

INSTRUCTION MANUAL
MODEL 2001
SWEEP/SIGNAL
GENERATOR

WAVETEK[®] INDIANA INC.

66 N. 1st AVENUE, P.O. BOX 190

BEECH GROVE, INDIANA 46107

317—783-3221

CONTENTS

SECTION 1 – GENERAL INFORMATION	
1.1 INTRODUCTION	1-1
1.2 SPECIFICATIONS	1-1
1.3 OPTIONS	1-4
1.4 ACCESSORIES	1-5
SECTION 2 – INSTALLATION	
2.1 MECHANICAL INSTALLATION	2-1
2.2 ELECTRICAL INSTALLATION	2-2
SECTION 3 – OPERATING INSTRUCTIONS	
3.1 INTRODUCTION	3-2
3.2 DESCRIPTION OF FRONT PANEL	3-2
3.3 DESCRIPTION OF REAR PANEL	3-4
3.4 TYPICAL OPERATING SET-UP	3-5
3.5 SPECIAL OPERATING NOTES	3-6
3.6 PROGRAMMING	3-7
SECTION 4 – CIRCUIT DESCRIPTION	
4.1 MECHANICAL ARRANGEMENT	4-3
4.2 SIMPLIFIED BLOCK DIAGRAM	4-3
4.3 POWER SUPPLY	4-4
4.4 SWEEP RATE (MODULE M1H)	4-4
4.5 SWEEP DRIVE (MODULE M2H)	4-6
4.6 SWEEP OSCILLATOR, BAND 1 (MODULE M9H)	4-6
4.7 OUTPUT AMPLIFIER, BAND 1 (MODULE M10H)	4-6
4.8 SWEEP OSCILLATOR, BANDS 2 & 3 (MODULE M19H)	4-7
4.9 MARKER ADDER (MODULE M5H)	4-8
4.10 MARKERS (MODULE M6's)	4-8
SECTION 5 – MAINTENANCE	
5.1 INTRODUCTION	5-1
5.2 SERVICE INFORMATION	5-1
5.3 PERFORMANCE CHECKS	5-3
5.4 MECHANICAL ADJUSTMENT OF FREQUENCY INDICATOR TAPES	5-7
5.5 CALIBRATION PROCEDURE	5-8
5.6 TROUBLESHOOTING	5-12
SECTION 6 – PARTS LISTS	
6.1 INTRODUCTION	6-1
6.2 MANUFACTURERS CODE	6-1
SECTION 7 – SCHEMATICS	
7.1 INTRODUCTION	7-1
7.2 SCHEMATIC NOTES	7-1
7.3 ABBREVIATION CODE	7-2
7.4 SCHEMATIC INDEX	7-2

1

SECTION

GENERAL INFORMATION

1.1 INTRODUCTION

The compact WAVETEK MODEL 2001 Sweep/Signal Generator offers programming, versatility and an exceptionally wide frequency range (1 to 1400 MHz) in a ruggedized inexpensive instrument. Its unique adaptability promotes sophisticated laboratory applications, as well as automatic production testing.

Each of its three frequency ranges (1-500 MHz, 450-950 MHz, and 900-1400 MHz) may be used in 3 modes of operation; start-stop, Δf or CW. It can be swept from end-to-end, up-or-down, at any rate from 50 sweeps per second to 1 sweep every 100 seconds. Manual, triggered, or recurring sweeps are provided and the sweep frequency, sweep width, and output attenuation all may be controlled by external voltages.

Up to six crystal controlled birdy marker modules (single frequency or harmonic type) may be plugged into the 2001. Each module has its own Front Panel On/Off switch. Front Panel amplitude and width controls enable optimum adjustment of the marker display. In application, the

markers may be tilted 90° for easy viewing when displayed with steep transition signals or rectified for X-Y plotter applications by a Front Panel switch. A 1kHz square wave modulator, providing 100% amplitude modulation of the RF output for low level recovery applications, is available as an optional feature.

Most optional features, as well as the functional circuits for the basic sweep generator, have modular plug-in construction. This allows optional features to be factory installed at the time of purchase, or customer installed at a later date. This concept offers protection against obsolescence since updated and additional features can be simply and economically added as new test procedures dictate.

Maintenance problems can be greatly simplified by stocking several modules instead of hundreds of discrete components. Servicing time of a defective instrument can be cut to a fraction of the time previously required and can be performed by relatively inexperienced technicians. Modules for the 2001 are stocked in Wavetek service centers around the world.

1.2 SPECIFICATIONS

Table 1-1. lists the specifications for MODEL 2001 Sweep/Signal Generator.

**TABLE 1-1.
SPECIFICATIONS**

<u>RF SPECIFICATIONS</u>	
Frequency Range —	1 to 1400 MHz in three overlapping bands
	Band 1 1 to 500 MHz
	Band 2 450 to 950 MHz
	Band 3 900 to 1400 MHz
Operating Modes —	Start/Stop, Δf , and CW

TABLE 1-1. Specifications (Con't.)

Frequency Dial Calibration —	10 MHz intervals	
Accuracy —	Band 1	10 MHz
	Band 2	2% of selected frequency
	Band 3	2% of selected frequency
Sweep Width —	200 kHz to 500 MHz-calibrated in 10 MHz intervals	
Accuracy —	Band 1	±10 MHz
	Band 2	±20 MHz
	Band 3	±20 MHz
Display Linearity —	2%	
Spurious Signals —	Band 1	10 to 500 MHz 26dB below output
	Band 2	500 to 950 MHz, 26dB below output
	Band 3	900 to 1400 MHz, 26dB below output
Residual FM —	Less than 15kHz	
Drift —	100 kHz/5 minutes — 2 MHz/8 hours (after 1/2 hour warm-up at a constant ambient, and allowing a 5 minute stabilizing period after a frequency change)	
Blanking —	Retrace blanking of the RF output provided for sweep operation. Removed for CW operation.	
RF Output Amplitude —	Continuously adjustable from +10 to -80 dBm; 70 dB in 10 dB steps, plus a 20 dB vernier, calibrated in 1 dB increments. Step attenuator and vernier attenuator accuracy:	
	±0.5 dB to 500 MHz	
	±1 dB to 1000 MHz	
	±2 dB to 1400 MHz	
Flatness at +10 dBm —	±0.5 dB over 1 to 1400 MHz (when read with negative detector) ±0.75 dB over 1 to 1400 MHz (when read with a power meter)	
Impedance —	50 ohms	

REMOTE PROGRAMMING

A Rear Panel REMOTE Jack provides necessary connections for Remote Control of frequency, sweep width and the 0 to 20 dB vernier output control. This jack also provides connections for EXTERNAL amplitude and frequency modulation.

Frequency — May be remotely programmed within the selected band by a ±16 V signal. (-16 volts corresponds to LOW frequency)

TABLE 1-1. Specifications (Con't.)

	band end and +16 volts to HIGH frequency band end) Tuning sensitivity: 16 MHz/volt (approx.)
Sweep Width —	May be controlled by a remote potentiometer. (Input and output connections provided in Rear Panel REMOTE jack)
Vernier 0-20 dB Output —	May be remotely programmed over a 20 dB range with a 0 to -18 volt signal. (-18 volts corresponds to a maximum output)
External FM —	Full deviation of ± 250 MHz possible at rates up to 4kHz. With reduced deviation and linearity, modulation rates to 100kHz are possible. Sensitivity: 16 MHz/volt (approx.)
External AM —	External AM signals are applied to same connections as for vernier 0-20 dB control. Therefore, vernier range must be restricted so the 0 to -18 volt range is not exceeded or distortion will occur. With average voltage set to mid-range, 100% modulation is possible to 1kHz, 40% modulation possible to a 40kHz rate.
<u>SWEEP SPECIFICATIONS</u>	
Sweep Modes —	Repetative sweep Single sweep Externally triggered sweep Manual sweep Line lock sweep
Sweep time —	Continuously variable from less than 10 ms to over 100 seconds, in 4-decade steps, plus vernier
Horizontal Output —	16 volts peak-to-peak (symmetrical about ground)
<u>EXTERNAL LEVELING</u>	
External Monitor (ALC) —	An external negative signal, between 0.2 and 2 volts, may be used to level the RF output
<u>MARKER SPECIFICATIONS</u>	
Type —	Birdy by-pass markers with provisions for six plug-in marker modules, plus Front Panel external marker input. Markers may be either single frequency or harmonic (comb.) type. (See Options A1 and A2)
Accuracy —	0.005%

TABLE 1-1. Specifications (Con't.)

External Market Input —	Front Panel BNC connector accepts external CW signal for conversion to a Birdy marker. Input level: 100 mV into 50 ohms
Marker Width —	Adjustable from (approx.) 15 to 400 kHz in four steps
Marker Size	
Large —	Adjustable from (approx.) 12 V to 15 mV peak-to-peak
Small —	Adjustable from (approx.) 50 mV to 100 uV peak-to-peak
Rectified Birdy (for use with X-Y plotters) —	Size varies with detector's impedance. Adjustable from (approx.) 6 V to 1 mV with detector impedance of 1 meg ohm, or from 0.5V to 1 mV with detector impedance of 0 ohms. Rectified birdy is positive polarity
Marker Tilt —	Provides horizontal markers have a size equal to approximately 10% of horizontal display. Adjustment of marker size vectorily adds the normal vertical marker to the horizontal marker, causing the resulting marker to vary from a horizontal position toward a vertical position.

POWER REQUIREMENTS

Line Supply 115 or 230 VAC $\pm 10\%$, 50 to 60 Hz, (approx 20 watts)

MECHANICAL SPECIFICATIONS (See Figure 1-1.)

- A For total length, including knobs,
add 11/16 inch
- B For total height, including feet,
add 5/8 inch
- C For total width, including screw
heads, add 3/16 inch

Weight

Net — 19 lbs.
Shipping — 25 lbs.

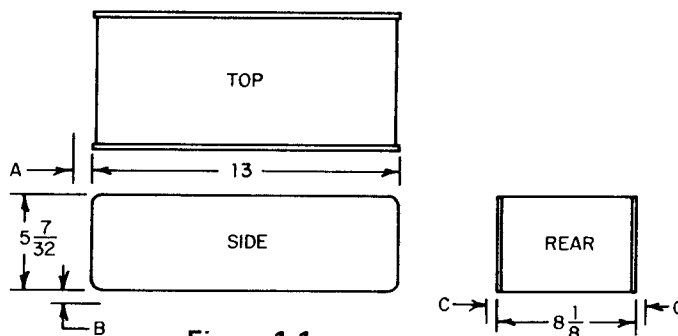


Figure 1-1.

1.3 OPTIONS

- 1.3.1 Marker A-1. Any single frequency between 1 to 1400 MHz.
- 1.3.2 Marker A-2. Harmonic type at 1, 10 or 50 MHz. (Other frequencies available on special order.)
- 1.3.3 Modulator A-4. Provides 100% amplitude modulation at a 1 kHz rate.
- 1.3.4 Perlift A-5. Provides contact closure during sweep time.

1.4 ACCESSORIES

1.4.1 Accessories furnished: Instruction manual and plug to mate with Rear Panel REMOTE jacks.

1.4.2 Accessories Available:

- a. Wide-band RF Detector — Model D-152.
- b. Service Kit — K102. Contains a module extender and extension cables.
- c. Rack Mount Kit — K103. Mounts single instruments in a 5-1/4 inch space. See Figure 2-1.
- d. Rack Mount Kit — K104. Mounts one or two instruments in a 7 inch space. See Figure 2-2.

SECTION 2

INSTALLATION

2.1 MECHANICAL INSTALLATION

2.1.1 Initial Inspection

After unpacking the instrument, visually inspect the external parts for damage to knobs, connectors, surface areas, etc. The shipping container and packing material should be saved in case it is necessary to reship the unit.

2.1.2 Damage Claims

If the instrument is received mechanically damaged in transit, notify the carrier and either the nearest Wavetek area representative or the factory in Indiana. Retain the shipping carton and packing material for the carrier's inspection.

The local representative, or the factory, will immediately arrange for either the replacement or repair of your instrument, without waiting for damage claim settlements.

2.1.3 Rack Mounting

The instrument is 1/2 rack size and two rack mounting kits are available. The K-103 kit provides the necessary hardware to mount the unit to either the right or left of a standard 5 1/4" x 19" opening. The K-104 kit provides

the necessary hardware to rack mount two instruments. These may be two 1000 or 2000 series Wavetek, Indiana Instruments, or two 130 or 140 series Wavetek, San Diego Instruments, or a combination of either. This provides a 7" x 19" package. Facilities are provided for Front Panel mounting of instrument Rear Panel connectors.

2.1.4 K-103, Rack Mounting Kit (Refer to Figure 2-1)

CONTENTS		
Item	Qty.	Part No.
A (Side)	1 ea.	B000-608
B (Side)	1 ea.	C000-691
C (Screw)	8 ea.	HS101-806

Procedure:

Remove the screws from one side panel at a time. Mount item A or B against the side panel of the instrument and secure with screws provided (item C). Repeat operation for other side. NOTE: Items A & B may be interchanged to position the unit to the side of the rack desired.

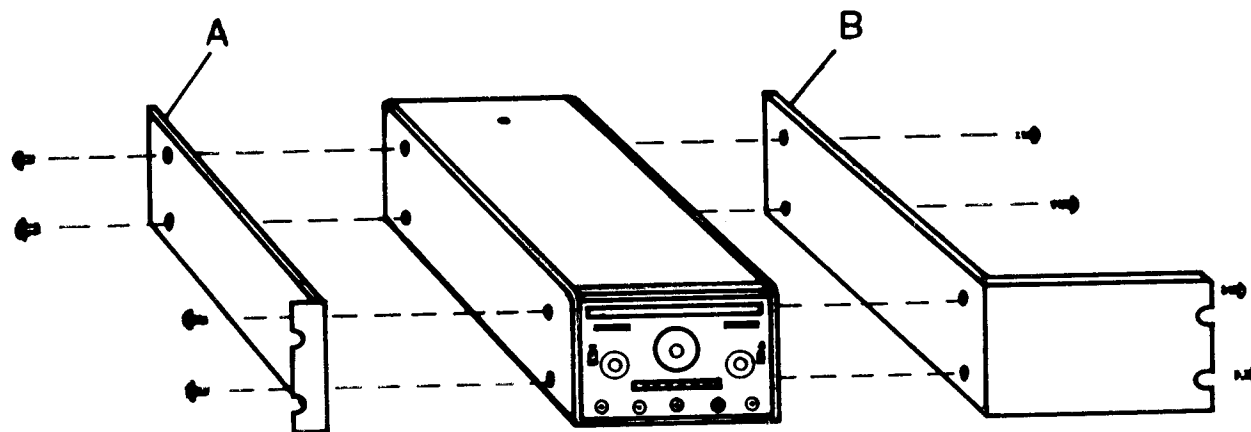


Figure 2-1. K-103 Rack Mounting

2.1.5 K-104 Rack Mounting Kit (Refer to Figure 2-2)

CONTENTS		
Item	Qty.	Part No.
A (Tray)	2 ea.	C000-729
B (Side)	2 ea.	A500-230
C (Screw)	12 ea.	HS106-905

Procedure:

Install both sides (item B) to one tray (item A) using 10-32 x 3/16" screws (item C). Position the instrument on the tray so that the feet extend into the provided holes. Holes are provided for all Wavetek, Indiana 1000 and 2000 series and for most Wavetek, San Diego 130, 140, and 700 series instruments. Other instruments not exceeding 5¼" x 8" may also be mounted by drilling additional holes for their feet.

When one or both instruments are properly seated, install the other "A" and secure with the remaining screws (item C).

NOTE: If the Wavetek instrument has been supplied with a bail, it must be removed before installing in the K-104 rack mounting kit.

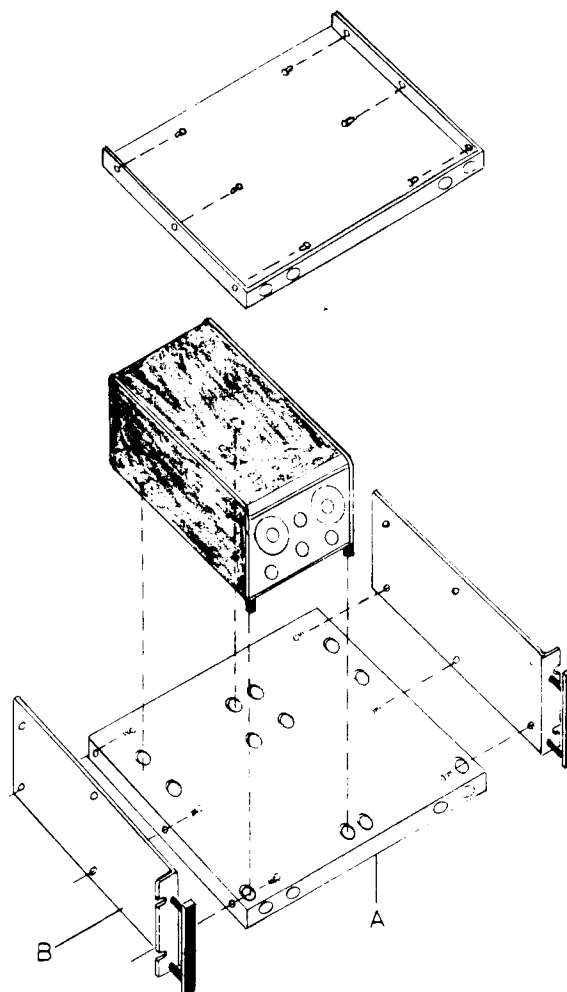


Figure 2-2. K-104 Rack Mounting

2.2 ELECTRICAL INSTALLATION

2.2.1 Primary Power Requirements

These instruments operate from either 115 volt AC or 230 volt AC supply mains as selected by a Slide Switch located on the Rear Panel. Before operating the instrument, check that the fuse mounted in the Rear Panel Fuse Holder corresponds to the correct value for the selected voltage; i.e., 0.5 amp for a 115 volt AC, and 0.25 amp for 230 volt AC.

The power supply has been designed to operate from either 50 or 60 Hz supply mains, however, the line operated sweep rate function must be adjusted to the line frequency.

Instruments are shipped from the factory for operation at 115 volt AC, 60 Hz unless specified for 230 volt AC or 50 Hz operation.

2.2.2 Performance Checks

The electrical performance of this instrument should be verified. Performance checks for incoming inspection are given in Section 5, Maintenance.

Model 2001

SECTION 3

OPERATING INSTRUCTIONS

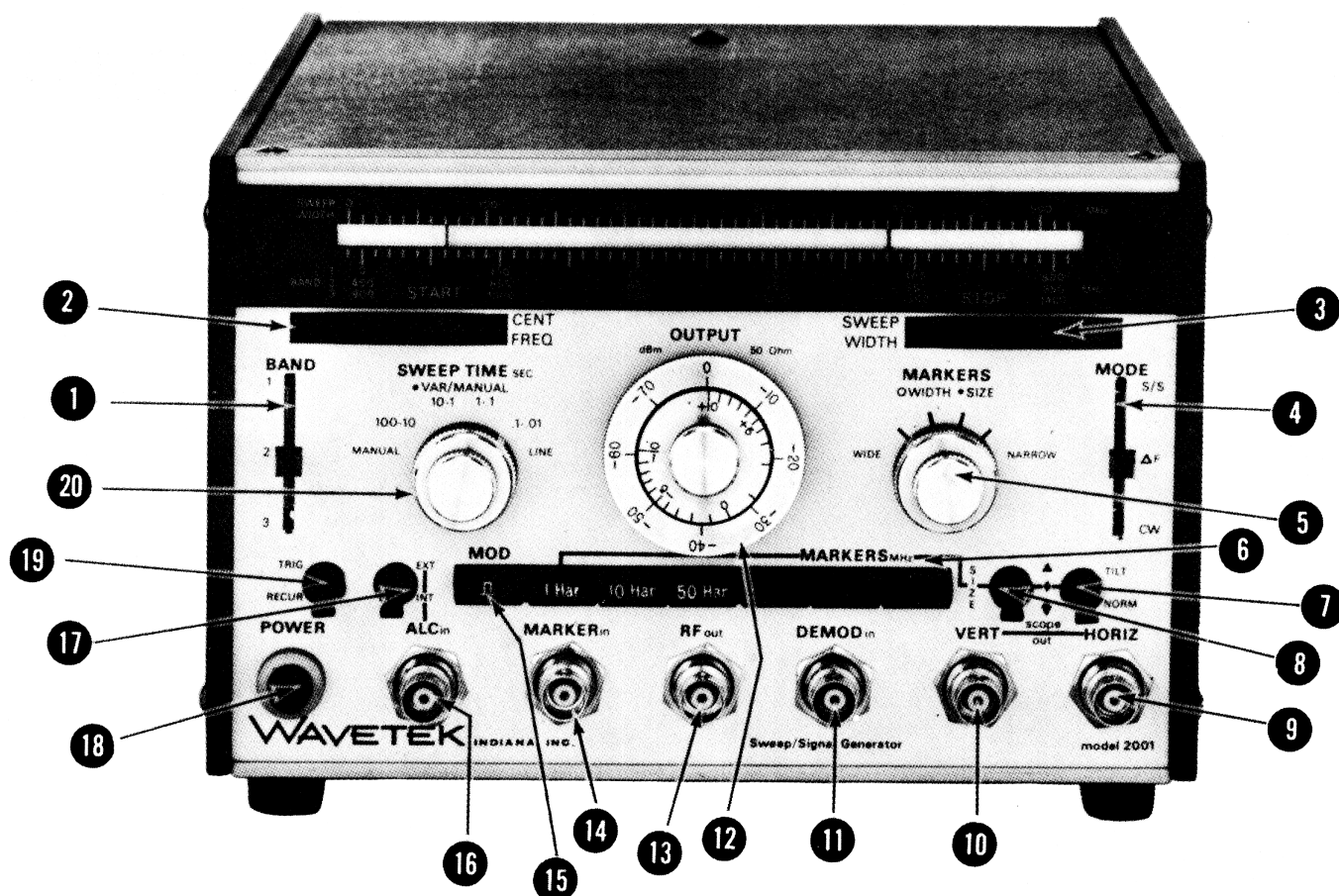


Figure 3-1. Front Panel

3.1 INTRODUCTION

This section provides complete functional control description, operating instructions, and programming instructions for the Model 2001 Sweep/Signal Generator.

In addition, special operating notes cover sweep rate errors, overloading, low level measurements and operation with networks analyzers and X-Y plotters.

3.2 DESCRIPTION OF FRONT PANEL (Refer to Figure 3-1 for control location)

- | | |
|----------------------|---|
| ① BAND Switch — | Selects desired band; 1 to 500 MHz, 450 to 950 MHz or 900 to 1400 MHz. |
| ② START/CENT FREQ. — | Controls Start Frequency when MODE Switch is set to S/S (Start/Stop) or Center Frequency when MODE Switch is set to Δf and C.W. |
| ③ STOP/SWEEP WIDTH — | Controls Stop Frequency when MODE Switch is set to S/S (Start/Stop) or controls Sweep Width when MODE Switch is set to Δf . |
| ④ MODE Switch — | Selects Start/Stop, Δf or continuous wave operation. |

- ⑤ MARKERS ϕ WIDTH • SIZE — Dual concentric control; outer knob adjusts marker width from 15 to 400 kHz in four steps; inner knob controls marker size.
- ⑥ MARKERS — Six push button switches control A1 and A2 Marker Options (Marker frequency is engraved on push button).
- ⑦ TILT/NORM Switch — Provides vertical markers in the NORM (down) position. In the TILT (up) position provides horizontal markers having a fixed amplitude of approximately 10% of the horizontal display, when MARKER SIZE is set to minimum.
NOTE: Increasing the marker size will cause the horizontal marker to tilt toward a vertical position. This feature is used to identify frequencies on Steep response skirts.
- ⑧ MARKER SIZE Switch — This three position switch provides; large markers in its Lower position (12 V to 50mV peak-to-peak), small markers in its Center position (50mV to 100uV volts peak-to-peak) and rectified positive markers in its Up position. These rectified markers are for use with X-Y recorders.
- ⑨ SCOPE HORIZ. Out — BNC connector provides a 16 volt peak-to-peak triangle wave, symmetrical about ground, to drive the Horizontal (x) axis of the oscilloscope or other indicating device. (An alternate connection is available at the Rear Panel).
- ⑩ SCOPE VERT. Out — BNC connector provides the combined markers and demodulated RF (when DEMOD in is connected) for connection to the oscilloscope Vertical (y) axis input.
- ⑪ DEMOD in — BNC connector accepts the demodulated, swept, signal from the device under test so RF markers may be added. (The combined signal is available at the SCOPE VERT. OUTPUT connector).
- ⑫ OUTPUT-dBm-50 ohm — Attenuator; Outer knob provides calibrated adjustment of the RF output in 10 dB increments from 0 dBm to -70 dBm; inner knob provides calibrated vernier adjustment of the RF output from +10 dBm to -10 dBm.
- ⑬ RF out — BNC connector provides a connection for RF output signal.
- ⑭ MARKER in — BNC connector accepts an externally generated continuous wave signal to produce a frequency marker on the display.
- ⑮ MOD — Push button switch for A4 option (1 kHz square wave amplitude modulation).
- ⑯ ALC in — BNC connector accepts an automatic leveling control signal from a remote monitor when EXT/INT switch is in the EXT (up) position.
- ⑰ EXT/INT Switch — Closes the internal automatic leveling loop when in INT (down) position.
NOTE: When this switch is in the EXT position, and no external monitor is in use, the RF output is unleveled and not controlled by the 20 dB vernier attenuator.
- ⑱ POWER — Push button applies A.C. power to the power supply. The light indicates that the instrument is operating.

①⑨ TRIG/RECUR Switch –

Selects recurring sweep of the time selected by SWEEP TIME Control when in RECUR (down) position and with MODE Switch in either S/S or ΔF . When TRIG/RECUR Switch is in the center position, the sweep may be triggered for single sweep operation by momentarily contacting the TRIG (up) position

②⑩ SWEEP TIME Sec.
VAR/MANUAL Control –

This is a six position Switch/Control. The outer knob provides selection of MANUAL, LINE or Four Decade Ranges of variable sweep time. The inner knob provides manual frequency sweeping when SWEEP TIME Sec. Switch is set to MANUAL, and variable adjustment of sweep time in each of the four decade ranges. (The sweep may be triggered in the four decade ranges only).

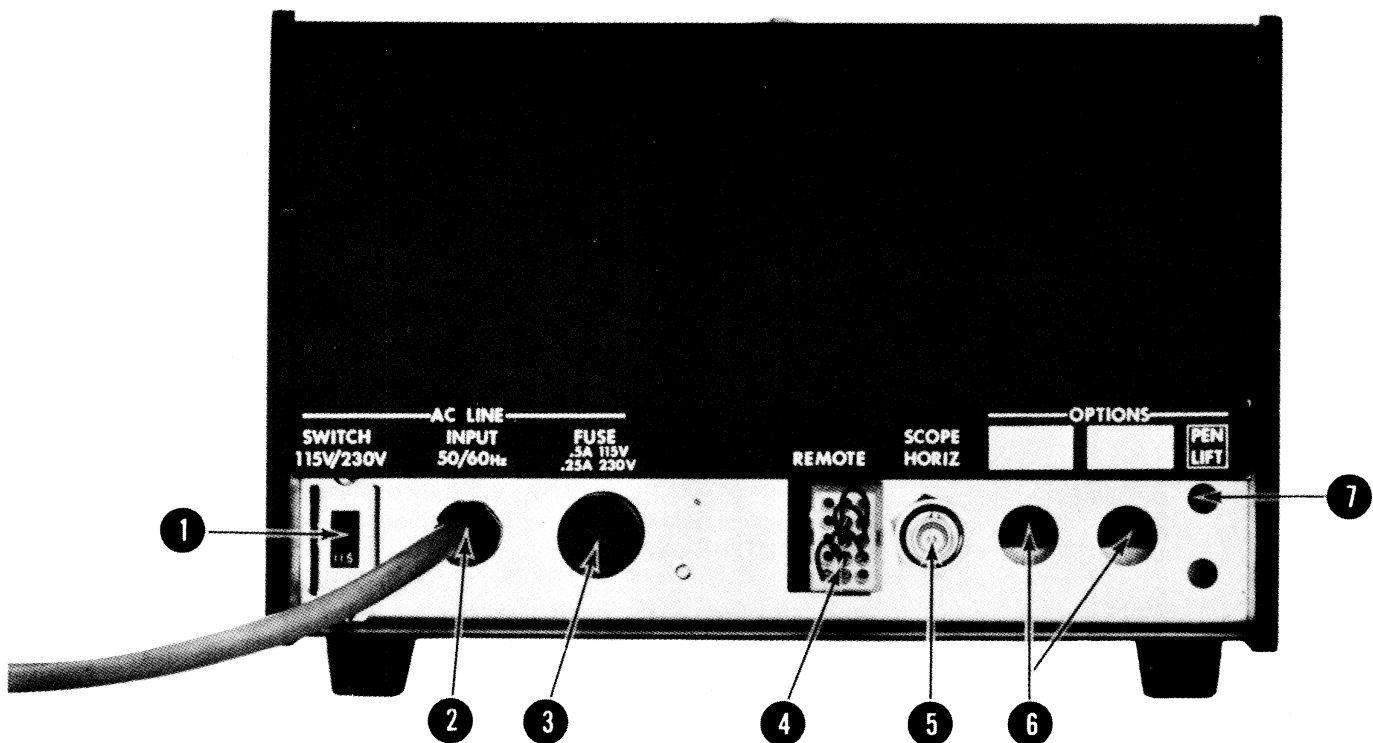


Figure 3-2. Rear Panel

3.3 DESCRIPTION OF REAR PANEL (Refer to Figure 3-2 for location)

① SWITCH 115/230V –

Selects 115 or 230 V line voltage.

② INPUT 50/60Hz –

3 prong AC plug provides connection to AC mains.

③ AC LINE FUSE –

0.5A for 115 V AC or 0.25A for 230 V AC.

④ REMOTE Jack –

Provides connection for programming of frequency, sweep width and RF output level. (See paragraph 3-6 for detailed instructions). This jack is supplied with a mating "jumped plug" which provides Front Panel control.

⑤ SCOPE HORIZ. Jack –

BNC jack provides connection to (X) axis of oscilloscope or plotter. This connector is in parallel with the SCOPE HORIZ. connector located on the Front Panel.

⑥ OPTIONS —

Provides mounting holes for BNC connectors used with special modifications or options.

⑦ PEN LIFT OPTION (A-5) —

When Pen Lift Option is installed, these 2 terminals provide contact closure during sweep "ON" time. This option operates only when the Front Panel SWEEP TIME Selector is set to the 100-10 SEC. position.

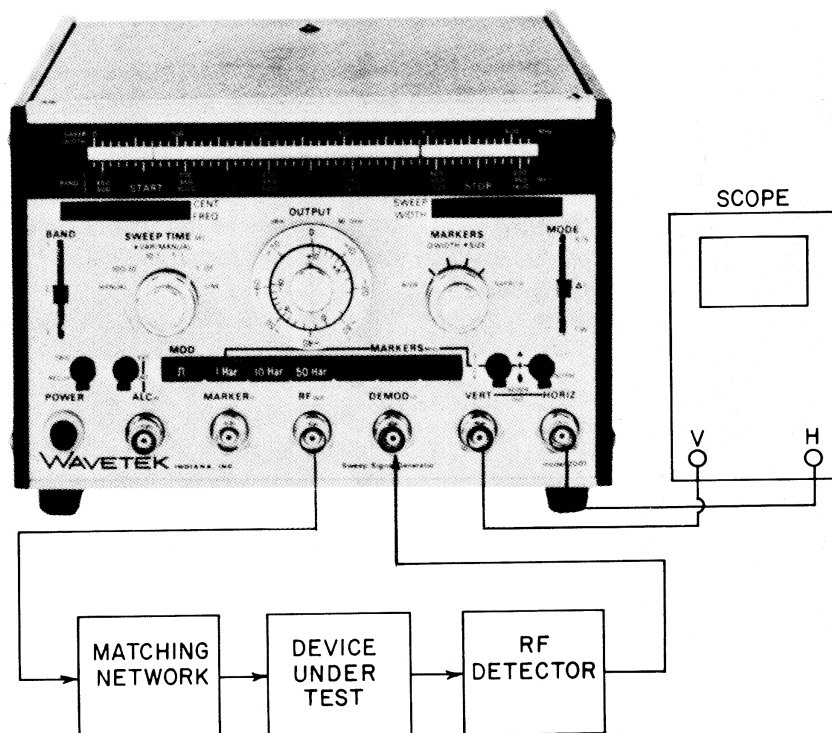


Figure 3-3. Typical Operating Set-up

3.4 TYPICAL OPERATING SET-UP

When initially setting up instrument, first check Rear Panel AC LINE VOLTAGE Selector Switch and Fuse to ensure the instrument is set for operation with the available AC mains.

Make connections between the Model 2001, the device under test, and the oscilloscope as shown in Figure 3-3. Since hum, RF leakage, and spurious signal pick-up must be kept to a minimum, it is essential that good connections and grounds be maintained throughout the entire setup. Use coaxial cables with BNC connectors wherever possible. The RF OUTPUT cable is especially critical. It should

have a characteristic impedance of 50 ohms, and should be kept as short as practical (under 3 feet). If the input impedance of the device under test is not 50-ohms, a matching network, as shown in Figure 3-3, should be used to ensure a constant amplitude input signal to the device under test.

After the RF signal passes through the RF circuit of the device under test it must be demodulated before being connected to the DEMOD IN of the Model 2001. If a demodulator is not a part of the device under test, one must be added externally. (See Figure 3-3). The input impedance of the demodulator must present the proper load to the RF circuit being tested. The Wavetek Model D152 RF Detector is recommended for 50-ohm applications.

Depress the POWER push-button. The light in the switch button should light, indicating an operating condition.

(Note: This instrument does not require a warmup period unless it is to be used at the extreme limits of its specifications.)

After completing the set-up, adjust the Model 2001 controls for the required center frequency, sweep width, output amplitude, and sweep rate. Turn the desired markers on, and adjust their size and width.

3.5 SPECIAL OPERATING NOTES

3.5.1 Errors From Sweep Rate Effects

When sweeping RF circuits having rapid amplitude changes, errors may occur, due mainly to detector delays. Decreasing the detector output time constant will minimize this effect. Figure 3-4 illustrates sweep rate effect.

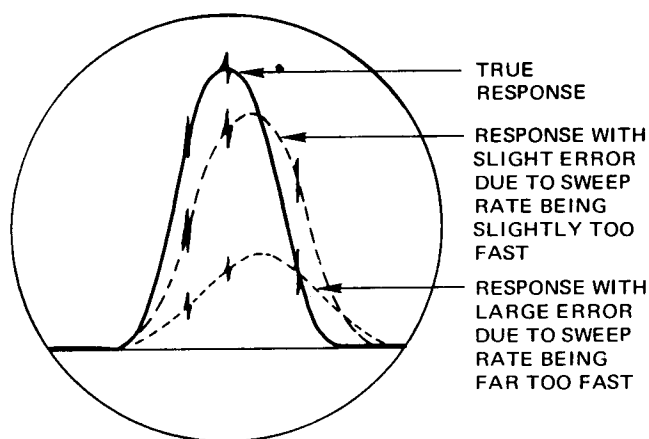


Figure 3-4. Sweep Rate Effects

To check for sweep rate effect, first set the sweep width to its lowest practical amount, then reduce sweep time while closely observing the swept output response. Any change in the response indicates the sweep rate is too fast for a true response. When a further reduction of sweep time does not change the response, a true response has been obtained.

3.5.2 Effects From Overloading

The use of excessive signal from the Model 2001 can overload the receiver circuits. To assure that this condition is not present, and that the response is a true representation of the device under test, turn the OUTPUT dbm controls to minimum output amplitude. Gradually increase

the output amplitude until a response is obtained. Further increase of the output amplitude should not change the configuration of the response envelope except in amplitude. If the response envelope does change, such as flattening at the top, decrease the output just far enough to restore the proper configuration.

3.5.3 Making Measurements At Low Levels

When making measurements at low levels, radiation and ground loops become problems. Using double shielded cables for cables carrying RF signals helps minimize the radiation problem. Ground loops causing hum pick-up can sometimes be eliminated by completing only one ground connection between each instrument. This applies particularly to the scope horizontal input. If the ground connection is made at the vertical input terminal, an additional ground at the horizontal input terminal will often result in hum pick-up.

3.5.4 Operation With Network Analyzers

To operate properly with certain network analyzers several modifications might be required. Some analyzers require the removal of the blanking signal during the sweep return trace. This can be accomplished by disconnecting the single wire connected to pin 10 of the M1H Module. Another modification sometimes required is to provide a horizontal output ramp that varies from zero to some positive voltage instead of the standard -8 to +8 volt ramp. This can be accomplished by connecting a 56 K ohm resistor between pins 2 and 11 of the M1H Module. This connection provides a horizontal output signal from approximately 0 to 11 volts.

3.5.5 Operation With X-Y Plotters

Two features are incorporated into the Model 2001 to facilitate operation with X-Y plotters. First, a marker clamp switch that is a part of the Front Panel SIZE Selector Switch. This marker clamp switch converts the hi-frequency marker signals to a lower frequency which is compatible with the operating speed of the plotter pen.

Second is an optional feature (A5). This feature provides a contact closure during the sweep time to operate the plotter's pen lift. The A5 feature operates only when the sweep time selector switch is set to its slowest position, 10 to 100 sec.

3.5.6 Operation With An External Monitor

Operation with an external monitor can produce a flatter

(less amplitude variation) input signal to the device under test than is obtainable with the internal monitor, since the monitor point is located at the point where greatest flatness is desired, and is not affected by cable VSWR or input impedance of the device under test. Another application is to level at the output point of a wide band power amplifier, in order to increase the output power capability of the sweep generator.

To operate with an external monitor, first set the OUTPUT controls for maximum, +10 dBm. Next, connect the output from the external monitor to the Front Panel BNC jack labeled ALC IN and set the ALC EXT/INT Switch to the EXT position. The signal from the external monitor must be of a negative polarity between 0.2 and 2 volts. If the signal is larger than 2 volts, use a resistive divider to obtain the less than 2 volts signal. While observing the output from the monitor on an oscilloscope, adjust the Vernier OUTPUT Control until the monitor signal becomes leveled. (Refer to Figure 3-5.)

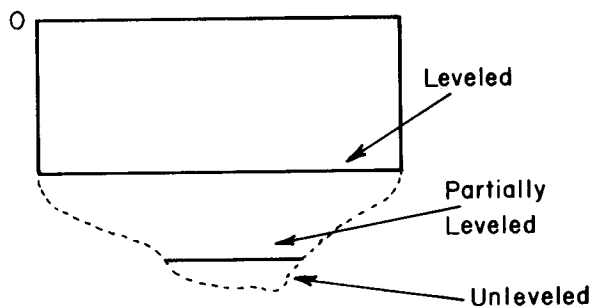
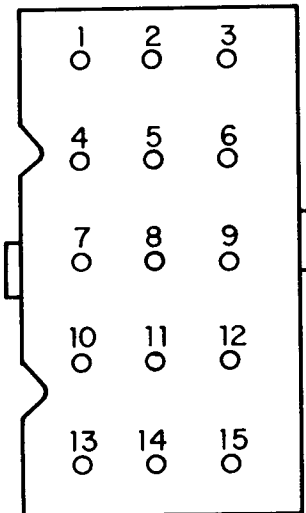


Figure 3-5. External Monitor Output Signal

3.6 PROGRAMMING

Connections for remote operation of OUTPUT AMPLITUDE, FREQUENCY and SWEEP WIDTH plus EXTERNAL AM and FM MODULATION and triggering of the sweep circuit is provided by a Rear Panel REMOTE programming connector. The programming jack and its pin functions are shown below.



Rear Panel
Remote Jack J 101

VOLTAGE AND SIGNAL SOURCES

- Pin 1 – Ground
- Pin 2 – +16 volts ✓
- Pin 3 – -16 volts ✓
- Pin 4 – -18 volts ✓
- Pin 10 – Ramp for Driving Sweep Width Control
- Pin 15 – Same as Pin 10 Except Inverted

CONTROL INPUTS

- Pin 6 – Output Level Control (AM Modulation)
- Pin 7 – Sweep Time Trigger Input
- Pin 9 – Frequency Control
- Pin 12 – Sweep Width Control (FM Modulation)

INTERNAL CONTROL

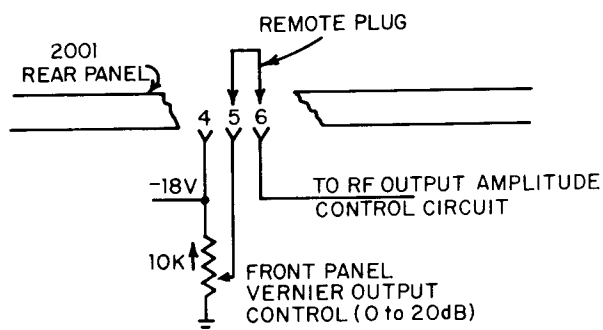
Pins 5, 8 and 11 are used to program internal operation of Output, Frequency and Sweep Width.

