INSTRUCTION MANUAL

MODEL 3010

SIGNAL GENERATOR

WAVETEK® INDIANA, INC.
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BEECH GROVE, INDIANA 46107
317-787-3332
(TOLL FREE OUTSIDE INDIANA)
1-800-428-4424

Serial No. _____

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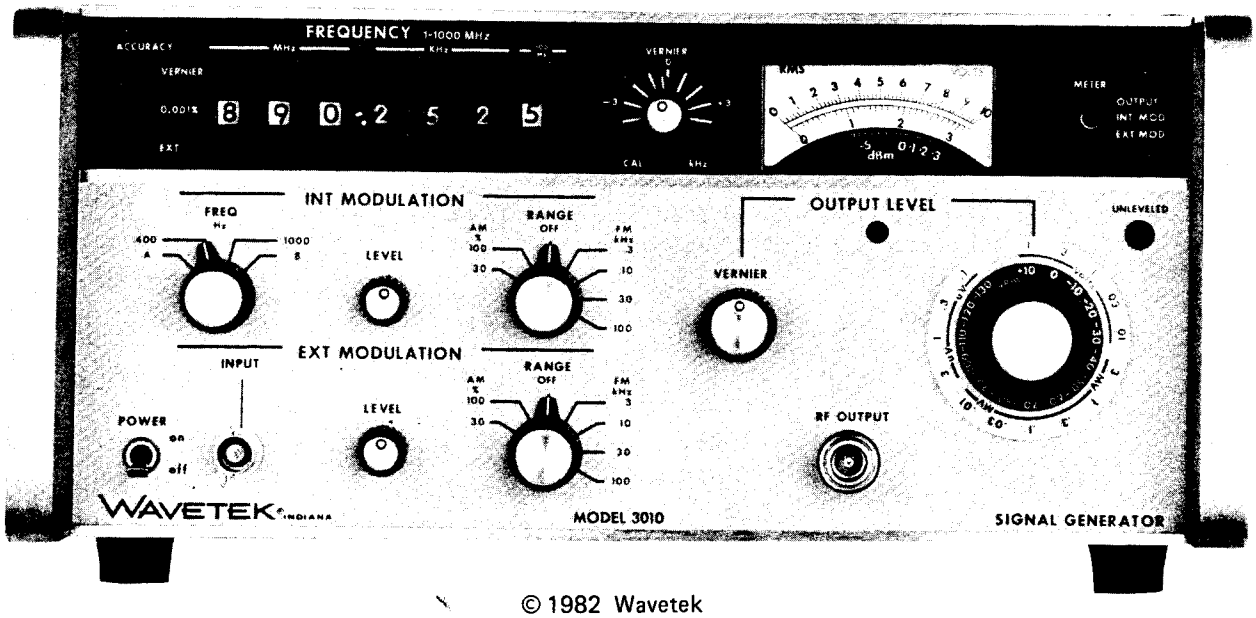

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SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance and repair of the Wavetek Model 3010 Signal Generator.

CONTENTS

CONTENTS continued

SECTION 1
GENERAL INFORMATION

1.1 INTRODUCTION

The Wavetek Model 3010 is a rugged, completely solid-state Signal Generator covering the frequency range of 1 to 1000 MHz. The output can be amplitude or frequency modulated and the level can be set between +13 and -137 dBm.

1.1.1 FREQUENCY CHARACTERISTICS

The frequency of the instrument is set via 7 front-panel Lever/Indicator switches which yield a resolution of 100 Hz. In addition, remote programmers are available to facilitate semi-automatic programming of frequency.

The accuracy of the instrument is based on a crystal-controlled oscillator that serves as a stable frequency reference, enabling the instrument to provide high-stability signals to an accuracy of 0.001% over its specified frequency range. This accuracy includes possible errors due to short-term drift, long-term drift, incidental FM, and variations due to line voltage changes and temperature changes. With the FREQUENCY VERNIER out of the CAL position, the frequency is accurate to 0.001% ±10 kHz.

The accuracy of the instrument can be improved by using either the optional External Reference input, or the optional High Stability Internal Reference.

1.1.2 MODULATION

This instrument features both internal and external AM and FM capabilities. The internal and external sources can operate independently, or may be used simultaneously to produce complex modulation.

Internal modulation frequencies include 400 Hz, 1000 Hz, and two preset frequencies between 100 Hz and 10 kHz, selected by the user.

Modulation is indicated on a front-panel meter calibrated for full-scale readings of 30% and 100% AM, and 3, 10, 30, and 100 kHz deviation for FM operation.

1.1.3 OUTPUT LEVEL FEATURES

The output power is indicated on a front-panel meter calibrated in both dBm and VRMS. A fifteen-position, 10 dB/step Attenuator used in conjunction with an 11 dB VERNIER control provides the user with a range of +13 dBm to -137 dBm.

The calibrated output of the instrument is leveled to within ±2.75 dB across the complete frequency range of the instrument.

Reverse-power protection is available as an option.

1.2 SPECIFICATIONS

1.2.1 FREQUENCY

Range	1 to 999.9999 MHz
Readout	Lever/Indicator Switches: 7 digits.
Resolution	100 Hz
Accuracy	±0.001% in all modes
Stability	Below 520 MHz: 0.2 ppm/hr., 500 Hz/10 min. when frequency vernier is not in CAL position. 520 MHz and up: 0.4 ppm/hr., 1000 Hz/10 min. when frequency vernier is not in CAL position.

1.2.2 RF OUTPUT

Impedance	50Ω (SWR < 1.2 at RF output levels below 0.1 V).
Output Connector	Type N
Power Level Range	+13 to -137 dBm (1 V to 0.03 μVRMS)
Level Control	Continuously adjustable in 10 dB steps with an 11 dB vernier. Output level is indicated on a front panel meter calibrated in volts and dBm.
Total Level Accuracy	+13 to -7 dBm ±1.50 dB -7 to -77 dBm ±2.20 dB -77 to -137 dBm ±3.00 dB
Accuracy Breakdown	Flatness: (+13 to -7 dBm) ±1.0 dB Output Meter: ±0.5 dB Step Attenuator: ±0.5 dB to 70 dB (±0.2 dB Cal Error) ±1.0 dB to 130 dB (±0.5 dB Cal Error)
Leakage	< 1 μV into a 2 turn, 1 in. diameter loop held 1 in. from any surface.

1.2.3 SPECTRAL PURITY

Harmonic Output	
1 - 10 MHz	< -26 dBc at +13 dBm RF output < -20 dBc at all other levels
Subharmonics	1 to 999.9999 MHz: < -30 dBc.

Nonharmonics

Fundamental	Spurious Level
1 to 3 MHz	< -60 dB in 1 to 3 MHz band
3 to 250 MHz	< -65 dB in 3 to 250 MHz band
3 to 350 MHz	< -55 dB in 3 to 350 MHz band
3 to 999.9999 MHz	< -35 dB in 3 to 1000 MHz band

Residual AM	> 65 dB below carrier in a 50 Hz to 15 kHz post-detection bandwidth.
Residual FM	1 to 519.9999 MHz: < 100 Hz in 300 Hz to 3 kHz post-detection bandwidth. < 200 Hz in a 50 Hz to 15 kHz post-detection bandwidth. 1 to 999.9999 MHz: < 200 Hz in a 300 Hz to 3 kHz post-detection bandwidth. < 400 Hz in a 50 Hz to 15 kHz post-detection bandwidth.

1.2.4 AMPLITUDE MODULATION

Internal Frequency	400 Hz, 1000 Hz and two preset frequencies between 100 Hz and 10 kHz (accuracy: ±2%)
External Frequency	DC to 20 kHz (3 dB bandwidth). Input level required: 1 VRMS into 600Ω to provide full scale adjustment with EXT MOD LEVEL control.
Range	0 to 90%
Distortion	Measured at 1 kHz. 0 to 70% AM: < 3% 0 to 90% AM: < 5%
Meter	Scales of 30% AM and 100% AM Accuracy: ± (2% of Full Scale Reading + 5% of Meter Reading) at 1 kHz modulation frequency.

1.2.5 FREQUENCY MODULATION

Internal Frequency	400 Hz, 1000 Hz, and two preset frequencies between 100 Hz and 10 kHz (accuracy: ±2%).
External Frequency	50 Hz to 10 kHz (1 dB bandwidth) with Frequency Vernier in CAL. DC to 25 kHz (1 dB bandwidth) with Frequency Vernier not in CAL. Input level required: 1 VRMS into 600Ω to provide full scale adjustment with EXT MOD LEVEL control.
Range	0 - 100 kHz deviation.
Distortion	Measured at 1 kHz. 10 kHz to max deviation: < 2% 3 kHz to 10 kHz deviation: < 4%.
Meter	Scales of 3, 10, 30 and 100 kHz deviation. Accuracy: ±3% of Full Scale Reading. Measured with 1 kHz modulation.

1.2.6 GENERAL

Dimensions	30.3 cm (12 in.) wide; 13.4 cm (5 1/4 in.) high; 34.9 cm (13 3/4 in.) deep.
Weight	13 kg (28.6 lb.) net; 13.6 kg (30 lb.) shipping.
Power	115 or 230 V ±10%; 50 to 400 Hz: approximately 40 watts.

1.3 OPTIONS

Option 3. Reverse-Power Protection. Relay in RF output circuit trips if more than 0.5 W (5 VRMS) is applied to the RF OUTPUT. Maximum RF power is 50 W (50 VRMS). Breaker is reset by turning AC power off momentarily.

Option 5. External Reference. Provides a rear-panel BNC connector for an external frequency reference. Reference frequency can be 1, 2, 2.5, 5, or 10 MHz, with minimum level of 50 mV into 1 kΩ.

Option 5A. Internal/External Reference. Switch selects internal TCXO or external reference. Internal TCXO improves accuracy to ±1 ppm from the standard ±10 ppm, and can be used to reference other devices. External reference may be 5 or 10 MHz, 0.5 to 5 VRMS.

Option 6. High-Stability Reference. Provides a 5 MHz reference for Option 5 and other instruments. (Maximum fan-out is four, including Option 5.) Accuracy is improved to 0.2 ppm from the standard 10 ppm.

1.4 ACCESSORIES

Furnished with instrument	Instruction Manual
Available	Rack Mount, K108 Precision Frequency Standard, Model 2102 12-Channel Frequency Programmer, Model 3900-1

SECTION 2
OPERATION

2.1 INTRODUCTION

This section provides complete installation and operating instructions for the Wavetek Models 3003 through 3006. The instructions include information on mechanical installation, electrical installation, front-and-rear-panel features, installation checks and operating procedures.

2.2 MECHANICAL INSTALLATION

2.2.1 INITIAL INSPECTION

After unpacking the instrument, visually inspect 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.

2.2.2 DAMAGE CLAIMS

If instrument received has been damaged in transit, notify carrier and either the nearest Wavetek area representative or the factory in Indiana.

Retain shipping carton and packing material for the carrier's inspection.

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

2.2.3 RACK MOUNTING (K108)

CONTENTS (See Figure 2-1).

ITEM	QTY	PART NO.
A (Insert)	2 ea	1410-00-4650
B (Side)	2 ea	1410-00-5260
C (Screw)	8 ea	2810-17-8108
D (Screw)	4 ea	2810-17-8110

PROCEDURE

Remove the screws from one side panel. Mount items A and B against side panel of the instrument and secure with screws provided. Repeat for other side of unit. If rack mount kit is removed from unit, use screws originally installed in side panels to avoid possible internal damage.

2.3 ELECTRICAL INSTALLATION

The instrument can operate from either 115 VAC or 230 VAC supply mains. The rear-panel AC LINE switch selects which of these operating voltages is being used, and adjusts the Power Supply accordingly. The Power Supply is designed to operate over an AC supply frequency range of 50 to 400 Hz.

Instruments are shipped from the factory set up for 115 V operation unless otherwise specified.

NOTE

Before operating the instrument, check that the rear-panel AC LINE fuse is the correct value for the supply voltage (see Section 2.5).

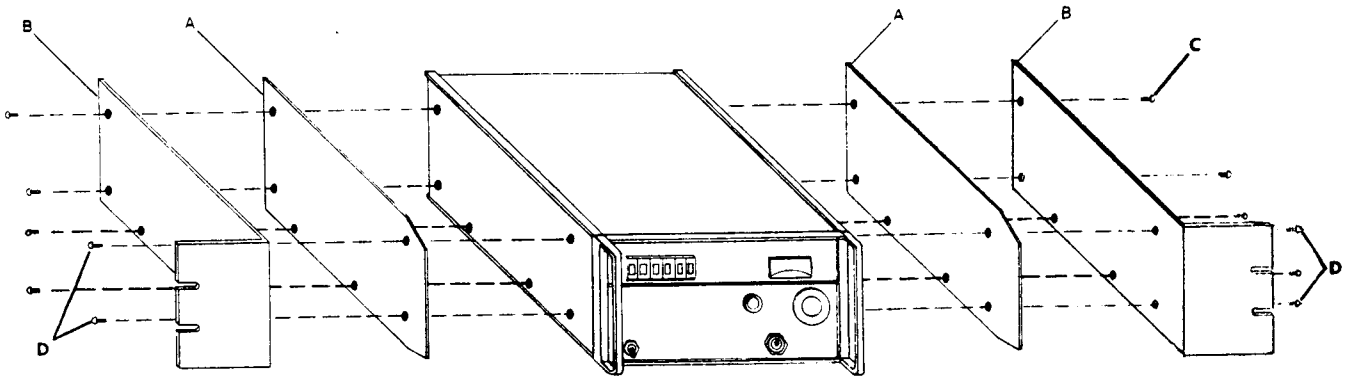


Figure 2-1. K108 Rack Mount

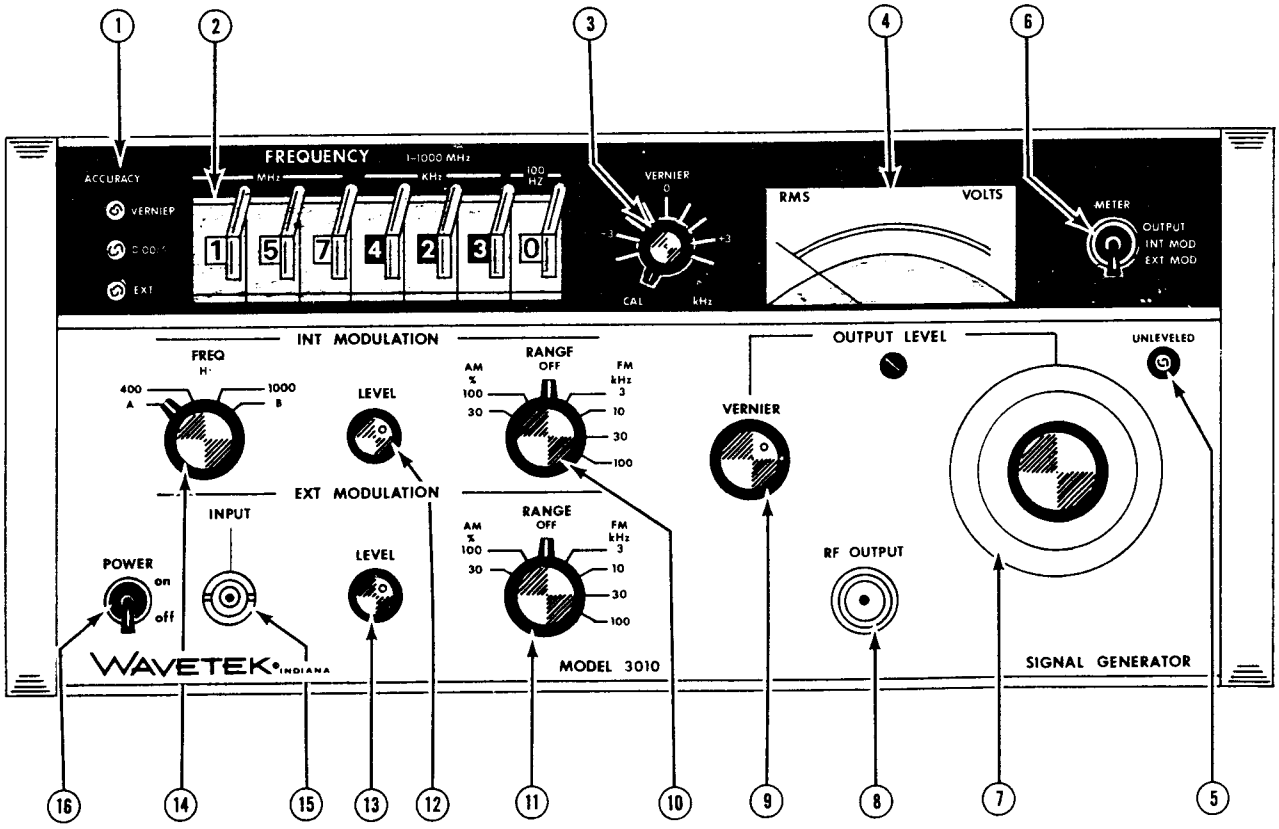


Figure 2-2. Front Panel

2.4 DESCRIPTION OF FRONT PANEL

Refer to Figure 2-2.

(1) ACCURACY lamps indicate the frequency accuracy of the instrument.

"VERNIER" indicates ±0.001% +10 kHz
"0.001%" indicates ±0.001%
"EXT" indicates accuracy of external source

Typically, the lamp will flash for a few seconds after the instrument is turned on. Normally, a steady light indicates that the instrument is phase locked and the frequency accuracy indicated is valid. A continuously flashing light indicates that one or more of the phase-locked loops is open.

(2) Lever/Indicator switches select and indicate output frequency.

(3) FREQ VERNIER shifts output frequency ±5 kHz at frequencies below 520 MHz, ±10 kHz at 520 MHz and above.

When the FREQ VERNIER is in CAL, the instrument accuracy is ±0.001%. When the FREQ VERNIER is not in CAL, the instrument accuracy is ±0.001% +10 kHz (20 kHz at 520 MHz and above). The 100 Hz level/indicator switch has no effect when the FREQ VERNIER is not in CAL.

(4) OUTPUT METER indicates RF output level over a 10 dB range in VRMS and dBm, %AM, or FM deviation, depending on the METER switch setting.

(5) UNLEVELED lamp lights when the OUTPUT METER reading is not valid.

(6) METER switch selects measurement of RF output, internal modulation, or external modulation.

(7) OUTPUT Step Attenuator controls the RF output level over a 140 dB range from +10 to -130 dBm in 10 dB steps. The Attenuator dial indicates both dBm and VRMS.

(8) RF OUT provides the RF output signal from the instrument (type N connector).

(9) OUTPUT VERNIER controls the RF output level over an 11 dB range.

(10) (11) INT/EXT MOD RANGE switches select amplitude, frequency, or no modulation, and the appropriate METER range.

(12) (13) INT/EXT MOD LEVEL controls provide continuous adjustment of % modulation (AM) and frequency deviation (FM).

(14) INT MOD FREQ switch selects one of four internal modulation frequencies, 400 Hz, 1000 Hz, A, or B, where A and B are user-preset frequencies between 100 Hz and 10 kHz.

(15) EXT MOD INPUT connector (type BNC) accepts external modulating signals (1 VRMS level) as follows:

AM	DC to 20 kHz
FM ((3) in CAL)	50 Hz to 20 kHz
FM ((3) not in CAL)	DC to 20 kHz

(16) POWER switch provides AC power to Power Supply.

2.5 DESCRIPTION OF REAR PANEL

Refer to Figure 2-3.

(1) AC LINE switch enables unit to operate from either 115 VAC or 230 VAC supply mains.

(2) AC LINE Fuse (time-delay); 1.0 amp for 115 VAC operation; 0.5 amp for 230 VAC operation.

(3) AC LINE Cord provides connection to AC mains via 3 prong plug.

(4) PROGRAMMING JACK provides connection for remote programming of frequency.

(5) MOD TP provides convenient connection for monitoring amplitude and/or frequency of internal modulating signal.

2.6 INSTALLATION CHECKS

The following procedure is used to determine that the instrument is operating properly. Performance testing and calibration procedures for the instrument are contained in other sections of this manual. If it is determined that the unit is not operating properly, refer to these sections.

2.6.1 TURN ON

Verify that the power-transformer primary is matched to the available line voltage, and that the proper fuse is installed (see Section 2.5). Turn the POWER switch to ON. One of the front-panel ACCURACY lamps will indicate operation. No warmup is needed for the following checks.

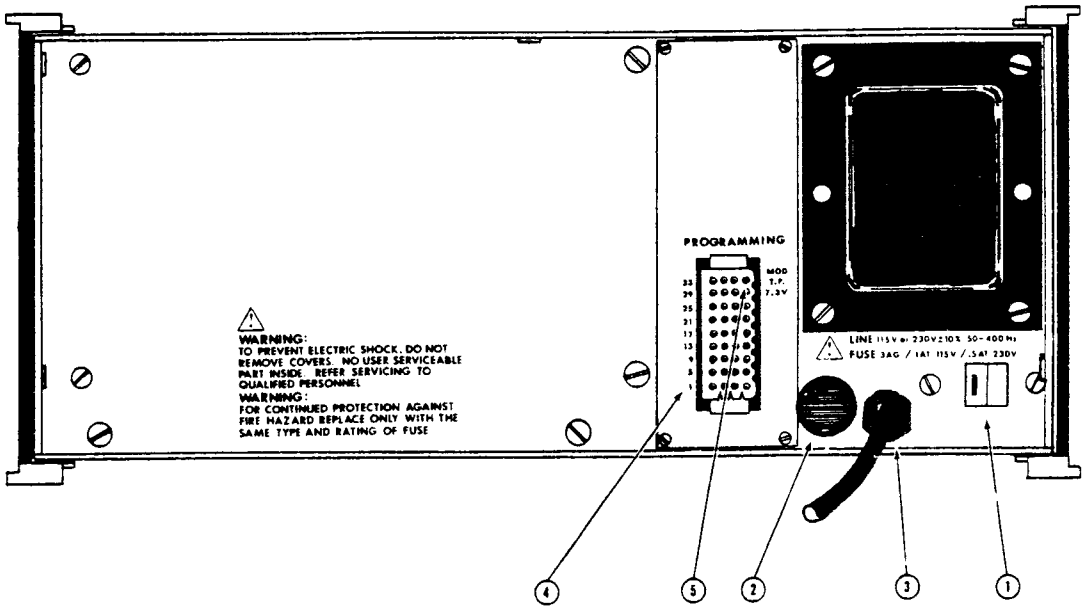


Figure 2-3. Rear Panel

NOTE: MUST BE HIGH-FREQUENCY OSCILLOSCOPE (GREATER THAN 10 MHz)

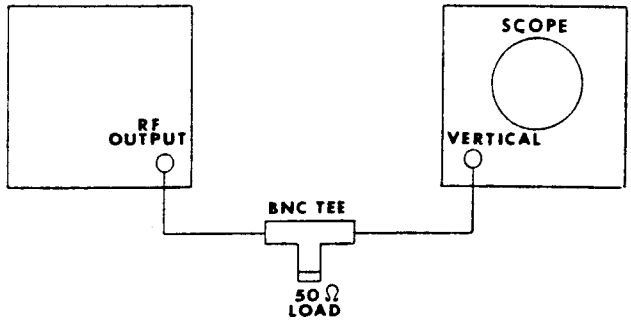


Figure 2-4. Test Setup

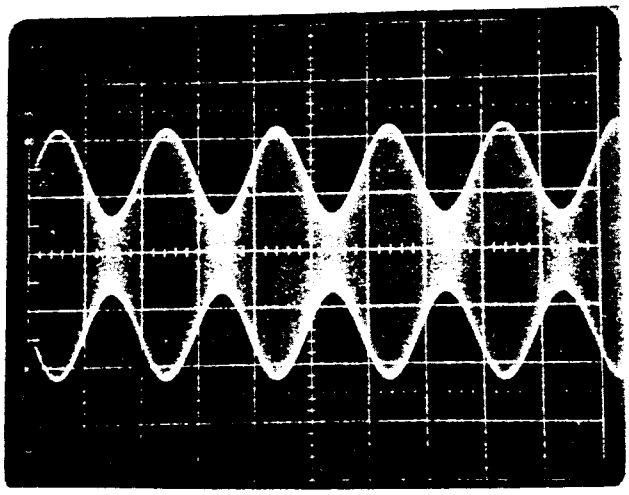


Figure 2-5. Amplitude Modulation

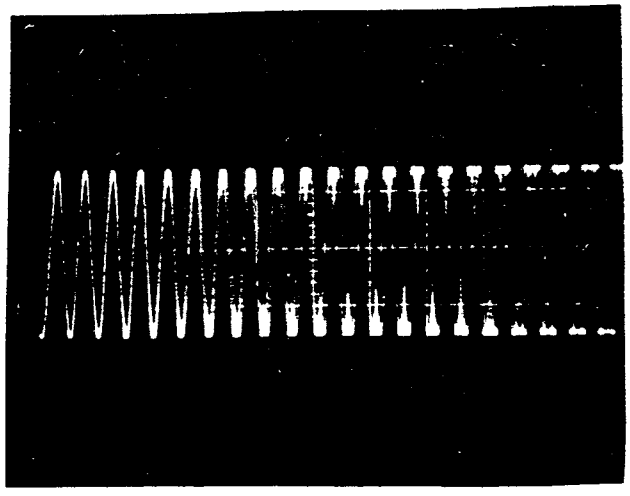


Figure 2-6. Frequency Modulation

2.6.2 INITIAL CONTROL ADJUSTMENT

Set the instrument front-panel controls as follows:

Lever/Indicator switches	010.0000
FREQ VERNIER	CAL
INT MOD RANGE	OFF
EXT MOD RANGE	OFF
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
EXT MOD LEVEL	N/A
METER switch	OUTPUT
OUTPUT Step	0 dBm
OUTPUT VERNIER	full cw

2.6.3 RF OUTPUT CHECK

Connect the equipment as shown in Figure 2-4. The 10 MHz signal should be ~0.9 Vpp. (A high-frequency oscilloscope must be used for these checks.)

2.6.4 AM CHECK

Set the INT MOD RANGE switch to 100% AM, the METER switch to INT MOD, the INT MOD FREQ switch to 1000, and adjust the INT MOD LEVEL control so that the METER reads 50% AM (half scale). Verify that the AM envelope displayed on the oscilloscope has a peak-to-valley voltage of ~0.45 V, and period of 1 msec (see Figure 2-5).

Set the INT MOD FREQ switch to 400. The peak-to-valley voltage should still be ~0.45 V, and the period should now be 2.5 msec.

Turn the INT MOD LEVEL control both ways, verifying that the % AM shown on the METER and the AM envelope on the scope display rise and fall accordingly. Set the METER switch to OUTPUT and verify that turning the INT MOD LEVEL control causes a change in RF output level.

NOTE

The UNLEVELED lamp may come on during this test.

Return the METER switch to the INT MOD position.

2.6.5 FM CHECK

Set the INT MOD RANGE switch to 3 kHz FM. Turn the INT MOD LEVEL control both ways, verifying that an FM display appears on the oscilloscope (see Figure 2.6).

Repeat for INT MOD RANGE settings of 10, 30, and 100 kHz FM.

2.6.6 ATTENUATION CHECK

Set the METER switch to OUTPUT and the INT MOD RANGE switch to OFF. Verify that both the OUTPUT Step and VERNIER controls vary the amplitude of the signal displayed on the oscilloscope, and that the OUTPUT VERNIER varies the METER reading of RF output level.

2.6.7 FREQ VERNIER CHECK

Switch FREQ VERNIER out of CAL position. The .001% lamp should go out, and the VERNIER lamp should light. Moving the VERNIER from -5 kHz to +5 kHz should show a slight change in frequency on oscilloscope.

2.7 OPERATING PROCEDURE

No preparation for operation is required beyond completion of the initial installation checks contained in Section 2.6. To insure that the instrument will perform as stated in the specifications, the instrument should have a two-hour warmup before using.

2.7.1 TURN ON

Turn the POWER switch to ON. One of the front-panel ACCURACY lamps will light, indicating an operating condition. A flashing light indicates an unlocked condition. This should cease in a matter of seconds.

If the unit is not going to be used to the extreme limits of its specifications, it can be used immediately.

CAUTION

When working with active circuits, transceivers, etc., care must be used to keep DC voltage or RF power from being applied to the RF OUT connector, otherwise damage may occur to the output circuitry of the instrument.

2.7.2 CW OPERATION

With the METER switch set to OUTPUT and the INT and EXT MOD RANGE switches set to OFF, adjust the output frequency and level to the desired settings. The FREQ VERNIER should be in its CAL position.

NOTE

With the FREQ VERNIER in the CAL position, output frequencies having an accuracy of ±0.001% may be selected by the Lever/Indicator switches. When the FREQ VERNIER is out of the CAL position, the selected output frequency can be shifted ±5 kHz with the FREQ VERNIER

control. The output frequency at the "0 kHz" position of the FREQ VERNIER corresponds closely to the output frequency in CAL.

Connect the RF output to the device under test.

2.7.3 INT AM/FM OPERATION

Starting with the basic set-up of Section 2.7.2, set the METER switch to INT MOD, the INT MOD RANGE switch for the desired modulation function and METER range, and the INT MOD FREQ switch for the desired modulation frequency (400 Hz, 1000 Hz, or pre-set frequencies A or B, see Section 5.4.8). Adjust the INT MOD LEVEL control for the desired % AM or frequency deviation (read on the METER scale).

2.7.4 EXT AM/FM OPERATION

Starting with the basic set-up of Section 2.7.2, set the METER switch to EXT MOD, the EXT MOD RANGE switch for the desired modulation function and METER range, and connect the modulating signal (level should be ~1 VRMS for best resolution of the EXT MOD LEVEL control) to the EXT MOD INPUT connector. Adjust the EXT MOD LEVEL control for the desired % AM or frequency deviation (read on METER scale).

NOTE

At modulating frequencies less that 50 Hz, the METER may start to "wobble". In this case, the "peak" Meter reading is the valid measurement of % AM or frequency deviation.

CAUTION

Input voltage greater than ±5 VDC or 3.5 VRMS should not be applied to the EXT MOD INPUT connector, or damage to the instrument may occur.

NOTE

When amplitude modulating, care must be taken to not exceed the +13 dBm maximum level, or excessive distortion and an unleveled condition can exist. In some cases, a high % AM may cause the UNLEVELED light to come on when the OUTPUT VERNIER control is at minimum. This is caused by "bottoming" of the PIN diode leveler which, in turn, can cause an increase in distortion. If this is the case, add 10 dB of fixed attenuation and turn OUTPUT VERNIER control toward maximum. The UNLEVELED light should then go out.

2.7.5 SIMULTANEOUS INT/EXT MODULATION

Internal and external modulation can be performed simultaneously by following the procedure given in Sections 2.7.3 and 2.7.4 with both INT and EXT MOD RANGE switches active. In this way, FM/FM, FM/AM, or AM/AM can be accomplished.

NOTE

The METER switch provides for reading the internal and external modulations separately. The METER will not show the complex modulation.

2.7.6 PROGRAMMING

Frequency is programmable via a rear-panel input connector using standard 8-4-2-1 BCD contact closure or TTL signals. (Logic "0"= open = ⩾ 2.2 V. Logic "1" = closed = ⩽0.4 V.) The rear-panel PROGRAMMING jack pins are in parallel with the front-panel Lever/Indicator switches; thus, if rear-panel programming is to be implemented, the front-panel switches must indicate all zeroes.

Example - To program 132.4508 MHz (refer to Figure 2-7):

FREQ DIGIT	1	3	2.	4	5	0	8
GND PINS	4	7,8	11	14	18,20	–	26

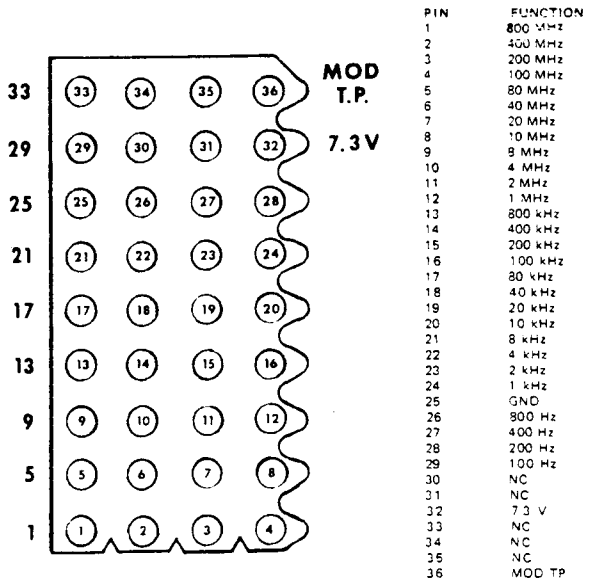


Figure 2-7. PROGRAMMING Jack Pins

SECTION 3
THEORY OF OPERATION

3.1 INTRODUCTION

Section 3.2 presents a block diagram analysis to enable the reader to get a brief overall view of the operation of the entire instrument. Sections 3.3 - 3.17 contain more detailed descriptions of each subassembly.

For actual wiring of the chassis and subassemblies, refer to the schematics in Section 7 of the manual.

3.2 OVERALL BLOCK DIAGRAM

The signal generator is essentially a voltage controlled oscillator from 1 to 520 MHz to which phase-locked loops and a crystal reference have been added for improved accuracy and resolution. A doubler provides frequencies above 520 MHz.

The discussion will first deal with the basic signal generator, then it will describe how the phase-locked loops provide the additional accuracy.

The numbers within the block diagram symbols refer to the particular assembly in which the circuit is located.

3.2.1 BASIC SIGNAL GENERATOR

This discussion briefly describes how the RF is generated and how its frequency is controlled, also how the signal is amplified, leveled and amplitude modulated.

Refer to Figure 3-1 for a block diagram of the basic signal generator without phase locking or doubling.

RF GENERATION

The RF output frequency is generated by two UHF oscillators and a mixer. The outputs of the two oscillators are heterodyned in the mixer. The difference frequency is amplified and fed to the output amplifier.

The frequencies of these oscillators are controlled by DC voltages applied to their varactor diodes. The Narrow Oscillator yields a single frequency. The Wide Oscillator can be programmed over a range which extends from the frequency of the Narrow Oscillator to 520 MHz higher than the Narrow Oscillator frequency.

RF FREQUENCY CONTROL

The RF output frequency is determined by programming the frequency of the Wide Oscillator. The Wide Oscillator is ultimately controlled by the front-panel Lever/Indicator switches. The BCD output of these switches is converted to an analog voltage which programs the oscillator in 1 MHz steps. This analog signal can provide approximately 3 MHz accuracy.

RF AMPLIFICATION AND LEVELING

The RF power is amplified by a multi-stage, wide-band amplifier in the M164 Doubler. The flat output is maintained by a closed-loop leveling system around this Output Amplifier.

The Leveler includes a monitor diode, an error amplifier, and a voltage-variable attenuator. The monitor detects the peak output of the Output Amplifier. This detected level is compared to a DC reference by the error amp. The output of the error amp is fed to a PIN diode (voltage variable) attenuator which changes the input level to the Output Amplifier until the monitored signal produces a DC level equal to the reference level.

LEVEL CONTROL AND AM

The circuitry for controlling the RF output level is directly related to the above leveling system because changing the DC level reference changes the RF output level.

Of the 150 dB output range, 130 dB is passive attenuation. The remaining 20 dB is controlled by changing the level reference. The OUTPUT VERNIER has a 10 dB range. The remaining 10 dB is provided by switching the level reference range. This range switch is provided so that when AM is not required, the Output Amplifier can provide a carrier at the highest possible power.

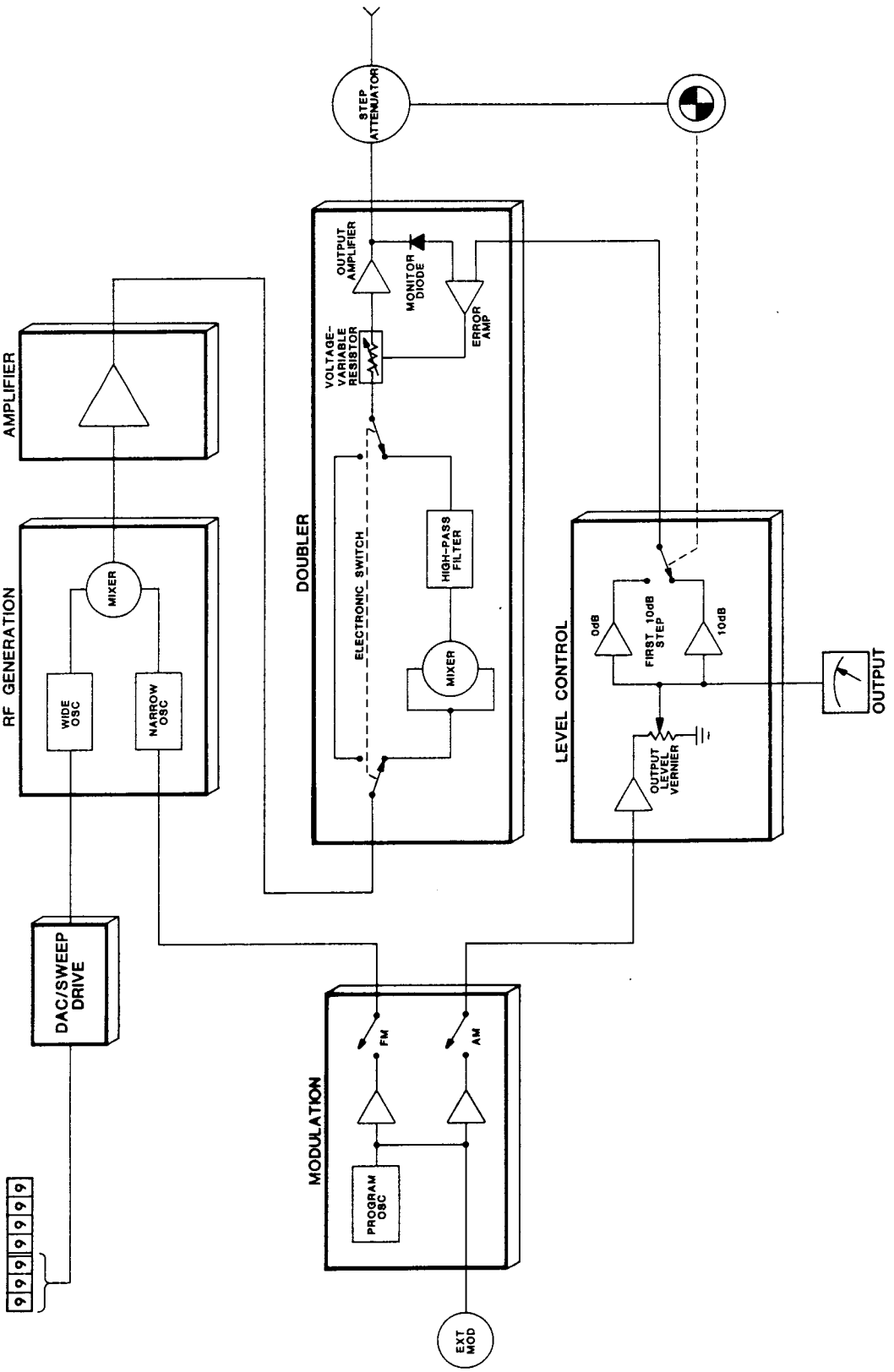


Figure 3-1. Basic Block Diagram

Since the RF level can be voltage controlled, AM can be accomplished by applying the modulating signal to the OUTPUT VERNIER. This causes the reference voltage to the error amp to change at the frequency of the modulating signal. The modulating signal is taken from either an internal oscillator or an external source.

