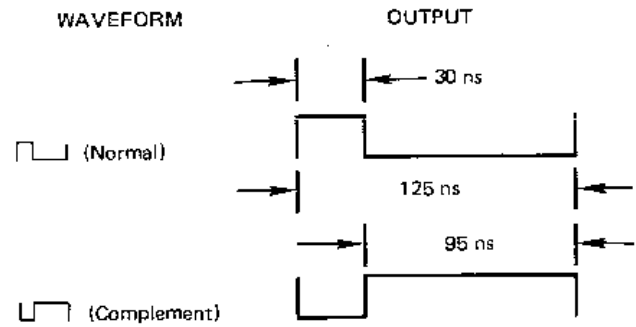


Figure 3-4. VCG Voltage-to-Frequency Nomograph

### 3.3.3 Sweep Operation

1. Set SWEEP MODE to SWP START and adjust the FREQUENCY dial and FREQ range for start sweep frequency.
2. Set SWEEP MODE to SWP STOP. Set SWEEP STOP control for the desired upper frequency.

3. Set GEN MODE switch to SWEEP and SWEEP TIME switch to the approximate sweep duration desired.
4. Set to CONT SWP mode and sync the oscilloscope with the SWEEP OUT signal. This completes the setup for continuous sweeping.
5. If a triggered sweep mode is desired, select TRIG SWP or SWP HOLD, connect a qualified trigger source (paragraph 3.1) to the TRIG IN BNC and to the oscilloscope trigger input. Set the scope to trigger on the external signal. Rotate the Model 166 TRIG LEVEL control fully ccw, then rotate cw until the desired triggering occurs.



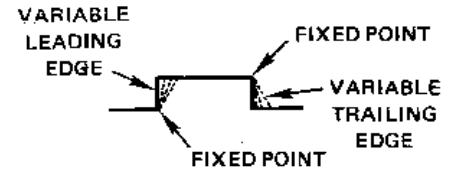
3. Set the pulse leading and trailing edges. Pulse transition times are restricted to less than pulse width.

**3.3.4 Pulse Operation**

1. Set up the controls as given in paragraph 3.3.1 for continuous operation. For pulse operation, select , or waveform, normal or inverted (figure 3-5).
2. Set the pulse width as desired. Keep in mind that the pulse width cannot exceed approximately 70% of the "normal" waveform period. For wider pulses than those that can be normally obtained, set up the pulse with the complement of the width that is desired, then switch to the complement pulse (). For example, a 95 ns pulse with a 125 ns repetition rate is desired. The complement of 95 ns is

$$125 - 95 = 30\text{ns}$$

Set up a 30 ns pulse with a 125 ns repetition rate and switch to the complement pulse as shown.



**3.3.5 Voltage Controlled Amplitude (VCA) Operation**

Set up the controls as given in paragraph 3.3.1 for continuous operation. The amplitude selected will be the reference amplitude. A voltage at the VCA BNC will cause the output amplitude to deviate from the reference amplitude. The VCA GAIN control can be used to attenuate the VCA input. For AM operation, 5V p-p gives 100% amplitude control or modulation, while 10V p-p gives 200% (suppressed carrier) modulation.

WAVEFORM	NORM/INVERT SWITCH	OUTPUT	REMARKS
	NORM		Amplitude is arbitrarily one.
	INVERT		Inversion rotates  about 0 axis.
	NORM		A 0 to Vp pulse.
	NORM		The complement of .
	INVERT		Inversion rotates  about 0 axis.
	INVERT		Inversion rotates  about 0 axis.

Figure 3-5. Comparison of Available Pulses

SECTION  
CIRCUIT DESCRIPTION

#### 4.1 GENERAL

The circuits summarized in figure 4-1 are placed on two circuit boards in the generator. All circuits outside the dotted lines of the Sweep and Transition Time board (-0629) are on the Main board (-0628). The manual controls and connectors are mounted on the front panel. The power supply, which is not shown, is located on the rear panel and Main board.

#### 4.2 BASIC WAVEFORM DEVELOPMENT

The heart of the generator (the bold path in figure 4-1) is a triangle and square wave generator. The triangle waves are developed by charging a capacitor with constant currents that are alternately reversed in polarity. The polarity reversal is caused by a flip-flop circuit, or hysteresis switch, that in turn produces the square waves. The flip-flop changes states, causing the constant current to change polarity, upon detecting amplitude limits of the triangle waveforms.

The VCG dial buffer sums the currents from the frequency dial, frequency vernier, VCG IN connector and the sweep circuit. The VCG dial buffer is an inverting amplifier whose output voltage can be applied directly to the GCV amplifier or through the log converter to the GCV amplifier. The output voltage of the GCV amplifier controls the positive and negative current sources. This voltage is also present at the GCV OUT connector. For all waveforms except the ramp the currents from the two current sources are equal and linearly (logarithmically in log mode) proportional to the voltage of the VCG dial buffer output in linear (log) operation. The diode gate, which is controlled by the hysteresis switch, is used to switch the positive or negative current to the integrating capacitor selected by the frequency multiplier. If the positive current is switched into the integrating capacitor, the voltage across the capacitor will rise linearly to generate the triangle rise transition. If the current is negative, the voltage across the integrating capacitor will fall linearly to produce the fall transition.

The triangle amplifier is a unity gain amplifier whose output is fed to the hysteresis switch. The hysteresis switch has two voltage limit points (approximately  $\pm 1.25V$ ) at its input.

During the time the output voltage of the triangle amplifier is rising, the output voltage of the hysteresis switch is positive, but when the output voltage of the triangle reaches  $+1.25V$ , it triggers the hysteresis switch, causing the output to switch negative. Once the control voltage into the diode gate becomes negative, it will switch the positive current out and switch the negative current in to the integrating capacitor, so that the voltage across the capacitor will reverse, starting a linear decrease of the triangle wave. When the decreasing voltage reaches  $-1.25V$ , the output of the hysteresis switch will switch back to positive, reversing the process. This action generates the triangle waveform as shown in figure 4-2. Since the output of the hysteresis switch is a square wave, the result is simultaneous generation of a square wave and a triangle wave at the same frequency.

The output frequency is determined by the magnitude of the capacitor selected by the frequency multiplier and magnitude of the current sources. Since the current sources are linearly proportional to the control voltage of the VCG circuit, the output frequency will also be linearly proportional to the control voltage. The relations become logarithmic if the log mode of operation is chosen. The capacitance multiplier is used to sink a precise amount of the current supplied to the integrating capacitor on the low frequency ranges.

#### 4.3 WAVE SHAPE AND AMPLIFICATION

The output of the hysteresis switch is shifted to MECL level and fed to the pulse width circuitry. The pulse width is determined by varying the RC time constant of an MECL one-shot. The output of the pulse width circuit feeds the TTL and  $\overline{TTL}$  buffer and the rise/fall circuit. The TTL and  $\overline{TTL}$  buffer circuit provides an approximate 0 to 2.4V output into 50 ohm load. The rise/fall circuit controls the transition time via selected RC networks, then returns the shaped square wave to the square wave clipper on the main board. When a square or pulse mode is selected, this clipper is activated to supply the signal to a pair of transistors which convert the single ended pulse to the differential input required by the multiplier.

The triangle wave from the triangle amplifier is coupled to another pair of transistors and the sine converter. This pair of transistors are turned on when triangle or ramp are selected

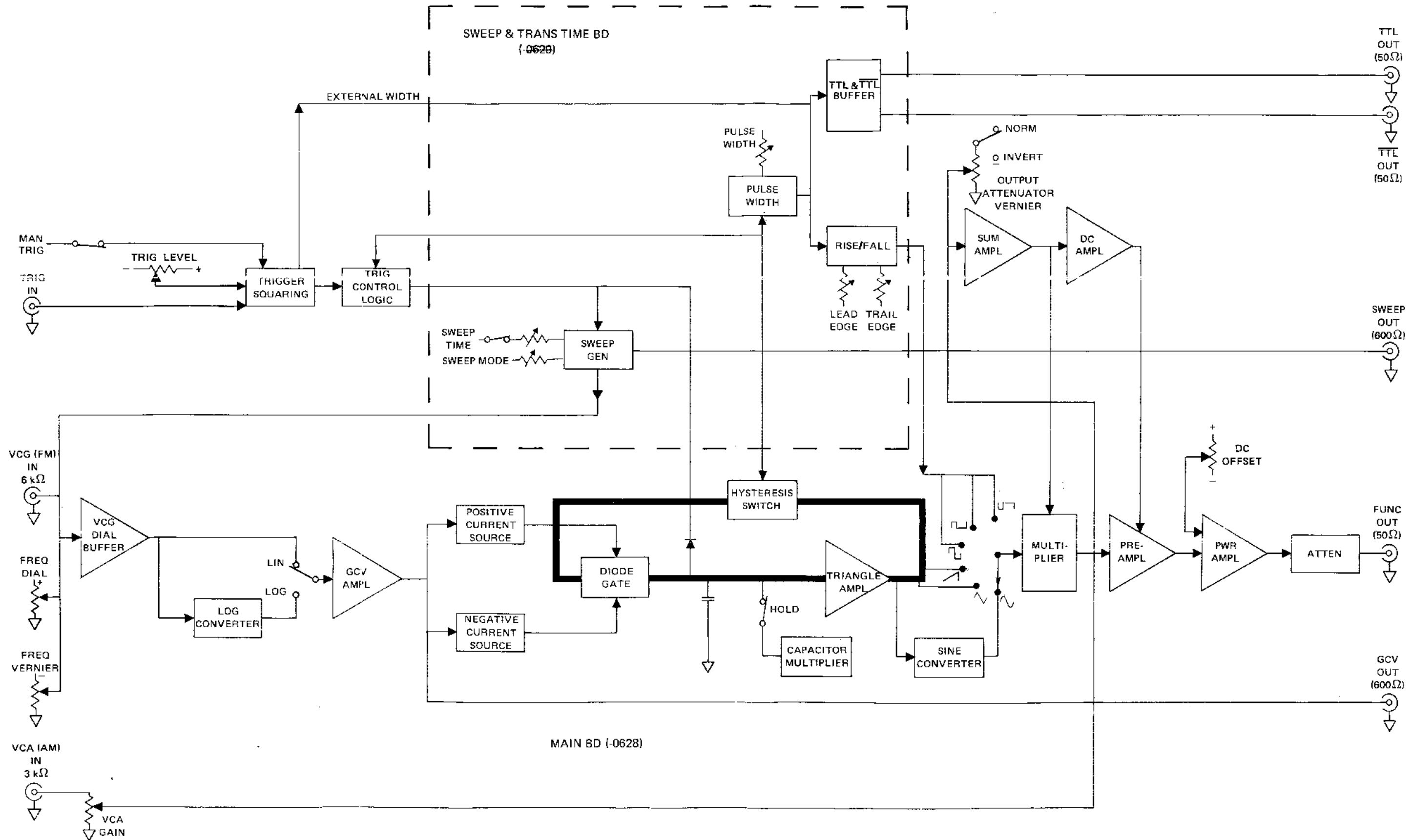


Figure 4-1. Generator Block Diagram

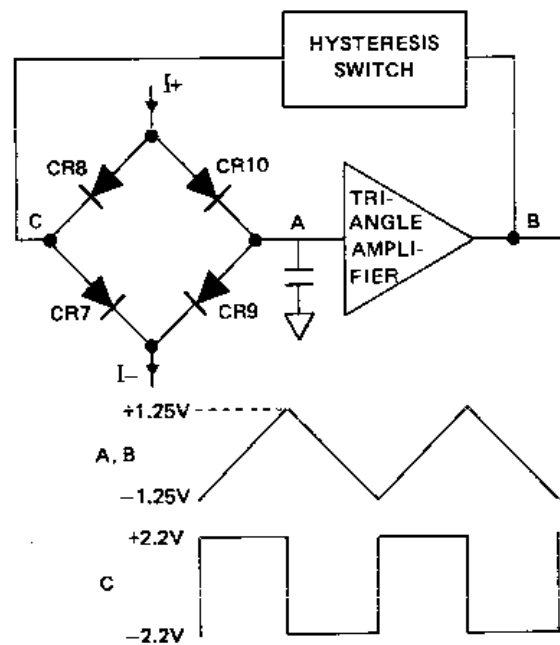


Figure 4-2. Basic Generator and Timing Diagram

and convert the single ended output to the differential input needed by the multiplier. The output of the sine converter is coupled through a similar pair of transistors before reaching the multiplier.

The amplitude vernier voltage and the VCA IN voltage are summed in the summing amplifier whose output is used to control the multipliers output amplitude. The phase of the output waveform is determined by the polarity of this voltage with the NORM/INVERT switch controlling the polarity of the dc from the amplitude vernier. In addition to being coupled to the modulating input of the multiplier, the output of the summing amplifier is coupled to another dc amplifier which keeps the pre-amplifier summing junction at the appropriate level when normal or complimentary pulse is selected.

A current mirror is used to convert the multiplier differential output to single ended output before it is applied to the inverting pre-amplifier. The output of the pre-amplifier provides an input to the summing junction of the output amplifier. The dc voltage from the DC OFFSET switch and potentiometer are also added in at the summing junction. The signal is again inverted and amplified before it is applied to the attenuator. The attenuator provides 60 dB of attenuation in three 20 dB steps. Maximum output at 0 dB is 15V into a 50 ohm load. Adjustment between steps is provided by the vernier.

#### 4.4 TRIGGERED AND GATED MODES

In the triggered and gated modes, the forward biased trigger diode sinks the current from the positive current source, thereby preventing the integrating capacitor from charging and, therefore, the generator from oscillating. The trigger pulse resets a flip-flop which reverse biases the diode, so the capacitor begins to charge. The hysteresis switch transition, which occurs when the triangle wave reaches its negative peak, clocks the flip-flop back to the original state, which prevents the voltage at the integrating capacitor from rising above ground. In the haver modes, this voltage is held at the negative triangle peak. In gated mode, the falling edge of the trig in signal (the gating signal) releases the flip-flop to clock on next hysteresis switch transition occurring at a negative triangle peak. This forward biases the trigger diode so the voltage at the integrating capacitor may not rise above the set voltage (ground or the minus peak). The double trigger is accomplished by a series of flip-flops which "count" two negative triangle peak transitions of the hysteresis switch.

In EXT WIDTH mode, the signal to be shaped is applied to TRIG IN where it is squared in the trigger squaring circuit before being coupled to the rise/fall circuit, from which point it follows the normal square wave path. The generator must be set to square wave of pulse to obtain an output.

#### 4.5 SWEEP GENERATOR MODES

The sweep generator is an independent generator with a 0 to +5V ramp out at the sweep out connector. It will drive up to 600 ohm impedance and can be used to externally trigger, VCG or VCA the main generator by connecting sweep out to the appropriate front panel connector.

The sweep generator can also be connected to the main generator internally by selecting SWEEP on the GEN MODE switch. The basic sweep generator consists of the current source, FET input amplifier, clamping circuit and hysteresis switch.

The current source charges a capacitor with a constant current which produces a voltage ramp across the capacitor. The ramp is buffered by the FET amplifier and applied to the hysteresis switch. When the ramp reaches the threshold voltage of the hysteresis switch, it changes state and discharges the capacitor very quickly through the discharge diode. The clamping circuit clamps the peaks of the ramp to precise levels which assume 1000:1 sweep control.

As the output of the sweep generator is internally connected to the input of the VCG dial buffer, it controls the frequency of the generator.

In **SWP START** mode, the sweep generator is held at its 0V peak so that the start frequency may be set with the combination of the frequency dial, frequency range and vernier. In **SWP STOP** mode, the sweep generator is held at its +5V peak, so that the portion of the voltage to reach the VCG dial buffer may be set in **SWEEP STOP** mode which determines the maximum frequency. In **CONT SWP** mode, the main generator is swept between the frequency limits set by sweep start and stop.

In **TRIG SWP** mode, the main generator oscillates at the start frequency until the trigger input triggers the sweep

generator. At the end of one ramp, the main generator returns to the start frequency and waits for the next trigger pulse.

In **SWP HOLD** mode, the main generator oscillates at the start frequency as long as the trigger input signal is below the trigger level threshold. As the threshold is crossed, the main generator is swept up to stop frequency, where it will remain until the trigger input falls below the threshold, at which time the main generator returns to the start frequency.

# 5

## SECTION 5

### CALIBRATION

#### 5.1 FACTORY REPAIR

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to minimize turnaround time.

#### 5.2 REQUIRED TEST EQUIPMENT

DVM . . . . . Millivolt dc measurement (0.1% accuracy)  
 Differential Oscilloscope, Dual Channel 500 MHz bandwidth  
 Distortion Analyzer . . . . . 600 kHz  
 Frequency Counter . . . . . 50 MHz (0.1% accuracy)

#### 5.3 CALIBRATION

Perform calibration according to table 5-1. If performing a partial calibration, check previous settings and adjustments for applicability. See figures 5-1, 5-2 and 5-3 for calibration point location.

1. Use 50Ω cable for all instrument connections.
2. Allow the instrument to warm up at least 30 minutes for the final calibration. Keep the instrument covers on to maintain heat. Remove covers only to make adjustments or measurements.

Table 5-1. Model 166 Calibration Chart



Step	Check	Tester	Calibration Point	Control Setting	Adjust	Desired Results	Remarks
1	Power Supplies	DVM or Differential Scope	-0628-TP1	FREQ: X 1K	-0645-R16	+12 Vdc ±50 mV	All measurements are referenced to ground.
2			-0628-TP2	FREQUENCY: 5		-12 Vdc ±100 mV	
3			-0628-TP3	FREQ VERNIER: CAL		+22 Vdc ±400 mV	
4			-0628-TP4	GEN MODE: CONT		-22 Vdc ±400 mV	
5			-0628-TP5	DC OFFSET: OFF	-0645-R24	+5.2 Vdc ±20 mV	
		WAVEFORM: 					
		OUTPUT ATTEN: 0					
		OUTPUT VERNIER:					
		12 o'clock					
		SWEEP MODE:					
		CONT SWP					
		SWEEP TIME: 10s   1s					
		PULSE WIDTH: 					
		TRANSITION TIME:					
		7 ns   50 ns					
		LEADING EDGE: Full ccw					
		TRAILING EDGE: Full ccw					
		LIN/LOG: LIN					
		NORM/INVERT: NORM					

Table 5-1. Model 166 Calibration Chart (Continued)

Step	Check	Tester	Calibration Point	Control Setting	Adjust	Desired Results	Remarks
6	Hysteresis Switch Balance	Scope	-0628-TP9		-0628-R150	□ Offset 0V ±100 mV	
7	□ Amplitude Zero		-0628-TP8	WAVEFORM: □	-0629-R31	□ Offset 0V ±50 mV	
8	∧ Amplitude Zero	DVM	-0628-TP6	GEN MODE: TRIG	-0628-R86	0 Vdc ±5 mV	
9	Multiplier Null	Scope	FUNC OUT	GEN MODE: CONT WAVEFORM: ∼ OUTPUT VERNIER: Full ccw	-0628-R330, R334	As near dc as possible	
10	Time Symmetry			WAVEFORM: □ Set output for 10V p-p	-0628-R46	Time symmetry within ±0.1%	See figure 5-4 for equipment setup. Set scope to 20 μs/div.
11	∼ Distortion	Distortion Analyzer		WAVEFORM: ∼	-0628-R103, R142	Minimum sine distortion	Trim R216, R226 and R238 for lowest distortion (typically 0.15%).
12	∼ Offset Shift	Scope			-0628-R241	No dc shift between normal and inverted output	Neglect the dc offset if any. Amplitude may be different between normal and inverted.
13	∧ Offset Shift			WAVEFORM: ∼	-0628-R210		
14	∼ Amplitude			WAVEFORM: Switch between ∼ and ∼	-0628 Select R212	∼ and ∼ peaks are within ±50 mV	Verify or retrim R212.
15	Preamp Zero	Differential Scope	-0628-TP7	WAVEFORM: ∼	-0628-R308	Positive and negative peak voltages are within 15 mV of each other.	
16	Output Amplifier Zero		FUNC OUT		-0628-R248	Positive and negative peak voltages are within 20 mV of each other.	

Table 5-1. Model 166 Calibration Chart (Continued)










Step	Check	Tester	Calibration Point	Control Setting	Adjust	Desired Results	Remarks
17	<input type="checkbox"/> Positive Peak	Differential Scope	FUNC OUT	WAVEFORM: Switch between  and 	-0628-R198	Positive peaks of  to  are within 50 mV	Verify or retrim R212.
18	<input type="checkbox"/> Offset Shift	Scope		WAVEFORM: 	-0628-R203	No dc shift between normal and inverted output (or match to the negative  peak)	Amplitude can be different between normal and inverted output.
19	<input type="checkbox"/> Normal/Inverted Amplitude			WAVEFORM: <input type="checkbox"/> Switch between NORM and INVERT	-0628-R297	Zero levels are within 50 mV	Neglect the dc offset if any.
20	Output Amplitude			WAVEFORM:  OUTPUT VERNIER: Full cw	-0628-R254	Peak-to-peak voltages are 15V $\pm$ 150 mV	
21	Trigger Baseline			WAVEFORM:  GEN MODE: GATED	-0628-R86	0 Vdc $\pm$ 20 mV	
22	Hover Baseline			GEN MODE: TRIG HAV Connect SWEEP OUT to TRIG IN SWEEP TIME: 10 ms  ms	-0628-R178	Baselines are at the same level of the negative peak	Set the trigger level control to obtain a burst of  signal.
23	VCG Null			GEN MODE: CONT FREQ: X 100K FREQUENCY: Full cw WAVEFORM: <input type="checkbox"/> Set output to 10V p-p	-0628-R4	Less than 1% frequency shift while opening and shorting VCG IN to ground	
24	1000:1 Time Symmetry			LIN/LOG: LOG	-0628-R34, R59	Each half cycle <input type="checkbox"/> is 1.2 ms and symmetry is < 1%	
25	Symmetry at 5 X 1 kHz			LIN/LOG: LIN FREQ: X 1K FREQUENCY: 5	-0628-R46	Time symmetry within 0.1%	
26	Symmetry at 0.5 X 1 MHz			FREQ: X 1M FREQUENCY: 0.5	-0628-R47	Time symmetry within 0.2%	
27	Symmetry at 0.5 X 10 MHz		FREQ: X 10M	-0628-R45 (trim)	Time symmetry < 1%	R45 must be installed for unit to oscillate on X 10M range. Verify or retrim.	