UNUSED

Pins 13 and 14 are unused

3.6.1 OUTPUT AMPLITUDE CONTROL (AM MODULATION)

Normal internal control is provided by a jumper wire connected between pins 5 and 6 of the REMOTE plug as shown below.



To provide external control, remove jumper wire and connect an external OUTPUT Control as shown below. The RF OUTPUT is a linear function of the programming voltage as shown in Figure 3-6.

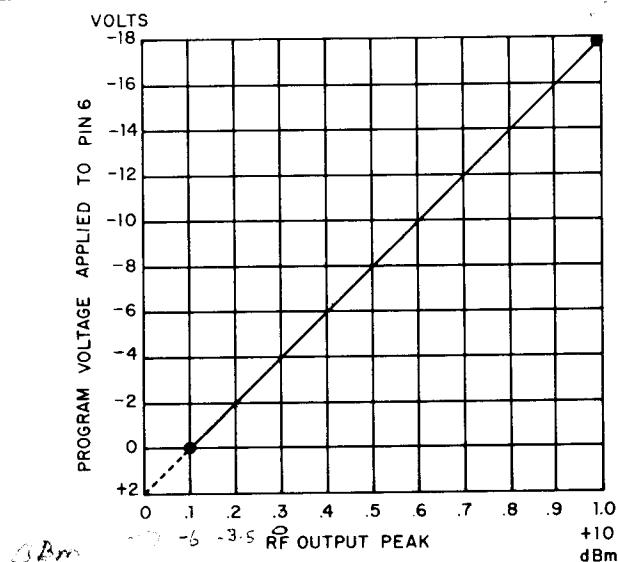
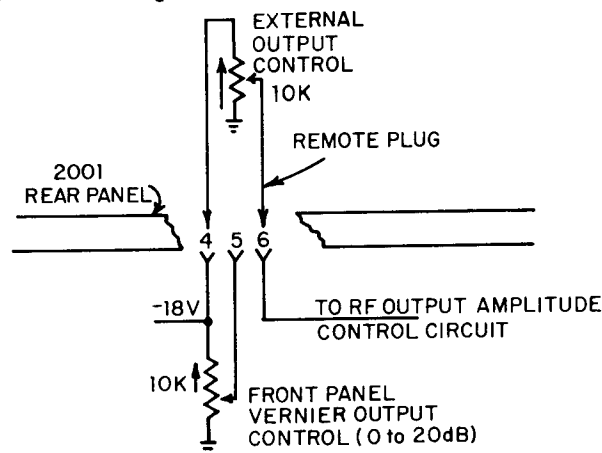
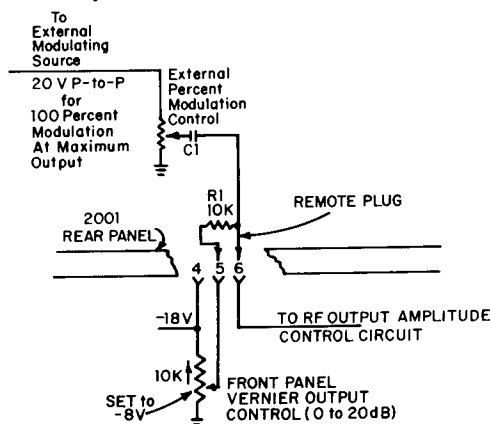


Figure 3-6. Program Voltage/Rf Output

To provide AM MODULATION, connect as shown at right. The low frequency modulation will be limited by the reactance of capacitor C1. Lower frequency modulation, down to DC, can be provided with a modulating source having a DC offset. In this case, resistor R1 is omitted. In all cases, the peak modulating voltage plus the DC offset must be within the limits of -18 to +2 volts, as shown in Figure 3-6, or distortion will occur. The modulation frequency limits the maximum useable percentage of modulation as shown in Figure 3-7. This graph was obtained with the DC level set to -8 volts.



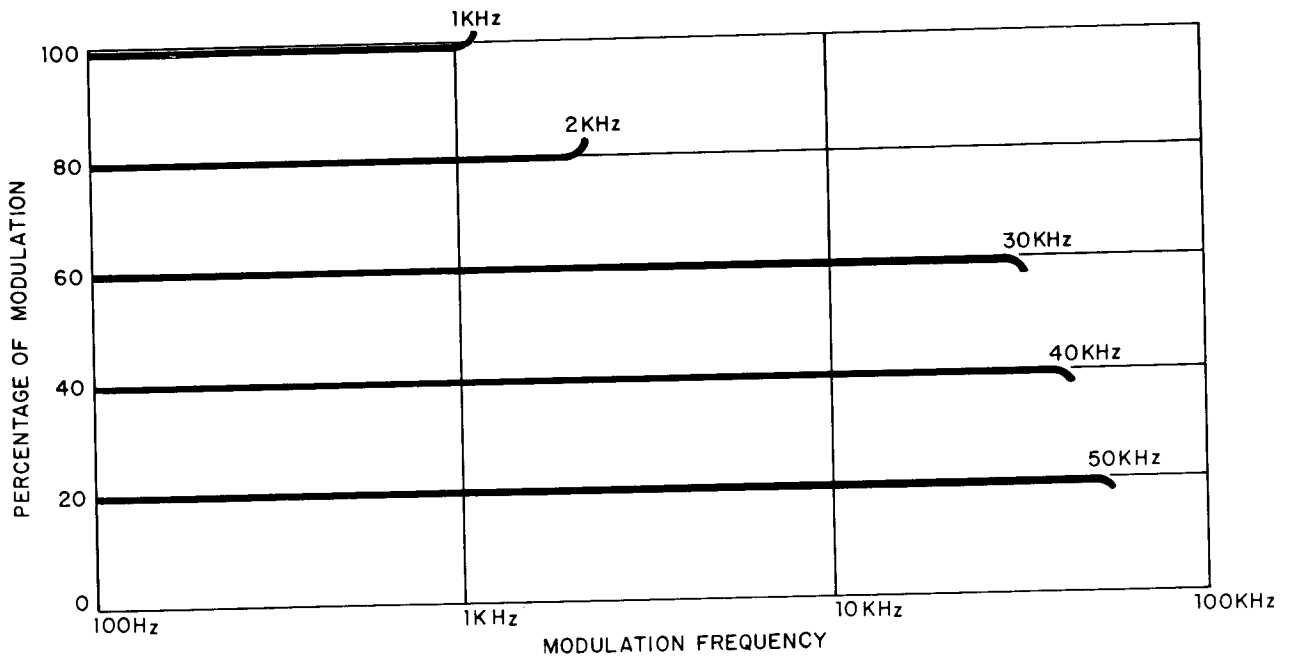
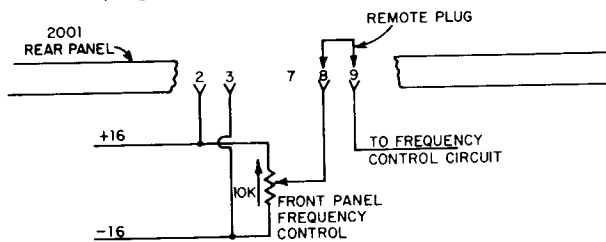


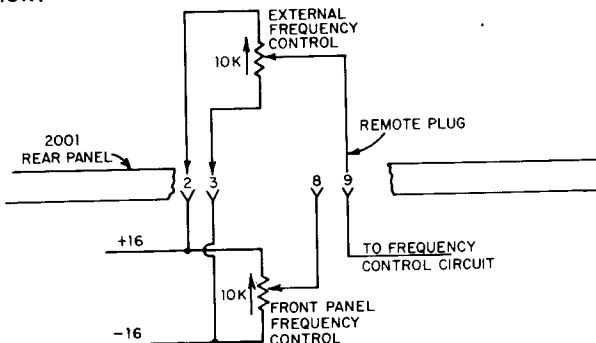
Figure 3-7. Percentage Modulation/Modulating Frequency

3.6.2 FREQUENCY CONTROL

Normal internal control of frequency is provided by a jumper wire connected between pins 9 and 8 of the REMOTE plug as shown below.



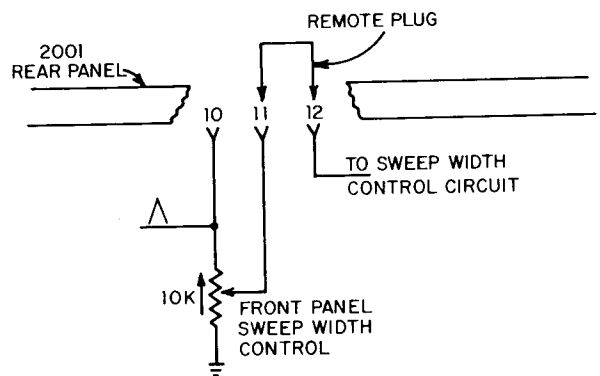
To provide external control, remove the jumper and connect pin 9 to an external Frequency control as shown below.



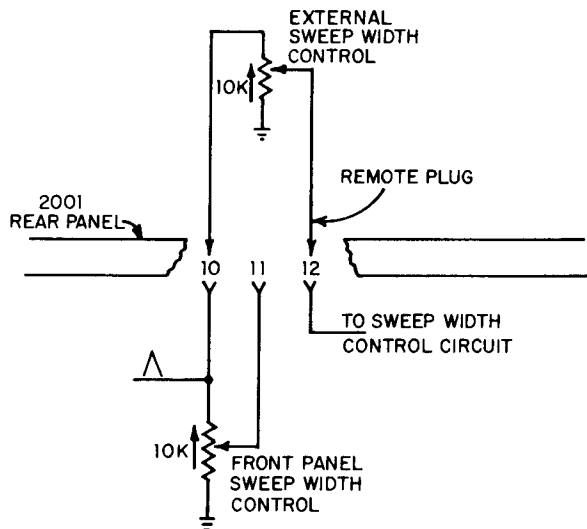
Tuning sensitivity, which is approximately 16 MHz/volt, is shown graphically in Figure 3-8.

3.6.3 SWEEP WIDTH CONTROL (FM Modulation)

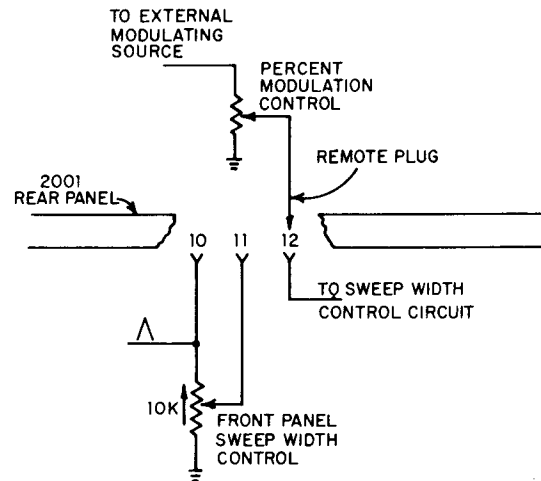
Normal internal control of sweep width is provided by a jumper wire between pins 11 and 12 of the REMOTE plug as shown below.



To provide external control, remove the jumper and connect pin 12 to an external Sweep Width control as shown on page 3-10.



To provide FM modulation, connect as shown at right and set the Front Panel MODE Switch for CW operation.



The modulating wave form should have an average potential of zero volts. Frequency sensitivity, which is approximately 16 MHz/volt, is shown graphically in Figure 3-8. The maximum modulating frequency, while still maintaining the 16 MHz/volt relationship, varies from approximately 4 kHz at maximum deviation to 20 kHz for 1 MHz deviation. (See Figure 3-9.) With decreased frequency sensitivity, frequency up to 200 kHz can be used, as shown in the shaded area of Figure 3-9 on page 3-11.

The peak amplitude of the modulating signal plus the DC voltage supplied to the Frequency Control (pin 9 of REMOTE plug) should not exceed + or -16 volts. This amplitude would program the unit to sweep beyond the band limits.

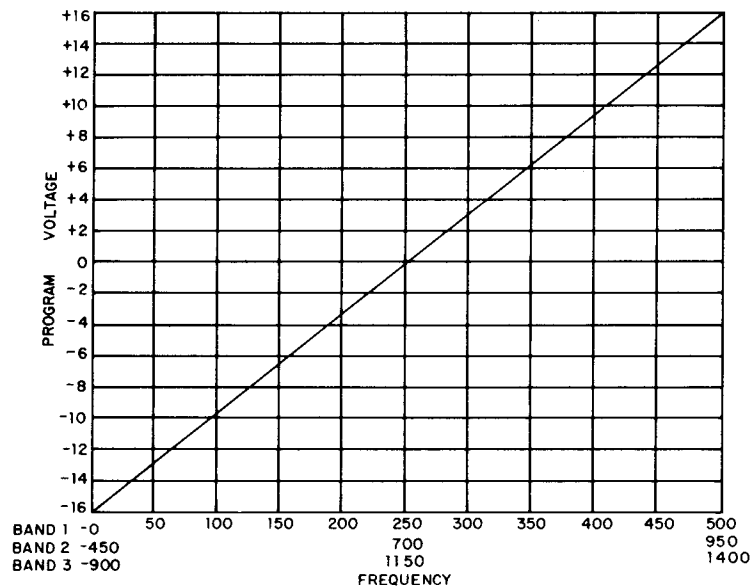


Figure 3-8. Program Voltage (pin 9 or 12)/Frequency

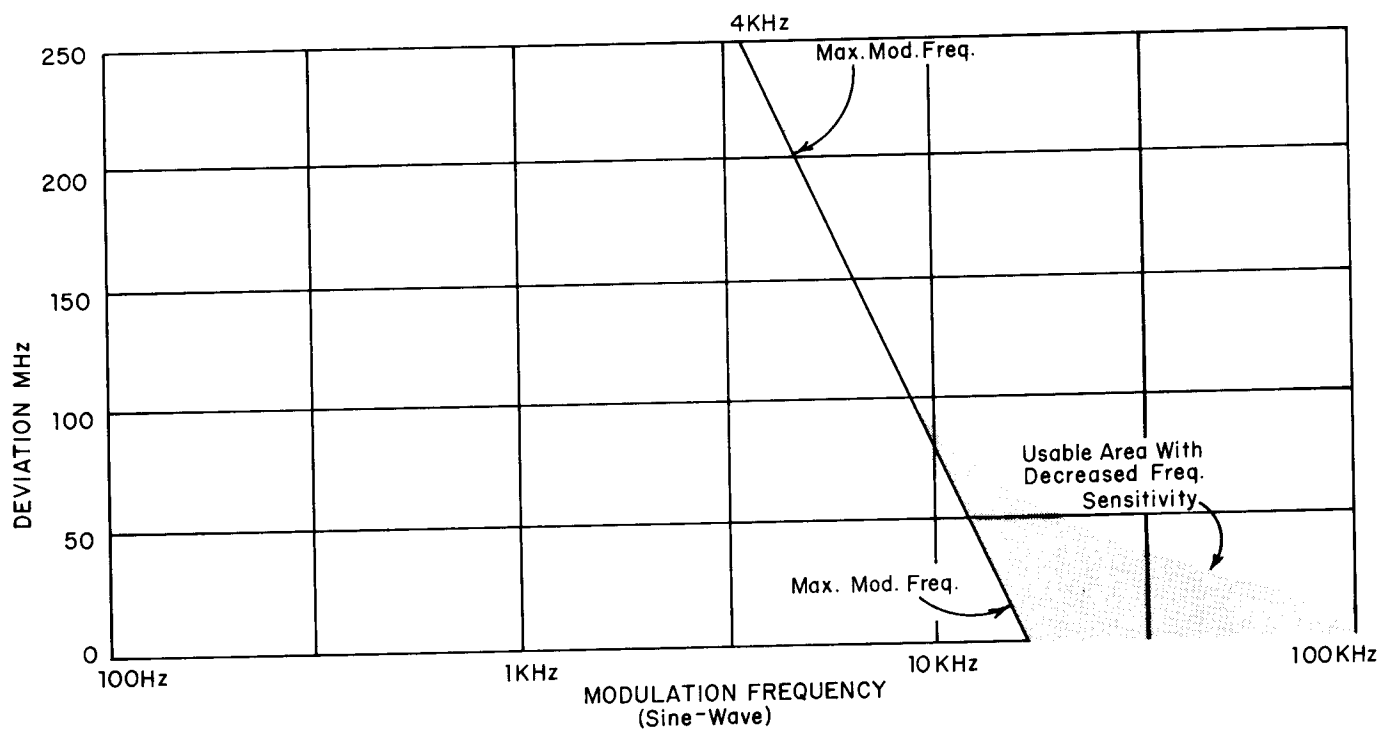


Figure 3-9. FM Modulation Frequency Limits

3.6.4 REMOTE TRIGGERING OF SWEEP TIME CIRCUIT

The Sweep Time Circuit can be remotely triggered by applying a 10 volt positive pulse to pin 7 of the REMOTE plug. For proper operation, the Front Panel SWEEP TIME Selector must be set for one of the four variable sweep

time positions, and the TRIG/RECUR Switch set to the TRIG position. The repetition rate of the external trigger should be slower than the frequency running rate set by the Front Panel SWEEP TIME Selector and VAR/MANUAL Control.

Model 2001

SECTION 4

CIRCUIT DESCRIPTION

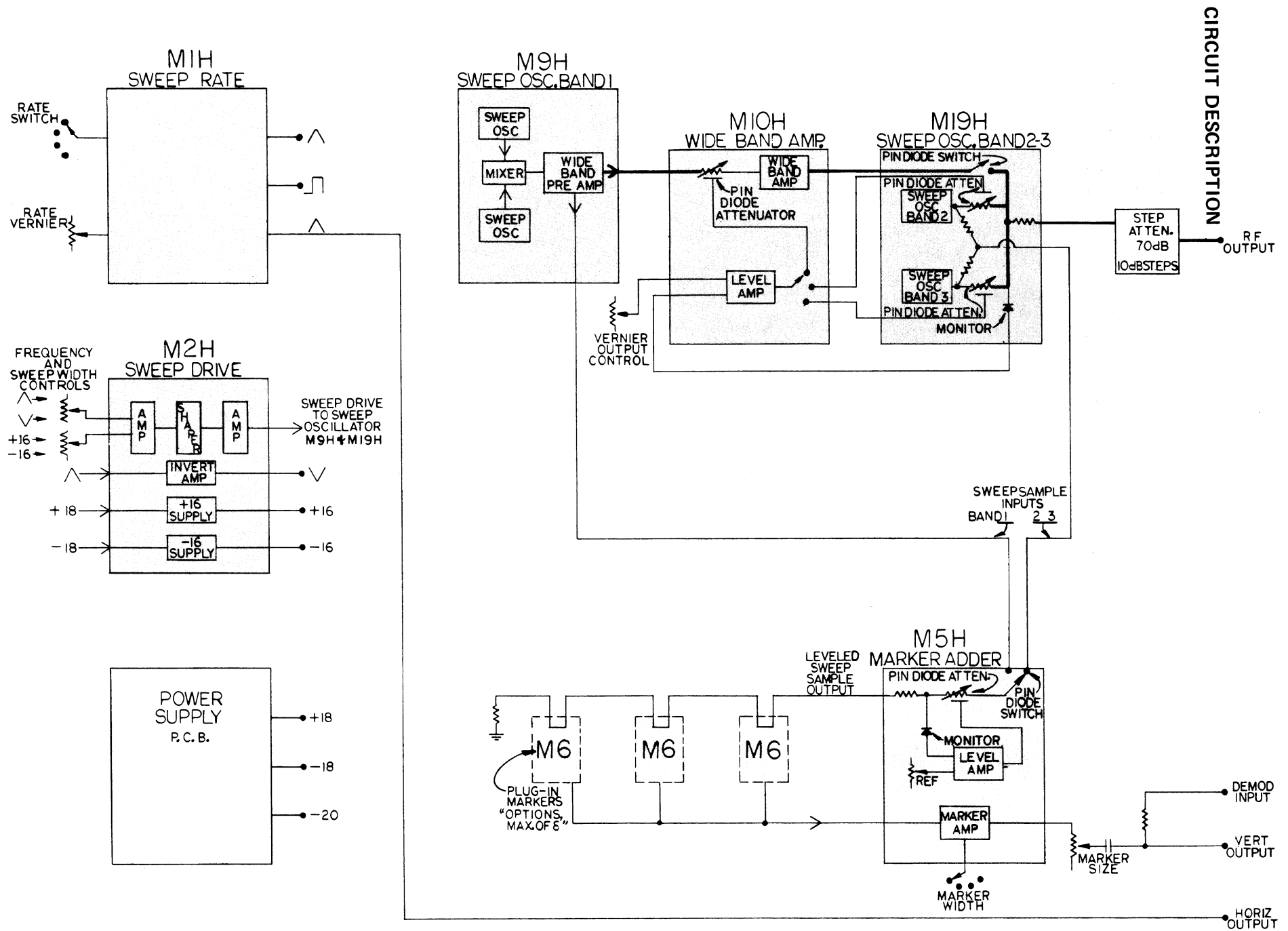


Figure 4-1. Simplified Block Diagram

4.1 MECHANICAL ARRANGEMENT

Before beginning the actual circuit description, it would be well to consider the mechanical arrangement of the instrument. This will enable the following block diagram and circuit description to be associated with its physical position, thereby, providing a better understanding of the overall instrument. The mechanical arrangement can be seen by referring to Figure 5-17 in the Maintenance section. This TOP VIEW shows the Front Panel, plug-in module and the rear chassis Power Supply sections.

4.2 SIMPLIFIED BLOCK DIAGRAM

The block diagram in Figure 4-1 contains both block and module information. The blocks contained within each module are indicated by the **module outline**.

The Power Supply provides three regulated voltage sources of +18, -18, and -20 volts for connections to the plug-in modules.

The M1H module generates the sweep ramp, blanking and scope horizontal voltages.

The M2H module contains four distinct circuits; a -16 volt reference supply, a +16 volt reference supply, an inverted sweep ramp supply, and the sweep drive circuits.

The two reference supplies and the two sweep ramp voltages provide the signals to the FrontPanel frequency and sweep width controls. The signal from these controls is then fed to the sweep drive circuit in the M2H module, where they are combined into a single signal, which drives the frequency determined varactor diodes in the sweep oscillator modules. Necessary level shifting, shaping and amplitude control is provided by the sweep drive circuit.

The RF signal for BAND 1 (1 to 500 MHz) is generated in the M9H module where the signal from two sweep oscillators are combined in a diode mixer. The resultant, difference signal, is fed to a 1-500 MHz pre-amplifier and then to the M10H module. This module contains a voltage variable attenuator and the final 1-500 MHz amplifier. The output from this amplifier is then fed to the M19H module where a PIN diode switch completes the circuit to the RF output circuit.

Leveling of the RF output is accomplished by a monitor diode which measures the RF voltage and compares it to a reference voltage supply by the vernier output control. Any

error between the two voltages is amplified in the leveler amplifier located in the M10H module. The error voltage is then connected to the voltage variable attenuator at the input of the final 1 to 500 MHz amplifier. This closed loop system maintains a constant amplitude RF signal at the monitor point, which compensates for amplitude variation in the sweep oscillator, mixer, and amplifier circuit and also creates a zero impedance at the monitor point. In order to create a 50 ohm source impedance, a 50 ohm resistor is connected between the zero impedance point and the RF output system.

The sweep oscillators for bands 2 & 3 are located in the M19H module. The RF output from the oscillators is fed through voltage variable attenuators directly to the RF output circuit without amplification. Leveling for bands 2 & 3 is accomplished in the same manner as for band 1.

The marker circuit is comprised of the marker adder module M5H, and the individual marker generators M6's. In addition to the marker adding function of the M5H module, it also provides for selection and leveling of the sweep sample signal in the same manner as the main RF output signal was leveled. This provides a constant amplitude sweep sample signal to the individual marker modules which is extremely important to obtain a "flat comb" output from the harmonic generating marker modules. It also standardizes the sweep sample amplitude in all 2001 instruments, which insures proper operation of field installed markers.

This constant amplitude sweep sample signal is then fed to the individual M6 marker modules where it is combined in a mixer with a crystal controlled CW signal. The resultant difference signals (birdy markers) are then fed back to the marker adder module where they are combined, amplified, and shaped into a single composite signal. This signal is then fed through the marker size control and to the Front Panel vertical output connector.

The following circuit descriptions are referenced to the schematics appearing in Section 6.

4.3 POWER SUPPLY (PS6)

The PS6 power supply provides three regulated voltages and an optional "pen-lift" circuit.

AC POWER & RECTIFIER CIRCUITS

A dual-primary transformer allows operation at a line voltage of 115 or 230 volts. AC power is supplied through a 4 wire receptacle from the Front Panel ON/OFF switch. The transformer is located away from the sweep drive module to reduce magnetically coupled line ripple. Unregulated plus and minus voltages are supplied by two full wave rectifier circuits and filtered by C1 and C7. A 12 pin plug, mounted to the printed circuit board, provides access to three unregulated voltages as well as the regulated +18, -18, and -20V. This plug also accepts a scope horizontal signal for connection to a Rear Panel connector. The pen-lift switching circuit is also enabled through this plug.

PEN LIFT OPTION

Installation of K50 and Rear Panel jacks provides a contact closure which occurs during the sweep on-time. Q11 is normally conducting from current supplied through pin 9 of the 12 pin plug. When the base drive to Q11 is removed, the relay is energized by the turn-on of Q12. To prevent early failure of the relay contacts, the relay is only energized during slow sweep speeds and in the manual position of the front panel sweep rate selector.

+18 VOLT SERIES REGULATOR

Regulation is provided by IC1 which contains its own internal reference supply. R9 provides an adjustment to +18.00 volts. An external pass transistor, Q2, boosts the current capability, and Q1 improves the current limiting characteristics of IC1 by providing amplification before limiting. The +18 volt supply is protected against reverse voltage by CR7.

-18 VOLT SERIES - SHUNT REGULATOR

The voltage reference for this supply is obtained from the +18 volt supply through R20, and R19 provides the feedback which is applied to IC2 which provides high gain forcing Q5 to maintain a shunt regulated voltage across R13. Q3 and Q4 provide the series pass element and are connected as a compound emitter follower so that the voltage across R13 is not loaded heavily. Short circuit protection of Q5 is provided by CR8. Current limiting is provided by Q5, when Q6 conducts sufficiently to forward bias CR9 and CR10. Reverse voltage protection is provided by CR12.

-20 VOLT SERIES REGULATOR

The reference voltage for the -20V supply is applied to a differential amplifier, Q9 and Q10, which in conjunction with Q8 provides a compound emitter following action similar to the pass element of the -18V supply.

CR 17 provides reverse voltage protection. Current limiting is provided by shutting down of the -18 volt supply by Q7 through CR14 to the base of Q5, reducing the reference voltage to the base of Q9. This action is helped along by the conduction of CR13 if the -20 volt supply drops below -18 volts.

4.4 SWEEP RATE (MODULE M1H)

M1H SWEEP RATE GENERATOR

This module generates a variable rate square and triangular waveform. Front Panel switching provides recurring, triggered, or manual modes. The triangular waveform is a 32 volt peak-to-peak signal with a sweep time variable from 10ms to 100 seconds in four steps. Retrace time is held constant at the fastest sweep time of each range. The triangular waveform is used to provide the sweep drive and the scope horizontal signals.

The square wave output is a -1 to +15 volt signal whose -1 volt level corresponds to the sweep time and whose 15 volt level corresponds to the retrace time. The square wave is used to provide blanking of the RF output during retrace time.

Triangular waveforms are generated in an integrator, Q1, Q2, Q3, and Q4, by applying positive and negative voltage levels to the integrator input. When the integrator positive ramp output exceeds a threshold voltage, a bi-stable hysteresis switch is switched, reversing the polarity of the integrator dc input, causing the triangular waveform to start down toward another threshold. If the module is programmed in a recurring mode, the negative ramp will trip the hysteresis switch producing continuous oscillations. The hysteresis switch output is clipped on the negative polarity and is used for blanking (pin 10).

The symmetrical square wave output from the hysteresis switch (pin 9) is connected, through the Front Panel SWEEP TIME vernier and one of the range determining resistors of the SWEEP TIME selector switch, to the integrator input (pin 7). Since the integrator output voltage change is proportional to the input voltage level, the SWEEP TIME vernier provides a sweep time increase by reducing the hysteresis switch output if the polarity is negative. If the polarity is

positive, full output is retained (a diode opens the vernier ground connection) producing a nearly constant retrace time.

For triggered modes, the negative threshold of the hysteresis switch is shifted out of the way by a diode and resistor connected through Q14 or through S102D, when in "line" position. The integrator will now continue its negative ramp until it is stopped by a clamp circuit turned on by a comparator. The integrator output is now held at this level unless a trigger is applied to the hysteresis switch. A trigger cannot flip the hysteresis switch until this clamp level is reached because the triggers must pass through an amplifier which is gated off until the clamp comparator (Q9) conducts.

Triggers are prevented from reaching the hysteresis switch (pin 6) by a voltage at pin 1, which causes comparator Q8 to open FET switch Q14. The primary function of the voltage at pin 1 is to shift the clamp comparator input out of the way to allow free-running oscillations.

Since the integrator is an inverting amplifier, and both input (pin 7) and output (pin 8) are available, a feedback resistor network allows the SWEEP TIME vernier, R102, to be used as a dc level shifter in the manual mode. A non-inverting amplifier consisting of Q6, Q7 and Q19, with a gain of 2, provide a 32 volt peak-to-peak wave output which is used for sweep drive. This output is divided by R18 and R53 to provide a horizontal drive of about 16 volts peak-to-peak at an impedance of about 23K ohms.

A centering adjustment (R41) provides a dc level adjustment of the integrator and horizontal outputs (pin 8, pin 12, and pin 11) by shifting both positive and negative thresholds of the hysteresis switch. A size adjustment (R45) provides an amplitude adjustment by effectively varying the size of the hysteresis window. Symmetry of trace and retrace time (for equal positive and negative input voltages to the integrator) is established by adjusting the integrator balance control R7. This adjustment also affects the manual mode centering and the sweep period for fully counterclockwise rotation of the SWEEP TIME vernier.

The four sections of the SWEEP TIME selector switch program the M1H module. The functions of each section are listed below:

Section A	Integrator input selector
Section B	Clamp level shift and routing switch disconnect
Section C	Trigger source selector
Section D	Line trigger routing, and hysteresis switch hold.

Circuit operation as modified by the switch positions may be understood by considering the MANUAL, VARIABLE RATE, and LINE positions one at a time.

MANUAL POSITION

Section A. A feedback resistor R113 is connected from output (pin 8) to input (pin 7) of the integrating amplifier, converting it to an inverting dc amplifier. Resistor R114 shifts the amplifier output dc level to -8 volts for zero input voltage to R104. When the SWEEP TIME vernier control R102 is fully clockwise, the negative input voltage to R104 is sufficient to shift the output voltage to +8 volts dc.

Section B. The clamp is disabled in this position by applying +18V to pin 1, causing the hysteresis switch input to be disconnected from any internal source of triggers by opening the routing switch Q14 (since Q8 is turned off). The shift bias is disconnected when Q14 is open.

Section C. The trigger input point pin 4 is grounded.

Section D. The hysteresis switch is held in one state by applying -18 volts to its input through a 33K ohm resistor. This causes the output to be negative (this bistable circuit is a positive feedback amplifier) providing the proper polarity to R102 and preventing blanking of the RF output.

VARIABLE RATE POSITIONS

Section A. Proper integrator input resistors are selected in decade increments in these positions, R105 - R108.

Section B. The clamp is disabled and triggers are held off unless the "pull trigger" switch is opened, removing +18 volts.

Section C. Two trigger sources are connected to pin 4; an external trigger from REMOTE jack J101-7 and triggers from the Front Panel momentary TRIG switch S103.

Section D. No connection is made to pin 6 in any of the four variable rate positions.

LINE POSITION

Section A. The proper value integrating resistor is selected, by-passing the SWEEP TIME vernier, to produce equal sweep and retrace periods.

Section B. Clamping, works in this position independently of the "pull trig" switch.

Section C. The line rate square wave from the power supply is connected to the trigger input.

Section D. Amplified triggers are routed into the hysteresis switch independently of the internal routing transistor, providing additional (redundant) line rate reliability.

4.5 SWEEP DRIVE (MODULE M2H)

The M2H module provides the correct sweep drive voltage required by each oscillator as programmed by the Front Panel Tuning controls, Sweep Width controls, and the Mode switch.

These programs are summed to a standard voltage level and then feed shaping circuits for each band which are enabled by the B-1 and B-2 voltages and by a synthesized B-3 voltage.

The shaping diodes conduct at levels determined by a resistor network driven by a constant current source, Q7. As each diode conducts, an additional current is fed into the summing junction of the output amplifier consisting of Q12, Q13, and Q14.

The output waveform amplitude is controlled by R72, R76, and R80 which are connected by switch transistors Q15, Q16, and Q17 into the feedback path to the summing junction.

This module also provides two regulated voltages for use primarily as programming voltages and an inverting amplifier to furnish an inverted triangle wave for use in the start-stop mode of programming.

4.6 SWEEP OSCILLATOR, BAND 1 (MODULE M9H)

The RF sweep signal for band 1 is developed by the heterodyne method which utilizes two UHF sweep oscillators, a diode mixer, and a wide-band RF amplifier.

Sweep oscillator, Q2, sweeps from approximately 1.4 to 1.65 GHz. The average frequency is adjusted by R2 which controls the average bias on the varactor diodes, CR1, CR2, and CR3. The sweep drive voltage from pin 9 of the module is connected to the opposite side of these diodes causing the frequency to vary above and below this average frequency in a low-to-high frequency direction.

Sweep oscillator, Q5, is similar to the Q2 circuit, however, the varactor diodes have been reversed, and the polarity of the bias voltage supplied by R12, coarse adjustment, and R13, CENT FINE adjustment, has been changed. These

changes cause the oscillator frequency to vary from a high to low frequency. The approximate output frequency is 1.4 and 1.15 GHz. This out of phase sweep technique has several advantages. First, larger sweep widths are obtainable and second, the nonlinearity (FREQ versus TIME) of one oscillator is cancelled by the nonlinearity of the second oscillator. R9, which is a linearity adjustment, optimizes this cancelling process by controlling the sweep drive ratio between the oscillators.

The two sweep signals are combined in a single balance diode mixer comprised of L4, L5, CR8 and CR9. The resultant, difference frequency, of 0 to 500 MHz, is then amplified in the wide band amplifier consisting of transistor stages Q11, Q12, and Q13.

Transistor stages Q6 and Q7 supply the blanking voltage to the wide band amplifier and causes it to be shut off during the sweep retrace time. The output from the wide band amplifier is connected to J1, which in turn is connected to the output wide band amplifier located in module M10H. A second output is also obtained from this amplifier and is coupled, via R45, to a similar wide band amplifier consisting of transistor stages Q14, Q15, and Q16. The output from this amplifier is connected to J2 which in turn is connected to the marker generating circuits.

Transistors Q8, Q9, and Q10 provide a -15 volt supply to operate the sweep oscillators. This improves stability and provides isolation between the oscillators and the -18 volt supply.

4.7 OUTPUT AMPLIFIER, BAND 1 (MODULE M10H)

The M10H module contains a wide band amplifier, an electronic attenuator, and a leveler amplifier.

WIDE BAND AMPLIFIER

This amplifier provides 2 stages of RF amplification to increase the RF input level present at Q1 by about 40dB.

The frequency response of this amplifier is reduced for frequencies near 0.5 MHz or lower and above 500 MHz.

The input amplifier stage consisting of Q1, Q2, and Q3 is enabled by the B+1 switching voltage, and the output stage, consisting of Q4, Q5, and Q6 by the -20 voltage, when the Front Panel band switch is in the Band 1 position. The -20 voltage also provides current through R30 and the RF out-

put cable to turn on a pin diode, located in the M19H module, which couples the band 1 RF output into the RF output system.

ELECTRONIC ATTENUATOR

Ahead of the first RF amplifier is an electronic attenuator consisting of PIN diodes, CR1, CR2, and CR3 which provides variable RF conductance proportional to the positive current supplied through the switching transistor Q7.

LEVELER OUTPUT (PIN 6)

The leveler amplifier (Q9, Q10, and Q11) provides leveling of the RF output for Bands 1, 2 and 3 by supplying a positive current to the electronic attenuator system for each band as directed by the band switching voltages (B-1, B-2, and B-3) which turn on the correct switching transistor for that band (in the M10H module or the M19H module).

A positively increasing output voltage from the leveler amplifier will increase the RF output level. RF blanking is effected by a positive input voltage (pin 4) to switching transistor Q8 which causes the leveler output (pin 6) to go negative during sweep retrace time shutting off the electronic attenuator.

LEVELER INPUTS (Pin 5 and Pin 7)

A monitor diode, located external to the M10H, provides a negative DC voltage related to the RF output level present in the output system. The output system and monitor diode is located in the M19H module or in an external monitor circuit. This negative voltage is connected to one input of the operational amplifier, consisting of Q9, Q10, and Q11.

Since an increasingly negative voltage at the input will reduce the positive current supplied to each electronic attenuator, the RF output level is held constant, by negative feedback, at a level determined by a reference voltage. This reference voltage varies under control of the LEVEL PROGRAM input voltage at pin 7 of the M10H module. The magnitude of this negative voltage is determined by the MAX pot which sets the maximum RF level when the program voltage is maximum (-18 volts). The MIN pot provides a small negative reference voltage which determines the minimum RF level when the level program voltage at pin 7 is zero.

4.8 SWEEP OSCILLATOR, BANDS 2 & 3 (MODULE M19H)

This module contains two separate sweep oscillators, each with its voltage variable attenuator and the necessary switching circuitry to connect either band 1, band 2, or band 3 to the common monitor and RF output connector.

Band 1 is connected to the RF output circuit by PIN diode CR9. The control current for switching this diode is contained in the M10H module.

Band 2 oscillator, consisting of Q6 and its associated circuitry, is a common base oscillator varactor-tuned by CR2, CR3, CR4 and CR5. Biasing of the varactor diodes is provided by Q1 and Q2. Q3 is a switching transistor which disconnects the bias voltage from the varactors when the unit is operated on band 1 or band 3. The B -voltage for the oscillator is modulated by the blanking signal, from pin 4, in transistor stages Q4 and Q5. This modulation causes the oscillator to be cut off during the sweep retrace period, thereby providing a zero RF output level during the retrace time. The RF signal is coupled from the oscillator, by L9, to a voltage variable attenuator consisting of CR6, CR7 and CR8. This attenuator is part of the closed loop leveling system consisting of the monitor diode CR20, the leveler amplifier, (located in the M10H module) and the voltage variable attenuator. The operation of this circuit maintains a constant amplitude RF signal at the monitor point and also allows adjustment of this signal over a 20dB range. Since the effective impedance at the monitor point is zero ohms, R46 establishes the output impedance at approximately 50 ohms.

Band 3 oscillator is almost identical to band 2. The oscillator tank inductance has been decreased and the oscillator transistor, Q14, is operated at a slightly higher current. The varactor bias is provided by Q9 and Q10 and the B-blanking is provided by Q11 and Q12. Current during the sweep retrace time is not completely removed but is steered by Q13 through CR12. This current will not cause oscillation since L15 has been by-passed. It does, however, provide better frequency stability in the oscillator. The RF signal is coupled from the oscillator, by L20, through the voltage variable attenuator consisting of CR17, CR18 and CR19 and to the RF output.

Q7 and Q8 help provide the proper bias to the shunt diodes in the voltage variable attenuators, in order to maintain a constant load for the oscillator, thus minimizing the frequency pulling effects of the attenuator.

Transistors Q15 and Q16 are switching transistors which connect the output of the leveling amplifier to the voltage variable attenuator associated with the operating band.

4.9 MARKER ADDER (MODULE M5H)

The main function of this module is adding together and amplifying the individual marker signals from the M6 marker modules. It also contains the external marker mixer circuit and the sweep sample selection and leveling circuits.

The desired sweep sample signal (band 1 or band 2 and band 3) is selected by the PIN diode switch CR4 and CR5. The sweep sample signal is then leveled in the same manner as the main RF output signal. The voltage from the monitor, CR7, and the reference voltage from R46 is fed to the leveling amplifier consisting of transistor stages Q12 and Q13. Q11 provides blanking of the leveling amplifier. Any error between the two input signals is amplified and fed to the voltage variable attenuator CR6. The operation of this circuit produces a constant amplitude signal at the monitor point.