3.2.2 PHASE-LOCKED LOOPS

The basic signal generator discussed in Section 3.2.1 has a frequency range of 1 to 520 MHz, has an output voltage which is leveled and adjustable, and has the ability to be amplitude modulated. With the above circuitry, however, the frequency accuracy is only 3 MHz with 1 MHz resolution. To achieve the desired resolution and accuracy, the instrument includes five phase-locked loops.

PLL 1, 2 and 4 are used to stabilize the Wide Oscillator and tune it in 1 kHz steps. The Wide VCO is part of PLL 4. PLL 1 and 2 convert the Lever/Indicator switch setting to reference frequencies for PLL 4.

PLL 3 and 5 provide stabilization to the Narrow VCO and allow FM operation. The Narrow VCO is part of PLL 3. PLL 5 converts a modulating signal (if present) to a reference frequency for PLL 3. PLL 5 is also used to program 100 Hz offset steps into the Narrow VCO for 100 Hz resolution.

Figure 3-2 illustrates the relationship between the five numbered loops and the "basic signal generator".

PLL 1

The purpose of PLL 1 is to generate a CW signal which changes in 1 kHz steps from 10.000 to 9.001 MHz as the front-panel frequency selector is switched from .000 MHz to .999 MHz. This signal will be used as a reference signal for PLL 4.

Figure 3-3 shows a simplified block diagram of PLL 1. It includes a voltage controlled oscillator capable of frequencies from 9 to 10 MHz, a phase detector and a ÷N counter. A sample of the output signal from the VCO is fed to a programmable counter. The divisor of the counter is controlled by the three front-panel kHz selector switches. The output from the counter is fed to a phase detector where it is compared to a 1 kHz crystal reference signal. If the two input signals to the phase detector are not the same frequency, an error signal is produced. This error voltage corrects the frequency of the VCO until the phase detector input from the counter is exactly 1 kHz. See Section 3.12 for a more detailed explanation.

PLL 2

The purpose of PLL 2 is to generate a CW signal which changes in 1 MHz steps from 1448 to 1487 MHz when the front-panel frequency selector is switched from 001 to 039 MHz. These CW steps are then repeated every 40 MHz throughout the entire 1 to 520 MHz range. Use of this signal to control the Wide Oscillator will be discussed in the description of PLL 4.

Figure 3-4 shows a simplified block diagram of PLL 2. PLL 2 operates in the same manner as PLL 1 with one exception. The circuit includes a mixer and band-pass amplifier. The purpose of this additional circuit is to offset the 1448 to 1487 MHz output from the VCO to 8 to 47 MHz. This offset is necessary in order to make the frequency compatible with the programmable counter and phase detector circuits. The other circuits in this loop operate in the same way as those in PLL 1. In this case, the programmable counter is controlled by the three "MHz" selector switches and the loop reference frequency is 1 MHz. For a more complete description, see Section 3.13.

PLL 4

The purpose of PLL 4 is to adjust the Wide Oscillator in 1 kHz steps from 1198 MHz to 1718 MHz as the front-panel frequency selector is adjusted from 001.000 to 520.000.

The Wide Oscillator frequency is offset by Mixers 1 and 2 and compared to the reference (from PLL 1) by the phase detector. A difference in phase or frequency causes an error signal to tune the Wide Oscillator until both phase detector inputs are identical. How this loop locks on a particular frequency can best be explained in three steps: 1) phase locking at 40 MHz intervals across the band, 2) phase locking at 1 MHz intervals, 3) phase locking at 1 kHz intervals. Figure 3-5 is a simplified block diagram of PLL 4.

To understand locking at 40 MHz intervals, assume temporarily that the reference frequencies from PLL 1 and PLL 2 are fixed (10 MHz and 1448 MHz respectively). Figure 3-5 shows the frequencies throughout the loop for this discussion. This step of the PLL 4 explanation can be described more clearly by considering the entire Wide Oscillator range rather than discussing single frequencies. The Wide Oscillator covers the range of 1198 to 1718 MHz as the output frequency changes from 0 to 520 MHz (Figure 3-5, lines A and C).

When the Oscillator range is heterodyned in Mixer 1 with 1448 MHz, the difference frequency produced ranges from

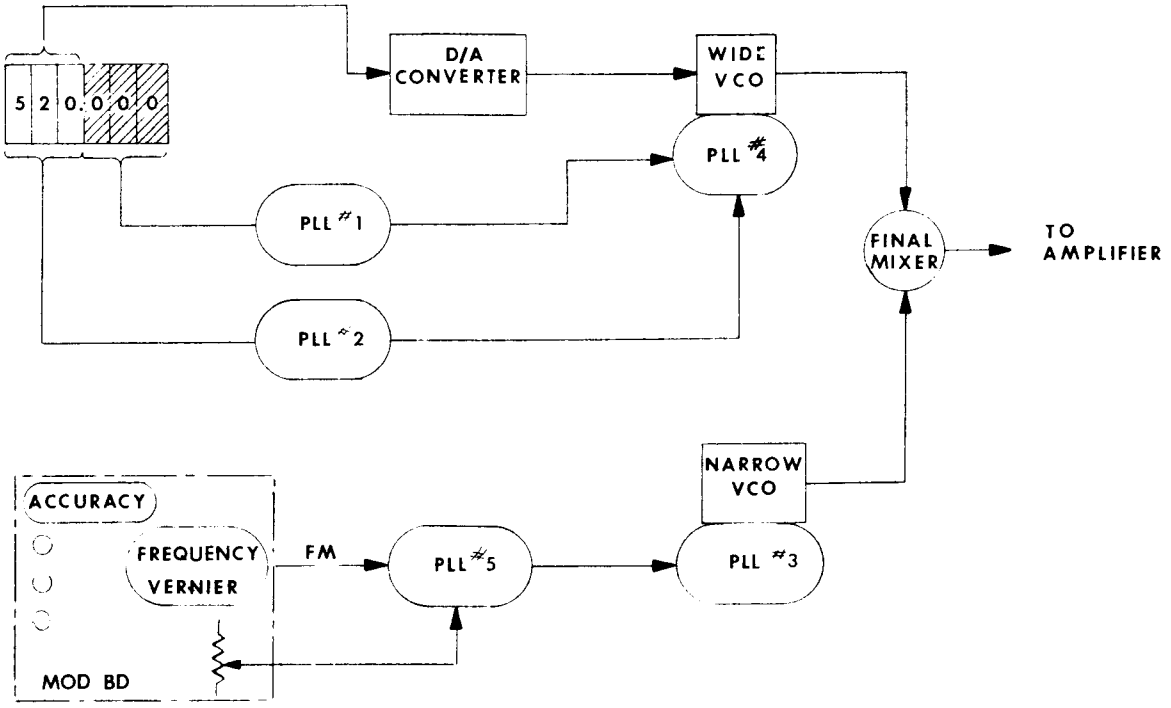


Figure 3-2. PLL Relationships

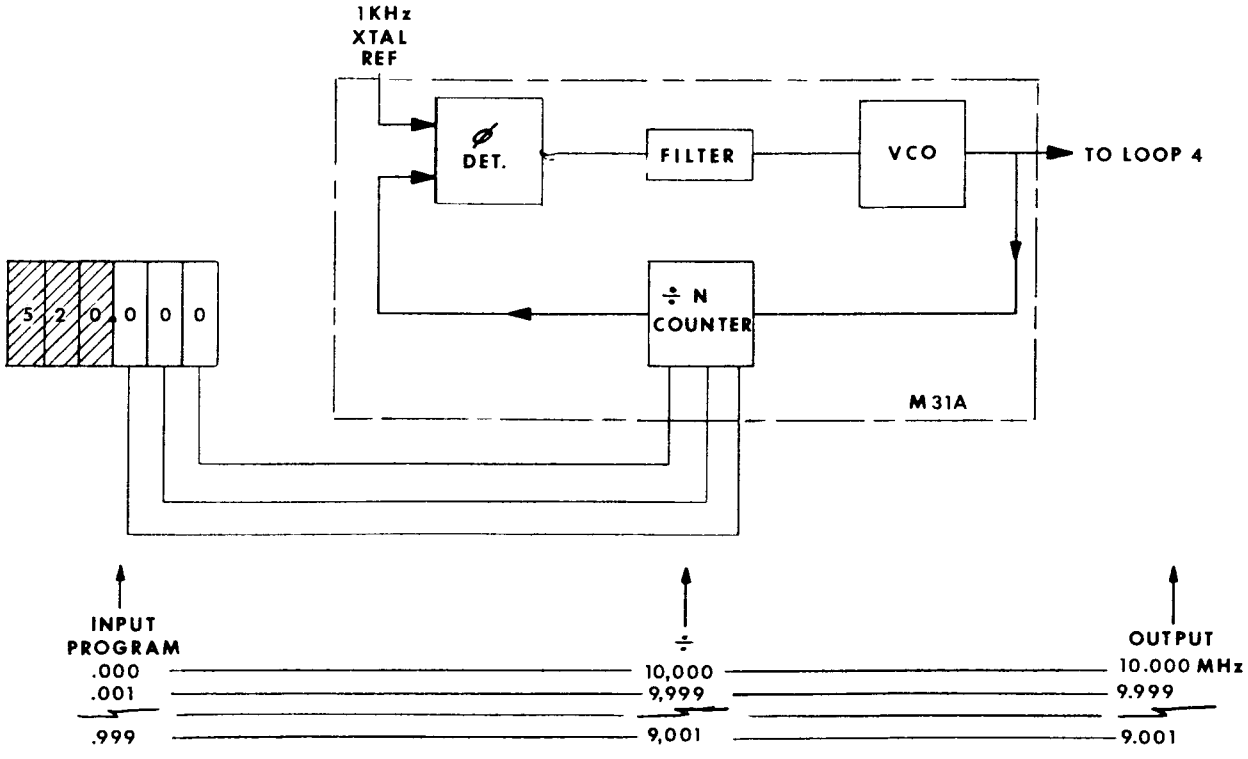


Figure 3-3. PLL 1

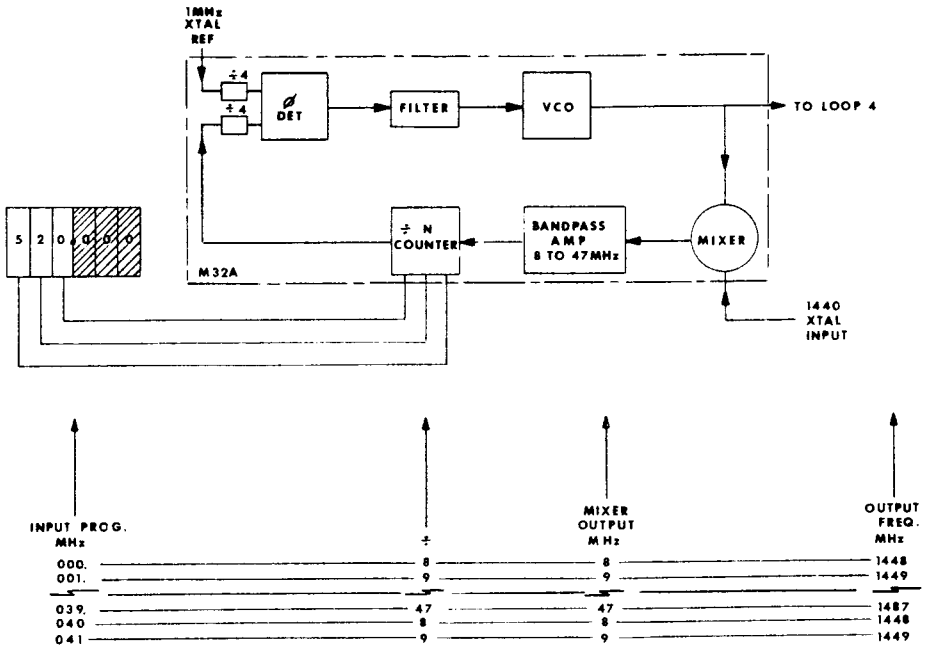


Figure 3-4. PLL 2

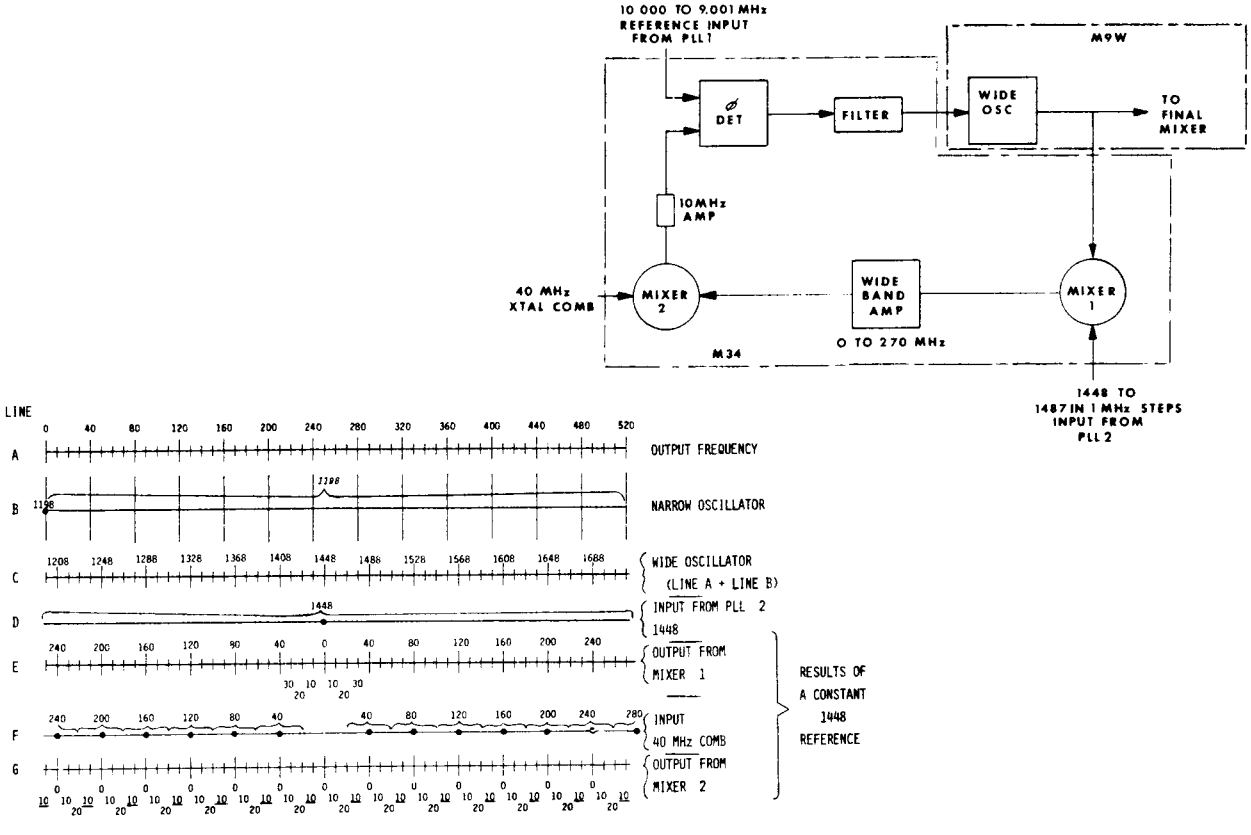


Figure 3-5. PLL 4

250 to 0 to 270 MHz (Figure 3-5, line E). This signal is then mixed with a 40 MHz comb (all harmonics of 40 MHz) in Mixer 2 (Figure 3-5, line F). Taking the difference between lines E and F yields the repetitive frequency range from 0 to 20 to 0 MHz as shown in line G. This signal is fed to the phase detector.

The reference to the phase detector is 10 MHz, but the loop will not lock on every 10 MHz output of Mixer 2. The only 10 MHz signals which will produce lock are those which would decrease in frequency if the Wide VCO tried to drift higher. Therefore, at every 40 MHz interval of the output frequency, an input to the phase detector would allow the loop to lock. Section 3.2.1 explains that an analog signal drives the Wide Oscillator to within three MHz of the proper frequency. Therefore, although there are 14 possible lock points on line G, the only one selected will correspond to the analog-tuned frequency of the Wide Oscillator. The unit as described so far is capable of phase locked output at 0, 40, 80. . . 520 MHz. The following is an explanation of locking at 1 MHz intervals.

To allow phase locking at 1 MHz intervals, the reference frequency to Mixer 1 is made adjustable in 1 MHz steps over a 40 MHz range (1448-1487 MHz).

If, for example, this reference frequency to Mixer 1 were 1449 MHz, the input range to the phase detector would look the same except the entire range would be shifted 1 MHz to the right. Lock points would then be possible at output frequencies of 1, 41, 81 MHz, etc.

Being able to change this reference in 1 MHz steps allows phase locking from 0 to 520 MHz in 1 MHz steps.

To provide phase locking in 1 kHz steps, the PLL 4 phase detector's reference from PLL 1 is adjustable in 1 kHz steps (10.000 to 9.001 MHz). This causes the Wide Oscillator frequency to change in 1 kHz steps in order to keep the loop locked.

PLL 3

The purpose of PLL 3 is to stabilize the Narrow Oscillator at a frequency of 1198 MHz.

Figure 3-6 shows a simplified block diagram of PLL 3. This loop operates in the same manner as PLL 1 and PLL 2, except that it does not require the use of a programmable counter. The 1198 MHz output from the Narrow Oscillator is combined in a mixer with a 1200 MHz crystal controlled signal. This produces a 2 MHz difference signal. This signal is fed to a phase detector where it is compared to a 2 MHz reference. Any difference in the input signals will produce an error voltage which is applied to the Narrow Oscillator to correct the frequency error.

PLL 5

PLL 5 supplies the reference for PLL 3. The 100 kHz Steps Module supplies a reference that goes from 2.0000 to 2.0009 kHz in steps of 0.1 Hz; PLL 5 multiplies this to 2.0000 to 2.009 MHz, changing the output frequency in 100 Hz steps. In FM mode the VCO is modulated; the loop ignores modulation faster than about 50 Hz, so the center frequency remains locked.

The loop includes a voltage controlled oscillator, a divider for reducing the frequency from 2 MHz to 2 kHz, a phase detector, and a filter for the phase detector output. If the variable input to the phase detector deviates from the reference frequency (slower than 50 Hz), the phase detector sends an error signal to the VCO to correct the frequency.

The reference is produced by taking a 40 MHz reference signal from the Crystal Reference and dividing it by a number (20000-19991) determined by the 100 Hz Lever/ Indicator switch. This divided signal (2.0000-2.0009 kHz) then becomes the reference for PLL 5; thus the PLL 5 output signal to PLL 3 can be offset from 0 to 900 Hz in 100 Hz steps, and 100 Hz resolution is accomplished.

CRYSTAL REFERENCE

All the reference frequencies for the phase-locked loops are derived from a single 40 MHz crystal source by means of appropriate multiplication or division.

3.2.3 SUBASSEMBLY DESCRIPTIONS

The overall block diagram discussed in this section describes basically how the instrument functions as a unit. The unit is made up of three printed circuit board assemblies, a power supply, and 11 module assemblies. These can be identified in Figure 5-6. Sections 3.3 thru 3.17 describe the operation of each subassembly. The name of the subassembly describes, to an extent, the primary function it performs.

3.3 C315-2 - METER BOARD

The primary functions of this assembly are to provide the program voltage to the Output Amplifier leveler circuit and indicate the RF output amplitude and modulation (see Figure 3-8).

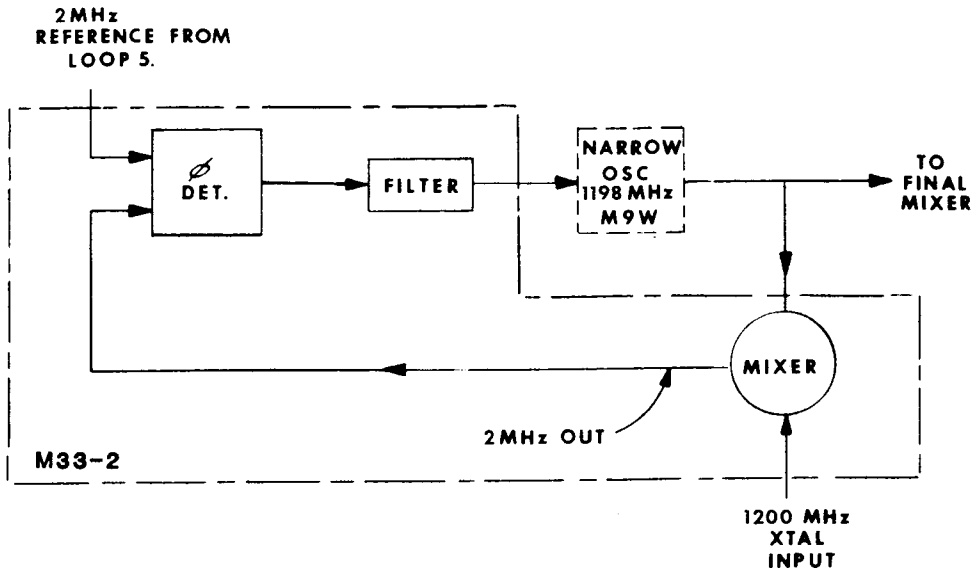


Figure 3-6. PLL 3

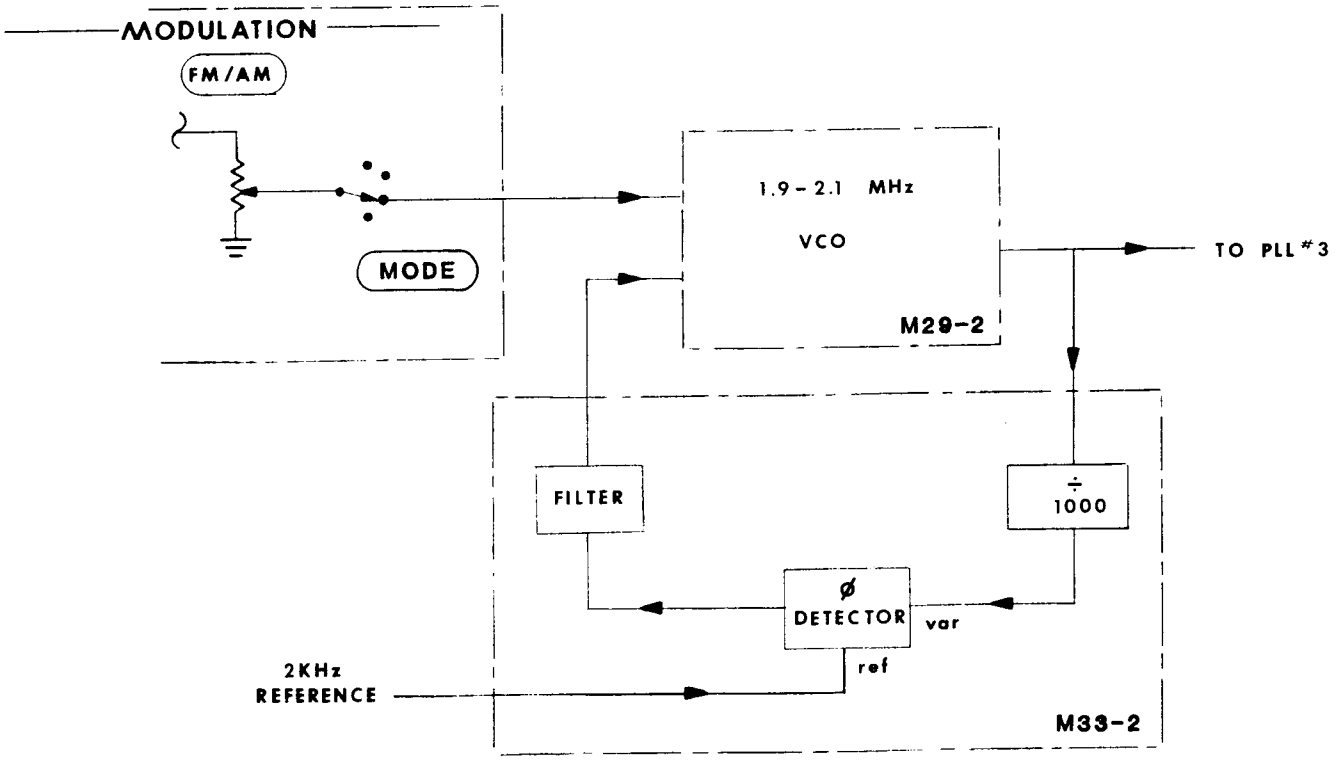


Figure 3-7. PLL 5

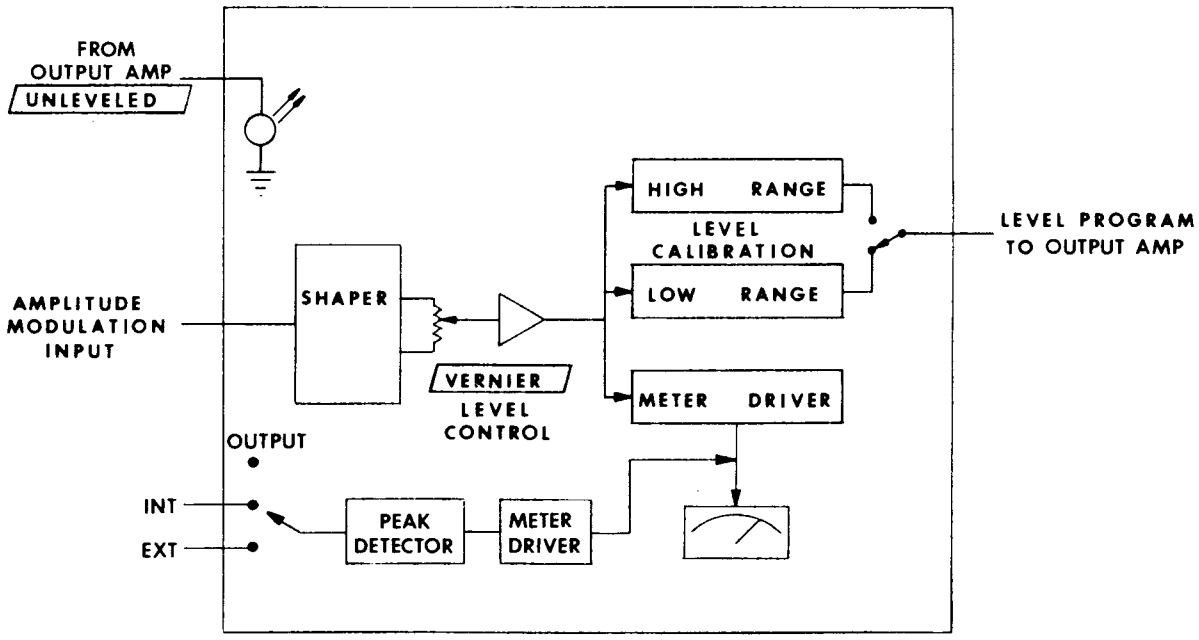


Figure 3-8. C315-2 Meter Board

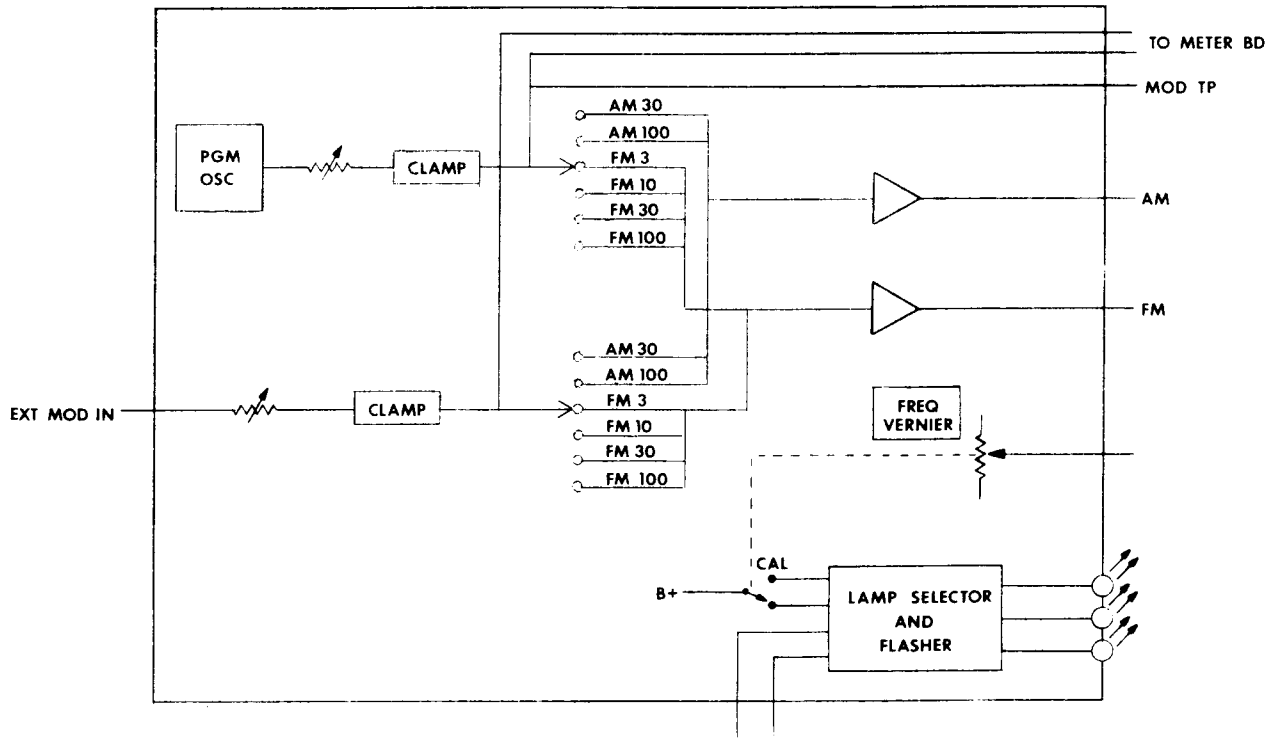


Figure 3-9. Modulation Board

3.3.1 LEVEL PROGRAM

During CW operation of the instrument, the level program is controlled by the OUTPUT VERNIER on the front panel. The output of this control goes to two range calibration circuits which convert the voltage from the OUTPUT VERNIER to a voltage level appropriate to drive the leveler circuit in the Doubler module.

The "low" circuit provides the program for all ranges of the detented power output dial except +10 dBm. At "+10", the level program is taken from the "high" circuit. The "high" level program enables the full gain capabilities of the Doubler module to be used when the output is not amplitude modulated.

During amplitude modulation, the modulating signal from the Modulation Board is applied to the OUTPUT VERNIER, which ultimately causes the RF level to change. The leveler in the Doubler does not cause the RF level to respond linearly to changes in the level program voltage. To compensate for this, a stage is included to shape the modulating signal before it is applied to the OUTPUT VERNIER.

3.3.2 METER

The front-panel meter is controlled by the level program when the METER switch is set to OUTPUT. The meter and its driver circuits are calibrated to display a reading corresponding to the actual RF level from the Doubler module.

When the METER switch is set to either INT MOD or EXT MOD, the meter displays the modulation present (%AM or FM deviation) on the selected circuit. The meter scale being read is selected by the front-panel INT MODULATION RANGE and EXT MODULATION RANGE switches.

3.3.3 UNLEVELED LIGHT

A light-emitting diode is mounted on this assembly and appears on the front panel of the instrument. Refer to the Doubler module description for an explanation of the circuit driving this light.

3.4 MODULATION BOARD

This assembly provides the modulating signals used in the AM and FM modes. The front-panel ACCURACY lights and associated circuitry are also on this assembly (see Figure 3-9).

3.4.1 MODULATING SIGNALS

The front-panel INT MODULATION FREQ switch selects one of four internal modulating frequencies derived from a programmable oscillator. The INT MODULATION RANGE switch selects the type of modulation (AM or FM), and the proper resistor network corresponding to the selected METER scale. The INT MODULATION LEVEL control adjusts the amount of modulating signal fed into the resistor networks, and so the amount of modulation (%AM or FM deviation) produced.

An EXT MODULATION INPUT connector is provided for modulating from an external source. The EXT MODULATION RANGE and LEVEL controls perform the same functions as their INT counterparts.

IC4A sums the INT and EXT AM signals, while IC4B sums the INT and EXT FM signals, allowing complex modulation (AM/FM, FM/AM, FM/FM, AM/AM) to be accomplished.

For FM at frequencies above 520 MHz the modulating voltage is halved because the deviation doubles when the frequency is doubled.

3.4.2 ACCURACY LAMPS

The CAL switch on the FREQUENCY VERNIER (or an input from Option 5 or 5A) determines which lamp is lit. If any of the phase-locked loops unlock, the energized LED is made to flash by an IC timer activated by a DC level from any of the five phase-locked loops in the instrument.

3.5 DPS2A - POWER SUPPLY

The DPS2A provides DC power for the rest of the instrument (see Figure 3-10).

3.5.1 TRANSFORMER & FILTERS

The transformer steps down the line voltage to appropriate levels for the three circuits. Full wave rectifiers and filter capacitors convert this voltage to DC. Both the +18 V and −18 V supplies use protected pass transistors with integral current limiting and thermal protection.

3.5.2 +18 V SUPPLY

The +18 V circuit has a temperature-compensated precision voltage reference. This reference is compared to the output voltage by an error amplifier which corrects any error in the output voltage.

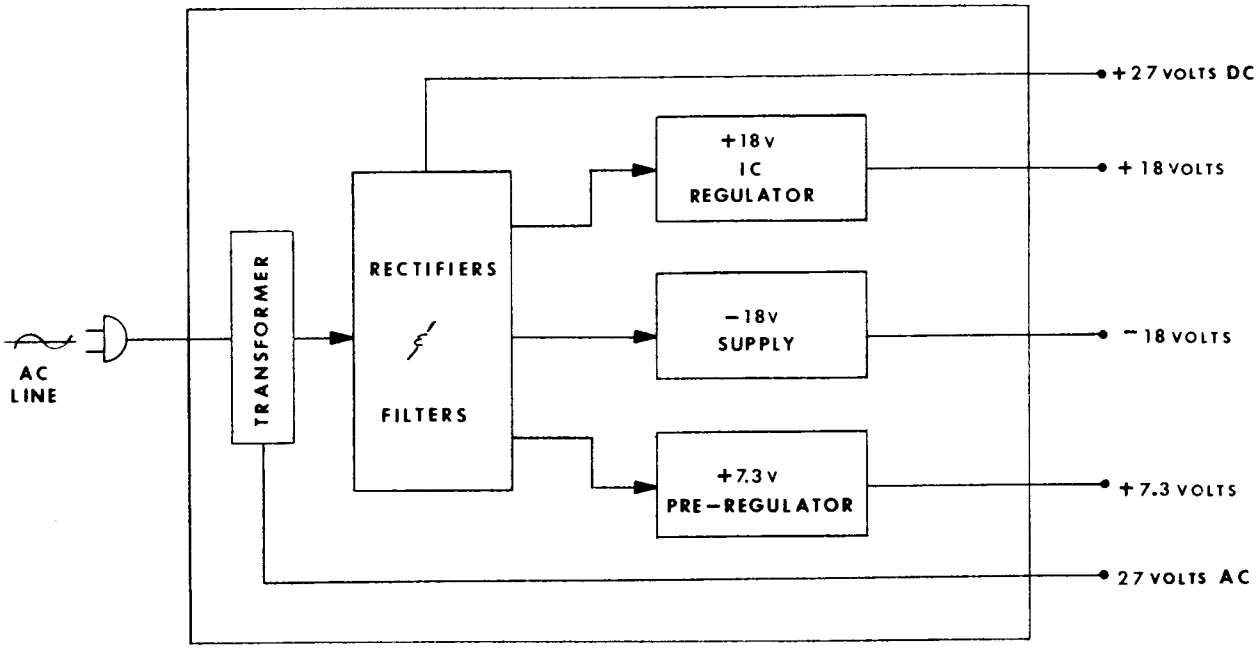


Figure 3-10. DPS2A Power Supply

TABLE 3-1. 20's CONVERSION

"MHz" Switch Setting	Original 20's Line	Artificial 20's Line
0	0	0
20	1	1
40	0	0
60	1	1
80	0	0
100	0	1
120	1	0
140	0	1
160	1	0
180	0	1
200	0	0
. . .		

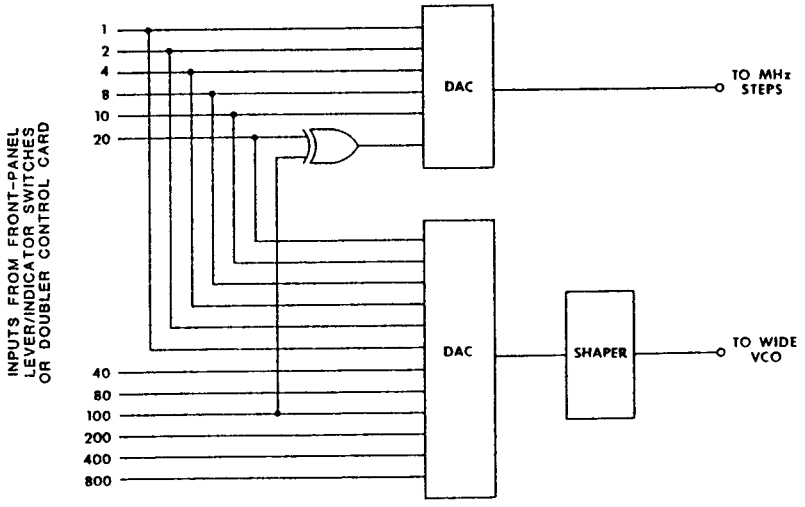


Figure 3-11. M172 Sweep Drive/DAC

3.5.3 −18 V SUPPLY

The −18 V circuit compares the +18 V and −18 V outputs and holds the difference in their magnitudes to zero.

3.5.4 +7.3 V SUPPLY

The +7.3 V circuit uses a three-terminal adjustable voltage regulator IC to provide a pre-regulated +7.3 V output. This voltage supplies other voltage regulators throughout the instrument.

3.6 DOUBLER CONTROL CARD

The Doubler Control Card accepts inputs from the front-panel FREQUENCY switches. When the frequency is 520 MHz or below, the levels are fed directly to the frequency-determining circuits. The electronic switch in the M164 Doubler Module is set to send the generated RF directly to the output attenuator. When the frequency is above 520 MHz, the Doubler Control Card sends half the indicated frequency to the frequency-determining circuits, and sets the M164 to send the generated RF to the doubler circuit.

3.7 M172 SWEEP DRIVE/DAC

Figure 3-11 shows a block diagram of the M172. This module provides two output voltages: one is linear from 0 V to −5 V as the frequency goes from 0 to 39 MHz, repeating every 40 MHz; the other varies from +7 V to −8 V as the frequency goes from 0 to 520 MHz. The second voltage is shaped to linearize the VCO in the M9W Sweep Oscillator.

3.7.1 D-TO-A CONVERTER

Two digital-to-analog converter ICs, programmed from the Doubler Control Card, provide the 0 to 520 MHz voltage. This is shaped in the next section of the module. A third DAC provides the repeating 0 - 40 MHz voltage. Since the state of the 20's line depends on the 100's line (see Table 3-1), the 20's line is inverted when the 100's line is high.

