

OPERATOR'S & MAINTENANCE MANUAL

**Model 288**  
**20 MHz Synthesized**  
**Function Generator**

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Manual Revision 4/91  
Manual Part Number: 1300-00-0561  
Instrument Part Number: 1000-00-0561

## WARRANTY

Wavetek warrants that all products manufactured by Wavetek conform to published Wavetek specifications and are free from defects in materials and workmanship for a period of one (1) year from the date of delivery when used under normal operating conditions and within the service conditions for which they were furnished.

The obligation of Wavetek arising from a Warranty claim shall be limited to repairing, or at its option, replacing without charge, any product which in Wavetek's sole opinion proves to be defective within the scope of the Warranty. In the event Wavetek is not able to modify, repair or replace non-conforming defective parts or components to a condition as warranted within a reasonable time after receipt thereof, Buyers shall be credited for their value at the original purchase price.

Wavetek must be notified in writing of the defect or nonconformity within the Warranty period and the affected product returned to Wavetek's factory or to an authorized service center within thirty (30) day after discovery of such defect or nonconformity.

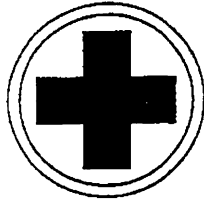
For product warranties requiring return to Wavetek, products must be returned to a service facility designated by Wavetek. Buyer shall prepay shipping charges, taxes, duties and insurance for products returned to Wavetek for warranty service. Except for products returned to Buyer from another country, Wavetek shall pay for return of products to Buyer.

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## SAFETY FIRST



**Protect yourself.** Follow these precautions:

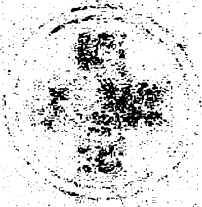
- Don't touch the outputs of the instrument or any exposed test wire carrying the output signals. This instrument can generate hazardous voltages and currents
- Don't bypass the power cord's ground lead with two-wire extension cords or plug adapters.
- Don't disconnect the green and yellow safety-earth-ground wire that connects the ground lug of the power receptacle to the chassis ground terminal (marked with  or ).
- Don't hold your eyes extremely close to an RF output for a long time. The normally nonhazardous low-power RF energy generated by the instrument could possibly cause eye injury.
- Don't plug in the power cord until directed to by the installation instructions.
- Don't repair the instrument unless you are a qualified electronics technician and know how to work with hazardous voltages.
- Pay attention to the **WARNING** statements. They point out situations that can cause injury or death.
- Pay attention to the CAUTION statements. They point out situations that can cause equipment damage.

### WARNING

**This instrument normally contains a lithium battery. Where lithium is prohibited, such as aboard U.S. Navy ships, verify that the lithium battery has been removed.**

**Do not recharge, short circuit, disassemble, or apply heat to the lithium battery. Violating this rule could release potentially harmful lithium. Observe polarity when you replace the battery.**

SECRET



MEMORANDUM FOR THE DIRECTOR

Reference is made to the report of the Special Agent in Charge, New York, dated 10/15/54, and the report of the Special Agent in Charge, New York, dated 10/15/54.

It is noted that the above information was obtained from a confidential source who has provided reliable information in the past.

The information is being furnished to you for your information and is being classified as Confidential.

Very truly yours,  
Special Agent in Charge

Enclosure

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Approved for Release by NSA on 05-08-2014 pursuant to E.O. 13526

SECRET

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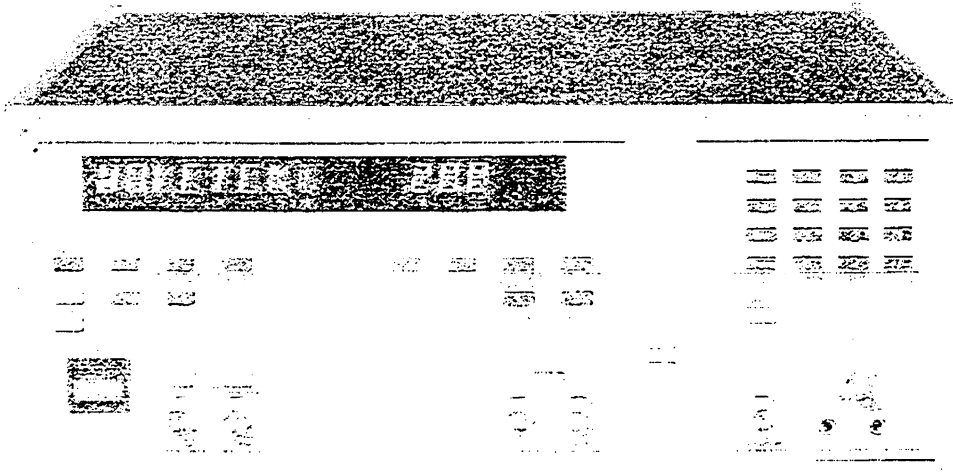
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Model 288 20 MHz Synthesized Function Generator

# SECTION 1 GENERAL

## 1.1 INTRODUCTION

The Model 288 Signal Generator is a precision source of sine, triangle, and variable symmetry (ramp and pulse) waveforms for use in the installation and maintenance of radio receivers, transmitters, and other electronic equipment.

- Push button control for easy operation.
- Indicator lights give constant equipment status.
- Large, 16 character (fourteen segments/ character), display for all parameters.
- Programmed interface for remote operation.
- Programmable sine, triangle, square, and dc outputs.
- Variable symmetry provides pulse and ramp waveforms.
- Balanced and unbalanced outputs.
- Built-in calibration and fault analysis programs with extensive self-adjustment.
- Battery backup for saving system setups.

### 1.1.1 List of Abbreviations

This list identifies abbreviations and descriptions used in this manual that are not contained in MIL-STD-12. For abbreviations used in this manual but not contained in this list refer to MIL-STD-12.

Abbreviation	Term
dBc	dB relative to carrier
dBm	dB relative to 1 milliwatt
fc	carrier frequency
fm	modulating frequency
GPiB	General Purpose Interface Bus
VCF	Voltage Controlled Frequency
VFD	Vacuum Fluorescent Display

## 1.2 OPTIONS

**001: 24-pin Extender Card** – Special 24-pin extender card when used in conjunction with Option 002 permits user access to test points and components on the various circuit cards with or without power being applied.

**002: 40-pin Extender Card** – Special 40-pin extender card when used in conjunction with Option 001 permits user access to test points and components on the various circuit cards with or without power being applied.

**003: Rack Mounting Kit**

## 1.3 SPECIFICATIONS

### 1.3.1 Waveforms (Functions)

Sine, triangle and square; variable symmetry for pulse and ramp waveforms; and dc.

### 1.3.2 Operational Modes

**Continuous (CW):** Synthesized frequency output with selected parameters.

**Amplitude Modulation (AM):** Same as CW except that maximum amplitude limited to 15 Vp-p (open circuit) and external signal modulates the amplitude of the selected output.

**Frequency Modulation (FM and VCF):** External input modulates the frequency output.

**Sweep Modulation:** All symmetrical waveforms swept over 3 decades from Start to Stop frequency (up or down) at programmed rate.

*Rate:* 100 ms to 100s.

*Start/Stop Accuracy:*  $< \pm 3\%$ .

**Phase Lock:** Frequency, stability and purity controlled by external reference. In all modes except FM and Sweep, generator will lock to applied external 20 Hz to 20 MHz sine wave.

*Lock Phase Angle:*  $\pm 180^\circ (\pm \pi \text{ radians})$ .

Resolution: 1°.

Accuracy: 50 Hz to 10 MHz,  $\pm (4^\circ + 20 \text{ ns})$ .

### 1.3.3 Waveform Quality

**Sine Distortion:** Unbalanced output, Total Harmonic Distortion.

2 mHz to 20 Hz:	- 40 dB.
20 Hz to 100 kHz:	- 46 dB.
100 kHz to 1 MHz:	- 40 dB.
1 MHz to 6 MHz:	- 34 dB.
6 MHz to 20 MHz:	- 26 dB.

**Time Symmetry:** Programmable from 5% to 95% in 1% steps to 2 MHz, linearly decreasing to 50% fixed at 20 MHz.

Accuracy:  $\pm (2\% + 20 \text{ ns})$ . At 50%,  $\pm (0.1\% + 20 \text{ ns})$ .

**Square Wave Transition Time:** < 13 ns, 10% to 90%, full output, from 50 $\Omega$  source into 50 $\Omega$  load.

**Square Wave Aberrations:** Overshoot and ringing < (5% + 20 mV) of p-p amplitude.

**Triangle Linearity:** From 10% to 90% points:

2 mHz to 100 kHz:	$\pm 1\%$ .
100 kHz to 2 MHz:	$\pm 2\%$ .
2 MHz to 5 MHz:	$\pm 10\%$ .

### 1.3.4 Frequency

**Range:** 2 mHz to 20 MHz.

*Synthesized:* 20 Hz to 20 MHz.

*600 $\Omega$  or Balanced Output:* 2 mHz to 1 MHz.

*Amplitude Modulation:* 0.1 Hz to 20 MHz.

**Resolution:** 3 1/2 digits (200 to 2000 counts in the display).

**Accuracy:** Percent of setting:

2 mHz to 20 Hz and FM or Sweep Modes:	$\pm 3\%$ .
20 Hz to 20 MHz:	$\pm 0.05\%$ .

### Stability

*Within 10 Minutes:*

$\leq 20 \text{ Hz}$ and FM or Sweep Modes:	$\pm 0.1\%$
$> 20 \text{ Hz}$ and Continuous or AM Modes:	$\pm 0.001\%$ .

*Within 24 Hours:*

$\leq 20 \text{ Hz}$ and FM or Sweep Modes:	$\pm 0.5\%$
$> 20 \text{ Hz}$ and Continuous or AM Modes:	$\pm 0.002\%$ .

$\pm 10\%$  Line Voltage Variation:

$\leq 20 \text{ Hz}$ and FM and Sweep Modes:	$\pm 0.1\%$ .
$> 20 \text{ Hz}$ and Continuous or AM Modes:	$\pm 0.001\%$ .

*Temperature:*

$\leq 20 \text{ Hz}$ and FM and Sweep Modes:	$< 100 \text{ ppm}/^\circ\text{C}$ .
$> 20 \text{ Hz}$ and Continuous or AM Modes:	$< 2 \text{ ppm}/^\circ\text{C}$ .

*With Output level Variation:*

$\leq 20 \text{ Hz}$ and FM and Sweep Modes:	$\pm 0.1\%$
$> 20 \text{ Hz}$ and Continuous or AM Modes:	$\pm 0.001\%$ .

### 1.3.5 Amplitude

**Range:**

*Open Circuit:* 2 mVp-p to 30 Vp-p.

*Impedance Terminated:* 1 mVp-p to 15 Vp-p.

**Resolution:** With no offset:

2 mVp-p to 20 Vp-p Open Circuit, (1 mVp-p to 10 Vp-p Terminated): 3 digits.

To 30 Vp-p (15 Vp-p Terminated): 3 1/2 digits.

**Accuracy:** % of Setting:

*Sine :*

To 999 mVp-p:  $\pm (2\% + 2 \text{ mV})$ .

To 30 Vp-p:  $\pm (2\% + 10 \text{ mV})$ .

*Triangle and Square :*

To 999 mVp-p:  $\pm (3\% + 4 \text{ mV})$ .

To 30 Vp-p:  $\pm (3\% + 20 \text{ mV})$ .

**Flatness:** To accuracy percent of setting:

For 100 kHz to 1 MHz: Additional  $\pm 2\%$ .

To 5 MHz: Additional  $\pm 3\%$ .

To 20 MHz: Additional  $\pm 10\%$ .

### 1.3.6 Offset

**Range**

$\pm 10\text{V}$  ( $\pm 5\text{V}$  terminated).

**Resolution**

3 digits; may be reduced if both offset and waveform amplitude are programmed.

**Accuracy**

0.5V to 10V:  $\pm (1\% \text{ of setting} + 20 \text{ mV})$ .

1 mV to 500 mV:  $\pm (1\% \text{ of setting} + 5 \text{ mV})$ .

### 1.3.7 Outputs

#### Sync (Trigger) Output

Pulse at frequency of and in phase with square wave.

*Low Level:* < 0.4V.

*High level:* > 1.8V into 50 $\Omega$ .

*10-90% Transition Times:* < 13 ns.

#### Horizontal Output

Ramp indicates sweep position.

*Level:* Fixed 0V to approx. + 5V (open circuit).

*Source Impedance:* 600 $\Omega$ .

#### Unbalanced Output

*Source Impedance:*

To 1 MHz: 600 $\Omega \pm 1\%$ .

To 20 MHz: 50 $\Omega \pm 1\%$  or 75 $\Omega \pm 1\%$ .

### Balanced Output

Banana jacks for differential output of sine wave; universal binding post for common.

#### Source Impedance:

To 1 MHz:  $135\Omega \pm 0.5\%$  or  $600\Omega \pm 1\%$

#### Output Unbalance:

10 Hz to 1 MHz: < 1% referenced to 1 kHz.

### 1.3.8 Inputs

#### External Trigger/Freq In

Input Impedance:  $10\text{ k}\Omega \pm 2\%$ .

Range (Sine Wave): 600 mVp-p to 30 Vp-p (into  $10\text{ k}\Omega$ ), 20 Hz to 20 MHz.

#### Modulation In

Input Impedance:  $10\text{ k}\Omega \pm 2\%$ .

Bandwidth: DC to 100 kHz

Max Level:  $\pm 20\text{ Vp-p}$  (into  $10\text{ k}\Omega$ ).

FM Mode:  $\pm 10\text{V}$  gives 1000:1 change. Apply as DC for VCF or AC for FM.

AM Mode: 4 Vp-p into  $10\text{ k}\Omega$  gives 100% AM.

### 1.3.9 Displays

Amplitude: V or mV peak-to-peak or peak. For symmetrical waveforms with no offset, displays amplitude in RMS or dBm.

Resolution: 100 to 999 counts or 0.1 dBm.

Offset: V or mV.

Resolution: 100 to 999 counts.

Frequency Including Sweep Start/Stop): mHz, Hz, kHz or MHz.

Resolution: 3 1/2 digits.

Period: sec, ms,  $\mu\text{s}$  or ns.

Resolution: 4 digits.

Symmetry: In %.

Resolution:  $\geq 10$  counts.

Resolution: resolves in  $1^\circ$  (deg) increments, displays radians in 4 digits.

Sweep Time: sec or ms with  $\geq 100$  counts.

### 1.3.10 GPIB Programming

Address: 0-30 selectable, battery backed.

Subsets: SH1, AH1, SR1, RL1, PP0, DC1, DT0, C0, T6, L4, TE0, LE0 and E1.

### 1.3.11 General

MIL-T-28800 Class 5 qualified.

Temperature Range: 0 to  $+50^\circ\text{C}$ , - 40 to  $+70^\circ\text{C}$  for storage.

Warm-up Time: 20 minutes for specified operation at  $25 \pm 10^\circ\text{C}$  ambient temperature.

Humidity: 0 to  $+25^\circ\text{C}$  at 95% RH, 0 to  $+40^\circ\text{C}$  at 75% RH, and 0 to  $50^\circ\text{C}$  at 45% RH.

Altitude: 3050m (10,000 ft.); non-operating to 12,000m (40,000 ft.).

Vibration: 0.013 in. from 5 to 55 Hz (2g acceleration at 55 Hz).

Shock: Non-operating; 30g, 11 ms half-sine.

Electromagnetic Compatibility: MIL-STD-461A Notice 4 (EL). Emission and susceptibility requirements of CE02, CE04, CS02, CS06, RE02, RE02.1 and RS03.

Dimensions: 35.6 cm (14.00 in.) wide, 13.3 cm (5.219 in.) high and 43.2 cm (17.00 in.) deep.

Weight: Approximately 11.4 kg (25 lb) net; 13.6 kg (30 lb) shipping.

Power: 90 to 108, 108 to 126, 198 to 231, or 216 to 252 Vrms; 48 to 440 Hz; 1 phase; < 60 VA.

### 1.4 EQUIPMENT SUPPLIED

The Model 288 is supplied with a shielded power cord, spare fuse, and manual.

### 1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED

All items required for the Model 288 are supplied.

1971-1972

Annual Report of the  
Department of the Interior  
Bureau of Land Management

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# SECTION 2

## PREPARATION

### 2.1 RECEIVING AND INSPECTING SHIPMENTS

Use the following steps to inspect a shipment of Wavetek equipment.

1. **Inspect the shipment.** Before unpacking the instrument, your receiving clerk should have checked the shipment for missing boxes, inspected each box for damage, and if necessary, have had the driver describe the box damage and list shortages on the delivery bill. If you find unreported shortages or damage, notify the shipper before further unpacking.
2. **After unpacking the boxes.** Save all of the packing material.
3. **Inspect the equipment for damage.** Inspect it carefully, regardless of the condition of the shipping boxes.
4. **If necessary, file a damage claim.** If any damage is found, call the shipper immediately (within 10 days) and start the claim process.
5. **Call Wavetek.** Call Wavetek's Customer Service department (619-279-2200) and tell them that the equipment arrived damaged.

### 2.2 RETURNING EQUIPMENT FOR REPAIR

Use the following steps when returning Wavetek equipment to Wavetek for repair.

1. **Save the packing material.** Always return the equipment to Wavetek in its original packing material and boxes. If you use inadequate packing material, you will have to pay to repair any shipping damage as carriers will not pay claims on incorrectly packed equipment.
2. **Call Wavetek for a Return Authorization.** Wavetek's customer service representative will ask for the name of the person returning the equipment, telephone number, company name, equipment type, and a description of the problem.

### 2.3 INITIAL CHECKOUT

#### 2.3.1 Introduction

The following paragraphs provide information required to prepare, turn-on, and checkout the Model 288 Signal Generator in the local mode. Information required for remote mode is provided in Section 3. Table 2-1 lists maintenance messages and error codes along with the probable cause and corrective action. Numbers shown in parentheses refer to keyed items in figure 2-1.

#### 2.3.2 Preparation for Use

##### WARNING

The Model 288 Signal Generator is equipped with a three-wire power cable. When connected to a grounded AC power receptacle, this cable grounds the instrument front panel and cabinet. Do not use extension cords or AC adapters without a ground.

1. Verify that the power switch (1) is set to Off.
2. Verify the the voltage selection card (5) on the rear panel matches the line voltage available in your area. Connect the power cable (6) to ac power connector (7) on rear panel.

Table 2-1. Voltage Selection Card Position and Fuse Size.

Input Voltage	Voltage Selection Card	Fuse
90 to 108	100	3/4 amp, Slo-Blo
108 to 126	120	3/4 amp, Slo-Blo
198 to 231	220	3/8 amp, Slo-Blo
216 to 252	240	3/8 amp, Slo-Blo

##### WARNING

This instrument uses an internal battery that contains 0.2 grams of Lithium. Do not charge or short this battery. A hazard of explosion and or contamination exists.

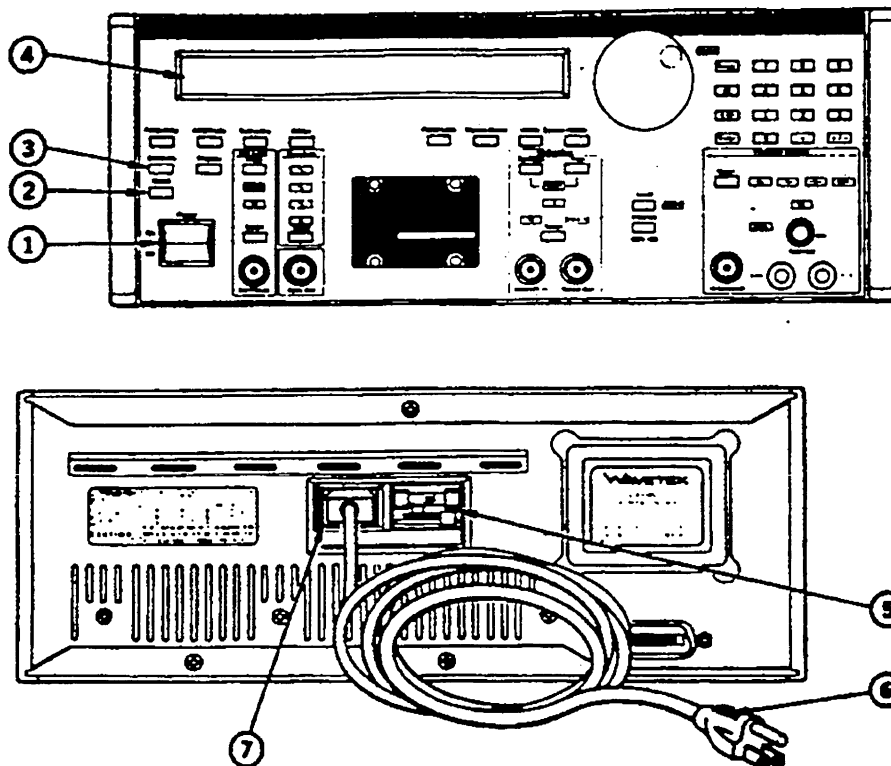


Figure 2-1. Equipment Setup

### 2.3.3 Turn-on and Initial Checkout Procedure

1. Verify that only the power cable (6) is connected to the Model 288. All other cables should be disconnected.
2. Set the Power On/Off switch (1) from Off to On. Verify that the Model 288 display (4) indicates "WAVETEK 288".

NOTE

*If a maintenance message or error code is shown in display, refer to table 2-2 for probable cause and corrective action.*

3. Press the Reset key (2). Verify that the following front panel conditions exist:
 

Display:	RESET (VX.XX)
Function:	Sine indicator ON
Modulation:	CW indicator ON
Function Outputs:	50Ω and UNBAL indicators ON

All other displays and indicators:	Off
Frequency:	FREQ 1 KHZ, PER 1 MILLISEC*
Amplitude:	AMPL 5VPP, AMPL 2.5VP, AMPL 1.77VRMS, AMPL 18DBM
Display:	INTENSITY 16*
Symmetry:	SYMM 50 PCT*
Phase:	PHASE 0 DEG/PHASE 0 RAD*
Offset:	DCOFF 0 VDC*
Start/Stop:	START 2 HZ/STOP 2 KHZ*
Time:	SWPTIME 1 SEC, SWPRATE 1 HZ*
Address:	ADDRS 00 to 30*
* Default value. Press key to display value(s).	

4. Allow the Model 288 Signal Generator 20 minutes of warm-up time.



NOTE

- Whenever the power cable has been disconnected, or the power switch has been in the Off position, the Model 288 requires a 20 minute waiting/warm-up period before the Calibrate key can be selected. If the Calibrate key is selected before 20 minutes, the display will indicate "WAIT XX.XX MIN" to show the time remaining.

- The Calibrate key performs only a 20 second self-check, and does not replace standard maintenance calibration.

5. Press the Calibrate key (3). Verify that the display (4) indicates "CALIBRATING".
6. Wait approximately 20 seconds. Verify that the display (4) indicates "AUTOCALIBRATED".
7. If all above conditions are correct, the signal generator is ready for operation. If indication is incorrect, notify your maintenance department or return the instrument to Wavetek for repair.

### 2.3.4 Maintenance Messages and Error Codes

Some internal circuit failures cause maintenance messages or error codes to appear in the display. See table 2-2 for a list of possible maintenance messages/error codes and probable cause.

### 2.3.5 Performance Verification

Performance verification tests the operation of every selectable parameter and input/output connector and to verify correct operation within each major specification. This verification is necessary only when there is a problem that is not identified by the AutoCal tests. All data obtained during the performance verification should be permanently recorded for future reference. The Performance Verification Form in Appendix A can be used as a master to generate additional copies as needed. Perform initial checkout procedures shown in paragraphs 2.3.2 and 2.3.3 prior to starting the performance verification.

**Required Test Equipment** - Table 5-2 lists the test equipment required to perform the performance verification procedure. Always keep test equipment interconnecting cables as short as possible.

**Table 2-2. Maintenance Messages and Error Codes.**

Display	Probable Cause	Corrective Action
Err xxxxxxxx	Improper self-check/unit	Press Calibrate key. If identical failure error is displayed, refer to section 6 (Troubleshooting Procedure). If a different error displayed, press the Calibrate key again. If "AUTO-CALIBRATED" is displayed, the unit is operational.
Low batt x.xxx v	Internal battery voltage low.	Unit is available for immediate operation. Replace the battery.
Cal Required	Internal battery dead.	Unit has lost its calibration data but can be used after performing and passing AutoCal. Instrument may not meet all specifications.

**Table 5-2. Required Test Equipment**

Test Equipment	Recommended Model
Scope	Tektronix 2465 or equivalent.
THD Analyzer	Hewlett Packard 8903B or equivalent.
Digital Multimeter (DMM)	Not Critical
Signal Generator (Signal Source)	Not Critical

### Frequency Range

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-2.

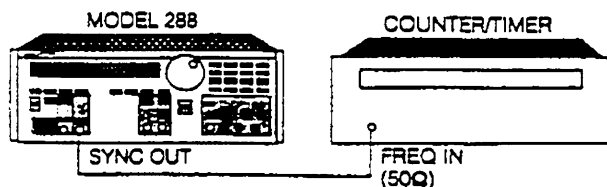


Figure 2-2. Frequency Measurement Setup

3. Program frequency to the top frequency of each of the top six decade frequency ranges and check synthesized frequency accuracy per the table in recorded data: RECORD.
4. Select FM Mode and repeat step 3 testing the unlocked frequency accuracy on all 10 ranges: RECORD.

### Frequency Resolution

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-2.
3. Vary the synthesized frequency in steps over the 1999 Hz to 222 Hz frequency range per Appendix A - Performance Verification Form and measure the frequency resolution: RECORD.

### Symmetry

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-2.
3. Program time symmetry in steps per Appendix A - Performance Verification Form and measure symmetry accuracy: RECORD.

### VCF/FM

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-3.
3. Program the signal source for 0 Volts dc output. Program the Model 288 for FM mode and measure the  $1\text{kHz} \pm 3\%$  frequency: RECORD.

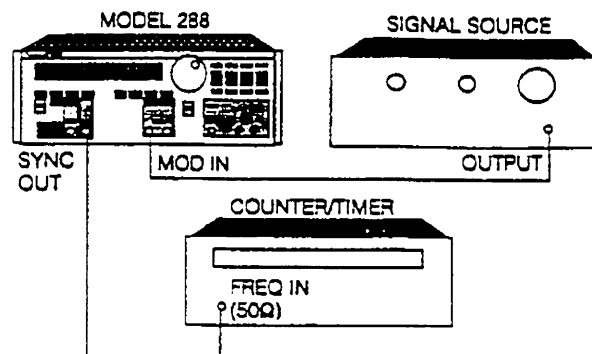


Figure 2-3. VC/FM Setup

4. Program the signal source for +5 Volts dc output into 10 kΩ load. Verify frequency is  $2\text{kHz} \pm 5\%$  ( $[\pm 3\% \text{ unlocked accuracy}] + [\pm 2\% \text{ uncertainty of } 10\text{ k}\Omega \text{ input impedance}]$ ): RECORD.

### Waveforms and Sweep

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-4.

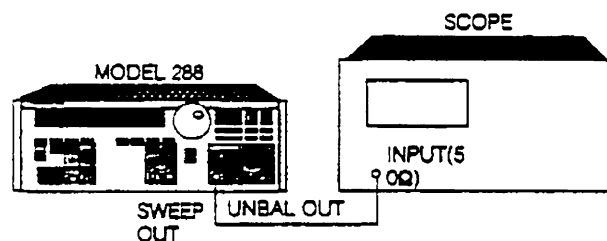


Figure 2-4. Waveforms/Sweep Verification

3. Program the Model 288 through the sine, triangle, square and dc functions while observing them for normal appearance on the scope: yes/no RECORD.
4. Program the Model 288 to start sweeping and observe a normal 100 Hz to 10 kHz, 1 second sweep: yes/no RECORD.
5. Remove the cable at Unbal Out and connect it to Sweep Out and observe the 1 second sweep ramp (600Ω impedance): yes/no RECORD.

### Pulse

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-4. Verify 50Ω source into 50Ω feed-thru termination.
3. Program the Model 288 for 10 MHz square wave and measure rise time, fall time, positive-going transition peak-to-peak aberration in percent and negative-going transition peak-to-peak aberration in percent: RECORD.
4. Disconnect the cable at Unbal Out and connect it to the Sync (trigger) Out. Measure peak-to-peak amplitude, rise time and fall time: RECORD.

### Outputs

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-4.
3. With the Unbal out connected to the scope, program the Model 288 for 50Ω, 75Ω and 600Ω output impedance and verify normal waveform appearance and amplitude into matched feed-thru terminations: yes/no RECORD.
4. Connect the Model 288 and test equipment as shown in figure 2-5.

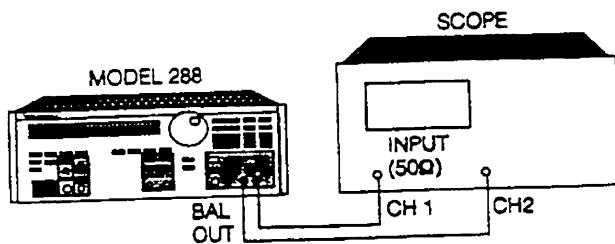


Figure 2-5. Balanced Output Verification

5. Sync the scope internally from channel 1 only, place a 135Ω load resistor across the Bal Out terminals and program the Model 288 for 135Ω balanced output. Observe channel 1 and 2 sine waves 180° out of phase on the scope and each at 1/2 the amplitude of the Unbal Out sine wave of step 3: yes/no RECORD.
6. Change the loading resistor and the Model 288 source impedance to 600Ω. Observe same scope display as in the previous step: yes/no RECORD.

### Amplitude Modulation

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-6.

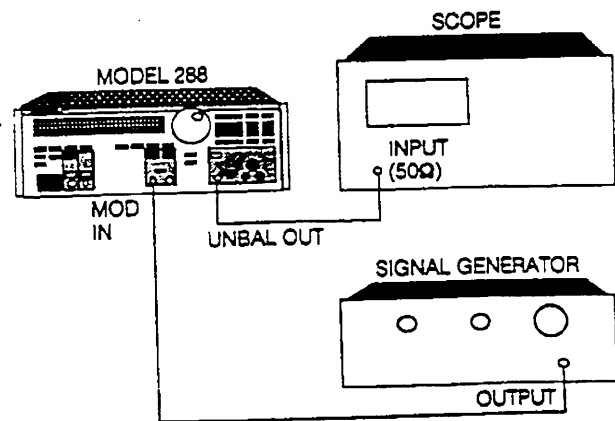


Figure 2-6 AM Verification

3. Program the signal generator for a 1kHz, 2Vp-p open circuit sine wave and the Model 288 for 100 kHz, AM mode. Observe a normal amplitude modulation of approximately 50% on the scope: yes/no RECORD.

### Sine Wave Purity

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-7.

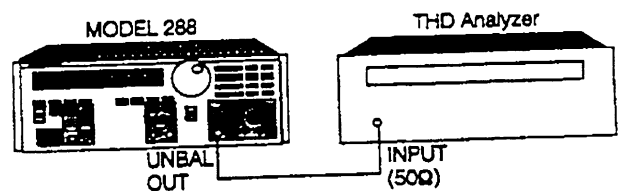


Figure 2-7. Sine Purity Measurement

3. Measure the sine total harmonic distortion in dB: RECORD.

### Amplitude Accuracy

1. Reset the Model 288.
2. Connect the Model 288 and test equipment as shown in figure 2-8.

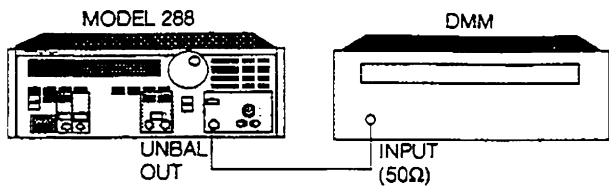


Figure 2-8. Amplitude Accuracy

3. Program the Model 288 sine amplitude to the unattenuated amplitude values per Appendix A - Performance Verification Form. Measure the true rms amplitude at each step: RECORD.
4. Repeat step 3 for the square wave: RECORD.
5. Repeat step 3 for the triangle wave: RECORD.

#### DC Output and Attenuator Accuracy

1. Reset the Model 288
2. Connect the Model 288 and test equipment as shown in figure 2-8.
3. Program the Model 288 dc offset to the attenuated values per Appendix A - Performance Verification Form. Measure the dc voltage at each step: RECORD.

#### External Lock

1. Reset the Model 288
2. Connect the Model 288 and test equipment as shown in figure 2-9.
3. Measure the 1kHz frequency of the Model 288: RECORD.
4. Program the signal source for a 1010 Hz, 5Vp-p sine wave. Program the Model 288 to externally lock and measure the frequency of both the signal generator and the Model 288: RECORD.
5. Program the Model 288 locking phase angle between  $\pm 180^\circ$  per Appendix A - Performance Verification Form. Measure the phase angle at each step: RECORD.

#### Front Panel

Observe the display and annunciators while manually operating the various keys and check for normal appearance and operation: yes/no RECORD.

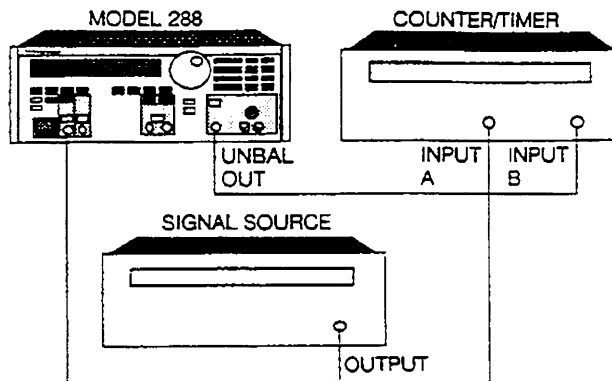


Figure 2-9. Phase Angle Measurement

## 2.4 PREVENTIVE MAINTENANCE

### 2.4.1 General

To be sure that your equipment is always ready for operation, you must perform scheduled preventive maintenance. When you are doing any PM or routine checks, keep in mind the WARNINGS and CAUTIONS about electrical shock and bodily harm.

### 2.4.2 PM Procedures.

No tools or equipment are required for operator preventive maintenance. Cleaning materials required are soap, water, and rags.

PM is limited to routine checks as follows:

- Cleaning
- Dusting
- Wiping
- Checking for frayed cables
- Storing items not in use
- Covering unused receptacles

Perform these routine checks anytime you see they must be done.

# SECTION 3

## OPERATION

### 3.1 USE AND FUNCTION OF EACH CONTROL

Paragraphs 3.1.1 and 3.1.2 describe all of the operator "Controls, Indicators, and Connectors" for the Model 288 signal generator.

#### 3.1.1 Front Panel Controls, Indicators, and Connectors.

Due to the large number of controls and indicators on the front panel, it is necessary to separate the front panel

into five different sections. Figure 3-1 shows the location of each section of the front panel (called views) used in table 3-1.

Table 3-1 shows each section (views A thru E) of the front panel as an enlarged view immediately followed by the description of the controls, indicators, and connectors for that view.

The rear panel (paragraph 3.1.2) is shown in figure 3-2 and described in table 3-2.

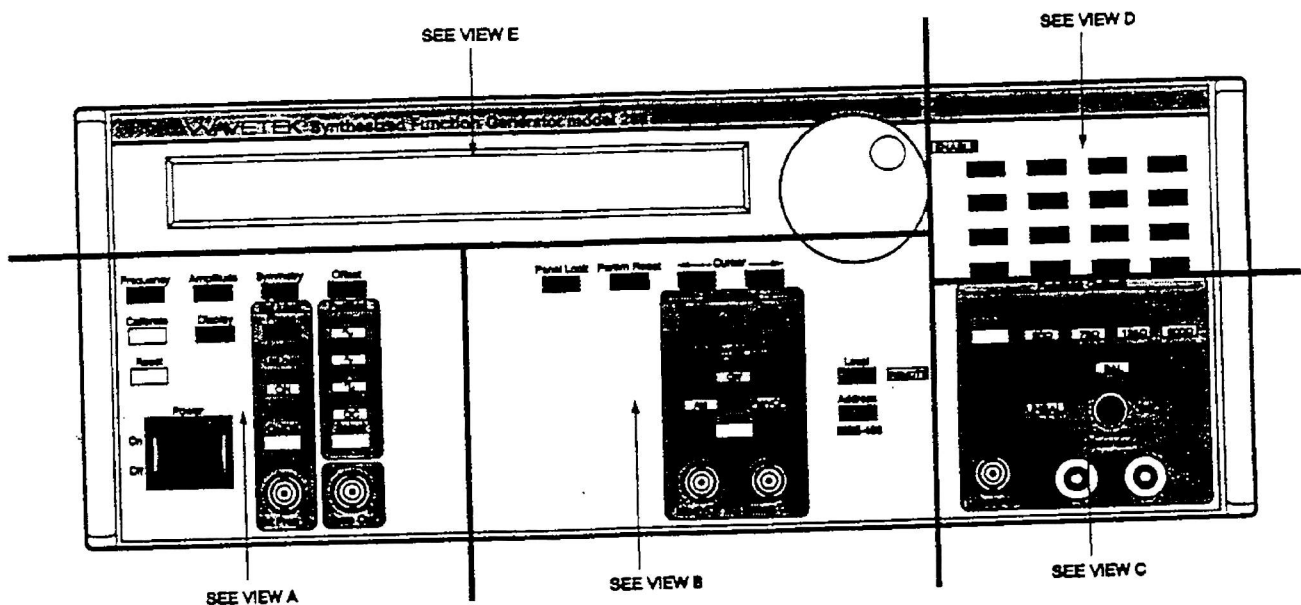
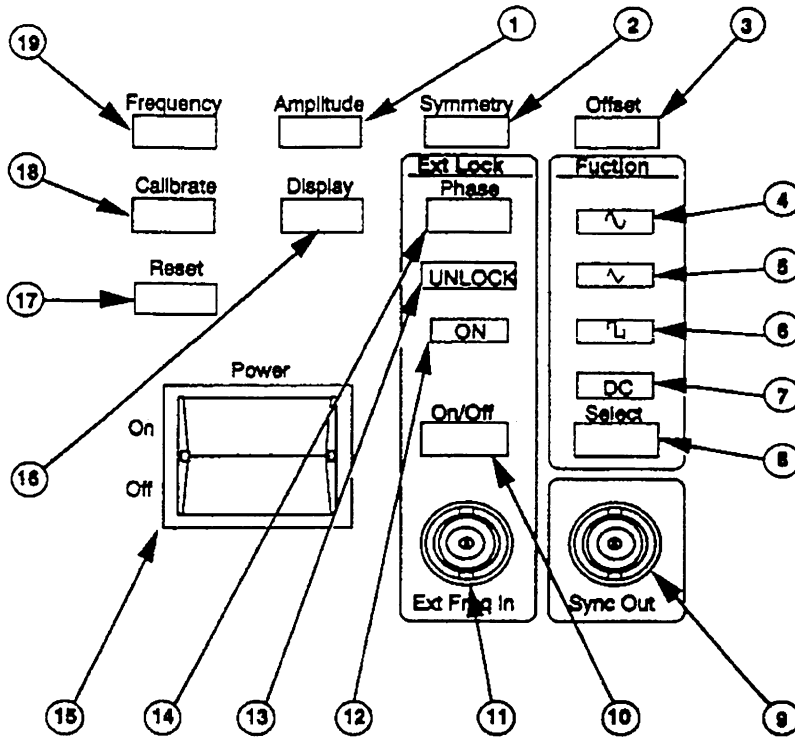


Figure 3-1. Operator's Controls, Indicators and Connectors (front view).

Table 3-1. Front Panel Controls, Indicators, and Connectors

Key	Control, Indicator or Connector	Function
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VIEW A

1	Amplitude key	<p>Used to display and enter output amplitude. Displayed units in Vpp, Vp, Vrms, or dBm. To enter a new value, press key until desired units are displayed. Use Cursor keys and control Knob or Numeric and Enter keys to enter a new value. All units reflect new value. Range is from 0.001 to 15.0 Vpp, 0.0005 to 7.5 Vp, 0.0004 to 5.3 Vrms, and -56.0 dBm to +27.5 dBm. Defaults to 5 Vpp.</p> <p>Restrictions: If the DC Offset is not 0 Vdc or symmetry not 50%, can select only units of Vpp and Vp with decreased range.</p>
2	Symmetry key	<p>Used to display and enter output waveform symmetry from 5% to 95%. Press to display the present value. Use the control Knob or the Numeric and Enter keys to enter a new value in 1% increments. Defaults to 50%.</p> <p>Restrictions: Fixed at 50% when either BAL, FM/VCF, or Sweep is selected. Linearly increases (from 5%) and decreases (from 95%) at frequencies above 2 MHz to 50% at 20 MHz.</p>

Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)

Key	Control, Indicator or Connector	Function
3	Offset key	<p>Used to display and enter DC offset value from +5.000 to -5.000V. In DC function, controls signal output polarity and level. In sine, triangle, and square functions it controls reference level of output waveform. Press to display the present value. Use the Cursor keys and control Knob or the Numeric and Enter keys to enter a new value. Defaults to 0 Vdc.</p> <p><b>Restrictions:</b> Fixed at 0 Vdc when BAL selected. When Sweep, CW, and FM/VCF are selected, range limited at amplitudes <math>\geq 5</math> Vdc. When AM is selected, range limited at amplitudes <math>\geq 2.5</math> Vdc.</p>
4	(Sine) indicator	<p>When ON, indicates that Sine function is active. Provides an operator defined sine waveform from Unbalanced or Balanced output connectors. To activate, press the Function Select key until the indicator lights.</p> <p><b>Restrictions:</b> Locked in when BAL and/or AM selected.</p>
5	(Triangle) indicator	<p>When ON, indicates that Triangle function is active. Provides an operator defined triangle waveform from Unbalanced connector. To activate, press the Function Select key until indicator lights.</p> <p><b>Restrictions:</b> Locked out when BAL and/or AM selected.</p>
6	(Square) indicator	<p>When ON, indicates that Square function is active. Provides an operator defined square waveform from Unbalanced connector. To activate, press the Function Select key until indicator lights.</p> <p><b>Restrictions:</b> Locked out when BAL and/or AM selected.</p>
7	DC indicator	<p>When ON, indicates that DC function is active. Provides an operator defined dc voltage level from Unbalanced connector. To activate, press the Function Select key until indicator lights.</p> <p><b>Restrictions:</b> Locked out when BAL, AM, and/or phase lock ON is selected.</p>
8	Function Select key	<p>Used to select Sine, Triangle, Square, or DC function. Press until the desired indicator lights.</p> <p><b>Restrictions:</b> See Sine, Triangle, Square, and DC indicators.</p>
9	Sync Out connector	<p>BNC female connector with capacity of driving 50<math>\Omega</math>. Provides a 1.0 to 2.5 Vpp TTL pulse at output waveform frequency. Signal is used when synchronizing the signal generator to any external equipment. Signal symmetry is same as square wave. Signal is "in phase" with square wave but leads sine and triangle waveforms by 90°.</p> <p><b>Restrictions:</b> Signal not present in DC function.</p>

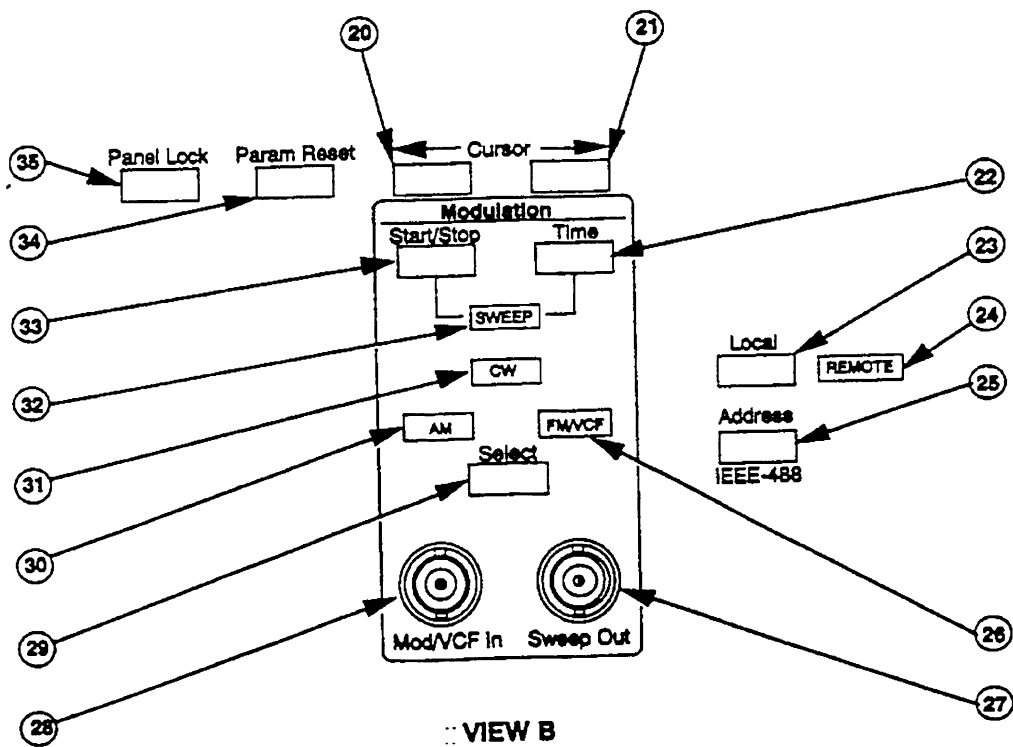
Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)

Key	Control, Indicator or Connector	Function
10	Ext Lock On/Off key	Used to select the external reference frequency signal connected to the Ext Freq In connector. OFF activates internal frequency reference signal. ON deactivates internal frequency reference and an external signal must be used. Press for on (Ext Lock ON indicator on), press for off (Ext Lock ON indicator off).  <b>Restrictions:</b> Locked out when frequency < 20 Hz, and when DC, Sweep, and/or FM/VCF is selected.
11	Ext Freq In connector	BNC female connector with 10k $\Omega$ input impedance accepts 20 Hz to 20 MHz sine wave at from 600 mVrms to 30 Vpp signal. Frequency must be set to Model 288 output frequency $\pm$ 3%. Used to connect an external frequency reference to the Model 288 for increased accuracy and stability.
12	Ext Lock On indicator	When ON, indicates that signal connected to Ext Freq In connector is to be used for reference frequency. Does not indicate signal is present at Ext Freq In connector. See Ext Lock ON/OFF key description for further explanation.
13	UNLOCK indicator	When flashing, indicates a problem with internal or external frequency reference signal, causing the signal generator output frequency to be inaccurate. Normally off. When ON continuously, indicates that current instrument set-up does not allow locking to a frequency reference.
14	Phase key	Used to display and enter the output signal phase. Phase relationship compared to an external signal connected to the Ext Freq In connector. Displayed units are in +/- degrees or in +/- radians. To enter a new value, press the key until desired units are displayed. Use Cursor keys and control Knob or the Numeric and Enter keys to enter a new value. Both units reflect new value. Range from +180° to -180° or +3.14 to -3.14 radians. Defaults to 0°.
15	Power switch	Used to set voltage to Model 288 on or off. ON when button rocked up, OFF when button rocked down.
16	Display key	Used to show and adjust the intensity of the display from 00 to 31. 31 is brightest setting. Press to display the present value. Use control Knob or the Numeric and Enter keys to enter a new value. Defaults to 16.
17	Reset key	Used to set the Model 288 parameters to the default condition (para 2-6). The GPIB address remains unchanged. Press to activate.
18	Calibrate key	Used to perform the Model 288 Self-test and Auto-Calibration. Performs a 20 second functional check and fine tune of certain internal circuits. The display will indicate "CALIBRATING" during the Self-test, and "AUTOCALIBRATED" after a successful Self-test. Press to activate.  <b>Restrictions:</b> Requires 20 minute warm-up each time power is applied.



Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)

Key	Control, Indicator or Connector	Function
19	Frequency key	<p>Used to display and enter output frequency/period. Displayed frequency units in MHz, kHz, Hz, and mHz. Displayed period units in SEC and ms. To enter a new value, press key until desired units are displayed. Use the Cursor keys and control Knob or the Numeric and Enter keys to enter a new value in Hz or SEC. Both units reflect new value. Range is from 0.002 Hz to 20.00 MHz or 500.0 SEC to 0.00005 ms. Defaults to 1.000 kHz.</p> <p><b>Restrictions:</b> Frequencies &gt; 2 MHz are limited when symmetry is not 50%. Frequencies &lt; 20 Hz are locked out when phase lock ON is selected. Frequencies &gt; 1 MHz locked out when BAL, 135Ω, and/or 600Ω is selected. Frequencies &lt; 0.1 Hz locked out when AM selected.</p>



20	← Cursor key	<p>Used to change display setting. Moves selectable digit to left through all possible display combinations. Press key until desired digit flashes, then use the control Knob to change value.</p> <p><b>Restrictions:</b> Not used for Display, Phase, Symmetry, and Address keys.</p>
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**Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)**

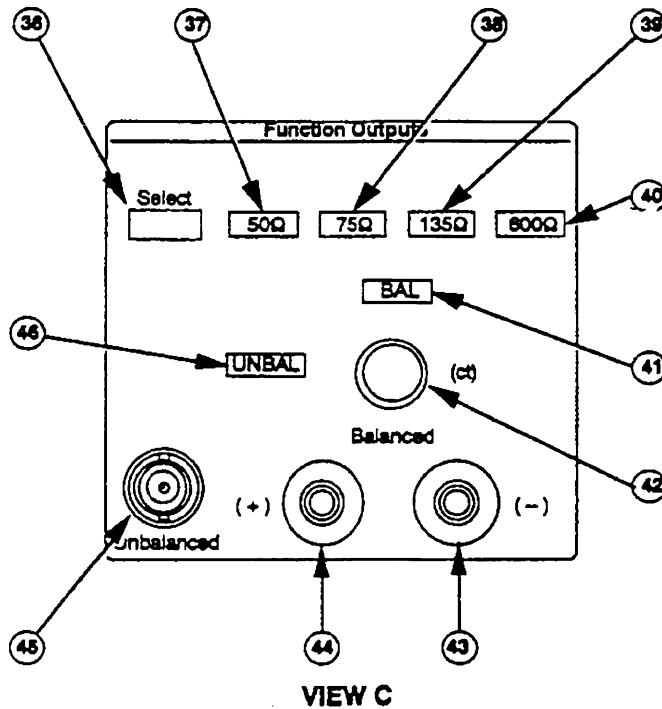
Key	Control, Indicator or Connector	Function
21	Cursor ⇒ key	<p>Used to change display setting. Moves selectable digit to right through all possible display combinations. Press key until desired digit flashes, then use control Knob to change value.</p> <p><b>Restrictions:</b> Not used for Display, Phase, Symmetry, and Address keys.</p>
22	Time key	<p>Used to display and enter the time or rate for one complete sweep. Only used during sweep modulation. Displayed units are in SEC or Hz. To enter a new value, press key until desired units are displayed. Use the Cursor keys and control Knob or the Numeric and Enter keys to enter a new value. Both units reflect new value. Range is from 0.1 to 100 SEC or 10 to 0.01 Hz. Defaults to 1 SEC.</p>
23	Local key	<p>Used to return the Model 288 to front panel control from the remote (GPIB) mode. Front panel displays "GOTO LOCAL". Press to activate.</p> <p><b>Restrictions:</b> Will not select if Local Lockout set by external Controller during remote operation.</p>
24	REMOTE indicator	<p>When ON, indicates that Model 288 is in remote (GPIB) operation using the external Controller. Instrument settings can be queried but not changed.</p>
25	Address key	<p>Used to display and enter IEEE-488 (GPIB) address from 00 to 30. Press to display present value. Use control Knob or the Numeric and Enter keys to enter a new value. Defaults to 09 when (34) is pressed.</p> <p><b>Restrictions:</b> Will not select if Local Lockout is set by an external Controller during remote operation.</p>
26	FM/VCF indicator	<p>When ON, indicates that FM/VCF modulation mode is active. Provides an operator defined frequency modulated waveform from Unbalanced or Balanced output connectors. An external signal source connected to MOD/VCF IN connector is required for FM/VCF operation. External signal amplitude of 0 to 10 Vpp controls deviation. External signal frequency of DC to 100 kHz controls rate. To activate, press Modulation Select key until indicator lights.</p> <p><b>Restrictions:</b> Locked out when symmetry not 50% and/or when Phase Lock ON is selected.</p>
27	Sweep Out connector	<p>BNC female connector with 600Ω output impedance. Provides a 0 to +5V or +5 to 0V linear ramp voltage from start to stop frequency at sweep time selected. Signal is used for sweeping an external signal source.</p> <p><b>Restrictions:</b> Signal only present during sweep modulation mode.</p>
28	Mod/VCF In connector	<p>BNC female connector with 10kΩ input impedance. Used to connect an externally supplied DC to 100 kHz signal for modulation of Unbalanced and Balanced output signals. Maximum signal input is 20 Vpp. Input amplitude controls AM depth and FM/VCF deviation. Input frequency controls AM and FM/VCF modulation rate.</p>

Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)

Key	Control, Indicator or Connector	Function
29	Modulation Select key	<p>Used to select Sweep, CW, AM, or FM/VCF modulation. Press until desired indicator lights.</p> <p><b>Restrictions:</b> See Sweep, CW, AM, or FM/VCF indicators.</p>
30	AM indicator	<p>When ON, indicates that AM modulation mode is active. Provides an operator defined amplitude modulated waveform from Unbalanced or Balanced output connectors. An external signal source connected to MOD/VCF IN connector is required for AM operation. External signal amplitude of 0 to 4 Vpp controls depth. A 4 Vpp provides 100% depth. External signal frequency of DC to 100 kHz controls rate. To activate, press Modulation Select key until indicator lights.</p> <p><b>Restrictions:</b> Locked out when the Triangle, Square, or DC function is selected, frequency is set to &lt; 0.1 Hz, and/or the sum of amplitude (Vpp) and Offset (Vdc) exceeds 7.5.</p>
31	CW indicator	<p>When ON, indicates that CW modulation mode is active. Provides an operator defined continuous waveform from Unbalanced or Balanced output connectors. To activate, press Modulation Select key until indicator lights. Defaults to CW.</p> <p><b>Restrictions:</b> Locked in when Triangle, Square, Ext Lock ON. Amplitude, and/or symmetry selections lock out sweep, AM, and FM/VCF modes.</p>
32	SWEEP indicator	<p>When ON, indicates that sweep modulation mode is active. Provides an operator defined swept waveform from Unbalanced or Balanced output connectors. To activate, press Modulation Select key until indicator lights and "SWEEP RUN" is shown on display.</p> <p><b>Restrictions:</b> Locked out when symmetry not 50%, when Ext Lock ON selected, and/or when the combination of Start/Stop frequencies exceed range limits.</p>
33	Start/Stop key	<p>Used to display and enter the start and stop frequencies for sweep modulation mode. Displayed units in mHz, Hz, kHz, and MHz. Press for start frequency, and again for stop frequency. If Sweep indicator is on, pressing again will cause swept output (display indicates "SWEEP RUN"). To enter a new value, press key until desired parameter is displayed. Use the Cursor keys/control Knob or the Numeric and Enter keys to enter a new value. Range from 2 mHz to 20 MHz. Defaults are 2.0 Hz start and 2 kHz stop.</p> <p><b>Restrictions:</b> If sweep is selected while entering start and stop frequencies, it will automatically change value entered first to provide sweep within acceptable range limits.</p>
34	Param Reset key	<p>Used to reset only parameter currently shown in the display to default value. Does not change non-displayed parameters. Press to activate.</p>

**Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)**

Key	Control, Indicator or Connector	Function
35	Panel Lock key	Used to disable all front panel key selections, except the Power switch. Does not affect signals at output connectors. Press to activate, press again to deactivate. Display indicates "PANEL LOCKED" or "PANEL UNLOCKED" to show status.  <b>Restrictions:</b> If panel is locked when power is set to OFF, it will remain locked when power is set to ON; however, the display will not indicate locked status.



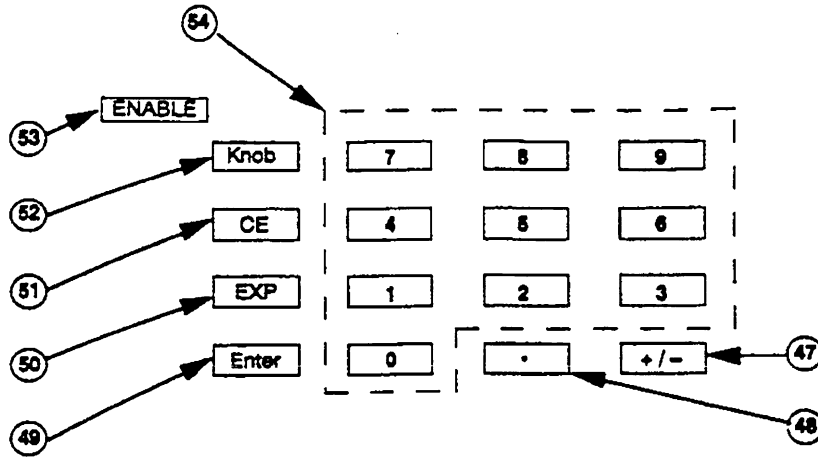
36	Function Outputs Select key	Used to select desired output impedance (50Ω, 75Ω, 135Ω, or 600Ω) and output connector (UNBAL or BAL) combination. Press until desired indicators light.  <b>Restrictions:</b> See 50Ω, 75Ω, 135Ω, 600Ω, UNBAL, or BAL indicators.
37	50Ω indicator	When ON, indicates 50Ω output impedance. Select to match 50Ω load impedance. Provides a signal output with 50Ω impedance at the Unbalanced output connector. To activate, press Function Outputs Select key until 50Ω and UNBAL indicators light. Defaults to 50Ω UNBAL.
38	75Ω indicator	When ON, indicates 75Ω output impedance. Select to match 75Ω load impedance. Provides a signal output with 75Ω impedance at the Unbalanced output connector. To activate, press Function Outputs Select key until 75Ω and UNBAL indicators light.

Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)

Key	Control, Indicator or Connector	Function
39	135Ω indicator	<p>When ON, indicates 135Ω output impedance. Select to match 135Ω load impedance. Provides signal output with 135Ω impedance at the Balanced output connector. To activate, press Function Outputs Select key until 135Ω and BAL indicators light.</p> <p><b>Restrictions:</b> Locked out for frequencies greater than 1 MHz. See BAL indicator for further restrictions.</p>
40	600Ω indicator	<p>When ON, indicates 600Ω output impedance. Select to match 600Ω load impedance. Provides signal output with 600Ω impedance at the Unbalanced or Balanced output connectors. To activate, press Function Outputs Select key until 600Ω and BAL, or 600Ω and UNBAL indicators light.</p> <p><b>Restrictions:</b> Locked out for frequencies greater than 1 MHz. See BAL indicator for further restrictions.</p>
41	BAL indicator	<p>When ON, indicates that Balanced output connectors are providing an operator defined balanced output signal. Impedance is selectable for 135Ω or 600Ω. To activate, press Function Outputs Select key until 135Ω and BAL, or 600Ω and BAL indicators light.</p> <p><b>Restrictions:</b> Locked out for frequencies greater than 1 MHz, for Triangle, Square, or DC functions, for Offset other than 0 Vdc, and/or symmetry other than 50%.</p>
42	Balanced (ct) terminal	<p>Captive screw binding post used as neutral center tap with Balanced (-) and Balanced (+) jacks.</p>
43	Balanced (-) jack	<p>Female banana jack with 135Ω or 600Ω output impedance. Provides a balanced output from 2 mHz to 1 MHz when used as negative signal lead with Balanced (+) jacks. Selected when BAL indicator on.</p>
44	Balanced (+) jack	<p>Female banana jack with 135Ω or 600Ω output impedance. Provides a balanced output from 2 mHz to 1 MHz when used as positive signal lead with Balanced (-) jacks. Selected when BAL indicator on.</p>
45	Unbalanced connector	<p>BNC female connector with 50Ω, 75Ω, or 600Ω output impedance. Provides an unbalanced output from 2 mHz to 20 MHz (2 mHz to 1 MHz for 600Ω). Selected when UNBAL indicator on.</p>
46	UNBAL indicator	<p>When on, indicates Unbalanced output connector is providing an operator defined unbalanced output signal. Impedance is selectable from 50Ω, 75Ω, or 600Ω. To activate, press Function Outputs Select key until 50Ω and UNBAL, 75Ω and UNBAL, or 600Ω and UNBAL indicators light. Defaults to 50Ω UNBAL.</p> <p><b>Restrictions:</b> 600Ω UNBAL locked out for frequencies greater than 1 MHz.</p>

Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)

Key	Control, Indicator or Connector	Function
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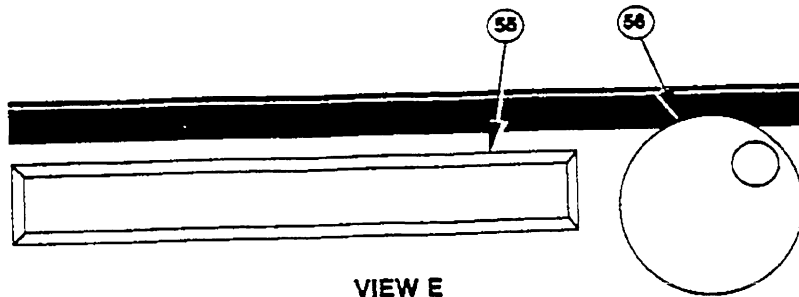


VIEW D

47	+/- key	Used to enter a positive or negative sign for numeric data entry. Used for standard and exponent entry. Blank indicates positive, - indicates negative. Press to change sign.
48	. (DECIMAL) key	Used to enter a decimal point for numeric data entry.
49	Enter key	Used to terminate entries from the Numeric keypad. Pressing after numeric data entry transfers the display contents to MODEL 288 internal circuits. All values entered not within specifications are disregarded. Values exceeding resolution are rounded or entered to nearest allowable value.
50	EXP key	Used to enter an exponent digit. To enter an exponent, use Numeric keypad to enter prefix, press EXP key, then exponent value using Numeric key 0 to 9. Exponent can be entered as a negative by pressing +/- key.
51	CE key	Used to clear a numeric entry error when using the Numeric keys. Unwanted data must be cleared before pressing Enter key. Press once to clear display of numeric entry.
52	Control Knob key	Used to enable or disable the control Knob. When ON, selecting appropriate parameter key activates control Knob (ENABLE indicator ON). When OFF, control Knob is deactivated (ENABLE indicator remains OFF). Press for ON, press again for OFF. Defaults to ON.
53	ENABLE indicator	When ON, indicates that control Knob will change value in the display. Press the Knob key to activate.  Restrictions: ENABLE indicator will light only when selecting a parameter that can use the control Knob as input.

Table 3-1. Front Panel Controls, Indicators, and Connectors (Continued)

Key	Control, Indicator or Connector	Function
54	NUMERIC keypad (0 — 9)	Used to enter a 0, 1, 2, 3, 4, 5, 6, 7, 8, or 9 for numeric data entry. Used with +/-, DECIMAL, Enter, EXP, and CE keys to enter data. Press desired digit.



55	DISPLAY	Indicates all output signal information, entry information, operator messages, and error codes. Variable brightness 16-digit alphanumeric display with decimal point and minus sign.
56	Control KNOB	Used to change numeric value of flashing digit as selected by Cursor keys. CW rotation increases value, CCW rotation decreases value. Active when ENABLE indicator is ON.

### 3.1.2 Rear Panel Controls, Indicators, and Connectors.

This paragraph provides information on the location, description, and use of the rear panel controls, indica-

tors, and connectors. Refer to figure 3-2 for the location of the rear panel controls, indicators, and connectors. Table 3-2 provides the description and use of the rear panel controls, indicators, and connectors.

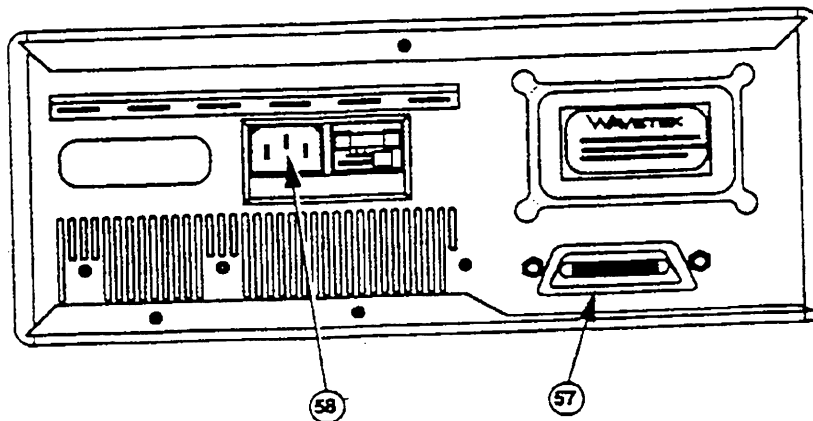


Figure 3-2. Operator's Controls, Indicators, and Connectors (rear view).

Table 3-2. Rear Panel Controls, Indicators, and Connectors

Key	Control, Indicator, or Connector	Function
57	GPIB connector	Used to connect an external Controller to Model 288 during remote operation. Connector has 24 pins and threaded posts conforming to IEEE-488 1978.
58	INPUT POWER connector	Used as ac power input connector for Model 288. Also contains the line fuse and voltage selection facilities. Voltage selection is from 100/120/220/240 Vac. Number visible in window indicates nominal line voltage for which the Model 288 is set to operate. Power input connector accepts female end of power cable (supplied). Protective grounding conductor connects the Model 288 through this connector. Line power fuse is 0.75 amp, 250V for 100/120 Vac and 0.375 amp, 250V for 220/240 Vac operation.

### 3.2 NORMAL OPERATION

This section provides the information required to set up and operate the Model 288 signal generator. Operation of the signal generator is divided into sections: continuous wave, sweep modulation, amplitude modulation, frequency modulation, voltage controlled frequency, and GPIB operation.

Operation of signal generator is provided in paragraphs 3.2.2 thru 3.2.7. Refer to tables 3-1 and 3-2 for use and description of the front and rear panel controls, connectors, and indicators. Table 2-2 lists all operator errors along with the probable cause.

#### 3.2.1 Start Up

Refer to section 2, paragraph 2.3.3, for turn-on procedures.

#### 3.2.2 Continuous Wave (CW)

Perform the following steps (using figure 3-3) to provide a continuous wave output signal from 2 MHz to 20 MHz at from 1 mVpp to 15 Vpp.

1. Press the Reset key (15). Verify that CW indicator (13) is on.
2. Select desired output waveform (sine, triangle, square, or dc) using the Function Select key (14).
3. Press the following keys and then enter desired value. Use the Cursor keys (6) and control Knob (7), or the Numeric keypad (9) and Enter key (8). Entry will appear in the display (5).

- Press the Frequency key (1) and enter desired output frequency (Hz) or period (SEC).
  - Press the Amplitude key (2) and enter desired output amplitude in Vpp, Vp, Vrms, or dBm.
  - Press the Symmetry key (3) and enter desired output waveform symmetry in percent.
  - Press the Offset key (4). If Sine, Triangle, or Square is selected (14), enter desired output waveform reference level in volts dc. If dc is selected (14), enter desired dc output level in volts dc.
4. Select desired output impedance (50Ω, 75Ω, 135Ω, or 600Ω) and connector (BAL or UNBAL) using Function Outputs Select key (12) to match load termination.

#### NOTE

- *When connecting the Model 288 output connector to a load, use a cable with the correct impedance for the output selected.*
  - *Balanced ct connector is internally connected to the shield of all the other Model 288 BNC connectors. When connecting to external equipment, whose connector shields are at chassis ground, a ground loop will be formed that will adversely affect the Balanced output signal.*
5. Connect the selected output Balanced (10) or Unbalanced (11) connector to load.



### 3.2.3 Sweep Modulation

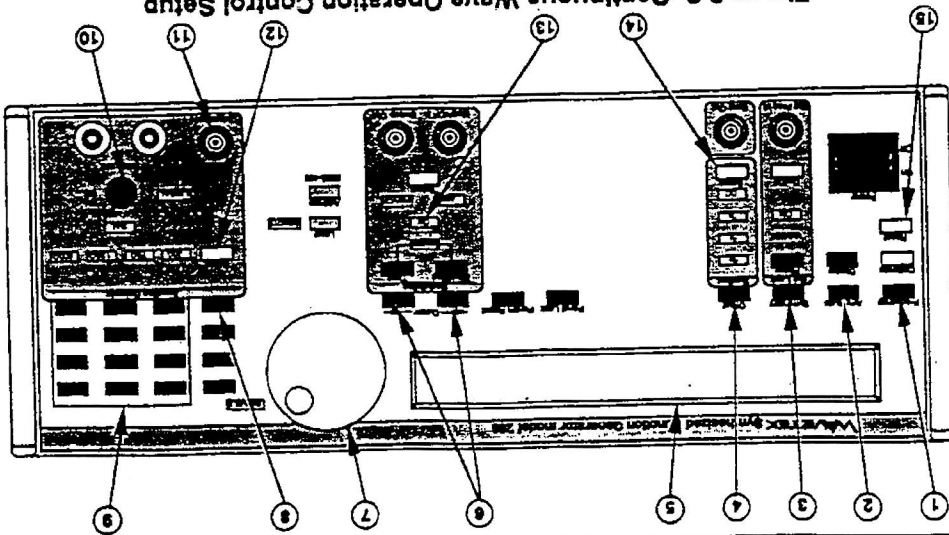
Perform the following steps (using figure 3-4) to provide a swept output signal from 0.002 Hz to 20 MHz at 1 mVpp to 15 Vpp with sweep rate from 0.1 to 100 seconds.

1. Press the Reset key (16). Select Sweep indicator (13) using the Modulation Select key (12).
2. Select the desired output waveform (Sine, Triangle, Square, or DC) using Function Select key (15).
3. Press the following keys and then enter desired value. Use the Cursor keys (4) and control knob (5), or the Numeric keypad (7) and Enter key (6). Entry will appear in the display (3).
  - Press the Time key (11) and enter the desired sweep time in SEC or HZ.
  - Press Start/Stop key (14) until "START X HZ" is displayed and enter desired sweep start frequency in HZ.
  - Press the Start/Stop key (14) until "STOP X KHZ" is displayed and enter the desired sweep stop frequency in HZ.

#### NOTE

- If the entered start and/or stop frequency exceeds the Model 288 sweep limits, one parameter will be adjusted. Press the Start/Stop key (14) as required to verify entered frequencies.
- Press the Amplitude key (1) and enter desired sweep output amplitude in Vpp, Vp, Vrms, or dbm.

Figure 3-3. Continuous Wave Operation Control Setup



Press the Offset key (2). If Sine, Triangle, or Square selected (15), enter desired swept output waveform reference level in volts dc. If dc selected (15), enter desired dc output level in volts dc.

4. Select the desired output impedance (50Ω, 75Ω, 135Ω, or 600Ω) and connector (BAL or UNBAL) using Function Outputs Select key (10) to match load termination.

#### NOTE

- When connecting the Model 288 output connector to the load, use cable with correct impedance for the output selected.

- Balanced ct connector is internally connected to the shield of all the other Model 288 BNC connectors. When connecting to external equipment, whose connector shields are at chassis ground, a ground loop will be formed that will adversely affect the Balanced output signal.

5. Press Start/Stop key (14) until "SWEEP RUN" is displayed.
6. Connect the selected output Balanced (8) or Unbalanced (9) connector to load.

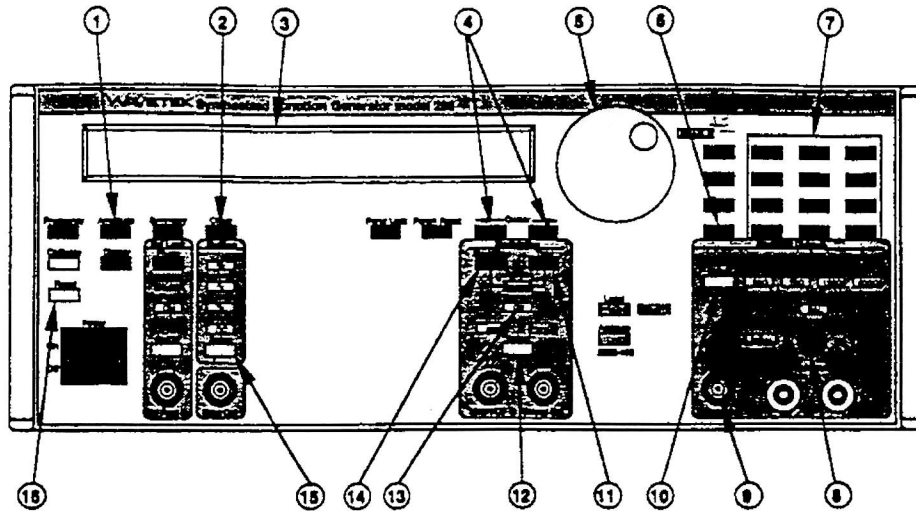


Figure 3-4. Sweep Modulation Operation Control Setup

### 3.2.4 Amplitude Modulation (AM)

Perform the following steps (using figure 3-5) to provide an amplitude modulated output signal from 0.1 Hz to 20 MHz at 1 mVpp to 7.5 Vpp with modulation rate from DC to 100 kHz and modulation depth from 0 to 100%.

1. Press the Reset key (16). Select AM indicator (15) using the Modulation Select key (13).
2. Press the following keys and then enter desired value. Use the Cursor keys (6) and control Knob (7), or the Numeric keypad (9) and Enter key (8). Entry will appear in the display (5).
  - Press the Frequency key (1) and enter desired output carrier frequency (Hz) or period (SEC).
  - Press the Amplitude key (2) and enter desired output carrier amplitude in Vpp, Vp, Vrms, or dBm.
  - Press the Symmetry key (3) and enter desired output carrier waveform symmetry in percent.
  - Press the Offset key (4) and enter desired output carrier waveform reference level in volts DC.
3. Connect the external signal source sine wave to the MOD/VCF IN connector (14).
4. Set the external signal source to desired frequency from DC to 100 kHz. This is the rate at which the Model 288 will modulate the output signal.

5. Set the external signal source to desired amplitude from 0 to 4 Vpp. This is the depth at which the Model 288 will modulate the output signal. Modulation depth is directly proportional to the input signal amplitude.

Example: A 4 Vpp input provides 100% depth, 2 Vpp input provides 50% depth, etc.

6. Select the desired output impedance (50Ω, 75Ω, 135Ω, or 600Ω) and connector (BAL or UNBAL) using Function Outputs Select key (12) to match load termination.

#### NOTE

- When connecting Signal Generator output connector to the load, use cable with correct impedance for the output selected.
  - Balanced output connector is internally connected to the shield of all the other Model 288 BNC connectors. When connecting to external equipment, whose connector shields are at chassis ground, a ground loop will be formed that will adversely affect the Balanced output signal.
7. Connect selected output Balanced (10) or Unbalanced (11) connector to load.

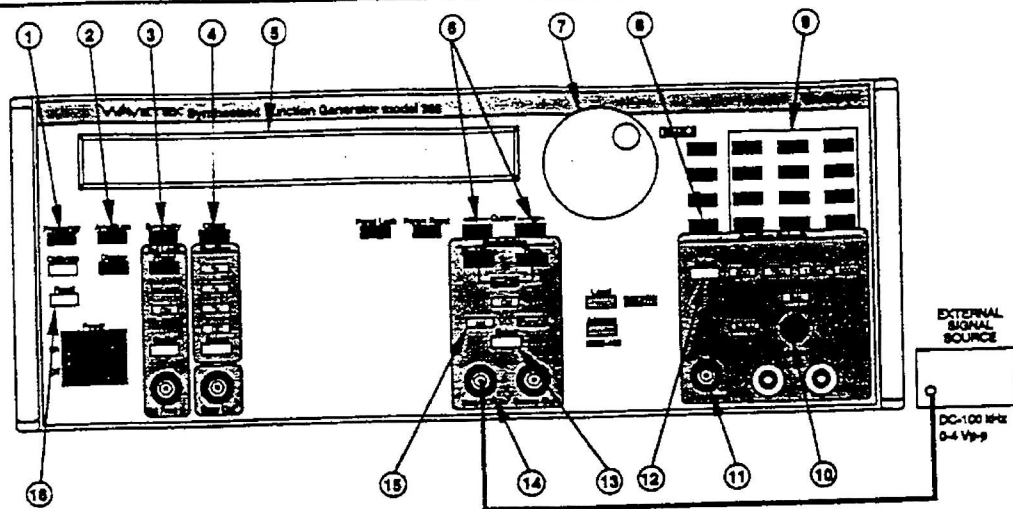


Figure 3-5. Amplitude Modulation Operation Control Setup

### 3.2.5 Frequency Modulation (FM)

Perform the following steps (using figure 3-6) to provide a frequency modulated output signal from 0.002 Hz to 20 MHz at 1 mVpp to 15 Vpp with modulation rate from DC to 100 kHz and deviation as specified below.

1. Press Reset key (17). Verify CW indicator (15) is on.
2. Calculate and record upper and lower modulation limit frequencies required as follows:

$$\text{UPPER LIMIT} = \text{CTRF} + \text{PEAK DEVIATION}$$

$$\text{LOWER LIMIT} = \text{CTRF} - \text{PEAK DEVIATION}$$

where: UPPER LIMIT is upper modulation limit required  
 LOWER LIMIT is lower modulation limit required  
 CTRF is desired center frequency  
 PEAK DEVIATION is desired positive OR negative deviation

Example: Desired Center Frequency = 200 kHz  
 Peak Deviation =  $\pm 25$  kHz

$$\text{Upper Limit} = 200 \text{ kHz} + 25 \text{ kHz} = 225 \text{ kHz}$$

$$\text{Lower Limit} = 200 \text{ kHz} - 25 \text{ kHz} = 175 \text{ kHz}$$

3. Using table 3-3, find and record the range number that contains the calculated upper limit (step 2). Verify calculated lower limit (step 2) is within limits of table for range selected.

Example: Upper limit of 225 kHz is range number 8.  
 Calculated lower limit within range (range 8 lower limit 2.0 kHz and calculated lower limit 175 kHz).