Table 5-1. Model 166 Calibration Chart (Continued)


Step	Check	Tester	Calibration Point	Control Setting	Adjust	Desired Results	Remarks
28	Frequency	Frequency Counter	TTL OUT	FREQ: X 1K FREQUENCY: 5	-0628- R13	5 kHz $\pm$ 10 Hz	R13 affects frequency calibration in all frequency ranges.
29				FREQ: X 100	-0628- R18	500 Hz $\pm$ 1 Hz	
30				FREQ: X 10M	-0628- C24	50MHz $\pm$ 500kHz	C22/23 may be added to lower frequency.
31				FREQ: X 1M	-0628- R15	5 MHz $\pm$ 10 kHz	Trim C27 if R15 in stops.
32				FREQ: X 100K	-0628- R16	500 kHz $\pm$ 1 kHz	Trim C25 if R16 in stops.
33				FREQ: X 10K	-0628- R17	50 kHz $\pm$ 100 Hz	Trim R117 if R17 in stops.
34	Low Frequency Symmetry	Scope	FUNC OUT	FREQ: X 10 FREQUENCY: 0.5	-0628- R188	Time symmetry within 0.2%	
35	Low Frequency	Counter	TTL OUT	FREQUENCY: 5	-0628- R182	50 Hz $\pm$ 0.2 Hz (20 ms $\pm$ 40 $\mu$ s)	Trim R181 if R182 in stops.
36	Logarithmic Frequency			FREQUENCY: 1 (Lin scale) FREQ: X 100K LIN/LOG: LOG	-0628- R50	1.99 kHz $\pm$ 40 Hz	Cross Reference of Dial Dial (lin)      Dial (log)
37				FREQUENCY: 4	-0628- R20	125.6 kHz $\pm$ 2.5 kHz	0            .005 1            .020 1.67        .050 2            .079 3            .316 3.33        .500
38				Repeat steps 24, 36 and 37 several times			4            1.26 5            5.00
39	High Frequency Waveform	Sampling Scope	FUNC OUT	WAVEFORM:  LIN/LOG: LIN FREQ: X 10M FREQUENCY: 0.6	-0628- R266, R285 R351	Minimum rise/fall time and aberration	
40	Sweep Ramp Positive Peak	Scope	SWP OUT (no load)	SWEEP MODE: CONT SWP SWEEP TIME: 100 ms I 10 ms	-0629- R110	Positive peak just starts to flatten	
41	Sweep Ramp Zero Peak			SWEEP TIME VARIABLE: Full cw	-0629- R107	Zero peak just starts to round	

Table 5-1. Model 166 Calibration Chart (Continued)

Step	Check	Tester	Calibration Point	Control Setting	Adjust	Desired Results	Remarks
42	Sweep Ramp Start	Scope	SWP OUT (no load)	SWEEP MODE: SWP START	-0629-R62	0V (0 to -5 mv)	
43	Final Calibration (optional)			Close covers and warm up for 1 hour; repeat step 11, then step 28.			Sine distortion calibration will affect all frequency calibration. Adjusting R13 will restore the frequency calibration.

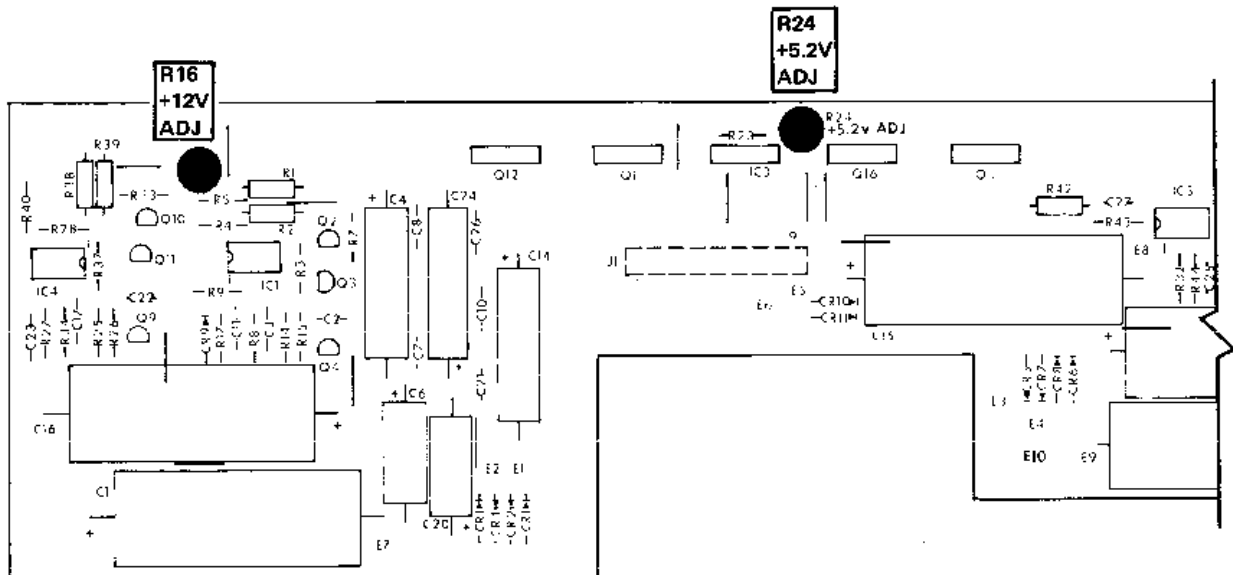


Figure 5-1. Power Supply (-0645) Calibration Points

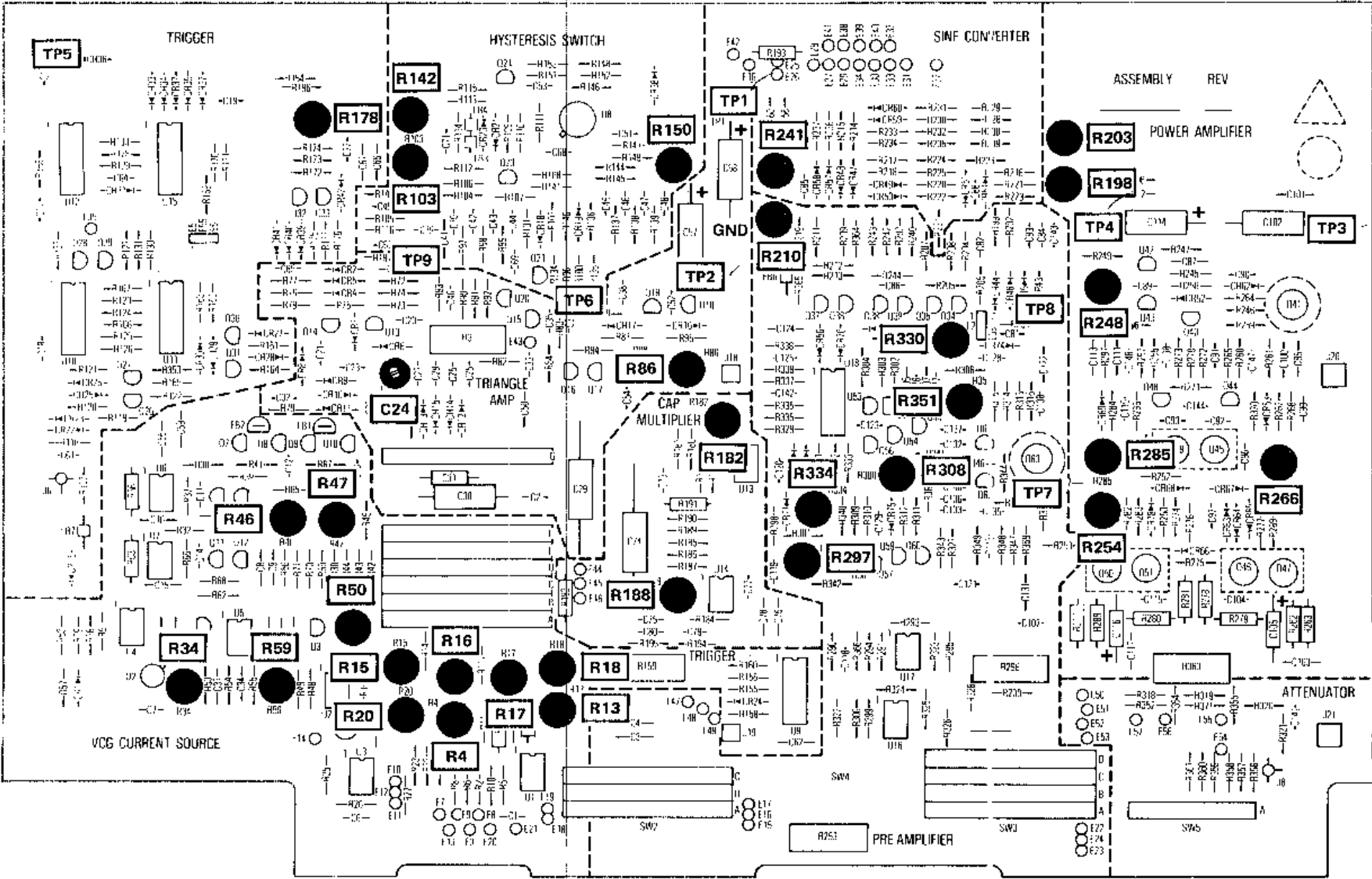


Figure 5-2. Main Board (-0628) Calibration Points

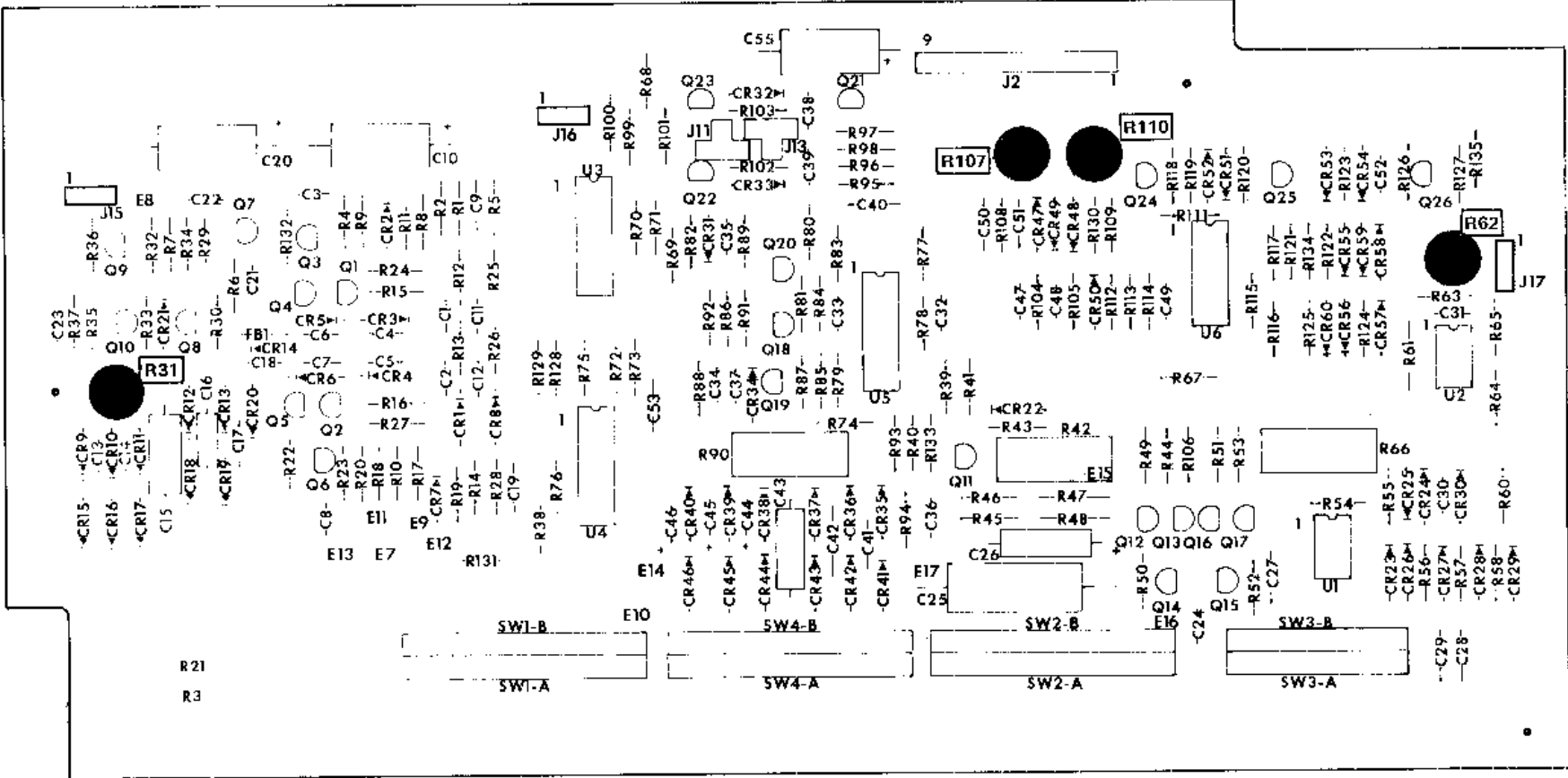
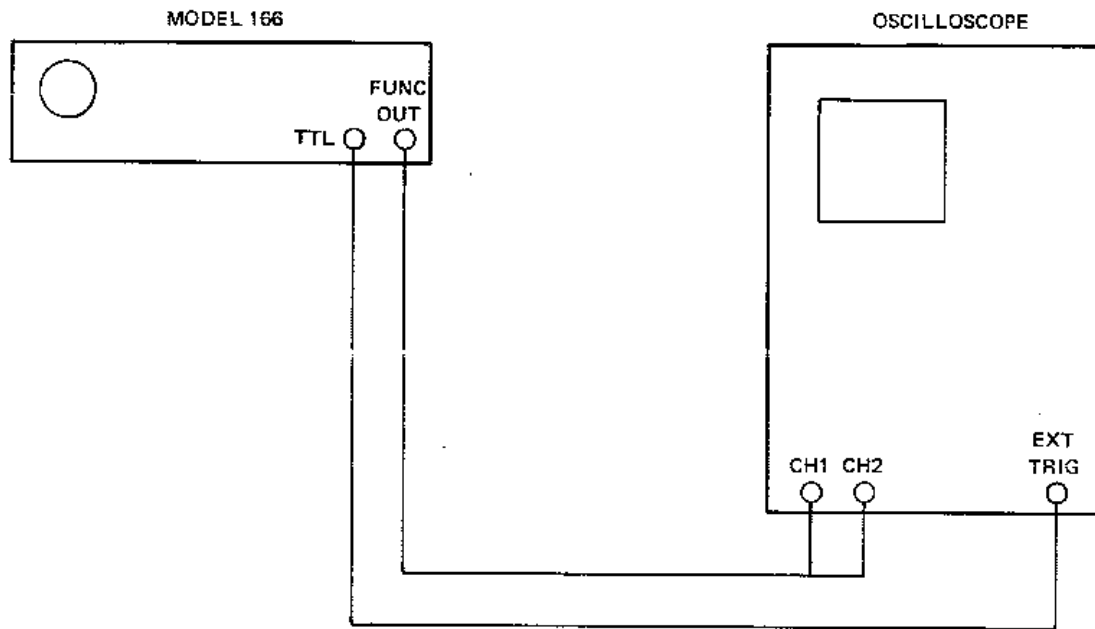


Figure 5-3 Sweep and Transition Time Board Calibration Points



**NOTE**

*Set scope to normal external trigger. Use alternate or chop vertical mode. Set scope time so that one cycle just fills the screen. Using X 10 multiplication or delay time, expand time by 10. Now each cm represents 1% difference in symmetry.*

Figure 5-4 Time Symmetry Calibration Setup

**6.1 INTRODUCTION**

Familiarize yourself with the Model 166 by reviewing the operating procedures as well as the circuit descriptions. Successful fault isolation depends upon knowledge of the correct instrument operation. The physical arrangement of the instrument and component listings are given in Section 7.

Table 6-1 lists six basic problem areas and possible causes and corrections to problems in those areas.

**PROBLEM AREAS**

- Power Supply
- Output Waveform
- Time Symmetry
- Frequency Accuracy
- Generator Mode
- Sweep Circuit

Check points, expected values and component functions are given in tables 6-2 through 6-10, the troubleshooting guides.

**TROUBLESHOOTING GUIDES**

- Power Amplifier
- AM and Preamp
- Waveform Switching
- Hysteresis Switch
- Capacitance Multiplier
- VCG Current Source
- Transition Time
- Sweep Circuit

**6.2 ACCESS**

For access to the Power Supply board (-0645) and Main board (-0628), remove the top cover. For access to the Sweep and Transition Time board (-0629), remove the bottom cover.

**6.3 TEST EQUIPMENT**

Test equipment are listed in paragraph 5.2.

**Table 6-1. Troubleshooting**

<b>Problem</b>	<b>Definition</b>	<b>Possible Cause/Correction</b>
<b>POWER SUPPLY PROBLEM</b>		
1. Blown fuse	1. AC line voltage is not properly set.  2. Short circuit if fuse blows again after replacement.  3. Fuse blows again or voltage output at J1 is not correct.	Measure the ac line voltage and check for proper selection of line voltage in the unit. Refer to paragraph 2.2.1 for selection procedure.  To locate source of short circuit, isolate the power supply by unplugging J1 on power supply board and J2 on sweep board.  Turn on and check for correct voltage output at J1 on power supply board.  Use an ohmmeter to detect possible short circuit between each power supply and ground: check at both input and output of the regulator to ground and also to chassis ground.









Table 6-1. Troubleshooting (Continued)


Problem	Definition	Possible Cause/Correction
<p>2. Power regulator</p>	<p>4. Short is not found in the regulator.</p>	<p>Check for short circuit of transformer, power switch or defective CR1 - CR8, CR10 or CR11.</p> <p>Check for short circuit between collector of Q1, Q5, Q12 or Q16 to chassis and also IC3.</p>
	<p>5. If voltage output at J1 is normal, the short circuit is in main board or sweep board.</p>	<p>In most cases, short circuits in main board and sweep board do not cause blown fuses, unless the current limiting circuit in the power supply regulator has also failed. Q3, Q7, Q11 and Q15 in power supply board are the current limiting device.</p>
	<p>1. Unplug and check voltage at J1 on power supply board. If voltage is not normal, proceed to the following steps.</p>	
	<p>2. +5.2V is normal, but all ±12V, ±24V supplies are abnormal.</p>	<p>Problem is in the +12 volt regulator; check for defective Q1 - Q4, IC1, CR9 and the associated circuitry.</p>
	<p>3. Both -12V and -22V are abnormal.</p>	<p>Problem is in the -12V regulator; check for defective Q9 - Q12, IC4 and the associated circuitry.</p>
<p>3. Power supply voltage below normal</p>	<p>4. Only +22V, -22V or +5.2V is abnormal.</p>	<p>Check the regulator in which the output voltage is abnormal.</p>
	<p>5. All regulator outputs are abnormal.</p>	<p>Check line voltage and proper selection of line voltage. Refer to paragraph 2.2.1 for line voltage selection.</p> <p>Check for defective transformer and loose wiring in the primary circuit.</p>
	<p>1. Unplug and check voltage at J1 on power supply board. If voltage is normal, the problem is in main circuit board or sweep board. Otherwise, refer to power regulator problem.</p>	<p>Overloading the +12V supply will cause all ±12V and ±22V supplies to be low. Overloading the -12V supply will cause the -22V supply to be low.</p> <p>Isolate the power supply to the sweep board by unplugging J2 on sweep board.</p>
<p>2. Both ±22V supplies below normal.</p>	<p>Check for defective transistors Q45 - Q47 and Q49 - Q51 in power amplifier.</p>	

OUTPUT WAVEFORM PROBLEM

<p>1. No output waveform at FUNC OUT and TTL OUT</p>	<p>Main generator is not running.</p>	<p>Ensure power supply voltages are normal and switches and controls are set properly. Triangle amplifier, hysteresis switch or current source is malfunctioning. Refer to troubleshooting tables 6-5, 6-6, and 6-8.</p>
<p>2. No output waveform at FUNC OUT, but TTL OUT is normal</p>		<p>Problem in power amplifier, preamplifier or the AM circuit. Refer to troubleshooting tables 6-2 and 6-3.</p>

Table 6-1. Troubleshooting (Continued)

Problem	Definition	Possible Cause/Correction
✓ 3. No square waveform at FUNC OUT	<p>1. TTL OUT is normal,  is seen at TP8 on main board.</p> <p>2. TTL OUT is normal,  is not seen at TP8 on main board.</p> <p>3.  output is normal, but no pulse width control.</p> <p>4. Also no TTL out. Check for <math>\pm 2.2V</math>  at emitter of Q22 to ensure the triangle generator loop is functioning. If not refer to tables 6-5, 6-6, and 6-8.</p> <p>Check the continuity of the square wave path to locate the defective components. Starting from main board pins 11 and 13 of U11 to pins 14 and 15 of U11 through connector P16 to J16 on the sweep board. Then on the sweep board, pins 6 and 7 of U3, to pins 2 and 3 of U4 if  is selected, or pin 6 and 2 of U5 if  is selected.</p>	<p>Check for defective Q34, Q35, CR43 - CR46 and associated circuitry.</p> <p>Connector P15 is not plugged in.</p> <p>Transition time circuit is malfunctioning; check Q1 - Q6 and associated circuitry on sweep board.</p> <p>Transition time amplifier is malfunctioning; check Q7 - Q10 on sweep board.</p> <p>Check pulse width circuit, U5 and Q18 - Q20 on sweep board.</p>
4. No sine waveform output	All other waveforms are normal.	Check sine amplifier Q38 and Q39 on main board.
5. Distorted sine waveform below 100 kHz.	<p>1. Time symmetry of  is not <math>50\% \pm 0.5\%</math>.</p> <p>2. Nonlinear or distorted .</p> <p>3. Defective sine converter</p> <p>4. Defective X-Y multiplier circuit.</p>	<p>Square wave time symmetry is not calibrated correctly. Refer to TIME SYMMETRY PROBLEM.</p> <p>If the edge of the triangle is nonlinear at all frequency ranges, troubleshoot the VCG current source circuit (table 6-8).</p> <p>Check for defective Q15 and CR7 to CR11. If the peak of the triangle is distorted, check for defective range capacitors C22 to C31.</p> <p>Check for defective CR47 to CR61.</p> <p>Check for defective U18, Q52 and Q53.</p>

Problem	Definition	Possible Cause/Correction
6. Sine distortion out of specification at frequencies above 100 kHz.	Usually square wave will show up distorted or with slow rise/fall times.	Check preamplifier Q54 - Q63, or power amplifier Q42 - Q51. Check for defective capacitors in the circuit.
7. Transition time problem.		Check transition time circuit, Q1 - Q6, on sweep board.
8. No TTL and $\overline{\text{TTL}}$ output.		Check for defective U3, Q21 - Q23, on sweep board.
9. Excess of waveform rolloff at high frequency	1. Excess rolloff shown at emitter of Q63.	Check for defective C126, C127, C133, C135, C145 and other frequency compensation components in this area, by connecting a capacitor in parallel with each capacitor.
	2. Only sine waveform rolloff excess.	C86 is open or C88 has wrong value on main board.
	3. Otherwise.	Check for defective capacitor in the power amplifier.
10. Drooping on square wave (  not square)		Check for defective C126 or C127 on main board.
11. Nonlinear triangle waveform	1. Occurs at only one frequency range.	Check for defective timing capacitors C22 - C31 of the associated range.
	2. Occurs at all frequencies and gets worse at bottom of frequency dial.	Check for defective Q15 and CR7 - CR11.