The leveled sweep sample signal is connected to the external marker mixer, CR1 and CR2, and to the sweep sample output connector, J4. A 47 ohm resistor, which is connected between J4 and the monitor point, establishes the source impedance at approximately 50 ohm. The signal is then routed to each M6 marker module.

The marker output signals from the individual M6 marker modules are connected to the input pins 1, 2, 3, and 4 of the M5H module. One or two M6 outputs are connected to each input. The signals are then amplified in the input stages (Q2, Q3, Q4, and Q5) and combined in the common collector load. The collector load is an external 10mH choke when the Front Panel MARKER WIDTH Selector is set to "WIDE", or a 3.3k ohm resistor, R21, when the Width Selector is set to "NARROW." The combined marker signals are then amplified in transistor stages Q6, Q7 and Q8. The Front Panel Marker WIDTH Selector also varies the high frequency gain of the amplifier by connecting capacitance across R27, the feedback resistor. The amplified signal is then fed to the complimentary output stage, Q9 and Q10, which is biased so that input signals less than 0.5 volts are not amplified. This eliminates most spurious markers and noise from the output. The output is then connected to the Front Panel MARKER SIZE Control and finally to the Front Panel SCOPE VERT. connector.

4.10 MARKERS (MODULE M6's)

Each marker module contains a crystal oscillator, a tuned or untuned mixer and a marker amplifier. Harmonic generator marker modules also include one or more harmonic generating stages.

Several types of marker modules are required to cover the wide frequency range and to produce both single frequency and harmonic type markers. A single frequency marker generator produces a marker at a single frequency while the harmonic marker generator produces markers at harmonically related frequencies of the crystal oscillator.

The model number for single frequency markers is M6S followed by the marker frequency. The model number for harmonic markers is M6H followed by the harmonic marker frequency.

The Crystal Oscillator operates between the frequencies of 100 kHz and 55 MHz. Several different types of oscillators are required to cover this range of frequencies. The 100 kHz oscillators use a tuned oscillator with the crystal operating at its fundamental frequency in a series resonant mode. The 1 to 17 MHz crystal oscillators are either tuned series resonant mode oscillators or untuned pierce type oscillators. The 17 to 55 MHz oscillators use a tuned Colpits oscillator with the crystal operating at its third overtone frequency in a series resonant mode. The tuning suppresses the crystal fundamental and higher order resonant frequencies. The crystal and marker frequency are the same for frequencies between 100 kHz and 55 MHz. The markers above 55 MHz use harmonic generating techniques.

The output from the crystal oscillator (or harmonic generator) is combined with the sweep sample in the mixer stage. In the case of single frequency markers, the mixer includes a tuned circuit which selects the desired crystal or crystal-harmonic frequency and the sweep sample frequency. In the case of a harmonic marker, the mixer is untuned. The mixer circuit is generally a diode mixer, although transistor mixers are sometimes used. The fundamental and product signals are filtered from the mixer output, leaving the "difference signal" which is applied to the marker amplifier stage.

The marker amplifier is a single stage amplifier having a frequency response of several kHz to approximately 500 kHz. The output of the marker amplifier is connected through the SIZE Control to the output pin of the module.

5

SECTION 5

MAINTENANCE

5.1 INTRODUCTION

This section provides information for testing, calibrating, and trouble shooting the sweep generator. The performance test is designed for incoming inspection and periodic evaluation. If performance is not to specifications, refer to the calibration and trouble shooting sections.

5.2 SERVICE INFORMATION

5.2.1 DISASSEMBLY INFORMATION

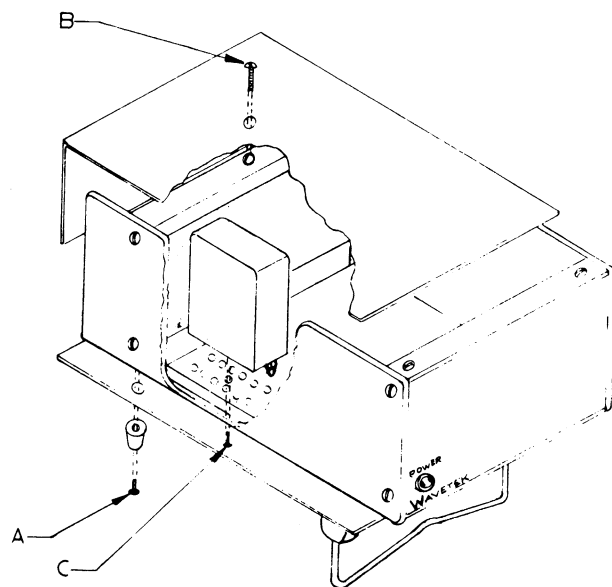


Figure 5-1. Disassembly

REMOVAL OF BOTTOM COVER — Remove the two rear feet (A) and lift cover off with a slight rear movement.

REMOVAL OF TOP COVER — Remove the single screw (B) from the top and lift off cover with a slight rear movement.

REMOVAL OF SIDE PANEL — Either side panel can be removed to provide better access by removing the four screws holding the side panel to the instrument. The Front Panel/Module Section can be removed from the power supply section by removing two screws holding the sections together and by disconnecting the electrical connectors between the two sections. **NOTE:** The separation of the two sections performs no useful purpose during normal

service procedures.

5.2.2 MODULE SERVICING

SERVICE KIT K102 — This service kit contains a module extender and RF extension cables which enables the module to be electrically operated while physically located above the rest of the modules, thereby making all parts easily accessible.

REMOVAL OF MODULE — Modules may be removed by removing any cables attached to the top of the module and removing the hold-down screw (C) from the bottom.

REMOVAL OF MODULE COVER — Remove all nuts and screws from the top of the module and slide the cover off.

REINSTALLING MODULE — Before reinstalling the module, check the module pins for proper alignment, then carefully seat the module pins into the chassis socket and replace the hold-down screw (C) to insure a good ground connection between module and chassis.

MODULE PIN NUMBERING SYSTEM — The module pins are numbered as shown in Figure 5-2. The index studs for the circuit modules are located off center to prevent the module's being plugged in backwards. This off-center stud location also provides a method for locating pin #1.

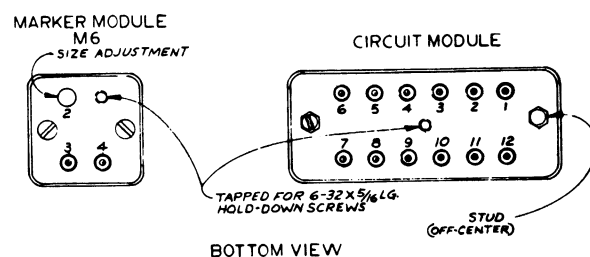


Figure 5-2. Module Pin Numbering System

5.2.3 TRANSISTOR LEAD CONFIGURATION – Transistor lead configurations are shown in Figure 5-3.

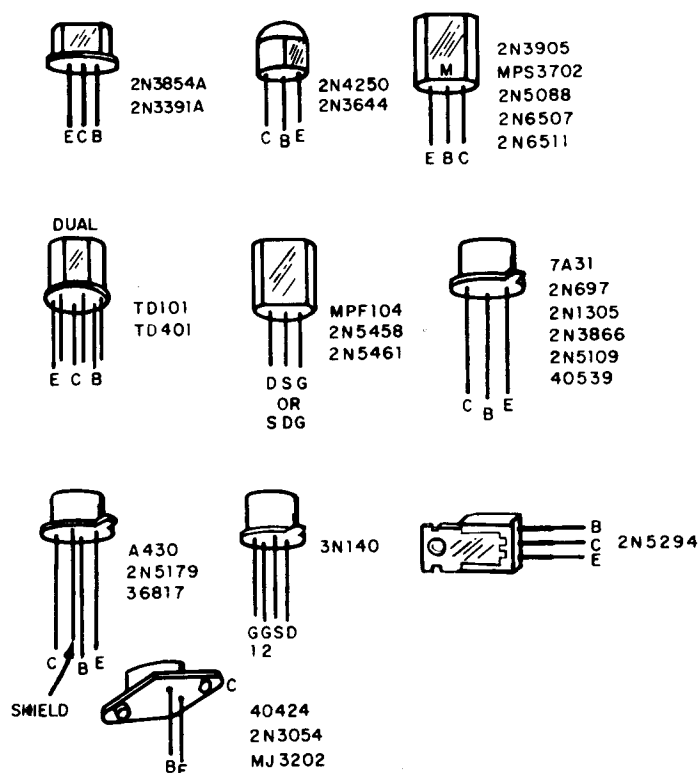


Figure 5-3. Transistor Lead Configuration

5.2.4 RECOMMENDED TEST EQUIPMENT — The following test equipment, recommended for servicing, trouble shooting, and calibrating the Wavetek Model 2001, is shown in Table 5-1.

TABLE 5-1. RECOMMENDED TEST EQUIPMENT

INSTRUMENT	CRITICAL REQUIREMENT	RECOMMENDED
Oscilloscope	DC Coupled 1mV/cm sensitivity	HP-130
Digital Voltmeter	0.1% Accuracy	Weston 1240
Power Meter	Frequency Range 10 to 1500 MHz	HP-437A HP-8485A
RF Detector	Frequency Range 1 to 1500 MHz	Wavetek D152
Spectrum Analyzer	Frequency Range 10 MHz to 3 GHz	HP8555A/8552A
Precision Attenuator Pads	10, 20, & 40dB	Weinchel 50-10, 50-20, 50-40
Marker Generators	1, 10 & 50 MHz Harmonic Markers	Wavetek M6H-1, M6H-10, M6H-50
CW Signal Generator	Adjustable to 925 MHz with 0.1 V output, accuracy ± 10 MHz	

5.3 PERFORMANCE CHECKS

The following procedure is intended to ensure that the instrument meets its published specifications. The checks specified assume that the instrument is equipped with A-2 options at 1 MHz, 10 MHz, and 50 MHz. While it is possible to check the instrument's performance without the use of harmonic markers, by using suitable external CW sources, a complete check by this method is impractical.

5.3.1 PRELIMINARY CHECK

Rotate both START and STOP thumb wheels to their lowest frequency position (turn full left). Both frequency indicators must read 0 MHz, ± 2 MHz, when read on the SWEEP WIDTH frequency scale. (Interpolation on the Sweep Width scale between 0 and 10 MHz is necessary to locate ± 2 MHz).

Preset controls as follows: BAND to 1, SWEEP TIME to LINE, OUTPUT to +10dBm, MARKER WIDTH to WIDE, MODE to CW, the four paddle switches to their extreme down position, 50 MHz HAR markers to on (in position) and the remaining markers and MOD off. Set the CENT FREQ to 250 MHz (left thumb wheel) and connect the power meter to the RF out connector. (Ensure the power meter is on the +10dBm scale).

Turn AC power on and allow the instrument to stabilize

for 5 minutes. The power meter must read between +9.5 to +10.5dBm. The calibrating procedure calls for +10dBm adjustment at 300 MHz. However, some error must be allowed for changes due to ambient operating temperature and variations between power meters.

5.3.2 FREQUENCY CHECKS

Connect the instrument to the RF detector and scope as shown in typical setup Figure 5-4. Set the SWEEP WIDTH control (right thumb wheel) to 520 MHz and the MODE switch to ΔF . Leave the rest of the controls as previously set in step 5.3.1. Adjust the MARKER SIZE, the scope vertical, and scope horizontal controls to obtain a pattern as shown in Figure 5-5. Use DC coupling on both the vertical and horizontal scope inputs. The output voltage from the detector will be approximately 0.8 volts. A detected output less than 0.7 volts indicates a defective detector or an uncalibrated scope. Each 50 MHz marker must fall within ± 0.2 cm of each CM line on the scope graticule. This is equivalent to a display linearity of 2%. This 2% specification is extremely important since all dial accuracy specifications are directly related to it. Repeat check on BANDS 2 and 3. In order to identify absolute frequencies on bands 2 and 3, an external CW signal can be connected to the EXTERNAL MARKER IN connector to identify one of the 50 MHz harmonic markers. This also verifies the operation of the external marker circuit.

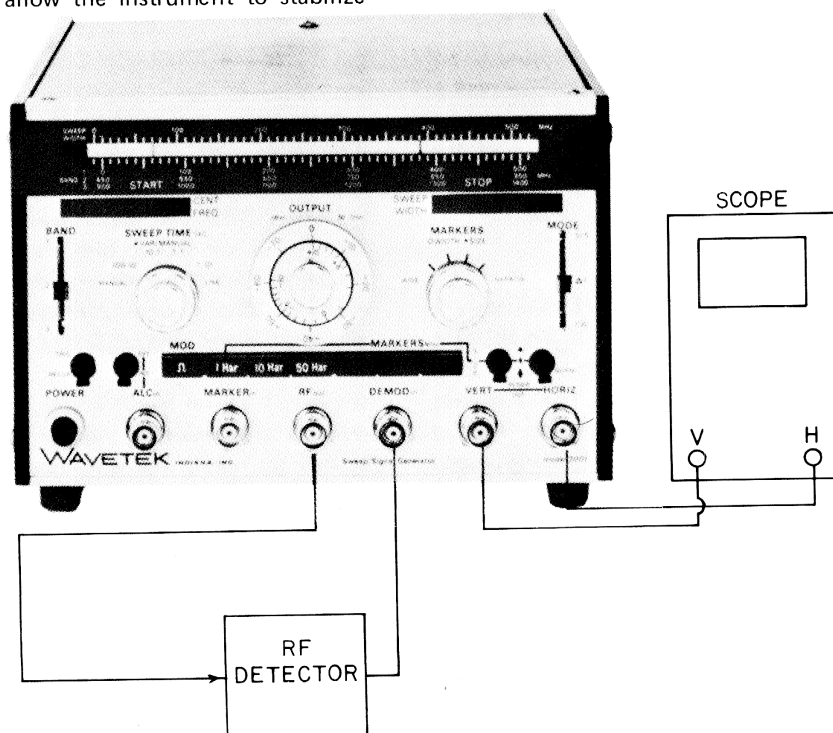


Figure 5-4. Typical Set-Up

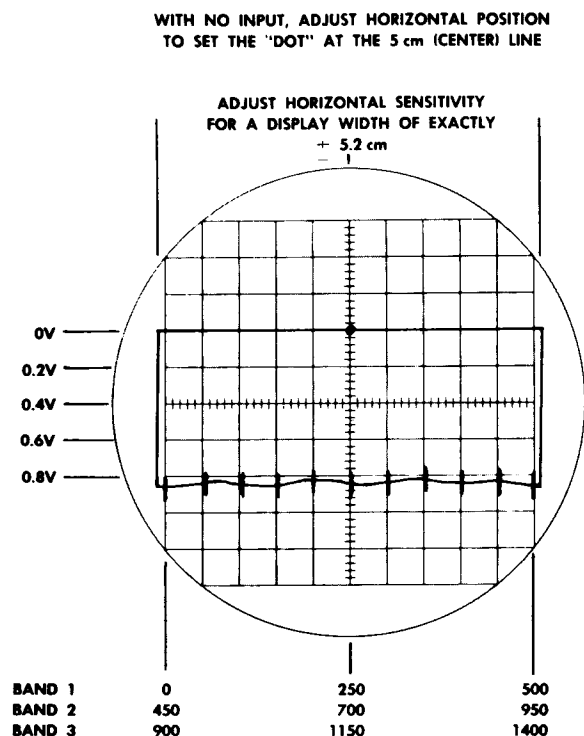


Figure 5-5. RF Detector Display

To check the minimum frequency on band 1, set BAND to 1 and frequency dials (use either S/S or ΔF MODE) to sweep approximately 0 to 10 MHz. Turn on the 10 MHz harmonic marker and locate the first marker on the right of zero lock-in point. Turn on the 1 MHz harmonic marker and count down to 1 MHz. The detected output must be leveled down to the 1 MHz marker at all settings of the OUTPUT vernier.

5.3.3 MINIMUM SWEEP WIDTH CHECK

Set MODE to ΔF and adjust SWEEP WIDTH to exactly 1 MHz (use 1 MHz markers). Adjust the MARKER WIDTH to produce a marker approximately 200 kHz wide. Next, adjust the SWEEP WIDTH to minimum. The 200 kHz wide marker should cover the entire scope display. Repeat the above check for bands 2 and 3, readjusting sweep width and center frequency as required. The minimum sweep width is less than 200 kHz on all bands.

5.3.4 RESIDUAL FM CHECK

Readjust SWEEP WIDTH to produce a calibrated frequency display of exactly 1 MHz full scale. Adjust CENTER FREQUENCY control to center one of the 1 MHz har-

monic markers on the scope display. Residual FM can be read directly on the scope display by noting the amount of jitter of the marker. (A jitter of 0.2cm would be equal to 20 kHz).

Change SWEEP TIME selector from LINE to the 0.1 - 0.01 position and again read the marker jitter. The additional jitter in this position represents the line related residual. Maximum allowable jitter is 15 kHz. Alternate Method to read residual FM is with a spectrum analyzer.

5.3.5 FREQUENCY DRIFT

Return SWEEP TIME selector to LINE and again calibrate the display's sweep width to 1 MHz. Position the marker to the exact center of the oscilloscope display and read frequency drift directly from the scope display by noting the change in the markers position with time. Each centimeter represents 100 kHz. When reading drift over long periods of time, calibrate the display sweep width to 5 MHz, using the 1 MHz harmonic marker. Next turn off the 1 MHz marker and turn on the 50 or 10 MHz harmonic markers. Center a marker on the scope display and read drift as before, except each centimeter now represents 500 kHz.

Maximum allowable drift is 100 kHz per 5 minutes or 2 MHz per 8 hours, after a one hour warm-up at a constant ambient temperature, and allowing a 5 minute stabilizing period after a frequency change.

5.3.6 DIAL ACCURACY CHECK

ΔF MODE: Set MODE to ΔF , BAND to 1, MARKER WIDTH to wide and turn on the 50 MHz harmonic marker. (1 and 10 marker off). Set SWEEP WIDTH to approximately 1 to 2 MHz and adjust CENT FREQ control until the zero frequency lock-in point is exactly center on the scope display. Read the error on the frequency scale. Repeat at each 50 MHz harmonic intervals across the band. The allowable error is ± 10 MHz.

Repeat check on bands 2 and 3. An additional frequency error is produced by the pulling effect of the OUTPUT vernier on bands 2 and 3, therefore, rotate the OUTPUT vernier thru its entire range at each 50 MHz check point. Increasing the SWEEP WIDTH to approximately 5 MHz will simplify reading. The allowable error on band 2 and 3 is 2% of the indicated frequency.

The accuracy of the SWEEP WIDTH scale can be checked with the 50 MHz harmonic marker in a similar manner. Set the actual sweep width to 50, 100, 150, etc., and read the error on the SWEEP WIDTH scale. Accuracy on band 1 is

± 10 MHz, and on band 2 and 3 ± 20 MHz. Again, accuracy on band 2 and 3 is affected by the OUTPUT vernier control.

START/STOP MODE: Return to BAND 1 and set the MODE to S/S (Start/Stop). Set START to -10 MHz and STOP to 510 MHz. A pattern similar to Figure 5-5 should be present on the scope display. Reduce STOP control until the 500 MHz marker just disappears from the right side of its scope display; read error of the STOP frequency indicator (red), repeat at each 50 MHz interval.

Return STOP dial to 510 MHz and adjust START control until the zero lock-in point just disappear from the left side of the scope display; read error of the START frequency indicator (green), repeat at each 50 MHz interval. Allowable error is the same as band 1 in the Δf mode, ± 10 MHz.

Recheck for bands 2 and 3, vary OUTPUT vernier at each 50 MHz check point. Allowable error is 2% of indicated frequency.

5.3.7 CW MODE CHECK

Turn MODE switch to CW. This position removes the return trace blanking and the sweep width drive from the oscillator. The output frequency is controlled by the CENTER FREQ control and the dial accuracy will be the same as previously checked at the Δf mode. The detected pattern on the scope will be a negative voltage equal to that produced in the S/S and Δf mode with the absence of the zero level return trace.

5.3.8 SPURIOUS SIGNAL CHECK

Checking for spurious signal content is not normally required for periodic calibration, only for initial incoming inspection. The only practical way to measure the spurious signal content is with a high quality spectrum analyzer covering the frequency range of 10 MHz to 3 GHz. The spurious check is made in accordance to the instructions furnished with the particular spectrum analyzer.

The main spurious signals on all three bands is the second and third harmonic of the output signal and should be more than 26dB below the main output signal from 10 to 500 MHz on band 1 and 26dB below the output signal from 500 to 1400 MHz on bands 2 and 3. Harmonic content is not specified below 10 MHz on band 1 and an increase of the second harmonic output to approximately 22dB below the output in the 450 to 500 MHz area of band 2 is normal.

In addition to the harmonically related spurious signals, band 1 will have non-harmonic spurious signals due to the

heterodyne method of obtaining the sweep output signal. These spurious signals are typically 40 to 50dB below the output from 10 to 400 MHz and increase to no more than 26dB below the output in the 400 to 500 MHz area.

5.3.9 RF OUTPUT FLATNESS (amplitude variations vs. frequency)

Flatness can be checked with a negative polarity RF detector or a power meter. The power meter method is to be preferred since its own flatness is better than that of most RF detectors. A 0.5dB detector flatness is typical of many detectors over this frequency range. However, the power meter has two limitations not present in the RF detector. First, slow response time and second, not useable below 20 MHz. The first limitation can be overcome by making the flatness measurements in the CW mode, the second by making flatness measurements with a detector in the low frequency area.

To measure flatness, set the MODE switch to CW, OUTPUT control to +10dBm, and connect the power meter to the RF output connector. Tune the entire frequency range from 20 to 1400 MHz and note the frequency where maximum output was obtained. With the OUTPUT VERNIER control set the output at that frequency to exactly +10dBm. Again tune the entire band and note the minimum output reading. A minimum output of 8.5dBm or more is required to meet the flatness specifications of ± 0.75 dB.

5.3.10 RF OUTPUT LEVEL

The MAX RF output level is set to produce exactly +10dBm at 300 MHz. This produces the minimum error over the greatest frequency range and can be checked by using the power meter while operating the instrument in the CW mode.

5.3.11 ATTENUATORS

20dB Vernier: The accuracy of the 20dB vernier can be checked using the power meter while operating the instrument in the CW mode. The vernier dial is calibrated at 300 MHz. Dial accuracy is ± 0.5 dB to 500 MHz, ± 1 dB to 1000 MHz, and ± 2 dB to 1400 MHz. This error is contributed by the vernier and does not include the basic flatness error at +10dBm.

70dB Attenuator: The accuracy of the step attenuator can be measured by using a suitable Attenuation Test Set or by directly substituting precision RF attenuator pads for each 10dB step of the attenuator. The difference between the two outputs represents the attenuator error. An RF

detector can be used to recover the signal at levels down to approximately -40dBm. Below this level an RF amplifier or sensitive receiver (spectrum analyzer) must be used. Allowability error is $\pm 0.5\text{dB}$ to 500 MHz, $\pm 1\text{dB}$ to 1000 MHz, and $\pm 2\text{dB}$ to 1400 MHz. This error is that produced by the step attenuator alone and does not include the basic flatness or the vernier attenuator error.

5.3.12 SWEEP TIME CHECK (Horizontal Output Check)

Connect the horizontal output of the sweep generator to the oscilloscope vertical input. Adjust the oscilloscope controls for an internally generated, automatic, line-triggered sweep of 2ms/cm and a vertical sensitivity of 2V/cm. Adjust the sweep generator SWEEP TIME selector to LINE lock and ensure that the TRIG/RECUR switch is in the RECUR position. Adjust the oscilloscope vertical position, horizontal position, and trigger level to obtain the wave-form shown in Figure 5-6.

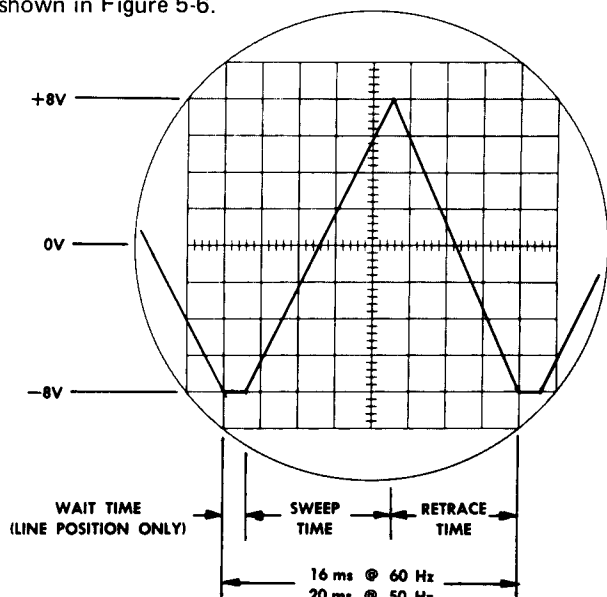


Figure 5-6. Scope Horizontal Output

Adjust the sweep generator SWEEP TIME selector to .1-.01 position. Ensure that the VARIABLE MANUAL control is fully clockwise. The wait time should disappear and the sweep time should be less than 10ms with approximately equal sweep time and retrace time periods. Adjust the oscilloscope time base to 50ms/cm. Adjust the sweep generator VARIABLE/MANUAL control fully counterclockwise. The sweep time should be more than 100ms with approximately a 10:1 ratio between the sweep and retrace time periods.

NOTE: The retrace time period remains constant within any one SWEEP TIME range setting and the VARIABLE/MANUAL control varies the sweep time period. With the

VARIABLE/MANUAL control fully clockwise the sweep and retrace times are both approximately 0.01 seconds. With the control fully counterclockwise the sweep time becomes approximately 0.1 seconds and the retrace time remains 0.01 seconds. On the next lower range (1-.1) the retrace time would remain 0.1 sec and the sweep time would vary from 0.1 to 1 second.

Repeat these checks for the 1-.1, 10-.1, and 100-10 sec positions of SWEEP TIME selector switch. Adjust oscilloscope time base as necessary to ensure that the VARIABLE/MANUAL control will adjust the sweep time from faster than the maximum to slower than the minimum specifications for each range.

Adjust the SWEEP TIME selector to MANUAL and adjust the VARIABLE/MANUAL throughout its range. A DC voltage should be present that is variable from -8V, $\pm 0.5\text{V}$, with the control fully counterclockwise to +8V, $\pm 0.5\text{V}$, with the control fully clockwise.

Adjust the SWEEP TIME selector to the .1-.01 position and set the TRIG/RECUR switch to TRIG. The sweep should now be disabled. Moving the switch to the upper most position (spring loaded position) and releasing it should produce one complete sweep cycle.

NOTE: The triggered mode of operation is only possible in the variable rate positions and will not operate in the LINE lock position of the SWEEP TIME selector.

5.3.13 MARKER SYSTEM CHECK

Connect the equipment as shown in Figure 5-4. Adjust the sweep generator and oscilloscope controls to obtain the display shown in Figure 5-5. The actual control settings would be the same as in paragraph 5.3.2.

NOTE: The following performance check is for a 50 MHz harmonic marker. Specifications, with the exception of spurious markers, are the same for either single frequency or harmonic type markers and the procedure for verification of performance does not differ.

Single frequency markers should have no spurious markers throughout the swept range. Harmonic type markers may or may not have small spurious markers at one half or one third the specified marker interval.

MARKER SIZE

Observe the markers and ensure they are of equal amplitude throughout the range. Repeat this check for bands 2 and 3.

Set the oscilloscope vertical gain to 2V/cm and adjust the **MARKER SIZE** control fully clockwise. The markers should be approximately 12V peak-to-peak in amplitude. Set the **MARKER SIZE** switch to mid-position and adjust the oscilloscope vertical gain to 50mV/cm. The markers should be approximately 50mV peak-to-peak in amplitude. Adjust the **MARKERS SIZE** control fully counterclockwise and set the oscilloscope vertical gain to 100uV/cm. The markers should be less than 100uV peak-to-peak in amplitude. Set the **MARKER SIZE** switch to the down position and adjust the oscilloscope vertical gain to 50mV/cm. The markers should be approximately 50mV peak-to-peak in amplitude. Set the **MARKER SIZE** switch to the up position. Positive rectified markers should be present for use with X-Y recording instruments. The amplitude will be dependent on the output impedance of the RF detector being used. The amplitude should be adjustable from approximately 6V maximum to 1mV minimum with a detector impedance of 1 meg ohm, or from 0.5V to 1mV with a detector impedance of 0 ohms. **NOTE:** The sweep width must be decreased or the sweep time increased to observe the rectified marker.

MARKER TILT

Set the **MARKER SIZE** switch to the down position and set the **MARKER TILT** switch to the up position.

While adjusting the **MARKER SIZE** control throughout its range, note that the birdy marker is adjustable from a 12V peak-to-peak vertical marker to a horizontal marker approximately equal to 10% of the horizontal deflections (1 cm on a 10cm deflection).

MARKER WIDTH

Return the **MARKER TILT** switch to the down position. Turn on the 1 MHz markers and adjust the **MARKER SIZE** control for approximately a 4cm marker. Adjust the **CENTER FREQUENCY** and **SWEEP WIDTH** controls to calibrate the oscilloscope for a 1 MHz sweep width.

Adjust the **CENTER FREQUENCY** to center the birdy zero beat on the oscilloscope center graticule line and note that the marker width is approximately 400 KHz wide (each cm equals 100 kHz). Decrease the **MARKER WIDTH** switch one position and note that the marker is approximately 200 kHz wide. Decrease the **MARKER WIDTH** switch one position and note that the marker is approximately 100 kHz wide. Decrease the **MARKER WIDTH** switch to the most narrow position. The marker is now approximately 10 kHz wide.

MARKER ACCURACY

Marker accuracy may be verified by one of several methods. The first method requires a signal generator and a frequency counter covering the desired marker frequency. First adjust the sweep generator's center frequency to the markers frequency and the sweep width to approximately 2 MHz. Connect the output from the signal generator to the **EXTERNAL MARKER IN** jack, located on front panel, and carefully adjust the signal generator for a zero beat with the internally generated birdy marker. Next, connect the signal generator's output to the counter and read the signal generator frequency which is now identical to the internal markers frequency. Allowable error is 0.005% of the marker frequency. The second method uses the counter only but requires the removal of the instrument and marker module covers. Probe the marker box with the input lead from the counter until sufficient signal is picked up to provide a counter reading. The highest crystal frequency used is 50 MHz. Markers above this frequency use harmonics of the crystal frequency. Again the allowable error is 0.005% of the crystal frequency.

Test equipment for the marker accuracy check is not listed in the recommended test equipment chart since the requirements vary with the method and the specific markers installed in the unit. Also, the inherent stability of the quartz crystal makes a marker accuracy check unnecessary in all but the most critical applications.

5.3.14 EXTERNAL PROGRAMMING

External programming inputs are not normally checked on incoming inspection unless these special functions are to be used in a particular application. The program input signals, external controls necessary, and input pin connectors are covered in Section 3 under Operating Instructions. If it is necessary to check these functions at incoming inspection, reference can be made to that section of the manual for complete set-up instructions.

5.4 MECHANICAL ADJUSTMENT OF FREQUENCY INDICATOR TAPES

Rotate both **START** and **STOP** thumb wheels to their lowest frequency position, turn to left. Both frequency indicators must read 0 MHz \pm 2 MHz when read on the **SWEEP WIDTH** frequency scale; if not, proceed as follows: With reference to Figure 5-7, disengage **IDLER** by forcing **IDLER SPRING** to a disengaged position. While **IDLER** is disengaged, rotate the **TAPE DRIVE** until the frequency indicator indicates zero frequency, release the **IDLER SPRING** and engage the **IDLER**. If the frequency error is

still more than 2 MHz, loosen the screw holding the TAPE GUIDE and rotate the GUIDE so the TAPE can be disengaged from the sprockets on the TAPE DRIVE. Disengage the TAPE from the TAPE DRIVE sprockets and advance the tape one sprocket in the opposite direction of the frequency error. Engage the TAPE on the sprockets, reposition the TAPE GUIDE and tighten the screw. Again disengage the IDLER and turn the TAPE DRIVE to indicate zero frequency. The Front Panel frequency control thumb wheel must be held against its mechanical stop during the entire adjustment procedure.

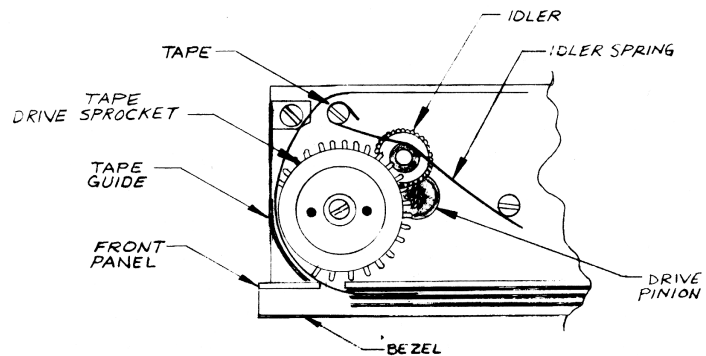


Figure 5-7. Tape Drive

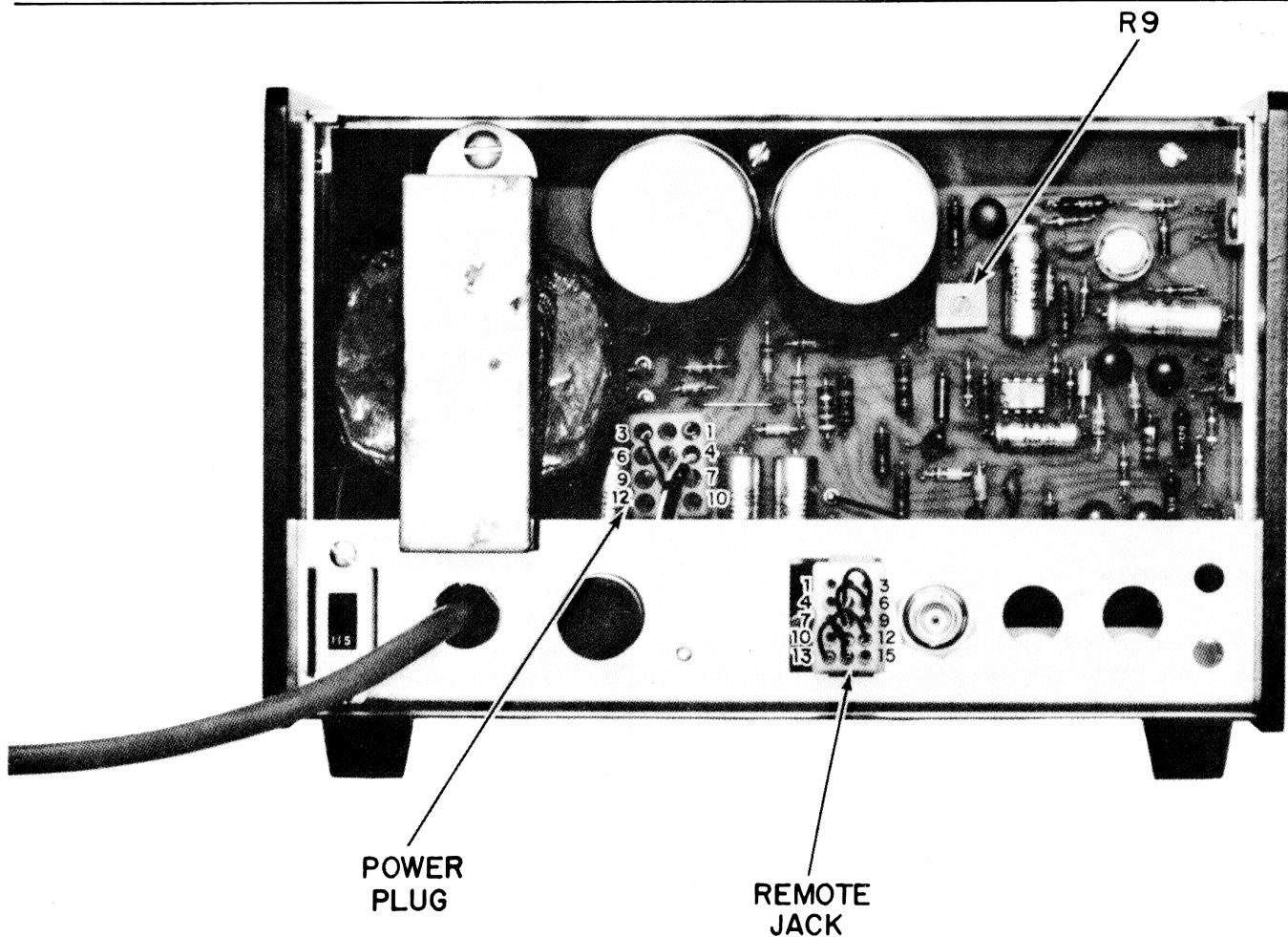


Figure 5-8. Power Supply

5.5 CALIBRATION PROCEDURE

Remove top cover, bottom cover, left side panel and M2H module cover. Allow a 15 minute warm-up period before

calibrating. In general, calibration must be performed in the sequence given. Refer to Figures 5-8, 5-9 and 5-17 for adjustment and test point location.

5/03

✓ 5.5.1 +18 VOLT ADJUSTMENT 18.008

Connect the digital voltmeter to the +18 volt supply, pin 6 on the power plug and adjust R9 to produce $+18V \pm 10mV$. (See Figure 5-8).

✓ 5.5.2 -18 VOLT CHECK -18.016

Connect the digital voltmeter to the -18 volt supply, pin 4 on power plug. The reading must be -18 volts $\pm 50mV$.

✓ 5.5.3 -20 VOLT CHECK 20.31

Connect the digital voltmeter to the 20 volt supply, pin 5 on the power plug. The reading must be -20 volts $\pm 0.3V$.

✓ 5.5.4 -16 VOLT CHECK 16.005

CAUTION: The + and -16 volt supplies are not short circuit protected. Connect the digital voltmeter to the -16 volt supply, pin 3 of the remote jack. It must read -16 volts ± 0.1 volt. (Record reading).

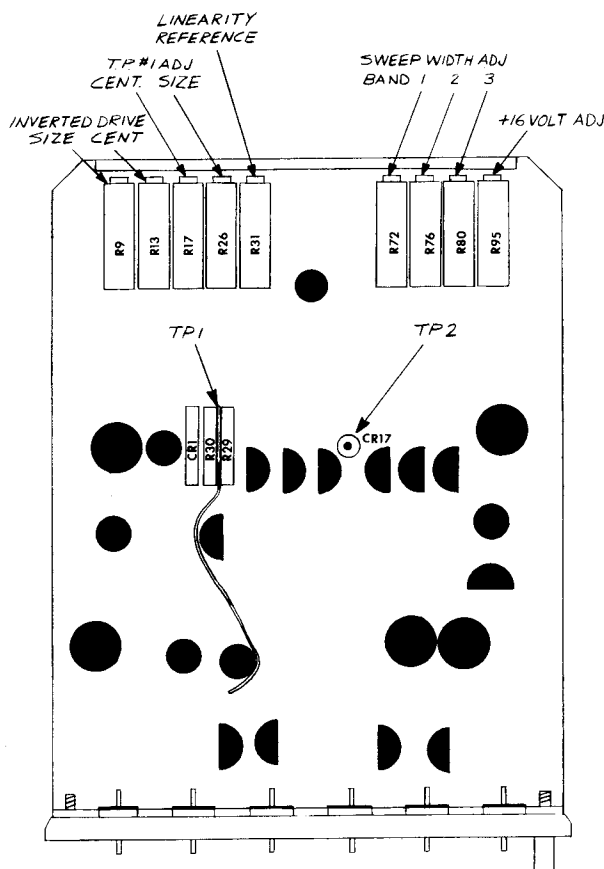


Figure 5-9. M2H Module

✓ 5.5.5 +16 VOLT ADJUSTMENT 16.005

Connect the digital voltmeter to the +16 volt supply, pin 2 of the remote jack, and adjust R95 (see Figure 5-9) to obtain exactly the same voltage, but of opposite polarity, as recorded for the -16 volt supply in paragraph 5.5.4.

5.5.6 SWEEP RATE ADJUSTMENTS – MODULE M1H

See Figure 5-17 for location of M1H module and adjustment. Set Front Panel controls as follows: TRIG/RECUR switch to RECUR, SWEEP TIME switch to .1-.01 sec, and VAR/MANUAL control completely clockwise. Connect the scope vertical input to the output of the rate generator, pin 10 of the REMOTE jack, and adjust the scope vertical and horizontal time base controls to produce a stable pattern similar to Figure 5-10. Adjust M1H CENT control to obtain an output symmetrical about zero volts and the M1H SIZE control to obtain the 32 volt peak-to-peak amplitude. This is a preliminary adjustment, final adjustment will be covered in paragraph 5.5.7.

