Serial No. 102160

INSTRUCTION MANUAL

MODEL 2001
SWEEP/SIGNAL
GENERATOR

WAVETEK® INDIANA INC.

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BEECH GROVE, INDIANA 46107

317—783-3221

WARRANTY

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

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

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

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

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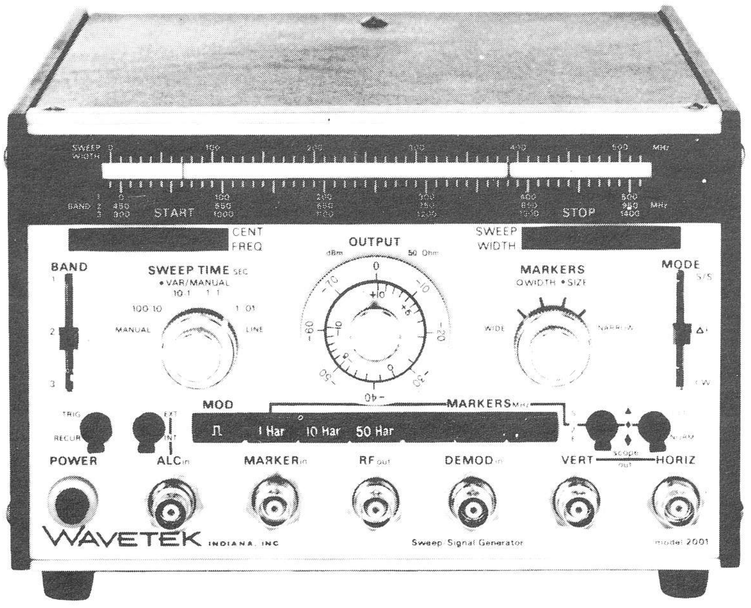


FIGURE i – MODEL 2001 SWEEP/SIGNAL GENERATOR

SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance, and repair of the WAVETEK Model 2001 Sweep/Signal Generator.

SECTION 1
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^{o} 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 obsolesence 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

RF SPECIFICATIONS		
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.
SWEEP SPECIFICATIONS	
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)
EXTERNAL LEVELING	
External Monitor (ALC) –	An external negative signal, between 0.2 and 2 volts, may be used to level the RF output
MARKER SPECIFICATIONS	
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%

N.B. BANDS 2 & 3 LACK A BUFFER STAGE IN OUTPUT AMPLIFIER, HENCE, f_{OUT} FOR V_{PARAM} = CONST. DEPENDS ON LOAD IMPEDANCE.

TO OBTAIN RATED ACCURACY, DO NOT CHANGE THE ATTENUATOR SETTING (COARSE & FINE) DURING A MEASUREMENT. (ONLY THE 0db POSITION OF THE STEP ATTENUATOR IS DIFFERENT. -10 → -60 ARE EQUIVALENT.)

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 ±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.

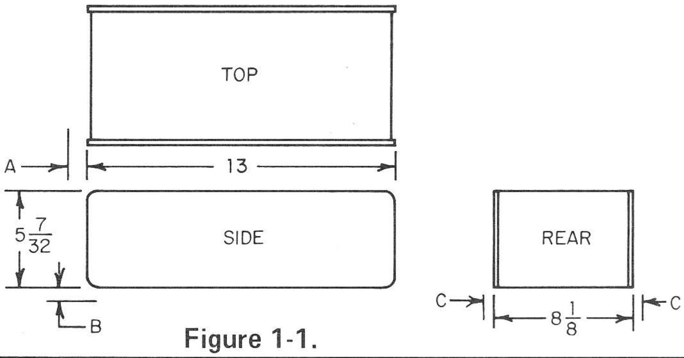


Figure 1-1.

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 Penlift 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.	C000-610
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.

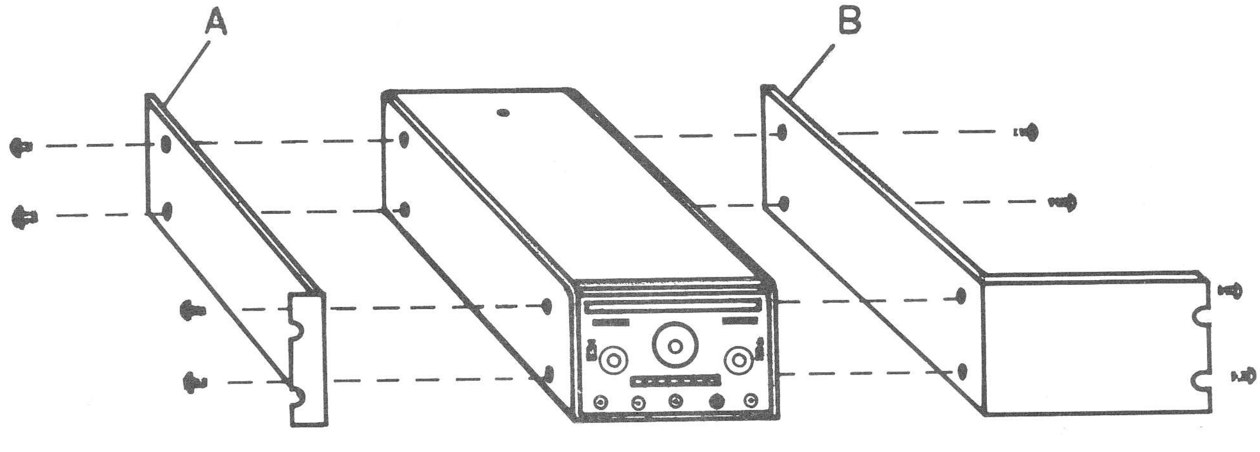


Figure 2-1. K-103 Rack Mounting

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

CONTENTS

Item	Qty.	Part No.
A (Tray)	2	C000-729
B (Side)	2	A500-230
C (Screw)	12	HS101-903

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 item "A" and secure with the remaining screws (item C).

NOTE: If the Wavetek instrument has been supplied with a bale, it must be removed before installing in the K104 rack mounting kit.

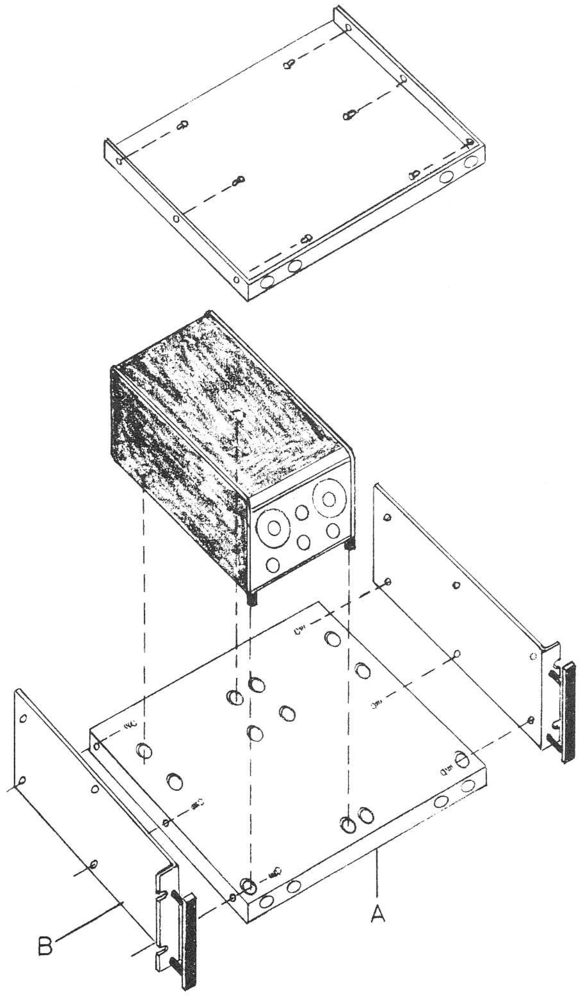


Figure 2-2. K-104 Rack Mounting

2.2 ELECTRICAL INSTALLATION

2.2.1 Primary Power Requirements

These instruments operate from either 115 VAC or 230 VAC 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 VAC, and 0.25 amp for 230 VAC.

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 adjust to operate at 115 VAC, 60 Hz unless specified for 230 VAC 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.

SECTION 3
OPERATING INSTRUCTIONS

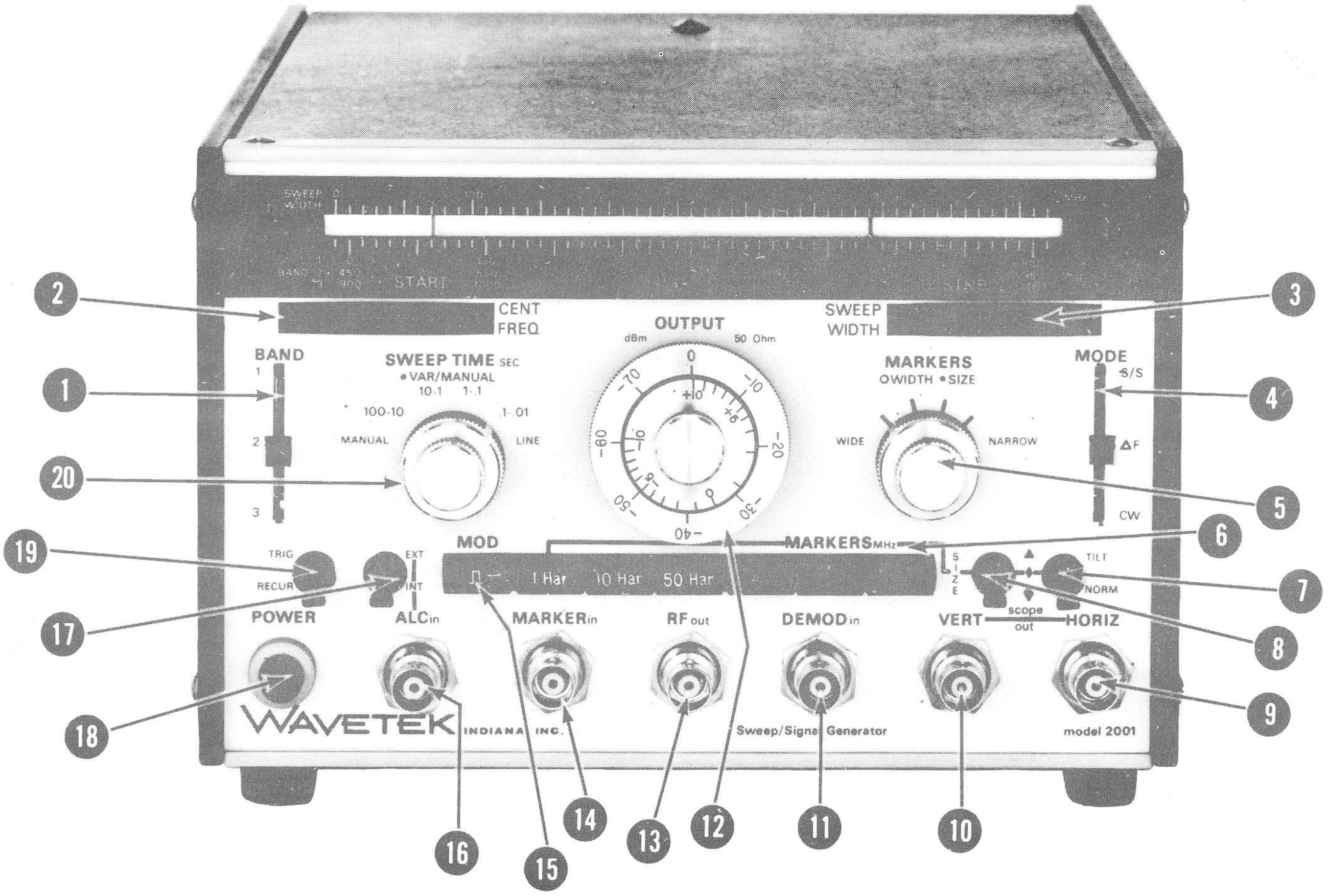


Figure 3-1. Front Panel

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/CENTER 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 O 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

(20) 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).

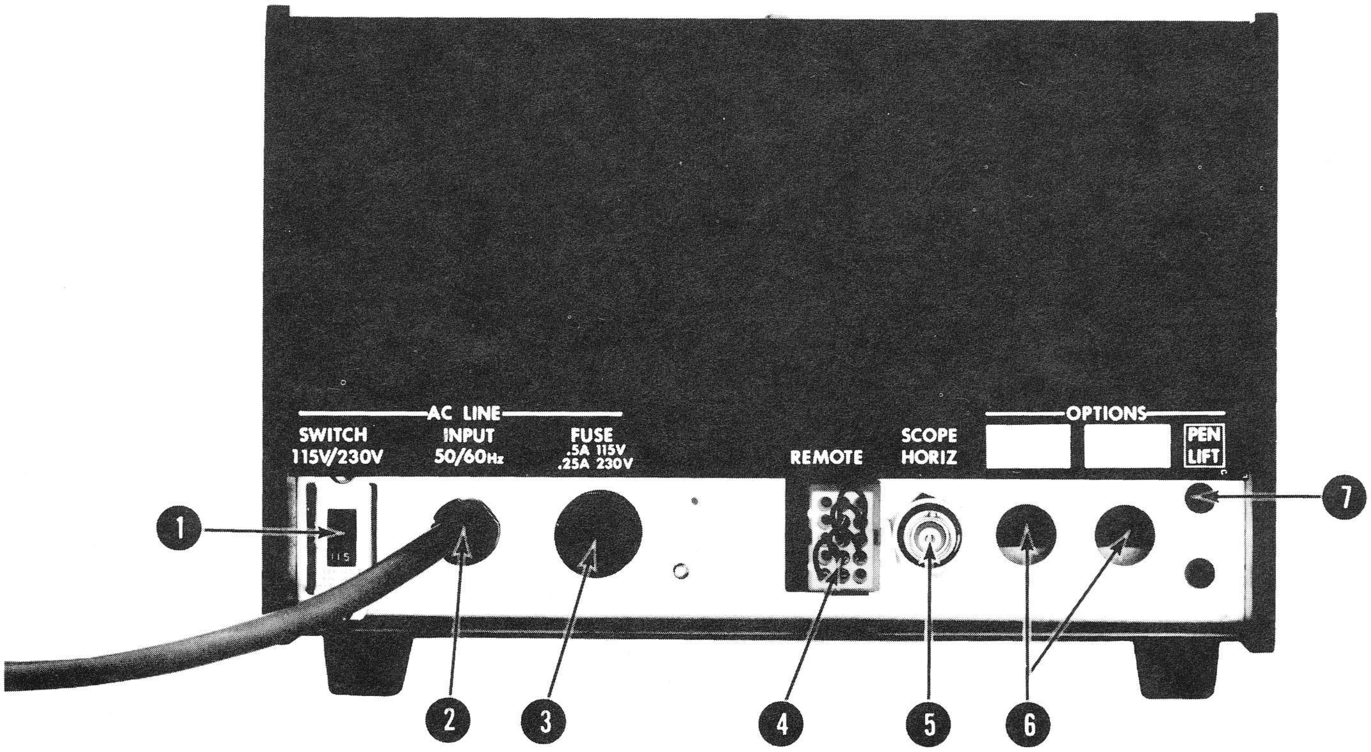


Figure 3-2. Rear Panel

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 "jumpered 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.

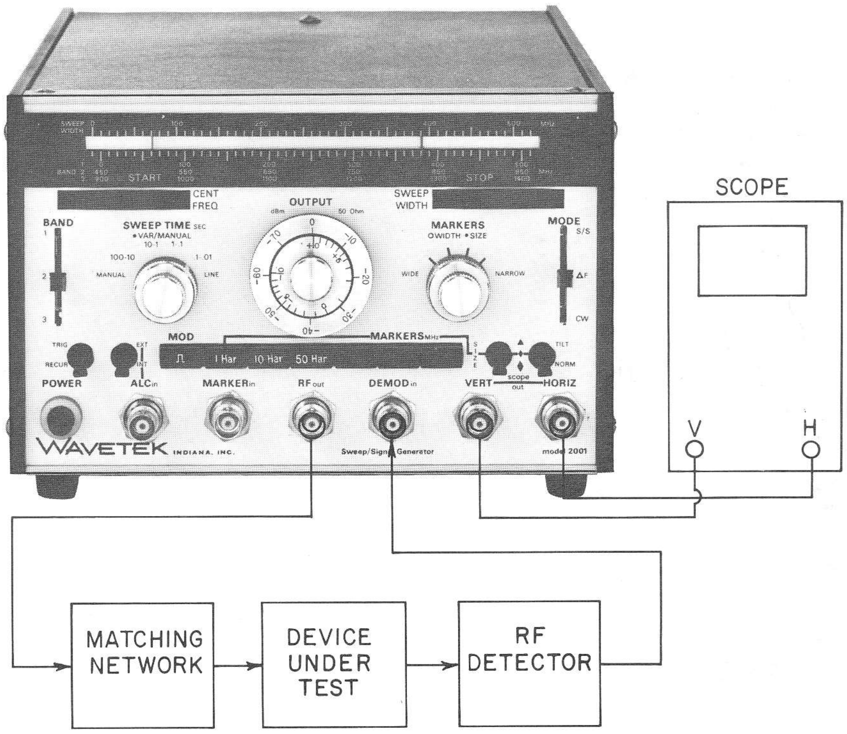


Figure 3-3. Typical Operating Set-up

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.

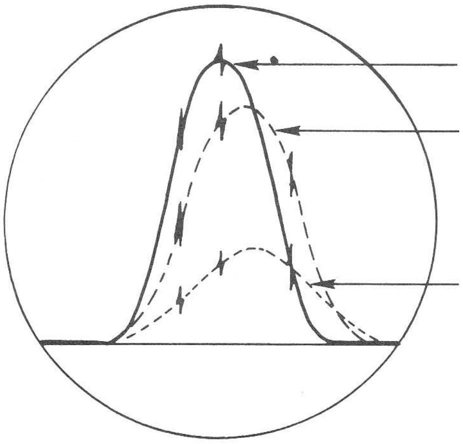


Figure 3-4. Sweep Rate Effects

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 compatable 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.)

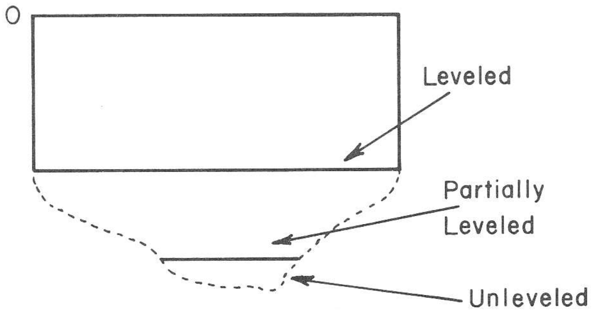
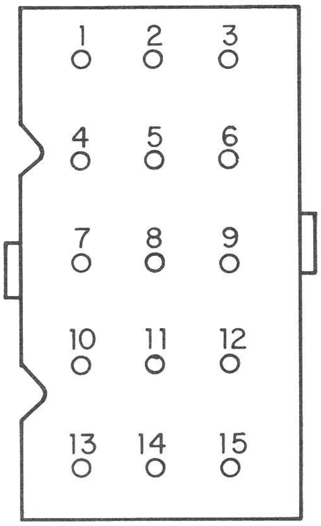


Figure 3-5. External Monitor Output Signal

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)

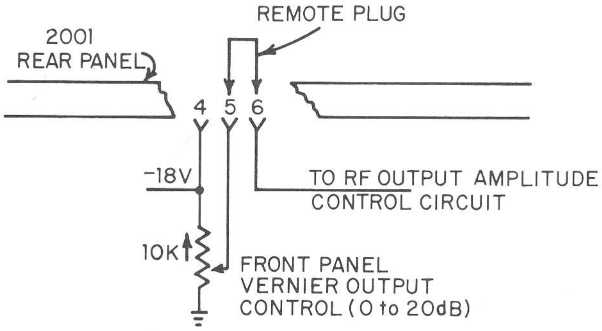
INTERNAL CONTROL
Pins 5, 8 and 11 are used to program internal operation of Output, Frequency and Sweep Width.

UNUSED
Pins 13 and 14 are unused

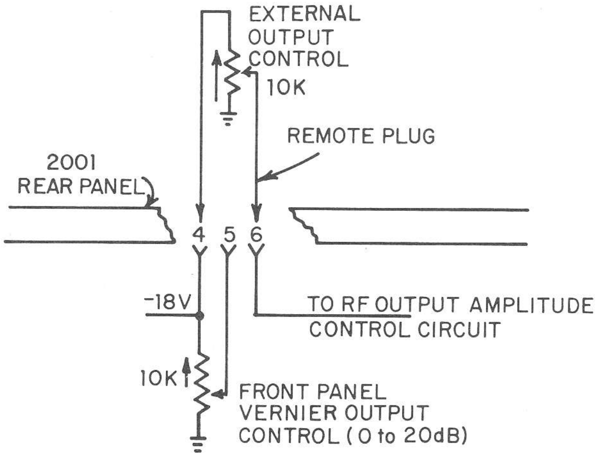
With plug as connected from factory, we have: 5-6
8-9
11-12
13-14 (no connection to jack)

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.



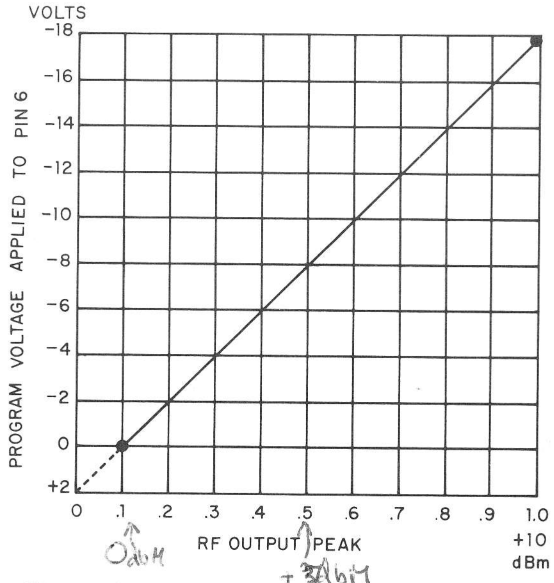
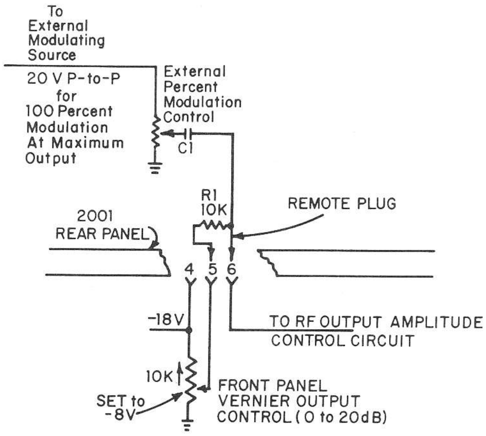


Figure 3-6. Program Voltage/RF Output

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.



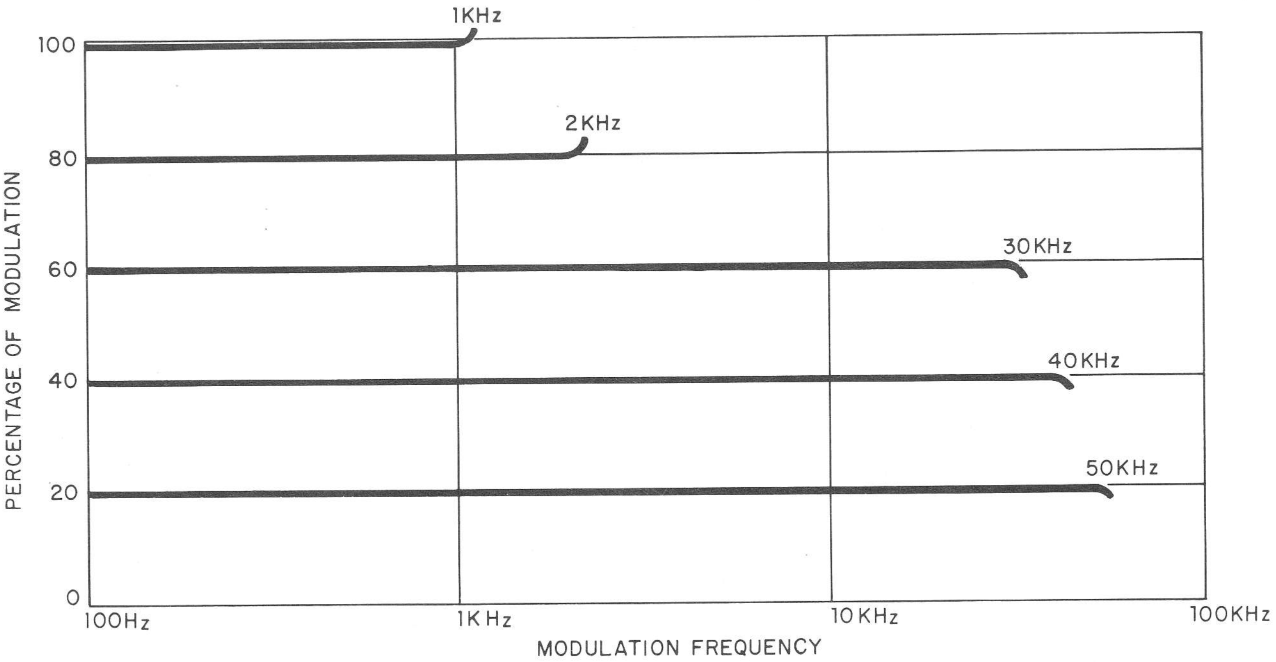
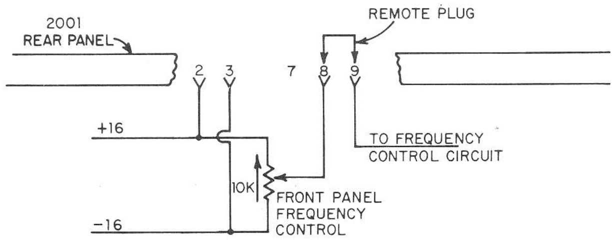


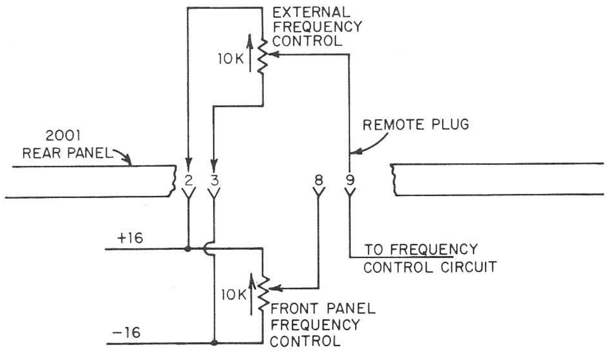
Figure 3-7. Percentage Modulation/Modulating Frequency

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.