## TIME SYMMETRY PROBLEM

Waveform time symmetry is off and cannot be calibrated to within specifications	1. All frequencies.	Usually due to the malfunctioning of the VCG current source circuit, U3 - U7, on main board. Check for leakage current at gate of Q2 - Q5, Q7, Q9 and Q11. check for excess source current at input of U3 - U7.
	2. Frequency ranges X 10 and and below.	Capacitance multiplier is malfunctioning. Check for defective U13 - U14 on main circuit board.

## FREQUENCY ACCURACY PROBLEM

Frequency out of specification	1. Out of specification at all ranges.	Mismatched dial and potentiometer (R1). Ensure that the number on the back of the dial matches the number on the potentiometer.  Check for defective components in the VCG current source, U1 - U7 and Q2 - Q12 on main board.
	2. Out of specification at X 10K range and up.	Check for defective components C35, C36, C39, C42 - C48, C53, C68, R97 - R99, R109, R116 and R137 - R139 on the main board.

Table 6-1. Troubleshooting (Continued)

Problem	Definition	Possible Cause/Correction
	3. Out of specification at X .001 Hz to X 10M.	Check for defective U13 - U14 and R185, R189 - R195 on main board.
	4. Frequency problem when LOG is selected.	Check for defective U2 and Q1 on main board.

**GENERATOR MODE PROBLEM**

1. Generator cannot be triggered or gated	1. Trigger sweep mode is ok.	Check for defective Q30 - Q33, U15, CR2 and the associated circuitry on main board. Troubleshoot using figure 6-1.
	2. Trigger sweep mode is not operating.	Check for defective Q26, Q27 and the associated circuitry on main board.
2. Triggered or gated mode ok, but no triggered haver-waveform		Check for defective SW2-B, CR42 and R178 on main board.
3. No frequency sweep	1. No sweep signal at SWEEP OUT.	Sweep circuit is malfunctioning. Check for defective U1, U2, U6, Q11 - Q17 on sweep board.
	2. SWEEP OUT is normal.	Check for loose wire connection between sweep board and main board.  Check for defective SW2-A on main board or R66 on sweep board.

**SWEEP CIRCUIT PROBLEM (Unless otherwise specified, components referred to are on the sweep board)**

1. No signal at SWEEP OUT	1. Sweep signal is seen at pin 6 of U1.	Check for defective U2, CR28 and CR29.
	2. No sweep signal is seen at pin 6 of U1.	Refer to table 6-10.
2. Sweep signal runs continuously at TRIG SWP and SWP HOLD	Sweep mode control logic problem.	Check for defective CR53 - CR60 and SW3-B.
3. TRIG SWP and SWP HOLD are not operating	1. Manual trigger switch has no effect.	Check for defective MAN TRIG switch and U9 on main board.
	2. Cannot be triggered by MAN TRIG or external signal at TRIG IN.	Check for defective Q26 and Q27 on main board and Q26 and CR55 - CR60 on sweep board.

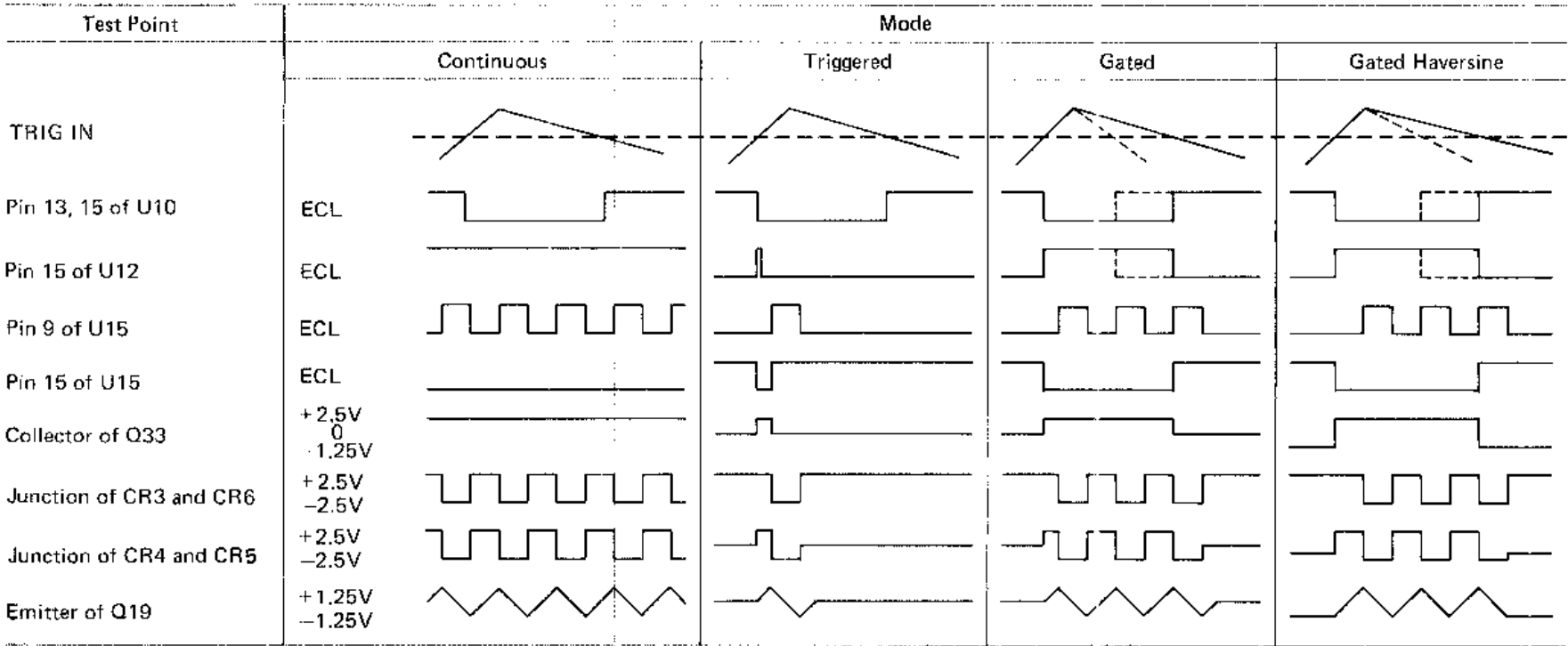


Figure 6-1. Generator Mode Timing Diagram










Table 6-2. Power Amplifier Troubleshooting Guide

Test Point	Observation
Junction R279 and R281.	Power amplifier output: 0 to 30 Vp-p signal.
Junction C92 and C93	Summing junction: 0 V with less than 2 Vac transient.
Emitter of Q63	Preamp output: 0 to 4 Vp-p signal, inverted from power amplifier output
Q40-Q43	Dc biasing circuit for power amplifier.
Base of Q44 and emitter of Q45	+19 Vdc.
Base of Q48 and emitter of Q49	-20 Vdc.
Q46 and Q47	Slow rise time if one of the transistors is open
Q50 and Q51	Slow fall time if one of the transistors is open
C92, C93, C96-C99, C109, C110, R266-R268 and R284-R286	These components affect the power amplifier frequency response the most.

Table 6-3. AM and Preamp Troubleshooting Guide

Test Point	Observation
Emitter of Q63	Preamp output: 0 - 3 Vp-p signal.
Q57-Q60	Dc bias circuit for the preamp.
Junction of C132 and C136	Summing junction, +1.8 Vdc typically.
Emitter of Q61	+5.5 Vdc.
Emitter of Q62	-5.5 Vdc.
C132-C137, C139-C140 and R351	Frequency compensation components.
U18	AM modulator.
Pins 6 and 12 of U18	AM current output. Out of phase with each other.
Q54-Q56	Current mirror circuit: sums current from pin 12 to pin 6.
C126 and C127	Excess drooping of square wave if defective.
Pins 2 and 3 of U18	Differential signal input: -4.5 Vdc level.
Pin 10 of U18	Amplitude control input: ± 200 mV.
U16 and U17	Amplitude control amplifiers.

Table 6-4. Waveform Switching Troubleshooting Guide

Test Point	Observation
Q38 and Q39	 amplifier and switch.
Q36 and Q37	 amplifier and switch.
Q34 and Q35	 ,  ,  amplifier and switch
Junction of CR43 and CR45	± 1.5 V  approximately
Junction of CR44 and CR46	± 0.5 V  .
Base of Q37	± 1.25 V  .
Base of Q38	± 0.4 V  approximately.
CR47-CR61	Sine converter diodes. Matched set.



Test Point	Observation
Base of Q15	$\pm 1.25\text{ V}$  (input).
Emitter of Q19	$\pm 1.25\text{ V}$  (output).
Base of Q16	-9 Vdc.
R86	For amplifier offset calibration.
Q15 and Q17	Matched for $V_{GS}$ . Q17 sets the bias current for Q15.
Q18 and Q19	Matched for $V_{BE}$ . Excess offset between input and output of the amplifier may be due to defective or mismatched Q15 and Q17, or Q18 and Q19.

Table 6-6. Hysteresis Switch Troubleshooting Guide







Test Point	Observation
Junction of R101 and R136	$\pm 1.25\text{ V}$  .
Pin 1 of U8	Negative peak detector input.
Pin 4 of U8	Positive peak detector input.
Base of Q23 and Q24	+6 Vdc with $1.4\text{ V}$  .
Q23	Q23 on (collector + 2V) when  going positive. Off (collector - 2.5V) when  going negative.
Q24	On/off cycle inverts from Q23.
Emitter of Q22	$\pm 2.2\text{ V}$  .
Emitter of Q21	$2.5\text{ V}_{pp}$  .
Pin 3 and 9 of U8	-3 Vdc.
C70 and C42-C44	Negative peak compensation.
C45-C48	Positive peak compensation.
C71, C68, C70 and C48	Compensation for frequency above 10 MHz.

Table 6-7. Capacitance Multiplier Troubleshooting Guide

Test Point	Observation
Capacitance multiplier	Used only at frequency ranges X.001 to X10.
Junction of R195 and C80	+1.25V -1.25V
Pin 6 of U13	+7.5V -7.5V
Pin 6 of U14 (Dial at 5)	+3.75V -3.75V
Pin 6 of U14 (Varies with Frequency)	+3.75V -3.75V

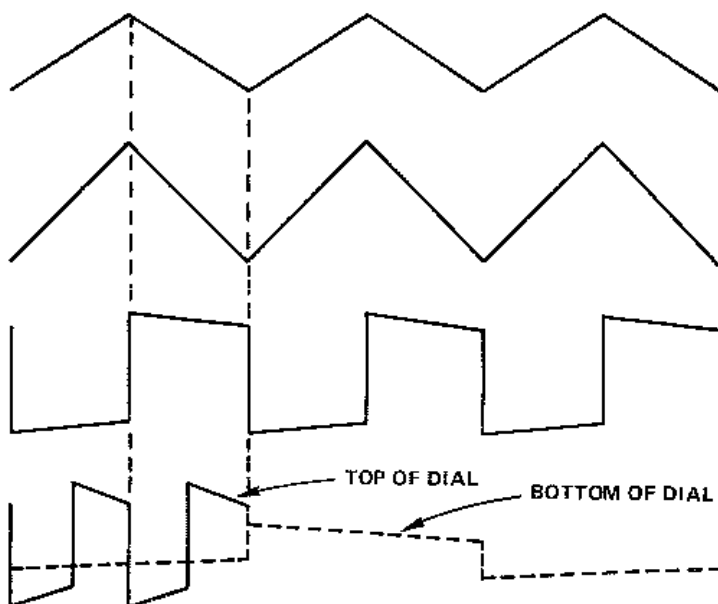


Table 6-8. Current Source Troubleshooting Guide


Test Point	Observation
Pin 6 of U1	0 to -5.6 V. Varies with frequency.
Pin 6 of U3	0 to +5.6 V.
Gate of Q2	+12 V (Q2 is on) except when ramp waveform (  ) is selected; then voltage is 0V (Q2 is off).
Pin 2 of U4	0 to 5.6 V. Varies with frequency.
Pins 2 and 3 of U6	+12 to 7.3 V.
Emitter of Q8	Approximately 4 V below emitter of Q6.
Pin 6 of U4	Voltage equal or greater than voltage at Pin 3 of U6.
Pin 6 of U6	Voltage equal or greater than voltage at S of Q5.
Pin 2 of U5	0 V.
Pin 2 and 3 of U7	-12 V to -6.4 V.
Emitter of Q10	Approximately 4 V above emitter of Q12.
U2 and Q1	Log converter. Used in log frequency only.
Emitter of Q24	+7.5 Vdc.
Base of Q13	$\pm 1.2V$ pulse.
Pins 9 and 13 of U6	0V in CONT SWP.
Q26	Trigger sweep control input buffer amplifier.
CR53-CR60	Sweep mode control logic.

Table 6-9. Transition Time Troubleshooting Guide

Note: All components are on the sweep board

Test Point	Observation
Junctions of C1 and C2, C11 and C12	Square wave (ECL level) input to the transition time generator.
Q1 and Q4	Leading edge current switch.
Q2 and Q5	Trailing edge current switch.
CR3-CR6	Peak level clamp.
Q7-Q10	Unity gain amplifier. Output (emitter of Q9) is $\pm 1.2 V$ pulse.

Table 6-10. Sweep Circuit Troubleshooting Guide

Note: Unless otherwise noted, the sweep generator is set to CONT SWP and SWEEP TIME to 10 ms. All components are on the sweep board.

Test Point	Observation
Base of Q11	+6 Vdc.
Emitter of Q14	+6 Vdc.
Pins 3 and 6 of U1	-0.2 to +5.5 V ramp.
Pin 3 of U2	0 to +5 V ramp.
Q12 and Q13	Q12 is off and Q13 is on during ramp up time. Q12 is on and Q13 is off when ramp resets.
Q15	Reset current is discharged through the collector-base junction of Q15.
Q16 and Q17	In TRIG SWP mode, Q16 and Q17 hold the quiescent voltage of the ramp at pin 3 of U1 to -200 mV, which ensures CR29 is reverse biased and output at U2 is 0V.
P 2 of U6	0 V peak detector input.
Pin 6 of U6	+5V peak detector input.

# SECTION 7

## PARTS AND SCHEMATICS

### 7.1 DRAWINGS

The following assembly drawings, parts lists and schematics are in the arrangement shown below.

### 7.2 ORDERING PARTS

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

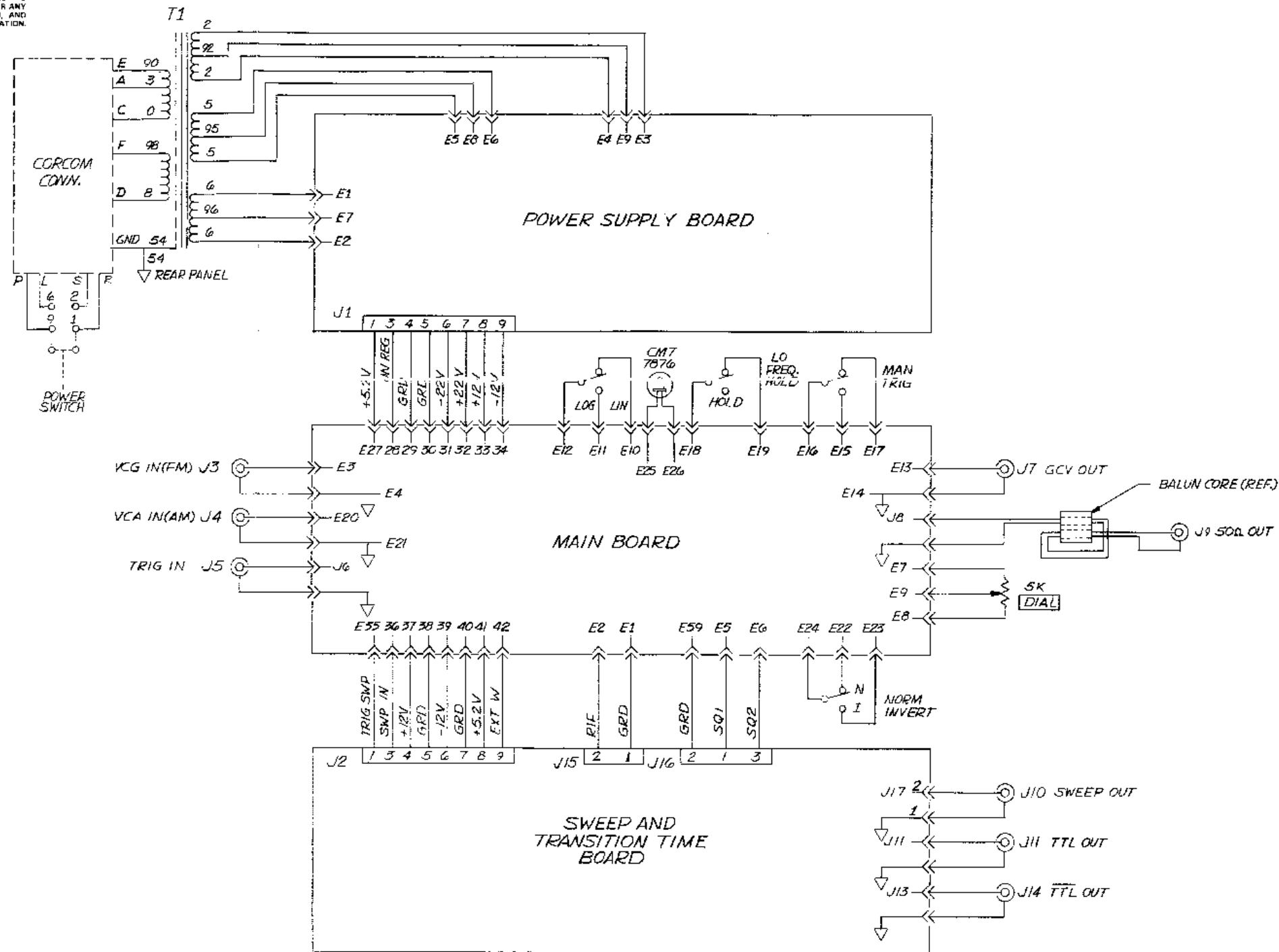
Drawing	Drawing No.
Instrument Schematic	0004-00-0128
Chassis Assembly	0102-00-0649
Chassis Parts List	1101-00-0649
Main Board Schematic	0103-00-0628
Main Board Assembly	0101-00-0628
Main Board Parts List	1100-00-0628
Main Board Switch Assemblies	1202-00-0041
Shield Board Assembly	0101-00-0684
Shield Board Parts List	1100-00-0684

### 7.3 ADDENDA

Under Wavetek's product improvement program, the latest electronic designs and circuits are incorporated into each Wavetek instrument as quickly as development and testing permit. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the cover.