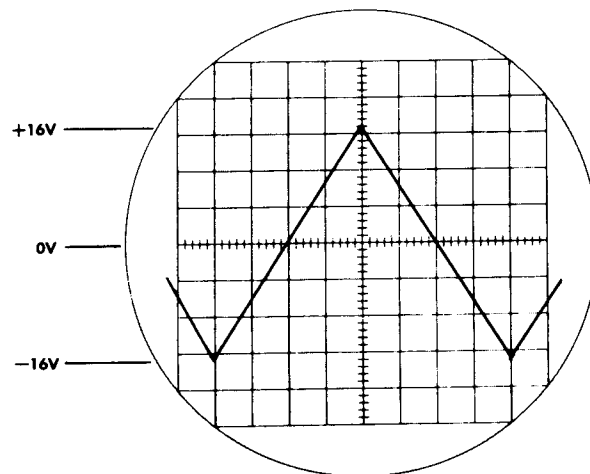


Figure 5-10. Sweep Ramp (M1H Output)

Next set the Front Panel VAR/MANUAL control fully CCW and adjust the M1H INT/BAL to produce a sweep time of 0.12 seconds. See Figure 5-11.

Then set the Front Panel SWEEP TIME to LINE and adjust the M1H CLAMP control to clamp the negative going peak of the M1H output to -16 volts. See Figure 5-12.

Finally adjust the WAIT control mounted on rear of the SWEEP TIME switch assembly, see Figure 5-17, until the wait time as shown in Figure 5-12 is approximately 1 millisecond.

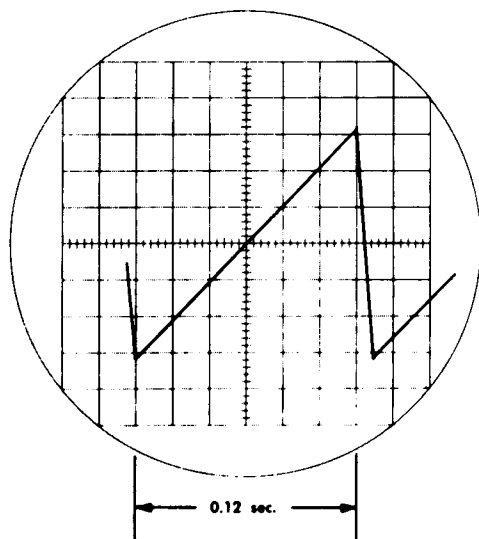


Figure 5-11. M1H Bal Adjustment

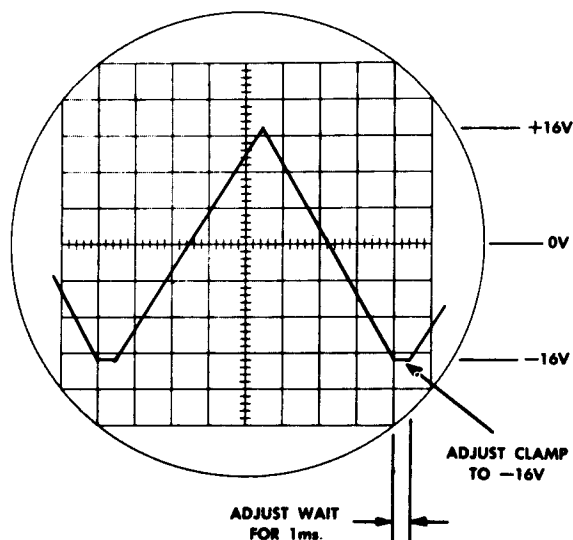


Figure 5-12. Sweep Ramp

5.5.7 RELATIONSHIP BETWEEN +16, -16, SWEEP RAMP and INVERTED SWEEP RAMP

The next step is possibly the most critical to the overall performance of the generator and requires some explanation.

The frequency accuracy of the unit is dependent on the +16 volt reference supply, the -16 volt reference supply, the 32 volt peak-to-peak sweep ramp and the inverted 32 volt sweep ramp. These four voltages must be precisely adjusted in relation to each other to maintain dial and display accuracy.

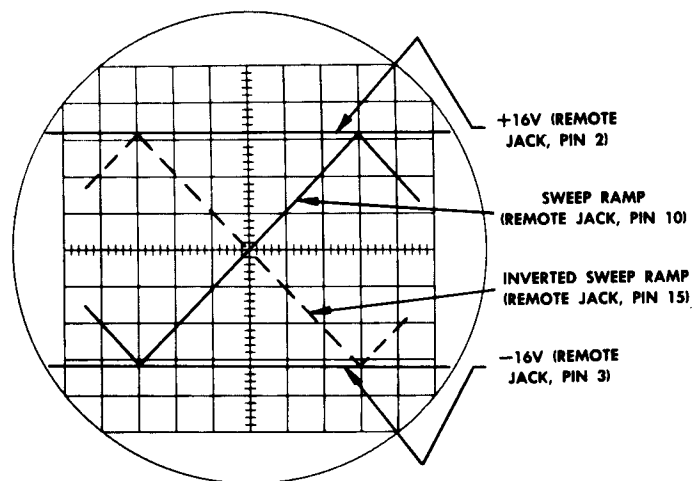


Figure 5-13. Relationship Between Sources

The + and -16 volt references can easily be set up accurately as already described in paragraphs 5.5.4 and 5.5.5. The next problem is to adjust the peak "positive and negative" excursions of the sweep ramp, M1H pin 12, to within 0.1 volt of the +16 volt and -16 volt references.

Since the entire 32 volt change from -16 to +16 volts is equivalent to a frequency change of 520 MHz, the 0.1 volt ramp accuracy would be equivalent to a frequency error, due to the program voltage, of 1.6 MHz, which is allowable.

It can be seen in the initial adjustment of the sweep ramp, made in paragraph 5.5.6, that the required 0.1 volt resolution when viewing the entire 32 volt sweep ramp is not obtainable. Offsetting the scope position control to view only the positive or negative peak is not practical since the M1H CENT and SIZE adjustments vary both the positive and negative peaks. A practical approach is to use a scope probe containing two back-to-back 12 volt zener diodes in a zero suppressing circuit. The schematic of the probe is shown in Figure 5-14.

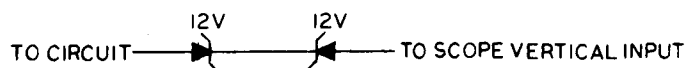


Figure 5-14. Zero Suppressing Probe

Repeat the adjustment procedure outlined in paragraph 5.5.6, with the zero suppressing probe. However, this time set the scope vertical sensitivity to 1 volt/cm. Instead of the waveform shown in Figure 5-10, the waveform shown in Figure 5-15 should be present.

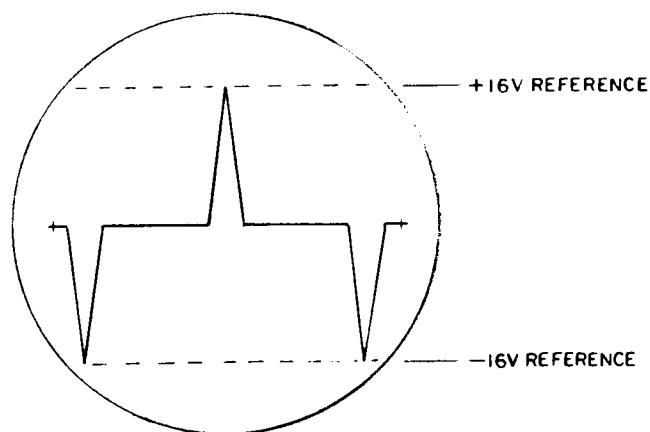


Figure 5-15. Sweep Ramp (Probe)

Calibrate the display by connecting the probe to +16 volts, and then to -16 volts. Mark these points on the scope face or record the exact amplitude of the 16 volt references. Next, connect the probe to the sweep ramp, REMOTE plug pin 10, and adjust the M1H CENT and SIZE controls until the positive and negative peaks agree precisely with the + and -16 volt calibration points. Repeat the calibration to check for scope drift while the adjustments were being made.

Next, adjust the inverted sweep ramp in the same manner

by connecting the probe to REMOTE Plug, pin 15, and adjusting M2H, R9 (SIZE), and M2H, R13 (CENT). See Figure 5-9.

5.5.8 SWEEP DRIVE ADJUSTMENT – MODULE M2H

Connect the scope vertical INPUT (straight connection, do not use the zero suppressing probe) to test point #1 in the M2H module. See Figure 5-9. Set the Front Panel MODE switch to Δf , SWEEP WIDTH control for minimum and the CENTER FREQUENCY control to indicate a dial frequency of 250 MHz on band 1, then adjust M2H, R17 for zero volts at TP1.

Next, adjust the Front Panel SWEEP WIDTH control to MAXIMUM sweep width. Do not move the Front Panel CENT FREQ control. Adjust M2H, R26, for a 28 volt peak-to-peak signal at test point #1.

Without disturbing the Front Panel CENT FREQ or SWEEP WIDTH adjustments return the scope to an X-Y operating mode with the HORIZ OUTPUT of the sweep generator driving the scope X input. Set the SWEEP TIME to .1-.01 sec and adjust the SCOPE display width to 10.4cm (.2cm overlap on each end). See Figure 5-16a.

Connect the scope Y input to M2H test point #2, which is the top side of any of the three diodes adjacent to M2H, Q7. (Linearity correcting resistors may or may not be connected to the diodes depending on the inherent linearity of the sweep oscillator). Adjust M2H, R31, to position the "knee" approximately 2/3cm to the left of the 10cm mark, as shown in Figure 5-16b. The M2H module cover, and the left side panel may now be replaced.

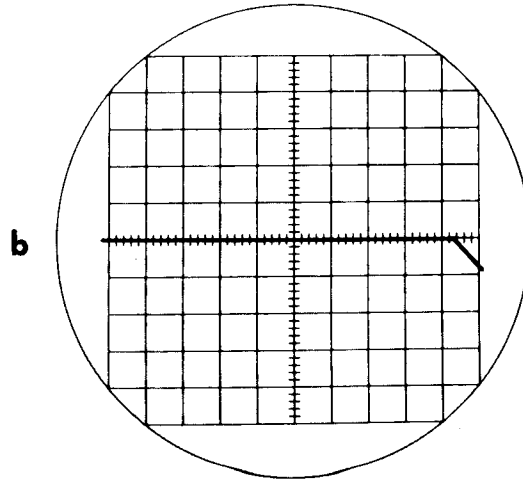
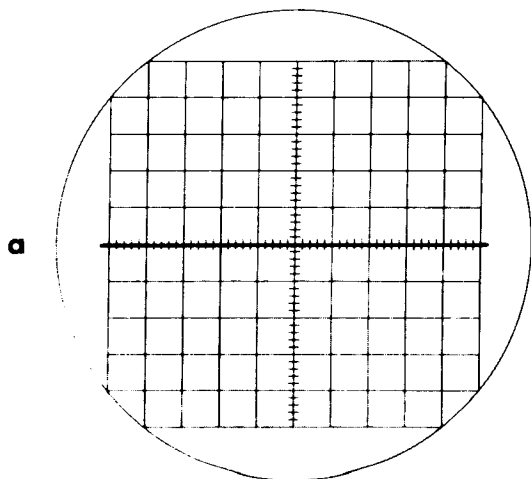


Figure 5-16. M2H Linearity Ref Adj

MAINTENANCE

5.5.9 LEVEL MIN AND MAX ADJUSTMENT — MODULE M10H

Preset the Front Panel controls as follows:

BAND Switch	to 1
MODE Switch	to CW
FREQ Control	to 300 MHz
OUTPUT Control	to +10dBm
ALC Switch	to INT

✓ Set the power meter to read +10dBm and connect the thermistor mount to the sweep generator's RF output connector. Adjust the M10H LEVEL MAX control to produce a power meter reading of exactly +10dBm. Turn the Front Panel vernier OUTPUT control to -10dBm (completely counterclockwise), change the power meter scale to read -10dBm and adjust the M10H LEVEL MIN control to produce a power meter reading of exactly -10dBm. Some interaction exists between the LEVEL MIN and LEVEL MAX controls so repeat the adjustment until both the +10 and -10dBm readings are obtained.

5.5.10 CENTER FREQUENCY AND SWEEP WIDTH ADJUST — Bands 1, 2 and 3

Connect SWEEP, SCOPE and RF DET as shown in TYPICAL SET-UP, Figure 5-4. Set:

BAND Switch	to 1
MODE Switch	to Δf
CENTER FREQUENCY Control	to 250 MHz
SWEEP WIDTH Control	to 520 MHz
OUTPUT Control	to +10dBm
SWEEP TIME Switch	to .1-.01 sec
Four Paddle Switches	down
50 har marker Switch	on
MARKER WIDTH Switch	to WIDE
MARKER SIZE	for a display similar to Figure 5-5.

The sweep generator should be thoroughly stabilized by operating approximately one hour with all covers in place before the following adjustments are made.

Adjust the scope per Figure 5-5. Adjust the M9H CENT control, band 1, to position the 250 MHz marker at the exact center of the scope display. Adjust the M2H SWEEP WIDTH 1 to position the 0 frequency and 500 MHz markers as shown in Figure 5-5. Compromise between 0 and 500 if necessary.

Set BAND switch to 2, wait 5 minutes, then adjust the M19H CENT, BAND 2, to position the 700 MHz marker to

the exact center of the display. Adjust the M2H SWEEP WIDTH 2, to position the 450 and 950 MHz markers as shown in Figure 5-5. Compromise between 450 and 950 if needed.

Set band switch to 3, wait 5 minutes, then adjust the M19H CENT, BAND 3 to position the 1150 MHz marker to the exact center of the display. Adjust the M2H SWEEP WIDTH, BAND 3, to position the 900 and 1400 MHz markers as shown in Figure 5-5. Compromise between 900 and 1400 if needed.

5.5.11 FINAL ADJUSTMENT OF M1H CLAMP

While operating the sweep generator as set up in paragraph 5.5.10, carefully note the extreme left side of the scope display. The trace should extend 0.2cm beyond the first graticule line, as shown in Figure 5-5.

Switch SWEEP TIME from .1-.01 sec to LINE, and adjust the M1H CLAMP for the identical display width.

5.5.12 SWEEP SAMPLE ADJUSTMENT M5H

Connect the RF detector to the SWEEP SAMPLE OUT Jack of the M5H module, using the adapter cable supplied in the service kit, and adjust the M5H SWEEP SAMPLE ADJ. to produce a detected output of 35 millivolts when the Front Panel BAND switch is set to band 1.

5.5.13 MARKER SIZE ADJUSTMENT

Each marker module has a SIZE adjustment potentiometer which is accessible from the under side of the sweep generator, when the bottom cover is removed. (See Figure 5-2). The control is adjusted until a saturated marker is obtained on the scope display when operating the unit as shown in the typical set-up, Figure 5-4. A saturated marker is obtained when a further increase in the marker modules SIZE adjustment does not increase the marker amplitude on the scope display. Increasing the size adjustment beyond this point will result in spurious markers on the display.

5.6 TROUBLESHOOTING

Trouble shooting is generally a systematic procedure of "divide and conquer." A thorough understanding of the block diagram and circuit description located in Section 4 of this manual will enable the trouble symptom to be associated with a particular module. Once this has been accomplished the module can be replaced or trouble shot with the aid of the module schematic. A problem in a power supply often causes many symptoms pointing to

other areas and should be checked when the symptom does not clearly indicate a specific problem. The +18, -18, and -20V supplies are located on the rear chassis printed circuit board and the +16 and -16 reference voltage supplies are located in the M2H module. Performance of these supplies are indicated in the calibration procedure.

5.6.1 TROUBLE SHOOTING HINTS

The following is a list of several typical symptoms followed by the probable cause or a trouble shooting procedure.

INTERMITTENT OPERATION OF ANY TYPE — Defective module pin sockets or loose RF cables.

NO RF OUTPUT

ALL THREE BANDS — Defective attenuator or RF cables connecting to the input or output of the attenuator.

SINGLE BAND ONLY — Check for the presence of the band switching voltages B-1, B-2, and B-3 at module M9H, M10H, and M19H as shown on the Module Wiring Diagram.

RF OUTPUT NOT FLAT — Most common cause is the external RF detector being defective. Another is the monitor diode located in the M19H module. This is a point contact diode and can be damaged if the RF output is momentarily connected to a B+ voltage. A good monitor diode will produce a negative detected voltage (pin 8 of M19H) approximately twice the amplitude of the external detector. For example, at an RF output of +10dBm an external RF detector will read approximately 0.8V. The internal monitor, pin 8 of M19H, will read approximately -1.6V.

FREQUENCY UNSTABLE (JITTER) — Check all modules for loose hold-down screws, especially module M2H. Check the + and -16V reference supplies. Operating the unit in a strong magnetic field, such as setting on top of or adjacent to another instrument containing a large power transformer, can produce 60Hz HUM modulation.

SWEEP RATE PROBLEM — Probable cause is a defective M1H module or wiring to the Front Panel SWEEP TIME

selector switch. See the calibration procedure for verifying proper operation.

NO RF SWEEP — First check pin 12 of the M1H module for the presence of a 32V ramp. This ramp indicates proper operation of the M1H. Next check for the ramp at the input of the M2H pin 7 (ΔF mode). Finally check the output of the M2H at pin 9. It should be similar to the input except it will be lower in amplitude, approximately 12V peak-to-peak, and will have an average value of 0V when the Front Panel center frequency control is set to mid-band. If the M2H output is correct the trouble would probably be in the M9H or M19H sweep oscillator module.

MARKER PROBLEMS

To isolate the cause of a marker problem when the symptom does not clearly indicate a specific circuit or component, first check the sweep sample output at the M5H Sweep Sample Out connector. It should be a detected signal between 30 to 50 mV. If the proper sweep sample signal is not present it indicates that the trouble is in the sweep oscillator module or connecting sweep sample cables. Next connect the detector in place of the terminating plug P102.

A signal at this point indicates all jumper cables and RF jacks on the M6 modules are intact. Then check for the birdy output at pin 3 of the marker module. A 10 to 15mV peak-to-peak birdy is sufficient to drive the M5H module and indicates the M6 module is operating properly. With the 15mV peak-to-peak birdy present at the input of the M5H, pins 1, 2, 3, or 4, a 32V peak-to-peak signal will be produced at the output pin 7. This indicates proper operation of the M5H. This output signal at pin 7 is controllable in width by the Front Panel MARKER WIDTH control. The signal is now routed through the Front Panel Marker Size control and to the Front Panel SCOPE VERTICAL connector. A 12V peak-to-peak signal is normally at this point when the Front Panel SIZE control is set to maximum. A common marker problem is that caused by one of the interconnecting cables between the M6 modules being loose. This causes a notch in the sweep sample input to the module causing uneven harmonics or weak output.

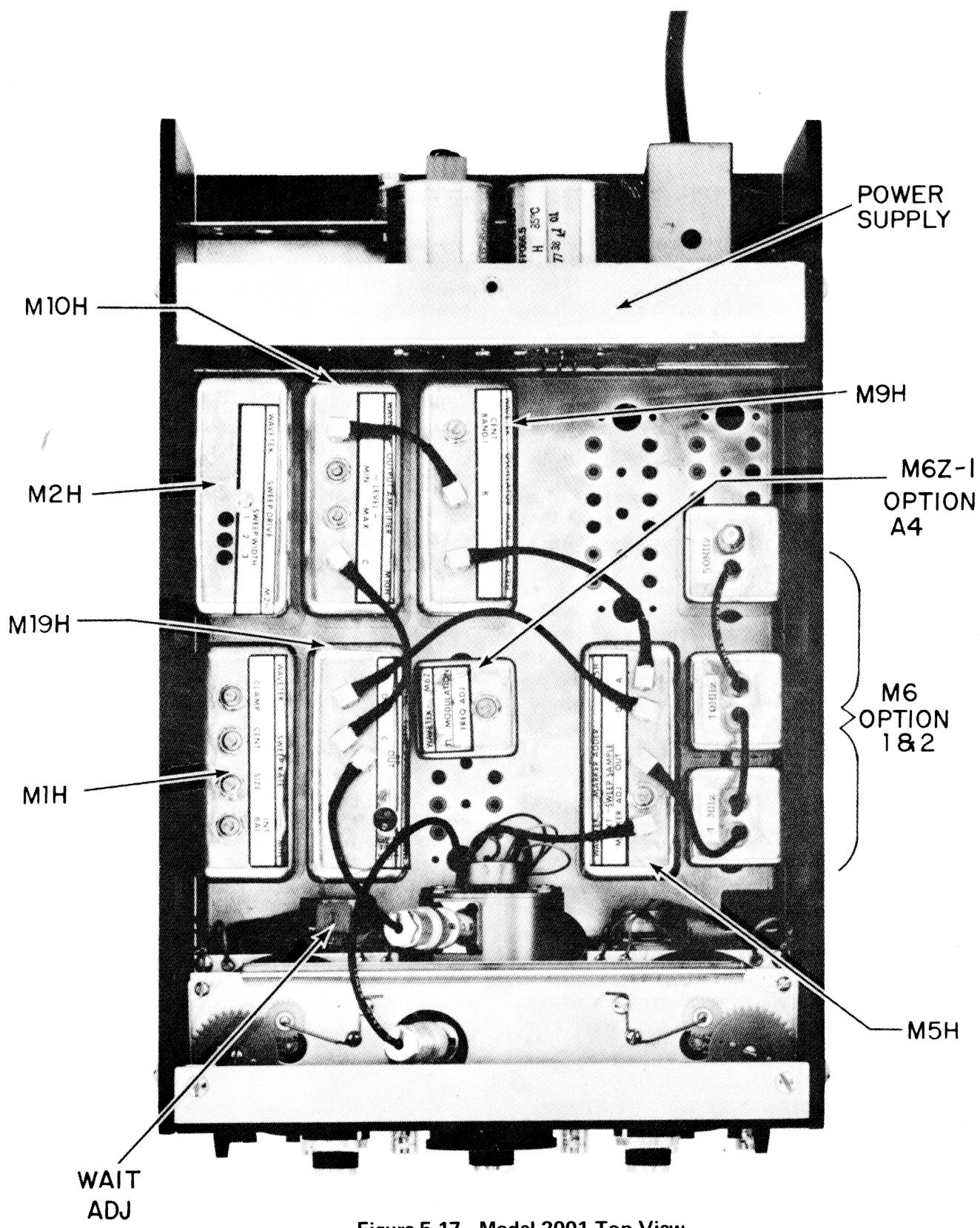


Figure 5-17. Model 2001 Top View

200014

2001

±.33
 0 - Array out
 0 - 63.0

±.9
 0

SECTION 6

REPLACEABLE PARTS

6.1 INTRODUCTION

This section contains lists of all replaceable parts for the instrument.

For an assembly containing one or more subassemblies, the assembly list appears first, and is followed by the subassembly list.

The lists appear in the following order.

<u>PARTS LIST</u>	<u>ASSEMBLY</u>
1010-00-0011	2001
1111-00-0007	SWEEP - 2001
1112-00-0008	SWEEP TIME - 2001
1112-00-0005	MKR SHPR/SZ - 2001
1118-00-0001	REMOTE PLUG - 2001
1219-00-0005	HARNES - 2001
1115-00-0001	PS6
1218-00-0012	PC - PS6
1114-00-0002	M1H
1114-00-0029	M2H
1114-00-0027	M5H
1114-00-0003	M9H
1114-00-0004	M10H
1114-00-0005	M19H
1114-00-0050	M6H-1
1114-00-0099	M6H-10
1114-00-0100	M6H-100
1114-00-0045	M6S-3
1114-00-0150	M6Z-1

6.2 MANUFACTURERS CODE

The following code is used on the parts lists to identify the manufacturer.

ABBRV	NAME.....	CITY.....	ST
A-B	ALLEN-BRADLEY	MILWAUKEE	WI
A-D	ANALOG DEVICES	CAMBRIDGE	MA
A-H	ARROW HART, INC.	KEETERING	OH
A-I	ALAN INDUSTRIES	COLUMBUS	IN
A-M	AMERICAN MAGNETICS	CARTERVILLE	IL
A-P	AMERICAN PLASTICRAFT CO.	CHICAGO	IL
ABAC	ABACUS PACKAGING CO.	CHICAGO	IL
ACI	ADVANCE COMPONENTS, INC.	CENTERBROOK	CT
AER	AVX CERAMICS	MYRTLE BEACH	SC
AERTK	AERTECH INDUSTRIES	SUNNYVALE	CA
AHAM	AHAM COMPANY	AZUSA	CA
AIN	ALPHA INDUSTRIES, INC.	WOBURN	MA
ALC	ALCO ELECTRONICS PRODUCTS	NORTH ANDOVER	ME
ALLPL	ALL PLASTICS, INC.	INDIANAPOLIS	IN
AMP	AMP, INC.	HARRISBURG	PA
APL	AMPHENOL CONNECTOR SYSTEMS	BROADVIEW	IL
APX	AMPEREX ELECTRONIC CORP.	SLATERSVILLE	RI
ARC	ARCO ELECTRIC PRODUCTS	SHELBYVILLE	IN
ASC	ASSOCIATED SPRING	BRISTOL	CT
ASE	AIRCO SPEER ELECTRONICS	ST. MARYS	PA
AT/IN	ATLANTIC INDIA RUBBER COMPANY	CHICAGO	IL
ATC	AMERICAN TECHNICAL CERAMICS	HUNTINGTON STATION	NY
ATR	ATR COIL CO.	BLOOMINGTON	IN
AUGAT	AUGAT, INC.	ATLEBORO	MA
AVT	AVANTEK, INC.	SANTA CLARA	CA
AWC	ALPHA WIRE	ELIZABETH	NJ
B-T	BEK-TEK, INC.	READING	PA
BEK	BECKMAN INSTRUMENTS, INC.	FULLERTON	CA
BEL	BELDEN CORP.	GENEVA	IL
BER	BERG ELECTRONICS	NEW CUMBERLAND	PA
BGH	BEECH GROVE HARDWARE	BEECH GROVE	IN
BOU	BOURNS, INC.	RIVERSIDE	CA
BREZ	BREEZE CORPORATIONS, INC.	UNION	NJ
BUCK	BUCKEYE STAMPING CO.	COLUMBUS	OH
BUD	BUD RADIO, INC.	WILLOUGHBY	OH
BURND	BURNDY CORP.	NORWALK	CT
BUS	BUSSMAN MFG.	ST. LOUIS	MO
C-D	CORNELL DUBILIER ELECT. DIV.	NEWARK	NJ
C-E	CLINTON ELECTRONICS	ROCKFORD	IL
C-H	CUTLER-HAMMER, INC.	MILWAUKEE	WI
C-I	COMPONENTS, INC.	BIDDEFORD	ME
C-J	TRW/CINCH	ELK GROVE VILLAGE	IL
C-K	C & K COMPONENTS, INC.	WATERTOWN	MA
C-L	CENTRALAB DIV.	MILWAUKEE	WI
C-W	C-W INDUSTRIES	WARMINSTER	PA
CAM	CAMBION	CAMBRIDGE	MA
CAR	CARLING ELECTRIC, INC.	WEST HARTFORD	CT
CDC	COMPONENT DEVELOPMENT CORP.	CARSON	CA
CECO	CENTRAL COIL CO.	BRAZIL	IN
CGW	CORNING GLASS WORKS	CORNING	NY
CHE	CHERRY ELECTRICAL PRODUCTS	WAUKEGAN	IL
CIMCO	CIMCO WIRE AND CABLE INC.	ALLENDALE	NJ
CKI	CTS KNIGHTS, INC.	SANDWICH	IL
CLA	CLAIREX CORP.	MT. VERNON	NY
CLAR	CLAROSTAT MFG. CO	DOVER	NH

ABBRV	NAME.....	CITY.....	ST
CLFX	COLE-FLEX CORP.	BABYLON	NY
CPKG	CREATIVE PACKAGING DIV.	INDIANAPOLIS	IN
CTS	CHICAGO TELEPHONE SYSTEMS	CHICAGO	IL
CTS-E	CTS OF ELKHART	ELKHART	IN
CTSB	CTS OF BERNE	BERNE	IN
CTSBV	CTS OF BROWNSVILLE	BROWNSVILLE	TX
DAL	DALE TECHNOLOGY CORP.	HARTSDALE	NY
DAV	HARRY DAVIES MOLDING CO.	CHICAGO	IL
DEL	DELEVAN DIV.	EAST AURORA	NY
DEW	DEWIRE FABRICATING CORP.	LOWELL	MA
DIO	DIODES, INC.	CHATSWORTH	CA
DRA	DRAKE MANUFACTURING CO.	HARWOOD HEIGHTS	IL
E-C	ELECTRONIC CRYSTALS	KANSAS CITY	MO
E-M	ELECTRA/MIDLAND CORP.	MINERAL WELLS	TX
ELCO	ELCO INDUSTRIES	ROCKFORD	IL
ELFX	ELECTRO-FLEX HEAT INC.	BLOOMFIELD	CT
EPITK	EPITEK ELECTRONICS	KANATA, ONT., CAN.	**
ETP	ERIE TECHNOLOGICAL PRODUCTS	ERIE	PA
EXAR	EXAR INTEGRATED SYSTEMS	SUNNYVALE	CA
F-K	FROST-KING	****	CT
F-S	FEDERAL SCREW	CHICAGO	IL
FAN	FAN COURT & CO.	GREENSBORO	NC
FCD	FAIRCHILD	MOUNTAIN VIEW	CA
FRTE	FAIR RITE PRODUCTS CORP.	WALLKILL	NY
FRXC	FERROXCUBE DIVISION	SAUGERTIES	NY
G-E	GENERAL ELECTRIC	INDIANAPOLIS	IN
G-H	GRAYHILL, INC.	LA GRANGE	IL
G-I	GEN'L INSTRUMENT SEMICONDUCTOR	HICKSVILLE	NY
GAL	GALILEO ELECTRO-OPTICS	CARMEL	IN
GRIES	GRIES REPRODUCER	NEW ROCHELLE	NY
GRIP	GRIPMASTER CO.	MARLBORO	NJ
GUDL	GUDEBROD BROS. SILK CO.	CHICAGO	IL
H-P	HEWLETT-PACKARD	INDIANAPOLIS	IN
HEL	HELIPOT	ANAHEIM	CA
HEY	HEYMAN MFG. CO.	WAUKESHA	WI
HHS	HERMAN H. SMITH, INC.	BROOKLYN	NY
HIT	HITACHI AMERICA, LTD.	SAN FRANCISCO	CA
HOLUB	HOLUB DISTRIBUTING CO.	NEWPORT	KY
HUD	HUDSON TOOL & DIE CO.	NEWARK	NJ
HY/PL	HYDRO PLASTICS INC.	GEORGETOWN	KY
HYT	HYTRONICS	PINELLAS PARK	FL
INT	INTERSIL, INC.	CUPERTINO	CA
IRC	INTERNATIONAL RESISTANCE CO.	PHILADELPHIA	PA
ITT	INT'L TELEPHONE & TELEGRAPH	W. PALM BEACH	FL
JAN	JAN HARDWARE MFG. CO.	LONG ISLAND CITY	NY
JEF	JEFFERS	DUBOIS	PA
JEFWC	JEFFERSON WIRE AND CABLE	WORCHESTER	MA
JEW	JEWELL ELECTRICAL INSTRUMENTS	MANCHESTER	NH
JHSN	JOHANSON MANUFACTURING CORP.	BOONTON	NJ
JON	E.F. JOHNSON CO.	WASECA	MN
K-L	KERRIGAN LEWIS MFG.	CHICAGO	IL
K-S	K & S ENGINEERING CO.	CHICAGO	IL
KEENE	KEENE CORP.	NEWARK	DE
KEM	KEMTRON ELECTRON PRODUCTS	NEWBURYPORT	MA

ABBRV	NAME.....	CITY.....	ST
KEY	KEYSTONE ELECTRONIC CORP.	NEW YORK	NY
KID	KIDCO, INC.	MEDFORD	NJ
KIN	KINGS ELECTRONICS	TUCKAHOE	NY
KSTR	KESTER SOLDER DIV.	CHICAGO	IL
KSW	KSW ELECTRONICS	INDIANAPOLIS	IN
LEYSE	LEYSE ALUMINUM CO.	KEWANEE	WI
LIT	LITTELFUSE, INC.	DES PLAINES	IL
LRC	LRC ELECTRONICS, INC.	HORNELL	NY
M-A	MICROWAVE ASSOCIATES	BURLINGTON	MA
M-D	MILLER DIAL & NAMEPLATE CO.	EL MONTE	CA
M-E	MEPCO ELECTRA, INC.	MORRISTOWN	NJ
M-O	ILLUMINATED PRODUCTS INC.	SANTA ANA	CA
MAL	MALLORY CONTROLS CO.	FRANKFORT	IN
MAND	MANDEX	CHICAGO	IL
MDC	MAIDA DEVELOPMENT CO.	HAMPTON	VA
MILN	MILLEN MFG. CO.	NEW YORK	NY
MMM	3M COMPANY	ST. PAUL	MN
MOL	MOLEX PRODUCTS	LISLE	IL
MOT	MOTOROLA SEMI. PROD. DIV.	INDIANAPOLIS	IN
MSP	MICRO SEMICONDUCTOR CORP.	SANTA ANA	CA
MYERS	MYERS SPRING CO.	LOGANSPOUT	IN
N-T	NATIONAL TEL-TRONICS	LAREDO	TX
NAT	NATIONAL SEMICONDUCTOR CORP.	SANTA CLARA	CA
NEC	NIPPON ELECTRIC CO.	TOKYO, JAPAN	**
NEW	NEWARK ELECTRONICS	INDIANAPOLIS	IN
NYLO	NYLOMATIC	MORRISVILLE	PA
O-G	OPTI-GAGE INC.	DAYTON	OH
O-S	OMNI SPECTRA INC.	FARMINGTON	MI
OAK	OAK INDUSTRIES INC.	CRYSTAL LAKE	IL
OHM	OHMITE MFG. CO.	SKOKIE	IL
OMEGA	OMEGA WIRE & CABLE	HARLEYSVILLE	PA
OPTRN	OPTRON INC.	CARROLLTON	TX
P-B	POTTER AND BRUMFIELD	PRINCETON	IN
P-C	POWER COMPONENTS	WOODLAND HILLS	CA
P-K	PARKER KALON CORP.	CLIFTON	NJ
R-T	PENN TUBE PLASTICS CO.	CLIFTON HEIGHTS	PA
PAND	PANDUIT CORP.	TINLEY PARK	IL
PARA	PARAMETRIC INDUSTRIES	NORTHFIELD	IL
PEC	PACIFIC ELECTRICORD CO.	GARDENA	CA
PEC	PACIFIC ELECTRICORD CO.	GARDENA	CA
PHC	PHILADELPHIA HANDLE CO.	CAMDEN	NJ
PLSSY	PLESSEY ENG.	SCHILLER PARK	IL
POM	POMONA ELECTRONICS CO., INC.	POMONA	CA
PRMD	PYRAMID INDUSTRIES, INC.	PHOENIX	AZ
PRSN	PRECISION TUBE CO., INC	NORTH WALES	PA
PTN	PENN TRAN CORP.	BELLEFONT	PA
PYRO	PYROFILM CORP.	WHIPPANY	NY
PYTT	PYTTRONICS INDUSTRIES, INC.	MONTGOMERYVILLE	PA
Q-C	QUALITY COMPONENTS	ST. MARYS	PA
RAY	RAYTHEON	INDIANAPOLIS	IN
RCA	RCA	CAMDEN	NJ
REL	RELIANCE MICA CO.	BROOKLYN	NY
RICH	RICHCO PLASTIC CO.	CHICAGO	IL
RMC	RADIO MATERIALS CORP.	CHICAGO	IL
ROGAN	ROGAN CORP.	NORTHBROOK	IL

ABBRV	NAME.....	CITY.....	ST
S-C	SPECIALTY CONNECTOR	INDIANAPOLIS	IN
S-G	STANDARD GRIGSBY	AURORA	IL
S-I	SWITCHCRAFT, INC.	CHICAGO	IL
S-S	SERVICE SUPPLY	INDIANAPOLIS	IN
S-T	SARKES TARZIAN	BLOOMINGTON	IN
SCBE	SCANBE DIVISION	EL MONTE	CA
SCC	STACKPOLE CARBON CO.	ST. MARYS	PA
SEAST	SEASTROM MFG. CO.	GLENDALE	CA
SEL	SEAELECTRO CORP.	MAMARONECK	NY
SEM	SEMTECH	NEWBURY PARK	CA
SGM	SIGMA INSTRUMENTS	BRAINTREE	MA
SHAM	SHAMROCK PLASTICS & RUBBER CO.	INDIANAPOLIS	IN
SIEM	SIEMENS	ISELIN	NJ
SIG	SIGNETICS CORPORATION	SUNNYVALE	CA
SOUTH	SOUTHCO FASTENERS	LESTER	PA
SPE	SPECTROL	DAYTON	OH
SPEC	SPECTRUM CONTROL, INC.	FAIRVIEW	PA
SPR	SPRAGUE ELECTRIC CO.	INDIANAPOLIS	IN
SSS	SOLID STATE SCIENTIFIC	MONTGOMERYVILLE	PA
STR	STETTNER TRUSH CO.	CAZENOVIA	NY
STSA	STEEL SALES	INDIANAPOLIS	IN
SYL	GTE SYLVANIA	WALTHAM	MA
SYS	SYSCON INTERNATIONAL, INC.	SOUTH BEND	IN
T-I	TEXAS INSTRUMENTS	DALLAS	TX
TCPL	TACONIC PLASTIC	PETERSBURG	NY
TEK	TEKTRONIX	INDIANAPOLIS	IN
TELE	TELETYPE CORP.	ELK GROVE VILLAGE	IL
THR	THERMALLOY CO.	DALLAS	TX
TIMES	TIMES WIRE AND CABLE	CINCINNATI	OH
TIN	TINNERMAN PRODUCTS, INC.	CLEVELAND	OH
TKN	TECHNICAL WIRE	CRAWFORD	NJ
TLNC	TELONIC ALTAIR	LAGUNA BEACH	CA
TORCO	TOR CORP.	VAN NUYS	CA
TRU	WALDES TRUARC	LONG ISLAND CITY	NY
TRW	TRW CAPACITOR DIV.	OGALLALA	NE
U-C	UNIVERSAL COMPONENTS	LOS ANGELES	CA
UNIC	UNICORP	ORANGE	NJ
UNIT	UNITRODE CORP.	WATERTOWN	MA
USECO	USECO DIV.	VAN NUYS	CA
VAC	VACTEC INC.	MARYLAND HEIGHTS	MO
VAR	VARADYNE CAPACITOR DIV.	SANTA MONICA	CA
VARIL	VARI-L CO.	DENVER	CO
VLIER	VLIER ENGINEERING CORP.	BURBANK	CA
VONGT	VONNEGUT HARDWARE	INDIANAPOLIS	IN
W-E	WELLS ELECTRONICS	SOUTH BEND	IN
W-I	WAVETEK INDIANA, INC.	BEECH GROVE	IN
WAG	WAGNER ELECTRIC CORP.	ST. LOUIS	MO
WECK	WECKESSER CO., INC.	CHICAGO	IL
WKFLD	WAKEFIELD ENGINEERING	WAKEFIELD	MA
WSD	WAVETEK	SAN DIEGO	CA
WSR	WAVETEK	SANTA ROSA	CA
ZEN	ZENITH RADIO CORP.	CHICAGO	IL
ZERO	ZERO MANUFACTURING CO.	BURBANK	CA
ZPT	ZIPPERTUBING, CO.	LOS ANGELES	CA