#### CAUTION

Exceeding lower limit will cause output signal distortion.

4. Calculate and record the external source amplitude (Vpp) as follows:

$$\text{OUT AMP} = \text{P-P DEVIATION} + \text{DEVIATION PER V}$$

where: OUT AMP is external source amplitude (Vpp)  
 P-P DEVIATION is desired positive AND negative deviation  
 DEVIATION PER V from table above using range number recorded in step 3

Example: P-P Deviation = 50 kHz (+ and - 25 kHz)  
 Deviation per volt = 200 kHz (from table, range 8)  
 Output Amplitude = 50 kHz + 200 kHz = 0.25 Vpp

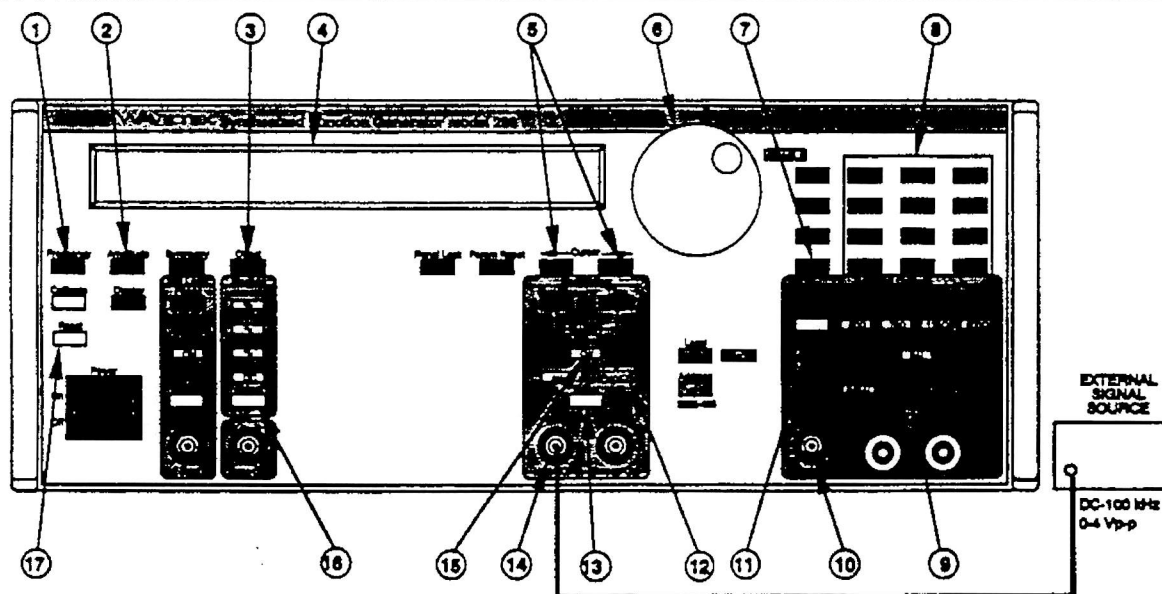
5. Press the Frequency key (1) and enter calculated upper limit frequency (step 2) in Hz. Use either Cursor keys (5) and control Knob (6), or the Numeric keypad (8) and Enter key (7). Entry will appear in the display (4).

6. Select FM/VCF indicator (12) using the Modulation Select key (13).
7. Select the desired output waveform (Sine, Triangle, Square, or DC) using function Select key (16).
8. Press the following keys and then enter desired value. Use either Cursor keys (5) and control Knob (6), or the Numeric keypad (8) and Enter key (7). Entry will appear in the display (4).
  - Press the Frequency key (1) and enter center frequency used in calculation (step 2) in Hz.
  - Press the Amplitude key (2) and enter desired output carrier amplitude in Vpp, Vp, Vrms, or dBm.
  - Press the Offset key (3). If Sine, Triangle, or Square selected (16), enter desired output carrier waveform reference level in volts dc. If dc selected (16), enter desired dc output level in volts DC.
9. Connect the external signal source sine wave to MOD/VCF IN connector (14).
10. Set the external signal source to desired frequency from DC to 100 kHz. This is the rate at which the Model 288 will modulate the output signal.
11. Set the external signal source to calculated amplitude (step 4) from 0 to 10Vpp. This is the deviation at which the Model 288 will modulate the output signal.
12. Select desired output impedance (50Ω, 75Ω, 135Ω, or 600Ω) and connector (BAL, or UNBAL) using Function Outputs Select key (11) to match load termination.

**NOTE**

- When connecting Signal Generator output connector to the load, use cable with correct impedance for the output selected.
- Balanced output connector is internally connected to the shield of all the other Model 288 BNC connectors. When connecting to external equipment, whose connector shields are at chassis ground, a ground loop will be formed that will adversely affect the Balanced output signal.

13. Connect selected output Balanced (9) or Unbalanced (10) connector to load.



**Figure 3-6. Frequency Modulation Operation Control Setup**

**Table 3-3. Frequency Modulation Range Information.**

Range Number	Modulation Upper Limit Range	Modulation Lower Limit	Deviation per Volt
0	20 mHz to 2 mHz	2 mHz	2 mHz
1	200 mHz to 20.1 mHz	2 mHz	20 mHz
2	2 Hz to 201 mHz	2 mHz	200 mHz
3	20 Hz to 2.01 Hz	20 mHz	2 Hz
4	200 Hz to 20.1 Hz	200 mHz	20 Hz
5	2 kHz to 201 Hz	2 Hz	200 Hz
6	20 kHz to 2.01 kHz	20 Hz	2 kHz
7	200 kHz to 20.1 kHz	200 Hz	20 kHz
8	2.0 MHz to 201 kHz	2.0 kHz	200 kHz
9	20 MHz to 2.01 MHz	20 kHz	2 MHz

**3.2.6 Voltage Controlled Frequency (VCF)**

Perform the following steps (using figure 3-7) to provide a voltage controlled frequency output signal from 0.002 Hz to 20 MHz at 1 mVpp to 15 Vpp.

1. Press Reset key (17). Verify CW indicator (15) is on.
2. Calculate and record upper and lower frequency limits required as follows:

$$\text{UPPER LIMIT} = \text{INT} + \text{FREQ CHG}$$

$$\text{LOWER LIMIT} = \text{INT} - \text{FREQ CHG}$$

where: UPPER LIMIT is upper frequency limit required  
 LOWER LIMIT is lower frequency limit required  
 INT is desired initial frequency  
 FREQ CHG is desired positive or negative frequency change

Example: Desired Initial Frequency = 200kHz, Frequency Change = (+25kHz) and (-10 kHz)

$$\text{Upper Limit} = 200 \text{ kHz} + 25 \text{ kHz} = 225 \text{ kHz}$$

$$\text{Lower Limit} = 200 \text{ kHz} - 10 \text{ kHz} = 190 \text{ kHz}$$

3. Using table 3-4, find and record the range number that contains the calculated upper limit (step 2). Verify calculated lower limit (step 2) is within limits of table for range selected.

Example: Upper limit of 225 kHz is range number 8. Calculated lower limit within range (range 8 lower limit 2.0 kHz and calculated lower limit 190 kHz).

**NOTE**

*Exceeding lower limit will cause output signal distortion.*

4. Calculate and record the external DC source level (Vdc) as follows:

$$\text{OUT VOLT} = \text{FREQ CHG} + \text{CHG PER V}$$

where: OUT VOLT is external source voltage (+ or - Vdc)  
 FREQ CHG is desired positive or negative frequency change  
 CHG PER V from table above using range number recorded in step 3.

Example: Frequency Change = + 25 kHz and - 10 kHz  
 Change per volt = 200 kHz (from table, range 8)

$$\text{Output Voltage} = + 25 \text{ kHz} + 200 \text{ kHz} = + 0.125\text{V}$$

and

$$\text{Output Voltage} = - 10 \text{ kHz} + 200 \text{ kHz} = - 0.05\text{V}.$$

5. Press the Frequency key (1) and enter calculated upper limit frequency (step 2) in Hz. Use either Cursor keys (5) and control Knob (6), or the Numeric keypad (8) and Enter key (7). Entry will appear in the display (4).
6. Select FM/VCF indicator (12) using Modulation Select key (13).
7. Select desired output waveform (Sine, Triangle, Square, or DC) using function Select key (16).

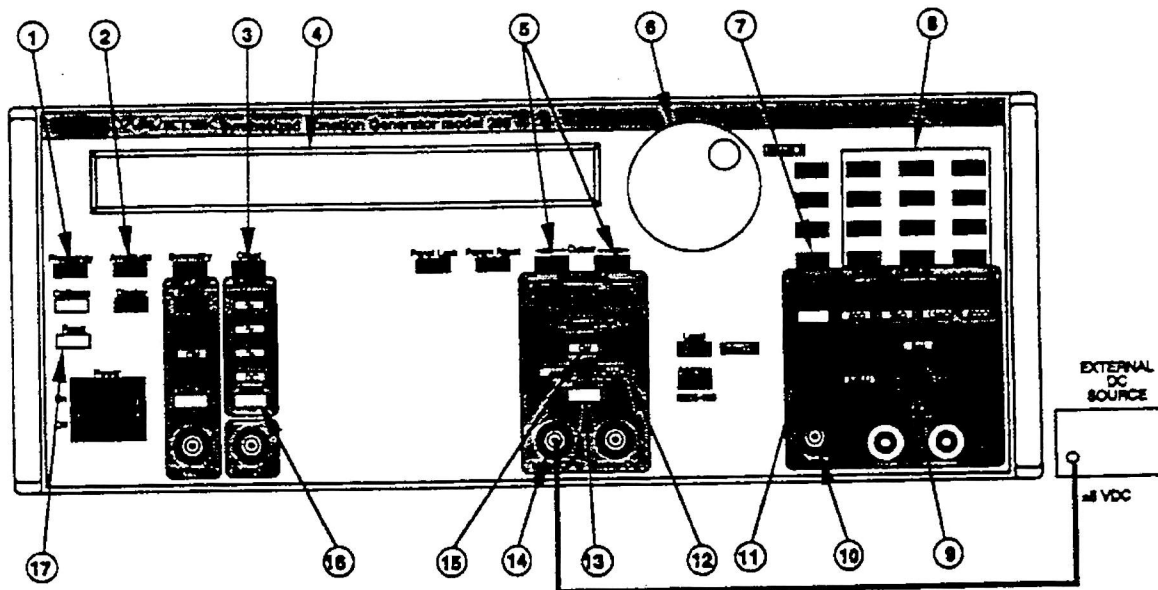
8. Press the following keys and then enter desired value. Use the Cursor keys (5) and control Knob (6), or the Numeric keypad (8) and Enter key (7). Entry will appear in the display (4).
  - Press Frequency key (1) and enter initial frequency used in calculation (step 2) in Hz.
  - Press Amplitude key (2) and enter desired output amplitude in Vpp, Vp, Vrms, or dBm.
  - Press Offset key (3). If Sine, Triangle, or Square selected (16), enter desired output waveform reference level in volts dc. If dc selected (16), enter desired dc output level in volts DC.
9. Connect the external DC source DC level to MOD/VCF IN connector (14).
10. Set the dc signal source to the calculated level (step 4) from -5 to +5V.
11. Select desired output impedance (50Ω, 75Ω, 135Ω, or 600Ω) and connector (BAL/UNBAL) using

Function Outputs Select key (11) to match load termination.

**NOTE**

- When connecting the Model 288 output connector to the load, use cable with correct impedance for the output selected.
- Balanced ct connector is internally connected to the shield of all the other Model 288 BNC connectors. When connecting to external equipment, whose connector shields are at chassis ground, a ground loop will be formed that will adversely affect the Balanced output signal.

12. Connect selected output Balanced (9) or Unbalanced (10) connector to load.



**Figure 3-7. VCF Operation Control Setup**

Table 3-4. Voltage Controlled Frequency Range Information.

Range Number	Upper Limit Range	Lower Limit	Change per Volt
0	20 mHz to 2 mHz	2 mHz	2 mHz
1	200 mHz to 20.1 mHz	2 mHz	20 mHz
2	2 Hz to 201 mHz	2 mHz	200 mHz
3	20 Hz to 2.01 Hz	20 mHz	2 Hz
4	200 Hz to 20.1 Hz	200 mHz	20 Hz
5	2 kHz to 201 Hz	2 Hz	200 Hz
6	20 kHz to 2.01 kHz	20 Hz	2 kHz
7	200 kHz to 20.1 kHz	200 Hz	20 kHz
8	2.0 MHz to 201 kHz	2.0 kHz	200 kHz
9	20 MHz to 2.01 MHz	20 kHz	2 MHz

### 3.2.7 GPIB (Remote) Operation

The following paragraphs describe the Model 288 remote operation (GPIB) procedures using an external controller. GPIB Digital Interface conforms to IEEE 488 1978 subsets SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, CO, and E1.

Remote operation of the Model 288 is very similar to local operation, except that the commands are entered

and received using an external Controller, and not by pressing keys and observing the display and indicators on the front panel. The GPIB connector permits remote control of all functions except Power switch, Local key, and Address key. Refer as necessary to Section 2 for descriptions of controls, indicators, and connectors, and individual operating procedures (paragraphs 3.2.2 thru 3.2.7). GPIB connector wiring data is shown in figure 3-8.

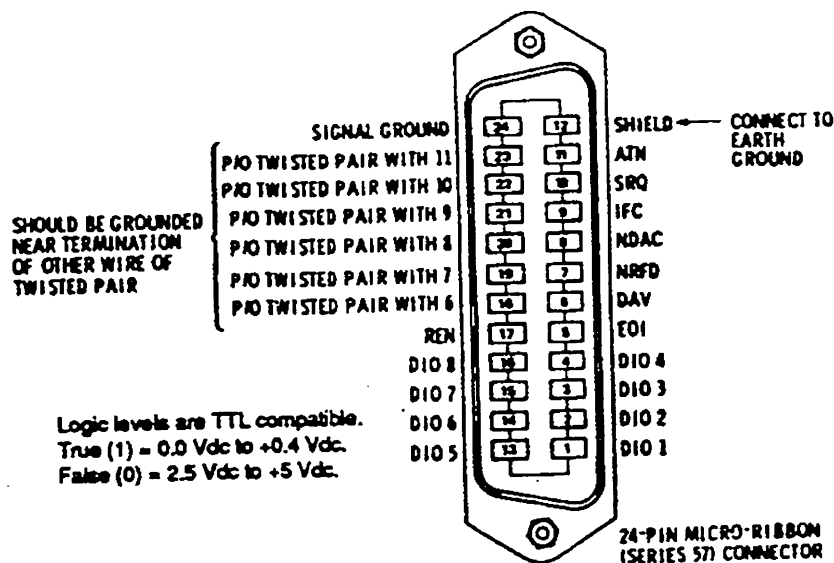


Figure 3-8. GPIB Wiring Connector Pin Out

Perform the following steps (using figure 3-9) for remote operation of the Model 288 signal generator.

1. Connect the equipment as shown below.

NOTE

*Keep GPIB interconnect cable length below 2 meters (6.6 feet)*

2. Perform Model 288 turn-on procedure (refer to paragraph 2.2.3).
3. On Signal Generator front panel:
  - Press the Local key (8), verify that the display (1) indicates "GOTOLocal", and that the REMOTE indicator (6) is out.
  - Press the Address key (7) and enter desired address from 00 to 30. Use the control Knob (3), or the Numeric keypad (5) and Enter key (4). Entry will appear in the display (1). Default address is 09.
4. Operator commands are programmed using an external Controller and GPIB commands listed in table 3-6.

### 3.3 GPIB COMMAND STRUCTURE

#### 3.3.1 Introduction

This paragraph tells how to control the Model 288 remotely over the GPIB bus and is divided into the following topics:

- Model 288 Commands.
- Universal and Addressed Commands.
- Detailed Command Descriptions.
- Service Requests.
- Displaying Messages.
- GPIB Keys.

#### 3.3.2 Model 288 Commands

The following is a discussion of the Model 288 commands and the rules that must be followed to apply them.

- Commands Types
- Command Syntax
- Command List

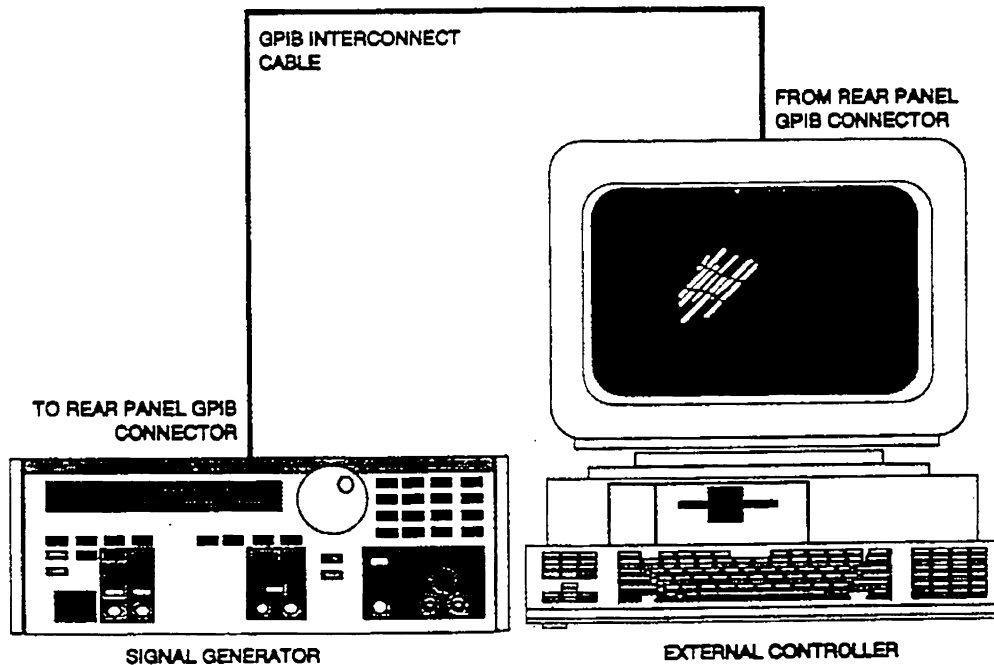


Figure 3-9. GPIB Interconnect Wiring



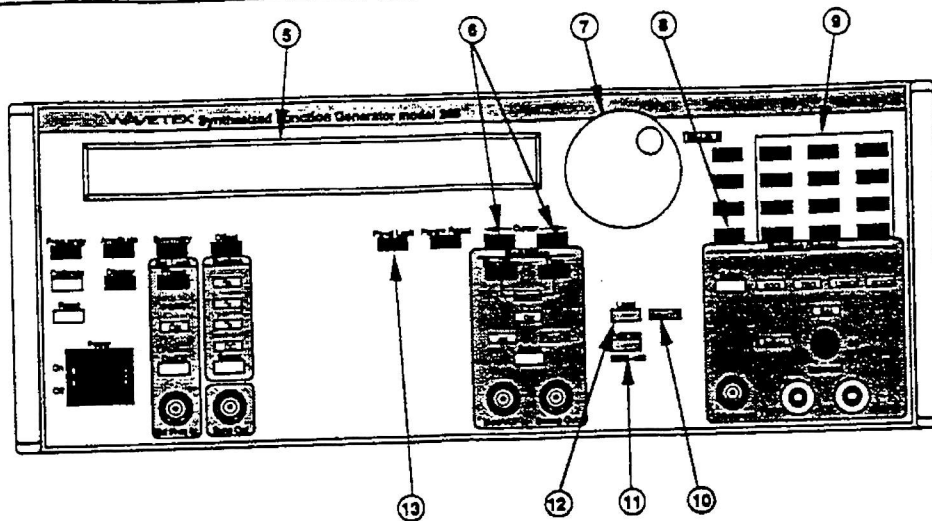


Figure 3-10. GPIB Operation Control Setup

### 3.3.2.1 Command Types

The Model 288 has four types of commands: parameter, enumerated, direct, and query.

The following text discusses each type of command separately. The examples terminate the commands with semicolons (;) or closing quotes ("). The controller may send just the command name without a value and the 288 will display that parameter's current value. Replacing the numerical value with a "?" (query) will make the Model 288 display and send the current value to the controller as a string of characters. Do not send an Execute command after a query command, the string will not be sent because the Execute command has put the Model 288 in a "listen for more commands" mode. See "terminators" for more information.

#### Parameter Commands

Parameter commands specify a particular numerical value within a continuous range of values. The values should use exponential (E) notation.

Format: <header>SPACE<value>TERMINATION

The header specifies the parameter and the value specifies the numerical value. Table 3-6 lists the parameter commands and their allowable value ranges.

Example:

<b>FREQUENCY 2E3;</b>	Sets the frequency at 2 kHz
<b>PHASE 87;</b>	Sets the phase at 87°
<b>SWEEPTIME 2.3;</b>	Sets the second sweep time at 2.3

#### Enumerated Commands

Enumerated commands provide a list of distinct choices. Either the name or numerical value can be used (AM may be sent by sending either "MA;E" or "M1;E").

Format: <header>SPACE<argument>TERMINATION

The header specifies the parameter and the argument specifies the choice. A number or a descriptive character string can be used for the argument. Table 3-6 lists the enumerated commands and their arguments.

Example:

<b>FUNC 2 or</b>	Selects the square
<b>FUNC SQUARE</b>	output function.

#### Direct Commands

Direct commands make the Model 288 perform an immediate action.

Format: <header>TERMINATION

The header specifies the action. Direct commands have no value or argument. Table 3-6 lists all the direct commands.

Examples:

<b>RESET;</b>	Resets 288 parameters
<b>TRIGGER;</b>	Triggers waveform or sweep
<b>EXECUTE;</b>	Executes preceding commands in string.

## Query Commands

Query commands tell the Model 288 to send information to the controller.

The Model 288 will not send the information when it receives the command, but will wait until the controller subsequently addresses it as a talker. Query commands can be sent only one at a time. If two or more are sent in a query string, the Model 288 will respond only to the last one.

Format: <header> <?>TERMINATION

The header specifies the type of information. Because all parameter command headers (and most enumerated command headers) can also serve as query headers, the question mark tells the Model 288 to send (rather than receive) the information. Certain other headers appear only in query commands. See Query Commands in paragraph 3.3.2.2, 288 Command Syntax for a sample query program.

### Parameter Header Examples:

FREQUENCY? "	Returns current frequency.
PHASE? "	Returns current phase.

### Enumerated Header Examples:

FUNCTION? "	Returns current output waveform.
OUTPUT ? "	Returns current output setting.

### Query Header Examples:

MAINPARAMETERS? "	Returns current output waveform.
SRQ? "	Returns current output setting.
STATUSBYTE? "	Returns status byte.

## 3.3.2.2 288 Command Syntax

Commands sent by an instrument controller to the Model 288 must follow the syntax given in table 3-5. The following text discusses command operation, command processing, semicolons, minimum uniqueness, and ? commands.

### Command String Operation

The command string at the top of the table (written to run on a particular model of Instrumentation Controller) works as follows:

```
WRITE @ 709:"FR 2E4;OU 1;FU SQ;FR;E"
```

FR 2E4	Sets the frequency to 20 kHz.
OU 1	Selects unbal 75Ω as the output configuration of channel 1.
FU SQ	Selects a square waveform.
FR	Tells the Model 288 to display the frequency menu.
E	Makes the Model 288 convert all these commands to a signal output.

### How Does the 288 Process Commands?

The 256-character listen buffer receives the commands from the instrument controller. If it fills up before receiving an Execute command, it will stop accepting commands, distribute its contents to the next-setup registers, then again accept commands. The commands in the next-setup registers will not take effect until the Model 288 receives an Execute.

The listen buffer accepts all commands regardless of syntax errors. When the Model 288 processes the commands in the listen buffer, it copies the defective commands over into the SRQ buffer and labels them with PE:0 to indicate defective syntax. The parameters and functions that the defective commands would have changed retain their previous values. If a command appears in the SRQ buffer, the Model 288 ignores it.

### Terminators

A terminator tells the Model 288 that it has reached the end of the current command. Although the Model 288 recognizes both semicolons (;) and spaces as terminators, semicolons greatly simplify debugging. When the controller sends the Model 288 more than one command in a string, the individual commands should have semicolons (;) inserted between them as terminators. When using spaces, the Model 288 will copy (and ignore) all commands after the first defective command into the SRQ buffer. With semicolons, the Model 288 will accept all good commands and put only the defective ones in the SRQ buffer. Consider these two examples with and without semicolons (the defective command **FR2E4** should read **FR 2E4**):

#### With Semicolons:

```
Write @ 709:"FR2E4;OU 1;FN SQ;FR;E"
```

```
Message: SRQ = /PE:0 FR2E4*/
```

#### Without Semicolons:

```
Write @ 709:"FR2E4 OU 1 FN SQ FR;E"
```

```
Message: SRQ = /PE:0 FR2E4* CH 1 OT 1 FN RM FR E/
```

### Minimum Uniqueness

The Model 288 will interpret the following three command lines exactly the same. String 1 uses the minimum character set each command requires, string 2 uses longer abbreviations that contain each command's minimum character set, while string 3 completely spells out each command. The expansion of the function command (FN 3, FUNC DC, and FUNCTION DC) demonstrates the use of numbers and descriptive character strings in the argument of enumerated commands.

Write @ 709:

```
"FR 2E4;OU 1;FN 3;FR;E" (1)
```

Write @ 709:

```
"FREQ 2E4;OUTP 1;FUNC SQR;FREQ ;EXEC" (2)
```

Write @ 709:

```
"FREQUENCY 2E4;OUTPUT 1;FUNCTION SQUARE ;FREQUENCY;EXECUTE" (3)
```

### Query Commands

Query commands (such as FR?) make the Model 288 return the current setting of the parameter as a string of characters and require a program to make the controller use the returned data. The following sample program requests the data, accepts it, and writes it to the particular Instrumentation Controller's screen.

Program Statements	Explanation
10 CLEAR	Clear screen
20 WRITE @ 709:"FR?"	Write command to Model 288 (port 7, address 09)
30 DIM STRING\$*25	Dimension string to 25 characters
40 READ @709:STRING\$	Read returning string
50 PRINT STRING\$	Print string to screen
60 END	End program

### 3.3.2.3 288 Command List

Table 3-6 uses the following format to list and briefly describe the complete Model 288 GPIB command set. See the detailed command descriptions part or the cor-

responding menu key description for more information about each command.

Command	Range/String	Function
FREQUENCY	2E-3 to 20E6	Sets the generator frequency.
FREQUENCY?	FREQUENCY n	Returns generator frequency n.
Function	0 to 3	Selects a channel output waveform.

### Command Column

- 1) Lists commands alphabetically by their full names
- 2) Indicates minimum uniqueness with capitol letters
- 3) Indents command arguments

### Range/String Column

- 1) Gives the value range for each parameter command.
- 2) Gives the argument number range for each enumerated command.
- 3) Lists the arguments (names and numbers) for each enumerated command.
- 4) Gives the string returned in response to each query command.

### Function Column

- 1) States briefly the function of each command.
- 2) Uses an asterisk (\*) to indicate further explanation in the detailed command description section.

### Minimum Uniqueness

Capitol letters (AutoCalibrate) indicate the minimum letter combination required by the Model 288. Use just the caps (AC), a longer abbreviation that contains all the caps (AUTOCAL), or the entire command (AUTOCALIBRATE).

### Other Sources of this Data

The HELP? command provides less complete forms of the data given in table 3-6. HELP? sends a list of all the commands, arguments, and ranges to the GPIB controller.

**Table 3-5. Model 288 Command Syntax**

Typical Command Line: <code>WRITE @709:"FR 2E4;OU 1;FN SQ;FR;E"</code>	
Syntax	Explanation
<code>WRITE @ 709</code>	Varies depending on the controller. This particular format used throughout this manual tells the controller to send the command string out port 7 (the GPIB port) to the Model 288 (at address 09 on the GPIB bus).
<code>"_" or ' _ '</code>	Enclose the command string in quotes. Either single or double quotes can serve as string delimiters.
<code>;</code>	Separate commands with semicolons. See "terminators" in the text for the reasons for this requirement.
<code>E</code>	Use exponent notation to avoid entering long strings of zeros. For example, enter 20000 as <code>2E4</code> and 0.0005 as <code>5E-4</code> .
<code>FR</code> <code>FREQUENCY</code>	Use the minimum uniqueness version ( <code>FR</code> ), a longer version that contains the minimum uniqueness letters ( <code>FREQ</code> ), or the full version ( <code>FREQUENCY</code> ) of each <code>FREQUENCY</code> command in programming. Table 3-6 spells out the commands and indicates the minimum uniqueness with capital letter ( <code>FRequency</code> ). The text gives examples of full, partial, and minimum uniqueness command strings.
<code>FU 2</code> <code>FU SQ</code>	Enumerated commands that select a function (such as <code>FU</code> , select channel output <code>FU SQ</code> waveform) allow the function to be selected by either number (3) or by name ( <code>SQ</code> ), (square waveform). Table 3-6 lists the enumerated commands and their arguments.
<code>;CMD;</code>	Drop the numerical value of a parameter command to make the Model 288 display that parameter. For example, <code>;A;</code> will display the amplitude. Use this feature in step-by-step operation to follow and verify program operation.
<code>E"</code>	Place an Execute command at the end of a command string to make the Model 288 put the commands into effect. The Model 288 will accept commands and put them in the pending setup registers, but it will not generate their output until an <code>E</code> command is sent. <code>E</code> also puts the Model 288 in the "listen for more commands" mode; therefore, do not put <code>E</code> after a query ( <code>?</code> ) command as it will prevent the Model 288 from returning the answer.
<code>?</code>	Replace the numerical value of a parameter command with a <code>"?"</code> to make the Model 288 return the current setting of that parameter as a string of characters. Table 3-6 lists the query commands and shows the format of the returning strings. Query commands also make the Model Model 288 display the menu of the requested parameter. The text gives a short program that makes the controller accept and display the returning information. Do not use <code>E</code> after a <code>?</code> command.

Table 3-6. Model 288 Command Set

Command	Abbreviation	Range/Value		Description
		Min	Max	
Amplitude	A	1E-3	15	Set Amplitude
Amplitude?	A?			Request current Amplitude setting
AutoCalibrate	AC			Start Auto-Calibrate
Execute	E			Execute previous commands
FRequency	FR	2E-3	20E6	Set Frequency
FRequency?	FR?			Request current Frequency setting
FUnction	FU	0	3	Set Function
DC	D		3	Set dc Function
SIne	SI		0	Set Sine Function
SQuare	SQ		2	Set Square Function
TriAngle	T		1	Set Triangle Function
FUnction?	FU?			Request current Function setting
Help?	H?			Request this Command list
Modulation mode	M	0	5	Set Modulation mode
Am	A		1	Set to AM modulation mode
Cw	C		0	Set to CW modulation mode
Fm	F		2	Set to FM/VCF Modulation mode
Sweep	S		5	Set to Sweep Modulation mode
SweepStArt	SSA		3	Set to Sweep start
SweepStOp	SSO		4	Set to Sweep stop
Modulation mode?	M?			Request current Modulation type
MainParameters?	MNP?			Request current main parameters
Offset	OF	-5	5	Set Offset voltage
Offset?	OF?			Request current Offset value
OUtputtype	OU	0	4	Set Output type
Balanced 135	B1		4	Set Output to 135Ω Balanced
Balanced 600	B6		3	Set Output to 600Ω Balanced
Unbalanced 50	U5		0	Set Output to 50Ω Unbalanced
Unbalanced 75	U7		1	Set Output to 75Ω Unbalanced
Unbalanced 600	U6		2	Set Output to 600Ω Unbalanced
OUtputtype?	OU?			Request current Output type
PhaseLock	PL	0	1	Set Phase lock source
External	E		1	Set Phase lock source to external
Internal	I		0	Set Phase lock source to internal
PhaseLock?	PL?			Request current Phase lock source
Phase	P	-180	180	Set phase against external source
Phase?	P?			Request current phase value
PANellock	PAN	0	1	Set Panel lock
ON	ON		1	Set Panel to locked
Off	OFF		0	Set Panel to unlocked
PARameterreset	PAR			Reset previously transmitted parameter
RANgelock	RA	0	1	Set Range lock
ON	ON		1	Locks generator in the current range
Off	OFF		0	Sets Range to normal
Reset	R			Reset parameters except GPIB address
SYmmetry	SY	5	95	Set Symmetry value
SYmmetry?	SY?			Request current Symmetry value
SWEepStArtfreq	SWSA	2E-3	20E6	Set Sweep start frequency
SWEepStArtfreq?	SWSA?			Request current Sweep start frequency

**Table 3-6. Model 288 Command Set (Continued)**

Command	Abbreviation	Range/Value		Description
		Min	Max	
SWEEPSTOPFREQ	SWSO	2E-3	20E6	Set Sweep stop frequency
SWEEPSTOPFREQ?	SWSO?			Request current Sweep stop frequency
SWEEPTime	SWT	100E-3	100	Set Sweep time
SWEEPTime?	SWT?			Request current Sweep time value
SRQMask	SRQM	0	255	Set Service Request Mask value
SRQMask?	SRQM?			Request current SRQ Mask value
SRQ?	SRQ?			Request current SRQ value
STATUSByte?	STB?			Request current Status Byte value
SERIALnumbers?	SE?			Request instrument serial numbers
STARTCALibration	STARTCAL			Initiate instrument Auto-Cal
Talkmode	T	0	10	Set instrument to send a value
Version?	V?			Request software version number

**3.3.3 Universal and Addressed Commands**

Universal and addressed (U/A) commands make most GPIB instruments perform generally accepted standard functions. Usually, universal commands control all the instruments on the GPIB bus, while addressed commands control individual instruments at specific addresses on the bus. The Model 288 accepts the following U/A commands:

Command	Type	Function
DCL	Universal	Device Clear
GET	Addressed	Group execute trigger
GTL	Addressed	Go to local
LLO	Universal	Local lock out command
SDC	Addressed	Selected device clear

Paragraph 3.3.4 (detailed command descriptions) discusses these U/A commands and selected Model 288 commands in detail.

**U/A Syntax**

This manual uses generic names to identify the universal and addressed commands and the functions they perform. Individual controllers will use differently named commands to perform these same functions. See the manual for the controller being used to determine the actual command names and the syntax they require.

**3.3.4 Detailed Command Descriptions**

The following paragraphs describe in detail the unique Model 288 GPIB commands that perform functions not

controlled by the front panel and also the GPIB universal and addressed commands recognized by the Model 288. Use the following list to identify these specialized commands.

Command	Type	Description
DCL	Universal	Device Clear
GET	Address	Group Execute Trigger
GTL	Address	Go To Local
HELP?	288	HELP?
LLO	Universal	Local Lock Out
MNP	288	Main Parameters
SDC	Address	Selected Device Clear
SRQ?	288	Service ReQuest?
SRQM	288	Service ReQuest Mask
SRQM?	288	Service ReQuest Mask?
STB?	288	Status Byte?
V?	288	Version?

**GPIB Control**

The Model 288 limits the operator's use of the front panel with two levels of increasing restrictions as shown in table 3-7.

The Model 288 switches to GPIB control when the instrument controller asserts the GPIB REN (remote enable) line and sends to the Model 288 its listen address. The particular instrument controller command string `WRITE #709: "command string "` will automatically perform these two actions. The GPIB control restricts further front panel operation as described in table 3-7. The Model 288 will remain under the GPIB control until the operator presses the Local key.

**Table 3-7. Front Panel Restrictions**

IF Front Panel Operation is Limited With → THEN the Operator Can:	Nothing	GPIB Control	LLO Command
See the Screen Display?	Yes	Yes	Yes
Display Parameters?	Yes	Yes	Yes
Take Control Back From the GPIB?	Yes	Yes	No
Change Parameters?	Yes	No	No

**LLO Command**

All instruments on the bus recognize the universal command **LLO**; it cannot be directed to just one instrument. **LLO** restricts operation of the Model 288 front panel as described in table 3-7. For a particular Instrumentation Controller, **LLO** has the format **LLO #7**, where 7 specifies the GPIB bus port of the controller.

**GTL Command**

**GTL** cancels the **LLO** command and returns the Model 288 front panel to full operator control. All instruments on the bus recognize the addressed command **GTL**; however, it must be sent to each instrument individually. The particular Instrumentation Controller uses the **LCL** command to issue **GTL** commands. **LCL #7** sends **GTL** commands to all the instruments on the bus, while **LCL #709** sends the **GTL** to just the specified instrument. In these command formats, 7 specifies the GPIB bus port of the controller and 09 specifies the address of a particular instrument on the bus. **LCL** becomes effective on receipt; the Model 288 does not require that it be followed with another command.

**GET Command**

The **GET** command triggers whatever trigger function that is set up within the Model 288. All instruments on the bus recognize the GPIB addressed command **GET** (group execute trigger); however, it can be sent to just one instrument at a time. For the particular Instrumentation Controller, the **TRG** command sends the group execute trigger to individual instruments on the GPIB bus. **TRG** has the format **TRG #709**, where 7 specifies the GPIB bus port of the controller and 09 the address of a particular instrument on the bus. The Model 288 triggers the selected function immediately on receipt of the **TRG** command.

**HELP? Command**

The **HELP?** command makes the Model 288 return a list of the Model 288's primary and secondary commands

and their limits as a string to the controller. **HELP?** requires that a program be written to make the instrument controller accept and print the returned list. The following sample program requests the list, accepts it, and sends it to a printer connected to the GPIB bus. To make this program work, set the address switches of the printer to 04. Table 3-6 provides the same information as the list this program prints.

**Sample HELP Print Program**

```

100 DIM A$*255           Dimension String to 255
                          characters.
110 WRITE #709:"HELP?" Write HELP to port 7,
                          address 09.
120 READ #709:A$         Read the String
130 IF A$="0" THEN 170  If string is "0" jump to
                          170
132 PRINTER IS #704     Printer is at port 7, ad-
                          dress 04.
140 PRINT A$             Print the list
150 GO TO 120
170 END                 End Program

```

**MainParameters? Command**

The **MNP?** command makes the Model 288 return the current setting of the Model 288's main parameters as a string to the controller. The controller can save this string, then send it back to the Model 288 at a later time to restore the parameters to their previous values.

**DCL and SDC Commands**

The **DCL** and **SDC** commands reset the Model 288 to the power-up conditions, but leave it in the remote (GPIB controlled) mode. All instruments on the bus recognize the GPIB universal command **DCL** (device clear). Individual instruments recognize the GPIB addressed

command **SDC** (selected device clear). For the particular Instrumentation Controller, the **DCL** command issues **DCL** and **SDC**. To reset everything on the bus, use **DCL @7**, where 7 specifies the GPIB bus port of the controller. To reset just one instrument, use **DCL @709**, where 09 specifies the instrument address. The Model 288 resets itself immediately when it receives either command.

### Reset Command

The **Reset** command resets the Model 288 to default conditions.

### Version? Command

The **Version?** command makes the Model 288 return the software version of the Model 288 EPROM as a string of characters. **Version?** requires a program to make the instrument controller use the returned string. The following sample program requests the version, accepts it, and writes it to the controller's screen.

#### Sample Version? Print Program

```

10 CLEAR          Clear screen
20 WRITE @709:"V?" Write VERSION? to
                   port 7, address 09.
30 DIM VERSION$*50 Dimension string to
                   50 characters.
40 READ @709:VERSION$ Read returning string
50 PRINT VERSION$  Print string to screen
60 END           End program

```

Running the above program will produce the following display:

```

WVTK 288 (VX.XX)

```

In this display, **x.xx** gives the version number.

### 3.3.5 Service Requests

The following paragraphs discuss the concepts of service requests, describes the commands associated with them, and then lists the service request messages that the Model 288 generates. The Model 288 can set the SRQ line whenever a programming error occurs, a hardware error occurs, an event is completed, Phase lock changes state, or a Calibration message is displayed.

#### SRQ CONCEPTS

##### What Does the Service Request Tell the Controller?

The Model 288 service request tells the controller that the Model 288 wants attention. The Model 288 makes the request by asserting the SRQ line of the GPIB bus. Because any instrument on the bus can assert this line, the

controller must read the status byte of each instrument in turn to determine which one requested attention.

##### What Does the Status Byte Tell the Controller?

The Model 288 uses six of the eight bits in its status byte. One tells the controller if the Model 288 requested service. The others indicate the type or types of messages (programming error, hardware error, event, Phase Lock state, or Calibration) that the Model 288 wants to send. Figure 3-11 shows the format of the Model 288 status byte. If the controller wants to know the specific message within the category, it must read the Model 288's SRQ buffer.

##### What Does the SRQ Buffer Tell the Controller?

The Model 288 SRQ buffer stores the programming error, hardware error, event complete, Phase Lock state, and Calibration messages until the controller can read them. Tables 3-8 thru 3-12 list all of the SRQ messages.

#### SRQ COMMANDS

The following paragraphs discuss the commands related to the service request mask, the status byte and the service request messages.

##### SRQMask Command

The **SRQM** command makes the Model 288 selectively ignore one or more of the three types of conditions that make it produce service requests. For example, if programming errors were masked out, the Model 288 would not load messages for specific programming errors into the SRQ buffers and it would not set the PE and service request bits in the status byte. Figure 3-9 shows the positions and the corresponding decimal mask values required to block out PE, HE, and EV messages. The SRQ mask is reset to SRQmask #1 (programming error only) on power on. It is not changed by "RESET"

##### SRQMask? Command

The **SRQM?** command makes the Model 288 return the current mask setting to the controller. The Model 288 sends the SRQ mask setting as the character string **SRQMASK#**, where # gives the decimal equivalent of the binary mask bits. To use **SRQMASK?**, write a program that first asks the Model 288 to send the mask, then tells the controller how to receive and process the returning string.

##### STatusByte? Command

The **STB?** command makes the Model 288 send its current status byte to the controller over the GPIB bus. The Model 288 sends its status byte as a string of characters with the format **STB=##**, where ## gives the decimal equivalent of the status byte. **StatusByte?** reads, *but does not reset*, the status byte of the Model



288. To use `StatusByte?`, write a program that first asks the Model 288 to send the status byte, then tells the controller how to receive and process the returning string.

### SRQ? Command

The `SRQ?` command makes the Model 288 send the contents of the SRQ buffer to the controller over the GPIB bus. The Model 288 sends its SRQ buffer contents as a string of characters with the format `SRQ = MESSAGES`, where `MESSAGES` represents a string of messages. Reading the SRQ buffer empties it. To use `SRQ?`, write a program that first asks the Model 288 to send the SRQ buffer messages, then tells the controller how to receive and process them.

## SRQ MESSAGES

### SRQ Message Format

The Model 288 puts messages in the SRQ buffer in this general format:

```
SRQ=/PE:n Description//HE:n
Description//EV:n Description/
```

Slashes (/) enclose each message. PE identifies a programming error message, HE a hardware error message, and EV an event complete message. "n" identifies a specific message within the type. This fixed format header allows a computer to easily parse (decode) the message. "Description" describes the error in English for the benefit of human readers. Table 3-8. lists all the SRQ programming error messages, table 3-9 lists all the

SRQ hardware error messages, table 3-10 lists all the SRQ event error messages, table 3-11 lists all the SRQ phase lock state change error messages, and table 3-12 lists all the SRQ Calibration error messages.

### 3.3.6 Displaying Messages

The Model 288 can accept messages from the GPIB bus and display them on the front panel display. Use this feature to give instructions to an operator or to display information.

### Command Format

Send messages in this format:

```
WRITE #709:" 'TEXT' "
```

The standard double quotes (") identify the command string. The single quotes (') identify the contents as a message rather than commands. Messages do not require an Execute command.

Although the Model 288 accepts either single or double quotes as string delimiters, the controller interprets the double quotes as its own program string delimiters. This restricts use to the single quotes for Model 288 display strings when using the particular controller used throughout this manual. Other controllers might reverse this situation.

### Message Size

The screen will allow a maximum message size of four line of 16 characters. The Model 288 will ignore any characters beyond these limits.

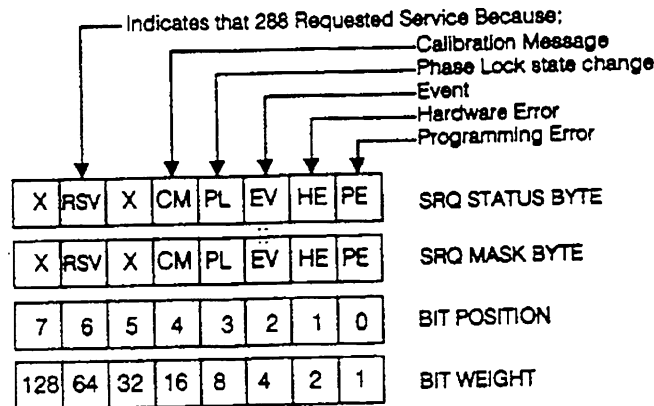


Figure 3-11 Model 288 Status Byte and SRQ Mask

### Erasing

Press any menu key or send another GPIB command string to return to normal Model 288 displays. To erase the previous message, send a new message.

### 3.3.7 GPIB Keys

#### Address Key

The address key enables entry of an alternate GPIB address using the front panel controls. The GPIB bus address identifies the Model 288 to the instrument controller. Press the address key to display the current GPIB address on the display. Key in a new address using the numeric keypad or the control knob and then press Execute.

### Local Key

The Local key switches control of the Model 288 from the GPIB bus to the front panel. Receipt of any GPIB command (if the controller simultaneously asserts the REN line of the GPIB) by the Model 288 disables the front panel to the extent that parameter settings can be read but modes or numbers cannot be changed. Pressing the Local key returns full control to the front panel except when the universal command LLO has been issued by the controller. LLO disables the Local key so that full control cannot be obtained at the front panel.

**Table 3-8. SRQ Programming Error Messages**

Command	Description																														
/PE:0 < defective command string > /	The Model 288 did not recognize the command it received. < defective command string > is whatever garbage the Model 288 received over the bus.																														
/PE:1 < parameter header > /	This is a limit error. An attempt was made to set a parameter to an illegal value. < parameter header > is the maximum header string e.g. "FREQUENCY" or "SWEEPSTOPFREQ".																														
/PE:2:< param# >:< param# > < param name >-< param name > CONFLICT/	This is a setting conflict error. This service request will occur after an execute command if there are conflicting settings. It will only flag the first conflict that it finds. < param# > and < param name > are redundant and are as follows:  <table border="0"> <tr> <td>&lt; param# &gt;</td> <td>&lt; param name &gt;</td> </tr> <tr> <td>1</td> <td>FREQUENCY</td> </tr> <tr> <td>2</td> <td>AMPLITUDE</td> </tr> <tr> <td>3</td> <td>OFFSET</td> </tr> <tr> <td>4</td> <td>SYMMETRY</td> </tr> <tr> <td>5</td> <td>PHASE</td> </tr> <tr> <td>6</td> <td>FUNCTION</td> </tr> <tr> <td>7</td> <td>MODULATION</td> </tr> <tr> <td>8</td> <td>EXTLOCK</td> </tr> <tr> <td>9</td> <td>OUTPUT</td> </tr> <tr> <td>10</td> <td>SWP. START</td> </tr> <tr> <td>11</td> <td>SWP STOP</td> </tr> <tr> <td>12</td> <td>SWP TIME</td> </tr> <tr> <td>13</td> <td>AMPLITUDE-OFFSET</td> </tr> <tr> <td>14</td> <td>RANGE LOCK</td> </tr> </table>	< param# >	< param name >	1	FREQUENCY	2	AMPLITUDE	3	OFFSET	4	SYMMETRY	5	PHASE	6	FUNCTION	7	MODULATION	8	EXTLOCK	9	OUTPUT	10	SWP. START	11	SWP STOP	12	SWP TIME	13	AMPLITUDE-OFFSET	14	RANGE LOCK
< param# >	< param name >																														
1	FREQUENCY																														
2	AMPLITUDE																														
3	OFFSET																														
4	SYMMETRY																														
5	PHASE																														
6	FUNCTION																														
7	MODULATION																														
8	EXTLOCK																														
9	OUTPUT																														
10	SWP. START																														
11	SWP STOP																														
12	SWP TIME																														
13	AMPLITUDE-OFFSET																														
14	RANGE LOCK																														

**Table 3-9. SRQ Hardware Error Messages**

Command	Description
/HE:0 < cal index > < cal name >AUTOCAL ERROR/	This is a failure to complete and autocal step. < cal index > is a number associated with the calibration parameter that failed adjustment. < cal name > is is an archaic name associated with the calibration parameter that failed adjustment.
/HE:1 WAIT < time > MIN/	This means an autocal was attempted before the required 20 minute warm-up. < time > is the time (in minutes) remaining before an autocal can be performed.

**Table 3-10. SRQ Event Complete Error Messages**

Command	Description
/EV:0 AUTOCALIBRATION COMPLETE/	This means that autocalibration was completed.
/EV:1 EXECUTE COMPLETE/	This means that execute was complete. After an execute command, the Model 288 will send either this service request or a PE:2 (assuming both PE and EV SRQ's are enabled by the SRQ mask).

**Table 3-11. SRQ Phase Lock State Change Error Messages**

Command	Description
/PL:0 PLL UNLOCKED/	This means that the phase lock loop has changed from an unlocked state to a locked state.
/PL:0 PLL LOCKED/	This means that the phase lock loop has changed from a locked state to an unlocked state.

**Table 3-12. SRQ Calibration Error Messages**

Command	Description
/CM:1:<cal index> <cal name>/	This is an information message usually requesting a manual operation. < cal index > is a number associated with the calibration parameter or step that needs attention. < cal name > is anarchic name associated with the calibration parameter or step that needs attention.
/CM:2:< cal index >: < number >< cal name > /	This is an information message having an unchangable number associated with it.
/CM:3:< cal index >: < number>< cal name > /	This is a request for a numeric calibration parameter. < number > is the previous value of this parameter.
/CM:4 CALIBRATION BUTTON NOT PUSHED/	This is sent if an attempt is made to enter the calibration procedure without the internal calibration enable key pushed.
/CM:5 THANKS I NEEDED THAT! /	This is sent after the completion of the full calibration procedure if the calibration was required because of lost RAM data.

# SECTION 4

## CIRCUIT DESCRIPTION

### 4.1 THE MODEL 288

The Model 288, a 20 MHz synthesized function generator, operates with synthesizer accuracy ( $<0.02\%$ ) over the 20 Hz to 20 MHz range, CW or AM only. Between 2mHz to 20 Hz and in FM or sweep, the unit operates as a standard function generator with  $<3\%$  accuracy. A separate generator sweeps the generator's frequency up to three decades between a start frequency and a stop frequency (up or down). The Model 288 to an external source and allows the Model 288's output phase (relative to the external source) to be varied  $\pm 180^\circ$ .

The Model 288 consists of six separate assemblies as shown in figure the Instrument Schematic (0004-00-0510): motherboard, front panel, function generator, phase lock loop, output, and rear panel. The motherboard links all the assemblies within the Model 288. Plus it receives, input data from the front panel, processes that data into commands and control lines, and distributes the commands and control lines to the other assemblies. The motherboard also route data from the assemblies back to the front panel. The front panel

contains the operator interface: keypad for parameter selection and value entry; control knob for value entry; the display for output signal information, operator messages, and error codes; and LEDs for front panel annunciation. The function generator produces the generator's two basic waveforms: square and sine. In addition, the function generator controls the units frequency and symmetry control. The phase lock assembly locks the function generator to an internal reference for frequency synthesis or locks the function generator to an external source for variable phase operation. Also, the phase lock assembly contains the convertor for triangle to sine conversion and the X-Y multiplier for amplitude modulation. The output assembly selects, amplifies, and attenuates the waveform. The rear panel assembly contains the units power input connector, power transformer, and fuse.

### Signal Flow

Signal flow through the Model 288's assemblies depends upon the function and mode selected. The signal originates on the function generator assembly (see figure 4-1) which produces the basic waveforms: tri-

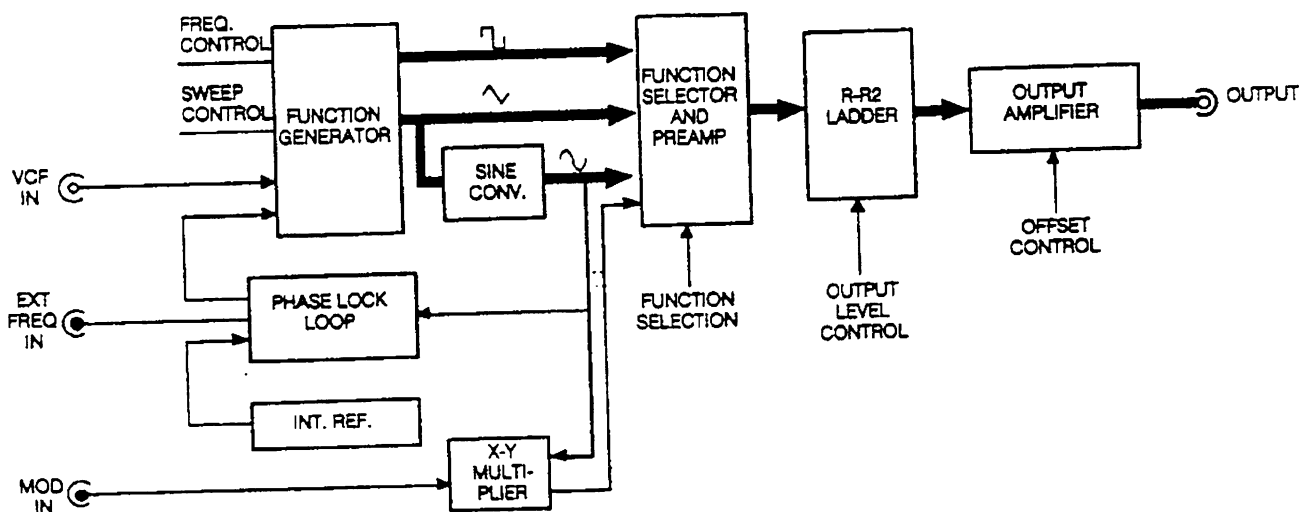


Figure 4-1. Model 388 Signal Flow

angle and square. The motherboard routes both waveforms to the function selector on the output assembly. The triangle also runs to the sine convertor located on the phase lock assembly. The motherboard routes the sine wave to the function selector. The output signal from the function selector flows through the output circuits to the output connectors. The sine wave also drives the X-Y multiplier whose output is routed to the function selector just like the triangle, square and sine waves.

In the synthesized mode, the phase lock loop, referenced to an internal frequency standard, controls the stabilizes the frequency of the function generator. The same phase lock loop, using an external reference frequency, locks the Model 288 to an external source.

#### **Control**

All control inputs originate from either the front panel keypad or a GPIB controller. The microprocessor circuit on the motherboard processes this input data and produces the control lines for the Model 288's circuits. Each plug-in board (function generator, phase lock loop, and output) contains input registers that decode the control data.

## **4.2 DETAILED CIRCUIT DESCRIPTION**

### **4.2.1 Motherboard Assembly**

The mother board (see schematic 0103-00-3000) provides overall control, interconnection and signal routing, dc voltages, internal reference frequency signals, and remote operation in the Model 288. The mother board sends and receives all data and control signals to and from the assemblies. All input and output connectors located on the rear panel, except the input power connector, connect through the mother board. Connectors for the plug-in assemblies are staggered to prevent accidental insertion into incorrect positions.

The mother board contains:

- Microprocessor Circuit
- GPIB Interface Circuit
- Frequency Synthesizer Circuit.
- Internal Calibration Network Circuit
- DAC/Sample and Hold Network Circuit
- Secondary Input/Output Network Circuit
- Relay Driver Network Circuit.
- Balanced Output Attenuator Network and Impedance Control Circuit
- Unbalanced Output Attenuator Network and Impedance Control Circuit
- Power Supplies Circuit

### **4.2.1.1 Microprocessor Circuit**

The microprocessor circuit (schematic 0103-00-3000 sheet 3) receives input data from the front panel keyboard and control knob, or GPIB interface, processes the data, and provides data and control lines for internal operation. The microprocessor circuit consist of a microprocessor, a processor support controller, and memory (RAM and ROM). There are no test points or adjustments in this circuit.

The microprocessor (Motorola MC6803) controls the microprocessor circuit and provides 16-bit data memory location addresses. The microprocessor performs computations as defined by the operating system instructions in memory (ROM) and provides the 8-bit output for the memory (RAM) and GPIB interface Circuit.

The processor support controller U7 converts the microprocessor data and the instrument feedback data into control signals, quiet address (QA) buses, and quiet data (QD) buses.

The Memory is both RAM and ROM. RAM (8K), a nonvolatile memory, stores the calibration values generated at each calibration, and any other values required for current operation. A RAM backup battery (BT1) prevents the loss of data when power is turned off. ROM (16K), programmed at the factory, contains the operating system instructions. Maintenance Calibration switch (SW1) used in conjunction with the front panel keyboard allows performance of several maintenance functions. A flashing Life Light verifies microprocessor sequencing.

### **4.2.1.2 GPIB Interface Circuit**

The GPIB interface circuit (schematic 0103-00-3000 sheet 10) allows remote operation of the Model 288 using an external IEEE-488 compatible controller. All functions except power and GPIB address are programmable using the interface. The GPIB circuit consist of a GPIB controller and two transceivers. This circuit contain no test points or adjustments.

The GPIB controller (Motorola MC68488) functions as a traffic controller, permitting data to flow in either direction when the correct control information is received. The 'handshaking' routine will ensure neither the signal generator nor the remote controller will send data faster than the other can use. The controller has internal registers where control, data, and address words are loaded and stored until needed or requested. The controller bus connects to the microprocessor circuit address bus A0-A2. The identification address of an instrument is determined by five bits in the controller address register. The default address (09) automati-

cally loads into the controller from RAM at turn-on. A new address must be entered using the front panel keypad.

The transceivers permit bidirectional flow. They have sufficient input sensitivity to minimize false signals and sufficient drive current to minimize signal loss.

#### **4.2.1.3 Frequency Synthesizer Circuit**

The frequency synthesizer (schematic 0103-00-3000 sheet 4) supplies the internal reference frequency for the signal generator. The frequency generated corresponds to the front panel frequency setting. However, it does not operate below 20 Hz. This circuit has two test points located under the shield. TP5 is the loop control voltage. TP17 is the synthesizer output (SYNTH). There are no adjustments in this circuit.

The frequency synthesizer circuit consists of a phase lock loop, voltage controlled oscillator, divide by two circuit, and a counter/divider. The output from a 10 MHz crystal controlled reference is multiplied and divided by three numbers computed by the microprocessor circuit. The three numbers are a serial data stream of 64 bits: 14 bits divide the reference, 14 bits divide the variable, and 36 bits divide the VCO to the desired frequency. All are under software control and respond to the front panel frequency settings.

#### **4.2.1.4 Internal Calibration Network Circuit**

During the measurement portion of the auto calibration cycle, the internal calibration network (schematic 0103-00-3000 sheet 2) measures five analog voltages. FGTST and FGTST100 voltages monitor the function generator condition. THD, +PK, and -PK voltages monitor the output assembly status. VLOOP monitors the phase lock loop assembly status. The microprocessor circuit monitors the digital equivalent of these voltage, and if any are incorrect, they are corrected by applying an analog calibration voltage from the DAC/sample and hold network circuit.

A sixth voltage, the RAM backup battery (DVMBAT), is tested during the power on sequence. If the voltage tests low, the microprocessor circuit causes the display to show "LOW BATT". If the battery tests dead, the Microprocessor circuit causes the display to show "CAL REQUIRED". There are no test points or adjustments in this circuit (TP1 is not used).

#### **4.2.1.5 DAC/Sample and Hold Network Circuit**

The DAC/sample and hold network circuit (schematic 0103-00-3000 sheet 5) supplies the control voltages for the signal generator. The DAC/Sample and Hold Net-

work Circuit consists of a digital to analog converter and a demultiplexer. TP7 connects to the sample and hold digital/analog output. There are no adjustments in this circuit.

The digital to analog circuit (DAC) converts the binary data from the microprocessor circuit into one of eight control levels in the form of a stepped waveform.

The Demultiplexer converts the stepped waveform containing the eight control levels from the DAC into eight separate analog control voltages. Four control voltages, VOFSET, VPHASE, VSLEN, and VFREQ respond to the front panel settings. The other four control voltages VSINCAL, VAMCAL, VCGZERO, and VTRIBAL respond to calibration data from the microprocessor circuit.

During the measurement portion of the auto calibration cycle, SHCLK clocks the serial data (SHDATA) into the (DAC). From this data, the eight analog calibration voltages (-5V and +5V) are produced which slightly changes the normal outputs of the eight circuits during the calibration portion of the auto calibration cycle which changes the circuit output to correct the signal output to the internal frequency and voltage standards. The DAC sample and hold network circuit and the internal calibration network circuit work together to alternately measure and adjust a circuit. The serial data is stored in RAM until the next auto calibration cycle. If the analog calibration voltage cannot change the measured voltage enough to bring it into limits, the microprocessor circuit will generate an error message to be displayed. This error refers to the affected circuit.

#### **4.2.1.6 Secondary Input/Output Network Circuit**

The secondary input/output network (schematic 0103-00-3000 sheet 6) conditions and routes the Ext Freq In signal to phase lock loop's reference frequency input. This circuit squares the input signal and compensates the signal for any nonsymmetry. It also routes the Sync Out square wave from the function generator assembly through this circuit's 50Ω driver to the front panel connector. This circuit also routes the Mod/VCF In signal directly to the phase lock loop assembly and function generator assembly. While The Sweep Out is routed to the front panel from the function generator assembly.

To test the external frequency input circuit, an external signal must be connected to the Ext Freq In connector. All test points and components are located under the shield. TP9 is the limited external frequency input. TP10 is the buffered external frequency. There are no adjustments in this circuit.

#### 4.2.1.7 Relay Driver Network Circuit.

The relay driver network circuit (schematic 0103-00-3000 sheet 7) controls the relays used in the balanced and unbalanced output attenuator network and impedance control circuits. Microprocessor data lines drive this circuit. There are no test points or adjustments in this circuit.

#### 4.2.1.8 Balanced Output Attenuator Network and Impedance Control Circuit

This circuit (schematic 0103-00-3000 sheet 7) routes output signals to BAL output connectors. The relays in this circuit are driven by the relay driver network circuit. Output signals (BOUT1 and BOUT2) from the output assembly are selected and routed through a -40 dB attenuator as required by the amplitude setting at the front panel. The desired impedance of 135 $\Omega$  or 600 $\Omega$  is selected, and the signal is routed to the front panel BAL connectors. There are no test points or adjustments in this circuit.

#### 4.2.1.9 Unbalanced Output Attenuator Network and Impedance Control Circuit

This circuit (schematic 0103-00-3000 sheet 7) routes output signals to UNBAL output connector. The relays in this circuit are driven by the relay driver network circuit. Output signal (UBOUT) from the output assembly are selected and routed through a -40 dB attenuator as required by the amplitude setting at the front panel. The desired impedance of 50 $\Omega$ , 75 $\Omega$  or 600 $\Omega$  is selected, and the signal is routed to the front panel UNBAL connector. There are no test points or adjustments in this circuit.

#### 4.2.1.10 Power Supplies Circuit

These circuits provides the ac and dc operating voltages for all circuits in the signal generator. The power supplies circuit consist of a +5V power supply,  $\pm 12V$  power supply,  $\pm 22V$  power supply, and VFD ac filament supply.

**+5V Power Supply.** This circuit (schematic 0103-00-3000 sheet 8) supplies the +5 Vdc for the TTL logic and relay circuits in the signal generator. Remove the jumper JMP6 to isolate the +5V supply from the circuits .

**$\pm 12V$  Power Supplies.** This circuit (schematic 0103-00-3000 sheet 8) supplies the positive and negative 12 Vdc for the signal generator. These power supplies are highly regulated by a precision voltage reference source, VREF, which is also used by the internal calibration network. Remove the jumper JMP4 to isolate the +12V supply, and remove the jumper JMP5 to isolate the -12V supply.

**$\pm 22V$  Power Supplies.** This circuit (schematic 0103-00-3000 sheet 9) supplies the positive and negative 22V used in the signal generator. The +12V supply provides a reference voltage for the positive 22V supply. This power supply cannot be isolated.

**VFD AC Filament Supply.** An unregulated ac voltage (schematic 0103-00-3000 sheet 9) approximately 8 Vrms supplies current to the display characters in the Vacuum Fluorescent Display .

These power supplies have five test points:

JMP4 is the +12 Vdc output.

JMP5 is the -12 Vdc Output.

JMP6 is the +5 Vdc output.

TP14 is the +22 Vdc output.

TP15 is the -22 Vdc output.

There are no adjustments in these circuits.

#### 4.2.2 Front Panel

The front panel provides operator interface to the signal generator. It allows the operator to input commands, and provides the operator with a display showing output signal parameters and equipment status. This assembly contains the following circuits:

Control Knob Circuit.

Display

Keyboard Circuit

Light Emitting Diode Circuit.

##### 4.2.2.1 Control Knob

The control knob (SW1 - schematic 0103-00-3001 sheet 1) rotates continuously in both directions. Knob values depend on the function, mode, and range selected. Two output lines, RKA and RKB, are pulsed at TTL logic levels as the knob is rotated. The microprocessor circuit on the motherboard counts the pulses to determine the amount of change. The microprocessor circuit detects the knob's direction by comparing the TTL logic level of the signals and detecting the first one to change to a new level. For clockwise rotation, RKA will change first, and for counterclockwise rotation, RKB will change first. The microprocessor circuit determines when the rotation has reached the end of the range selected, in either direction. If there is a further range in the direction the knob is turning, the range will automatically change. If the range is at the limit, the limit value will be displayed.

##### 4.2.2.2 Display

The front panel display (schematic 0103-00-3001 sheet 1) receives its data via the quiet data bus QD5-7. The display controller/driver (U1) receives a serial word of



eight bits on the DISPDATA line. DSPCLK clocks each bit, most significant bit (MSB) first. The serial word may be either a display character or a control word, the MSB determines which. The 64 possible combinations of the remaining seven bits display standard ASCII upper case characters or control various functions and addresses. This display information drives the florescent display. The display controller/driver will retain only the most recent data received.

The display circuit is supplied by its own +15 Vdc regulator (VR1) which uses the +22V for its input. The florescent display filament receives its power from the 9Vac supply. Both voltages originate from the power supply on the motherboard.

#### 4.2.2.3 Keyboard Circuit

The keyboard circuit (schematic 0103-00-3001 sheet 2) consists of 48 push buttons in a eight-column, six-row matrix. The control signal FPREG latches the quiet data bus QD0-2 lines into the decoder. The decoder selects one of the six rows and applies +5 Vdc. If any key is pressed on that row, the +5V will appear on one of the keyboard bus lines P10-P17. The microprocessor circuit on the motherboard determines which key has been pushed by analyzing the position of the decoder when detecting +5V on a column (keyboard bus lines P10-P17).

#### 4.2.2.4 LED Circuit

The LED circuit (schematic 0103-00-3001 sheets 2 and 3) consists of 18 LED's that indicate the mode and function selected. The control signal FPS permits quiet address bus QA0 and QA1 to select one of the four least significant outputs of the decoder. Control signals CLOCK0 and CLOCK 1 of the decoder sequentially strobes an 8-bit number from quiet data bus (QD0-7) into both latches. Each bit (QD0-7) entered into the latches will turn on the LED indicator related to that bit. Control signal FPREG illuminates the UNLK LED and ON/OFF LED in the same way. Once the LED is set, it remains on until a change occurs. Pressing a key associated with a LED will latch new data. The previous LED will turn off and the new one will turn on.

The Power On/Off switch connects the line voltage to the transformer located in the rear panel. The CT (center tap) connector provides a neutral connection for the balanced output connectors.

#### 4.2.3 Function Generator

The function generator produces the Model 288's square and triangle waveforms. The triangle drives the sine

converter on the the phase lock loop assembly. The unit routes the triangle and square waves to the output assembly for selection and amplification. The function generator's input registers decodes digital control signals from the microprocessor circuit for use in selecting and maintaining frequency, symmetry, sweep, and modulation. The VCF In (frequency modulation) allows an external signal to control the frequency of the function generator. The function generator also provides the Sync Out and Sweep Out signals. The function generator includes the following circuits:

- Voltage Controlled Generator (VCG) Summing Amplifier
- Sweep Generator
- Symmetry Control
- VCG Current Sources
- High Frequency Compensation
- Comparator
- Frequency Range Switches
- Capacitance Multiplier
- Triangle Buffer
- Auto Calibration

#### 4.2.3.1 VCG Summing Amplifier

The voltage controlled generator, VCG, (schematic 0103-00-3004 sheet 2) produces a voltage that is the negative sum of its input control voltages. The input control voltages can consist of up to five analog signals:

Fixed frequency set point (VFREQ) originating from the motherboard's DAC/sample and hold network.

Calibration voltage (VCGZERO) generated by the DAC/ sample and hold network on the motherboard.

Feedback control (VLOOP) supplied by the phase lock loop filter on the phase lock loop assembly.

Sweep voltage (SWEEP) generated by the sweep generator (if selected).

Modulating signal (MOD IN) originating at the VCF In connector and routed from the secondary input/output network on the motherboard (if selected).

These control voltages summed by the amplifier provide an accurate dc voltage (VSUM), test point TP2, for symmetry control and auto calibration circuit. There are no adjustments in this circuit.

#### 4.2.3.2 Sweep Generator

The sweep generator (schematic 0103-00-3004 sheet 2) produces the sweep voltage (0 to -8V) for the function generator. In addition, the sweep generator supplies

the sweep output ramp to the Sweep Out connector. The operator, via the front panel, sets the sweep start and stop frequency, as well as, the sweep time. The microprocessor circuit interpret and routes the data to the sweep generator. The microprocessor circuit determines the correct data (byte) to set the sweep generator DAC to produce a voltage that sets the function generator to the start frequency. Then the microprocessor steps DAC, in turn the function generator, to the stop frequency at a rate dependent on the sweep time. At the stop frequency, the microprocessor resets the sweep generator to the start frequency. Another portion of the sweep generator's DAC produces a ramp proportional to the sweep frequency. A calibration voltage (VSLEN) from the DAC/sample and hold circuit provides a correction voltage to the sweep DAC. The voltage (VSLEN) is generated when the internal calibration circuit, during the auto cal cycle reads the sweep output and makes corrections to the sweep generator. The microprocessor circuit stores the correction value as VSLEN which provides the reference voltage for the sweep generator DAC.

#### **4.2.3.3 Symmetry Control**

The symmetry control (schematic 0103-00-3004 sheet 3) provides control of the generated waveform's symmetry. VCG summing amplifiers divide the signal VSUM into two signals. One signal controls the one half of the waveform; the other signal controls the other half of the waveform. If the symmetry setting remains at 50% (symmetrical waveform), each signal receives the same amplification. As the symmetry setting changes from 50%, in either direction, one signal receives greater amplification and the other receives less amplification. Control lines QD0-7 from the microprocessor circuit control the outputs from the DAC which in turn set the gain of the VCG amplifiers. The two symmetry control outputs (+FCV and -FCV) drive the VCG current source and high frequency compensation circuit. The auto cal circuit also receives inputs from these two lines. This circuit has two test points: TP3 monitors the positive function control voltage (+FCV) and TP4 monitors the negative function control voltage (-FCV). There are no adjustments in this circuit.

#### **4.2.3.4 VCG Current Sources**

The VCG current sources (schematic 0103-00-3004 sheet 4) converts the +FCV and -FCV voltages from the symmetry control into two currents (ISWITCH+ and ISWITCH-) for use by the comparator circuit. The positive current (ISWITCH+) flows into the comparator, and the negative current (ISWITCH-) flows from the com-

parator. At 50% the current flow is equal flow to and from the comparator. However, if the symmetry setting is not 50%, the current flow will be unsymmetrical.

This circuit has four test points. TP5 is the VCG current sources positive reference voltage. TP8 is the VCG current sources negative reference voltage. TP6 is the positive integrator voltage source current flow into the comparator circuit. TP7 is the negative integrator voltage source current flow out of the comparator circuit. There are no adjustments in this circuit.

#### **4.2.3.5 High Frequency Compensation**

The high frequency compensation circuit (schematic 0103-00-3004 sheet 4) offsets any internal circuit time delays in the function generator circuit on the 200 kHz to 2MHz and 2MHz to 20 MHz frequency ranges. At higher frequencies, the time it takes to control or calculate the shape of the waveform, as well as the rise and fall times, and levels takes a measurable part of the time required by the waveform. A calculated value (+COMP and -COMP) compensates for the time delay by slightly altering the +FCV and -FCV signals from the symmetry control circuit at the comparator. The +COMP and -COMP output signal drives auto calibration circuit. There are no test points or adjustments in this circuit.

#### **4.2.3.6 Comparator**

The comparator circuit (schematic 0103-00-3004 sheet 7) combines the input signal representing the frequency set point (+COMP and -COMP), and compares it with the actual triangle waveform being generated by the current flows (+VI and -VI). As the output triangle reaches the positive peak set point, the comparator switches the output signal (SQWAVE) to a negative level. When the triangle reaches the negative peak, SQWAVE switches to a positive value. SQWAVE is used as the source square output waveform, and SYNC OUT signal. The switching SQWAVE signal alternately permits the current from the VCG Current Sources Circuit to flow into then out of the Comparator Circuit current sense point (TRINODE). This carefully controlled alternating current flow is sensed in the Triangle Buffer Circuit as a triangle wave (TRIOUT). During the control part of the auto calibration cycle, VTRIBAL is adjusted to the necessary voltage to insure a symmetrical triangle signal is measured by the measurement part of the auto calibration cycle. This circuit has two test points. TP13 is reference square wave, or the level the triangle must reach in order to switch. TP14 is the switched square wave. TP15 is the Square Wave output. There are no adjustments in this circuit.

#### 4.2.3.7 Frequency Range Switches

The frequency range switches (schematic 0103-00-3004 sheet 5) selects the four switchable range capacitors for the Model 288's five upper ranges. The microprocessor circuit via the function generator's data latches selects the capacitors. On the 20 MHz range, the capacitance consists of approximately 50 pF (15 pF plus stray capacitance) permanently connected to the input of the triangle buffer (TRINODE). For the 2MHz range the microprocessor circuit adds 440 pF in parallel with the existing 50 pF ( $\approx 500$  pF total). For the 200 kHz range, the microprocessor circuit adds to 0.0047  $\mu$ F in parallel with 440 pF ( $\approx 0.005$   $\mu$ F total). For the 20 kHz range, the microprocessor adds 0.047  $\mu$ F in parallel with 0.0047  $\mu$ F ( $\approx 0.05$   $\mu$ F total). For the 2kHz range, the microprocessor adds 0.47  $\mu$ F in parallel with 0.047  $\mu$ F ( $\approx 0.5$   $\mu$ F total). On the 200 Hz range and below, the capacitance multiplier (paragraph 4.2.3.8) selects the range "capacitors".

When the Model 288 produces an unsymmetrical waveform, the frequency range divides by 10. The microprocessor circuit automatic compensates for this by programming the next higher range.

#### 4.2.3.8 Capacitance Multiplier

Lower frequencies require larger capacitors that often fail to maintain the precise value over time needed for accurate frequencies. To eliminate the need for large capacitors, the Model 288 uses a capacitance multiplier (schematic 0103-00-3004 sheet 6) which controls the current at the TRINODE point. When the VCG current source supplies current (+VI) to the comparator, the capacitance multiplier draws a portion of the current from the TRINODE point. When the VCG current source draws current (-VI) from the comparator, the capacitance multiplier adds current to the TRINODE point.

This effectively decreases the amount of current to the range capacitor, which decreases the time it takes for the capacitor to charge to the comparator sense point; making the frequency lower. Microprocessor circuit data lines, routed through the function generator's data latches, select the capacitance multiplier's control line. TP11 is the capacitance multiplier output. There are no adjustments in this circuit.

#### 4.2.3.9 Triangle Buffer

The triangle buffer (schematic 0103-00-3004 sheet 6) amplifies the triangle generated by charging and discharging the range capacitor. The buffer output (TRIOUT) drives the comparator sense point, the waveform

selector on the output assembly, and the sine convertor on the phase lock loop assembly.

The auto cal circuit measure the triangle balance (TRIBAL) relative to the triangle buffer's ground (TRICOM) and produces a triangle balance voltage (VTRIBAL) that adjusts the comparator. The Model 288 stores the triangle balance voltage in the microprocessor circuit. The stored value changes only during the auto cal cycle.

#### 4.2.3.10 Auto Calibration

The function generator's auto calibration circuit (schematic 0103-00-3004 sheet 4) selects and buffers six key points on the function generator assembly during the auto cal cycle. The circuit's output (FGTST) drives the units internal calibration network on the motherboard. In addition, another circuit amplifies the FGTST by +100 and route it to the internal calibration network. There are no test points or adjustments in this circuit.

#### 4.2.4 Phase Lock Loop Assembly

The phase lock loop assembly contains three blocks: the phase lock loop itself, the sine convertor, and the AM modulator. The phase lock loop selects and locks triangle or square wave signal to internal or external reference. The sine convertor transforms the triangle into the sine wave. The AM modulator controls the amplitude modulation of the sine wave signal. All the control lines for this assembly originate from the microprocessor circuit and transfer through the assembly data latches.

##### 4.2.4.1 Phase Lock Loop

Phase lock loop circuit consists of the sine-Z-cross circuit, the source selector circuit, the phase comparator circuit, the phase comparator circuit, the charge pump circuit, and the lock loop filter circuit.

##### Sine-Zero-Crossing Detector

The sine zero crossing detector (schematic 0103-00-3003 sheet 2) converts the sine wave (SIN 3) from the sine buffer into a square wave. As the sine wave passes through its zero crossing point, the output from the crossing detector changes its dc level, thus producing the square wave. This square wave drives the source selector for the phase comparator. All test points and components are located under the shield. TP1 is the sine wave zero crossing output. There are no adjustments in this circuit.

##### Source Selector

The source selector circuit (schematic 0103-00-3003

sheet 2) selects the reference frequency source for the phase comparator. The source selector selects from two reference frequency sources:SYNTH the internal frequency synthesizer or BXFREQ the external reference source from the Ext Freq In connector. The selector also selects one of the two available variable frequency waveforms: SQWAVE (square wave) and SIN3 (sine wave). When using the internal frequency reference, the comparator receives the square wave as the variable frequency waveform. When using the external frequency reference, the comparator uses the zero-crossed square wave as the variable frequency (triangle and sine wave functions) or square wave (square wave function). The front panel circuit through the microprocessor circuit controls the signal selection and routing. All components are located under the shield. TP2 is the buffered external reference frequency (external signal must be connected to EXT FREQ IN). TP3 is the frequency synthesizer output. There are no adjustments in this circuit.