Drawing	Drawing No.
Sweep and Transit Time Board Schematic	0103-00-0629
Sweep and Transit Time Board Assembly	0101-00-0629
Sweep and Transit Time Board Parts List	1100-00-0629
Sweep and Transit Time Board Switch Assemblies	1202-00-0042
Power Supply Schematic	0103-00-0645
Power Supply Assembly	0101-00-0645
Power Supply Parts List	1100-00-0645
Rear Panel Assembly	0102-00-0648
Rear Panel Parts List	1206-00-0648

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NOTE: UNLESS OTHERWISE SPECIFIED

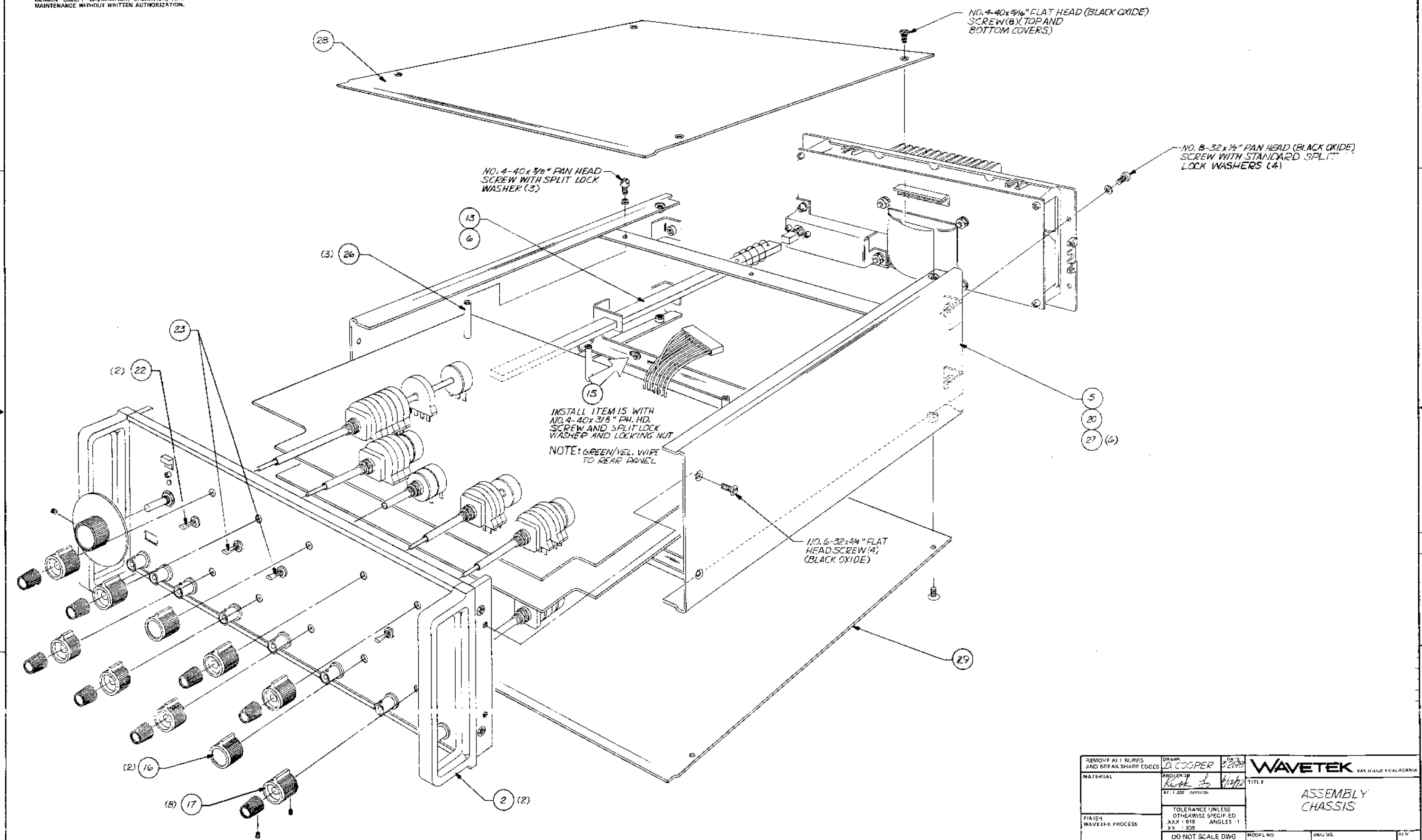
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 3-30-78	WAVETEK SAN DIEGO - CALIFORNIA	
MATERIAL	APPROVED <i>[Signature]</i>	RELEASE APPROV	TITLE SCHEMATIC INSTRUMENT	
FINISH WAVE TEK PROCESS	TOLERANCES UNLESS OTHERWISE SPECIFIED XXX ± 0.10 ANGLES 1 XX ± 0.25		MODEL NO 166	DWG NO 0004-00-0128
	SCALE	DID NOT SCALE DWG	REV A	REV A
			CODE 23338	SHEET 1 OF 1

REV	ECN	BY	DATE	APP
B	ECN 1790	RO	5-16-78	
C	ECN 1879		2-2-78	

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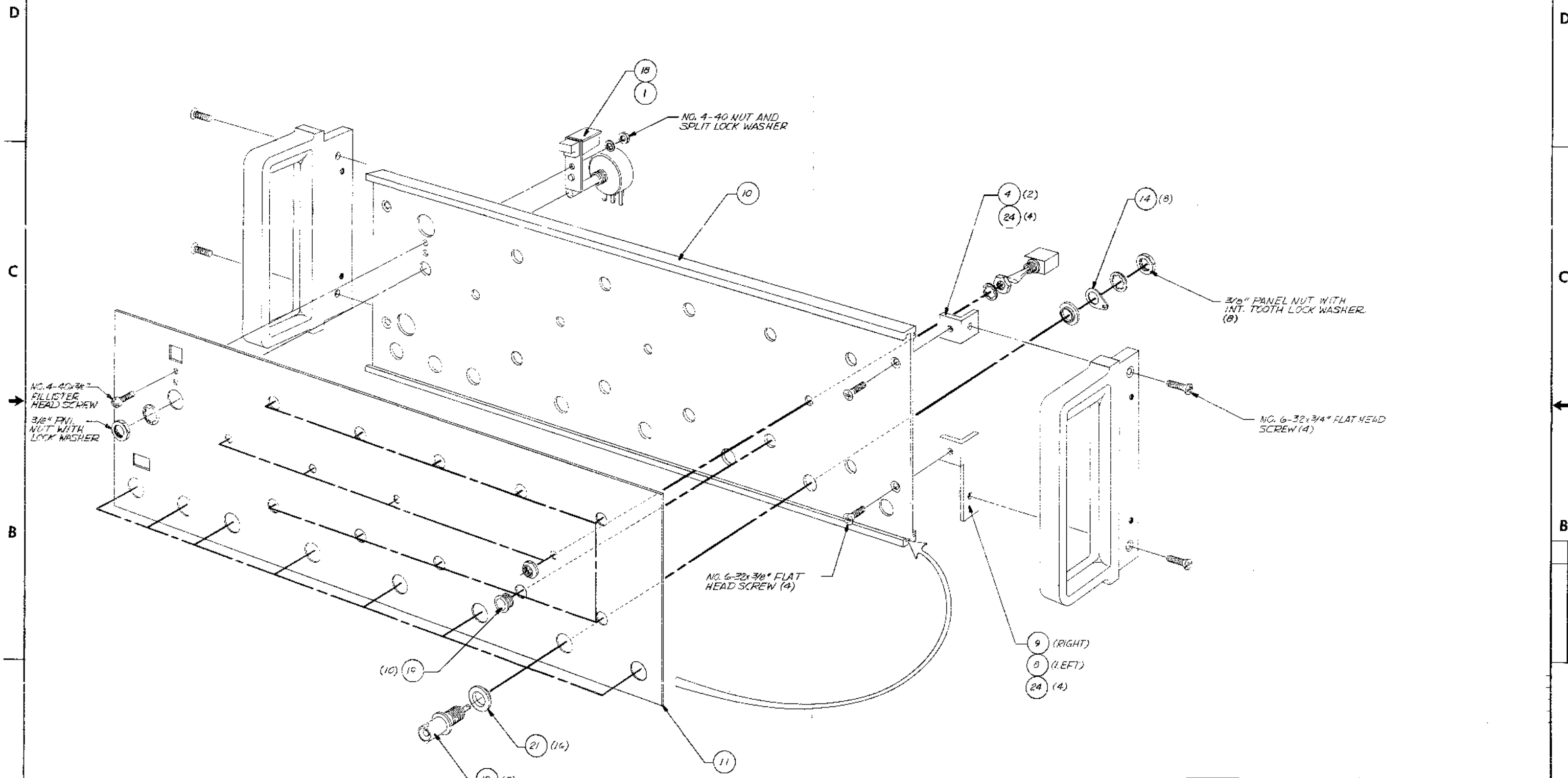


NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN: D. COOPER	DATE: 2/2/78	<b>WAVETEK</b> <small>SAN DIEGO, CALIFORNIA</small>
MATERIAL	PROJECT: <i>Kwik to High</i>	BY: <i>RO</i>	
FINISH: WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED: .XXX ± .010 ANGLES: 1:1 XX ± .020		TITLE: ASSEMBLY CHASSIS
SCALE	DO NOT SCALE DWG	MODEL NO: 166	REV: C
		DESG. NO: 0102-00-0649	
		CODE: 2333B	SHEET 1 OF 3

8 7 6 5 4 3 2 1

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NO. 4-40x3/8" FILLISTER HEAD SCREW  
3/8" FNI NUT WITH LOCK WASHER

NO. 6-32x3/8" FLAT HEAD SCREW (4)

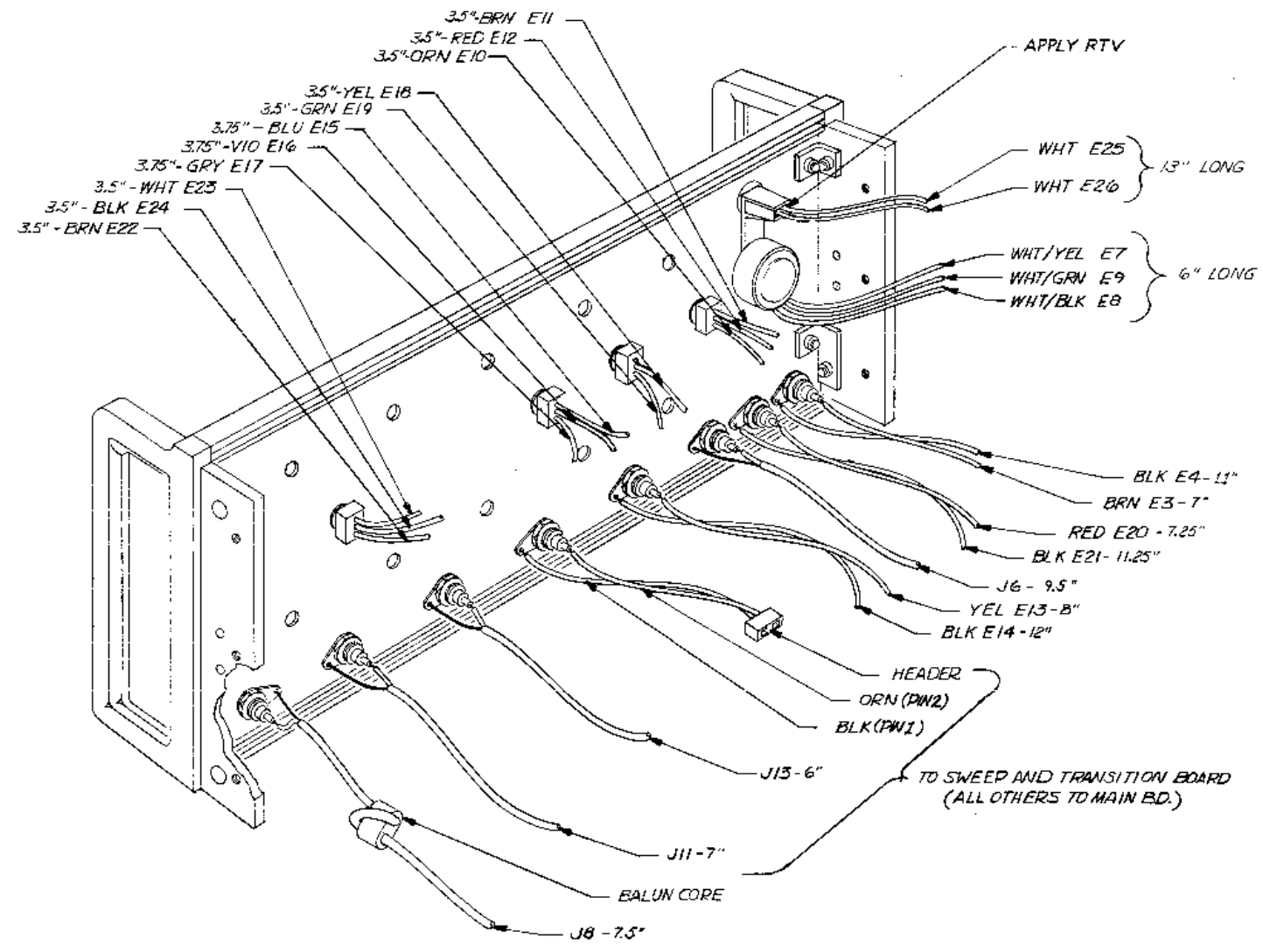
3/8" PANEL NUT WITH INT. TOOTH LOCK WASHER (8)

NO. 6-32x3/4" FLAT HEAD SCREW (4)

REMOVE ALL BURRS AND BREAK SHARP EDGES	DESIGNED BY <i>D. COOPER</i>	DATE <i>5/17/78</i>	<b>WAVETEK</b> SAN DIEGO • CALIFORNIA
MATERIAL	PRODUCED BY <i>Wavetek</i>	RELEASE APPROVAL	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .010 ANGLES .1		TITLE <b>ASSEMBLY CHASSIS</b>
SCALE	DO NOT SCALE DWG	MODEL NO. <b>166</b>	DWG NO. <b>0102-00-0649</b>
		DATE <b>23338</b>	REV. <b>C</b>
		SHEET	2 OF 3

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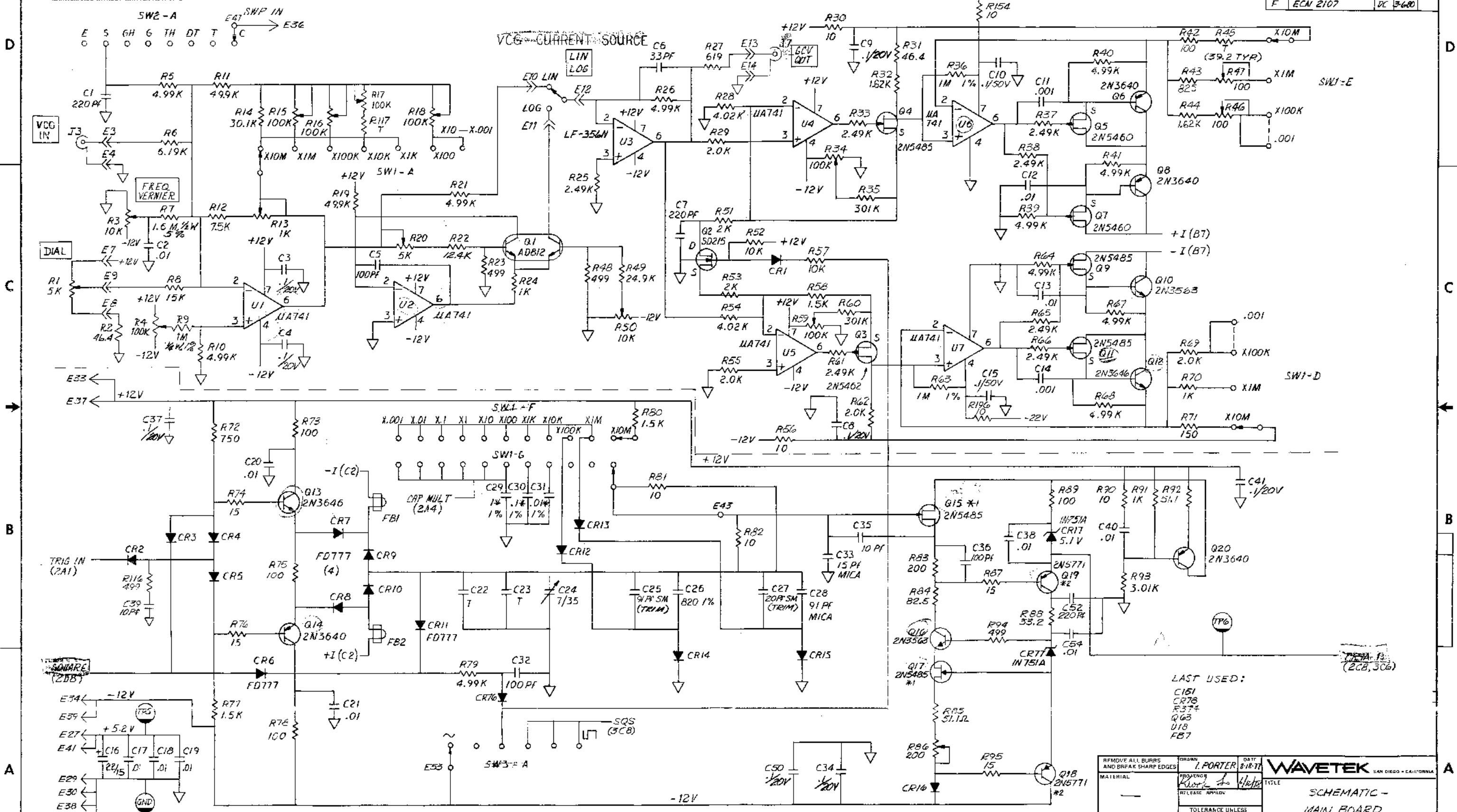
NOTE: UNLESS OTHERWISE SPECIFIED

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MATERIAL	DESIGNED BY <i>[Signature]</i>	DATE <i>[Signature]</i>	
FINISH WAVETEK PROCESS	RELEASE APPROV <i>[Signature]</i>	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX - .010 ANGLES 1 XX - .030	MODEL NO 166
	DO NOT SCALE DWG	SCALE	DWG NO 0102-00-0649
			REV C
			CODE IDENT 23338
			SHEET 3 OF 3



REV	ECN	BY	DATE	APP
C	ECN 1186	RD	8-15-78	
D	ECN 1877	DC	12-8-78	
E	ECN 2088	DC	1-9-80	
F	ECN 2107	DC	3-6-80	

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1. ALL DIODES ARE FD6666 \* MATCHED SET  
NOTE: UNLESS OTHERWISE SPECIFIED

TRIANGLE AMP

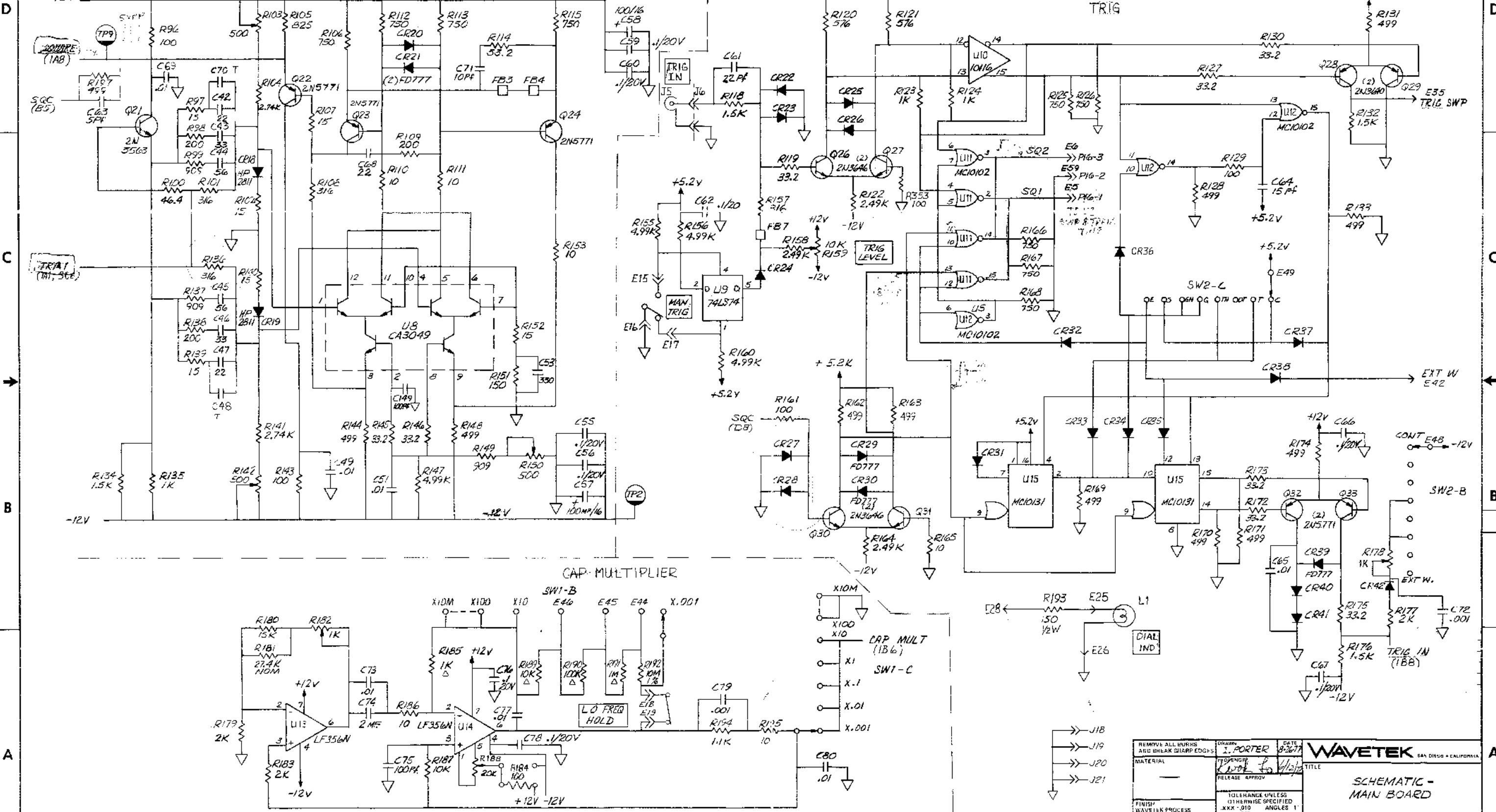
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MATERIAL	PROFESSOR K. L. ...	TITLE SCHEMATIC - MAIN BOARD	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX - .010 ANGLES - 1° XX - .030	DO NOT SCALE DWG	MODEL NO. 106
SCALE	DWG NO. 0103-00-0628	REV F	DWG NO. 23338

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HYS SWT

TRIG

CAP MULTIPLIER



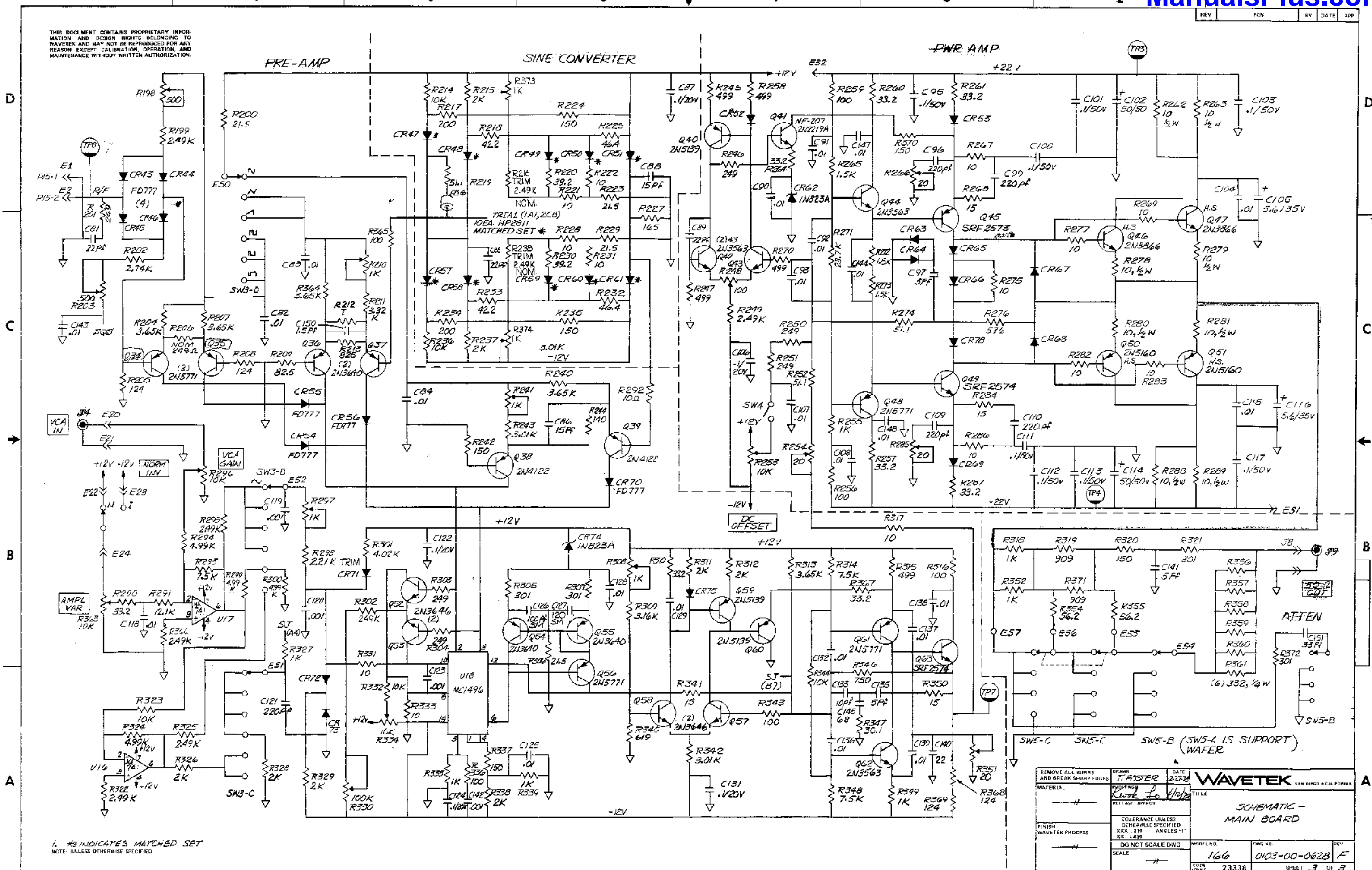
NOTE: UNLESS OTHERWISE SPECIFIED

Δ MATCHED SET

REMOVE ALL BURRS AND BREAK SHARP EDGES	DESIGNED BY 1. PORTER	DATE 8-28-77	WAVETEK SAN DIEGO • CALIFORNIA
MATERIAL	APPROVED BY K. W. L. TO	11/2/77	
FINISH WAVE/ILK PROCESS	RELEASE APPROV	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX - .010 ANGLES 1/2 X .035	TITLE SCHEMATIC - MAIN BOARD
SCALE	DO NOT SCALE DWG	MODEL NO 166	DWG NO 0103-00-0628
		CODE 23338	REV F
			SHEET 2 OF 3