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	ATTEN, 5070-01	5070-01	W-I	1113-30-0024	1
2	MKR SHPR/SZ ASSY B500-224	B500-224	W-I	1112-00-0005	1
3	SWEEP TIME SW ASSY B500-225	B500-225	W-I	1112-00-0008	1
4	REMOTE JUMPER PLUG A500-223	A500-233	W-I	1118-00-0001	1
5	POWER SUPPLY, PS6	PS6	W-I	1115-00-0001	1
12	SWP RATE, M1H	M1H	W-I	1114-00-0002	1
7	SWP DRIVE, M2H	M2H	W-I	1114-00-0029	1
10	MKR ADDER, M5H	M5H	W-I	1114-00-0027	1
9	SWP OSC, M9H	M9H	W-I	1114-00-0003	1
8	OUTPUT AMP, M10H	M10H	W-I	1114-00-0004	1
11	SWP OSC, M19H	M19H	W-I	1114-00-0005	1
A1	CABLE ASSY, 2-1/4 IN	WX2000-A1	W-I	1217-00-0022	1
A2	CABLE ASSY, 3-1/4 IN	WX3001-W7	W-I	1217-00-0032	1
A3	CABLE ASSY, 3-1/2 IN	WX2001-A3	W-I	1217-80-0008	1
A4	CABLE ASSY, 10-1/2 IN	WX2001-A4	W-I	1217-80-0009	1
WAVETEK PARTS LIST		TITLE SWP GEN, 2001	ASSEMBLY NO. 1010-00-0011 PAGE: 1		REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
A5	CABLE ASSY, 3-3/4 IN	WX2000-A5	W-I	1217-00-0036	1
A6	CABLE ASSY, 5 IN	WX3000-200-W18	W-I	1217-00-0050	1
A7	CABLE ASSY, 2-3/4 IN	WX2001-A7	W-I	1217-02-0026	1
A8	CABLE ASSY, 8-1/4 IN	WX2001-A8	W-I	1217-80-0010	1
P102	SMC TERM, 50 A500-267	A500-267	W-I	1118-00-0007	1
13	HARNESS ASSY	WY2001	W-I	1219-00-0005	1
WAVETEK PARTS LIST		TITLE SWP GEN, 2001	ASSEMBLY NO. 1010-00-0011 PAGE: 2		REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C105	CAP,CER,120PF,1KV CD102-112	60U121M	MDC	1510-10-1121	1
C106	CAP,CER,20PF,1KV CD101-020	60C0G200J	MDC	1510-10-0200	1
C108	CAP,CER,360PF,1KV CD102-136	60U361M	MDC	1510-10-1361	1
CR102	DIODE DG100-341	1N34A	HIT	4807-01-0034	1
J103 J105 J106 J107	CONN,UG911A/U JB109-111	KC79-146	KIN	2110-01-1013	4
L103 L104	CHOKE, 10.0MH,10% LA005-010	08N100K	ASE	1810-03-0100	2
R101	RES,C,1/4W,5%,68K RC103-368	CF1/4-68K	ASE	4700-15-6802	1
R115 R116	POT,CONT,10K RV103-310	534	SPE	4610-20-1103	2
R122	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
R123	RES,C,1/4W,5%,1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1
S101	SWITCH,PILOT LIGHT SZ000-003	616-6-1-A1H	M-O	5102-00-0001	1
S103	SWITCH,TOGGLE ST002-006	7107PN-BLK	C-K	5106-00-0011	1
WAVETEK PARTS LIST		TITLE SWEEP, A500-222 ASSEMBLY NO. 1111-00-0007 PAGE: 1			REV G

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
S106 S110	SWITCH,TOG,BLK ANOD. ST001-006	7101PN	C-K	5106-00-0009	2
S107	SWITCH,PB,SZ001-004	2KCB070000-304BL	C-L	5110-00-0006	1
S109	SWITCH,TOGGLE ST000-006	7103PN-BLK	C-K	5106-00-0004	1
WAVETEK PARTS LIST		TITLE SWEEP, A500-222 ASSEMBLY NO. 1111-00-0007 PAGE: 2			REV G

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
CR101	DIODE DR000-001	1N4004	P-C	4806-01-4004	1	
R103	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	1	
R104 R111	RES,C,1/4W,5%,33K RC103-333	CF1/4-33K	ASE	4700-15-3302	2	
R105	RES,C,1/4W,5%,47M RC103-647	CB4765	A-B	4700-15-4705	1	
R106	RES,C,1/4W,5%,4.7M RC103-547	CB4755	A-B	4700-15-4704	1	
R107	RES,C,1/4W,5%,470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1	
R108	RES,MF,1/8W,1%,47.5K RF213-475	MF55K-47.5K	ASE	4701-03-4752	1	
R109	POT,50K,RP129-350	360S503B	CTS	4610-00-1503	1	
R110 R113	RES,C,1/4W,5%,39K RC103-339	CF1/4-39K	ASE	4700-15-3902	2	
R112	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1	
R114	RES,C,1/4W,5%,75K RC103-375	CF1/4-75K	ASE	4700-15-7502	1	
S102	SWITCH ASSY, ROTARY SR000-017	SR000-017	W-I	5104-00-0005	1	
WAVETEK PARTS LIST		TITLE SWEEP TIME SW ASSY B500-225			ASSEMBLY NO. 1112-00-0008 PAGE: 1	REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C101	CAP,CER,,002MF,1KV CD102-220	5GAD20	SPR	1510-10-1202	1
C102	CAP,CER,,02UF,50V	TG-S20	SPR	1510-10-2203	1
C103	CAP,CER,68PF,1KV CD104-068	68U2J680J	MDC	1510-10-3680	1
C104	CAP,CER,150PF,1KV CD102-115	60U151M	MDC	1510-10-1151	1
C107	CAP,CER,10PF,1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	1
L101 L102	CHOKE,10MILH,10% LA004-310	15S103K	ASE	1810-02-1001	2
R118	RES,C,1/4W,5%,2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	1
R120	RES,C,1/4W,5%,33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1
R121	RES,C,1/4W,5%,2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
S108	SWITCH ASSY, ROTARY SR000-016	SR000-016	W-I	5104-00-0004	1
<div>WAVETEK PARTS LIST</div>		<div>TITLE MKR SHPR/SZ ASSY B500-224</div> <div>ASSEMBLY NO. 1112-00-0005 PAGE: 1</div>			<div>REV</div>

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
J101	PLUG,MC000-017	03-06-2151	MOL	2113-04-0001	1
2	TERMINAL,MALE MC000-019	1854	MOL	2113-05-0002	8
WAVETEK PARTS LIST		TITLE REMOTE JUMPER PLUG A500-223 ASSEMBLY NO. 1118-00-0001 PAGE: 1			REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
1	PLUG MC000-035	03-06-2042	MOL	2113-04-0002	1
2	TERMINAL,MALE MC000-019	1854	MOL	2113-05-0002	4
3	RECEPTACLE,MC000-030	03-09-1121	MOL	2113-08-0001	1
4	TERM,MALE MC000-033	02-09-2143	MOL	2113-09-0002	1
5	TERMINAL,FEMALE MC000-032	02-09-1143	MOL	2113-09-0001	6
6	RECEPTACLE,MC000-016	03-06-1151	MOL	2113-03-0001	1
7	TERMINAL,FEMALE MC000-018	1855	MOL	2113-05-0001	13
WAVETEK PARTS LIST		TITLE HARNESS ASSY ASSEMBLY NO. 1219-00-0005 PAGE: 1			REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
F1	FUSE, S.B., .5 AMP MF000-007	MDL 1/2	BUS	2410-05-0004	1
J1	RECEPTACLE MC000-034	03-06-1041	MOL	2113-03-0002	1
J4	CONN, UG911A/U JB109-111	KC79-146	KIN	2110-01-1013	1
P3	POWER CORD, WL002-088	17237SVT	BEL	6011-80-0001	1
Q2 Q3 Q8	TRANS QA052-940	2N5294	RCA	4901-05-2940	3
S1	SWITCH, DPDT, LOCKING SS000-003	46256LFE	S-I	5105-00-0003	1
T1	XFMR, PWR, TT000-022	TT000-022	W-I	5610-00-0006	1
13	TERMINAL, FEMALE MC000-018	1855	MOL	2113-05-0001	3
17	TERM, FEMALE MC000-042	02-06-1103	MOL	2113-05-0004	1
19	POWER SUPPLY BOARD	PS6 CARD	W-I	1218-00-0012	1
TITLE POWER SUPPLY, PS6		ASSEMBLY NO. 1115-00-0001			REV E
WAVETEK PARTS LIST		PAGE: 1			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C01 C07	CAP,ELECT,1250MF,50V CE114-212	1510-20-7122	MAL	1510-20-7122	2	
C02	CAP,ELECT,50MF,50V CE107-050	TE1307	SPR	1510-20-5500	1	
C03 C06 C10 C11	CAP,ELECT,100MF,25V CE105-110	TE1211	SPR	1510-20-4101	4	
C04 C12	CAP,CER,100PF,1KV CD102-110	60U101M	MDC	1510-10-1101	2	
C05	CAP,CER,.005MF,1KV CD103-250	TG-050	SPR	1510-10-2502	1	
C08	CAP,CER,120PF,1KV CD102-112	60U121M	MDC	1510-10-1121	1	
C09	CAP,TANT,10MF,25V CE120-010	1620106X0025DU2	SPR	1510-21-7100	1	
CR01 CR02 CR03 CR04 CR05 CR06 CR07 CR08 CR09 CR10 CR11 CR12 CR13 CR14 CR15 CR16 CR17	DIODE DR000-001	1N4004	P-C	4806-01-4004	17	
IC01	IC,IC000-001	LM723CH	NAT	7000-17-2300	1	
IC02	IC,IC000-002	N5741CV	SIG	7000-57-4100	1	
P02	WAFERCON,MC000-031	1840-12-2	MUL	2112-09-0001	1	
WAVETEK PARTS LIST		TITLE POWER SUPPLY BOARD			ASSEMBLY NO. 1218-00-0012 PAGE: 1	REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q01 Q04 Q05 Q09 Q10	TRANS QA036-440	2N3644	FCD	4901-03-6440	5
Q06 Q07 Q11 Q12	TRANS QA038-541	2N3854A	G-E	4901-03-8541	4
R01	RES,C,1/4W,5%,270 RC103-127	CF1/4-270	ASE	4700-15-2700	1
R02	RES,C,1/4W,5%,1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	1
R03 R11 R22	RES,1/2W,1%,5 RD01R-050	K20-5	KID	4701-23-0050	3
R04 R14 R21	RES,MF,1/8W,1%,1K RF212-100	MF55K-1K	ASE	4701-03-1001	3
R05	RES,MF,1/8W,1%,12.1K RF213-121	MF55K-12.1K	ASE	4701-03-1212	1
R06	RES,C,1/4W,5%,1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1
R07	RES,C,1/4W,5%,220 RC103-122	CF1/4-220	ASE	4700-15-2200	1
R08	RES,C,1/4W,5%,3.9K RC103-239	CF1/4-3.9K	ASE	4700-15-3901	1
R09	POT,1K,RP131-210	360T102H	CTS	4610-00-3102	1
R10	RES,C,1/4W,5%,2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
WAVETEK PARTS LIST		TITLE POWER SUPPLY BOARD	ASSEMBLY NO. 1218-00-0012 PAGE: 2		REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R12 R25	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	2
R13	RES,C,1/2W,5%,2.7K RC105-227	CF1/2-2.7K	ASE	4700-25-2701	1
R15 R24	RES,MF,1/8W,1%,15K RF213-150	MF55K-15K	ASE	4701-03-1502	2
R16 R17	RES,C,1/4W,5%,1K RC103-210	CF1/4-1K	ASE	4700-15-1001	2
R18	RES,C,1/4W,5%,4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	1
R19 R20	RES,SEI,2-10K,1/8W QTY:2:4701-03-1002	RX000-003	W-I	4789-00-0004	1
R23 R29	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	2
R26	RES,C,1/2W,5%,2.2K RC105-222	CF1/2-2.2K	ASE	4700-25-2201	1
R27	RES,MF,1/8W,1%,825 RF211-825	MF55K-825	ASE	4701-03-8250	1
R28	RES,MF,1/8W,1%,6.81K RF212-681	MF55K-6.81K	ASE	4701-03-6811	1
R30	RES,C,1/2W,5%,470 RC105-147	CF1/2-470	ASE	4700-25-4700	1
R31	RES,C,1/2W,5%,220	CF1/2-220	ASE	4700-25-2200	1
WAVETEK PARTS LIST		TITLE POWER SUPPLY BOARD	ASSEMBLY NO. 1218-00-0012 PAGE: 3		REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=MFGR=PART=NO	MFGR	WAVETEK NO.	QTY
R17 R30 R31 R48	RES,C,1/4W,10%,10K RC104=310AB	CB1031	A=B	4705-16-1002	4
R19 R24 R28 R29	RES,C,1/4W,5%,100K RC103=410	CF1/4=100K	ASE	4700-15-1003	4
R21	RES,C,1/4W,5%,18K RC103=318	CF1/4=18K	ASE	4700-15-1802	1
R22	RES,C,1/4W,5%,62K RC103=362	CF1/4=62K	ASE	4700-15-6202	1
R23	RES,C,1/4W,5%,560K RC103=456	CF1/4=560K	ASE	4700-15-5603	1
R25	RES,C,1/4W,5%,1M RC103=510	CF1/4=1M	ASE	4700-15-1004	1
R32	RES,C,1/4W,5%,1K RC103=210	CF1/4=1K	ASE	4700-15-1001	1
R34	RES,C,1/4W,10%,10M RC104=610	CB1061	A=B	4700-16-1005	1
R35 R43 R52	RES,C,1/4W,5%,100 RC103=110	CF1/4=100	ASE	4700-15-1000	3
R40 R47	RES,C,1/4W,5%,220K RC103=422	CF1/4=220K	ASE	4700-15-2203	2
R42 R55	RES,C,1/4W,5%,6.8K RC103=268	CF1/4=6.8K	ASE	4700-15-6801	2
TITLE SWP RATE,M1H		ASSEMBLY NO. 1114=00=0002 PAGE: 3			REV B
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=MFGR=PART=NO	MFGR	WAVETEK NO.	QTY	
R44	RES,C,1/4W,5%,12K RC103-312	CF1/4-12K	ASE	4700-15-1202	1	
R46	RES,C,1/4W,5%,39K RC103-339	CF1/4-39K	ASE	4700-15-3902	1	
R49	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	1	
R50	RES,C,1/4W,5%,15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1	
R54 R56	RES,C,1/4W,5%,27K RC103-327	CF1/4-27K	ASE	4700-15-2702	2	
<div>WAVETEK PARTS LIST</div>		<div>TITLE SWP RATE,M1H</div>			<div>ASSEMBLY NO. 1114-00-0002</div> <div>PAGE: 4</div>	<div>REV B</div>

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C07 C08 C09 C12 C14 C15 C16 C17 C20	CAP,F.T.,.6,8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	10
C02 C06 C11	CAP,CER,470PF,1KV CD102-147	60U471M	MDC	1510-10-1471	3
C03	CAP,FILM,.15MF,100V	60C154K100	PLSSY	1510-60-7154	1
C04	CAP,CER,10PF,1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	1
C05	CAP,CER,.001MFD,1KV CD102-210	5GAD10	SPR	1510-10-1102	1
C10	CAP,CER,.02UF,50V	TG-S20	SPR	1510-10-2203	1
C13	CAP,CER,120PF,1KV CD102-112	60U121M	MDC	1510-10-1121	1
C18 C19	CAP,F.T.,.470PF CF101-147	FA5C-4712	A-B	1510-30-0471	2
C21	CAP,CER,.01MF,100V CD103-310	68U103M	MDC	1510-10-2103	1
CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9	DIODE UR000-001	1N4004	P-C	4806-01-4004	9
Q01 Q02	TRANS,M/PR,2N5458 QTY:2:4901-05-4580	QB000-014	W-I	4998-00-0002	1
Q03 Q04 Q07 Q08 Q09 Q11 Q16 Q17 Q19	TRANS QB000-009	MPS3702	MOT	4902-03-7020	9
TITLE SWP RATE,M1H		ASSEMBLY NO. 1114-00-0002 PAGE: 1			REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=MFGR=PART=NO	MFGR	WAVETEK NO.	QTY
Q05 Q14	TRANS QA054-580	2N5458	MUT	4901-05-4580	2
Q06 Q15	TRANS QB000-010	TD101	SPR	4902-00-1010	2
Q10 Q12 Q13 Q18	TRANS QA038-541	2N3854A	G-E	4901-03-8541	4
R01 R09	RES,C,1/4W,5%,220 RC103-122	CF1/4-220	ASE	4700-15-2200	2
R02 R03 R05 R11 R14 R37	RES,C,1/4W,5%,4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	6
R04 R13 R18 R33 R38 R39 R53	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	7
R06	RES,C,1/4W,5%,180K RC103-418	CF1/4-180K	ASE	4700-15-1803	1
R07 R20 R41 R45	POT,20K,RP129-320	360S203B	CTS	4610-00-1203	4
R08 R26 R27 R36	RES,C,1/4W,5%,22K RC103-322	CF1/422K	ASE	4700-15-2202	4
R10	RES,C,1/4W,10%,5.6M RC104-556	C85651	A-H	4700-16-5604	1
R12 R57	RES,C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	2
R15	RES,C,1/4W,5%,68K RC103-368	CF1/4-68K	ASE	4700-15-6802	1
R16 R51	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	2
TITLE SWP RATE,M1H		ASSEMBLY NO. 1114-00-0002 PAGE: 2			REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=MFGR=PART=NO	MFGR	WAVETEK NO.	QTY
C01 C04 C05 C06 C07 C14	CAP,F,T.,6.8PF CF102=R68	FA5C=6892	A-B	1510-30=1689	6
C02	CAP,CER,120PF,1KV CD102=112	60U121M	MDC	1510-10=1121	1
C03	CAP,CER,10PF,1KV CD101=010	10ICC=Q10	SPR	1510-10=0100	1
C08	CAP,CER,15PF,1KV CD101=015	10ICC=Q15	SPR	1510-10=0150	1
C09	CAP,Q=C,2.4PF,10% CG101=224	QC=2.4PF	Q-C	1510-40=0249	1
C10 C11 C15 C18 C19 C22	CAP,F,T.,470PF CF101=147	FA5C=4712	A-B	1510-30=0471	6
C12	CAP,CER,25PF,1KV CD101=025	60C0G250J	MDC	1510-10=0250	1
C13	CAP,Q=C,10PF,10%, CG101=310	QC=10PF	Q-C	1510-40=0100	1
C16 C20	CAP,TANT,10MF,25V CE120=010	162D106X0025002	SPR	1510-21=7100	2
C17 C21	CAP,CER,470PF,1KV CD102=147	60U471M	MDC	1510-10=1471	2
C23 C24	CAP,CER,.01MF,100V CD103=310	68U103M	MDC	1510-10=2103	2
TITLE SWP DRIVE,M2H		ASSEMBLY NO. 1114=00=0029 PAGE: 1			REV H
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C25 C26	CAP,Q.C.,3.9PF CG101-239	QC-3.9PF	Q-C	1510-40-0399	2
C27 C28	CAP,ELECT,1MF,25V CE120-001	162D105X90250C2	SPR	1510-21-7010	2
CR01 CR02 CR03 CR04 CR06 CR07 CR09 CR10 CR13 CR14 CR15 CR16 CR17 CR18 CR19 CR20 CR21 CR22	DIODE DR000-001	1N4004	P-C	4806-01-4004	18
Q01 Q04 Q18	TRANS DR000-010	T0101	SPR	4902-00-1010	3
Q02 Q03 Q05 Q06 Q07 Q19	TRANS QA042-500	2N4250	FCO	4901-04-2500	6
Q08	TRANS QA036-440	2N3644	FCO	4901-03-6440	1
Q09 Q10 Q11 Q15 Q16 Q17	TRANS QA054-610	2N5461	MOT	4901-05-4610	6
Q12 Q21	TRANS DR000-011	T0401	SPR	4902-00-4010	2
Q13 Q14 Q20 Q22	TRANS QA050-840	2N5088	MOT	4901-05-0840	4
Q23	TRANS DR000-009	MPS3702	MOT	4902-03-7020	1
R01 R29 R54 R55	RES,C,1/4W,5%,100K RC103-410	CF1/4-100K	ASE	4700-15-1003	4
R02 R19 R32 R33 R34 R62 R71 R75 R79	RES,C,1/4W,5%,4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	9
TITLE SWP DRIVE,M2H		ASSEMBLY NO. 1114-00-0029 PAGE: 2			REV H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R03 R63	RES,C,1/4W,5%,27K RC103-327	CF1/4-27K	ASE	4700-15-2702	2
R04 R21 R57 R64	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	4
R06 R08 R23 R25	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	4
R07 R10 R24 R27 R66	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	5
R09 R13 R17 R26 R31 R72 R76 R80 R95	POT,20K,RP130-320	M9PR20K	BEK	4610-00-2203	9
R11	RES,C,1/4W,5%,33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1
R12 R18	RES,C,1/4W,5%,470K RC103-447	CF1/4-470K	ASE	4700-15-4703	2
R14 R15 R16	RES,SET,3-178K,1/8W QTY:3:4701-03-1783	RX000-002	W-I	4789-00-0001	1
R20 R83 R89	RES,C,1/4W,5%,8.2K RC103-282	CF1/4-8.2K	ASE	4700-15-8201	3
R28	RES,C,1/4W,5%,82K RC103-382	CF1/4-82K	ASE	4700-15-8202	1
R30 R81 R87	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	3
TITLE SWP DRIVE,M2H		ASSEMBLY NO. 1114-00-0029 PAGE: 3			REV H
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R35 R36 R37 R38	RES,C,1/4W,5%,2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	4
R56	RES,C,1/4W,5%,1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1
R58 R59 R60 R69 R73 R77	RES,C,1/4W,5%,10M RC103-610	CR1065	A-H	4700-15-1005	6
R61 R67	RES,C,1/4W,5%,10 RC103-010	CF1/4-10	ASE	4700-15-1009	2
R68	RES,C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R70 R74 R78	RES,C,1/4W,5%,18K RC103-318	CF1/4-18K	ASE	4700-15-1802	3
R82 R88	RES,C,1/4W,5%,560 RC103-156	CF1/4-560	ASE	4700-15-5600	2
R84 R92	RES,C,1/4W,5%,4.7 RC103-R47	CF1/4-4.7	ASE	4700-15-4708	2
R85 R86	RES,SET,2-10K,1/8W QTY:2:4701-03-1002	RX000-003	W-I	4789-00-0004	1
R91	RES,MF,SET,MATCHED CONSIST:4799-00-0001 THRU:0002	RX000-004	W-I	4789-00-0003	1
	RES,MF,1/8W,1%,19.1K PART OF 4789-00-0003 QTY:1:4701-03-1912	4799-00-0001	W-I	4799-00-0001	-
TITLE SWP DRIVE,M2H		ASSEMBLY NO. 1114-00-0029 PAGE: 4		REV H	

WAVETEK
PARTS LIST

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGH-PART-NO	MFGH	WAVETEK NO.	QTY
R90	RES,MF,1/8W,1%,21.5K PART OF 4789-00-0005 QTY:1:4701-03-2152	4799-00-0002	W-I	4799-00-0002	-
R93 R94	RES,C,1/4W,5%,15K RC103-315	CF1/4-15K	ASE	4700-15-1502	2
R96	RES,C,1/4W,5%,1.2M RC104-512	CF1/4-1.2M	ASE	4700-15-1204	1
WAVETEK PARTS LIST		TITLE SWP DRIVE,M2H			REV H
		ASSEMBLY NO. 1114-00-0029 PAGE: 5			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C21 C22	CAP,FI,500PF,20X250V CF104-150	4420-500PF	AER	1510-30-3501	3
C02	CAP,CER,,025MF,50V CD103-325	TG-S25	SPR	1510-10-2253	1
C03 C04 C05 C06 C09 C10 C11 C13 C18	CAP,F,T.,6,8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	9
C07	CAP,TANT,10MF,25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	1
C08 C14 C15 C19	CAP,CER,,05MF,100V CD103-350	TG-S50	SPR	1510-10-2503	4
C12 C24 C26	CAP,F,T.,470PF CF101-147	FA5C-4712	A-B	1510-30-0471	3
C16 C17	CAP,ELECT,100MF,25V CE105-110	TE1211	SPR	1510-20-4101	2
C20	CAP,CER,,005MF,1KV CD103-250	TG-D50	SPR	1510-10-2502	1
C23	CAP,CER,470PF,1KV CD102-147	60U471M	MDC	1510-10-1471	1
C25	CAP,CER,120PF,1KV CD102-112	60U121M	MDC	1510-10-1121	1
CR02 CR07	DIODE DG100-821	1N82AG	G-I	4807-01-0082	2
CR03	DIODE DR000-001	1N4004	P-C	4806-01-4004	1
TITLE MKR ADDER,MSH		ASSEMBLY NO. 1114-00-0027 PAGE: 1			REV E
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
CR04 CR05 CR06	DIODE DP000-040	MA47980	M-A	4805-02-0001	3
Q01 Q02 Q03 Q04 Q05	TRANS QA050-880	2N5088	MOT	4901-05-0880	5
Q06 Q12	TRANS QB000-010	TD101	SPR	4902-00-1010	2
Q07 Q08 Q09 Q13	TRANS QB000-009	MPS3702	MOT	4902-03-7020	4
Q10	TRANS QA038-541	2N3854A	G-E	4901-03-8541	1
Q11	TRANS QA054-580	2N5458	MOT	4901-05-4580	1
R01 R32 R33 R48	RES,C,1/4W,5%,1K RC103-210	CF1/4-1K	ASE	4700-15-1001	4
R02	RES,C,1/4W,5%,180 RC103-118	CF1/4-180	ASE	4700-15-1800	1
R03 R35 R36	RES,C,1/4W,5%,680 RC103-168	CF1/4-680	ASE	4700-15-6800	3
R04 R05	RES,C,1/4W,5%,56 RC103-056	CF1/4-56	ASE	4700-15-5609	2
R06 R08 R10 R13 R16 R19	RES,C,1/4W,5%,22K RC103-322	CF1/4-22K	ASE	4700-15-2202	6
R07 R11 R14 R17 R20	RES,C,1/4W,5%,270 RC103-127	CF1/4-270	ASE	4700-15-2700	5
R09 R12 R15 R18	RES,C,1/4W,5%,5.6K RC103-256	CF1/4-5.6K	ASE	4700-15-5601	4
TITLE MKR ADDER,MSH		ASSEMBLY NO. 1114-00-0027			REV E
WAVETEK PARTS LIST		PAGE: 2			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R21 R29	RES,C,1/4W,5%,3,3K RC103-233	CF1/4-3,3K	ASE	4700-15-3301	2
R22 R23 R28 R31 R34 R51 R52	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	7
R24 R38 R50	RES,C,1/4W,5%,4,7K RC103-247	CF1/4-4,7K	ASE	4700-15-4701	3
R25 R54 R55 R56	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	4
R26 R40	RES,C,1/4W,5%,2,2K RC103-222	CF1/4-2,2K	ASE	4700-15-2201	2
R27	RES,C,1/4W,5%,220K RC103-422	CF1/4-220K	ASE	4700-15-2203	1
R30	RES,C,1/4W,5%,1,8K RC103-218	CF1/4-1,8K	ASE	4700-15-1801	1
R37 R39 R49	RES,C,1/4W,5%,2,7K RC103-227	CF1/4-2,7K	ASE	4700-15-2701	3
R42	RES,C,1/2W,5%,47 RC105-047	EB4705	A-H	4705-25-4709	1
R43	RES,C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R44	RES,C,1/4W,5%,1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1
WAVETEK PARTS LIST		TITLE MKR ADDER,MSH		ASSEMBLY NO. 1114-00-0027 PAGE: 3	
				REV E	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R45	RES,C,1/4W,10%,2,2M RC104-522AB	CB2251	A-H	4705-16-2204	1
R46	POT,20K RP124-320	WA2G032S-203MA	A-H	4610-10-7203	1
R47	RES,C,1/4W,5%,470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1
R53	RES,C,1/4W,5%,220 RC103-122	CF1/4-220	ASE	4700-15-2200	1
41	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	1
WAVETEK PARTS LIST		TITLE MKR ADDER,MSH		ASSEMBLY NO. 1114-00-0027 PAGE: 4	
				REV E	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C01 C03 C07 C08 C09 C11 C14 C18 C19 C25 C27	CAP, FT, 500PF, 20X250V CF104-150	4420-500PF	AER	1510-30-3501	11	
C02 C10	CAP, CER, 100PF, 1KV CD108-110	CN1500	RMC	1510-10-5101	2	
C04 C05 C12	CAP, FT, CER, 100PF, 20X CF104-110	4420-100PF	AER	1510-30-3101	3	
C06 C13	CAP, F, T., 6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	2	
C15 C28 C29 C30	CAP, F, T., 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	4	
C16	CAP, CER, 120PF, 1KV CD102-112	60U121M	MDC	1510-10-1121	1	
C17 C33 C34	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	3	
C20	CAP, Q, C., .75PF CG101-175	QC-.75PF	Q-C	1510-40-0758	1	
C21 C24	CAP, VALUE DETERMINED IN CALIBRATION	CAP, TRIM	W-I	1519-99-9999	2	
C22	CAP, Q-C, 2.4PF, 10X CG101-224	QC-2.4PF	Q-C	1510-40-0249	1	
C23 C26	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	2	
WAVETEK PARTS LIST		TITLE SWP OSC, M9H			ASSEMBLY NO. 1114-00-0003 PAGE: 1	REV I

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C31	CAP,TANT,10MF,25V CE120-010	162D106X00250D2	SPK	1510-21-7100	1
C32	CAP,CER,.05MF,100V CD103-350	TG-S50	SPR	1510-10-2503	1
C35	CAP,CER,.001MFD,1KV CD102-210	SGA010	SPR	1510-10-1102	1
C36	CAP,Q.C.,3.9PF CG101-239	QC-3.9PF	Q=C	1510-40-0399	1
21	CAP,M.C.,.47PF CG102-147	MC-.47PF	Q=C	1510-40-1478	1
CR01 CR02 CR03 CR04 CR05	DIODE DC000-005	BR141A	IIT	4889-00-0001	5
CR08 CR09	DIODE DG100-823	1N82A	S-T	4807-03-0002	2
J01 J02	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L01 L03	CHOKE .22MH 10X LA005-R02	08NR22K	ASE	1810-03-0228	2
L02 L04 L05 L07 L08	RF CHOKE	CHOKE	W-I	1819-99-9999	5
L06	CHOKE, 1MH, 10X LA005-R10	08N1R0K	ASE	1810-03-0010	1
L09 L10	FERRITE CHOKE LA009-004	T1255-1	HYT	1810-05-0001	2
TITLE SWP OSC,M9H		ASSEMBLY NO. 1114-00-0003 PAGE: 2			REV I
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
20	FERR. BEAD,LC000-009	K5-001-00/38	FRXC	1813-00-0007	2
Q01 Q04 Q07 Q09	TRANS QB000-009	MPS3702	MOT	4902-03-7020	4
Q02	TRANS QB000-013	A430	APX	4902-00-4300	1
Q03	TRANS QA050-880	2N5088	MOT	4901-05-0880	1
Q05 Q14 Q16	TRANS QA051-790	2N5179	RCA	4901-05-1790	3
Q06 Q10	TRANS QA038-541	2N3854A	G-E	4901-03-8541	2
Q08	TRANS QB000-011	TD401	SPR	4902-00-4010	1
Q11 Q12 Q13 Q15	TRANS QA050-530	2N5053	APX	4901-05-0530	4
Q17	TRANS QA054-580	2N5458	MOT	4901-05-4580	1
R01	RES,C,1/4W,5%,22K RC103-322	CF1/422K	ASE	4700-15-2202	1
R02 R12	POT,10K,RP129-310	360S103B	CTS	4610-00-1103	2
R03 R14 R17 R24	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	4
R04 R19 R39 R40 R47 R48	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	6
R05 R06 R15 R20 R21 R41 R49	RES,C,1/4W,5%,4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	7
R07 R22	RES,C,1/4W,5%,10 RC103-010	CF1/4-10	ASE	4700-15-1009	2
TITLE SWP USC,M9H		ASSEMBLY NO. 1114-00-0003 PAGE: 3			REV 1
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=MFGR=PART=NO	MFGR	WAVETEK NO.	QTY
R08 R29	RES,C,1/4W,5%,5.6K RC103-256	CF1/4-5.6K	ASE	4700-15-5601	2
R09	POT,20K,RP129-320	360S203B	CTS	4610-00-1203	1
R11	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
R13	POT,20K RP124-320	WA2G032S-203MA	A-H	4610-10-7203	1
R16 R30 R33	RES,C,1/4W,5%,33K RC103-333	CF1/4-33K	ASE	4700-15-3302	3
R18	RES,C,1/4W,5%,2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	1
R25	RES,C,1/4W,5%,1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1
R26 R32	RES,C,1/4W,5%,27K RC103-327	CF1/4-27K	ASE	4700-15-2702	2
R28	RES,C,1/4W,5%,39K RC103-339	CF1/4-39K	ASE	4700-15-3902	1
R31	RES,C,1/4W,5%,100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
R34	RES,C,1/4W,5%,12K RC103-312	CF1/4-12K	ASE	4700-15-1202	1
TITLE SWP OSC,M9H		ASSEMBLY NO. 1114-00-0003 PAGE: 4			REV 1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R36	RES,C,1/4W,5%,4.7 RC103-R47	CF1/4-4.7	ASE	4700-15-4708	1	
R37	RES,C,1/4W,5%,390 RC103-139	CF1/4-390	ASE	4700-15-3900	1	
R38 R43 R45 R46 R51	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	5	
R42 R44 R50	RES,C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	3	
R52	RES,C,1/4W,5%,22 RC103-022	CF1/4-22	ASE	4700-15-2209	1	
R53	RES,C,1/4W,5%,150 RC103-115	CF1/4-150	ASE	4700-15-1500	1	
R54	RES,C,1/4W,10%,10M RC104-610	CB1061	A-B	4700-16-1005	1	
18	RES,C,1/4W,10%,4.7K RC104-247AB	CB4721	A-B	4705-16-4701	2	
22	RES,C,1/4W,10%,10K RC104-310AB	CB1031	A-B	4705-16-1002	3	
WAVETEK PARTS LIST		TITLE SWP OSC,M9H			ASSEMBLY NO. 1114-00-0003 PAGE: 5	REV I

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C17 C26 C28 C30	CAP,F,T,,470PF CF101-147	FA5C-4712	A-B	1510-30-0471	5
C02 C27 C29 C31	CAP,CER,,01MF,100V CD103-310	68U103M	MDC	1510-10-2103	4
C03 C04	CAP,FT,500PF,20X250V CF104-150	4420-500PF	AER	1510-30-3501	2
C05	CAP,CER,,025MF,50V CD103-325	TG-925	SPR	1510-10-2253	1
C06 C07 C08 C15	CAP,TANT,,47MF,50V CE113-447	935	TRW	1510-21-9470	4
C09 C13 C14 C23	CAP,TANT,10MF,25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	4
C10	CAP,CER,15PF,1KV CD101-015	10TCC-Q15	SPR	1510-10-0150	1
C11	CAP,CER,4,7PF,1KV CD101-R47	10TCC-V47	SPR	1510-10-0479	1
C12	CAP,CER,10PF,1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	1
C16	CAP,FT,CER,100PF,20X CF104-110	4420-100PF	AER	1510-30-3101	1
C18 C19 C24 C32 C33	CAP,F,T,,6,8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	5
WAVETEK PARTS LIST		TITLE OUTPUT AMP,M10H ASSEMBLY NO. 1114-00-0004 PAGE: 1			REV G

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C20	CAP,CER,,001MFD,1KV CD102-210	5GAD10	SPR	1510-10-1102	1
C21	CAP,CER,360PF,1KV CD102-136	60U361M	MDC	1510-10-1361	1
C22	CAP,CER,,005MF,1KV CD103-250	TG-050	SPR	1510-10-2502	1
C25	CAP,CER,120PF,1KV CD102-112	60U121M	MDC	1510-10-1121	1
C34 C35	CAP,CER,200PF,1KV CD102-120	5GA-T20	SPR	1510-10-1201	2
C36	CAP,CER,47PF,1KV CD104-047	60U2J470J	MDC	1510-10-3470	1
CR01 CR02 CR03	DIODE DP000-050	5082-3080	H-P	4805-02-0002	3
CR04 CR05 CR06 CR07	DIODE DC000-008	88205	APX	4803-02-0004	4
CR08	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1
CR09 CR10	DIODE DR000-001	1N4004	P-C	4806-01-4004	2
J01 J02	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L01 L04 L05 L09 L11	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	5
L06 L07 L08 L10	FERRITE CHOKE LA009-004	T1255-1	HYT	1810-05-0001	4
WAVETEK PARTS LIST		TITLE OUTPUT AMP,M10H ASSEMBLY NO. 1114-00-0004 PAGE: 2			REV G

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L12	CHOKE,10MILH,10X LA004-310	158103K	ASE	1810-02-1001	1
Q01 Q02	TRANS QA050-530	2N5053	APX	4901-05-0530	2
Q03 Q05 Q06	TRANS QB000-018	SD1006	SSS	4902-01-0060	3
Q04	TRANS QB000-013	A430	APX	4902-00-4300	1
Q07 Q10 Q11	TRANS QB000-009	MPS3702	MOT	4902-03-7020	3
Q08	TRANS QA054-580	2N5458	MOT	4901-05-4580	1
Q09	TRANS QB000-010	TD101	SPR	4902-00-1010	1
R01 R05 R26	RES,C,1/4W,5X,47 RC103-047	CF1/4-47	ASE	4700-15-4709	3
R02	RES,C,1/4W,5X,330 RC103-133	CF1/4-330	ASE	4700-15-3300	1
R03 R33 R46	RES,C,1/4W,5X,1K RC103-210	CF1/4-1K	ASE	4700-15-1001	3
R06	RES,C,1/4W,5X,150 RC103-115	CF1/4-150	ASE	4700-15-1500	1
R07	RES,C,1/4W,5X,820 RC103-182	CF1/4-820	ASE	4700-15-8200	1
R08 R50	RES,C,1/4W,10X,100 RC104-110AB	CB1001	A-B	4705-16-1000	2
WAVETEK PARTS LIST		TITLE OUTPUT AMP,M10H			REV G
		ASSEMBLY NO. 1114-00-0004 PAGE: 3			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R09	RES,C,1/4W,5X,56 RC103-056	CF1/4-56	ASE	4700-15-5609	1
R10	RES,C,1/4W,5X,560 RC103-156	CF1/4-560	ASE	4700-15-5600	1
R11 R44 R52	RES,C,1/4W,5X,220 RC103-122	CF1/4-220	ASE	4700-15-2200	3
R12 R21	RES,C,1/4,5X,27 RC103-027	CF1/4-27	ASE	4700-15-2709	2
R13 R30	RES,C,1/4W,5X,470 RC103-147	CF1/4-470	ASE	4700-15-4700	2
R14 R17 R22 R25	RES,C,1/4W,5X,10 RC103-010	CF1/4-10	ASE	4700-15-1009	4
R15 R19 R20	RES,C,1/4W,5X,82 RC103-082	CF1/4-82	ASE	4700-15-8209	3
R16	RES,C,1/4W,5X,1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1
R18	RES,C,1/4W,5X,22 RC103-022	CF1/4-22	ASE	4700-15-2209	1
R23	RES,C,1/2W,5X,360 W-I/RC105-136AB	EB3615	A-B	4705-25-3600	1
R24	RES,C,1W,5X,150 RC107-115	GB1515	A-B	4700-35-1500	1
WAVETEK PARTS LIST		TITLE OUTPUT AMP,M10H			REV G
		ASSEMBLY NO. 1114-00-0004 PAGE: 4			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR=PART-NO	MFGR	WAVETEK NO.	QTY	
R27 R28 R31	RES,C,1/4W,5%,33K RC103-333	CF1/4-33K	ASE	4700-15-3302	3	
R29	RES,C,1W,5%,100 RC107-110	GB1015	A-B	4700-35-1000	1	
R32	RES,C,1/4W,5%,100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1	
R34 R47	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	2	
R35	RES,C,1/4W,5%,1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1	
R36	RES,C,1/4W,10%,2,2M RC104-522AB	CB2251	A-B	4705-16-2204	1	
R37 R39	POT,20K RP124-320	WA2G032S-203MA	A-B	4610-10-7203	2	
R38	RES,C,1/4W,5%,15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1	
R40	RES,C,1/4W,5%,470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1	
R41	RES,C,1/4W,5%,1,2K RC103-212	CF1/4-1,2K	ASE	4700-15-1201	1	
R42	RES,C,1/4W,5%,680K RC103-468	CF1/4-680K	ASE	4700-15-6803	1	
WAVETEK PARTS LIST		TITLE OUTPUT AMP,M10H			ASSEMBLY NO. 1114-00-0004 PAGE: 5	REV G

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R43	RES,C,1/4W,5%,2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
R45 R51	RES,C,1/4W,5%,4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	2
R49	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
20	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	2