3.7.2 SHAPER

The analog tuning signal from the M22 is "shaped" before driving the M9W wide oscillator. The shaper is an inverting DC amplifier which amplifies the input by a smaller factor for smaller magnitude inputs.

Shaping this analog voltage compensates for the nonlinear change in capacitance of the varactor diodes in the M9W oscillator circuit.

3.8 M9W SWEEP OSCILLATOR

The M9W is the origin of the instrument's RF output frequency. This frequency is generated by heterodyning the signals from two higher frequency voltage controlled oscillators (see Figure 3-12).

3.8.1 MIXER

The Narrow Oscillator applies a signal of 1198 MHz to the mixer. The Wide Oscillator provides between 1199 and 1718 MHz. The difference (1-520 MHz) is applied to a wide band pre-amp and then sent to the Output Amplifier.

3.8.2 WIDE OSCILLATOR

The wide range of oscillation is achieved by applying to varactor diodes in the tank circuit an analog signal which is dependent upon the setting of the frequency switches on the instrument's front panel. An additional signal is applied to the VCO from the phase detector in PLL 4. This is the fine tuning signal which locks the Wide Oscillator on the proper frequency.

3.8.3 NARROW OSCILLATOR

This oscillator also uses a varactor diode so that the frequency can be voltage controlled for phase locking and for FM operation.

The coarse modulating signal (FM) is applied to the varactor from the Modulation Board. The frequency of this oscillator is further controlled by a "fine tuning" bias voltage from the phase detector. The deviation can be controlled up to 100 kHz.

In CW mode the 100 Hz steps are programmed through PLL 3, and thus into the Narrow Oscillator (see Section 3.14).

3.8.4 LEVELERS

This module contains three RF leveling circuits as shown in Figure 3-12. These maintain a constant amplitude RF over the frequency range and with temperature variation. The output of a peak detector is compared to a constant DC level. Any error is amplified and applied to a PIN diode attenuator in series with the RF signal.

3.9 M10W-9 DRIVER AMPLIFIER

The main function of the M10W-9 Driver Amplifier module is to amplify the RF signal from the M9W to a

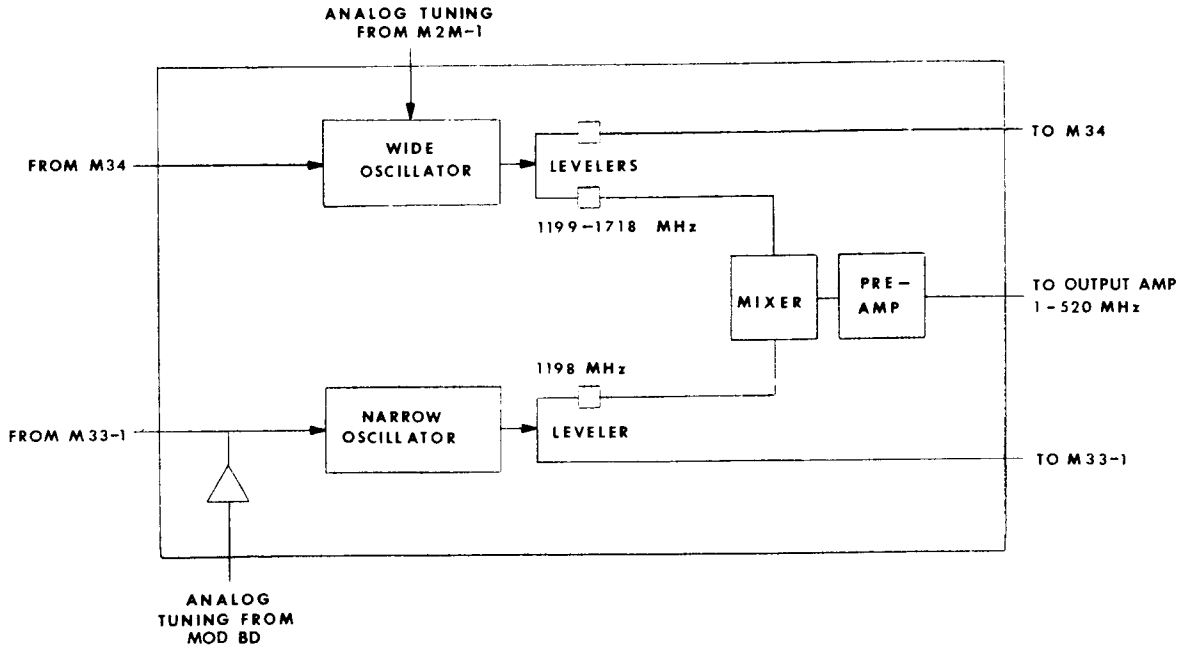


Figure 3-12. M9W Sweep Oscillator

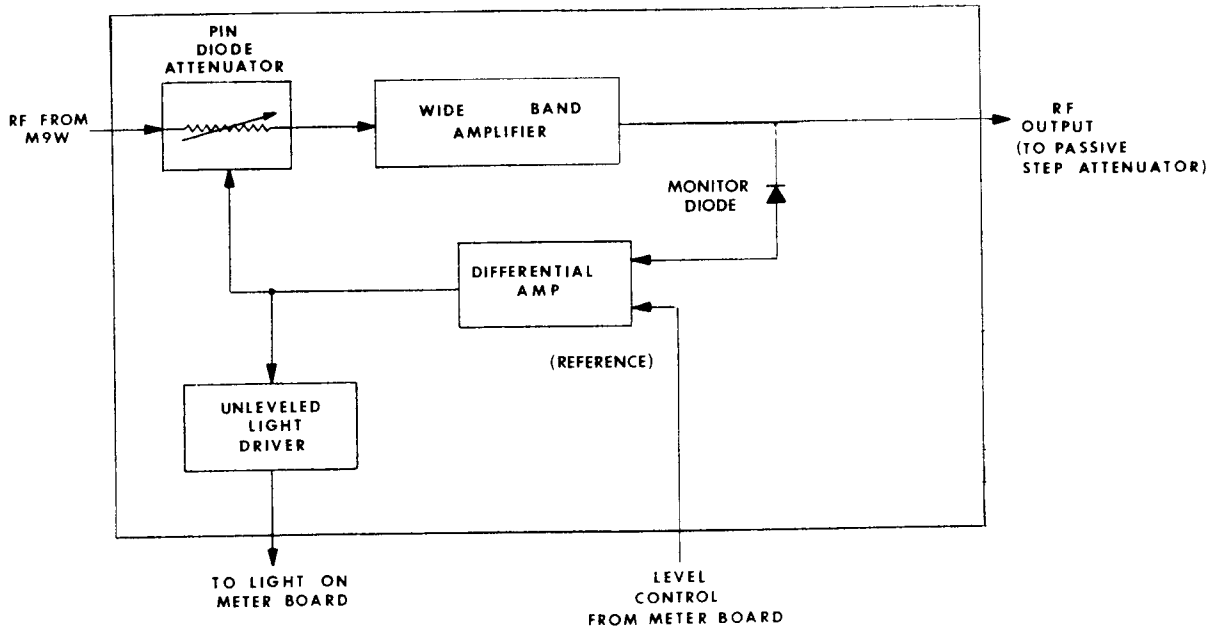


Figure 3-13. M10W-9 Driver Amplifier

(Figure 3-14 deleted.)

level suitable for driving the M164 Doubler module. A leveler circuit maintains a constant amplitude output signal over the wide frequency range. The UNLEVELED light driver causes the front-panel light to glow when the leveler circuit exceeds its proper operating range (see Figure 3-13).

3.9.1 AMPLIFIER

This section is a four-transistor, wide band amplifier which can increase the RF by about 23 dB.

3.9.2 LEVELER

The leveler uses a peak detector, differential amplifier and PIN diode attenuator. The peak detector is fed from the RF output. The resulting level is compared to a DC reference by the differential amp which supplies the control current to the PIN diode attenuator. If the detected RF output deviates from the reference level, the signal to the PIN diode causes the input to be decreased or increased.

In addition to providing a flat frequency response, the leveler allows for electronic control of the RF output amplitude by varying the DC reference. The reference comes from the M164 Doubler.

3.9.3 UNLEVELED LIGHT DRIVER

When the differential amp in the leveler circuit is putting out a voltage which would cause the PIN diode attenuator to be at its high or low resistance limit, the leveling circuit can no longer be effective. These extreme voltage levels, which are applied to the UNLEVELED light driver, are adequate to turn on a source of current for the indicator which appears through the front panel.

3.10 M29-2 FM REFERENCE

The M29-2 is a voltage to frequency converter, the output of which is used as a phase lock reference in the M33-2. The module includes a voltage variable current source which feeds (determines the frequency of) a square wave oscillator (see Figure 3-15). Zero volts in yields 2 MHz out.

The M29-2 is the VCO for PLL 5. The input to the M29-2 from the phase detector is essentially added to the modulation input. The FREQUENCY VERNIER voltage is also added here (VERNIER input becomes zero volts when the VCO is locked).

3.10.1 CURRENT SOURCES

This circuit provides both a positive and a negative source of current. The positive source is referenced to the negative source so that the instantaneous currents in both sources are equal.

The change in output current is directly proportional to the change in input voltage to the circuit. The input voltage may vary between −5 and +5 volts. The circuit is designed for a very linear relationship of current-out vs. voltage in.

3.10.2 OSCILLATOR

The square wave output is produced by the combination of an integrator and a hysteresis switch. The integrator converts a square wave to a triangle wave. The triangle wave causes the hysteresis switch to produce the square wave which is fed back to the integrator.

The integrator is made up of a current switch and a capacitor. The square wave applied to the current switch causes a square current signal to be applied to the capacitor.

Positive constant current produces an increasing voltage ramp on the capacitor and negative constant current produces a decreasing voltage ramp. For a square wave input, therefore, the output is a triangle wave.

Changing the magnitude of the "currents", by changing the input voltage to the module, changes the rate at which the capacitor charges and discharges to the hysteresis points; thus the frequency of oscillation changes.

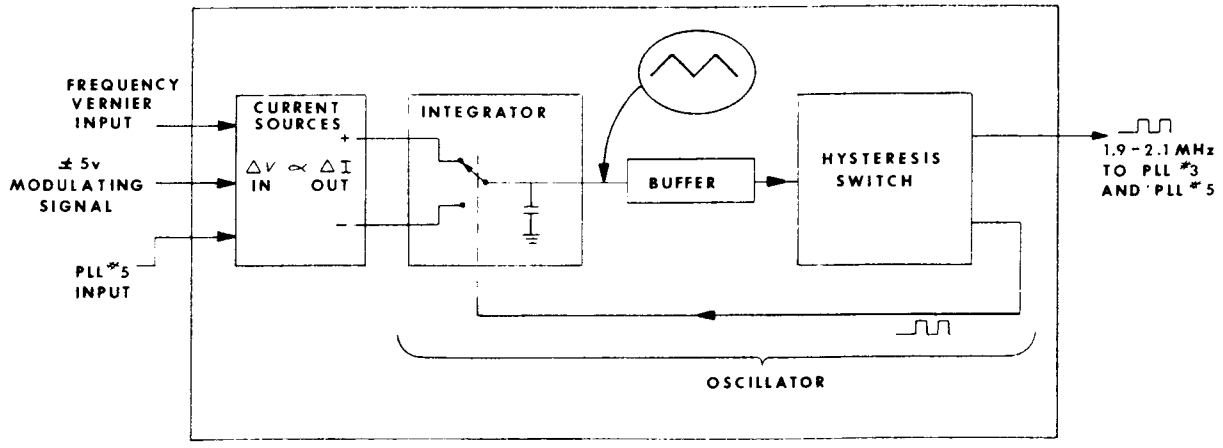


Figure 3-15. M29-2 FM Reference

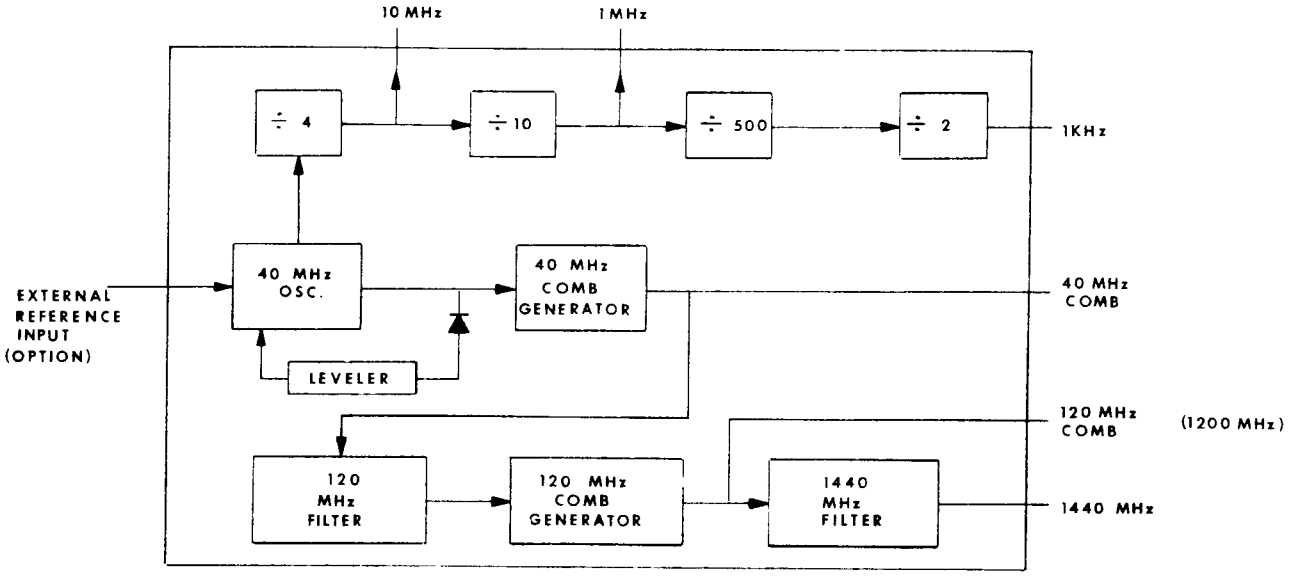


Figure 3-16. M30-5 Crystal Reference

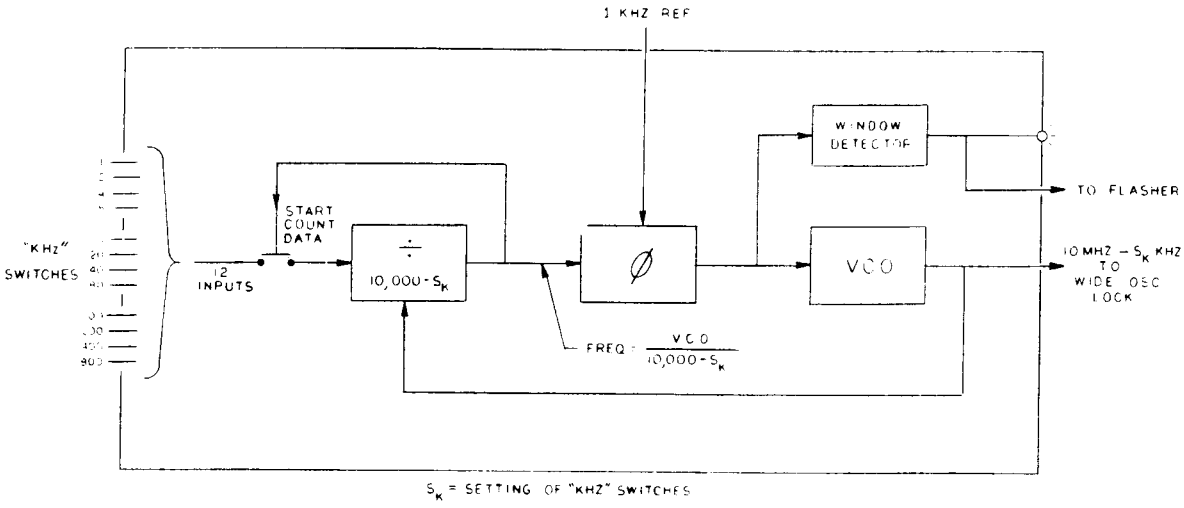


Figure 3-17. M31A kHz Steps

3.11 M30-5 CRYSTAL REFERENCE

This module supplies reference frequencies at 1 kHz, 1 MHz, 10 MHz, 40 MHz and its harmonics, 1200 MHz (from 120 comb), and 1440 MHz to the phase locked loops. These signals are produced by a 40 MHz cyrstal oscillator and a series of dividers and multipliers (see Figure 3-16).

3.11.1 40 MHz OSCILLATOR

This crystal oscillator is the heart of the accuracy of the frequency determining circuits in the instrument. It is temperature compensated for frequency stability. A varactor diode is included to enable this oscillator to be phase locked to a high stability reference. A leveler circuit causes the oscillator output level to be the same in all M30-5 modules.

3.11.2 DIVIDERS

The frequencies below 40 MHz are produced by a series of TTL counters. A "divide by 4" produces the 10 MHz output for the phase-locked loop in the optional high stability reference. This frequency is further divided as shown in Figure 3-16 to provide the reference outputs.

3.11.3 MULTIPLIERS

The 40 MHz CW is fed to a harmonic generator which produces the comb output.

From the 40 MHz comb, 120 MHz is selected and applied to another harmonic generator. A sample of the 120 MHz comb output is also fed to a filter which provides the 1440 MHz output.

3.12 M31A - kHz STEPS

The input to this module is the BCD data from the three front-panel "kHz" switches (to the right of the decimal point). The output frequency is (10 MHz– Sk kHz), where Sk is the number indicated by the kHz switches. If the frequency is set to 333.333 MHz, for example, the M31A output is 9.667 MHz. The block diagram of the M31A is shown in Figure 3-17.

3.12.1 VCO

The output frequency is generated by a voltage controlled oscillator which is tuneable from 9.001 to 10.000 MHz.

3.12.2 PHASE LOCKED LOOP

Including the VCO is a phase-locked loop permits accurate programmability. The VCO tuning voltage comes from the phase/frequency detector circuit. A 1 kHz signal from the Crystal Reference is applied to one input of the phase detector (IC9). A sample of the VCO output is divided by the programmable divider, and the result is applied to the other input of the phase detector. Any difference in phase or frequency in the signals applied to the phase detector inputs produces an error voltage at the phase detector output, which controls the VCO. The system is stable only when the phase and frequency error is zero, so that the output frequency is phase locked to the 1 kHz reference signal.

3.12.3 PROGRAMMABLE DIVIDER

In order for the M31A to perform properly, the divider is designed to divide the VCO frequency by (10,000–Sk) where Sk is the number set on the "kHz" switches. The divider counts the number of cycles at its input and puts out a pulse when the count reaches 10,000. The starting count is the number shown on the "kHz" switches. For example, if the instrument is set for 222.500 MHz, this circuit would divide by 9.500 (count from 500 to 10,000). Therefore, the variable input to the phase detector would be correct (1 kHz) only if the VCO output were 9,500 MHz.

3.12.4 UNLOCK INDICATOR

When the phase-locked loop is unlocked, the LED on top of the module will light and the front-panel ACCURACY lamps will flash.

A window detector monitors the voltage level which is being fed from the phase detector to the VCO. If the voltage exceeds the normal operating range, power is applied to the module light and the flasher circuit on the Modulation Board.

3.13 M32A - MHz STEPS

The M32A provides, for the M34, a reference frequency which corresponds to the setting on the "MHz" switches (see Figure 3-18). The M32A output range is 1448 to 1487 MHz, which repeats itself with every 40 MHz change of the frequency switches. Any specific M32A output relates to the "MHz" switch setting (Sm) by the equation (Output = (1448 + R) MHz), where R is the Remainder of dividing Sm by 40. If the front-panel is set, for example, for 333.000, R would be 13 (333.000 ÷ 40 = 8 with a Remainder of 13). The output of the M32A would then be 1448 +13 = 1461 MHz.

3.13.1 VCO

The output of the M32A is produced by a voltage controlled oscillator. This VCO is coarsely tuned by the

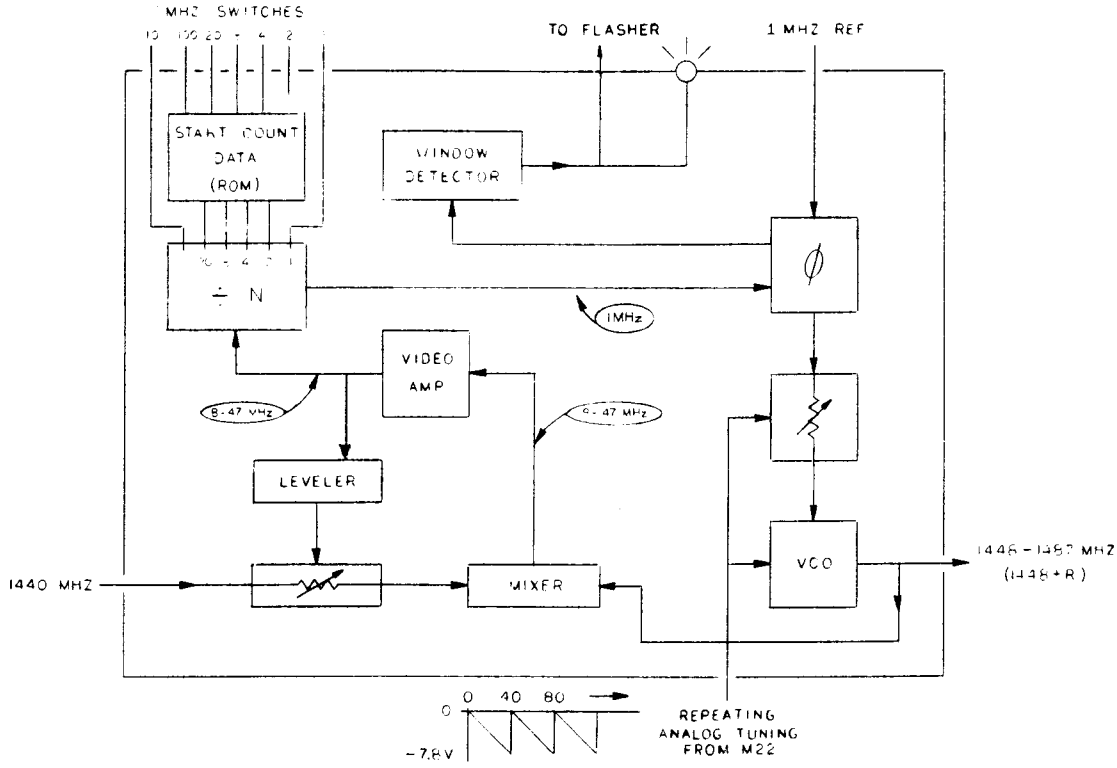


Figure 3-18. M32A MHz Steps

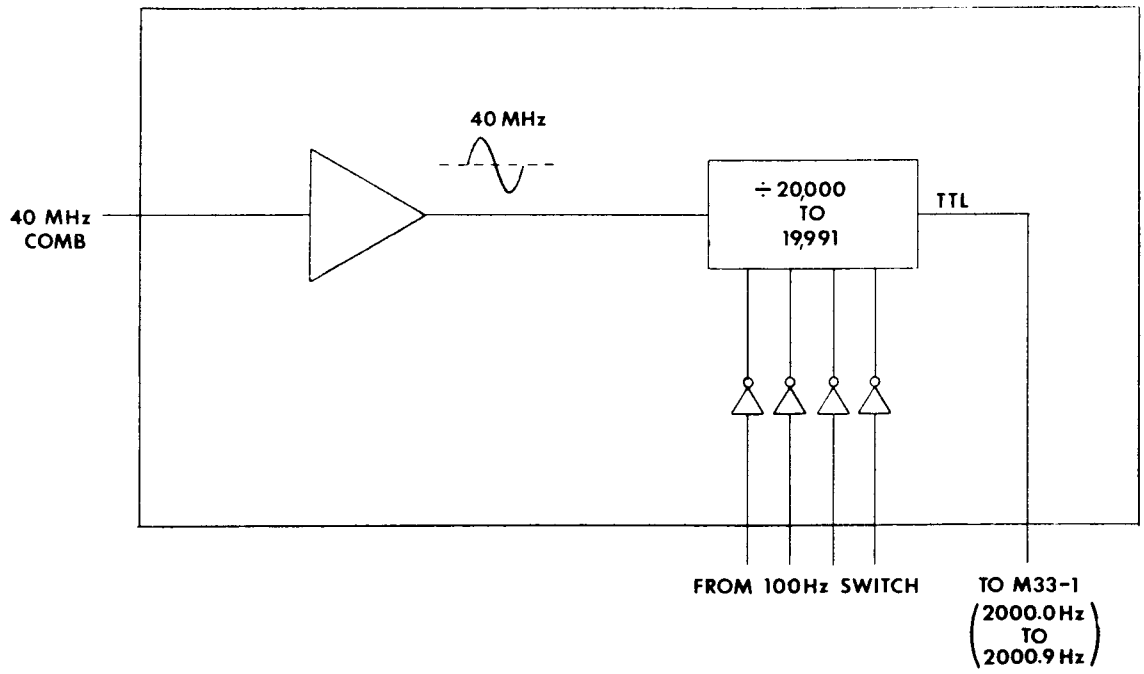


Figure 3-19. M149B 100 Hz Steps

repeating analog output of the M172. Fine tuning is the result of including the VCO in a phase-locked loop. In addition to the VCO, the phase-locked loop includes a phase detector and programmable divider.

3.13.2 PROGRAMMABLE DIVIDER

A sample of the VCO output is mixed with the 1440 MHz signal from the Crystal Reference producing a difference frequency of from 8 to 47 MHz, which is then shaped into TTL pulses and applied to the programmable divider.

The divider counts the falling edges of the 8-47 MHz input pulses, resetting each time a count of 47 is reached. The reset pulse is applied to one input of the phase detector. By controlling the starting count of the programmable divider, the effective divisor can be controlled.

The starting count of the programmable divider is selected by a read only memory, which is programmed to provide the correct "R" information for each "Sm" setting. This "R" is then applied to the programmable divider as the starting count . Thus, as the starting count varies from 0 to 39, the effective divisor varies from 47 to 8.

When the VCO is running at the correct frequency, the programmable divider reset pulse rate will be 1 MHz.

3.13.3 PHASE DETECTOR

One input to the phase detector is the reset pulse from the programmable divider. The other input is a 1 MHz fixed reference signal from the Crystal Reference. The phase detector output is a voltage determined by the difference in phase at the phase detector inputs, and is used to correct any error in the VCO frequency or phase.

If the VCO output frequency is too high, for example, the phase detector output becomes more negative, thus increasing the VCO varactor diode tuning capacitance and lowering the VCO frequency. If the VCO frequency is too low, the reverse occurs. Thus, the loop will tend to maintain zero phase or frequency error. A voltage-controlled attenuator between the phase detector circuit and the VCO keeps the open-loop gain of the phase-locked loop relatively constant over the programmed frequency range, allowing the loop noise to be minimized.

3.13.4 UNLOCKED INDICATOR

When the phase-locked loop is unlocked, the LED on top of the module will light and the front-panel ACCURACY will flash.

A window detector monitors the voltage level being fed from the phase detector to the VCO. If the voltage exceeds the normal operating range, power is applied to the module light and the flasher circuit on the Modulation Board.

3.14 M149B - 100 Hz STEPS

The M149B 100 Hz Steps module allows 100 Hz resolution. The module is essentially a programmable ÷N counter which produces a reference signal for PLL 5 from a reference input from the M30-5 Crystal Reference.

The 40 MHz comb signal from the M30-5 is amplified and fed into the programmable counter which divides the signal by (20000−H) where H is the 100 Hz Lever/Indicator switch setting. For example, if the front-panel switch setting were 214.6127, the counter would divide by 19993 (20000-7). Dividing 40 MHz by 19993 yields a counter output of 2.0007 kHz. The counter output is then used as the reference for PLL 5, and thus ultimately the PLL 3 reference and Narrow Oscillator are offset (shifted) by 700 Hz.

NOTE

Due to the manner in which the 100 Hz steps offset to the Narrow Oscillator is obtained, the exact offsets for each 100 Hz Lever/Indicator switch setting are as follows:

100 Hz SWITCH SETTING	OFFSET (Hz)	ERROR (Hz)
0	000.0000	0.0000
1	100.0050	0.0050
2	200.0200	0.0200
3	300.0450	0.0450
4	400.0800	0.0800
5	500.1250	0.1250
6	600.1801	0.1801
7	700.2451	0.2451
8	800.3201	0.3201
9	900.4052	0.4052

Note that the maximum error is less than 0.5 Hz.

When the FREQUENCY VERNIER is not in its CAL position, PLL 5 is disabled, and the M149B has effectively

no function (100 Hz resolution is not obtainable with the FREQUENCY VERNIER not in CAL).

3.15 M33-2 - NARROW OSCILLATOR LOCK

The M33-2 contains the circuits to phase lock the Narrow Oscillator in the M9W (PLL 3) and the M29-2 FM Reference (PLL 5). As explained in Section 3.2.2, PLL 5 provides the reference frequency for PLL 3.

3.15.1 PHASE DETECTOR FOR PLL 3

This circuit compares the reference frequency to the variable frequency which represents the M9W Narrow Oscillator output. If the frequency is too high, for example, the phase detector puts out a more positive voltage which is filtered and inverted by an integrator, and applied to the Narrow Oscillator to lower the frequency.

3.15.2 MIXER

The phase detector cannot operate at UHF frequencies, so the Narrow Oscillator signal is mixed with 1200 MHz CW. This provides an offset frequency which is the variable input to the phase detector. The deviation of this variable signal from 2 MHz is precisely the same as the deviation of the VCO from 1198 MHz.

3.15.3 PHASE DETECTOR FOR PLL 5

This circuit compares the 2 kHz reference from the M149B 100 Hz Steps module to the variable frequency which is the M29-2 output divided by 1000. The variable frequency is divided by 1000 so that even when M29-2 is frequency modulated, the variable frequency will remain in the capture range of the phase detector. Any frequency modulation (above 50 Hz) is filtered out by the integrator filter and the error voltage is fed to the M29-2.

3.15.4 UNLOCK INDICATOR

Window detectors are fed by the integrator outputs. If the integrators put out a voltage outside their normal operating range, the window detectors apply voltage to the module's unlock indicator and to the flasher circuit on the Modulation Board.

3.16 M34 - WIDE OSCILLATOR LOCK

This module provides the fine tuning program for the Wide Oscillator in the M9W. Figure 3-21 is the block diagram of the M34. The letters A thru F relate the signals at the associated points in the module to the graphs A thru F in Figures 3-22 and 3-23. The M34 phase locks the Wide Oscillator to 1198 MHz plus the frequency indicated on the six high-order front-panel switches (discounting the 100 Hz switch, which affects the Narrow Oscillator). The frequency offset circuit converts the frequency of the VCO to a lower frequency which retains the frequency error information for use by the phase detector. In addition to the frequency offset circuit and the phase detector, several auxiliary circuits are included.

3.16.1 PHASE DETECTOR

The phase detector compares the "offset" Wide Oscillator frequency to the reference frequency from the M31A. (Refer to the description of the M31A for a more detailed description of this 10.000 - 9.001 MHz reference.)

The phase detector output voltage goes positive or negative to ultimately drive the Wide Oscillator higher or lower in frequency until both inputs to the phase detector are the same frequency. The integrator serves as a low pass filter for the phase detector.

3.16.2 FREQUENCY OFFSET CIRCUIT

The Wide Oscillator error information must be converted to a frequency useable by the phase detector. This conversion is made by mixer 1, a 270 MHz low pass filter, mixer 2, and a 10 MHz low pass filter. Refer to Figures 3-21, 3-22 and 3-23 for descriptions of signals.

Mixer 1 heterodynes the Wide Oscillator frequency with the "MHz steps" reference frequency (1448 + R MHz). The difference frequency, | 1448 + R − WO |, is below 270 MHz. This signal is sent to mixer 2 where it is heterodyned with the 40 MHz comb. For any output frequency, graph D in Figure 3-22 shows the comb frequency which will yield the desired output (below 20 MHz) of mixer 2. If PLL 4 is locked, mixer 2 will produce a 10 MHz difference as shown in Figure 3-22 (assuming the "kHz" switches are set for 000). Figure 3-23 shows signals A thru F for a case when the kHz switches are not 000.

The filter after mixer 2 blocks all the outputs of the mixer except the lower frequency signal containing the Wide Oscillator error information. When the unit is unlocked, the filter passes up to 20 MHz (to be able to capture over the 20 MHz range allowed for analog tuning). Once PLL 4 is locked, the filter decreases to 10 MHz to further eliminate phase-locked-loop-related spurious signals.

3.16.3 AUXILIARY CIRCUITS

The "speed-up circuit" is activated when the phase-locked loop becomes unlocked. The output of this circuit is sent to the M9W to cause the Wide Oscillator to be tuned faster

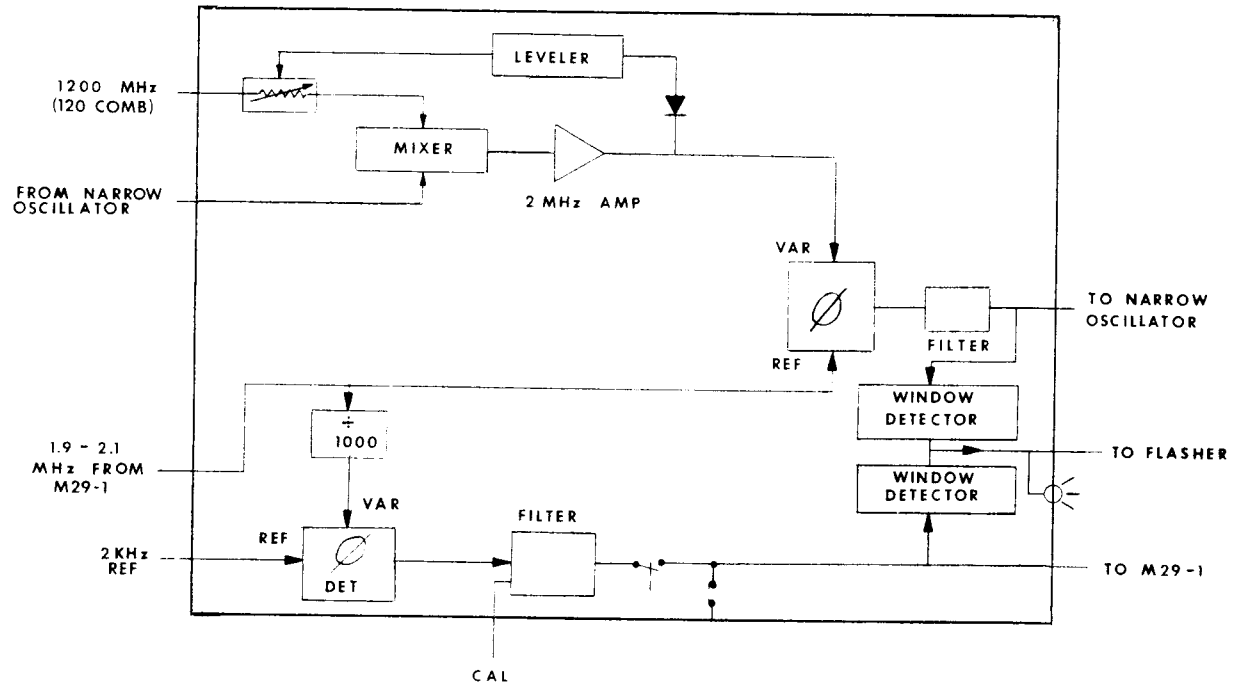


Figure 3-20. M33-2 Narrow Oscillator Lock

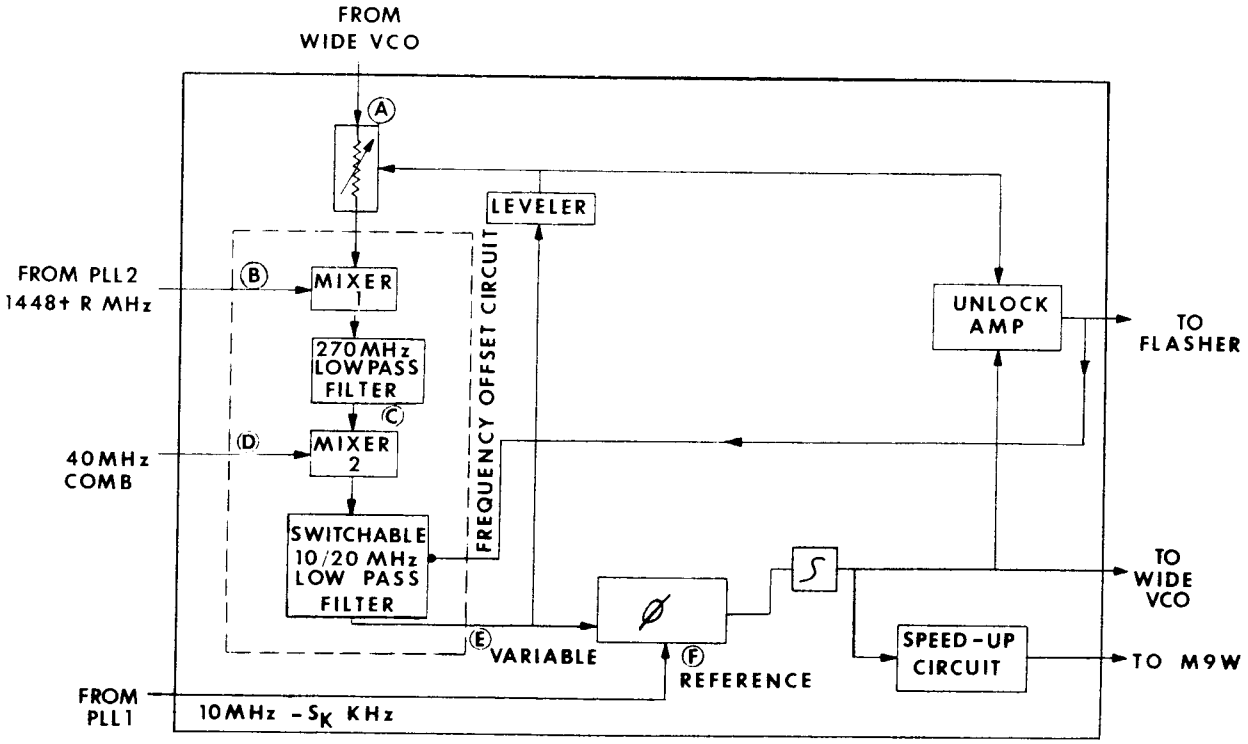


Figure 3-21. M34 Wide Oscillator Lock

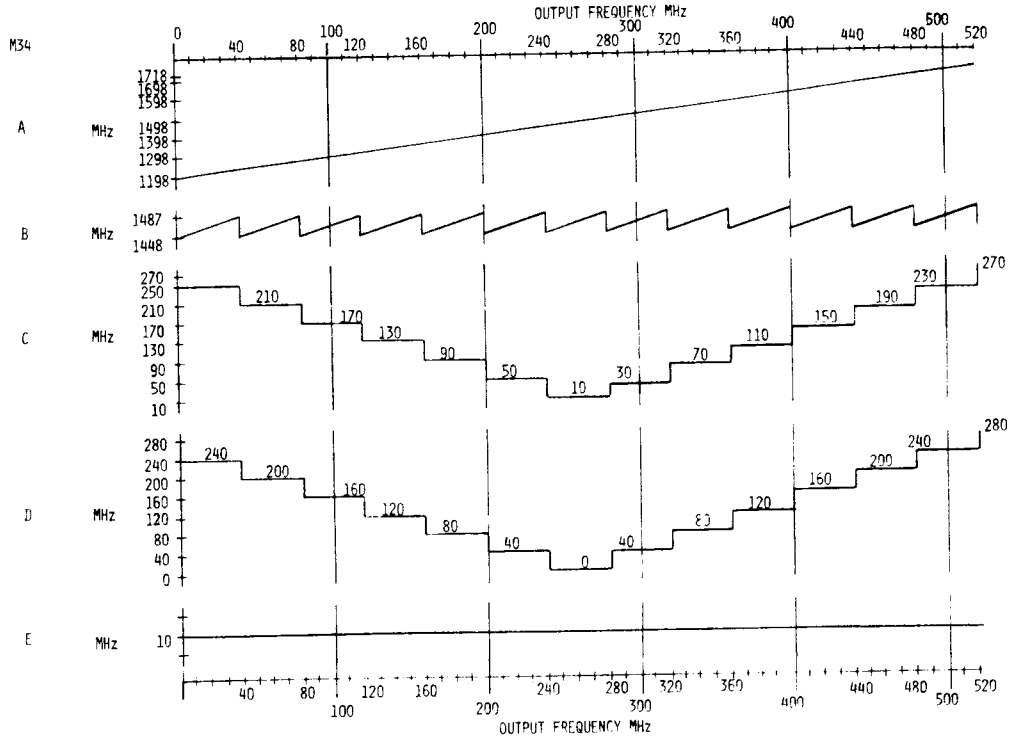


Figure 3-22. M34 Frequencies

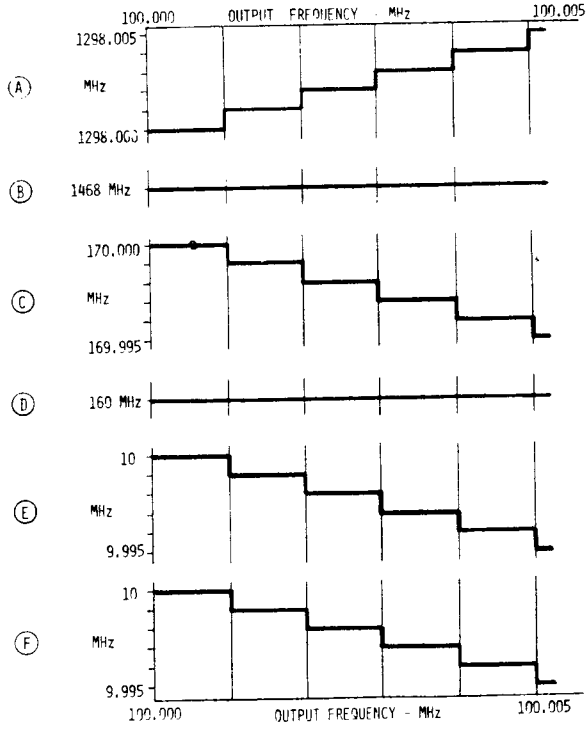


Figure 3-23. M34 Frequencies (Expanded)

by the analog voltage.