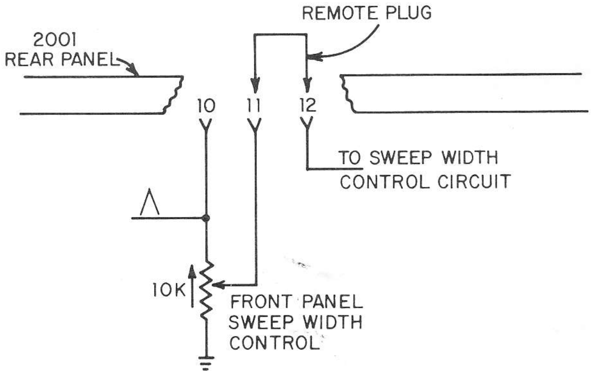
To provide external control, remove the jumper and connect pin 9 to an external Frequency control as shown below.



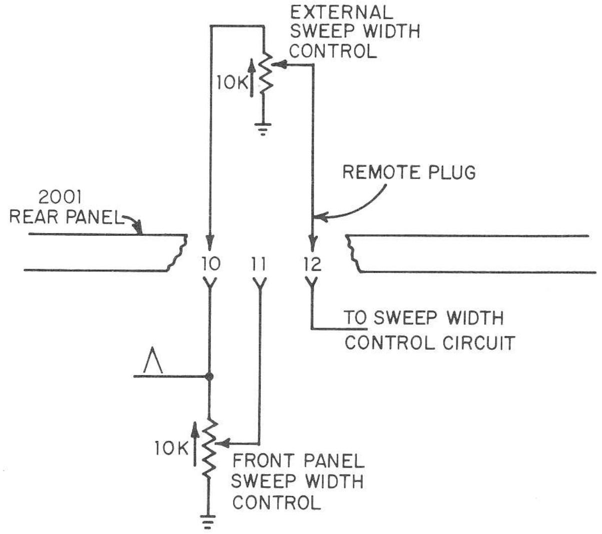
Tuning sensitivity, which is approximatley 16 MHz/volt, is shown graphically in Figure 3-8.

3.6.3 SWEEP WIDTH CONTROL (FM Modulation)

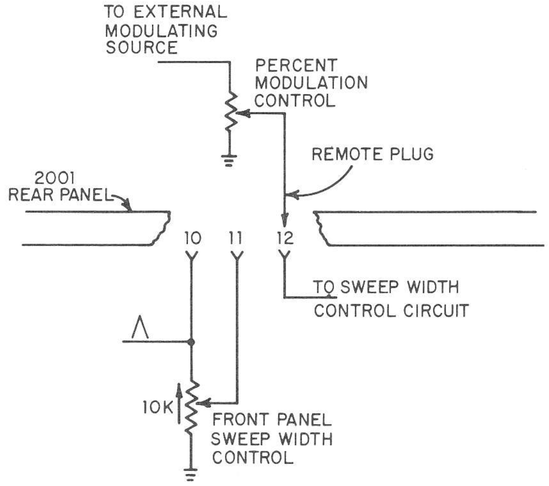
Normal internal control of sweep width is provided by a jumper wire between pins 11 and 12 of the REMOTE plug as shown below.



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.

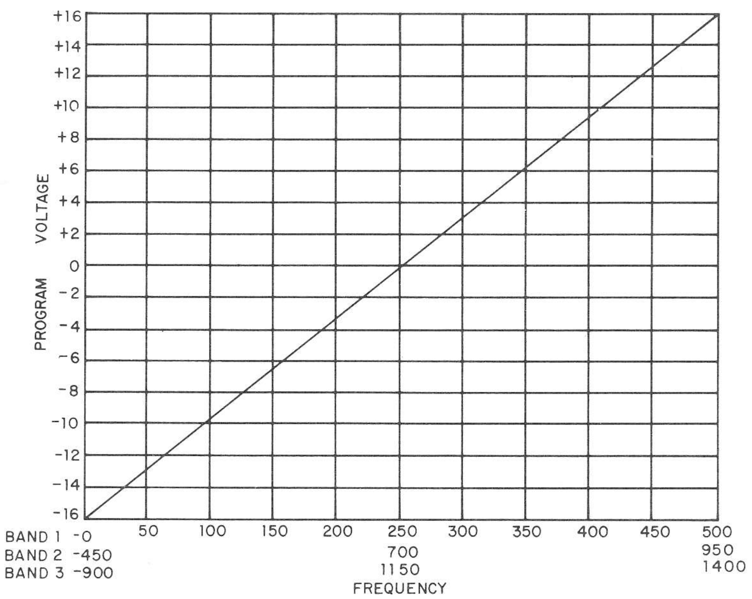


Figure 3-8. Program Voltage (pin 9 or 12)/Frequency

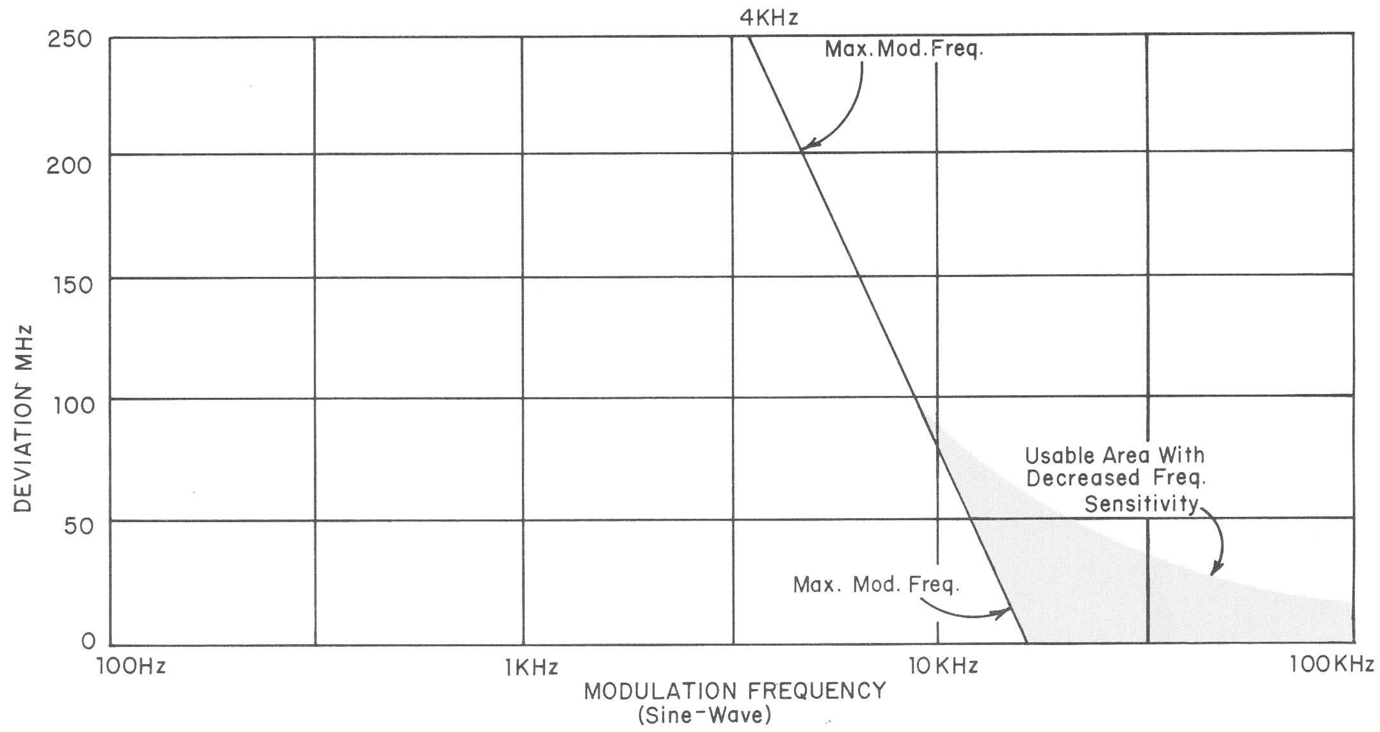


Figure 3-9. FM Modulation Frequency Limits

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.

SECTION 4
CIRCUIT DESCRIPTION

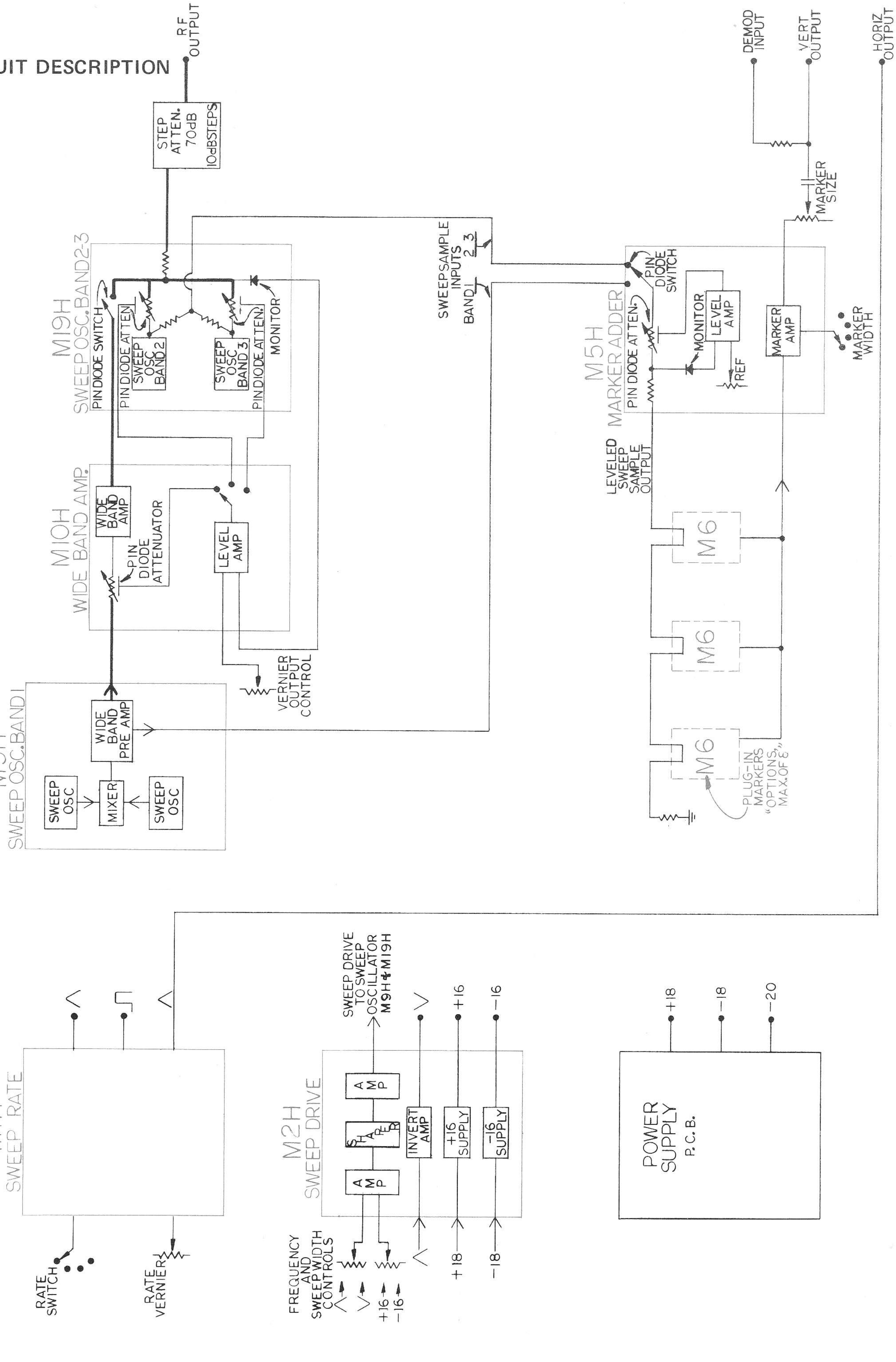


Figure 4-1. Simplified Block Diagram

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 red module outline.

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

The M1A 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 Front Panel 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 different signal, which is the birdy marker, is 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 M1A 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 synthezied 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 hetrodyne 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, course 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 output 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 Selecter 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 supresses 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.

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

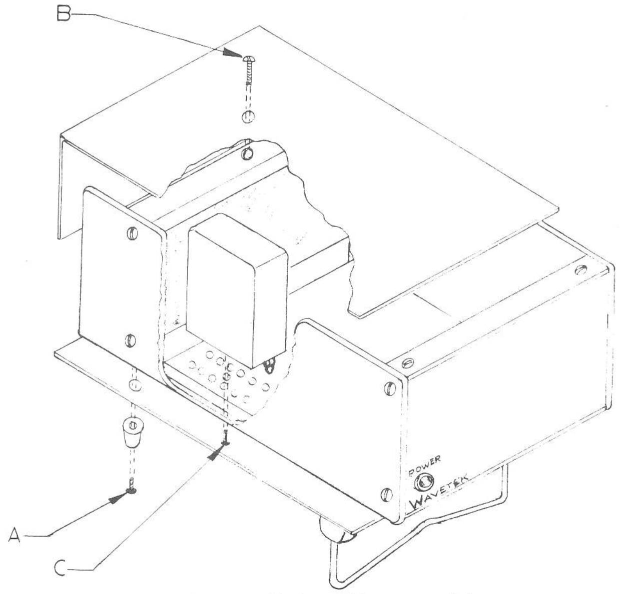


Figure 5-1. Disassembly

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. Pushing up on the module ball studs will help free the ball studs from the chassis mounted spring clips.

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 ball studs for the circuit modules are located off center to prevent the module's being plugged in backwards. This off-center ball stud location also provides a method for locating pin #1.

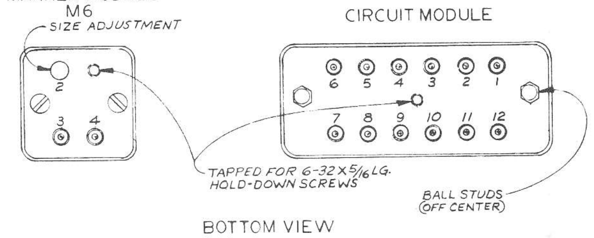


Figure 5-2. Module Pin Numbering System

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

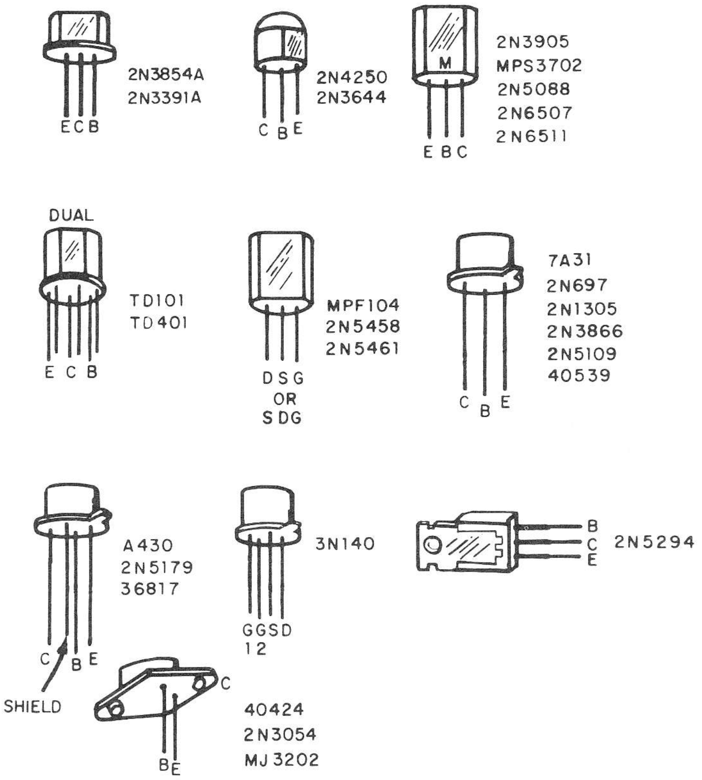


Figure 5-3. Transistor Lead Configuration

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, ±2MHz, 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 specification 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.

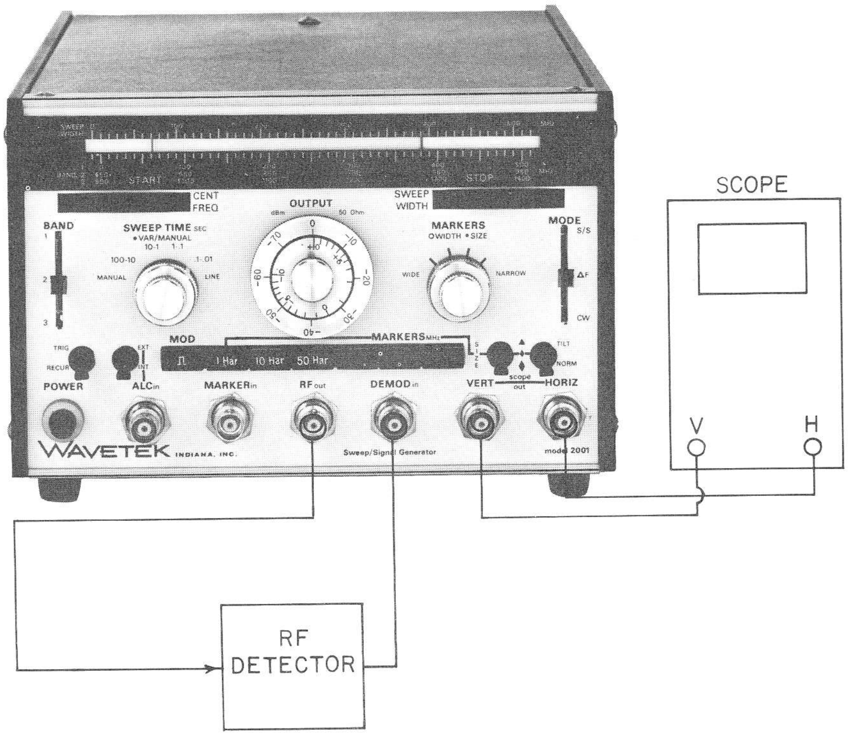


Figure 5-4. Typical Set-Up

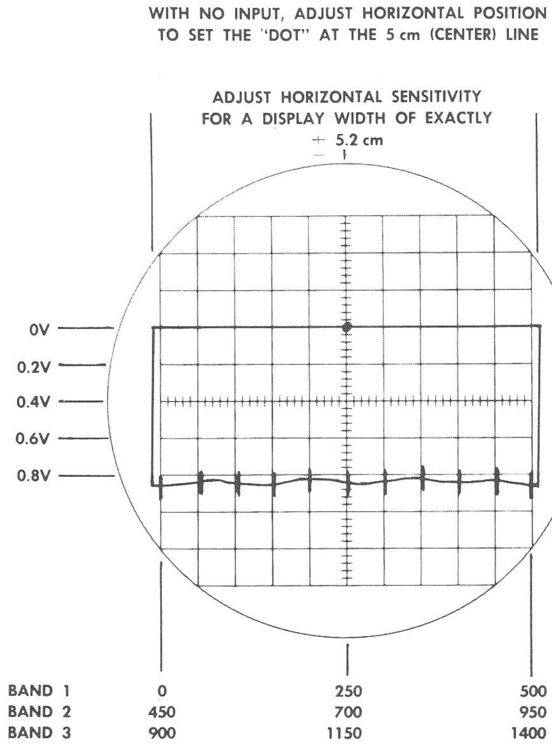


Figure 5-5. RF Detector Display

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 harmonic 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 hetrodyne 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 ±0.75dB.

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 ±0.5dB to 500 MHz, ±1dB to 1000 MHz, and ±2dB 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 ±0.5dB to 500 MHz, ±1db to 1000 MHz, and ±2dB 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.

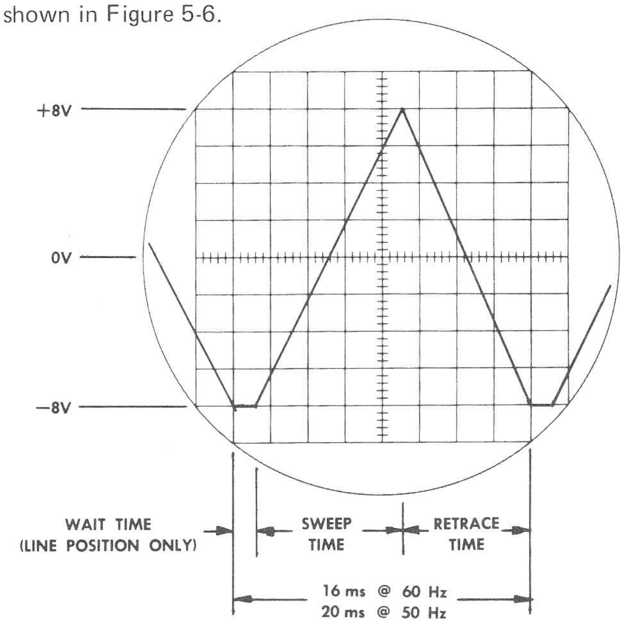


Figure 5-6. Scope Horizontal Output

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, ±.5V, with the control fully counterclockwise to +8V, ±.5V, 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 MH_Z 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 inheritent 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 ±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.

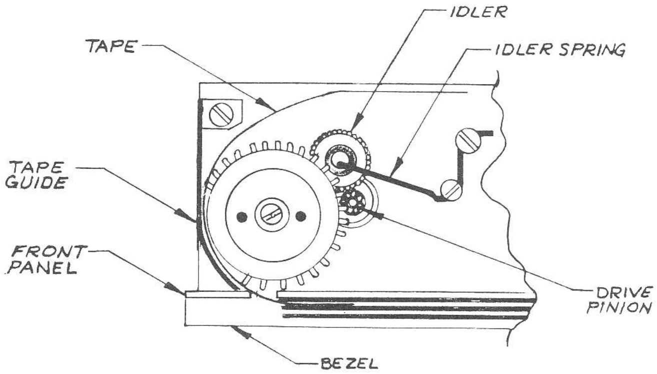


Figure 5-7. Tape Drive

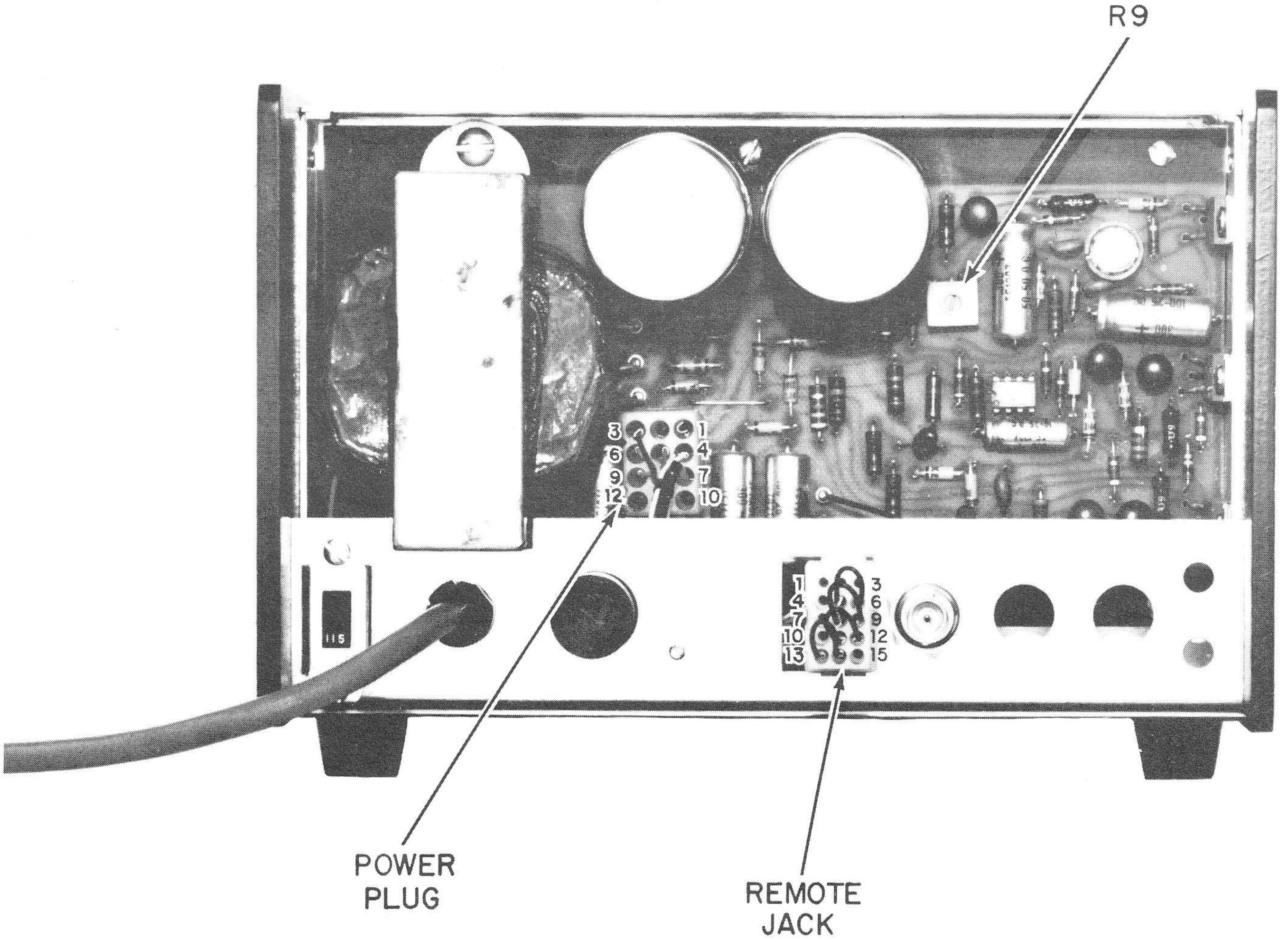


Figure 5-8. Power Supply

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.

5.5.1 +18 VOLT ADJUSTMENT

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

5.5.2 -18 VOLT CHECK

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

5.5.3 -20 VOLT CHECK

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

5.5.4 -16 VOLT CHECK

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).