WAVETEK PARTS LIST	TITLE OUTPUT AMP,M10H	ASSEMBLY NO. 1114-00-0004	REV G
		PAGE: 6	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
C01 C13 C24 C25 C26	CAP,F,T.,6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	5	
C02 C04 C05 C06 C10 C11 C12 C14 C15 C16 C17 C18 C22 C23 C33	CAP,FT,500PF,20X250V CF104-150	4420-500PF	AER	1510-30-3501	14	
C03 C08 C09 C19 C20 C21	CAP,FT,CER,100PF,20X CF104-110	4420-100PF	AER	1510-30-3101	6	
C07 ML32	CAP,Q,C.,.75PF CG101-175	QC= .75PF	Q-C	1510-40-0758	2	
C27 C28 C29 C30 C31	CAP,F,T.,470PF CF101-147	FA5C-4712	A-B	1510-30-0471	5	
C39	CAP,VALUE DETERMINED IN CALIBRATION	CAP,TRIM	W-I	1519-99-9999	1	
33	CAP,Q-C,2.0PF,10X CG101-220	QC=2.0PF	Q-C	1510-40-0020	1	
34	CAP,M,C.,.47PF CG102-147	MC= .47PF	Q-C	1510-40-1478	2	
CR01 CR10 CR11 CR21	DIODE DR000-001	1N4004	P-C	4806-01-4004	4	
CR02 CR03 CR04 CR05 CR13 CR14 CR15 CR16	DIODE DC000-008	88205	APX	4803-02-0004	8	
CR20	DIODE DG100-821	1N82AG	G-I	4807-01-0082	1	
J01 J02 J03	CONN JF000-005	37JR116-1	S-C	2110-03-0002	3	
WAVETEK PARTS LIST		TITLE SWP USC,M19H			ASSEMBLY NO. 1114-00-0005 PAGE: 1	REV J

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG=MFGR=PART=NO	MFGR	WAVETEK NO.	QTY
L01 L02 L10 L11 L12 L13 L21 L22	FERRITE CHOKE LA009-004	T1255-1	HYT	1810-05-0001	8
L03 L05 L14 L16	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0228	4
L24	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	1
L25 L26	FERRITE CHOKE,4 TURN FROM:1813-00-0007	LA007-004	W-I	1210-30-0005	2
Q01 Q04 Q07 Q08 Q09 Q11 Q15 Q16	TRANS QB000-009	MPS3702	MOT	4902-03-7020	8
Q02 Q05 Q10 Q12 Q13	TRANS QA038-541	2N3854A	G-E	4901-03-8541	5
Q03	TRANS QA054-610	2N5461	MOT	4901-05-4610	1
Q06	TRANS QA051-090	2N5109	SSS	4901-05-1090	1
Q14	TRANS QB000-015	2N5947	MOT	4901-05-9470	1
R01 R30	RES,C,1/4W,5%,7.5K RC103-275	CF1/4-7.5K	ASE	4700-15-7501	2
R02 R07 R31 R39 R40	RES,C,1/4W,5%,4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	5
R03	RES,C,1/4W,10%,10M RC104-610	CR1061	A-B	4700-16-1005	1
R04 R22	RES,VAL DET IN CALIB	RES,TRIM	W-I	4799-99-9999	2
WAVETEK PARTS LIST		TITLE SWP USC,M19H			REV J
		ASSEMBLY NO. 1114-00-0005 PAGE: 2			

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY	
R05 R19 R24 R28 R33	RES,C,1/4W,5%,22K RC103-322	CF1/422K	ASE	4700-15-2202	5	
R06 R23 R34	RES,C,1/4W,5%,68K RC103-368	CF1/4-68K	ASE	4700-15-6802	3	
R08 R17 R18 R35 R49 R50	RES,C,1/4W,5%,100K RC103-410	CF1/4-100K	ASE	4700-15-1003	6	
R09 R10	RES,C,1/2W,5%,220 RC105-122	CF1/2-220	ASE	4700-25-2200	2	
R11	RES,C,1/4W,5%,390 RC103-139	CF1/4-390	ASE	4700-15-3900	1	
R12 R15 R36	RES,C,1/4W,5%,2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	3	
R14 R16	POT,CONT,10K RV102-310	3067P-10K	BOU	4610-20-0103	2	
R20	RES,C,1/4W,5%,39K RC103-339	CF1/4-39K	ASE	4700-15-3902	1	
R21	RES,C,1/4W,5%,91K RC103-391	CF1/4-91K	ASE	4700-15-9102	1	
R25 R29	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	2	
R26 R27	RES,C,1/4W,5%,220K RC103-422	CF1/4220K	ASE	4700-15-2203	2	
WAVETEK PARTS LIST		TITLE SWP OSC,M19H		ASSEMBLY NO. 1114-00-0005 PAGE: 3		REV J

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R32	RES,C,1/4W,5%,6.8K RC103-268	CF1/4-6.8K	ASE	4700-15-6801	1
R37	RES,C,1W,5%,160 RC107-116	GB1615	A-B	4700-35-1600	1
R38	RES,C,1/2W,5%,82 RC105-082	CF1/2-82	ASE	4700-25-8209	1
R41	RES,C,1W,10%,470 RC108-147	GB4711	A-B	4700-36-4700	1
R42	RES,C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R43	RES,C,1/4W,5%,330 RC103-133	CF1/4-330	ASE	4700-15-3300	1
R44	RES,C,1/4W,5%,1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R45 R48	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	2
R46	RES,L-A,1/4W,1%,49.9 RF404-990	SPS-N-347-49.9	IRC	4741-49-9007	1
R47	RES,C,1/4W,5%,56 RC103-056	CF1/4-56	ASE	4700-15-5609	1
28	RES,C,1/4W,10%,4.7K RC104-247AB	CB4721	A-B	4705-16-4701	8
30	RES,C,1/4W,10%,2.2M RC104-522AB	CB2251	A-B	4705-16-2204	1
TITLE SWP OSC,M19H		ASSEMBLY NO. 1114-00-0005 PAGE: 4			REV J
WAVETEK PARTS LIST					

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT	
C01 C07	CAP,CER,47PF,1KV CD104-047	60U2J470J	MDC	1510-10-3470	2	
C02	CAP,CER,330PF,1KV CD104-133	10TCU-T33	SPR	1510-10-3331	1	
C03	CAP,CER,120PF,1KV CD104-112	10TCU-T12	SPR	1510-10-3121	1	
C04	CAP,FT,500PF,20X250V CF104-150	4420-500PF	AER	1510-30-3501	1	
C05	CAP,VAR,3.5-13PF250V CV101-013	7S-TRIK0-02-3.5-13PF	STR	1510-70-0130	1	
C06	CAP,CER,15PF,1KV CD101-015	10TCC-Q15	SPR	1510-10-0150	1	
C08 C09	CAP,CER,.001MFD,1KV CD102-210	5GAD10	SPR	1510-10-1102	2	
C10	CAP,CER,.01MF,100V CD103-310	68U103M	MDC	1510-10-2103	1	
C11	CAP,F.T.,.6.8PF CF102-R68	FA5C-6892	A-H	1510-30-1689	1	
C12	CAP,F.T.,.470PF CF101-147	FA5C-4712	A-H	1510-30-0471	1	
C13	CAP,TANT,10MF,25V CE120-010	162D106X00250D2	SPR	1510-21-7100	1	
CR1	DIODE DG100-821	1N824G	G-I	4807-01-0082	1	
WAVETEK PARTS LIST		TITLE 10 MHZ HARMONIC MARKER, M6H-10			ASSEMBLY NO. 1114-00-0099 PAGE: 1	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT	
J1 J2	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2	
L1 L3	RF CHOKE	CHOKE	W-I	1819-99-9999	2	
L2	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	1	
L4	FERRITE CHOKE LA009-004	T1255-1	HYT	1810-05-0001	1	
Q1	TRANS QA038-541	2N3854A	G-E	4901-03-8541	1	
Q2	TRANS QB000-013	A430	APX	4902-00-4300	1	
Q3	TRANS QA054-580	2N5458	MOT	4901-05-4580	1	
Q4	TRANS QA050-880	2N5088	MOT	4901-05-0880	1	
R01	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1	
R02	RES,C,1/4W,5%,56 RC103-056	CF1/4-56	ASE	4700-15-5609	1	
R03	RES,C,1/4W,5%,1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1	
R04 R17	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	2	
R05	RES,C,1/4W,5%,75 RC103-075	CR1/4-75	ASE	4700-15-7509	1	
R06	RES,C,1/4W,5%,3.9K RC103-239	CF1/43.9K	ASE	4700-15-3901	1	
<div>WAVETEK PARTS LIST</div>		TITLE 10 MHZ HARMONIC MARKER, M6H-10			ASSEMBLY NO. 1114-00-0099 PAGE: 2	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
R07	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
R08	RES,C,1/4W,5%,33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1
R09	RES,C,1/4W,5%,1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1
R10	RES,C,1/4W,5%,1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R11	RES,C,1/4W,5%,8.2K RC103-282	CF1/4-8.2K	ASE	4700-15-8201	1
R12	RES,C,1/4W,5%,15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1
R13	RES,C,1/4W,5%,1.5M RC103-515	CF1/4-1.5M	ASE	4700-15-1504	1
R14	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	1
R15	POT,20K RP124-320	WA2G032S-203MA	A-B	4610-10-7203	1
R16	RES,C,1/4W,5%,100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
X1	CRYSTAL,XX000-321	X32W-00.00000	W-I	2310-00-0321	1
<div>WAVETEK PARTS LIST</div>		<div>TITLE 10 MHZ HARMONIC MARKER, M6H-10</div> <div>ASSEMBLY NO. 1114-00-0099 PAGE: 3</div>			<div>REV C</div>

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT	
C01	CAP,CER,20PF,1KV CD101-020	60C0G200J	MDC	1510-10-0200	1	
C02	CAP,CER,120PF,1KV CD104-112	10TCU-T12	SPR	1510-10-3121	1	
C03 C07	CAP,CER,47PF,1KV CD104-047	60U2J470J	MDC	1510-10-3470	2	
C04	CAP,FT,500PF,20%250V CF104-150	4420-500PF	AER	1510-30-3501	1	
C05	CAP,VAR,3.5-13PF250V CV101-013	7S-TRIKO-02-3.5-13PF	STR	1510-70-0130	1	
C06	CAP,CER,15PF,1KV CD101-015	10TCC-Q15	SPR	1510-10-0150	1	
C08 C09	CAP,CER,.001MFD,1KV CD102-210	5GAD10	SPR	1510-10-1102	2	
C10	CAP,CER,.01MF,100V CD103-310	68U103M	MDC	1510-10-2103	1	
C11	CAP,F.T.,6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	1	
C12	CAP,F.T.,470PF CF101-147	FA5C-4712	A-B	1510-30-0471	1	
C13	CAP,TANT,10MF,25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	1	
CR1	DIODE DG100-821	1N82AG	G-I	4807-01-0082	1	
WAVETEK PARTS LIST		TITLE 50 MHZ HARMONIC MARKER, M6H-50			ASSEMBLY NO. 1114-00-0100 PAGE: 1	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT	
J1 J2	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2	
L1 L3	RF CHOKE	CHOKE	W-I	1819-99-9999	2	
L2	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	1	
L4	FERRITE CHOKE LA009-004	T1255-1	HYT	1810-05-0001	1	
R01	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1	
R02	RES,C,1/4W,5%,56 RC103-056	CF1/4-56	ASE	4700-15-5609	1	
R03	RES,C,1/4W,5%,1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1	
R04 R17	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	2	
R05	RES,C,1/4W,5%,75 RC103-075	CR1/4-75	ASE	4700-15-7509	1	
R06	RES,C,1/4W,5%,3.9K RC103-239	CF1/43.9K	ASE	4700-15-3901	1	
R07	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	1	
R08	RES,C,1/4W,5%,33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1	
WAVETEK PARTS LIST		TITLE 50 MHZ HARMONIC MARKER, M6H-50			ASSEMBLY NO. 1114-00-0100 PAGE: 2	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT	
R09	RES,C,1/4W,5%,1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1	
R10	RES,C,1/4W,5%,1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1	
R11	RES,C,1/4W,5%,8.2K RC103-282	CF1/4-8.2K	ASE	4700-15-8201	1	
R12	RES,C,1/4W,5%,15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1	
R13	RES,C,1/4W,5%,1.5M RC103-515	CF1/4-1.5M	ASE	4700-15-1504	1	
R14	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	1	
R15	POT,20K RP124-320	WA2G032S-203MA	A-B	4610-10-7203	1	
R16	RES,C,1/4W,5%,100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1	
X1	CRYSTAL,XX000-331	X33W-00.00000	W-I	2310-00-0331	1	
<div>WAVETEK PARTS LIST</div>		TITLE 50 MHZ HARMONIC MARKER, M6H-50			ASSEMBLY NO. 1114-00-0100 PAGE: 3	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
C01	CAP,CER,47PF,1KV CD104-047	60U2J470J	MDC	1510-10-3470	1
C02	CAP,CER,20PF,1KV CD101-020	60C0G200J	MDC	1510-10-0200	1
C03	CAP,CER,120PF,1KV CD104-112	10TCU-T12	SPR	1510-10-3121	1
C04 C09	CAP,FT,500PF,20%250V CF104-150	4420-500PF	AER	1510-30-3501	2
C05	CAP,F.T.,470PF CF101-147	FA5C-4712	A-B	1510-30-0471	1
C08	CAP,VALUE DETERMINED IN CALIBRATION	CAP,TRIM	W-I	1519-99-9999	1
C10	CAP,CER,.01MF,100V CD103-310	68U103M	MDC	1510-10-2103	1
C11	CAP,CER,.05MF,100V CD103-350	TG-350	SPR	1510-10-2503	1
C12	CAP,F.T.,6.8PF CF102-R68	FA5C-6892	A-B	1510-30-1689	1
CR1A	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1
CR2	DIODE DG100-821	1N82AG	G-I	4807-01-0082	1
J1 J2	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L2	CHOKE,2.2MH,10% LA005-R22	08N2R2K	ASE	1810-03-0229	1
WAVETEK PARTS LIST		TITLE SING FREQ MKR M6S-3		ASSEMBLY NO. 1114-00-0045 PAGE: 1	
				REV A	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY/PT
Q1 Q2	TRANS QA038-541	2N3854A	G-E	4901-03-8541	2
R1	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
R2	RES,C,1/4W,5%,56 RC103-056	CF1/4-56	ASE	4700-15-5609	1
R3 R4	RES,C,1/4W,5%,1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	2
R5	RES,C,1/4W,5%,180K RC103-418	CF1/4-180K	ASE	4700-15-1803	1
R6	RES,C,1/4W,5%,470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1
R7 R9	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	2
R8	POT,20K RP124-320	WA2G032S-203MA	A-B	4610-10-7203	1
X1	CRYSTAL,XX000-331	X33W-00.00000	W-I	2310-00-0331	1
WAVETEK PARTS LIST		TITLE SING FREQ MKR M6S-3		ASSEMBLY NO. 1114-00-0045 PAGE: 2	
				REV A	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGN-PART-NO	MFGN	WAVETEK NO.	QTY	
C1	CAP,FILM,10KPF,160V CP105-310	SXM110	MAL	1510-60-5103	1	
C2	CAP,CER,10PF,1KV CD101-010	10TCC-Q10	SPK	1510-10-0100	1	
C3	CAP,CER,F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	1	
C4	CAP,F.T.,6.8PF CF102-R68	FA5C-6892	A-M	1510-30-1699	1	
CR1 CR2 CR3	DIODE DG109-140	1N4148	FCD	4807-01-0914	3	
IC1	IC,8 PIN,IC000-008	LM301-AN	WAT	7000-03-0100	1	
R1	POT,20K RP124-320	WA26032S-203MA	A-B	4010-10-7203	1	
R2	RES,C,1/4W,5%,56K RC103-356	CF1/4-56K	ASE	4700-15-5602	1	
R3	RES,C,1/4W,5%,150 RC103-115	CF1/4-150	ASE	4700-15-1500	1	
R4	RES,MF,1/8W,1%,47.5K RF213-475	MF55K-47.5K	ASE	4701-03-4752	1	
R5	RES,MF,1/8W,1%,48.7K RF213-487	MF55K-48.7K	ASE	4701-03-4872	1	
R6	RES,MF,1/8W,1%,46.4K RF213-464	MF55K-46.4K	ASE	4701-03-4642	1	
WAVETEK PARTS LIST		TITLE 1 KHZ SQR WAVE MODULATOR, M6Z-1			ASSEMBLY NO. 1114-00-0150 PAGE: 1	REV

SECTION 7

SCHEMATICS

7.1 INTRODUCTION

This section contains all schematics for the instrument. A schematic index is given in Section 7.4.

7.2 SCHEMATIC NOTES

The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics

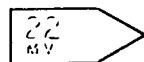
are included on each schematic if required.

All values are shown in the following units unless otherwise specified.

Components	Units
Resistor	ohms
Capacitor	picofarads
Inductor	microhenries



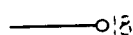
Denotes DC voltage reading in volts unless otherwise specified.



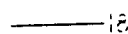
Denotes high impedance crystal detector reading in volts unless otherwise specified.



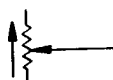
Denotes 50 ohm crystal detector reading in volts unless otherwise specified.



Signal or voltage source.



Connects to indicated signal or voltage source.



Arrow indicates clockwise rotation of wiper.



Coaxial jack

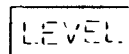


Coaxial plug



Coaxial cable

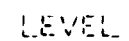
* Factory adjusted part.



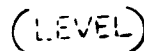
Denotes a front-panel device.



Denotes a rear-panel device.



Denotes a PC board adjustment or accessible module adjustment.



Denotes an internal module adjustment not accessible without removing module cover.

SCHEMATICS

7.3 ABBREVIATION CODE

A	Assembly	IF	intermediate frequency	Ω	ohm
A	ampere	J	jack	OC	opto coupler
AC	alternating current	K	relay	P	plug
C	capacitor	kHz	kilohertz	pp	peak-to-peak
CR	diode	k Ω	kilohm	pF	picofarad
CW	continuous wave	kV	kilovolt	Q	transistor
cw	clockwise	kW	kilowatt	R	resistor
dB	decibel	L	inductor	RF	radio frequency
dBm	decibel referred to 1 mW	MHz	megahertz	RMS	root-mean-square
dBmV	decibel referred to 1 mV	M Ω	megohm	R.P.	rear panel
DC	direct current	μ F	microfarad	S	switch
DS	indicating device, lamp	μ A	microampere	T	transformer
F	farad	μ H	microhenry	T.P.	test point
F.P.	front panel	M	meter	V	volt
H	henry	mA	milliampere	VA	voltampere
Har	harmonic	mH	millihenry	W	watt
Hz	hertz	mV	millivolt	X	crystal
IC	integrated circuit	mW	milliwatt		

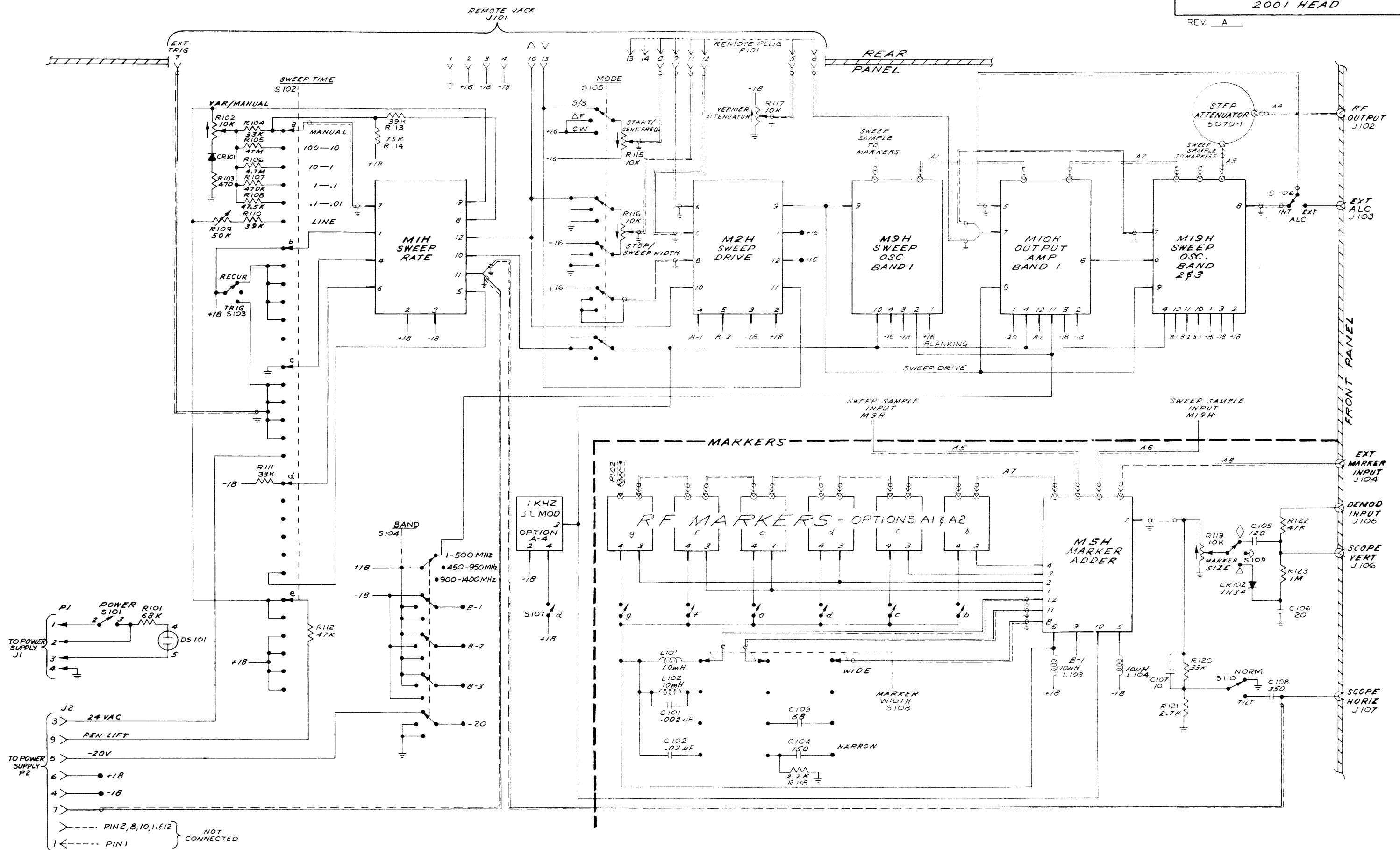
7.4 SCHEMATIC INDEX

The schematics appear in the following order.

<u>ASSEMBLY</u>	<u>NAME</u>
2001	Wiring Diagram
PS6	Power Supply
M1H	Sweep Rate
M2H	Sweep Drive
M5H	Marker Adder
M9H	Oscillator - Mixer
M10H	Output Amplifier
M19H	Sweep Oscillator
M6H-1	Harmonic Marker (1 MHz)
M6H-5-50	Harmonic Marker (5-50 MHz)
M6S	Single Freq. Marker
M6Z-1	1 kHz Modulation

MODULE WIRING DIAGRAM
2001 HEAD

REV. A



2001A HEAD
REV. _____
TACAN MARKER SYSTEM

REAR PANEL

FRONT PANEL

RF MARKERS

EXT. TRIG 7

SWEET TIME S102

VAR/MANUAL

MANUAL

LINE

TRIG (PULL) S103

S104 TRIG

R111 33K

R112 47K

R102 10K

R104 33K

R105 47M

R106 47M

R107 470K

R108 47.5K

R109 50K

R110 33K

R113 39K

R114 75K

R115 10K

R116 47K

R118 39K

R119 10K

R117 1K

R120 10K

R121 10K

R122 10K

R123 20K

R124 4.7K

R125 8.05K

R126 10.0K

R127 215

R128 191

R129 174

R130 154

R131 137

R132 121

R133 110

R134 95.3

R135 86.6

R136 78.7

R137 68.1

R138 1K

R139 220

S105 500

S106 39K

S107 ATTENUATOR 0-11dB

S108 BAND

S109

S110 MARKER WIDTH

S111 INT. PLOTTER SWITCH

S112 TILT (PULL)

S113 120

S114 47K

S115 20

S116 350

S117 2.7K

S118 10

S119 104H

S120 104H

S121 104H

S122 104H

S123 104H

S124 104H

S125 104H

S126 104H

S127 104H

S128 104H

S129 104H

S130 104H

S131 104H

S132 104H

S133 104H

S134 104H

S135 104H

S136 104H

S137 104H

S138 104H

S139 104H

S140 104H

S141 104H

S142 104H

S143 104H

S144 104H

S145 104H

S146 104H

S147 104H

S148 104H

S149 104H

S150 104H

S151 104H

S152 104H

S153 104H

S154 104H

S155 104H

S156 104H

S157 104H

S158 104H

S159 104H

S160 104H

S161 104H

S162 104H

S163 104H

S164 104H

S165 104H

S166 104H

S167 104H

S168 104H

S169 104H

S170 104H

S171 104H

S172 104H

S173 104H

S174 104H

S175 104H

S176 104H

S177 104H

S178 104H

S179 104H

S180 104H

S181 104H

S182 104H

S183 104H

S184 104H

S185 104H

S186 104H

S187 104H

S188 104H

S189 104H

S190 104H

S191 104H

S192 104H

S193 104H

S194 104H

S195 104H

S196 104H

S197 104H

S198 104H

S199 104H

S200 104H

S201 104H

S202 104H

S203 104H

S204 104H

S205 104H

S206 104H

S207 104H

S208 104H

S209 104H

S210 104H

S211 104H

S212 104H

S213 104H

S214 104H

S215 104H

S216 104H

S217 104H

S218 104H

S219 104H

S220 104H

S221 104H

S222 104H

S223 104H

S224 104H

S225 104H

S226 104H

S227 104H

S228 104H

S229 104H

S230 104H

S231 104H

S232 104H

S233 104H

S234 104H

S235 104H

S236 104H

S237 104H

S238 104H

S239 104H

S240 104H

S241 104H

S242 104H

S243 104H

S244 104H

S245 104H

S246 104H

S247 104H

S248 104H

S249 104H

S250 104H

S251 104H

S252 104H

S253 104H

S254 104H

S255 104H

S256 104H

S257 104H

S258 104H

S259 104H

S260 104H

S261 104H

S262 104H

S263 104H

S264 104H

S265 104H

S266 104H

S267 104H

S268 104H

S269 104H

S270 104H

S271 104H

S272 104H

S273 104H

S274 104H

S275 104H

S276 104H

S277 104H

S278 104H

S279 104H

S280 104H

S281 104H

S282 104H

S283 104H

S284 104H

S285 104H

S286 104H

S287 104H

S288 104H

S289 104H

S290 104H

S291 104H

S292 104H

S293 104H

S294 104H

S295 104H

S296 104H

S297 104H

S298 104H

S299 104H

S300 104H

S301 104H

S302 104H

S303 104H

S304 104H

S305 104H

S306 104H

S307 104H

S308 104H

S309 104H

S310 104H

S311 104H

S312 104H

S313 104H

S314 104H

S315 104H

S316 104H

S317 104H

S318 104H

S319 104H

S320 104H

S321 104H

S322 104H

S323 104H

S324 104H

S325 104H

S326 104H

S327 104H

S328 104H

S329 104H

S330 104H

S331 104H

S332 104H

S333 104H

S334 104H

S335 104H

S33

PARTS LIST

MODEL 2001A HEAD
with TACAN Markers

MODULE

REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
	<u>STANDARD MODULES</u>				
M1H	Sweep Rate Module	M1H	W-I	M1H	1
M2J	Sweep Drive Module	M2J	W-I	M2J	1
M5H-1	Marker Adder Module (modified)	M5H-1	W-I	M5H-1	1
M10H-1	Output Amplifier Module, Band 1(modified)	M10H-1	W-I	M10H-1	1
M19H	Oscillator Module, Band 2 & 3	M19H	W-I	M19H	1
M66H.2,1	Harmonic Markers, 200kHz, 1 MHz,(modified)	M66H.2,1-1	W-I	M66H.2,1-1	1
M6H5	Harmonic Markers, 5 MHz, (modified)	M6H5-1	W-I	M6H5-1	1
M6H20	Harmonic Markers, 20 MHz (modified)	M6H20-1	W-I	M6H20-1	1
M66 63.0	Single frequency marker at 63.0 MHz with sidebands at 62.1 MHz and 63.9 MHz and a 62.65 and 63.35 MHz	M66 63.0	W-I	M66 63.0	1
"A"	<u>ASSEMBLIES</u>				
1	RF Cable, 50 ohm	WX2001A-A1	W-I	WX2001A-A1	1
2	RF Cable, 50 ohm	WX2001A-A2	W-I	WX2001A-A2	1
3	RF Cable, 50 ohm	WX2001A-A3	W-I	WX2001A-A3	1
4	RF Cable, 50 ohm	WX2001A-A4	W-I	WX2001A-A4	1
5	RF Cable, 50 ohm	WX2001A-A5	W-I	WX2001A-A5	1
6	RF Cable, 50 ohm	WX2001A-A6	W-I	WX2001A-A6	1
7	RF Cable, 50 ohm	WX2001A-A7	W-I	WX2001A-A7	1
8	RF Cable, 50 ohm	WX2001A-A8	W-I	WX2001A-A8	1
9	RF Cable, 50 ohm	WX2001A-A9	W-I	WX2001A-A9	1
10	RF Cable, 50 ohm	WX2001A-A10	W-I	WX2001A-A10	1
11	RF Cable, 50 ohm	WX2001A-A11	W-I	WX2001A-A11	1
----	S102 Assembly with associated parts	B500-225	W-I	B500-225	1
----	S107 Assembly with associated parts	B500-232	W-I	B500-232	1
----	S108 Assembly with associated parts	B500-224	W-I	B500-224	1
5070-2	RF Attenuator	5070-2	W-I	5070-2	1
"C"	<u>CAPACITORS</u>				
101	Ceramic disc, .01uF +20% 100V	CD103-310	SPR	TG-S10	1
102	Ceramic disc, .002uF +20% 1kV	CD102-220	SPR	5GA-D20	1
103	Ceramic disc, .02uF +20% 100V	CD103-320	SPR	TG-S20	1
104	Ceramic disc, 68pF +5% 1kV	CD104-068	SPR	10TCU-Q68	1
105	Ceramic disc, 150pF +20% 1kV	CD102-115	SPR	5GA-T15	1
106	Ceramic disc, 10pF +5% 1kV	CD101-010	SPR	10TCC-Q10	1
107	Ceramic disc, 350pF +20% 1kV	CD102-135	SPR	5GA-T35	1
108	Ceramic disc, 120pF +20% 1kV	CD102-112	SPR	5GA-T12	1
109	Ceramic disc, 20pF +5% 1kV	CD101-020	SPR	10TCC-Q20	1
"J"	<u>CONNECTORS (JACKS)</u>				
2	12-pin receptacle	MC000-030	MOL	1360-R1	1
	Contact, female, for above	MC000-032	MOL	1433	6
	Contact, male, for above	MC000-033	MOL	1434	1
101	15-pin receptacle	MC000-016	MOL	1625-15R	1
	Contact, female, for above	MC000-018	MOL	1855	14
102,103,104	BNC, Cable	JB000-003	W-I	JB000-003	3
105	Phone, receptacle, submin.	MC000-036	S-I	142A	1

PARTS LIST

MODULE

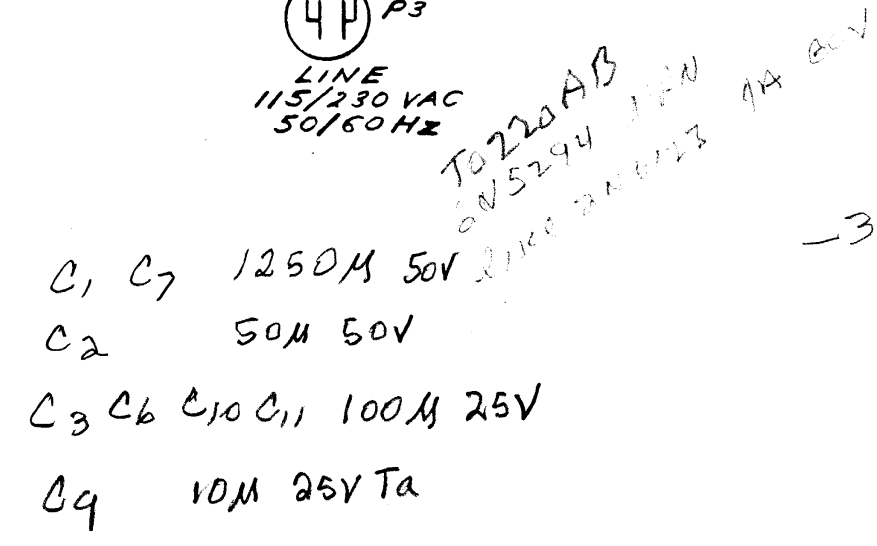
REV

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
	SEE STANDARD 2001A HEAD PARTS LIST FOR SHEET 2 and 3				

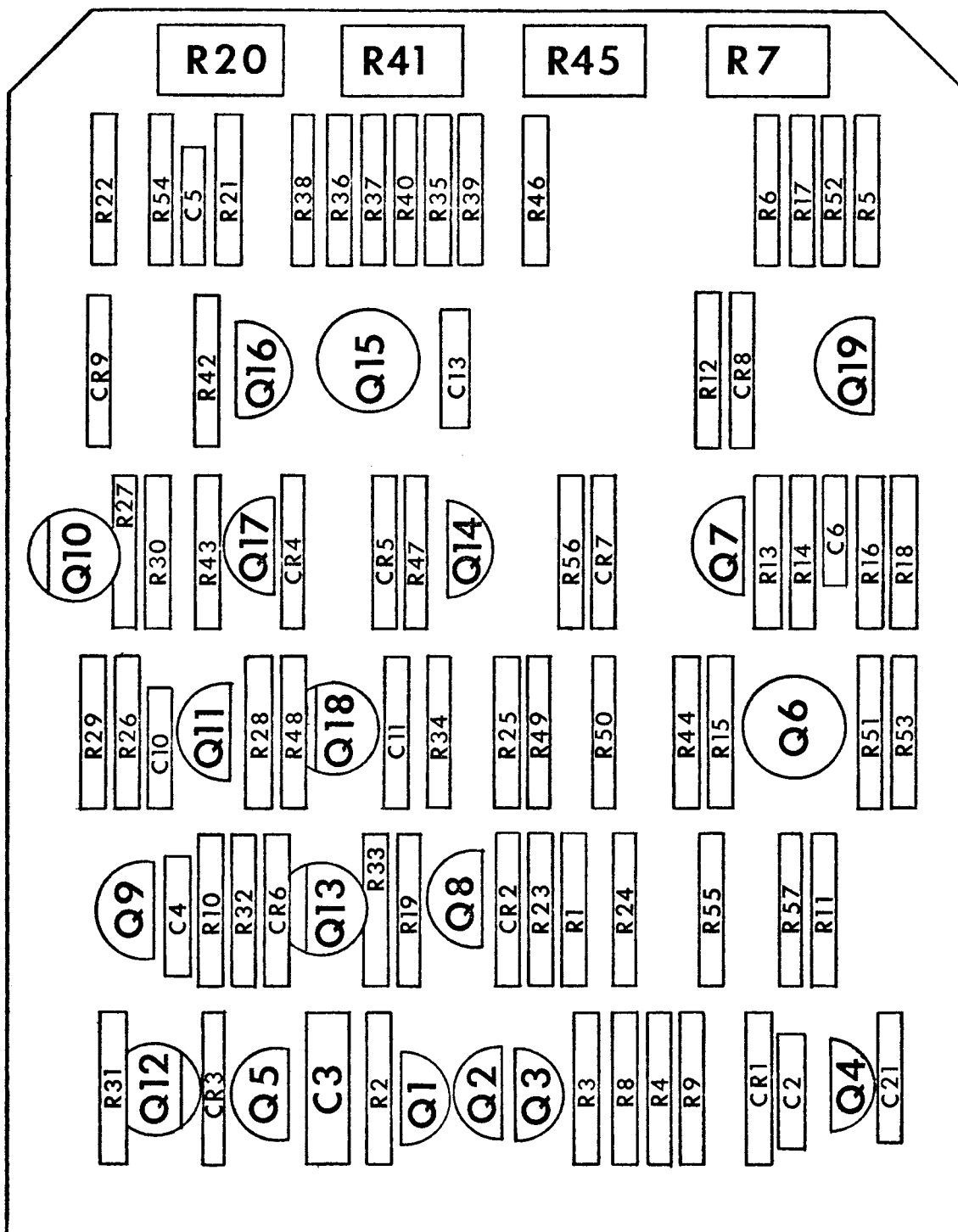
Diagram illustrating the connection of a scope to a power supply:

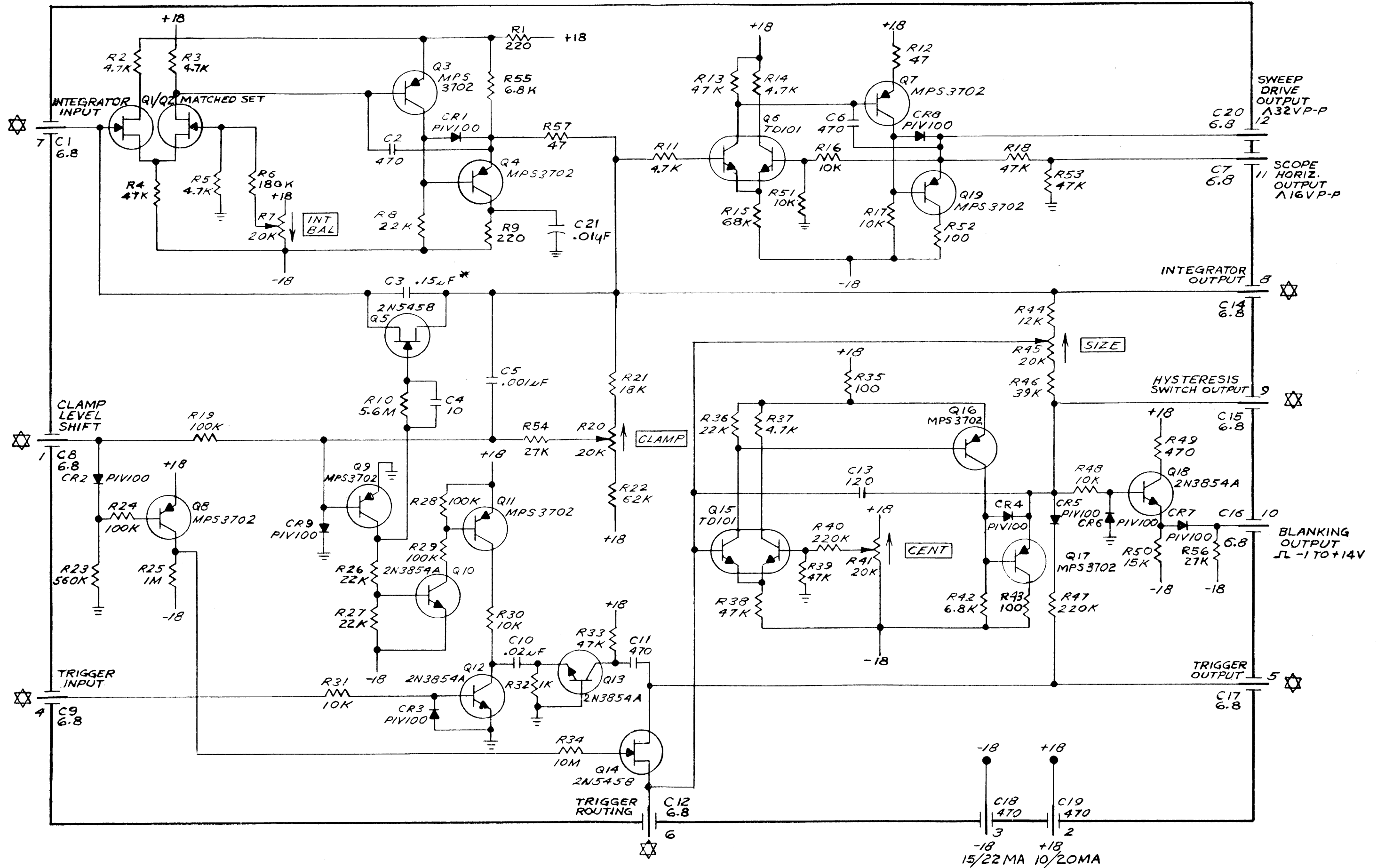
- Line 1: +30V (checked ✓)
- Line 2: -30V (checked ✓)
- Line 3: 20 (resistor symbol)
- Line 4: +18V
- Line 5: -18V (+17.9)
- Line 6: Short (-.8)
- Line 7: SCOPE HORIZ (-.55)
- Line 8: PEN LIFT
- Line 9: NO CONNECTION (lines 8, 10, 11, 12 grouped together)