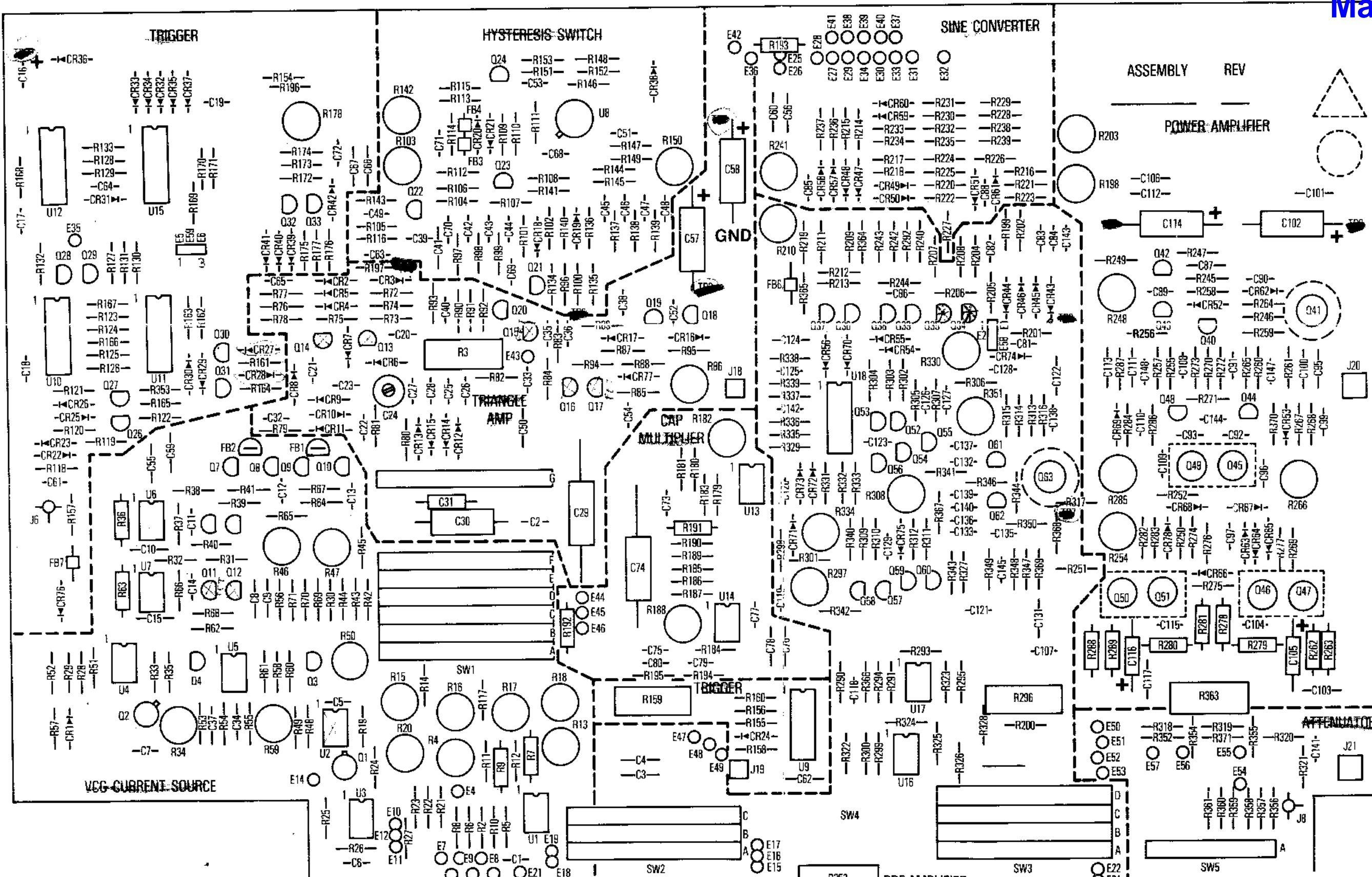
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REV	FCN	BY	DATE	APP



1. \*# INDICATES MATCHED SET  
NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL SURRS AND BREAK SHARP EDGES	DRAWN: T. FOSTER	DATE: 2/27/78	
MATERIAL	PROF: K. L. PO	REVISION: 1/1/78	
FINISH: WAVETEK PHDCSS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX .010 ANGLES 1° XX .030		<b>SCHEMATIC - MAIN BOARD</b>
DO NOT SCALE DWG	MODEL NO. 166	DWG NO. 0103-00-0628 F	
SCALE	CODE: 23338	SHEET 3 OF 3	



ASSEMBLY REV

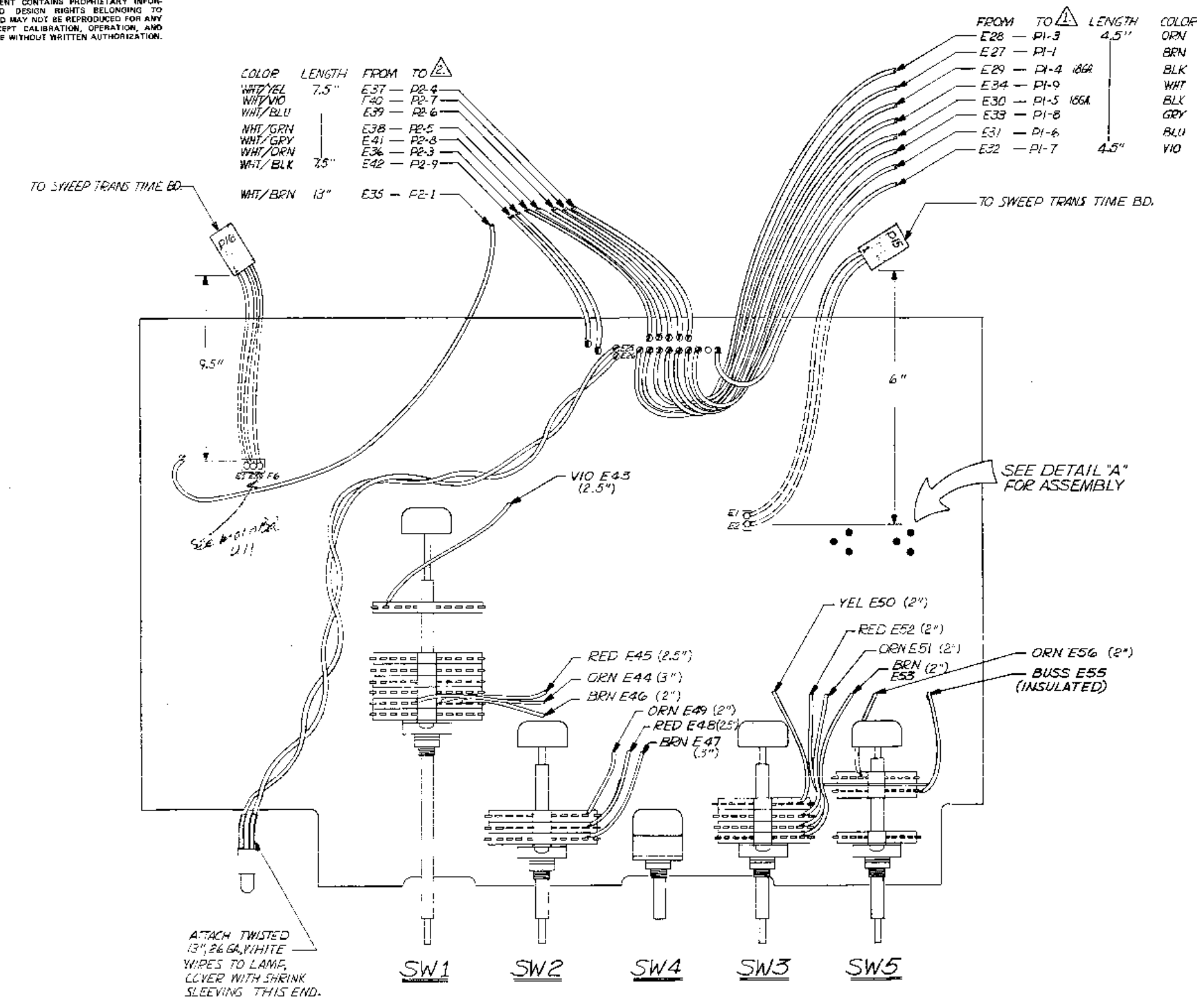
POWER AMPLIFIER

ATTENUATOR

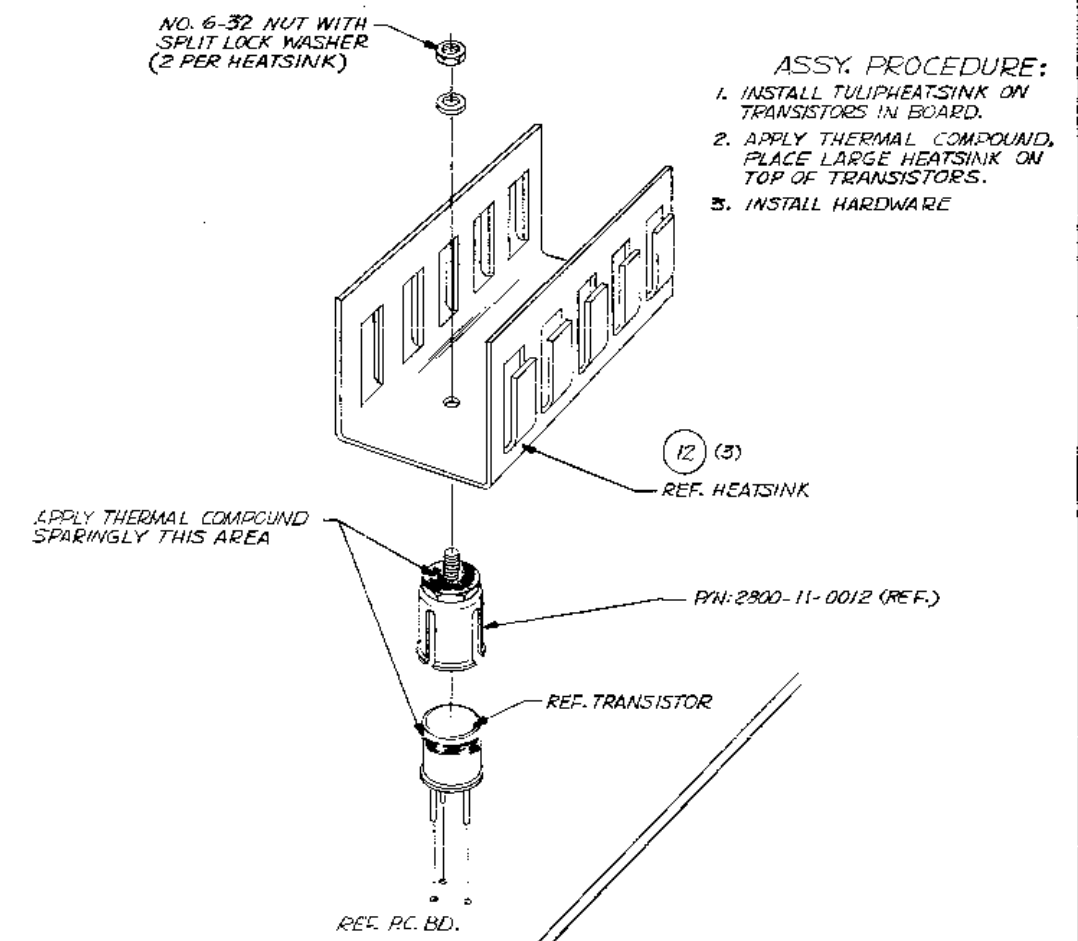
PRE-AMPLIFIER

REMOVE ALL BLURBS AND BREAK SHARP EDGES		DATE	<b>WAVETEK</b> SAN DIEGO CALIFORNIA	
MATERIAL	PROJ: ENGR	TITLE	<b>ASSEMBLY MAIN BOARD</b>	
FINISH WAVETEK PROCESS	RELEASE APPROV	TOL: FRANCE UNLESS OTHERWISE SPECIFIED XXX .010 ANGLES 1 XX .030	MODEL NO	REV
	SCALE	DO NOT SCALE DWG	<b>166</b>	<b>0101-00-0628 A</b>
		SCALE	23338	SHEET 1 OF 2

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DETAIL "A"  
TRANSISTOR HEATSINK HARDWARE STACK-UP



▲ MOLEY CONN. (P2) GOES TO SWEEP TRANS TIME BD.  
▲ MOLEY CONN. (P1) GOES TO POWER SUPPLY BD.

NOTE: UNLESS OTHERWISE SPEC. P.C.B.

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 7/31/78	WAVETEK SAN DIEGO - CALIFORNIA	
MATERIAL	DESIGNED BY R. COOPER	DATE 7/31/78	TITLE ASSEMBLY MAIN BOARD	
FINISH WAVETEK PROCESS	RELEASE APPROV	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX - 010 ANGLES 11° .XX - 45°	MODEL NO. 166	DWG NO. 0101-00-0628
SCALE DO NOT SCALE DWG	SCALE	DO NOT SCALE DWG	SHEET 2	OF 2
	CODE 23338			

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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT	
NONE	ASSY DRAG MAIN	0101-00-0628	WVTX	0101-00-0628	1	C251 C28	CAP,MICA,9.1PF,500V	0M15-910J	ARC0	1500-19-1008	2	R334 R55	POT,TRIM,10K	91AR10K	BECK	4600-01-0315	2	
NONE	SCHEMATIC MAIN	0103-00-0628	WVTX	0103-00-0628	1	C57 C58	CAP,ELECT,100MF,16V	500D187R016DCT	SPRAG	1500-31-0101	2	R15 R16 R17 R18 R340 R34 R4 R59	POT,TRIM,100K	91AR100K	BECK	4600-01-0482	8	
NDNF	ASSY SWITCHES MAINBOARD	166-0041	WVTX	1202-00-0041	1	C102 C114 C74	CAP,ELECT,50MF,50V	500D506030DD7	SPRAG	1500-35-0003	2	R254 R266 R285 R351	POT,TRIM,20	91AR20	BECK	4600-02-0008	4	
12	HEATSINK,MOD FROM:2500-11-0011	1400-00-8879	WVTX	1400-00-8879	3	C24	CAP,MYLR,2MF,200V	2MF200SW	AMPAD	1500-43-0504	1	R86	POT,TRIM,200	91AR200	BECK	4600-02-0101	1	
C155 C141 C63 C97	CAP,CER,5PF,1KV	00-050	CRL	1500-00-5011	4	C16	VARJ,7-35PF,250V	78-THTK0-02 7/35 PF	TRIKO	1500-53-5000	1	R188	POT,TRIM,20K	91AR20K	BECK	4600-02-0301	1	
C133 C35 C54 C71	CAP,CER,10PF,1KV	00-100	CRL	1500-01-0011	4	C105 C116	CAP,TANT,22MF,15V	1960226X9015441	SPPAB	1500-72-2601	1	R101 R102 R150 R198 R203	POT,TRIM,500	91AR500	BECK	4600-05-0104	5	
C149	CAP,CER,100PF,1KV	00-101 LONG LEAD	CRL	1500-01-0101	1	C29	CAP,TANT,5.6MF,35V	1500565K9035592	SPRAG	1500-75-6502	2	R20	POT,TRIM,5K	91AR5K	BECK	4600-05-0205	1	
C52 C56 C5 C75	CAP,CER,100PF,1KV	00-101	CRL	1500-01-0111	4	C10	CAP,SET,POLYCL MIXED MATCHED SET	100-501-101	WVTX	1509-80-0008	1	R253	POT,SWITCH,10K	GM-1879	CTS	4602-01-0400	1	
C11 C119 C128 C125 C14 C147 C72 C79	CAP,CER,100PF,1KV	00-102	ARC0	1500-01-0211	8	C10	CAP,POLYCL,1MF,100V PART OF 1509-80-0008 QTY(1)					R262 R263 R278 R279 R280 R281 R288 R289	RES,C,1/2W,5K,10	PC20GF-100	STKPL	4700-25-0100	8	
C104 C107 C135 C115 C118 C12 C125 C129 C129 C13 C132 C136 C137 C138 C139 C143 C144 C147 C173 C17 C18 C19 C2 C20 C21 C24 C40 C49 C51 C54 C65 C69 C73 C77 C80 C82 C83 C84 C90 C91 C92 C93	CAP,CER,01MF,50V	04-103	CRL	1500-01-0310	42	C10	CAP,POLYCL,1MF,100V PART OF 1509-80-0008 QTY(1)					R193	RES,C,1/2W,10K,150	PC20GF-151	STKPL	4700-25-1500	1	
C10 C100 C101 C104 C111 C112 C115 C117	CAP,CER,1MF,50V	04-104	CRL	1500-01-0410	10	C51	CAP,POLYCL,0.01MF,100V PART OF 1509-80-0008 QTY(1)					R129 R145 R161 R184 R256 R259 R316 R336 R345 R355 R365 R42 R73 R75 R78 R89 R96	RES,WF,1/8W,1K,100	RM55D-1000F	TRW	4701-03-1000	17	
						NONE	MAIN BD	1700-00-0628	WVTX	1700-00-0628	1	R123 R124 R135 R24 R255 R318 R327 R335 R330 R349 R352 R70	RES,WF,1/8W,1K,1K	RM55D-1001F	TRW	4701-03-1001	15	
						NDNF	CONN,9PIN	04-56-7041	WGLEX	2100-02-0051	4							
						318 319 320 321	CONN	22-11-2822	WGLEX	2100-02-0061	4							
WAVETEK PARTS LIST TITLE: PCA,MAIN BD ASSEMBLY NO. 1100-00-0628 REV F PAGE 1					WAVETEK PARTS LIST TITLE: PCA,MAIN BD ASSEMBLY NO. 1100-00-0628 REV F PAGE 3					WAVETEK PARTS LIST TITLE: PCA,MAIN BD ASSEMBLY NO. 1100-00-0628 REV F PAGE 5								

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
C15 C95						NONE	SPRING SOCKET	3-35-888-9	AMP	2100-03-0017	2	R91					
C135 C132 C124 C131 C1 C34 C17 C4 E31 C54 C55 C56 C59 C60 C62 C66 C67 C75 C78 C8 C87 C9	CAP,CER,1MF,20V	UK20-104	CRL	1501-01-0413	27	NDNF	COAX SOCKET	2262F7-2	AMP	2100-03-0038	2	R187 R214 R256 R323 R332 R344 R352 R57	RES,WF,1/8W,1K,10K	RM55D-1002F	TRW	4701-03-1002	8
C44 C46 C48	CAP,CER,15PF,1KV	00-150	ARC0	1500-01-5011	5	NDNF	CABLE CONTACT	2262E6-2	AMP	2100-03-0048	2	R110 R111 R153 R154 R165 R126 R195 R196 R221 R222 R228 R231 R267 R269 R275 R277 R282 R285 R286 R292 R30 R317 R331 R333 R56 R81 R82 R98	RES,WF,1/8W,1K,10	RM55D-1008F	TRW	4701-03-1009	28
C150	CAP,CER,1.5PF,1KV	10TCC-V15	SPRAG	1501-01-5507	1	NDNF	MOUNTING,CONN 3-POS	07400-5	AMP	2100-03-0042	2	R205 R208 R368 R369	RES,WF,1/8W,1K,1.1K	RM55D-1101F	TRW	4701-03-1101	1
C140 C40 C47 C61 C68 C81 C85 C89	CAP,CER,22PF,1KV	00-220	ARC0	1500-02-2011	8	NDNF	TERM	200AK1	USECO	2100-05-0009	1	R221	RES,WF,1/8W,1K,12.1K	RM55D-1212F	TRW	4701-03-1212	1
C1 C109 C110 C131 C52 C7 C96 C99	CAP,CER,220PF,1KV	00-221	ARC0	1500-02-2111	9	NDNF	FIN	02-51-0105	WGLEX	2100-05-0025	16	R205 R208 R368 R369	RES,WF,1/8W,1K,1.1K	RM55D-1200F	TRW	4701-03-1200	4
C43 C46 C6	CAP,CER,15PF,1KV	00-350	ARC0	1500-01-3011	5	NDNF	PINS,CONN	M756T-2	AMP	2100-05-0030	5	R221	RES,WF,1/8W,1K,12.4K	RM55D-1247F	TRW	4701-03-1247	1
C53	CAP,CER,330PF,1KV	00-331	ARC0	1500-03-3111	1	NDNF	ETANDOFF,SWAGE 1/8" H, .250 HEX 4-40, LOCK W/AL	08115-30-94	UNICP	2800-05-0001	3	R204	RES,WF,1/8W,1K,14K	RM55D-1400F	TRW	4701-03-1400	1
C44 C45	CAP,CER,56PF,1KV	00-560	ARC0	1500-05-6001	2	NDNF	HEAT SINK	HF-207	WAKC	2800-11-0001	2	R151 R224 R235 R242 R320 R337 R370 R71	RES,WF,1/8W,1K,150	RM55D-1500F	TRW	4701-03-1500	8
C145	CAP,CER,68PF,1KV	00-680	CRL	1500-06-8001	1	NDNF	1/4WASIPAD	101224	WPIR8	2800-11-0001	8	R118 R132 R134 R176 R265 R272 R273 R58 R77 R80	RES,WF,1/8W,1K,1.5K	RM55D-1501F	TRW	4701-03-1501	10
C126	CAP,MICA,100PF,500V	0M15-101J	ARC0	1500-11-0100	1	NDNF	HEATSINK	2666M5E	WAKE	2800-11-0012	6	R180 R4	RES,WF,1/8W,1K,15K	RM55D-1502F	TRW	4701-03-1502	2
C127	CAP,MICA,100PF,500V	0M15-121J	ARC0	1500-11-2100	1	NDNF	FERRITE BEAD	56-540-65/38	FERR8	3100-10-0001	4	R102 R107 R139 R140 R152 R268 R281 R341	RES,WF,1/8W,1K,15	RM55D-15K0F	TRW	4701-03-1509	14
C55	CAP,MICA,15PF,500V	0M15-150J	ARC0	1500-11-5000	1	NDNF	RALLN CORE	2873M00902	PAWJT	3100-10-0002	2						
C271	CAP,MICA,20PF,500V	0M15-210J	ARC0	1500-12-0000	1	R248 R46 R47	POT,TRIM,10K	91AR10K	BECK	4600-01-0101	3						
C24	CAP,MICA,820PF,300V	0M15-821F	ARC0	1500-18-2101	1	R13 R178 R182 R210 R241 R297 R348 R373 R374	POT,TRIM,1K	91AR1K	BECK	4600-01-0209	9						
WAVETEK PARTS LIST TITLE: PCA,MAIN BD ASSEMBLY NO. 1100-00-0628 REV F PAGE 7					WAVETEK PARTS LIST TITLE: PCA,MAIN BD ASSEMBLY NO. 1100-00-0628 REV F PAGE 4					WAVETEK PARTS LIST TITLE: PCA,MAIN BD ASSEMBLY NO. 1100-00-0628 REV F PAGE 6							

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	
MATERIAL	PROF/ENR		
	RELEASE APPROV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX .010 ANGLES 1:1 XX .030		
FINISH WAVETEK PROCESS			DO NOT SCALE DWG
SCALE			MODEL NO. 166
NOTE: UNLESS OTHERWISE SPECIFIED			DWG NO. 1100-00-0628
			REV. F
			DATE: 2.3.38
			SHEET 1 OF 3

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Table with 3 columns of parts lists. Each column contains a 'WAVETEK PARTS LIST' with columns for REFERENCE DESIGNATORS, PART DESCRIPTION, ORIG-MFG#-PART-NO, MFR, WAVETEK NO., QTY/PT, TITLE, ASSEMBLY NO., and REV. The lists include various electronic components like resistors, capacitors, and diodes.