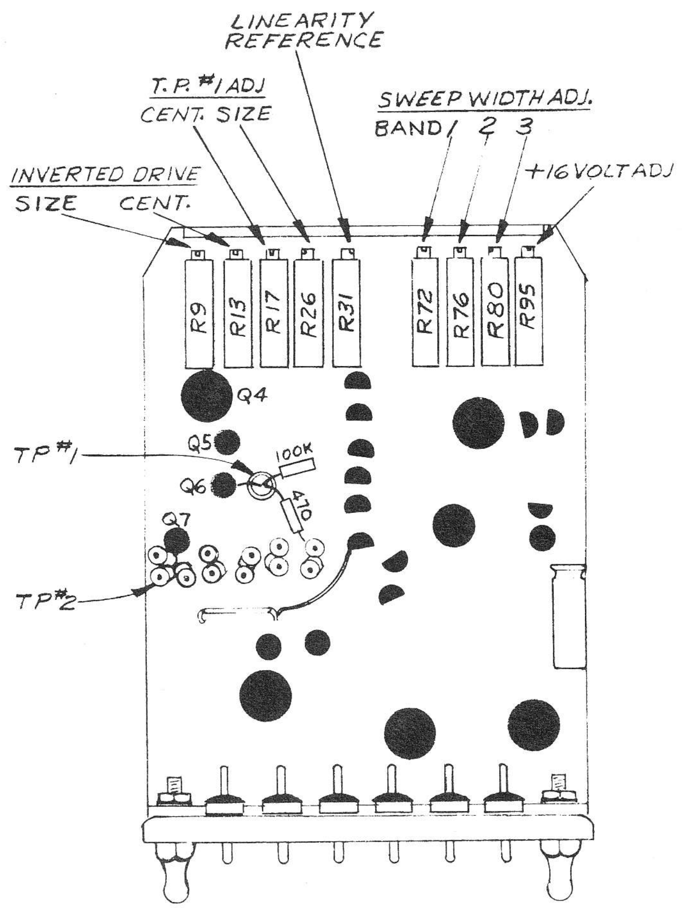


Figure 5-9. M2H Module

5.5.5 +16 VOLT ADJUSTMENT

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 symetrical 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.

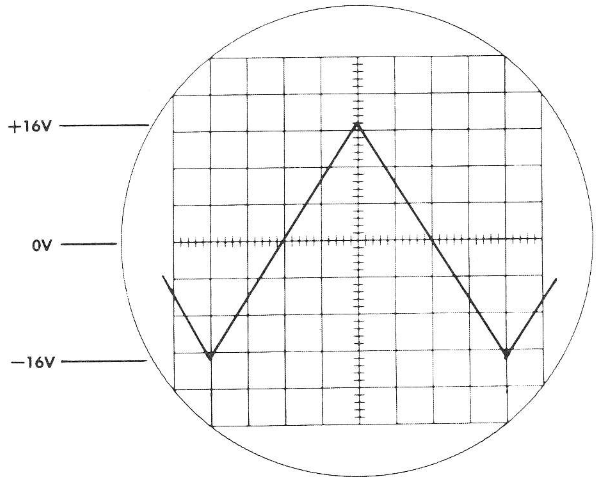


Figure 5-10. Sweep Ramp (M1H Output)

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.

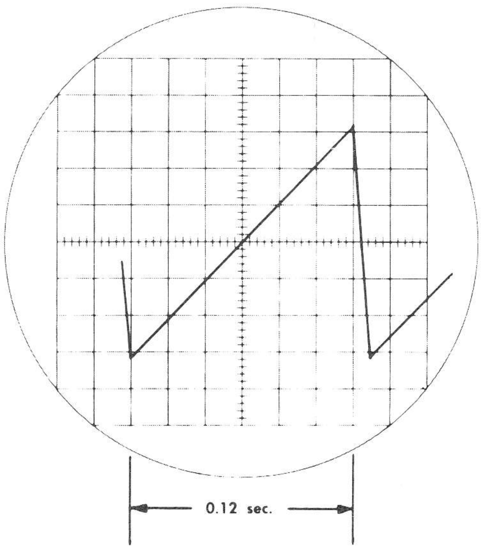


Figure 5-11. M1H Bal Adjustment

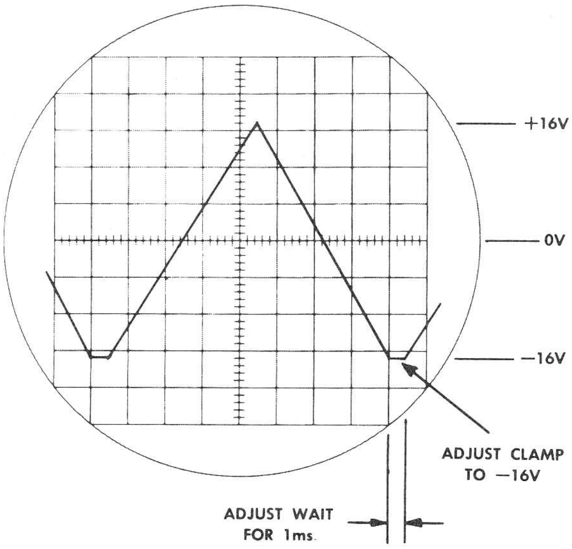


Figure 5-12. Sweep Ramp

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.

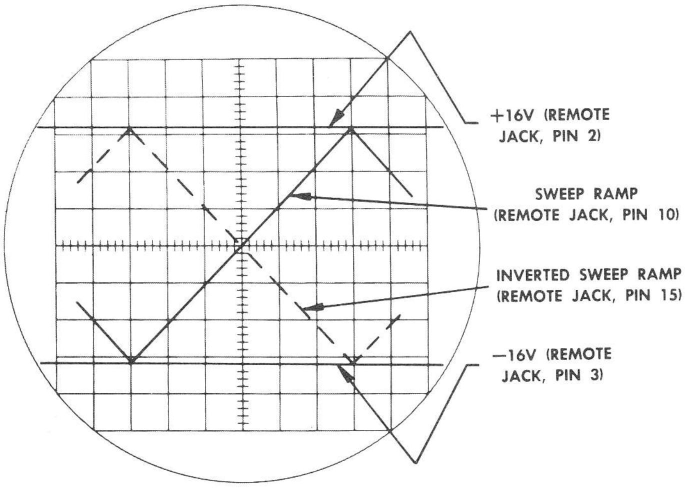


Figure 5-13. Relationship Between Sources

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 supressing circuit. The schematic of the probe is shown in Figure 5-14.

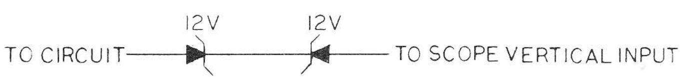


Figure 5-14. Zero Suppressing Probe

Repeat the adjustment procedure outlined in paragraph 5.5.6, with the zero supressing 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.

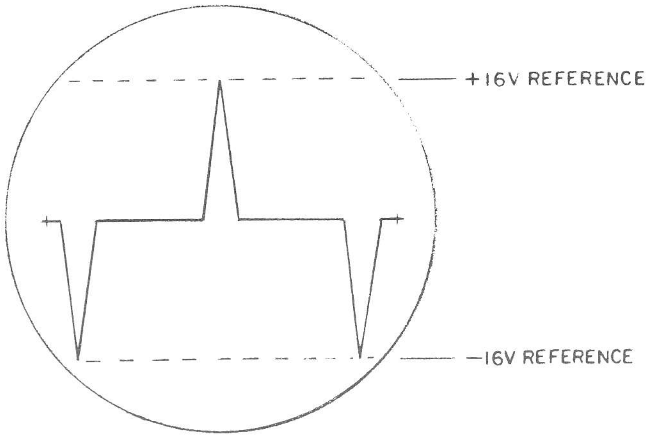


Figure 5-15. Sweep Ramp (Probe)

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 supressing 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 Y 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 "X" 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.

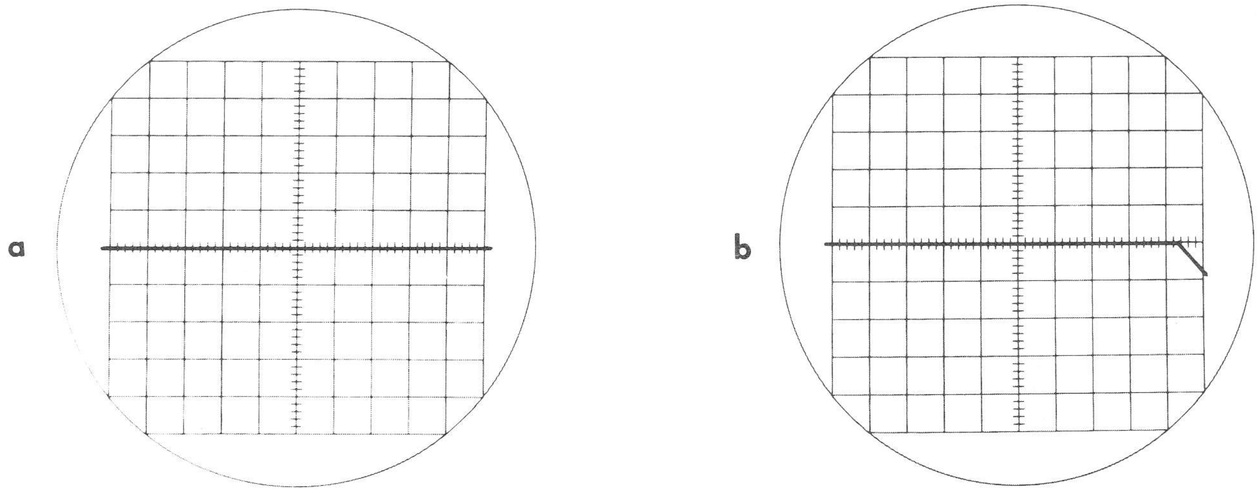


Figure 5-16. M2H Linearity Ref Adj

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.

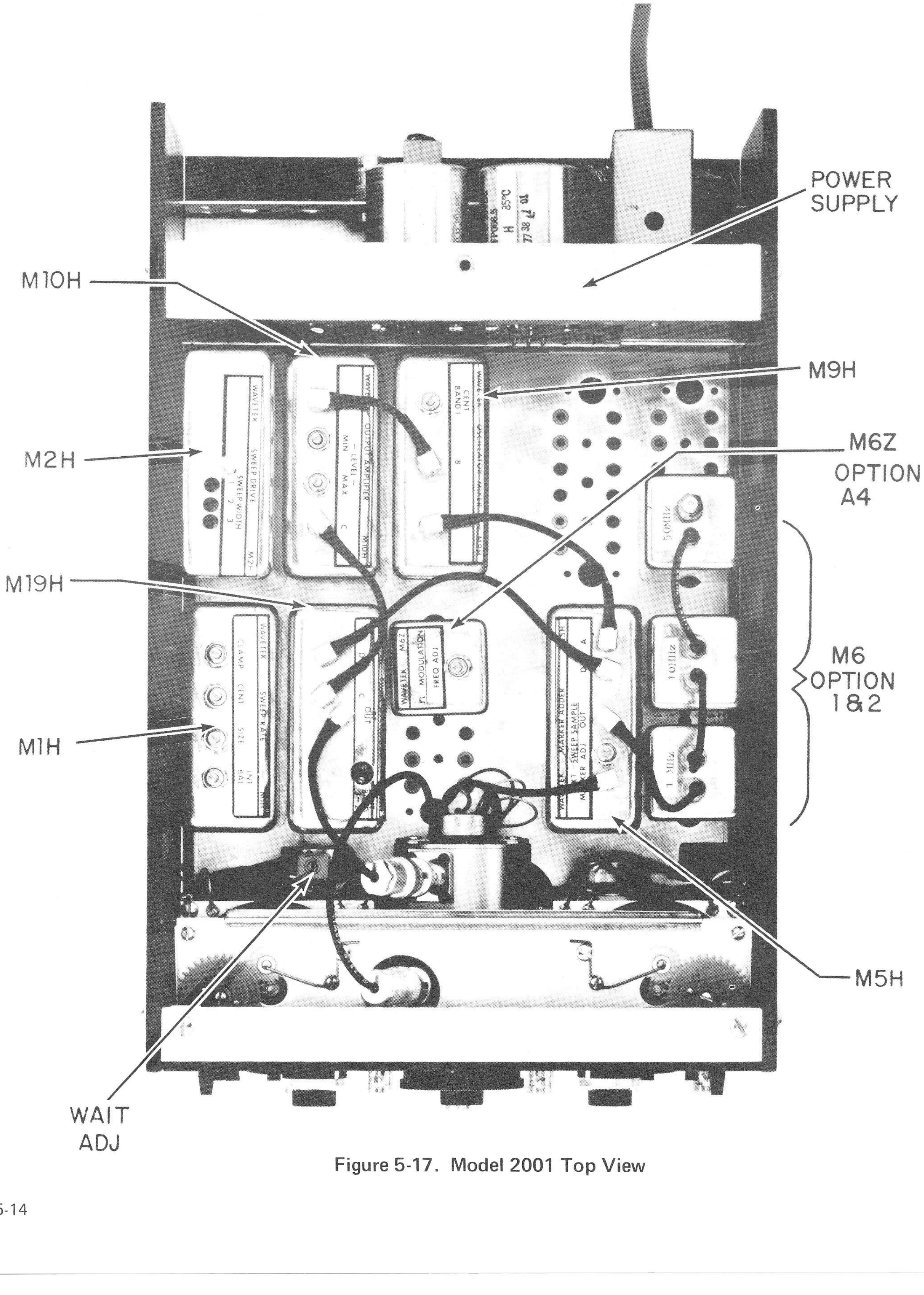


Figure 5-17. Model 2001 Top View

SECTION 6
SCHEMATICS AND PARTS LIST

6.1 INTRODUCTION — This section contains all schematics and a list of replaceable parts for the instrument. Parts lists are located on the reverse side of the associated schematics.

6.2 MANUFACTURER'S CODE — The following code is used on the parts list to identify the manufacturer.

A-B	Allen-Bradley	Milwaukee, Wisconsin
A-E	Arco-Elmenco	Great Neck, New York
AER	Aerovox	New Bedford, Massachusetts
ALC	Alco Electronic Products Inc.	Lawrence, Massachusetts
AMP	AMP, Inc.	Harrisburg, Pennsylvania
APL	Amphenol	Danbury, Conn.
APX	Amperex	Slatersville, R. I.
BEK	Beckman Instruments, Inc.	Fullerton, California
BEL	Belden	Chicago, Illinois
BOU	Bourns	Riverside, California
BUS	Bussman	St. Louis, Missouri
CAM	Cambion	Cambridge, Massachusetts
C-D	Cornell Dubilier	Newark, New Jersey
CGW	Corning Glass Works	Corning, New York
C-J	Cinch Jones	Elk Grove Village, Illinois
C-K	C & K Components	Watertown, Massachusetts
C-L	Centralab	Milwaukee, Wisconsin
CTS	Chicago Telephone Systems	Elkhart, Indiana
C-W	Continental Wire	Philadelphia, Pennsylvania
DIO	Diodes, Inc.	Chatsworth, California
DRA	Drake Mfg. Company	Harwood Heights, Illinois
ETP	Erie Technological Prod. Inc.	Erie, Pennsylvania
FCD	Fairchild	Mountain View, California
G-E	General Electric	Syracuse, New York
G-H	Grayhill	La Grange, Illinois
HHS	Herman H. Smith, Inc.	Brooklyn, New York
H-P	Hewlett-Packard	Palo Alto, California
HEY	Heyman Mfg. Company	Kenilworth, New Jersey
IRC	International Resistance Co.	Philadelphia, Pennsylvania
ITT	International Telephone & Telegraph	West Palm Beach, Florida
JEF	Jeffers	Dubois, Pennsylvania
KID	Kidco, Inc.	Medford, New Jersey
LIT	Littelfuse	Des Plaines, Illinois
MAL	Mallory	Indianapolis, Indiana
M-O	Marko-Oak	Anaheim, California
MOL	Molex	Downers Grove, Illinois
MOT	Motorola	Phoenix, Arizona
P-B	Potter & Brumfield	Princeton, Indiana
POM	Pomona Electronics Co., Inc.	Pomona, California
Q-C	Quality Components	St. Marys, Pennsylvania
RCA	Radio Corporation of America	Harrison, New Jersey

RMC	Radio Material Company	Chicago, Illinois
SCC	Stackpole Carbon Co.	St. Marys, Pennsylvania
SEL	Selectro	Mamaroneck, New York
SEM	Semtech	Newbury Park, California
SIG	Signetics Corporation	Sunnydale, California
S-I	Switchcraft, Inc.	Chicago, Illinois
SPR	Sprague	North Adams, Massachusetts
S-T	Sarkes Tarzian	Bloomington, Indiana
STR	Stettner & Co.	Nurnburg, Western Germany
SYL	Sylvania	Woburn, Massachusetts
THR	Thermalloy, Co.	Dallas, Texas
TRW	TRW Capacitor Division	Ogallala, Nebraska
W-E	Wells Electronics	South Bend, Indiana
W-I	Wavetek, Indiana, Inc.	Indianapolis, Indiana
WSD	Wavetek, San Diego	San Diego, California

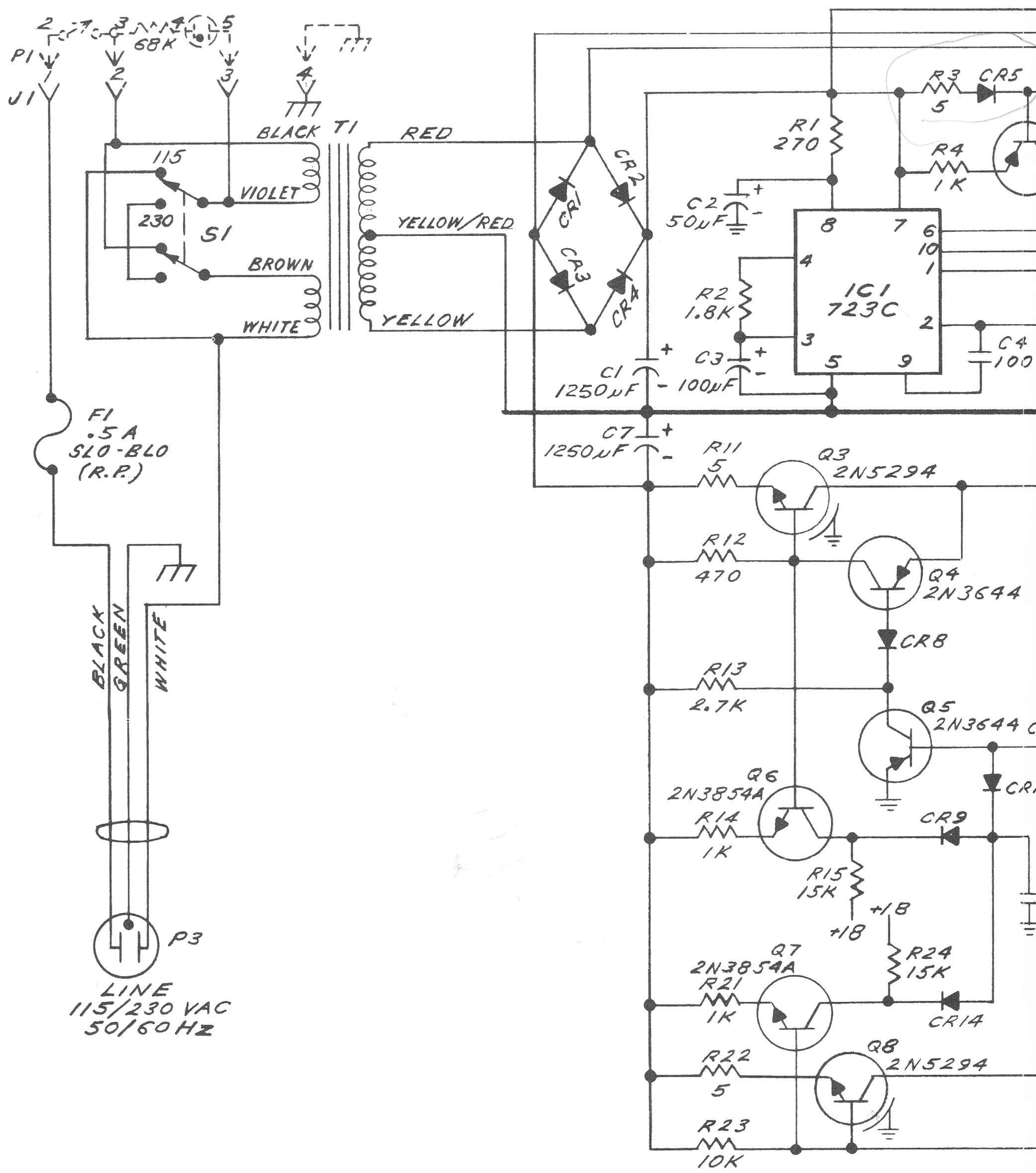
6.3 SCHEMATIC NOTES — The following notes and abbreviations pertain to all schematics. Additional notes pertaining to specific schematics are included on each schematic if required.

All resistor values are shown in "ohms" unless otherwise specified.
All capacitor values are shown in picofarads "pF" unless otherwise specified.
All inductor values are shown in microhenries "uH" unless otherwise specified.

2 Denotes DC voltage reading in volts unless otherwise specified.
22 mV Denotes high impedance crystal detector reading in volts unless otherwise specified.
12 Denotes 50ohm crystal detector reading in volts unless otherwise specified.
Signal or voltage source
Connect to indicate signal or voltage source
Arrow indicates clockwise rotation of wiper
Coaxial jack
Coaxial plug
Coaxial cable
* Factory adjusted part

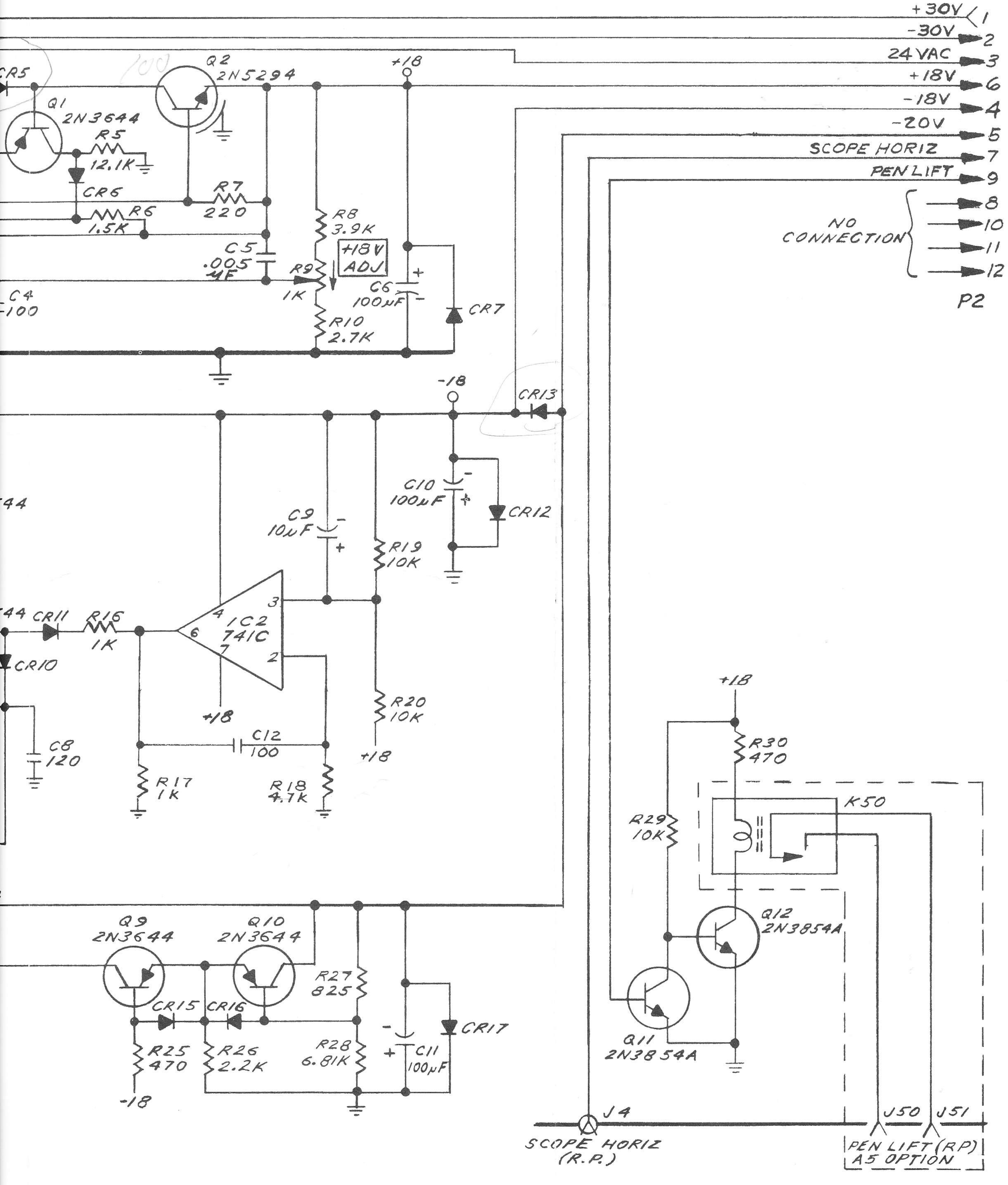
6.4 ABBREVIATION CODE

A	ampere	IF	intermediate frequency	Ω	ohm
ac	alternating current	kHz	kiloherz	p-p	peak to peak
C	capacitor	Kohm	kilohm	pF	picofarad
CR	diode	kv	kilovolt	Q	transistor
dB	decibel	kW	kilowatt	R	resistor
dBm	decibel referred to 1mW	L	inductor	RF	radio frequency
dc	direct current	MHz	megahertz	rms	root-mean-square
DS	device indicating, lamp	Mohm	megohm	R.P.	rear panel
F	farad	uF	microfarad	S	switch
F.P.	front panel	uA	microampere	T	transformer
H	henry	uH	microhenry	V	volt
Har	harmonic	mA	milliampere	VA	voltampere
Hz	hertz	mH	millihenry	W	watt
IC	integrated circuit	mV	millivolt	X	crystal
		mW	milliwatt		


P1
J1
68K
BLACK
T1
RED
115
VIOLET
230
S1
YELLOW/RED
BROWN
WHITE
YELLOW
CR1
CR2
CR3
CR4
R1
270
C2
50μF
R2
1.8K
C3
100μF
C1
1250μF
IC1
723C
R3
5
CR5
R4
1K
C4
F1
.5A
SLO-BLO
(R.P.)
C7
1250μF
R11
5
Q3
2N5294
R12
470
Q4
2N3644
CR8
R13
2.7K
Q5
2N3644
Q6
2N3854A
R14
1K
CR9
R15
15K
+18
R24
15K
Q7
2N3854A
R21
1K
CR14
R22
5
Q8
2N5294
R23
10K
BLACK
GREEN
WHITE
P3
LINE
115/230 VAC
50/60 HZ