P2



M1H

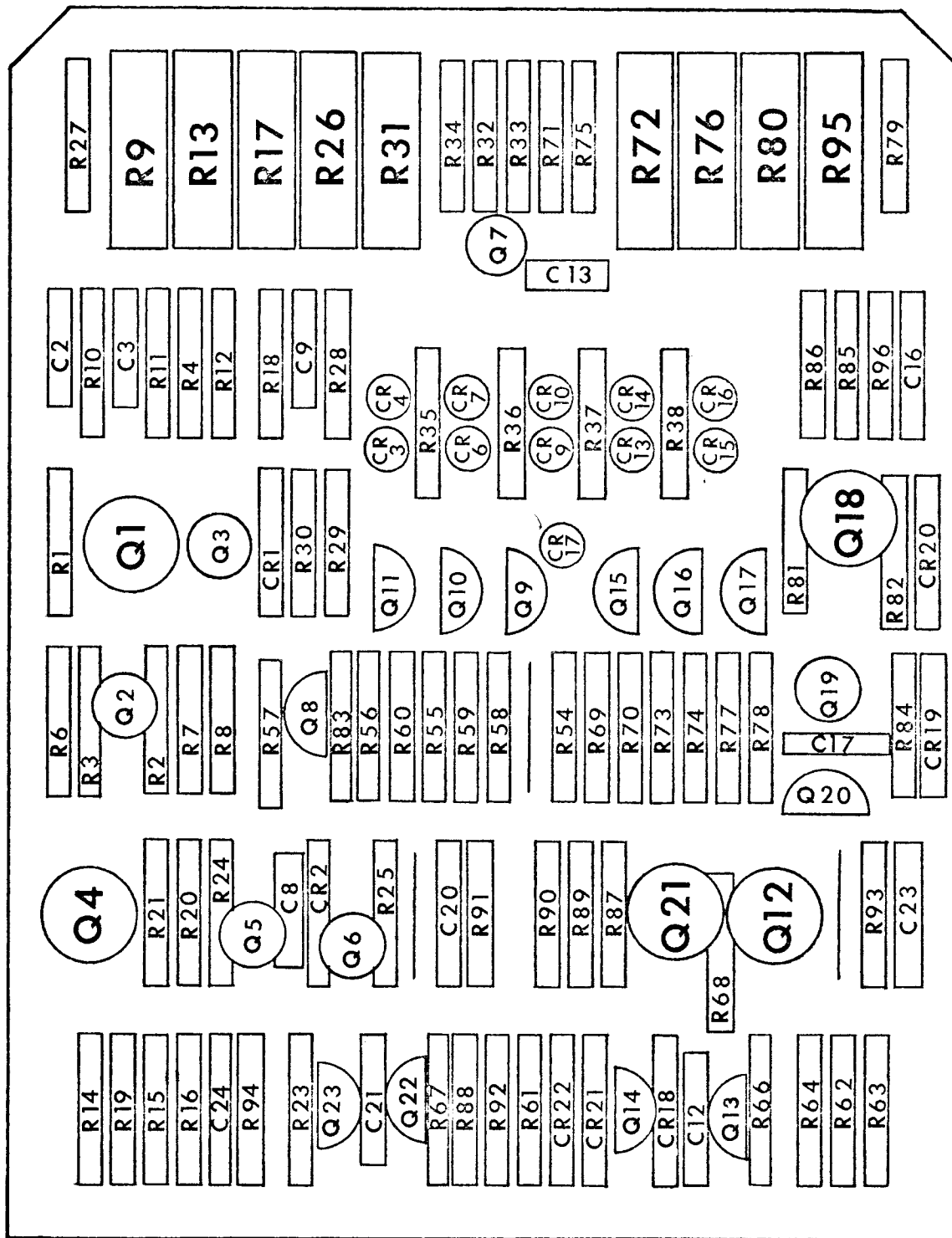


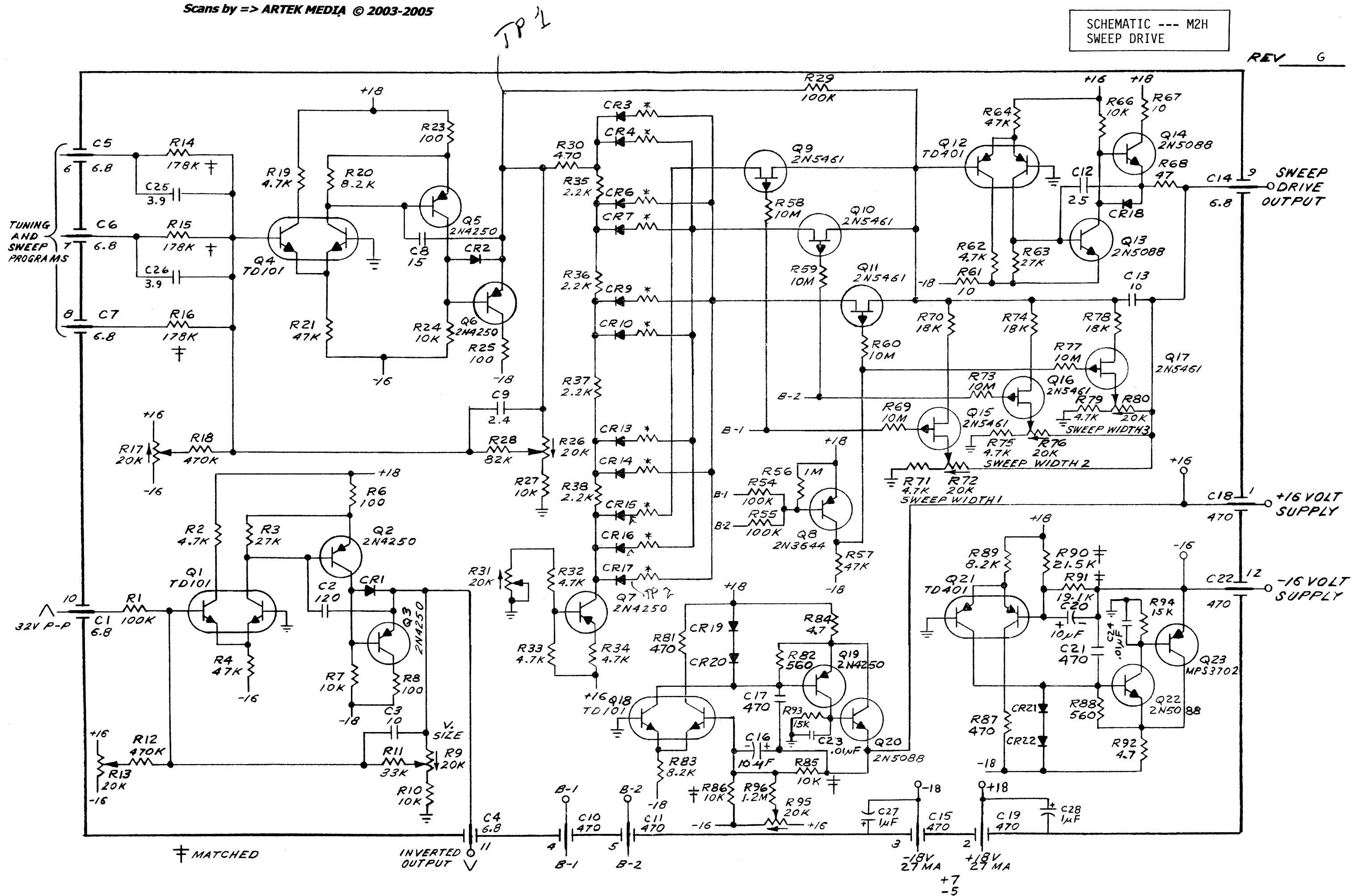


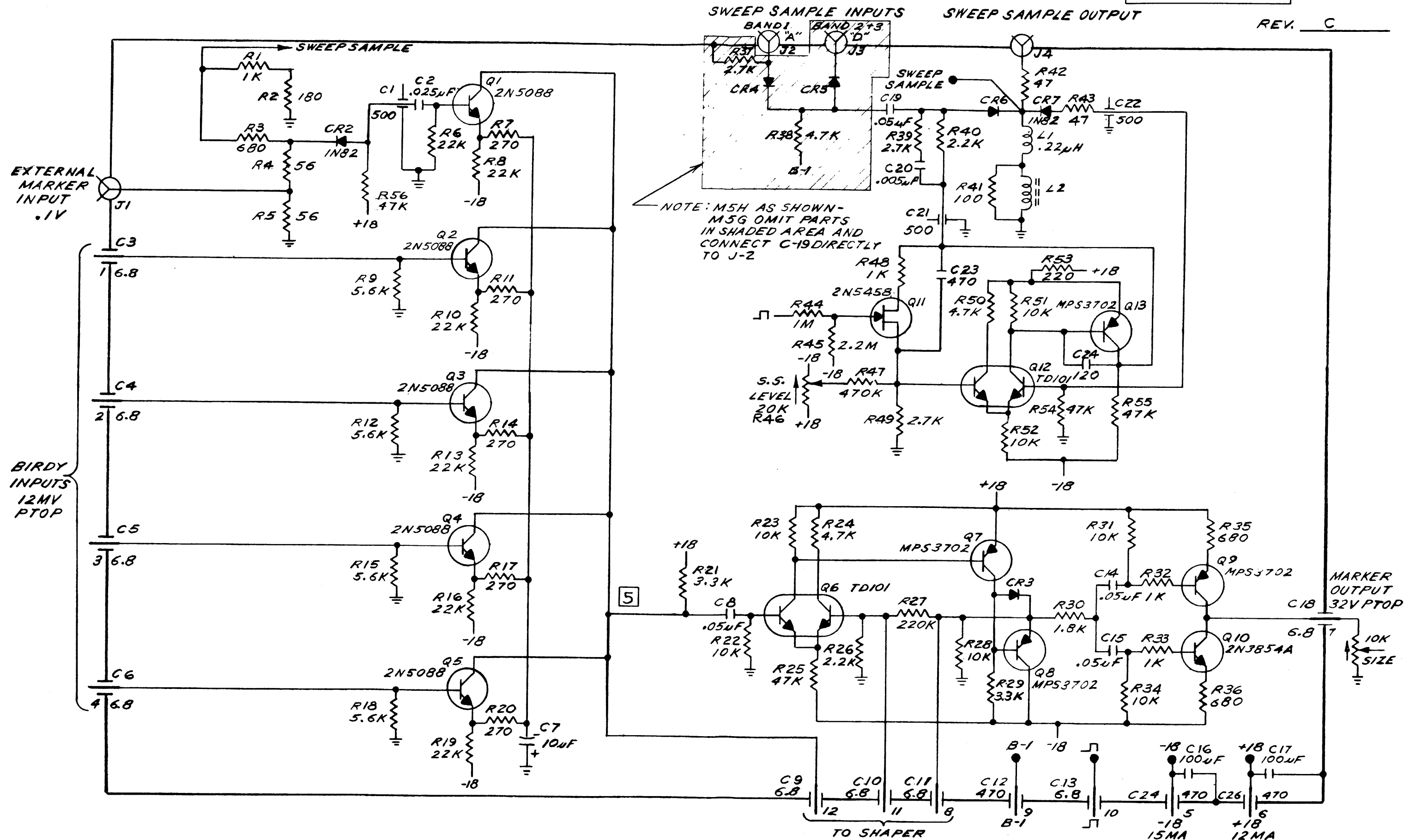
* = CONNECTED TO SWEEP TIME SWITCH

-18 +18
C18 470 C19 470
15/22 MA 10/20 MA

M2H

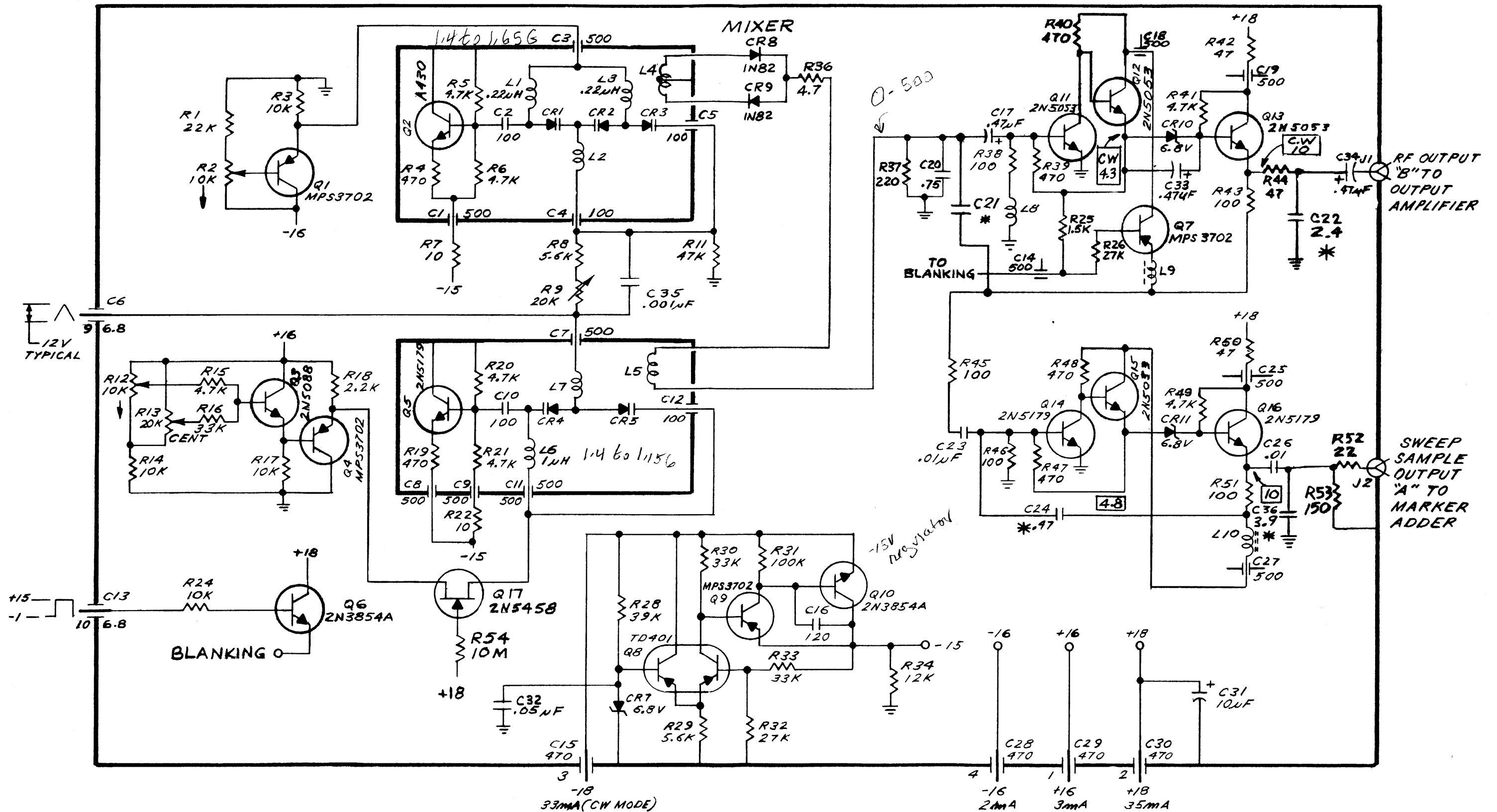






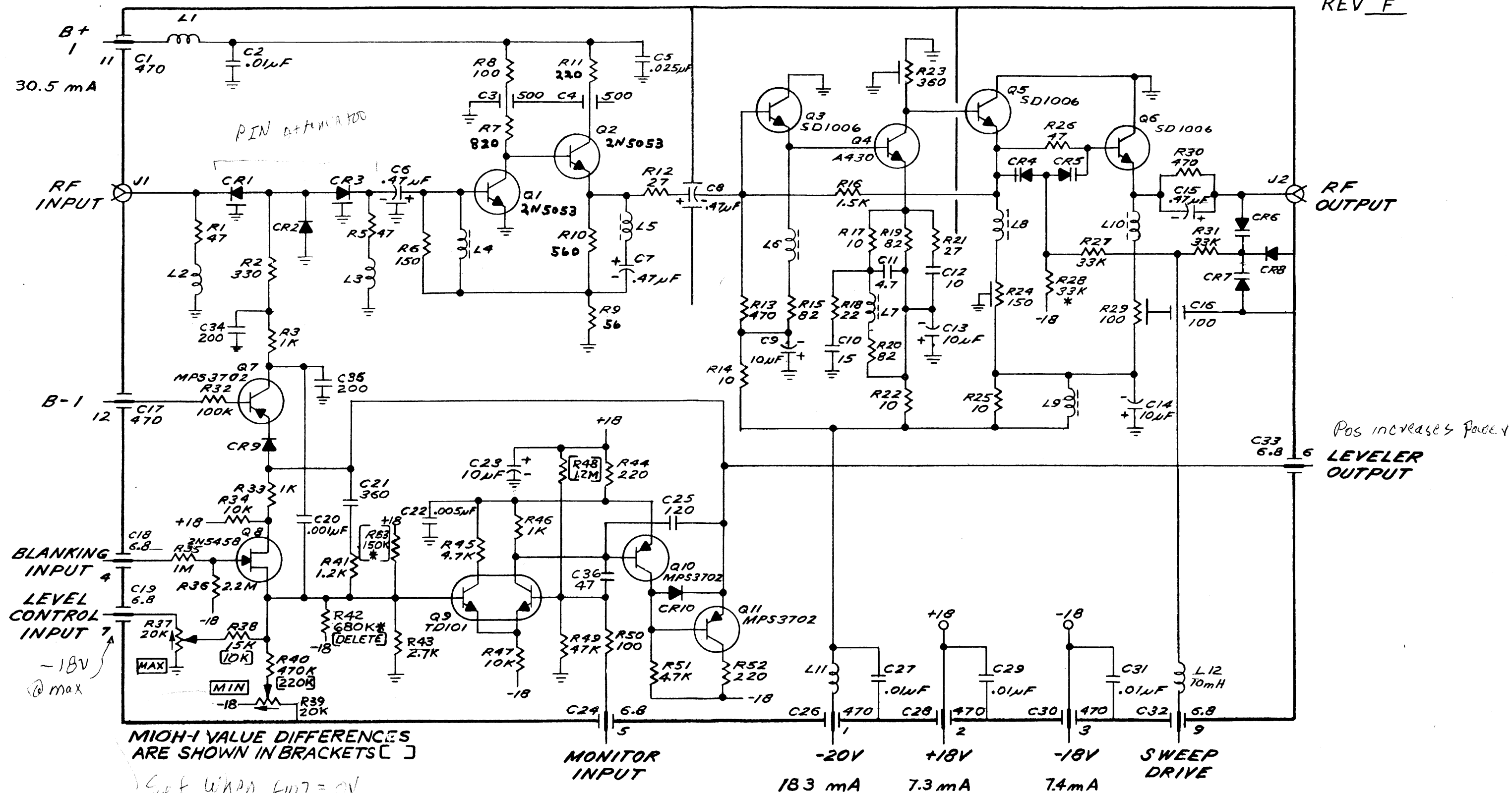
SCHEMATIC --- M9H
SWP OSC (BAND 1)

REV I



SCHEMATIC --- M10H
OUTPUT AMPLIFIER

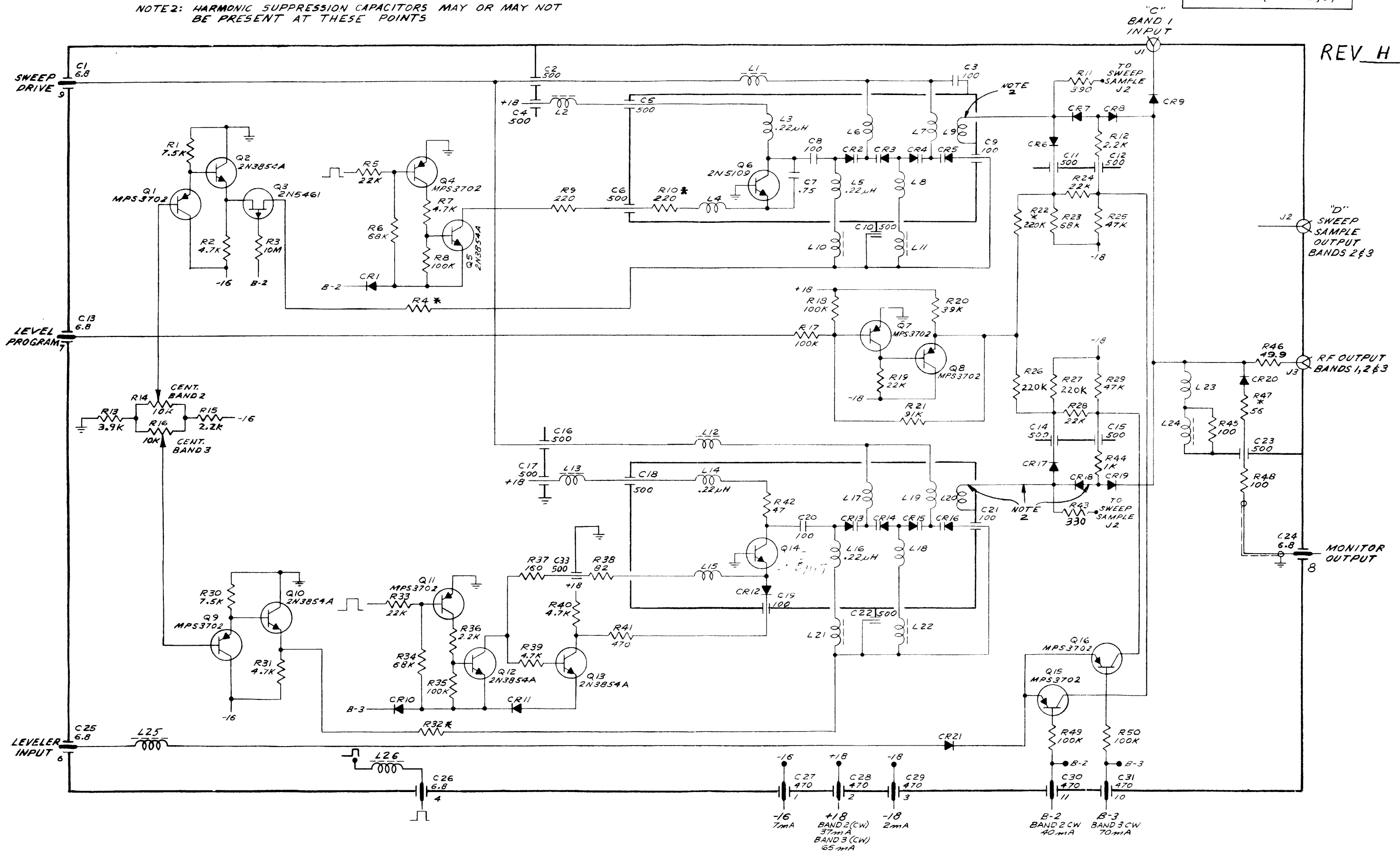
REV_F

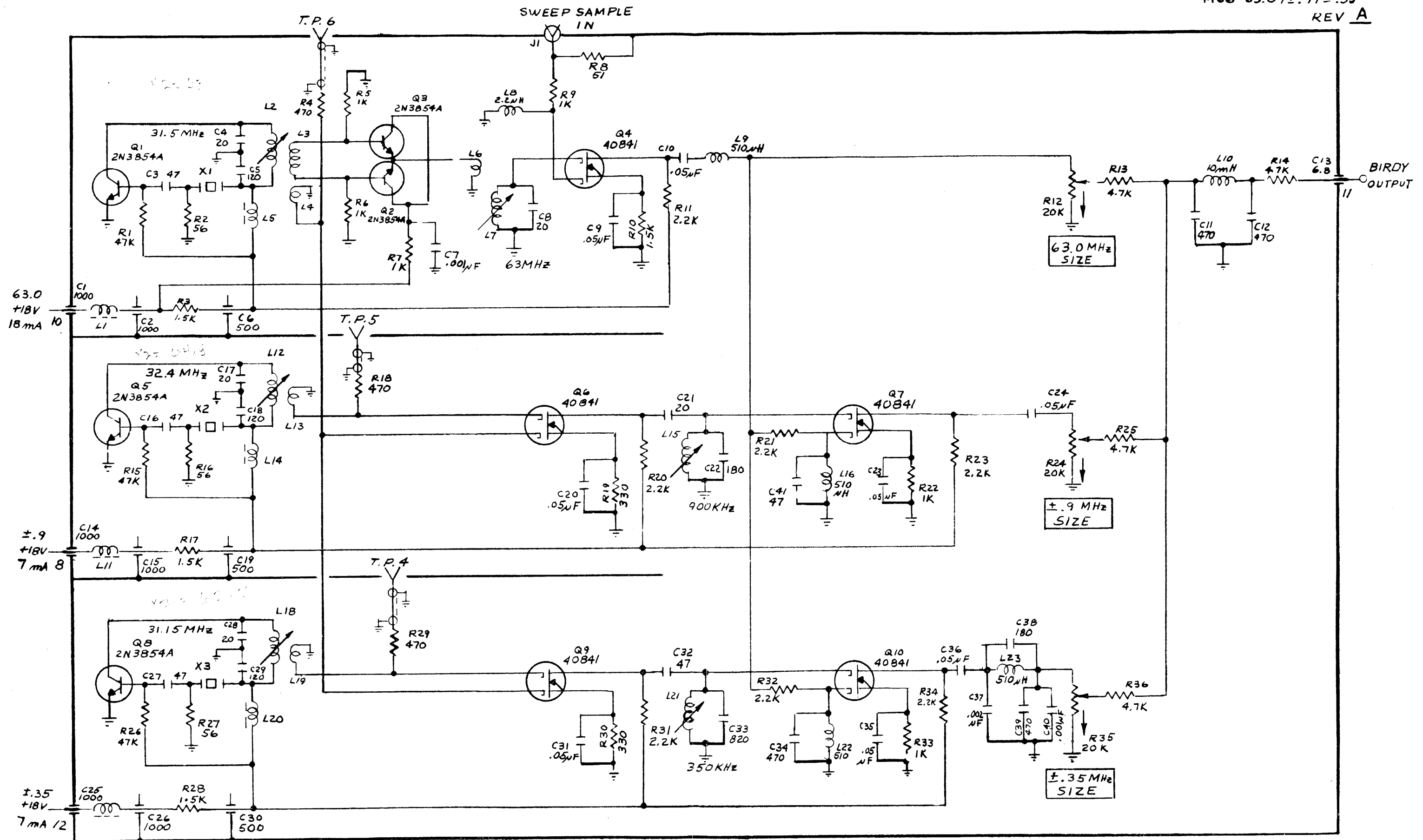


NOTE 1: "A" VERSION CHANGES OUTPUT IMPEDANCE TO 75Ω.
PARTS AFFECTED ARE R46, R47, & J3 (SEE PARTS LIST).
NOTE 2: HARMONIC SUPPRESSION CAPACITORS MAY OR MAY NOT
BE PRESENT AT THESE POINTS

SCHEMATIC --- M19H
SWP OSC (BAND 2,3)

REV H





PARTS LIST

MODULE M66 63.0 REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
"C"	CAPACITORS				
1,2,14,15 25,26	Ceramic feedthru 1000pF, 500V	CF112-210	A-B	FA5C	6
3,16,27,32, 41	Ceramic disc., 47pF +5% 1kV	CD104-047	SPR	10TCU-Q47	5
4,8,17,21,28	Ceramic disc., 20pF +5% 1kV	CD101-020	SPR	10TCC-Q20	5
5,18,29	Ceramic disc., 120pF +5% 1kV	CD104-112	SPR	10TCU-T12	3
6,19,30	Ceramic feedthru 500pF +20% 250V	CF104-150	AER	EF4	3
7,40	Ceramic disc., .001uF +20% 1kV	CD102-210	SPR	5GA-D10	2
9,10,20,23, 24,31,35,36	Ceramic disc., .05uF +20% 1kV	CD102-350	SPR	TG-S50	8
11,12,34,39	Ceramic disc., 470pF +20% 1kV	CD102-147	SPR	5GA-T47	4
13	Ceramic feedthru 6.8pF +10% 500V	CF102-R68	A-B	FA5C	1
22,38	Mica, 180pF +5% 500V	CM101-118	A-E	DM19 181J	2
33	Mica 820pF +5% 500V	CM101-182	A-E	DM19 821J	1
37	Ceramic disc., .002uF +20% 1kV	CD102-220	SPR	5GA-D20	1
"J"	CONNECTORS				
1	Jack, receptacle, 50 ohm	JF000-005	APL	27-9	1
"X"	CRYSTALS				
1	31.5 MHz	Y-8	W-I	Y-8	1
2	32.4 MHz	Y-10	W-I	Y-10	1
3	31.15 MHz	Y-9	W-I	Y-9	1
"L"	INDUCTORS				
1,11,17	Fixed	LA006-010	W-I	LA006-010	3
2,12,18	Variable	Not assign	W-I	-----	--
3	Fixed	Not assign	W-I	-----	--
4,13,19	Fixed	Not assign	W-I	-----	--
5,14,20	Fixed	LA006-004	W-I	LA006-004	3
6	Fixed	Not assign	W-I	-----	--
7	Variable	Not assign	W-I	-----	--
8	Fixed 2.2uH	LA001-R22	JEF	15	1
9,16,22,23	Fixed, 510uH	LA002-151	JEF	19	4
10	Fixed, 10mH	LA004-310	JEF	15S103K	1
15,21	Variable	Not Assign	W-I	-----	2
"R"	RESISTORS				
1,15,26	Fixed, comp., 47kohm +10% 1/4W	RC104-347	A-B	CB4731	3
2,16,27	Fixed, comp., 56 ohm +10% 1/4W	RC104-056	A-B	CB5601	3
3,17,28,10	Fixed, comp., 1.5k ohm +10% 1/4W	RC104-215	A-B	C B1521	4
4,17,29	Fixed, comp., 470 ohm +10% 1/4W	RC104-147	A-B	CB4711	3
5,6,7,9,22 23	Fixed, comp., 1k ohm +10% 1/4W	RC104-210	A-B	CB1021	6
8	Fixed, comp., 51 ohm +5% 1/4W	RC103-051	A-B	CB5103	1

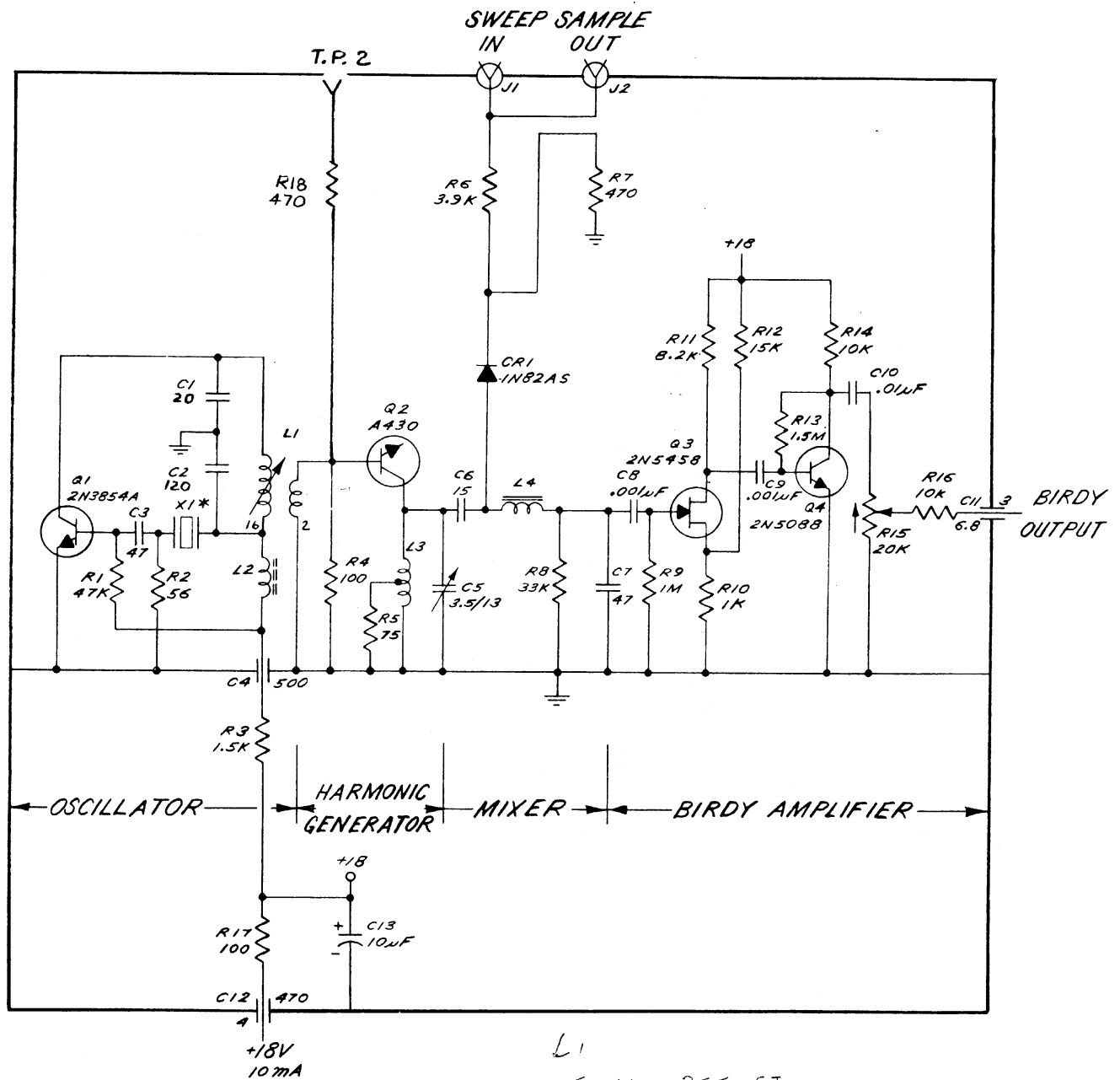
PARTS LIST

MODULE M66 63.0 REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
"R"	RESISTORS				
11,20,21,23 31,32,34	Fixed, comp., 2.2k ohm +10% 1/4W	RC104-222	A-B	CB2221	7
12,24,35	Fixed, comp., 20k ohm +10% 1/4W	RP130-320	BEK	89PR20K	3
13,14,25,36	Fixed, comp., 4.7k ohm +10% 1/4W	RC104-247	A-B	CB4721	4
19,30	Fixed, comp., 330 ohm +10% 1/4W	RC104-133	A-B	CB3311	2
"Q"	TRANSISTORS				
1,2,3,5,8 4,6,7,9,10	NPN, Silicon N channel IG FET	QA038-541 QB000-020	G-E RCA	2N3854A 40841	5 5

HARMONIC MARKER SCHEMATIC

INTERVAL: 30MHz
MODULE M6H 30-1

REV A

L1

5mH 35T 5T

20 20T 2T

30 16T 2T

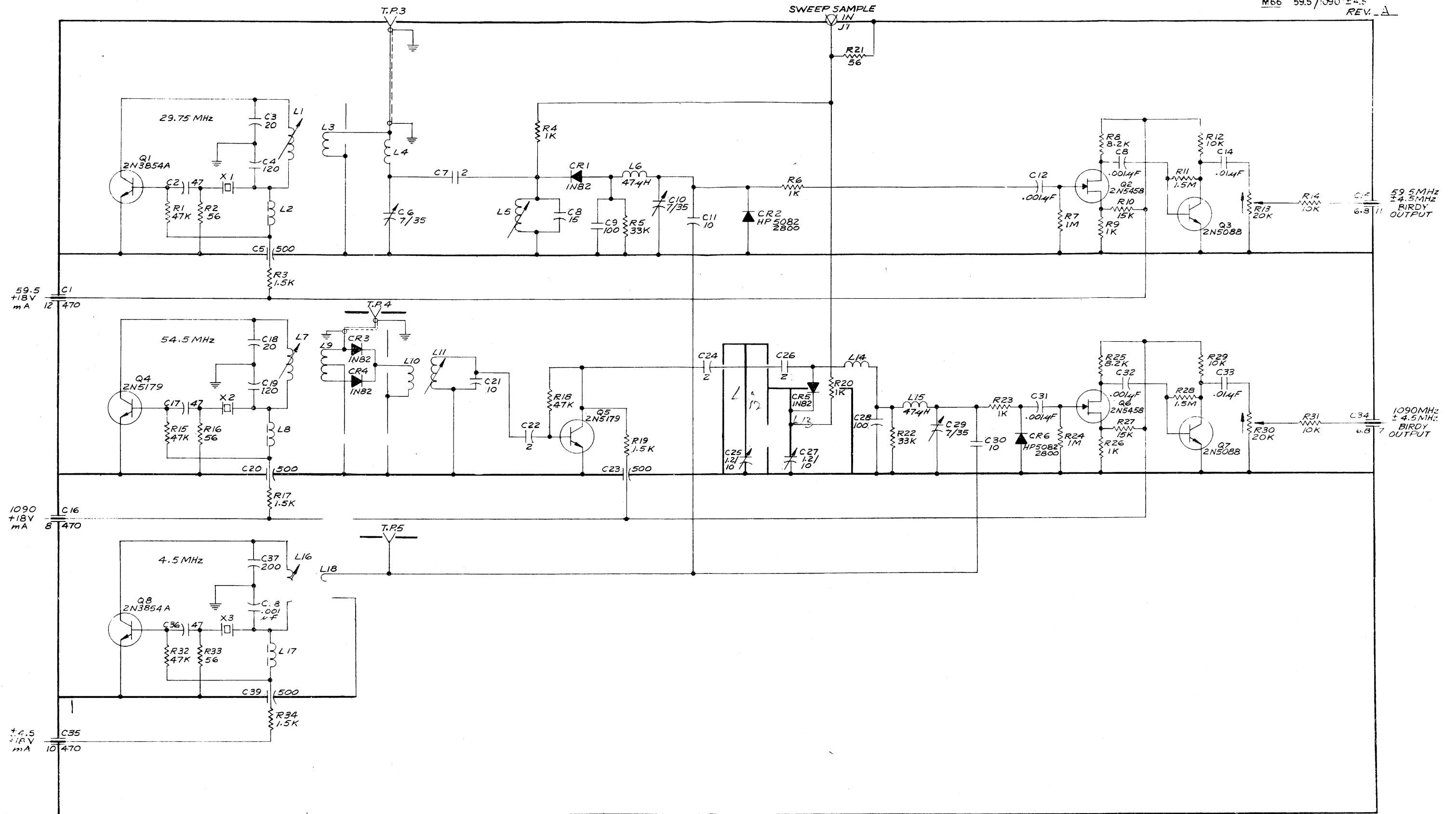
50mH 10T 2T

12T 2T

PARTS LIST

MODULE M6H 30-1REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
" C "	<u>CAPACITORS</u>				
1	Ceramic disc, 20 pF \pm 5% 1kV	CD101-020	SPR	10TCU-Q20	1
2	Ceramic disc, 120 pF \pm 5% 1kV	CD104-112	SPR	10TCC-T12	1
3,7	Ceramic disc, 47pF \pm 5% 1kV	CD104-047	SPR	10TCC-Q47	2
4	Ceramic feedthru, 500pF \pm 20% 250V	CF104-150	AER	EF4	1
5	Variable, ceramic, 3.5/13pF	CV101-013	STR	7STRK0-02	1
6	Ceramic disc, 15pF \pm 5% 1kV	CD101-015	SPR	10TCC-Q15	1
8,9	Ceramic disc, .001uF \pm 20% 1kV	CD102-210	SPR	5GA-D10	2
10	Ceramic disc, .01uF \pm 20% 100V	CD103-310	SPR	TG-S10	1
11	Ceramic feedthru, 6.8pF \pm 10% 500V	CF102-R68	A-B	FA5C	1
12	Ceramic feedthru, 470pF \pm 20% 500V	CF101-141	A-B	FA5C	1
13	Electrolytic, 10uF 25V	CE105-010	SPR	TE1204	1
"J "	<u>CONNECTORS</u>				
1,2	Jack, receptacle, 50ohm submin	JF000-005	APL	27-9	2
3	Pin socket, teflon	MC000-002	W-I	MC-000-002	1
"X "	<u>CRYSTALS</u>				
1	30MHz	Y-4	W-I	Y-4	1
"CR "	<u>DIODES</u>				
1	Silicon, point contact	DG100-821	SYL	IN82AS	1
"L "	<u>INDUCTORS</u>				
1	Coilform LB-003-000 with 16 turns, 2 turns of 32 gage magnet wire	Not Assign.	---	-----	---
2	Fixed---	LA006-010	W-I	LA006-010	1
3	Formed from 24 ga. buss wire	Not Assign.	---	-----	---
4	Fixed---	LA006-004	W-I	LA006-004	1
"R "	<u>RESISTORS</u>				
1	Fixed, comp., 47kohm \pm 10% $\frac{1}{4}$ W	RC104-347	A-B	CB4731	1
2	Fixed, comp., 56ohm \pm 10% $\frac{1}{4}$ W	RC104-056	A-B	CB5601	1
3	Fixed, comp., 1.5kohm \pm 10% $\frac{1}{4}$ W	RC104-215	A-B	CB1521	1
4,17	Fixed, comp., 100ohm \pm 10% $\frac{1}{4}$ W	RC104-110	A-B	CB1021	2
5	Fixed, comp., 75ohm \pm 5% $\frac{1}{4}$ W	RC103-075	A-B	CB7505	1
6	Fixed, comp., 3.9kohm \pm 10% $\frac{1}{4}$ W	RC104-239	A-B	CB3921	1
7,18	Fixed, comp., 470ohm \pm 10% $\frac{1}{4}$ W	RC104-147	A-B	CB4711	2
8	Fixed, comp., 33kohm \pm 10% $\frac{1}{4}$ W	RC104-333	A-B	CB3331	1
9	Fixed, comp., 1Mohm \pm 10% $\frac{1}{4}$ W	RC104-510	A-B	CB1051	1
10	Fixed, comp., 1kohm \pm 10% $\frac{1}{4}$ W	RC104-210	A-B	CB1021	1
11	Fixed, comp., 8.2kohm \pm 10% $\frac{1}{4}$ W	RC104-282	A-B	CB8221	1
12	Fixed, comp., 15kohm \pm 10% $\frac{1}{4}$ W	RC104-315	A-B	CB1531	1
13	Fixed, comp., 1.5Mohm \pm 10% $\frac{1}{4}$ W	RC104-515	A-B	CB1551	1
14,16	Fixed, comp., 10kohm \pm 10% $\frac{1}{4}$ W	RC104-310	A-B	CB1031	2
15	Variable, carbon, 20kohm \pm 20% $\frac{1}{4}$ W	RP124-320	A-B	WA2G032	1
"Q "	<u>TRANSISTORS</u>				
1	NPN, Silicon	QA038-541	G-E	2N3854A	1
2	NPN, Silicon	QB000-013	APX	A430	1
3	N-channel JFET	QA054-580	MOT	2N5458	1
4	NPN, Silicon	QA050-880	MOT	2N5088	1