### Phase Comparator

The phase comparator circuit (schematic 0103-00-3003 sheet 2) compares the reference frequency signal and the variable frequency signal and produces an output based on positive edge arrival times of each selected signal. The comparator generates three output conditions on the output lines VLAGR and VLEADR.

1. The reference signal and generated waveform arrive at the same time.
2. The reference signal leads the generated waveform.
3. The reference signal lags the generated waveform.

VLAGR and VLEADR drives the charge pump. All components are located under the shield. There are no test points or adjustments in this circuit.

### Charge Pump

The charge pump circuit (schematic 0103-00-3003 sheet 3) controls the current flow to and from the lock-loop filter. The two output line from the phase comparator (VLAGR and VLEADR) regulates the charge pumps current flow. Current flow represents the difference between the selected reference frequency signal and the variable frequency signal which is set from the front panel. The current pulses briefly during the positive edge comparison and then stops. The time difference between the input signals VLAGR and VLEADR determine the amount of current pumped to the lock-loop filter. The arrival order of the input signal VLAGR and VLEADR determine the direction of the current flow. If the signals arrive at the same time, no current is pumped

to the lock-loop filter. All test points and components are located under the shield. TP7 is the variable lag reference. TP8 is the variable lead reference. There are no adjustments in this circuit.

### Lock-Loop Filter

The lock-loop filter circuit (schematic 0103-00-3003 sheet 3) converts the current flow from the charge pump into an error voltage (VLOOP) for the function generator's VCG summing amplifier. The filter smooths the pulsing current flow into a voltage that is the average of the current pulses. The error voltage is positive when the average current is flowing from the filter and negative when the average current is flowing into the circuit. The error voltage VLOOP gradually changes the VCG summing amplifier's output signal (VSUM) changing generators frequency closer the reference frequency.

Under certain conditions the microprocessor circuit disconnects the VLOOP error signal from the VCG summing amplifier. If the reference to variable frequency difference is too great which generates an even greater error in the opposite direction the microprocessor circuit turns on the UNLOCK indicator at the front panel and disconnects the VLOOP signal. When FM or Sweep modulation is selected at the front panel, the VLOOP signal is disconnected, but the UNLOCK indicator is not turned on.

The microprocessor circuit varies the characteristics of the lock-loop filter characteristics based on the selected frequency. During the auto cal cycle, the internal calibration network produces a correction voltage VPHASE that fine tunes the lock-loop filter. TP9 is the phase lock loop error voltage. There are no adjustments in this circuit.

### 4.2.4.2 Sine Convertor

The sine convertor consists of three circuits: the variable supply, the sine convertor itself, and the sine buffer.

#### Variable Supply

The variable supply (schematic 0103-00-3003 sheet 5) produces an isolated  $\pm 12V$  used only by the sine converter. To provide minimum sine distortion, the internal calibration network on the motherboard measures the sine distortion and produces a correction voltage VSIN-CAL which fine tunes the sine convertor by adjusting the variable supply. There are no test points in this circuit. R97 provides course adjustment of the variable supply.

#### Sine Converter

The sine convertor (schematic 0103-00-3003 sheet 4) transforms the triangle (TRIOUT from the sine buffer) into a sine wave. The sine convertor uses the logarithmic

response characteristics of the ten matched diodes to approximate a sine wave current output SINCO. TP13 is the sine wave converter output. R33 adjusts the input level of the sine converter.

#### **Sine Buffer**

The sine buffer (schematic 0103-00-3003 sheet 4) converts the sine current supplied by the sine converter into two sine wave signals (SIN1 and SIN3). Signal SIN1 drives the function selector on the output assembly, and provides the carrier for the X-Y multiplier (AM). Signal SIN3 is routed to the phase lock-loop's sine zero-crossing Circuit. TP10 monitors the sine wave buffered output. R64 adjusts signal dc level. R208 adjusts sine wave amplitude.

#### **4.2.4.3 Amplitude Modulator**

The amplitude modulator consists of two circuits: the X-Y multiplier and the AM buffer.

#### **X-Y Multiplier Circuit.**

The X-Y multiplier (schematic 0103-00-3003 sheet 5) is a transconductance amplifier that produces differential currents that drive the AM buffer. The sine buffer from the sine converter provides the multiplier's carrier (X) input SIN1. The external Mod In signal supplies the circuit's modulation (Y) input MOD IN. During the auto cal cycle, the Model 288's internal calibration network measures the +PK and -PK signals (peak detector on the output board). The microprocessor circuit stores a correction value based on the measurement. During the control cycle, the DAC/sample and hold circuit converts the value into a voltage VAMCAL that fine tunes the X-Y multiplier. There are no test points in this circuit. R102 provides course adjustment of the sine wave input. R108 provides course adjustment of the modulation signal input.

#### **AM Buffer**

The AM buffer (schematic 0103-00-3003 sheet 5) is a differential amplifier that combines the two signals from the X-Y multiplier into one symmetrical around zero signal. The voltage level is compatible with the other signals selected at the output assembly. TP12 monitors the AM buffer output. R125 provides dc level offset adjustment.

#### **4.2.5 Output Assembly**

This assembly contains circuits that select the waveform, set the output level of the waveform, and provide waveform amplification. All waveforms can be dc offset. Waveform selection, amplitude, and dc offset are set from the front panel and processed by the microproces-

sor circuit. The assembly input registers read the data from the microprocessor circuit and routes the control lines to the circuits. This assembly contains the following circuits:

- Function Selector.
- Preamplifier.
- R-R2 Ladder.
- Power Amplifier.
- 20dB Attenuator.
- Balanced Drivers.
- Peak Detector.

#### **4.2.5.1 Function Selector**

The function selector (schematic 0103-00-3002 sheet 2) selects and routes either the square wave, triangle wave, sine wave, or amplitude modulated signal to the preamplifier. The triangle wave TRIOUT from the function generator assembly, sine wave SIN1 from the phase lock loop assembly, and amplitude modulated signal AMSIG from the phase lock loop assembly are unchanged. But, the square wave SQWAVE from the function generator assembly is shaped, and its amplitude set to the same level as the other signals. The output level from the function selector for all waveforms is 2Vp-p. The front panel selections, processed by the microprocessor circuit, select and route the waveforms to the preamplifier. TP1 is the shaped square wave input. There are no adjustments in this circuit.

#### **4.2.5.2 Preamplifier**

This circuit (schematic 0103-00-3002 sheet 2) amplifies the selected 2Vp-p waveform (square wave, triangle wave, sine wave, and amplitude modulation signal) from the function selector to a 6Vp-p signal (PREAMP) which drives both the R-R2 Ladder and the Peak Detector. TP2 is the preamplifier output. C22 adjusts frequency peaking.

#### **4.2.5.3 R-R2 Ladder**

The R-R2 ladder digital binary attenuator (schematic 0103-00-3002 sheet 2) provides 0 to 20 dB of variable attenuation of the output from the preamplifier. With the exception of the first step of attenuation, each selected step doubles the attenuation of the previous step. Attenuation depends on the front panel selections and microprocessor circuit processing. There are no test points or adjustments in this circuit.

#### **4.2.5.4 Power Amplifier**

The power amplifier, a fixed gain, wide-band inverting amplifier with a push-pull complimentary symmetry

output stage, (schematic 0103-00-3002 sheet 2) provides the gain and drive needed for the balanced and unbalanced outputs and -20 dB attenuator. The amplifier receives its input (PA IN) from the R-R2 ladder. Another input, VOFST, supplies the dc offset level. VOFST also allows the internal calibration network through auto cal to correct for amplifier aging and temperature effects. Two diodes, CR29 and CR30, protects the four output transistor that drive the output.

#### **4.2.5.5 -20 dB Attenuator**

The -20 dB attenuator circuit (schematic 0103-00-3002 sheet 6) reduces the power amplifier PA OUT level by either 0dB or -20 dB. The microprocessor circuit selects the attenuator based on the output level selected via the front panel. This attenuator together with the R-R2 ladder and the -40 dB attenuator on the balanced and unbalanced network sets the output level. There are no test points or adjustments in this circuit.

#### **4.2.5.6 Unbalanced and Balanced Drivers**

This circuit (schematic 0103-00-3002 sheet 6) routes the signal from the -20 dB attenuator to either the unbalanced output, UBOUT, or the balanced drivers. TP6 is the negative balance driver output. TP7 is the positive balance driver output. There are no adjustments in this circuit. The unbalanced signal is routed to the unbalanced output attenuator network and impedance control circuits on the A2 Motherboard unchanged as (UBOUT). The unbalanced signal (UNBAL OUT) is routed through two complimentary drivers which produces two 180° out signals, BOUT1 and BOUT2. Both signals drive the peak detector and balanced output attenuator network and impedance control circuits on the motherboard.

#### **4.2.5.6 Peak Detector**

During the auto cal cycle, the peak detector circuit (schematic 0103-00-3002 sheet 7) processes four signal lines generated on the output assembly. The peak detector circuit consists of the input selector and its positive and negative peak detectors, as well as a harmonic distortion notch filter.

For ac measurements the input selector routes one of the four inputs to the peak detector: preamplifier output PREAMP, balanced driver outputs BOUT 1 and BOUT2, and power amplifier output PAOUT. The peak detector senses the positive and negative value and produces a dc equivalent value for the internal calibration network. For dc measurements the input selector chooses one of the four inputs and routes it directly to the +PK. The sine wave from PREAMP drives the harmonic distortion notch filter whose output voltage, THD, represents the sine's distortion content. The voltage THD corrects for minor distortions in the sine convertor circuit.

TP8 is the total harmonic distortion notch filter output. TP9 is the positive peak detector output (not measurable). TP10 is the negative peak detector output (not measurable). There are no adjustments in this circuit.

#### **4.2.6 Rear Panel**

This assembly (refer to the instrument schematic 0004-00-0510) provides the operator with line power connection, voltage selection facilities, fuse protection, and GPIB connection. The selected input line voltage of 100/120/220/240 Vac is converted to ≈8 Vac, ≈32 Vac, and ≈52 Vac for use by the individual power supply circuits located on the A2 Motherboard Assembly. ≈9 Vac is provided to the Front Panel Assembly for display power. Front Panel Assembly provides On/Off switching.

# SECTION 5

## CALIBRATION PROCEDURE

### 5.1 CALIBRATION

This section contains the Model 288's calibration procedures (paragraph 5.2).

Wavetek maintains a factory repair department for those customers not possessing the necessary personnel or test equipment to calibrate or repair the instrument. Before returning the instrument, contact the Customer Service Department by calling or writing:

Wavetek San Diego, Inc.  
9045 Balboa Ave.  
San Diego, CA 92123  
Telephone: (619) 279-2200  
TWX: (910) 335-2007

The Model 288 provides the user with two calibration methods: Auto Cal and Calibrate.

#### 5.1.1 Auto Cal

Auto Cal (automatic calibration) provides a quick method of calibrating the Model 288 without using external test equipment. Auto Cal does not require opening the instrument or making adjustments. Use Auto Cal when Model 288 accuracy is critical, long term instrument storage, following drastic changes in the environment, or when the operator believes Auto Cal is necessary. Paragraph 5.3.1 describes the Auto Cal procedure.

#### 5.1.2 Calibrate

The calibrate mode provides a more extensive method of calibrating the Model 288 using external test equipment. Calibrate does require opening the instrument and making adjustments. Use Calibrate when the Model 288 displays "CAL REQUIRED" or "FAILED AUTO CAL", when the Model 288 has been repaired or fails the Performance Verification procedure (Paragraph 2. ), or when routine calibration is scheduled. Paragraph 5.3.2 describes the Calibrate procedure.

### 5.2 AUTO CAL PROCEDURE

To Auto Cal the Model 288, perform the following steps. Auto Cal requires no external test equipment, in fact, nothing must be connected to the input connectors otherwise the Auto Cal circuitry could miscalibrate the instrument. Also, disconnect all outputs from the instrument otherwise the sudden changes in the instrument's output waveforms could damage external equipment.

1. Turn on the Model 288 and allow it to warm up for 20 minutes. Pressing the Calibrate key prior to the 20 minute warm up time displays the count-down time to Auto Cal. The instrument automatically Auto Cals after the 20 minute count down. However, pressing any other key during the count down aborts Auto Cal and returns the instrument to normal operation.

Remember to remove all input and output connections to the Model 288 before pressing Auto Cal.

2. Press the Calibrate key and allow the unit time to complete the Auto Cal. When completed successfully, the Model 288 displays AUTOCALIBRATED and the unit returns to its last setting. If the Auto Cal fails the Model 288 displays an error message which identifies the parameter - ERR (Keyword). If this occurs occasionally, try to Calibrate the unit again. Note the error keywords and report the errors when the unit is returned for scheduled maintenance.

### 5.3 CALIBRATE PROCEDURE

To calibrate the Model 288 perform the following steps. This procedure contains five separate steps which the Model 288 guides you through. If a specific step needs adjustment, use the cursor key to advance to the desired step.

**Table 5-1. Recommended Test Equipment**

Test Equipment	Recommended Model
Scope	Tektronix 2465 or equiv.
Distortion Analyzer	Hewlett Packard 8903B or equiv.
Digital Voltmeter	Not Critical
Function Generator	Not Critical
Phase Meter (optional)	Hewlett Packard 5335A or Hewlett Packard 3575A

**NOTE**

Use rear panel for all ground connections unless otherwise specified.

All indications and waveforms are referenced to chassis ground unless otherwise specified.

**STEP 1 Initial Setup**

1. Remove five top cover screws.

**NOTE**

Keep the top shield and top cover in place during the procedures except when necessary to make an internal adjustment.

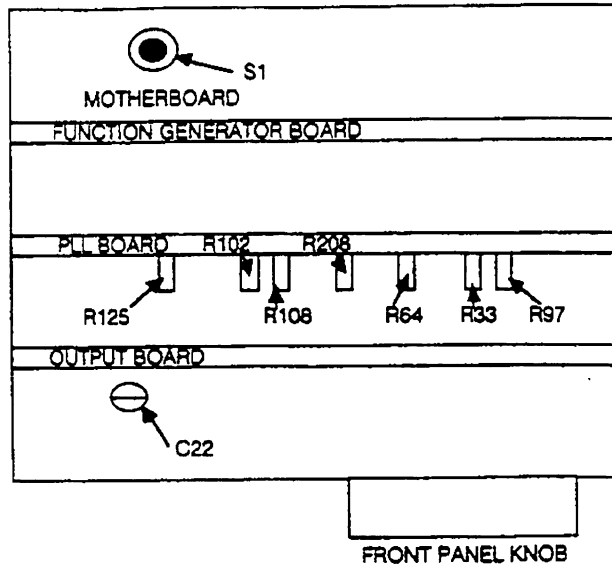
2. Perform the turn-on procedures as shown in paragraph 2.3.3.

**WARNING**

**Dangerous voltages are present with the covers removed. Where maintenance can be performed without power applied, the power should be removed. Battery voltage is present even with AC power cable removed.**

3. Slide the top cover back. Press and hold down the internal calibration switch S1 (figure 5-1) while pressing the front panel CALIBRATE key.
4. Verify the Model 288 display indicates **WVTK SN XXXXXX** or **WVTK SN 0**. Press the front panel → CURSOR key.

5. Verify the Model 288 display flashes **CALIBRATING** then indicates **USER SN XXXX** or **USER SN 0**.

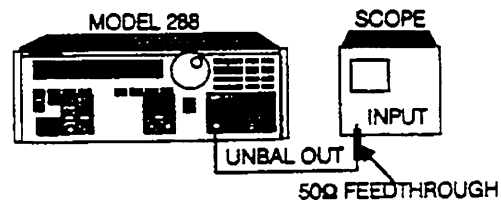


**Figure 5-1. Calibration Location**

**STEP 2 Adjust Square Wave**

Before performing any adjustment procedure, the initial setup (Step 1 of this procedure) must be completed.

1. Verify that the Model 288 display indicates **USER SN XXXX** or **USER SN 0**.
2. Verify that the Model 288 display flashes **CALIBRATING** then indicates **PEAKING C22**.
3. Connect the test equipment as shown in figure 5-2.



**Figure 5-2. Square Wave Adjust Setup**



4. Set the scope controls to display the Model 288 output. Verify that the scope displays peak-to-peak aberrations are greater than 3% and less than 5%.
  - .. If incorrect, adjust C22 (figure 5-1) until the reading is within specified limits.
5. On the Model 288,
  - Press the  $\Rightarrow$  Cursor key. Verify the display flashes **CALIBRATING** then indicates **R33, 97, 64 VSINE XX**.

### STEP 3 Adjust Sine Wave.

1. Connect the test equipment as shown in figure 5-3.

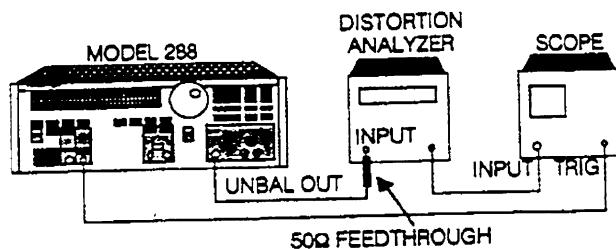


Figure 5-3. Sine Wave Adjust Setup

2. Set the distortion analyzer controls to display the Model 288 output signal Total Harmonic Distortion (THD) in dB.
  3. On the Model 288, slowly adjust the Front Panel Knob (figure 5-1) until the THD as displayed on the distortion analyzer is minimum. Verify that reading is  $\leq -50$  dB at 10 kHz.
- If correct, proceed to STEP 3 Adjust Amplitude.

4. If incorrect, set the scope controls to display the distortion analyzer output.

Adjust R33 (figure 5-1) until waveform peaks are clearly visible in the residue.

Adjust R97 until waveform peaks are symmetrical, one above the average value of the residue signal and one below.

5. Adjust R33 until the peaks disappear back into the residue.
6. Observe the overall ripple in the residue in the area of the waveform zero crossings as displayed on the scope. Turn the Model 288 Front Panel Control

Knob CW until the waveform peaks are clearly visible in the residue and repeat step 6.

If the overall ripple has decreased, continue the procedure always turning the Model 288 Front Panel Knob CW.

If the overall ripple has increased, continue the procedure always turning the Model 288 Front Panel Knob CCW.

7. Repeat steps 5 and 6 until:

The amplitude of the overall ripple in the residue signal is minimum as displayed on the scope.

The THD as measured on the distortion analyzer is  $\leq -50$  dB.

8. Disconnect the test equipment.

9. Connect the digital multimeter + lead to TP10 and - lead to TP11. Verify that the digital multimeter displays  $< 1$  mVdc.

If incorrect, adjust R64 until the reading is within specified limits.

10. On the Model 288, press the  $\Rightarrow$  Cursor key. Verify the display flashes **CALIBRATING** then indicates **SIN AMP R208**.

### STEP 4 Adjust Amplitude

1. Connect the test equipment as shown in figure 5-4.

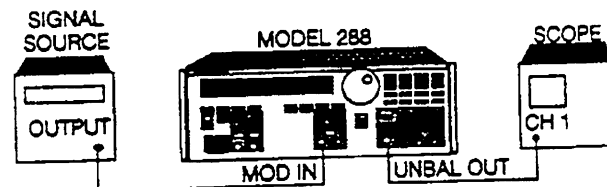


Figure 5-4. Adjust Amplitude Setup

2. Verify that the digital voltmeter reads  $7.071$  Vrms  $\pm 100$  mVrms.
  - If incorrect, adjust R208 (figure 5-1) until reading is within specified limits.

3. On the Model 288,

Press the  $\Rightarrow$  CURSOR key.

Verify that the display indicates **CALIBRATING** for approximately 5 seconds.

Verify that the display indicates **ADJ AM POTS.**

### STEP 5 Adjust Amplitude Modulation

1. Connect the test equipment as shown in figure 5-5.

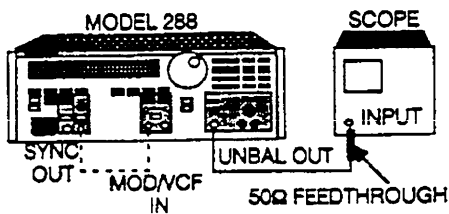


Figure 5-5. Adjust AM Setup

2. Set the scope controls to display the Model 288 output. Verify the scope displays carrier null with <50 mVp-p AC ripple and <5 mVdc offset.

If carrier null is incorrect, adjust R108 (figure 5-1) for minimum indication..

If DC offset is incorrect, adjust R125 until reading is within specified limits.

3. On the Model 288,

Press the  $\Rightarrow$  CURSOR key.

Verify that the display flashes **CALIBRATING** for approximately 1 second. then displays **AM MOD NULL.**

Connect a jumper between A7TP11 and TP13.

4. Connect a 50Ω BNC cable between the Sync Out and the Mod/VCF In connectors

5. Verify that the scope displays carrier null with <20 mVp-p AC ripple.

If incorrect, adjust R102 for minimum indication

6. On the Model 288,

Press the  $\Rightarrow$  Cursor key.

Verify that the display indicates **CALIBRATING** for approximately 5 seconds. then displays **PHASE 0 XX,XXX**

### STEP 6 Adjust Phase

1. Connect the test equipment as shown in figure 5-6.

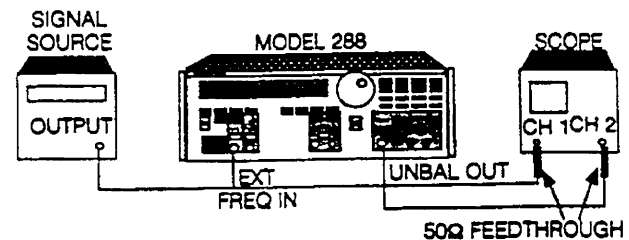


Figure 5-6. Adjust Phase Setup

2. Set the signal source controls as follows:

Set Function to Sine.

Frequency to 2kHz.

Output Level to 5V p-p.

3. Set the scope controls as follows:

Trigger to channel 1.

Channel 1 and 2 vertical controls so that settings are identical, and waveforms are displayed.

Channel 1 and 2 horizontal controls so that settings are identical, and waveforms are displayed.

Adjust the controls to accurately superimpose both waveforms.

Select channel 2 Invert.

Select 1 and 2 Add.

4. On the Model 288,

Adjust the Front Panel Knob to null the added waveform on the scope display.

Press the  $\Rightarrow$  CURSOR key.

Verify that the display flashes **CALIBRATING** for approximately 1 second.

Verify that the display indicates **PHASE +180 XX,XXX.**

5. Set the scope controls as follows:

Set Channels 1 and 2 Add to Off.

Channel 1 and 2 vertical controls so settings are identical, and waveforms are displayed.

Channel 1 and 2 horizontal controls so settings are identical, and waveforms are displayed.

Adjust the controls to accurately superimpose both waveforms.

Select channel 2 normal (non-invert).

Set Channels 1 and

6. On the Model 288,

Adjust the Front Panel Knob to null (minimum displayed signal) the added waveform on the scope display.

Press the ⇒ CURSOR key.

Verify that the display flashes **CALIBRATING** for approximately 1 second then displays **PHASE -180 XX,XXX.**

Adjust the Front Panel Knob to null (minimum displayed signal) the added waveform on the scope display.

7. On the Model 288,

Press the ⇒ CURSOR key.

Verify that the display flashes **CALIBRATING** for approximately 1 second then displays **SQ PHASE 0 XX,XXX.**

8. Set the Signal Source controls as follows:

Function to Square.

Frequency to 2kHz.

Output Level to 5V p-p.

9. Set the scope controls as follows:

Trigger on channel 1.

Channel 1 and 2 vertical controls so settings are identical, and waveforms are displayed.

Channel 1 and 2 horizontal controls so settings are identical, and waveforms are displayed.

Adjust controls to accurately superimpose both waveforms.

Select channel 2 Invert.

Select 1 and 2 Add.

10. On the Model 288,

Adjust the Front Panel Knob to null the added waveform on the scope display.

Press the CALIBRATE key.

Verify that the display indicates **CALIBRATION OFF.**

11. Remove the power and disconnect the test equipment. Install top cover .



# SECTION 6

## TROUBLESHOOTING

### 6.1 INTRODUCTION

This section provides a method of troubleshooting the Model 288 to the circuit level. The Model 288 uses several "tools" in addition to conventional operating failures, such as blown fuses and nonoperating functions. The Model 288 produces error messages which this section uses to guide you to a probable faulty block. Also, the Model 288's performance verification procedure (paragraph 2.3.5) tests the units operating parameters. If the unit fails any one of the performance verification tests, proceed to the manual calibration procedure (section 5).

### 6.2 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.

### 6.3 BEFORE STARTING

No troubleshooting guide can possibly cover all the potential problems, the aim of this section is to guide you to a figure that represents each of the Model 288's assemblies. These figures contain information about unit setup and test conditions for test point on the assembly. Also, it is necessary to become familiarize with the instrument by reviewing the function description and the detailed circuit description (section 4) in conjunction with the schematics (section 7). Successful troubleshooting depends upon understanding the circuit operation within each function block as well as the block relationships.

#### 6.3.1 Inspection

Before beginning the troubleshooting procedure, use the following inspection procedures to locate obvious malfunctions with the Model 288.

1. Inspect all external surfaces of Model 288 for physical damage, breakage, loose or dirty contacts, and missing components.

2. Remove top cover, shield, and bottom cover to access components.

#### WARNING

**The Model 288 contains high voltages. After power is removed, discharge capacitors to ground before working inside the instrument to prevent electrical shock.**

#### CAUTION

Do not disconnect or remove any board assemblies in the Model 288 unless the instrument is unplugged. Some board assemblies contain devices that can be damaged if the board is removed with the power on. Several components, including MOS devices, can be damaged by electrostatic discharge. Use conductive foam and grounding straps when servicing is required around sensitive components. Use care when unplugging IC's from high-grip sockets.

3. Inspect printed circuit board surfaces for discoloration, cracks, breaks, and warping.
4. Inspect printed circuit board conductors for breaks, cracks, cuts, erosion, or looseness.
5. Inspect all assemblies for burnt or loose components.
6. Inspect all chassis-mounted components for looseness, breakage, loose contacts or conductors.
7. Inspect the Model 288 for disconnected, broken, cut, loose, or frayed cables or wires.

### 6.4 TROUBLESHOOTING

This troubleshooting procedure relies on the the Model 288's error messages and performance verification failures. If during the normal operation the Model 288 fails, note the conditions and consult this table for the closest possible problem.

Table 6-1 lists the Models 288's error messages and references the recommended troubleshooting figure or

figures. Table 6-2 lists the items from the performance verification procedure and the recommended troubleshooting figures.

All control and signal lines, as well as voltages, are routed through the Motherboard; see figure 6-1. Check the Microprocessor circuit by verifying the flashing Life Light, if not check the supplies to the circuit. Also, remove all boards

tions and test point data. Use these figures by checking the output test points first, usually the right side of the block diagram, and proceeding by step back through the circuits. Once the suspected circuit has been isolated, use the appropriate assembly drawing, schematic, and parts list to aid in isolating the faulty component. Remember, the circuit description, section 4, provides a functional and detailed description of the circuit.

### Using the Troubleshooting Figures

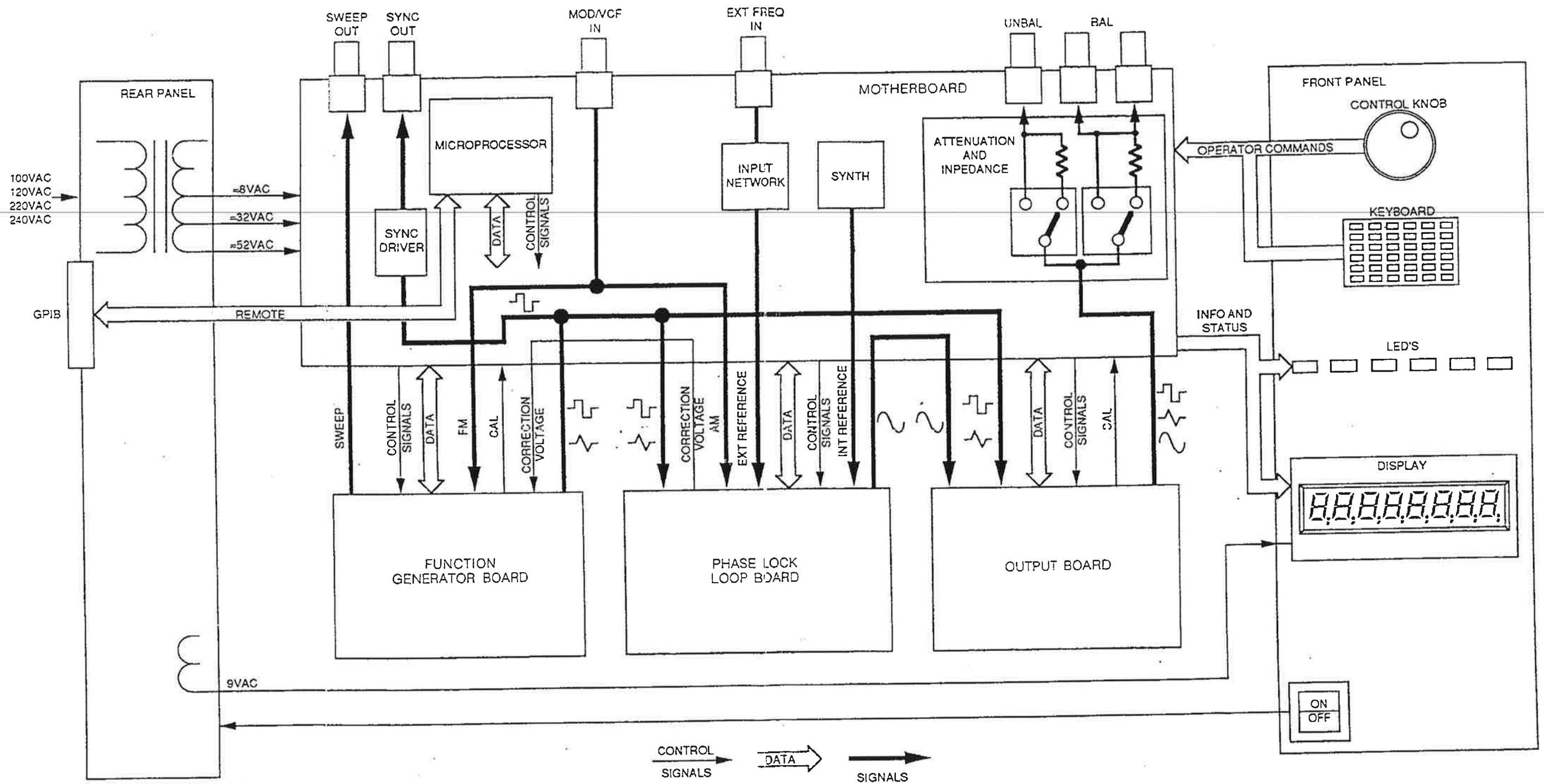
The troubleshooting figures contains test setup instruc-

**Table 6-1. Error Messages**

Error Message	Troubleshoot
VCGZERO VFREQ VFREQOS SPOVCGOFF .SNEGVCGOFF VTRIBAL SYMM50PCT POSVCGOFF SWPLENGTH SCALE TOFR7 TOFR6 TOFR5 TOFR4 TOFR3 COMP9+ COMP8+	Function Generator - Figure 6-7 Motherboard - Figures 6-1, 6-3, and 6-8 Front Panel - Figure 6-2
FINDNOTCH OFSTZERO OFSTGAIN BALOFFST SINEAMPL TRIAMPL SQURAMPL BALAMPL VSINCAL VAMCAL	Phase Lock Board - Figure 6-6 Output Board - Figure 6-4 Motherboard - Figures 6-1, 6-3, and 6-8

**Table 6-2. Performance Verification Failures**

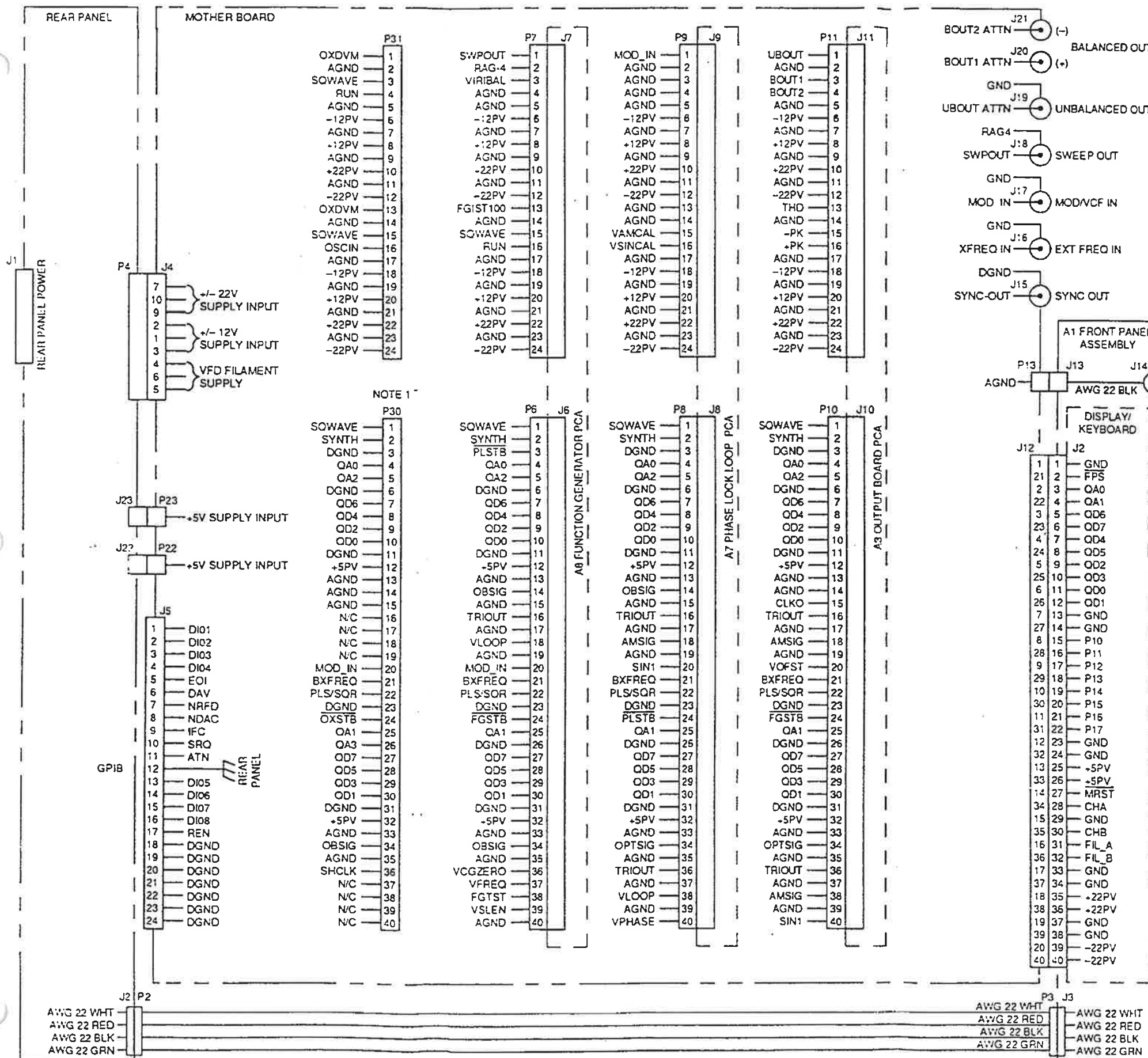
Test Failure	Troubleshoot
Frequency Range Frequency Resolution Symmetry VCF/FM Operation	Function Generator - Figure 6-7 Motherboard - Figure 6-1, 6-3, and 6-8 Front Panel - Figure 6-2 Phase Lock Board (Synth.) Figure 6-6
Waveform and Sweep Pulse Characteristics Output Verification AM Verification Sine Wave Purity Amplitude Accuracy DC Offset/Attenuator External Lock	Output Board - Figure 6-4 Phase Lock Board - Figure 6-6 Function Generator - Figure 6-7 Motherboard - 6-1, 6-3, and 6-8



BLOCK DIAGRAM

Figure 6-1. Instrument (Sheet 1 of 2).





NOTES:  
1. P30 AND P31 NOT USED. INFORMATION PROVIDED FOR TROUBLESHOOTING PURPOSES ONLY.

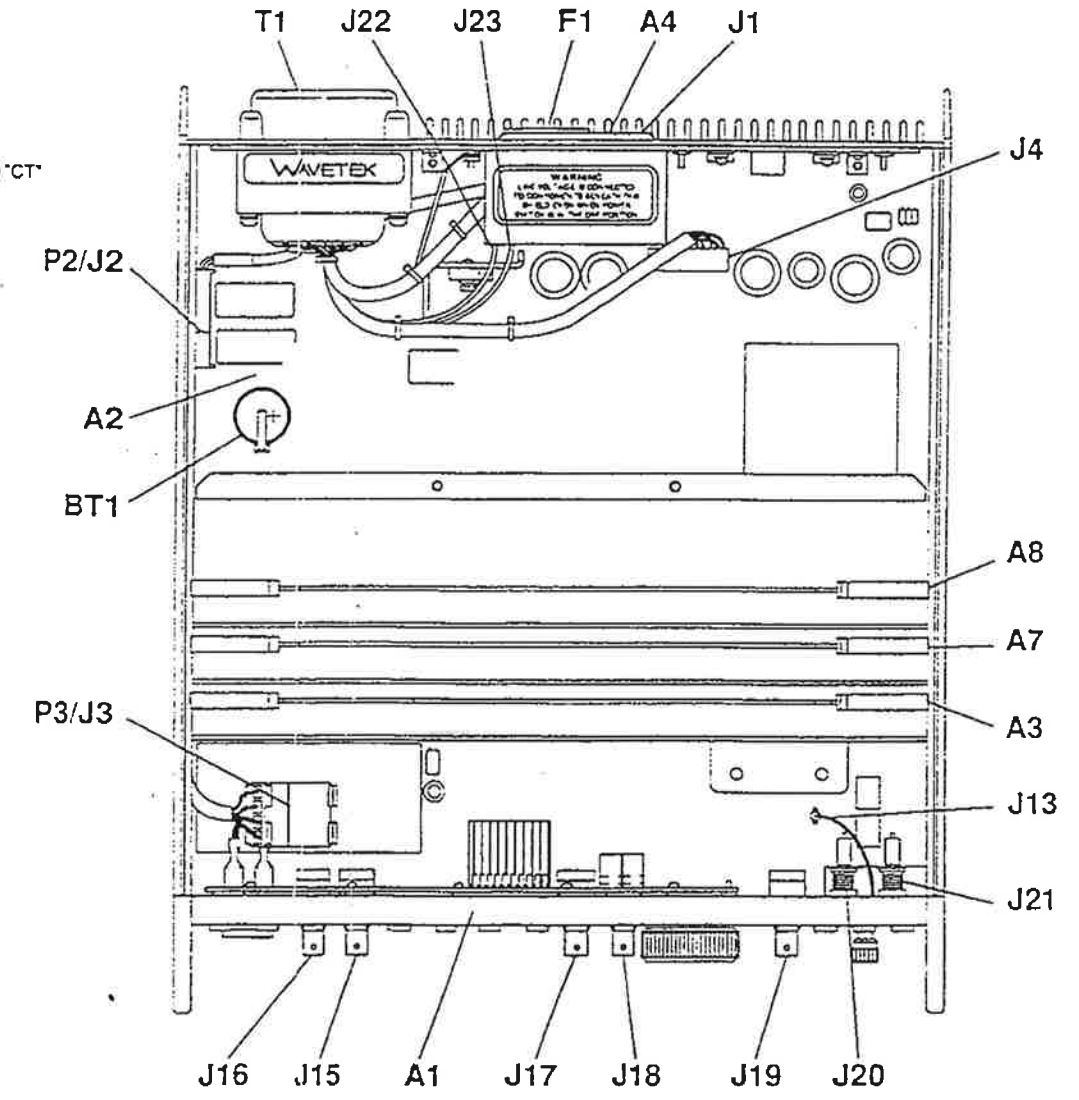


Figure 6-1. Instrument (Sheet 2 of 2).

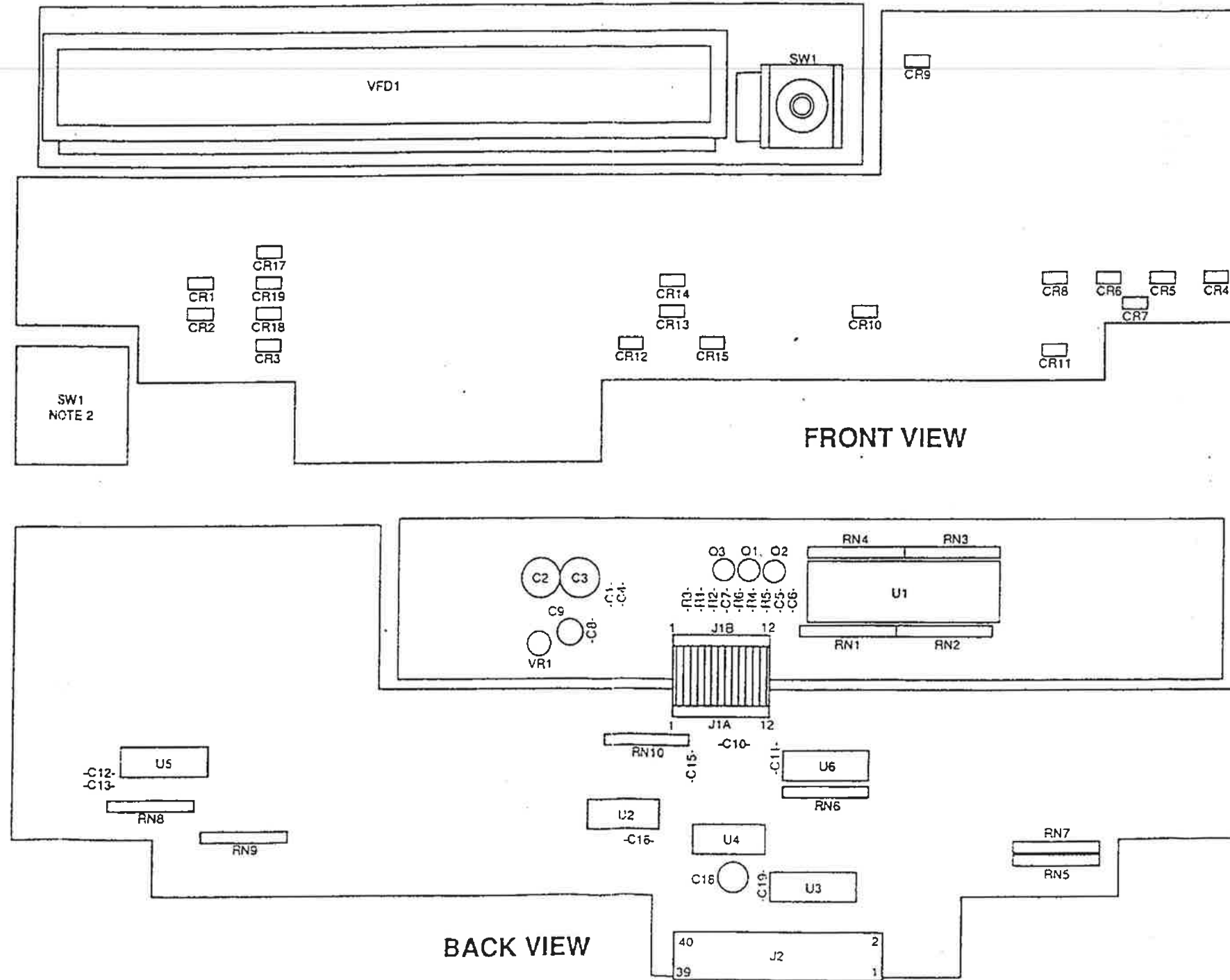
NOTES:

1. UNLESS OTHERWISE SPECIFIED:  
 RESISTANCE IS IN  $\Omega$  (METAL FILM 1/8W,  $\pm 1\%$ )  
 CAPACITANCE IS IN  $\mu\text{F}$   
 INDUCTANCE IS IN  $\mu\text{H}$

2. UNLESS OTHERWISE SPECIFIED, INITIAL SETUP FOR VOLTAGES AND WAVEFORMS IS:

SET POWER TO ON.  
 PRESS RESET KEY.  
 WAIT 20 MINUTES.  
 PRESS CALIBRATE KEY.  
 VERIFY DISPLAY SHOWS AUTOCALIBRATED.

3. UNLESS OTHERWISE SPECIFIED, ALL VOLTAGE READINGS AND WAVEFORMS TAKEN WITH RESPECT TO CHASSIS GROUND.



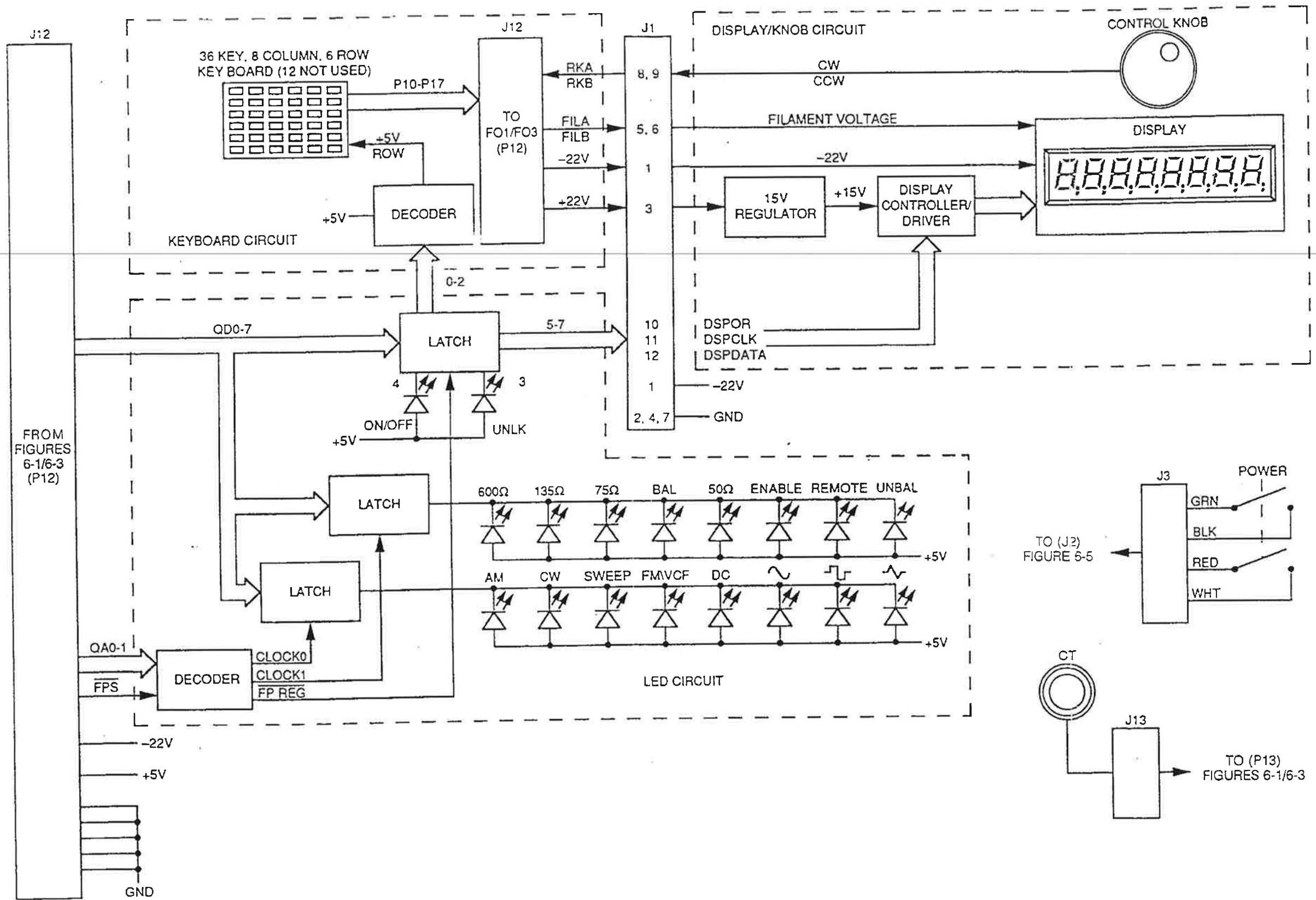


Figure 6-2. Front Panel (Sheet 2 of 2).

NOTES:

- UNLESS OTHERWISE SPECIFIED:  
RESISTANCE IS IN  $\Omega$  (METAL FILM 1/8W,  $\pm 1\%$ )  
CAPACITANCE IS IN  $\mu F$   
INDUCTANCE IS IN  $\mu H$
- UNLESS OTHERWISE SPECIFIED, INITIAL SETUP FOR VOLTAGES AND WAVEFORMS IS:  
  
SET POWER TO ON.  
PRESS RESET KEY.  
WAIT 20 MINUTES.  
PRESS CALIBRATE KEY.  
VERIFY DISPLAY SHOWS AUTOCALIBRATED.
- UNLESS OTHERWISE SPECIFIED, ALL VOLTAGE READINGS AND WAVEFORMS TAKEN WITH RESPECT TO CHASSIS GROUND.
- NOT FUNCTIONAL — TP1.
- GROUND — TP2, TP6, TP8, TP11 AND TP16.
- NOT USED — TP4, TP12, AND TP13.
- SIGNAL MEASURED WITH 1kHz AT 1Vp-p SINE WAVE SIGNAL. CONNECT TO EXTERNAL FREQUENCY INPUT. SELECT EXTERNAL LOCK ON INDICATOR TO ON.
- \* DENOTES CONTROL SIGNAL.

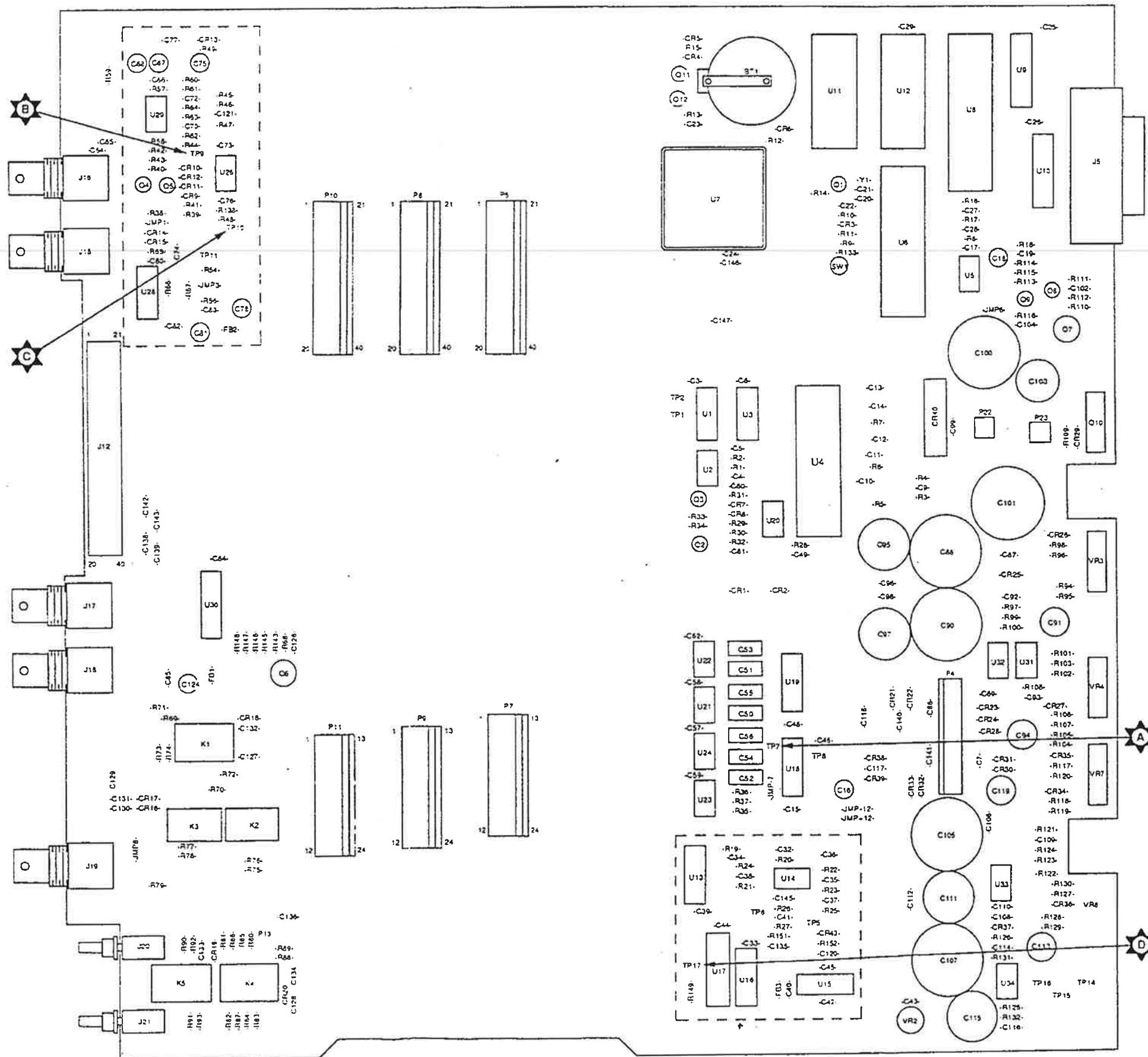
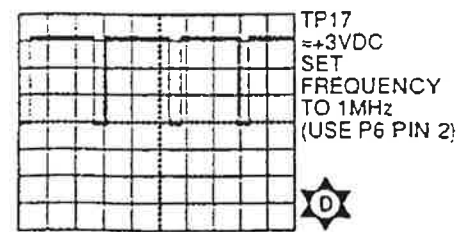
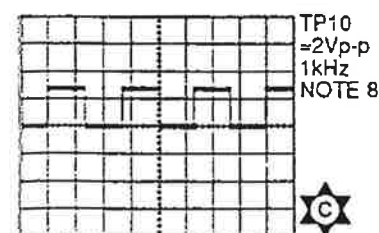
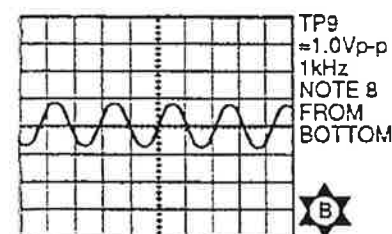
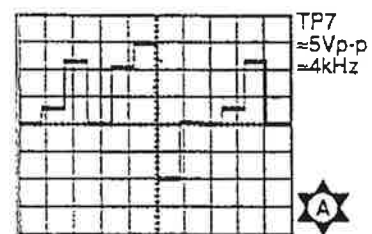


Figure 6-3. Motherboard (Sheet 1 of 2).

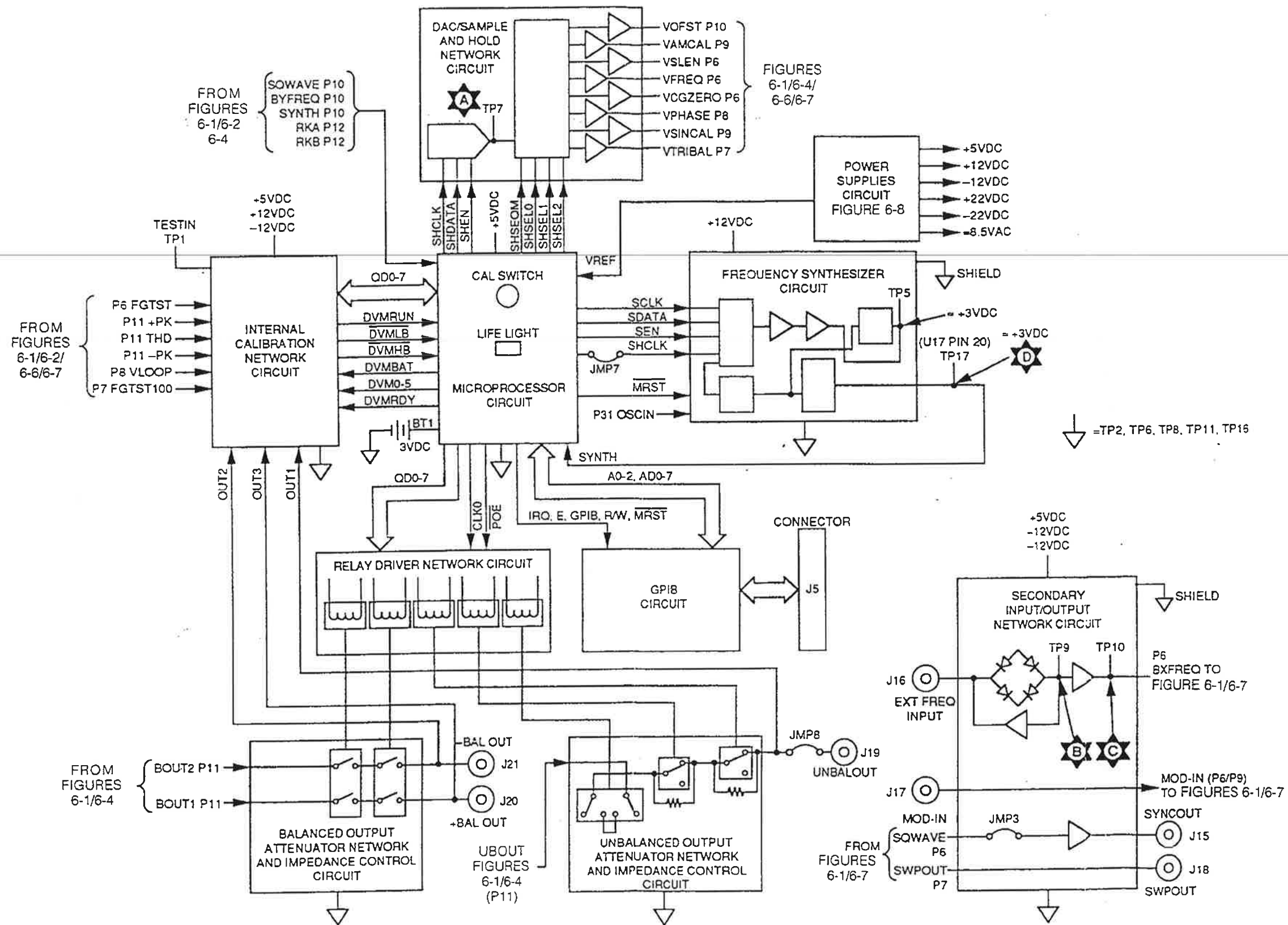


Figure 6-3. Motherboard (Sheet 2 of 2).

NOTES:

- UNLESS OTHERWISE SPECIFIED:  
RESISTANCE IS IN  $\Omega$  (METAL FILM 1/8W,  $\pm 1\%$ )  
CAPACITANCE IS IN  $\mu\text{F}$   
INDUCTANCE IS IN  $\mu\text{H}$

- UNLESS OTHERWISE SPECIFIED, INITIAL SETUP FOR VOLTAGES AND WAVEFORMS IS:

SET POWER TO ON.  
PRESS RESET KEY.  
WAIT 20 MINUTES.  
PRESS CALIBRATE KEY.  
VERIFY DISPLAY SHOWS AUTOCALIBRATED.

- UNLESS OTHERWISE SPECIFIED, ALL VOLTAGE READINGS AND WAVEFORMS TAKEN WITH RESPECT TO ANALOG/DIGITAL GROUND.

- ANALOG GROUND — TP3 AND TP5.

- NOT MEASURABLE — TP 9 AND TP10.

- SIGNAL MEASURED WITH FUNCTION SET TO SQUARE.

- SIGNAL MEASURED WITH OUTPUT SET TO 600 $\Omega$ .

- SIGNAL MEASURED WITH FREQUENCY AT =10KHZ TUNE TO MINIMUM SIGNAL.

- \* DENOTES CONTROL SIGNAL.

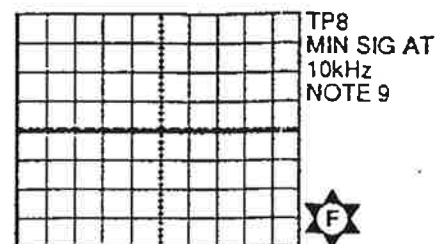
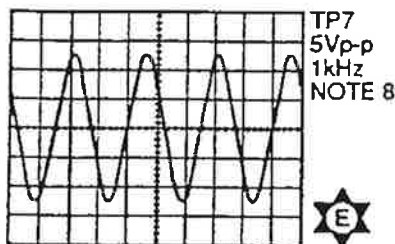
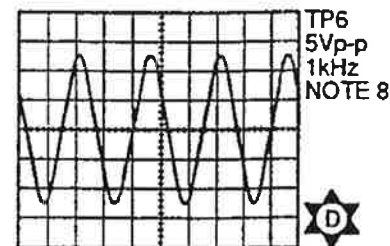
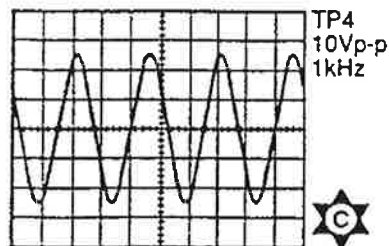
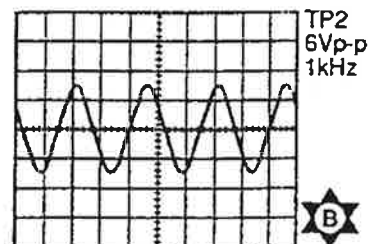
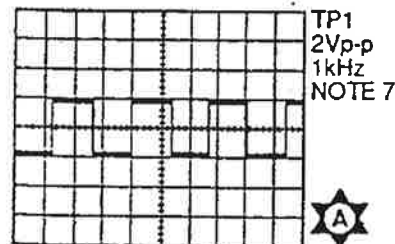
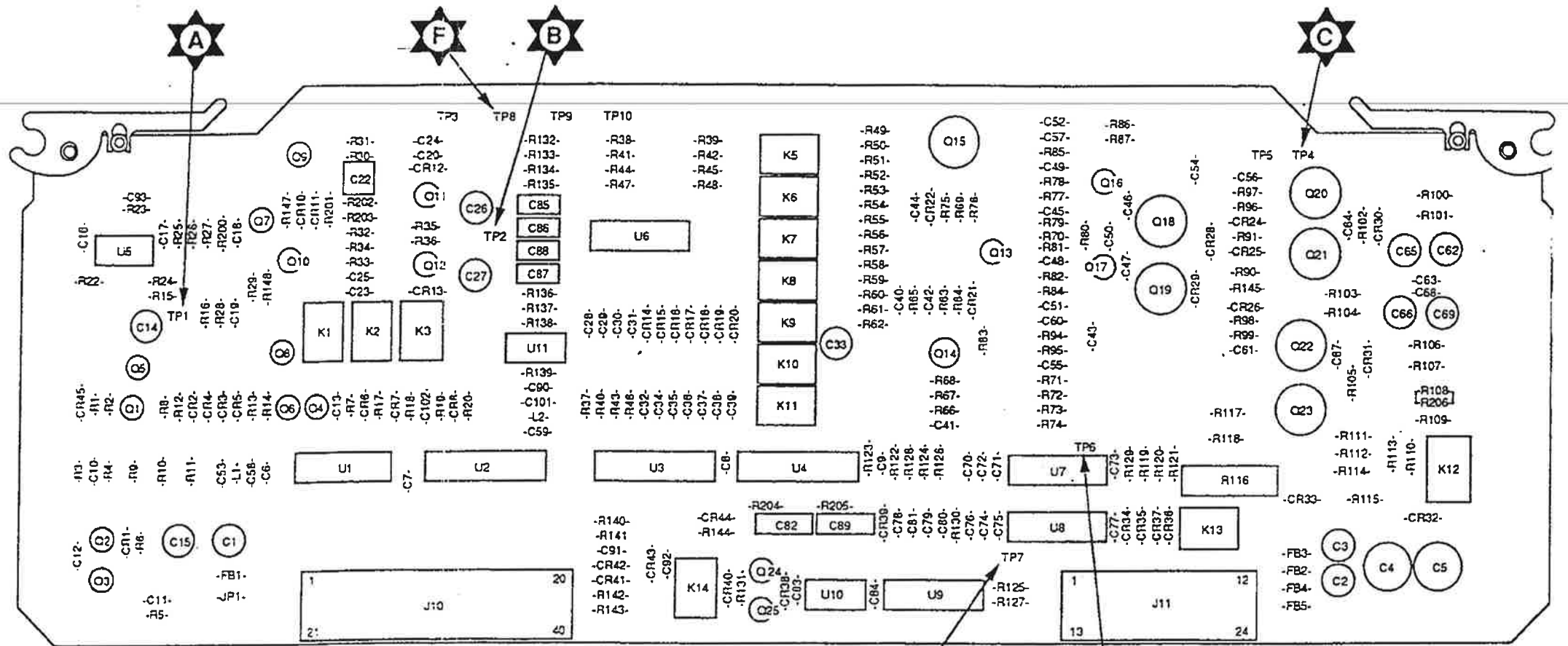


Figure 6-4. Output Board (Sheet 1 of 2).

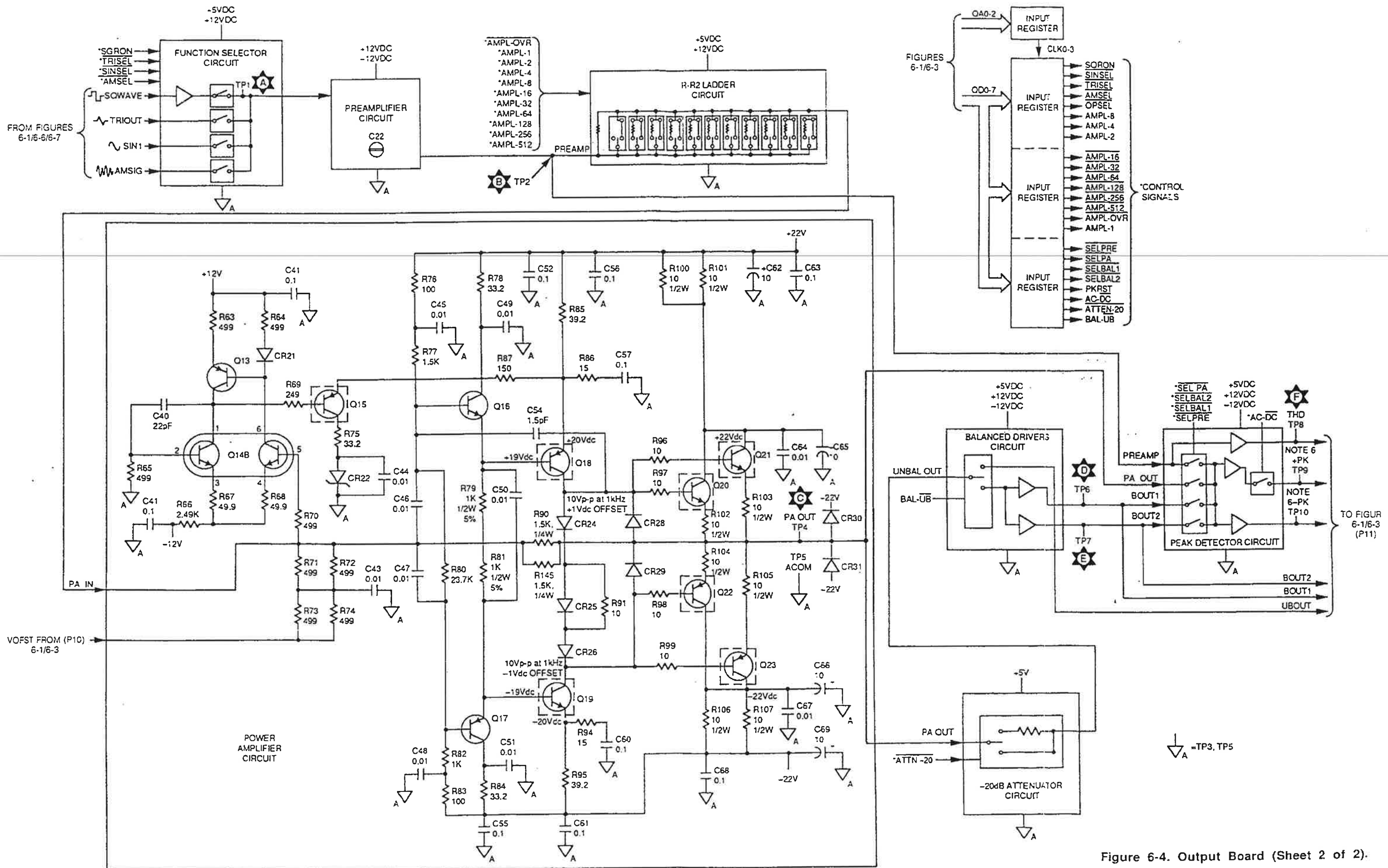
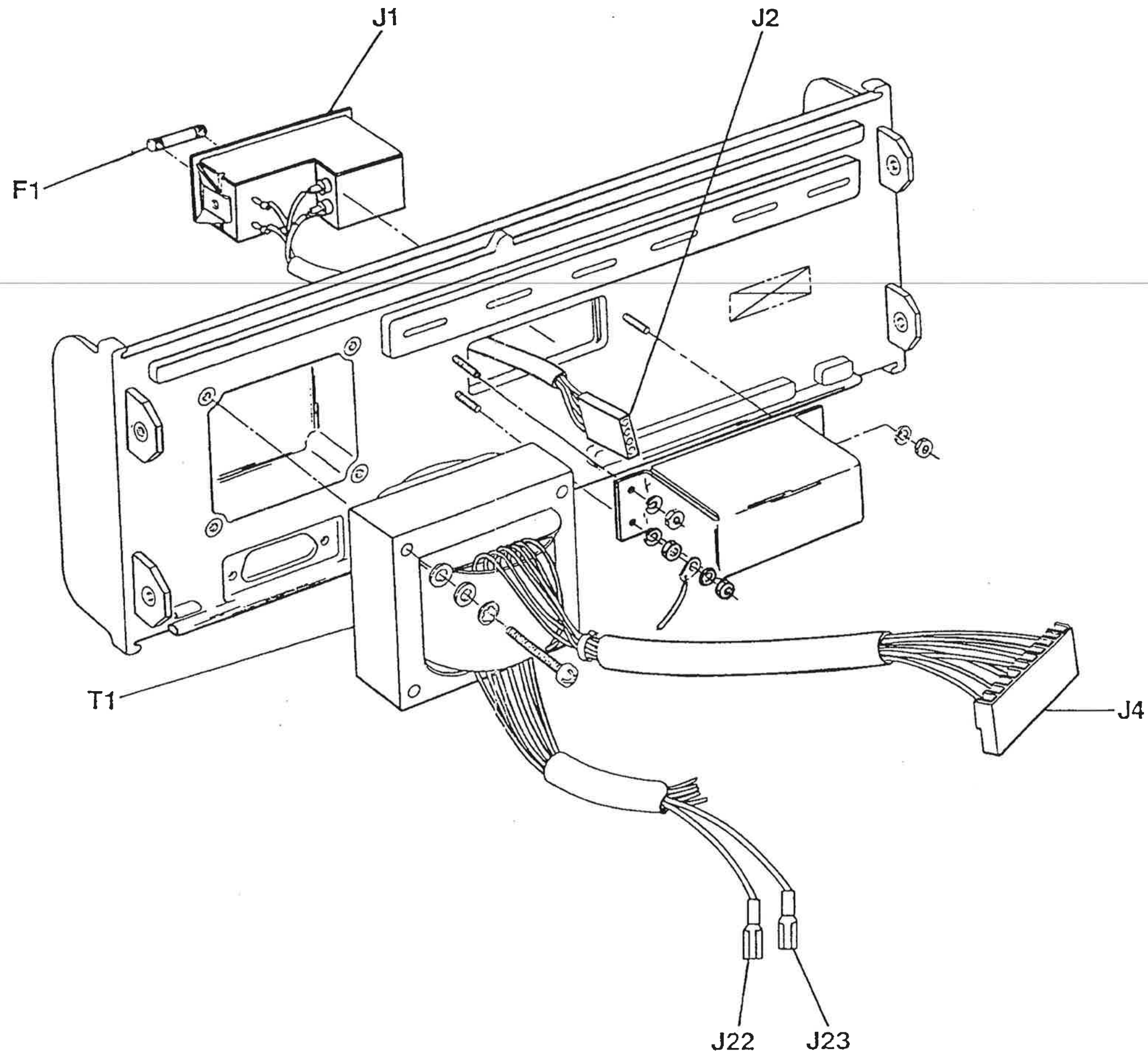


Figure 6-4. Output Board (Sheet 2 of 2).



NOTES:

1. UNLESS OTHERWISE SPECIFIED:  
 RESISTANCE IS IN  $\Omega$  (METAL FILM 1/8W,  $\pm 1\%$ )  
 CAPACITANCE IS IN  $\mu\text{F}$   
 INDUCTANCE IS IN  $\mu\text{H}$

2. UNLESS OTHERWISE SPECIFIED, INITIAL SETUP  
 FOR VOLTAGES AND WAVEFORMS IS:

SET POWER TO ON.  
 PRESS RESET KEY.  
 WAIT 20 MINUTES.  
 PRESS CALIBRATE KEY.  
 VERIFY DISPLAY SHOWS AUTOCALIBRATED.

3. UNLESS OTHERWISE SPECIFIED, ALL VOLTAGE  
 READINGS AND WAVEFORMS TAKEN WITH  
 RESPECT TO CHASSIS GROUND.

4. 100 VAC = A-B, C-D, E-F

120 VAC = E-F, B-C-D

220 VAC = A-B, D-E

240 VAC = B-C, D-E



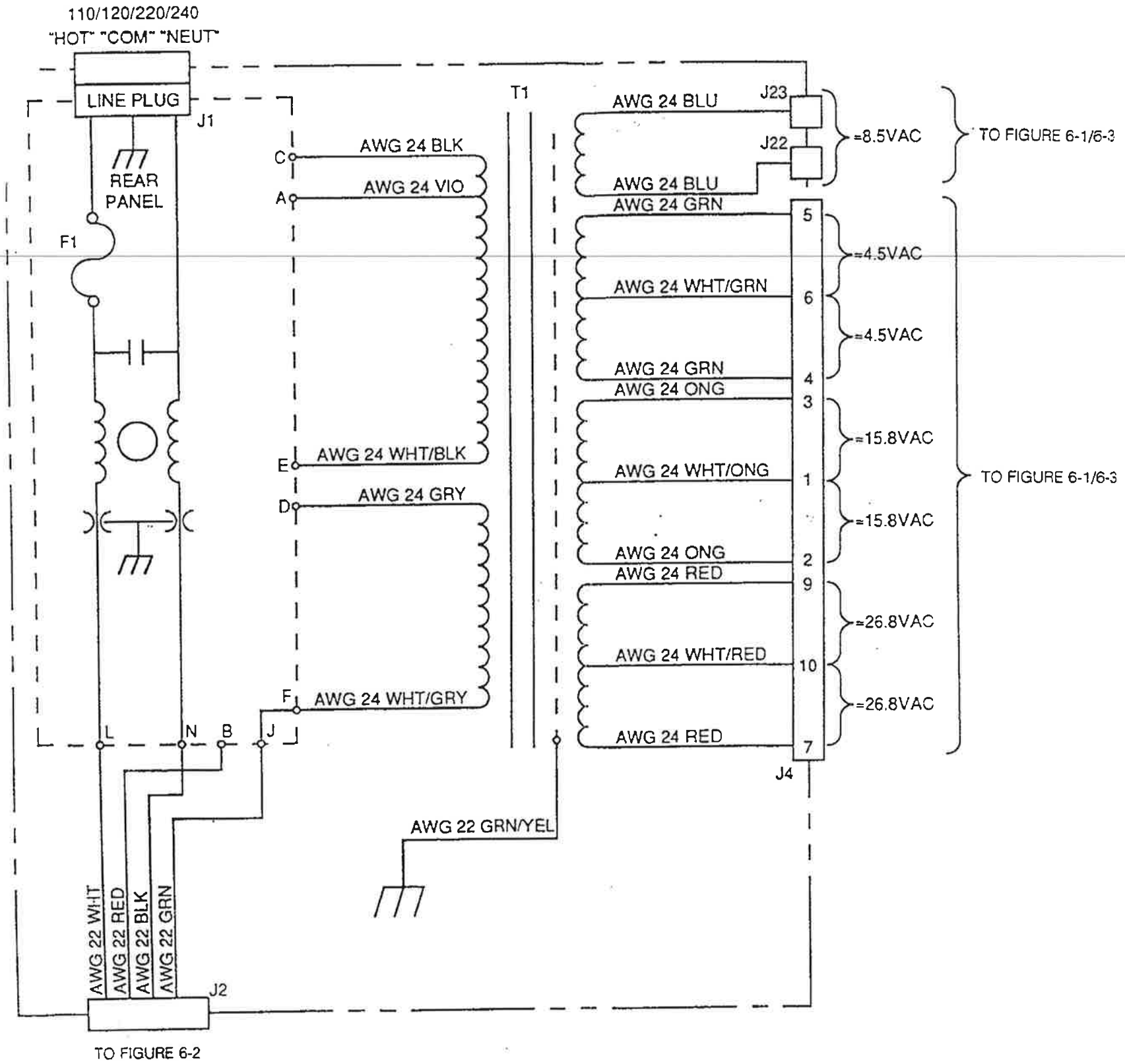


Figure 6-5. Rear Panel Assembly (Sheet 2 of 2).

NOTES:

1. UNLESS OTHERWISE SPECIFIED:  
RESISTANCE IS IN  $\Omega$  (METAL FILM 1/8W,  $\pm 1\%$ )  
CAPACITANCE IS IN  $\mu\text{F}$   
INDUCTANCE IS IN  $\mu\text{H}$

2. UNLESS OTHERWISE SPECIFIED, INITIAL SETUP FOR VOLTAGES AND WAVEFORMS IS:

SET POWER TO ON.  
PRESS RESET KEY.  
WAIT 20 MINUTES.  
PRESS CALIBRATE KEY.  
VERIFY DISPLAY SHOWS AUTOCALIBRATED.