The "unlock" amp monitors both the tuning voltage from the phase detector and the leveler voltage to detect an unlocked condition of the M34. When unlock occurs, it sends a voltage to the flasher circuit.

The leveler circuit maintains a constant input amplitude to the phase detector by controlling the amplitude of the input from the M9W Wide Oscillator. The input to the phase detector (about 10 MHz) is peak detected and compared to a DC reference in the leveler circuit. The leveler cirucit controls a PIN diode attenuator which is between the Wide Oscillator input and mixer 1.

3.17 M164 DOUBLER

The M164 contains an electronic switch, a doubler circuit, a wide-band amplifier, and a leveler circuit. See the block diagram, Figure 3-1.

3.17.1 ELECTRONIC SWITCH

The DPDT switch is controlled by the Doubler Control Card. For frequencies below 520 MHz, the input RF is fed directly to the amplifier. For frequencies of 520 MHz and above, the input is fed to the doubler circuit.

3.17.2 DOUBLER CIRCUIT

The doubler circuit is a double-balanced mixer. The input frequency is mixed with itself, producing the original frequencies, the sum (twice the input) and the difference (zero). A high-pass filter ensures that only the doubled frequency goes to the output. A tracking low-pass filter eliminates harmonics.

3.17.3 WIDE-BAND AMPLIFIER

The amplifier consists of a single transistor, with feedback to flatten the gain as frequency changes. Precise flatness is accomplished by the leveler circuit.

3.17.4 LEVELER CIRCUIT

The monitor diode samples the RF output level; the resulting voltage is compared with the output vernier voltage from the Meter Board. For AM the modulating waveform is the reference voltage. The difference voltage controls the voltage-variable attenuator, setting the proper input level.

SECTION 4
PERFORMANCE TESTS

4.1 INTRODUCTION

The purpose of the performance tests in the following sections is to verify that the Signal Generator meets its published specifications (Section 1.2). Individual performance tests consist of: the specification to be verified, the method of testing, a list of equipment required, and a detailed test procedure including, in some cases, a simplified setup drawing. If optional features are installed in the instrument, refer to Section 8 for possible changes to the performance test procedure.

Critical specifications for each item of test equipment are listed in Table 4-1, Recommended Test Equipment. Except as detailed, settings of test equipment apply to performance test procedures. All other test equipment operating details are omitted.

The Signal Generator should have its top and bottom covers installed for the performance tests. All of the tests can be performed without access to the internal controls. Before applying power to the Signal Generator, see Section 2 for details of electrical installation. The line voltage should be maintained at 115 or 230 volts ±10%, 50 to 400 Hz throughout the tests. The performance test procedures are begun after a two-hour minimum warmup of the Signal Generator in a +20 to +30° C ambient temperature range.

A copy of the Performance Test Record (PTR) is provided at the end of this section for convenience in recording the performance of the Signal Generator during performance tests. It can be filled out and used as a permanent record for incoming inspection, or it can be used as a guide for routing performance testing. The PTR lists the section, test, and specification limits. All tests refer to this record.

TABLE 4-1. RECOMMENDED TEST EQUIPMENT FOR PERFORMANCE TESTS

INSTRUMENT	CRITICAL REQUIREMENT	RECOMMENDED
(1) Digital Multimeter	10 VDC: ±(0.07%R+0.02%FS)	Dana 4200
(2) Distortion Analyzer	Range: 5 Hz to > 25 kHz	HP334A
(3) Frequency Counter	Range: 1 GHz	Racal-Dana 9919
(4) Function Generator	Level: 10 Vpp sine wave into 600 ohm load Range: > 0.2 Hz to > 25 kHz Distortion: < 1%	Wavetek 130
(5) Power Meter	Range: .1 to 4 GHz Input Level: −7 to +13 dBm Accuracy: ±1%FS	HP435A/8482A
(6) Modulation Meter	Range: .15 to 1300 MHz Residual FM: < 100 Hz (RMS) (quiet room) Residual AM: ±0.1% (RMS) (in CW) AM Accuracy: ±(2%R+1%FS)	HP8901
(7) Oscilloscope	Range: DC to 2 MHz Sensitivity: 2 V/cm (AC coupled)	Tektronix D10/ 5A18N/5B10N
(8) Spectrum Analyzer	Range: .01 to 23 GHz Display: 2 dB log and 10 dB log	HP8559A/182T
(9) Precision Attenuator Pads	10, 20, 30, and 40 dB	Weinschel 50-10, 50-20, 50-30, and 50-40
(10) Wideband Amplifier	Range: 1 to 1300 MHz Gain: 26 dB Impedance: 50 ohm	HP8447D
(11) Signal Generator	Range: 1 to 999.9999 MHz	Wavetek 3010
(12) VSWR Bridge	5 to 2000 MHz, 50 ohm 50 dB directivity	Wiltron 60N50
(13) Coaxial Short	Type N female	HP11511A
(14) Coaxial Termination 50 ohm	Type N male, 1.05 SWR	HP908A
(15) 50 ohm Load	----------	HP11593A
(16) Loop Probe	----------	See Figure 4-5

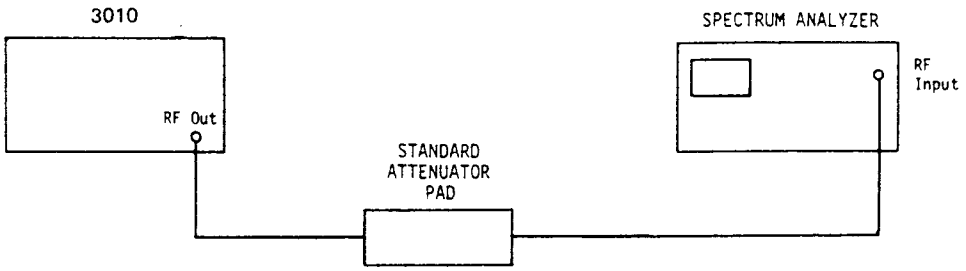


Figure 4-1. Test Set-up

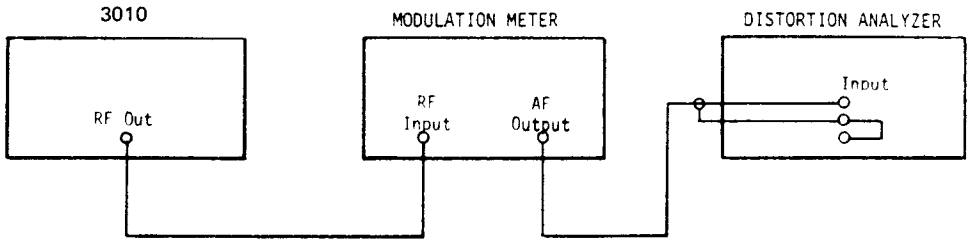


Figure 4-2. Test Set-up

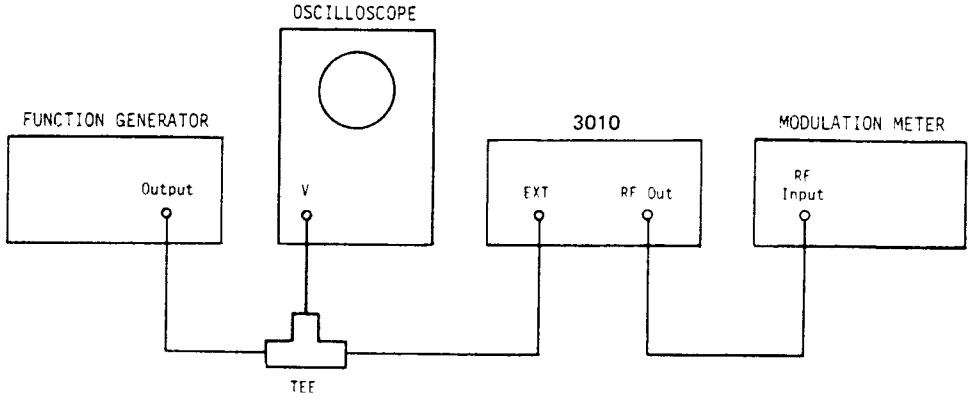


Figure 4-3. Test Set-up

4.2 FREQUENCY RANGE AND RESOLUTION TEST

SPECIFICATION	MIN FREQ	MAX FREQ	RESOLUTION
Model 3010	1 MHz	999.9999 MHz	100 Hz

METHOD

A frequency counter is used to measure frequency range and resolution. Each digit of the Lever/Indicator switches (a total of 70) will be tested.

EQUIPMENT

(3)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	050.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Connect the front panel RF OUT connector to the appropriate input of the frequency counter as indicated in the following table. Use a BNC Tee and a 50 ohm terminator at the 1 MΩ input of the counter.

3. Step through each Lever/Indicator switch digit and verify that the the actual counter frequency increase per step is equal to the allowable increase per step ±1 count (see following table).

COUNTER INPUT	LEVER/INDICATOR SWITCH SETTINGS	COUNTER RESOLUTION	INCREASE/STEP (±1 COUNT)
1 MΩ Low Range	050.0000-050.0009	10 Hz	100.0 Hz
1 MΩ Low Range	050.0000-050.0090	100 Hz	1.00 kHz
1 MΩ Low Range	050.0000-050.0900	100 Hz	10.000 kHz
1 MΩ Low Range	050.0000-050.9000	1 kHz	100.0 kHz
1 MΩ Low Range	050.0000-059.0000	1 kHz	1.000 MHz
50 Ω High Range	100.0000-190.0000	1 kHz	10.000 MHz
50 Ω High Range	020.0000-500.0000	1 kHz	100.000 MHz
50 Ω High Range	520.0001-520.0009	10 Hz	100.0 Hz
50 Ω High Range	520.0000-520.0090	100 Hz	1.00 kHz
50 Ω High Range	520.0000-520.0900	1 kHz	10 kHz
50 Ω High Range	520.0000-520.9000	1 kHz	100 kHz
50 Ω High Range	520.0000-529.0000	1 kHz	1 MHz
50 Ω High Range	520.0000-590.0000	1 kHz	10 MHz
50 Ω High Range	590.0000-990.0000	1 kHz	100.000 MHz

4. Verify the instrument frequency range by setting the Lever/Indicator switches to the minimum and maximum specified frequencies and noting the frequency counter readings.

5. If both the resolution (step 3) and range (step 4) are correct, place a check mark on line 1 of the PTR.

4.3 FREQUENCY ACCURACY TEST

SPECIFICATION

All modes (CW, AM and FM) ±0.001% after 15 minutes. ±0.001% + 10 kHz when FREQUENCY VERNIER is not in CAL position. (FREQUENCY VERNIER range is ±3 kHz below 520 MHz, ±6 kHz at 520 MHz and above.)

METHOD

A frequency counter is used to measure frequency accuracy. With the FREQ VERNIER in CAL position, all carrier frequencies are derived from a single crystal-controlled oscillator. The instrument will be tested at one CW frequency to verify that the crystal-controlled oscillator operates within specified limits.

When the FREQ VERNIER is not in CAL position, the carrier frequencies are derived from a voltage-controlled oscillator in addition to the crystal-controlled oscillator. Frequency accuracy with the FREQ VERNIER not in CAL position will be measured by utilizing DC modulation equal to maximum peak sinusoidal modulation in both FM modes. The FREQ VERNIER range will be tested in CW mode.

EQUIPMENT

(3)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	040.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Connect the 50 Ω input of the frequency counter to the RF OUT connector.

3. The counter should read between 39,999.59 and 40,000.41 kHz. Record the counter reading to seven places on line 2 of the PTR.

4. Set the FREQ VERNIER control to 0 kHz. The frequency counter should read between 39,989.59 and 40,010.41 kHz. Record the counter reading to 7 places on line 3 of the PTR.

5. Set the FREQ VERNIER to +3 kHz, and make a note of the counter reading in Hz.

6. Subtract the frequency counter reading in Step 4 from the reading in Step 5. The frequency difference should be between 2500 and 3500 Hz. Record the difference on line 4 of the PTR.

7. Set the FREQ VERNIER to -3 kHz and subtract the frequency counter reading from the reading at 0 kHz in Step 4. The difference should be as in Step 6. Record the difference in Hz on line 5 of the PTR.

NOTE: Because of the frequency doubling technique used in this instrument, the FREQ VERNIER range is ±6 kHz for output frequencies of 520.0000 MHz and higher.

4.4 FREQUENCY STABILITY TEST

SPECIFICATION

All modes (CW, AM, and FM) < 0.2 ppm/hour
(500 Hz per 10 min when FREQ VERNIER is not in CAL position for frequencies up to 519.9999 MHz, 1 kHz per 10 min for frequencies of 520 MHz and higher.)

METHOD

The frequency stability is measured with a frequency counter at the indicated time intervals after a 2 hour minimum warmup.

EQUIPMENT

(3)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	500.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	N/A
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Connect the 50 Ω input of the frequency counter to the RF OUT connector.

3. Allow the instrument to warm up for at least 2 hours. After the warm-up, record the frequency counter readings to nine places at 15-minute intervals for a one-hour period. The difference between the maximum and minimum readings in the one-hour period should not exceed 100 Hz. Record the difference between the maximum and minimum readings in Hz on line 6 of the PTR.

4. Set the front-panel FREQ VERNIER to 0 kHz. After a one-minute interval, record the frequency counter readings to nine places at five-minute intervals for a ten-minute period. The difference between the maximum and minimum readings in the ten-minute period should not exceed 500 Hz. Record the difference between the maximum and minimum frequency readings in Hz on line 7 of the PTR.

4.5 OUTPUT LEVEL ACCURACY TESTS

SPECIFICATION

Power Level: +13 to -137 dBm (1 V to 0.03 μV)

Attenuator Range: Continuously adjustable in 10 dB steps and an 11 dB VERNIER. Output level is indicated on a front-panel METER calibrated in dBm and volts RMS.

Total Level Accuracy:

	1 to 10 MHz	10 to 500 MHz	500 to 999.9999 MHz
+13 to -7 dBm	± 2.0 dBm	± 1.5 dBm	± 1.5 dBm
-7 to -137 dBm	± 2.75 dBm	± 2.25 dBm	± 3.0 dBm

Accuracy Breakdown:

Flatness: ± 1.5 dB 1 to 10 MHz; ± 1.0 dB 10 to 999.9999 MHz
Output Meter: ± 0.5 dB
Step Attenuator: ±0.75 dB 1 to 500 MHz; ±1.5 dB 500 to 999.9999 MHz

METHOD

The level accuracy between +13 and -7 dBm is the sum of the flatness for the given frequency ranges and the meter error. Both errors are measured with a power meter.

The output METER error is measured at 200 MHz in two 10 dB output ranges (+13 to +3 dBm and +3 to -7 dBm).

The flatness is measured relative to 200 MHz in 1 MHz steps from 1 to 10 MHz and in 10 MHz steps from 10 to 999.9999 MHz at +12, -3, and -7 dBm output levels.

The level accuracy below -7 dBm depends upon the OUTPUT Step Attenuator error in addition to the output METER error and the flatness. No Step Attenuator pads are active in +10 dBm and 0 dBm positions.

The OUTPUT Step Attenuator error is measured by an RF substitution method. Each of the five pads in the OUTPUT Step Attenuator is measured at 999 MHz. The second 30 dB pad and the 40 dB pad are measured in combination with other pads. A reference output level is set with a power meter. A reference trace is obtained with a spectrum analyzer and a standard attenuator pad. The standard pad is removed and the OUTPUT Step Attenuator position to be measured is substituted. The spectrum analyzer trace is returned to the reference level by resetting the output level. The resulting instrument output level is measured and compared to the original power meter reference level. A 26 dB RF amplifier is required to boost signal levels below the -60 dBm level.

The test may be repeated at other frequencies as desired.

4.5.1 OUTPUT METER ACCURACY TEST

EQUIPMENT

(5)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	200 MHz
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Calibrate the power meter and power sensor. Set the power meter to the +15 dBm range. Connect the power sensor to the front-panel RF OUT connector. (When reading the power meter, set the range switch so that the meter indicates between 0 and -5 dBm.)

NOTE: The indicated output level of the instrument is equal to the sum of the output METER reading and the Step Attenuator setting. The difference between the actual power meter reading and the indicated output level is the output METER error. For example, the indicated output level is +13 dBm for an output METER reading of +3 dBm and an OUTPUT Step Attenuator setting of +10 dBm. If the power meter reading is +13.15

dBm, the output METER error is +0.15 dB.

3. Adjust the front-panel OUTPUT VERNIER for a +3 dBm output METER reading. Observe the power meter reading and make a note of the output METER error to the nearest 0.05 dB (¼ division). Continue to adjust the OUTPUT VERNIER for output METER reading increments of 1 dB between +3 and -7 dBm, and note the output METER error at each reading. As the test progresses, make a note of the maximum output METER error to the nearest 0.05 dB. The allowable error is ±0.5 dB. Record the maximum output METER error on line 8 of the PTR.

4. Set the instrument OUTPUT Step Attenuator to 0 dBm and repeat step 3 above. Record the maximum output METER error on line 9 of the PTR.

4.5.2 FLATNESS TEST

EQUIPMENT

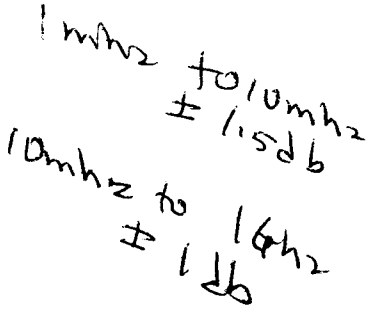
(5)

PROCEDURE

1. Set the instrument controls as in Section 4.5.1.

2. Set the power meter to the +15 dBm range. Connect the power sensor to the front-panel RF OUT connector.

3. Adjust the front-panel OUTPUT VERNIER for a +13 dBm power meter reading.



4. Set the instrument frequency selector in 10 MHz steps between 10 and 999 MHz and observe the maximum change in the power meter readings from +12 dBm reading in step 3. The maximum allowable change is ±1.0 dB. Record the maximum change to the nearest 0.05 dB (¼ division) on the right half of line 10 of the PTR. Repeat this procedure except switch the instrument in 1 MHz steps from 1 MHz to 10 MHz. The maximum allowable change is ±1.5 dB. Record the results in the left half of line 10 of the PTR.

5. Set the Lever/Indicator switches to 100.0000 MHz and adjust the OUTPUT VERNIER for a +3 dBm power meter reading.

6. Repeat step 4 above except observe the maximum change in the power meter readings from the +3 dBm reading in step 5. Record the maximum change from the +3 dBm reading to the nearest 0.05 dB on the right half of line 11 of the PTR, for 10 to 999.999 MHz. Use the left half of line 11 to record the results from 1 to 10 MHz.

7. Set the Lever/Indicator switches to 200.0000 MHz and the OUTPUT Step Attenuator to 0 dBm. Adjust the OUTPUT VERNIER for a -7 dBm power meter reading.

8. Repeat step 4 above except observe the maximum change in the power meter readings from the -7 dBm reading in step 7. Record the maximum change from the -7 dBm reading to the nearest 0.05 dB on line 12 of the PTR.

4.5.3 STEP ATTENUATOR ACCURACY TEST

EQUIPMENT

(5) (8) (9) (10)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	999.9999
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	0 dBm
OUTPUT VERNIER	fully clockwise

2. Set the power meter to the +5 dBm range. Connect the power sensor to the RF OUT connector.

3. Adjust the OUTPUT VERNIER control for a +1 dBm power meter reading.

4. Disconnect the power sensor from the front-panel RF OUT connector. Connect a standard 10 dB attenuator pad to the RF OUT connector. Connect the output of the attenuator pad to the spectrum analyzer as shown in Figure 4-1.

5. Set the spectrum analyzer to 999 MHz, the bandwidth to 10 kHz, the frequency span per division to 1 kHz, and the tuning stabilizer switch on. Set the video filter to 100 Hz and the vertical display to 2 dB per division.

6. Use the log reference controls to obtain a peak trace one division below the log reference line of the spectrum analyzer display. Center the trace in the display with fine tuning.

7. Set the OUTPUT Step Attenuator to -10 dBm.

8. Disconnect the 10 dB attenuator pad from the setup and reconnect the spectrum analyzer to the RF OUT connector.

9. Adjust the OUTPUT LEVEL VERNIER to realign the peak of the trace one division below the log reference line as in step 6.

10. Disconnect the cable from the front-panel RF OUT connector. Connect the power sensor and set the OUTPUT Step Attenuator to 0 dBm.

11. Observe the difference between the actual power meter reading and the +1 dBm reference setting in step 3. The difference or error should be ±1.5 dB maximum. Record the error on line 13 of the PTR.

12. Repeat steps 3 through 11 using the standard attenuator pads and the instrument OUTPUT Step Attenuator settings indicated in the following table.

Step 4 and 8 Attenuator pad (dB)	Step 7 OUTPUT Step Attenuator setting (dBm)	Step 11 Record Error on Line of PTR
10	-10	13
20	-20	14
30	-30	15
60	-60	16
90	-90	17

NOTE: To test the OUTPUT Step Attenuator below -20 dBm, and RF amplifier (> 20 dB gain) is required. Insert the 26 dB wideband amplifier between the standard attenuator pad and the spectrum analyzer (Figure 4-1). The OUTPUT Step Attenuator can be tested down to the -130 dBm position if a 40 dB RF amplifier is used and if precautions are taken to properly shield the RF output from the instrument proper.

The test may be repeated at other frequencies as desired. Below 500 MHz, maximum allowable error is ±0.75 dB.

4.6 HARMONICS TEST

SPECIFICATION

< -26 dBc from 1 to 10 MHz at +13 dBm
< -20 dBc from 1 to 10 MHz at +3 dBm
< -30 dBc from 10 MHz to 1 GHz

METHOD

A spectrum analyzer is used to measure harmonics in the frequency range of the instrument at +13 and +3 dBm output levels.

NOTE: Use the analyzer reference level control to maintain a constant reference level as instrument frequency is changed.

EQUIPMENT

(8)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	001.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Connect the spectrum analyzer to the instrument RF OUT connector.

3. Set the spectrum analyzer to measure harmonic distortion for fundamental frequencies below 10 MHz. Set the display to 10 dB/div. Locate the zero reference at the left edge of the graticule and adjust the fundamental amplitude to the log reference line (0 dB) in the display.

4. Increase the Lever/Indicator switch setting in 1 MHz steps up to 10 MHz. Record the maximum harmonic level observed (should be < -26 dBc) on line 18 of the PTR.

5. Set the OUTPUT Step Attenuator to 0 dBm and repeat steps 3 and 4. Record the maximum harmonic level observed on line 19 of the PTR. (Should be < -20 dBc.)

6. Set the front-panel frequency selector to 10 MHz and the OUTPUT Step Attenuator to +10 dBm.

7. Set the spectrum analyzer to measure the harmonic distortion of the instrument for fundamental frequencies between 10 and 999 MHz.

8. Increase the setting of the front-panel Lever/Indicator switches in 10 MHz steps between 10 and 999 MHz while observing the spectrum analyzer display. The harmonics should be > 30 dB below the fundamental. Note the maximum harmonic level observed in the display, and record the greater harmonic level observed in step 6 and step 9 for an OUTPUT Step Attenuator setting of +10 dBm on line 10 of the PTR.

9. Set the instrument OUTPUT Step Attenuator to 0 dBm and repeat steps 7 and 8 at the +3 dBm output level. Note the maximum harmonic level observed, and record the greater harmonic level observed in step 6 and step 10 for an OUTPUT Step Attenuator setting of 0 dBm on line 21 of the PTR.

4.7 NON-HARMONIC TEST

SPECIFICATION

Fundamental Range (MHz)	Non-harmonic Range (MHz)	Non-harmonic Level (dBc)
1 to 3	1 to 3	
below 3	below 3	< -60
3 to 250	3 to 250	< -65
3 to 350	3 to 350	< -55
3 to 519	3 to 1000	< -35
520 to 999	10 to 2000	< -30

METHOD

A spectrum analyzer is used to measure the level of nonharmonics in the frequency range of the instrument at the maximum specified output level of +13 dBm.

EQUIPMENT

(8)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	001.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF

EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Connect the front-panel RF OUT connector to the RF input of the spectrum analyzer.

3. Set the spectrum analyzer to measure the non-harmonic content of the instrument output between 0 and 3 MHz. Set the bandwidth to 30 kHz, the frequency span per division to 1 MHz, and the display to 10 dB/div. Locate the zero reference at the left edge of the graticule, and adjust the fundamental to the log reference line (0 dB) in the display.

4. Increase the setting of the Lever/Indicator switches in 0.1 MHz steps between 1 and 3 MHz. The non-harmonic below 3 MHz should be 60 dB below the fundamental. Record the maximum non-harmonic observed in the display below 3 MHz in dB below the fundamental on line 22 of the PTR.

5. Set the spectrum analyzer to measure the non-harmonic content of the instrument output between 3 and 250 MHz. Set the bandwidth to 300 kHz and the frequency span per division to 100 MHz.

6. Increase the settings of the Lever/Indicator switches in 1 MHz steps between 3 and 10 MHz, and in 10 MHz steps between 10 and 999 MHz while observing the spectrum analyzer display. Using the table below, record the maximum non-harmonic level observed in each range on the applicable line of the PTR.

7. Use the HP8559A (.01-21 GHz) spectrum analyzer to measure non-harmonics above 1 GHz.

FUNDAMENTAL RANGE (MHz)	NON-HARMONIC RANGE (MHz)	NON-HARMONIC LEVEL (dBc)	PTR LINE NUMBER
3-250	3-250	< -65	23
3-350	3-350	< -55	24
3-520	3-1000	< -35	25
500-999	10-2000	< -30	26

4.8 RESIDUAL AM TEST

SPECIFICATION

< -65 dBc in a 50 Hz to 15 kHz post-detection bandwidth.

METHOD

A modulation meter operating in AM mode is used to demodulate the instrument output at the minimum leveler point where AM noise is maximum. A distortion analyzer (operating in level mode) is used to increase the resolution of the demodulated output of the modulation meter. The system is calibrated at a 10% AM level. The 10% AM is removed and the residual AM is read in dB below the calibrated 10% AM level. 20 dB is added to the reading to relate the residual AM to the carrier.

EQUIPMENT

(2) (6)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	500.0000
FREQ VERNIER	CAL
INT MOD FREQ	1 kHz
INT MOD LEVEL	10% METER reading
INT MOD RANGE	30% AM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	0 dBm
OUTPUT VERNIER	-7 dB

2. Connect the equipment as shown in Figure 4-2.

3. Set the modulation meter to read %AM at 500 MHz. Set the RF input attenuation to 10 dB, the IF bandwidth to ±400 kHz, the meter response to FAST, the function switch to +AM, the range switch to 10 and the filter bandwidth to 50 Hz-15 kHz.

4. Adjust the front-panel INT MOD LEVEL control for a modulation meter reading of 10% AM. NOTE: 10% AM is obtained at a full-scale reading of 100 with the modulation meter range switch set to 10.

5. With the distortion analyzer operating in level mode, calibrate it for a 0 dB meter reading. The system is now calibrated at a reference level of -20dBc. Since the modulating signal and carrier amplitudes are equal at 100% AM, it follows that at 10% AM the modulating signal is -20 dBc.

6. Set the front-panel INTERNAL and EXTERNAL MODULATION RANGE control to OFF.

7. Without disturbing the instrument or modulation meter controls, set the distortion analyzer to read residual AM. Set the range switch so that the meter reads between 0 and -10 dB. First, read the residual AM below the 0 dB reference level in step 5. Then add 20 dB to the above reading to obtain the residual AM below the carrier. (For example, a 48 dB residual AM below the 0 dB reference +20 dB = 68 dB residual AM below the carrier.) The residual AM should be $<$ -65 dBc. Record the residual AM in dB on line 27 of the PTR.

Other frequencies may be tested as desired.

4.9 RESIDUAL FM TEST

SPECIFICATION

$<$ 100 Hz in a 300 Hz to 3 kHz post-detection bandwidth (1 to 520 MHz)
$<$ 200 Hz in a 50 Hz to 15 kHz post-detection bandwidth (1 to 520 MHz)
$<$ 200 Hz in a 300 Hz to 3 kHz post-detection bandwidth (520-999.999 MHz)
$<$ 400 Hz in a 50 Hz to 15 kHz post-detection bandwidth (520-999.999 MHz)

METHOD

A modulation meter which is set to read frequency deviation is used to measure residual FM. The test is performed at maximum frequency and output level. The instrument is operated in an FM mode where the residual FM is greater.

The residual FM is measured in an environment where the noise level is $<$ 60 dB relative to 2×10^{-4} μbar.

EQUIPMENT

(6)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	500.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	100 kHz deviation
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Connect the front-panel RF OUT connector to the 50 ohm RF input of the modulation meter.

3. Set the modulation meter to read FM deviation at 500 MHz. Set the range switch to 3, the RF input attenuation to 20 dB, the IF bandwidth to ±400 kHz, the meter response to fast, and the filter bandwidth to 50 Hz-15 kHz.

4. Measure the average level of the FM deviation on the modulation meter and disregard occasional peaks. The residual FM should be $<$ 200 Hz. Read the residual FM on the modulation meter with the function switch set to +FM and the -FM positions. Record the greater of the two readings in Hz on the left half of PTR line 28.

5. Set the Lever/Indicator switches for 600.000 MHz, and repeat this procedure. The residual FM should be $<$ 400 Hz. Record the reading on the right half of PTR line 28. Other frequencies may be tested as desired.

4.10 INTERNAL MODULATION FREQUENCY ACCURACY TEST

SPECIFICATION

400 Hz and 1 kHz ±2% (plus two user-preset frequencies)

METHOD

A frequency counter is used to measure modulation frequency at the instrument rear-panel MOD TP. Since the internal 400 Hz and 1 kHz oscillators are used for both the AM and FM modes, this will suffice for both modes. NOTE: Internal frequencies A and B are set by the user; therefore, no performance test is given for their accuracy.

EQUIPMENT

(3)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	N/A
FREQ VERNIER	N/A
INT MOD FREQ	400 Hz
INT MOD LEVEL	mid-range
INT MOD RANGE	30% AM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	N/A
OUTPUT Step Attenuator	N/A
OUTPUT VERNIER	N/A

2. Connect the low frequency input of the frequency counter to the MOD TP (pin 36 of the rear-panel jack J101) and the cable shield to ground (pin 25 of J101). (See Figure 2-3 and Schematic 1.)

3. The counter should read between 392 and 408 Hz. Record the counter reading on line 29 of the PTR.

4. Set the front-panel INT MOD FREQ control to 1 kHz.

5. The counter should read between 980 and 1020 Hz. Record the counter reading on line 30 of the PTR.

4.11 PERCENT AM ACCURACY TEST

SPECIFICATION

± (2% of full-scale reading +5% of METER reading) at a frequency of 1 kHz. NOTE: This specification applies at an output of +3 dBm. AM is possible above +3 dBm if the peak of the modulated output does not exceed +13 dBm.

METHOD

The %AM accuracy is measured in both AM ranges with a modulation meter.

EQUIPMENT

(6)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	520.0000
FREQ VERNIER	CAL
INT MOD FREQ	1 kHz
INT MOD LEVEL	30% METER reading
INT MOD RANGE	100% AM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	0 dBm
OUTPUT VERNIER	+3 dB

Connect the modulation meter input to the instrument RF OUT connector. Set the modulation meter to read %AM at 520 MHz. Set the range switch to 100%, the RF input attenuation to 10 dB, the IF bandwidth to ±400 kHz, the meter response to FAST, the function switch to +AM and the filter to 200 kHz.

3. With the METER reading exactly 30% AM, make a note of the modulation meter reading in %AM. Set the modulation meter function switch to -AM, and note the modulation meter %AM reading as before. Compute the average of the two readings. The average %AM should be between 26.5 and 33.5%. Record the average %AM to the nearest 0.5% on line 31 of the PTR.

4. Repeat the above procedure for the settings given in the table below. Other points may be tested as desired.

INT MOD RANGE AND MOD METER RANGE	MOD METER FILTER	INST METER READING	MOD METER READING (MIN)	(MAX)	PTR
100% AM	200 kHz	90%	83.5%	96.5%	32
30% AM	75 kHz	10%	8%	12%	33
30% AM	75 kHz	20%	17.5%	22.5%	34

4.12 AM BANDWIDTH TEST

SPECIFICATION

External, DC to 20 kHz (±3 dB bandwidth), input level required ∿1 VRMS into 600 ohms to provide full-scale adjustment with EXT MOD LEVEL control.

METHOD

The measurement is made with a modulation meter operating in AM mode and a function generator. The function generator supplies an external sine wave to amplitude-modulate the instrument. The system is calibrated at -6 dB on the modulation meter dB scale (approximately 50% AM). The external modulation frequency is increased from 1 kHz to 10 kHz and the AM bandwidth is measured as the change in dB level from the calibration level.

EQUIPMENT

(2) (6)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	050.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	fully counterclockwise
EXT MOD RANGE	100% AM
METER switch	EXT MOD
OUTPUT Step Attenuator	0 dBm
OUTPUT VERNIER	+3 dBm

2. Connect the equipment as shown in Figure 4-3.

3. Set the modulation meter to read %AM at 50 MHz. Set the RF input attenuation to 20 dB, the IF bandwidth to ±400 kHz, the meter response to FAST, the function switch to +AM, the range switch to 100% and the filter bandwidth to 200 kHz.

4. Set the function generator for a 1 kHz sine wave output and the attenuator controls for a 1 VRMS sine wave on the oscilloscope.

5. Adjust the front-panel EXT MOD LEVEL control for a modulation meter reading -6 dB (approximately 50% AM).

6. Maintain the 1 VRMS output level and increase the function generator frequency from 1 to 20 kHz. Observe the modulation meter scale. It should read between -3 and -9 dB. Note the change in dB from the -6 dB calibration level.

7. Repeat steps 4 through 6 with the modulation meter function switch set to -AM. Note the change in dB from the -6 setting as in step 6.

8. Record the larger of the two dB changes obtained in steps 6 and 7 of line 35 of the PTR.

4.13 AM DISTORTION TEST

SPECIFICATION

6% distortion to 70% AM (10% to 90% AM) at a frequency of 1 kHz. NOTE: This specification applies for an output level of +3 dBm. AM is possible above +3 dBm if the peak of the modulated output does not exceed +13 dBm.

METHOD

The measurement is made with a modulation meter and a distortion analyzer which measures the distortion of the demodulated AM from the modulation meter. The measurement is made at the minimum leveler point where the AM distortion is normally greatest.

EQUIPMENT

(2) (6)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	500.0000
FREQ VERNIER	CAL
INT MOD FREQ	1 kHz
INT MOD LEVEL	fully counterclockwise
INT MOD RANGE	100% AM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	0 dBm
OUTPUT VERNIER	-7 dB

2. Connect the equipment as shown in Figure 4-2.

3. Set the modulation meter to read %AM at 500 MHz. Set the RF input attenuation to 10 dB, the IF bandwidth to ±400 kHz, the meter response to FAST, the function switch to +AM, the range switch to 100% and the filter bandwidth to 50 Hz to 15 kHz.

4. Adjust the front-panel INT MOD LEVEL control for a modulation meter reading of 70%. Set the modulation meter function switch to -AM, and observe the modulation meter reading. Readjust the INT MOD LEVEL control until the average of the modulation meter readings in the +AM and -AM positions of the function switch is equal to 70% AM.

5. Calibrate the distortion analyzer and measure the distortion. The distortion should be less than 6%. Record the distortion on line 36 of the PTR.

6. Adjust the front-panel INT MOD LEVEL control as in step 4 until the average of the modulation meter readings in the +AM and -AM positions of the function switch is equal to 90% AM.

7. Calibrate the distortion analyzer and measure the distortion. The distortion should be less than 10%. Record the distortion on line 37 of the PTR.

4.14 FM DEVIATION ACCURACY TEST

SPECIFICATION

±3% of full-scale reading at 1 kHz modulation frequency.

METHOD

The FM deviation is measured in all FM ranges with a modulation meter.

EQUIPMENT

(6)

1. Set the instrument controls as follows:

Lever/Indicator switches	050.0000
FREQ VERNIER	0 kHz
INT MOD FREQ	1 kHz
INT MOD LEVEL	fully counterclockwise

INT MOD RANGE	3 kHz FM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Connect the input of the modulation meter to the instrument RF OUT connector.