SCHEMATIC, PS6 POWER SUPPLY

REV. C

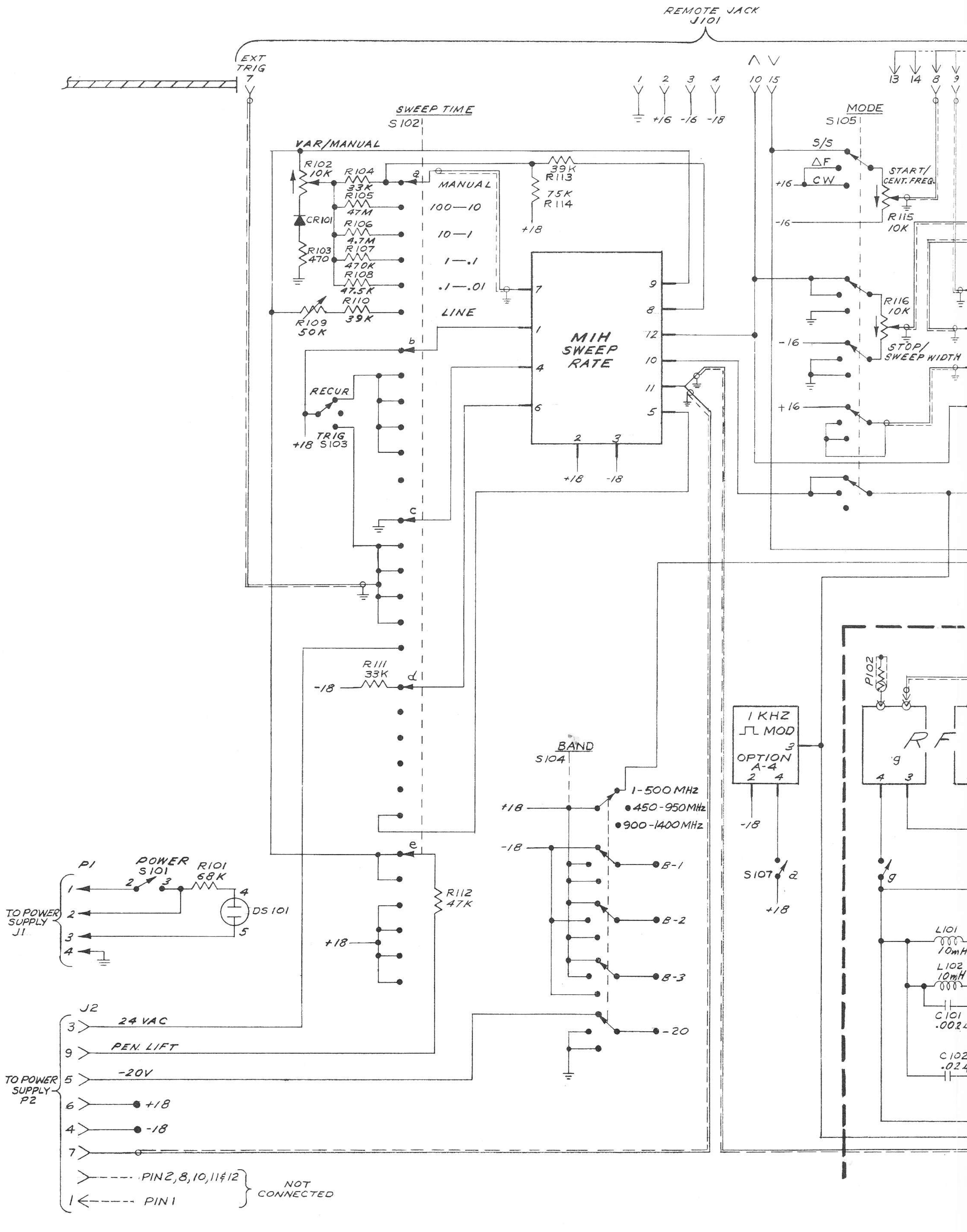


PARTS LIST PS6 POWER SUPPLY REV. C

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"Q "	TRANSISTORS				
1,4,5,9,10	PNP, Silicon	QA036-440	FCD	2N3644	5
2,3,8	NPN, Silicon	QA052-940	RCA	2N5294	3
6,7,11,12	NPN, Silicon	QA038-541	G-E	2N3854A	4
	PARTS MOUNTED ON CHASSIS, AND MISCELLANEOUS PARTS				
"J "	CONNECTORS (JACKS)				
1	4-pin receptacle	MC000-034	MOL	1625-4R-1	1
----	Contact, female, for above	MC000-018	MOL	1855	4
4	BNC, receptacle	JB109-111	APL	UG911A/I	1
"P "	CONNECTORS (PLUG)				
3	AC Plug/cord assembly (USA-Canada)	WL002-088	BEL	17237	1
	AC Plug/cord assembly (Western Europe)	WL007-088	BEL		
"F "	FUSES				
1	.5 Amp., slo-blo (used with 115Vac line)	MF000-007	BUS	MDV½	1
	.25Amp., slo-blo (used with 230Vac line)	MF000-006	BUS	MDV¼	--
	Fuse holder, for above	MF000-001	BUS	HMM	1
"S "	SWITCHES				
1	DPDT, slide, power change	SS000-003	S-I	46256LFE	1
	MISCELLANEOUS				
	Bushing, strain relief	HB004-000	HEY	SR5P1	1
	10 lead, TO-5 pad	HQ103-000	THR	7717-21DAP	1
	Insulated sholder washer	HW110-400	RCA	DF137A	3
	Transistor mtg. insulator, mica	HQ101-003	W-I	HQ101-003	3
	PARTS FOR PEN LIFT OPTION A5				
"J "	CONNECTORS (JACKS)				
50,51	Binding post, miniature, .104ID (mates with wire, or banana plug)	MC000-038	POM	2439	2
"K "	RELAYS				
50	SPST, N.O. 12V	MR000-001	P-B	JRM1006	1

PARTS LIST PS6 POWER SUPPLY REV. C

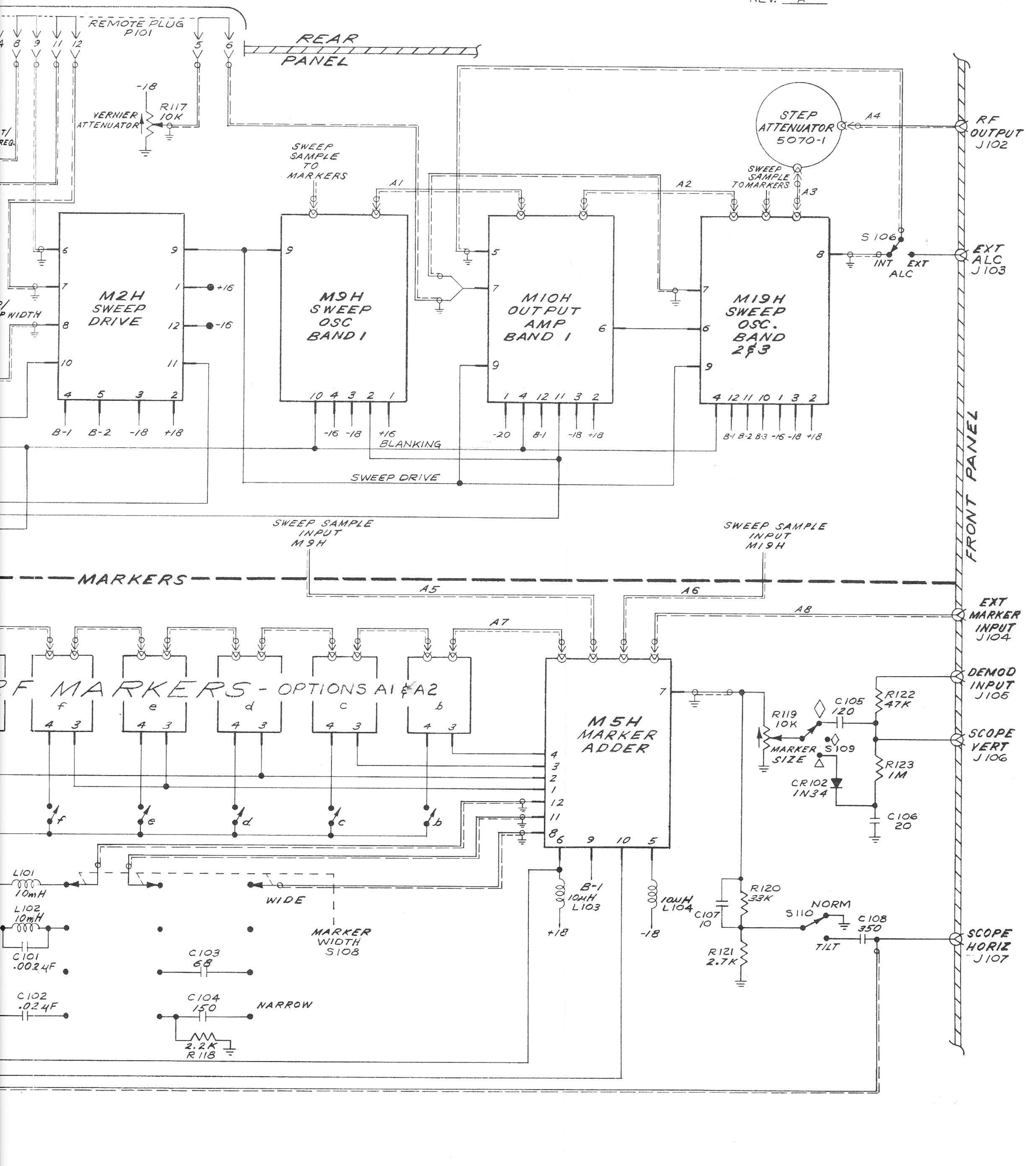
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
----------------	----PARTS MOUNTED ON PRINTED CIRCUIT BOARD	----------	----	----------------	--
"C "	CAPACITORS				
1,7	Electrolytic, 1250uF, 50V	CE114-212	SPR	PCL-1339	2
2	Electrolytic, 50uF, 50V	CE107-050	SPR	TE1307	1
3,6,10,11	Electrolytic, 100uF, 25V	CE105-110	SPR	TE1211	4
4,12	Ceramic disc., 100pF ±20% 1kV	CD102-110	SPR	5GA-T10	2
5	Ceramic disc., .005uF ±20%	CD103-250	SPR	TG-D50	1
8	Ceramic disc., 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
9	Electrolytic, 10uF, 25V	CE105-010	SPR	TE1204	1
"P "	CONNECTORS (PLUGS)				
2	12-pin printed circuit	MC000-031	MOL	03-04-4121	1
"CR "	DIODES				
1 to 17	Silicon, junction, 100piV, 3/4A	DR000-001	ITT	1N4002	17
"IC "	INTEGRATED CIRCUITS				
1	Voltage Regulator, 10 pin TO-5	IC000-001	FCD	U5R7723393	1
2	Operational amplifier, 8 pin in line	IC000-002	SIG	N5741V	1
"R "	RESISTORS				
1	Fixed, comp., 270ohm ±10% ¼W	RC104-127	A-B	CB2711	1
2	Fixed, comp., 1.8k ±10% ¼W	RC104-218	A-B	CB1821	1
3,11,22	Fixed, deposited carb., 5ohm ±1% ¼W	RD0R-050	K1D	K-C¼	3
4,14,21	Fixed, deposited carb. 1k ±1% ¼W	RD011-100	COR	RN60D	3
5	Fixed, deposited carb., 12.1k ±1% ¼W	RD012-121	COR	RN60D	1
6	Fixed, comp., 1.5k ±10% ¼W	RC104-215	A-B	CB1521	1
7	Fixed, comp., 220ohm ±10% ¼W	RC104-122	A-B	CB2211	1
8	Fixed, comp., 3.9k ±5% ¼W	RC103-239	A-B	CB3925	1
9	Variable, cermet, 1k ±20%	RP131-210	CTS	360T102B	1
10	Fixed, comp., 2.7k ±5% ¼W	RC103-227	A-B	CB2725	1
12,25	Fixed, comp., 470ohm ±10% ¼W	RC104-147	A-B	CB4711	2
13	Fixed, comp., 2.7k ±10% ½W	RC106-227	A-B	EB2721	1
15,24	Fixed, deposited carb., 15k ±1% ¼W	RD012-150	COR	RN60D	2
16,17	Fixed, comp., 1k ±10% ¼W	RC104-210	A-B	CB1021	2
18	Fixed, comp., 4.7k ±10% ¼W	RC104-247	A-B	CB4721	1
19,20	Dep. carb., 10k, matched set, ±.1%	RX000-003	W-I	RX000-003	1
23,29	Fixed, comp., 10k ±10% ¼W	RC104-310	A-B	CB1031	2
26	Fixed, comp., 2.2k ±10% ½W	RC106-222	A-B	EB2221	1
27	Fixed, deposited carb., 825ohm ±1% ¼W	RD010-825	COR	RN60D	1
28	Fixed, deposited carb., 6.81k ±1% ¼W	RD011-681	COR	RN60D	1
30	Fixed, comp., 470ohm ±10% ½W	RC106-147	A-B	EB4711	1
"T "	TRANSFORMERS				
1	115/230 X 48 Vac, center tapped	TT000-022	W-I	TT000-022	1



REMOTE JACK
J101
EXT TRIG
SWEEP TIME
S102
VAR/MANUAL
R102 10K
R104 33K
R105 47M
R106 4.7M
R107 470K
R108 47.5K
R110 39K
R109 50K
CR101
R103 470
MANUAL
100—10
10—1
1—.1
.1—.01
LINE
R113 39K
R114 75K
MIH SWEEP RATE
RECUR
TRIG S103
R111 33K
R112 47K
MODE
S105
S/S
ΔF
CW
START/ CENT. FREQ.
R115 10K
R116 10K
STOP/ SWEEP WIDTH
BAND
S104
1-500 MHz
450-950 MHz
900-1400 MHz
B-1
B-2
B-3
1 KHZ MOD
OPTION A-4
S107
P102
RF
L101 10mH
L102 10mH
C101
C102
P1
POWER
S101
R101 68K
DS101
TO POWER SUPPLY J1
J2
24 VAC
PEN. LIFT
-20V
TO POWER SUPPLY P2
PIN 2, 8, 10, 11 & 12
PIN 1
NOT CONNECTED

MODULE WIRING DIAGRAM
2001 HEAD

REV. A



PARTS LIST MODEL 2001 HEAD

REV. A

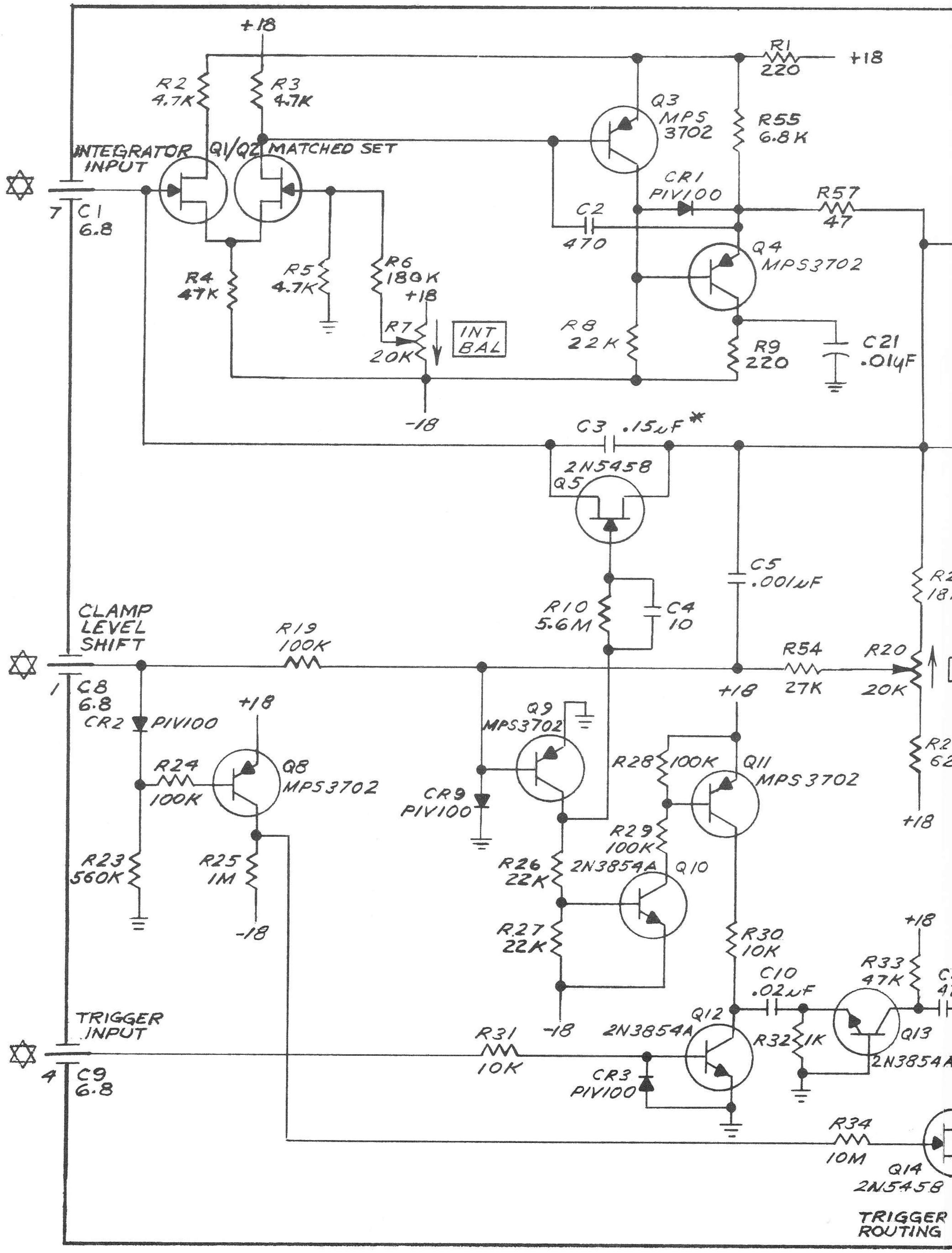
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"P "	CONNECTORS (PLUGS)				
1	4-pin	MC000-035	MOL	1625-4P1	1
	Contact, male, for above	MC000-019	MOL	1854	4
101	15-pin	MC000-017	MOL	1625-15P	1
	Contact, male, for above	MC000-019	MOL	1854	8
102	Termination	JF000-009	SEL	60-0010501	1
"CR "	DIODES				
101	Silicon, junction, 100piV, 750mA	DR000-001	ITT	1N4002	1
102	Germanium, point contact	DG100-341	SYL	1N34AS	1
"DS "	LAMPS				
101	Indicator, Neon, Part of S101	MB000-002	M-O	A1H	1
"L "	INDUCTORS				
101,102	Fixed, 10mH	LA104-310	JEF	15S	2
103,104	Fixed, 10uH	LA101-010	JEF	15	2
"R "	RESISTORS				
101	Fixed, comp., 68k ±10% ¼W	RC104-368	A-B	CB6831	1
102	Variable, 10k, part of S103 assembly	---------	---	------	-
103	Fixed, comp., 470ohm ±5% ¼W	RC103-147	A-B	CB4715	1
104,111	Fixed, comp., 33k ±5% ¼W	RC103-333	A-B	CB3335	2
105	Fixed, comp., 47M ±5% ¼W	RC103-647	A-B	CB4765	1
106	Fixed, comp., 4.7M ±5% ¼W	RC103-547	A-B	CB4755	1
107	Fixed, comp., 470k ±5% ¼W	RC103-447	A-B	CB4745	1
108	Fixed, dep. carbon, 47.5k ±1% ¼W	RD012-475	COR	RN60D	1
109	Variable, cermet, 50k ±20% 1W	RP129-350	CTS	360S503B	1
110,113	Fixed, comp., 39k ±5% ¼W	RC103-339	A-B	CB3935	2
112	Fixed, comp., 47k ±5% ¼W	RC103-347	A-B	CB4735	1
114	Fixed, comp., 75k ±5% ¼W	RC103-375	A-B	CB7535	1
115,116	Variable, wirewound, 10k	RV103-310	BOU	3500S2-103	2
117	Variable, carbon, 10k	RP128-310	W-I	RP128-310	1
118	Fixed, comp., 2.2k ±10% ¼W	RC104-222	A-B	CB2221	1
119	Variable, 10k, part of S108	---------	---	------	1
120	Fixed, comp., 33k ±10% ¼W	RC104-333	A-B	CB3331	1
121	Fixed, comp., 2.7k ±10% ¼W	RC104-227	A-B	CB2721	1
122	Fixed, comp., 47k ±10% ¼W	RC104-347	A-B	CB4731	1
123	Fixed, comp., 1M ±10% ¼W	RC104-510	A-B	CB1051	1
"S "	SWITCHES				
101	SPDT, Push/Push illuminated	SZ000-003	M-O	54-6169126	1
102	Rotary, 6-pole, 6-position, assembly	SR000-017	W-I	SR000-017	1
103	SPDT, on, off, on, momentary	ST002-006	C-K	7107P	1
104,105	Lever, 5-pole, 3-position	SL000-001	OAK	3991-63184	2
106,110	SPDT, on,none,on	ST001-006	C-K	7101P	2
107	Push-button switch assembly	SZ001-004	C-L	PB15,7 sta.	1
108	Rotary, 6-pole, 4-position, assembly	SR000-016	C-K	7103P	1
109	SPDT, on,off,on	ST000-006	C-K	7103P	1

PARTS LIST

MODEL 2001 HEAD

REV. A

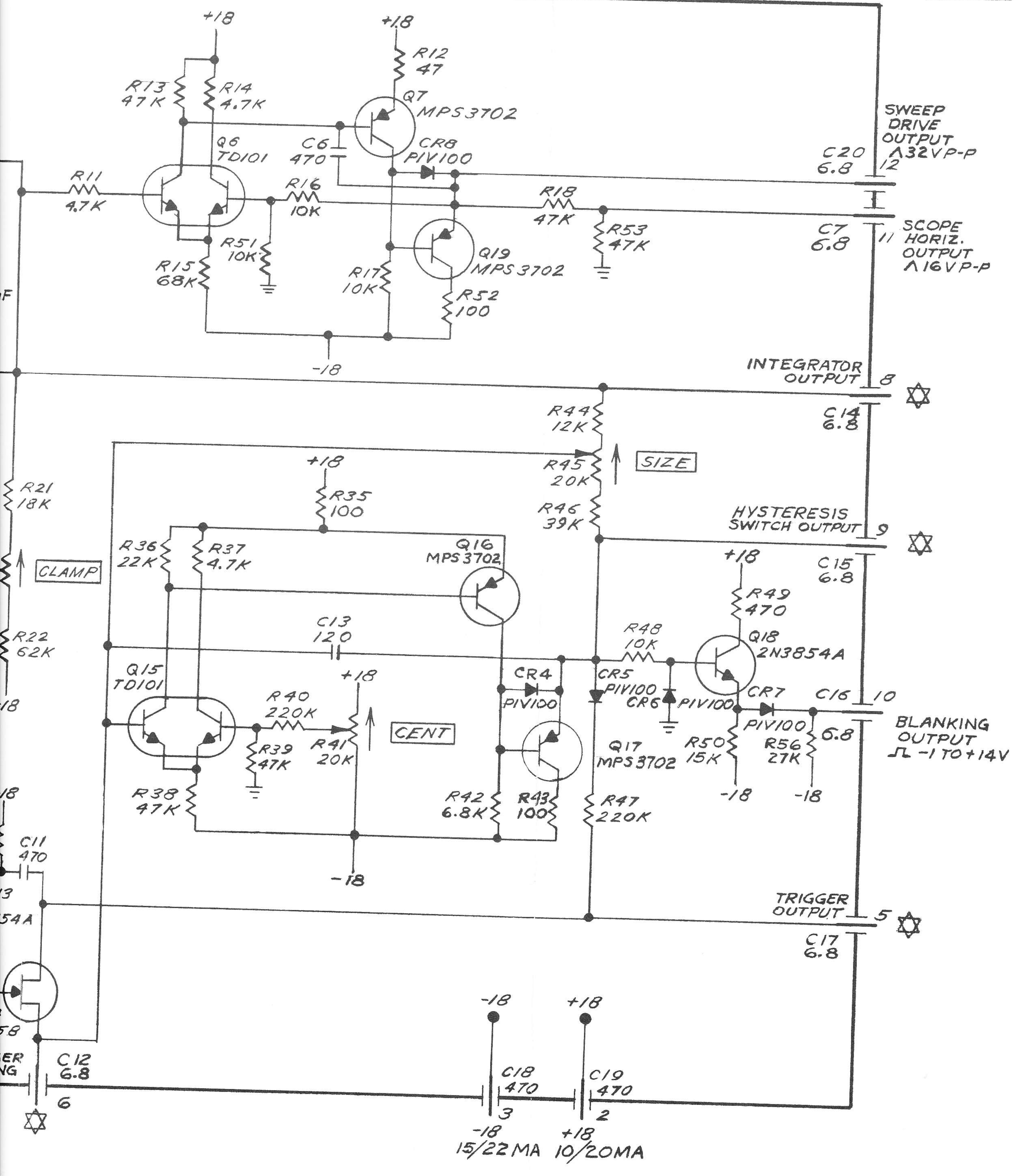
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
	<u>STANDARD MODULES</u>				
M1H	Sweep Rate Module	M1H	W-I	M1H	1
M2H	Sweep Drive Module	M2H	W-I	M2H	1
M5H	Marker Adder Module	M5H	W-I	M5H	1
M9H	Oscillator/Mixer Module, Band 1	M9H	W-I	M9H	1
M10H	Output Amplifier Module, Band 1	M10H	W-I	M10H	1
M19H	Oscillator Module, Band 2 & 3	M19H	W-I	M19H	1
	<u>OPTIONS</u>				
A1	Single frequency marker, 1 to 1400 MHz (specify frequency)	M6S_____	W-I	M6S_____	
A2	Harmonic markers 1, 10 & 50 MHz (specify frequency)	M6H_____	W-I	M6H_____	
A4	1 KHz Square Wave Modulation	M6Z	W-I	M6Z	
A5	(See Power Supply Parts List)	---	---	---	
<u>"A "</u>	<u>ASSEMBLIES</u>				
1	RF Cable, 50 ohm	WX2001-A1	W-I	WX2001-A1	1
2	RF Cable, 50 ohm	WX2001-A2	W-I	WX2001-A2	1
3	RF Cable, 50 ohm	WX2001-A3	W-I	WX2001-A3	1
4	RF Cable, 50 ohm	WX2001-A4	W-I	WX2001-A4	1
5	RF Cable, 50 ohm	WX2001-A5	W-I	WX2001-A5	1
6	RF Cable, 50 ohm	WX200-1A6	W-I	WX2001-A6	1
7	RF Cable, 50 ohm	WX2001-A7	W-I	WX2001-A7	1
8	RF Cable, 50 ohm	WX2001-A8	W-I	WX2001-A8	1
-----	S102 Assembly with Associated Parts	B500-225	W-I	B500-225	1
-----	S108 Assembly with Associated Parts	B500-224	W-I	B500-224	1
5070-1	RF Attenuator	5070-1	W-I	5070-1	1
<u>"C "</u>	<u>CAPACITORS</u>				
101	Ceramic disc, .002uF ±10% 1KV	CD102-220	SPR	5GAD20	1
102	Ceramic disc, .02uF ±10% 100V	CD103-320	SPR	TGS20	1
103	Ceramic disc, 68pF ±5% 1KV	CD104-068	SPR	10TCU	1
104	Ceramic disc, 150pF ±20% 1KV	CD102-115	SPR	5GAT15	1
105	Ceramic disc, 120pF ±20% 1KV	CD102-112	SPR	5GAT12	1
106	Ceramic disc, 20pF ±5% 1KV	CD101-020	SPR	10TCCQ20	1
107	Ceramic disc, 10pF ±5% LKV	CD101-010	SPR	10TCCQ10	1
108	Ceramic disc, 350pF ±20% 1KV	CD102-135	SPR	5GAT35	1
<u>"J "</u>	<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	13
102,104	Jack, cable, BNC	JB000-003	W-I	JB000-003	2
103,105 106,107	Jack, receptacle, BNC	JB109-111	APL	UG911A/U	4
-----	Pin socket, Teflon	MC000-002	W-I	MC000-002	