3. UNLESS OTHERWISE SPECIFIED, ALL VOLTAGE READINGS AND WAVEFORMS TAKEN WITH RESPECT TO ANALOG/DIGITAL GROUND.

4. DIGITAL GROUND — TP4.

5. ANALOG GROUND — TP11.

6. NOT USED — TP5 AND TP6.

7. SIGNAL MEASURED WITH 1kHz AT 1 Vp-p SINE WAVE SIGNAL. CONNECT TO EXTERNAL FREQUENCY INPUT. SELECT EXTERNAL LOCK ON INDICATOR TO ON.

8. SIGNAL MEASURED WITH EXTERNAL LOCK ON INDICATOR TO ON WITHOUT SIGNAL CONNECTED TO EXTERNAL FREQUENCY INPUT.

9. \* DENOTES CONTROL SIGNAL.

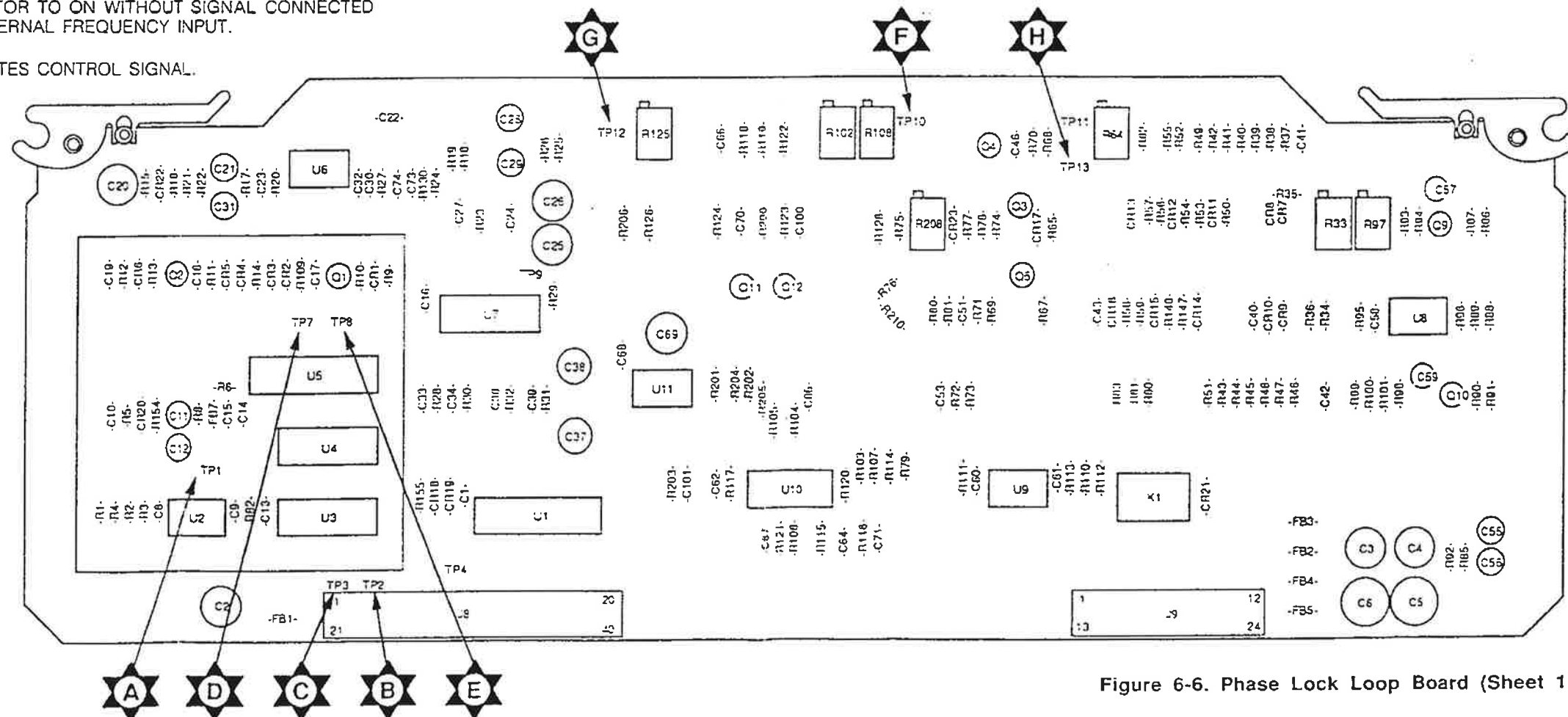
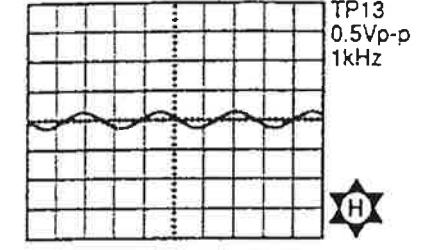
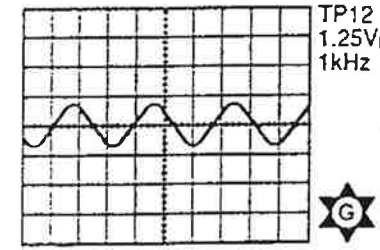
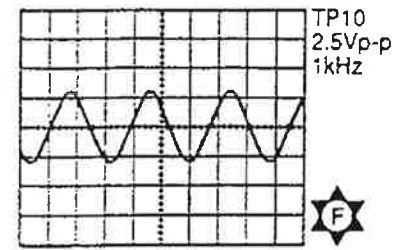
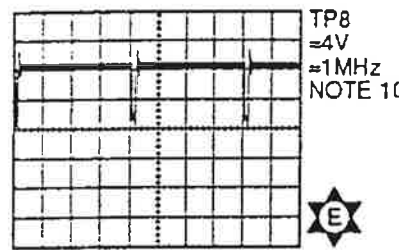
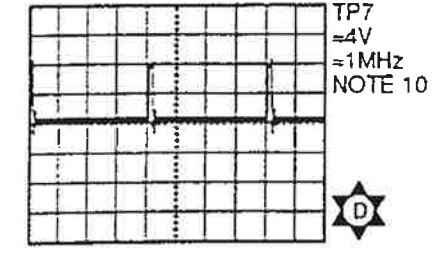
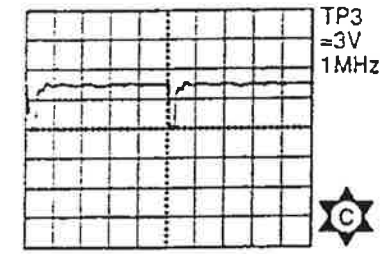
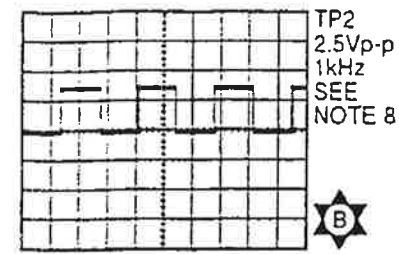
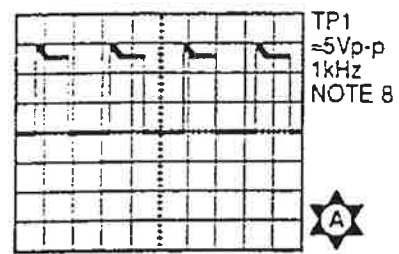


Figure 6-6. Phase Lock Loop Board (Sheet 1 of 2).

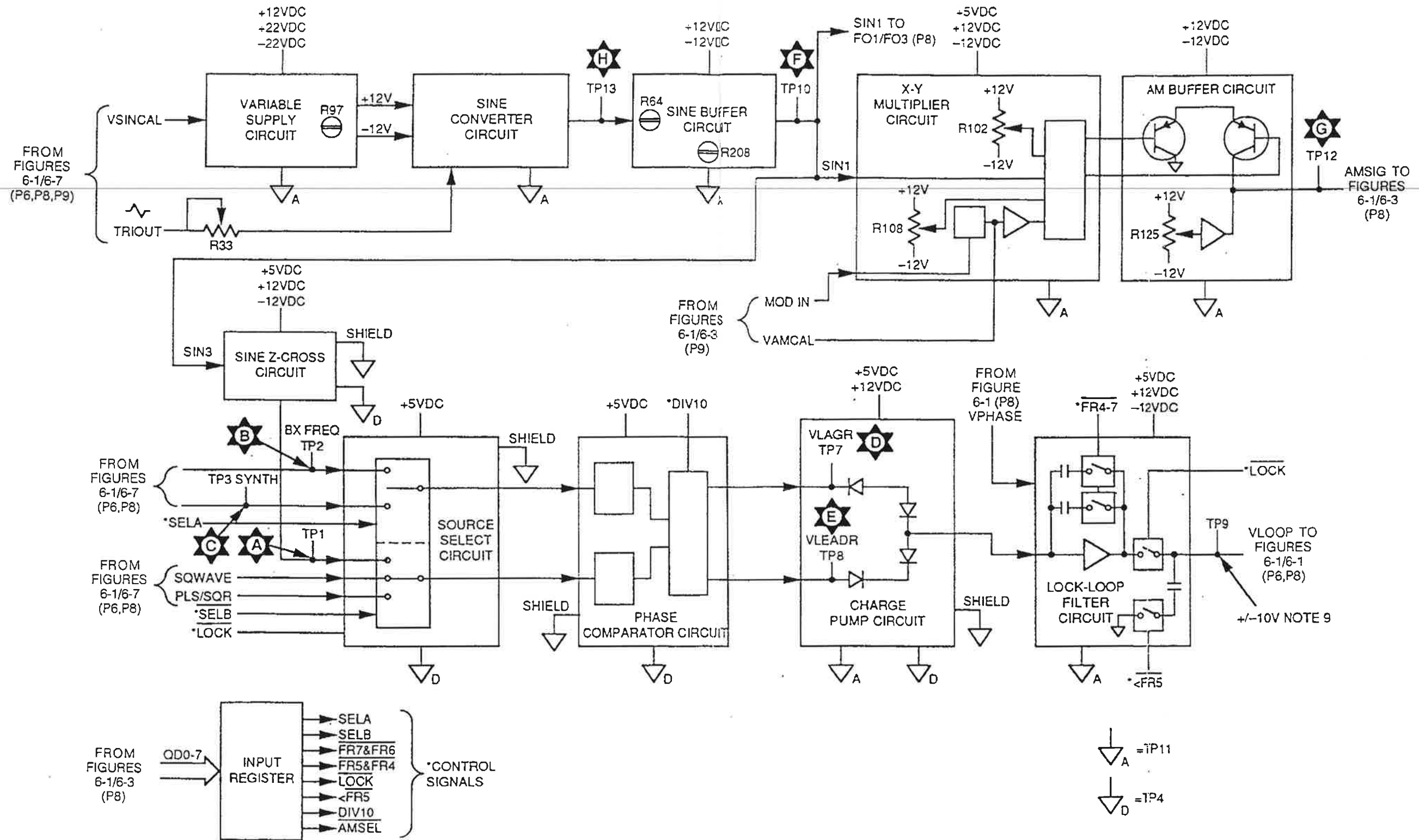


Figure 6-6. Phase Lock Loop Board (Sheet 2 of 2)

NOTES:

1. UNLESS OTHERWISE SPECIFIED:  
RESISTANCE IS IN  $\Omega$  (METAL FILM 1/8W,  $\pm 1\%$ )  
CAPACITANCE IS IN  $\mu\text{F}$   
INDUCTANCE IS IN  $\mu\text{H}$
2. UNLESS OTHERWISE SPECIFIED, INITIAL SETUP FOR VOLTAGES AND WAVEFORMS:

SET POWER TO ON.  
PRESS RESET KEY.  
WAIT 20 MINUTES.  
PRESS CALIBRATE KEY.  
VERIFY DISPLAY SHOWS AUTOCALIBRATED.

3. UNLESS OTHERWISE SPECIFIED, ALL VOLTAGE READINGS AND WAVEFORMS TAKEN WITH RESPECT TO ANALOG GROUND.
4. ANALOG GROUND -- TP1, TP10, AND TP16.
5. \* DENOTES CONTROL SIGNAL.

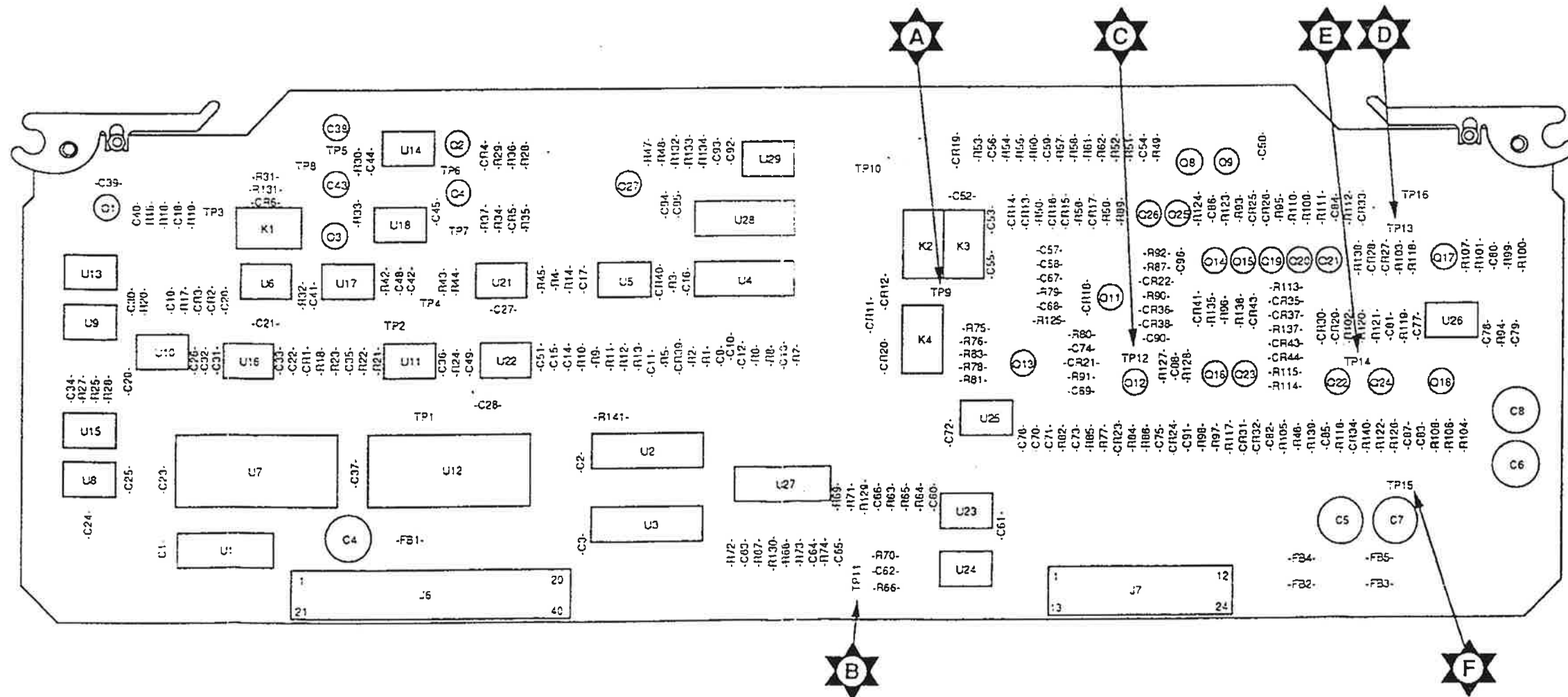
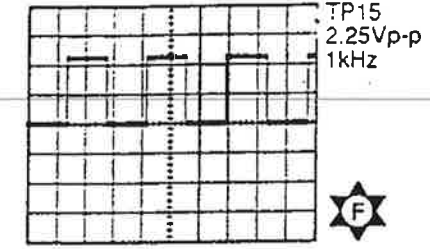
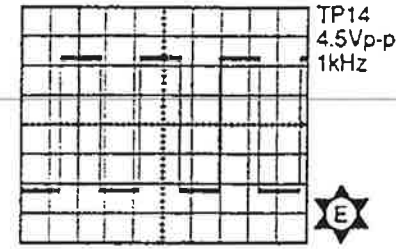
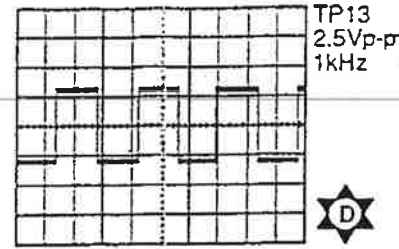
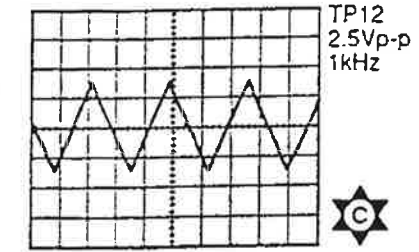
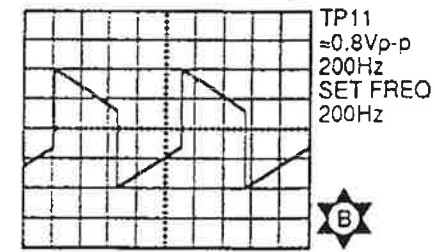
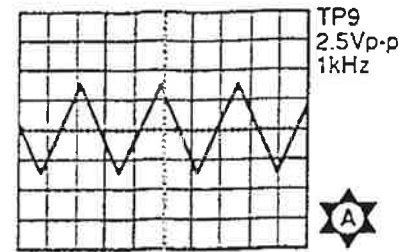


Figure 6-7. Function Generator (Sheet 1 of 2).

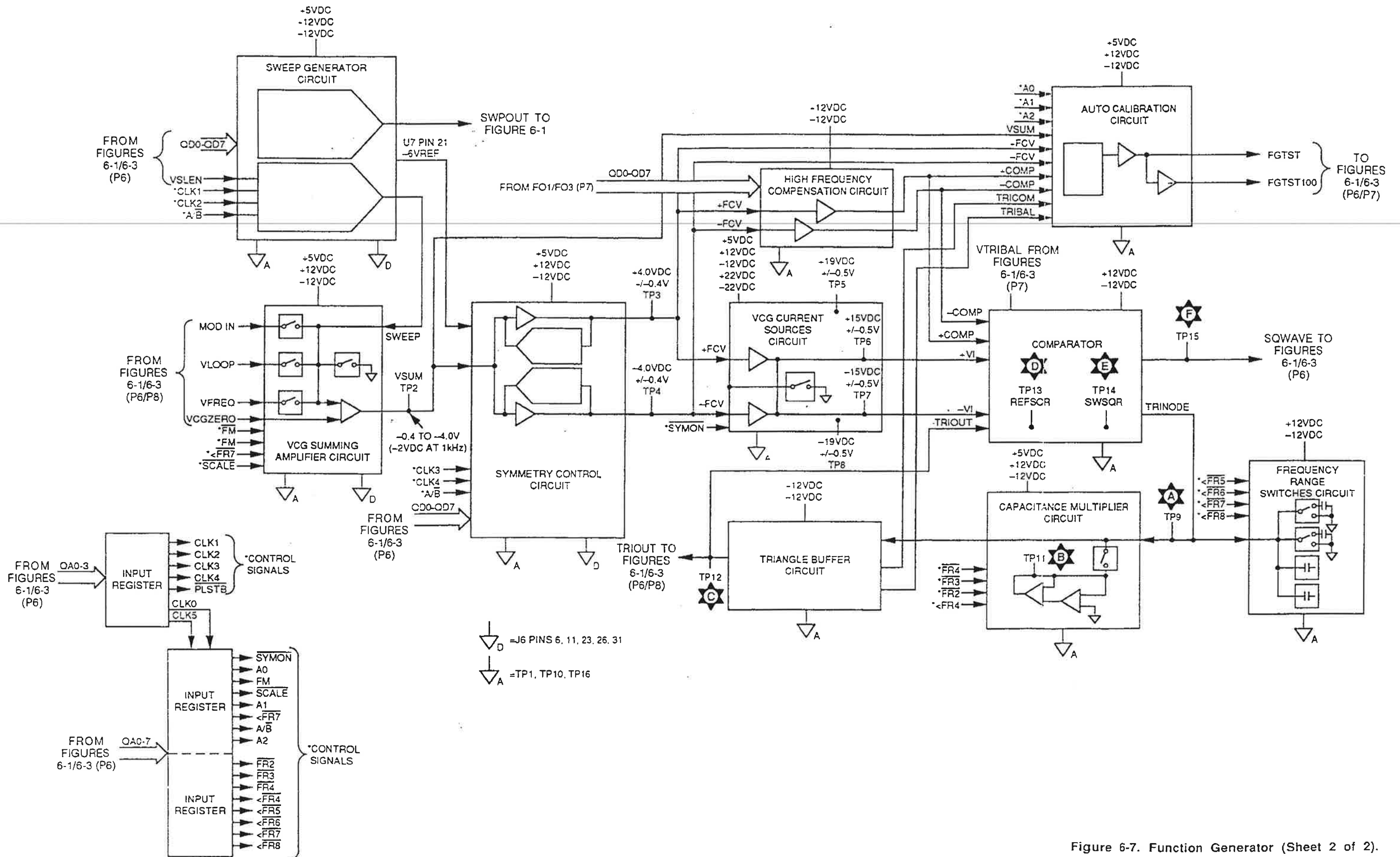
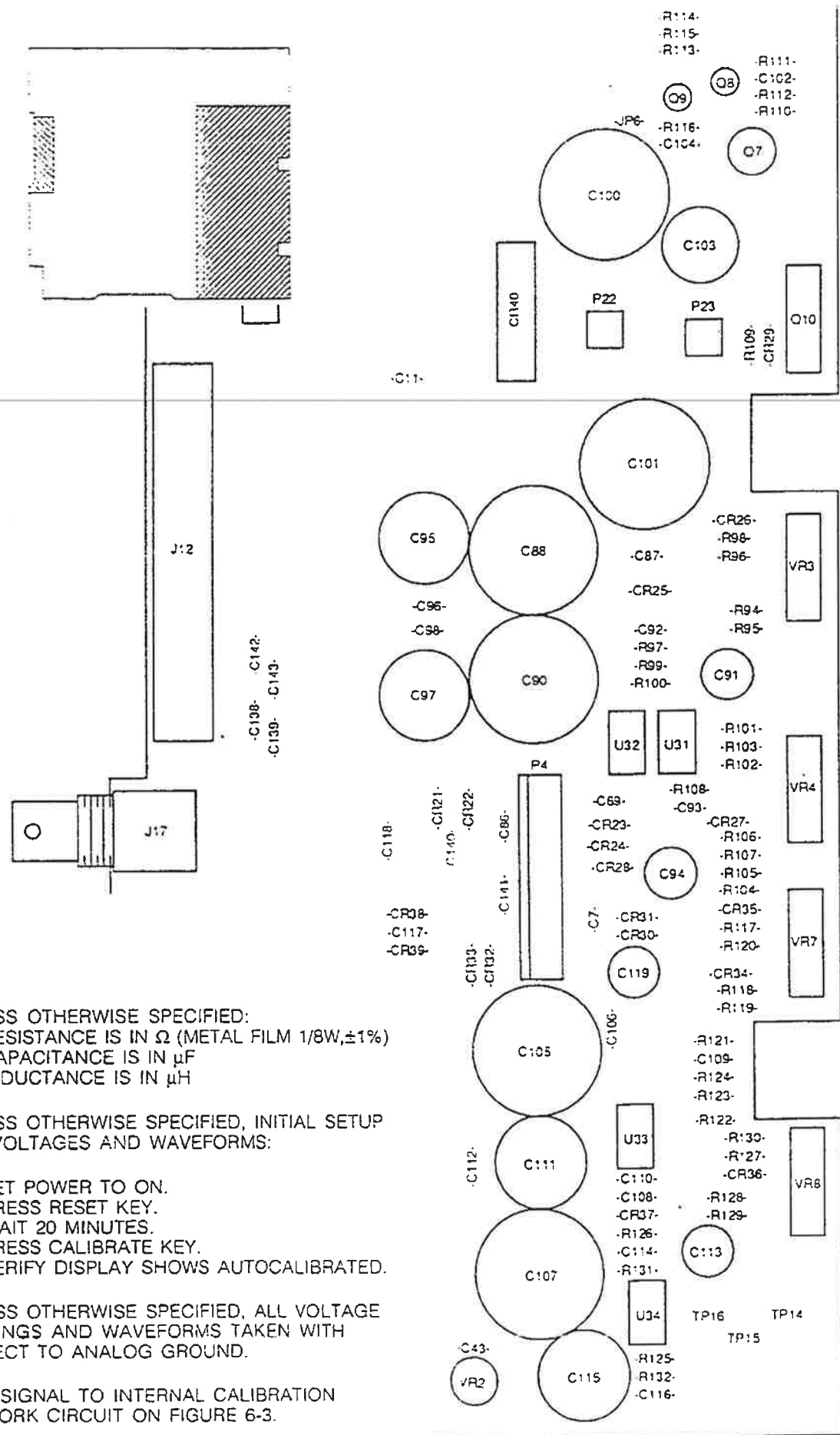


Figure 6-7. Function Generator (Sheet 2 of 2).



NOTES:

1. UNLESS OTHERWISE SPECIFIED:  
RESISTANCE IS IN  $\Omega$  (METAL FILM 1/8W,  $\pm 1\%$ )  
CAPACITANCE IS IN  $\mu\text{F}$   
INDUCTANCE IS IN  $\mu\text{H}$

2. UNLESS OTHERWISE SPECIFIED, INITIAL SETUP  
FOR VOLTAGES AND WAVEFORMS:

SET POWER TO ON.  
PRESS RESET KEY.  
WAIT 20 MINUTES.  
PRESS CALIBRATE KEY.  
VERIFY DISPLAY SHOWS AUTOCALIBRATED.

3. UNLESS OTHERWISE SPECIFIED, ALL VOLTAGE  
READINGS AND WAVEFORMS TAKEN WITH  
RESPECT TO ANALOG GROUND.

4. VREF SIGNAL TO INTERNAL CALIBRATION  
NETWORK CIRCUIT ON FIGURE 6-3.

5. +12REF SIGNAL FROM +12V SUPPLY IN FIGURE 6-3.

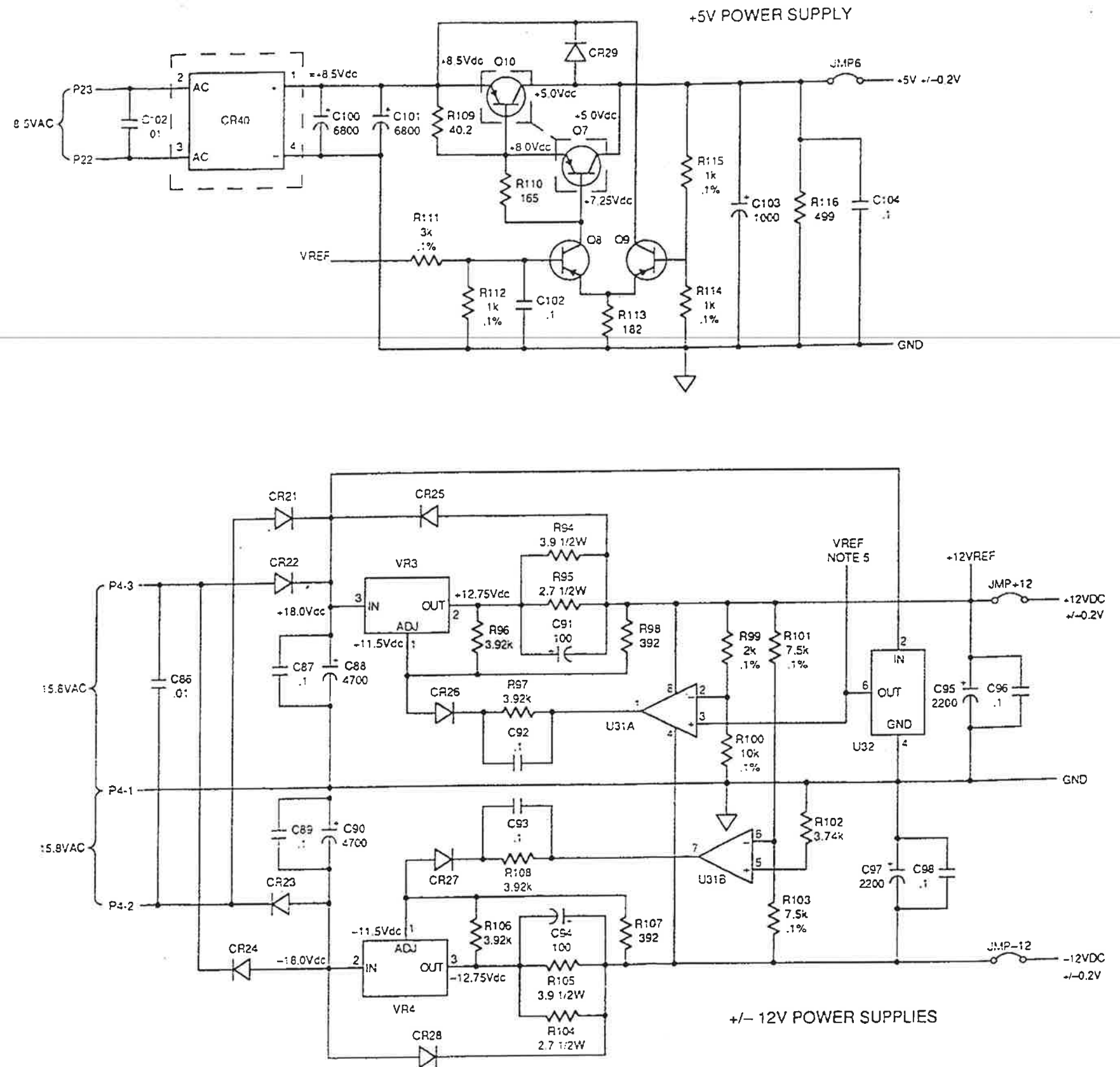
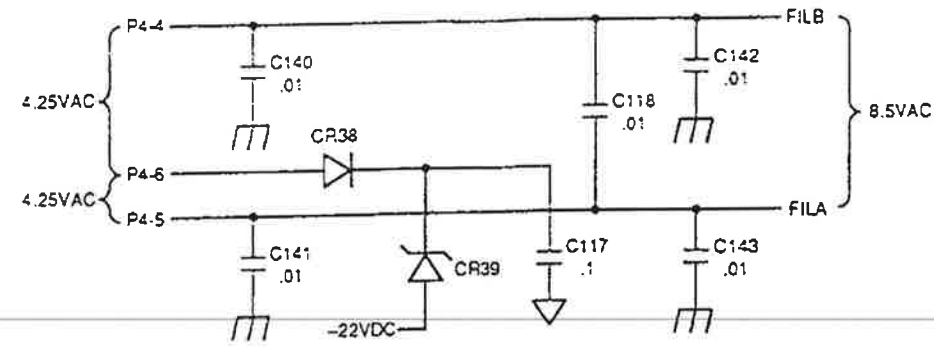


Figure 6-8. Power Supply (Sheet 1 of 2).

VFD AC FILAMENT SUPPLY



-22V POWER SUPPLY

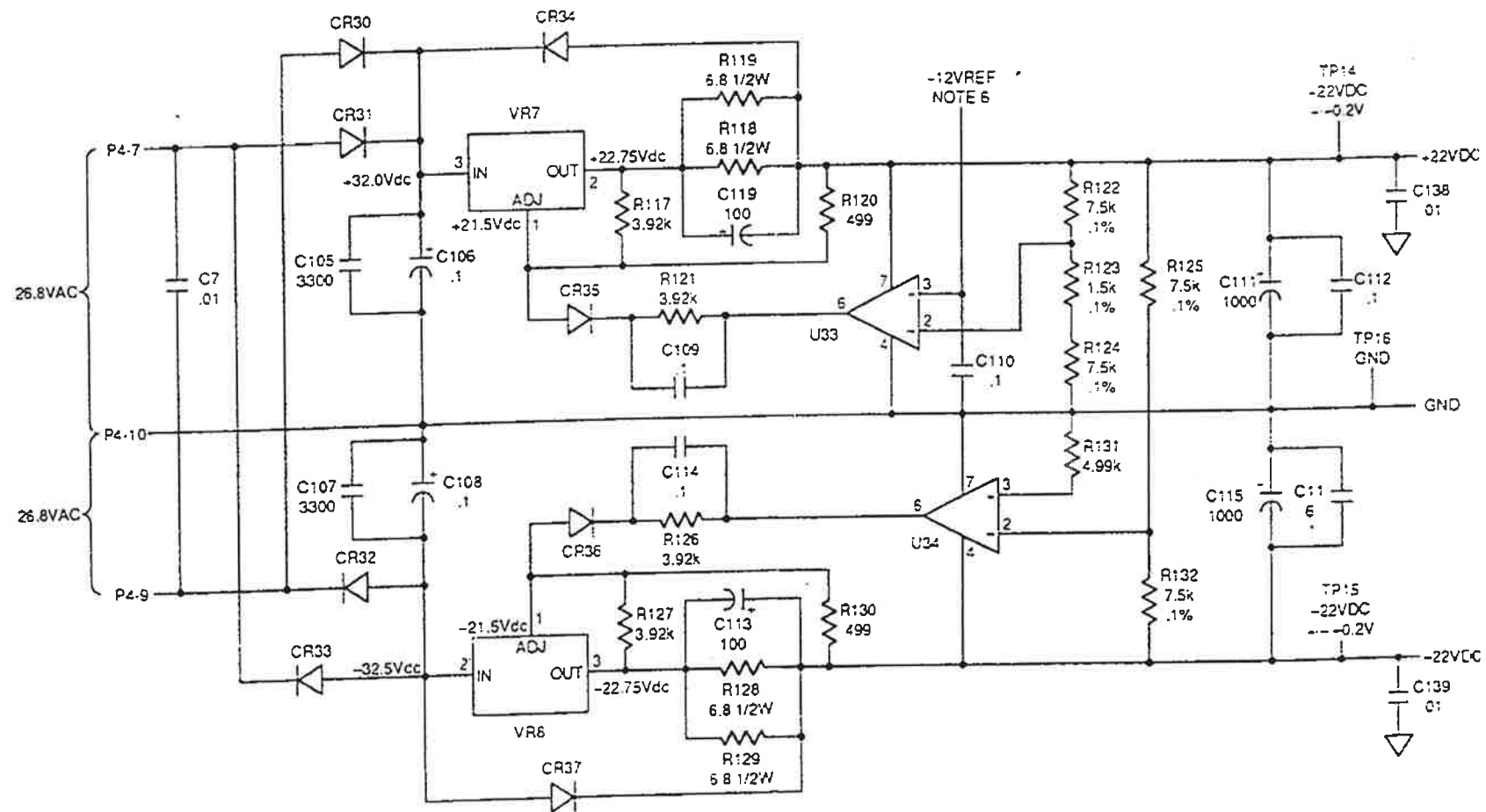


Figure 6-8. Power Supply (Sheet 2 of 2).

# SECTION 7

## PARTS LISTS AND SCHEMATICS

### 7.1 DRAWINGS

The following assembly drawings, schematics, and parts lists are arranged in order shown below.

#### 7.1 .1 Assembly Drawings

All of the mechanical assembly drawings are show in this section. These drawings contain enough detail and clarity to assist the repair technician in the disassembly and reassembly of the Model 288. The parts lists for each assembly drawing immediately follow that drawing.

#### 7.1.2. Schematics

All of the schematics for the Model 288 are shown in this section. Schematic drawings containing a proprietary message may not be copied for resale or use in any other publication nor for any use other than the repair and maintenance of the instrument associated with this manual.

#### 7.1.3 Parts Lists

The parts lists for each individual board or assembly are shown immediately following that board or assembly. The parts lists contain Wavetek and manufacturers parts information. All manufacturers are listed by a

Wavetek code designation. To convert the Wavetek code to a manufacturers name and address or FSCM, refer to table 7-1, Wavetek Code to FSCM and Manufacturers Name and Address.

### 7.2 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 permits. Because of the time needed to compose and print instruction manuals, it is not always possible to include the most recent changes in the initial printing. Whenever this occurs, addendum pages are prepared to summarize the changes made and are inserted immediately inside the rear cover. If no such pages exist, the manual is correct as printed.

### 7.3 ORDERING PARTS

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

The number etched into a PC board is the board part number. The assembly (PC board and components on the board) part number is stamped on the board.

DRAWING	DRAWING NUMBER
Instrument Schematic	0004-00-0561
Chassis Assembly	0002-00-0561
Instrument Parts List	1000-00-0561
Motherboard Schematic	0103-00-3000
Motherboard Assembly	1100-00-3198
Motherboard Parts List	1100-00-3198



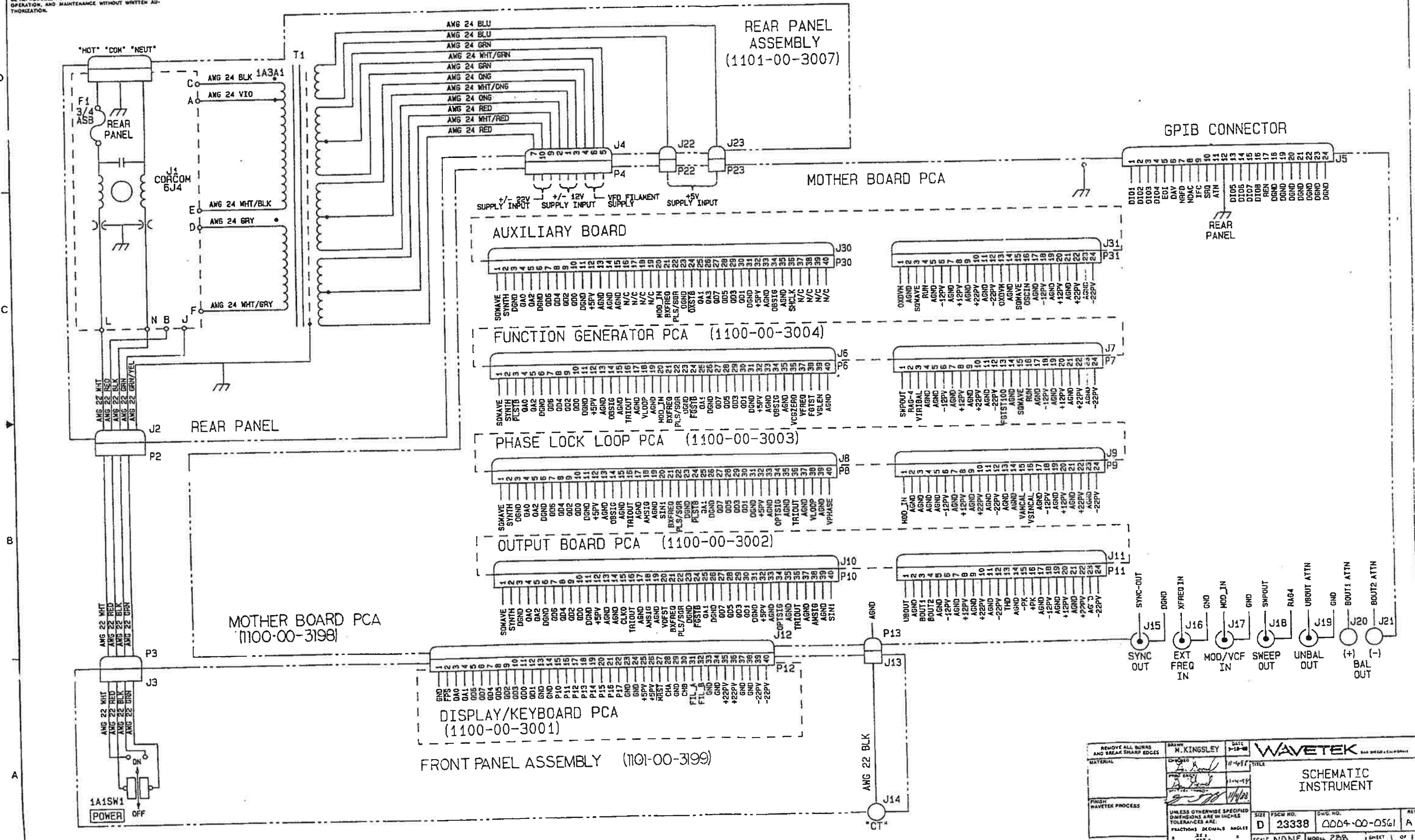


<b>DRAWING</b>	<b>DRAWING NUMBER</b>
Front Panel Assembly	1101-00-3199
Front Panel Parts List	1101-00-3199
Display / Keyboard Schematic	0103-00-3001
Display / Keyboard Assembly	1100-00-3001
Display / Keyboard Parts List	1100-00-3001
Output Board Schematic	0103-00-3002
Output Board Assembly	1100-00-3002
Output Board Parts List	1100-00-3002
Phase Lock Board Schematic	0103-00-3003
Phase Lock Board Assembly	1100-00-3003
Phase Lock Board Parts List	1100-00-3003
Function Generator Board Schematic	0103-00-3004
Function Generator Board Assembly	1100-00-3004
Function Generator Board Parts List	1100-00-3004
Rear Panel Assembly	1101-00-3007
Rear Panel Parts List	1101-00-3007



REV	ECO	BY	DATE	APP
A	ERD 89-025	MK	11-7-88	

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REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 3-18-88	WAVETEK	
MATERIAL	DESIGNED	11-9-88	TITLE	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES	SIZE D	PSCM NO. 23338	QWC NO. 0004-00-0561
DO NOT SCALE DRAWING	SCALE NONE	MODEL 228	SHEET 1 OF 1	

NOTE: UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-PFDR-PART-NO	PFDR	WAVETEK NO.	QTY/PT
NONE	ASSY DRWG. CHASSIS-288	0002-00-0561	WVTK	0002-00-0561	1
NONE	INSTRUMENT SCHEMATIC-288	0004-00-0561	WVTK	0004-00-0561	1
NONE	CALIBRATION SPEC/CALIBRATION PROCEDURE	0005-00-0561	WVTK	0005-00-0561	1
NONE	PRODUCTION ACCEPTANCE TEST SPECIFICATION	0007-00-0561	WVTK	0007-00-0561	1
NONE	288 PRODUCT STRUCTURE TREE	0010-00-0561	WVTK	0010-00-0561	1
7	ASSY. OUTPUT BOARD	1100-00-3002	WVTK	1100-00-3002	1
4	ASSY. PHASE LOCK BD	1100-00-3003	WVTK	1100-00-3003	1
4	ASSY. FUNCTION GENERATOR BD	1100-00-3004	WVTK	1100-00-3004	1
18	P.C.A. MOTHER BD-288	1100-00-3198	WVTK	1100-00-3198	1
20	ASSY. REAR PANEL	1101-00-3007	WVTK	1101-00-3007	1
9	ASY. FRONT PANEL-288	1101-00-3199	WVTK	1101-00-3199	1
8	ASSY. SIDE PLATE, RIGHT	1201-00-3012	WVTK	1201-00-3012	1
17	ASSY. SIDE PLATE, LEFT	1201-00-3013	WVTK	1201-00-3013	1
23	I. D. LABEL	801-9090	WVTK	1400-00-9090	1

<b>WAVETEK PARTS LIST</b>	TITLE MODEL 288	ASSEMBLY NO. 1000-00-0561	REV A
---------------------------	--------------------	------------------------------	----------

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-PFDR-PART-NO	PFDR	WAVETEK NO.	QTY/PT
24	SCREW PLPS PAN M/S 18-8 B/S 6-32X1/2	SCREW PH 6-32X1/2	CMRCL	2800-48-8106	3
19	SCREW, 6-32X7/16, 100DE 0 FH, PHLPS, SS	2800-34-8107	CMRCL	2800-34-8107	8
13	SCREW, 6-32 X 1/2, 100 DEG, FH, PHLPS, SS	2800-34-8108	CMRCL	2800-34-8108	4
10	SCREW, 6-32/3/8, FH, PHL, FB, 100 DEG, SS, NYLON	2800-60-6106	CMRCL	2800-60-6106	1
NONE	PWR CORD, SHIELDED	6001-80-0009	WVTK	6001-80-0009	1

<b>WAVETEK PARTS LIST</b>	TITLE MODEL 288	ASSEMBLY NO. 1000-00-0561	REV A
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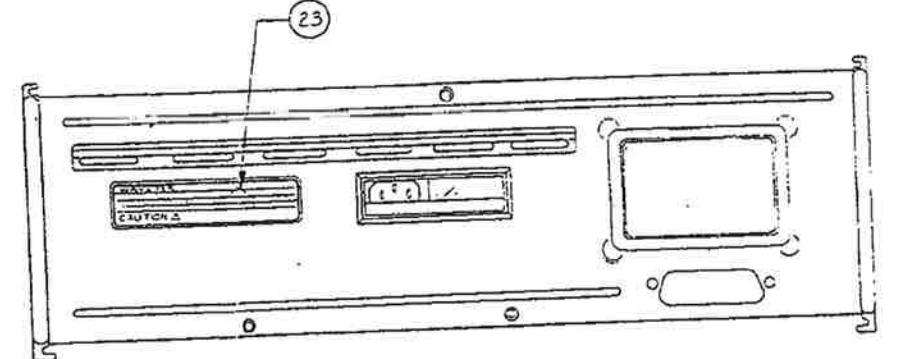
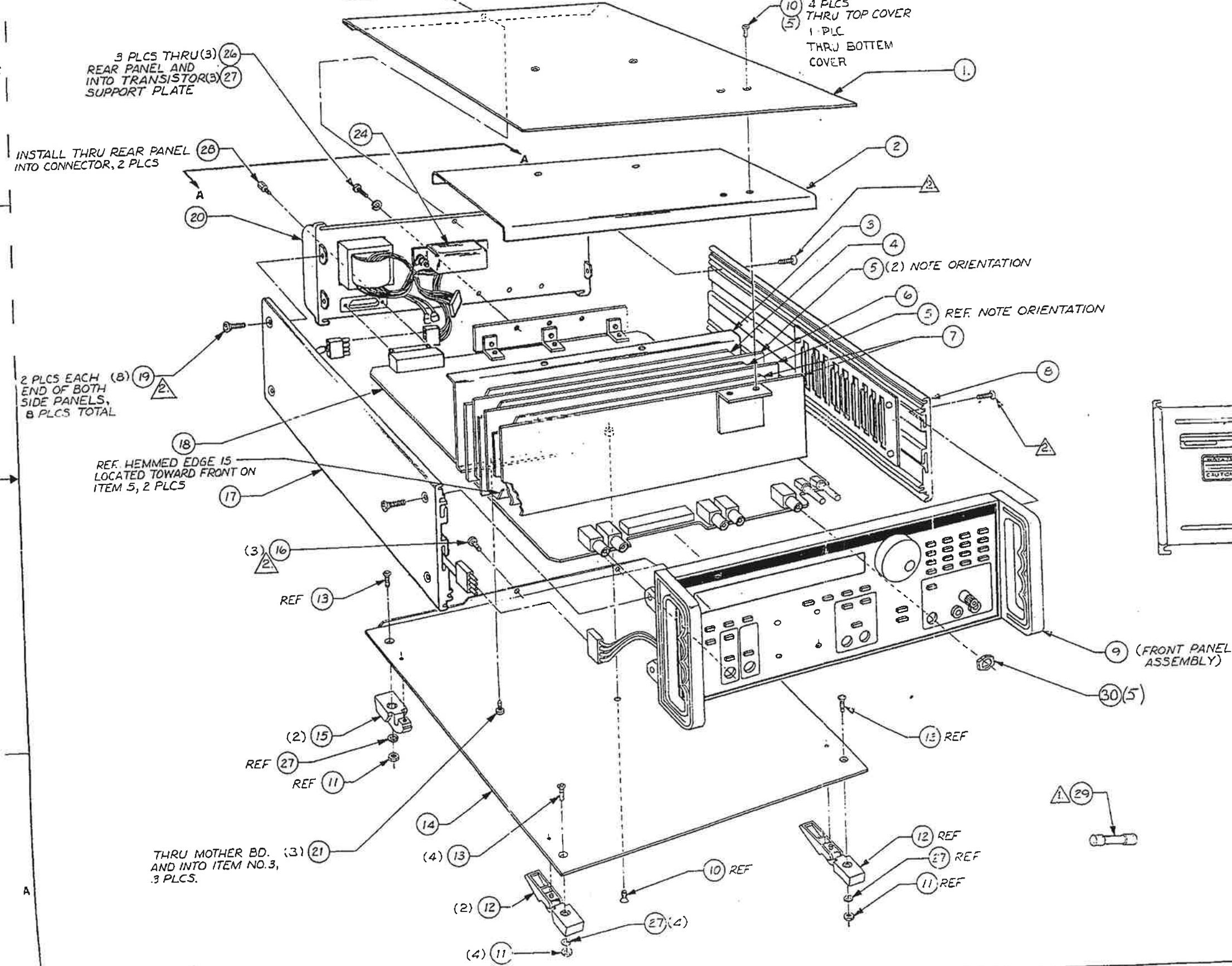
REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-PFDR-PART-NO	PFDR	WAVETEK NO.	QTY/PT
24	LABEL, CAUTION	859-1400	WVTK	1400-01-1400	1
5	SHIELD, INNER	1400-02-3323	WVTK	1400-02-3323	2
2	SHIELD, TOP	1400-02-3353	WVTK	1400-02-3353	1
1	COVER, TOP	1400-02-3332	WVTK	1400-02-3332	1
3	SHIELD, REAR	1400-02-4183	WVTK	1400-02-4183	1
14	COVER, BOTTOM	1400-02-4322	WVTK	1400-02-4322	1
28	HARDWARE KIT, GPIB CONN	954808-1	AMP	2100-07-0024	1
27	FUSE, 3/BA, 250V, 6-3	313.373	LITFU	2400-03-0009	1
136	FOOT	10603-324	SCHRIF	2800-08-0020	2
12	FOOT WITH TIP-UP	10603-023	SCHRIF	2800-08-0021	2
30	NUT, HEX, 1/2-28	1-329631-2	AMP	2800-16-0023	5
11	NUT, HEX, 6-32, 3/32 THK, .25 FLT, MINI, SS	2800-16-8106	CMRCL	2800-16-8106	4
27	LOCKWASHER, 68 SPLIT RING, SS	68BRLW	CMRCL	2800-42-8000	7
16	SCREW PLPS PAN M/S 18-8 B/S 6-32X3/8	PS 31737-28	CMRCL	2800-48-8106	3

<b>WAVETEK PARTS LIST</b>	TITLE MODEL 288	ASSEMBLY NO. 1000-00-0561	REV A
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REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> 240 BAYVIEW CALIFORNIA		
MATERIAL	CHECKED		TITLE <b>PARTS LIST INSTRUMENT</b>		
	PROV. ENGR.				
	RELEASE APPROV.				
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		SIZE <b>D</b>	FSM NO. <b>23338</b>	OWN. NO. <b>1000-00-0561</b>
DO NOT SCALE DRAWING	SCALE	MODEL <b>288</b>	SHEET <b>1</b>	OF <b>1</b>	REV <b>A</b>

REV	ECO	BY	DATE	APP
A	ERD 87-025	MK	11/16/88	

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VIEW A-A

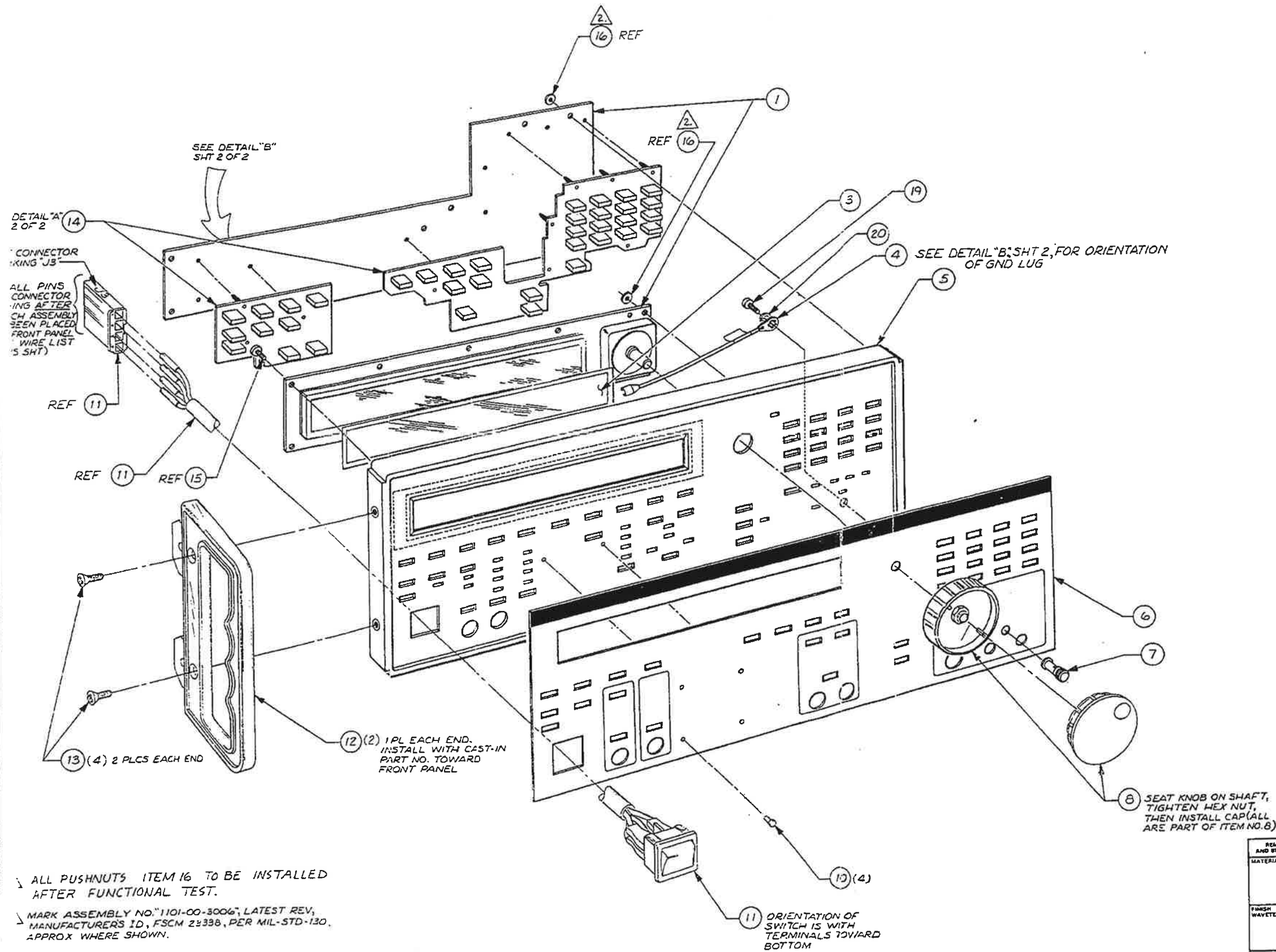
⚠ DO NOT USE LOCTITE (OR EQUIV) ON THESE SCREWS.

⚠ 3/4 A SLOW BLOW FUSE IS INSTALLED IN REAR PANEL FOR 100V/120V APPLICATION. 3/8A SLOW BLOW FUSE IS SUPPLIED WITH UNIT FOR 220V/240V APPLICATION.

NOTES: UNLESS OTHERWISE SPECIFIED, SEE SEPARATE PARTS LIST.

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 2-5-88	WAVETEK	
MATERIAL	CHECKED M. L...	11-9-88	TITLE	
FINISH WAVETEK PROCESS	PROJ. ENGR. [Signature]	11-4-88	ASSEMBLY, CHASSIS	
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES	21 32.2	SIZE D	PSCM NO. 23338
			DWG. NO. 0002-00-0561	REV. A
			SCALE NONE	MODEL 283
				SHEET 1 OF 1

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES. FOR REPAIR, REWORK, CALIBRATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.



WIRE LIST

"J3" CONN PIN NO.	WIRE COLOR	SWITCH TERMINAL (REF)
3	RED	2A
2	WHT	1A
4	GRN	5E
1	BLK	4B

SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN: CHERMACK	DATE: 1/4/69	
MATERIAL: ENGRD	CHKD: M. H...	DATE: 11-4-68	
FINISH: WAVETEK PROCESS	REL. APPR: [Signature]	DATE: 1/4/69	<b>ASSEMBLY, FRONT PANEL</b>
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES	SCALE: NONE	D 23338 1101-00-3197 MODEL 280

ALL PUSHNUTS ITEM 16 TO BE INSTALLED AFTER FUNCTIONAL TEST.  
 MARK ASSEMBLY NO. "1101-00-3006", LATEST REV, MANUFACTURER'S ID, FSCM 23338, PER MIL-STD-130, APPROX WHERE SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

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REV ECD BY DATE APP

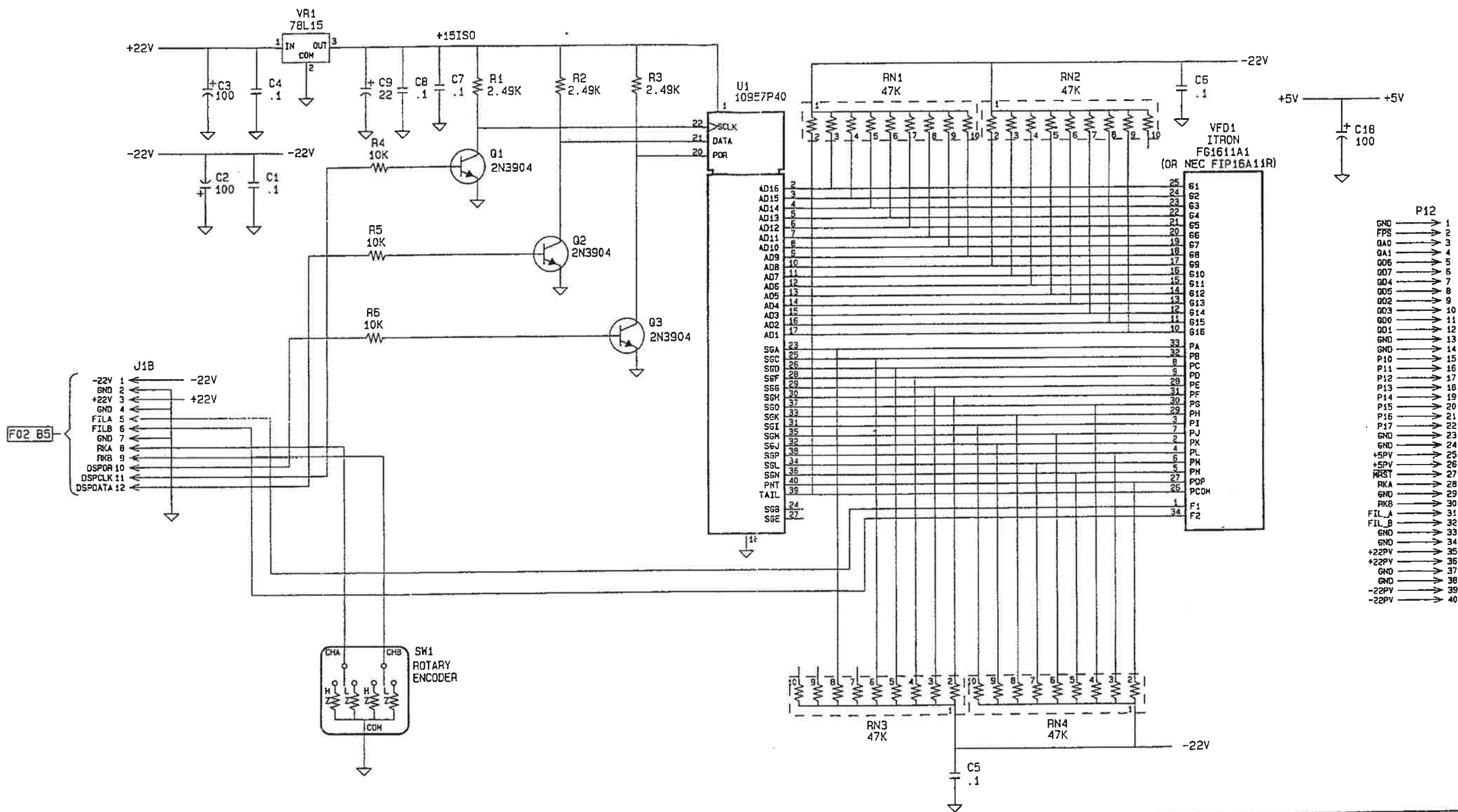
REFERENCE DESIGNATORS	PART DESCRIPTION	DRG-REFOR-PART-NO	MFR	WAVETEX NO.	QTY/PT
1	ASSY. DISPLAY/KEYBOARD	1100-00-3001	WVTK	1100-00-3001	1
11	CABLE ASSEMBLY, AC SWITCH	1207-00-3008	WVTK	1207-00-3008	1
4	WIRE ASSY	1207-00-3010	WVTK	1207-00-3010	1
5	FRONT PANEL, MOLDED	1400-02-3230	WVTK	1400-02-3230	1
12	HANDLE, PTD	1400-02-3232	WVTK	1400-02-3232	2
6	OVERLAY	1400-02-3280	WVTK	1400-02-3280	1
14	KEYPAD, 1288	1400-02-3420	CRY	1400-02-3420	1
15	MINI-M, DISPLAY	1400-02-3560	WVTK	1400-02-3560	1
7	LOG GROUNDING	159	WVTK	1400-02-3540	1
8	WAGO COLLET, 250	2400-01-0034	SELCO	2100-04-0043	1
10	7/8 DIA X 5/8 HIGH, BR-NY RIVET, NYLON, BLK, 140	2771F00438	MICRO	2800-12-0058	4
20	WASHER, LOCK, REG 8/8	MS 33338-136	CHRCL	2800-45-4000	1
15	SCREW, 2 X 3/16, TYPE B, THD FORM, PH, SS	2800-57-2903	CHRCL	2800-57-2903	23
WAVETEK PARTS LIST		TITLE ASY, FRONT PANEL-288	ASSEMBLY NO. 1101-00-3199		REV B
			PAGE 1		

REFERENCE DESIGNATORS	PART DESCRIPTION	DRG-REFOR-PART-NO	MFR	WAVETEX NO.	QTY/PT
19	SCREW, PH, 6-32 X 3/16, PHLPS, NYLON, SS	2800-59-6103	CHRCL	2800-59-6103	1
13	SCREW, 8-32 X 7/16, 100DE 9 PH, PHLPS, SS, NYLON	2800-40-8107	CHRCL	2800-40-8107	4
WAVETEK PARTS LIST		TITLE ASY, FRONT PANEL-288	ASSEMBLY NO. 1101-00-3199		REV B
			PAGE 2		

REMOVE ALL BURRS AND BREAK CHAMP EDGES	DRAWN	DATE	<b>WAVETEK</b> <small>1400 0000 0000 0000</small>	
LATERAL	CHECKED		TITLE <b>PARTS LIST FRONT PANEL</b>	
FINISH WAVETEK PROCESS	PROJ. ENGR.		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES	
DO NOT SCALE DRAWING	RELEASE APPROV.		SIZE / SCRN NO. <b>D 23338</b>	DRWG. NO. <b>1101-00-3199</b>
			SCALE	MODEL <b>288</b> SHEET <b>1</b> OF <b>1</b>

NOTE: UNLESS OTHERWISE SPECIFIED





2. ALL CAPACITORS ARE IN MICROFARADS.  
 1. ALL RESISTORS ARE IN OHMS, 1/8W, 1%, MF.

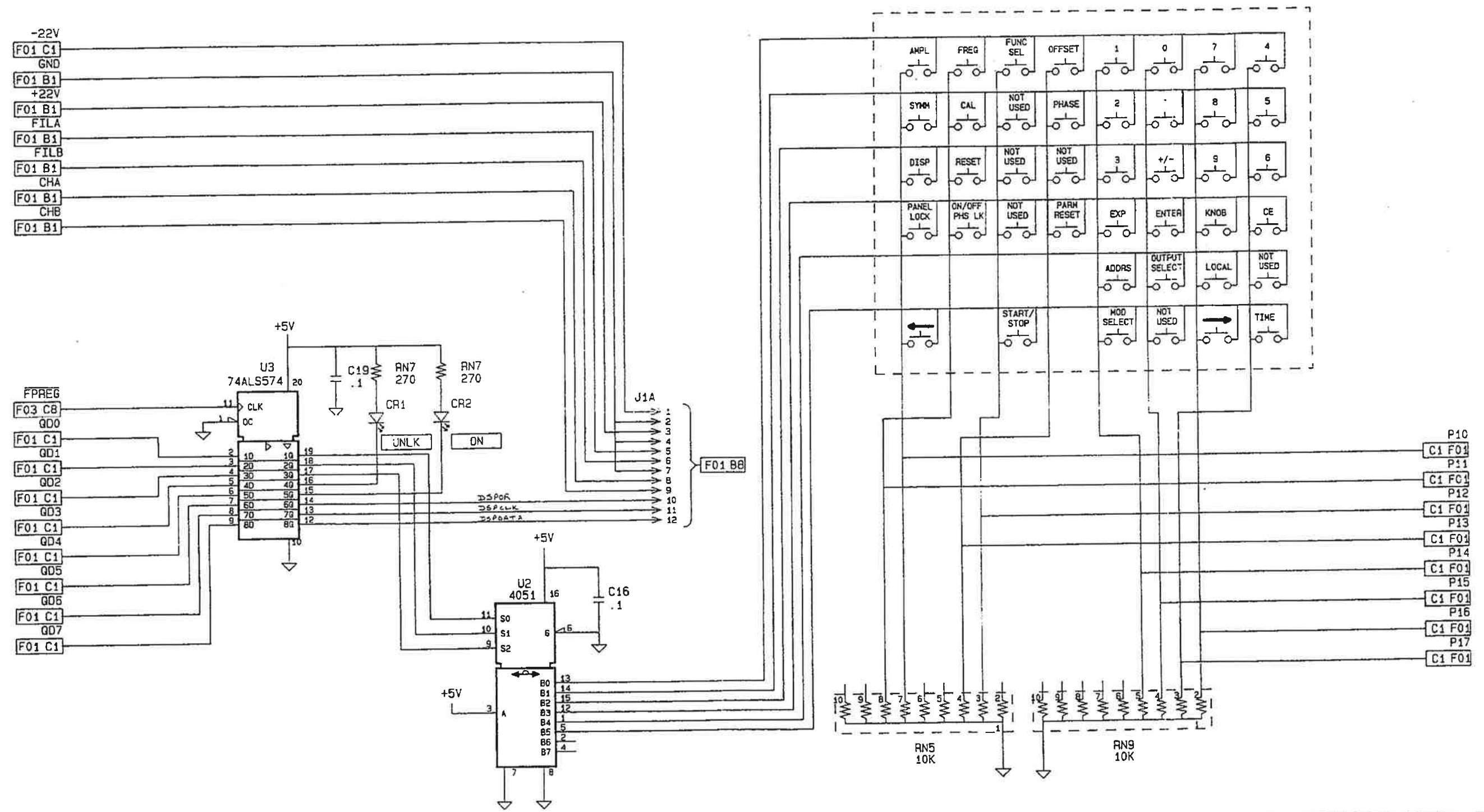
NOTE UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATORS LAST USED	REFERENCE DESIGNATORS NOT USED
R9, RN10, C19, U7, CR27, Q3, VFD1, VR1, SW1, KB1, J1	

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN N. KINGSLEY	DATE 1-18-88	
MATERIAL	CHECKED [Signature] DATE 3-21-88 PROOF. [Signature] DATE 3-25-88 RELEASE APPROV. [Signature] DATE 3-25-88	TITLE SCHEMATIC DISPLAY/KEYBOARD	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX .XXX °		SIZE D 23338 DWG. NO. 0103-00-3001 REV 3
DO NOT SCALE DRAWING	SCALE NONE	MODEL 1Z88	SHEET 1 OF 3

0103-00-3001 B B

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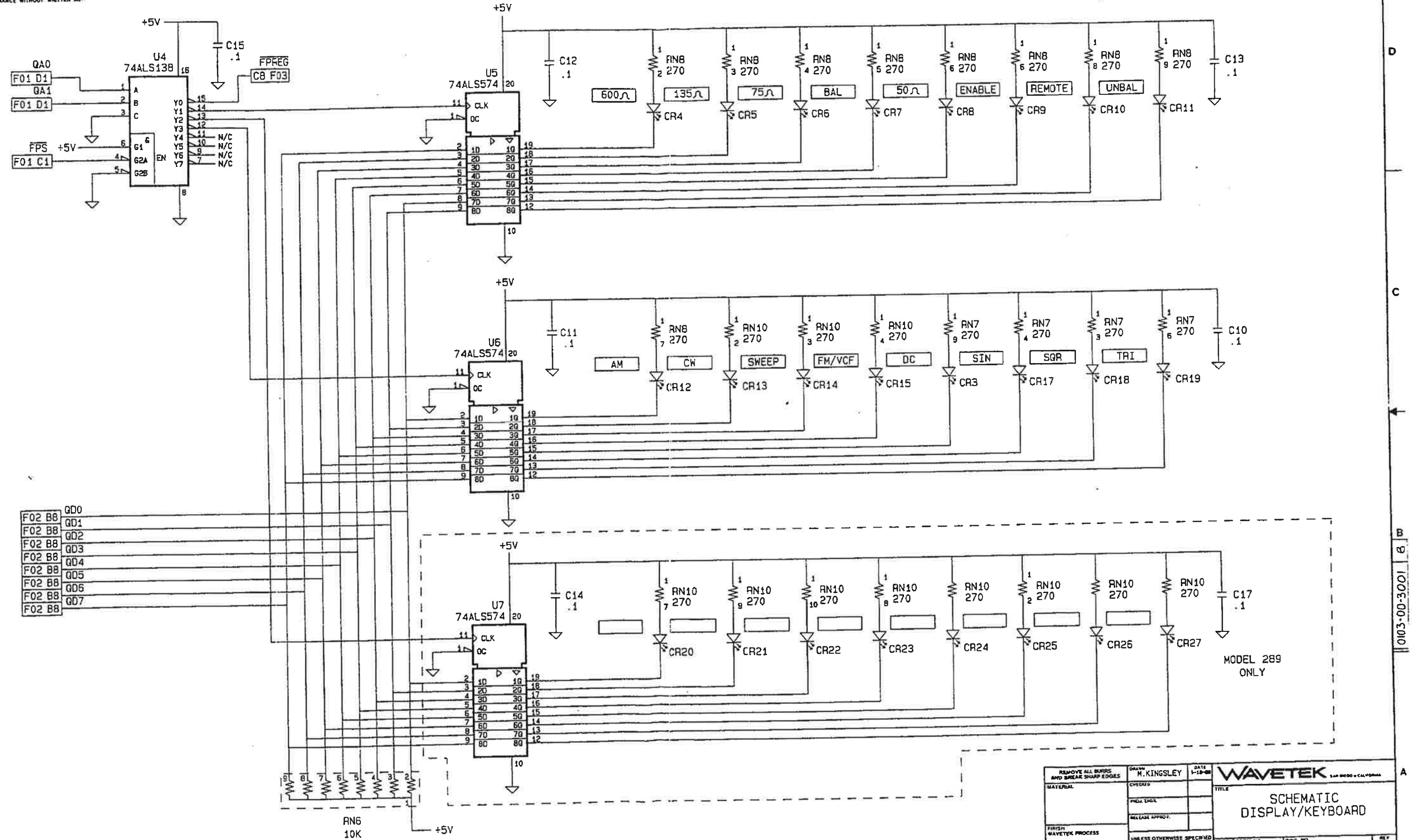
NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES		DATE	3-18-88	
MATERIAL		CHECKED	M. KINGSLEY	
FINISH WAVETEK PROCESS		PROJ. ENGR.		
DO NOT SCALE DRAWING		RELEASE APPROV.		
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		SCALE	PSCH NO.	DWG NO.
		SCALE NONE	D 23338	0103-00-3001
		MODL	1288	SHEET 2 OF 2

**WAVETEK** 8400 0000 00000000

**SCHMATIC DISPLAY/KEYBOARD**

DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, REVISION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.



- F02 B8 QD0
- F02 B8 QD1
- F02 B8 QD2
- F02 B8 QD3
- F02 B8 QD4
- F02 B8 QD5
- F02 B8 QD6
- F02 B8 QD7

REMOVE ALL BURRS AND BREAK SHARP EDGES		DRW: M. KINGSLEY	DATE: 1-18-88	<b>WAVETEK</b> 140 BEGG • CALIFORNIA
MATERIAL:	CHECKED:	PROJ. ENGR:	RELEASE APPROV.:	
FINISH: WAVETEK PROCESS		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES		<b>TITLE</b> SCHEMATIC DISPLAY/KEYBOARD <b>SIZE</b> / <b>PCBM NO.</b> / <b>DRG. NO.</b> / <b>REV</b> D / 23338 / 0103-00-3001 / 2
DO NOT SCALE DRAWING		SCALE: NONE	MODEL: 1288	

NOTE: UNLESS OTHERWISE SPECIFIED

0103-00-3001 B

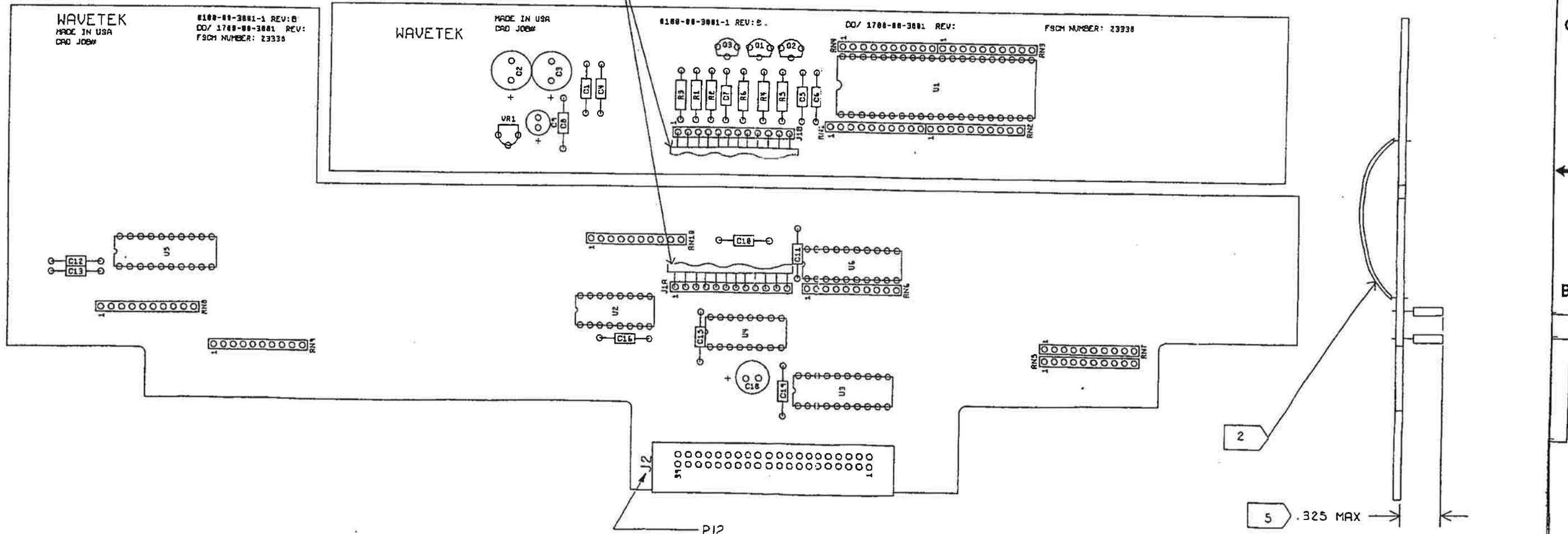
8 7 5 4 3 2 1

A	ECO# 9421	REV: 1/28/80	DATE: 1/28/80
B	ECO# 9583	REV: 1/28/80	DATE: 1/28/80
C	ECO# 9915	REV: 1/28/80	DATE: 1/28/80

NOTES:

1. COMPONENTS MOUNTED ON COMPONENT SIDE OF PCB SHOWN ON SHEET 1, COMPONENTS MOUNTED ON SOLDER SIDE OF PCB SHOWN ON SHEET 2.
2. RIBBON CABLE IS INSTALLED BETWEEN J1A ON LOWER KEYBOARD PCB AND J1B ON UPPER DISPLAY PCB.
3. LEADS OF COMPONENTS MOUNTED ON COMPONENT SIDE OF PCB OPPOSITE DISPLAY (VFD1), MUST HAVE LEADS TRIMMED TO WITHIN .050 OF PCB SURFACE.

4. MOUNTING OF DISPLAY (VFD1):
  - A. INSTALL AND SOLDER COMPONENTS ON COMPONENT SIDE OF PCB.
  - B. TRIM LEADS OF COMPONENT ON UPPER BOARD PER NOTE 3.
  - C. ATTACH DISPLAY CUSHION (PN: 1400-02-3510) TO DISPLAY, POSITIONING CUSHION SO THAT IT DOES NOT OVERLAP DISPLAY.
  - D. PLACE DISPLAY (VFD1) WITH ATTACHED CUSHION ON SOLDER SIDE OF PCB MAKING SURE THAT THE SURFACE OF THE CUSHION IS FLUSH TO THE PCB SURFACE. PINS OF COMPONENTS ON OPPOSITE SIDE OF PCB WILL PIERCE THE CUSHION.
  - E. ALLOW DISPLAY (VFD1 ON COMPONENT SIDE) TO SELF-LEVEL BEFORE SOLDERING THE PINS OF DISPLAY.
5. LEADS (CR1 THRU CR27) MAY BE MOUNTED FLUSH TO PCB.