3. Set the modulation meter to read FM deviation at 500 MHz. Set the range switch to 3, the RF input attenuation to 20 dB, the IF bandwidth to ±400 kHz, the meter response to FAST, and the filter to 3 kHz.

4. Adjust the INT MOD LEVEL control for a METER reading of exactly 1 kHz deviation. The modulation meter should read an actual deviation of between 910 and 1090 Hz. Record the modulation meter reading on line 38 of the PTR.

5. Repeat steps 3 and 4 for all settings in the table below. As many other points may be tested as desired.

INT MOD RANGE AND MOD METER RANGE	MOD METER FILTER	INST METER READING	MOD METER READING (Hz) (MIN)	(MAX)	PTR LINE
3 kHz	3 kHz	2 kHz	1910	2090	39
10 kHz	15 kHz	3 kHz	2700	3300	40
10 kHz	15 kHz	9 kHz	8700	9300	41
30 kHz	15 kHz	10 kHz	9100	10,900	42
30 kHz	15 kHz	20 kHz	19,100	20,900	43
100 kHz	75 kHz	30 kHz	27,000	33,000	44
100 kHz	75 kHz	90 kHz	87,000	93,000	45

4.15 FM BANDWIDTH TEST

SPECIFICATION

External, 50 Hz to 25 Hz (1 dB bandwidth), input level required ≅ 1 VRMS into 600 ohms to provide full-scale adjustment with EXT MOD LEVEL control (DC to 25 kHz when the FREQ VERNIER is not in CAL position).

METHOD

The measurement is made with a modulation meter and a function generator. The function generator supplies an external sine wave to frequency modulate the output signal. The system is calibrated with a 1 kHz external sine wave at an indicated deviation 1 dB below the 0 dB reference on the modulation meter dB scale (approximately 90 kHz deviation). The external modulation frequency is varied from 1 kHz to 50 Hz, and from 1 kHz to 25 kHz, and the FM bandwidth is measured as the change in dB level from the calibrated level.

EQUIPMENT

(4) (6) (7)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	500.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	fully counterclockwise

EXT MOD RANGE	100 kHz FM
METER switch	EXT MOD
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	-7 dBm

2. Connect the equipment as shown in Figure 4-3.

3. Set the modulation meter to read FM deviation at 500 MHz. Set the RF input attenuation to 20 dB, the IF bandwidth to ±400 kHz, the meter response to FAST, the function switch to +FM, the meter range switch to 300 kHz, and the filter bandwidth to 200 kHz.

4. Set the function generator for a 1 kHz sine wave output and the attenuator controls for a 1 VRMS sine wave on the oscilloscope.

5. Adjust the front-panel EXT MOD LEVEL control for a modulation meter reading of -1 dB (approximately 90 kHz deviation).

6. Maintain the 1 VRMS external input level during this step. Slowly decrease the function generator frequency from 1 kHz to 50 Hz, and then slowly increase the frequency to 25 kHz while observing the dB scale on the modulation meter. It should read between 0 and -2 dB. Note the maximum change from the -1 dB reference (step 5) to the nearest 0.25 dB.

7. Repeat steps 4 through 6 with the modulation meter function switch set to -FM. Note the change from -1 dB reference as in step 6. Record the larger of the two changes in dB (in this step and in step 6) on line 46 of the PTR.

4.16 FM DISTORTION TEST

SPECIFICATION

2% (10 kHz to 100 kHz deviation) at a frequency of 1 kHz.
4% (3 to 10 kHz deviation) at a frequency of 1 kHz.

METHOD

The measurement is made with a modulation meter and a distortion analyzer, which measures the distortion of the demodulated FM from the modulation meter. Distortion below 3 kHz deviation increases because of residual FM noise. The distortion at 3 kHz deviation is measured in an environment where the noise level is < 60 dB relative to 2×10^{-4} μbar.

EQUIPMENT

(2) (6)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	500.0000
FREQ VERNIER	CAL
INT MOD FREQ	1 kHz
INT MOD LEVEL	3 kHz METER reading
INT MOD RANGE	10 kHz FM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	fully clockwise

2. Connect the equipment as shown in Figure 4-2.

3. Set the modulation meter to read FM deviation at 500 MHz. Set the RF input attenuation to 20 dB, the IF bandwidth to ±400 kHz, the meter response to FAST, the function switch to +FM, the meter range switch to 10 kHz and the filter bandwidth to 50 Hz-15 kHz. The modulation meter should read approximately 3 kHz.

4. Calibrate the distortion analyzer and measure distortion. The distortion should be less than 4%.

5. Repeat steps 3 and 4 for FM deviations up to 10 kHz. The distortion at all points should be less than 4%. Record the worst-case distortion on line 47 of the PTR.

6. Repeat steps 3, 4, and 5 for FM deviations of between 10 and 100 kHz. The distortion at all points should be less than 2%. Record the worst-case distortion on line 48 of the PTR.

4.17 IMPEDANCE TEST

SPECIFICATION

50Ω, VSWR 1.2 at RF output levels below 0.1 VRMS.

METHOD

The measurement is made with a VSWR bridge and the return loss is displayed on a spectrum analyzer. An RF signal from a generator is fed to the input of the bridge. A reference level is established by shorting the bridge output port. The short is replaced by the RF impedance of the instrument. The signal generator is tuned from 1 to 999 MHz and the return loss versus frequency is displayed.

EQUIPMENT

(8) (11) (12) (13)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	999.9999
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	-10 dBm
OUTPUT VERNIER	+3 dB

2. Connect the equipment as shown in Figure 4-4. Connect the signal generator to the input port, the spectrum analyzer to the reflected output port, and the coaxial short to the device-under-test port of the VSWR bridge.

3. Set the signal generator output level to -10 dBm, the mode to CW and the frequency to 250 MHz.

4. Set the spectrum analyzer to span 0 to 1000 MHz and the bandwidth to 300 kHz. Use the log reference level controls to calibrate the 250 MHz signal at the top line (0 dB reference) of the display graticule.

5. Disconnect the coaxial short and connect the device-under test port of the VSWR bridge to the front-panel RF OUT connector. Use the signal generator frequency selector to tune from 1 to 999 MHz and verify that the signal level in the display is 21 dB below the 0 dB reference. Disregard the signal at 999.9999 MHz. Record the reading in dB below the reference on line 49 of the PTR.

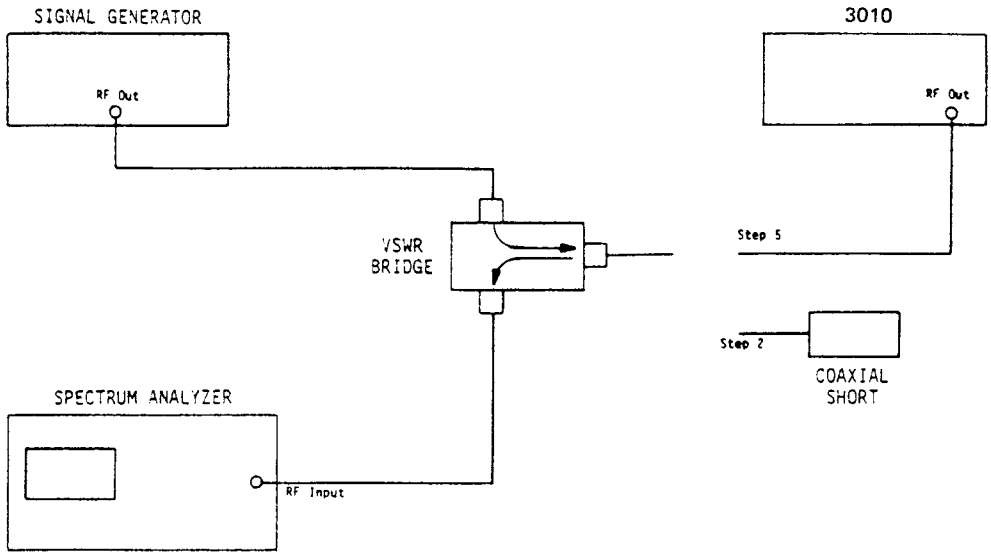
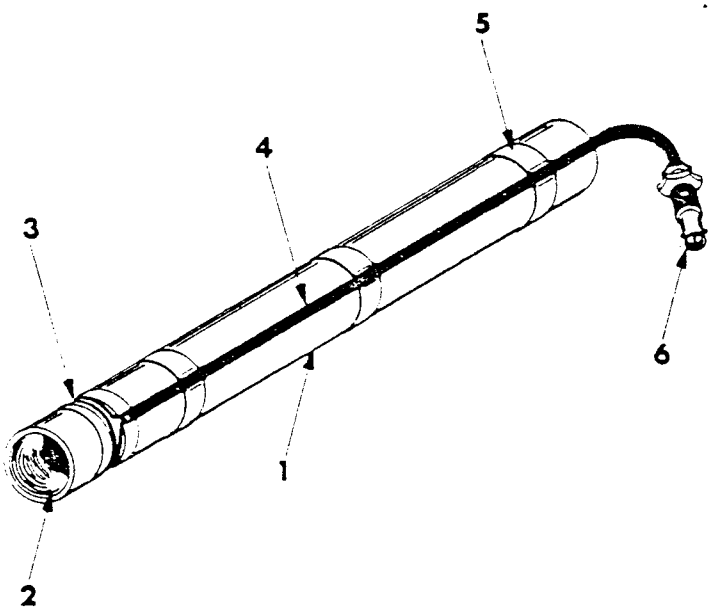


Figure 4-4. Test Set-up



1. Rexolite Rod: 1.25 in. dia. by 11 in.

2. Hole: 1.00 in dia. by 0.80 in. deep.

3. Groove: 0.120 in wide by 0.125 in deep 1.00 in from end of rod.

4. Coaxial Cable: (RG-174/U) 0.110" diameter by 19" long. Strip shield for 7 in, and cut off shield to ½ in length. Strip insulation from center conductor ½ in. Wind 2 turns of insulated center conductor in groove of rod. Solder shield to center conductor, and insulate the solder joint.

5. Wind mylar tape around the two-turn loop, and around the rod (three places).

6. BNC male connector.

Figure 4-5. Loop Probe

4.18 RFI TEST

SPECIFICATION

$< 1.0\ \mu V$ is induced in a two-turn, one-inch diameter loop which is held one inch away from any surface (loop feeds a 50 ohm receiver).

METHOD

A 50 ohm receiver consisting of a 26 dB amplifier and a spectrum analyzer are calibrated at a 1 μV level using the instrument. A loop probe is then connected to the receiver and the leakage is measured at a one-inch distance from the external surfaces of the instrument with the RF OUT connector terminated in 50 ohms. A screen room may be required for this measurement.

EQUIPMENT

(8) (10) (14) (15) (16)

PROCEDURE

1. Set the instrument controls as follows:

Lever/Indicator switches	500.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	-110 dBm
OUTPUT VERNIER	+3 dB

2. Connect the equipment as shown in Figure 4-6.

3. Set the spectrum analyzer bandwidth to 100 kHz, the scan width to 0.5 MHz/ div, the video filter to 100 Hz, the input attenuation to 0 dB, and the log reference level to -50 dBm with a 10 dB/div vertical scale. Center the signal in the display using the center frequency control. Calibrate the analyzer for the -107 dBm signal at the -31 dBm graticule using the log reference controls.

4. Disconnect the RF amplifier from the instrument and connect the 50 ohm coaxial termination to the instrument RF OUT connector. Tighten the termination to minimize RF leakage.

5. Set the instrument OUTPUT Step Attenuator to -10 dBm.

6. Connect the loop probe to the input of the RF amplifier. Move the loop probe over the surfaces of the instrument with the two-turn loop at a one-inch distance. The signal plus noise should be less than the -107 dBm reference. Record the maximum reading in dBm on line 50 of the PTR.

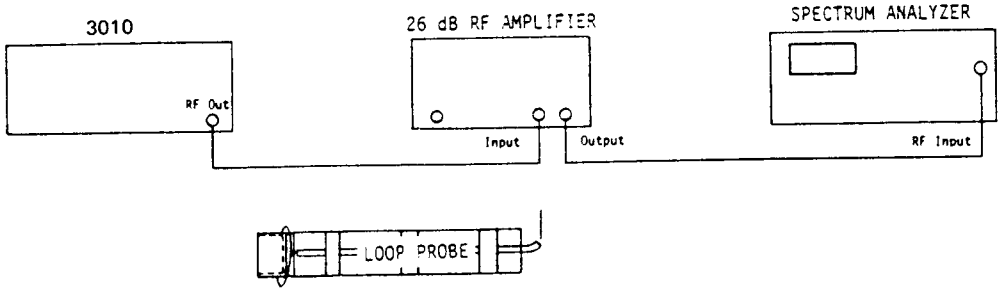


Figure 4-6. Test Set-up

PERFORMANCE TEST RECORD
MODEL 3010

S/N _____

DATE _____

SEC	TEST	MINIMUM SPECIFICATION	MEASUREMENT	MAXIMUM SPECIFICATION	LINE
4.2	FREQ RAMGE/RES	----------	( ) CHECK	----------	1
4.3	FREQ ACCURACY	39,999.60 kHz	kHz	40,000.40 kHz	2
		39,989.60 kHz	kHz	40,010.40 kHz	3
		2500 Hz	Hz	3500 Hz	4
			Hz		5
4.4	FREQ STABILITY	----------	Hz	104 Hz	6
			Hz	500 Hz	7
4.5.1	METER ACCURACY	-0.5 dB	dB	+0.5 dB	8
			dB		9
4.5.2	FLATNESS	-1.5 dB/-1.0 dB	dB/ dB		10
			dB/ dB	+1.5 dB/+1.0 dB	11
			dB/ dB		12
4.5.3	STEP ATT ACCURACY	-0.7 dB	dB	+0.7 dB	13
			dB		14
			dB		15
			dB		16
			dB		17
4.6	HARMONICS	-26 dBc	dBc	---------	18
		-20 dBc	dBc		19
		-30 dBc	dBc	---------	20
			dBc		21
4.7	NON-HARMONICS	-60 dBc	dBc	---------	22
		-65 dBc	dBc		23
		-55 dBc	dBc		24
		-35 dBc	dBc		25
		-30 dBc	dBc		26
4.8	RESIDUAL AM	-65 dBc	dBc	----------	27
4.9	RESIDUAL FM	----------	Hz / Hz	200 Hz/400 Hz	28
4.10	INT MOD FREQ ACC	392 Hz	Hz	408 Hz	29
		980 Hz	Hz	1020 Hz	30
4.11	% AM ACCURACY	26.5 %	%	33.5%	31
		83.5%	%	96.5%	32
		8%	%	12%	33
		17.5%	%	22.5%	34
4.12	AM BANDWIDTH	----------	dB	3 dB	35
4.13	AM DISTORTION	----------	%	6%	36
			%	10%	37
4.14	FM DEV ACCURACY	910 Hz	Hz	1090 Hz	38
		1910 Hz	Hz	2090 Hz	39
		2700 Hz	Hz	3300 Hz	40
		8700 Hz	Hz	9300 Hz	41
		9100 Hz	Hz	10,900 Hz	42
		19,100 Hz	Hz	20,900 Hz	43
		27,000 Hz	Hz	33,000 Hz	44
		87,000 Hz	Hz	93,000 Hz	45
4.15	FM BANDWIDTH	----------	dB	1 dB	46
4.16	FM DISTORTION	----------	%	4%	47
		----------	%	2%	48
4.17	IMPEDANCE	-21 dB	dBc	----------	49
4.18	RFI		dB	-107 dBm	50

SECTION 5
MAINTENANCE

5.1 INTRODUCTION

This section provides information for disassembly, calibration and troubleshooting of the Wavetek Model 3010 Signal Generator.

Measurements and adjustments will be facilitated by placing instrument on its right side, as access is required to top and bottom of unit for adjustments and test points.

5.2 SERVICE INFORMATION

Refer to Figure 5-1. The side panels form part of the support for the top and bottom covers; therefore these covers should be removed before removing either side panel. The covers and panels can be removed as indicated below.

NOTE

One side panel must remain on the instrument to secure front-panel assembly to chassis.

REMOVAL OF BOTTOM COVER – Remove the two rear feet (A) and lift the cover off with a slight rear movement. Reinstall the cover by reversing the removal procedure.

REMOVAL OF FRONT-TOP RAIL - The top rail may be removed to facilitate removal of the Meter Board or Modulation Board assembly. The rail is removed by removing the three screws (D) and lifting the rail upward.

REMOVAL OF SIDE PANEL - Either side panel can be removed to provide better access by removing the six screws (E) holding the side panel to the instrument.

CAUTION

To prevent possible damage to harness when reinstalling side panels, use only the original screws or equivalent. Longer screws in the bottom two holes can cause damage to wiring.

5.2.2 MODULE SERVICING

REMOVAL OF MODULE - A module may be removed by removing any cables attached to top of the module and removing the hold-down screw (C) from the bottom. Rock the module slightly while lifting upward to free it from its chassis socket.

REINSTALLING MODULE - Before installing the module, check that all module pins are straight and properly aligned; then, carefully seat the module pins into the chassis socket. Replace the module hold-down screw (C) to insure a good ground connection between the module and chassis, and replace any cables attached to the top of the module. Module cable connections are shown in Figure 5-6.

NOTE

If a module is replaced with a new module, it will be necessary to calibrate the phase-locked loop or other circuits involved (see Table 5-4).

MODULE PIN NUMBERING SYSTEM - The module pins are numbered as shown in Figure 5-2. The off-center index stud prevents the module's being plugged in backwards and also provides a method for locating pin 1.

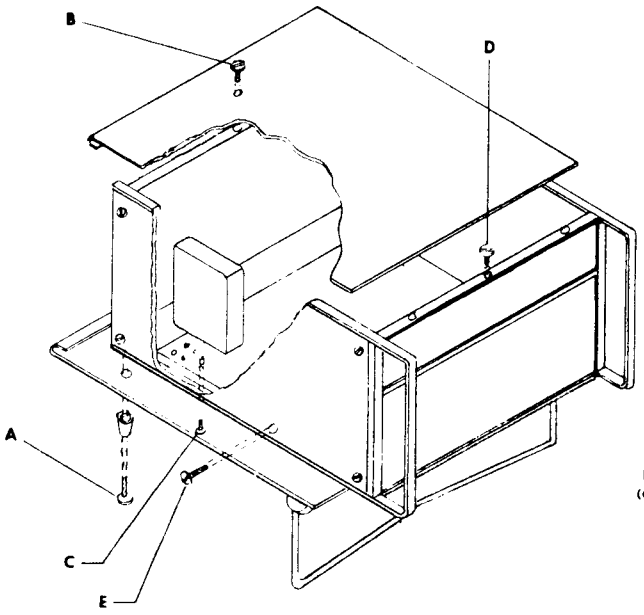


Figure 5-1. Dissassembly

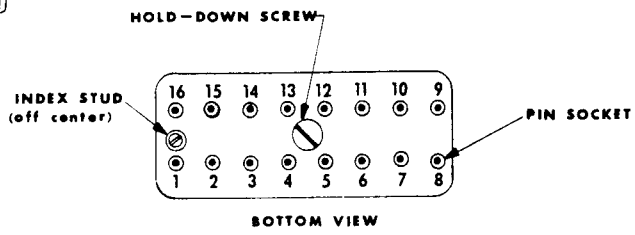


Figure 5-2. Module Pin Numbering System

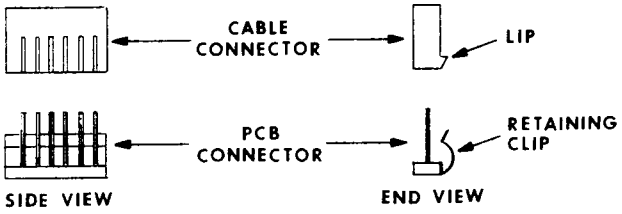


Figure 5-3. Connector Alignment

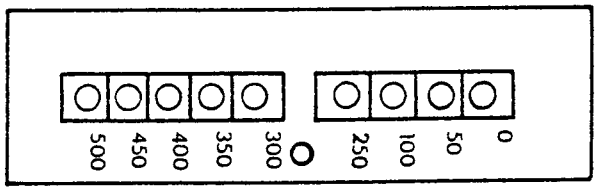


Figure 5-4. M172 Adjustments

NOTE

All 16 pins are not required in each module. Only the pins actually used are installed, but the numbering system remains the same.

5.2.3 PRINTED CIRCUIT BOARD SERVICING

PRINTED CIRCUIT BOARD CONNECTORS – When reinstalling a harness connector on a printed circuit board, be sure the connector is properly aligned with the board connector pins and that the connector faces the proper direction (see Figure 5-3).

METER BOARD REMOVAL - Removal of the Meter Board assembly requires that the OUTPUT Step Attenuator knob, the OUTPUT VERNIER knob and retaining nut, and the instrument top rail be removed. Remove the three screws which secure the Meter Board to the front panel. Disengage the six-pin harness connector from the Meter Board, the two-pin harness connector from the Modulation Board, and the three slip-on connectors from the Step Attenuator switch. The Meter Board assembly can now be moved rearward until the OUTPUT VERNIER shaft, UNLEVELED LED, and METER case clear the front panel and the assembly can be lifted from the instrument.

The Meter Board is reinstalled by reversing the removal procedure, being careful to avoid damaging the UNLEVELED LED.

MODULATION BOARD REMOVAL - To remove the Modulation Board assembly from the instrument, disengage the slip-on connectors from the Lever/Indicator switches. Disconnect the 12-pin and two-pin harness connectors from the board and unsolder the wire from the EXT MODULATION INPUT connector. Remove the knobs from the front-panel INT and EXT MODULATION controls and FREQ VERNIER. Remove the instrument top rail, the center screw from the bottom rail, the screw at the upper-outer corner of the Modulation Board, and the screw at the top-center corner of the Meter Board. The assembly can then be angled until the switch levers clear the front panel and the assembly can be lifted from the instrument.

The assembly is reinstalled by reversing the removal procedure.

NOTE

When replacing the connectors on the Lever/Indicator switches, be sure each connector is on the correct switch. The switch cables break out of the main harness in same order that the switches appear.

POWER SUPPLY BOARD REMOVAL- The Power Supply board and heatsink can be removed by removing the four screws which secure the printed circuit board to the instrument rear panel. After removal of the connecting harness, the board can be carefully lifted from the instrument.

CAUTION

The Power Supply board may be raised far enough to allow checking of many components with the harnesses still connected; however, power must NOT be applied to the instrument unless the negative (ground) side of C10 is connected to the instrument chassis ground and to the positive (ground) side of C9 (jumper wires are sufficient).

The Power Supply board is reinstalled by reversing the removal procedure.

5.2.4 RECOMMENDED TEST EQUIPMENT

The test equipment numbered (1) through (8) in Table 4-1 is recommended for servicing, troubleshooting and calibrating the Wavetek Model 3010.

5.3 CALIBRATION PROCEDURE

Remove the instrument top cover, the bottom cover, and the M172 module cover. Allow a two-hour warmup period before calibrating.

In general, calibration should be performed in the sequence given. Refer to Figures 5-4, 5-5 and 5-6 for test point and adjustment locations.

NOTE

All measurements are made with reference to chassis ground.

5.3.1 +18 VOLT ADJUSTMENT

Connect digital voltmeter to the orange +18 volt line on pin 3 of module M30-5 Set +18 V Adj on Power Supply to produce +18.00 V. (See Figures 5-5 and 5-6.)

5.3.2 –18 VOLT CHECK

Connect digital voltmeter to the yellow –18 volt line on pin 4 of module M30-5 Set –18 V Adj on Power Supply to produce –18.00 V.

5.3.3 +7.3 VOLT CHECK

Connect digital voltmeter to the green +7.3 volt line on pin 2 of module M30-5 The reading must be +7.3 V ±150 mV.

5.3.4 CRYSTAL FREQUENCY ADJUSTMENT M30-5

Connect a frequency counter with a 50 ohm input to the instrument RF connector. Set the signal generator Lever/Indicator switches to a high frequency which is within the counter's range, such as 500 MHz. Set the front-panel control as follows:

Lever/Indicator switches	500,0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	full cw

Adjust M30-5 Frequency Adjust trimmer (Figure 5-6 for minimum-frequency indication on counter; then, carefully turn Frequency Adjust trimmer clockwise until counter indicates the frequency selected by Lever/Indicator switches. Disconnect counter from RF OUT connector. A final frequency check will be covered in Section 5.3.12.

5.3.5 PHASE-LOCKED LOOP 1 ADJUSTMENT M31A

No adjustment of module M31A is necessary.

5.3.6 PHASE-LOCKED LOOP 2 ADJUSTMENT M32A

See Figure 5-6 for location of M32A test points and Figure 5-5 for adjustment controls. Set the Lever/Indicator switches to 200.0000 MHz and all other front-panel controls as in Section 5.3.4. Connect a digital voltmeter to M32A pin 14, and carefully adjust both Crystal Reference trimmers (A and B) to produce a minimum reading on voltmeter. This voltage should be between +0.5 and +3.0 VDC. Set the Lever/Indicator switches to 239.0000 MHz and note that the voltmeter reading is still within the above limits.

Set the Lever/Indicator switches to 200.0000 MHz and connect the scope vertical input (DC, 1 V/cm) to M32A pin 15. Adjust M32A control (A) for a 0 V scope indication. Set the Lever/Indicator switches to 239.0000 MHz and adjust M32A control (B) to again produce a 0 V scope indication.

5.3.7 PHASE-LOCKED LOOP 3 ADJUSTMENT

PLL 3 consists of two modules: The M33-2 and the M9W. The test point is on module M33-2 (Figure 5-5), while the adjustment controls are on module M9W (Figure 5-6). Set the Lever/Indicator switches to 250.0000 MHz and all other front-panel controls as in Section 5.3.4. Connect the scope vertical input (DC, 1 V/cm) to M33-2 pin 5. Adjust M9W control (D) for a 0 V scope indication.

Set the INT MOD FREQ control to 1 kHz, the INT MOD RANGE control to 100 kHz FM, the METER switch to INT MOD, and the INT MOD LEVEL control for exactly 100 kHz deviation, read on the METER. Set the scope vertical input (on M33-2 pin 5) for AC, 50 mV/cm. Adjust M9W control (C) for minimum (null) indication of 1 kHz sine wave on scope.

5.3.8 PHASE-LOCKED LOOP 4 ADJUSTMENT

Calibration of PLL 4 involves three modules: M172, M9W, and M34. Test points are located on modules M172 and M34 (see Figure 5-6), while adjustment controls are located on modules M172 and M9W (see Figures 5-4 and 5-5).

Set the Lever/Indicator switches to 250.000 MHz and all other front-panel controls as in Section 5.3.4. Connect a digital voltmeter to M172 pin 1; then, adjust M172 250 MHz Adj for a 0.00 V reading on the voltmeter. The voltmeter may now be disconnected.

Connect a frequency counter to the RF OUT connector and connect the scope vertical input (DC, 1 V/division) to M34 pin 8. Adjust M9W control (A) for 0 ±1 V on the scope. The counter should indicate a frequency of 250 MHz.

NOTE

Due to the way the M34 locks on harmonics of 40 MHz, it is possible to adjust M9W control (A) for 0 V at multiples of 40 MHz offset from 250 MHz. If this happens, it will be necessary to readjust M9W control (A) several turns to break lock and relock at the next multiple of 40 MHz until 0 ±1 V can be obtained with a 250 MHz counter reading.

Set the output frequency to 300 MHz and adjust M172 300 MHz Adj for 0 ±3 V on the scope with a counter reading of 300 MHz. Repeat this step, using the applicable M172 Adj for frequencies of 350, 400, and 450 MHz.

Set the Lever/Indicator switches to 500.000 MHz. Adjust M172 500 MHz Adj for a scope reading near 0 V. Increase the Lever/Indicator switch setting to 520.000 MHz and note the scope indication; then, adjust M172 500 MHz Adj to give scope indications at 500.000 and 520.000 MHz that are symmetrical about 0 V.

Set the Lever/Indicator switches to 100.000 MHz and adjust M172 100 MHz Adj for 0 ±3 V on the scope and a counter reading of 100 MHz. Repeat using the appropriate M172 Adj for frequencies of 50 and 0 MHz. (Set Lever/Indicator switches to 001.000 MHz for 0 MHz adjustment.)

Connect the digital voltmeter to M34 pin 14 (Leveler TP).

Step through the frequency range from 1 to 520 MHz in 10 MHz steps to find the frequency having highest leveler voltage; then adjust M9W control (B) for +1.0 VDC at this frequency setting.

5.3.9 PHASE-LOCKED LOOP 5 ADJUSTMENT

Connect an AC digital voltmeter to the rear-panel MOD TP and set the front-panel controls as follows:

Lever/Indicator switches	002.0000
FREQ VERNIER	0 kHz
INT MOD FREQ	1 kHz
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	full cw

Connect a frequency counter to the RF OUT connector. Adjust **M29-2** control (B) to produce an output frequency of 2.000 MHz ±100 Hz. Set the INT MOD RANGE control to 100 kHz FM and set the Lever/Indicator switches for 100.0000 MHz. Allow a few minutes for the oscillator to stabilize. Set the INT MOD LEVEL control for 3.535 VRMS at the MOD TP. (If 3.535 VRMS cannot be obtained, set Modulation Board control (Q) as in Section 5.3.11.)

Connect the modulation meter to the RF OUT connector and adjust **M29-2** control (A) for a 100 kHz FM average modulation meter reading.

5.3.10 METER BOARD CALIBRATION - C315-2

Refer to Figures 5-5 and 5-6.

In order to adjust the front-panel METER, the instrument must be resting on its bottom surface (normal operating position). Turn off AC power to the instrument and mechanically zero the METER with the front-panel screwdriver adjustment located just below the METER face. Restore power to the instrument and allow it to stabilize.

Turn the OUTPUT VERNIER fully cw and adjust Meter Board control (A) for a +3 dB METER reading.

Set the instrument front-panel controls as follows:

Lever/Indicator switches	050.0000
FREQ VERNIER	CAL
INT MOD FREQ	N/A
INT MOD LEVEL	N/A
INT MOD RANGE	OFF
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	full cw

Calibrate a power meter and its sensor. Set the power meter to its +15 dBm range and connect it to the instrument RF OUT connector.

Adjust Meter Board control (F) for a +13 dBm power meter reading. Set the OUTPUT VERNIER for a -7 dB reading on the METER. Set the power meter to its +5 dBm range and adjust Meter Board control (E) for a +3 dBm power meter reading.

Since Meter Board controls (E) and (F) interact, repeat the above procedure until the proper power meter readings are obtained without further adjustment of the controls.

Set the OUTPUT Step Attenuator to 0 dBm and the power meter to the +5 dBm range. Turn the OUTPUT VERNIER fully cw. Adjust Meter Board control (C) for a +3 dBm power meter reading. Set the OUTPUT VERNIER for a -6 dB reading on the METER and set the power meter to its -5 dBm range. Adjust Meter Board control (D) for a -6 dBm power meter reading.

Since Meter Board controls (C) and (D) interact, repeat the above procedure until the proper power meter readings are obtained without further adjustment of the controls.

Set the instrument front-panel controls as follows:

Lever/Indicator switches	100.0000
FREQ VERNIER	CAL
INT MOD FREQ	1 kHz
INT MOD LEVEL	full cw
INT MOD RANGE	100 kHz FM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	+10 dBm
OUTPUT VERNIER	full cw

Adjust the INT MOD LEVEL control for a DVM reading of 3.535 VRMS at the rear-panel MOD TP. Adjust Meter Board control (H) such that the METER reads exactly 100 kHz FM (full scale).

Connect the modulation meter to the RF OUT connector. Set the Lever/Indicator switches to 520.0000 MHz and the INT MOD LEVEL control for a reading of 3.18 VRMS at the MOD TP. Set the OUTPUT VERNIER for a +3 dBm reading on the METER and adjust Meter Board control (G) for an average reading of 90% AM on the modulation meter. Set the OUTPUT VERNIER for a -7 dBm reading on the METER and adjust Meter Board control (B) for an average reading of 90% AM on the modulation meter.

Since Meter Board controls (B) and (G) interact, repeat the above procedure until the proper modulation meter readings are obtained without further adjustment of the controls.

5.3.11 MODULATION BOARD CALIBRATION

Apply a 1 VRMS 1 kHz signal to the EXT MODULATION INPUT connector. Connect an AC digital voltmeter to the gray lead at the top of the METER switch. Adjust Modulation Board control (M) for exactly 3.535 VRMS.

Connect a frequency counter to the rear-panel MOD TP. Set the EXT MOD RANGE control to OFF and the INT MOD RANGE control to 100% AM. Set the INT MOD LEVEL control fully cw. Adjust Modulation Board controls (A), (B), (C), and (D) as follows:

INT MOD FREQ	MOD BD CTL	FREQ CTR READING
400	A	400 ± 8 Hz
1000	B	1000 ± 20 Hz
B	C	As desired
A	D	As desired

NOTE

If it is desired to set A or B to a frequency less than 1 kHz, a jumper must be added across the terminals of switch S1 as indicated on the schematic.

Set the instrument front-panel controls as follows:

Lever/Indicator switches	520.0000
FREQ VERNIER	CAL
INT MOD FREQ	1 kHz
INT MOD LEVEL	full cw
INT MOD RANGE	100% AM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	OUTPUT
OUTPUT Step Attenuator	0 dBm
OUTPUT VERNIER	full cw

Monitor the rear-panel MOD TP with a DVM. Adjust Modulation Board control (Q) for a 3.535 VRMS reading on the DVM.

Calibrate the distortion analyzer and connect it between the rear-panel MOD TP and ground.

NOTE

A 1 μF blocking capacitor should be inserted in series between the MOD TP and the distortion analyzer input.

Carefully adjust controls (P) and (N) for the lowest distortion analyzer reading (typically less than 1%). (Controls (P) and (N) interact considerably, so they will have to be adjusted alternately.)

Recheck the 3.535 VRMS MOD TP reading and readjust it accordingly; then recheck and readjust the settings of controls (P) and (N), if necessary, until the MOD TP voltage is correct and the distortion is at a minimum.

Disconnect the distortion analyzer and connect the modulation meter to the RF OUT connector. Set the METER switch to INT MOD and adjust the INT MOD LEVEL control for a 30% AM METER reading. Adjust Modulation Board control (K) for a 30% AM average modulation meter reading.

Set the INT MOD RANGE control to OFF and the EXT MOD RANGE control to 100% AM. Connect a function generator, set for 1 kHz at 1.00 VRMS, to the EXT MODULATION INPUT connector. Set the METER switch to EXT MOD and the EXT MOD LEVEL control for a 30% AM METER reading. Adjust Modulation Board control (J) for a 30% AM average modulation meter reading.

Set the instrument front-panel controls as follows:

Lever/Indicator switches	520.0000
FREQ VERNIER	CAL
INT MOD FREQ	1 kHz
INT MOD LEVEL	full cw
INT MOD RANGE	100 kHz FM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	0 dBm
OUTPUT VERNIER	full cw

Adjust **M29-2** control (A) for a 100 kHz average modulation meter deviation reading.

Set the INT MOD RANGE control to 30 kHz FM and adjust Modulation Board control (G) for a 30 kHz average modulation meter deviation reading.

Set the INT MOD RANGE control to 3 kHz FM and adjust Modulation Board control (H) for a 3 kHz average modulation meter deviation reading.

Set the INT MOD RANGE control to OFF, the EXT MOD RANGE control to 30 kHz FM, and the METER switch to EXT MOD. With the function generator set for 1 kHz at 1 VRMS connected to the EXT MODULATION INPUT connector, adjust Modulation Board control (E) for a 30 kHz average modulation meter deviation reading.

Set the EXT MOD RANGE control to 3 kHz FM and adjust Modulation Board control (F) for a 3 kHz average modulation meter deviation reading.

5.3.12 FINAL FREQUENCY CHECK - M30-5

Connect a frequency counter to the instrument RF OUT connector and set front-panel controls as specified in

Section 5.3.4. Note the frequency reading on counter. If it does not agree with the selected frequency within accuracy specifications, very carefully adjust the M30-5 Frequency Adjust trimmer (see Figure 5-5) until the desired frequency is obtained.

5.4 TROUBLESHOOTING

Effective troubleshooting requires a thorough understanding of the block diagrams and circuit descriptions located in Section 3 of this manual; then, the Performance Tests in Section 4 and Calibration Procedures in Section 5 will aid in localizing the trouble symptom to a particular module or PC board. Once this has been accomplished, the module or board can be replaced; or, repaired with aid of the proper schematic and parts layout diagram. In general, it is preferable to replace a defective module or PC board assembly.

Equipment troubles are frequently due simply to improper control settings; therefore, before engaging in a troubleshooting procedure, be sure the front-panel controls are set in proper operating position. Refer to the operating instructions in Section 2 of this manual for a complete explanation of each control's function along with typical operating instructions.

After verifying that the trouble is not improper setting of the controls or test setup, make a thorough visual inspection of the instrument for such obvious defects as loose or missing screws, broken wires, defective module pin sockets, loose RF cables, and burned or broken components.

After localizing the problem, voltage and resistance checks will help find the defective component.

For troubleshooting purposes, it is permissible to operate the instrument with any of the plug-in modules or RF cables removed; however, the instrument should be turned off when removing or installing modules. If substitute modules are available, possibly from another Wavetek signal generator, this provides an easy method of verifying if a suspected module is defective.

RF cables can be disconnected from the module output connectors; then, a power meter or spectrum analyzer can be connected directly to the module connector for power level or frequency measurements. Fabrication of a short coax adapter cable, terminated in a mating connector for the modules on one end and a BNC connector on the other, will facilitate connection of test equipment.

The front-panel ACCURACY lamps, together with the four internal module "unlock indicator" lamps, aid in troubleshooting phase-locked loop problems. One module in each loop contains an indicator lamp which lights to indicate when that loop is unlocked. The lamps indicate which loops are unlocked, not which module is at fault.

A problem in the Power Supply may cause many symptoms pointing to other areas. The Power Supply should be checked when the symptom does not clearly indicate a specific problem. Loss of the -18 V supply, for example, will cause the ACCURACY lamp to flash, while loss of the +18 V supply will extinguish all lamps. The +18, −18, and +7.3 V supplies comprise the DPS2A Power Supply which forms the rear panel of the instrument. Performance of these supplies is indicated in the Calibration Procedure.

5.4.1 TROUBLESHOOTING HINTS

Following is a list of several typical symptoms, accompanied by the possible cause(s) or a troubleshooting procedure. It is assumed the instrument has been properly calibrated previously, and that a warmup period will precede troubleshooting.

INTERMITTENT OPERATION- Defective module pin sockets or loose RF cables.

LOW RF OUTPUT (+10 dBm range) - If power is 10 dB low on this range, but is correct on the 0 dBm range, switch S1 mounted on the Step Attenuator is defective, is not being actuated by the Attenuator shaft, or a switch wire is disconnected.

LOW OR NO RF OUTPUT (ANY RANGE) - Defective Attenuator or RF cables connecting to input or output of Attenuator, defective Meter Board, Output Amplifier, or Sweep Oscillator module.

Check the voltage on pin 15 of Output Amplifier module. With the OUTPUT VERNIER fully clockwise, the voltage should be approximately −2.5 VDC on +10 dBm range. These voltages indicate proper operation of the Meter Board; while other values, particularly positive voltages, indicate a defective IC or other problem on the Meter Board.