✡ = CONNECTED TO SWEEP TIME SWITCH

SWEEP RATE SCHEMATIC MODULE M1H

REV. A



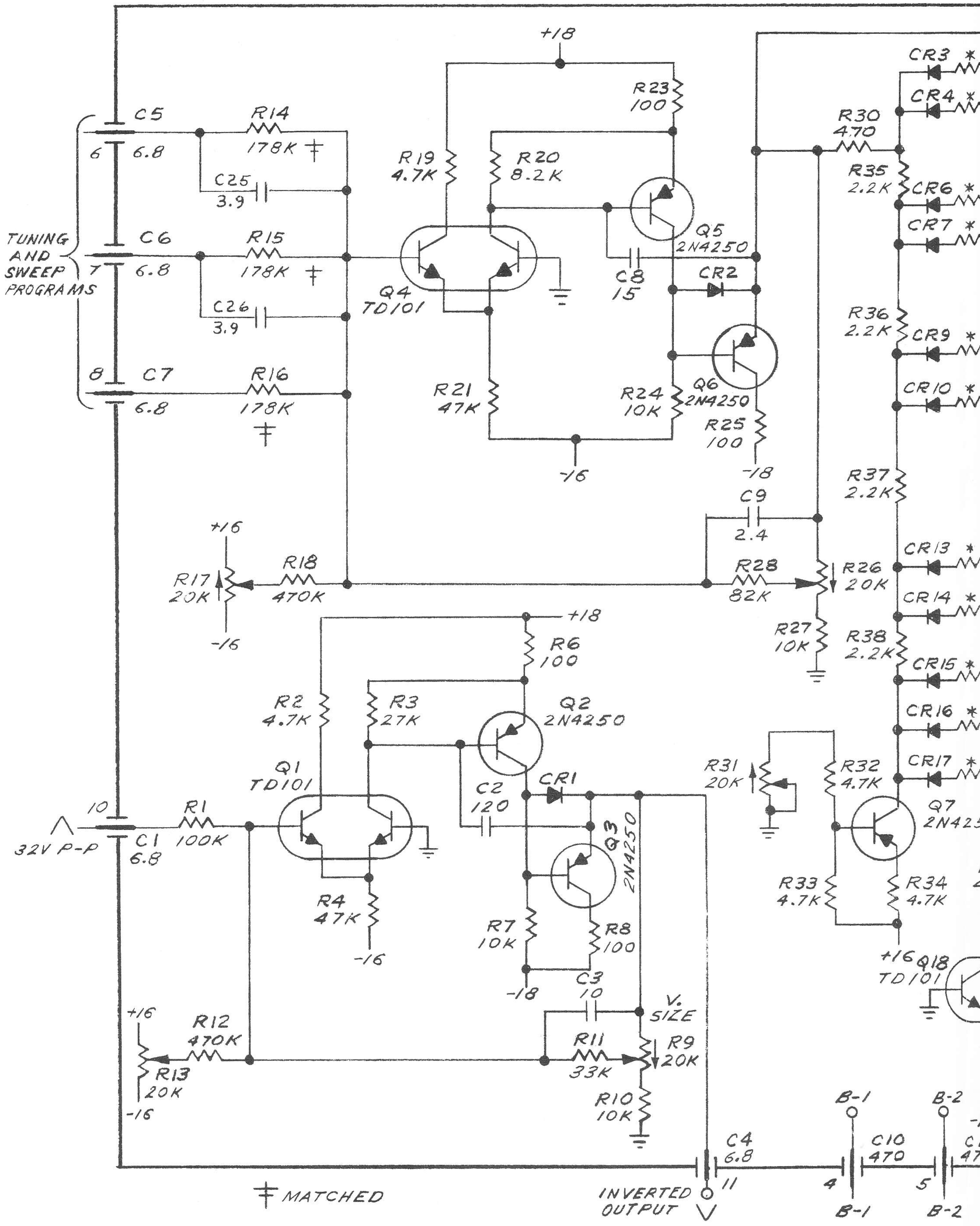
PARTS LIST MODULE M1H REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
"Q "	TRANSISTORS				
1,2	N-channel JFET'S, matched pair	QB000-014	W-I	QB000-014	1
3,4,7,8,9 11,16,17,19	PNP, Silicon	QB000-009	MOT	MPS3702	9
5,14	N-channel, Silicon, JFET	QA054-580	MOT	2N5458	2
6,15	Dual, NPN, Silicon	QB000-010	SPR	TD101	2
10,12,13,18	NPN, Silicon	QA038-541	G-E	2N3854A	4

PARTS LIST

MODULE M1H REV A

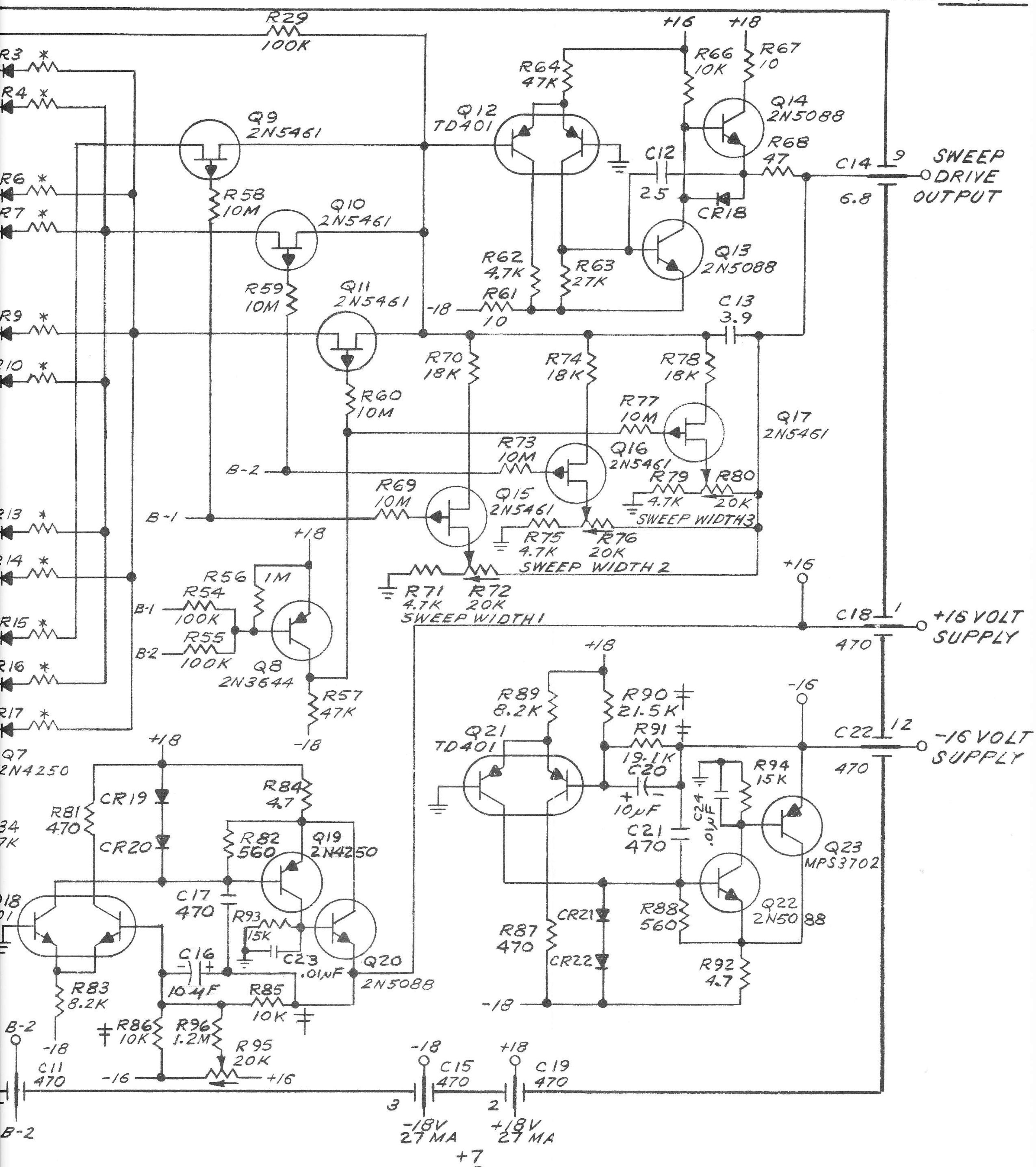
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,7,8,9 12,14,15 16,17,20	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	10
2,6,11	Ceramic disc, 470pF, ±20% 1KV	CD102-147	SPR	5GAT47	3
3	Mylar paper, 15uF ±10% 100V	CP103-415	C-D	WMF1P15	1
4	Ceramic disc, 10pF ±5% 1KV	CD101-010	SPR	10TCCV10	1
5	Ceramic disc, .001uF ±20% 1KV	CD102-210	SPR	5GA010	1
10	Ceramic disc, .02uF ±20% 100V	CD103-320	SPR	TGS20	1
13	Ceramic disc, 120pF ±20% 1KV	CD102-112	SPR	5GAT12	1
18,19	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	2
21	Ceramic disc, .01uF ±20% 100V	CD103-310	SPR	TGS10	1
"CR "	DIODES				
1,2,3,4,5 6,7,8,9	Silicon, junction, 100PIV, 750mA	DR000-001	ITT	1N4002	9
"R "	RESISTORS				
1,9	Fixed, comp., 220ohm ±10% ¼W	RC104-122	A-B	CB2211	2
2,3,5,11 14,37	Fixed, comp., 4.7k ±10% ¼W	RC104-247	A-B	CB4721	6
4,13,18,33 38,39,53	Fixed, comp., 47k ±10% ¼W	RC104-347	A-B	CB4731	7
6	Fixed, comp., 180k ±10% ¼W	RC104-418	A-B	CB1841	1
7,20,41,45	Variable, carbon, 20k ±20%	RP124-320	A-B	WA2G032	4
8,26,27,36	Fixed, comp., 22k ±10% ¼W	RC104-322	A-B	CB2231	4
10	Fixed, comp., 5.6M ±10% ¼W	RC104-556	A-B	CB5651	1
12,57	Fixed, comp., 47ohm ±10% ¼W	RC104-047	A-B	CB4701	2
15	Fixed, comp., 68k ±10% ¼W	RC104-368	A-B	CB6831	1
16,51	Fixed, comp., 10k ±5% ¼W	RC103-310	A-B	CB1035	2
17,30,31,48	Fixed, comp., 10k ±10% ¼W	RC104-310	A-B	CB1031	4
19,24,28,29	Fixed, comp., 100k ±10% ¼W	RC104-410	A-B	CB1041	4
21	Fixed, comp., 18k ±10% ¼W	RC104-318	A-B	CB1831	1
22	Fixed, comp., 62k ±5% ¼W	RC103-362	A-B	CB6235	1
23	Fixed, comp., 560k ±10% ¼W	RC104-456	A-B	CB5641	1
25	Fixed, comp., 1M ±10% ¼W	RC104-510	A-B	CB1051	1
32	Fixed, comp., 1k ±10% ¼W	RC104-210	A-B	CB1021	1
34	Fixed, comp., 10M ±10% ¼W	RC104-610	A-B	CB1061	1
35,43,52	Fixed, comp., 100ohm ±10% ¼W	RC104-110	A-B	CB1011	3
40,47	Fixed, comp., 220k ±10% ¼W	RC104-422	A-B	CB2241	2
42,55	Fixed, comp., 6.8k ±10% ¼W	RC104-268	A-B	CB6821	2
44	Fixed, comp., 12k ±10% ¼W	RC104-312	A-B	CB1231	1
46	Fixed, comp., 39k ±10% ¼W	RC104-339	A-B	CB3931	1
49	Fixed, comp., 470ohm ±10% ¼W	RC104-147	A-B	CB4711	1
50	Fixed, comp., 15k ±10% ¼W	RC104-315	A-B	CB1531	1
54,56	Fixed, comp., 27k ±10% ¼W	RC104-327	A-B	CB227	2



TUNING AND SWEEP PROGRAMS
C5 6.8
C6 6.8
C7 6.8
6
7
8
R14 178K
R15 178K
R16 178K
C25 3.9
C26 3.9
+18
R19 4.7K
R20 8.2K
R23 100
Q4 TD101
Q5 2N4250
C8 15
CR2
R21 47K
R24 10K
Q6 2N4250
R25 100
-16
-18
R30 470
R35 2.2K
R36 2.2K
R37 2.2K
R38 2.2K
CR3 *
CR4 *
CR6 *
CR7 *
CR9 *
CR10 *
CR13 *
CR14 *
CR15 *
CR16 *
CR17 *
C9 2.4
R17 20K
+16
-16
R18 470K
R28 82K
R26 20K
R27 10K
R6 100
R2 4.7K
R3 27K
Q2 2N4250
Q1 TD101
CR1
C2 120
Q3 2N4250
10
32V P-P
C1 6.8
R1 100K
R4 47K
R7 10K
R8 100
C3 10
V. SIZE
R31 20K
R32 4.7K
Q7 2N4250
R33 4.7K
R34 4.7K
Q18 TD101
R12 470K
R13 20K
R11 33K
R9 20K
R10 10K
C4 6.8
11
INVERTED OUTPUT
B-1
B-2
C10 470
4
5
MATCHED

SWEEP DRIVE SCHEMATIC
MODULE M2H

REV E



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-5

PARTS LIST

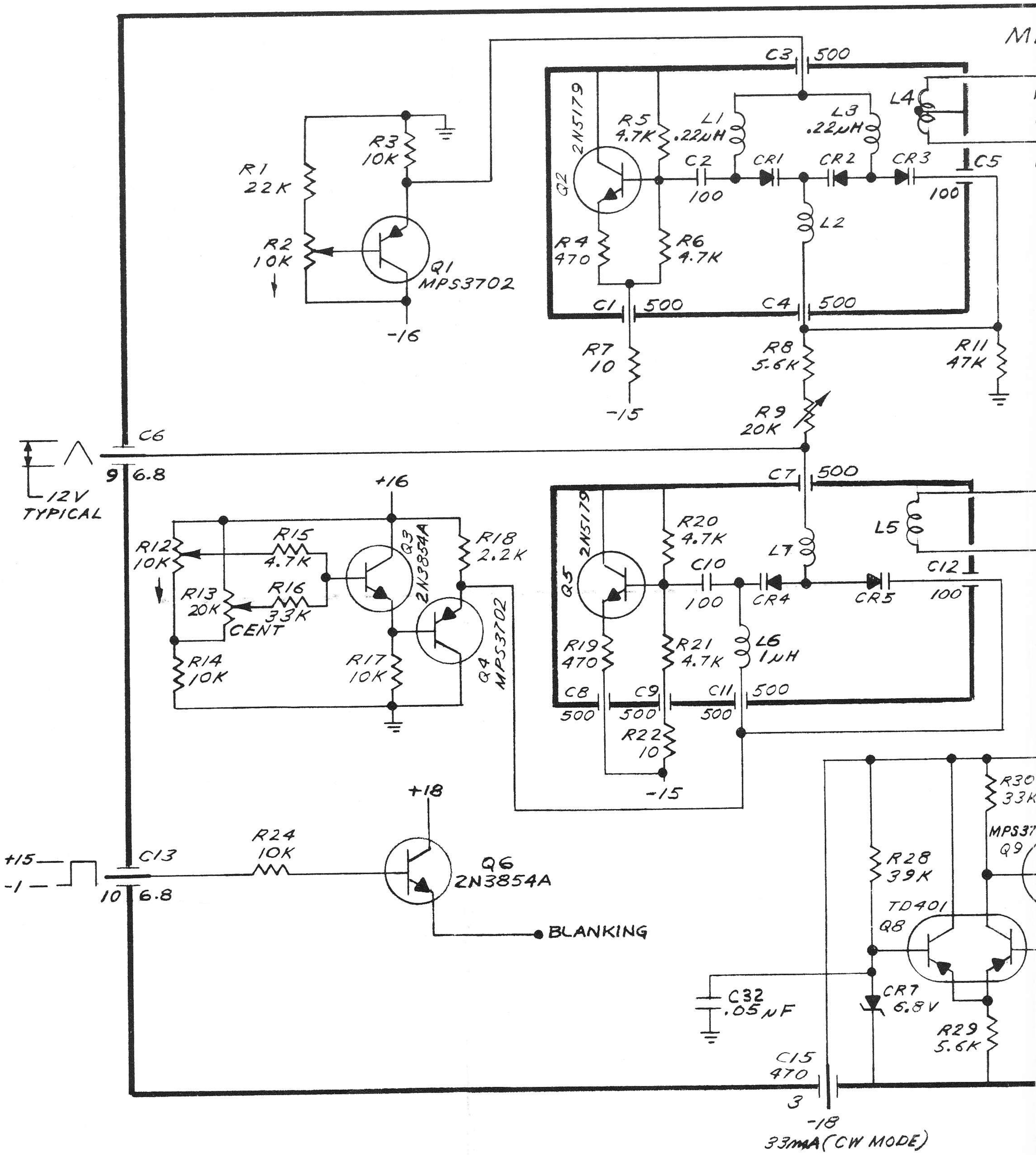
MODULE M2H REV. E

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
"Q "	TRANSISTORS				
1,4,18	NPN, Silicon, Dual	QB000-010	SPR	TD101	3
2,3,5,6,7,19	PNP, Silicon	QA042-500	FCD	2N4250	6
8	PNP, Silicon	QA036-440	FCD	2N3644	1
6,10,11,15	P channel JFET	QA054-610	MOT	2N5461	6
16,17					
12,21	PNP, Silicon, Dual	QB000-011	SPR	TD401	2
13,14,20,22	NPN, Silicon	QA050-880	MOT	2N5088	4
23	PNP, Silicon	QB000-009	MOT	MPS3702	1

PARTS LIST

MODULE M2H REV E

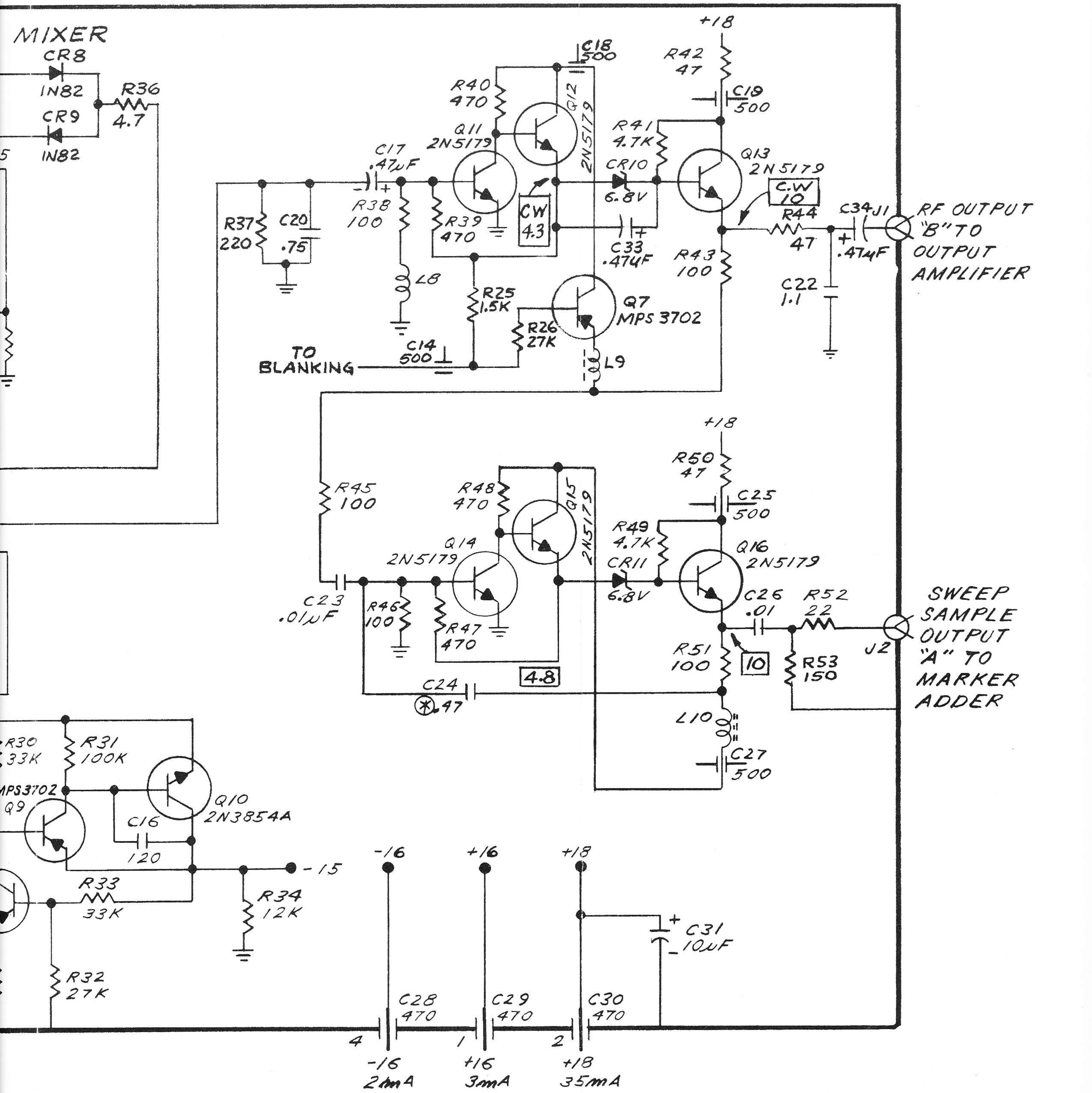
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C"	CAPACITORS				
1,4,5,6,7,14	Ceramic feedthru, 6.8pF ± 10% 500V	CF102-R68	A-B	FA5C	6
2	Ceramic disc., 120pF ± 20% 1kV	CD102-112	SPR	5GA-T12	1
3	Ceramic disc., 10pF ± 5% 1kV	CD101-010	SPR	10TCC-Q10	1
8	Ceramic disc., 15pF ± 5% 1kV	CD101-015	SPR	10TCC-Q15	1
9	Composition, 2.4 pF ± 10% 500V	CG101-224	Q-C	QC2.4	1
10,11,15,18 19,22	Ceramic feedthru, 470pF ± 20% 500V	CE101-147	A-B	FA5C	6
12	Ceramic disc., 25 pF ± 5% 1kV	CD101-025	SPR	10TCC-Q25	1
13,25,26	Composition, 3.9pF ± 10% 500V	CG101-239	Q-C	QC3.9	3
16,20	Electrolytic, 10uF,25V	CE105-010	SPR	TE1204	2
17,21	Ceramic disc., 470pF ± 20% 1kV	CD102-147	SPR	5GA-T47	2
23,24	Ceramic disc, .01uF ± 20% 100V	CD103-310	SPR	TG-S10	2
"CR"	DIODES				
1 to 4,6,7,9 10,13 to 22	Silicon, junction 100piV, 750mA	DR000-001	ITT	IN4002	18
"R"	RESISTORS				
1,29,54,55	Fixed, comp., 100kohm ± 10% ¼W	RC104-410	A-B	CB1041	4
2,19,32,33 34,62,71,75 79	Fixed, comp., 4.7kohm ± 10% ¼W	RC104-247	A-B	CB4721	9
3,63	Fixed, comp., 27kohm ± 10% ¼W	RC104-327	A-B	CB2731	2
4,21,57.64	Fixed, comp., 47kohm ± 10% ¼W	RC104-347	A-B	CB4731	4
6,8,23,25	Fixed, comp., 100ohm ± 10% ¼W	RC104-110	A-B	CB1011	4
7,10,24,27 66	Fixed, comp., 10kohm ± 10% ¼W	RC104-310	A-B	CB1031	5
9,13,17,26 31,72,76,80 95	Variable, cermet, 20kohm ± 10% 3/4W	RP130-320	BEK	89PR20K	9
11	Fixed comp., 33kohm ± 10% ¼W	RC104-333	A-B	CB3331	1
12,18	Fixed, comp., 470kohm ± 10% ¼W	RC104-447	A-B	CB4741	2
14,15,16	Deposited carb. 178kohm, matched set .1%	RX000-002	W-I	RX000-002	1
20,83,89	Fixed, comp., 8.2kohm ± 10% ¼W	RC104-282	A-B	CB8221	3
28	Fixed, comp., 82kohm ± 10% ¼W	RC104-382	A-B	CB8231	1
30,81,87	Fixed, comp., 470ohm ± 10% ¼W	RC104-147	A-B	CB4711	3
35,36,37,38	Fixed, comp., 2.2kohm ± 10% ¼W	RC104-222	A-B	CB2221	4
56	Fixed, comp., 1Mohm ± 10% ¼W	RC104-510	A-B	CB1051	1
58,59,60,69 73,77	Fixed, comp., 10Mohm ± 10% ¼W	RC104-610	A-B	CB1061	6
61,67	Fixed comp., 10 ohm ± 10% ¼W	RC104-010	A-B	CB1001	2
68	Fixed, comp., 47 ohm ± 10% ¼W	RC104-047	A-B	CB4701	1
70,74,78	Fixed, comp., 18kohm ± 10% ¼W	RC104-318	A-B	CB1831	3
82,88	Fixed, comp., 560ohm ± 10% ¼W	RC104-156	A-B	CB5611	2
84,92	Fixed, comp., 4.7ohm ± 10% ¼W	RC104-R47	A-B	CB47G1	2
85,86	Deposited carb. 10kohm, matched set .1%	RX000-003	W-I	RX000-003	1
90	Deposited carb. 21.5kohm matched set,				
91	Deposited carb. 19.1kohm 9:8 within .1%	RX000-004	W-1	RX000-004	1
93,94	Fixed, comp., 15k ohm ± 10% ¼W	RC104-315	A-B	CB1531	2
96	Fixed, comp., 1.2Mohm ± 10% ¼W	RC104-512	A-B	CB1251	1