COMPONENT SIDE

NOTE: THIS CONNECTOR IS MARKED J2 ON THE PC BOARD SILKSCREEN

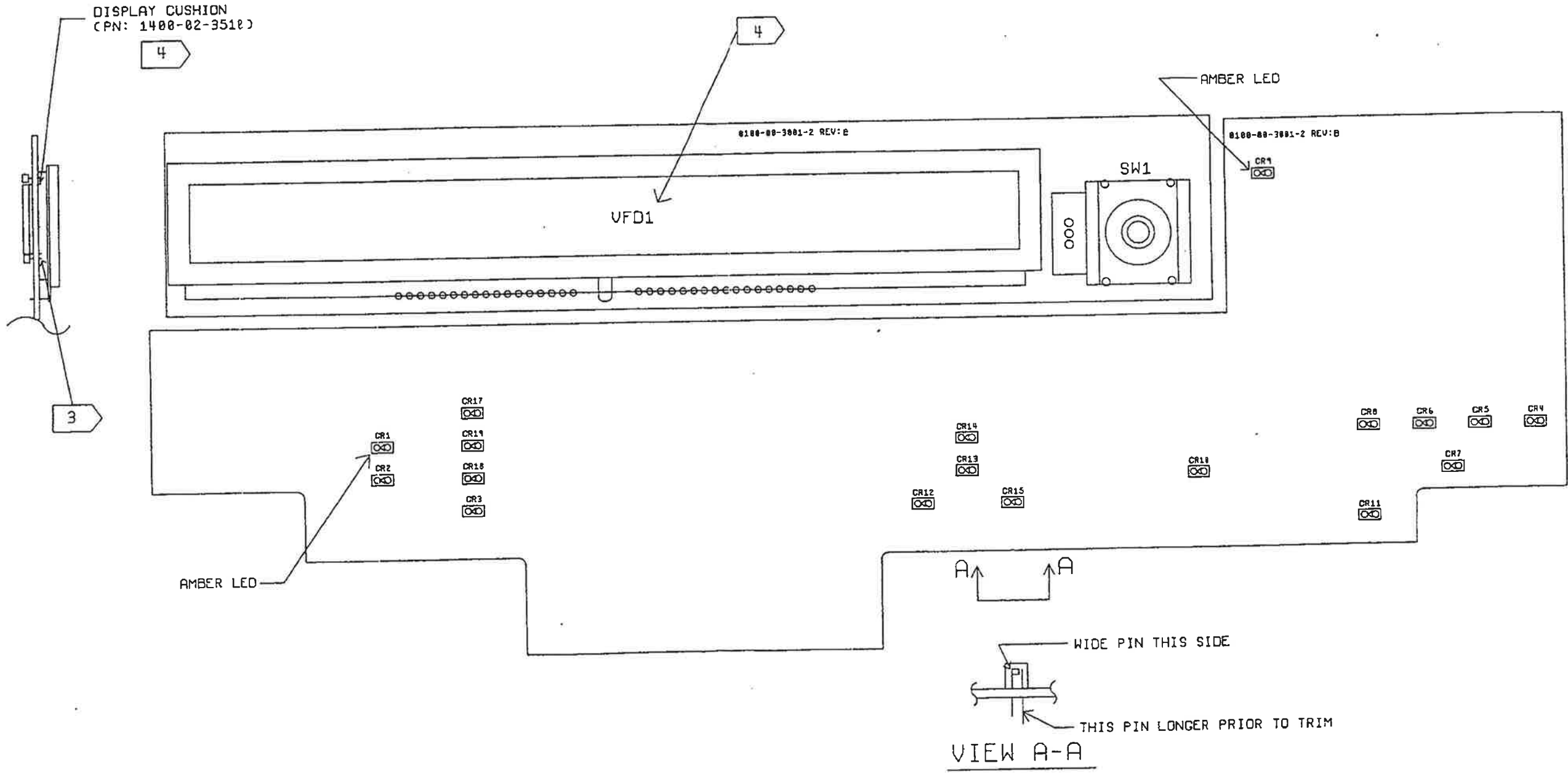
SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN: NTLIE	DATE: 1/80	
MATERIAL:	PROJ: M. Colman	DATE: 1-26-80	
FINISH: WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED: .XXX ±.010 ANGLES: 1:1	SCALE: NONE	TITLE: PCB ASSEMBLY - DISPLAY/KEYBOARD MODEL NO: 1288 DWG NO: 1100-00-3001 SHEET 1 OF 2

NOTE UNLESS OTHERWISE SPECIFIED

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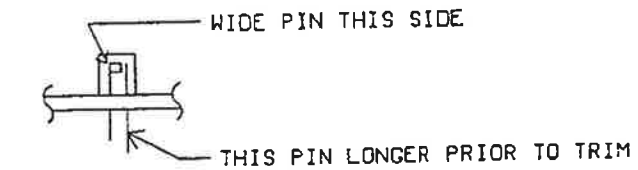
DISPLAY CUSHION  
(PN: 1400-02-3510)



AMBER LED

AMBER LED

SOLDER SIDE



REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN: MYLIE	DATE: 1/88	<b>WAVETEK</b> <small>ANALOG • DIGITAL • VIDEO</small>	
MATERIAL	PROJECT: 1100-00-3001	TITLE: PCB ASSEMBLY - DISPLAY/KEYBOARD	MODEL NO: 1288	DWG NO: 1100-00-3001
FINISH: WAVETEK PROCESS	RELEASE APPROV: [Signature]	TOLERANCE UNLESS OTHERWISE SPECIFIED: .XXX ± .010	SCALE: NONE	SHEET: 2 OF 2
		DO NOT SCALE DWG	CODE: 23338	

NOTE UNLESS OTHERWISE SPECIFIED

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REV	ECO	BY	DATE	APP
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REFERENCE DESIGNATORS	PART DESCRIPTION	QTY	WVTK NO.	QTY/PT
NONE	SCHEMATIC, DISPLAY/KEYBOARD	0100-00-3001	WVTK	0100-00-3001 1
NONE	CUSHION, DISPLAY	1400-02-3510	WVTK	1400-02-3510 1
C1 C10 C11 C12 C13 C15 C16 C19 C4 C5 C6 C7 C8	CAP, CER, MON., 1MF, 50V, AXIAL	CA00325U1042050A	CORNG	1500-01-0405 13
C18 C2 C3	CAP, ELECT, 100MF, 35V RADIAL LEAD, .8P .20	NRE101K03V8X11	NIC	1500-01-0102 3
C9	CAP, ELECT, 22MF, 25V, RA DIA.	5RA23V22R6X7LL	UNCON	1500-02-2002 1
NONE	PCB, DISPLAY/KEYBOARD	1700-00-3001	WVTK	1700-00-3001 1
NONE	CONN, HEADER, 40 PIN, PCB MT., .1 CTR 2X20, 5HRD	1-102692-3	AMP	2100-02-0238 1
VFD1	DISPLAY, VAC. FLUOR	F91611A1	ITRON	2400-03-0019 1
R4 R5 R6	RES, HF, 1/8W, 1%, 10K	RN03D-1002F	TRW	4701-03-1002 3
R1 R2 R3	RES, HF, 1/8W, 1%, 2.49K	RN03D-2491F	TRW	4701-03-2491 3
RN5 RN6 RN7	RES NETWORK 10K 2% 10PIN SIP BUSS	4310R-101-100	BOURN	4770-00-0008 3
RN1 RN2 RN3 RN4	RES NETWORK 47K 2% 10PIN SIP BUSS	4310R-101-473	BOURN	4770-00-0030 4
RN10 RN7 RN8	RES NETWORK 10PIN SIP	4310R-101-271	BOURN	4770-00-0053 3

**WAVETEK**  
PARTS LIST

TITLE  
ASSY. DISPLAY/KEYBOARD

ASSEMBLY NO.  
1100-00-3001

REV  
C

PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	QTY	WVTK NO.	QTY/PT
	270 OHM BUSS			
CR1 CR9	LED, AMBER, RECT BAR	LTL-3271A	LITE	4899-00-0056 2
CR10 CR11 CR12 CR13 CR14 CR15 CR17 CR18 CR19 CR2 CR3 CR4 CR5 CR6 CR7 CR8	LED, GREEN, RECT BAR	LTL-3231A	LITE	4899-00-0057 14
Q1 Q2 Q3	TRANS 2N2904 NPN GENERAL PURPOSE TD-92	2N2904	FAIR	4901-03-9040 3
SW1	ENCODER, ROTARY, MADE FROM 3104-00-0027	3109-00-0001	WVTK	3109-00-0001 1
J1A	CAJLE, FLEX, JMP, ASSY	1-86943-1	AMP	6001-60-0017 1
VR1	VOLT REGULATOR, POSITIVE	78L13	TI	7000-78-1801 1
U2	MUX/DEMUX, ANALOG	CD4031BE	RCA	8000-40-3100 1
U1	CONTROLLER, ALPH NUM DISP, 40V	10957P-50	ROCK	8001-09-3700 1
U4	DECODER/DEMUX, 3 TO 8 LINE	SN74ALS138N	TI	8007-41-3800 1
U3 U5 U6	FLIP-FLOP, OCTAL D	SN74ALS74N	TI	8007-43-7450 3

**WAVETEK**  
PARTS LIST

TITLE  
ASSY. DISPLAY/KEYBOARD

ASSEMBLY NO.  
1100-00-3001

REV  
C

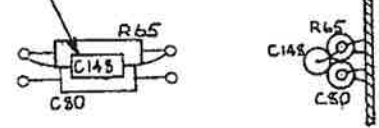
PAGE 2

NOTE UNLESS OTHERWISE SPECIFIED

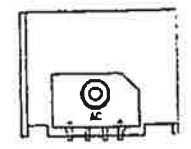
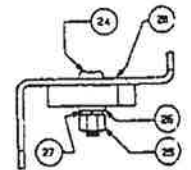
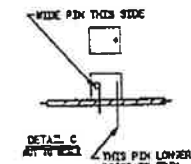
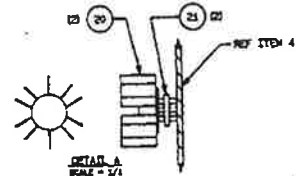
REMOVE ALL BURRS DO NOT BREAK SHARP EDGES	DRAWN	DATE	WAVETEK	
MATERIAL	CHECKED	PROJ. ENGR.	PARTS LIST DISPLAY/KEYBOARD	
FINISH WAVETEK PROCESS	RELEASE APPROV.	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES	SIZE <b>D</b>	PSCM NO. <b>23338</b>
DO NOT SCALE DRAWING	SCALE	MODEL <b>288</b>	DWG. NO. <b>1100-00-3001</b>	REV <b>C</b>
			SHEET <b>1</b> OF <b>1</b>	

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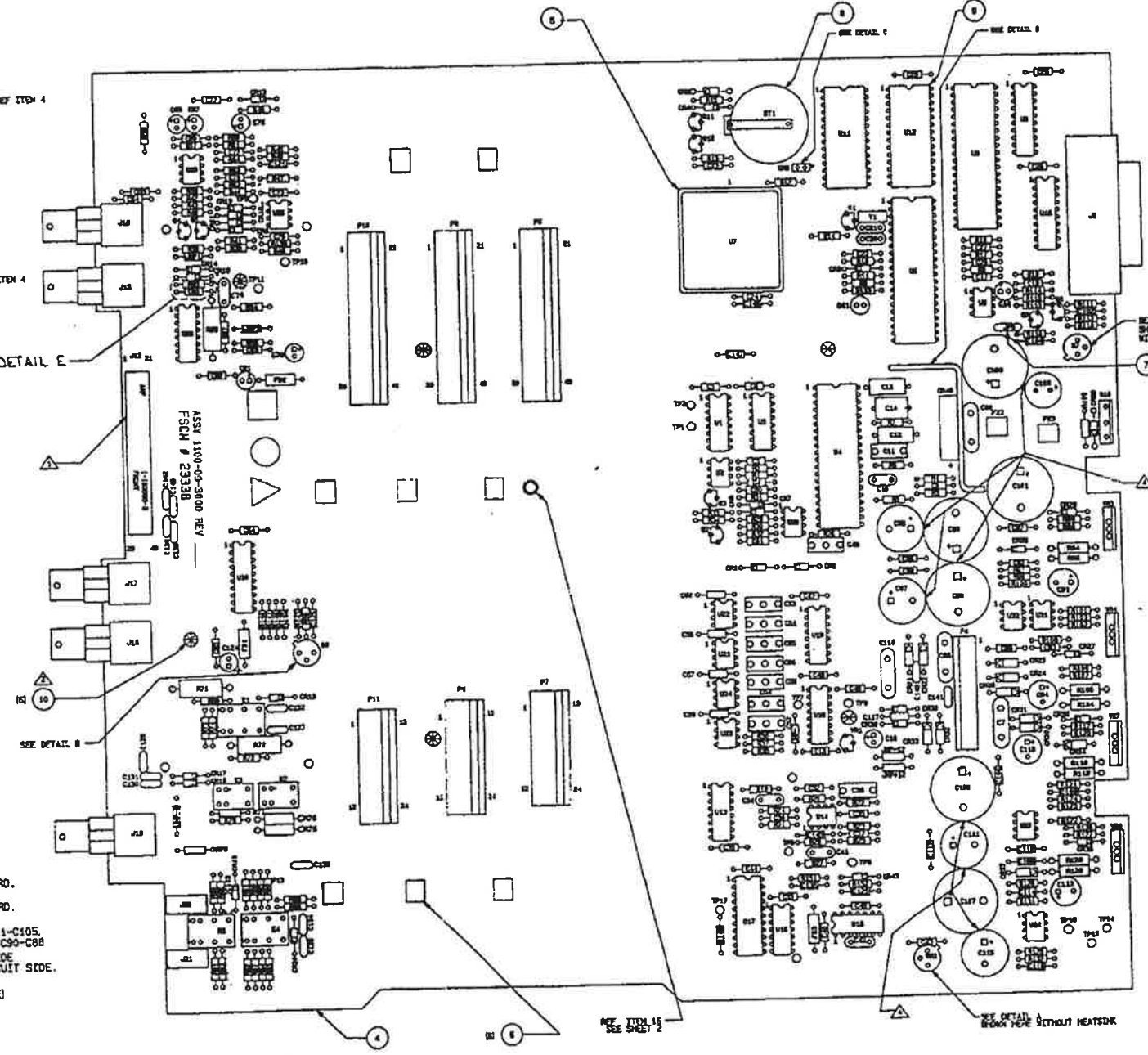
TACK ON C148 TO LEADS OF R65



DETAIL E  
SCALE = NONE



- ▲ COMPONENTS UNDER ITEM NO. 10 TO BE .465 MAX FROM SURFACE OF BOARD.
- ▲ COMPONENTS UNDER ITEM NO. 18 TO BE .325 MAX FROM SURFACE OF BOARD.
- ▲ INSTALL CLEAR RTY BETWEEN CAPACITORS: C115-C107, C107-C111, C111-C105, C97-C90, C90-C88, C88-C85, C103-C100, C90-C88
- ▲ INSTALL CANS FLUSH TO COMPONENT SIDE OF P.C. BOARD. SOLDER TABS TO CIRCUIT SIDE.
- ▲ ITEM 10 (SPACERS) TP BE INSTALLED FROM BOTTOM OF BOARD (CIRCUIT SIDE)
- ▲ MANUFACTURER'S MARKING INDICATES CORRECT ORIENTATION OF CONNECTOR



REF DETAIL A BURN HERE WITHOUT HEATSHIELD

REF DETAIL D BURN HERE WITHOUT HEATSHIELD

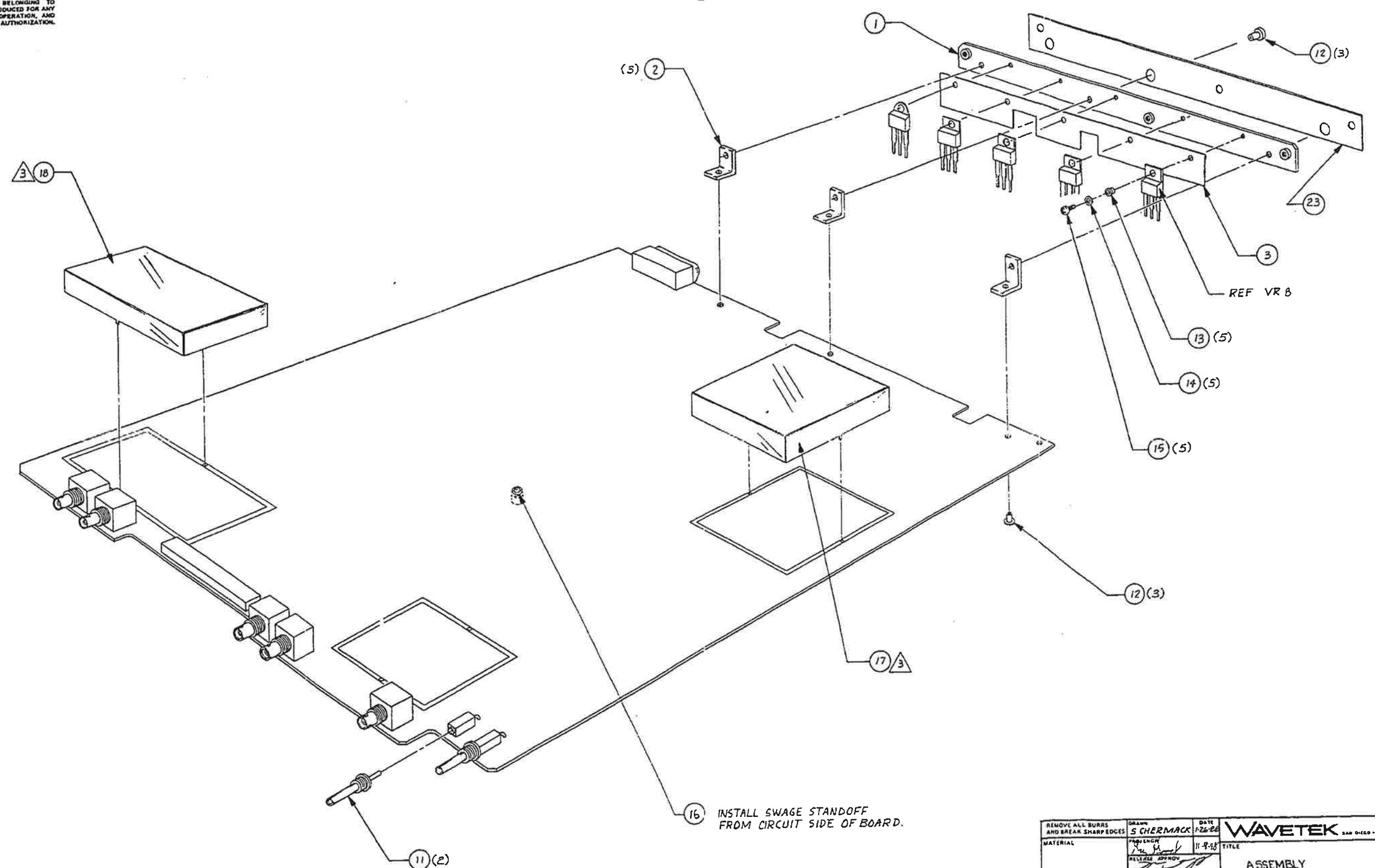
REF ITEM 15 SEE SHEET 2

SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 5-1-88	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA
MATERIAL	PHIL ENGA	RELEASE APPROV. [Signature]	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		TITLE <b>ASSEMBLY MOTHER BOARD</b>
DO NOT SCALE DRAWING	SCALE 1:1	MOOD 205	SHEET 1 OF 2
	SIZE D	FIG. NO. 23338	DWG. NO. 1100-00-3198

REV	ECH	BY	DATE	APP
A	ERO 89-025	M	11-2-88	

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NOTE: UNLESS OTHERWISE SPECIFIED

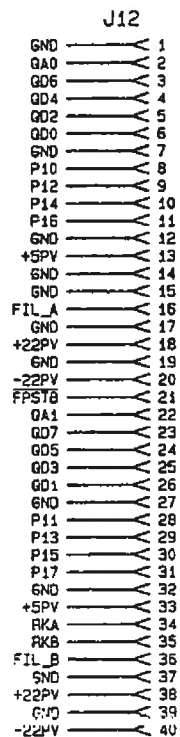
REMOVE ALL BURRS AND BREAK SHARPEGES	DRAWN S CHERMACK	DATE 11-26-88	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA	
MATERIAL	DESIGNED BY <i>[Signature]</i>	DATE 11-9-88	TITLE ASSEMBLY MOTHERBOARD	
FINISH WAVETEK PROCESS	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX ±.010 ANGLES 11°		MODEL NO. 288	QWC NO. 1100-00-3198
SCALE NONE	DO NOT SCALE DWG		REV A	SHEET 2 OF 2
	COPIES 23338			



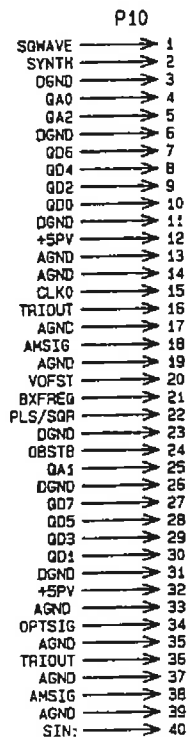
ALL DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REV	DATE	BY	CHKD
B	#9844	MG	7/88 DF
C	#90-050	AT	7/90 DF
D	#90-283	AT	7/90 LEL

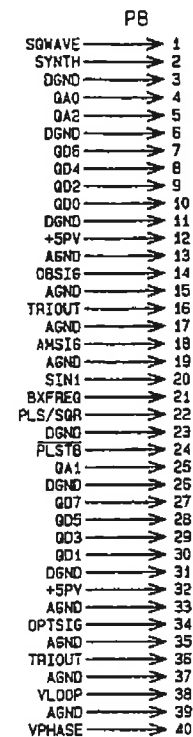
FRONT PANEL BOARD CONNECTOR



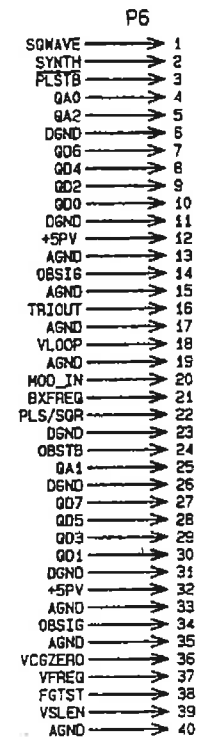
OUTPUT BOARD CONNECTORS



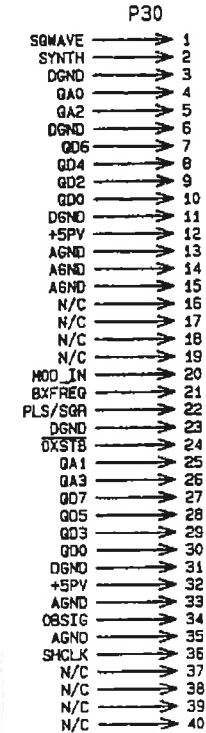
PHASE LOCK LOOP BOARD CONNECTORS



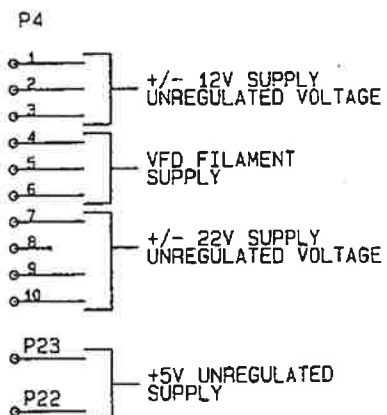
FUNCTION GENERATOR BOARD CONNECTORS



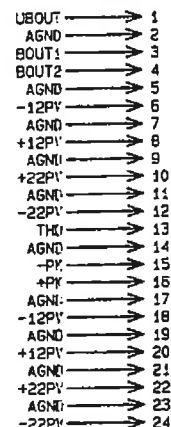
AUXILLARY BOARD CONNECTORS



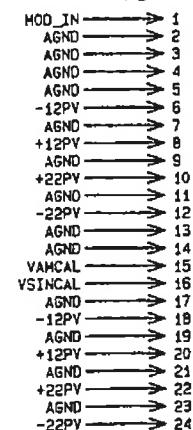
POWER SUPPLY UNREGULATED AC INPUT



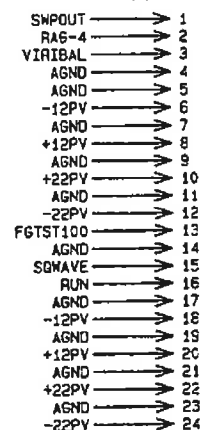
P11



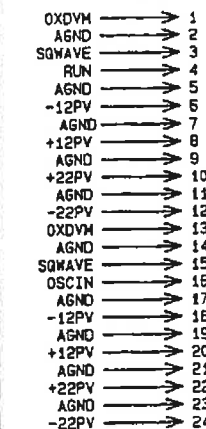
P9



P7



P31



MODEL 289 ONLY

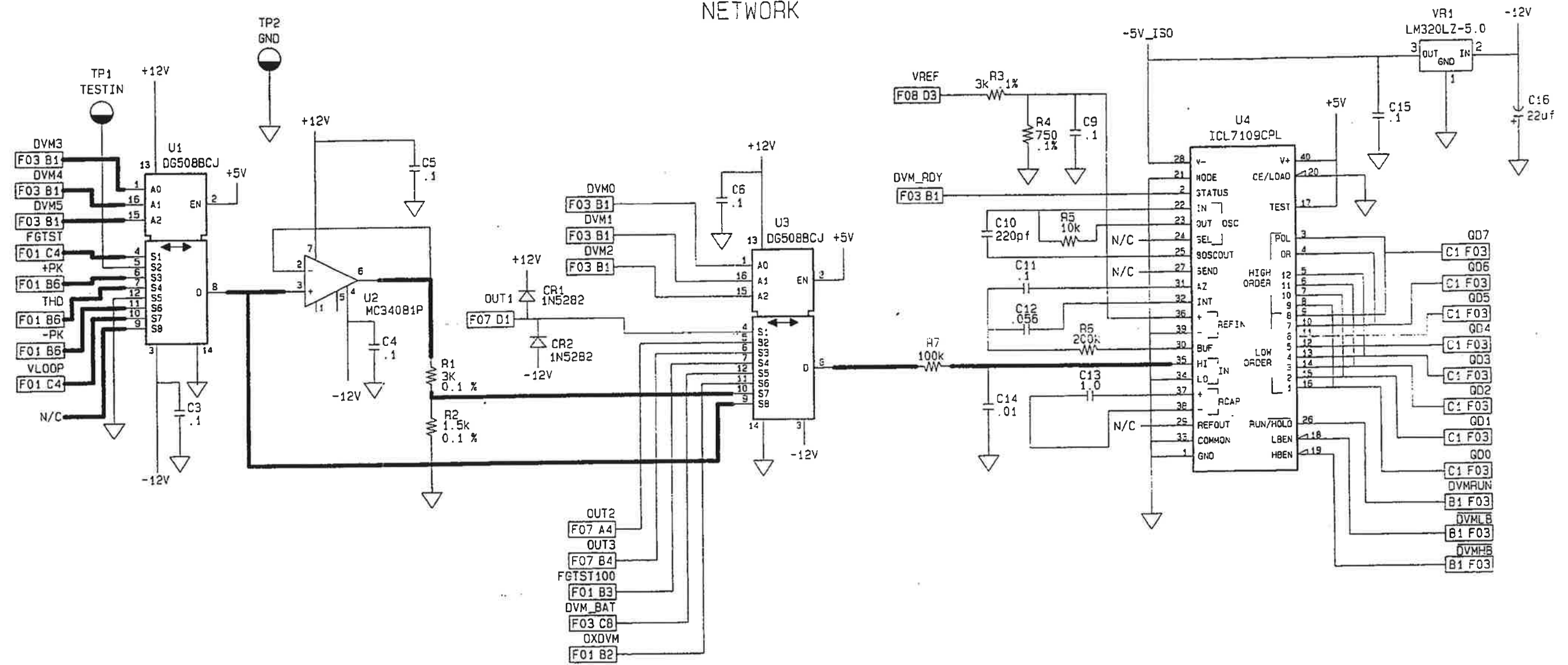
4. CHASSIS GROUND SYMBOL.
3. GROUND SYMBOL.
2. ALL CAPACITORS ARE IN MICROFARADS.
1. ALL RESISTORS ARE IN OHMS, 1/8W, 1%, MF.

NOTE: UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATORS LAST USED R152, C147, CR43, U34, TP17, Q12, VR8, SW1, BT1, Y1, FB3, JMP12	REFERENCE DESIGNATORS NOT USED R50, R134-R137, R139-R142, R144, R152, C1, C2, C30, C31, C63, C69, C71, C78, C122, C123, C125, C137, CR40-CR42, U25, U27, TP3, TP4, TP12, TP13, VR5, VR6	<table border="1"> <tr><td>REMOVE ALL BURRS AND BREAK SHARP EDGES</td><td>DRAWN M. KINGSLEY</td><td>DATE 8-18-88</td></tr> <tr><td>CHECKED</td><td>ML</td><td>22</td></tr> <tr><td>ENCL. ENGR.</td><td>W. J. J.</td><td>22</td></tr> <tr><td>RELEASE APPROV.</td><td>W. J. J.</td><td>22</td></tr> </table>	REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 8-18-88	CHECKED	ML	22	ENCL. ENGR.	W. J. J.	22	RELEASE APPROV.	W. J. J.	22	<table border="1"> <tr><td colspan="2">WAVETEK</td></tr> <tr><td colspan="2">MOTHERBOARD SCHEMATIC</td></tr> <tr><td>SIZE D</td><td>23338</td></tr> <tr><td>DWG NO.</td><td>0103-00-3000</td></tr> <tr><td>SCALE NONE</td><td>MODEL 1288</td></tr> <tr><td>SHEET 1</td><td>OF 11</td></tr> </table>	WAVETEK		MOTHERBOARD SCHEMATIC		SIZE D	23338	DWG NO.	0103-00-3000	SCALE NONE	MODEL 1288	SHEET 1	OF 11
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 8-18-88																									
CHECKED	ML	22																									
ENCL. ENGR.	W. J. J.	22																									
RELEASE APPROV.	W. J. J.	22																									
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SCALE NONE	MODEL 1288																										
SHEET 1	OF 11																										

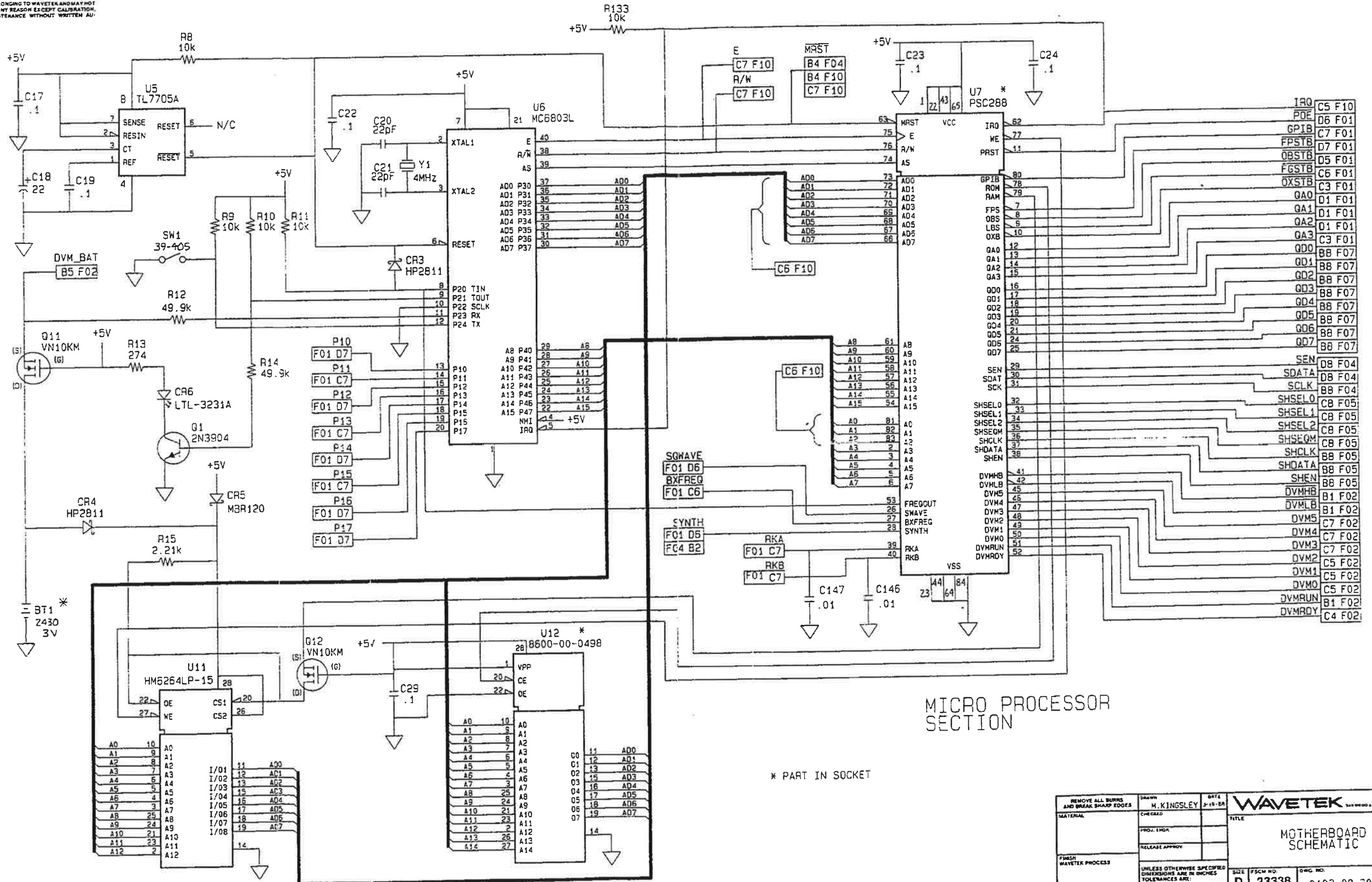
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\*\*\*DVM\*\*\*  
INTERNAL CALIBRATION  
NETWORK



NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BUMPERS AND BREAK SHARP EDGES		DATE	WAVETEK	
DESIGNED	M. KINGSLEY	3-18-88	MOTHERBOARD SCHEMATIC	
CHECKED				
PROJ. ENGR.				
RELEASE APPROV.				
FINISH WAVETEK PROCESS		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		
D3 NOT SCALE DRAWING		SIZE	D 23338	DWG. NO. 0103-00-3000
		SCALE	NONE	MODEL 1288 SHEET 2 OF 10



MICRO PROCESSOR SECTION

\* PART IN SOCKET

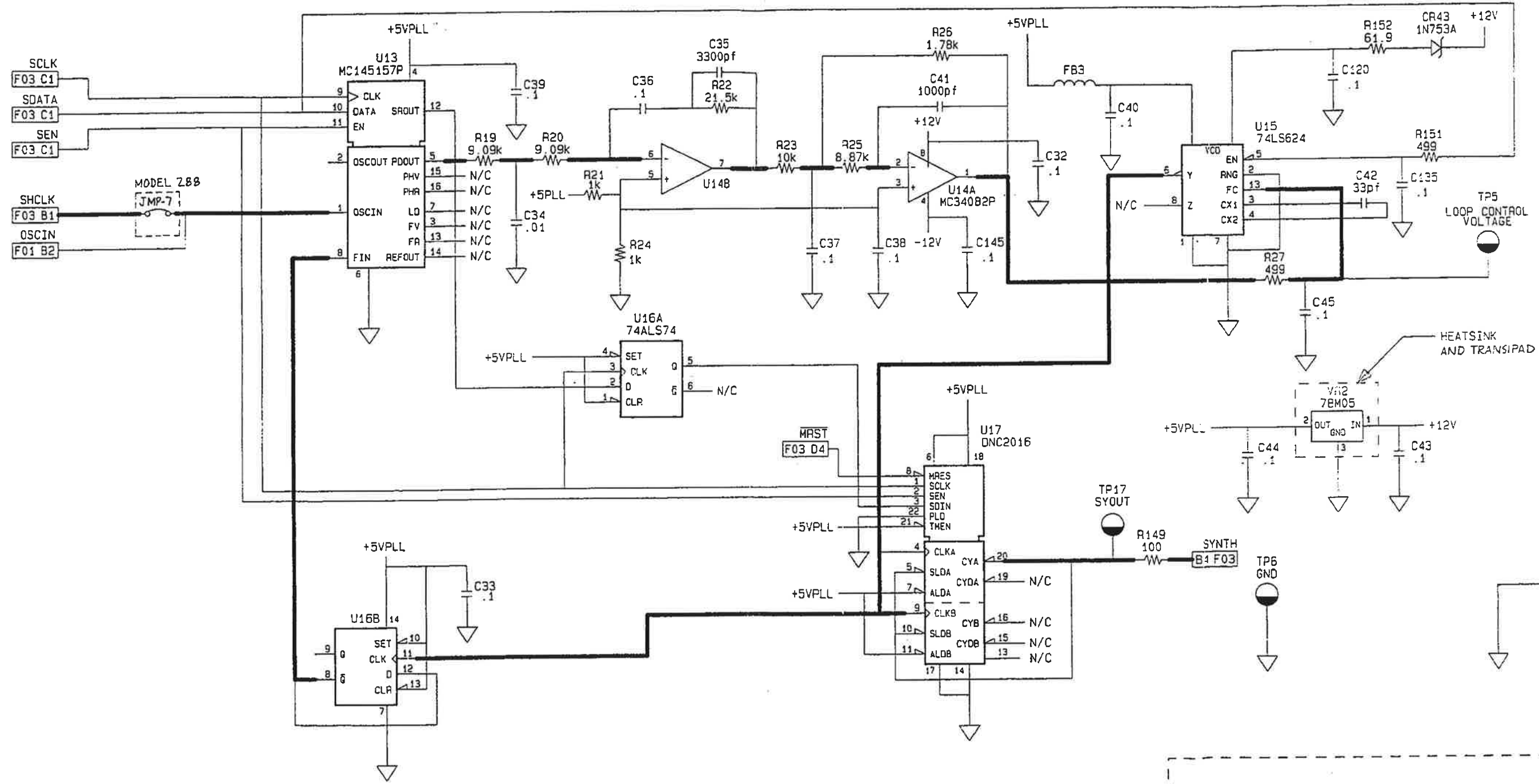
REMOVE ALL BURRS AND BREAK SHARP EDGES		DRAWN	M. KINGSLEY	DATE	3-18-88
MATERIAL	CHECKED	TITLE			
FRESH WAVETEK PROCESS		PROJ. ENGR.	MOTHERBOARD SCHEMATIC		
DO NOT SCALE DRAWING		RELEASE APPROV.	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		
SIZE	D	FSCH NO.	23338	DWG. NO.	0103-00-3000
SCALE	NONE	MODEL	1288	SHEET	3 OF 10

NOTE UNLESS OTHERWISE SPECIFIED

0103-00-3000

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 THORIZATION.

# FREQUENCY SYNTHESIZER

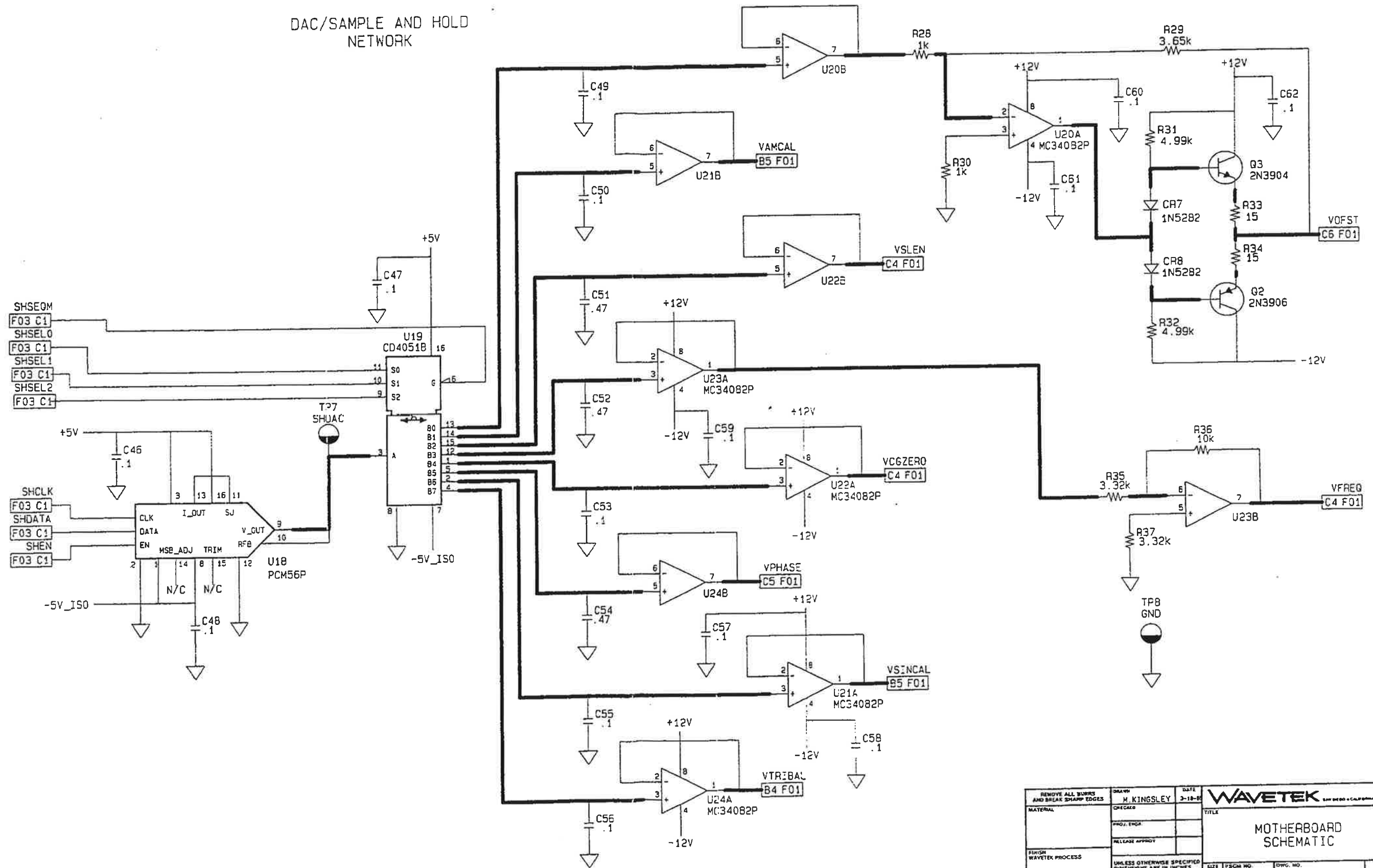


NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURNS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 3-18-85	<b>WAVETEK</b> <small>San Jose • Chula Vista</small>	
MATERIAL	CHECKED		TITLE	
	PROJ. ENGR.		MOTHERBOARD SCHEMATIC	
	RELEASE APPROV.			
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		SIZE D	PSCH NO. 23338
DO NOT SCALE DRAWING	SCALE NONE	MODEL 1268	DWG. NO. 0103-00-3000	REV 1
			SHEET 4	OF 4

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### DAC/SAMPLE AND HOLD NETWORK



NOTE: UNLESS OTHERWISE SPECIFIED

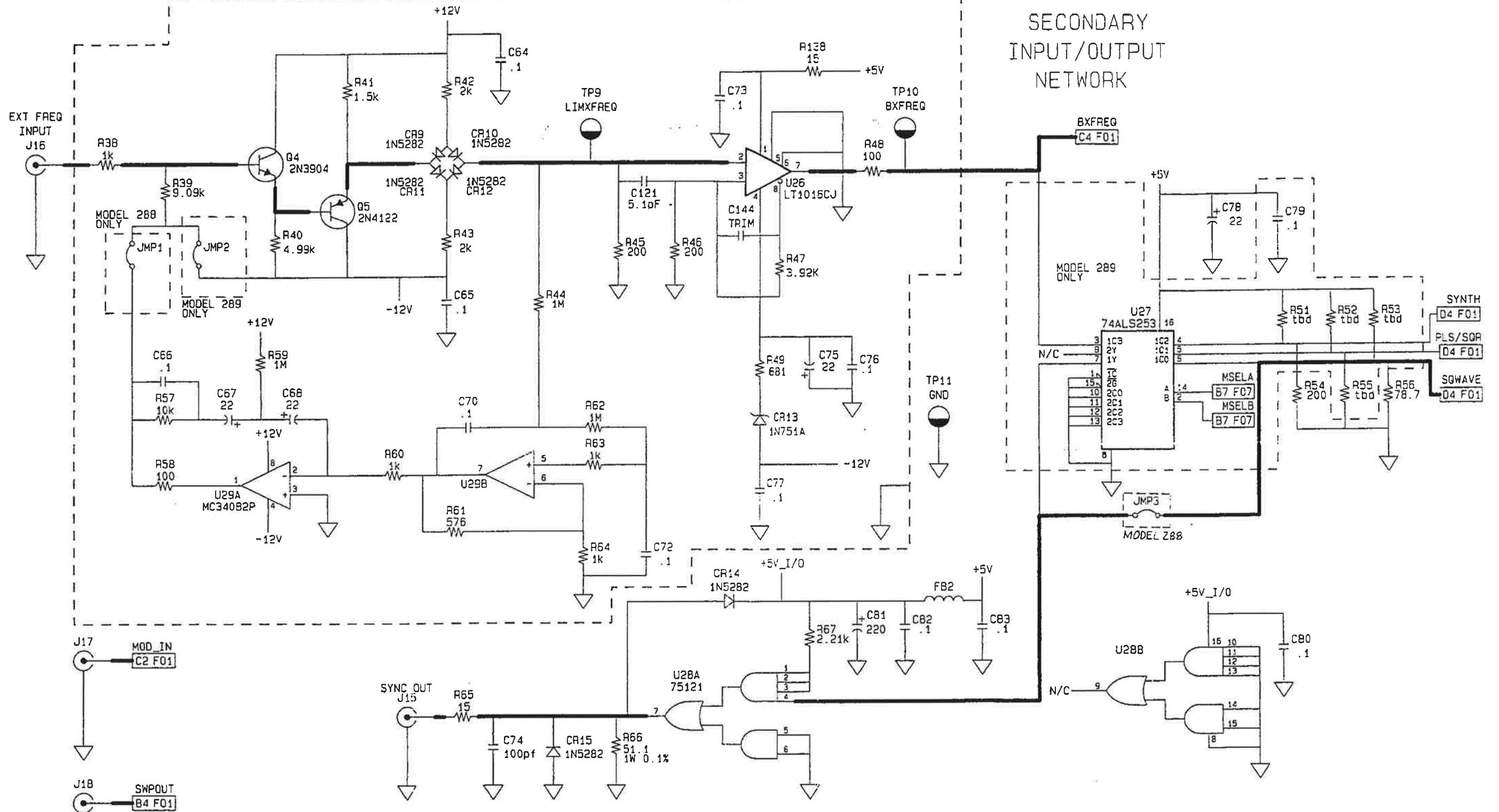
REMOVE ALL BURRS AND BREAK SHARP EDGES		DRAWN	DATE	WAVETEK	
MATERIAL		M. KINGSLEY	2-18-81	TITLE	
FINISH		PROJ. ENGR.		MOTHERBOARD SCHEMATIC	
WAVETEK PROCESS		RELEASE APPROV.		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:	
DO NOT SCALE DRAWING				SIZE	REV
				D	23338
				SCALE	MODEL
				NONE	12RE
				SHEET	5 OF 10

6 5 4 3 2 1

10107-00-3000 B C D

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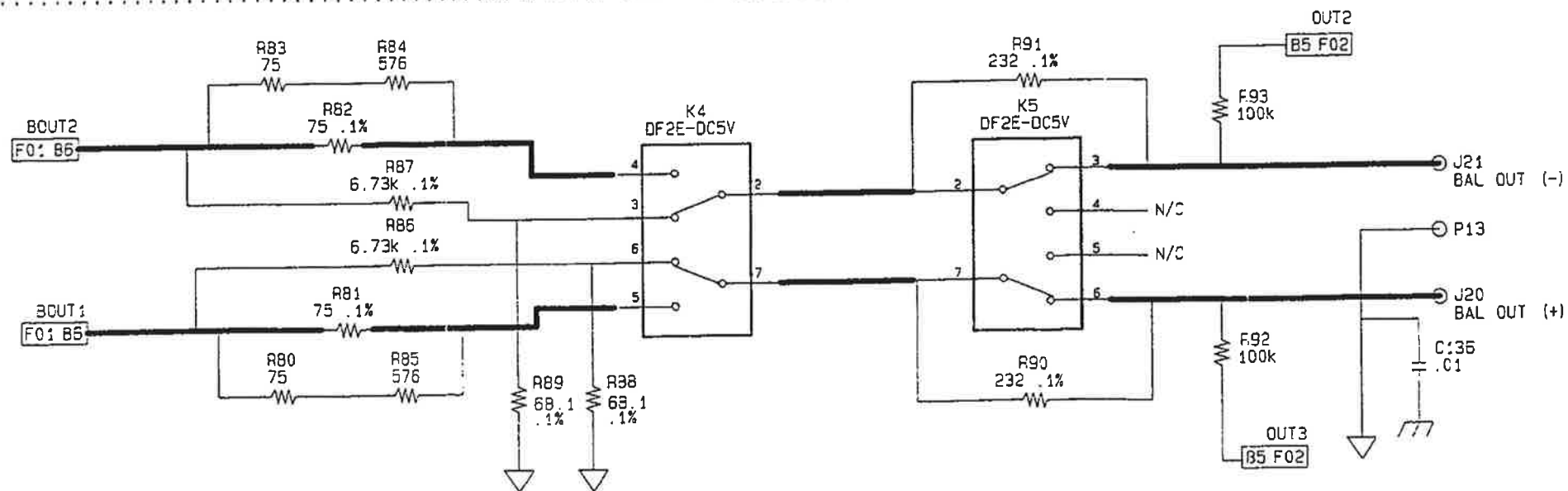
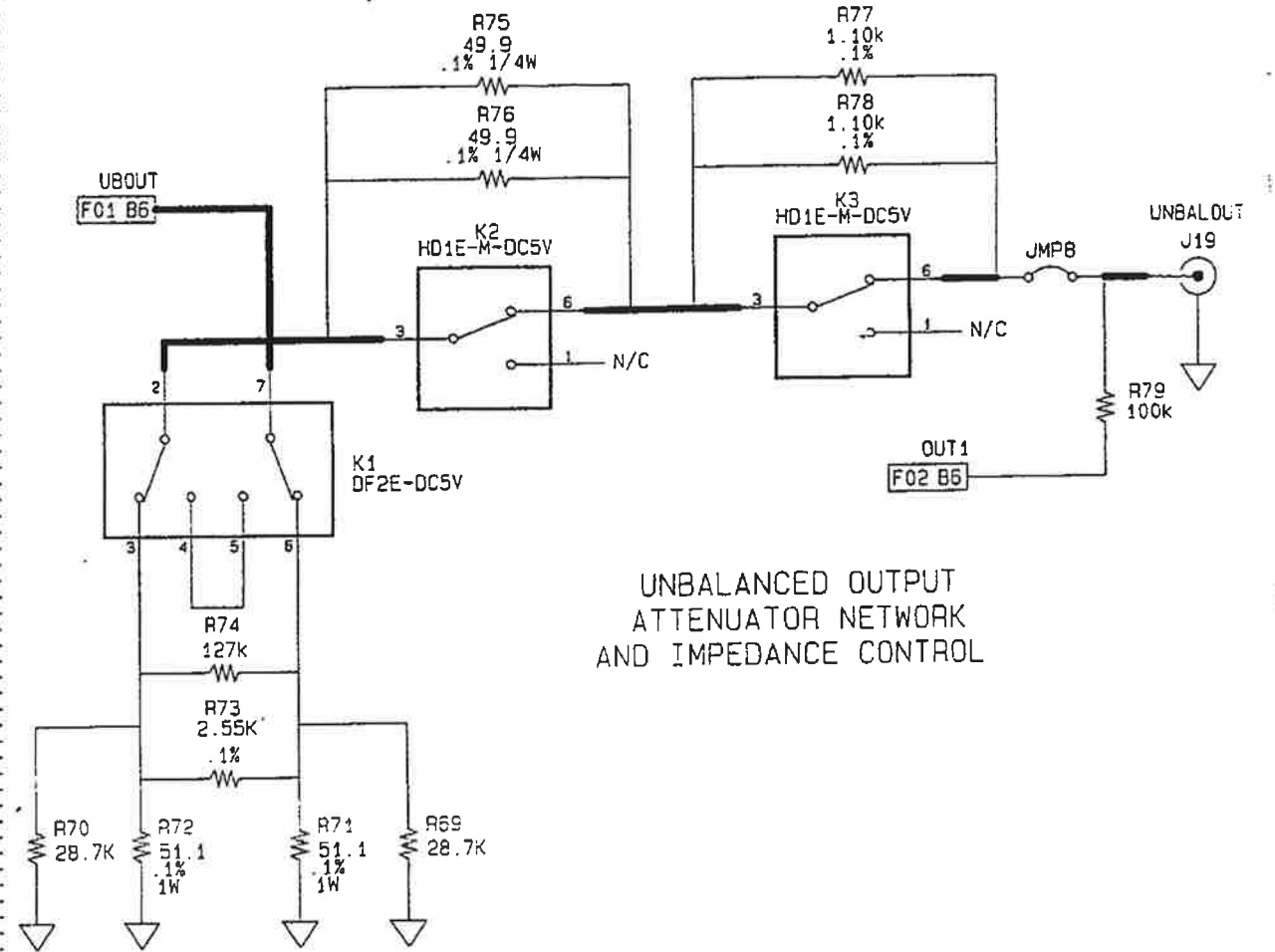
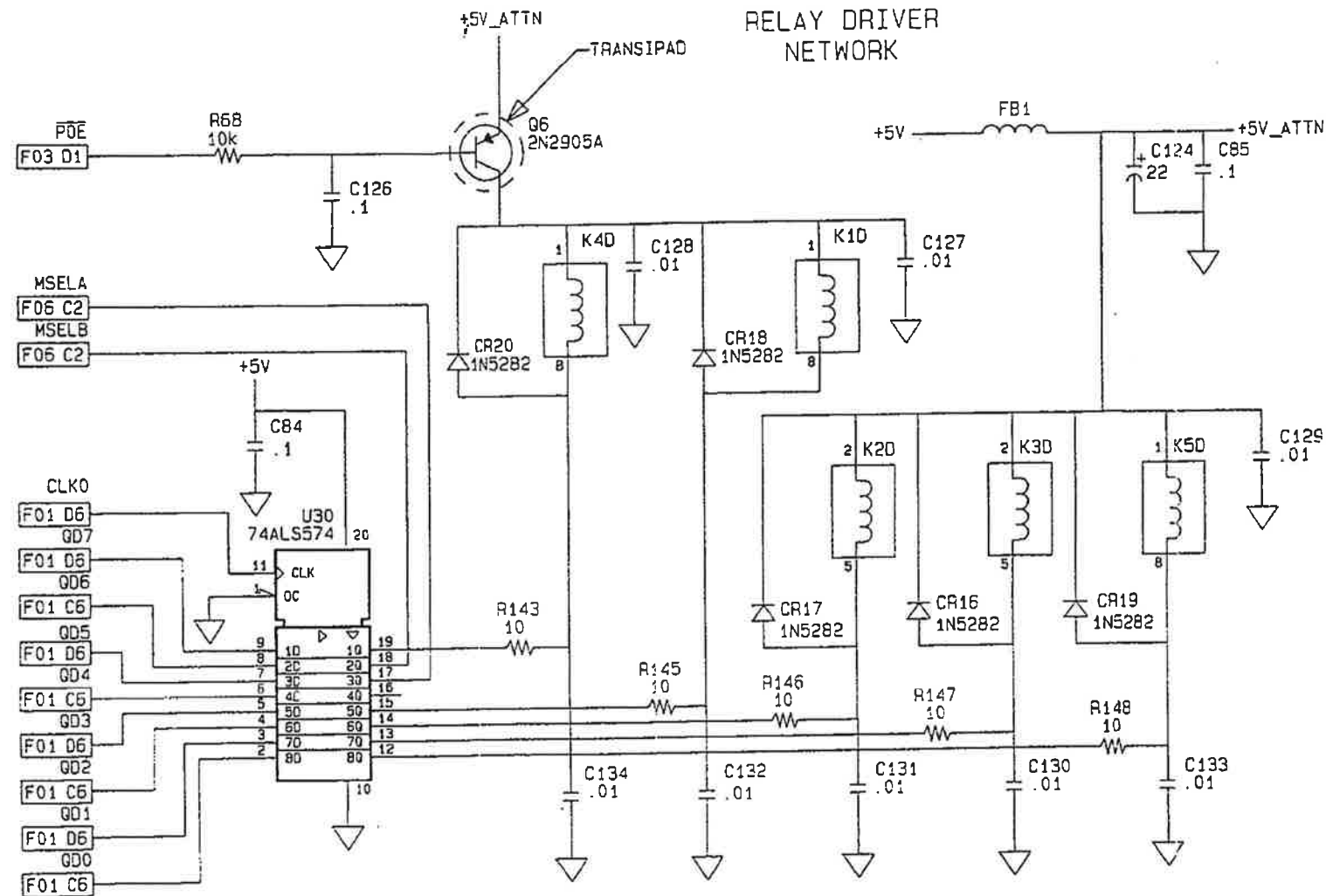
### SECONDARY INPUT/OUTPUT NETWORK



NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 3-10-86	<b>WAVETEK</b> 144 BROADWAY, CAMBRIDGE, MA 02142	
CHECKED	PROJ. ENGR.	RELEASE APPROV.	TITLE <b>MOTHERBOARD SCHEMATIC</b>	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS: DECIMALS: ANGLES: 22: .005 .001 .001		SIZE <b>D</b>	PSGM NO. <b>23338</b>
DO NOT SCALE DRAWING	SCALE NONE	DWG NO. 0103-00-3000	REV <b>D</b>	SHEET <b>6</b> OF <b>10</b>

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BALANCED OUTPUT ATTENUATOR NETWORK AND IMPEDANCE CONTROL

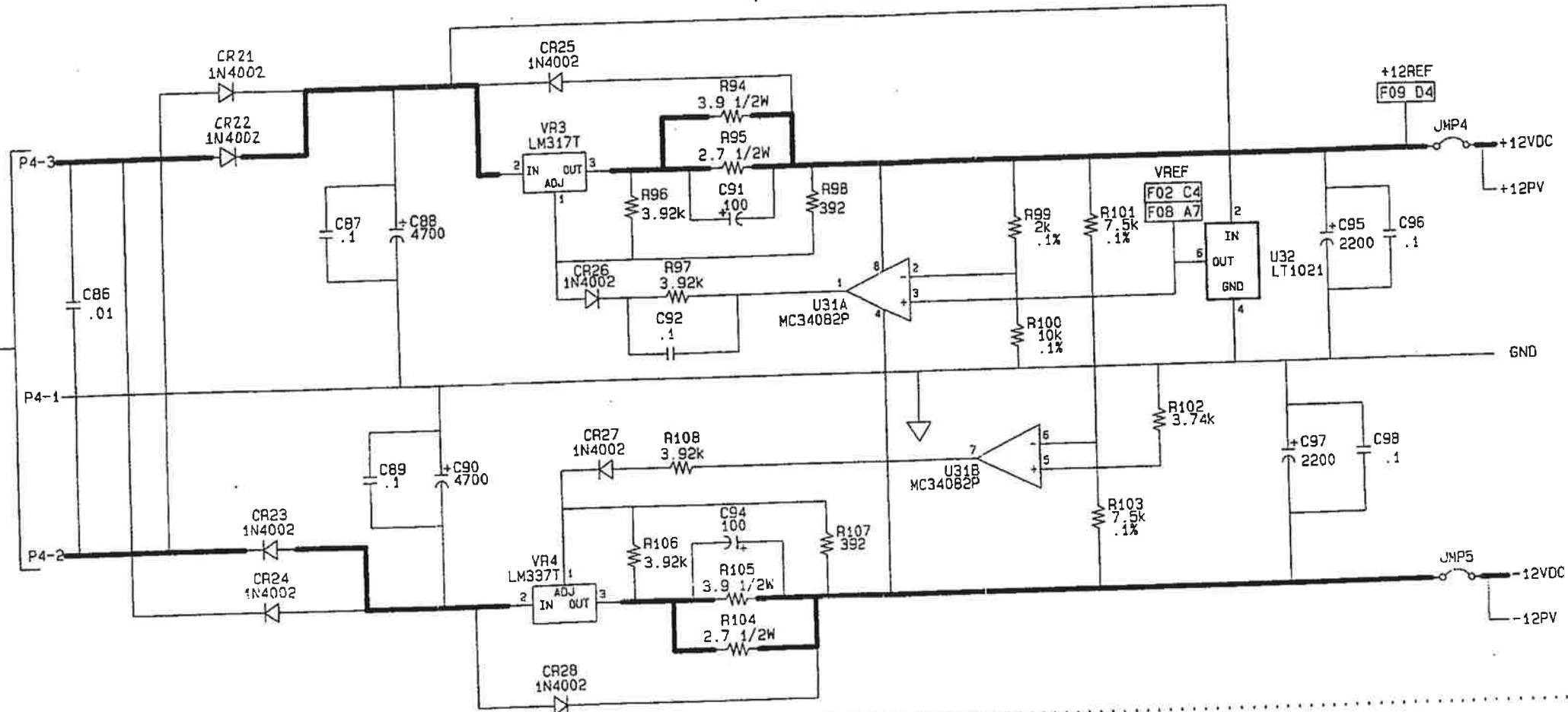
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 3-18-88	<b>WAVETEK</b> SANTA ANA, CALIFORNIA
MATERIAL	CHECKED		TITLE MOTHERBOARD SCHEMATIC
FINISH WAVETEK PROCESS	PROJ. ENGR.		SIZE / FCSCM NO. / DWG. NO. D / 23338 / 0103-00-3000
DO NOT SCALE DRAWING	RELEASE APPROV.		SCALE / NCNE / MODEL / 12-RR / SHEET 7 OF 11
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS - DECIMALS - ANGLES XXX - .XXX - .XXX			

NOTE: UNLESS OTHERWISE SPECIFIED

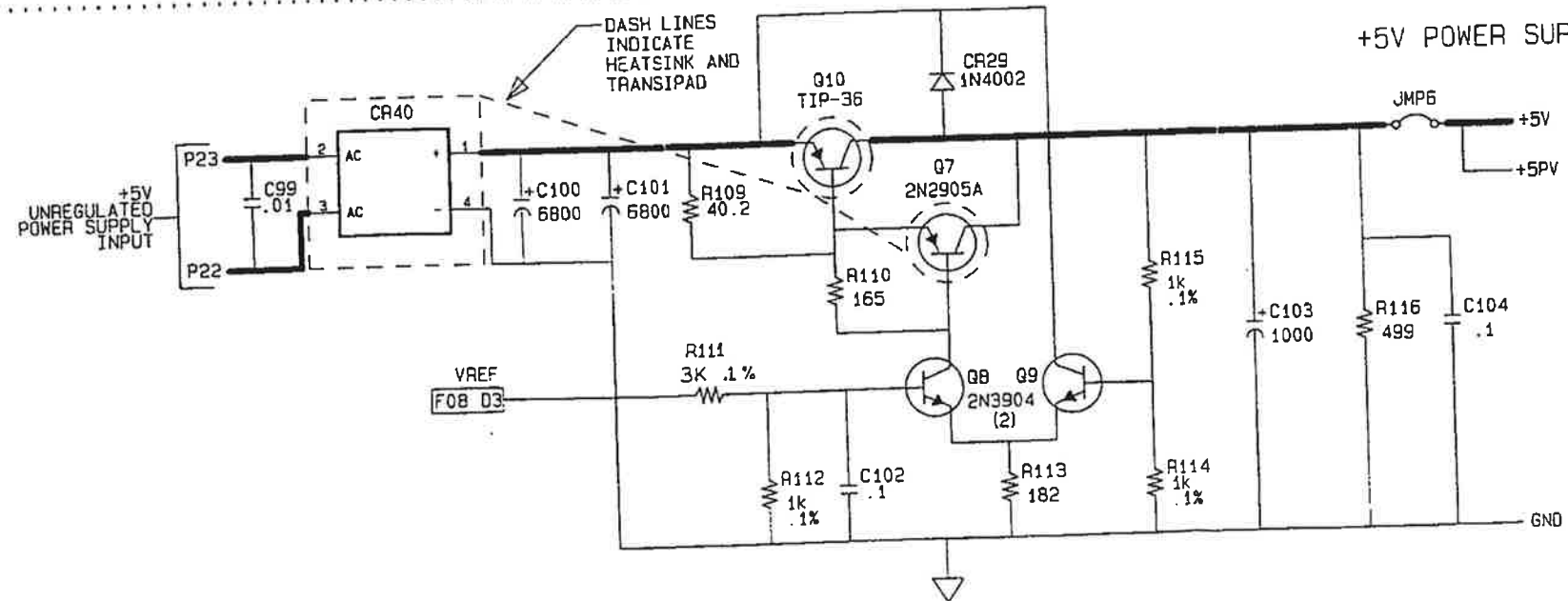
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 OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

### +/- 12V POWER SUPPLIES

+/- 12V  
UNREGULATED  
POWER SUPPLY  
INPUT



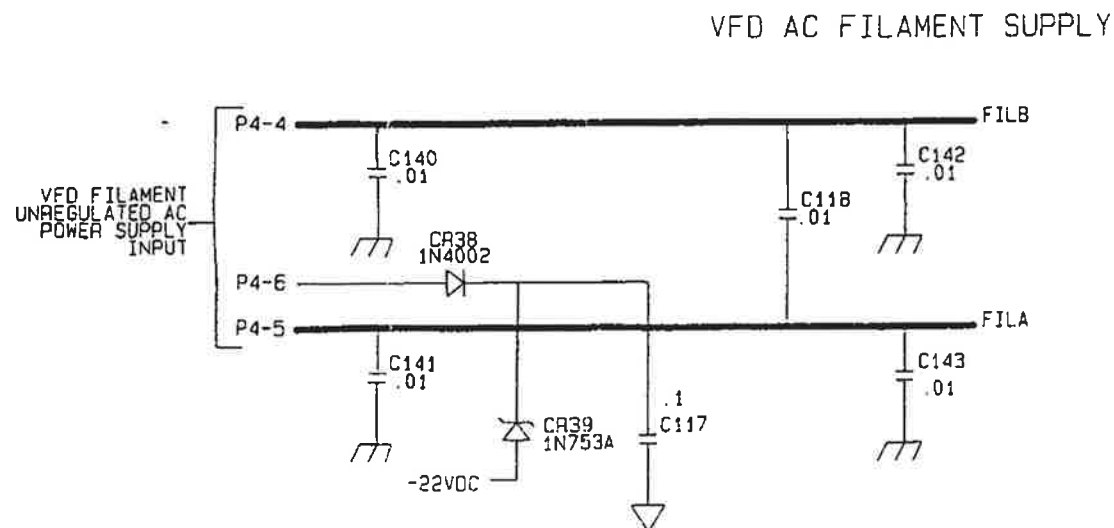
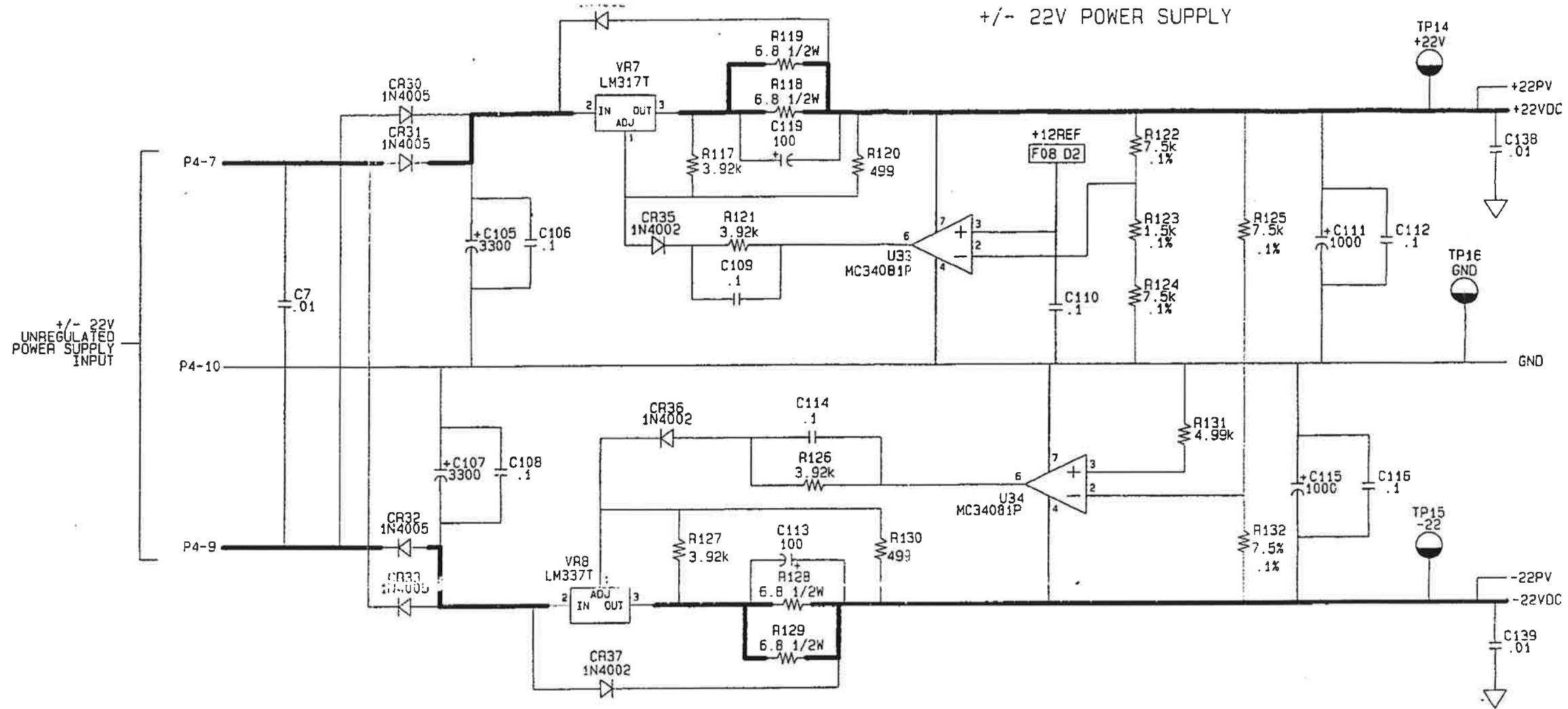
### +5V POWER SUPPLY



NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES		DRAWN M. KINGSLEY	DATE 3-18-84	WAVETEK SUN DIEGO CALIFORNIA	
MATERIAL		CHECKED		TITLE MOTHERBOARD SCHEMATIC	
FINISH WAVE'EK PROCESS		PROV. ENGR.		SIZE D 23338	DWG. NO. 0103-00-3000
DO NOT SCALE DRAWING		RELEASE APPROV.		SCALE NONE	MODEL 1285
		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES XX 1/XX 1/XX 1/XX		SHEET F OF 10	REV L





NOTE: UNLESS OTHERWISE SPECIFIED

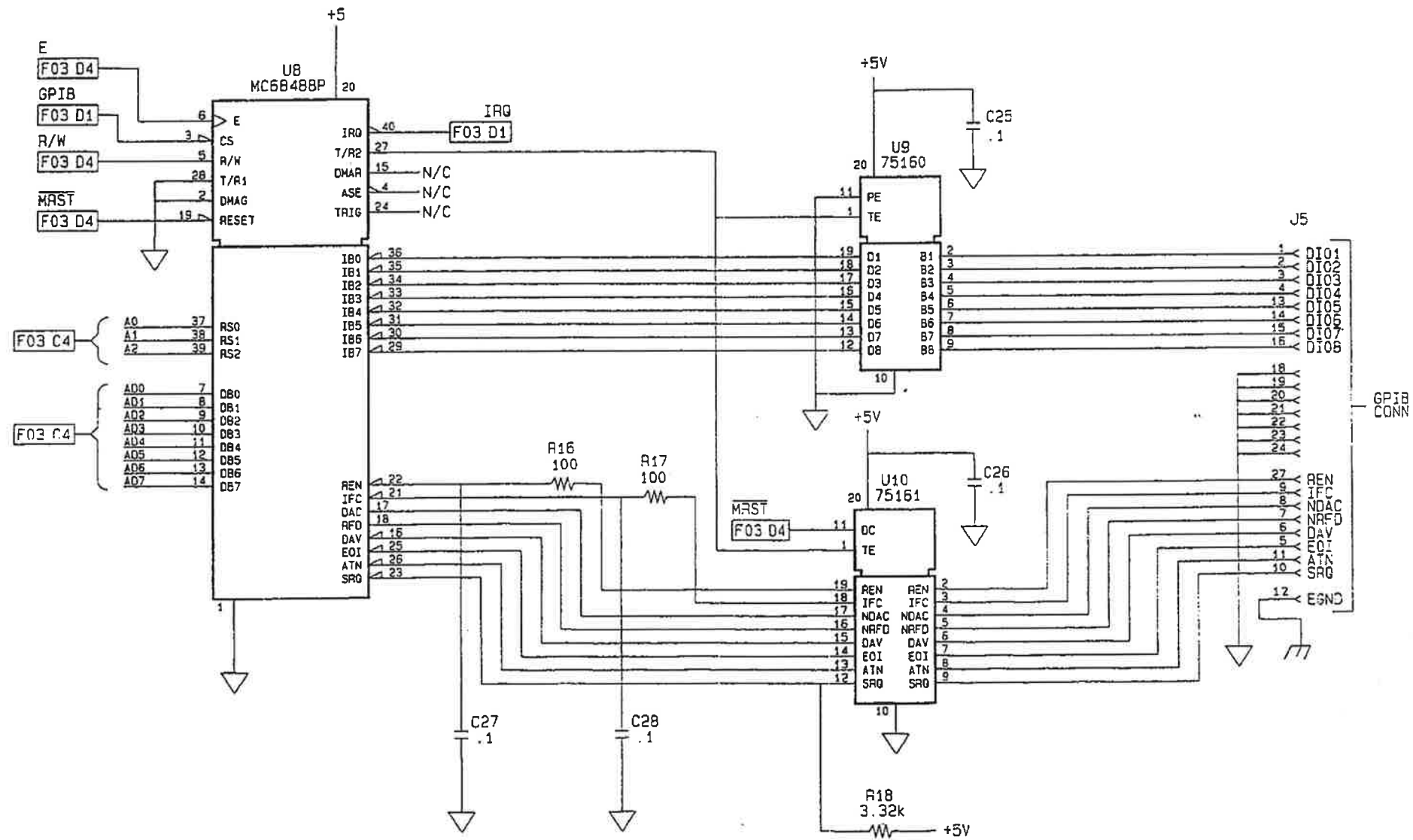
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 3-18-81	<b>WAVETEK</b>	
MATERIAL	CHECKED	PROJ ENGR		
FINISH WAVETEK PROCESS	RELEASE APPROV	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		SCALE NONE
DO NOT SCALE DRAWING	SCALE	REV	SHEET NO D 23338	MODEL NO 0103-00-3000

D  
C  
B  
A  
0103-00-3000 D

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REV ECO BY DATE APP

GPIB SECTION



NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINASLEV	DATE 2-18-88	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA	
MATERIAL	CHECKED		TITLE	
	PROJ. ENGR.		MOTHERBOARD SCHEMATIC	
	RELEASE APPROV.			
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX .XXX .XXX		SIZE D	PSCM NO. 23338
DO NOT SCALE DRAWING	SCALE NONE	MODEL 1288	DWG. NO. 0103-06-3000	REV L
			SHEET 10	OF 10

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REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEK NO.	QTY/PT
NONE	PCA SUB, MOTHER BD 1288/288			1208-00-3000	1
17	CAN. SYNTHESIZER	1400-02-3443	WVTK	1400-02-3443	1
18	CAN. FREQ IN/SYNC OUT	1400-02-3453	WVTK	1400-02-3453	1
C148	CAP. CER. 330PF, 100V, AXIAL	CAC02C09331J100A	CORNG	1500-03-3106	1
25	NUT, HEX. 6-32, Z	M835647-264	CDPL	2800-14-6100	1
26	WASHER #6 SAE FLAT, .375 D. D.	6 SAE FLAT WASHER	CHRCL	2800-26-6000	1
27	#6 LOCKWASHER, PLATED	#6SRLW	CHRCL	2800-42-6090	1
24	SCREW, PH. PHLPS. 6-32X9/16, SS	2800-61-6109	CMCRL	2800-61-6109	1
BT1	BATTERY, 3V LITH. COIN CELL, 200 MAHR	DL2400	DURCL	4000-02-0012	1
U12	EPROM, PROG. USES 1EA 8002-72-5610 FOR	B600-00-0320	WVTK	B600-00-0320	1

**WAVETEK PARTS LIST**  
 TITLE: PCA, MOTHER BD-288  
 ASSEMBLY NO.: 1100-00-3198  
 REV: A  
 PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEK NO.	QTY/PT
C120 C126 C135 C145 C15 C17 C19 C22 C23 C24 C25 C26 C27 C28 C29 C3 C32 C33 C37 C38 C39 C4 C40 C43 C44 C45 C46 C47 C48 C5 C57 C58 C59 C6 C60 C61 C62 C64 C65 C66 C70 C72 C73 C76 C77 C80 C82 C83 C84 C85 C87 C89 C9 C92 C93 C96 C98					
C20 C21	CAP. CER. 22PF, 100V, AXIAL	CAC02C09220J100A	CORNG	1500-02-2004	2
C10	CAP. CER. 220PF, 100V, AXIAL	CAC02C09221J100A	CORNG	1500-02-2104	1
C42	CAP. CER. 33PF, 100V, AXIAL	CAC02C09330J100A	CORNG	1500-03-3006	1
C148	CAP. CER. 330PF, 100V, AXIAL	CAC02C09331J100A	CORNG	1500-03-3106	1
C35	CAP. CER. 3300PF, 100V, 2 OZ. AXIAL	CAC02X7R332M100A	CORNG	1500-03-3206	1
C121	CAP. CER. 5.1PF, 100V, AXIAL	CAC02C0951J100A	CORNG	1500-05-1906	1
C113 C119 C91 C94	CAP. ELECT. 1000PF, 35V RADIAL LEAD, SP. 20	NRE101H35V8X11	NIC	1500-31-0102	4
C111 C115	CAP. ELECT. 1000PF/50V RADIAL LEAD, SP. 30	NRE102H50V16X28	NIC	1500-31-0203	2