Table with 3 columns of parts lists, similar to the one above. It includes parts like transistors, diodes, and other electronic components, each with detailed specifications and assembly information.

WAVETEK SAN DIEGO - CALIFORNIA MAIN BOARD. Includes fields for DRAWN, DATE, TITLE, FINISH WAVETEK PROCESS, TOLERANCE UNLESS OTHERWISE SPECIFIED, and a note: 'NOTE: UNLESS OTHERWISE SPECIFIED'. Also includes a revision table with columns for REV, EGN, BY, DATE, APP.

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REFERENCE DESIGNATORS	PART DESCRIPTION	DRG-MFR-PART-NO	MFR	WAVETEK NO.	QTY/PT
U1 U15 U17 U.P. U4 U5 U6 U7	IC	MA-741	FAIR	7000-07-4100	8
U1	IC	03 R12	ANDV	7000-08-1200	1
U15	IC	MC1496P	MUT	7000-14-9600	1
U8	IC	CA-3049	RCA	7000-30-4900	1
U9	IC	74LS74	TJ	8000-74-7410	1
U11 U12	IC	MC10102	MOT	8001-01-0200	2
U10	IC	MC10126P	MUT	8001-01-1600	1
U15	IC	MC10151	MDI	8001-01-1500	1

**WAVETEK**  
PARTS LIST

TITLE  
PCA, MAIN BU

ASSEMBLY NO.  
1100-00-0628

REV  
F

PAGE: 13

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA	
MATERIAL	PROJECTOR		TITLE MAIN BOARD	
	RELEASE	AMBLUV		
	TOLERANCE UNLESS OTHERWISE SPECIFIED			
	XXX - DIM	ANGLES - 1		
	XX - BUR			
FINISH - WAVETEK PROCESS	DO NOT SCALE DWG		MODEL NO. 166	DWG NO. 1100-00-0628
	SCALE		REV F	
	LOOSE IDENT	23338	SHEET 3 OF 5	

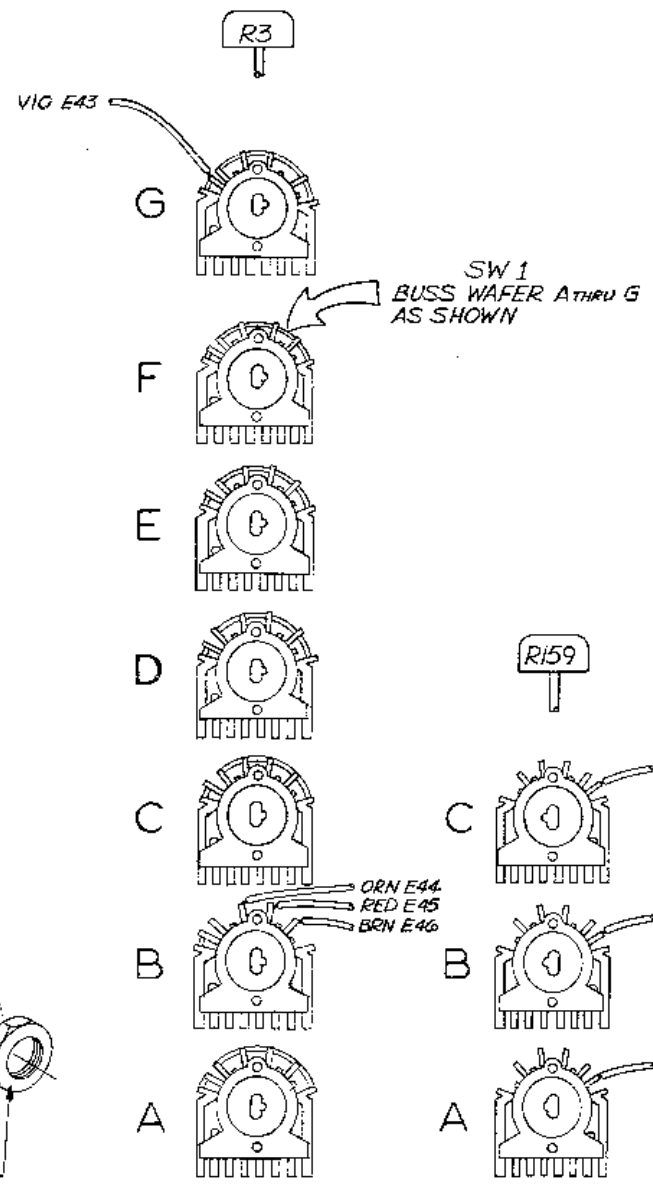
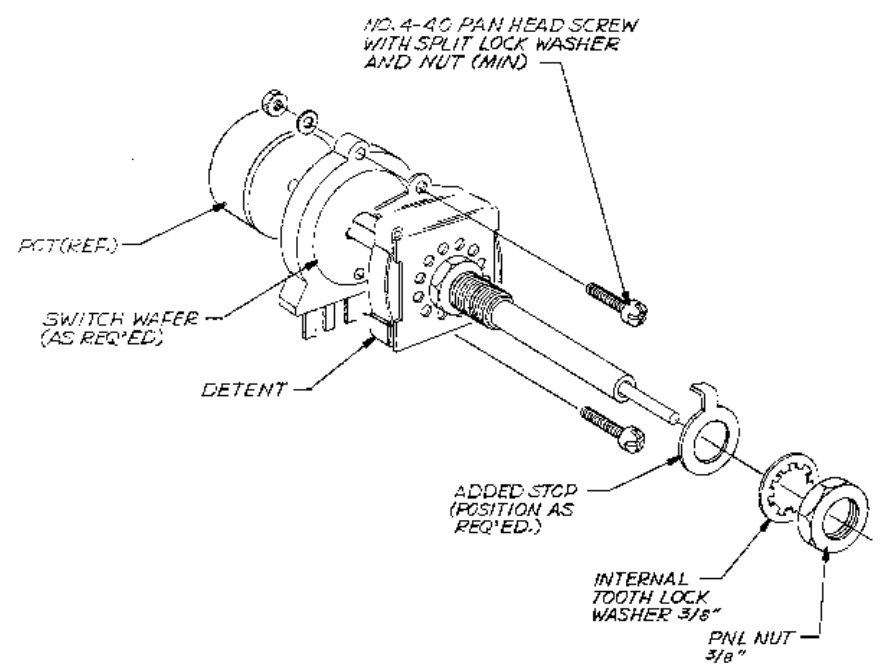
NOTE: UNLESS OTHERWISE SPECIFIED

REV	FCN	BY	DATE	APP
A	ECN 1878	D. COOPER	12-19-78	

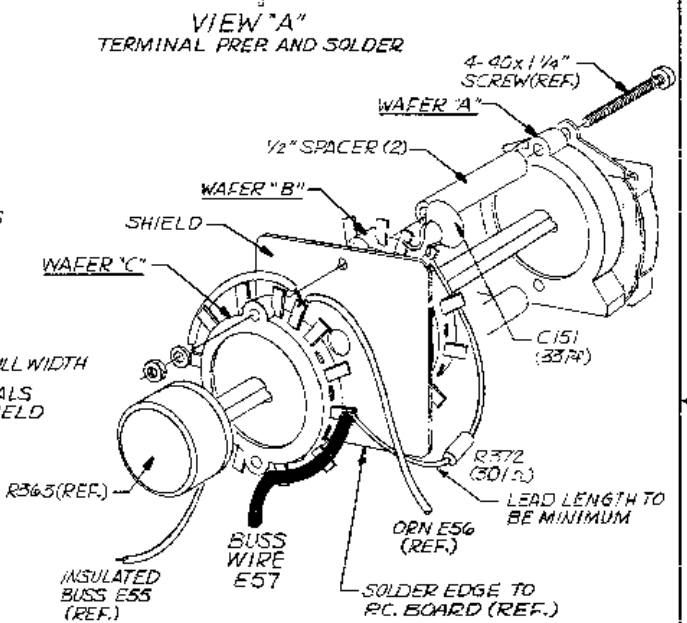
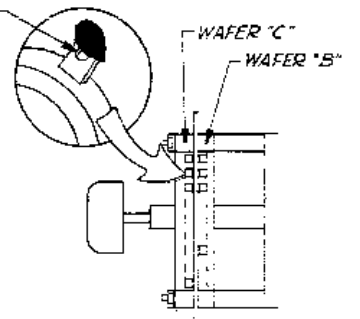
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D  
C  
B  
A

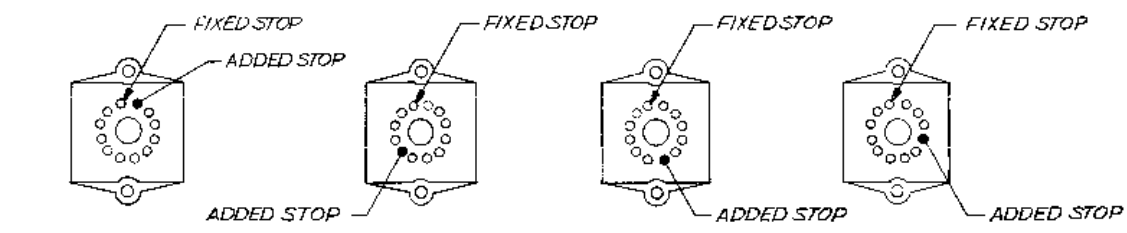
TYPICAL HARDWARE STACK-UP



BEND AND SOLDER TERMINAL TO SHIELD AS REQUIRED, (9 PLCS.) WAFER BAND C ONLY. (AS SHOWN)



DETAIL "A" SHIELD INSTALLATION SW1



- SW1 WIRING DETAIL**  
WAFER A,B,C,D,E,AND F  
4-40x1 1/4"  
DETENT: 5104-99-0040
- SW2 WIRING DETAIL**  
WAFER A,B,AND C 4-40x3/4"  
5104-99-0041
- SW3 WIRING DETAIL**  
WAFER A,B,C,AND D  
4-40x7/8"  
5104-99-0041
- SW5 WIRING DETAIL**  
WAFER A,B,AND C  
4-40x1 1/4" SEE DETAIL "A"  
5104-99-0041

1. SW1: TURN DETENT FULL CW, ADD STOP-TURN FULL CCW, ADD WAFERS  
NOTE: UNLESS OTHERWISE SPECIFIED

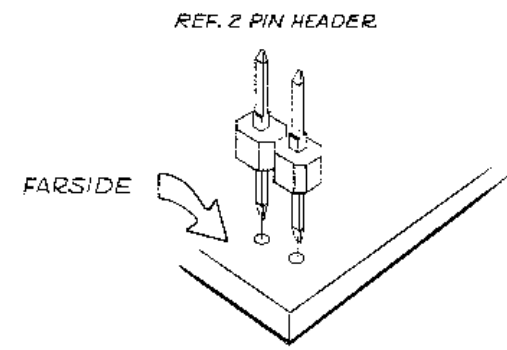
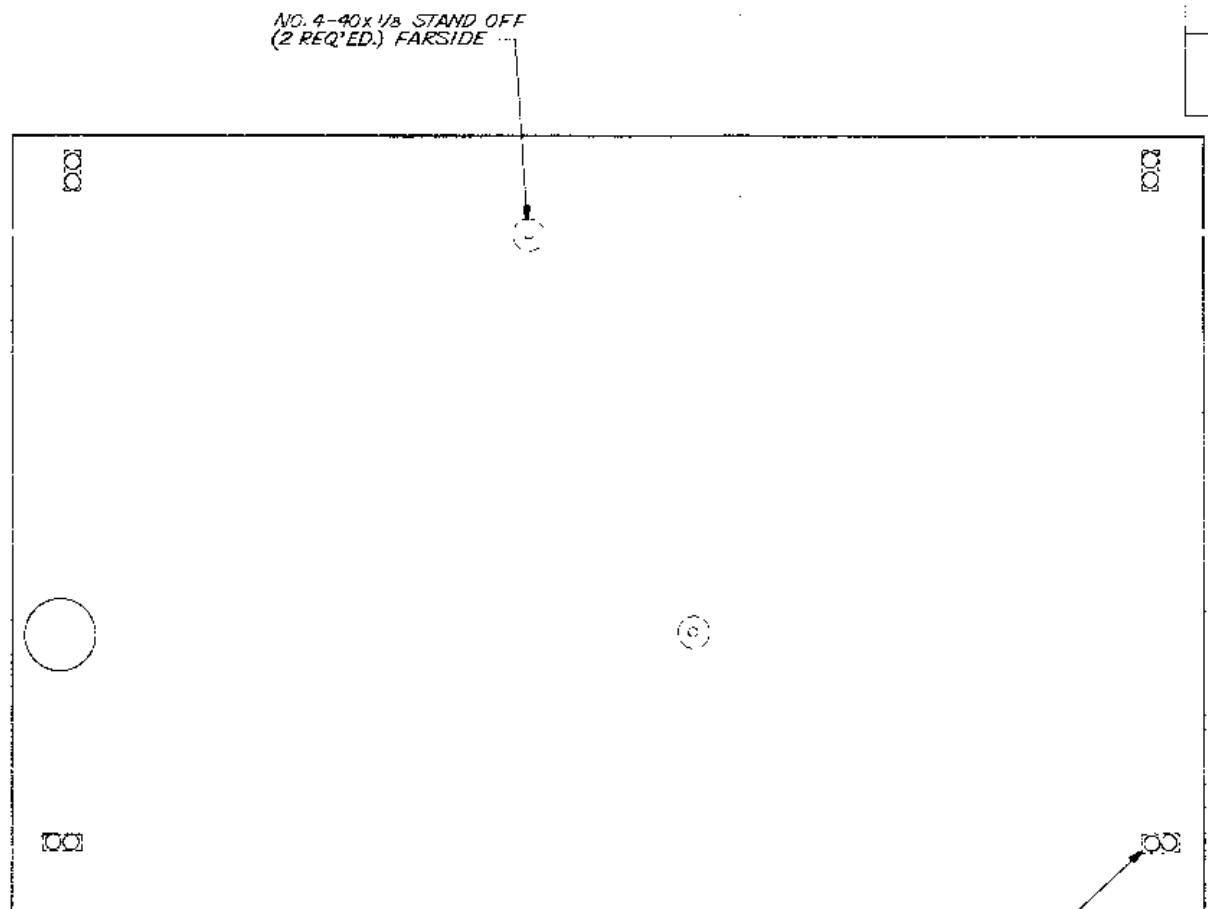
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN D. COOPER	DATE 4-2-78	<b>WAVETEK</b> SAN DIEGO - CALIFORNIA
MATERIAL	PROLIFERATE	RELEASE APPROV	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.030 ANGLES .1° XX ±.030		TITLE <b>ASSEMBLY MAIN BOARD SWITCHES</b>
SCALE	DO NOT SCALE DWG	MODEL NO 166	WORK NO 1202-00-0041
		REV A	SHEET 2 OF 2

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REV	ECN	BY	DATE	APP
E	ECN 1191	...	...	...

REFERENCE DESIGNATION	PART DESCRIPTION	QTY REQ'D	QTY ON HAND	WAVETEK NO.	QTY/PT
W001	W001 DRWS SHIELD BD	0101-00-0684	AVTK	0101-00-0684	1
W002	SHIELD BOARD	1700-10-0684	AVTK	1700-05-0684	1
W003	CONN PIN, W/LE (WOM-E4 PIN)	04-6215P-100-230-530	EA	1100-05-0934	6
W004	STANDOFF	9531b-0440-3A	AVTK	2600-03-0004	2

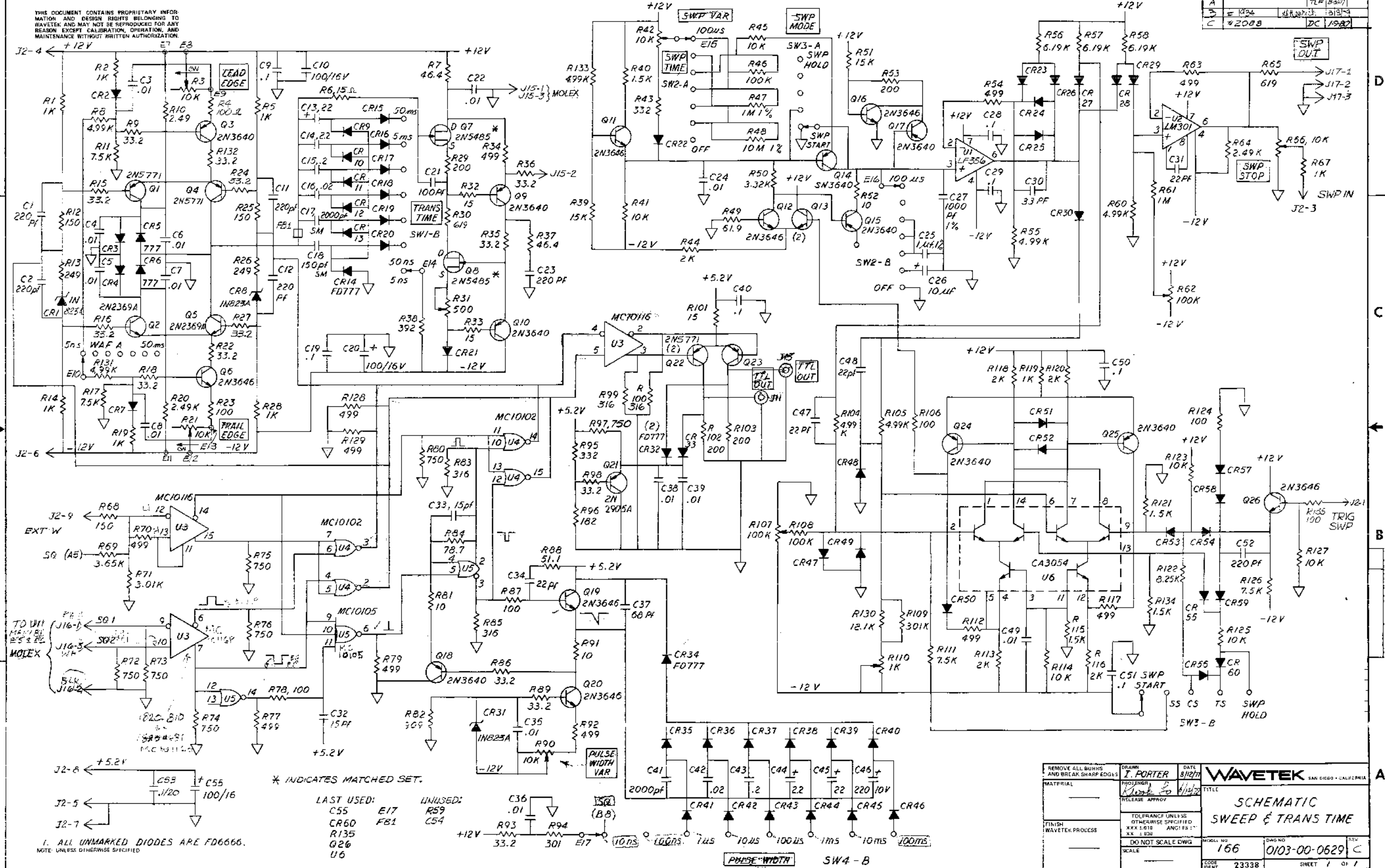
<b>WAVETEK PARTS LIST</b>	TITLE W001 SHIELD BOARD	ASSEMBLY NO. 1100-10-0684	REV E
		PAGE: 1	



NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DIAMN D. COOPER	DATE 3/20/78	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA	
MATERIAL	FINISH WAVETEK PROCESS	RELEASE APPROV <i>[Signature]</i>	TITLE <b>ASSEMBLY SHIELD MAIN BD.</b>	
	FINISH WAVETEK PROCESS	SCALE	SCALE 166	REV E
			CODE 23338	SHEET / OF /

REV	EDN	BY	DATE	APP
A		TLF	8/30/77	
B	1024		10/13/79	
C	42088	DC	1/9/82	



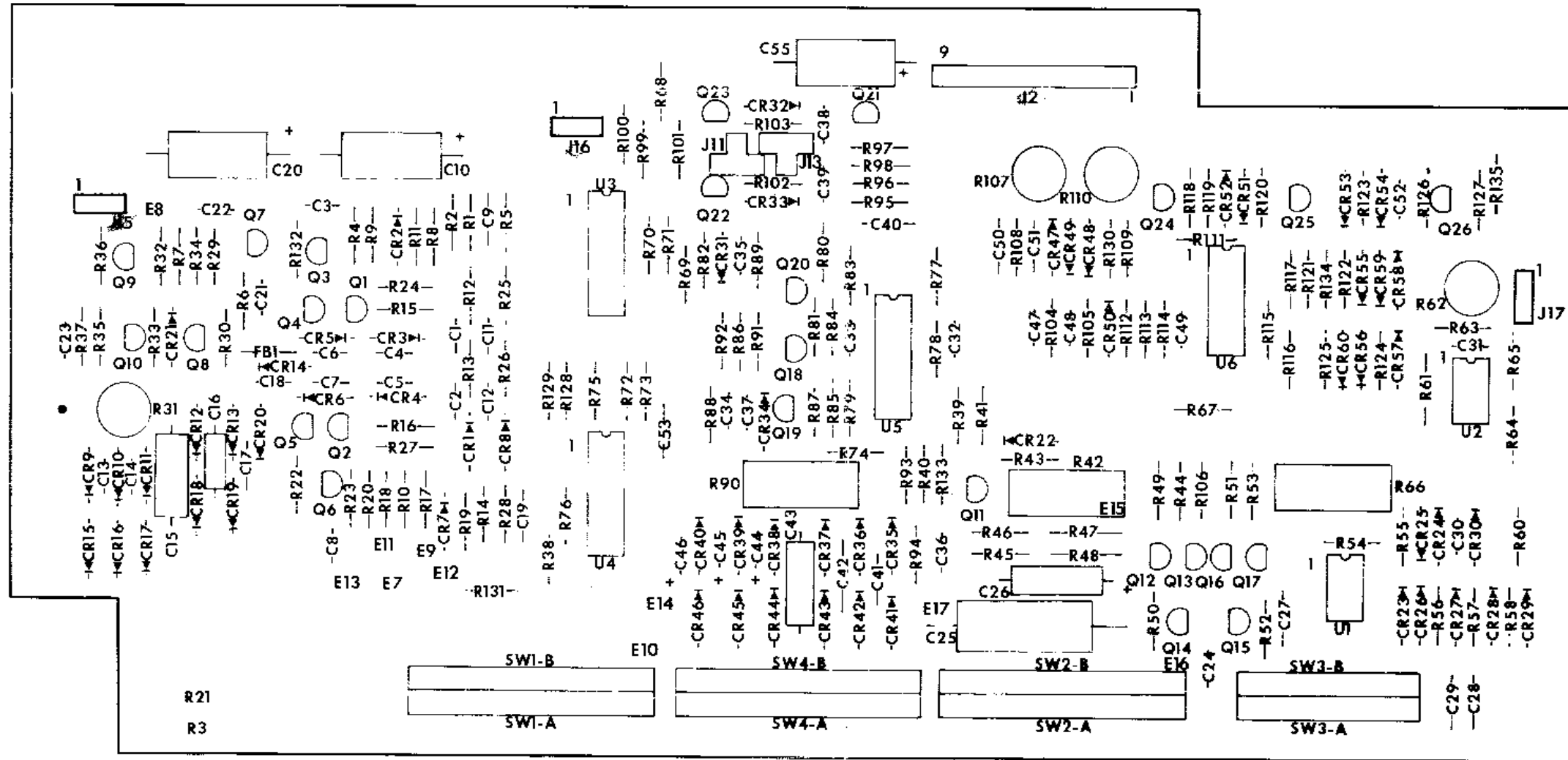
\* INDICATES MATCHED SET.

- LAST USED: C55 E17 UNUSED: R59 C54  
 CR60 F81 C54  
 R135 Q26 U6

1. ALL UNMARKED DIODES ARE FD6666.  
NOTE: UNLESS OTHERWISE SPECIFIED

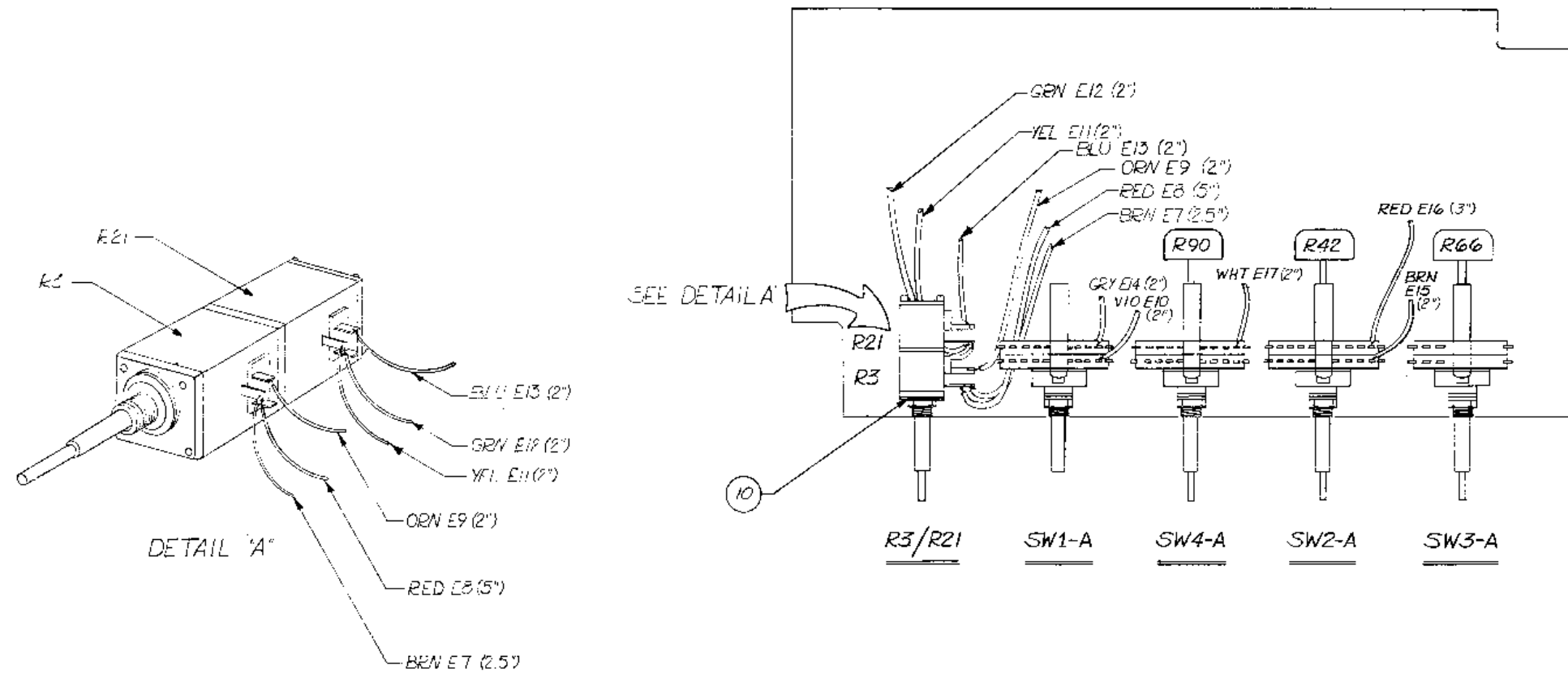
REMOVE ALL BUBBLES AND BREAK SHARP EDGES	DRAWN: J. PORTER	DATE: 8/12/77	
MATERIAL	PROJENGR: K. PORTER	RELEASE APPROV:	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED: XXX ± 0.10 ANGLE 5°		<b>SCHEMATIC SWEEP &amp; TRANS TIME</b>
SCALE	DO NOT SCALE DWG	MODEL NO: 166	
		DWG NO: 0103-00-0629	CODE IDENT: 23338 SHEET 1 OF 1

PHASE WIDTH SW4-B



REV	FCN	BY	DATE	APP
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NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN <i>D. COOPER</i>	DATE 4-4-78	
MATERIAL	DESIGNED BY <i>Bob J. 4/4/78</i>	RELEASE APPROV	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX - 018 ANGLES - 1 XX - 006	SCALE DO NOT SCALE DWG	MODEL NO. 166
			DRG. NO. 0101-00-0629
			REV. D
			FIG. NO. 23338
			SHEET 2 OF 2

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REFERENCE DESIGNATIONS	PART DESCRIPTION	QTY/PK	WAVETEK NO.	REV
NONE	ASSY DPMG TRANS TIME	1	1100-00-0629	C
NONE	SCHEMATIC TRANS TIME	1	1100-00-0629	C
NONE	ASSY SWITCHES	1	1272-00-0042	C
10	BRACKET	1	1000-00-4923	C
E21	CAP, CER, 100PF, 1KV	1	500-01-0111	C
E22 C24 E3 C55 C36	CAP, CER, 0.1UF, 50V	13	1500-01-0310	C
E23 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C37 C38 C39 C40 C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C56 C57 C58 C59 C60 C61 C62 C63 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78 C79 C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100	CAP, CER, 100PF, 1KV	1	500-01-0111	C
C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38 C39 C40 C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C55 C56 C57 C58 C59 C60 C61 C62 C63 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78 C79 C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100	CAP, CER, 100PF, 1KV	1	500-01-0111	C
C12 C33	CAP, CER, 150PF, 1KV	2	1500-01-5011	C
C31 C39 C47 C48	CAP, CER, 22PF, 1KV	4	1500-02-2011	C
C1 C11 C12 C2 C23 C32	CAP, CER, 220PF, 1KV	6	1500-02-2111	C
C30	CAP, CER, 50PF, 1KV	1	1500-02-2211	C
C37	CAP, CER, 68PF, 1KV	1	1500-06-8001	C
C27	CAP, MICA, 1045PF, 500V	1	1500-11-0201	C
C14	CAP, MICA, 150PF, 500V	1	1500-11-5100	C
C17 C41	CAP, MICA, 2045PF, 501V	2	1500-12-0200	C
C18 C20 C55	CAP, ELECT, 100MF, 1KV	3	1500-31-0101	C

REFERENCE DESIGNATIONS	PART DESCRIPTION	QTY/PK	WAVETEK NO.	REV
R31	POT, TRIM, 500	1	214500	C
NONE	POT, DUAL, 10K, LOG	1	19396	C
R106 R124 R135 R23 R25 R29 R37	RES, MF, 1/8W, 1%, 100	7	RN550-1000F	C
R1 R114 R19 R19 R2 R20 R3 R57	RES, MF, 1/8W, 1%, 1K	5	RN550-1001F	C
R114 R125 R125 R127 R41 R65	RES, MF, 1/8W, 1%, 10K	6	RN550-1002F	C
R108 R46	RES, MF, 1/8W, 1%, 100K	2	RN550-1003F	C
R52 R53 R91	RES, MF, 1/8W, 1%, 10	3	RN550-1000F	C
R130	RES, MF, 1/8W, 1%, 12, 1K	1	RN550-1212F	C
R12 R25 R58	RES, MF, 1/8W, 1%, 150	3	RN550-1500F	C
R115 R121 R124 R40	RES, MF, 1/8W, 1%, 1.5K	4	RN550-1501F	C
R53 R61	RES, MF, 1/8W, 1%, 1KV	2	RN550-1E00F	C
R101 R32 R53 R54	RES, MF, 1/8W, 1%, 15	4	RN550-1500F	C
R96	RES, MF, 1/8W, 1%, 182	1	RN550-1820F	C
R102 R105 R24 R51	RES, MF, 1/8W, 1%, 200	4	RN550-2000F	C
R115 R116 R116 R120 R24	RES, MF, 1/8W, 1%, 2K	5	RN550-2001F	C

REFERENCE DESIGNATIONS	PART DESCRIPTION	QTY/PK	WAVETEK NO.	REV
R30 R65	RES, MF, 1/8W, 1%, 0.1K	2	RN550-0100F	C
R56 R57 R58	RES, MF, 1/8W, 1%, 0.1K	3	RN550-0101F	C
R49	RES, MF, 1/8W, 1%, 0.1K	1	RN550-0109F	C
R72 R73 R74 R75 R76 R80 R97	RES, MF, 1/8W, 1%, 750	7	RN550-7500F	C
R11 R111 R126 R17	RES, MF, 1/8W, 1%, 7.5K	4	RN550-7501F	C
R46	RES, MF, 1/8W, 1%, 7.5K	1	RN550-7507F	C
R122	RES, MF, 1/8W, 1%, 7.5K	1	RN550-8251F	C
R92	RES, MF, 1/8W, 1%, 900	1	RN550-9000F	C
R47 R61	RES, MF, 1/8W, 1%, 1K	2	RN550-1000F	C
C11 C31 C34	DIODE, ZENER 6.2V	3	1N4234	C
C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25 C26 C27 C28 C29 C30 C31 C32 C33 C34 C35 C36 C37 C38 C39 C40 C41 C42 C43 C44 C45 C46 C47 C48 C49 C50 C51 C52 C53 C54 C55 C56 C57 C58 C59 C60 C61 C62 C63 C64 C65 C66 C67 C68 C69 C70 C71 C72 C73 C74 C75 C76 C77 C78 C79 C80 C81 C82 C83 C84 C85 C86 C87 C88 C89 C90 C91 C92 C93 C94 C95 C96 C97 C98 C99 C100	DIODE	51	FD-717	C

REFERENCE DESIGNATIONS	PART DESCRIPTION	QTY/PK	WAVETEK NO.	REV
C25	CAP, POLY, 1MF, 100V	1	1500-41-0504	C
C16 C42	CAP, MYLAR, 0.02UF, 100V	2	1500-42-0504	C
C15 C43	CAP, MYLAR, 2MF, 100V	2	1500-42-0604	C
C26	CAP, TANT, 10MF, 20V	1	1500-01-0601	C
C14 C44	CAP, TANT, 2.2MF, 25V	2	1500-02-0502	C
C13 C45	CAP, TANT, 22MF, 15V	2	1500-02-0601	C
C46	CAP, TANT, 220MF, 10V	1	1500-02-0701	C
NONE	SWEEP TRANS TIME BR	1	1700-00-0629	C
J2	CONN, 9PIN	1	2100-02-0032	C
J15 J16 J17	5 POS HEADER	3	2100-03-0034	C
J11 J13	SPRING SOCKET	2	2100-03-0037	C
NONE	COAX SOCKET	2	2100-03-0038	C
NONE	CABLE CONTACT	2	2100-03-0040	C
NONE	TRANSIFAD	1	2100-11-0034	C
R81	PERFITE READ	1	3100-00-0001	C
R110	POT, TRIM, 1K	1	4600-01-0200	C
R107 R42	POT, TRIM, 100K	2	4600-01-0402	C

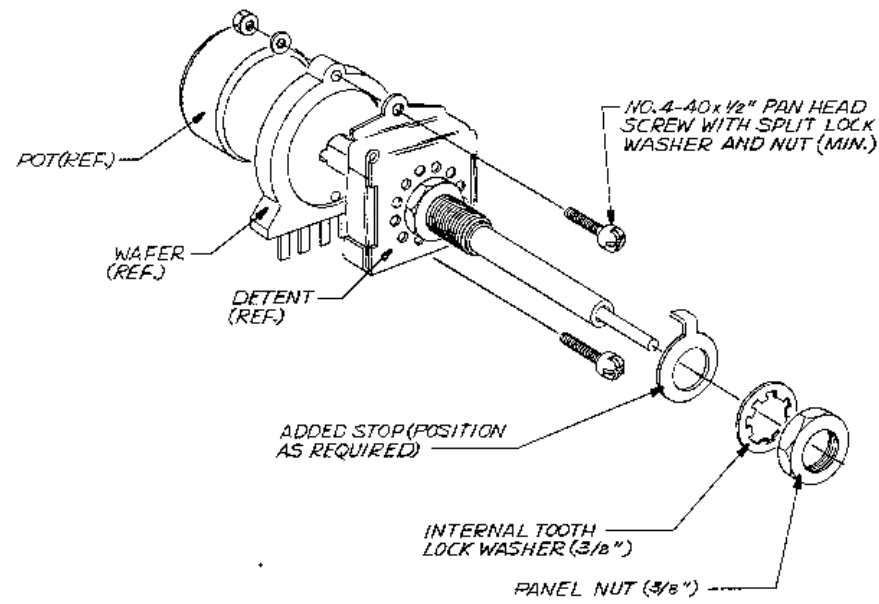
REFERENCE DESIGNATIONS	PART DESCRIPTION	QTY/PK	WAVETEK NO.	REV
R15 R26	RES, MF, 1/8W, 1%, 20K	2	RN550-2000F	C
R10 R20 R64	RES, MF, 1/8W, 1%, 2.2K	3	RN550-2001F	C
R94	RES, MF, 1/8W, 1%, 301	1	RN550-3010F	C
R71	RES, MF, 1/8W, 1%, 3.01K	1	RN550-3011F	C
R109	RES, MF, 1/8W, 1%, 301K	1	RN550-3013F	C
R101 R43 R45 R90	RES, MF, 1/8W, 1%, 316	4	RN550-3160F	C
R43 R95	RES, MF, 1/8W, 1%, 332	2	RN550-3320F	C
R50	RES, MF, 1/8W, 1%, 332K	1	RN550-3321F	C
R132 R15 R16 R14 R22 R24 R27 R35 R36 R38 R59 R9 R91 R98	RES, MF, 1/8W, 1%, 33.2K	14	RN550-3322F	C
R69	RES, MF, 1/8W, 1%, 3.35K	1	RN550-3351F	C
R58	RES, MF, 1/8W, 1%, 392	1	RN550-3920F	C
R37 R7	RES, MF, 1/8W, 1%, 46.4K	2	RN550-4640F	C
R112 R117 R129 R129 R34 R54 R65 R70 R77 R79 R92	RES, MF, 1/8W, 1%, 495	11	RN550-4950F	C
R104 R105 R131 R133 R55 R60 R8	RES, MF, 1/8W, 1%, 4.99K	7	RN550-4991F	C
R58	RES, MF, 1/8W, 1%, 51.1	1	RN550-5111F	C

REFERENCE DESIGNATIONS	PART DESCRIPTION	QTY/PK	WAVETEK NO.	REV
C28 C49 C50 C51 C52 C53 C54 C55 C56 C57 C58 C59 C60 C61 C62	TRANS	2	2N2250	C
Q2 Q5	TRANS	1	2N2904	C
Q1	TRANS	1	2N3640	C
Q10 Q14 Q15 Q17 Q18 Q24 Q25 Q3 Q9	TRANS	9	2N3640	C
Q11 Q12 Q13 Q16 Q19 Q20 Q26 Q6	TRANS	8	2N3646	C
Q1 Q22 Q23 Q4	TRANS	4	NPS-106	C
Q7 Q8	TRANS, M/PR, 2N5425 QTY: 24901-05-0450	1	102-E01-S3	C
U2	IC	1	LM 3014	C
U3	IC, OP-AMP	1	LF356N	C
U6	IC	1	CA-3054	C
U4	IC	1	MC10102	C
U5	IC	1	MC10105	C
U3	IC	1	MC10116P	C

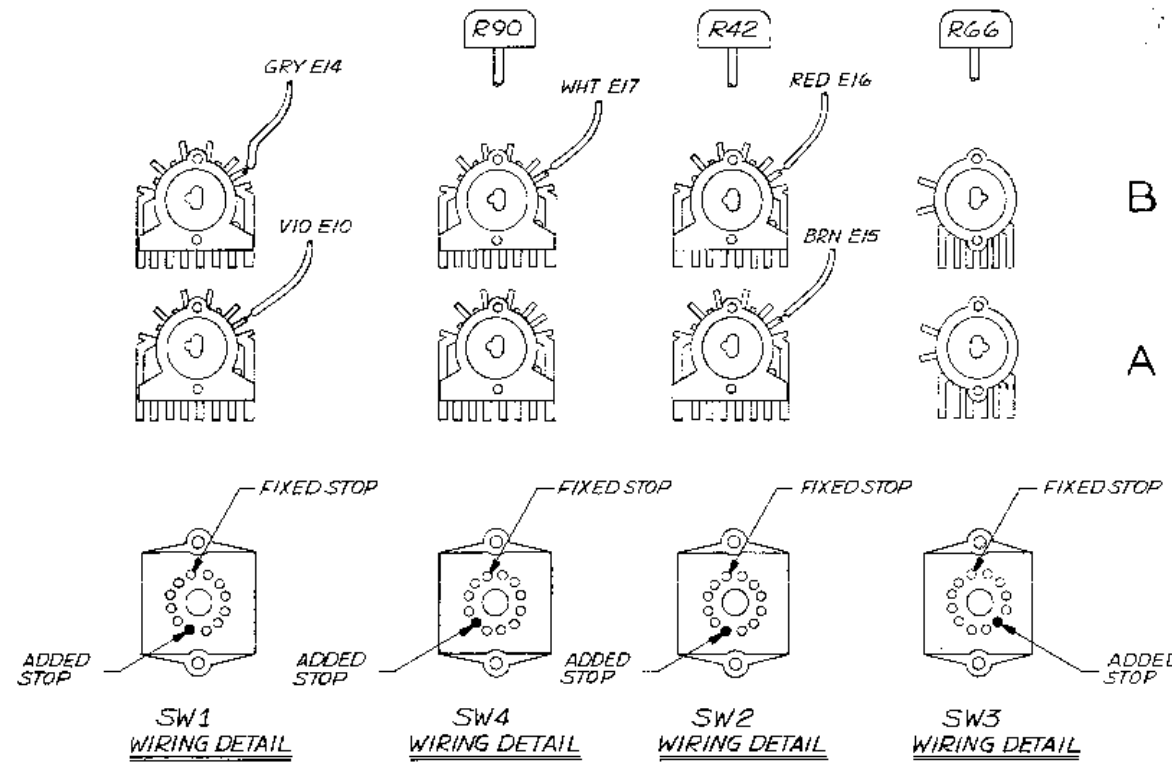
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA	
MATERIAL	PROJ ENGR		TITLE <b>SWEEP &amp; TRANSITION TIME ASSY</b>	
	RELEASE APPROV		MODEL NO <b>166</b>	
	TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX - 010 ANGLES - 1 .XX - 030		DWG NO <b>1100-00-0629</b>	
FINISH WAVETEK PROCESS	DO NOT SCALE DWG		REV <b>C</b>	
SCALE			CODE <b>23338</b>	
			SHEET <b>1</b> OF <b>1</b>	