C3 500
2N5179
Q2
R5 4.7K
L1 .22μH
L3 .22μH
L4
R3 10K
R1 22K
C2 100
CR1
CR2
CR3
C5 100
R2 10K
L2
R4 470
R6 4.7K
Q1 MPS3702
C1 500
C4 500
-16
R7 10
R8 5.6K
R11 47K
-15
R9 20K
C6
9 6.8
12V TYPICAL
+16
C7 500
2N5179
R20 4.7K
L5
R12 10K
R15 4.7K
Q3 2N3854A
R18 2.2K
L7
Q5
C10 100
CR4
CR5
C12 100
R13 20K
R16 33K
CENT
R19 470
R21 4.7K
L6 1μH
R14 10K
R17 10K
Q4 MPS3702
C8 500
C9 500
C11 500
R22 10
-15
R30 33K
+18
MPS37
Q9
R24 10K
+15
-1
C13
10 6.8
Q6 2N3854A
R28 39K
BLANKING
TD401
Q8
C32 .05μF
CR7 6.8V
R29 5.6K
C15 470
3
-18
33mA (CW MODE)

OSCILLATOR-MIXER SCHEMATIC
MODULE M9G & M9H

REV A



PARTS LIST

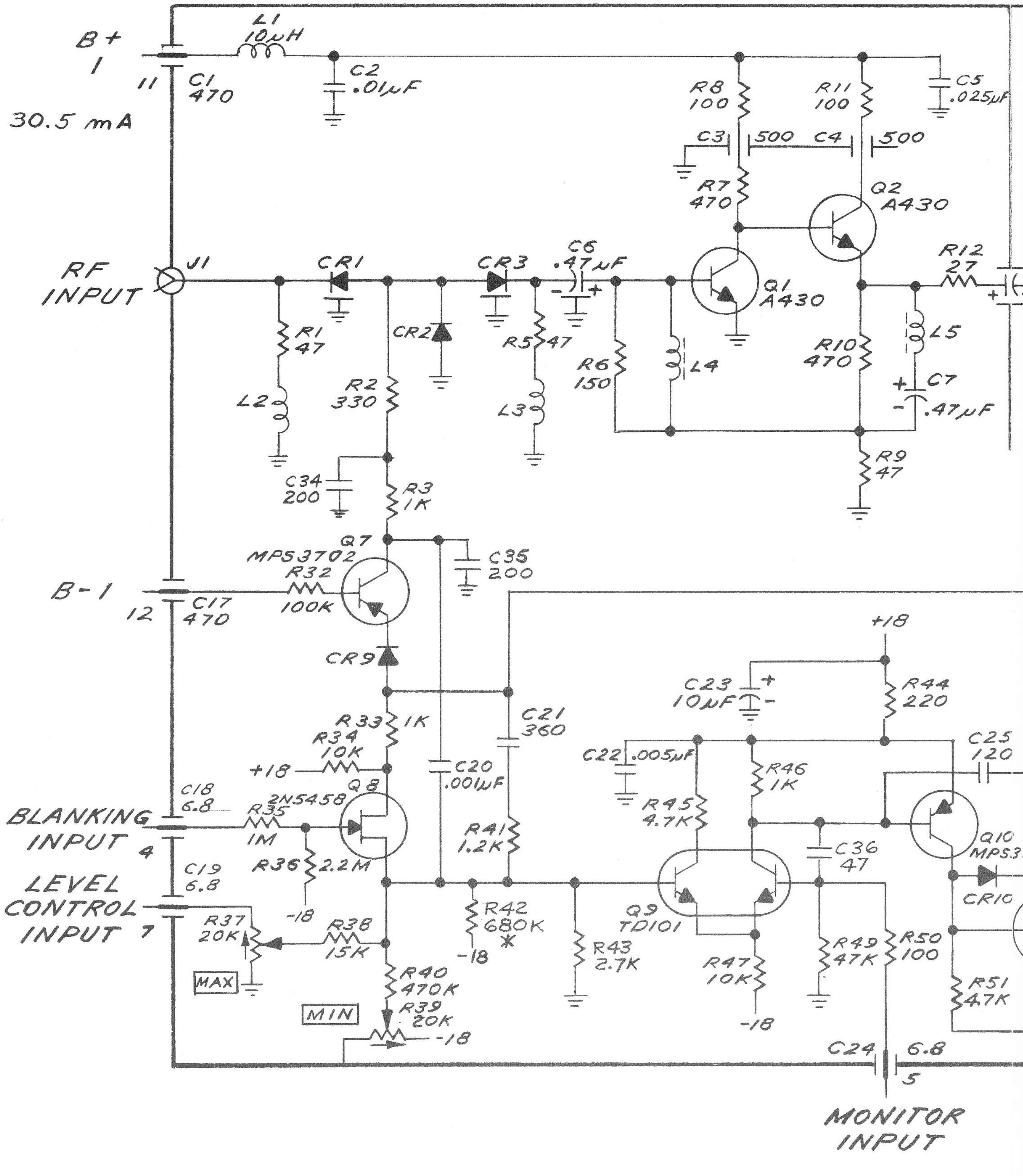
MODULE M9G M9H REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
"R "	RESISTORS				
18	Fixed, comp., 2.2kohm ±10% ¼W	RC-104-222	A-B	CB2221	1
25	Fixed, comp., 1.5kohm ±10% ¼W	RC-104-215	A-B	CB1521	1
26	Fixed, comp., 27kohm ±10% ¼W	RC-104-327	A-B	CB2731	1
28	Fixed, comp., 39kohm ±10% ¼W	RC-104-339	A-B	CB3931	1
31	Fixed, comp., 100kohm ±10% ¼W	RC-104-410	A-B	CB1041	1
32	Fixed, comp., 27kohm ± 5% ¼W	RC-103-327	A-B	CB2735	1
33	Fixed, comp., 33kohm ± 5% ¼W	RC-103-333	A-B	CB3335	1
34	Fixed, comp., 12kohm ±10% ¼W	RC-104-312	A-B	CB1231	1
36	Fixed, comp., 4.7ohm ±10% ¼W	RC-104-R47	A-B	CB47G1	1
37	Fixed, comp., 220ohm ±10% ¼W	RC-104-122	A-B	CB2211	1
38,43,45,46, 51	Fixed, comp., 100ohm ±10% ¼W	RC-104-110	A-B	CB1011	5
42,44,50	Fixed, comp., 47ohm ±10% ¼W	RC-104-047	A-B	CB4701	3
52	Fixed, comp., 22ohm ±10% ¼W	RC-104-022	A-B	CB2201	1
53	Fixed, comp., 150ohm ±10% ¼W	RC-104-115	A-B	CB1511	1
"Q "	TRANSISTORS				
1,4,5,9	PNP, Silicon,	QB-000-009	MOT	MPS3702	4
2,6,11,12,13, 14,15,16	NPN, Silicon,	QA-051-790	RCA	2N5179	8
3,7,10	NPN, Silicon,	QA-038-541	G-E	2N3854A	3
8	PNP, Silicon, dual	QB-000-011	SPR	TD401	1

PARTS LIST

MODULE M9G M9H REV A

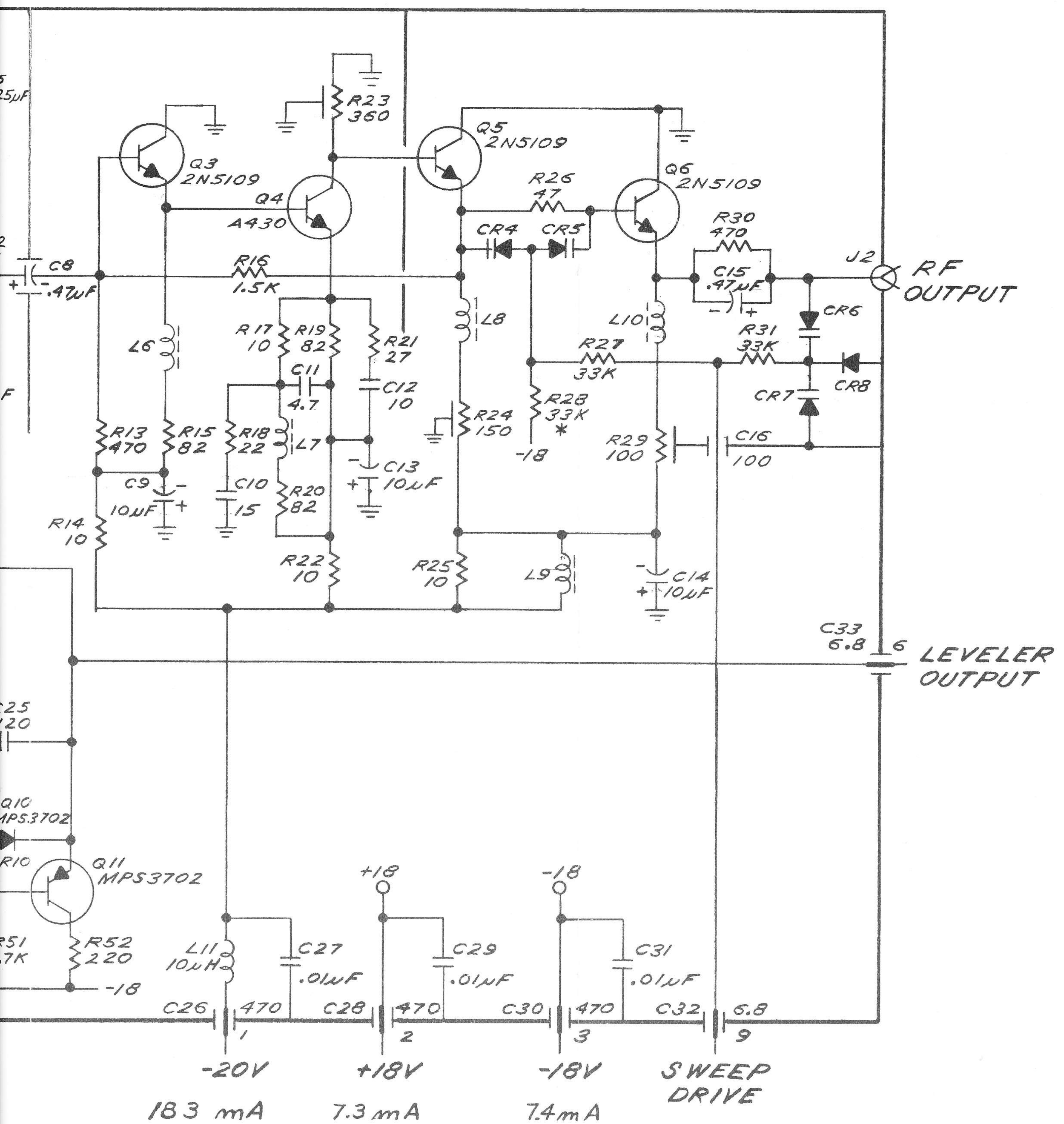
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
"C "	CAPACITORS				
1,3,4,7,8,9, 11,14,18,19, 25,27	Ceramic feedthru, 500pF ±20% 250V	CF-104-150	AER	EF4	12
2,10	Ceramic disc, 100pF ±10% 1kV	CD-108-110	RMC	C,N750	2
5,12	Ceramic feedthru, 100pF ±20% 250V	CF-104-110	AER	EF4	2
6,13	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FA5C	2
15,28,29,30	Ceramic feedthru, 470pF ±20% 500V	CF-101-147	A-B	FA5C	4
16	Ceramic disc, 120pF ±20% 1kV	CD-102-112	SPR	5GAT12	1
17,33,34	Electrolytic, .47uF 50V	CE-113-447	TRW	935	3
20	Composition, .75pF ±10% 500V	CG-101-175	Q-C	QC.75	1
21	Factory adjusted, nominal value shown	Not Assign.	---	--------	--
22	Composition, 1.1uF ±10%, factory adj.	CG-101-211	Q-C	QC1.1	1
23,26	Ceramic disc, .01uF ±20% 100V	CD-103-310	SPR	TGS10	2
24	Factory adjusted, nominal value shown	Not Assign.	---	--------	--
31	Electrolytic, 10uF 25V	CE-105-010	SPR	TE1204	1
32	Ceramic disc, .05uF ±20% 100V	CD-103-350	SPR	TGS50	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm, submin.	JF-000-005	APL	27-9	2
"CR "	DIODES				
1,2,3,4,5	Voltage variable capacitance	DC-000-005	W-I	DC-000-005	5
6	Not assigned	----------	---	---------	--
7,10,11	Zener, 6.8V	DB-000-001	C-L	HW-6.8	3
8,9	Silicon, point contact	DG-100-821	SYL	IN82AS	2
"L "	INDUCTORS				
1,3	Fixed, .22uH	LA-005-R02	W-E	506	2
2,7	Fixed ------	Not Assign.	W-I	----------	--
4	Fixed ------	Not Assign.	W-I	----------	--
5	Fixed ------	Not Assign.	W-I	----------	--
6	Fixed 1uH	LA-005-R10	W-E	506	1
8	Fixed ------	Not Assign.	W-I	----------	--
9,10	Fixed ------	LA-006-004	W-I	LA-006-004	2
"R "	RESISTORS				
1	Fixed, comp., 22kohm ±10% ¼W	RC-104-322	A-B	CB2231	1
2,12	Variable,cermet, 10kohm ±20%	RP-129-310	CTS	360S103B	2
3,14,17,24	Fixed, comp., 10kohm ±10% ¼W	RC-104-310	A-B	CB1031	4
4,19,39,40, 47,48	Fixed, comp., 470ohm ±10% ¼W	RC-104-147	A-B	CB4711	6
5,6,15,20,21, 41,49	Fixed, comp., 4.7kohm ±10% ¼W	RC-104-247	A-B	CB4721	7
7,22,	Fixed, comp., 10ohm ±10% ¼W	RC-104-010	A-B	CB1001	2
8,29	Fixed, comp., 5.6kohm ±10% ¼W	RC-104-256	A-B	CB5621	2
9	Variable, cermet, 20kohm ±10%	RP-129-320	CTS	360S203B	1
10,23,27,35	Not Assigned	----------	---	----------	--
11	Fixed, comp., 47kohm ±10% ¼W	RC-104-347	A-B	CB4731	1
13	Variable, carbon, 20kohm ±20%	RP-124-320	A-B	WA2G032	1
16, 30	Fixed, comp., 33kohm ±10% ¼W	RC-104-333	A-B	CB3331	2



B+
1
11
C1
470
30.5 mA
L1
10µH
C2
.01µF
R8
100
R11
100
C5
.025µF
C3
500
C4
500
R7
470
Q2
A430
RF
INPUT
J1
CR1
CR3
C6
.47µF
Q1
A430
R12
27
R1
47
CR2
R5
47
R6
150
L4
L5
R10
470
C7
.47µF
L2
R2
330
L3
R9
47
C34
200
R3
1K
Q7
MPS3702
C35
200
R32
100K
B-1
12
C17
470
+18
CR9
C23
10µF
R44
220
R33
1K
C21
360
R34
10K
C20
.001µF
C22
.005µF
R46
1K
C25
120
Q8
2N5458
R45
4.7K
C18
6.8
BLANKING
INPUT
4
R35
1M
R41
1.2K
C36
47
Q10
R36
2.2M
-18
C19
6.8
LEVEL
CONTROL
INPUT
7
CR10
Q9
TD101
R42
680K
R37
20K
R38
15K
-18
R43
2.7K
R47
10K
R49
47K
R50
100
MAX
R40
470K
R51
4.7K
MIN
R39
20K
-18
C24
6.8
5
MONITOR
INPUT

OUTPUT AMPLIFIER SCHEMATIC
MODULE M10H

REV A



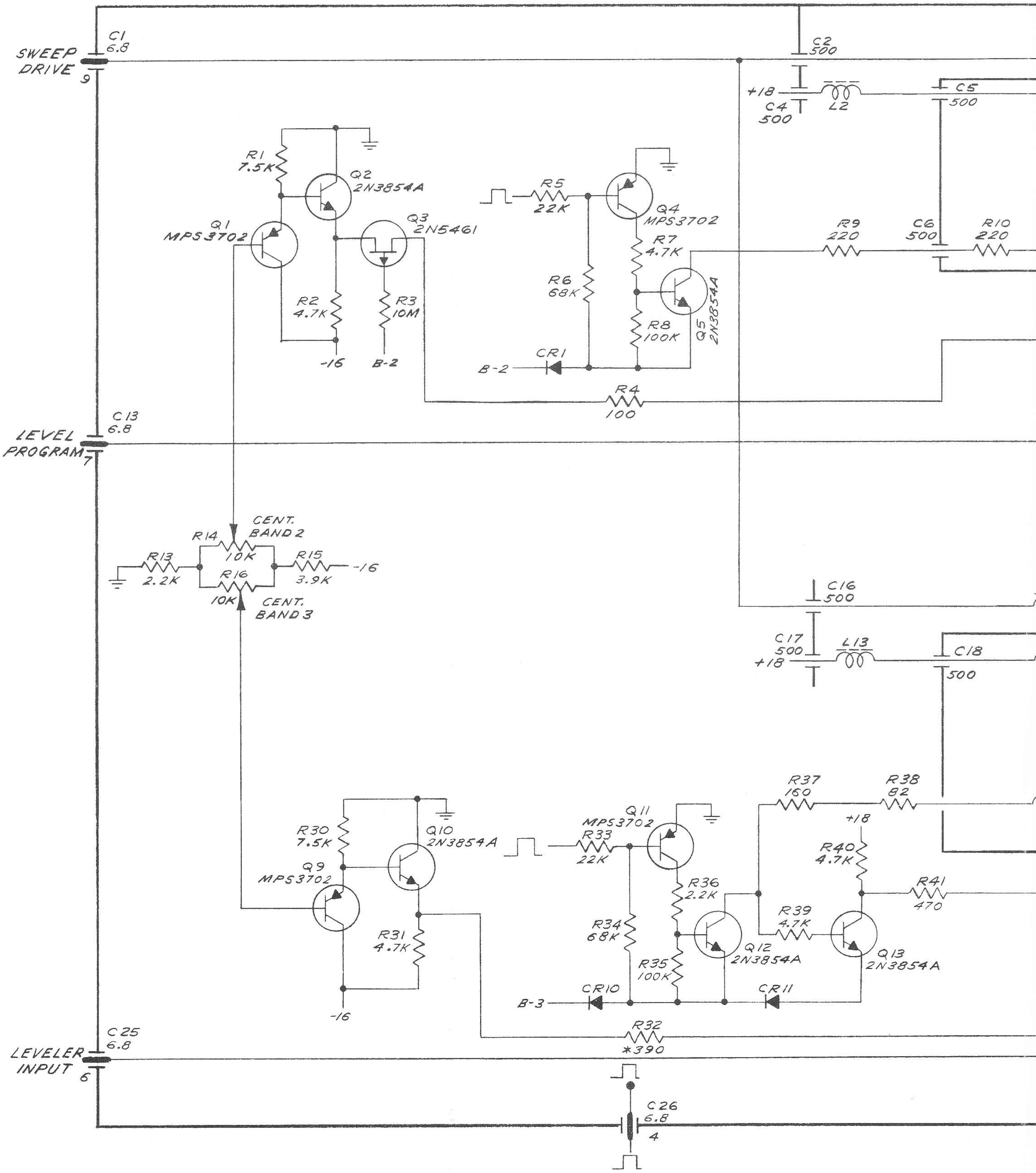
PARTS LIST

MODULE M10H REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS				
24	Fixed, comp., 150ohm ±5% 1W	RC107-115	A-B	GB1515	1
27,28,31	Fixed, comp., 33kohm ±10% ¼W	RC104-333	A-B	CB3331	3
29	Fixed, comp., 100ohm ±5% 1W	RC107-110	A-B	GB1015	1
32	Fixed, comp., 100kohm ±10% ¼W	RC104-410	A-B	CB1041	1
34,37	Fixed, comp., 10kohm ±10% ¼W	RC104-310	A-B	CB1031	2
35	Fixed, comp., 1Mohm ±10% ¼W	RC104-510	A-B	CB1051	1
36	Fixed, comp., 2.2Mohm ±10% ¼W	RC104-522	A-B	CB2251	1
37,39	Variable, carbon 20kohm ±20% ¼W	RC124-320	A-B	WA2032	2
38	Fixed, comp., 15kohm ±10% ¼W	RC104-315	A-B	CB1531	1
40	Fixed, comp., 470kohm ±10% ¼W	RC104-447	A-B	CB4741	1
41	Fixed, comp., 1.2kohm ±10% ¼W	RC104-212	A-B	CB1221	1
42	Fixed, comp., 680kohm ±10% ¼W	RC104-468	A-B	CB6841	1
43	Fixed, comp., 2.7kohm ±10% ¼W	RC104-227	A-B	CB2721	1
44,52	Fixed, comp., 220ohm ±10% ¼W	RC104-122	A-B	CB2211	2
45,51	Fixed, comp., 4.7kohm ±10% ¼W	RC104-247	A-B	CB4721	2
49	Fixed, comp., 47kohm 110% ¼W	RC104-347	A-B	CB4731	1
"Q "	TRANSISTORS				
1,2,4	NPN, Silicon	QB000-013	AER	A430	3
3,5,6	NPN, Silicon	QA051-090	SSS	2N5109	3
7,10,11	PNP, Silicon	QB000-009	MOT	MPS3702	3
8	N-channel JFET, Silicon	QA054-580	MOT	2N5458	1
9	NPN, Silicon, dual	QB000-010	SPR	TD101	1

PARTS LIST   MODULE M10H REV A

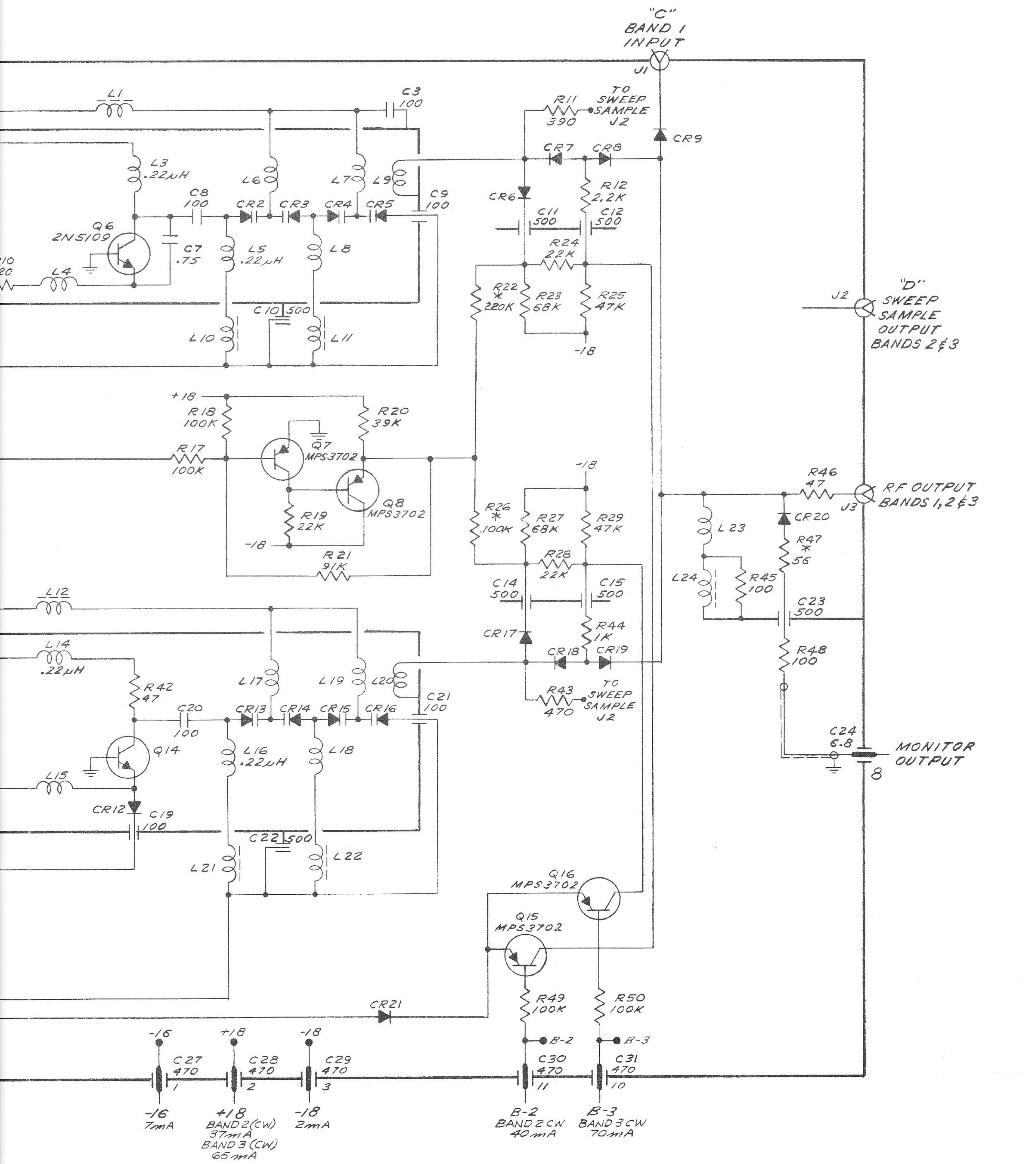
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
"C "	CAPACITORS				
1,17,26,28, 30	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	5
2,27,29,31	Ceramic disc, .01uF ±20% 100V	CD103-310	SPR	TG-S10	4
3,4	Ceramic feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	2
5	Ceramic disc, .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
6,7,8,15	Electrolytic, .47uF 50V	CE113-447	TRW	935	4
9,13,14,23	Electrolytic, 10uF 25V	CE105-010	SPR	TE1204	4
10	Ceramic disc, 15pF ±5% 1kV	CD101-015	SPR	10TCC-Q15	1
11	Ceramic disc, 4.7pF ±5% 1kV	CD101-R47	SPR	10TCC-V47	1
12	Ceramic disc, 10pF ±5% 1kV	CD101-010	SPR	10TCC-Q10	1
16	Ceramic feedthru, 100pF ±20% 250V	CF104-110	AER	EF4	1
18,19,24,32, 33	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	5
20	Ceramic disc, .001uF ±20% 1kV	CD102-210	APR	5GA-D10	1
21	Ceramic disc, 360pF ±20% 1kV	CD102-136	SPR	5GA-T36	1
22	Ceramic disc, .005uF ±20% 100V	CD103-250	SPR	TG-D50	1
25	Ceramic disc, 120pF ±20% 1kV	CD102-112	SPR	5GA-T12	1
34,35	Ceramic disc, 200pF ±20% 1kV	CD102-120	SPR	5GA-T20	2
36	Ceramic disc, 47pF ±5% 1kV	CD104-047	SPR	10TCU-Q47	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm submin.	JF000-005	APL	27-9	2
"CR "	DIODES				
1,2,3	Silicon, P.I.N.	DP000-050	W-I	DP000-050	3
4,5,6,7	Voltage variable capacitance	DC000-008	W-I	DC000-008	4
8	Silicon, Hot Carrier	DG000-007	W-I	DG000-007	1
9,10	Silicon, Junction, 100piV, 750mA	DR000-001	ITT	1N4002	2
"L "	INDUCTORS				
1,11	Fixed, 10uH	LA001-010	JEF	15	2
2,3	Fixed, ----	Not Assign.	W-I	----------	--
4,5,9	Fixed, ----	LC006-010	W-I	LC006-010	3
6,7,8,10	Fixed, ----	LC006-004	W-I	LC006-004	4
"R "	RESISTORS				
1,5,9,26	Fixed, comp., 47ohm ±10% ¼W	RC104-047	A-B	CB4701	4
2	Fixed, comp., 330ohm ±10% ¼W	RC104-133	A-B	CB3311	1
3,33,46	Fixed, comp., 1kohm ±10% ¼W	RC104-210	A-B	CB1021	3
4,48	Not Assigned	---------	---	----------	--
6	Fixed, comp., 150ohm ±10% ¼W	RC104-115	A-B	CB1511	1
7,10,30	Fixed, comp., 470ohm ±10% ¼W	RC104-147	A-B	CB4711	3
8,11,50	Fixed, comp., 100ohm ±10% ¼W	RC104-110	A-B	CB1011	3
12,21	Fixed, comp., 27ohm ±10% ¼W	RC104-027	A-B	CB2701	2
13	Fixed, comp., 470ohm ±5% ¼W	RC103-147	A-B	CB4715	1
14,17,22,25	Fixed, comp., 10ohm ±5% ¼W	RC103-010	A-B	CB1005	4
15,19,20	Fixed, comp., 82ohm ±5% ¼W	RC103-082	A-B	CB8205	3
16	Fixed, comp., 1.5kohm ±5% ¼W	RC103-215	A-B	CB1525	1
18	Fixed, comp., 22ohm ±10% ¼W	RC104-022	A-B	CB2201	1
23	Fixed, comp., 360ohm ±5% ½W	RC105-136	A-B	EB3615	1