Next, check RF power directly at the Output Amplifier output. If it is correct, the trouble lies in the Step Attenuator or its RF cables. If the Output Amplifier output is low, measure the Sweep Oscillator RF output. This should be approximately −10 to −11 dBm. If this level is correct, the Output Amplifier is defective; while if the level is low, Sweep Oscillator M9W is defective.

OUTPUT METER DOES NOT MOVE – If the METER is pegged at either end of scale, the trouble is probably a defective component on the Meter Board; while if METER remains at mechanical zero, the meter movement may be open or a Meter Board component may be defective.

UNLEVELED LAMP ON – RF OUT connector not terminated in 50 ohm load, AM percentage set so that peak of modulated output exceeds +13 dBm, defective Output Amplifier module, defective Attenuator or connecting RF cables.

Connect a power meter directly to the Output Amplifier output. Set the OUTPUT Step and VERNIER controls for a +13 dBm reading on the power meter at 50.0000 MHz. Step through the frequency range from 10 to 520 MHz in 10 MHz steps. A power meter reading of +13 dBm ±0.5 dB with the UNLEVELED lamp off indicates proper operation of the Output Amplifier module. If the output is correct, but the UNLEVELED lamp is on, the trouble is probably a defective lamp driver circuit in the Output Amplifier module. With proper operation of the Output Amplifier module, connect the power meter directly to the Step Attenuator output and repeat the above procedure. If the Attenuator output is correct, the trouble is due to a defective RF cable or possibly a poor ground connection at the RF OUT connector.

ACCURACY LAMP FLASHES CONTINUOUSLY – A steady light in CW mode but flashing in FM modes indicates a defective M29-2 or M33-2 module. If the ACCURACY lamp flashes in all modes, one or more of the phase-locked loops is open (see Phase-Locked Loop Troubles below).

PHASE–LOCKED LOOP TROUBLES – An open or unlocked loop, indicated by a lighted module lamp, can be caused by a number of factors including: low AC input voltage, low DC supply voltages, improper phase-locked loop DC voltages, an open or shorted RF cable, or a defective module.

A defective RF cable or module can have a "chain-reaction" effect that causes two or more loops to unlock. For example, loss of the 1 kHz signal to module M31A will cause PLL 1 to unlock; thus, module M31A may not supply a proper signal to module M34, causing PLL 4 to unlock. Failure of the M40 MHz crystal oscillator in module M30-5 will cause all loops to unlock, since all reference frequencies will be lost.

Table 5-2 lists typical RF signal-input levels for each of the phase-locked loops. Those signals having a TTL level or 1 V level may be measured with a high-frequency oscilloscope. The other signals are best measured with a spectrum analyzer (dBm), or a 50 ohm detector and calibrated scope (mV).

NOTE

The TTL waveform shown in Table 5-2 is for illustration of voltage values only, and does not necessarily represent the observed waveshape.

Phase-Locked Loop 1 – Unlocking of this loop may be caused by a defective module M31A, module M30-5, or RF cable connecting M30-5 to M31A.

If the M31A unlock indicator is on, check the 1 kHz signal as listed in Table 5-2. If the signal is correct, module M30-5 is operating properly. Check the RF cable between M30-5 and M31A. If the 1 kHz signal is being applied to M31A, check for 7.3 V on pin 6, +18 V on pin 7, and -18 V on pin 8 of M31A. If the input signal and DC voltages are correct, module M31A is defective.

Phase-Locked Loop 2 – Unlocking of PLL 2 can be caused by defective modules M172, M30-5, M32A, or RF cables connecting M30-5 to M32A.

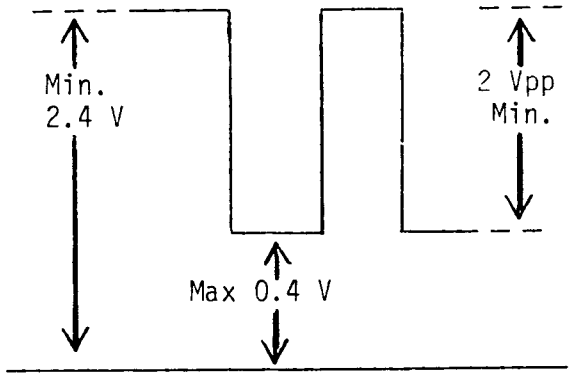
Connect a digital voltmeter to M32A pin 11 and observe the voltmeter reading while stepping through the frequency range from 200 to 239 MHz in 1 MHz steps. The voltmeter reading should change -0.2 V per MHz from 0 V at 200 MHz to -7.8 at 239 MHz. These voltages indicate proper operation of module M172.

Module M30-5 can be checked by measuring the 1 MHz and 1440 MHz signals directly at the M30-5. The levels specified in Table 5-2 indicate proper operation of module M30-5. Check connectors and RF cables connecting module M30-5 to module M32A. Check for +18 V on pin 7, -18 V on pin 8, and +7.3 V on pin 9 of M32A. If all input signals and DC voltages to module M32A are normal, but the M32A LED is on, module M32A is defective.

Phase-Locked Loops 3 and 5 – The LED indicator on module M33-2 serves both PLL 3 and PLL 5. If the M33-2 LED is on, determine which loop is defective by switching the FREQUENCY VERNIER out of its CAL

TABLE 5-2. PHASE-LOCKED LOOP RF-SIGNAL LEVELS

P.L.L.	MODULE	INPUT-SIGNAL FREQUENCY	INPUT-SIGNAL LEVEL dBm (mV)	MEASURED AT
1	M31A	1 kHz	TTL	M30-5 (W13)
2	M32A	1 MHz	TTL	M30-5 (W12)
		1440 MHz	-12 to -15 dBm (20 mV)	M30-5 (W9)
3 & 5	M33-1	1198 MHz	-10 dBm ±3 dB (150 m V)	M9W (W5)
		1200 MHz (120 comb)	-15 dBm ±5 dB (75 mV)	M30-5 (W10)
		2 kHz	TTL	M30-5 (W11)
		1.9 to 2.1 MHz	1 volt pp	M29-5 (W7)
4	M34	1198 to 1718 MHz	-10 dBm ±5 dB (25 mV)	M9W (W4)
		1448 to 1487 MHz	-2 dBm ±3 dB (200 mV)	M32A (W8)
		40 to 280 MHz (40 comb)	10 dBm ±3 dB (1 V)	M30-5 (W6)
		10 to 9 001 MHz	TTL	M31A (W14)



TTL LOGIC LEVEL

TABLE 5-3. BCD FREQUENCY SWITCHES

Decimal Digit	BCD Wires 8 4 2 1
0	- - - -
1	- - - 0
2	- - 0 -
3	- - 0 0
4	- 0 - -
5	- 0 - 0
6	- 0 0 -
7	- 0 0 0
8	0 - - -
9	0 - - 0

NOTE: 0 = Wire Grounded by Switch.
-- = Wire NOT Grounded.

position. If the M33-2 LED goes off, the trouble is in PLL 5. If the LED stays on, the trouble is in PLL 3.

PLL 3 consists of modules M33-2 and M9W. It is possible that PLL 3 can be restored to operation simply by re-calibrating per Section 5.3.7, and this should be attempted. If adjusting M9W control (D) has no effect on M33-2 pin 5 voltage, the problem is in module M33-2; however, if the pin 5 voltage changes, but phase lock cannot be established, or if the pin 5 voltage cannot be set to within 5 volts of 0 V, the trouble is in M9W. Measure M33-2 Leveler TP (pin 14). If it is between +0.5 and 5 VDC, the trouble is probably in module M33-2; however, if it is greater than 5 VDC, the trouble is probably in module M9W or M30-5. Check the M30-5 reference frequencies and M9W output level as shown in Table 5-2 to determine which module is defective.

PLL 5 consists of modules M29-2 and M33-2. With the FREQUENCY VERNIER in CAL, measure the PLL 5 voltage on M29-2 pin 6. Adjust M29-2 control (B) for 0 V on pin 6. If, while adjusting the M29-2 from 1.9 to 2.1 MHz, this voltage does not move, the problem is in module M33-2. If the voltage adjusts, but will not stay locked, the trouble is in the M29-2.

Phase-Locked Loop 4 – Unlocking of PLL 4 may, under certain conditions, be caused by problems originating in the other loops. Therefore, PLL 1, 2, and 3 should be operating properly before troubleshooting PLL 4.

Unlocking of PLL 4 can be caused by defective modules M9W, M30-5, M31A, M32A, M34, M172, or connecting RF cables.

Connect a digital voltmeter to M172 pin 6. The voltmeter reading should be +5 to +8 V at 000 MHz, 0 V at 250 MHz and -6 to -10 V at 500 MHz. If these voltages are obtained, module M172 is operating properly.

Measure the Wide Oscillator signal at module M9W. The frequency will be between 1198 MHz and 1718 MHz, depending upon the Lever/Indicator switch setting. If the signal level is as specified in Table 5-2, module M9W is probably operating correctly.

Measure the 40 comb line at module M30-5. The 40 MHz harmonics from 40 MHz to 280 MHz should be fairly equal in amplitude, and the level should be as specified in Table 5-2. This level indicates proper operation of the M30-5 module.

Measure the 1448 MHz to 1487 MHz signal at module M32A. The exact frequency is dependent upon the "MHz" switch setting. If the level is as specified in Table 5-2, the M32A is operating properly.

Next, measure the 10.000 to 9.001 MHz output of the M31A module. The output will be 10.000 MHz with the "kHz" switches set to 000 kHz, and the frequency will decrease to 9.001 MHz with the "kHz" switches set to 999 kHz. If the signal level is as specified in Table 5-2, module M31A is operating properly.

If the output of each of the above modules is correct, check the connectors and RF cables connecting M9W, M31A, M32A, and M30-5 to module M34. Check for +7.3 V on pin 2, +18 V on pin 3, and -18 V on pin 4 of M34. If all input signals and DC voltages to module M34 are correct, but the M34 module lamp is on, module M34 is probably defective, but the trouble could be caused by M9W.

A further check of the M34 can be made by monitoring M34 pin 8 with a digital voltmeter while stepping through the frequency range from 10 MHz to 520 MHz in 10 MHz steps. The voltmeter reading should be 0 ±3 V; however, a defective M34 may give a voltage reading of 12 to 16 volts.

LEVER/INDICATOR SWITCHES – Troubles in the BCD switch circuits may be caused by a defective switch, a loose or disengaged switch connector, or a broken switch wire.

The switches use four wires plus a ground to select decimal digits from 0 through 9. A BCD Truth Table, applicable to each of the switches, is given in Table 5-3.

Suspected switch problems can be checked by referring to Table 5-3 and the instrument Wiring Diagram to determine which module pins are grounded for a particular frequency. For example, to select a frequency of 200.5000 MHz, M172 pin 3 is grounded by selecting digit 2 on the 100's MHz switch, and M31A pins 2 and 4 are grounded by digit 5 on the 100's kHz switch.

MODULATION TROUBLES – The Modulation Board is the most common cause of modulation problems, particularly when the modulating signal is lost. Non-linear amplitude modulation at higher-audio frequencies from an external source may be caused by the Output Amplifier module.

Set the front-panel controls as follows to determine presence of modulating signal:

Lever/Indicator switches	050.0000
FREQ VERNIER	CAL
INT MOD FREQ	400 Hz
INT MOD LEVEL	30% METER reading
INT MOD RANGE	30% AM
EXT MOD LEVEL	N/A
EXT MOD RANGE	OFF
METER switch	INT MOD
OUTPUT Step Attenuator	0 dBm
OUTPUT VERNIER	full cw

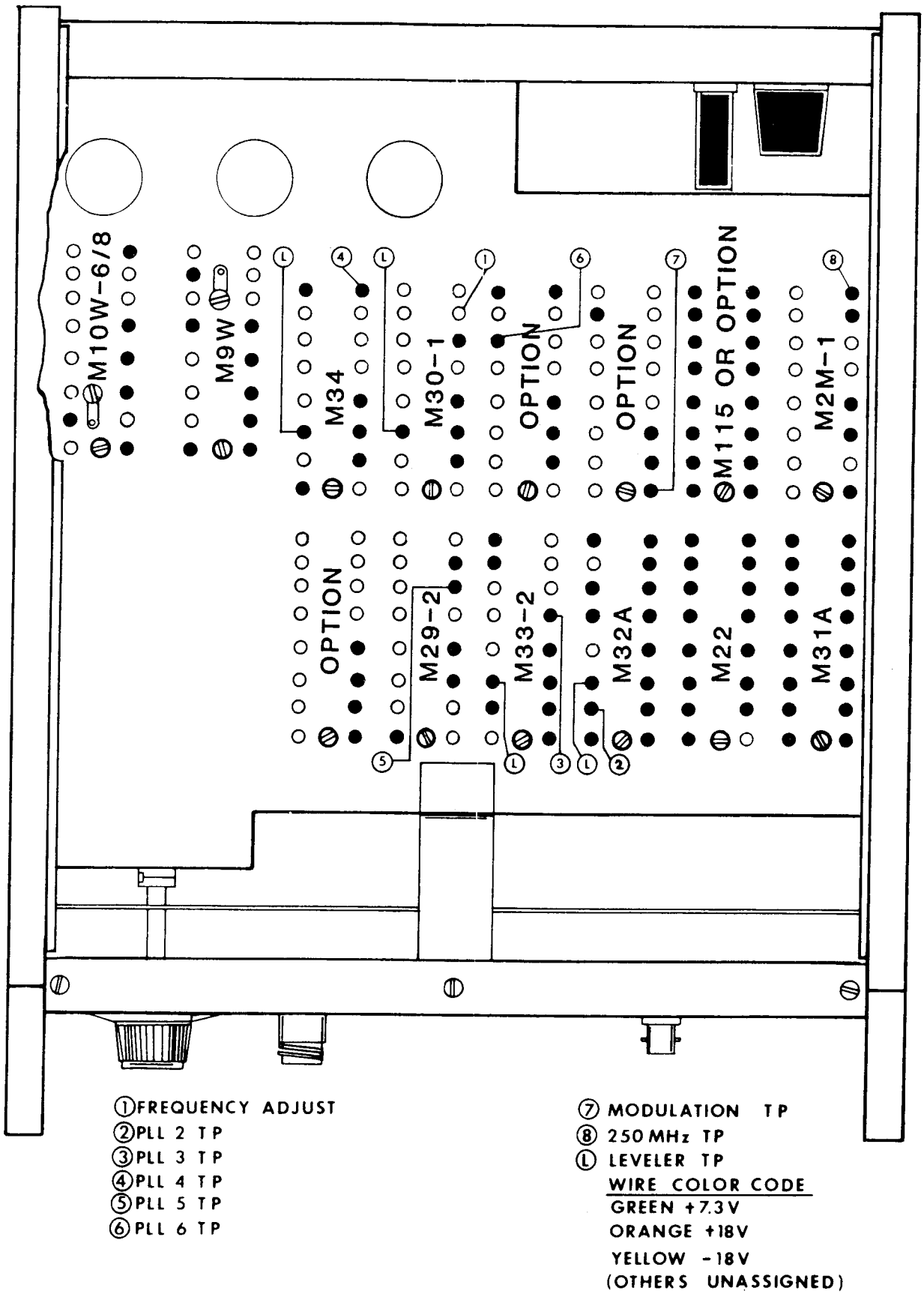


Figure 5-5. Bottom View

Connect the oscilloscope vertical input to the MOD TP. The scope should display a 1 VRMS sine wave at a frequency of 400 Hz (2.5 ms period). Set the INT MOD FREQ switch to 1 kHz. The scope dispiay should be a 1 VRMS sine wave with a period of 1 ms. If the 1 VRMS signals are not obtained, check for +7.3 V on pin 8, +18 V on pin 1, and -18 V on pin 2 of the Modulation Board. If the DC voltages are normal, the Modulation Board is defective.

AM Troubles — Connect the scope vertical input to pin 3 of the Modulation Board and check for a 1 VRMS sine wave. Connect the scope vertical input to pin 4 of the Meter Board and again check for a 1 VRMS sine wave. Presence of the sine wave at this point indicates proper operation of Modulation Board and wiring.

Connect the scope vertical input to pin 2 of the Meter Board and check for a sine wave having an approximate amplitude of 1.75 Vpp. If the 1.75 V signal is not present, check for +18 V on pin 6 and -18 V on pin 5 of the Meter Board. If the DC voltages are normal, the Meter Board is defective or a wire is disconnected from Attenuator switch S1.

Check for the 1.75 Vpp sine wave on pin 15 of the Output Amplifier module. If the sine wave is normal at this point, but amplitude modulation is abnormal, the Output Amplifier module is defective.

FM Troubles — Set the INT MOD RANGE control to 10 kHz FM and check for a 1 VRMS sine wave on pin 6 of the Modulation Board. Connect the scope vertical input to pin 16 of module M29-2 and again check for a 1 VRMS sine wave. A 1 VRMS sine wave at this point indicates proper operating of the Modulation Board and wiring.

Remove RF cable W7 from the top of module M29-2; then, check for a 1 volt peak-to-peak 1.9/2.1 MHz signal at this connector. If this signal is not present, check for +18 V on pin 3 and -18 V on pin 4 of M29-2. If the DC voltages are normal, the FM problems are caused by a defective module M29-2. If the 1.9/2.1 MHz signal is present at the M29-2 connector, the FM problems are probably caused by a defective M33-2 module.

5.4.2 MODULE REPLACEMENT

While in many cases the instrument will work satisfactorily after simply replacing a defective module, to maintain the high accuracy of which the unit is capable, module replacement should be followed by calibration of the affected circuits. Table 5-4 lists modules which affect calibration and the adjustment needed.

TABLE 5-4. MODULE REPLACEMENT CALIBRATION

MODULE REPLACED	ADJUSTMENT REQUIRED (See indicated sections in Calibration Procedure)
M9W Sweep Oscillator	Reset Phase-Locked Loops 3 and 4 (5.3.7 and 5.3.8)
M10W-9 Output Amplifier	Recalibrate C315-2 Meter Board (5.3.10)
M29-2 FM Reference	Reset Phase-Locked Loop 5 (5.3.9)
M30-5 Crystal Reference	Adjust Crystal Frequency (5.3.4 and 5.3.11)
M32A MHz Steps	Adjust Phase-Locked Loop 2 (5.3.6)
M33-2 Narrow Osc. Lock	Adjust Phase-Locked Loop 3 (5.3.7)
M34 Wide Osc. Lock	Set M34 pin 14 for +1.0 VDC (5.3.8)
M172 Sweep Drive/DAC	Reset Phase-Locked Loop 4 (5.3.8)
C315-2 Meter Board	Adjust Meter Board Calibration (5.3.10)
Modulation Board	Adjust Phase-Locked Loop 5 (5.3.9)
DPS2A Power Supply	Adjust ±18 V and check 7.3 V (5.3.1-5.3.3)

3010 TOP VIEW

(1) DPS2A POWER SUPPLY
A - +18 V ADJ
B - -18 V ADJ
C - FUSE, 2A TIME DEL

(2) M149B 100 Hz STEPS

(3) M30-5 XTAL REF
A - 1440 MHz ADJ
B - 1440 MHz ADJ

(4) M34 WIDE OSC LOCK
A - RF TP
B - UNLOCK IND

(5) M9W SWEEP OSC
A - WIDE OSC CENT ADJ
B - WIDE OSC LEV ADJ
C - NARROW OSC SW ADJ
D - NARROW OSC LEV ADJ

(6) M10W-9 DRIVER AMP

(7) M31A kHz STEPS
A- UNLOCK INDICATOR

(8) M172 DAC/SWEEP DRIVE

(9) M32A MHz STEPS
A - 000 MHz ADJ
B - 039 MHz ADJ
C - UNLOCK IND

(10) M33-2 NARROW OSC LOCK
A - RF TP
B - UNLOCK IND

(11) M29-2 FM REF
A - 2.1 MHz ADJ
B - 2.0 MHz ADJ

(12) M164 DOUBLER

(13) STEP ATTENUATOR

(14) DOUBLER CONTROL ASSY

(15) MODULATION BOARD
A - 400 Hz ADJ
B - 1000 Hz ADJ
C - RANGE B ADJ
D - RANGE A ADJ
E - EXT 30 kHz FM ADJ
F - EXT 3 kHz FM ADJ
G - INT 30 kHz FM ADJ
H - INT 3 kHz FM ADJ
J - EXT 30% AM ADJ
K - INT 30% AM ADJ

(16) C315-2 METER BOARD
A - METER CAL ADJ
B - %AM -7 DBM ADJ
C - LEVEL 0 DBM RANGE +3 ADJ
D - LEVEL 0 DBM RANGE -7 ADJ
E - LEVEL +10 RANGE +3 ADJ
F - LEVEL +10 DBM RANGE +13 ADJ
G - %AM +3 DBM ADJ

(17) M40 HIGH STABILITY REF (OPTION 6)

(18) M39 EXTERNAL REFERENCE (OPTION 5)

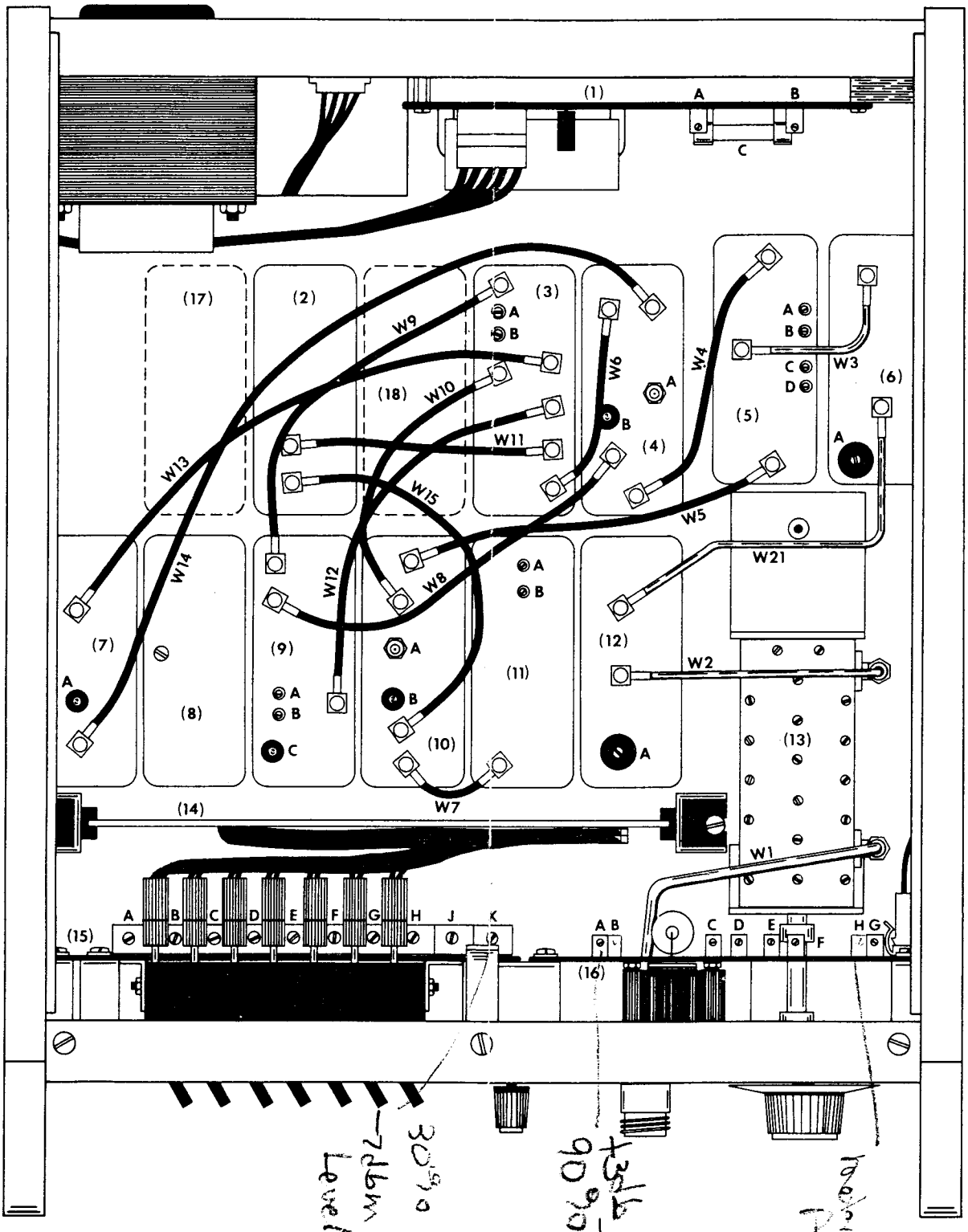
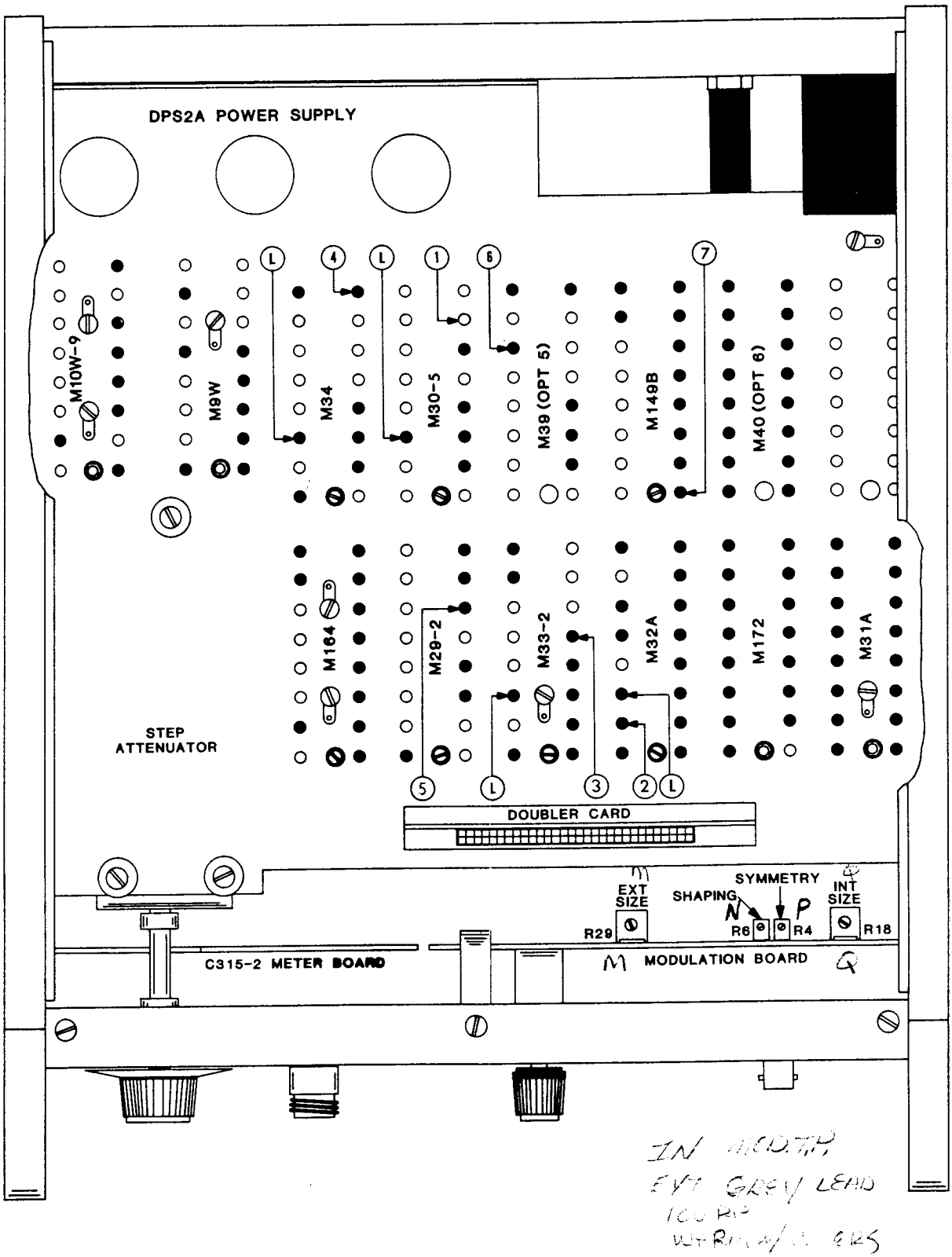


Figure 5-5. 3010 Top View.



1. Frequency Adjust
2. PLL 2 T.P.
3. PLL 3 T.P.
4. PLL 4 T.P.
5. PLL 5 T.P.
6. PLL 6 T.P.
7. Modulation T.P.
8. 250 MHz T.P.

L. Leveler T.P.

Figure 5-6. 3010 Bottom View.

SECTION 6
REPLACEABLE PARTS

6.1 INTRODUCTION

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

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

The lists appear in the following order.

Signal Generator, 3010	1010-00-0147
Meter Board, C315-2	1110-00-0292
Doubler Control Assembly	1110-00-1305
Modulation Board, 3010	1110-00-1320
Wide Oscillator Lock, M34	1114-00-0008
Mixer/Amp Assembly	1219-00-0129
Video Amp Assembly	1219-00-0019
Leveler Assembly	1218-00-0314
Phase-Lock Assembly	1218-00-0334
Video Mixer Assembly	1219-00-0020
FM Reference, M29-2	1114-00-0016
Sweep Oscillator, M9W	1114-00-0020
Mixer Assembly	1219-00-0055
Pre-Amp Assembly	1219-00-0054
Narrow Oscillator Lock, M33-2	1114-00-0023
kHz Steps, M31A	1114-00-0143
MHz Steps, M32A	1114-00-0215
Digital Program Board Assembly	1218-00-0022
Oscillator Control Board Assembly	1218-00-0021
Mixer Assembly	1219-00-0117
Video Amp Assembly	1219-00-0118
DAC/Sweep Drive, M172	1114-00-0320
100 Hz Steps, M149B	1114-00-0329
Frequency Doubler, M164	1114-00-0342
Leveler Assembly	1218-00-0160
Frequency Doubler Assembly	1218-00-0990
Xtal Ref, M30-5	1114-00-0349
Driver Amp, M10W-9	1114-00-0360
Amplifier Board	1218-00-0600
Leveler Board	1218-00-0610
Power Supply, DPS2A	1115-00-0011
PC Assembly, DPS2A	1218-00-0250
Line Cord Assembly	1219-00-0144

6.2 MANUFACTURERS CODE

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

ABBRV	NAME.....	CITY.....	ST
A-B	ALLEN-BRADLEY	MILWAUKEE	WI
A-D	ANALOG DEVICES	CAMBRIDGE	MA
A-H	ARROW HART, INC.	KETTERING	OH
A-I	ALAN INDUSTRIES	COLUMBUS	IN
A-M	AMERICAN MAGNETICS	CARTERVILLE	IL
A-P	AMERICAN PLASTICRAFT CO.	CHICAGO	IL
ABAC	ABACUS PACKAGING CO.	CHICAGO	IL
ACI	ADVANCE COMPONENTS, INC.	CENTERBROOK	CT
AER	AVX CERAMICS	MYRTLE BEACH	SC
AERTK	AERTECH INDUSTRIES	SUNNYVALE	CA
AHAM	AHAM COMPANY	AZUSA	CA
AIN	ALPHA INDUSTRIES, INC.	WOBURN	MA
ALC	ALCO ELECTRONICS PRODUCTS	NORTH ANDOVER	ME
ALLPL	ALL PLASTICS, INC.	INDIANAPOLIS	IN
AMD	ADVANCED MICRO DEVICES INC.	SUNNYVALE	CA
AMD	ADVANCED MICRO DEVICES, INC.	SUNNYVALE	CA
AMELC	AMERICAN ELECTRIC CORDSETS	BENSENVILLE	IL
AMP	AMP, INC.	HARRISBURG	PA
APL	AMPHENOL CONNECTOR SYSTEMS	BROADVIEW	IL
APX	AMPEREX ELECTRONIC CORP.	SLATERSVILLE	RI
ARC	ARCO ELECTRIC PRODUCTS	SHELBYVILLE	IN
ARN	ARNOLD ENGINEERING CO.	MARENGO	IL
ARW-M	ARROW-M CORP.	CARSON	CA
ASC	ASSOCIATED SPRING	BRISTOL	CT
ASE	AIRCO SPEER ELECTRONICS	ST. MARYS	PA
AT/IN	ATLANTIC INDIA RUBBER COMPANY	CHICAGO	IL
ATC	AMERICAN TECHNICAL CERAMICS	HUNTINGTON STATION	NY
ATR	ATR COIL CO.	BLOOMINGTON	IN
AUGAT	AUGAT, INC.	ATTLEBORO	MA
AULT	AULT INC.	MINNEAPOLIS	MN
AVT	AVANTEK, INC.	SANTA CLARA	CA
AWC	ALPHA WIRE	ELIZABETH	NJ
B-T	BEK-TEK, INC.	READING	PA
BEK	BECKMAN INSTRUMENTS, INC.	FULLERTON	CA
BEL	BELDEN CORP.	GENEVA	IL
BER	BERG ELECTRONICS	NEW CUMBERLAND	PA
BGH	BEECH GROVE HARDWARE	BEECH GROVE	IN
BORDN	BORDEN INC.	COLUMBUS	OH
BOU	BOURNS, INC.	RIVERSIDE	CA
BREZ	BREEZE CORPORATIONS, INC.	UNION	NJ
BUCK	BUCKEYE STAMPING CO.	COLUMBUS	OH
BUD	BUD RADIO, INC.	WILLOUGHBY	OH
BURND	BURNDY CORP.	NORWALK	CT
BUS	BUSSMAN MFG.	ST. LOUIS	MO
BWC	BARON WIRE AND CABLE CORP.	NILES	IL
C-D	CORNELL DUBILIER ELECT. DIV.	NEWARK	NJ
C-E	CLINTON ELECTRONICS	ROCKFORD	IL
C-H	CUTLER-HAMMER, INC.	MILWAUKEE	WI
C-I	COMPONENTS, INC.	BIDDEFORD	ME
C-J	TRW/CINCH	ELK GROVE VILLAGE	IL
C-K	C & K COMPONENTS, INC.	WATERTOWN	MA
C-L	CENTRALAB DIV.	MILWAUKEE	WI
C-W	C-W INDUSTRIES	WARMINSTER	PA
CAI	CUSTOM ACCESSORIES, INC.	SKOKIE	IL
CAM	CAMBION	CAMBRIDGE	MA
CAR	CARLING ELECTRIC, INC.	WEST HARTFORD	CT

ABBRV	NAME	CITY	ST
CKI	CTS KNIGHTS, INC.	SANDWICH	IL
CLA	CLAIREX CORP.	MT. VERNON	NY
CLAR	CLAROSTAT MFG. CO	DOVER	NH
CLFRM	COILFORM	GENEVA	IL
CLFX	COLE-FLEX CORP.	BABYLON	NY
CNCRD	CONCORD ELEX	NEW YORK	NY
CPKG	CREATIVE PACKAGING DIV.	INDIANAPOLIS	IN
CPLRD	COMPLETE READING		
CRTR	CORE-TRONICS	ORANGE	NJ
CTS	CHICAGO TELEPHONE SYSTEMS	CHICAGO	IL
CTS-E	CTS OF ELKHART	ELKHART	IN
CTS-F	C.T.S. OF FAIRBERRY	FAIRBERRY	IL
CTS-K	CTS OF KEENE	PASO ROBLES	CA
CTSBR	CTS OF BERNE	BERNE	IN
CTSBV	CTS OF BROWNSVILLE	BROWNSVILLE	TX
CW/AL	C.W./ALPHA	SOUTHAMPTON	PA
DAL	DALE TECHNOLOGY CORP.	HARTSDALE	NY
DATEL	DATEL SYSTEMS, INC.	MANSFIELD	MA
DAV	HARRY DAVIES MOLDING CO.	CHICAGO	IL
DAYTN	DAYTON ELECTRIC CO.	CHICAGO	IL
DEL	DELEVAN DIV.	EAST AURORA	NY
DEN	DENNISON MFG. CO.	FRAMINGHAM	MA
DEW	DEWIRE FABRICATING CORP.	LOWELL	MA
DILEC	DILECTRON	MONROVIA	CA
DIO	DIODES, INC.	CHATSWORTH	CA
DK-WR	DAKO-WARE	CHICAGO	IL
DLGHT	DIALIGHT	BROOKLYN	NY
DNTCH	DONTECH, INC.		
DRA	DRAKE MANUFACTURING CO.	HARWOOD HEIGHTS	IL
DRMYR	DORMEYER	ROCKVILLE	IN
DYNR	DYNEER CORP.	CHATSWORTH	CA
E-C	ELECTRONIC CRYSTALS	KANSAS CITY	MO
E-I	ELECTRICAL INDUSTRIES, INC.	MURRAY HILL	NJ
E-M	ELECTRA/MIDLAND CORP.	MINERAL WELLS	TX
EBY	EBY COMPANY	PHILADELPHIA	PA
ECKDT	ECKARDT LABORATORIES	ORANGE	CA
ECMC	ELECTRI-CORD MFG. CO. INC.	WESTFIELD	PA
ELC-I	ELECTRA	CUMBERLAND	IN
ELCO	ELCO INDUSTRIES	ROCKFORD	IL
ELEXP	ELECT EXPEDITERS	MILWAUKEE	WI
ELFX	ELECTRO-FLEX HEAT INC.	BLOOMFIELD	CT
ELHDW	ELECTRONIC HARD	FARMINGDALE	NY
ELNA	ELNA	CARSON	CA
EMRON			S
EPITK	EPITEK ELECTRONICS	KANATA, ONT., CAN.	**
EPOXT	EPOXY TECHNOLOGY, INC.	BILLERICA	MA
ETC	ELECTRONIC TRANSISTOR CORP.	FLUSHING	NY
ETP	ERIE TECHNOLOGICAL PRODUCTS	ERIE	PA
EVRDY	EVEREADY	NEW YORK	NY
EXAR	EXAR INTEGRATED SYSTEMS	SUNNYVALE	CA
EZLOK	E-Z LOK	GARDENIA	CA
F-K	THERMWELL PRODUCTS, INC.	FRAMINGHAM	MA
F-S	FEDERAL SCREW	CHICAGO	IL
FAN	FANCOURT & CO.	GREENSBORO	NC
FASTX	FASTEX DIV., ILL. TOOL WORKS	DES PLAINES	IL
FCD	FAIRCHILD	MOUNTAIN VIEW	CA
FNWL	FENWAL	FRAMINGHAM	MA
FRK	FRAKO	FRANKFORT, GER.	**
FRTE	FAIR RITE PRODUCTS CORP.	WALLKILL	NY
FRXC	FERROXCUBE DIVISION	SAUGERTIES	NY
G-E	GENERAL ELECTRIC	INDIANAPOLIS	IN
G-H	GRAYHILL, INC.	LA GRANGE	IL
G-I	GEN'L INSTRUMENT SEMICONDUCTOR	HICKSVILLE	NY
G-T	GRAND TRANSFORMERS	GRAND HAVEN	MI
GAL	GALILEO ELECTRO-OPTICS	CARMEL	IN
GATES	GATES ENERGY PROD.	DENVER	CO
GBN	GILBERT ENGINEERING CO. INC.	PHOENIX	AZ
GCE	GC ELECTRONICS	ROCKFORD	IL
GHZ	GHZ DEVICES, INC.	CHELMSFORD	MA
GLOBE	GLOBE	MILWAUKEE	WI
GNATR	GENERAL ATRONICS CORP.	PHILADELPHIA	PA
GOU	GOULD, INC.	ST. PAUL	MN
GRIES	GRIES REPRODUCER	NEW ROCHELLE	NY
GRIP	GRIPMASTER CO.	MARLBORO	NJ
GRVCO	GROVE COMPANY	DAYTON	OH
GUDL	GUDEBROD BROS. SILK CO.	CHICAGO	IL