NOTE: UNLESS OTHERWISE SPECIFIED

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TYPICAL HARDWARE STACK-UP



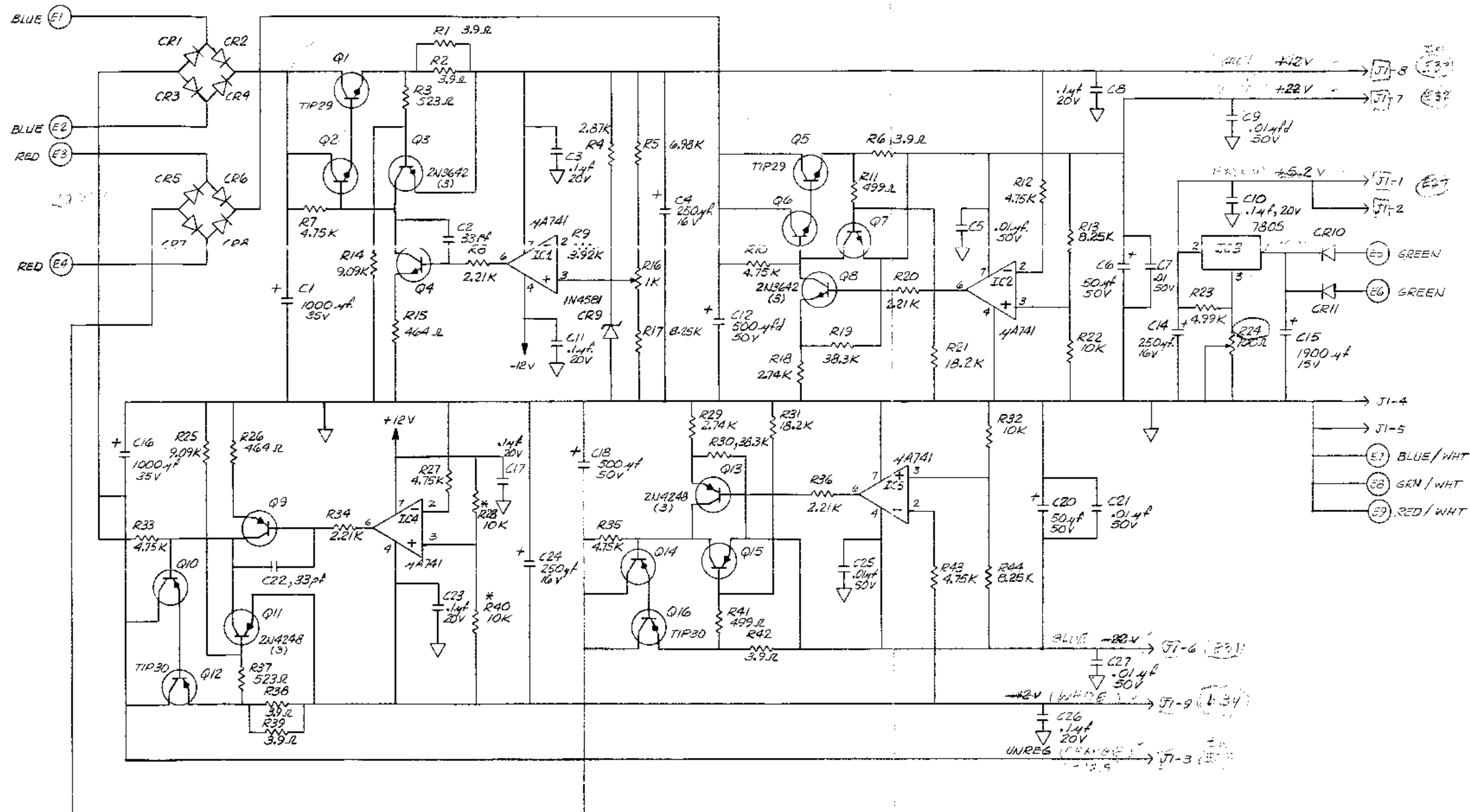
NOTE: ALL DETENTS SHOWN FROM FRONT VIEW IN FULL COUNTER CLOCKWISE POSITION

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARPEDEDGES	DESIGN D. COOPER	DATE 4-5-78	<b>WAVETEK</b> SAN JESU, CALIFORNIA
MATERIAL	PROJECTOR 3/10/78	DRWING 5-2	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX - .010 ANGLE ± 1 XX - .030		MODEL NO. 166
	DO NOT SCALE DWG		DWG NO. 1702-97-9042
	SCALE		REV. 23338
			SHFT 1 OF 2

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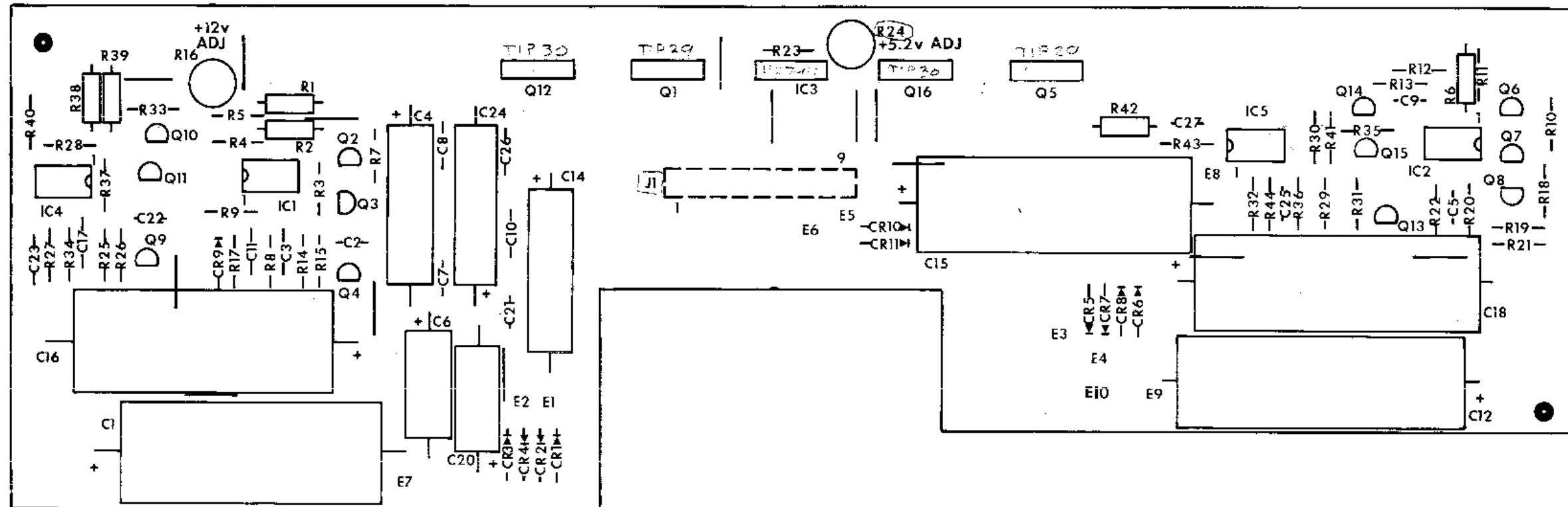
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LAST USED: C27, CR11, Q16, R44  
 UNUSED: C13, C19

4. COLORED CALLOUTS INDICATE TRANSFORMER LEADS.
  3. SEE CHASSIS SCHEMATIC FOR INTERWIRING.
  2. DIODES ARE SCE-1.
  1. \* INDICATES MATCHED PAIR.
- NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURS AND BREAK SHARP EDGES	DRAWN T. FLISTER	DATE 8-9-77	<b>WAVETEK</b> SAN DIEGO • CALIFORNIA
MATERIAL	PRODUCTION K. ...	RELEASE APPROV.	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± .10 ANGLES -1 XX .030	DO NOT SCALE DWG	MODEL NO. 166
	SCALE		DWG. NO. 0103-00-0645
			REV. C
			LOG IDENT 23338
			SHEET 1 OF 1



REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> SAN DIEGO • CALIFORNIA	
MATERIAL	PROFENOR		TITLE <b>ASSEMBLY POWER SUPPLY</b>	
FINISH WAVETEK PROCESS	RELEASE APPROP		TOLERANCE UNLESS OTHERWISE SPECIFIED .XXX 010 ANGLES 1 .XX 030	
	DO NOT SCALE DWG		MODEL NO <b>166</b>	DWG NO <b>0101-00-0645 B</b>
	SCALE		CODE IDENT <b>23338</b>	SHEET <b>1</b> OF <b>1</b>

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REV ECN BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFG	WAVETEK NO.	QTY/PK
NDNE	ASSY POWER SUPPLY	1101-00-0645	WVTK	0101-00-0645	1
NDNE	SCHEMATIC POWER SUPPLY	0103-00-0645	WVTK	0103-00-0645	1
NDNE	REAR PANEL ASSY	166-0648	WVTK	1266-00-0648	1
C21 C25 C27 C5 C7 C9	CAP, CER, .01MF, 50V	CK-103	CRL	1500-01-0310	6
C10 C11 C17 C23 C26 C3 C5	CAP, CER, .1NF, 20V	UK26-104	ARCO	1500-01-0413	7
C2 C22	CAP, CER, 33PF, 1KV	33-336	DKL	1500-03-3011	2
C1 C16	CAP, ELECT, 1000PF, 35V	39D1950035GL4	SP-AG	1500-51-0212	2
C15	CAP, ELECT, 1500PF, 15V	39D1980015GL4	SP-AG	1500-51-0201	1
C14 C24 C4	CAP, ELECT, 250PF, 16V	500D2570016GF7	SP-AG	1500-32-5101	3
C20 C3	CAP, ELECT, .01MF, 50V	500D5070015GF7	SP-AG	1500-32-5101	2
C12 C18	CAP, ELECT, 500PF, 50V	39D5070050GL4	SP-AG	1500-32-5103	2
NDNE	POWER SUPPLY	1700-00-0645	WVTK	1700-00-0645	1
J1	CONN, 4PIN	09-60-1091	MOLECK	2100-02-0352	1
R24	POT, TRIM, 100	91AR100	HEC	4600-01-0193	1
R16	POT, TRIM, 1K	91AR1K	HEC	4600-01-0209	1
R1 R2 R3 R4 R5 R6	RES, CARB, 1/2W, 5%, 3.9	HC200F-389	RTKPL	4700-25-0399	6
R22 R32	RES, MF, 1/8W, 1%, 10K	R4550-1002F	TRW	4701-03-1002	2

**WAVETEK PARTS LIST**

TITLE: PWA, POWER SUPPLY

ASSEMBLY NO. 1101-00-0645

PAGE: 1

REV 6

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFG	WAVETEK NO.	QTY/PK
DI1 DI16 DI17 DI18 DI19 DI20 DI21 DI22 DI23 DI24 DI25 DI26	DIODE	5CE-1	SELFC	4501-02-0001	10
D2 D3 D4 D5 D6 D7 D8	TRANS	2N3642	F41H	4901-03-0420	6
D9 D10 D11 D12 D13 D14 D15 D16	TRANS	2N4241	F41H	4901-03-2401	6
D17 D18	TRANS	TIP-29	T	4902-00-0290	2
D19 D20	TRANS	TIP-36	T	4902-00-0360	2
IC1 IC2 IC3 IC4 IC5	IC	741	F41H	7000-07-4100	4
IC6	VOLTAGE REGULATOR	7805304	F41H	5003-72-0500	1

**WAVETEK PARTS LIST**

TITLE: PWA, POWER SUPPLY

ASSEMBLY NO. 1100-00-0645

PAGE: 3

REV 3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFG	WAVETEK NO.	QTY/PK
R21 R41	RES, MF, 1/8W, 1%, 10.2K	R4550-1022F	TRW	4701-03-1022	2
R20 R34 R36 R6	RES, MF, 1/8W, 1%, 2.21K	R4550-2211F	TRW	4701-03-2211	4
R18 R29	RES, MF, 1/8W, 1%, 2.74K	R4550-2741F	TRW	4701-03-2741	2
R4	RES, MF, 1/8W, 1%, 2.87K	R4550-2871F	TRW	4701-03-2871	1
R19 R30	RES, MF, 1/8W, 1%, 3.3K	R4550-3322F	TRW	4701-03-3322	2
R9	RES, MF, 1/8W, 1%, 3.92K	R4550-3921F	TRW	4701-03-3921	1
R15 R26	RES, MF, 1/8W, 1%, 4.6K	R4550-4640F	TRW	4701-03-4640	2
R10 R12 R27 R33 R35 R43 R7	RES, MF, 1/8W, 1%, 4.75K	R4550-4751F	TRW	4701-03-4751	7
R11 R41	RES, MF, 1/8W, 1%, 4.99K	R4550-4990F	TRW	4701-03-4990	2
R23	RES, MF, 1/8W, 1%, 5.39K	R4550-4991F	TRW	4701-03-4991	1
R3 R37	RES, MF, 1/8W, 1%, 5.23K	R4550-5230F	TRW	4701-01-5230	2
R5	RES, MF, 1/8W, 1%, 6.95K	R4550-6951F	TRW	4701-03-6951	1
R13 R17 R44	RES, MF, 1/8W, 1%, 8.25K	R4550-8251F	TRW	4701-03-8251	3
R14 R25	RES, MF, 1/8W, 1%, 9.09K	R4550-9091F	TRW	4701-03-9091	2
R28 R40	RES, SET, 2-10K, 1/8W, 1% UT: 124701-03-1002	1W2-501-644	WVTK	4724-00-0019	1
CR3	DIODE	1N4581	MICRO	4901-01-4581	1

**WAVETEK PARTS LIST**

TITLE: PWA, POWER SUPPLY

ASSEMBLY NO. 1101-00-0645

PAGE: 2

REV 6

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA
MATERIAL	PROJECTOR	TITLE	
FINISH WAVETEK PROCESS	RELEASE APPROV	POWER SUPPLY	
TOLERANCE UNLESS OTHERWISE SPECIFIED XXX - DIM ANGLES - XX - USE		MODEL NO	REV
DO NOT SCALE DWG		SCALE	DATE
SCALE		1/8" = 1"	100 00 04 95
SCALE		23338	SHEET 1 OF 1

NOTE: UNLESS OTHERWISE SPECIFIED

8 7 6 5 4 3 2 1

REV ECN BY DATE APP

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D

C

B

A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-PPGR-PART-NO	PPGR	WAVETEK NO.	QTY/PT
NONF	ASSY DRWG REAR PANEL	1102-00-0648	WVTK	1102-00-0648	1
T1	TRANSFORMER	166-0520	WVTK	1204-00-0020	1
NOVE	INSULATOR	147-367	WVTK	1400-00-3700	1
1	BAR, CLAMP	147-379	WVTK	1400-00-3738	1
2	STRIP, CUMM REF:13200-06-C001	152-31P	WVTK	1400-00-3640	1
13	LABEL, WARNING	1400-00-6940	WVTK	1400-00-6940	1
3	MNTG PLATE, CORECM	1400-00-8132	WVTK	1400-00-8132	1
7	COVER, CORECM	1400-00-8140	WVTK	1400-00-8140	1
5	CASTING, REAR, VDD FRHM:1400-00-3671	1400-00-8154	WVTK	1400-00-8154	1
14	INSULATOR, PWR SWITCH REF:1600-99-0001	1400-00-6370	WVTK	1400-00-6370	1
4	I.D. LABEL	1400-00-9090	WVTK	1400-00-9090	1
6	RECEPTACLE	631	CORCM	2100-03-0026	1
9	SOLOER LUG	1485-A	SMITH	2100-00-0025	3
8	FUSE, 250V, 1/2A, 5B	313-500	LITFL	2400-05-0010	1
10	SPRFDWLT, TYPE PL	C12550-532-0	TZHN	2800-09-0002	4
11	SWITCH ASSY PR	5103-00-0020	WVTK	5102-00-0005	1

WAVETEK  
PARTS LIST

TITLE  
REAR PANEL ASSY

ASSEMBLY NO.  
1206-00-0648

PAGE: 1

REV  
B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-PPGR-PART-NO	PPGR	WAVETEK NO.	QTY/PT
12	PWP CORD	B-7786-005-0Y	PACRD	6001-R0-0005	1

WAVETEK  
PARTS LIST

TITLE  
REAR PANEL ASSY

ASSEMBLY NO.  
1206-00-0648

PAGE: 2

REV  
B

<p>REMOVE ALL BURRS AND BREAK SHARP EDGES</p> <p>MATERIAL</p> <p>FINISH WAVETEK PROCESS</p>	<p>DRAWN</p> <p>PROJ/ENGR</p> <p>RELEASE APPROV</p> <p>TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ± 0.10 ANGLES 1:1 XX ± 0.30</p> <p>DO NOT SCALE DWG</p> <p>SCALE</p>	<p>DATE</p>	<p><b>WAVETEK</b> SAN DIEGO • CALIFORNIA</p> <p>TITLE <b>REAR PANEL</b></p> <p>MODEL NO. 166      DWG NO. 1206-00-06-13      REV B</p> <p>CODE 23338      SHEET 1 OF 1</p>
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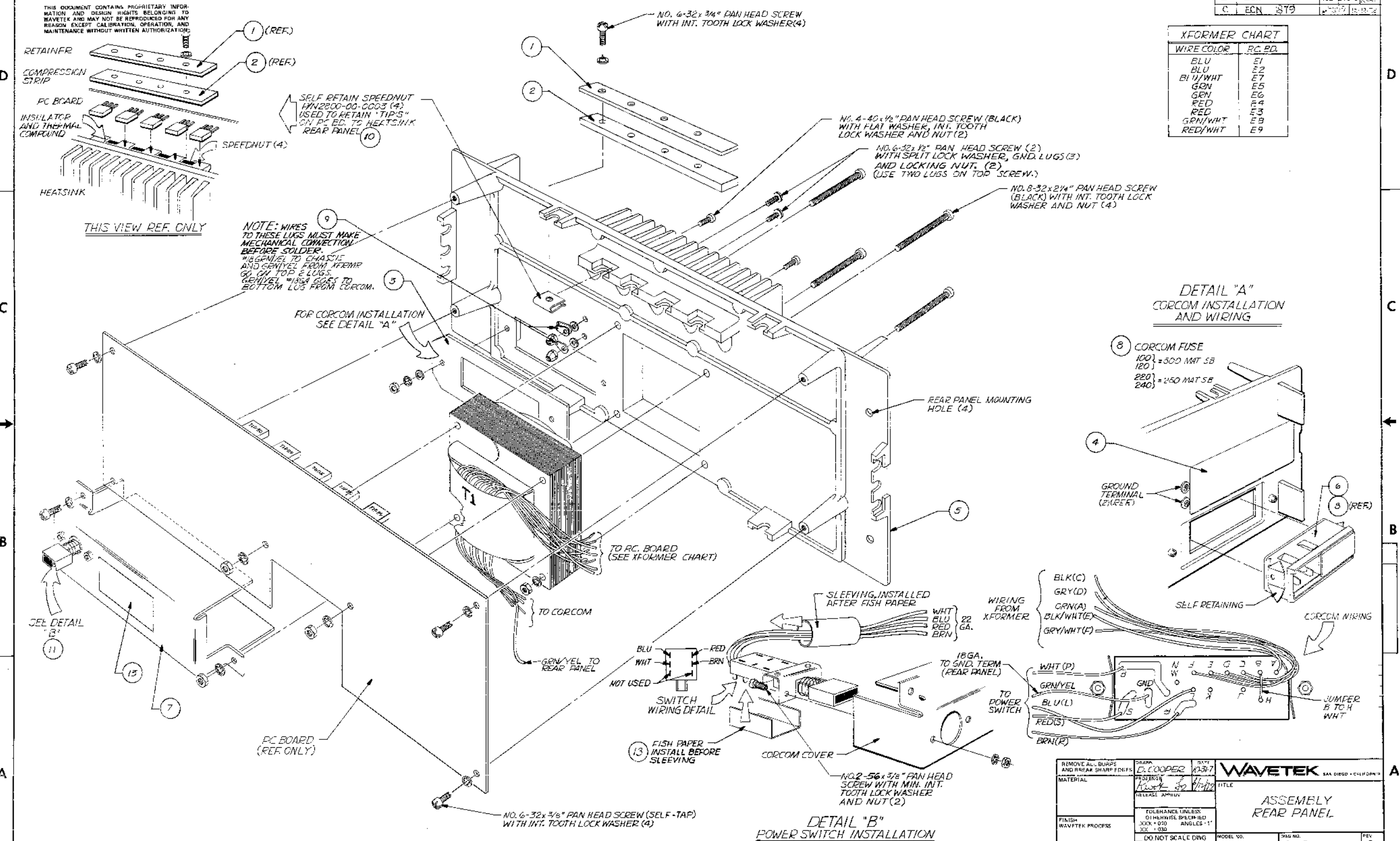
NOTE: UNLESS OTHERWISE SPECIFIED

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REV	ECN	BY	DATE	APP
B	ECN 1793		02/16/79	
C	ECN 1879			

**XFORMER CHART**

WIRE COLOR	PC BD.
BLU	E1
BLU	E2
BLU/WHT	E7
GRN	E5
GRN	E6
RED	E4
RED	E3
GRN/WHT	E8
RED/WHT	E9



NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN BY: COOPER	DATE: 10/3/77	<b>WAVETEK</b> SAN DIEGO • CALIFORNIA
MATERIAL	PROJECT: Power to Heat	RELEASE: 20/11/77	
FINISH: WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED: XXX ± .010 XX ± .030	DO NOT SCALE DWG	<b>ASSEMBLY REAR PANEL</b>
SCALE	MODEL NO. 166	DWG NO. 0102-00-0648	REV. C
	CODE: 23338	SHEET 1 OF 1	