SWEEP DRIVE 9
C1 6.8
C2 500
+18
C4 500
L2
C5 500
R1 7.5K
Q2 2N3854A
Q1 MPS3702
Q3 2N5461
R2 4.7K
R3 10M
-16
B-2
R5 22K
Q4 MPS3702
R7 4.7K
R6 68K
R8 100K
Q5 2N3854A
CR1
B-2
R4 100
R9 220
C6 500
R10 220
LEVEL PROGRAM 7
C13 6.8
CENT. BAND 2
R14 10K
R13 2.2K
R15 3.9K
-16
R16 10K
CENT. BAND 3
C16 500
C17 500
+18
L13
C18 500
R37 160
R38 82
+18
R30 7.5K
Q10 2N3854A
Q9 MPS3702
R31 4.7K
-16
Q11 MPS3702
R33 22K
R36 2.2K
R34 68K
R35 100K
Q12 2N3854A
R39 4.7K
R40 4.7K
R41 470
Q13 2N3854A
CR10
CR11
B-3
R32 *390
LEVELER INPUT 6
C25 6.8
C26 6.8
4

SWEEP OSCILLATOR SCHEMATIC
BAND 2 & 3
MODULE M19H

REV A



PARTS LIST

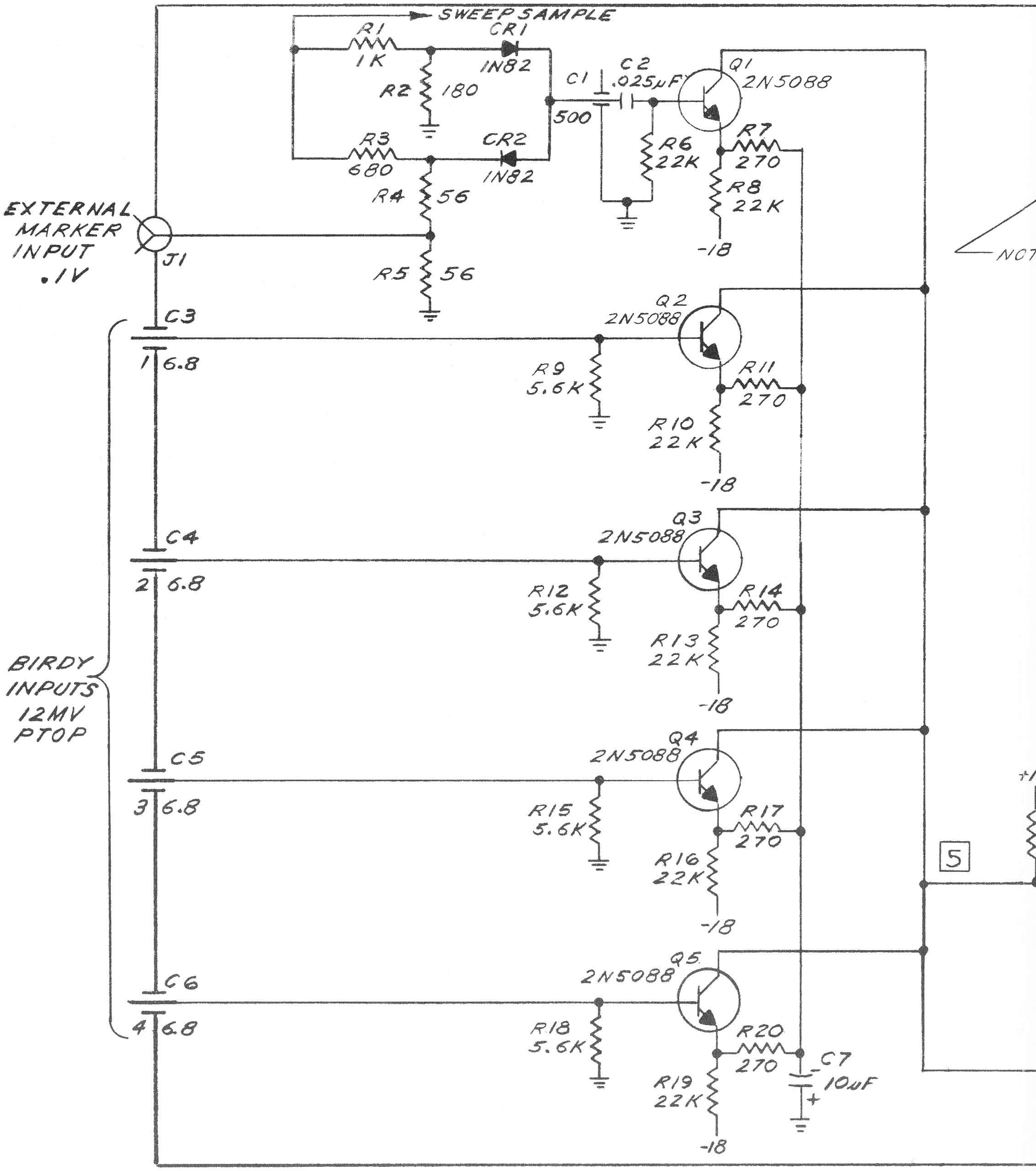
MODULE M19H REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
"R "	RESISTORS				
21	Fixed, comp. 91kohm ±5% ¼W	RC103-391	A-B	CB9135	1
22,26	Fixed, adjustable, nominal value shown	RC104----	---	------	--
25,29	Fixed, comp. 47kohm ±10% 1W	RC104-347	A-B	CB4731	2
37	Fixed, comp. 160ohm ±5% 1W	RC107-116	A-B	CB1615	1
38	Fixed, comp. 82ohm ±10% ½W	RC106-082	A-B	EB8201	1
41	Fixed, comp. 470ohm ±10% 1W	RC108-147	A-B	GB4711	1
42,46	Fixed, comp. 47ohm ±10% ¼W	RC104-047	A-B	CB4701	2
43	Fixed, comp. 470ohm ±10% ¼W	RC104-147	A-B	CB4711	1
44	Fixed, comp. 1kohm ±10% ¼W	RC104-210	A-B	CB1021	1
47	Fixed, comp. 56ohm ±10% ¼W	RC104-056	A-B	CB5601	1
"Q "	TRANSISTORS				
1,4,7,8,9 11,15,16	NPN, Silicon	QB000-009	MOT	MPS3702	8
2,5,10,12,13	NPN, Silicon	QA038-541	G-E	2N3854A	5
3	P-channel JFET	QA054-610	MOT	2N5461	1
6	NPN, Silicon	QA051-090	SSS	2N5109	1
14	NPN, Silicon	QB000-015	W-I	QB000-015	1

PARTS LIST

MODULE M19H REV A

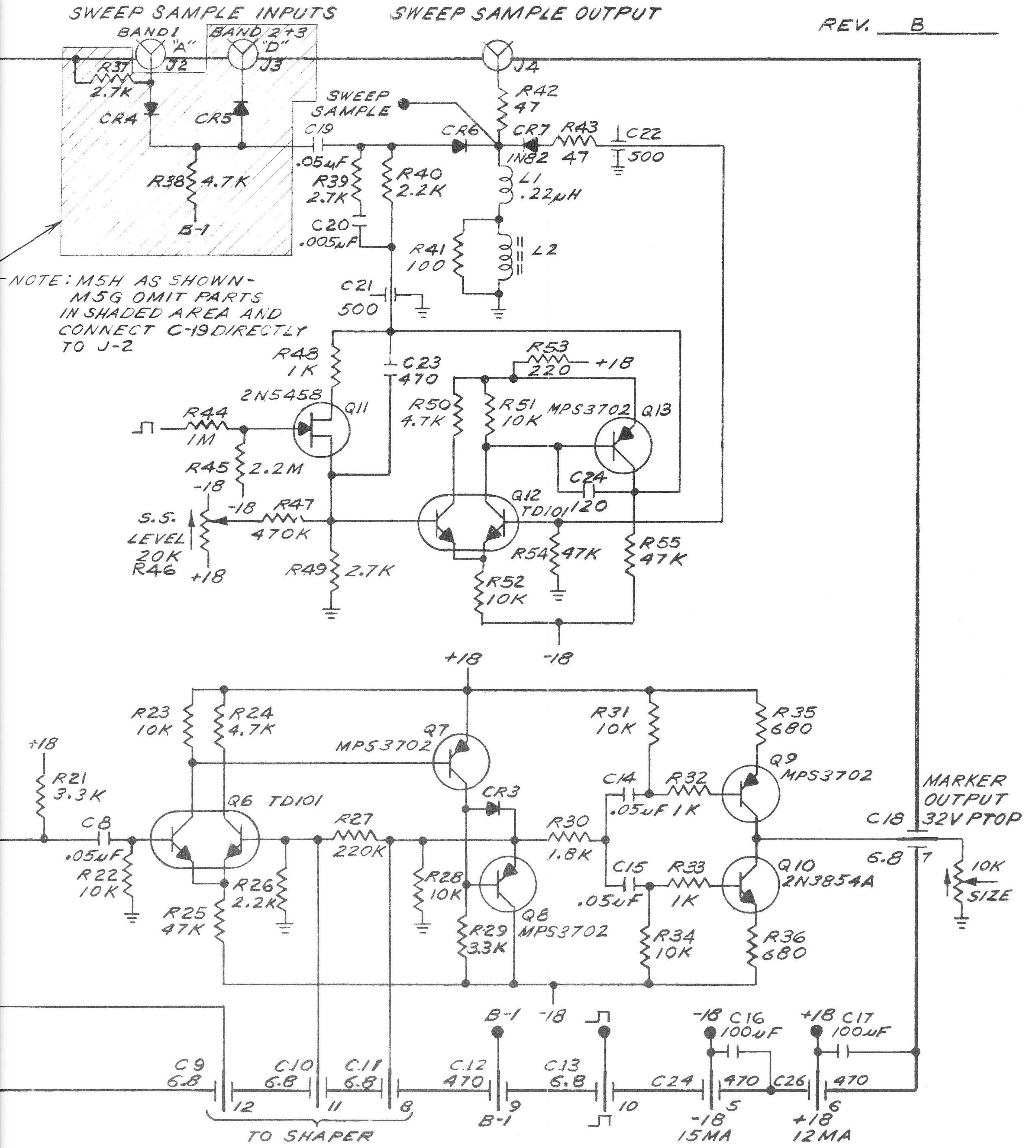
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
"C "	CAPACITORS				
1,13,24,25 26	Ceramic feedthru 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	5
2,4,5,6,10 11,12,14, 15,16,17,18 22,23	Ceramic feedthru 500pF ±20% 250V	CF104-150	AER	EF4	14
3	Ceramic disc 100pF ±20% 1kV	CD102-110	SPR	5GA-T10	1
7	Composition .75pF ±10% 500V	CG101-175	Q-C	QC.75	1
8,9,19,20,21	Ceramic feedthru 100pF ±20% 250V	CF104-110	AER	EF4	5
27,28,29,30 31,32	Ceramic feedthru 470pF ±20% 500V	CF101-147	A-B	FA5C	5
"J "	CONNECTORS				
1,2,3	Jack, receptacle, 50ohm submin	JF000-005	APL	27-9	3
"CR "	DIODES				
1,10,11,21	Silicon, Junction 100piV, 750mA	DR000-001	ITT	1N4002	4
2,3,4,5,13 14,15,16	Voltage variable capacitance	DC000-008	W-I	DC000-008	8
6,7,8,9,12 17,18,19	Silicon, P.I.N.	DP000-040	W-I	DP000-040	8
20	Silicon, point contact	DG100-821	SYL	1N82AS	1
"L "	INDUCTORS				
1,2,10,11,12 13,21,22	Fixed, -----	LA006-004	W-I	LA006-004	8
3,5,14,16	Fixed, .22uH	LA005-R02	W-E	506	4
4,7,8,15 17,18,19	Fixed, -----	Not assign.	W-I	Not assign.	--
6	Fixed, -----	Not assign.	W-I	Not assign.	--
9,20	Fixed, -----	Not assign.	W-I	Not assign.	--
23	Fixed, -----	Not assign.	W-I	Not assign.	--
24	Fixed, -----	LA006-010	W-I	LA006-010	1
"R "	RESISTORS				
1,30	Fixed, comp. 7.5kohm ±5% ¼W	RC103-275	A-B	CB7525	2
2,7,32,39 40	Fixed, comp. 4.7kohm ±10% ¼W	RC104-247	A-B	CB4721	5
3	Fixed, comp. 10Mohm ±10% ¼W	RC104-610	A-B	CB1061	1
4,45,48	Fixed, comp. 100ohm ±10% ¼W	RC104-110	A-B	CB1011	3
5,19,24,28 33	Fixed, comp. 22kohm ±10% ¼W	RC104-322	A-B	CB2231	5
6,23,27,34	Fixed, comp. 68kohm ±10% ¼W	RC104-368	A-B	CB6831	4
8,17,18,35 49,50	Fixed, comp. 100kohm ±10% ¼W	RC104-410	A-B	CB1041	6
9,10	Fixed, comp. 220ohm ±10% ½W	RC106-122	A-B	EB2211	2
11,32	Fixed, comp. 390ohm ±10% ¼W	RC104-139	A-B	CB3911	2
12,13,36	Fixed, comp. 2.2kohm ±10% ¼W	RC104-222	A-B	CB2221	3
14,16	Variable, wire wound 10kohm	RV102-310	BOU	3067P	2
15	Fixed, comp. 3.9kohm ±10% ¼W	RC104-239	A-B	CB3921	1
20	Fixed, comp. 39kohm ±10% ¼W	RC104-339	A-B	CB3931	1



SWEEP SAMPLE
R1
1K
CR1
1N82
R2
180
C1
500
C2
.025μF
Q1
2N5088
R3
680
CR2
1N82
R6
22K
R7
270
R8
22K
-18
R4
56
R5
56
EXTERNAL
MARKER
INPUT
.1V
J1
C3
1
6.8
Q2
2N5088
R9
5.6K
R10
22K
R11
270
-18
C4
2
6.8
Q3
2N5088
R12
5.6K
R13
22K
R14
270
-18
BIRDY
INPUTS
12MV
PTOP
C5
3
6.8
Q4
2N5088
R15
5.6K
R16
22K
R17
270
-18
5
C6
4
6.8
Q5
2N5088
R18
5.6K
R19
22K
R20
270
C7
10μF
-18

MARKER ADDER SCHEMATIC
MODULE M5G AND M5H

REV. B



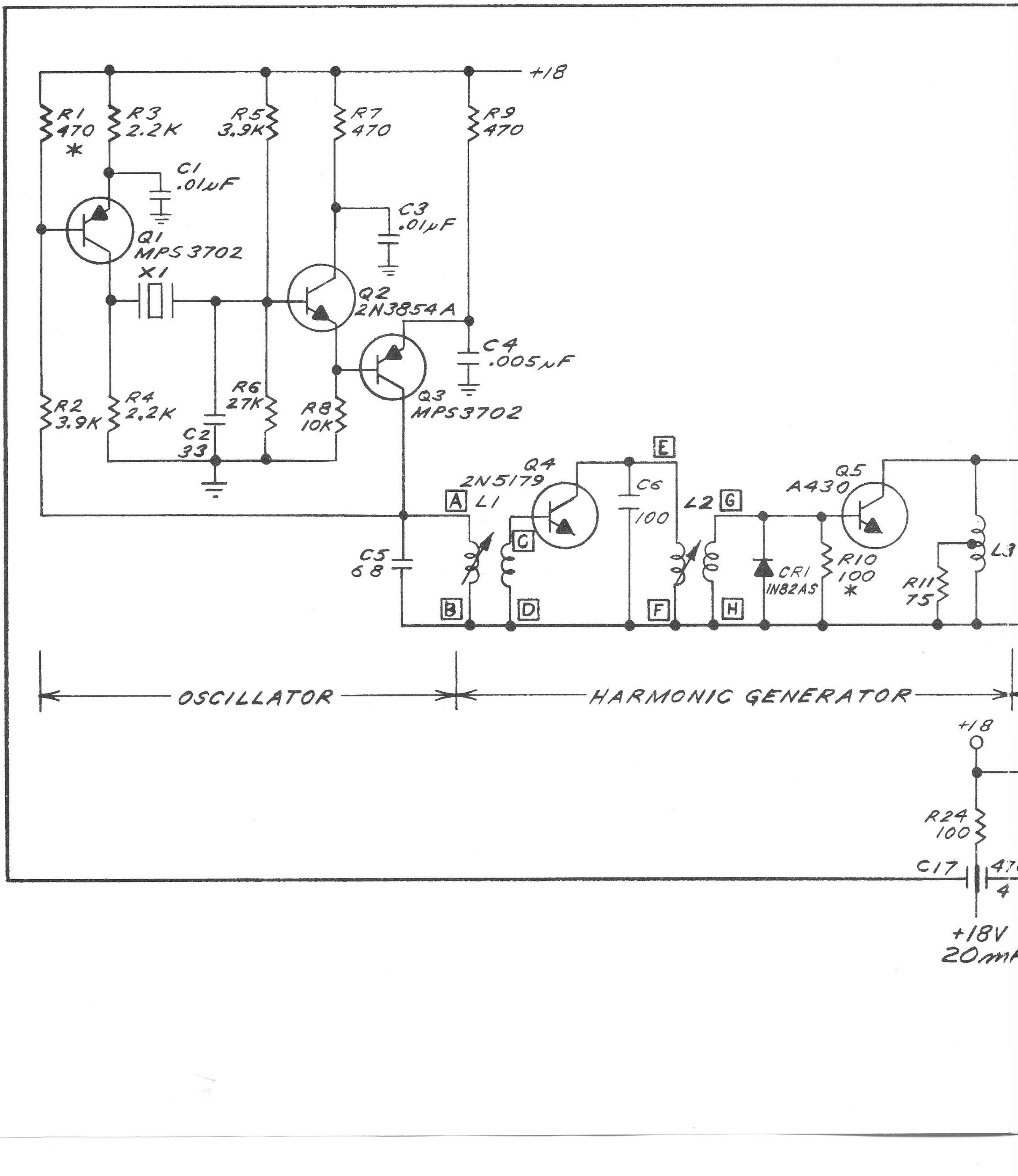
PARTS LIST

MODULE M5H REV. B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"R "	RESISTORS (Continued)				
46	Variable, carbon 20k ±20% ¼W	RP124-320	A-B	WA2G032	1
47	Fixed, comp., 470k ±10% ¼W	RC104-447	A-B	CB4741	1
53	Fixed, comp., 220ohm ±10% ¼W	RC104-122	A-B	CB2211	1
"Q "	TRANSISTORS				
1,2,3,4	NPN, Silicon	QA050-880	MOT	2N5088	5
5					
6,12	Dual NPN, Silicon	QB000-010	SPR	TD101	2
7,8,9,13	PNP, Silicon	QB000-009	MOT	MPS3702	4
10	NPN, Silicon	QA038-541	GE	2N3854A	1
11	N-channel JFET	QA054-580	MOT	2N5458	1

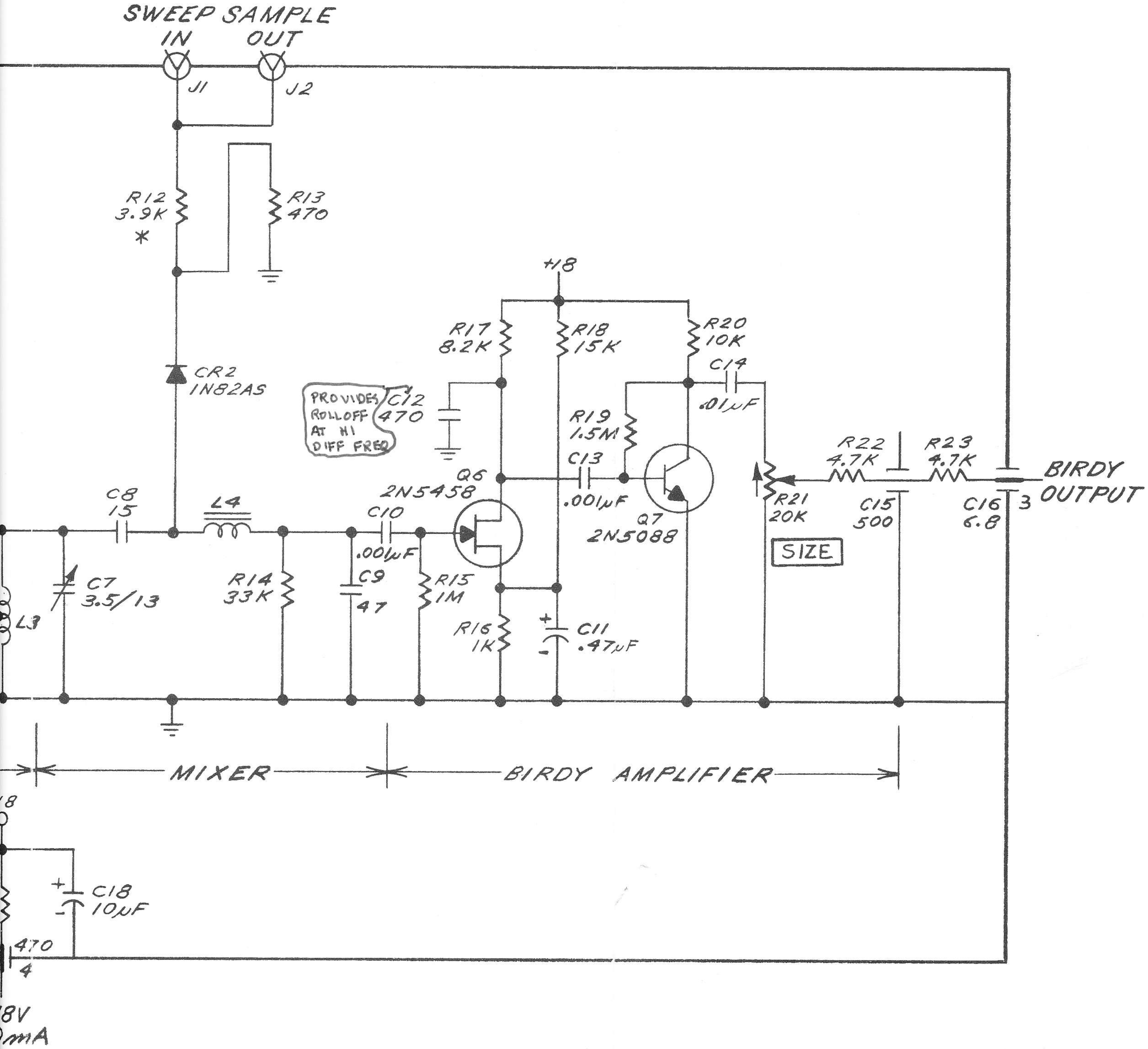
PARTS LIST MODULE M5H REV. B

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,21,22	Ceramic feedthru, 500pF ±20% 250V	CF104-150	AER	EF4	3
2	Ceramic disc., .025uF ±20% 100V	CD103-325	SPR	TG-S25	1
3,4,5,6,9 10,11,13,18	Ceramic feedthru, 6.8pF ±10% 500V	CF102-R68	A-B	FA5C	9
7	Electrolytic 10uF 25V	CE105-010	SPR	TE-1204	1
8,14,15,19	Ceramic disc., .05uF ±20% 100V	CD103-350	SPR	TG-S50	4
12,24,26	Ceramic feedthru, 470pF ±20% 500V	CF101-147	A-B	FA5C	3
16,17	Electrolytic 100uF 25V	CE105-110	SPR	TE-1211	2
20	Ceramic disc., .005uF ±20% 100V	CD103-250	SPR	TG-D50	1
23	Ceramic disc., 470uF ±20% 1kV	CD102-147	SPR	5GAT47	1
24	Ceramic disc., 120uF ±20% 1kV	CD102-112	SPR	5GAT12	1
"J "	CONNECTORS				
1,2,3,4	Jack, receptacle, 50ohm, submin.	JF000-005	APL	27-9	4
"CR "	DIODES				
1,2,7	Silicon, point contact	DG100-821	SYL	1N82AS	3
3	Silicon, junction, 100piV 750mA	DR000-001	ITT	1N4002	1
4,5,6	Silicon, P.I.N.	DP000-040	W-I	DP000-040	3
"L "	INDUCTORS				
1	Fixed, .22uH	LA005-R02	W-E	506	1
2	Fixed	LA006-010	W-I	LA006-010	1
"R "	RESISTORS				
1,32,33,48	Fixed, comp., 1k ±10% ¼W	RC104-210	A-B	CB1021	4
2	Fixed, comp., 180ohm ±10% ¼W	RC104-118	A-B	CB1811	1
3,35,36	Fixed, comp., 680ohm ±10% ¼W	RC104-168	A-B	CB6811	3
4,5	Fixed, comp., 56ohm ±10% ¼W	RC104-056	A-B	CB5601	2
6,8,10 13,16,19	Fixed, comp., 22k ±10% ¼W	RC104-322	A-B	CB2231	6
7,11,14 17,20	Fixed, comp., 270ohm ±10% ¼W	RC104-127	A-B	CB2711	5
9,12,15 18	Fixed, comp., 5.6k ±10% ¼W	RC104-256	A-B	CB5621	4
21,29	Fixed, comp., 3.3k ±10% ¼W	RC104-233	A-B	CB3321	2
22,23,28 31,34,51 52	Fixed, comp., 10k ±10% ¼W	RC104-310	A-B	CB1031	7
24,38,50	Fixed, comp., 4.7k ±10% ¼W	RC104-247	A-B	CB4721	3
25,54,55	Fixed, comp., 47k ±10% ¼W	RC104-347	A-B	CB4731	3
26,40	Fixed, comp., 2.2k ±10% ¼W	RC104-222	A-B	CB2221	2
27	Fixed, comp., 220k ±10% ¼W	RC104-422	A-B	CB2241	1
30	Fixed, comp., 1.8k ±10% ¼W	RC104-218	A-B	CB1821	1
37,39,49	Fixed, comp., 2.7k ±10% ¼W	RC104-227	A-B	CB2721	3
41	Fixed, comp., 100ohm ±10% ¼W	RC104-110	A-B	CB1011	1
42	Fixed, comp., 47ohm ±5% ½W	RC105-047	A-B	EB4705	1
43	Fixed, comp., 47ohm ±5% ¼W	RC103-047	A-B	CB4705	1
44	Fixed, comp., 1M ±10% ¼W	RC104-510	A-B	CB1051	1
45	Fixed, comp., 2.2M ±10% ¼W	RC104-522	A-B	CB2251	1