**WAVETEK PARTS LIST**  
 TITLE: PCA SUB, MOTHER BD 1288/288  
 ASSEMBLY NO.: 1208-00-3000  
 REV: A  
 PAGE 2

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEK NO.	QTY/PT
C12	CAP. POLYPRD. .056PF, 20 OV. 2X, AXIAL	0A1C563-0	IMB	1500-45-6300	1
4	PCB, MOTHER BOARD	1700-00-3000	WVTK	1700-00-3000	1
J15 J16 J17 J18 J19	CONN. BNC(PC)	227161-1	AMP	2100-01-0019	5
P4	CONN. HEADER	1-640286-0	AMP	2100-02-0079	1
J20 J21	PC JACK	09-9094-1-04	CONCD	2100-02-0190	2
J12	CONN. HEADER, 40 PIN, RECP. 2X20, .1 CTR PCMT	1-102583-2	AMP	2100-02-0256	1
P7 P9 P11	CONN. HEADER, 24 PIN, PCMT, .1 CTR, 2X12, SHRD	102692-2	AMP	2100-02-0257	3
P6 P8 P10	CONN. HEADER, 40 PIN, PCB MT, .1 CTR, 2X20, SHRD	1-102692-3	AMP	2100-02-0258	3
J5	CONN. RECP, CP18, 24POS, .125 TAIL, RT ANG, PC MT	488-2R4-248HQ2K9	BURND	2100-02-0259	1
9	SOCKET, IC, 28 PIN	D1L828P-108T	BURND	2100-03-0081	1
5	SOCKET, 84 PIN, PLCC, THRU HOLE	821573-1	AMP	2100-03-0094	1
7	SOCKET, CLSD ENTRY	450-3782-01-06-00	CAMP	2100-03-0096	2

**WAVETEK PARTS LIST**  
 TITLE: PCA SUB, MOTHER BD 1288/288  
 ASSEMBLY NO.: 1208-00-3000  
 REV: A  
 PAGE 4

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEK NO.	QTY/PT
VR1	Q: N.V. REG 3V (79L03)	LK320LZ-5.0	NSC	120.0054	1
CR39 CR43	SL ZR 6.2V 3X 400MH (1N753A)	1N753A	ROHM	131.9620	2
3	THERMAL GASKET-REAR PANEL-A	1400-02-4400	WVTK	1400-02-4400	1
23	THERMAL GASKET-REAR PANEL-B	1400-02-4410	WVTK	1400-02-4410	1
28	HEATBINK BRIDGE	1400-02-4463	WVTK	1400-02-4463	1
NONE	SUPPORT PLATE, TRANSISTOR	1400-02-5007	WVTK	1400-02-5007	1
C74	CAP. CER. 100PF, 100V, AXIAL	CAC02C09101J100A	CORNG	1500-01-0106	1
C41	CAP. CER. .001PF, 100V	SA101C102HAATR	AVX	1500-01-0206	1
C118 C7 C86 C99	CAP. CER. .01MF, 1KV	GAP-103	CRL	1500-01-0309	4
C138 C139 C146 C147 C34	CAP. CER. NON. .01MF 50V, AXIAL	CAC02Z3U103Z100A	CORNG	1500-01-0310	5
C127 C128 C129 C130 C131 C132 C133 C134 C136 C140 C141 C142 C143	CAP. CER. NON. .01MF 50V 75U +80/-20% RAD LD .2	1C2025U103M0308	SPRAD	1500-01-0311	13
C102 C104 C106 C108 C109 C110 C112 C114 C116 C117	CAP. CER. NON. .1MF, 50V, AXIAL	CAC03Z3U104Z050A	CORNG	1500-01-0405	67

**WAVETEK PARTS LIST**  
 TITLE: PCA SUB, MOTHER BD 1288/288  
 ASSEMBLY NO.: 1208-00-3000  
 REV: A  
 PAGE 1

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEK NO.	QTY/PT
C103	CAP. ELECT. 1000PF/16V RADIAL LEAD, SP. 20	NRE102H16V10X20	NIC	1500-31-0211	1
C81	CAP. ELECT. 220PF/10V	ECEA1A0221	PAMAS	1500-32-2001	1
C124 C16 C18 C67 C68 C75 C78	CAP. ELECT. 22MF, 25V, RADIAL	SRA23V822R16X7LL	UNCON	1500-32-2002	7
C95 C97	CAP. ELECT. 2200PF, 16V RADIAL LEAD, SP. 30	ECEA1CV2228C	PAMAS	1500-32-2201	2
C105 C107	CAP. ELECT. 3300PF, 50V RADIAL LEAD, SP. 40	NRE 3300/50	NIC	1500-33-3202	2
C88 C90	CAP. ELECT. 4700PF/25V RADIAL LEAD, SP. 50	NRE4725V22X41	NIC	1500-34-7202	2
C100 C101	CAP. ELECT. 6800PF, 16V RADIAL LEAD, SP. 50	NRE682H16V22X41	NIC	1500-36-8201	2
C14	CAP. POLY. .01MF, 100V, AXIAL	C31B103F	BISHO	1500-41-0304	1
C11 C36 C49 C50 C53 C55 C56	CAP. MET POLY. .1PF, 160V	171-104J160D	WEST	1500-41-0434	7
C13	CAP. NYLAR, 1MF, 100V, RADIAL	PRT2R1.0K100	ITT	1500-41-0524	1
C51 C52 C54	CAP. MET-POLY. 5X, 47MF, 50V RADIAL LEAD SP. 2	168/.47/J/63/F	WEST	1500-44-7413	3

**WAVETEK PARTS LIST**  
 TITLE: PCA SUB, MOTHER BD 1288/288  
 ASSEMBLY NO.: 1208-00-3000  
 REV: A  
 PAGE 3

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEK NO.	QTY/PT
P13 P22 P23	.040 PINS				
TP11 TP16 TP2 TP6 TP8	TERMINAL TAB (FASTON)	62747-1	AMP	2100-04-0038	3
TP1 TP10 TP14 TP15 TP17 TP9	TEST POINT, BLK, PC	TP-104-01-00	CONPO	2100-04-0054	3
	TEST POINT, RED, PC	TP-104-01-02	CONPO	2100-04-0055	8
11	CONN PIN, INSERT	2100-05-0061	WVTK	2100-05-0061	2
Y1	CRYSTAL, 4MHZ	180-502	NTRDM	2300-99-0004	1
6	FUSE HOLDER, CLIP	102071	LITFU	2400-05-0031	8
16	STANDOFF, SH. 6-32X3/32, 1/16 SW, BR, IN PL	3045-B-632-B MODL=5/32	RAF	2800-06-0062	1
20	HEAT BINK	207	WAKE	2800-11-0001	2
22	TRANSIPAD	10123M	METRS	2800-11-0003	1
21	TRANSIPAD	531-218	BIVAR	2800-11-0004	2
13	WASHER	5607-45	BEAST	2800-11-0015	5
12	RIVET, 1/8 BODY DIA, 1/8-3/16 GRIP BS	SSD425688	ENHRT	2800-12-0033	3
10	HOLE PLUG, BINDER HEAD, NTRAL NYLON	207-120241-03-0101	FASTX	2800-35-0009	6
14	WASHER, LOCK REQ, 5/8	MS 35338-135	CHRCL	2800-45-4000	3

**WAVETEK PARTS LIST**  
 TITLE: PCA SUB, MOTHER BD 1288/288  
 ASSEMBLY NO.: 1208-00-3000  
 REV: A  
 PAGE 5

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b>	
MATERIAL	CHECKED		TITLE: PARTS LIST MOTHERBOARD	
FINISH WAVETEK PROCESS	PROJ. ENGR.		SIZE: D	FSCM NO.: 23338
	RELEASE APPROV.		QWC NO.: 1100-00-3198	REV: A
			SCALE: 1X	MODEL: 288
DO NOT SCALE DRAWING				SHEET 1 OF 3

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REV ECO BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
13	SCREW PLPS PAN H/S 18-8 S/S 4-40X1/4	MS 31957-13	CHRC	2800-48-4104	5
JMP6	JUMPER	461-2871-01-03-10	CANBN	3000-00-0034	1
B	BATTERY HOLDER, LITH COIN CELL	BH1000	MEPCO	3000-00-0173	1
FB1 FB2 FB3	BALUN CORE, FERRITE, 680 OHMS	2942644471	FARIT	3100-00-0017	3
K1 K4 K5	RELAY, 2 FORMC, 5V, DIP 14	DF2E-DC3V	ARDPT	4500-00-0023	3
K2 K3	RELAY, 1 FORMC, 5V, 312M, 296M	ND1E-H-DC5V	ARDPT	4500-00-0034	2
R104 R95	RES. C, 1/2W, 5%, 2.7	RC-1/2-2R7J	STKPL	4700-25-0279	2
R105 R94	RES. C, 1/2W, 5%, 3.9	RC-1/2-3R9J	STKPL	4700-25-0379	2
R118 R119 R128 R129	RES. C, 1/2W, 5%, 6.8	RC-1/2-6R8J	STKPL	4700-25-0619	4
R112 R114 R115	RES. MF, 1/8W, 1%, 1K	RN35E-1001B	MEPCO	4701-02-1001	3
R100	RES. MF, 1/8W, 1%, 10K	RN35E-1002B	MEPCO	4701-02-1002	1
R77 R78	RES. MFLN, 1/8W, 1%, 1.1 K	3033RE1101B	MEPCO	4701-02-1101	2
R123 R2	RES. MF, 1/8W, 1%, 1.5K	RN35E-1501B	CORNO	4701-02-1501	2
WAVETEK PARTS LIST					REV
TITLE PCA SUB. MOTHER BD 1288/288		ASSEMBLY NO. 1208-00-3000		PAGE 6	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
R44 R59 R62	RES. MF, 1/8W, 1%, 1M	RN35D-1004F	TRW	4701-03-1004	3
R143 R145 R146 R147 R148	RES. MF, 1/8W, 1%, 10	5043ED10R100F	MEPCO	4701-03-1009	5
R74	RES. MFLN, 1/8W, 1%, 127K	3033RD1273F	MEPCO	4701-03-1273	1
R41	RES. MF, 1/8W, 1%, 1.3K	RN35D-1301F	TRW	4701-03-1301	1
R138 R33 R34 R65	RES. MF, 1/8W, 1%, 15	RN35D-15R0F	TRW	4701-03-1309	4
R110	RES. MF, 1/8W, 1%, 165	RN35D-1650F	TRW	4701-03-1650	1
R26	RES. MF, 1/8W, 1%, 1.78K	RN35D-1781F	TRW	4701-03-1781	1
R113	RES. MF, 1/8W, 1%, 182	RN35D-1820F	TRW	4701-03-1820	1
R45 R46 R54	RES. MF, 1/8W, 1%, 200	RN35D-2000F	TRW	4701-03-2000	3
R42 R43	RES. MF, 1/8W, 1%, 2K	RN35D-2001F	TRW	4701-03-2001	2
R6	RES. MF, 1/8W, 1%, 200K	RN35D-2003F	MEPCO	4701-03-2003	1
R22	RES. MF, 1/8W, 1%, 21.5K	RN35D-2152F	TRW	4701-03-2152	1
R13 R67	RES. MF, 1/8W, 1%, 2.21K	RN35D-2211F	TRW	4701-03-2211	2
R13	RES. MF, 1/8W, 1%, 274	RN35D-2740F	TRW	4701-03-2740	1
R69 R70	RES. MF, 1/8W, 1%, 28.7K	RN35D-2872F	TRW	4701-03-2872	2
R18 R35 R37	RES. MF, 1/8W, 1%, 3.32K	RN35D-3321F	TRW	4701-03-3321	3
R29	RES. MF, 1/8W, 1%, 3.65K	RN35D-3651F	TRW	4701-03-3651	1
WAVETEK PARTS LIST					REV
TITLE PCA SUB. MOTHER BD 1288/288		ASSEMBLY NO. 1208-00-3000		PAGE 8	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
R66 R71 R72	RES. MFLN, 1M, 1%, 51.1	5053RE51R1B	MEPCO	4701-32-5119	3
JMP+12 JMP-12 JMP1 JMP3 JMP7 JMP8	RES. 0 OHM JUMPER	JPO2768G	ROHM	4799-00-0087	6
CR13	DIODE, ZENOR, 3.1V, 500MA, Q18, IN751A	IN751A	FAIR	4801-01-0751	1
CR1 CR10 CR11 CR12 CR14 CR15 CR16 CR17 CR18 CR19 CR2 CR20 CR7 CR8 CR9	DIODE, HIGH CONDUCTANCE, ULTRA FAST	IN5282	FAIR	4801-01-5282	15
CR21 CR22 CR23 CR24 CR25 CR26 CR27 CR28 CR29 CR34 CR35 CR36 CR37 CR38	DIODE, 1N4002 GEN PURPOSE RECT, 100V, 1A	1N4002	FAIR	4801-02-0001	14
CR30 CR31 CR32 CR33	DIODE 1N4005 GENERAL PURPOSE RECTIFIER, 600 V, 1A	1N4005	MOT	4806-01-4005	4
CR5	DIODE, RECT, SCH BARRIER	MBR 120	MOT	4806-02-0120	1
CR3 CR4	DIODE 5082-2811 SCHOTTKY, 15V, 20MA	5082-2811	HP	4809-02-2811	2
CR40	BRIDGE ASSY, 4 AMP	RB602	DIODE	4899-00-0037	1
CR6	LED, GREEN, RECT BAR	LTL-3231A	LITE	4899-00-0057	1
Q6 Q7	TRANS 2N2905A PNP	2N2905A	NSC	4901-02-9051	2
WAVETEK PARTS LIST					REV
TITLE PCA SUB. MOTHER BD 1288/288		ASSEMBLY NO. 1208-00-3000		PAGE 10	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
R99	RES. MF, 1/8W, 1%, 2K	RN35E-2001B	MEPCO	4701-02-2001	1
R90 R91	RES. MFLN, 1/8W, 1%, 232	5033RE2320B	MEPCO	4701-02-2320	2
R73	RES. MFLN, 1/8W, 1%, 2.5 5K	5033RE2551B	MEPCO	4701-02-2551	1
R1 R11 R3	RES. MF, 1/8W, 1%, 3K	RN35E-3001B	MEPCO	4701-02-3001	3
R86 R87	RES. MFLN, 1/8W, 1%, 6.7 3K	5033RE6731B	MEPCO	4701-02-6731	2
R88 R89	RES. MFLN, 1/8W, 1%, 68. 1	5033RE6819B	MEPCO	4701-02-6819	2
R4	RES. MF, 1/8W, 1%, 750	RN35E-7500B	MEPCO	4701-02-7500	1
R101 R103 R122 R124 R125 R132	RES. MF, 1/8W, 1%, 7.5K	RN35E-7501B	MEPCO	4701-02-7501	6
R81 R82	RES. MFLN, 1/8W, 1%, 75	5033RE7509B	MEPCO	4701-02-7509	2
R149 R16 R17 R48 R58	RES. MF, 1/8W, 1%, 100	RN35D-1000F	TRW	4701-03-1000	5
R21 R24 R28 R30 R39 R60 R63 R64	RES. MF, 1/8W, 1%, 1K	RN35D-1001F	TRW	4701-03-1001	8
R10 R11 R13 R23 R36 R5 R37 R48 R8 R9	RES. MF, 1/8W, 1%, 10K	RN35D-1002F	TRW	4701-03-1002	10
R7 R79 R92	RES. MF, 1/8W, 1%, 100K	RN35D-1003F	TRW	4701-03-1003	4
WAVETEK PARTS LIST					REV
TITLE PCA SUB. MOTHER BD 1288/288		ASSEMBLY NO. 1208-00-3000		PAGE 7	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
R102	RES. MF, 1/8W, 1%, 3.74K	RN35D-3741F	TRW	4701-03-3741	1
R107 R98	RES. MF, 1/8W, 1%, 392	RN35D-3920F	TRW	4701-03-3920	2
R106 R108 R117 R121 R126 R137 R47 R96 R97	RES. MF, 1/8W, 1%, 3.92K	RN35D-3921F	TRW	4701-03-3921	9
R109	RES. MF, 1/8W, 1%, 40.2	RN35D-4022F	TRW	4701-03-4029	1
R116 R120 R130 R131 R27	RES. MF, 1/8W, 1%, 499	RN35D-4990F	TRW	4701-03-4990	5
R131 R31 R32 R40	RES. MF, 1/8W, 1%, 4.99K	RN35D-4991F	TRW	4701-03-4991	4
R12 R14	RES. MF, 1/8W, 1%, 49. 9K	RN35D-4992F	TRW	4701-03-4992	2
R61	RES. MF, 1/8W, 1%, 576	RN35D-5760F	TRW	4701-03-5760	1
R84 R85	RES. MF, 1/8W, 1%, 604	RN35D-6040F	TRW	4701-03-6040	2
R132	RES. MF, 1/8W, 1%, 61. 9	RN35D-6189F	TRW	4701-03-6199	1
R49	RES. MF, 1/8W, 1%, 681	RN35D-6810F	TRW	4701-03-6810	1
R80 R83	RES. MFLN, 1/8W, 1%, 75	5033RD75R0F	MEPCO	4701-03-7509	2
R36	RES. MF, 1/8W, 1%, 78. 7	RN35D-7877F	TRW	4701-03-7879	1
R25	RES. MF, 1/8W, 1%, 8. 87K	RN35D-8871F	TRW	4701-03-8871	1
R19 R20 R39	RES. MF, 1/8W, 1%, 9. 09K	RN35D-9091F	TRW	4701-03-9091	3
R75 R76	RES. MFLN, 1/4W, 1%, 49.	5043RE49R9B	MEPCO	4701-12-4999	2
WAVETEK PARTS LIST					REV
TITLE PCA SUB. MOTHER BD 1288/288		ASSEMBLY NO. 1208-00-3000		PAGE 9	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
Q1 Q3 Q4 Q8 Q9	GENERAL PURPOSE TD-5 TRANS 2N3904 NPN	2N3904	FAIR	4901-03-9040	5
Q2	GENERAL PURPOSE TD-92 TRANS 2N3906 PNP	2N3906	FAIR	4901-03-9060	1
Q5	GENERAL PURPOSE TD-92 TRANS, GENERAL PURPOSE, PNP, TD-92	2N4122	NSC	4901-04-1220	1
Q11 Q12	TRANS	VN104M	SLCON	4902-00-0100	2
Q10	TRANS	T1P-36	TI	4902-00-0360	1
QW1	SWITCH, PIN PUSHBUTTON, EPST BLK	39-40S	GRAHL	5102-00-0015	1
U18	DAC, SERIAL INP, 16 BIT, MONO	PCM56P	BURR	7000-00-5600	1
VR3 VR7	VOLT REGULATOR, 3 TERMINAL ADJUSTABLE POS	LMC17T	NSC	7000-03-1700	2
VR4 VR8	VOLT REGULATOR	LMC37T	NSC	7000-03-3700	2
U1 U3	MUX, CMOS, D 4C, 8 CHAN/DUAL 4 CHAN ANAL	DC308ACJ	SLCON	7000-05-0800	2
U26	COMP. VATOR, ULTRA FAST, 10NS	LT1016CMB	LINTE	7000-10-1600	1
WAVETEK PARTS LIST					REV
TITLE PCA SUB. MOTHER BD 1288/288		ASSEMBLY NO. 1208-00-3000		PAGE 11	

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND USE SHARP EDGES	CHECKED	DATE	<b>WAVETEK</b> <small>5000 DEPT. C/ENR/8000</small>		
MATERIAL	PROJ. ENGR	TITLE			
FINISH WAVETEK PROCESS	RELEASE APPROV.	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES			
DO NOT SCALE DRAWING	SCALE	MODEL	288	SHEET	2 OF 3

ALL RIGHTS RESERVED. THIS DRAWING AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEK NO.	QTY/PT
U32	VOLTAGE REFERENCE, 10V, 8 PIN DIP	LT1021CCMB-10	LINTE	7000-10-2101	1
U4	ADC, 12 BIT	ICL7109CPL	INTSL	7000-71-0900	1
U3	RESET GEN	TL7703A	TI	7000-77-0301	1
U2 U33 U34	OP AMP, HI BLEW RTE, WIDEBND, JFET, STD	MC34081P	MOT	7003-40-8100	3
U14 U20 U21 U22 U23 U24 U29	OP AMP, HI BLEW RTE, WIDEBND, JFET DUAL	MC34082P	MOT	7003-40-8200	8
U28	DRIVER, DUAL LINE	SN75121M	TI	7007-51-2100	1
U19	MUX/DEMUX, ANALOG	CD4051BE	RCA	8000-40-5100	1
U11	SRAM, 8KX8, 150NS, CMOS	MM4264LP-13	MTACH	8000-62-6400	1
U6	MICROPROCESSOR, 8BIT	MC6803L	MOT	8000-68-0300	1
U16	FLIP-FLOP, DUAL D, POS EDGE TRIG W/CLR/PRES	SN74ALS74M	TI	8000-74-7403	1
VR2	VOLT REGULATOR	LM78M05HC	FAIR	8000-78-0501	1
UB	ADPT, GP IS INTERFACE	MC68489P	MOT	8006-84-8000	1
U30	FLIP-FLOP, OCTAL D	SN74ALS574M	TI	8007-43-7450	1
U15	VCD, TTL	74LS624	TI	8007-46-2410	1
U9	XCVR, OSC BUS, TTL	75160	TI	8007-51-6000	1
<b>WAVETEK PARTS LIST</b>		TITLE PCA SUB, MOTHER BD 1288/288	ASSEMBLY NO. 1208-00-3000	REV	PAGE 12

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEK NO.	QTY/PT
U10	TRANSCEIVER, DCT BUS, TTL	SN751613M	TI	8007-51-4100	1
U13	PLL	MC143157P2	MOT	8014-51-5700	1
U7	GATE ARRAY, 84 PIN, PBC288	P8C288	PLESS	8700-00-0003	1
U17	ARRAY, GATE, SPEED GRADED DMC 2016-3	DNC 2016-3	CDI	8700-00-0005	1
<b>WAVETEK PARTS LIST</b>		TITLE PCA SUB, MOTHER BD 1288/288	ASSEMBLY NO. 1208-00-3000	REV	PAGE 13

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE	<b>WAVETEK</b> SAN JOSE, CALIFORNIA	
MATERIAL	CHECKED	TITLE PARTS LIST MOTHERBOARD	
FINISH WAVETEK PROCESS	PROJ. ENGR.	SIZE D	P/SCM NO. 23338
	RELEASE APPROV.	QTY. NO. 1100-00-3198	REV A
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES	SCALE	MODEL 288	SHEET 3 OF 3
DO NOT SCALE DRAWING	JUL XXX		

NOTE UNLESS OTHERWISE SPECIFIED

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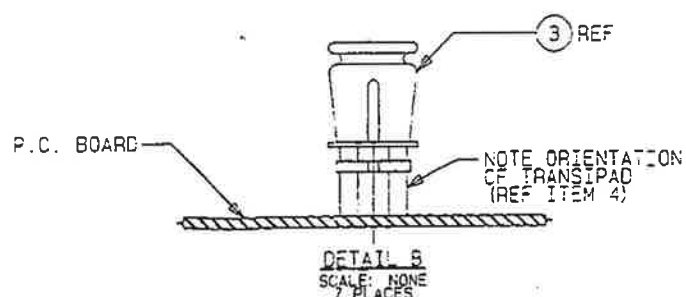
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1

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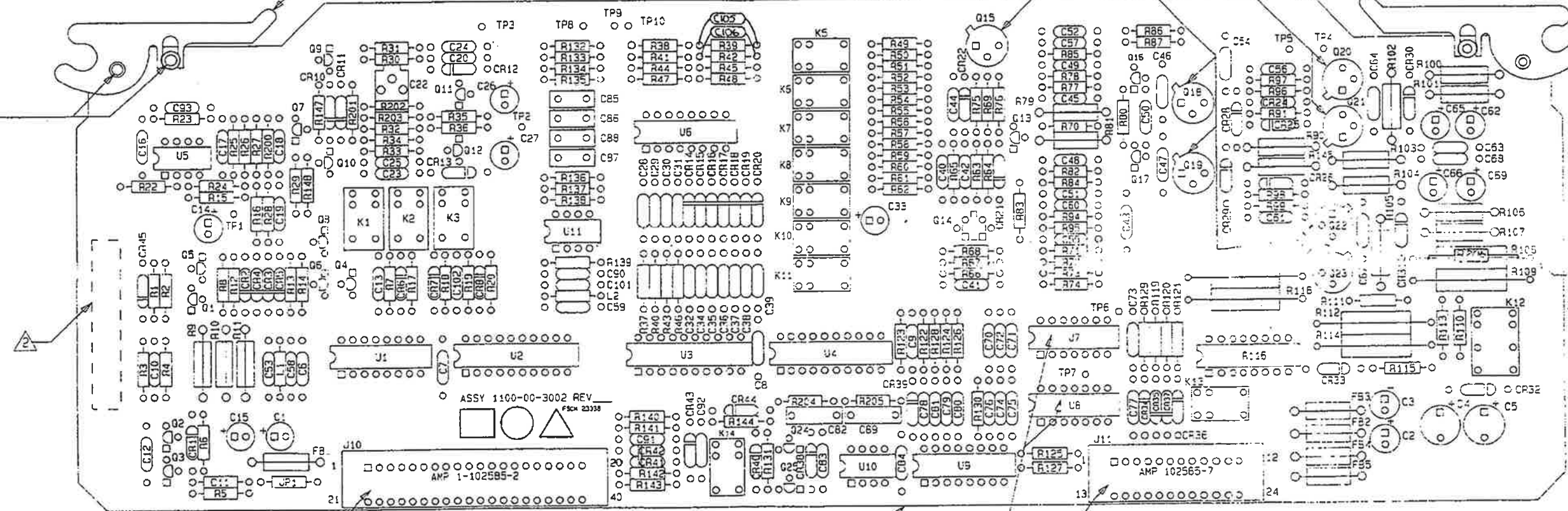
REV	ECO	BY	DATE	APP
A03	0041	PK	1/77	MC
B	ECO 9700 RERELEASE ONLY NO CHANGE FROM A03	PK	4/17/77	MC
C	ECO 9705	PK	5/2/77	MC
D	ECO 9770	PK	5/2/77	MC
E	ECO # 9842	MS	6/10/77	MC
F	ECO # 9866	MS	7/7/77	MC
G	ECO 89-002	EG	8/2/77	KA
H	ECO # 89-162	MS	8/2/77	MC
J	ECO # 90-520	MS	8/2/77	MC
K	ECO # 91-065	MS	8/2/77	MC



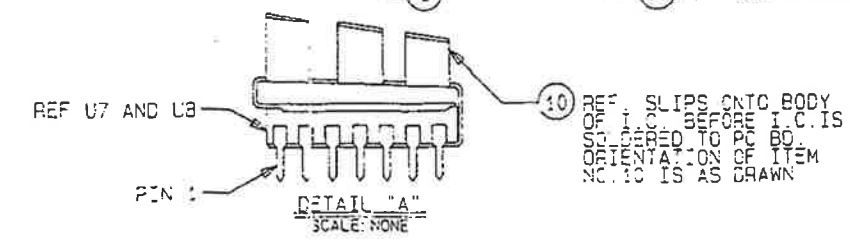
(7) SEE DETAIL "B" UNDER Q15, Q16, Q19, Q20, Q21, Q22, Q23 SHOWN HERE WITHOUT ITEM NO. 4 SEE SHEET 2

REF SEE SHEET 2

REF BOLL PINS SEE SHEET 2



INSTALL SERIAL NO. LABEL APPROXIMATE WHERE SHOWN  
 MARKER WITH MARKING IN PLACE CORRECT ORIENTATION OF CONNECTOR



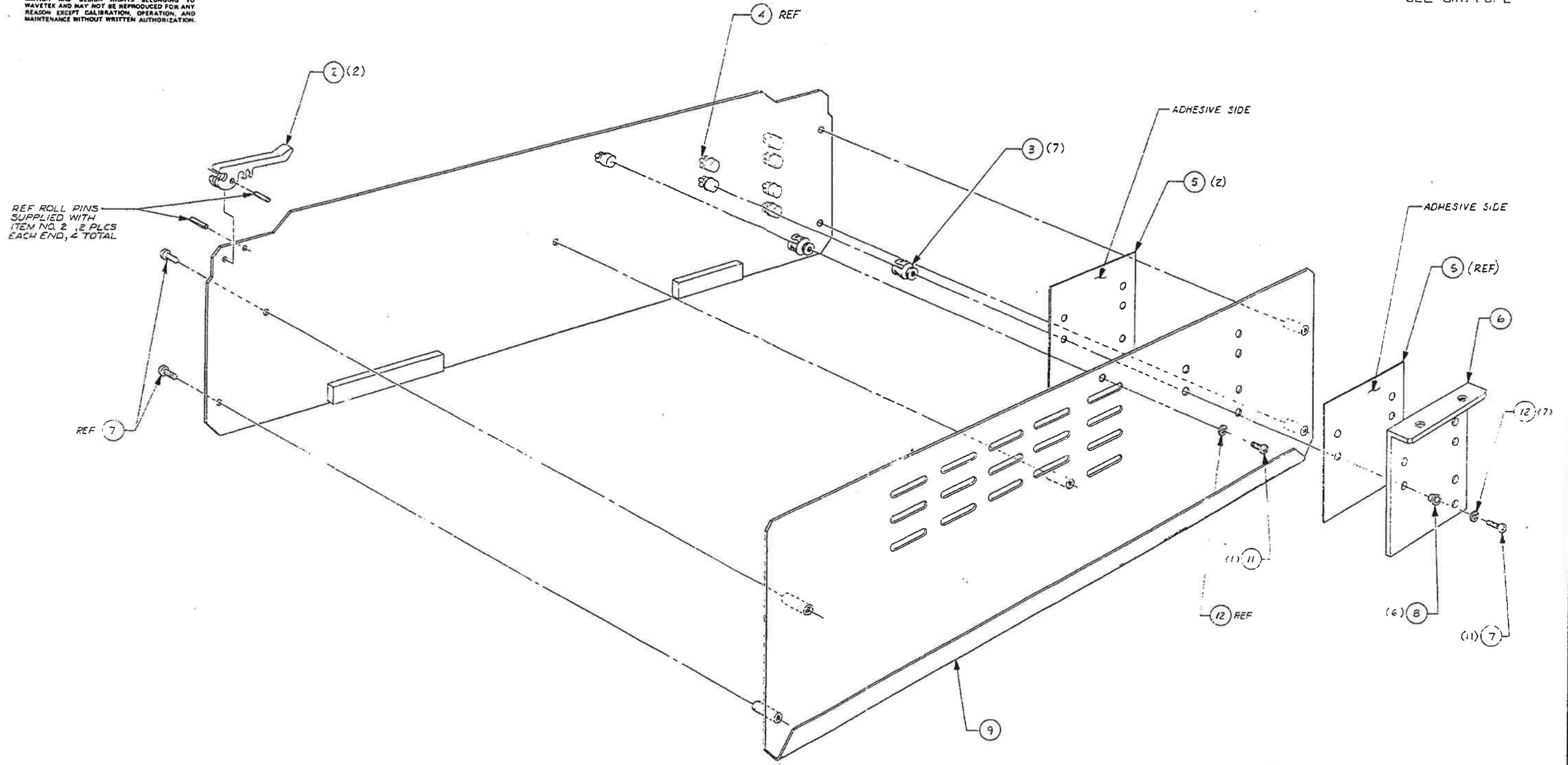
(2) SEE DETAIL "A"

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE: 5-12-77	<b>WAVETEK</b> CORPORATION 1100-00-3002 REV. 23338
WATERPROOF	DRAWN: M. KINGSLEY CHECKED: [Signature] PROJ. LEADER: [Signature] BILLING APPROVAL: [Signature]	
FINISH: WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES SEE 510 1"	TITLE: ASSEMBLY OUTPUT BOARD SIZE: D PSCM NO: 23338 DWG NO: 1100-00-3002 SCALE: 1:1 MODEL: 1282 SHEET 1 OF 1
DO NOT SCALE DRAWING		

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SEE SH. 1 OF 2



REF ROLL PINS SUPPLIED WITH ITEM NO. 2, 2 PLCS EACH END, 4 TOTAL

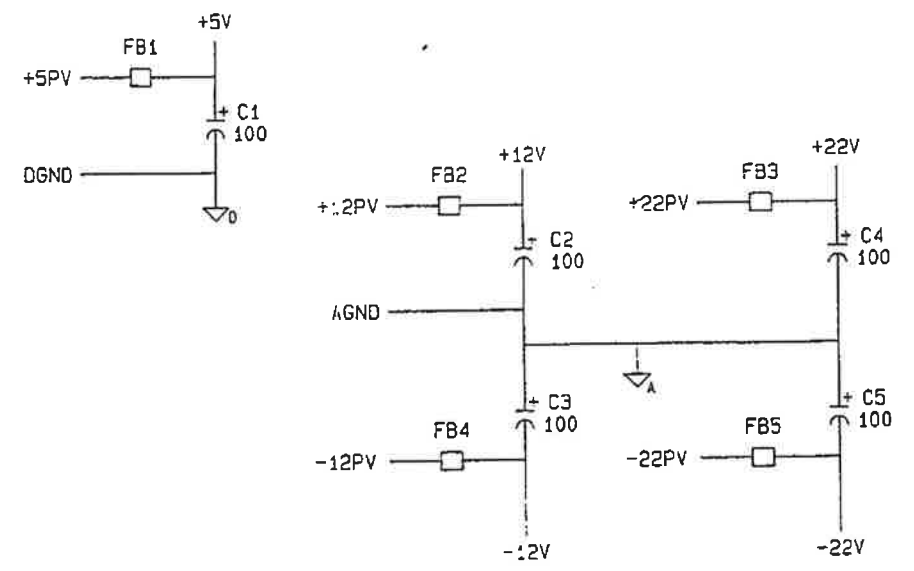
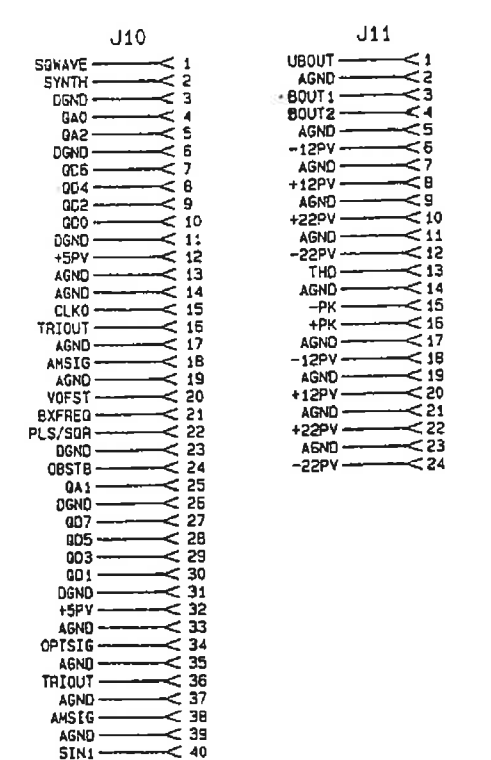
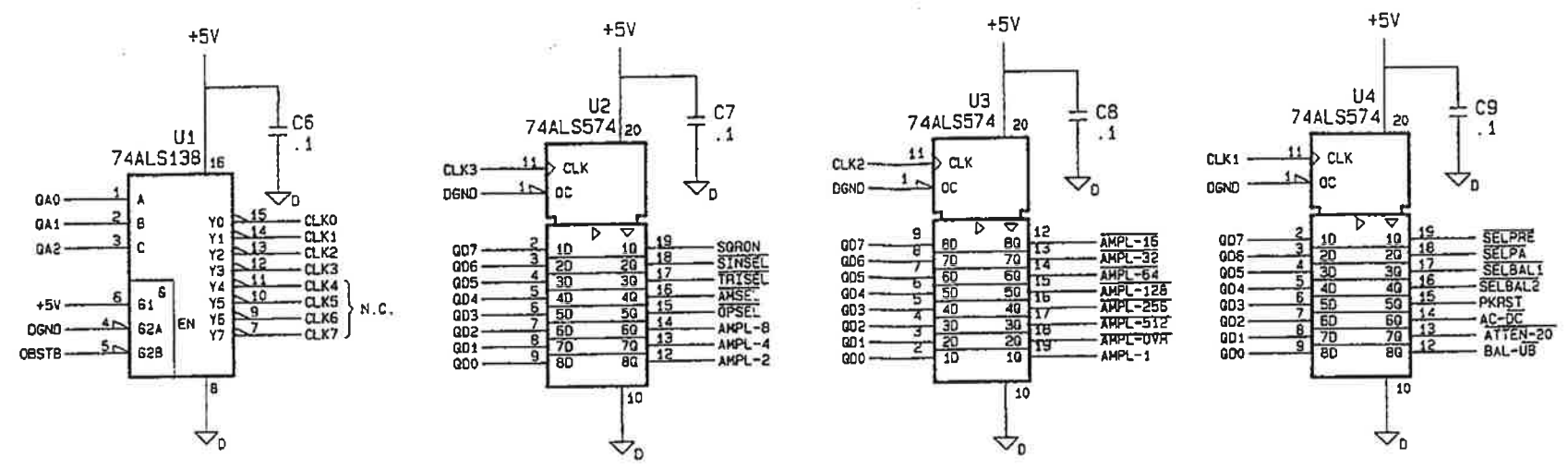
NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHEPMACK	DATE 11 16-2	<b>WAVETEK</b> SAN DIEGO - CALIFORNIA
MATERIAL	PROFILING 1 1/2	11/16	
FINISH WAVETEK PROCESS	RELEASE APPROV 11/16/72		TITLE ASSEMBLY OUTPUT ECAFU
	TOLERANCE UNLESS OTHERWISE SPECIFIED XXX .010 ANGLES .7 2X .030		MODEL NO 1100-00-3002
SCALE N/A	DO NOT SCALE DWG		REV 23338
			SHEET 2 OF 2

8      7      6      5      4      3      2      1

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REV	ECO	BY	DATE	APP
A	FRD 9896	MS	3/23/90	1/1
B	ECO # 9866	MS	4/11/90	1/1
C	ECO # 99-002	BS	3/23/91	1/1
D	ECO # 99-162	MS	3/23/91	1/1
E	ECO # 90-050	AT	1/19/92	1/1
F	ECO # 90-520	11A	1/14/91	1/1



- 4. ANALOG GROUND SYMBOL.
- 3. DIGITAL GROUND SYMBOL.
- 2. ALL CAPACITORS ARE IN MICROFARADS.
- 1. ALL RESISTORS ARE IN OHMS, 1/8W, 1%, MF.

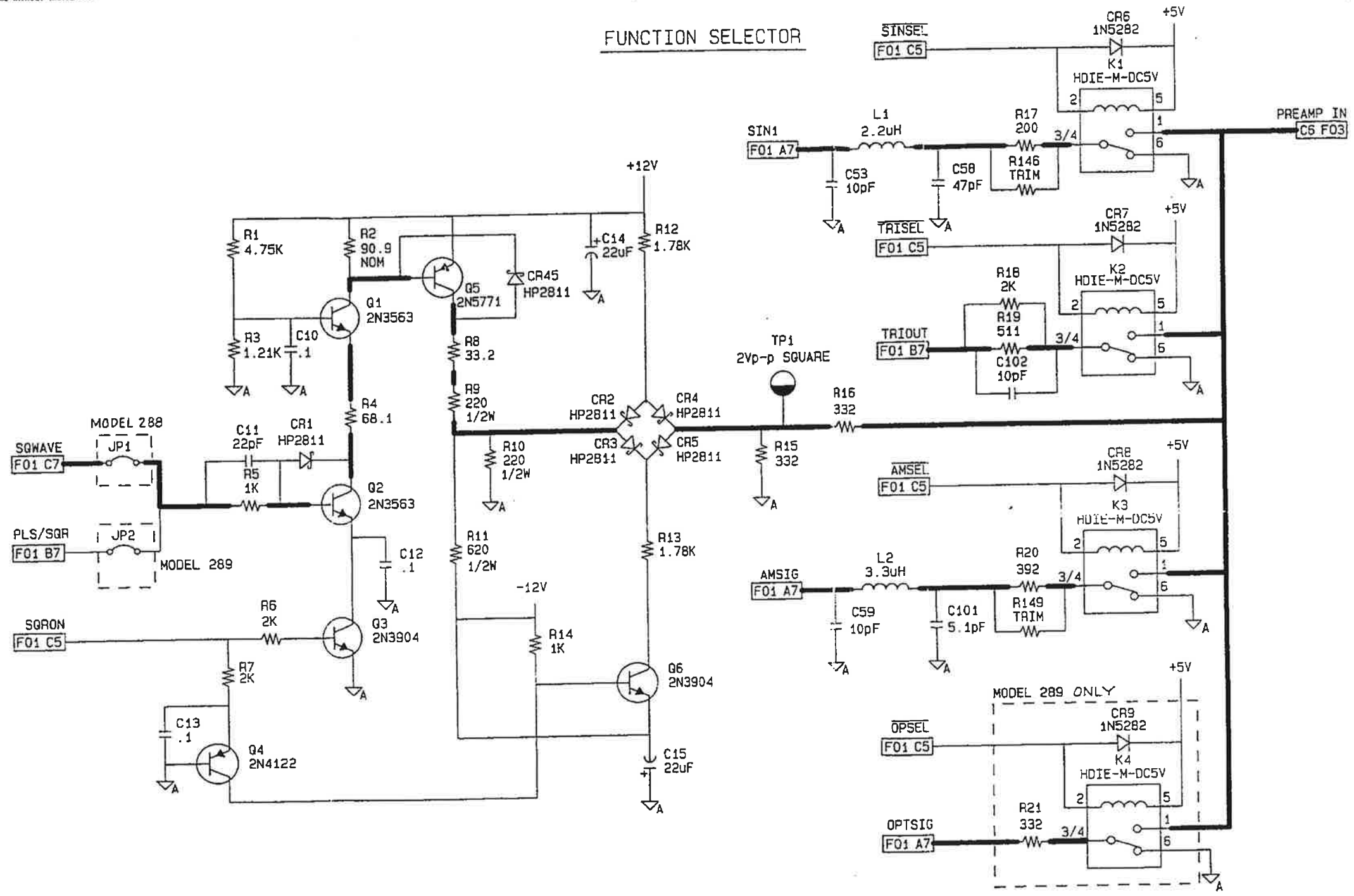
NOTE UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATORS LAST USED	REFERENCE DESIGNATORS NOT USED
R206, C106, CR45, Q25, K14, U11, TP10, FB5	R88, R89, R92, R93, R150-R199, C21, C94-C100, CR23, CR27

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE 3-18-90	<b>WAVETEK</b> SHEBURN, MA 01901
MATERIAL	3-25-90	
FRESH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES	SCALE NONE
DO NOT SCALE DRAWING	SCALE NONE	MODEL 126E
		SHEET 1 OF 1



FUNCTION SELECTOR



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0103-00-3002

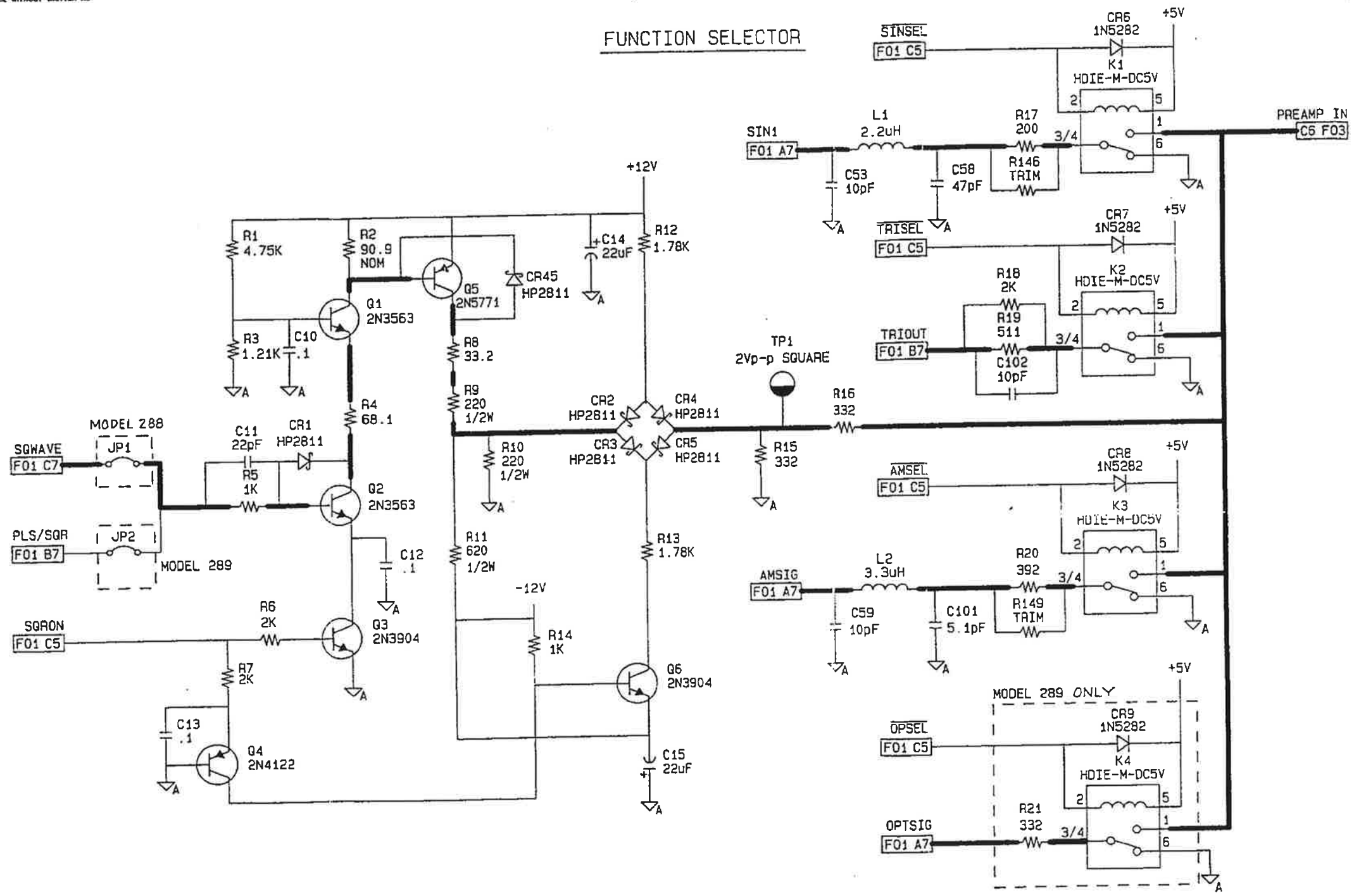
NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE 1-10-88	<b>WAVETEK</b> SAN DIEGO - CALIFORNIA	
MATERIAL CHECKED	DESIGNED BY M. KINGSLEY	TITLE SCHEMATIC OUTPUT BOARD	
PROJ. ENGR.	RELEASE APPROV.	SIZE D	FRM NO. 23338
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES	DWG. NO. 0103-00-3002	REV F
DO NOT SCALE DRAWING	SCALE NONE	MODEL 1288	SHEET 2 OF 7

ALL DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

SEE SH. 1 OF 7

FUNCTION SELECTOR



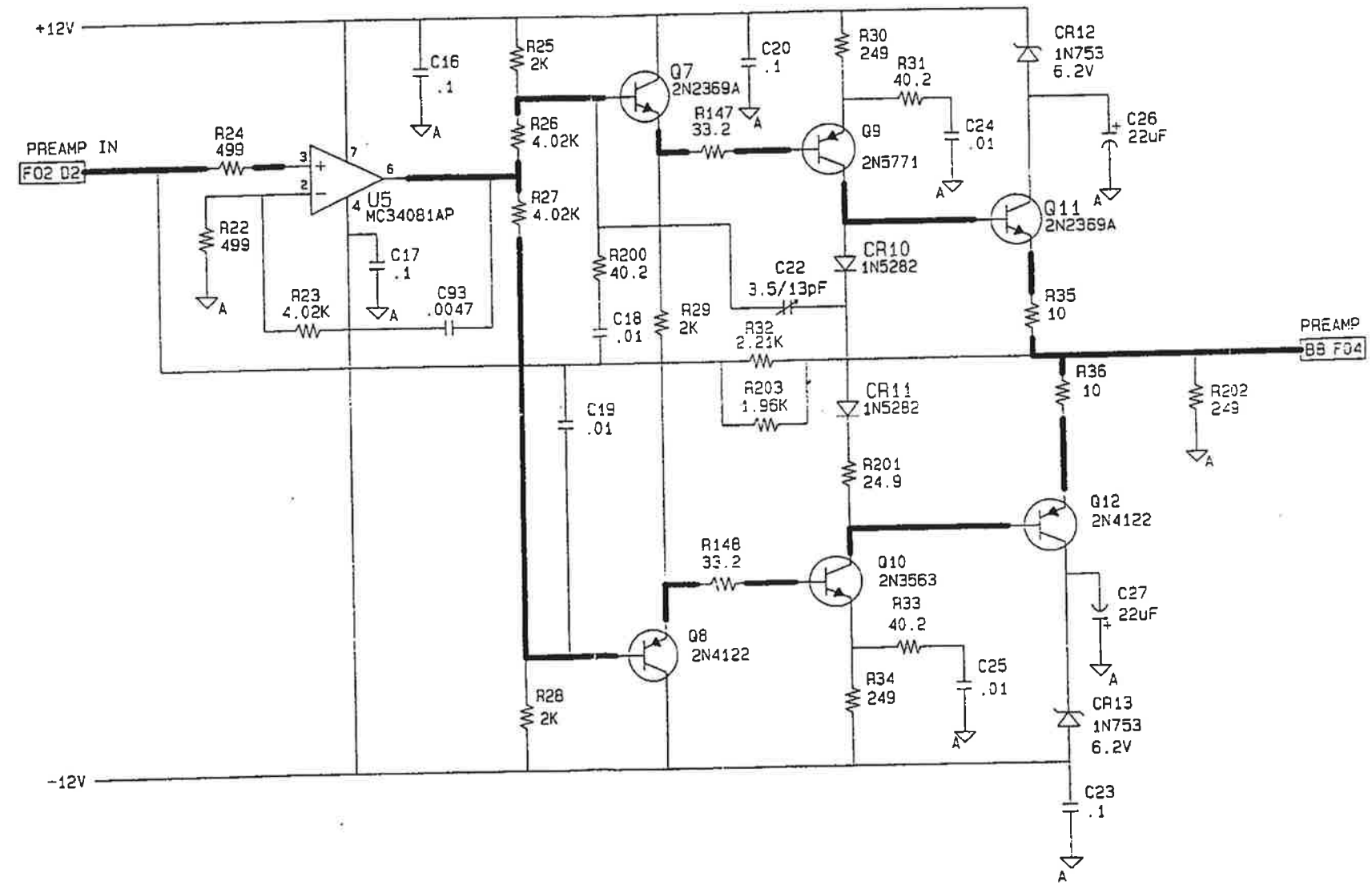
D  
C  
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0103-00-3002

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE 9-10-88	<b>WAVETEK</b> SAN DIEGO • CALIFORNIA	
MATERIAL	DESIGN H. KINGSLEY	TITLE SCHEMATIC OUTPUT BOARD	
FINISH WAVETEK PROCESS	PROJ. ENGR.	SIZE D	REV F
DO NOT SCALE DRAWING	RELEASE APPROV.	FRM NO. 23338	DRWG. NO. 0103-00-3002
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES	SCALE NONE	MODEL 1288 SHEET 2 OF 7

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PREAMPLIFIER



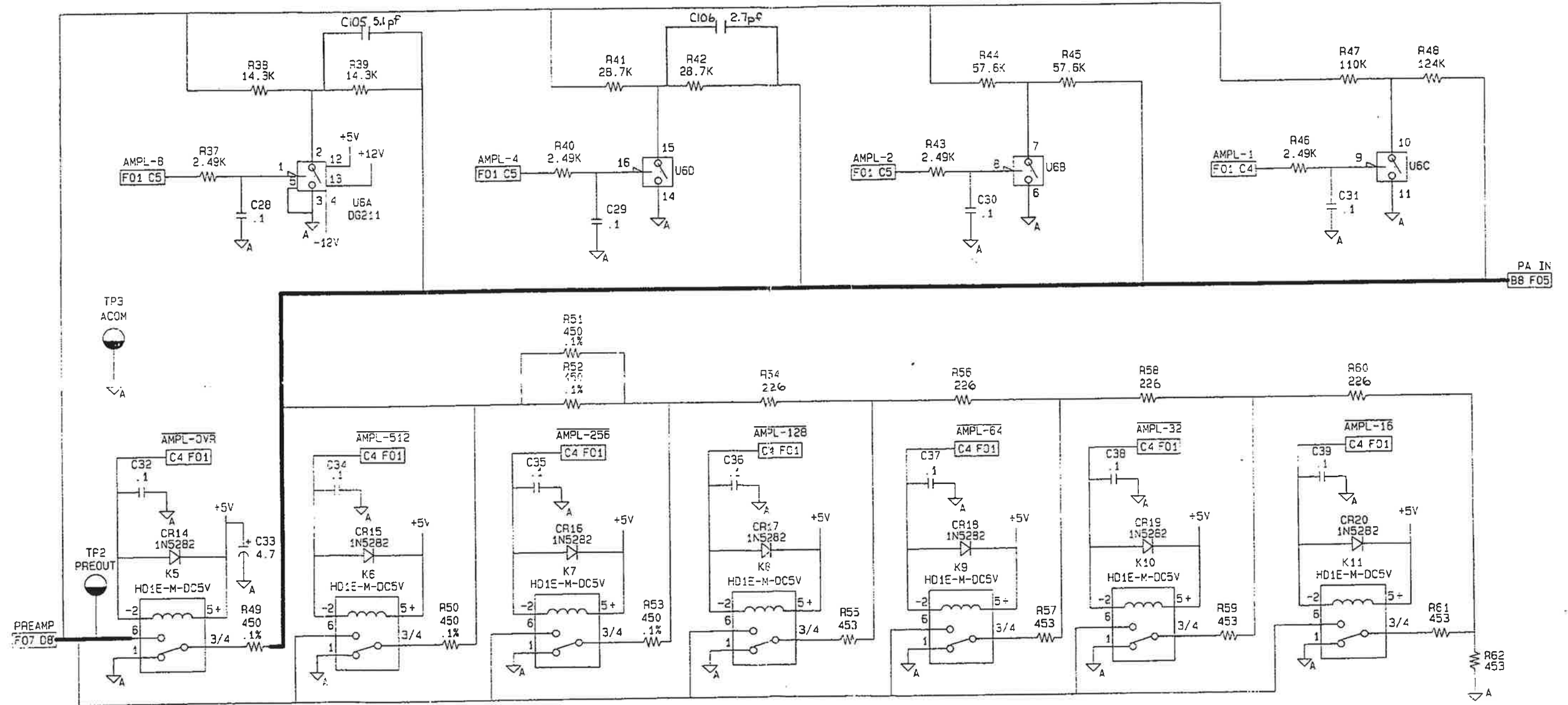
NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES		DESIGN: M. KINGSLEY	DATE: 3-18-64	WAVETEK	
MATERIAL:	CHECKED:	PROJ. ENGR.:	RELEASE APPROV.:	TITLE: SCHEMATIC OUTPUT BOARD	
FINISH: WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES			SIZE: D	ASCN NO: 23338
DO NOT SCALE DRAWING		SCALE: NONE	MODEL: 1286	OWG. NO.: 0103-00-3002	REV: F

REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

SEE CONT. FOR 1

### R-R2 LADDER



TP3  
ACOM

TP2  
PREOUT

PREAMP  
F07 D8

D  
C  
B  
A

0103-00-3002 F

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 3-18-68	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA	
MATERIAL	CHECKED		TITLE SCHEMATIC OUTPUT BOARD	
FINISH WAVETEK PROCESS	PROJ. ENGR.		SHEET NO. <b>D 23338</b>	DWG. NO. 0103-00-3002
DO NOT SCALE DRAWING	RELEASE APPROV.		SCALE NONE	MODEL 1288
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: XX .XXX" ANGLES XX°		SHEET 4 OF 7	

8 7 6 5 4 3 2 1

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# POWER AMP

REV ECO BY DATE APP

SEE SHT. 1 OF 1

+22V

+12V

-12V

+22V

-22V

+22V

-22V

PA IN  
F05 D1

VOFST  
F01 B7

TP4  
PA OUT

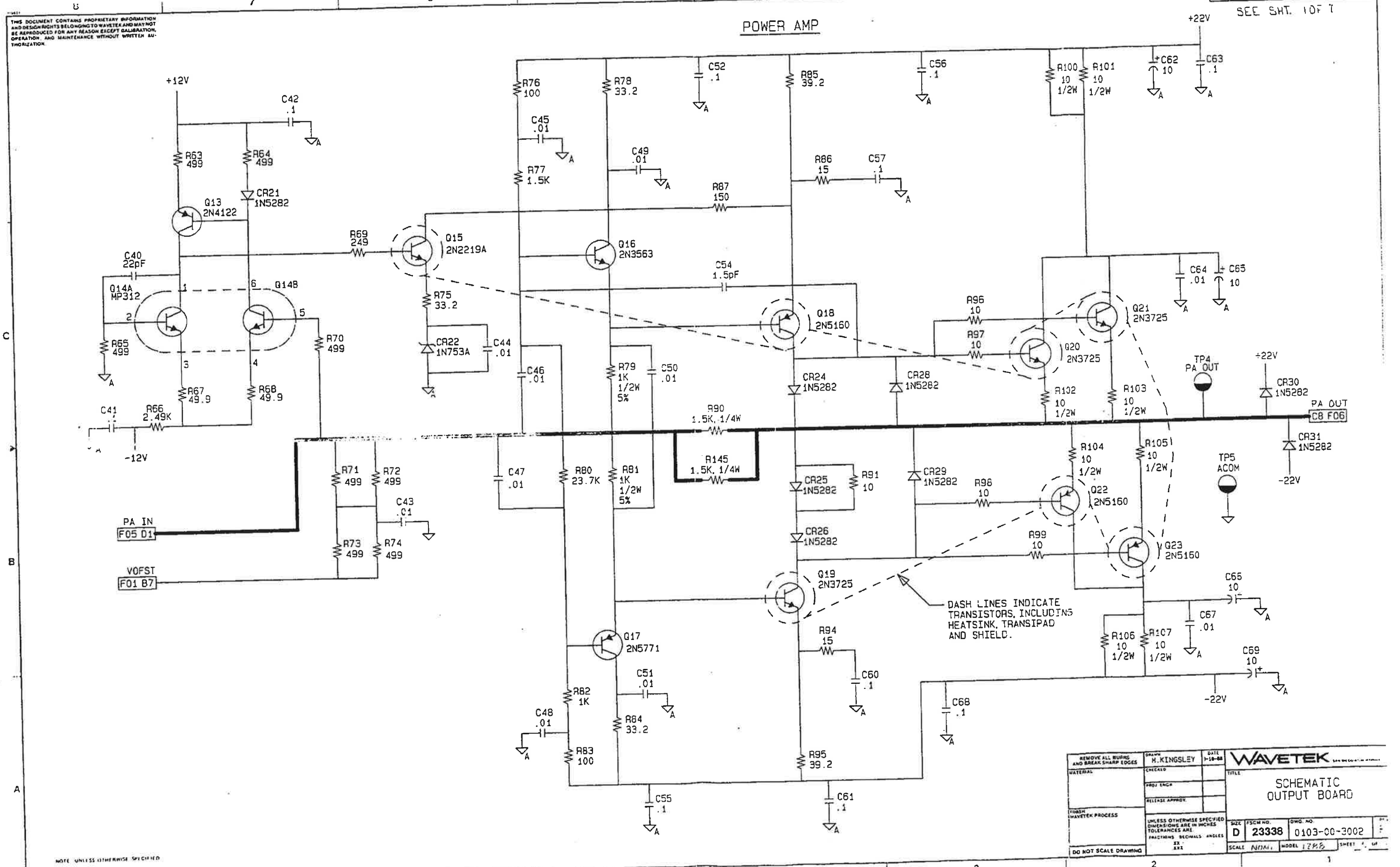
PA OUT  
C8 F06

TP5  
ACOM

DASH LINES INDICATE TRANSISTORS, INCLUDING HEATSINK, TRANSIPAD AND SHIELD.

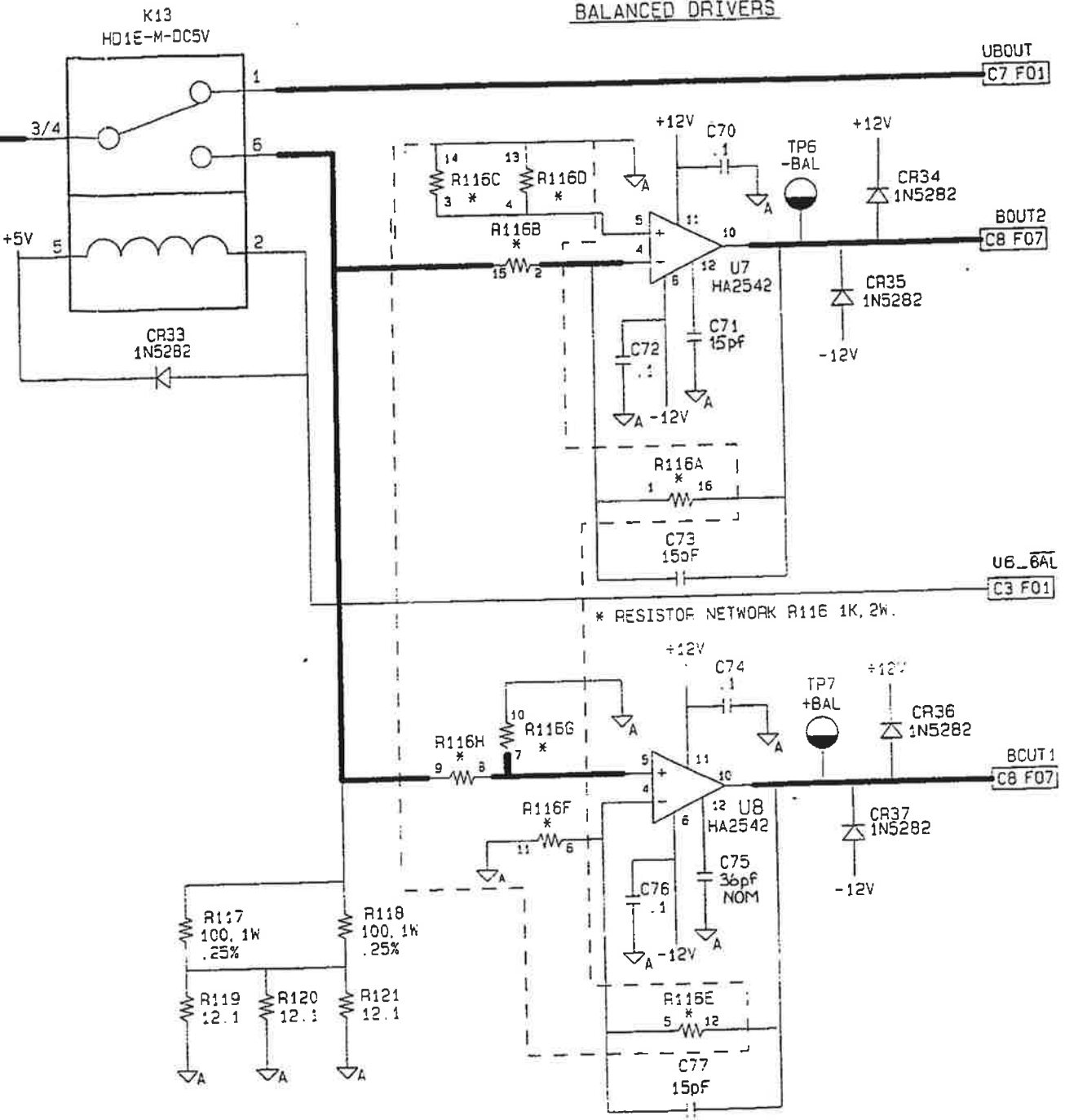
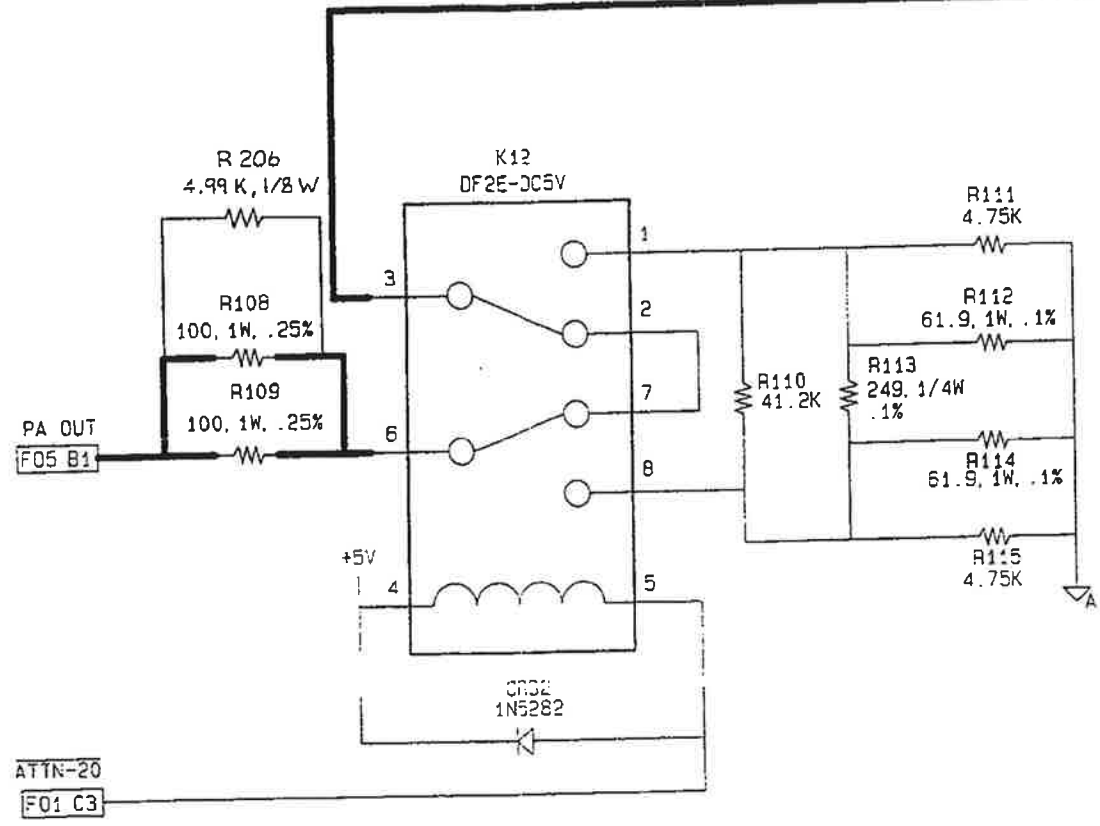
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 1-18-88	<b>WAVETEK</b>	
MATERIAL	CHECKED		TITLE	
FINISH WAVETEK PROCESS	PROJ ENGR		SCHEMATIC OUTPUT BOARD	
DO NOT SCALE DRAWING	RELEASE APPROV.		SIZE D	FSCM NO. 23338
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		DWG. NO. 0103-00-3002	SCALE N/A
			MODEL 1798	SHEET 1 OF 1

NOTE: UNLESS OTHERWISE SPECIFIED



ALL DESIGN RIGHTS BELONGING TO WAVELENGTH SHALL BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

-20dB ATTENUATOR



NOTE: UNLESS OTHERWISE SPECIFIED

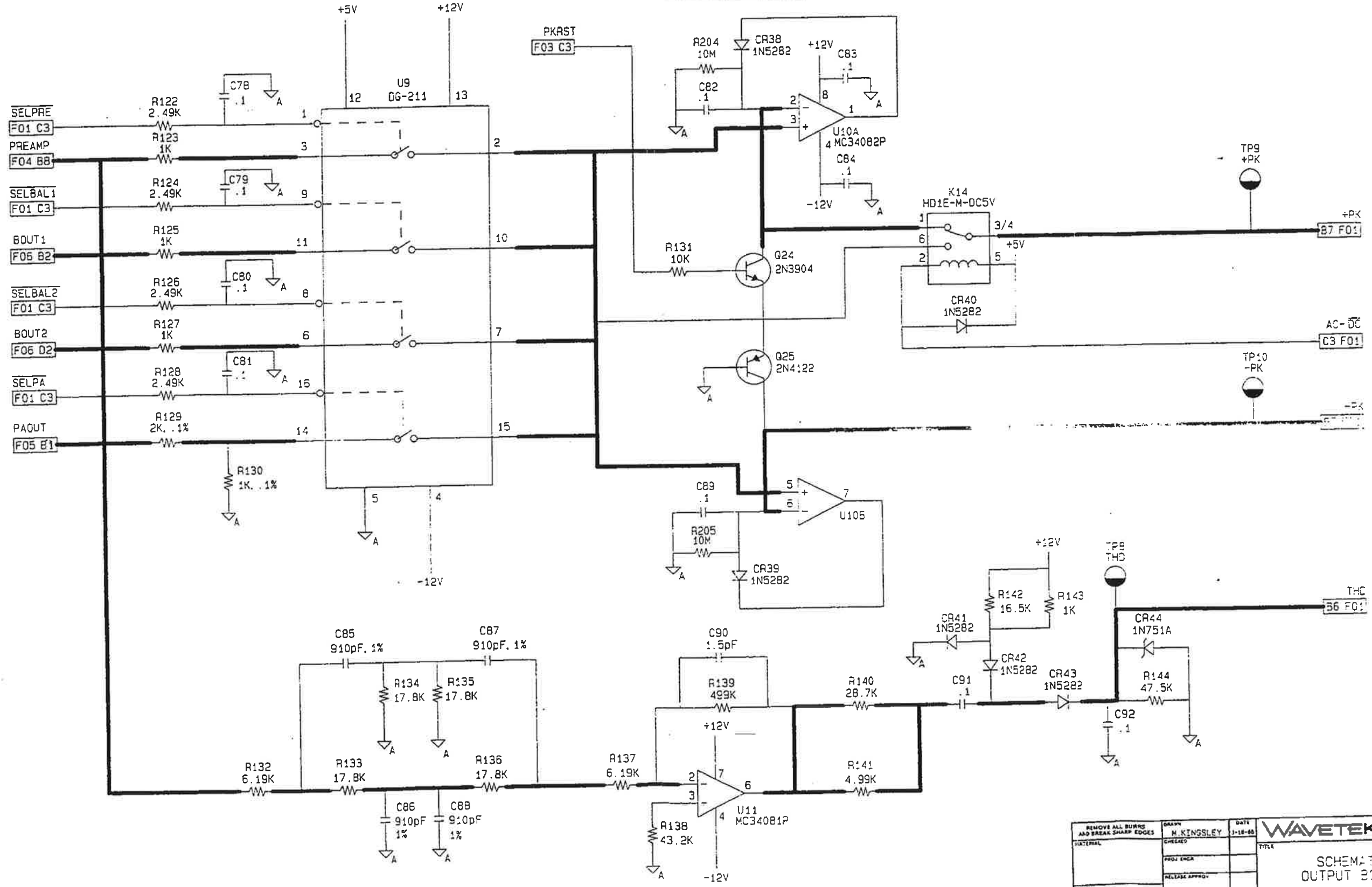
REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 3-18-88	<b>WAVETEK</b> <small>San Diego - Los Angeles</small>	
MATERIAL	CHECKED		TITLE SCHEMATIC OUTPUT BOARD	
FINISH WAVETEK PROCESS	PROJ. ENGR		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES 2X 3X 4X	
DO NOT SCALE DRAWING	RELEASE APPROV		SHEET NO. <b>D 23338</b>	DWG. NO. 0103-00-3002
			SCALE NAT. SIZE	MODEL 12RF
				REV F
				SHEET 6 OF 7

8 7 6 5 4 3 2 1

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REV EGO BY DATE APP  
SEE SH. 10: 1

PEAK DETECTOR



REMOVE ALL BURRS AND BREAK SHARP EDGES	DESIGN M. KINGSLEY	DATE 3-18-88	<b>WAVETEK</b>	
EXTERNAL	CHECKED		TITLE	
PROJ ENGR			SCHEMATIC OUTPUT BOARD	
RELEASE APPROV			UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES	
DO NOT SCALE DRAWING	SCALE NONE	MODEL 128E	SHEET 7 OF 7	

NOTE: UNLESS OTHERWISE SPECIFIED

REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT		
NONE	SCHEMATIC, OUTPUT PCB	0103-00-3002	WVTK	0103-00-3002	1	CR12 CR13 CR22	SL 2R 6.2V 5% 400PM (1N753A)	1N753A	ROHM	131.7620	3		V. RADIAL						
NONE	PCA SUB ASSY, OUTPUT BD 1288/288	1208-00-3002	WVTK	1208-00-3002	1	L1	L: FXD 2.2 UHY +/-10% SHLD	1441-222	DELVA	150.9220	1	C22	CAP. VAR. 3.5-13PF 250V	300448-411	STCO	1500-31-3010	1		
9	SHIELD, OUTPUT BOARD	1400-02-3403	WVTK	1400-02-3403	1	C105	CAP. CER DISK. 5PF. 1KV. 10%	0211-00018	WVTK	1500-00-3011	1	1	PCB, OUTPUT BD	1700-00-3002	WVTK	1700-00-3002	1		
6	HEATSINK, OUTPUT BOARD	1400-02-3413	WVTK	1400-02-3413	1	C102 C33 C39	CAP. CER. 10PF. 100V. AXIAL	CAC02C00100J100A	CORNG	1500-01-0006	3	L2	CHOKER, 3.3MH. 10%	1537-24	DLVAN	1800-00-0006	1		
5	THERMAL GASKET-OUTPUT	1400-02-4420	WVTK	1400-02-4420	2	C18 C19 C24 C25 C43 C44 C45 C46 C47 C48 C49 C50 C51 C64 C67	CAP. CER. MON. .01MF 50V. AXIAL	CAC02Z5U103Z100A	CORNG	1500-01-0310	15	P11	CONN. HEADER, 24 PIN. RECEPT. 2X12. .1 CTR. PCMT	102585-7	AMP	2100-02-0255	1		
2	PC BD EJECTOR	87-2-C	BRIT	2800-07-0032	2	C10 C12 C13 C16 C17 C20 C23 C28 C29 C30 C31 C32 C34 C35 C36 C37 C38 C39 C41 C42 C52 C55 C56 C57 C6 C60 C61 C63 C68 C7 C70 C72 C74 C76 C78 C79 C8 C80 C81 C83 C84 C9 C91 C92	CAP. CER. MON. .1MF. 50V. AXIAL	CAC03Z5U104Z050A	CORNG	1500-01-0403	44	P10	CONN. HEADER, 40 PIN. RECEPT. 2X20. .1 CTR. PCMT	1-102585-2	AMP	2100-02-0256	1		
8	WASHER	3607-150	SESTM	2800-11-0015	6	C71 C73 C77	CAP. CER. 15PF. 100V. AXIAL	CAC02C0C150J100A	CORNG	1500-01-3006	3	TP3 TP5	TEST POINT, BLK. PC	TP-104-01-00	COMPO	2100-04-0054	2		
11	SCREW, 4-40X3/16, PHF, NYLON PATCH	4-40 X 3/16	CHRCL	2800-23-4103	1	C54 C90	CAP. CER. 1.5PF. 100V. AXIAL	CAC02C091R5J100A	CORNG	1500-01-5906	2	TP1 TP10 TP2 TP4 TP6 TP7 TP8 TP9	TEST POINT, RED. PC	TP-104-01-02	COMPO	2100-04-0055	8		
12	WASHER, LOCK REQ. S/S #4	HS 35308-133	CHRCL	2800-45-4000	7	C11 C40	CAP. CER. 22PF. 100V. AXIAL	CAC02C0C220J100A	CORNG	1500-02-2006	2	4	TRANSIPAD	531-218	BIVAR	2800-11-0004	7		
7	SCREW, 4-40X3/8 PHF, NYLON PATCH, Z	4-40 X 3/8 PH, SL	CHRCL	2800-56-9106	6							NONE	HEATSINK, TOS. EPOXY INS	260-475E	MAKE	2800-11-0031	7		
												10	HEATSINK, 14-16 PIN DIP, ALUM. BLK AN. CLIPDN	5802B	AAVID	2800-11-0034	2		
												11	SCREW, 4-40X3/16, PHF, NYLON PATCH	4-40 X 3/16	CHRCL	2800-23-4103	6		
WAVETEK PARTS LIST		TITLE PCA SUB ASSY, OUTPUT BOARD 1288/288		ASSEMBLY NO. 1100-00-3002		REV K		PAGE 1		WAVETEK PARTS LIST		TITLE PCA SUB ASSY, OUTPUT BOARD 1288/288		ASSEMBLY NO. 1208-00-3002		REV		PAGE 3	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT		
C106	CAP. CER. MON. 2.7PF 50V +/-5%, AX	CCD2R7DNFD	ARCO	1500-02-7505	1	F81 F82 F83 F84 F85	BALUN CORE, FERRITE, 680 OHMS	2943466671	FARIT	3100-00-0017	5								
C75	CAP. CER. 36PF. 200V. +/-5%, AX	CAC02C00360J100A	AVX	1500-03-6001	1	K12	RELAY, 2 FORMC. 5V. DIP 14	DF2E-DC5V	AROMT	4500-00-0033	1	K1 K10 K11 K13 K14 K2 K3 K5 K6 K7 K8 K9	RELAY, 1 FORMC. 5V. .312H. .296H	HD1E-M-DC5V	AROMT	4500-00-0034	12		
C58	CAP. CER. 47PF. 100V. AXIAL	CAC02C00470J100A	CORNG	1500-04-7004	1	R100 R101 R102 R103 R104 R105 R106 R107	RES. C. 1/2W. 5% 10	RC-1/2-100J	STKPL	4700-25-0100	8	R10 R9	RES. C. 1/2W. 5% 220	RC-1/2-221J	STKPL	4700-25-2200	2		
C101	CAP. CER. 5.1PF. 100V. AXIAL	CAC02C0051R1J100A	CORNG	1500-05-1906	1	R11	RES. C. 1/2W. 5% 620	RC-1/2-621J	STKPL	4700-25-6200	1	R129	RES. MF. 1/8W. 1% 1K	RN55E-1001B	HEPCO	4701-02-1001	1		
C85 C86 C87 C88	CAP. NICA. 910PF. 100V. 1% RADIAL	2M15-911F	ARCO	1500-19-1101	4	R129	RES. MF. 1/8W. 1% 2K	RN55E-2001B	HEPCO	4701-02-2001	1	R49 R50 R51 R52 R53	RES. MF. 1/8W. 1% 450	RN55E4500BJ	HEPCO	4701-02-4500	5		
C62 C63 C66 C69	CAP. ELECT. 10MF/25V RADIAL LEAD. SP. 10	NRE 10/63	NIC	1500-31-0002	4	R76 R83	RES. MF. 1/8W. 1% 100	RN55D-1000F	TRW	4701-03-1000	2	R123 R125 R127 R14 R143 R5 R82	RES. MF. 1/8W. 1% 1K	RN55D-1001F	TRW	4701-03-1001	7		
C4 C5	CAP. ELECT. 100MF. 35V RADIAL LEAD. SP. 20	NRE101M35V811	NIC	1500-31-0102	2	R131	RES. MF. 1/8W. 1% 10K	RN55D-1002F	TRW	4701-03-1002	1	R204 R205	RES. MF. 1/8W. 10M	3033YD10M000F	HEPCO	4701-03-1005	2		
C1 C2 C3	CAP. ELECT. 100PF/16V RADIAL LEAD. SP. 20	NRE101M16V. 3X11	NIC	1500-31-0111	3	R35 R36 R91 R96 R97 R98 R99	RES. MF. 1/8W. 1% 10	3043ED10R100F	HEPCO	4701-03-1009	7								
C14 C15 C26 C27	CAP. ELECT. 22PF. 25V. RADIAL	BRA23V822R6X7LL	UNCDN	1500-32-2002	4														
C33	CAP. ELECT. 4.7MF/50V RADIAL LEAD. SP. 10	ECEA1M4R7SC	PANAS	1500-34-7903	1														
C82 C89	CAP. MET POLY. .1PF. 160V	171-104J160	WEST	1500-41-0434	2														
C93	CAP. NYLAR. .0047MF. 100	225P47291M03	SPRAD	1500-44-7204	1														
WAVETEK PARTS LIST		TITLE PCA SUB ASSY, OUTPUT BOARD 1288/288		ASSEMBLY NO. 1208-00-3002		REV		PAGE 2		WAVETEK PARTS LIST		TITLE PCA SUB ASSY, OUTPUT BOARD 1288/288		ASSEMBLY NO. 1208-00-3002		REV		PAGE 4	

NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE	WAVETEK	
MATERIAL	CAICAD	TITLE	
FINISH	PROJ ENGR	PARTS LIST OUTPUT BOARD	
WAVETEK PROCESS	RELEASE APPROV	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMAL ANGLES	
DO NOT SCALE DRAWING	SCALE	SIZE D 23338	REV K
	MODEL 288	DWG NO 1100-00-3002	SHEET 1 of 2

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 NO DESIGN RIGHTS BELONGING TO WAVETEK AND MAY NOT  
 BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION,  
 REPAIR, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
R47	RES. MF, 1/8W, 1%, 110K	RN55D-1103F	TRW	4701-03-1103	1
R3	RES. MF, 1/8W, 1%, 1.21K	RN55D-1211F	TRW	4701-03-1211	1
R119 R120 R121	RES. MFLH, 1/8W, 1%, 12.1	5033RD12R1F	MEPCO	4701-03-1219	3
R48	RES. MF, 1/8W, 1%, 124K	RN55D-1243F	TRW	4701-03-1243	1
R38 R39	RES. MF, 1/8W, 1%, 14.3K	RN55D-1432F	TRW	4701-03-1432	2
R87	RES. MF, 1/8W, 1%, 150	RN55D-1500F	TRW	4701-03-1500	1
R77	RES. MF, 1/8W, 1%, 1.5K	RN55D-1501F	TRW	4701-03-1501	1
R86 R94	RES. MF, 1/8W, 1%, 15	RN55D-1502F	TRW	4701-03-1502	2
R142	RES. MF, 1/8W, 1%, 16.3K	RN55D-1632F	TRW	4701-03-1632	1
R12 R13	RES. MF, 1/8W, 1%, 1.78K	RN55D-1781F	TRW	4701-03-1781	2
R133 R134 R135 R136	RES. MFLH, 1/8W, 1%, 17.8	5033RD1782F	MEPCO	4701-03-1782	4
R203	RES. MF, 1/8W, 1%, 1.96K	RN55D-1961F	TRW	4701-03-1961	1
R17	RES. MF, 1/8W, 1%, 200	RN55D-2000F	TRW	4701-03-2000	1
R18 R25 R28 R29 R6 R7	RES. MF, 1/8W, 1%, 2K	RN55D-2001F	TRW	4701-03-2001	6
R32	RES. MF, 1/8W, 1%, 2.21K	RN55D-2211F	TRW	4701-03-2211	1
R34 R36 R58 R60	RES. MF, 1/8W, 1%, 226	RN174 226 1% T1	STKPL	4701-03-2260	4

WAVETEK PARTS LIST TITLE PCA SUB ASSY, OUTPUT BD 1288/288 ASSEMBLY NO. 1208-00-3002 PAGE 5 REV

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
R22 R24 R63 R64 R65 R70 R71 R72 R73 R74	RES. MF, 1/8, 1%, 4.99	RN55D-4990F	TRW	4701-03-4990	10
R141 R206	RES. MF, 1/8W, 1%, 4.99K	RN55D-4991F	TRW	4701-03-4991	2
R139	RES. MF, 1/8W, 1%, 4.99K	RN55D-4993F	TRW	4701-03-4993	1
R67 R68	RES. MF, 1/8W, 1%, 49.9	RN55D-4999F	CCANO	4701-03-4999	2
R19	RES. MF, 1/8W, 1%, 511	RN55D-5110F	TRW	4701-03-5110	1
R44 R45	RES. MF, 1/8W, 1%, 57.6K	RN55D-5762F	TRW	4701-03-5762	2
R132 R137	RES. MF, 1/8W, 1%, 6.19K	RN55D-6191F	TRW	4701-03-6191	2
R4	RES. MF, 1/8W, 1%, 68.1	RN55D-6811F	TRW	4701-03-6811	1
R2	RES. MF, 1/8W, 1%, 90.9	RN55D-9099F	TRW	4701-03-9099	1
R113	RES. MFLH, 1/4W, 1%, 249	5043R2490B	MEPCO	4701-12-2490	1
R145 R90	RES. MF, 1/4W, 1%, 1.5K	RN60D1501F	TRW	4701-13-1501	2
R112 R114	RES. MFLH, 1W, 1%, 61.9	5053R6199B	MEPCO	4701-32-6199	2
R108 R109 R117 R118	RES. MF, 1W, 23%, T2 100	5053R100R0C	MEPCO	4701-38-1000	4
R116	RES NETWORK 1K 2W 16PIN DIP	4116A-001-102	BCURN	4770-00-0019	1
JP1	RES. 0 OHM JUMPER	JPO2T686	ROHM	4799-00-0087	1

WAVETEK PARTS LIST TITLE PCA SUB ASSY, OUTPUT BD 1288/288 ASSEMBLY NO. 1208-00-3002 PAGE 7 REV

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
Q17 Q5 Q9	TRANS 2S/71 PNP SWITCH T3-92	2N5771	NSC	4901-03-7710	3
Q14	TRANS. MONO. DUAL. NPN	LS312-52	LINSY	7000-06-1200	1
U7 U8	OP AMP. WIDEBND. HI SL RTE. HI OUT	HA3-2542-5	HARIS	7000-25-4200	2
U11	OP AMP. HI SLEW RTE. WIDEBND. JFET. STD	MC34081P	MOT	7003-40-8100	1
U5	OP AMP. HI SLEW RTE. WIDEBND. JFET. PRIM E	MC34081AP	MOT	7003-40-8101	1
U10	OP AMP. HI SLEW RTE. WIDEBND. JFET DUAL	MC34082P	MOT	7003-40-8200	1
U6 U9	SW. QUAD ANALOG. CMOS	DC211CJ	SILCON	8000-02-1100	2
U1	DECODER/DEMUX. 3 TO 8 LINE	SN74ALS138N	TI	8007-41-3800	1
U2 U3 U4	FLIP-FLOP. OCTAL D	SN74ALS574N	TI	8007-43-7430	3

WAVETEK PARTS LIST TITLE PCA SUB ASSY, OUTPUT BD 1288/288 ASSEMBLY NO. 1208-00-3002 PAGE 9 REV

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
R80	RES. MF, 1/8W, 1%, 23.7K	RN55D-2372F	TRW	4701-03-2372	1
R202 R30 R34 R69	RES. MF, 1/8W, 1%, 249	RN55D-2490F	TRW	4701-03-2490	4
R122 R124 R126 R128 R37 R40 R43 R46 R66	RES. MF, 1/8W, 1%, 2.49K	RN55D-2491F	TRW	4701-03-2491	9
R201	RES. MF, 1/8W, 1%, 24.9	RN55D-2499F	TRW	4701-03-2499	1
R140 R41 R42	RES. MF, 1/8W, 1%, 28.7K	RN55D-2872F	TRW	4701-03-2872	3
R15 R16	RES. MF, 1/8W, 1%, 332	RN55D-3320F	TRW	4701-03-3320	2
R147 R148 R75 R78 R8 RB4	RES. MF, 1/8W, 1%, 33.2	RN55D-3322F	TRW	4701-03-3322	6
R20	RES. MF, 1/8W, 1%, 392	RN55D-3920F	TRW	4701-03-3920	1
R83 R93	RES. MF, 1/8W, 1%, 39.2	RN55D-3922F	TRW	4701-03-3922	2
R23 R26 R27	RES. MF, 1/8W, 1%, 4.02K	RN55D-4021F	TRW	4701-03-4021	3
R200 R31 R33	RES. MF, 1/8W, 1%, 40.2	RN55D-4022F	TRW	4701-03-4022	3
R110	RES. MF, 1/8W, 1%, 41.2K	RN55D-4122F	TRW	4701-03-4122	1
R136	RES. MF, 1/8W, 1%, 43.2K	RN55D-4322F	TRW	4701-03-4322	1
R53 R57 R59 R61 R62	RES. MF, 1/8W, 1%, 433	RN55D-4330	TRW	4701-03-4330	3
R1 R111 R115	RES. MF, 1/8W, 1%, 4.73K	RN55D-4731F	TRW	4701-03-4731	3
R14	RES. MF, 1/8W, 1%, 47.3K	RN55D-4732F	TRW	4701-03-4732	1

WAVETEK PARTS LIST TITLE PCA SUB ASSY, OUTPUT BD 1288/288 ASSEMBLY NO. 1208-00-3002 PAGE 6 REV

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFG-PART-NO	MFR	WAVETEK NO.	QTY/PT
R79 R81	RES. CARBON, 1/2W, 5%, 1K	RCR10-9-102J5	AB	4799-00-0213	2
CR44	DIODE. ZENOR, 5.1V, 300MA, GIB, IN751A	IN751A	FAIR	4801-01-0751	1
CR10 CR11 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR21 CR24 CR25 CR26 CR28 CR29 CR30 CR31 CR32 CR33 CR34 CR35 CR36 CR37 CR38 CR39 CR40 CR41 CR42 CR43 CR6 CR7 CR8	DIODE. HIGH CONDUCTANCE. ULTRA FAST	1N5282	FAIR	4801-01-5282	22
CR1 CR2 CR3 CR4 CR45 CR5	DIODE 5082-2811 SCHOTTKY. 15V, 20MA	5082-2811	HP	4809-02-2811	6
Q15	TRANS 2N2219A NPN GENERAL PURPOSE TO-5	2N2219A	NSC	4901-02-2191	1
Q11 Q7	TRANS. SILICON. PLANAR. EPITAXIAL. NPN. TO-18	2N2269A	MOT	4901-02-2691	2
Q1 Q10 Q16 Q2	TRANS. NPN. TO-92	2N3563	FAIR	4901-03-5630	4
Q19 Q20 Q21	TRANS. NPN. TO-99	2N3725	FAIR	4901-03-7250	3
Q24 Q3 Q6	TRANS 2N3904 NPN GENERAL PURPOSE TO-92	2N3904	FAIR	4901-03-9040	3
Q12 Q13 Q25 Q4 Q8	TRANS. GENERAL PURPOSE. PNP. TO-92	2N4122	NSC	4901-04-1220	5
Q18 Q22 Q23	TRANS	2N5160-18	MOT	4901-03-1600	3

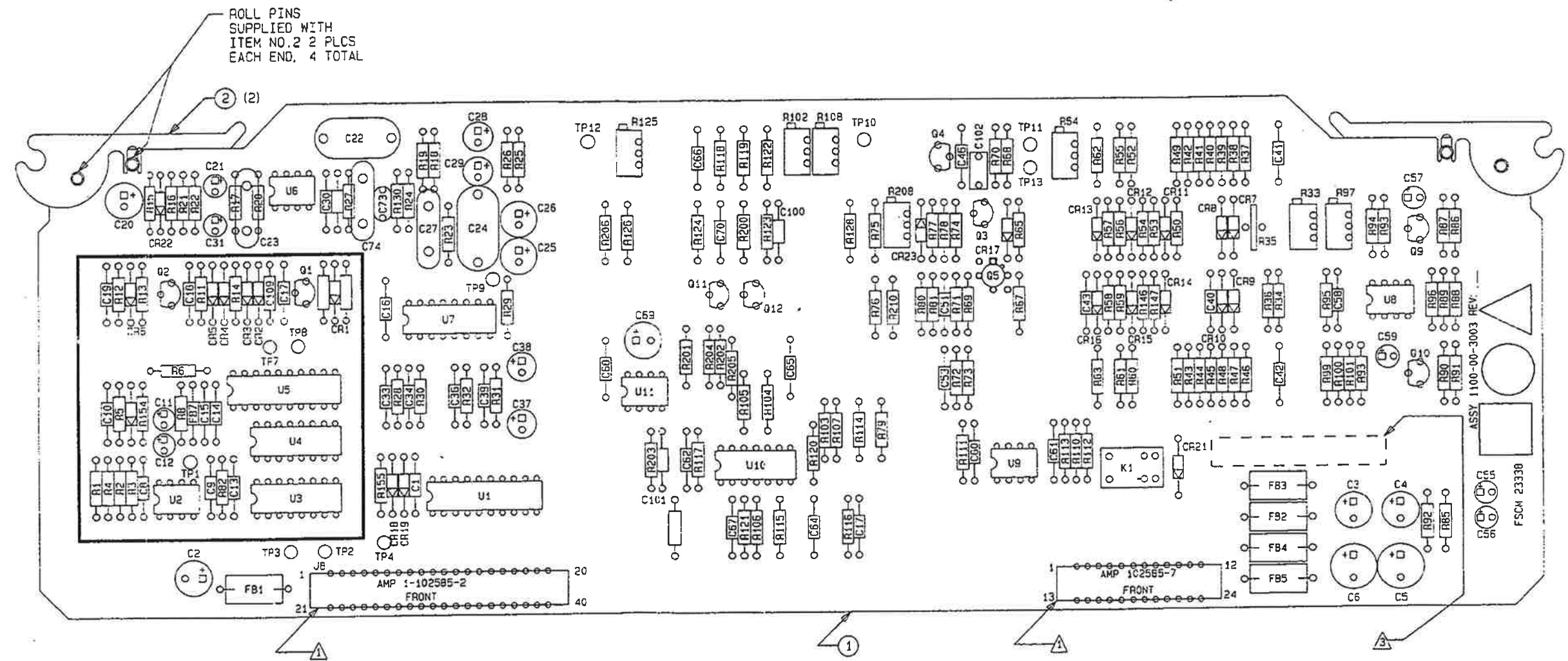
WAVETEK PARTS LIST TITLE PCA SUB ASSY, OUTPUT BD 1288/288 ASSEMBLY NO. 1208-00-3002 PAGE 8 REV

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	WAVETEK SAN DIEGO - CALIFORNIA	
MATERIAL	CHECKED		TITLE	
	PROJ. ENGR		PARTS LIST OUTPUT BOARD	
	RELEASE APPROV			
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		SIZE	REV
DO NOT SCALE DRAWING	SCALE	MODEL	288	SHEET 2 OF 2

NOTE: UNLESS OTHERWISE SPECIFIED

BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

REV	ECO #	DATE	BY	CHKD
A03	ECO #0032		MK	3/88
A04	ECO #0044		MK	3/88
B	ERO #9717 RELEASE		MK	5/88
	# CHANGE FROM A04			
C	ECO #9772		MK	5/88
D	ECO #9805		MS	7/88
E	ECO #9914		MS	8/88
F	ECO #9973		RG	10/88
G	ECO #99-017		MS	10/88
H	ECO #99-261		RG	11/88
I	90-028			
J	ECO 90-074			
L	ENG-W/D 41W	1/79		
M	ECO 90-272	1/79		



- ③ INSTALL SERIAL NO. LABEL APPROXIMATELY WHERE SHOWN.
- ② INSTALL CAN FLUSH TO COMPONENT SIDE OF PC BOARD. SOLDER TABS ON CIRCUIT SIDE.
- ① MANUFACTURER'S MARKING INDICATES CORRECT ORIENTATION OF CONNECTOR.

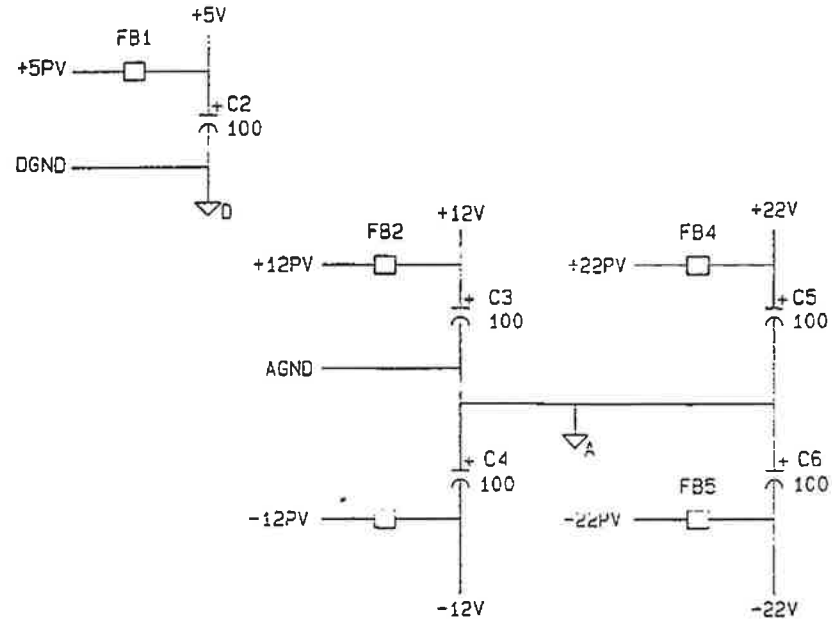
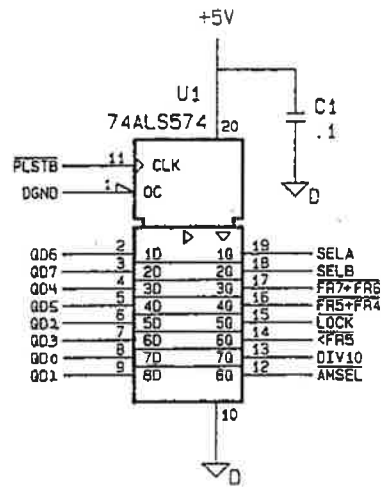
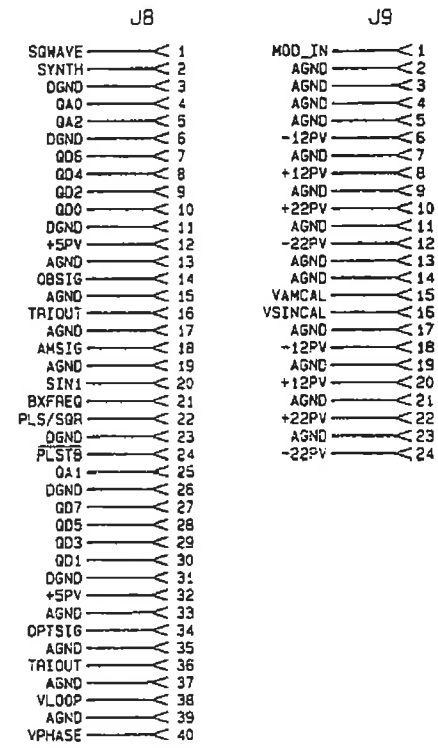
NOTE: UNLESS OTHERWISE SPECIFIED

CAD JOB #: B0318

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 7-31-88	
MATERIAL	CHECKED		
FINISH WAVETEK PROCESS	PROJ ENGR		TITLE
DO NOT SCALE DRAWING	RELEASE APPROV. RBG	7-11-88	PCA, PHASE LOCK LOOP
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX .XXX °		SIZE FSCM NO. DWG. NO. REV. <b>D 23338</b> 1100-00-3003 M
	SCALE 1:1	MODEL 128P	SHEET 1 OF 1

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REV	ECO	BY	DATE	APP
A	FR0 9896	M6	3/17	1/1
B	ECO 9973	BG	10/28	1/2
C	ECO # 89-017	MS	7/17	1/3
D	ECO 89-261	BG	7/25	1/4
E	ECO 90-008	BG	10/28	1/4
F	ENG. PROTO	AT	4/93	1/4
G	ECO 90-050	AT	4/90	1/5



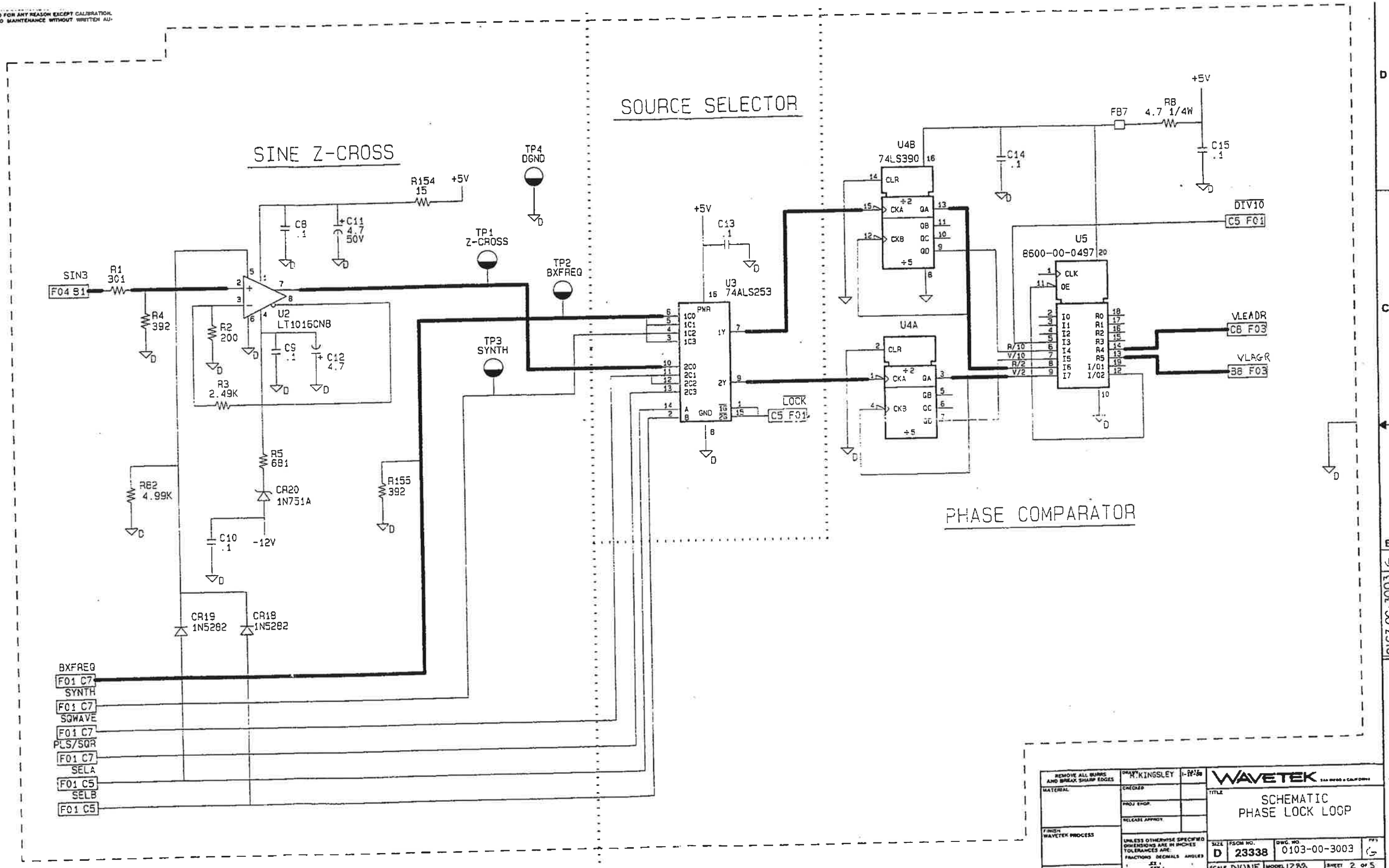
- 4. ANALOG GROUND SYMBOL.
- 3. DIGITAL GROUND SYMBOL.
- 2. ALL CAPACITORS ARE IN MICROFARADS.
- 1. ALL RESISTORS ARE IN OHMS, 1/8W, 1%, MF.

NOTE UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATORS LAST USED	REFERENCE DESIGNATORS NOT USED
R204, C101, FB7, TP13, U11, U12, CR23	R7, R24, R66, R83, R84, R127, R129, R131-R145, R148-R153, R156-R199, R207, C7, C35, C44, C45, C47-C50, C52, C54, C63, C72, C75-C99, FB6, Q6-Q8, TP5, TP6

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE 3-18-90									
CHECKED <i>M6</i>	30 86									
DESIGNED <i>W. King</i>	25 89									
RELEASE APPROVED <i>W. King</i>	25 89									
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		<table border="1"> <tr> <td>SIZE</td> <td>FSCM NO.</td> <td>DWG. NO.</td> <td>REV.</td> </tr> <tr> <td>D</td> <td>23338</td> <td>0103-00-3003</td> <td>-</td> </tr> </table>	SIZE	FSCM NO.	DWG. NO.	REV.	D	23338	0103-00-3003	-
SIZE	FSCM NO.	DWG. NO.	REV.							
D	23338	0103-00-3003	-							
DO NOT SCALE DRAWING		<table border="1"> <tr> <td>SCALE</td> <td>MODEL</td> <td>SHEET</td> </tr> <tr> <td>NONE</td> <td>1286</td> <td>1 OF 2</td> </tr> </table>	SCALE	MODEL	SHEET	NONE	1286	1 OF 2		
SCALE	MODEL	SHEET								
NONE	1286	1 OF 2								

REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.



- 8 BXFREQ
- 7 F01 C7 SYNTH
- 6 F01 C7 SQWAVE
- 5 F01 C7 PLS/SQR
- 4 F01 C7 SELA
- 3 F01 C5 SELB
- 2 F01 C5
- 1

NOTE: UNLESS OTHERWISE SPECIFIED

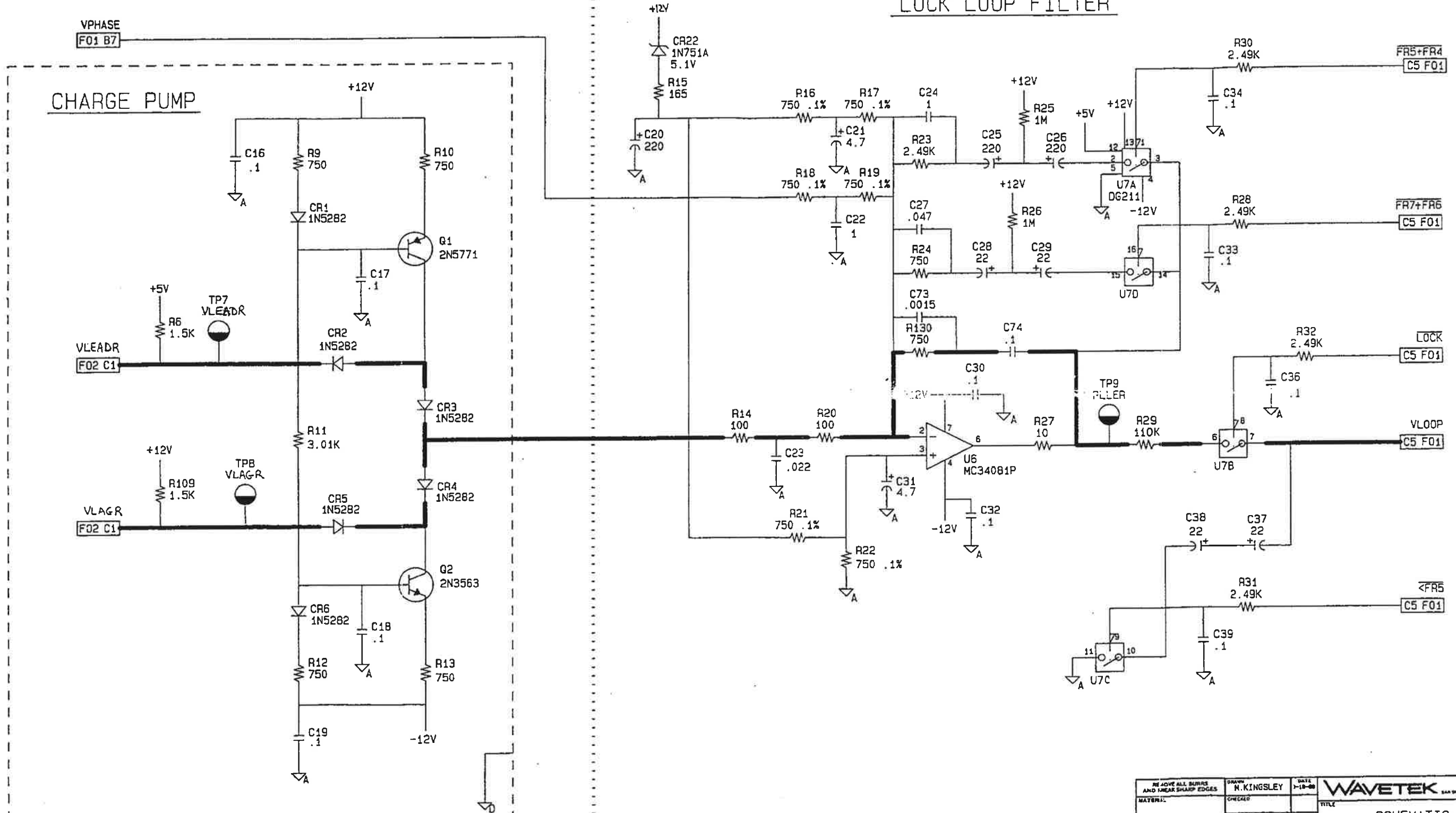
REMOVE ALL BURRS AND BREAK SHARP EDGES	WAVETEK	1-800-848-6264	
MATERIAL	CREATED	TITLE	
FINISH	PROJ ENGR	SCHEMATIC PHASE LOCK LOOP	
WAVETEK PROCESS	RELEASE APPROV	SIZE	D 23338
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES	DWG. NO.	0103-00-3003
	SCALE	NONE	MOODL 1288
			SHEET 2 OF 5

0103-00-3003 G

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### LOCK LOOP FILTER

### CHARGE PUMP

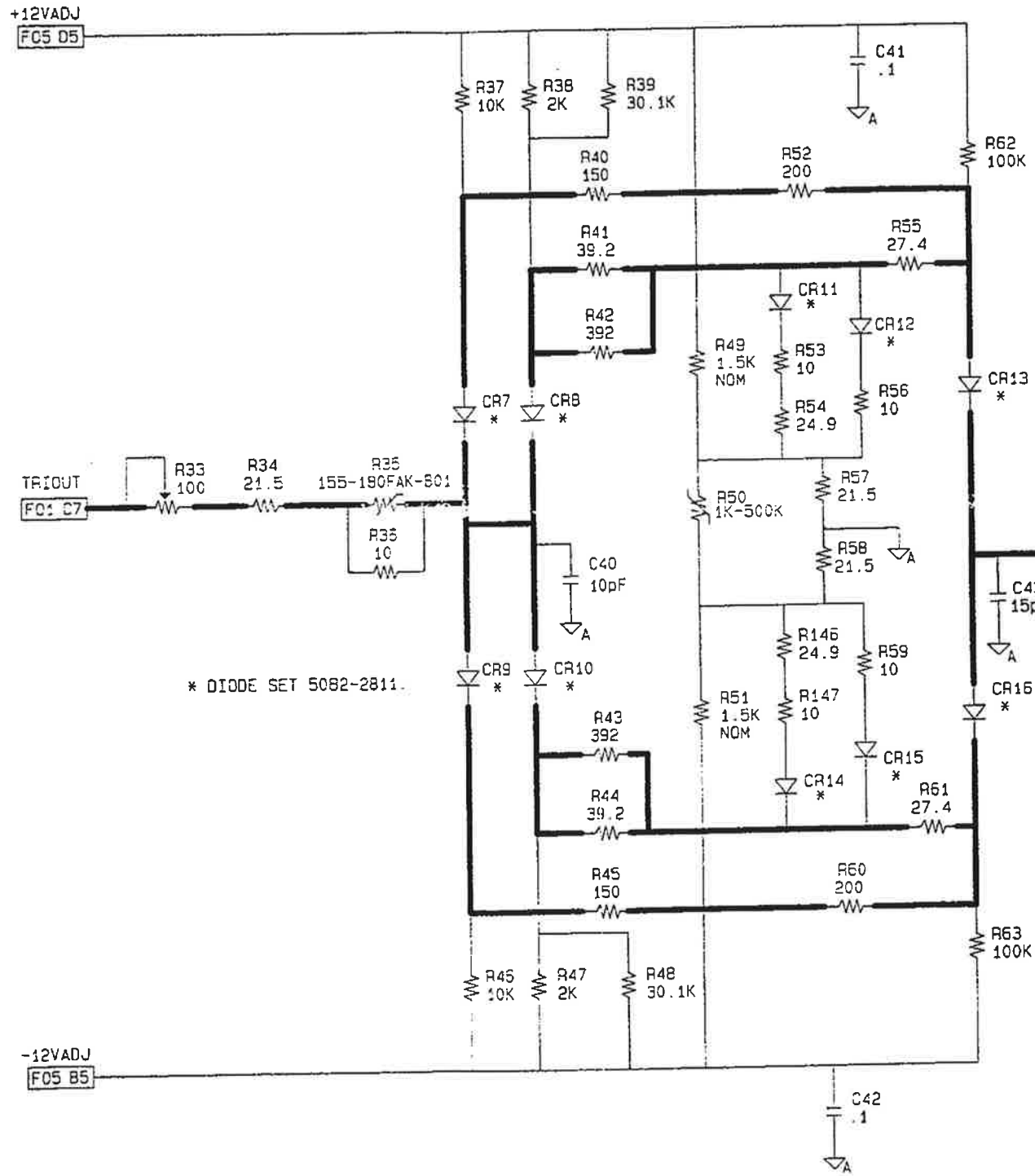


NOTE UNLESS OTHERWISE SPECIFIED

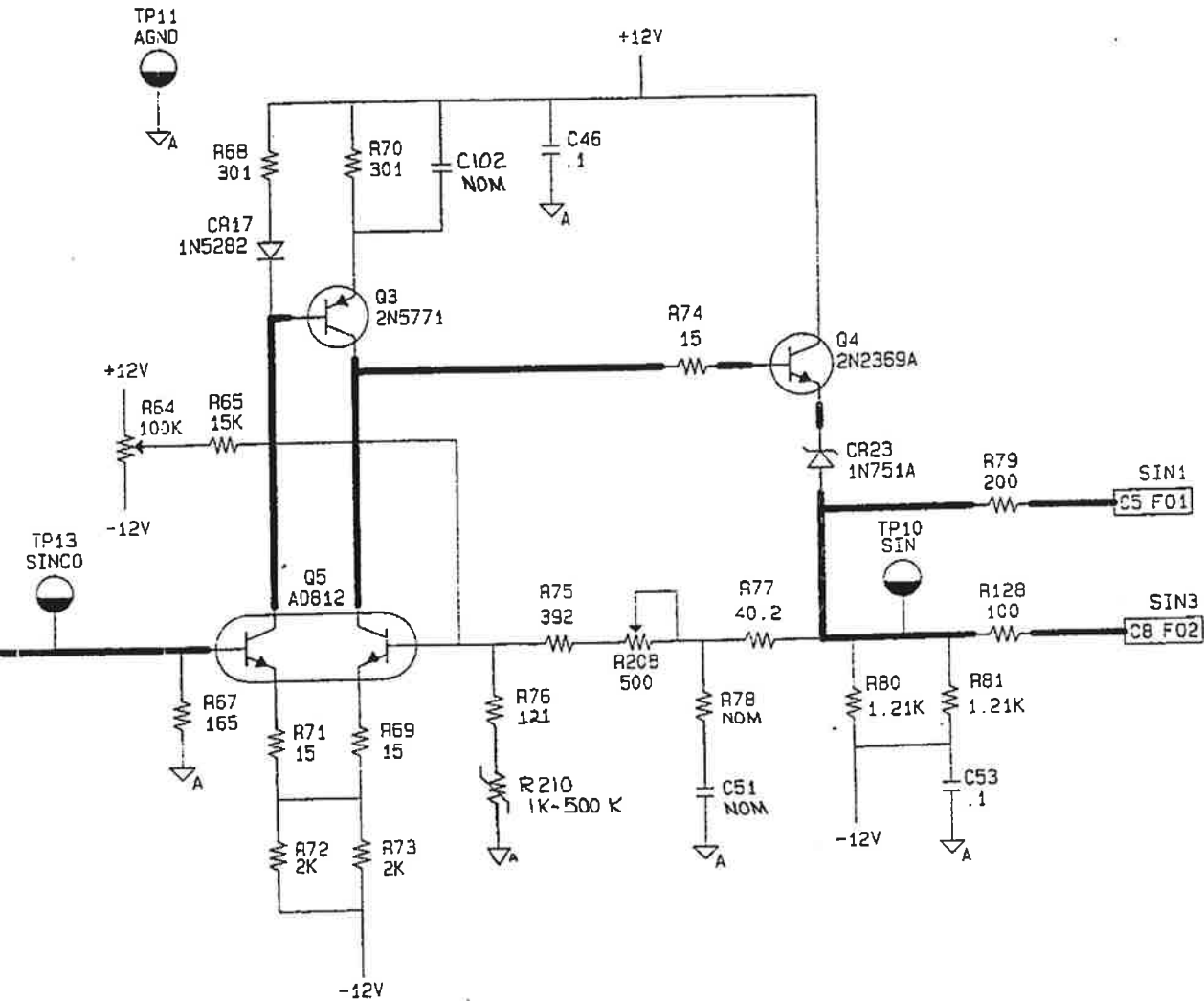
RE MOVE ALL BURRS AND BREAK SHARP EDGES		DATE 7-18-88	<b>WAVETEK</b> SAN DIEGO - CALIFORNIA	
DRAWN N. KINGSLEY		CHECKED	TITLE SCHEMATIC PHASE LOCK LOOP	
MATERIAL		PROJ. ENGR.	SIZE D	
FIMSH WAVETEK PROCESS		RELEASE APPROV.	PSCM NO. 23338	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		DWG. NO. 0103-00-3003		REV 1
DO NOT SCALE DRAWING		SCALE NONE	MODEL 1288	SHEET 3 OF 5

ALL RIGHTS BELONGING TO WAVETEK AND MAY NOT BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION.

### SINE CONVERTER



### SINE BUFFER

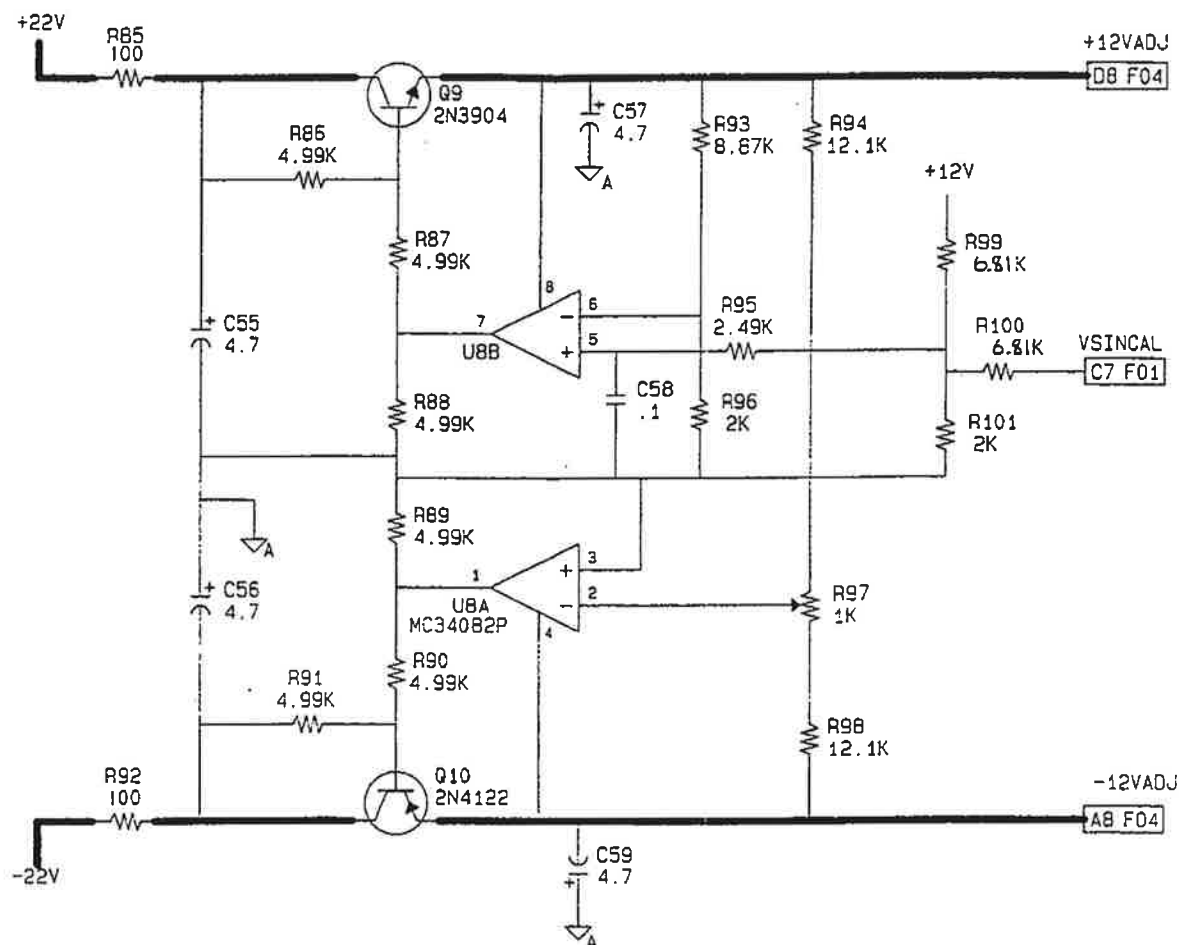


NOTE: UNLESS OTHERWISE SPECIFIED

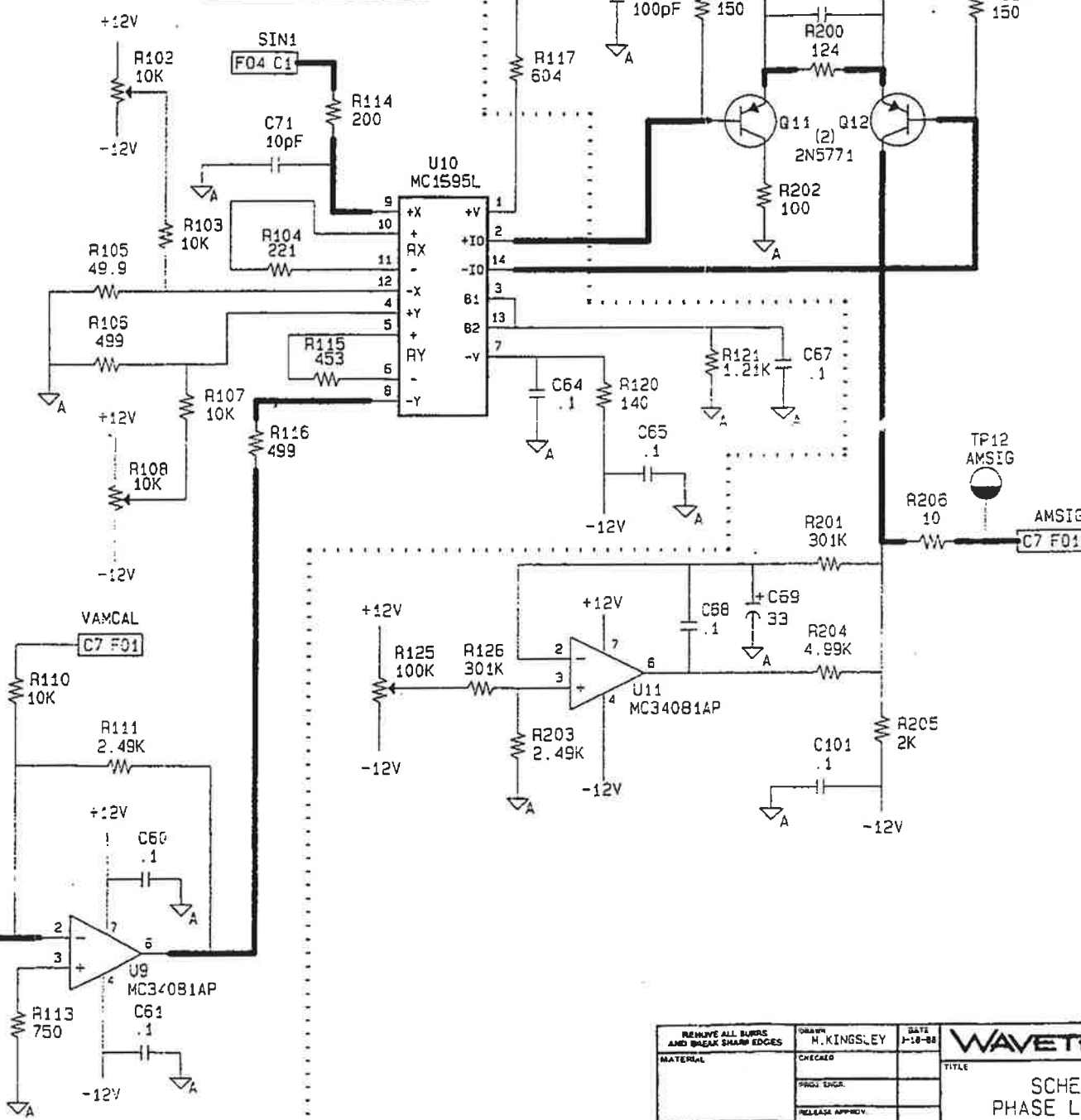
REMOVE ALL BURRS AND BREAK SHARP EDGES		DRAWN M. KINGSLEY	DATE 3-18-80	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA	
MATERIAL	FINISH WAVETEK PROCESS	CHECKED	PROJ. ENGR.	TITLE SCHEMATIC PHASE LOCK LOOP	
DO NOT SCALE DRAWING		RELEASE APPROV.	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES 1/16" ± .005" 0.125 ± .005" 90° ± 30'	SIZE <b>D</b>	SCM NO. <b>23338</b>
				DWG. NO. 0103-00-3003	SHEET 5 OF 7
				SCALE NONE	MODEL 1288

0103-00-3003 G

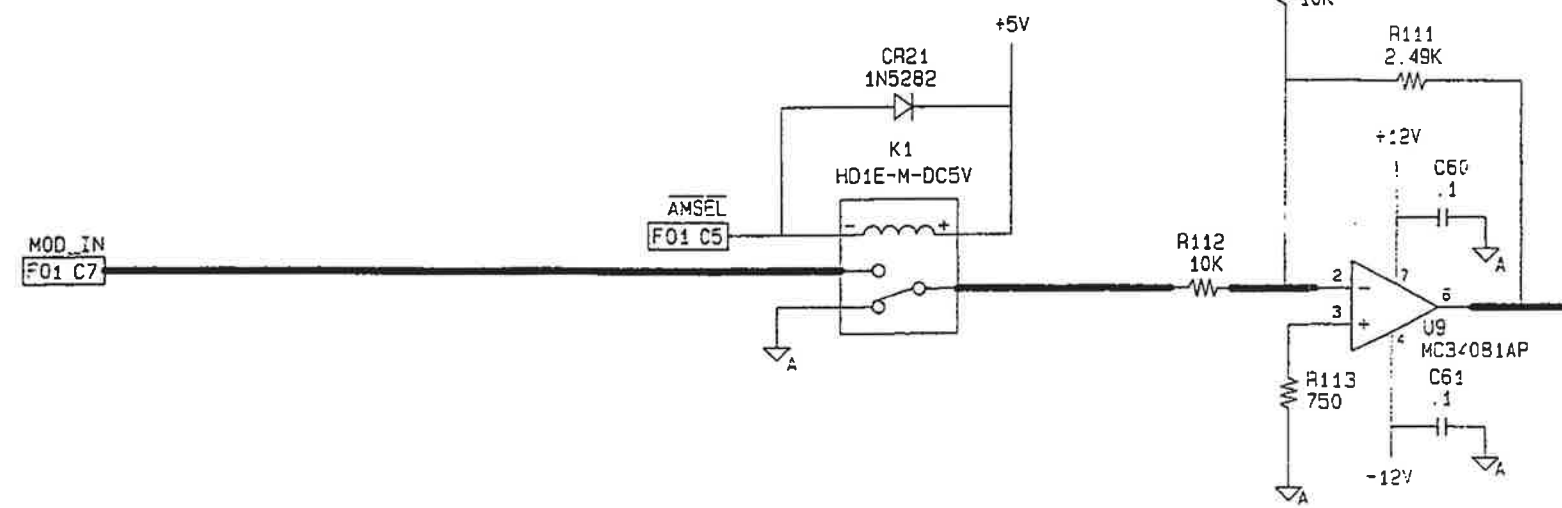
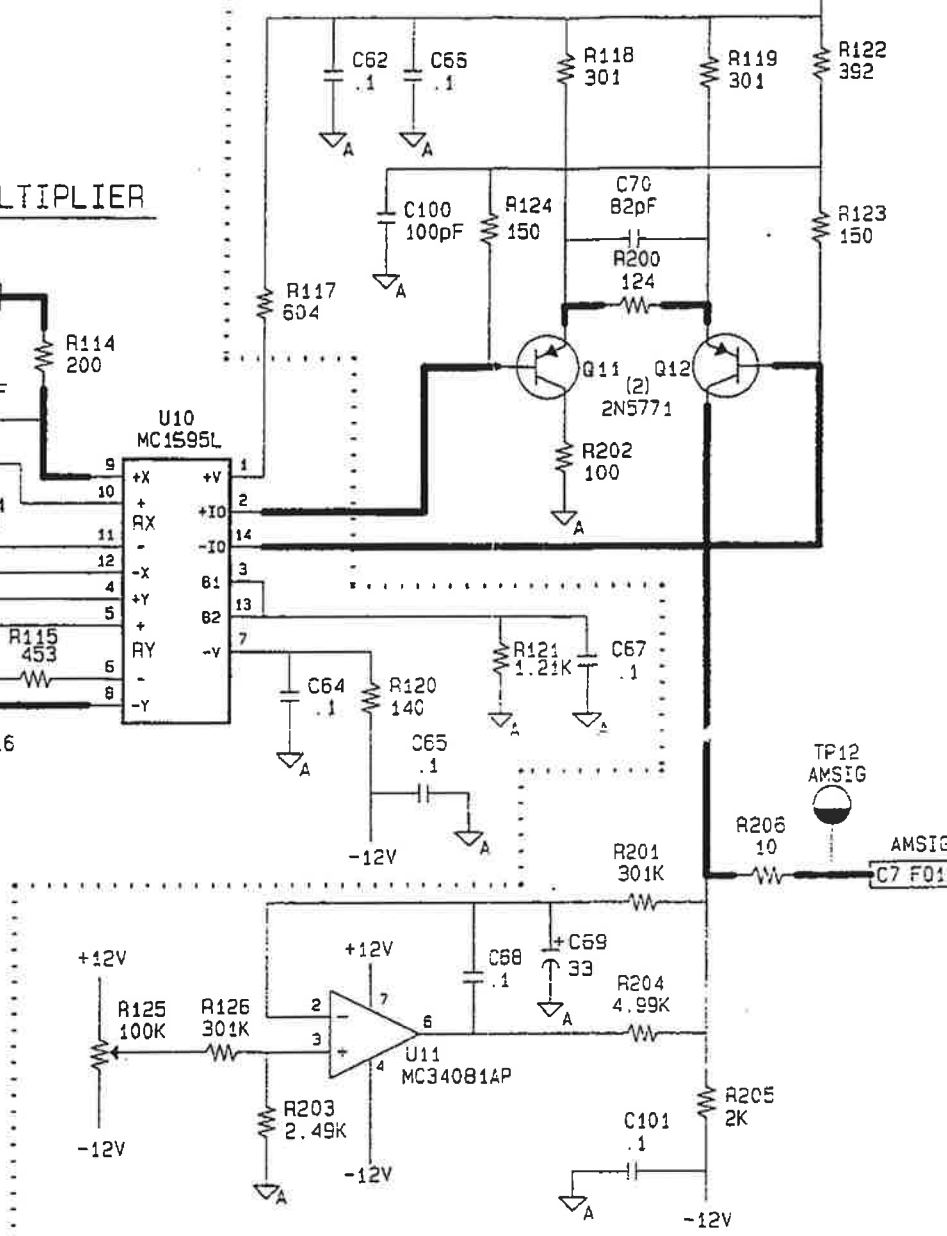
VARIABLE SUPPLY



X-Y MULTIPLIER



AM BUFFER



NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES		DESIGN: M. KINGSLEY	DATE: 7-18-88	<b>WAVETEK</b> SAN DIEGO - CALIFORNIA
MATERIAL:	CHECKED:	PROJ. ENGR.:	RELEASE APPROV.:	
FINISH: WAVETEK PROCESS		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		TITLE: SCHEMATIC PHASE LOCK LOOP
DO NOT SCALE DRAWING		SIZE: D	FIG. NO.: 23338	DWG. NO.: 0103-00-3003
		SCALE: NONE	MODEL: 1288	SHEET 5 OF 5

1003-00-3003 G B C D

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
NONE	SCHEMATIC, PHASE LOCK PCB	0103-00-3003	WVTK	0103-00-3003	1
NONE	PCA SUB ASSY, PLL BOARD 1288/288			1208-00-3003	1
3	CAN. SYNTHESIZER	1400-02-3443	WVTK	1400-02-3443	1
2	PC BD EJECTOR	87-2-C	BRIT	2800-07-0032	2

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, PLL BOARD	ASSEMBLY NO. 1100-00-3003	REV M
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
R8	RES. CFLM 4.7 OHM 3% 1/4W	8043CX4R700J	MEPCO	116.9471	1
C40 C71	CAP. CER. 10PF, 100V, AXIAL	CAC02C00100J100A	CORNG	1500-01-0006	2
C100	CAP. CER. 100PF, 100V, AXIAL	CAC02C00101J100A	CORNG	1500-01-0106	1
C1 C10 C101 C13 C14 C15 C16 C17 C18 C19 C20 C22 C23 C24 C26 C29 C41 C42 C46 C33 C38 C50 C51 C62 C64 C65 C66 C67 C68 C8 C9	CAP. CER. MON. .1MF. 50V, AXIAL	CAG03Z5U104Z050A	CORNO	1500-01-0405	31
C43	CAP. CER. 15PF, 100V, AXIAL	CAC02C00150J100A	CORNO	1500-01-3006	1
C73	CAP. CER. .0015PF, 1KV	DD-152 LONG LEAD	CRL	1500-01-5201	1
C51T	CAP. CER. 27PF, 5% COG, 100V, AXIAL	CAC02C00270J100A	CORNO	1500-02-7006	1
C102T	CAP CER MON 2.7PF 50V	CCDR7DNP0	ARCO	1500-02-7505	1
C70	CAP. CER. 82PF, 100V, 5% COG, AXIAL	BA102A820JAA	AVX	1500-08-2006	1
C5 C6	CAP. ELECT. 100MF, 35V RADIAL LEAD, .20	NRE101K03V8X11	NIC	1500-31-0102	2
C2 C3 C4	CAP. ELECT. 100MF, 25V, RADIAL LEAD-.8P SIZE	NRE101K025V6.3X11	NIC	1500-31-0122	3

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, PLL BOARD 1288/288	ASSEMBLY NO. 1208-00-3003	REV
		PAGE 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
TP11 TP4	TEST POINT, BLK, PC	TP-104-01-00	COMP0	2100-04-0054	2
TP1 TP10 TP12 TP13 TP2 TP3 TP7 TP8 TP9	TEST POINT, RED, PC	TP-104-01-02	COMP0	2100-04-0055	9
F81 F82 F83 F84 F85	BALUN CORE, FERRITE, 680 OHMS	2943666671	FARIT	3100-00-0017	3
F87	BALUN CORE, FERRITE, 82 OHMS	2743013111	FARIT	3100-00-0018	1
K1	RELAY, 1 FORMC, 5V, .312H, .296W	HD1E-11-DC5V	AROMT	4500-00-0034	1
R102 R108	POT. SIDE TRIM, 20T, 10K	68XR10K	BECK	4609-90-0009	2
R123 R64	POT. SIDE TRIM, 20T, 100K	68XR100K	BECK	4609-90-0012	2
R208	POT. SIDE TRIM, 20T, 500	68XR500	BECK	4609-90-0014	1
R97	POT. SIDE TRIM, 20T, 1K	68XR1K	BECK	4609-90-0015	1
R37	POT. SIDE TRIM, 20T, 100	68XR100	BECK	4609-90-0017	1
R16 R17 R18 R19 R21 R22	RES. MF, 1/BW, 1% 1Z, 750	RN55D-7500B	MEPCO	4701-02-7500	6
R128 R14 R20 R202 R85 R92	RES. MF, 1/BW, 1% 100	RN55D-1000F	TRW	4701-03-1000	6
R103 R107 R110 R112 R37 R46	RES. MF, 1/BW, 1% 10K	RN55D-1002F	TRW	4701-03-1002	6
R62 R63	RES. MF, 1/BW, 1% 100K	RN55D-1003F	TRW	4701-03-1003	2

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, PLL BOARD 1288/288	ASSEMBLY NO. 1208-00-3003	REV
		PAGE 3	

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
C28 C29 C37 C38	CAP. ELECT. 22MF, 25V, RADIAL	BR123V822R6X7LL	UNCON	1500-32-2002	4
C20 C25 C26	CAP. ELECT. 220MF, 20% 16V, RADIAL	16VMS220M	RUBY	1500-32-2104	3
C69	CAP. ELECT. 33MF, 25V RADIAL LEAD, .8P .14	RL4 33ARLR025M	IC	1500-33-3002	1
C11 C12 C21 C31 C35 C36 C37 C39	CAP. ELECT. 4.7MF/50V RADIAL LEAD, .8P .10	ECC1A1H4R75C	PANAS	1500-34-7903	8
C74	CAP. MET POLY. .1PF, 160V	171-104J160D	WEST	1500-41-0434	1
C22 C24	CAP. NYLAR, 1MF, 100V, RADIAL	PH12R1.0M100	ITT	1500-41-0324	2
C23	CAP. NYLAR, .022MF, 100V	223P22391MD3	SPRAC	1500-42-2314	1
C27	CAP. NYLAR, .047MF, 100V	223P47391MD3	SPRAC	1500-44-7314	1
1	PCB, PHASE LOCK LOOP	1700-00-3003	WVTK	1700-00-3003	1
J9	CONN. HEADER, 24 PIN, RECPY, 2X12, .1 CTR, PCNT	102985-7	AMP	2100-02-0255	1
J8	CONN. HEADER, 40 PIN, RECPY, 2X20, .1 CTR, PCNT	1-102985-2	AMP	2100-02-0256	1

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, PLL BOARD 1288/288	ASSEMBLY NO. 1208-00-3003	REV
		PAGE 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
R25 R26	RES. MF, 1/BW, 1% 1M	RN55D-1004F	TRW	4701-03-1004	2
R147 R206 R27 R36 R33 R36 R59	RES. MF, 1/BW, 1% 10	5043ED10R100F	MEPCO	4701-03-1009	7
R29	RES. MF, 1/BW, 1% 110K	RN55D-1103F	TRW	4701-03-1103	1
R76	RES. MF, 1/BW, 1% 121	RN55D-1210F	TRW	4701-03-1210	1
R121 R90 R81	RES. MF, 1/BW, 1% 1.21K	RN55D-1211F	TRW	4701-03-1211	3
R94 R98	RES. MF, 1/BW, 1% 12.1K	RN55D-1212F	TRW	4701-03-1212	2
R200	RES. MF, 1/BW, 1% 124	RN55D-1240F	TRW	4701-03-1240	1
R120	RES. MF, 1/BW, 1% 140	RN55D-1400F	TRW	4701-03-1400	1
R123 R124 R40 R43	RES. MF, 1/BW, 1% 150	RN55D-1500F	TRW	4701-03-1500	4
R109 R49T R51T R6	RES. MF, 1/BW, 1% 1.5K	RN55D-1501F	TRW	4701-03-1501	4
R63	RES. MF, 1/BW, 1% 15K	RN55D-1502F	TRW	4701-03-1502	1
R154 R59 R71 R74	RES. MF, 1/BW, 1% 15	RN55D-150F	TRW	4701-03-1509	4
R13 R67	RES. MF, 1/BW, 1% 165	RN55D-1650F	TRW	4701-03-1650	2
R114 R2 R52 R60 R79	RES. MF, 1/BW, 1% 200	RN55D-2000F	TRW	4701-03-2000	3
R101 R205 R38 R47 R72 R73 R96	RES. MF, 1/BW, 1% 2K	RN55D-2001F	TRW	4701-03-2001	7
R34 R37 R58	RES. MF, 1/BW, 1% 21.5	RN55D-21R5F	TRW	4701-03-2159	3

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, PLL BOARD 1288/288	ASSEMBLY NO. 1208-00-3003	REV
		PAGE 4	

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> SAP DESO 4 CALIFORNIA
MATERIAL	CHECKED		
	PROJ ENGR		
	RELEASE APPROV.		
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		REV M
DO NOT SCALE DRAWING	SIZE D	P/SCM NO 23338	DWG. NO 1100-00-3003
	SCALE	MODR. 288	SHEET 1 OF 2



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 NO RIGHTS BELONGING TO WAVETEK AND MAY NOT  
 BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION,  
 OPERATION AND MAINTENANCE WITHOUT WRITTEN AU-  
 THORIZATION.

REV ECO BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT
R104	RES. MF. 1/8W. 1%. 221	RN350-2210F	TRW	4701-03-2210	1	Q1 Q11 Q12 Q3	TRANS 2N3771 PNP SWITCH TO-92	2N3771	NSC	4901-03-7710	4
R111 R203 R23 R26 R3 R30 R21 R23 R93	RES. MF. 1/8W. 1%. 2.49K	RN350-2491F	TRW	4701-03-2491	9	R33	THERMISTOR 10,000OHMS .25% CUST. COATED	153-180FAK-801	FENML	3300-00-0002	1
R146 R54	RES. MF. 1/8W. 1%. 24.9	RN350-2499F	TRW	4701-03-2499	2	R210 R50	THERMISTOR 50 OHM. +/-10%. 8 25 DEG C	1K-300-K	MCI	3300-00-0013	2
R55 R61	RES. MF. 1/8W. 1%. 27.4	RN350-2784F	TRW	4701-03-2749	2	Q5	TRANS. MONO. DUAL. NPN	LS312-32	LINSY	7000-08-1200	1
R1 R116 R119 R68 R70	RES. MF. 1/8W. 1%. 301	RN350-3010F	TRW	4701-03-3010	5	U2	COMPARATOR. ULTRA FAST. 10MS	LT1016CMB	LINTE	7000-10-1600	1
R11	RES. MF. 1/8W. 1%. 3.01K	RN350-3011F	TRW	4701-03-3011	1	U10	MULTIPLIER. WIDEBAND MONOLITHIC. 4 QUAD	MC1395L	MOT	7000-15-9300	1
R39 R48	RES. MF. 1/8W. 1%. 30.1K	RN350-3012F	TRW	4701-03-3012	2	U6	OP AMP. HI SLEW RTE. WIDEBAND. JFET. STD	MC34081P	MOT	7003-40-8100	1
R126 R201	RES. MF. 1/8W. 1%. 301K	RN350-3013F	TRW	4701-03-3013	2	U11 U9	OP AMP. HI SLEW RTE. WIDEBAND. JFET. PRIM E	MC34081AP	MOT	7003-40-8101	2
R122 R193 R4 R42 R43 R75 R78T	RES. MF. 1/8W. 1%. 392	RN350-3920F	TRW	4701-03-3920	7	U8	OP AMP. HI SLEW RTE. WIDEBAND. JFET DUAL	MC34082P	MOT	7003-40-8200	1
R41 R44	RES. MF. 1/8W. 1%. 39.2	RN350-3929F	TRW	4701-03-3929	2	U7	SH. QUAD ANALOG. CMOS	DC211CJ	ELCON	8000-02-1100	1
R77	RES. MF. 1/8W. 1%. 40.2	RN350-4029F	TRW	4701-03-4029	1	U3	MUX/SEL. DUAL 1 OF 4 DATA. 3/STATE	SN74ALS253N	TI	8007-42-5300	1
R113	RES. MF. 1/8W. 1%. 433	RN350-4330	TRW	4701-03-4330	1	U4	COUNTER. DUAL 48 BCD.	74LS290PC	FAIR	8007-43-9010	1
R106 R116	RES. MF. 1/8. 1%. 499	RN350-4990F	TRW	4701-03-4990	2						
R204 R82 R86 R87 R88 R89 R90 R91	RES. MF. 1/8W. 1%. 4.99K	RN350-4991F	TRW	4701-03-4991	8						
R105	RES. MF. 1/8W. 1%. 49.9	RN350-4999F	CORNO	4701-03-4999	1						
<b>WAVETEK PARTS LIST</b>		TITLE PCA SUB ASSY. PLL BOARD 1288/288	ASSEMBLY NO. 1208-00-3003	REV		<b>WAVETEK PARTS LIST</b>		TITLE PCA SUB ASSY. PLL BOARD 1288/288	ASSEMBLY NO. 1208-00-3003	REV	
PAGE 5					PAGE 7						

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT	REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFR-PART-NO	MFR	WAVETEX NO.	QTY/PT
R117	RES. MF. 1/8W. 1%. 604	RN350-6040F	TRW	4701-03-6040	1	U1	TTL FLIP-FLDP. OCTAL D	SN74ALS574N	TI	8007-45-7450	1
R5	RES. MF. 1/8W. 1%. 681	RN350-6810F	TRW	4701-03-6810	1	U5	PAL. PROG. USER I EA 8000-16-8000	8600-00-0497	MVTK	8600-00-0497	1
R100 R99	RES. MF. 1/8W. 1%. 6.81K	RN350-6811F	TRW	4701-03-6811	2						
R10 R113 R12 R13 R130 R24 R9	RES. MF. 1/8W. 1%. 750	RN350-7500F	TRW	4701-03-7500	7						
R93	RES. MF. 1/8W. 1%. 8.87K	RN350-8871F	TRW	4701-03-8871	1						
CR20 CR22 CR23	DIODE. ZENOR. 5.1V. 500MW. 018. IN751A	1N751A	FAIR	4801-01-0751	3						
CR1 CR17 CR18 CR19 CR2 CR21 CR3 CR4 CR5 CR6	DIODE. HIGH CONDUCTANCE. ULTRA FAST	1N3282	FAIR	4801-01-5282	10						
CR10 11 12 13 14 15 16 7 B 9	DIODE SET. 5082-2811 QTY: 10: 4807-02-2811	4898-00-0015	KLD	4898-00-0015	1						
Q4	TRANS. SILICON. PLANAR. EPITAXIAL. NPN. TO-18	2N2369A	MOT	4901-02-3691	1						
Q2	TRANS. NPN. TO-92	2N3363	FAIR	4901-03-5630	1						
Q9	TRANS. 2N3904 NPN GENERAL PURPOSE TO-92	2N3904	FAIR	4901-03-9040	1						
Q10	TRANS. GENERAL PURPOSE. PNP. TO-92	2N4122	NSC	4901-04-1220	1						
<b>WAVETEK PARTS LIST</b>		TITLE PCA SUB ASSY. PLL BOARD 1288/288	ASSEMBLY NO. 1208-00-3003	REV		<b>WAVETEK PARTS LIST</b>		TITLE PCA SUB ASSY. PLL BOARD 1288/288	ASSEMBLY NO. 1208-00-3003	REV	
PAGE 6					PAGE 8						

NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> SAN DIEGO • CALIFORNIA		
MATERIAL	CHECKED		TITLE		
	PROJ. ENGR.		PARTS LIST		
	RELEASE APPROV.		PHASE LOCK BOARD		
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		SIZE	DWG. NO.	REV
DO NOT SCALE DRAWING	SCALE	MODEL	23338	1100-00-3003	M
		288			2 OF 2

R

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4

3

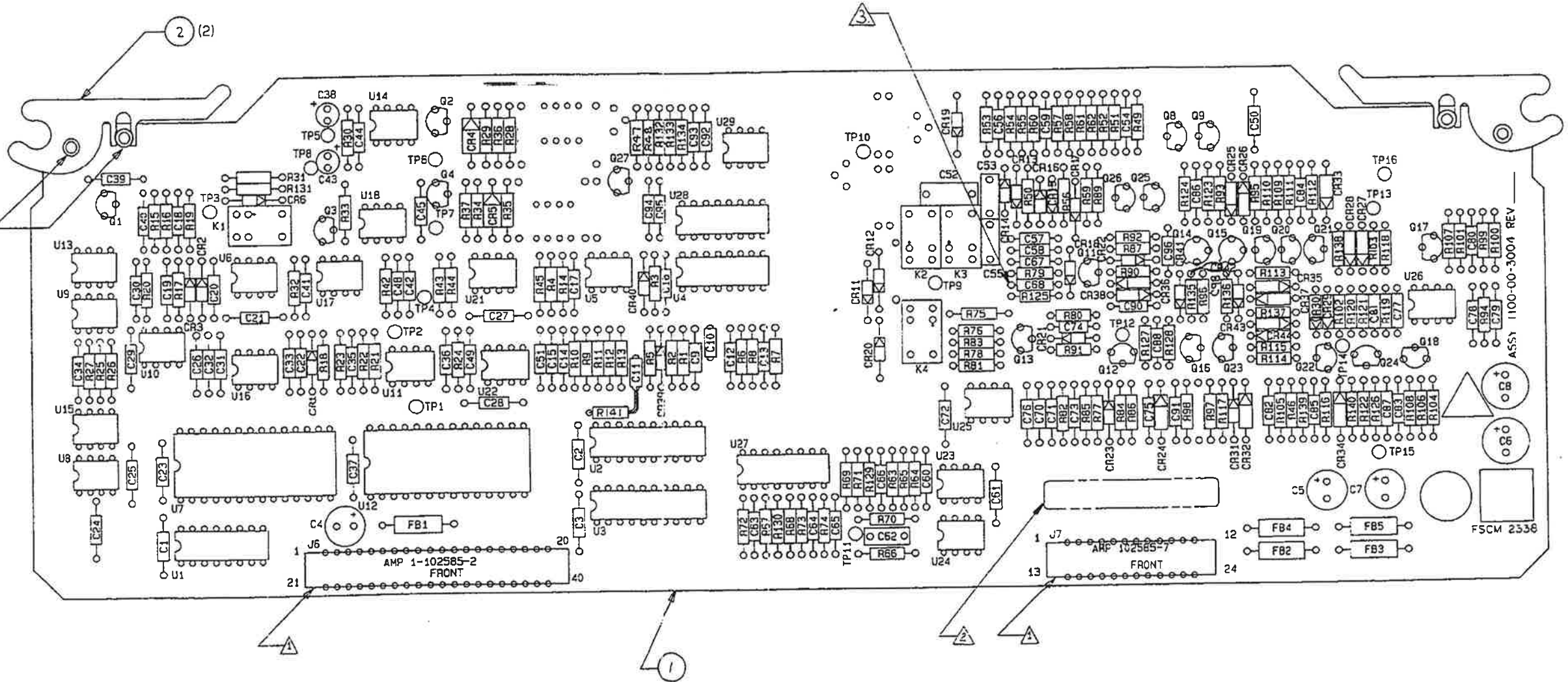
2

1

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AD2	ECL 0005	MM	3-2-81	
AD3	ECL 0005	MM	3-2-81	
A04	ECL 0013	MK	2-7-80	
A05	ECL 0043	MK	3-2-81	
B	ERO # 9718 RERELEASE ONLY NO CHANGE FROM A05	MK	5-2-81	41
C	ECL # 9780	MK	5-2-81	2022
D	ECO # 9913	MS	7-2-81	124
E	ERO # 89-090	BG	7-2-81	114
F	89-261	BG	7-2-81	114
G	89-424	BG	7-2-81	114

REF ROLL PINS  
SUPPLIED WITH  
ITEM NO. .2PLCS  
EACH END .4 TOTAL



- △ C.68 IS A TRIM VALUE
  - △ INSTALL SERIAL NO. LABEL WHERE SHOWN.
  - △ MANUFACTURER'S MARKING INDICATE CORRECT ORIENTATION OF CONNECTOR.
- NOTE: UNLESS OTHERWISE SPECIFIED

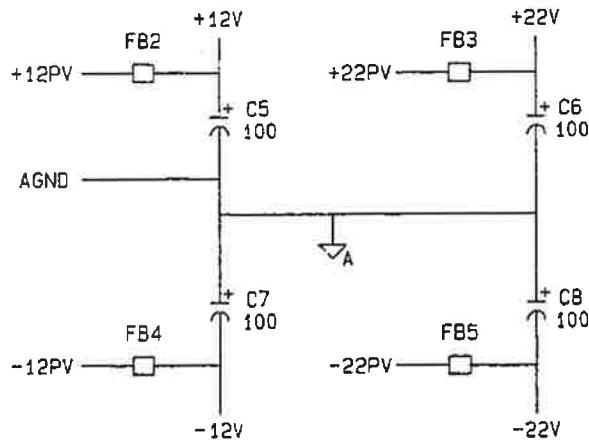
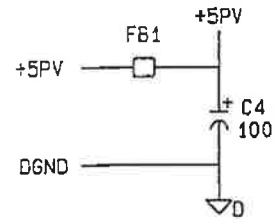
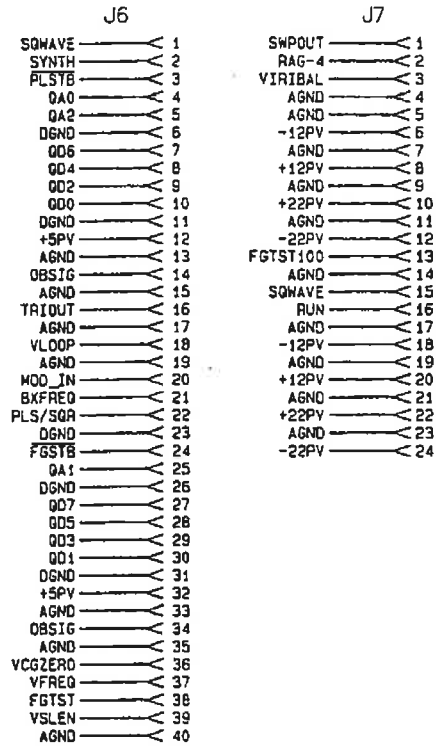
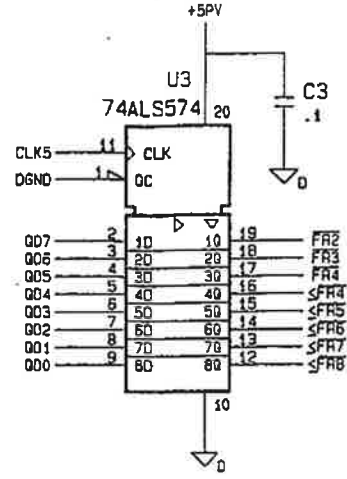
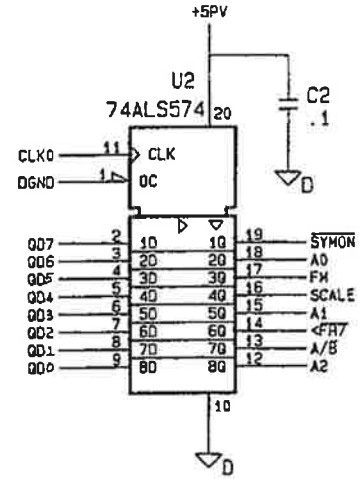
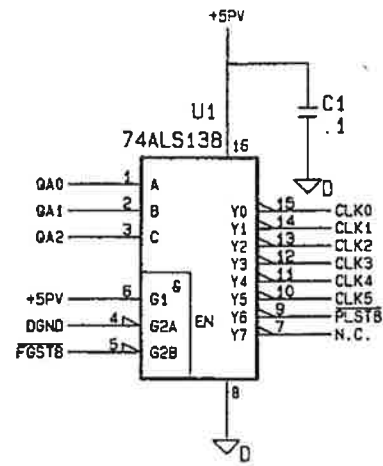
SEE SEPARATE PARTS LIST PL1100-00-3004

REMOVE ALL BURRS AND BREAK SHARP EDGES	DATE: 1-25-88	<b>WAVETEK</b>	
MATERIAL: C10000	BY: M. KINGSLEY	ASSEMBLY FUNCTION GENERATOR BOARD	
FINISH: WAVETEK PROCESS	RELEASE APPROV: RSK	SIZE: D	FSCM NO.: 23338
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES	SCALE: 2:1	MODEL: 1288

1100-00-3004

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REV	ECO	BY	DATE	APP
A	ERO 9896	Mb.	3-15-88	WJ
B	89-261	BG	7-25-89	NA
C	89-424	BG	7-25-89	NA
D	90-050	AT	4-10-90	DF
E	90-135	AT	4-10-90	DF



- 4. ANALOG GROUND SYMBOL.
- 3. DIGITAL GROUND SYMBOL.
- 2. ALL CAPACITORS ARE IN MICROFARADS.
- 1. ALL RESISTORS ARE IN OHMS, 1/8W, 1%, MF.