ABBRV	NAME.....	CITY.....	ST
H-P	HEWLETT-PACKARD	INDIANAPOLIS	IN
HARTW	HARTWELL CORP.	PLACENTIA	CA
HEL	HELIPOT	ANAHEIM	CA
HEY	HEYMAN MFG. CO.	WAUKESHA	WI
HHS	HERMAN H. SMITH, INC.	BROOKLYN	NY
HI-G	HI-G INC.	WINDSOR LOCKS	CT
HI-G	HI-G INC	WINDSOR LOCKS	CT
HIT	HITACHI AMERICA, LTD.	SAN FRANCISCO	CA
HMLN	HAMLIN	LAKE MILLS	WI
HOLGW	HOLLINGSWORTH SLDRLS TERM.	POTTSTOWN	PA
HOLUB	HOLUB DISTRIBUTING CO.	NEWPORT	KY
HSD	HARRIS CORP. SEMICDR. DIV.	MELBOURNE	FL
HUD	HUDSON TOOL & DIE CO.	NEWARK	NJ
HY/PL	HYDRO PLASTICS INC.	GEORGETOWN	KY
HYSYS	HYBRID SYSTEMS	BEDFORD	MA
HYT	HYTRONICS	PINELLAS PARK	FL
ICI	ILLINOIS CAPACITOR INC.	MORTON GROVE	IL
ICO-R	ICO-RALLY	PALO ALTO	CA
IERC	INT'L ELEC. RESEARCH CORP.	BURBANK	CA
INDCP	INDUCTIVE COMPONENTS	HAUPPAUGE	NY
INDEC	INDUSTRIAL ELECTRONIC HDWR.	NEW YORK	NY
INLOK	INTERLOK/WM J PURDY CO.	BURLINGAME	CA
INT	INTERSIL, INC.	CUPERTINO	CA
INWEB	INTERNATIONAL WEBBING	WHITEHALL	PA
IRC	INTERNATIONAL RESISTANCE CO.	PHILADELPHIA	PA
IREC	INT'L RECTIFIER CORP.	LOS ANGELES	CA
ITRON	ISE ELECTRONICS	ISE, JAPAN	**
ITT	INT'L TELEPHONE & TELEGRAPH	W. PALM BEACH	FL
JAMES	JAMES ELECTRONICS	CHICAGO	IL
JAN	JAN HARDWARE MFG. CO.	LONG ISLAND CITY	NY
JEF	JEFFERS	DUBOIS	PA
JEFWC	JEFFERSON WIRE AND CABLE	WORCHESTER	MA
JEW	JEWELL ELECTRICAL INSTRUMENTS	MANCHESTER	NH
JFD	JFD ELECTRONICS	BROOKLYN	NY
JFW	JFW INDUSTRIES	BEECH GROVE	IN
JHSN	JOHANSON MFG. CORP.	BOONTON	NJ
JON	E.F. JOHNSON CO.	WASECA	MN
JUDD	JUDD WIRE DIV. ECC	TURNERS FALLS	MA
K-L	KERRIGAN LEWIS MFG.	CHICAGO	IL
K-S	K & S ENGINEERING CO.	CHICAGO	IL
KDI-P	KDI-PYROFILM CORP.	WHIPPANY	NJ
KEENE	KEENE CORP.	NEWARK	DE
KEM	KEMTRON ELECTRON PRODUCTS	NEWBURYPORT	MA
KEY	KEYSTONE ELECTRONIC CORP.	NEW YORK	NY
KID	KIDCO, INC.	MEDFORD	NJ
KIN	KINGS ELECTRONICS	TUCKAHOE	NY
KMYO	KAMAYA OHM	JAPAN	**
KRYST	KRYSTINEL	PATERSON	NJ
KSTR	KESTER SOLDER DIV.	CHICAGO	IL
KSW	KSW ELECTRONICS	BURLINGTON	MA
KSW	KSW ELECTRONICS	BURLINGTON	MA
KUL	KULKA ELECTRIC CORP.	MT. VERNON	NY
LAURN	LAUREN MFG CO.	NEW PHILADELPHIA	OH
LEYSE	LEYSE ALUMINUM CO.	KEWANEE	WI
LIT	LITTELFUSE, INC.	DES PLAINES	IL
LNMST	LINEMASTER SWITCH CORP.	WOODSTOCK	CT
LOCTT	LOCTITE CORP.	NEWINGTON	CT
LRC	LRC ELECTRONICS, INC.	HORNELL	NY
LTRNX	LITRONIX	CUPERTINO	CA
M-A	MICROWAVE ASSOCIATES	BURLINGTON	MA
M-D	MILLER DIAL & NAMEPLATE CO.	EL MONTE	CA
M-E	MEPCO ELECTRA, INC.	MORRISTOWN	NJ
M-O	ILLUMINATED PRODUCTS INC.	SANTA ANA	CA
M-P	MICRO PLASTICS INC.	CHATSWORTH	CA
MAL	MALLORY CONTROLS CO.	FRANKFORT	IN
MAND	MANDEX	CHICAGO	IL
MARQ	J. & J. MARQUARDT	TUTTLINGEN, GER.	**
MCREL	MICRO ELEX LTD	HONG KONG	**
MD-AM	MID AMERICA	CHICAGO	IL
MDC	MAIDA DEVELOPMENT CO.	HAMPTON	VA
MDLRS	MIDLAND ROSS	CINCINNATI	OH
MDTC	MODUTEC	NORWALK	CT
MILN	MILLEN MFG. CO.	NEW YORK	NY
MILSP	MILITARY SPECIFICATION	WASHINGTON	DC
MIN-C	MINI-CIRCUITS	BROOKLYN	NY
MINIS	MINI SYSTEMS	NORTH ATTLEBORO	MA

ABBRV	NAME.....	CITY.....	ST
MINOR	MINOR RUBBER CO.	BLOOMFIELD	NJ
MITEK	MITEK	LEXINGTON	MA
MLRJW	J.W. MILLER	COMPTON	CA
MMM	3M COMPANY	ST. PAUL	MN
MNO	MONSANTO COMM. PROD. DIV.	PALO ALTO	CA
MOL	MOLEX PRODUCTS	LISLE	IL
MORAD	MORGAN ADHESIVES	STOW	OH
MOSTK	MOSTK CORP.	CARROLLTON	TX
MOT	MOTOROLA SEMI. PROD. DIV.	INDIANAPOLIS	IN
MRM	M. ROSS MASON	INDIANAPOLIS	IN
MRO	MICRO SWITCH DIV.	FREEPORT	IL
MRRUB	MARION RUBBER PROD.	INDIANAPOLIS	IN
MSN	MICROSONICS DIV.	WEYMOUTH	MA
MSP	MICRO SEMICONDUCTOR CORP.	SANTA ANA	CA
MULSO	MULTICORE SOLDERS LTD.	WESTBURY	NY
MURA	MURA		
MURA	MURA	WESTBURY	NY
MURGA	MURATA-GEORGIA	MARIETTA	GA
MWS	MAGNET WIRE SUPPLY CO.	CHATSWORTH	CA
MYERS	MYERS SPRING CO.	LOGANSPORT	IN
N-T	NATIONAL TEL-TRONICS	LAREDO	TX
NAT	NATIONAL SEMICONDUCTOR CORP.	SANTA CLARA	CA
NCC	NATIONAL CERAMIC CO	TRENTON	NJ
NCSVC	NATL COM SERV.	WILLOW GROVE	PA
NEC	NIPPON ELECTRIC CO.	TOKYO, JAPAN	**
NEL	NATIONAL ENGINEERING LABS	INDIANAPOLIS	IN
NEW	NEWARK ELECTRONICS	INDIANAPOLIS	IN
NHWC	NEW HAVEN WIRE & CABLE	NEW HAVEN	IN
NICHN	NICHICON (AMERICA) CORP.	SCHAUMBURG	IL
NMB	NMB CORP.	ARLINGTON HEIGHTS	IL
NMC	MAGNUM MICROWAVE CORP.	SUNNYVALE	CA
NPC	NUCLEONIC PRODUCTS CO.	CANOGA PARK	CA
NYLO	NYLOMATIC	MORRISVILLE	PA
O-G	OPTI-GAGE INC.	DAYTON	OH
O-S	OMNI SPECTRA INC.	FARMINGTON	MI
OAK	OAK INDUSTRIES INC.	CRYSTAL LAKE	IL
OHM	OHMITE MFG. CO.	SKOKIE	IL
OMEGA	OMEGA WIRE & CABLE	HARLEYSVILLE	PA
OPTRN	OPTRON INC.	CARROLLTON	TX
P-B	POTTER AND BRUMFIELD	PRINCETON	IN
P-C	POWER COMPONENTS	WOODLAND HILLS	CA
P-K	PARKER KALON CORP.	CLIFTON	NJ
P-T	PENN TUBE PLASTICS CO.	CLIFTON HEIGHTS	PA
P-U	PROJECTS UNLIMITED INC.	DAYTON	OH
POLPH	POLYPHASE INSTR. CO.	BRIDGEPORT	PA
PACTC	PACTEC DIV.	PHILADELPHIA	PA
PAM	PAMOTOR DIV.	BURLINGAME	CA
PAND	PANDUIT CORP.	TINLEY PARK	IL
PARA	PARAMETRIC INDUSTRIES	NORTHFIELD	IL
PCC	PANEL COMPONENTS CORP.	BERKELEY	CA
PEC	PACIFIC ELECTRICORD CO.	GARDENA	CA
PEM	PENN ENGRG & MANUF CO.	DANBORO	PA
PFZR	PFIZER, INC.		
PHC	PHILADELPHIA HANDLE CO.	CAMDEN	NJ
PHILP	PHILPOTT RUBBER CO.	CLEVELAND	OH
PIC	PIHER INTERNATIONAL CORP.	ARLINGTON HEIGHTS	IL
PLI	PRECISION LAMP, INC.	MT. VIEW	CA
PLSSY	PLESSEY ENG.	SCHILLER PARK	IL
PLSTI	PLASTIC TECHNIQUES, INC	NEW BOSTON	NH
PLYCL	POLYCLAD LAMINATES	SOUTHFIELD	MI
PMCL	PERMACEL DIV.	NEW BRUNSWICK	NJ
PMI	PRECISION MONOLITHICS INC.	SANTA CLARA	CA
PNSNC	PANASONIC		
POM	POMONA ELECTRONICS CO., INC.	POMONA	CA
PREH	PREH VERT, MBH	GERMANY	**
PRMD	PYRAMID INDUSTRIES, INC.	PHOENIX	AZ
PRSLK	PRESTO-LOCK	GARFIELD	NJ
PRSN	PRECISION TUBE CO., INC	NORTH WALES	PA
PTN	PENN TRAN CORP.	BELLEFONT	PA
PWRMT	POWER-MATE CORP.	HACKENSACK	NJ
PYRO	PYROFILM CORP.	WHIPPANY	NY
PYTT	PYTTRONICS INDUSTRIES, INC.	MONTGOMERYVILLE	PA
Q-C	QUALITY COMPONENTS	ST. MARYS	PA
R-N	ROBINSON-NUGENT	NEW ALBANY	IN
R-OHM	R-OHM	IRVINE	CA
RAWST	RAW STOCK	*****	**

ABBRV	NAME.....	CITY.....	ST
RAY	RAYTHEON	INDIANAPOLIS	IN
RCA	RCA	CAMDEN	NJ
REL	RELIANCE MICA CO.	BROOKLYN	NY
RGNCY	REGENCY ELECTRONICS, INC.	INDPLS.	IN
RGR	ROGERS CORP.	CHANDLER	AZ
RICH	RICHCO PLASTIC CO.	CHICAGO	IL
RICHM	RICHARDS METAL PRODUCTS	WOLCOTT	CT
RMC	RADIO MATERIALS CORP.	CHICAGO	IL
RMF	RMF PRODUCTS INC.	BATAVIA	IL
ROCKW	ROCKWELL INTL.	ANAHEIM	CA
ROGAN	ROGAN CORP.	NORTHBROOK	IL
ROTRN	ROTRON INC.	WOODSTOCK	NY
RPBLC	REPUBLIC ELECTRONICS CORP	PATTERSON	NJ
RSSLL	RUSSELL	OCEANSIDE	NY
S-C	SPECIALTY CONNECTOR	INDIANAPOLIS	IN
S-G	STANDARD GRIGSBY	AURORA	IL
S-I	SWITCHCRAFT, INC.	CHICAGO	IL
S-S	SERVICE SUPPLY	INDIANAPOLIS	IN
S-T	SARKES TARZIAN	BLOOMINGTON	IN
SAGE	SAGE LABORATORIES, INC.	NATIC	MA
SAYRO	SAYROSA ENGINEERS LTD.	ALTON, HANTS, U.K.	**
SCBE	SCANBE DIVISION	EL MONTE	CA
SCC	STACKPOLE CARBON CO.	ST. MARYS	PA
SCX	SILICONIX INC.	SANTA CLARA	CA
SEAST	SEASTROM MFG. CO.	GLENDALE	CA
SECR	SECOR INC.	WESTWOOD	NJ
SEL	SEALECTRO CORP.	MAMARONECK	NY
SEM	SEMTECH	NEWBURY PARK	CA
SEMTX	SEMTEX	DAYTON	OH
SGM	SIGMA INSTRUMENTS	BRAINTREE	MA
SGS-A	SGS-ATES COMP ELET SPA	AGRATE BRIANZE, ITALY	**
SHAM	SHAMROCK PLASTICS & RUBBER CO.	INDIANAPOLIS	IN
SHDW	I.E.E. SCHADOW	EDEN PRAIRIE	MN
SHKMN	SHACKMAN INSTRUMENTS	CHESHAM, ENGLAND	**
SIEM	SIEMENS	ISELIN	NJ
SIG	SIGNETICS CORPORATION	SUNNYVALE	CA
SIGPT	SIGMA PLASTRONICS	DEARBORN	MI
SINCR	SINCLAIR & RUSH, INC.	ST. LOUIS	MO
SKDRV	STOCK DRIVE PROD. DIV.	NEW HYDE PARK	NY
SLT	SOLITRON/MICROWAVE DIV.	PORT SALERNO	FL
SMTC	SAMTEC INC.	NEW ALBANY	IN
SOUTH	SOUTHCO FASTENERS	LESTER	PA
SPE	SPECTROL	DAYTON	OH
SPEC	SPECTRUM CONTROL, INC.	FAIRVIEW	PA
SPR	SPRAGUE ELECTRIC CO.	INDIANAPOLIS	IN
SPRTX	SUPERTEX INC.	CUPERTINO	CA
SPST	SPECTRA-STRIP	GARDEN GROVE	CA
SSS	SOLID STATE SCIENTIFIC	MONTGOMERYVILLE	PA
STDFS	STANDARD PRESSED STEEL	JENKINTOWN	PA
STKFS	STAKE FASTENERS	SOUTH EL MONTE	CA
STR	STETTNER TRUSH CO.	CAZENOVIA	NY
STSA	STEEL SALES	INDIANAPOLIS	IN
SYL	GTE SYLVANIA	WALTHAM	MA
SYNTC	SYNTAC CORP.	CLEVELAND	OH
SYNTK	SYNERTEK	**	*
SYS	SYSCON INTERNATIONAL, INC.	SOUTH BEND	IN
T-I	TEXAS INSTRUMENTS	DALLAS	TX
TCPL	TACONIC PLASTIC	PETERSBURG	NY
TEK	TEKTRONIX	INDIANAPOLIS	IN
TEKA	TEKA PRODUCTS INC.	COLLEGE POINT	NY
TEKNT	TECKNIT	CRANFORD	NJ
TELE	TELETYPE CORP.	ELK GROVE VILLAGE	IL
TELRY	TELEDYNE RELAYS	HAWTHORNE	CA
TFI	T&F INDUSTRIES DIV.	ROLLING MEADOWS	IL
THR	THERMALLOY CO.	DALLAS	TX
TIMES	TIMES WIRE AND CABLE	CINCINNAI	OH
TIN	TINNERMAN PRODUCTS, INC.	CLEVELAND	OH
TKN	TECHNICAL WIRE	CRAWFORD	NJ
TLNC	TELONIC ALTAIR	LAGUNA BEACH	CA
TOKO	TOKO AMERICA	SKOKIE	IL
TOKO	TOKO AMERICA	SKOKIE	IL
TORCO	TOR CORP.	VAN NUYS	CA
TR-UT	TRIAD-UTRAD DIV.	HUNTINGTON	IN
TRIYX	TRIONYX INDUSTRIES	INDIANAPOLIS	IN
TRU	WALDES TRUARC	LONG ISLAND CITY	NY

ABBRV	NAME.....	CITY.....	ST
TRW	TRW CAPACITOR DIV.	OGALLALA	NB
TSHBA	TOSHIBA	**	*
TVL	TEL-VISION LABS	WAUCONDA	IL
TWAY	TWAY COMPANY	INDIANAPOLIS	IN
TYTON	TYTON CORP.	MILWAUKEE	WI
U-C	UNIVERSAL COMPONENTS	LOS ANGELES	CA
ULSP	UNDERWRITERS LAB. SPEC.	CHICAGO	IL
UNCAR	UNION CARBIDE COMPONENTS	GREENVILLE	SC
UNIC	UNICORP	ORANGE	NJ
UNIT	UNITRODE CORP.	WATERTOWN	MA
USECO	USECO DIV.	VAN NUYS	CA
UTK	UNITRACK DIV.	UPPER DARBY	PA
VAC	VACTEC INC.	MARYLAND HEIGHTS	MO
VACO	VACO PRODUCTS CO.	NORTHBROOK	IL
VAR	VARADYNE CAPACITOR DIV.	SANTA MONICA	CA
VARIL	VARI-L CO.	DENVER	CO
VELCR	VELCRO USA INC	NEW YORK	NY
VISCM	VISUAL COMM		
VLIER	VLIER ENGINEERING CORP.	BURBANK	CA
VONGT	VONNEGUT HARDWARE	INDIANAPOLIS	IN
VRN	VERNITRON CORP.	GREAT NECK	NY
VTRMN	VITRAMON, INC.	BRIDGEPORT	CT
W-E	WELLS ELECTRONICS	SOUTH BEND	IN
W-I	WAVETEK INDIANA, INC.	BEECH GROVE	IN
WAG	WAGNER ELECTRIC CORP.	ST. LOUIS	MO
WECK	WECKESSER CO., INC.	CHICAGO	IL
WHTMN	WHITMAN	CINCINNATI	OH
WKFLD	WAKEFIELD ENGINEERING	WAKEFIELD	MA
WLDM	WALDOM	CHICAGO	IL
WMBG	W.M. BERG	ROCKAWAY	NY
WNSL	WEINSCHEL ENGINEERING	GAITHERSBURG	MD
WNZLR	WINZLER MFG	CHICAGO	IL
WSD	WAVETEK	SAN DIEGO	CA
WSTN	WESTON COMPONENTS	ARCHBALD	PA
ZEN	ZENITH RADIO CORP.	CHICAGO	IL
ZERO	ZERO MANUFACTURING CO.	BURBANK	CA
ZIE	ZIERICK MFG. CORP.	MOUNT KISCO	NY
ZPT	ZIPPERTUBING, CO.	LOS ANGELES	CA

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
ZA01	METER BD, C315-2	C315-2	W-I	1110-00-0292	1
ZA02	DBLR CTRL ASSY	1110-00-1305	W-I	1110-00-1305	1
ZA03	MOD BD, 3010	1110-00-1320	W-I	1110-00-1320	1
ZA04	CHASSIS, 3010	1111-00-0100	W-I	1111-00-0100	1
ZA05	WIDE OSC LK, M34	M34	W-I	1114-00-0008	1
ZA06	FM REF, M29-2	M29-2	W-I	1114-00-0016	1
ZA07	SWP OSC, M9W	M9W	W-I	1114-00-0020	1
ZA08	NAR OSC LK, M33-2	M33-2	W-I	1114-00-0023	1
ZA09	KHZ STEPS, M31A	M31A	W-I	1114-00-0143	1
ZA10	MHZ STEPS, M32A	M32A	W-I	1114-00-0215	1
ZA11	DAC/SWP DRIVE, M172	M172	W-I	1114-00-0320	1
ZA12	100 HZ STEPS, M149B	M149B	W-I	1114-00-0329	1
ZA13	FREQ DBLR, M164	M164	W-I	1114-00-0342	1
ZA14	XTAL REF, M30-5	M30-5	W-I	1114-00-0349	1
ZA15	DRIVER AMP, M10W-9	M10W-9	W-I	1114-00-0360	1
ZA16	POWER SUPPLY, DPS2A	DPS2A	W-I	1115-00-0011	1
W1	CABLE ASSY, 9IN	WX3010-W1	W-I	1217-90-0052	1

WAVETEK PARTS LIST	TITLE SIG GEN, 3010	ASSEMBLY NO. 1010-00-0147 PAGE: 1	REV -

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
W2	CABLE ASSY, 4-3/8 IN	WX3010-W2	W-I	1217-90-0053	1
W3	CABLE ASSY, 2-1/4 IN	WX3000-200-W10	W-I	1217-90-0004	1
W4	CABLE ASSY, 3-3/4 IN	WX3000-A9	W-I	1217-00-0036	1
W5 W8	CABLE ASSY, 4-3/4 IN	WX3000-200-W20	W-I	1217-00-0046	2
W6	CABLE ASSY, 3 IN	WX1504-A3	W-I	1217-00-0030	1
W7	CABLE ASSY, 1-3/4 IN	WX3010-W7	W-I	1217-00-0016	1
W9	CABLE ASSY, 4-1/2 IN	WX3010-W9	W-I	1217-00-0044	1
W10 W11	CABLE ASSY, 3-1/8 IN	WX3010-W11	W-I	1217-00-0034	2
W12	CABLE ASSY, 5 IN	WX3000-200-W18	W-I	1217-00-0050	1
W13	CABLE ASSY, 7-1/2 IN	WX3000-200-W11	W-I	1217-00-0074	1
W14	CABLE ASSY, 9-1/2 IN	WX3010-W14	W-I	1217-00-0094	1
W15	CABLE ASSY, 2-1/8 IN	WA3001-W10	W-I	1217-00-0032	1
W21	CABLE ASSY, 4-1/8 IN	WX3010-W21	W-I	1217-90-0056	1
HH1	HARNESS ASSY	1219-00-0182	W-I	1219-00-0182	1
HH2	HARNESS ASSY	WX3010FP	W-I	1219-00-0187	1
HH3	HARNESS ASSY	WX3010MB	W-I	1219-00-0188	1
P101	PLUG 36-PIN MICRO-D/M	MS-06-2362	MDL	2113-04-0005	1

WAVETEK PARTS LIST	TITLE SIG GEN, 3010	ASSEMBLY NO. 1010-00-0147 PAGE: 2	REV -

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	1
C2	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	1
C3	CAP, MYLAR, .15MF, 100V CP103-415	WMF1P15	C-D	1510-60-2154	1
C4	CAP, ELECT, 2000MF, 3V CE123-220	500D208G003FH7	SPR	1510-21-8202	1
CR2 CR3	DIODE DR000-001	1N4004	P-C	4806-01-4004	2
CR4	DIODE DG109-140	1N4148	T-I	4807-01-0914	1
CR5	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1
IC1 IC2 IC3	IC, IC000-005	RC4558N8	RAY	7000-14-5800	3
IC4	IC, IC000-030	LM318N	NAT	7000-03-1800	1
J3	HSG, MINI-LATCH, 7-PIN MC000-113	65039-030	BER	2113-10-0003	1
M1	0-1 MA METER WITH 3 METER SCALE PER B/P	2410-06-0004	W-I	2410-06-0004	1
P1	PLUG, 6-PIN KONEKTON MC000-075	09-65-1061	MOL	2112-05-0002	1
P2	HEADER, 7-PIN, R.A. REF: 2112-08-0000	MC000-099	W-I	2112-08-0002	1

WAVETEK PARTS LIST	TITLE METER BD, C315-2	ASSEMBLY NO. 1110-00-0292 PAGE: 1	REV G

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
P3	HEADER, RA, 5-PIN REF: 2112-08-0000	2112-08-0020	W-I	2112-08-0020	1
Q1	TRANS QA054-580	2N5458	INT	4901-05-4580	1
R01	POT, 5K, RP130-250	89PR5K	BEK	4610-00-2502	1
R02	RES, C, 1/4W, 5%, 7.5K RC103-275	CF1/4-7.5K}RD025-5%	ASE}K	4700-15-7501	1
R03	RES, MF, 1/8W, 1%, 36.5K RF213-365	MF55K-36.5K	ASE	4701-03-3652	1
R04 R21	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K}RD025-5%	ASE}K	4700-15-3302	2
R05 R06	RES, MF, 1/8W, 1%, 10K RF213-100	MF55K10K	ASE	4701-03-1002	2
R22 R7	RES, C, 1/4W, 5%, 20K RC103-320	CF1/4-20K}RD025-5%	ASE}K	4700-15-2002	2
R08	RES, MF, 1/8W, 1%, 2.74K RF212-274	MF55K-2.74K	ASE	4701-03-2741	1
R09	RES, MF, 1/8W, 1%, 11.3K RF213-113	MF55K-11.3K	ASE	4701-03-1132	1
R10	RES, MF, 1/8W, 1%, 3.92K RF212-392	MF55K-3.92K	ASE	4701-03-3921	1
R11	POT, MOD, 10K, 10% RP140-310	70AIN048P103U	A-B	4610-11-3103	1

WAVETEK PARTS LIST	TITLE METER BD, C315-2	ASSEMBLY NO. 1110-00-0292 PAGE: 2	REV G

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R12 R15 R17 R18 R25	POT, 20K, RP130-320	89PR20K	BEK	4610-00-2203	5
R13	RES, C, 1/4W, 5%, 5.6K RC103-256	CF1/4-5.6K}RD025-5%	ASE}K	4700-15-5601	1
R14	RES, C, 1/4W, 5%, 220K RC103-422	CF1/4220K}RD025-5%	ASE}K	4700-15-2203	1
R16 R20	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K}RD025-5%	ASE}K	4700-15-1002	2
R19	RES, C, 1/4W, 5%, 1M RC103-510	CF1/4-1M}RD025-5%	ASE}K	4700-15-1004	1
R23	RES, C, 1/4W, 5%, 68K RC103-368	CF1/4-68K}RD025-5%	ASE}K	4700-15-6802	1
R24	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K}RD025-5%	ASE}K	4700-15-1003	1
R26	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K}RD025-5%	ASE}K	4700-15-1502	1
R27	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K}RD025-5%	ASE}K	4700-15-2202	1
R28	RES, C, 1/4W, 10%, 100M RC104-710	CB1071	A-B	4700-16-1006	1
R29	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K}RD025-5%	ASE}K	4700-15-2201	1
R30	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K}RD025-5%	ASE}K	4700-15-4702	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R31	RES, MF, 1/8W, 1%, 4.02K RF212-402	MF55K-4.02K	ASE	4701-03-4021	1
R32	POT, 2K, RP130-220	89PR2K	BEK	4610-00-2202	1
R33	RES, C, 1/4W, 5%, 1.2K RC103-212	CF1/4-1.2K}RD025-5%	ASE}K	4700-15-1201	1
R34	RES, VAR. CERMET, 100	89PR100	BEK	4610-00-2101	1
HH1	HARNESS, C315-2	WYC315-2	W-I	1219-00-0328	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
IC01 IC02 IC03 IC04 IC05 IC12	HEX INVERTER	SN74LS04N	T-I	8000-74-0410	6
IC06	NBCD ADDER STATIC SENSITIVE	MC14560CP	MOT	8001-45-6000	1
IC07 IC08 IC09 IC10 IC11	4-BIT BINARY ADDER	SN74LS283	T-I	8007-42-8310	5
IC13 IC14 IC15 IC16 IC17 IC18	QUAD DATA SEL/MPXR	SN74LS158N	MOT	8007-41-5810	6
IC19	QUAD POS NAND	SN74LS00N	T-I	8000-74-0010	1
IC21	IC,IC000-011	78M05U1C	FCD	7000-78-0500	1
IC22	QUAD NOR	SN74LS02N	T-I	8000-74-0210	1

WAVETEK PARTS LIST	TITLE DBLR CTRL ASSY	ASSEMBLY NO. 1110-00-1305 PAGE: 1	REV -

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C07 C08 C09	CAP,TANT,10MF,25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	4
C02 C11	CAP,CER,.05MF,100V CD103-350	TG-S50	SPR	1510-10-2503	2
C03	CAP,,FILM,.015MF400V	50B153K400	PLSSY	1510-61-0153	1
C04	CAP,FILM,.15MF,100V	60C154K100	PLSSY	1510-60-7154	1
C05	CAP,ELECT,1MF,25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	1
C10 C12 C13	CAP,CER,.01MF,100V CD103-310	68U103M	MDC	1510-10-2103	3
CR02	DIODE DR000-001	1N4004	P-C	4806-01-4004	1
CR03 CR04 CR05 CR06 CR07	DIODE DG10?-14?	1N4148	T-I	4807-01-0914	5
CR08 CR09 CR10	LED DL000-001	NSL5046	NAT	4810-02-0001	3
HH1	HARNESS,3000MB	WY3003MB	W-I	1219-00-0127	1
IC01	MULTI-C FUNCT, QPN	XR2206CP	EXAR	8000-22-0600	1
IC02	IC,IC000-00?	N5741CV	SIG	7000-57-4100	1
IC03 IC04	IC,IC000-009	RC4558N8	RAY	7000-14-5800	2
IC05	IC,IC000-00?	MC1455P1	MOT	7000-14-5500	1

WAVETEK PARTS LIST	TITLE MOD BD ASSY	ASSEMBLY NO. 1110-00-1320 PAGE: 1	REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
K01	RELAY, SPDT MR000-002	191TE1C1-12G	SGM	4510-00-0002	1
P1	PLUG, LOCKING	09-65-1121	MOL	2112-05-0004	1
P2	HEADER, STRT, 2 PIN REF: 2112-07-0000	2112-07-0007	W-I	2112-07-0007	1
Q02	POWER FET	VN10KM	SCX	4902-00-0100	1
Q04 Q06 Q08	TRANS GB000-009	MPS3702	NAT	4902-03-7020	3
R02 R03 R17 R20 R21 R28 R52 R54 R57 R58 R59	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	11
R04	POT, 20K, RP130-320	89PR20K	BEK	4610-00-2203	1
R05	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	1
R06 R09	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K	ASE	4700-15-3302	2
R07 R22 R24 R30 R32	RES, C, 1/4W, 5%, 12K RC103-312	CF1/4-12K	ASE	4700-15-1202	5
R08 R61	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	2
R08 R36 R45 R53 R55	RES, MF, 1/8W, 1%, 1K RF212-100	MF55K-1K	ASE	4701-03-1001	5
R11	POT, 5 K	363S105B	CTS	4610-00-1502	1

WAVETEK PARTS LIST	TITLE MOD BD, 3010	ASSEMBLY NO. 1110-00-1320 PAGE: 2	REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R10 R13	POT, 100K, RP129-410	360S104B	CTS	4610-00-1104	2
R12	POT, 2K, RP129-220	360S202B	CTS	4610-00-1202	1
R16	POT, 1K, RP130-210	89PR1K	BEK	4610-00-2102	1
R18 R29 R37 R46	POT, 50K, RP129-350	360S503B	CTS	4610-00-1503	4
R19 R27	POT, , 10K, 30%, 0 TERM, D, .125 X 1-7/8 SHAFT	SER, 200	CTS	4610-13-6103	2
R23 R25 R31 R33	RES, C, 1/4W, 5%, 3.9K RC103-239	CF1/43.9K	ASE	4700-15-3901	4
R26	RES, C, 1/4W, 5%, 680 RC103-168	CF1/4-680	ASE	4700-15-6800	1
R34 R43	POT, 1K, RP129-210	360S102B	CTS	4610-00-1102	2
R35 R44	RES, C, 1/4W, 5%, 3K RC103-230	CF1/4-3K	ASE	4700-15-3001	2
R38 R47	RES, C, 1/4W, 5%, 150K RC103-415	CF1/4-150K	ASE	4700-15-1503	2
R39 R48	RES, 1/8W, 1%, 49.9K	MF55K-49.9K	ASE	4701-03-4992	2
R40 R50	RES, MF, 1/8W, 1%, 15K RF213-150	MF55K-15K	ASE	4701-03-1502	2
R41 R49	POT, 10K, RP129-210	360S103B	CTS	4610-00-1103	2

WAVETEK PARTS LIST	TITLE MOD BD, 3010	ASSEMBLY NO. 1110-00-1320 PAGE: 3	REV A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R42 R51	RES, MF, 1/8W, 1%, 4.99K RF212-499	MF55K-4.99K	ASE	4701-03-4991	2
R56	POT/SWITCH 10K 10% RP150-310	70K1G040R103U(1001)	A-B	4610-30-8103	1
R60	RES, C, 1/4W, 5%, 200 RC103-120	CF1/4-200	ASE	4700-15-2000	1
R62	RES, C, 1/4W, 5%, 330 RC103-133	CF1/4-330	ASE	4700-15-3300	1
R63	RES, C, 1/4W, 10%, 22M RC104-622	CB2261	A-B	4700-16-2205	1
R64	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
R65	RES, C, 1/4W, 10%, 47M RC104-647	CB4761	A-B	4700-16-4705	1
R66 R67	RES, C, 1/4W, 5%, 82K RC103-382	CF1/4-82K	ASE	4700-15-8202	2
R69	RES, C, 1/4W, 5%, 270 RC103-127	CF1/4-270	ASE	4700-15-2700	1
R70	RES, C, 1/4W, 5%, 20K RC103-320	CF1/4-20K	ASE	4700-15-2002	1
S1	SWITCH, ROTARY	5104-00-0023	W-I	5104-00-0023	1
S2 S3	SWITCH, ROTARY	5104-00-0022	W-I	5104-00-0022	2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
S101 S102 S103 S107	LEVER SWITCH SL001-002	L20-36AD	CHE	5101-00-0004	4
S104	LEVER SWITCH SL002-002	L20-37AD	CHE	5101-00-0005	1
S105 S106	LEVER SWITCH SL003-002	L20-02A	CHE	5101-00-0006	2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01	CAP, ELECT, 100MF, 12V CE119-110	500D107G012CC7	SPR	1510-21-2101	1
C02 C06 C09	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	3
C03	CAP, ELECT, 100MF, 6V CE118-110	500D107G006CC7	SPR	1510-21-1101	1
C04 C05 C07 C08	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	4
C10 C11 C12	CAP, ELECT, 1MF, 25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	3
C13	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	1
C14 C15 C16 C17 C20	CAP, F.T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	5
C18 C19	CAP, F.T., 120PF CF102-112	54-794-001-121K	SPEC	1510-30-1121	2
C21	CAP, CER, 200PF, 1KV CD102-120	5GA-T20	SPR	1510-10-1201	1
C602	CAP, CER, F.T., 39PF CF114-039	4420-39PF	AER	1510-31-0390	1
CR1	DIODE DG000-009	5082-2835	H-P	4809-02-0002	1
CR2	LED DL000-001	NSL5046	NAT	4810-02-0001	1

WAVETEK PARTS LIST	TITLE WIDE OSC LK, M34	ASSEMBLY NO. 1114-00-0008 PAGE: 1	REV Q

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
IC1	IC, IC000-011	78M05U1C	FCD	7000-78-0500	1
IC2	IC, IC000-029	11C44DC	FCD	8000-11-4400	1
J1 J2 J3 J4 J5	CONN JF000-005	37JR116-1	S-C	2110-03-0002	5
L01	FERRITE CHOKE, 1 TURN FROM: 1813-00-0007	LA007-001	W-I	1210-30-0004	1
L02 L03 L04 L05 L07 L08 L09 L11 L12	TOROID	LA009-010-1	HYT	1810-05-0004	9
L10	TOROID, 10 TURN	LA009-010-2	HYT	1810-05-0005	1
L301 L601	CHOKE, 4.7MH, 10% LA005-R47	08N4R7K	ASE	1810-03-0479	2
R01	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	1
R02 R07	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	2
R03 R08	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	2
R04	RES, C, 1/8W, 5%, 47 RC101-047	CF1/8-47	ASE	4700-05-4709	1
R06	RES, C, 1/4W, 5%, 1.2K RC103-212	CF1/4-1.2K	ASE	4700-15-1201	1

WAVETEK PARTS LIST	TITLE WIDE OSC LK, M34	ASSEMBLY NO. 1114-00-0008 PAGE: 2	REV Q

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
NONE	VID AMP ASSY	M34S-4	W-I	1219-00-0019	1
NONE	VID MIXER ASSY	M34S-7	W-I	1219-00-0020	1
NONE	W.B. MIXER/AMP ASSY	M34-S2/3	W-I	1219-00-0129	1
NONE	LEV ASSY	M34S-5	W-I	1218-00-0314	1
NONE	PH LK ASSY	M34S-6	W-I	1218-00-0334	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	WIDE OSC LK,M34	1114-00-0008	Q
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C101 C104 C203	CAP,FT,500PF,20%250V CF104-150	4420-500PF	AER	1510-30-3501	3
C102 C103	CAP,CER,DISC,.001MF 50V,CD112-210	8101-050-102M	ETP	1510-10-7102	2
C105*	CAP,G.C.,1.5PF CG101-215	GC-1.5PF	G-C	1510-40-0159	1
C201 C204	CAP,CER,.005MF,100V	TG-D50	SPR	1510-10-2502	2
C202* C207 C210	CAP,CER,6.8PF,1KV CD101-R68	60C0H6R8D	MDC	1510-10-0689	3
C205*	CAP,G.C.,2.7PF CG101-227	GC-2.7PF	G-C	1510-40-0279	1
C206	CAP,M-C,4.7PF,10% CG102-247	GC-4.7PF	G-C	1510-40-1479	1
C208 C209	CAP,CER,15PF,1KV CD101-015	10TCC-015	SPR	1510-10-0150	2
CR101 CR102	DIODE DP000-040	MA47980	M-A	4805-02-0001	2
CR103 CR104	DIODE DG000-009	5082-2835	H-P	4809-02-0002	2
L101	FERRITE CHOKE,1TURN PROM: 1813-00-0007	LA007-001	W-I	1210-30-0004	1
L102	TORRID, 10 TURN	LA009-010-1	HYT	1810-05-0004	1
L201 L202 L203 L204	RF CHOKE	CHOKE	W-I	1819-99-9999	4