+18
R1 470 *
R3 2.2K
R5 3.9K
R7 470
R9 470
C1 .01µF
C3 .01µF
Q1 MPS3702
X1
Q2 2N3854A
C4 .005µF
Q3 MPS3702
R2 3.9K
R4 2.2K
C2 33
R6 27K
R8 10K
Q4 2N5179
E
C6 100
A L1
C
L2 G
Q5 A430
C5 68
CR1 1N82AS
R10 100 *
R11 75
L3
B
D
F
H
OSCILLATOR
HARMONIC GENERATOR
+18
R24 100
C17
+18V
20mA

HARMONIC MARKER SCHEMATIC
(OPTION A2) INTERVAL: 1 MHz
MODULE M6H1

REV A



PARTS LIST

MODULE M6H 1 REV A

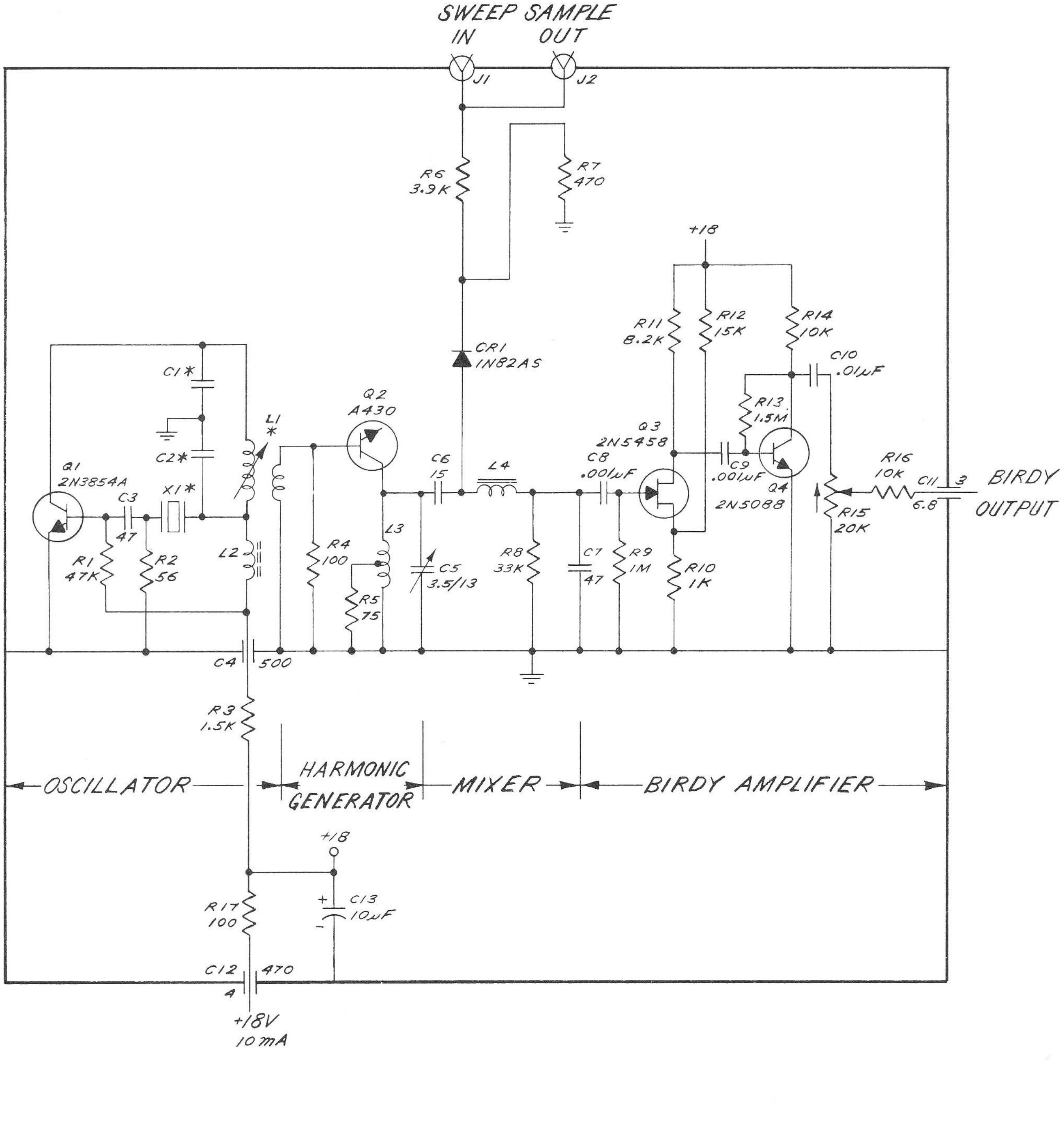
REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"Q "	TRANSISTORS				
1,3	PNP, Silicon	QB-000-009	MOT	MPS3702	2
2	NPN, Silicon	QA-038-541	G-E	2N3854A	1
4	NPN, Silicon	QA-051-790	RCA	2N5179	1
5	NPN, Silicon	QB-000-013	APX	A430	1
6	N-channel JFET	QA-054-580	MOT	2N5458	1
7	NPN, Silicon	QA-050-880	MOT	2N5088	1

PARTS LIST

MODULE M6H 1 REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,3,14	Ceramic disc, .01uF ±20% 100V	CD-103-310	SPR	TG-S10	3
2	Ceramic disc, 33pF ±5% 1kV	CD-104-033	SPR	10TCU-Q33	1
4	Ceramic disc, .005uF ±20% 100V	CD-103-250	SPR	TG-D50	1
5	Ceramic disc, 68pF ±5% 1kV	CD-104-068	SPR	10TCU-Q68	1
6	Ceramic disc, 100pF ±5% 1kV	CD-104-110	SPR	10TCU-T10	1
7	Variable, ceramic, 3.5/13pF	CV-101-013	STR	7S-TRIKO-02	1
8	Ceramic disc, 15pF ±5% 1kV	CD-101-015	SPR	10TCC-Q15	1
9	Ceramic disc, 47pF ±5% 1kV	CD-104-047	SPR	10TCU-Q47	1
10,13	Ceramic disc, .001uF ±20% 1kV	CD-102-210	SPR	5GA-D10	2
11	Electrolytic, .47uF ±10% 50V	CE-113-447	TRW	935	1
12	Ceramic disc, 470pF ±20% 1kV	CD-102-147	SPR	5GA-T47	1
15	Ceramic feedthru, 500pF ±20% 250V	CF-104-150	AER	EF4	1
16	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FASC	1
17	Ceramic feedthru, 470pF ±10% 500V	CF-101-147	A-B	FASC	1
18	Electrolytic, 10uF 25V	CE-105-010	SPR	TE1204	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm, submin.	JF-000-005	APL	27-9	2
"X "	CRYSTALS				
1	X25W at 1MHz	XX-000-251	W-I	XX-000-251	1
"CR "	DIODES				
1,2	Silicon, point contact	DG-100-821	SYL	1N82AS	2
"L "	INDUCTORS				
1	Coil form LB-002-000 with 160 turns, 20 turns 32 ga. wire	Not Assign.	----	----------	1
2	Coil form LB-003-000 with 35 turns, 10 turns 32 ga. wire	Not Assign.	----	----------	1
3	-------24 ga. wire	Not Assign.	----	----------	-
4	Fixed -----	LA-006-004	W-I	LA-006-004	1
"R "	RESISTORS				
1,7,9,13	Fixed comp., 470ohm	RC-104-147	A-B	CB4711	4
2,5,12	Fixed comp., 3.9kohm ±10% ¼W	RC-104-239	A-B	CB3921	3
3,4	Fixed comp., 2.2kohm ±10% ¼W	RC-104-222	A-B	CB2221	2
6	Fixed comp., 27kohm ±10% ¼W	RC-104-327	A-B	CB2731	1
8,20	Fixed comp., 10kohm ±10% ¼W	RC-104-310	A-B	CB1031	2
10,24	Fixed comp., 100ohm ±10% ¼W	RC-104-110	A-B	CB1011	2
11	Fixed comp., 75ohm ±5% ¼W	RC-103-075	A-B	CB7515	1
14	Fixed comp., 33kohm ±10% ¼W	RC-104-333	A-B	CB3331	1
15	Fixed comp., 1Mohm ±10% ¼W	RC-104-510	A-B	CB1051	1
16	Fixed comp., 1 kohm ±10% ¼W	RC-104-210	A-B	CB1021	1
17	Fixed comp., 8.2kohm ±10% ¼W	RC-104-282	A-B	CB8221	1
18	Fixed comp., 15kohm ±10% ¼W	RC-104-315	A-B	CB1531	1
19	Fixed comp., 1.5Mohm ±10% ¼W	RC-104-515	A-B	CB1551	1
21	Variable, carbon, 20kohm ±20% ¼W	RP-124-320	A-B	WA2032	1
22,23	Fixed comp., 4.7kohm ±10% ¼W	RC-104-247	A-B	CB4721	2

HARMONIC MARKER SCHEMATIC
(OPTION A2) INTERVAL: 5 TO 50 MHz
MODULE M6H 5-50
REV A



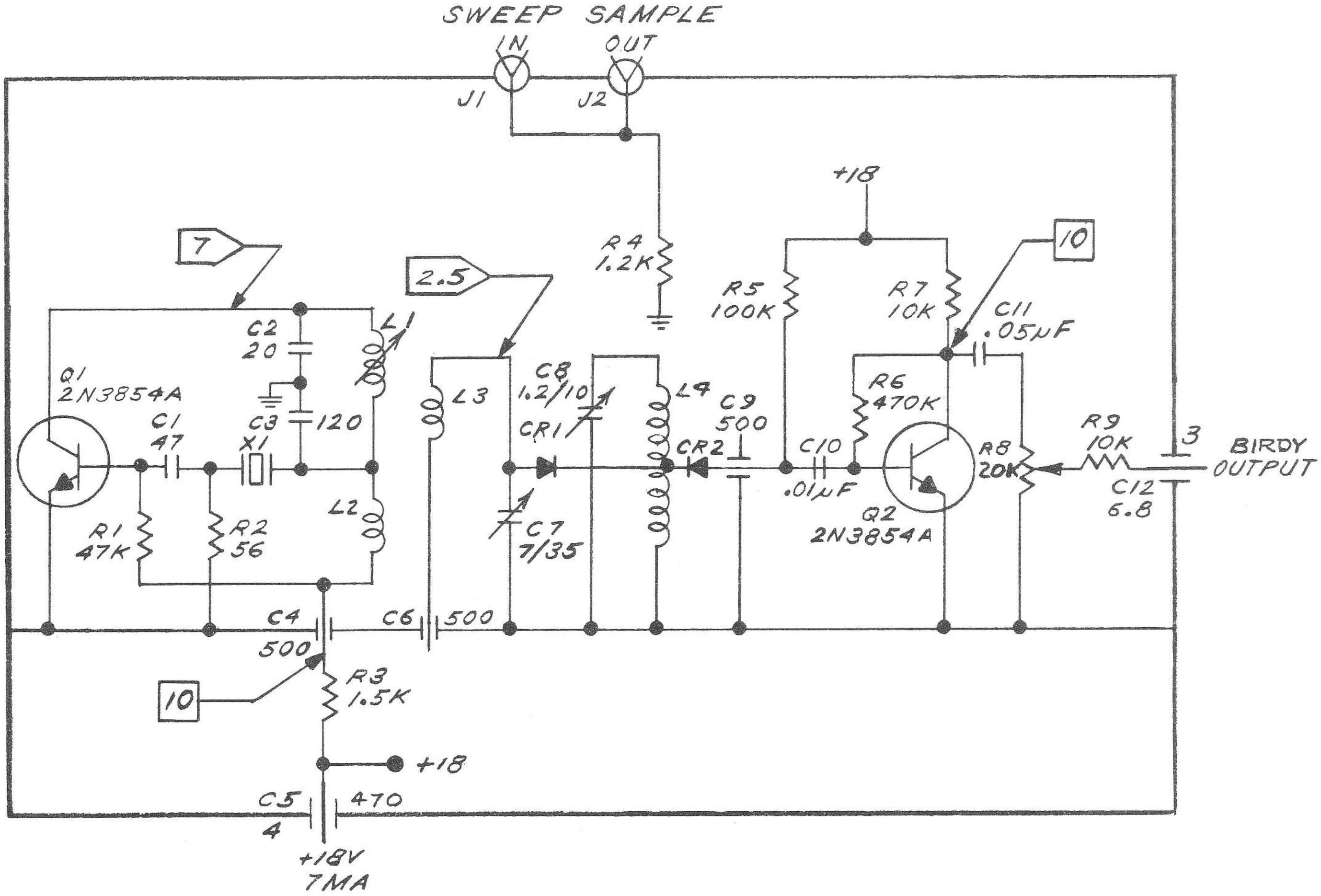
PARTS LIST

MODULE M6H5-50 REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,2	Ceramic disc, vary with crystal freq.	----------	---	----------	--
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	7STRIK0-02	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 "	CONNECTORS				
1,2	Jack, receptacle, 50ohm submin	JF000-005	APL	27-9	2
"X "	CRYSTALS				
1	Type to vary with Harmonic interval	----------	---	----------	--
"CR "	DIODES				
1	Silicon, point contact	DG100-821	SYL	IN82AS	1
"L "	INDUCTORS				
1	Coilform with 32 ga. magnet wire, number of turns varies with crystal freq.	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 "	RESISTORS				
1	Fixed, comp., 47kohm ±10% ¼W	RC104-347	A-B	CB4731	1
2	Fixed, comp., 56ohm ±10% ¼W	RC104-056	A-B	CB5601	1
3	Fixed, comp., 1.5kohm ±10% ¼W	RC104-215	A-B	CB1521	1
4,17	Fixed, comp., 100ohm ±10% ¼W	RC104-110	A-B	CB1021	2
5	Fixed, comp., 75ohm ±5% ¼W	RC103-075	A-B	CB7505	1
6	Fixed, comp., 3.9kohm ±10% ¼W	RC104-239	A-B	CB3921	1
7	Fixed, comp., 470ohm ±10% ¼W	RC104-147	A-B	CB4711	1
8	Fixed, comp., 33kohm ±10% ¼W	RC104-333	A-B	CB3331	1
9	Fixed, comp., 1Mohm ±10% ¼W	RC104-510	A-B	CB1051	1
10	Fixed, comp., 1kohm ±10% ¼W	RC104-210	A-B	CB1021	1
11	Fixed, comp., 8.2kohm ±10% ¼W	RC104-282	A-B	CB8221	1
12	Fixed, comp., 15kohm ±10% ¼W	RC104-315	A-B	CB1531	1
13	Fixed, comp., 1.5Mohm ±10% ¼W	RC104-515	A-B	CB1551	1
14,16	Fixed, comp., 10kohm ±10% ¼W	RC104-310	A-B	CB1031	2
15	Variable, carbon, 20kohm ±20% ¼W	RP124-320	A-B	WA2G032	1
"Q "	TRANSISTORS				
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

SINGLE FREQ MARKER SCHEMATIC
(OPTION A1) RANGE 450 TO 1000 MHz
MODULE M6S

REV ________



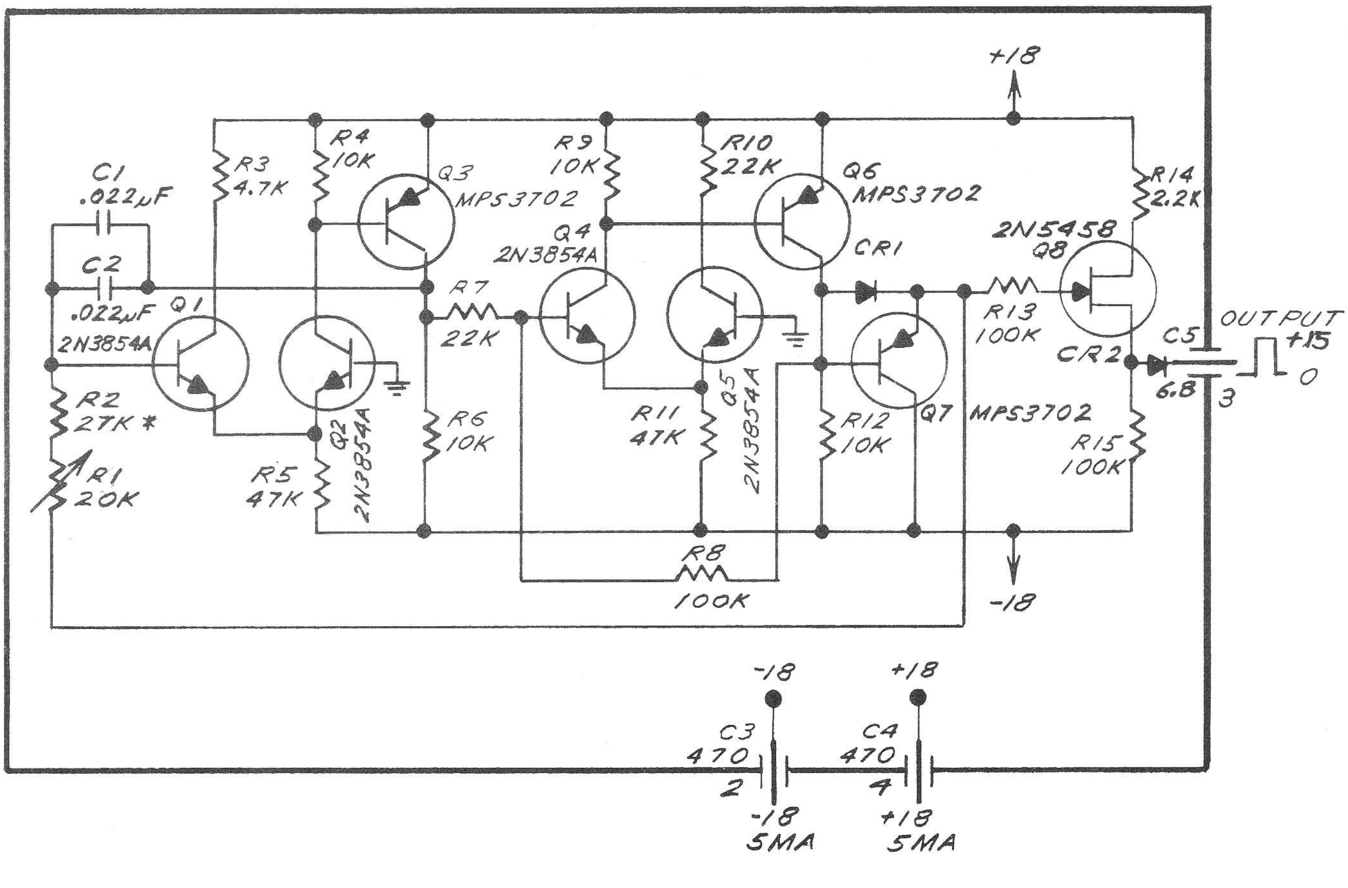
PARTS LIST

MODULE M6S 450-1000 REV

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	T Q
"C "	CAPACITORS				
1	Ceramic disc, 47pF ±5% 1kV	CD-104-047	SPR	10TCU-Q47	1
2	Ceramic disc, 20pF ±5% 1kV	CD-101-020	SPR	10TCC-Q20	1
3	Ceramic disc, 120pF ±5% 1kV	CD-104-112	SPR	10TCU-T12	1
4,6,9	Ceramic feedthru, 500pF ±20% 250V	CF-104-150	AER	EF4	3
5	Ceramic feedthru, 470pF ±20% 500V	CF-101-147	A-B	FA5C	1
7	Variable, ceramic, 7/35pF	CV-101-035	STR	S-TRIKO	1
8	Variable, ceramic, 1.2/10pF	CV-103-010	STR	R-TRIKO	1
10	Ceramic disc, .01uF ±20% 100V	CD-103-310	SPR	TG-S10	1
11	Ceramic disc, .05uF ±20% 100V	CD-103-350	SPR	TG-S50	1
12	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FA5C	1
"J "	CONNECTORS				
1,2	Jack, receptacle, 50ohm submin.	JF-000-005	APL	27-9	2
"X "	CRYSTALS				
1	Quartz crystal, frequency varies with marker frequency	XX-000-331	W-I	XX-000-331	1
"CR "	DIODES				
1,2	Silicon, point contact	DG-100-821	SYL	IN82AS	2
"L "	INDUCTORS				
1	Coil form No. LB-003-000 wound with 8 turns, 32 gauge magnet wire	Not Assign.	W-I	Not Assign.	-
2	Fixed, 2.2uH	LA001-R22	JEF	15	1
"R "	RESISTORS				
1	Fixed, comp., 47kohm ±10% ¼W	RC-104-347	A-B	CB4731	1
2	Fixed, comp., 56ohm ±10% ¼W	RC-104-056	A-B	CB5601	1
3	Fixed, comp., 1.5kohm ±10% ¼W	RC-104-215	A-B	CB1521	1
4	Fixed, comp., 1.2kohm ±10% ¼W	RC-104-212	A-B	CB1221	1
5	Fixed, comp., 100kohm ±10% ¼W	RC-104-410	A-B	CB1041	1
6	Fixed, comp., 470kohm ±10% ¼W	RC-104-447	A-B	CB4741	1
7,9	Fixed, comp., 10kohm ±10% ¼W	RC-104-310	A-B	CB1031	2
8	Variable, carbon, 20kohm	RP-124-320	A-B	WA2G032	1
"Q "	TRANSISTORS				
1,2	NPN, Silicon	QA-038-541	G-E	2N3854A	2

1kHz MODULATOR SCHEMATIC (OPTION A4) MODULE M6Z

REV A



PARTS LIST

MODULE M6Z

REV A

REFERENCE SYMBOL	DESCRIPTION	WAVETEK PART NO.	MANUFACTURER CODE	MANUFACTURER NUMBER	TQ
"C "	CAPACITORS				
1,2	Mylar paper, .022uF ±10% 200V	CP-101-322	C-D	WMF	2
3,4	Ceramic feedthru, 470pF ±20% 500V	CF-101-147	A-B	FA5C	2
5	Ceramic feedthru, 6.8pF ±10% 500V	CF-102-R68	A-B	FA5C	1
"CR "	DIODES				
1,2	Silicon, junction, 100piV 750mA	DR-000-001	ITT	IN4002	2
"R "	RESISTORS				
1	Variable, carbon, 20kohm ±20% ¼W	RP-124-320	A-B	WA2032	1
2	Fixed, comp., 27kohm ±10% ¼W	RC-104-327	A-B	CB2731	1
3	Fixed, comp., 4.7kohm ±10% ¼W	RC-104-247	A-B	CB4721	1
4,6,9,12	Fixed, comp., 10kohm ±10% ¼W	RC-104-310	A-B	CB1031	4
5,11	Fixed, comp., 47kohm ±10% ¼W	RC-104-347	A-B	CB4731	2
7,10	Fixed, comp., 22kohm ±10% ¼W	RC-104-322	A-B	CB2231	2
8,13,15	Fixed, comp., 100kohm ±10% ¼W	RC-104-410	A-B	CB1041	3
14	Fixed, comp., 2.2kohm ±10% ¼W	RC-104-222	A-B	CB2221	1
"Q "	TRANSISTORS				
1,2,4,5	NPN, Silicon	QA-038-541	G-E	2N3854A	4
3,6,7	PNP, Silicon	QB-000-009	MOT	MPS3702	3
8	N-channel, J-FET	QA-054-580	MOT	2N5458	1