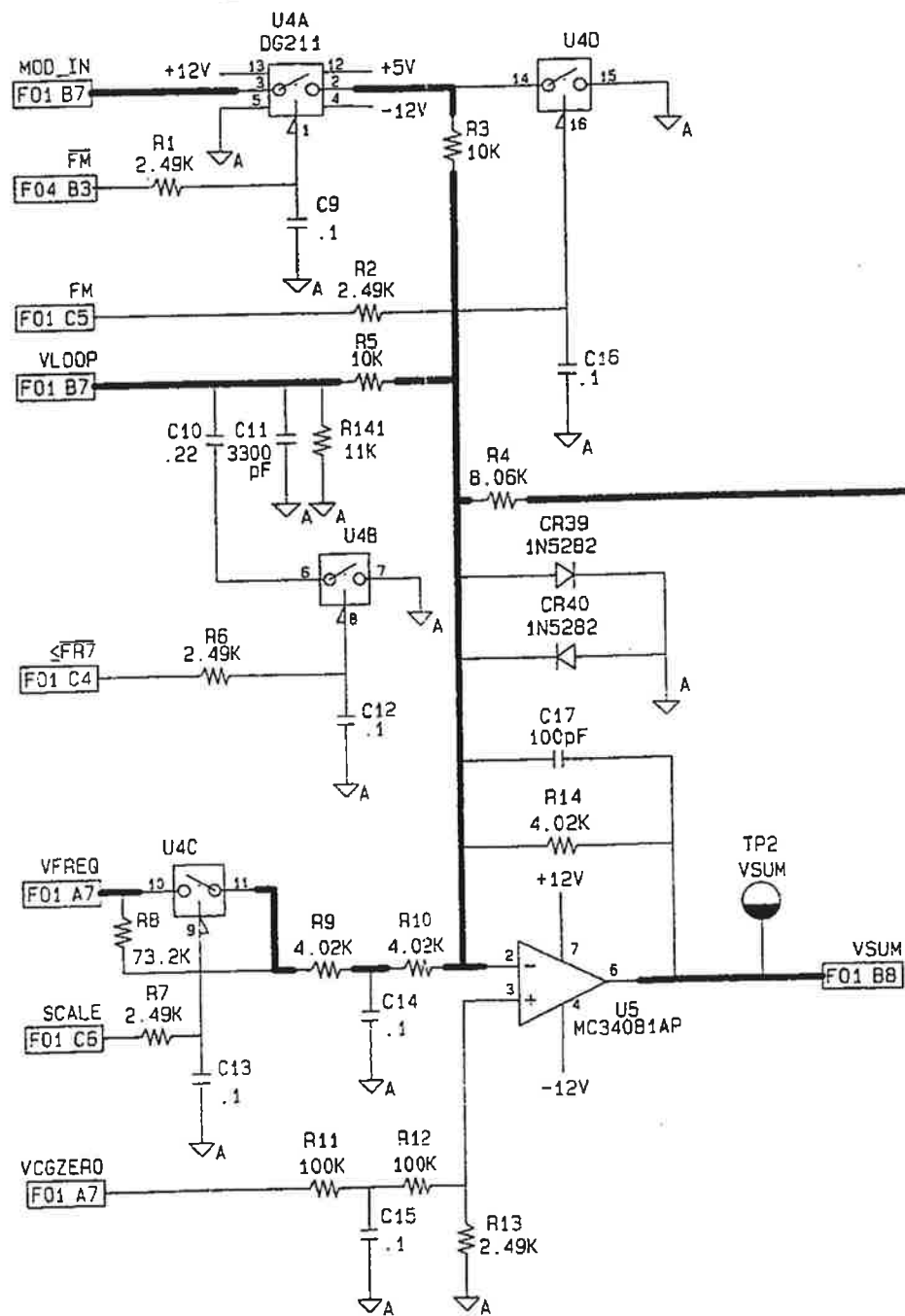
NOTE UNLESS OTHERWISE SPECIFIED

REFERENCE DESIGNATORS LAST USED	REFERENCE DESIGNATORS NOT USED	REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 3-15-88			
R141, C96, Q27, U29, K4, TP16, FB5, CR44,	R88, C46, C47, C66, C89, Q5, Q6, Q7, Q10 CR7-CR10, U19, U20	MATERIAL	3-15-88	3-22-88		TITLE SCHEMATIC FUNCTION GENERATOR	
		FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES	SIZE D	PDM NO. 23338	DWG. NO. 0103-00-3004	REV E
		DO NOT SCALE DRAWING	SCALE NONE	MODEL 1288	SHEET 1 OF 7		

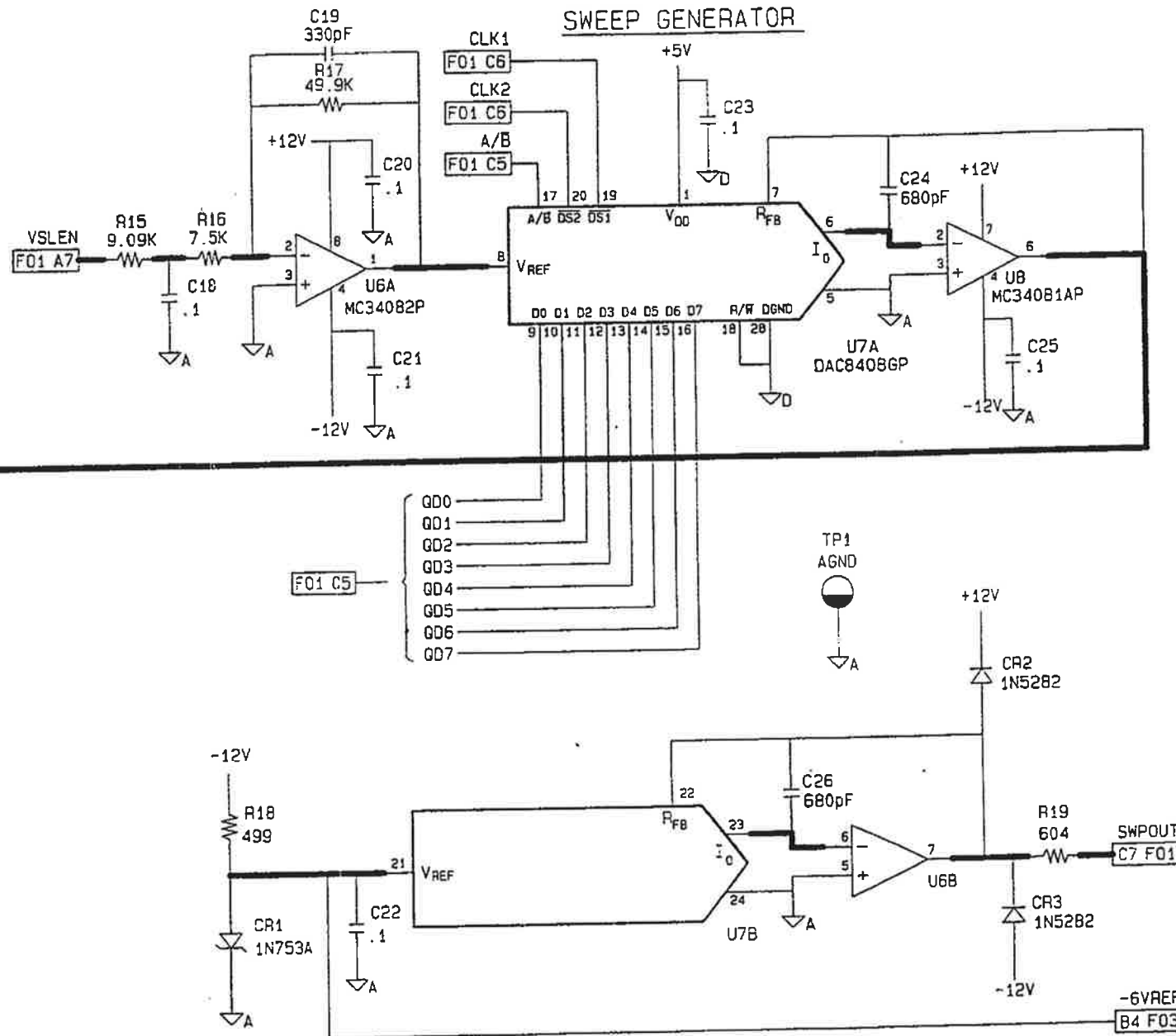
0103-00-3004 E

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### VCG SUMMING AMPLIFIER



### SWEEP GENERATOR



NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES		DATE	WAVETEK	
MATERIAL		DESIGNED BY	H. KINGSLEY	
FINISH		PROJ. ENGR.		
WAVETEK PROCESS		RELEASE APPROV.		
DO NOT SCALE DRAWING		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES	SIZE	FRONT NO.
		SCALE NONE	MODEL 1288	DWG. NO. 0103-00-3004
				REV E
				SHEET 2 OF 7

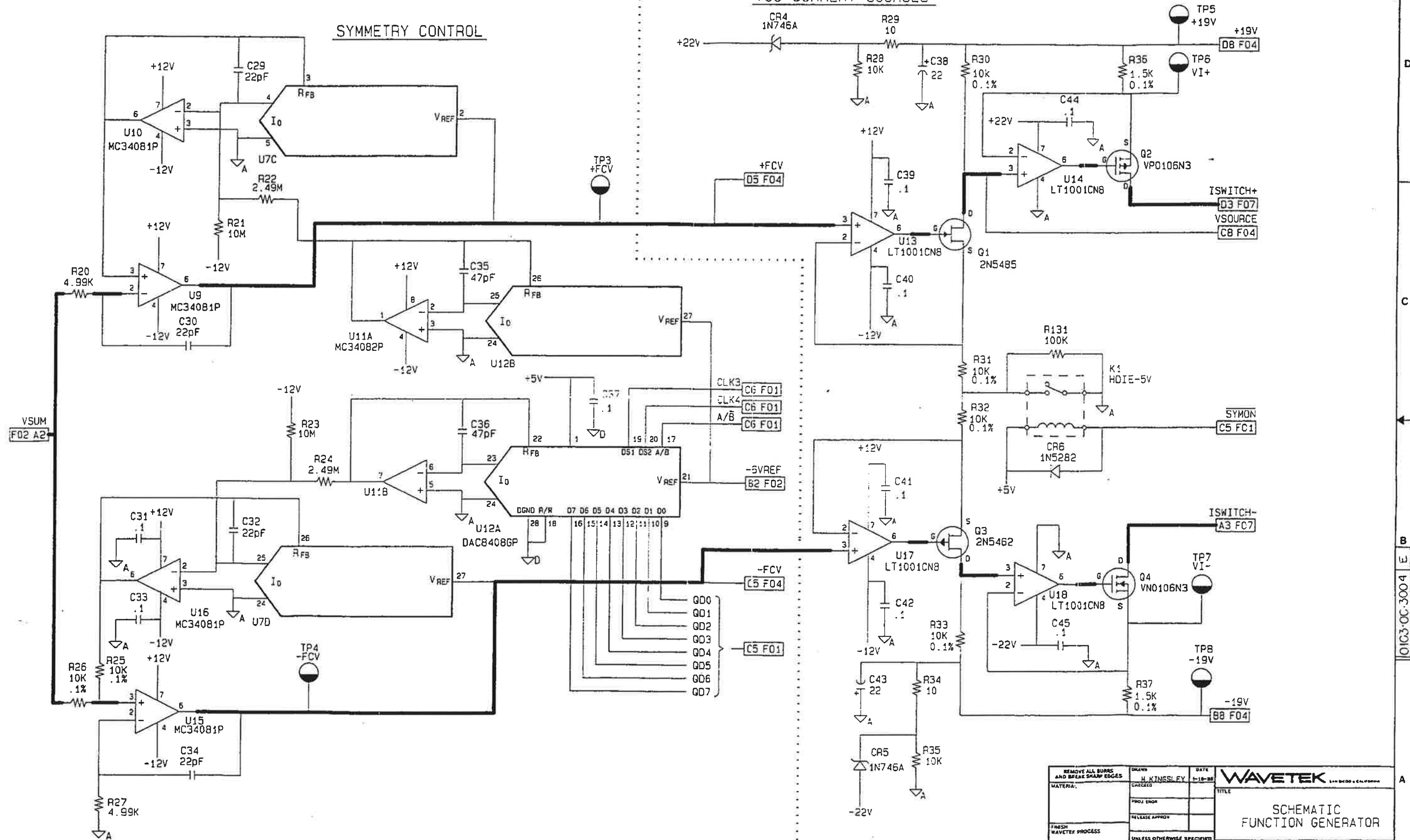
10103-00-3004 E B

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REV ECO BY DATE APP

VCG CURRENT SOURCES

SYMMETRY CONTROL



VSUM  
F02 A2

+FCV  
05 F04

CLK3  
C6 F01

CLK4  
C6 F01

A/B  
C6 F01

-5VREF  
B2 F02

-FCV  
C5 F04

QD0  
QD1  
QD2  
QD3  
QD4  
QD5  
QD6  
QD7  
C5 F01

TP5  
+19V  
08 F04

TP6  
VI+  
03 F07

ISWITCH+

VSOURCE  
08 F04

SYMON  
C5 FC1

ISWITCH-

A3 FC7

TP7  
VI-

TP8  
-19V  
08 F04

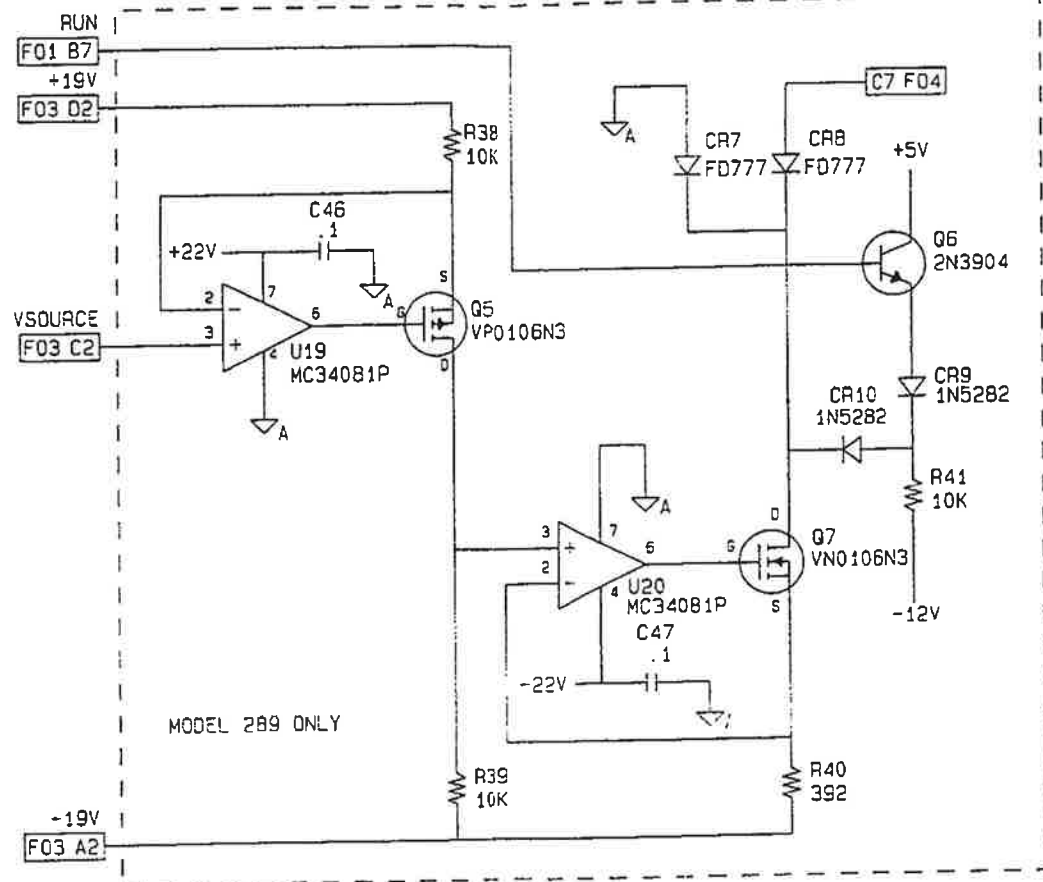
NOTE UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN H. KINGSLY	DATE 1-18-88	<b>WAVETEK</b> SAN DIEGO, CALIFORNIA
MATERIAL:	CHECKED		
FINISH WAVETEK PROCESS	PROJ ENGR	RELEASE APPROV	TITLE SCHEMATIC FUNCTION GENERATOR
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		SIZE PEGM NO. D 23338
	SCALE 1:100	MODEL 1285	DWG. NO. 0103-00-3004
			REV 1
			SHEET 3 OF 7

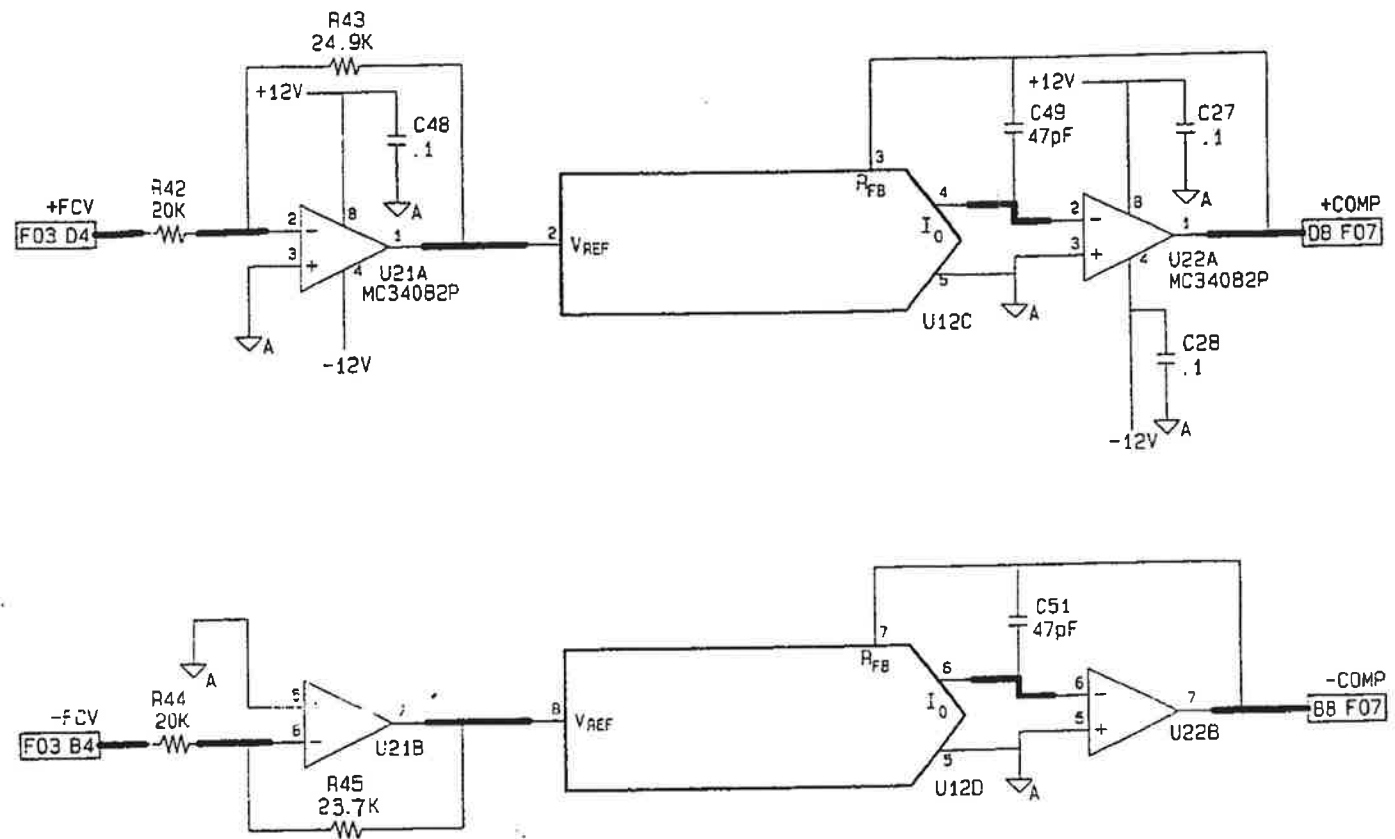
0103-00-3004 E

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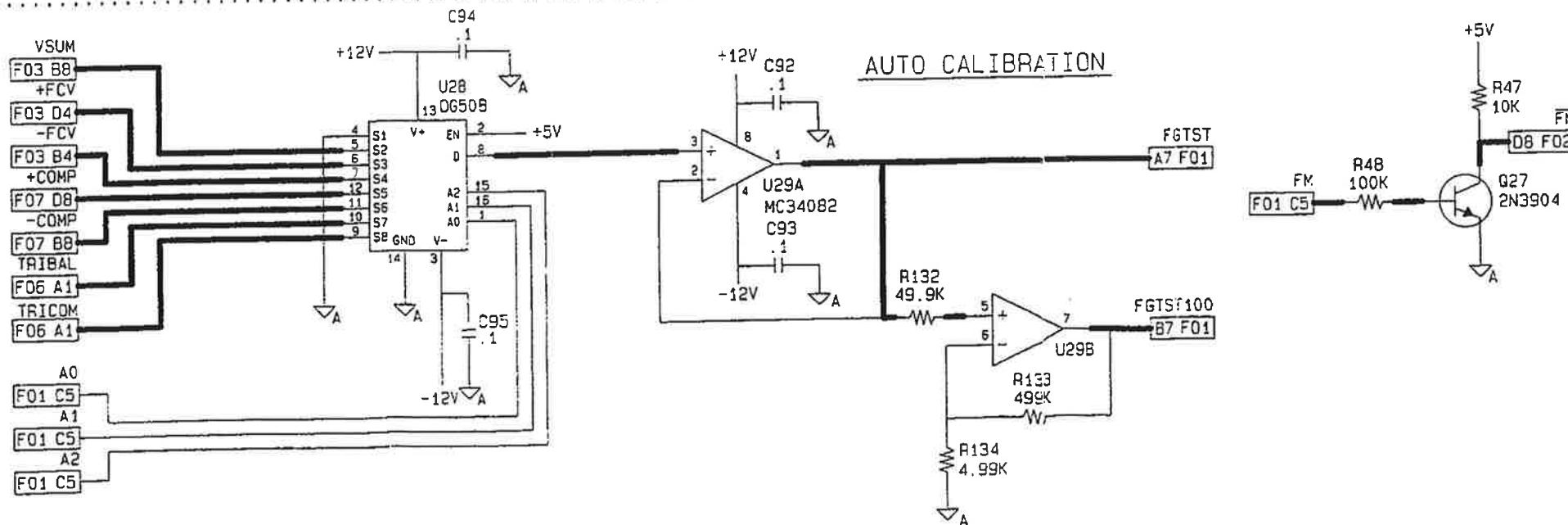
### TRIGGER BASELINE COMPENSATION



### HIGH FREQUENCY COMPENSATION



### AUTO CALIBRATION

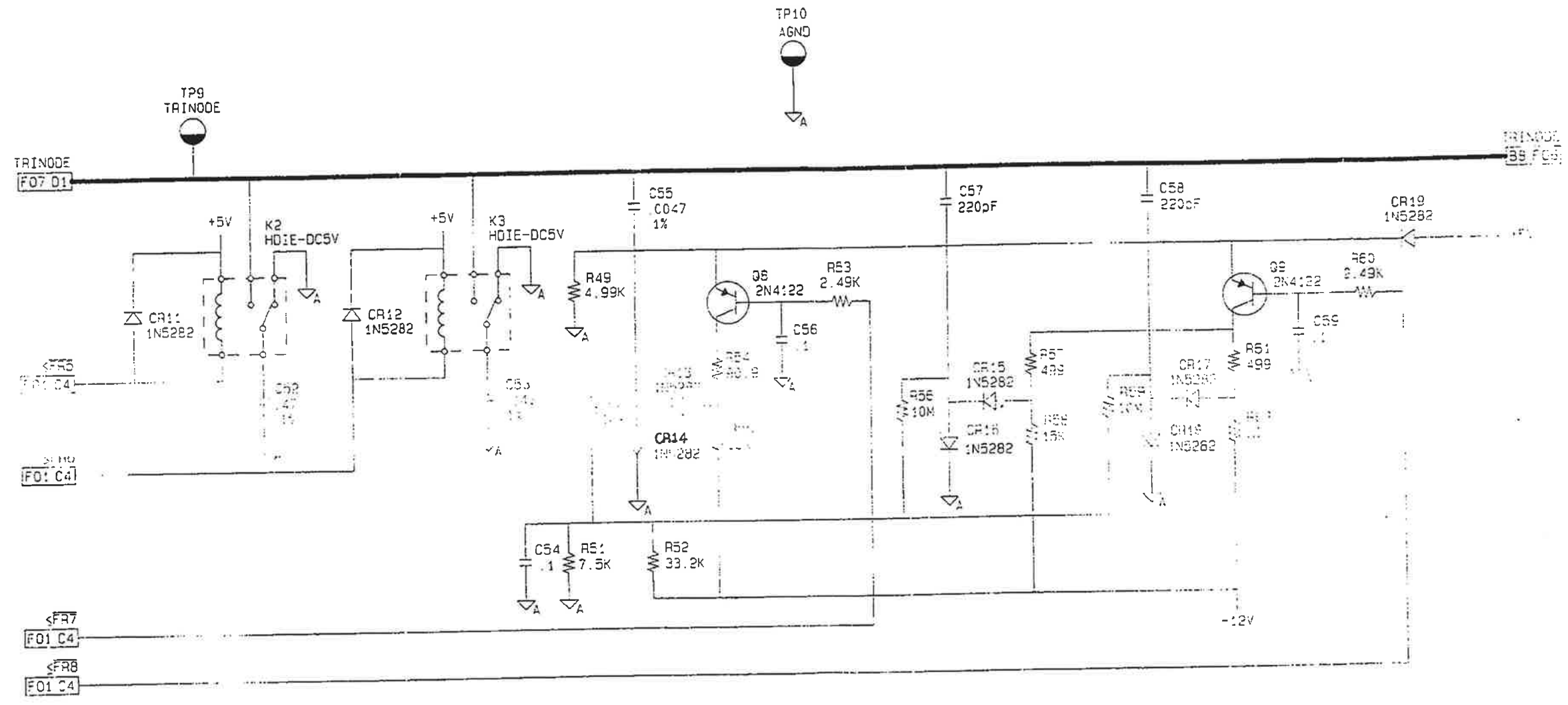


NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINGSLEY	DATE 1-18-80	<b>WAVETEK</b> SAN DIEGO - CALIFORNIA
MATERIAL	CHECKED		
FINISH WAVETEK PROCESS	PROJ. ENGR.		TITLE <b>SCHEMATIC FUNCTION GENERATOR</b>
DO NOT SCALE DRAWING	RELEASE APPROV.		SIZE PCHM NO. <b>D 23338</b> DWG. NO. <b>0103-00-3004</b> REV <b>E</b>
	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES		SCALE NONE MODEL 1288 SHEET 4 OF 7

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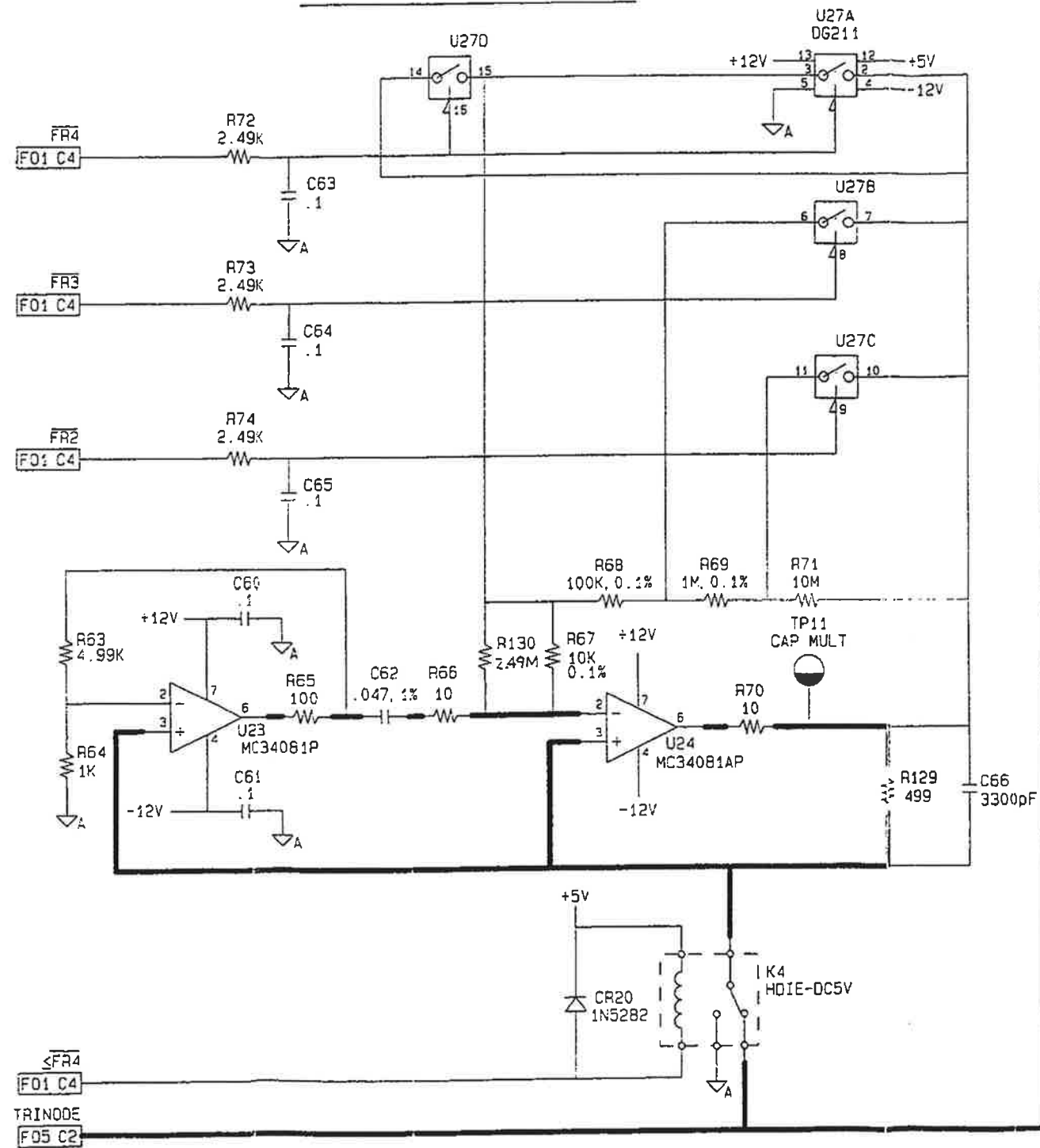
### FREQUENCY RANGE SWITCHES



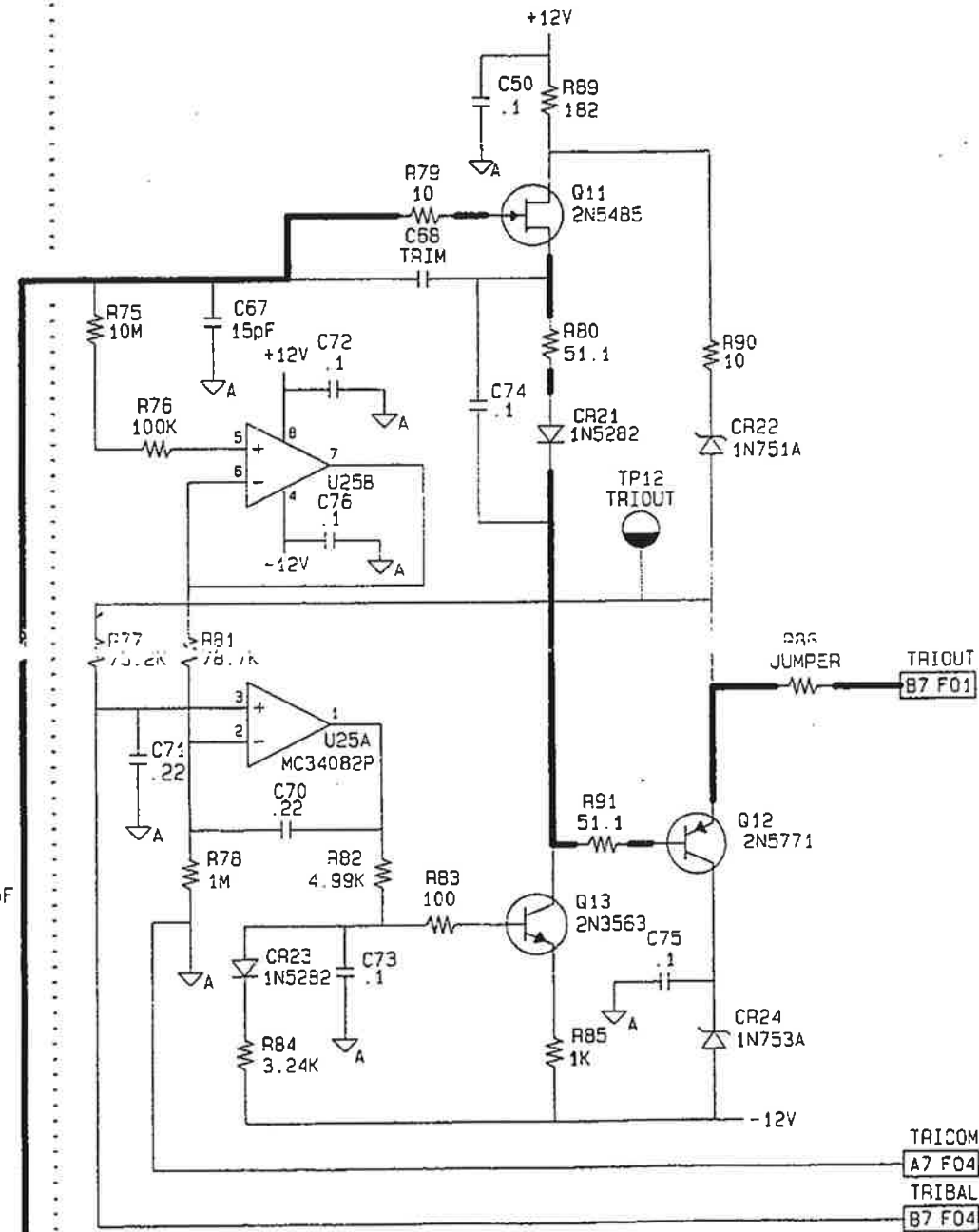
REMOVE ALL BURRS AND BREAK SHARP EDGES		DATE	REV	<b>WAVETEK</b>
MATERIAL	FINISH			
FINISH		DIMENSIONS ARE IN INCHES		SYNTHETIC OSCILLATION GENERATOR
TOLERANCES ARE		TOLERANCES ARE		
DO NOT SCALE DRAWING	SCALE NONE	MODEL 23338	SWT 5	

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### CAPACITANCE MULTIPLIER



### TRIANGLE BUFFER



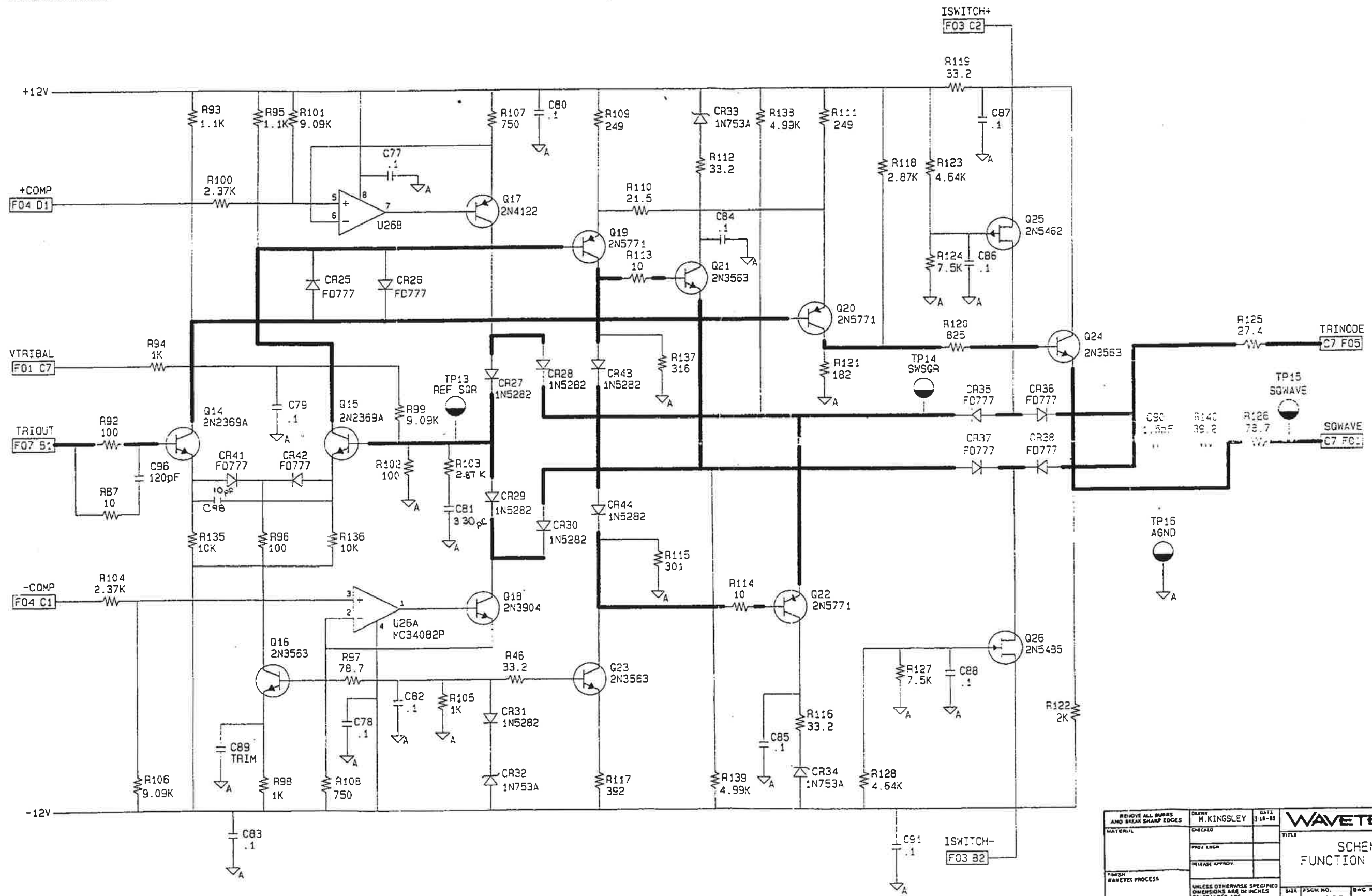
NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN M. KINRSLEY	DATE 2-18-80	<b>WAVETEK</b> 14000 W. CENTER RD. IRVING, TEXAS 75039
MATERIAL CHECKED	PROJ. ENGR.	RELEASE APPROV.	
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES		
DO NOT SCALE DRAWING	SCALE 2:1	MODEL 0103-00-3004	TITLE <b>SCHEMATIC FUNCTION GENERATOR</b> SIZE <b>D</b> PCHM NO. <b>23338</b> DWG NO. <b>0103-00-3004</b> REV. <b>E</b> SCALE 2:1 MODEL 0103-00-3004 SHEET 6 OF 7



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REV ECO BY DATE APP



NOTE: UNLESS OTHERWISE SPECIFIED

REMOVE ALL BURRS AND BREAK SHARP EDGES		DRAWN H. KINGSLEY	DATE 3-18-88	<b>WAVETEK</b>	
MATERIAL	CHECKED	PROJ ENGR	RELEASE APPROV	TITLE SCHEMATIC FUNCTION GENERATOR	
FINISH WAVETEK PROCESS		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		SIZE D	PSCH NO. 23338
DO NOT SCALE DRAWING		SCALE N/11L		MODEL 1298	SHEET 7 OF 7

IF REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
NONE	SCHEMATIC, FUNCTION GENERATOR	0103-00-3004	WVTK	0103-00-3004	1
NONE	PCA SUB ASSY, FUNCTION GEN BD 1288/288			1208-00-3004	1
C99	CAP, CER, 100PF, 100V, AXIAL	CAC02C09101J100A (085)	CORNG	1500-01-0106	1
2	PC BD EJECTOR	87-2-C	BRIT	2800-07-0032	2

<b>WAVETEK PARTS LIST</b>	TITLE ASSY, FUNCTION GENERATOR BD	ASSEMBLY NO. 1100-00-3004	REV J
PAGE 1			

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
CR1 CR24 CR32 CR33 CR34	SL ZR 6.2V 5% 400PW (1N733A)	2N733A	RDHM	131.9620	3
C98	CAP, CER, 10PF, 100V, AXIAL	CAC02C09100J100A	CORNG	1500-01-0006	1
C17	CAP, CER, 100PF, 100V, AXIAL	CAC02C09101J100A	CORNG	1500-01-0106	1
C1 C12 C13 C14 C15 C16 C18 C2 C20 C21 C22 C23 C25 C27 C28 C3 C31 C33 C37 C39 C40 C41 C42 C44 C45 C48 C50 C54 C56 C57 C60 C61 C63 C64 C65 C72 C73 C74 C75 C76 C77 C78 C79 C80 C82 C83 C84 C85 C86 C87 C88 C9 C91 C92 C93 C94 C95	CAP, CER, NON. 1MF, 50V, AXIAL	CAC03Z5U104Z050A	CORNG	1500-01-0405	57
C96	CAP, CER, 120PF, 100V, 5% AXIAL	CAC02C09121J100A	CORNG	1500-01-2104	1
C67	CAP, CER, 15PF, 100V, AXIAL	CAC02C09150J100A	CORNG	1500-01-5006	1
C90	CAP, CER, 1.5PF, 100V, AXIAL	CAC02C091R5J100A	CORNG	1500-01-3906	1
C29 C30 C32 C34	CAP, CER, 22PF, 100V, AXIAL	CAC02C09220J100A	CORNG	1500-02-2006	4
C57 C58	CAP, CER, 220PF, 100V, AXIAL	CAC02C09221J100A	CORNG	1500-02-2106	2

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, FUNCTION GEN BD 1288/288	ASSEMBLY NO. 1208-00-3004	REV A
PAGE 1			

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
J7	CONN. HEADER, 24 PIN, RECPY, 2X12, .1 CTR. PCMT	102583-7	AMP	2100-02-0255	1
J6	CONN. HEADER, 40 PIN, RECPY, 2X20, .1 CTR. PCMT	1-102583-2	AMP	2100-02-0256	1
TP1 TP10 TP16	TEST POINT, BLK, PC	TP-104-01-00	CORPO	2100-04-0034	3
TP11 TP12 TP13 TP14 TP15 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9	TEST POINT, RED, PC	TP-104-01-02	CORPO	2100-04-0035	13
FB1 FB2 FB3 FB4 FB5	BALLN CORE, FERRITE, 680 OHMS	2942666671	FARIT	2100-00-0017	5
K1 K2 K3 K4	RELAY, 1 FORMC, 5V, .312H, .296H	HD1E-M-DC3V	ARQHT	4500-00-0034	4
R23 R26 R30 R31 R32 R33 R67	RES, MF, 1/BW, 1% 10K	RN55E-1002B	MEPCO	4701-02-1002	7
R68	RES, MF, 1/BW, 1% 100K	RN55E-1003B	MEPCO	4701-02-1003	1
R69	RES, MF, 1/BW, 0.1% 1.0M	CMF-53-1004BT-9	DALE	4701-02-1004	1
R36 R37	RES, MF, 1/BW, 1% 1.5K	RN55E-1501B	CORNG	4701-02-1501	2
R102 R63 R83 R92 R96	RES, MF, 1/BW, 1% 100	RN55D-1000F	TRW	4701-03-1000	3
R105 R64 R85 R94 R98	RES, MF, 1/BW, 1% 1K	RN55D-1001F	TRW	4701-03-1001	3

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, FUNCTION GEN BD 1288/288	ASSEMBLY NO. 1208-00-3004	REV A
PAGE 3			

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C10 C70 C71	CAP, CER, .22MF, 25V	CH30C224K	CRL	1500-02-2409	3
C19 C81	CAP, CER, 330PF, 100V, AXIAL	CAC02C09331J100A	CORNG	1500-03-3106	2
C11 C66	CAP, CER, 3300PF, 100V, 5% AXIAL	CAC02X7R332M100A	CORNG	1500-03-3206	2
C33 C36 C49 C51	CAP, CER, 47PF, 100V, AXIAL	CAC02C09470J100A	CORNG	1500-04-7006	4
C55	CAP, CER, 4700PF, 50V, 2%	S92C094720090E	SPRAC	1500-04-7213	1
C24 C26	CAP, CER, 680PF, 100V, AXIAL	CAC02C09681J100A	CORNG	1500-06-8106	2
C6 C8	CAP, ELECT, 100MF, 33V RADIAL LEAD, 6P .20	NRE101M33V8K11	NIC	1500-31-0102	2
C4 C5 C7	CAP, ELECT, 100MF, 25V, RADIAL LEAD-6P SIZE	NRE101M25V6.3K11	NIC	1500-31-0122	3
C38 C43	CAP, ELECT, 22MF, 25V, RADIAL	SRA23V822RM6X7LL	UNCON	1500-32-2002	2
C53 C62	CAP, MYLR, .047HF, 50V	C3R473F	ELPAC	1500-44-7303	2
C52	CAP, MYLR, .47HF, 50V	C3R474F	ELPAC	1500-44-7403	1
1	PCB, FUNCTION GENERATOR BD	1700-00-3004	WVTK	1700-00-3004	1

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, FUNCTION GEN BD 1288/288	ASSEMBLY NO. 1208-00-3004	REV A
PAGE 2			

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R135 R136 R28 R3 R23 R47 R5	RES, MF, 1/BW, 1% 10K	RN55D-1002F	TRW	4701-03-1002	7
R11 R12 R131 R48 R76	RES, MF, 1/BW, 1% 100K	RN55D-1003F	TRW	4701-03-1003	3
R78	RES, MF, 1/BW, 1% 1M	RN55D-1004F	TRW	4701-03-1004	1
R21 R23 R50 R56 R59 R71 R73	RES, MF, 1/BW, 10M	9035YD10M000F	MEPCO	4701-03-1005	7
R113 R114 R29 R34 R66 R70 R79 R87 R90	RES, MF, 1/BW, 1% 10	9043ED10R100F	MEPCO	4701-03-1009	9
R93 R95	RES, MF, 1/BW, 1% 1.1K	RN55D-1101F	TRW	4701-03-1101	2
R141	RES, MF, 1/BW, 1% 11K	RN55D-1102F	TRW	4701-03-1102	1
R33 R58 R62	RES, MF, 1/BW, 1% 15K	RN55D-1502F	TRW	4701-03-1502	3
R121 R89	RES, MF, 1/BW, 1% 182	RN55D-1820F	TRW	4701-03-1820	2
R122	RES, MF, 1/BW, 1% 2K	RN55D-2001F	TRW	4701-03-2001	1
R42 R44	RES, MF, 1/BW, 1% 20K	RN55D-2002F	TRW	4701-03-2002	2
R110	RES, MF, 1/BW, 1% 21.5	RN55D-21R5F	TRW	4701-03-2159	1
R100 R104	RES, MF, 1/BW, 1% 2.37K	RN55D-2371F	TRW	4701-03-2371	2
R45	RES, MF, 1/BW, 1% 23.7K	RN55D-2372F	TRW	4701-03-2372	1
R109 R111	RES, MF, 1/BW, 1% 249	RN55D-2490F	TRW	4701-03-2490	2
R1 R13 R2 R33 R6 R60 R7 R72 R73 R74	RES, MF, 1/BW, 1% 2.49K	RN55D-2491F	TRW	4701-03-2491	10

<b>WAVETEK PARTS LIST</b>	TITLE PCA SUB ASSY, FUNCTION GEN BD 1288/288	ASSEMBLY NO. 1208-00-3004	REV A
PAGE 4			

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> SUN REDD - CALIFORNIA								
MATERIAL	CHECKED										
FINISH	PROJ. ENGR										
WAVETEK PROCESS	RELEASE APPROV.										
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE FRACTIONS DECIMALS ANGLES		<table border="1"> <tr> <td>SIZE</td> <td>DSCM NO.</td> <td>DWG NO.</td> <td>REV</td> </tr> <tr> <td>D</td> <td>23338</td> <td>1100-00-3004</td> <td>J</td> </tr> </table>	SIZE	DSCM NO.	DWG NO.	REV	D	23338	1100-00-3004	J
SIZE	DSCM NO.	DWG NO.	REV								
D	23338	1100-00-3004	J								
	SCALE	MOOD	288								
		SHEET	1 OF 2								

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REV ECO BY DATE APP

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
R43	RES. MF. 1/BW. 1%. 24. 9K	RN55D-2492F	TRW	4701-03-2492	1
R130 R22 R24	RES. MFLM. 1/BW. 2. 49M. 1 X	CHF-552494F T-8	DALE	4701-03-2494	3
R125	RES. MF. 1/BW. 1%. 27. 4	RN55D-274F	TRW	4701-03-2749	1
R103 R118	RES. MF. 1/BW. 1%. 2. 87K	RN55D-2871F	TRW	4701-03-2871	2
R115	RES. MF. 1/BW. 1%. 301	RN55D-3010F	TRW	4701-03-3010	1
R137	RES. MF. 1/BW. 1%. 314	RN55D-3160F	TRW	4701-03-3160	1
R84	RES. MF. 1/BW. 1%. 3. 24K	RN55D-3241F	TRW	4701-03-3241	1
R32	RES. MF. 1/BW. 1%. 33. 2K	RN55D-3322F	TRW	4701-03-3322	1
R112 R116 R119 R46	RES. MF. 1/BW. 1%. 33. 2	RN55D-3322F	TRW	4701-03-3329	4
R117	RES. MF. 1/BW. 1%. 392	RN55D-3920F	TRW	4701-03-3920	1
R140	RES. MF. 1/BW. 1%. 39. 2	RN55D-3922F	TRW	4701-03-3929	1
R10 R14 R9	RES. MF. 1/BW. 1%. 4. 02K	RN55D-4021F	TRW	4701-03-4021	3
R123 R128	RES. MF. 1/BW. 1%. 4. 64K	RN55D-4641F	TRW	4701-03-4641	2
R129 R18 R57 R61	RES. MF. 1/B. 1%. 499	RN55D-4990F	TRW	4701-03-4990	4
R124 R138 R139 R20 R27 R49 R63 R62	RES. MF. 1/BW. 1%. 4. 99K	RN55D-4991F	TRW	4701-03-4991	8

**WAVETEK PARTS LIST**

TITLE  
PCA SUB ASBY. FUNCTION GEN BD  
1288/288

ASSEMBLY NO. 1208-00-3004  
PAGE 5

REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
CR22	DIODE. ZENER. 3. 1V. 500PM. G/B. IN751A	1N751A	FAIR	4801-01-0751	1
CR11 CR12 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR2 CR20 CR21 CR23 CR27 CR28 CR29 CR3 CR30 CR31 CR39 CR40 CR43 CR44 CR6	DIODE. HIGH CONDUCTANCE. ULTRA FAST	1N5282	FAIR	4801-01-5282	24
CR25 CR26 CR35 CR36 CR37 CR38 CR41 CR42	DIODE. ULTRA FAST	FD777	FAIR	4807-02-0777	8
Q14 Q15	TRANS. SILICON. PLANAR. EPITAXIAL. NPN. TO-18	2N2369A	NOT	4901-02-2691	2
Q13 Q16 Q21 Q23 Q24	TRANS. NPN. TO-92	2N2563	FAIR	4901-03-5630	3
Q18 Q27	TRANS. 2N3904 NPN GENERAL PURPOSE TO-92	2N3904	FAIR	4901-03-9040	2
Q17 Q8 Q9	TRANS. GENERAL PURPOSE. PNP. TO-92	2N4122	NSC	4901-04-1220	3
Q23 Q3	TRANS. P-CHANNEL JFETS	2N5462	NOT	4901-05-4620	2
Q1 Q11 Q26	TRANS. N-CANNEL JFETS	2N5485	NOT	4901-05-4850	3
Q12 Q19 Q20 Q22	TRANS. 2N5771 PNP SWITCH TO-92	2N5771	NSC	4901-05-7710	4
Q4	TRANS. FET N CHANNEL	2N6060	SUPER	4902-01-0600	1

**WAVETEK PARTS LIST**

TITLE  
PCA SUB ASBY. FUNCTION GEN BD  
1288/288

ASSEMBLY NO. 1208-00-3004  
PAGE 7

REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
R132 R17	RES. MF. 1/BW. 1%. 49. 9K	RN55D-4992F	TRW	4701-03-4992	2
R133	RES. MF. 1/BW. 1%. 499K	RN55D-4993F	TRW	4701-03-4993	1
R80 R91	RES. MF. 1/BW. 1%. 51. 1	RN55D-51R1F	TRW	4701-03-5119	2
R19	RES. MF. 1/BW. 1%. 604	RN55D-6040F	TRW	4701-03-6040	1
R107 R108	RES. MF. 1/BW. 1%. 750	RN55D-7500F	TRW	4701-03-7500	2
R124 R127 R16 R31	RES. MF. 1/BW. 1%. 7. 5K	RN55D-7501F	TRW	4701-03-7501	4
R81	RES. MF. 1/BW. 1%. 78. 7K	RN55D-7872F	TRW	4701-03-7872	1
R126 R97	RES. MF. 1/BW. 1%. 78. 7	RN55D-7877F	TRW	4701-03-7879	2
R4	RES. MF. 1/BW. 1%. 8. 04K	RN55D-8061F	TRW	4701-03-8061	1
R120	RES. MF. 1/BW. 1%. 825	RN55D-8250F	TRW	4701-03-8250	1
R101 R106 R15 R99	RES. MF. 1/BW. 1%. 9. 09K	RN55D-9091F	TRW	4701-03-9091	4
R54	RES. MF. 1/BW. 1%. 90. 9	RN55D-9099F	TRW	4701-03-9099	1
R84	RES. 0 OHM JUMPER	JF02T680	ROHM	4799-00-0087	1
R77 R8	RES. MFLM. 1/BW. 1%. 73. 2 K	D033RE7322F	MEPCO	4799-00-0234	2
CR4 CR5	DIODE. ZENER. 3. 3V. 5% TOL. 500PM. G/B. IN746A	1N746A	FAIR	4801-01-0746	2

**WAVETEK PARTS LIST**

TITLE  
PCA SUB ASBY. FUNCTION GEN BD  
1288/288

ASSEMBLY NO. 1208-00-3004  
PAGE 6

REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	DR10-MFOR-PART-NO	MFOR	WAVETEX NO.	QTY/PT
Q2	TRANS. FET P CHANNEL	VF0106N3	SUPER	4902-01-0601	1
U28	MUX. CMOS. D AC. 8 CHAN/DUAL. 4 CHAN ANAL.	DC308ACJ	SLCON	7000-03-0800	1
U13 U14 U17 U18	OP AMP. LOW DRIFT. LOW OFFSET	LT1001CNB	LINTE	7000-10-0180	4
U12 U7	DAC. QUAD 8 BIT. MULT W/HEM. CMOS	DAC84080P	PHI	7000-84-0800	2
U10 U15 U16 U23 U9	OP AMP. HI SLEW RTE. WIDEBND. JFET. STD	MC34081P	NOT	7003-40-8100	5
U24 U5 U8	OP AMP. HI SLEW RTE. WIDEBND. JFET. PRIM E	MC34081AP	NOT	7003-40-8101	3
U11 U21 U22 U25 U26 U29 U6	OP AMP. HI SLEW RTE. WIDEBND. JFET DUAL	MC34082P	NOT	7003-40-8200	7
U27 U4	SM. QUAD ANALOG. CMOS	DC211CJ	SLCON	8000-02-1100	2
U1	DECODER/DEMUX. 3 TO 8 LINE	SN74ALS138N	TI	8007-41-3800	1
U2 U3	FLIP-FLOP. OCTAL D	SN74ALS574N	TI	8007-45-7450	2

**WAVETEK PARTS LIST**

TITLE  
PCA SUB ASBY. FUNCTION GEN BD  
1288/288

ASSEMBLY NO. 1208-00-3004  
PAGE 8

REV A

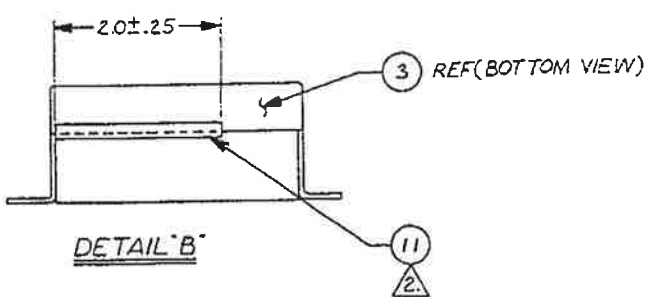
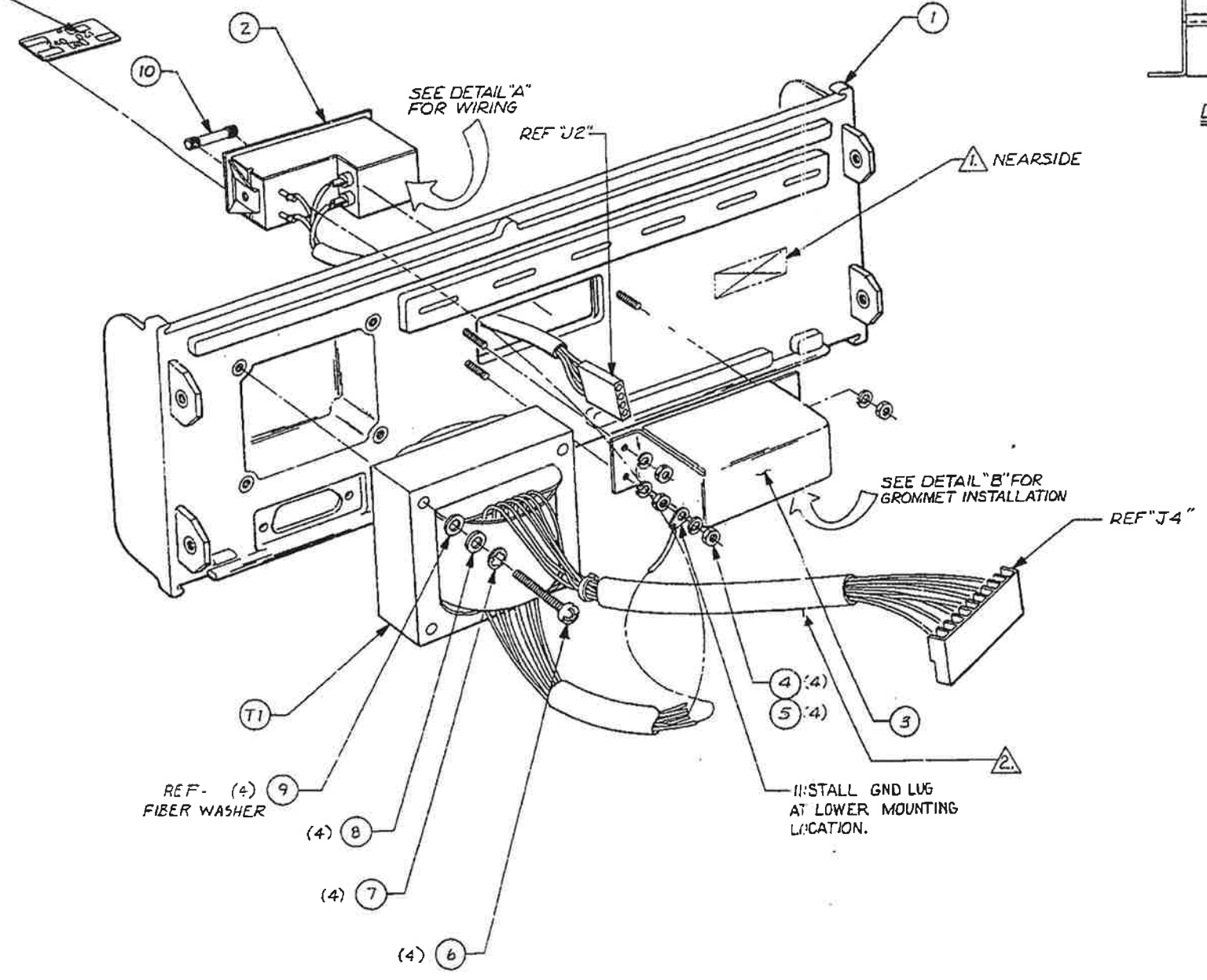
RE-ONE ALL BURNS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b>		
MATERIAL	CHECKED	PROJ ENGR	TITLE <b>PARTS LIST</b> <b>FUNCTION GENERATOR BOARD</b>		
FINISH WAVETEK PROCESS	RELEASE APPROV	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES FRACTIONS DECIMALS ANGLES	SIZE <b>D 23338</b>	DWG. NO. <b>1100-00-3004</b>	REV <b>J</b>
DO NOT SCALE DRAWING	SCALE	MOOD. <b>288</b>	SHEET <b>2</b> OF <b>2</b>		

NOTE: UNLESS OTHERWISE SPECIFIED

BE REPRODUCED FOR ANY REASON EXCEPT CALIBRATION, OPERATION, AND MAINTENANCE WITHOUT WRITTEN AUTHORIZATION

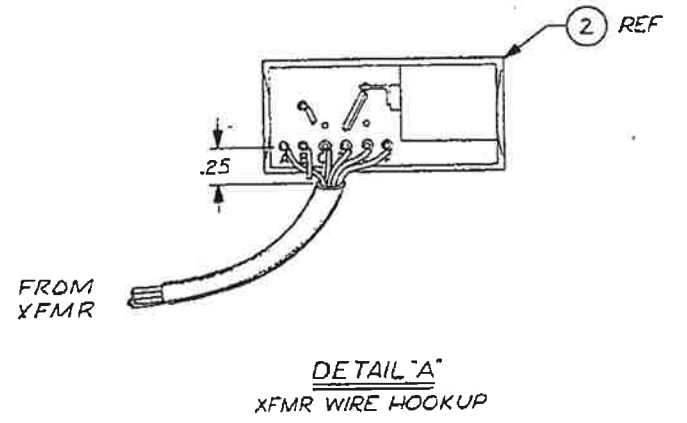
02	ECL # 000B	MG	2/28/81	1/21
03	ECL # 0021	MC	2/22/81	1/21
04	ECL # 0027	SC	3-16-81	1/21
06	ECL # 0037	SC	3-16-81	1/21
A	RELEASE ONLY NO CHANGE ERO # 9703	Y.C.	4/3/81	1/21
B	ELO # 9845	M.S.	1/5/81	1/21

NOTE ORIENTATION, "120" IS TO BE VISIBLE THRU WINDOW OF A.C. LINE FILTER, REF ITEM NO.2



WIRE LIST

XFMR WIRE COLOR	LINE FILTER TERM. MARKING
VIOLET	A
BLACK	C
GRAY	D
WHT/BLK	E
WHT/GRAY	F



INSTALL GROMMET 3200-06-0079 (LESIG PART 924) OR 3200-06-0053 (MINOR RUBBER PART NO. ZX-4064) OR EQUIV. TO SHIELD (ITEM 3) WITH ADHESIVE 1600-03-0013 (LOCTITE PART NO. 44) OR EQUIV.

MARK ASSEMBLY NO. "1101-00-3007", LATEST REV, FSCM 2333B, PER-MIL-STD-130, APPROX WHERE SHOWN.

NOTE UNLESS OTHERWISE SPECIFIED

SEE SEPARATE PARTS LIST

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN CHERMACK	DATE 11-11-87	WAVETEK SAN DIEGO, CALIFORNIA	
MATERIAL	CHECKED M. G. G. G.	2-17-88	TITLE ASSEMBLY, REAR PANEL	
FINISH WAVETEK PROCESS	PROJ. ENGR. M. G. G. G.	2-17-88	SCALE D	REV B
DO NOT SCALE DRAWING	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .005 .005 .005	32 ± .005	SCALE NONE	MODEL 1288
			23338	1101-00-3007
			1101-00-3007	SHEET 1 OF 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFCR-PART-NO	MFCR	WAVETEK NO.	QTY/PT
T1	TRANSFORMER ASSEMBLY	1204-00-3009	MVTK	1204-00-3009	1
2	CABLE ASSY, LINE FILTER	1207-00-3011	MVTK	1207-00-3011	1
1	PANEL, REAR, PAINTED	1400-02-3242	MVTK	1400-02-3242	1
3	SHIELD, AC CONN	1400-02-3463	MVTK	1400-02-3463	1
10	FUSE, 3/4A, 250V, S-8	313-750	LITFU	2400-05-0011	1
4	NUT, HEX, 4-40	MS35649-244	COHL	2900-14-4100	4
9	WASHER, #8 FIBER BIN 470	#8 FIBER WASHER	CHRCL	2900-28-8000	4
5	WASHER, LOCK REC. S/S #4	MS 35338-135	CHRCL	2900-45-4000	4
8	WASHER, #8, FLT, SS, THK .050, ID .174, OD .375	2900-46-8000	CHRCL	2900-46-8000	4
6	SCREW, #32 X 1 3/8, UNC2A, PHLP, PH, SS	2900-48-8126	CHRCL	2900-48-8126	4
7	WASHER, #8, INT TOOTH, LOCK, SS	2900-56-0002	CHRCL	2900-56-0002	4
11	EXTRU, RUBBER, U CHNL, 1/16 INSIDE, 1/8 OUTSIDE	924	LESIG	3200-06-0079	2
<b>WAVETEK PARTS LIST</b>		TITLE ASSY, REAR PANEL	ASSEMBLY NO. 1101-00-3007	REV B	PAGE 1

REMOVE ALL BURRS AND BREAK SHARP EDGES	DRAWN	DATE	<b>WAVETEK</b> SAN DIEGO & CALIFORNIA		
MATERIAL	CHECKED		TITLE PARTS LIST REAR PANEL		
	PROJ ENGR		SIZE <b>D</b>	FSCM NO. <b>23338</b>	DWG NO. 1101-00-3007
	RELEASE APPROV		SCALE	MODEL <b>288</b>	REV SHEET 1 OF 1
FINISH WAVETEK PROCESS	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES XX ± XXX ±				



## APPENDIX A PERFORMANCE VERIFICATION FORM

Date \_\_\_\_\_

Technician \_\_\_\_\_

Serial No \_\_\_\_\_

### Frequency Ranges

	Measured value	Specified value
Step 3: CW		
20 MHz	_____ MHz	19.98 to 20.02 MHz
2 MHz	_____ MHz	1.998 to 2.002 MHz
200 kHz	_____ kHz	199.8 to 200.2 kHz
20 kHz	_____ kHz	19.98 to 20.02 kHz
2 kHz	_____ kHz	1.998 to 2.002 kHz
200 Hz	_____ Hz	199.8 to 200.2 Hz
 Step 4: FM		
20 MHz	_____ MHz	19.4 to 20.6 MHz
2 MHz	_____ MHz	1.94 to 2.06 MHz
200 kHz	_____ kHz	194 to 206 kHz
20 kHz	_____ kHz	19.4 to 20.6 kHz
2 kHz	_____ kHz	1.940 to 2.060 kHz
200 Hz	_____ Hz	194 to 206 Hz
20.00 Hz	_____ Hz	19.4 to 20.6 Hz
2.000 Hz	_____ Hz	1.94 to 20.6 Hz
200.0 mHz	_____ Hz	194 to 206 mHz
20.00 mHz	_____ mHz	19.4 to 20.6 mHz

### Frequency Resolution

	Measured value	Specified value
Step 3:		
1999 Hz	_____ Hz	1997.001 to 2000.999 Hz
1888 Hz	_____ Hz	1886.112 Hz to 1889.888 Hz
1777 Hz	_____ Hz	1775.223 Hz to 1778.777 Hz
1666 Hz	_____ Hz	1664.334 Hz to 1667.666 Hz
1555 Hz	_____ Hz	1553.445 Hz to 1556.555 Hz
1444 Hz	_____ Hz	1442.556 Hz to 1445.444 Hz
1333 Hz	_____ Hz	1331.667 Hz to 1334.333 Hz
1222 Hz	_____ Hz	1220.778 Hz to 1223.222 Hz
1111 Hz	_____ Hz	1109.889 Hz to 1112.111 Hz
999 Hz	_____ Hz	998.001 Hz to 999.999 Hz
888 Hz	_____ Hz	887.112 Hz to 888.888 Hz
777 Hz	_____ Hz	776.223 Hz to 777.777 Hz
666 Hz	_____ Hz	665.334 Hz to 666.666 Hz
555 Hz	_____ Hz	554.445 Hz to 555.555 Hz
444 Hz	_____ Hz	443.556 Hz to 444.444 Hz
333 Hz	_____ Hz	332.667 Hz to 333.333 Hz
222 Hz	_____ Hz	221.778 Hz to 222.222 Hz

RECORDS OF THE  
FEDERAL BUREAU OF INVESTIGATION

DATE	DESCRIPTION	INITIALS
1944	...	...
1945	...	...
1946	...	...
1947	...	...
1948	...	...
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2011	...	...
2012	...	...
2013	...	...
2014	...	...
2015	...	...
2016	...	...
2017	...	...
2018	...	...
2019	...	...
2020	...	...
2021	...	...
2022	...	...
2023	...	...
2024	...	...
2025	...	...



### Symmetry

Step 3:

- 10% Symmetry
- 20% Symmetry
- 30% Symmetry
- 40% Symmetry
- 50% Symmetry
- 60% Symmetry
- 70% Symmetry
- 80% Symmetry
- 90% Symmetry

#### Measured value

\_\_\_\_\_  $\mu$ s  
 \_\_\_\_\_  $\mu$ s  
 \_\_\_\_\_  $\mu$ s  
 \_\_\_\_\_  $\mu$ s  
 \_\_\_\_\_  $\mu$ s  
 \_\_\_\_\_  $\mu$ s  
 \_\_\_\_\_  $\mu$ s  
 \_\_\_\_\_  $\mu$ s  
 \_\_\_\_\_  $\mu$ s

#### Specified value

98 to 102  $\mu$ s  
 196 to 204  $\mu$ s  
 294 to 306  $\mu$ s  
 392 to 408  $\mu$ s  
 490 to 510  $\mu$ s  
 588 to 612  $\mu$ s  
 686 to 714  $\mu$ s  
 714 to 816  $\mu$ s  
 812 to 918  $\mu$ s

### VCF/FM

Step 3:

Center Frequency

Step 4:

Deviation Frequency

#### Measured value

\_\_\_\_\_ kHz  
 \_\_\_\_\_ kHz

#### Specified value

970 to 1030 Hz  
 1900 to 2100 Hz

### Waveforms and Sweep

Step 3:

- Sine Wave
- Triangle Wave
- Square Wave
- DC

Step 4:

Swept Output

Step 5:

Sweep Ramp

#### Measured value

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

#### Specified value

Record: Yes or No  
 Record: Yes or No  
 Record: Yes or No  
 Record: Yes or No  
 Record: Yes or No  
 Record: Yes or No

### Pulse

Step 3

- Unbal rise time
- Unbal fall time
- Unbal +p-p aberration
- Unbal -p-p aberration

Step 4

- Sync Out rise time
- Sync Out fall time

#### Measured value

\_\_\_\_\_ ns  
 \_\_\_\_\_ ns  
 \_\_\_\_\_ %  
 \_\_\_\_\_ %  
 \_\_\_\_\_ ns  
 \_\_\_\_\_ ns

#### Specified value

< 13 ns  
 < 13 ns  
 < 5% +20 mV  
 < 5% +20 mV  
 < 13 ns  
 < 13 ns

### Outputs

Step 3: Unbal 5Vp-p Sine

50 $\Omega$

75 $\Omega$

600 $\Omega$

Step 4: Bal 5Vp-p Sine

135 $\Omega$  Bal 180 $^\circ$

600 $\Omega$  Bal 180 $^\circ$

#### Measured value

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

#### Specified value

Record: Yes or No  
 Record: Yes or No  
 Record: Yes or No  
 Record: Yes or No  
 Record: Yes or No  
 Record: Yes or No



### Amplitude Modulation

Step 3:

50% AM

Measured value

\_\_\_\_\_

Specified value

Record: Yes or No

### Sine Wave Purity

Step 3

THD at 1 kHz

Measured value

\_\_\_\_\_ dB

Specified value

$\leq -46$  dB (0.5%)

### Amplitude Accuracy

Step 3

1.11 Vp-p Sine

2.22 Vp-p Sine

3.33 Vp-p Sine

4.44 Vp-p Sine

5.55 Vp-p Sine

6.66 Vp-p Sine

7.77 Vp-p Sine

8.88 Vp-p Sine

9.99 Vp-p Sine

15.0 Vp-p Sine

Measured value

\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms

Specified value

0.3806 to 0.4033 Vrms  
0.7658 to 0.8042 Vrms  
1.1499 to 1.2040 Vrms  
1.5351 to 1.6049 Vrms  
1.9192 to 2.0047 Vrms  
2.3044 to 2.4056 Vrms  
2.6885 to 2.8054 Vrms  
3.0737 to 3.2063 Vrms  
3.4578 to 3.6061 Vrms  
5.1934 to 5.4125 Vrms

Step 4

1.11 Vp-p Triangle

2.22 Vp-p Triangle

3.33 Vp-p Triangle

4.44 Vp-p Triangle

5.55 Vp-p Triangle

6.66 Vp-p Triangle

7.77 Vp-p Triangle

8.88 Vp-p Triangle

9.99 Vp-p Triangle

15.0 Vp-p Triangle

\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
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\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms

0.3074 to 0.3326 Vrms  
0.6187 to 0.6632 Vrms  
0.9291 to 0.9928 Vrms  
1.2405 to 1.3234 Vrms  
1.5509 to 1.6530 Vrms  
1.8623 to 1.9836 Vrms  
2.1727 to 2.3132 Vrms  
2.4831 to 2.6428 Vrms  
2.7944 to 2.9735 Vrms  
4.1971 to 4.4629 Vrms

Step 5

1.11 Vp-p Square

2.22 Vp-p Square

3.33 Vp-p Square

4.44 Vp-p Square

5.55 Vp-p Square

6.66 Vp-p Square

7.77 Vp-p Square

8.88 Vp-p Square

9.99 Vp-p Square

15.0 Vp-p Square

\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms  
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\_\_\_\_\_ Vrms  
\_\_\_\_\_ Vrms

0.5333 to 0.5766 Vrms  
1.0717 to 1.1483 Vrms  
1.6100 to 1.7199 Vrms  
2.1484 to 2.2916 Vrms  
2.6867 to 2.8632 Vrms  
3.2251 to 3.4349 Vrms  
3.7634 to 4.0065 Vrms  
4.3018 to 4.5782 Vrms  
4.8401 to 5.1498 Vrms  
7.2700 to 7.7300 Vrms

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### DC Output and Attenuator Accuracy

Step 3: Into 50Ω:

- 5.00 Vdc
- 2.50 Vdc
- 1.00 Vdc
- 500 mVdc
- 250 mVdc
- 100 mVdc
- 50 mVdc
- 25 mVdc
- 10 mVdc
- 5.0 mVdc
- 2.5 mVdc
- 1.0 mVdc

#### Measured value

\_\_\_\_\_ Vdc  
 \_\_\_\_\_ Vdc  
 \_\_\_\_\_ Vdc  
 \_\_\_\_\_ Vdc  
 \_\_\_\_\_ Vdc  
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 \_\_\_\_\_ Vdc

#### Specified value

4.9300 to 5.0700 Vdc  
 2.455 to 2.545 Vdc  
 0.970 to 1.030 Vdc  
 475.0 to 525.0 mVdc  
 242.5 to 257.5 mVdc  
 94.00 to 106.0 mVdc  
 44.50 to 55.50 mVdc  
 19.75 to 30.25 mVdc  
 4.90 to 15.10 mVdc  
 -0.050 to +10.05 mVdc  
 -2.525 to +7.525 mVdc  
 -4.010 to +6.010 mVdc

### External Lock

Step 3:

Internal Lock

Step 4:

External Lock—Source

External Lock—Unbal

Step 5

- 0° Phase
- +90° Phase
- +180° Phase
- 90° Phase
- 180° Phase

#### Measured value

\_\_\_\_\_ Hz  
 \_\_\_\_\_ Hz  
 \_\_\_\_\_ Hz  
 \_\_\_\_\_ °  
 \_\_\_\_\_ °  
 \_\_\_\_\_ °  
 \_\_\_\_\_ °  
 \_\_\_\_\_ °

#### Specified value

999 to 1001 Hz  
 959.5 to 1060.5 Hz  
 957.5 to 1061.5 Hz  
 -4° to +4°  
 +86° to +94°  
 +176° to +184°  
 -94° to -86°  
 -184° to -176°

### Front Panel

Step 1:

Display/Annunciators Operate

#### Measured value

\_\_\_\_\_

#### Specified value

Record: Yes or No