MARKER SCHEMATIC
M66 59.5/1090 ±4.5
REV. A

PARTS LIST

MODULE M66 REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
"C "	CAPACITORS				
1,16,35	Ceramic feedthru, 470pF ±20% 500V	CF-101-147	A-B	FA5C	3
2,17,36	Ceramic disc, 47pF ±5% 1kV	CD-104-047	SPR	10TCU-Q47	3
3,18	Ceramic disc, 20pF ±5% 1kV	CD-101-020	SPR	10TCC-Q20	2
4	Ceramic disc, 120pF ±5% 1kV	CD-104-112	SPR	10TCU-T12	1
5,20,23,39	Ceramic feedthru, 500pF ±20% 250V	CF-104-150	AER	EF4	4
6,10,29	Variable, ceramic, 7/35pF	CV-101-035	STR	S-TRIKO	3
7,22,24,26	Composition 2pF ±10% 500V	CG-101-220	Q-C	Q C	4
8	Ceramic disc, 15pF ±5% 1kV	CD-101-015	SPR	10TCC-Q15	1
9,19,28	Ceramic disc, 100pF ±5% 1kV	CD-104-110	SPR	10TCU-T10	3
11,21,30	Ceramic disc, 10pF ±5% 1kV	CD-101-010	SPR	10TCC-Q10	3
12,13,31,32	Ceramic disc, .001uF ±20% 1kV	CD-102-210	SPR	5GA-D10	4
14,33	Ceramic disc, .01uF ±20% 100V	CD-103-310	SPR	TG-S10	2
15,34	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FA5C	2
25,27	Variable, ceramic, 1.2/10pF	CV-103-010	STR	R-TRIKO	2
37	Ceramic disc, 200pF ±5% 1kV	CD-104-120	SPR	10TCU-T20	1
38	Mica, 1000pF ±5% 500V	CM-101-210	A-E	DM19-102J	1
"J "	CONNECTORS				
1	Jack, receptacle, 50 ohm	JF-000-005	APL	27-9	1
"X "	CRYSTALS				
1	29.75 MHz	Y-3	W-I	Y-3	1
2	54.5 MHz	Y-5	W-I	Y-5	1
3	4.5 MHz	Y-2	W-I	Y-2	1
"CR "	DIODES				
1,3,4,5	Silicon, Point contact	DG-100-821	SYL	1N82AS	4
2,6	Silicon, Hot carrier	DG-000-007	H-P	5082-2800	2
"L "	INDUCTORS				
1	Variable ----	Not Assign.	W-I	-----	--
2,8,17	Fixed ----	LA-006-010	W-I	LA-006-010	3
3	Fixed ----	Not Assign.	W-I	-----	--
4	Fixed ----	Not Assign.	W-I	-----	--
5	Fixed ----	Not Assign.	W-I	-----	--
6,15	Fixed, 47uH	LA-001-047	JEF	15	2
7	Variable ----	Not Assign.	W-I	-----	--
9	Variable ----	Not Assign.	W-I	-----	--
10	Variable ----	Not Assign.	W-I	-----	--
11	Variable ----	Not Assign.	W-I	-----	--
12	Fixed ----	Not Assign.	W-I	-----	--
13	Fixed ----	Not Assign.	W-I	-----	--
14	Fixed ----	LA-006-004	W-I	LA-006-004	1
16	Variable ----	Not Assign.	W-I	-----	--
18	Fixed ----	Not Assign.	W-I	-----	--

PARTS LIST

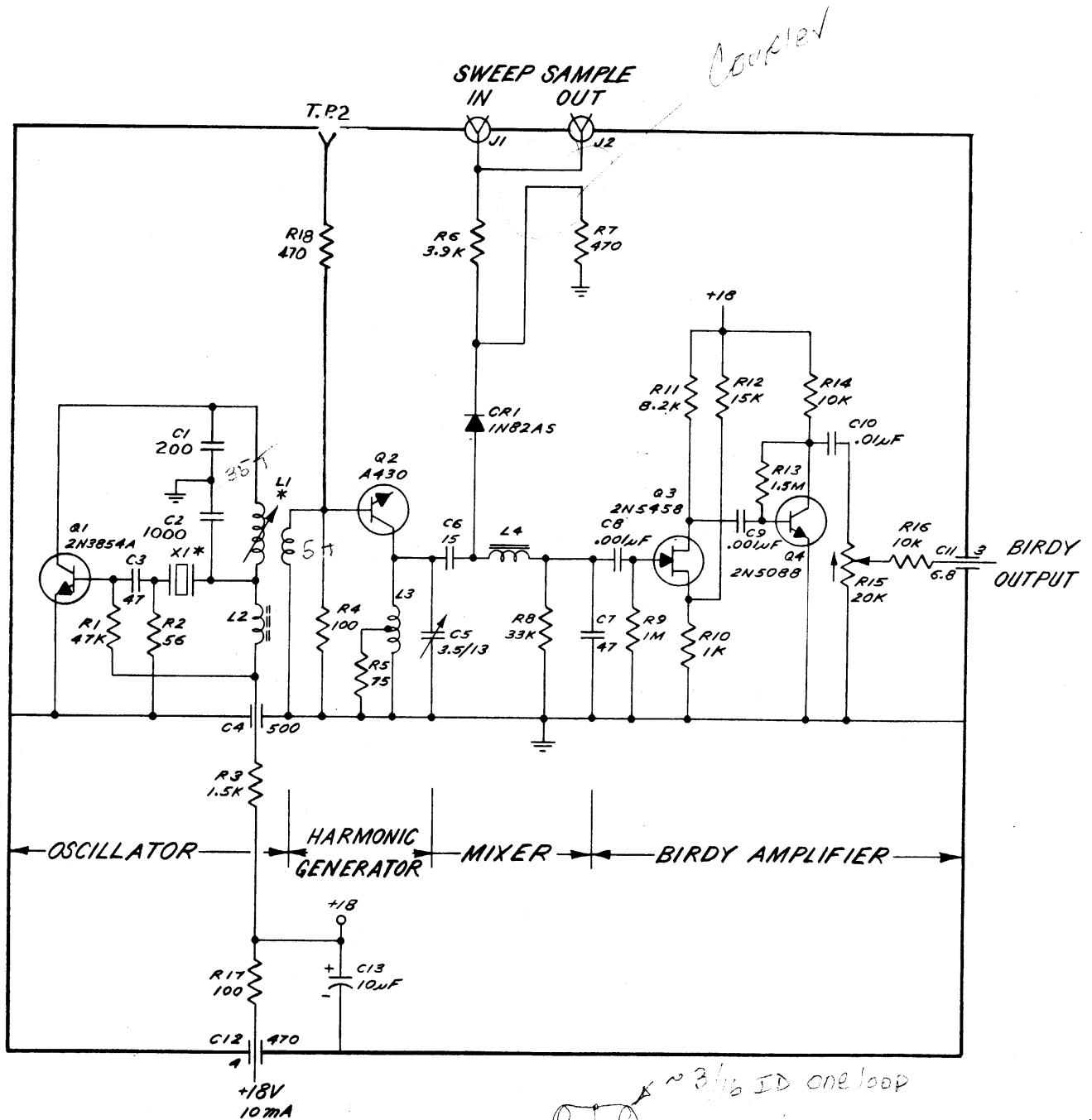
MODULE M66 REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
"R "	RESISTORS				
1,15,18,32	Fixed, comp., 47k ohm ±10% ¼W	RC-104-347	A-B	CB4731	4
2,16,21,33	Fixed, comp., 56 ohm ±10% ¼W	RC-104-056	A-B	CB5601	4
3,17,19,34	Fixed, comp., 1.5k ohm ±10% ¼W	RC-104-215	A-B	CB1521	4
4,6,9,20,23,26	Fixed, comp., 1k ohm ±10% ¼W	RC-104-210	A-B	CB1021	6
5,22	Fixed, comp., 33k ohm ±10% ¼W	RC-104-333	A-B	CB3331	2
7,24	Fixed, comp., 1M ohm ±10% ¼W	RC-104-510	A-B	CB1051	2
8,25	Fixed, comp., 8.2k ohm ±10% ¼W	RC-104-282	A-B	CB8221	2
10,27	Fixed, comp., 15k ohm ±10% ¼W	RC-104-315	A-B	CB1531	2
11,28	Fixed, comp., 1.5M ohm ±10% ¼W	RC-104-515	A-B	CB1551	2
12,14,29,31	Fixed, comp., 10k ohm ±10% ¼W	RC-104-310	A-B	CB1031	2
13,30	Variable, carbon, 20k ohm ±20% ¼W	RC-124-320	A-B	WA2G032	2
"Q "	TRANSISTORS				
1,8	NPN, Silicon	QA-038-541	G-E	2N3854A	2
2,6	N-channel JFET	QA-054-580	MOT	2N5458	2
3,7	NPN, Silicon	QA-050-880	MOT	2N5088	2
4,5	NPN, Silicon	QA-051-790	RCA	2N5179	2

HARMONIC MARKER SCHEMATIC

(OPTION A2) INTERVAL: 5 MHz
MODULE M6H 5-1

REV A



~3

~ 3/16 ID one loop

SOME CU 2011152

L2 = 9T on ferrite bead

L4 = 5T on ferrite bead

PARTS LIST

MODULE M6H 5-1 REV A

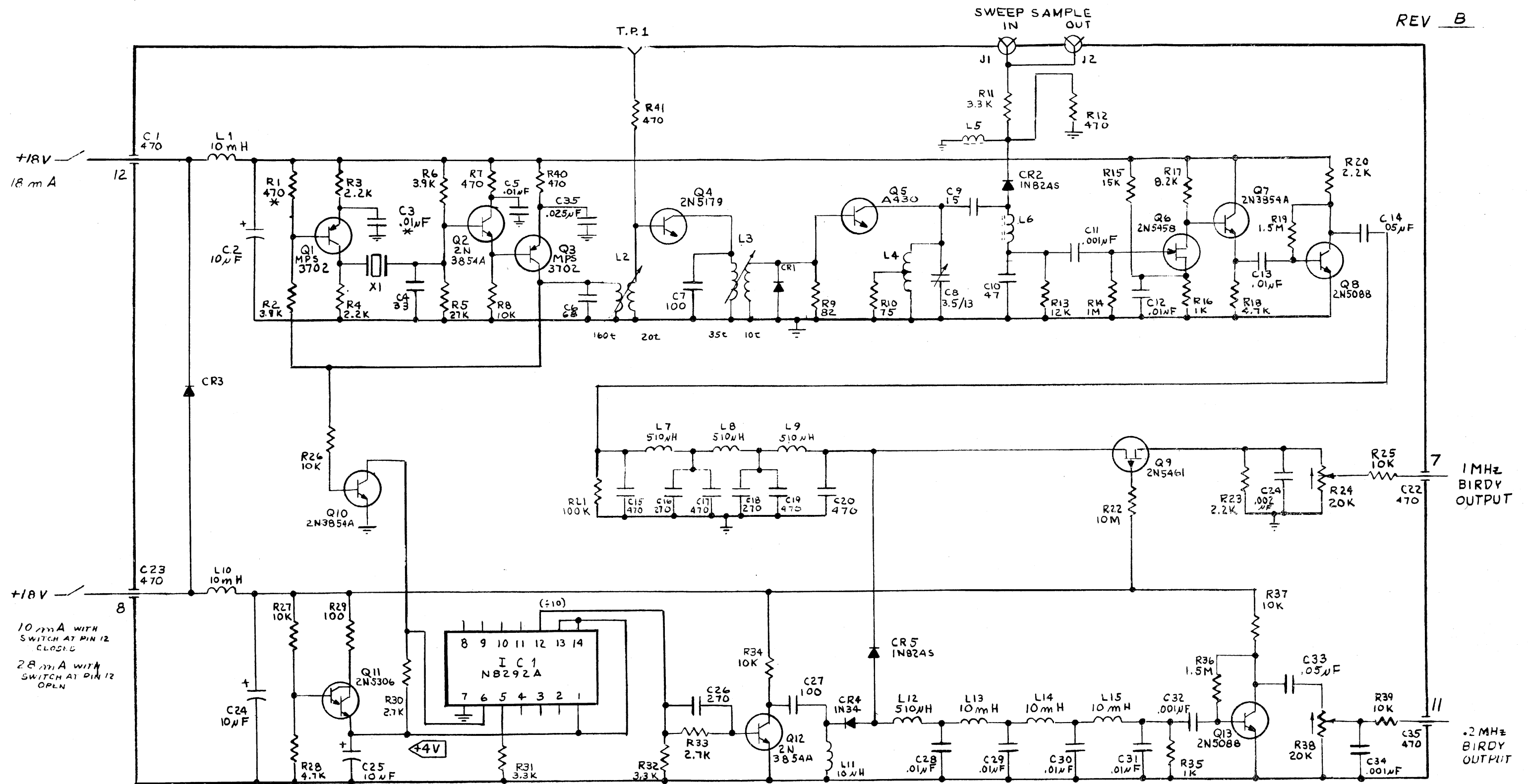
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
" C "	<u>CAPACITORS</u>				
1	Ceramic disc, pF + 5% 1kV	CD104-120	SPR	10TCC-T20	1
2	Silvered mica, 1000pF + 5%	CM101-210	A-E	DM-19-102J	1
3,7	Ceramic disc, 47pF ±5% 1kV	CD104-047	SPR	10TCC-Q47	2
4	Ceramic feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	1
5	Variable, ceramic, 3.5/13pF	CV101-013	STR	7STRKJ-02	1
6	Ceramic disc, 15pF ±5% 1kV	CD101-015	SPR	10TCC-Q15	1
8,9	Ceramic disc, .001uF ±20% 1kV	CD102-210	SPR	5GA-D10	2
10	Ceramic disc, .01uF ±20% 100V	CD103-310	SPR	TG-S10	1
11	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	1
12	Ceramic feedthru, 470pF ±20% 500V	CF101-141	A-B	FA5C	1
13	Electrolytic, 10uF 25V	CE105-010	SPR	TE1204	1
"J "	<u>CONNECTORS</u>				
1,2	Jack, receptacle, 50ohm submin	JF000-005	APL	27-9	2
3	Pin socket, teflon	MC000-002	W-I	MC-000-002	1
"X "	<u>CRYSTALS</u>				
1	5MHz	Y- 5, 5.0	W-I	Y-5,5.0	1
"CR "	<u>DIODES</u>				
1	Silicon, point contact	DG100-821	SYL	IN82AS	1
"L. "	<u>INDUCTORS</u>				
1	Coilform LB-003-000 with 35 turns, 5 turns of 32 gage magnet wire	Not Assign.	---	-----	---
2	Fixed---	LA006-010	W-I	LA006-010	1
3	Formed from 24 ga. buss wire	Not Assign	---	-----	---
4	Fixed---	LA006-004	W-I	LA006-004	1
"R "	<u>RESISTORS</u>				
1	Fixed, comp., 47kohm ±10% ½W	RC104-347	A-B	CB4731	1
2	Fixed, comp., 56ohm ±10% ½W	RC104-056	A-B	CB5601	1
3	Fixed, comp., 1.5kohm ±10% ½W	RC104-215	A-B	CB1521	1
4,17	Fixed, comp., 100ohm ±10% ½W	RC104-110	A-B	CB1021	2
5	Fixed, comp., 75ohm ±5% ½W	RC103-075	A-B	CB7505	1
6	Fixed, comp., 3.9kohm ±10% ½W	RC104-239	A-B	CB3921	1
7,18	Fixed, comp., 470ohm ±10% ½W	RC104-147	A-B	CB4711	2
8	Fixed, comp., 33kohm ±10% ½W	RC104-333	A-B	CB3331	1
9	Fixed, comp., 1Mohm ±10% ½W	RC104-510	A-B	CB1051	1
10	Fixed, comp., 1kohm ±10% ½W	RC104-210	A-B	CB1021	1
11	Fixed, comp., 8.2kohm ±10% ½W	RC104-282	A-B	CB8221	1
12	Fixed, comp., 15kohm ±10% ½W	RC104-315	A-B	CB1531	1
13	Fixed, comp., 1.5Mohm ±10% ½W	RC104-515	A-B	CB1551	1
14,16	Fixed, comp., 10kohm ±10% ½W	RC104-310	A-B	CB1031	2
15	Variable, carbon, 20kohm ±20% ½W	RP124-320	A-B	WA2G032	1
"Q "	<u>TRANSISTORS</u>				
1	NPN, Silicon	QA038-541	G-E	2N3854A	1
2	NPN, Silicon	QB000-013	APX	A430	1
3	N-channel JFET	QA054-580	MOT	2N5458	1
4	NPN, Silicon	QA050-880	MOT	2N5088	1

HARMONIC MARKER SCHEMATIC

INTERVAL : .2 MHz AND 1 MHz

M66H.2,1-1

REV B



PARTS LIST

MODULE

M66H
.2,1-1 REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
"C"	CAPACITORS				
1,22,23,35	Ceramic feedthru 470pF ±20% 500V	CF101-147	A-B	FA5C	4
2,24,25	Electrolytic 10uF 25V	CE105-010	SPR	TE1204	3
3,5,12,13,28	Ceramic disc .01uF ±20% 100V	CD103-310	SPR	TG-S10	8
29,30,31					
4	Ceramic disc 33pF ±5% 1kV	CD104-033	SPR	10TCU-Q33	1
6	Ceramic disc 68pF ±5% 1kV	CD104-068	SPR	10TCU-Q68	1
7	Ceramic disc 100pF ±5% 1kV	CD104-110	SPR	10TCU-T10	1
8	Variable, ceramic 3.5/13	CV101-013	STE	S-TRIKO	1
9	Ceramic disc 15pF ±5% 1kV	CD101-015	SPR	10TCC-Q15	1
10	Ceramic disc 47pF ±5% 1kV	CD104-047	SPR	10TCU-Q47	1
11,32,34	Ceramic disc .001uF ±20% 1kV	CD102-210	SPR	5GA-D10	3
14,33	Ceramic disc .05uF ±20% 100V	CD103-350	SPR	TG-S50	2
15,17,19,20	Ceramic disc 470pF ±20% 1kV	CD102-147	SPR	5GA-T47	4
16,18,26	Ceramic disc 270pF ±20% 1kV	CD102-127	SPR	5GA-T27	3
21	Ceramic disc .002uF ±20% 1kV	CD102-220	SPR	5GA-D20	1
27	Ceramic disc 100pF ±20% 1kV	CD102-110	SPR	5GA-T10	1
35	Ceramic disc .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
"J"	CONNECTORS				
1,2	Jack, receptacle, 50 ohm submin	JF000-005	APL	27-9	2
3	Pin socket, teflon	MC000-002	W-I	MC000002	1
"X"	CRYSTALS				
1	1 MHz	Y-1	W-I	Y-1	1
"CR"	DIODES				
1	Silicon, Hot carrier	DG000-007	H-P	5082-2800	1
2,5	Silicon, Point contact	DG100-821	SYL	1N82AS	2
3	Silicon, Junction	DR000-001	ITT	1N4002	1
4	Germanium, Point contact	DG100-341	SYL	1N34AS	1
"L"	INDUCTORS				
1,10,13,14	Fixed, 10mH	LA004-310	JEF	15S	5
15					
2	Coil form LB002-000 with 160 turns, 20 turns #32 gauge magnet wire	Not assign.	W-I	-----	-
3	Coil form LB003-000 with 35 turns, 15 turns #32 gauge magnet wire	Not assign.	W-I	-----	-
4	24 gauge buss wire	Not assign.	W-I	-----	-
5	Fixed, ---	LA006-010	W-I	LA006-010	1
6	Fixed, ---	LA006-004	W-I	LA006-004	1
7,8,9,12	Fixed, 510uH	LA002-151	JEF	19	4
11	Fixed, 10uH	LA001-010	JEF	15	1
"IC"	INTEGRATED CIRCUITS				
1	Decade counter	IC000-003	SIG	N8292A	1
"R"	RESISTORS				
1,12,7,40,41	Fixed, comp. 470 ohm ±10% ½W	RC104-147	A-B	CB4711	5
2,6	Fixed, comp. 3.9k ohm ±10% ½W	RC104-239	A-B	CB3921	2
3,4,20,23	Fixed, comp. 2.2k ohm ±10% ½W	RC104-222	A-B	CB2221	4

PARTS LIST

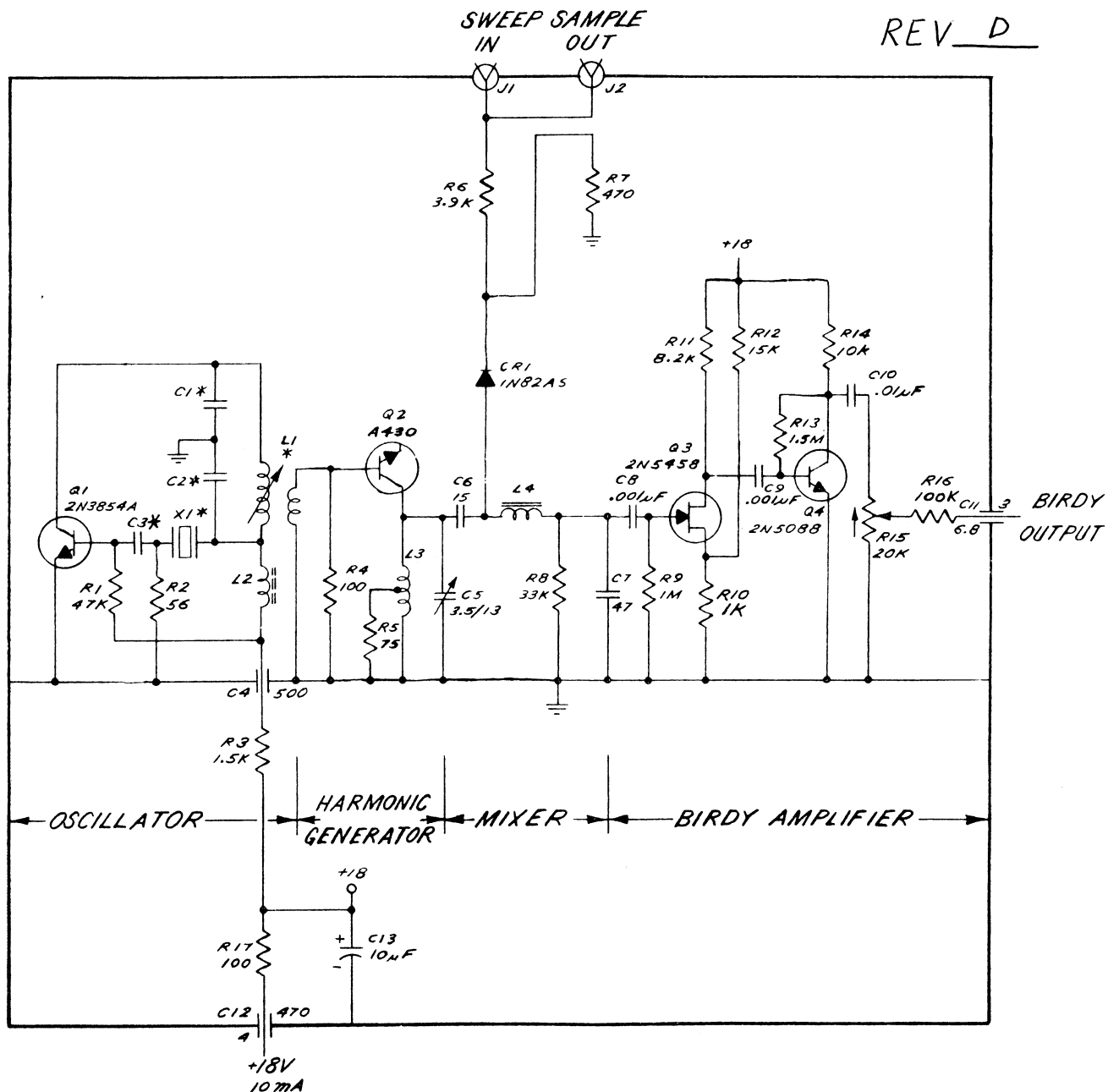
MODULE

M66H
.2,1-1 REV B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER		T Q
			CODE	NUMBER	
"R"	RESISTORS				
5	Fixed, comp. 27k ohm ±10% ½W	RC104-327	A-B	CB2731	1
8,25,34,37					
39	Fixed, comp. 10k ohm ±10% ½W	RC104-310	A-B	CB1031	5
9	Fixed, comp. 82 ohm ±10% ½W	RC104-082	A-B	CB8201	1
10	Fixed, comp. 75 ohm ±5% ½W	RC103-075	A-B	CB7505	1
11,31,32	Fixed, comp. 3.3k ohm ±10% ½W	RC104-233	A-B	CB3321	3
13	Fixed, comp. 12k ohm ±0% ½W	RC104-312	A-B	CB1231	1
14	Fixed, comp. 1M ohm ±10% ½W	RC104-510	A-B	CB1051	1
15	Fixed, comp. 15k ohm ±10% ½W	RC104-315	A-B	CB1531	1
16,35	Fixed, comp. 1k ohm ±10% ½W	RC104-210	A-B	CB1021	2
17	Fixed, comp. 8.2k ohm ±10% ½W	RC104-282	A-B	CB8221	1
18	Fixed, comp. 4.7k ohm ±10% ½W	RC104-247	A-B	CB4721	1
19,36	Fixed, comp. 1.5M ohm ±10% ½W	RC104-515	A-B	CB1551	2
21	Fixed, comp. 100k ohm ±10% ½W	RC104-410	A-B	CB1041	1
22	Fixed, comp. 100M ohm ±10% ½W	RC104-710	A-B	CB1071	1
24,38	Variable, carbon 20k ohm ±20% ½W	RP124-320	A-B	WA2G032	2
27	Fixed, comp. 10k ohm ±5% ½W	RC103-310	A-B	CB1035	1
28	Fixed, comp. 4.7k ohm ±5% ½W	RC103-247	A-B	CB4725	1
29	Fixed, comp. 100 ohm ±10% ½W	RC104-110	A-B	CB1011	1
30,33	Fixed, comp. 2.7k ohm ±10% ½W	RC104-227	A-B	CB2721	2
"Q"	TRANSISTORS				
1,3	PNP, Silicon	QB000-009	MOT	MPS3702	2
2,7,10,12	NPN, Silicon	QA038-541	G-E	2N3854A	4
4	NPN, Silicon	QA051-790	RCA	2N5179	1
5	NPN, Silicon	QB000-013	APX	A430	1
6	N-channel JFET	QA054-580	MOT	2N5458	1
8,13	NPN, Silicon	QA050-880	MOT	2N5088	2
9	P-channel JFET	QA054-610	MOT	2N5461	1
11	Darlington NPN Silicon	QA053-060	G-E	2N5306	1

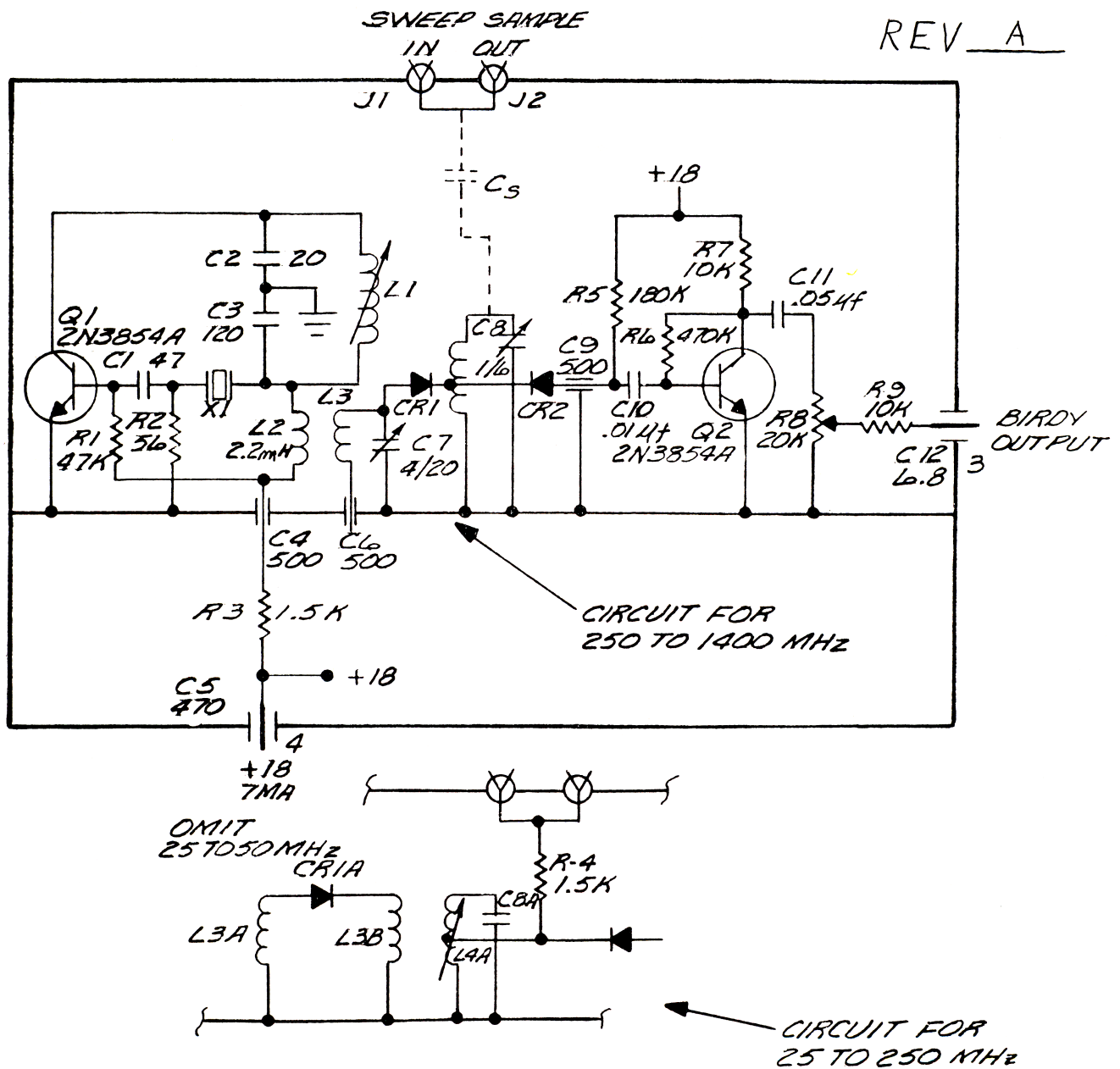
SCHEMATIC — M6H-5-50
HARMONIC MARKER (5-50 MHZ)

REV D



SCHEMATIC — M6S
SINGLE FREQ. MARKER

REV A



4.11

The preceding paragraph, 4.10, described marker circuits in general. The circuits described below are the specific markers of the model 2001A and 2001B.

4.11.1 M66-59.5/1090/±4.5 MHz

This module contains two single frequency markers (59.5 MHz and 1090 MHz) and a side band circuit at 4.5 MHz.

The 59.5 MHz marker frequency is obtained from a 29.75 MHz crystal oscillator circuit (Q1). The 2nd harmonic is tuned by L4, C6 and coupled into a tuned mixer circuit consisting of L5, C8 and CR1. Birdies from this mixer are coupled through a low pass filter consisting of L6 and C10. If the side band oscillator is on, 4.5 MHz CW is coupled into the mixer through C11. C10 is tuned to emphasize the 4.5 MHz video, providing side band marker video of about the same amplitude as the 59.5 MHz marker.

Operation of the 1090 MHz marker is the same except for the harmonic generation section. A 54.5 MHz oscillator is doubled by CR3-CR4 and L11-C21 tunes to 109 MHz. Q5 amplifies harmonics of 109 MHz, and 545 MHz is selected by L12-C25. 545 MHz is coupled to the mixer diode CR5 where its 2nd harmonic is emphasized by the sweep sample tuning circuit L13-C27, which is tuned to the desired marker frequency of 1090 MHz. L18 couples 4.5 MHz from Q8 through C30 and C29 to produce the 4.5 MHz side bands.

4.11.2 M66-63/±.9/±.35 MHz

This module contains a single frequency marker 63.0 MHz and two side band circuits ±.9 and ±.35 MHz.

The 63.0 MHz marker frequency is obtained from 31.5 MHz crystal oscillator circuit Q1, the output of which is doubled by Q2 and 3, and coupled to the tuned FET mixer circuit consisting of L7, C8 and Q4. Birdies from this mixer are coupled through 63.0 MHz marker size control R12 to the low pass filter C11, 12 and L10 and then to the marker amplifier module.

The 900 kHz (±.9 MHz) side band frequency is obtained from a 32.4 MHz crystal oscillator, Q5, the output of which is mixed with the 31.5 MHz signal in the FET mixer, Q6. C21 couples the output to the 900 kHz tuned mixer L15, C27 and Q7 where it is mixed with the 63.0 MHz birdy.

When the 350 kHz (±.35 MHz) side band marker is on, the 31.15 MHz oscillator, Q8, output mixed with 31.5 MHz in FET, Q9, produces a 350 kHz difference frequency emphasized by L21, C33 and mixed with the 63.0 MHz birdy marker in Q10. C37, 38, 39 and L23 are a low pass filter which attenuates higher side bands.

4.11.3 M6H-5, 20, 30 MHz

Circuit functions for these markers are labeled on the M6H schematics. A tuned Colpitts oscillator with the crystal operating at its third overtone frequency in a series resonant mode drives a harmonic generator Q2. The CW comb is mixed with sweep sample in CR1 and the resultant birdies are amplified by Q3 and Q4, and coupled through the SIZE control R15 to pin 3 of the module.

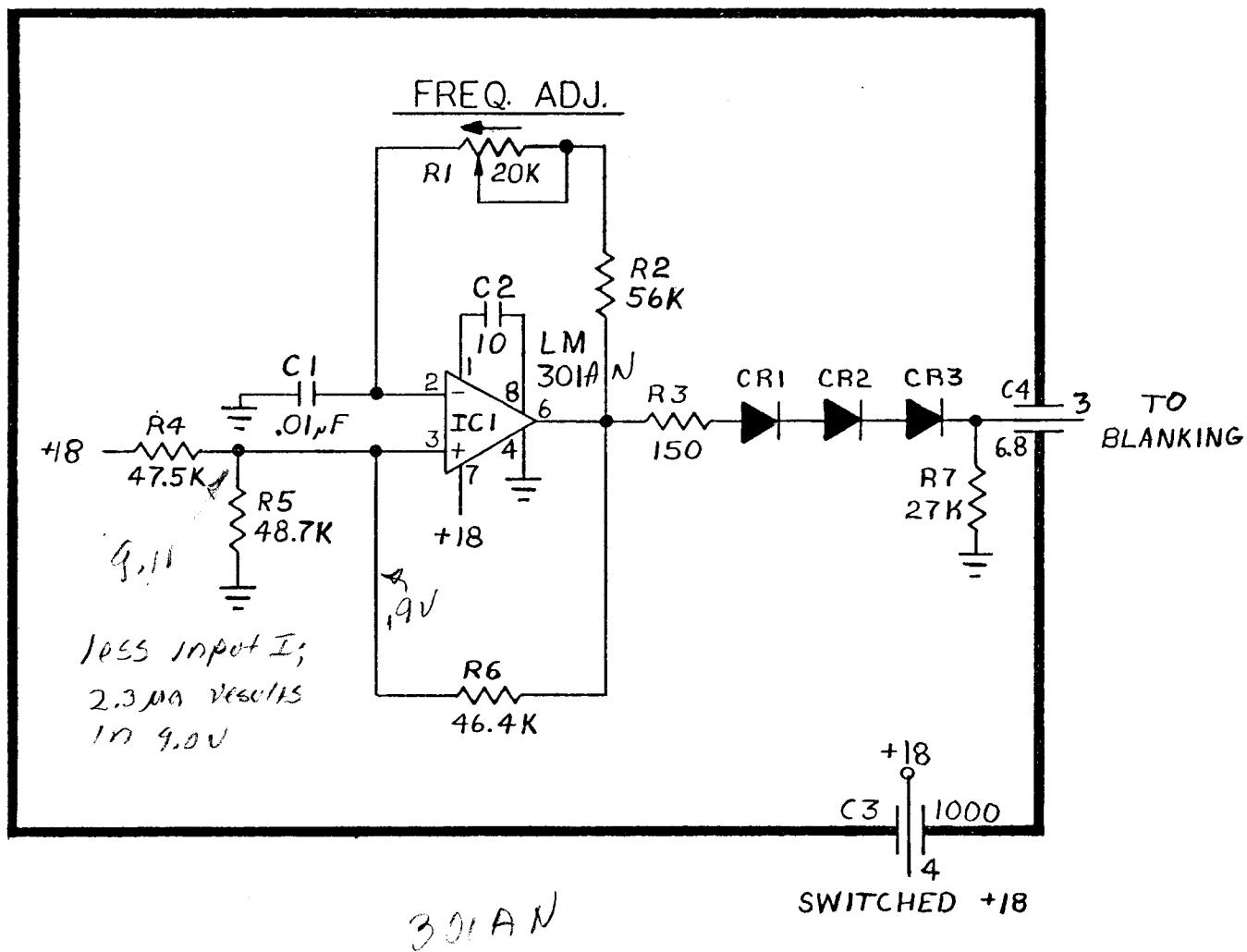
4.11.4 M66H-.2/1 MHz

This module contains a 1 MHz harmonic marker and a side band 200 kHz marker generator.

A 1 MHz series crystal oscillator consisting of Q1, Q2 and Q3 drives a harmonic generator, consisting of Q4 and Q5, to produce a CW comb. The comb is mixed with a sweep sample in CR2 to produce birdies, which are then amplified by a video amplifier consisting of Q6, Q7 and Q8. The marker birdies are coupled through Q9 to pin 7 providing the 1 MHz marker output. A low pass filter, comprised of L7, L8, L9 and associated capacitors attenuate the 1 MHz oscillator signal, and any side band video frequencies higher than 500 kHz. This side band video is also used to produce 200 kHz markers by mixing with the CW comb from Q12, in CR4 and CR5, when 200 kHz B+ is applied.

The switch at pin 8 supplies B+ to the 200 kHz marker circuits and if the 1 MHz switch is not on, activates the 1 MHz section through diode CR3, while disabling the 1 MHz birdy output through Q9. The 1 MHz oscillator provides a clock for IC1 connected as a 5:1 frequency divider to produce a 200 kHz CW output. The first and second harmonics are coupled through Q12 into the 200 kHz mixer CR4-CR5. The 200 kHz signal and all video frequencies above 40 kHz are then attenuated by a low pass filter L12-L15. The birdy is then amplified by Q13 and coupled through the SIZE control R38 to pin 11 of the module, providing the 200 kHz marker output.

M6Z-1
1KHZ MODULATOR



$$F = \frac{1}{2\pi RC}$$

$$60K; F = 265$$