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	W.B. MIXER/AMP ASSY	1219-00-0129	B
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q201 Q202	TRANS 04050-030	2N5058	APx	4901-05-0530	2
R101 R102	RES.C,1/8W,5% +2% RC101-347	CF1/8-47K	ASE	4700-05-4702	2
R103	RES.C,1/4,5%,2T RC102-027	CF1/4-2T	ASE	4700-15-2709	1
R201	RES.C,1/4W,5% 020 RC103-182	CF1/4-820	ASE	4700-15-8200	1
R202	RES.C,1/4W,5%,560 RC103-156	CF1/4-560	ASE	4700-15-5600	1
R203	RES.C,1/4W,5%,68 RC103-068	CF1/4-68	ASE	4700-15-6809	1
R204	RES.C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R205	RES.C,1/4W,5%,100 RC103 110	CF1/4-100	ASE	4700-15-1000	1
T101	RF xFMR FROM 1813-00-0000	T5001-001	W-I	1210-40-0001	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	A.B. MIXER/AMP ASSY	1219-00-0129	B
		PAGE 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C301	CAP, CER, F.T., 39PF CF114-039	4420-39PF	AER	1510-31-0390	1
C302	CAP, CER, F.T., 27PF CF114-027	4420-27PF	AER	1510-31-0270	1
C303 C306 C308 C320	CAP, CER, .01MF, 50V CD113-310	CY15C103M	C-L	1510-10-B103	4
C304 C305 C307 C309 C310 C312	CAP, CER, FT, 2200PF, GMV, CF115-222	4420-2200PF	AER	1510-31-1222	6
C311 C321 C322	CAP, ELECT, 1MF, 25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	3
C313 C315 C316*	CAP, CER, F.T., 120PF CF116-112	4420-120PF	AER	1510-31-2121	3
C314	CAP, CER, F.T., 150PF CF116-115	4420-150PF	AER	1510-31-2151	1
C317	CAP, CER, F.T., 360PF CF116-136	4420-360PF	AER	1510-31-2361	1
C318*	CAP, CER, F.T., 18PF CF113-018	4420-18PF	AER	1510-30-9180	1
C319	CAP, CER, 100PF, 1KV CD104-110	10TCU-T10	SPR	1510-10-3101	1
CR301 CR302 CR303	DIODE, SIL, HOT CAR DG000-013	5082-3188	H-P	4812-02-0002	3

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	VID AMP ASSY	1219-00-0019	I
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L06 L308	TOROID	LA009-010-1	HYT	1810-05-0004	2
L302	CHOKE, 4.7MH, 10% LA005-R47	08N4R7K	ASE	1810-03-0479	1
L303	TOROID, 4 TURN	LA009-004-1	HYT	1810-05-0003	1
L304	CHOKE .47MH 10% LA005-R04	08NR47K	ASE	1810-03-0478	1
L305 L306 L307	CHOKE, 1MH, 10% LA005-R10	08N1R0K	ASE	1810-03-0010	3
Q301 Q302 Q303 Q304	TRANS QA050-530	2N5053	APX	4901-05-0530	4
R05	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
R301 R308 R310	RES, C, 1/8W, 5%, 22K RC101-322	CF1/8-22K	ASE	4700-05-2202	3
R302 R307 R309 R313	RES, C, 1/8W, 5%, 47 RC101-047	CF1/8-47	ASE	4700-05-4709	4
R303 R305 R311	RES, C, 1/8W, 5%, 2.2K RC101-222	CF1/8-2.2K	ASE	4700-05-2201	3
R304 R306 R312	RES, C, 1/8W, 5%, 390 RC101-139	CF1/8-390	ASE	4700-05-3900	3
R314 R315 R316	RES, C, 1/8W, 5%, 2K RC101-220	CF1/8-2K	ASE	4700-05-2001	3

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R317	RES, MF, 1/8W, 1%, 15K RF213-150	MF55K-15K	ASE	4701-03-1502	1
R318	RES, MF, 1/8W, 1%, 1K RF212-100	MF55K-1K	ASE	4701-03-1001	1
R319	RES, MF, 1/8W, 1%, 499 RF211-499	MF55K-499	ASE	4701-03-4990	1
R320	RES, MF, 1/8W, 1%, 2.43K RF212-243	MF55K-2.43K	ASE	4701-03-2431	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C401 C404	CAP, ELECT, 1MF, 25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	2
C402	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	1
C403	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	1
CR401 CR402 CR403 CR404 CR405 CR406 CR407 CR408	DIODE DR000-001	1N4004	P-C	4806-01-4004	8
IC401	IC, IC000-005	RC4558NB	RAY	7000-14-5800	1
Q401 Q402 Q403 Q405	TRANS QA039-040	2N3904	NAT	4901-03-9040	4
Q404	TRANS QB000-009	MPS3702	NAT	4902-03-7020	1
R401 R403	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	2
R402 R410 R417	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	3
R404 R405	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	2
R406	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R407	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R408 R409	RES, C, 1/4W, 5%, 7.5K RC103-275	CF1/4-7.5K	ASE	4700-15-7501	2
R411	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
R412	RES, C, 1/4W, 5%, 1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1
R413	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	1
R414	RES, C, 1/4W, 5%, 330K RC103-433	CF1/4-330K	ASE	4700-15-3303	1
R415	RES, C, 1/4W, 5%, 2.2M RC103-522	CF1/4-2.2M	ASE	4700-15-2204	1
R416	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1
R418	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	1
R419	RES, C, 1/4W, 5%, 1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C501	CAP, CER, 25PF, 1KV CD101-025	60C0G250J	MDC	1510-10-0250	1
C502	CAP, MYLAR, .022MF200V CP101-322	WMF2S22	C-D	1510-60-0223	1
C503	CAP, ELECT, 1MF, 25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	1
C504 C507	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	2
C505	CAP, CER, 150PF, 1KV CD102-115	60U151M	MDC	1510-10-1151	1
C506	CAP, CER, 470PF, 1KV CD102-147	60U471M	MDC	1510-10-1471	1
C508	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	1
C509	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	1
CR501 CR502 CR503 CR504 CR505 CR506	DIODE DR000-001	1N4004	P-C	4806-01-4004	6
IC501 IC502	DUAL OP AMP, RAYTHEON IC000-027	RC4558DN	RAY	7000-45-5801	2
Q501	TRANS QA054-580	2N5458	MOT	4901-05-4580	1
Q502	TRANS QA054-610	2N5461	MOT	4901-05-4610	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	PH LK ASSY	1218-00-0334	H
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R501	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
R502	RES, C, 1/4W, 5%, 82K RC103-382	CF1/4-82K	ASE	4700-15-8202	1
R503	RES, C, 1/4W, 10%, 1.2K	CB1221	A-B	4705-16-1201	1
R504 R510	RES, C, 1/4W, 10%, 3.3K RC104-233AB	CB3321	A-B	4705-16-3301	2
R505	RES, C, 1/4W, 5%, 27K RC103-327	CF1/4-27K	ASE	4700-15-2702	1
R506	RES, C, 1/4W, 5%, 12K RC103-312	CF1/4-12K	ASE	4700-15-1202	1
R507 R508	RES, C, 1/4W, 10%, 10K RC104-310AB	CB1031	A-B	4705-16-1002	2
R509	RES, C, 1/4W, 10%, 2.2M RC104-522AB	CB2251	A-B	4705-16-2204	1
R511	RES, C, 1/4W, 10%, 4.7K RC104-247AB	CB4721	A-B	4705-16-4701	1
R512 R514	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	2
R513 R515	RES, C, 1/4W, 10%, 10M RC104-610	CB1061	A-B	4700-16-1005	2
R516 R519 R521	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K	ASE	4700-15-3302	3

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	PH LK ASSY	1218-00-0334	H
		PAGE: 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R517 R518	RES, C, 1/4W, 5%, 680K RC103-468	CF1/4-680K	ASE	4700-15-6803	2
R520 R522	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	PH LK ASSY	1218-00-0334 PAGE: 3	H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C601	CAP, CER, F.T., 18PF CF113-018	4420-18PF	AER	1510-30-9180	1
CR601 CR602	DIODE DG000-009	5082-2835	H-P	4809-02-0002	2
R601	RES, C, 1/8W, 5%, 47 RC101-047	CF1/8-47	ASE	4700-05-4709	1
R602	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
T601	RF XFMR FROM 1813-00-0007	TR001-002	W-I	1210-40-0002	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	VID MIXER ASSY	1219-00-0020 PAGE: 1	H

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1 C29 C30 C31	CAP, F.T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	4
C2	CAP, CER, 75PF, 1KV CD104-075	10TCU-075	SPR	1510-10-3750	1
C6	CAP, CER, 3000PF, 1KV CD102-230	59A-D30	SPR	1510-10-1302	1
C7	CAP, CER, 68PF, 1KV CD104-068	68U2J680J	MDC	1510-10-3680	1
C10 C4	CAP, CER, 150PF, 1KV CD102-115	50P151M	MDC	1510-10-1151	2
C11	CAP, VARI, 7.35PF, 2KV CV101-035	75TRIK0-02	STR	1510-70-0350	1
C12*	CAP, MICA, 27PF	CM05ED270J03	ARC	1510-50-0270	1
C13	CAP, MICA, 470PF, 500V CM101-147	DM15-471J	ARC	1510-50-0471	1
C15 C18	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	2
C16 C17	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	2
C19 C24 C25 C26 C27 C3 C5 C8 C9	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	9
C20	CAP, CER, .001MFD, 1KV CD102-210	50AD10	SPR	1510-10-1102	1

WAVETEK PARTS LIST	TITLE FM REF, M29-2	ASSEMBLY NO. 1114-00-0016 PAGE: 1	REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C21	CAP, MICA, 100PF, 500V CM101-110	DM15-101J	C-D	1510-50-0101	1
C23 C28	CAP, CER, 20PF, 1KV CD101-020	50C0G200J	MDC	1510-10-0200	2
CR1 CR10 CR11	DIODE DR000-001	1N4004	P-C	4806-01-4004	3
CR2 CR7 CR8 CR9	DIODE DG000-011	FD-6666	FCD	4807-02-0003	4
CR3 CR4 CR5 CR6	DIODE DG000-010	FD777	FCD	4807-02-0002	4
IC1 IC2	IC, 8 PIN, IC000-008	LM301-AN	NAT	7000-03-0100	2
IC03	DUAL DIFF AMP	CA3102AE	RCA	7000-31-0200	1
J1	CONN JF000-005	CIR116-1	S-C	2110-03-0002	1
L01 L02	TOROID	5009-010-1	HYT	1810-05-0004	2
Q1	TRANS QB000-011	2N5401	SPR	4902-00-4010	1
Q2	TRANS QB000-009	MPS3702	NAT	4902-03-7020	1
Q3	TRANS QB000-010	TD101	SPR	4902-00-1010	1
Q4	TRANS QA039-040	2N3904	NAT	4901-03-9040	1
Q5	TRANS QA039-060	2N3906	T-I	4901-03-9060	1
Q6	TRANS QB000-026	A03958	A-D	4902-03-9580	1

WAVETEK PARTS LIST	TITLE FM REF, M29-2	ASSEMBLY NO. 1114-00-0016 PAGE: 2	REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q8 Q9	TRANS QA036-400	[illegible]0-18	NAT	4901-03-6400	2
Q10 Q7	TRANS QA051-390	2N5139	NAT	4901-05-1390	2
R1	POT, 2K, RP130-220	89PR2K	BEK	4610-00-2202	1
R02	RES, MF, 1/8W, 1%, 4.87K RF212-487	MF55K-4.87K	ASE	4701-03-4871	1
R10 R16 R19 R22 R25 R3 R5	RES, MF, 1/8W, 1%, 1K RF212-100	MF55K-1K	ASE	4701-03-1001	7
R12 R15 R6	RES, MF, 1/8W, 1%, 110K RF214-110	MF55K-110K	ASE	4701-03-1103	3
R13	RES, C, 1/4W, 5%, 150K RC103-415	CF1/4-150K	ASE	4700-15-1503	1
R14 R30 R32 R33 R44 R9	RES, MF, 1/8W, 1%, 499 RF211-499	MF55K-499	ASE	4701-03-4990	6
R17 R29 R56 R57	RES, MF, 1/8W, 1%, 5.11K RF212-511	MF55K-5.11K	ASE	4701-03-5111	4
R18	POT, 20K, RP130-320	89PR20K	BEK	4610-00-2203	1
R20 R23 R58	RES, MF, 1/8W, 1%, 4.02K RF212-402	MF55K-4.02K	ASE	4701-03-4021	3
R21 R8	RES, MF, 1/8W, 1%, 249 RF211-249	MF55K-249	ASE	4701-03-2490	2
R26	RES, C, 1/8W, 1%, 33.2 RF21R-332	MF55K-33.2	ASE	4701-03-3329	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R28 R39 R41 R42 R46	RES, MF, 1/8W, 1%, 100 RF211-100	MF55K100	ASE	4701-03-1000	5
R34	RES, MF, 1/8W, 1%, 845 RF211-845	[illegible]-845	ASE	4701-03-8450	1
R35 R50	RES, MF, 1/8W, 1%, 1.1K RF212-110	MF55K-1.1K	ASE	4701-03-1101	2
R36 R37 R51	RES, MF, 1/8W, 1%, 1.50K RF212-150	MF55K-1.50K	ASE	4701-03-1501	3
R38 R4 R40 R7	RES, MF, 1/8W, 1%, 2K RF212-200	MF55K-2K	ASE	4701-03-2001	4
R43 R54	RES, MF, 1/8W, 1%, 15K RF213-150	MF55K-15K	ASE	4701-03-1502	2
R45	RES, MF, 1/8W, 1%, 174 RF211-174	MF55K-174	ASE	4701-03-1740	1
R47 R49	RES, MF, 1/8W, 1%, 357 RF211-357	MF55K-357	ASE	4701-03-3570	2
R48	RES, MF, 1/8W, 1%, 2.10K RF212-210		MF55K	4701-03-2101	1
R55	RES, MF, 1/8W, 1%, 2.49K RF212-249	[illegible]2.49K	ASE	4701-03-2491	1
R59	RES, MF, 1/8W, 1%, 1M RF215-100	MF55D	ASE	4701-03-1004	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R60	RES, MF, 1/8W, 1%, 48.7K RF213-487	MF55K-48.7K	ASE	4701-03-4872	1
R61	RES, MF, 1/8W, 1%, 10K RF213-100	MF55K10K	ASE	4701-03-1002	1

WAVETEK PARTS LIST	TITLE FM REF, M29-2	ASSEMBLY NO. 1114-00-0016 PAGE: 5	REV F

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C04 C22 C23	CAP, F.T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	4
C02	CAP, F.T., 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	1
C03	CAP, F.T., 120PF CF102-112	54-794-001-121K	SPEC	1510-30-1121	1
C05	CAP, Q-C, 2.0PF, 10% CG101-220	QC-2.0PF	Q-C	1510-40-0020	1
C06 C07 C08 C09 C24 C38 C40 C41 C42	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	9
C10 C11 C12 C20 C21 C26 C28 C36 C43 C46	CAP, FT, CER, 100PF, 20% CF104-110	4420-100PF	AER	1510-30-3101	10
C13	CAP., CHIP, .1 MF	51C1209-B104Z	CFI	1510-00-3104	1
C14 C15 C16 C17 C32 C33 C34	CAP, Q-C, 10PF, 10%, CG101-310	QC-10PF	Q-C	1510-40-0100	7
C18 C35	CAP, CER, 120PF, 1KV CD102-112	60U121M	MDC	1510-10-1121	2
C19	CAP, CER, .02UF, 50V	TG-520	SPR	1510-10-2203	1
C25	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	1
C27	CAP, Q.C., 1PF CG101-210	QC-1PF	Q-C	1510-40-0010	1

WAVETEK PARTS LIST	TITLE SWP OSC, M9W	ASSEMBLY NO. 1114-00-0020 PAGE: 1	REV L

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C29	CAP, Q.C., .75PF CG101-175	QC-.75PF	Q-C	1510-40-0758	1
C30	CAP, CHIP, 1PF, 100V CC101-R10	3BN100S1R0C(S)	VAR	1510-00-0010	1
C31	CAP, Q.C., 3PF CG101-230	QC-3PF	Q-C	1510-40-0030	1
C37 C39	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	2
C44	CAP, CER, 100PF, 1KV CD102-110	60U101M	MDC	1510-10-1101	1
CR01 CR02 CR03 CR04 CR09	DIODE DC000-008	BB205B	APX	4803-02-0004	5
CR05 CR07 CR10	DIODE DP000-040	MA47980	M-A	4805-02-0001	3
CR06 CR08 CR11	DIODE, 1N82 MITEK ONLY	1N82	MTK	4807-03-0003	3
IC1 IC2 IC3 IC4	IC, IC000-004	N5741T	SIG	7000-57-4101	4
J1 J2 J201	CONN JF000-005	37JR116-1	S-C	2110-03-0002	3
L01 L21 L22	TORRID, 10 TURN	LA009-010-1	HYT	1810-05-0004	3
L02	TORRID, 10 TURN	LA009-010-2	HYT	1810-05-0005	1
L03 L04 L07 L08 L11 L12 L14 L15 L16 L17 L20	RF CHOKE	CHOKE	W-I	1819-99-9999	11

WAVETEK PARTS LIST	TITLE SWP OSC, M9W	ASSEMBLY NO. 1114-00-0020 PAGE: 2	REV L

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L05 L09 L10 L13 L18 L19	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0228	6
L06	CHOKE, .22MH, 10% LA008-R02	506-000022V1	SYS	1810-04-0228	1
L23	TORRID, 4 TURN	LA009-004-1	HYT	1810-05-0003	1
Q05	TRANS QB000-018	SD1006	SSS	4902-01-0060	1
Q1	TRANS QB000-013	A430	APX	4902-00-4300	1
Q2	TRANS QA054-580	2N5458	INT	4901-05-4580	1
Q3 Q4 Q6 Q7	TRANS QA050-530	2N5053	APX	4901-05-0530	4
R01 R14	RES, C, 1/4W, 5%, 12K RC103-312	CF1/4-12K	ASE	4700-15-1202	2
R02 R38	POT, 5K, RP130-250	89PR5K	BEK	4610-00-2502	2
R03	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	1
R04 R27 R29 R42 R60	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	5
R05	RES, C, 1/4W, 5%, 330 RC103-133	CF1/4-330	ASE	4700-15-3300	1
R06 R40	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R07	RES, C, 1/4W, 10%, 10M RC104-610	CB1061	A-B	4700-16-1005	1
R08	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1
R09	RES, C, 1/4W, 5%, 10 RC103-010	CF1/4-10	ASE	4700-15-1009	1
R10	RES, C, 1/4W, 5%, 680 RC103-168	CF1/4-680	ASE	4700-15-6800	1
R11 R15	RES, C, 1/4W, 5%, 8.2K RC103-282	CF1/4-8.2K	ASE	4700-15-8201	2
R12 R13	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	2
R16 R22 R28 R32 R33 R34 R50 R54 R59 R61	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	10
R17 R20 R23 R37 R39 R48 R51 R55	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	8
R18 R24 R52 R56	RES, C, 1/4W, 5%, 560 RC103-156	CF1/4-560	ASE	4700-15-5600	4
R19 R21 R49 R53	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	4
R25 R46	POT, 20K, RP130-320	89PR20K	BEK	4610-00-2203	2
R26 R31	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R30 R57	POT, 20K, RP129-320	360S203B	CTS	4610-00-1203	2
R35 R62	RES, C, 1/2W, 5%, 47 RC105-047	EB4705	A-B	4705-25-4709	2
R36 R63	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	2
R41 R58	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	2
R43	RES, C, 1/4W, 5%, 5.6K RC103-256	CF1/4-5.6K	ASE	4700-15-5601	1
R44	RES, C, 1/2W, 5%, 150 RC105-115	CF1/2-150	ASE	4700-25-1500	1
R45	RES, C, 1/4W, 5%, 3.9K RC103-239	CF1/43.9K	ASE	4700-15-3901	1
R47	RES, C, 1/4W, 5%, 1.2K RC103-212	CF1/4-1.2K	ASE	4700-15-1201	1
R64	RES, C, 1/4W, 5%, 270 RC103-127	CF1/4-270	ASE	4700-15-2700	1
R65	RES, C, 1/4W, 10%, 1.2K	CB1221	A-B	4705-16-1201	1
R66	RES, 1/4, 5%, 6.2K A-B RC103-262AB	CB6225	A-B	4705-15-6201	1
R68	RES, C, 1/4W, 5%, 3.3K RC103-233	CF1/4-3.3K	ASE	4700-15-3301	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
31	RF MIXER ASSY	A500-319	W-I	1219-00-0055	1
30	RF PRE AMP ASSY	A500-318	W-I	1219-00-0054	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C101	CAP, Q-C, 2.4PF, 10% CG101-224	QC-2.4PF	Q-C	1510-40-0249	1
MX101	DIODE, QUAD, BAL MIXER	5082-2830	H-P	4899-02-0001	1
T101	RF XFMR FROM: 1813-00-0007	TR001-003	W-I	1210-40-0003	1
T102	RF XFMR FROM: 1813-00-0008	TR002-001	W-I	1210-41-0001	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C201 C205	CAP, TANT, .47MF, 50V CE113-447	935	TRW	1510-21-9470	2
C202	CAP, ELECT. 1MF, 25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	1
C203 C204	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	2
C206	CAP, Q-C, 2.0PF, 10% CG101-220	QC-2.0PF	Q-C	1510-40-0020	1
CR201	DIODE DB000-001	HW6.8B	MSP	4801-02-0001	1
L201 L203	RF CHOKE	CHOKE	W-I	1819-99-9999	2
L202	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-02-0228	1
L204	FERRITE CHOKE	LA009-010-3	HYT	1810-05-0006	1
Q201 Q202 Q203	TRANS QA050-530	2N5053	APX	4901-05-0530	3
R201	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	1
R202	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
R203	RES, C, 1/4W, 5%, 330 RC103-133	CF1/4-330	ASE	4700-15-3300	1

WAVETEK PARTS LIST	TITLE RF PRE AMP ASSY	ASSEMBLY NO. 1219-00-0054 PAGE 1	REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R204	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	1
R205 R206	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	2
R207	RES, C, 1/4W, 5%, 150 RC103-115	CF1/4-150	ASE	4700-15-1500	1

WAVETEK PARTS LIST	TITLE RF PRE AMP ASSY	ASSEMBLY NO. 1219-00-0054 PAGE 2	REV D

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1 C20 C21	CAP, F.T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	3
C2	CAP, G-C, 10PF, 10%, CG101-310	GC-10PF	G-C	1510-40-0100	1
C24 C3 C31 C7	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	4
C10 C4	CAP, CER, F.T., 150PF CF116-115	4420-150PF	AER	1510-31-2151	2
C11 C15 C26 C27 C30 C32 C5 C6 C8 C9	CAP, ELECT, 1MF, 25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	10
C12	CAP, CER, 470PF, 1KV CD102-147	60U471M	MDC	1510-10-1471	1
C13	CAP, CER, 33PF, 1KV CD104-033	10TU-Q33	SPR	1510-10-3330	1
C14 C18 C19 C37	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	4
C16 C42	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	2
C17 C35 C36	CAP, CER, .002MF, 1KV CD102-220	5GAD20	SPR	1510-10-1202	3
C22	CAP, ELECT, 100MF, 12V CE119-110	500D107G012CC7	SPR	1510-21-2101	1
C23 C28 C29 C33 C34	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	5

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C25	CAP, ELECT, 100MF, 6V CE118-110	500D107G006CC7	SPR	1510-21-1101	1
C38 C39	CAPACITOR, MON, 4.7, 50V, 20%	C350C475M5U1CA	KEM	1510-11-3475	2
C40	CAP, CER, .1MF, 50V CD103-410	TGP-10	SPR	1510-10-2104	1
C41	CAP, F.T., 120PF CF102-112	54-794-001-121K	SPEC	1510-30-1121	1
CR1 CR2	DIODE DP000-040	MA47980	M-A	4805-02-0001	2
CR3	DIODE DG000-009	5082-2835	H-P	4809-02-0002	1
CR4	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1
CR9	LED DL000-001	NSL5046	NAT	4810-02-0001	1
CR11 CR12 CR13 CR14 CR15 CR16 CR17 CR18 CR5 CR6 CR7 CR8	DIODE DR000-001	1N4004	P-C	4806-01-4004	12
CR10	DIODE DB000-010	1N4732	ITT	4801-01-4732	1
IC01	OP AMP LO NOISE	NE5534AN	SIG	7000-55-3401	1
IC02 IC03 IC09	DUAL OP AMP, RAYTHEON IC000-027	RC4558DN	RAY	7000-45-5801	3
IC4	IC, IC000-011	78M05U1C	FCD	7000-78-0500	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
IC5	IC, ID001-001 STATIC SENSITIVE	MC14553BCL	MOT	8001-45-5300	1
IC6	IC, IC000-023	SN7405N	T-I	8000-74-0500	1
IC7 IC8	IC, IC000-013	MC4044P	MOT	8000-40-4400	2
J1 J2 J3 J4 J5	CONN JF000-005	37JR116-1	S-C	2110-03-0002	5
L1 L2 L5 L6	CHOKE, 3.3MH, 10% LA005-R33	08N3R3K	ASE	1810-03-0339	4
L03 L04 L08 L09 L10 L11 L12 L13	TORRID, 10 TURN	LA009-010-1	HYT	1810-05-0004	8
L07	TORRID, 4 TURN	LA009-004-1	HYT	1810-05-0003	1
L14	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	1
Q1 Q2	TRANS QA038-541	2N3854A	SPR	4901-03-8541	2
Q3	TRANS QA050-530	2N5053	APX	4901-05-0530	1
Q4	TRANS QA054-610	2N5461	T-I	4901-05-4610	1
Q5	TRANS QA054-580	2N5458	INT	4901-05-4580	1
R1 R2 R5	RES, C, 1/4W, 5%, 56 RC103-056	CF1/4-56	ASE	4700-15-5609	3
R3 R41 R43 R44 R45 R46	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	6

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R10 R13 R25 R4 R55	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	5
R7 R8	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	2
R14 R9	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	2
R15	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R16*	RES, C, 1/4W, 5%, 330 RC103-133	CF1/4-330	ASE	4700-15-3300	1
R17	RES, C, 1/4W, 5%, 1.2K RC103-212	CF1/4-1.2K	ASE	4700-15-1201	1
R18	RES, MF, 1/8W, 1%, 619 RF211-619	MF55K-619	ASE	4701-03-6190	1
R19	RES, MF, 1/8W, 1%, 2.74K RF212-274	MF55K-2.74K	ASE	4701-03-2741	1
R20 R30 R32 R49 R61 R62	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	6
R21	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1
R22 R28 R29 R50	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	4

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R23	POT, 100K, RP144-410 FROM: 4610-00-7104	91WR100K	BEK	4610-00-4104	1
R24	RES. C, 1/4W, 10%, 2.2M RC104-522AB	CB2251	A-B	4705-16-2204	1
R26	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
R27 R34 R38 R66	RES, C, 1/4W, 5%, 1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	4
R31 R33 R63 R64	RES, C, 1/4W, 5%, 180K RC103-418	CF1/4-180K	ASE	4700-15-1803	4
R35	RES, C, 1/4W, 5%, 820 RC103-182	CF1/4-820	ASE	4700-15-8200	1
R37	RES, C, 1/4W, 5%, 39K RC103-339	CF1/4-39K	ASE	4700-15-3902	1
R39 R42 R51 R52 R53 R54 R67	RES, C, 1/4W, 5%, 27K RC103-327	CF1/4-27K	ASE	4700-15-2702	7
R40	RES, C, 1/4W, 5%, 270 RC103-127	CF1/4-270	ASE	4700-15-2700	1
R47	RES, C, 1/4W, 5%, 33K RC103-333	CF1/4-33K	ASE	4700-15-3302	1
R48	RES, C, 1/4W, 5%, 7.5K RC103-275	CF1/4-7.5K	ASE	4700-15-7501	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R56 R57	RES, C, 1/4W, 5%, 12K RC103-312	CF1/4-12K	ASE	4700-15-1202	2
R58	RES, C, 1/4W, 5%, 3.3K RC103-233	CF1/4-3.3K	ASE	4700-15-3301	1
R59 R60	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	2
R65	RES, C, 1/4W, 5%, 6.8K RC103-268	CF1/4-6.8K	ASE	4700-15-6801	1
R68 R69	RES, C, 1/4W, 5%, 150K RC103-415	CF1/4-150K	ASE	4700-15-1503	2
R70	POT, 20K	43P203T601	SPE	4610-00-5203	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C02 C03 C04 C05 C06 C07 C08 C09 C10 C11 C12 C13 C14 C15 C16	CAP,CER,F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	16
C17	CAP,ELECT,100MF,12V CE119-110	500D107G012CC7	SPR	1510-21-2101	1
C18	CAP,ELECT,100MF,6V CE118-110	500D107G006CC7	SPR	1510-21-1101	1
C19 C20 C25 C28 C32 C37	CAP,TANT,10MF,25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	6
C21 C22 C27 C29	CAP.FILM,.13MF,100V 5%	160C124J100C	PLSSY	1510-60-8124	4
C23 C24 C26	CAP,MON,1MF,50V,20%	3420-050-E105M	AER	1510-11-3105	3
C30	CAP,MICA,1000PF,500V CM101-210	DM15-102J	ARC	1510-50-0102	1
C31	CAP,CER,10PF,1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	1
C33 C34	CAP,MICA,180PF,500V CM101-118	DM15-181J	ARC	1510-50-0181	2
C35	CAP,CER,.001MFD,1KV CD102-210	5GAD10	SPR	1510-10-1102	1
C36	CAP,CER,.01MF,100V CD103-310	68U103M	MDC	1510-10-2103	1

WAVETEK PARTS LIST	TITLE KHZ STEPS,M31A	ASSEMBLY NO. 1114-00-0143 PAGE: 1	REV I

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
CR01	MOT MV2301 TUNER DIODE	MV2301	MOT	4803-02-0008	1
CR02 CR03 CR05	DIODE DG109-140	1N4148	T-I	4807-01-0914	3
CR04	LED DL000-001	NSL5046	NAT	4810-02-0001	1
IC01 IC02 IC12	IC,IC000-012	SN7404N	T-I	8000-74-0400	3
IC03 IC04 IC05 IC06	DECADE CTR PRESET LS	SN74LS196N	T-I	8007-41-9610	4
IC07	IC,IC000-019	SN74H102N	T-I	8007-41-0200	1
IC08	IC,IC000-018	N74H11A	SIG	8000-74-1100	1
IC09	IC,IC000-029	11C44DC	FCD	8000-11-4400	1
IC10	IC,IC000-005	RC4558NB	RAY	7000-14-5800	1
IC11	IC,IC000-002	N5741CV	SIG	7000-57-4100	1
IC13	IC,IC000-011	78M05UC	FCD	7000-78-0500	1
J01 J02	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L11 L12 L13 L14 L15 L16	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	16
L17	CHOKE,2.2MH,10% LA005-R22	08N2R2K	ASE	1810-03-0229	1

WAVETEK PARTS LIST	TITLE KHZ STEPS,M31A	ASSEMBLY NO. 1114-00-0143 PAGE: 2	REV I

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L18	CHOKE .47MH 10% LA005-R04	08NR47K	ASE	1810-03-0478	1
L19	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0228	1
Q01	TRANS QA054-580	2N5458	INT	4901-05-4580	1
Q02	TRANS QA053-060	2N5306	G-E	4901-05-3060	1
Q03 Q04	TRANS QA038-541	2N3854A	SPR	4901-03-8541	2
R01 R02	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	2
R03 R04 R06 R07 R26	RES, C, 1/4W, 5%, 30K RC103-330	CF1/4-30K	ASE	4700-15-3002	5
R05	POT, 2K, RP144-220 FROM: 4610-00-7202	91WR2K	BEK	4610-00-4202	1
R08 R27	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	2
R09	RES, C, 1/4W, 5%, 68K RC103-368	CF1/4-68K	ASE	4700-15-6802	1
R10 R11 R14	RES, C, 1/4W, 5%, 6.8K RC103-268	CF1/4-6.8K	ASE	4700-15-6801	3
R12	RES, C, 1/4W, 5%, 3.3K RC103-233	CF1/4-3.3K	ASE	4700-15-3301	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R13 R22 R25	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	3
R15	RES, MF, 1/8W, 1%, 30.1K RF213-301	MF55K-30.1K	ASE	4701-03-3012	1
R16	RES, MF, 1/8W, 1%, 4.32K RF212-432	MF55K-4.32K	ASE	4701-03-4321	1
R17 R18	RES, MF, 1/8W, 1%, 19.6K RF213-196	MF55K-19.6K	ASE	4701-03-1962	2
R19	RES, MF, 1/8W, 1%, 2.10K RF212-210	MF55K-2.10K	ASE	4701-03-2101	1
R20 R30	RES, C, 1/4W, 5%, 1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	2
R21	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R23	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1
R24	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
R28	RES, C, 1/4W, 5%, 160K RC103-416	CF1/4-160K	ASE	4700-15-1603	1
R29	RES, C, 1/4W, 5%, 20K RC103-320	CF1/4-20K	ASE	4700-15-2002	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	1
C02	CAP, ELECT, 100MF, 6V CE118-110	500D107G006CC7	SPR	1510-21-1101	1
C03 C04 C05 C06 C07 C08 C09 C10 C11 C12	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	10
C13	CAP, Q.C., 3.9PF CG101-239	QC-3.9PF	Q-C	1510-40-0399	1
C14	CAP, M.C., .62PF CG102-162	MC-.62PF	Q-C	1510-40-1628	1
C16 C17 C19	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	3
C18	CAP, M.C., 3.9PF CG102-239	MC-3.9PF	Q-C	1510-40-1399	1
C20	CAP, MC, 1.1PF, 10% CG102-211	MC1.1PF	Q-C	1510-40-1119	1
C21	CAP, VAR, .3/1.2PF	7263	JHSN	1510-70-9129	1
C22 C23	CAP, FT, CER, 100PF, 20% CF104-110	4420-100PF	AER	1510-30-3101	2
C24	CAP, MON, 1MF, 50V, 20%	3420-050-E105M	AER	1510-11-3105	1
C26 C27 C28 C29	CAP, F.T., 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	4

WAVETEK PARTS LIST	TITLE MHZ STEPS, M32A	ASSEMBLY NO. 1114-00-0215 PAGE: 1	REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C30 C31	CAP., CHIP, .1 MF	51C1209-B104Z	CFI	1510-00-3104	2
CR04 CR05 CR06	DIODE DR000-001	1N4004	P-C	4806-01-4004	3
CR1	DIODE DC000-008	BB205B	APX	4803-02-0004	1
CR2	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1
CR3	LED DL000-001	NSL5046	NAT	4810-02-0001	1
IC1	IC, IC000-011	78M05UC	FCD	7000-78-0500	1
J1 J2 J3 J301	CONN JF000-005	37JR116-1	S-C	2110-03-0002	4
L01 L02 L03 L04 L05 L06 L07 L08 L09 L10 L13 L19	TORRID, 10 TURN	LA009-010-1	HYT	1810-05-0004	12
L15	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0228	1
Q1	TRANS QA050-530	2N5053	APX	4901-05-0530	1
Q2	TRANS QB000-013	A430	APX	4902-00-4300	1
Q3	TRANS QB000-035	BFR90	APX	4902-00-0900	1
R01	RES, C, 1/8W, 5%, 68 RC101-068	CF1/8-68	ASE	4700-05-6809	1
R02	RES, C, 1/8W, 5%, 2K RC101-220	CF1/8-2K	ASE	4700-05-2001	1

WAVETEK PARTS LIST	TITLE MHZ STEPS, M32A	ASSEMBLY NO. 1114-00-0215 PAGE: 2	REV E

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R03	RES, C, 1/4W, 5%, 430 RC103-143	CF1/4-430	ASE	4700-15-4300	1
R04 R08 R11	RES, C, 1/8W, 5%, 4.7K RC101-247	CF1/8-4.7K	ASE	4700-05-4701	3
R05 R10	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	2
R06	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	1
R07	RES, C, 1/4W, 5%, 2.7 RC103-R27	CF1/4-2.7	ASE	4700-15-2708	1
R09	RES, MF, 1/8W, 1%, 499 RF211-499	MF55K-499	ASE	4701-03-4990	1
R12	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
R13	RES, C, 1/8W, 5%, 820 RC101-182	CF1/8-820	ASE	4700-05-8200	1
2	DIG PGM BD ASSY	M32A-S2	W-I	1218-00-0022	1
1	OSC CTL BD ASSY	M32A-S1	W-I	1218-00-0021	1
3	MIXER ASSY	M32A-S3	W-I	1219-00-0117	1
4	VIDEO AMP ASSY	M32A-S4	W-I	1219-00-0118	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C101	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	1
C102 C104	CAP., CHIP, .1 MF	51C1209-B104Z	CFI	1510-00-3104	2
C103	CAP., CHIP, 360PF, 10%	100B361KP200X	ATC	1510-00-2361	1
C105	CAP, CER, DISC, .001MF 50V, CD112-210	B101-050-102M	ETP	1510-10-7102	1
CR101 CR102 CR103	DIODE DG000-007	5082-2800	H-P	4809-02-0001	3
CR104	DIODE DG000-009	5082-2835	H-P	4809-02-0002	1
IC101	PROM, PER M32A FROM: 8007-42-8800	8410-00-0001	W-I	8410-00-0001	1
IC102 IC103	DECADE COUNTER	SN74S196N	T-I	8007-41-9601	2
IC104	DUAL J-K FLIP-FLIP	SN74S112N	T-I	8007-41-1200	1
IC105	IC: IC000-029	11C44DC	FCD	8000-11-4400	1
J101	SOCKET, S.I.L., 6-PIN	1-583773-3	AMP	2112-00-0017	1
J102	TERM., MINISERT	75060-008	BER	2112-23-0001	1
L101 L102 L103 L104	TOROID, 10 TURN, 1/16" INSULATION	LA-009-010-3	HYT	1810-05-0006	4
P101A P101B P101C P101D P101E P101F	EDGE-CLIP CONNECTOR	75382-001	BER	2112-22-0001	10

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
P101G P101H P101I P101J					
Q101	TRANS GA050-530	2N5053	APX	4901-05-0530	1
R101	RES. NETWORK, 7-4.7K, 8-PIN, 5%	807-472J	EPITK	4770-00-0006	1
R102	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	1
R103	RES, C, 1/4W, 5%, 33 RC103-033	CF1/4-33	ASE	4700-15-3309	1
R104	RES, C, 1/4W, 5%, 1.2K RC103-212	CF1/4-1.2K	ASE	4700-15-1201	1
R105	RES, MF, 1/8W, 1%, 2.10K RF212-210	MF55K-2.10K	ASE	4701-03-2101	1
R106	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1
R107	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R108	RES, MF, 1/8W, 1%, 499 RF211-499	MF55K-499	ASE	4701-03-4990	1
R109	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
R110 R111	RES, C, 1/8W, 5%, 4.7K RC101-247	CF1/8-4.7K	ASE	4700-05-4701	2

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	DIG PGM BD ASSY	1218-00-0022	D
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C201	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	1
C202	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	1
C203 C210 C211	CAP, MON, 1MF, 50V, 20%	3420-050-E105M	AER	1510-11-3105	3
C204 C205	CAP, CER, 150PF, 1KV CD102-115	60U151M	MDC	1510-10-1151	2
C206 C207	CAP, FILM, .047MF, 250V 5%	B32547-.047-5%-250V	SIEM	1510-60-9473	2
C208 C209	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	2
CR201 CR202 CR203 CR204	DIODE DG109-140	1N4148	T-I	4807-01-0914	4
IC201 IC202 IC203	DUAL OP AMP. RAYTHEON IC000-027	RC4558DN	RAY	7000-45-5801	3
OC201 OC202	LED, AXIAL VACTROL MP000-002	VTL5C3	VAC	3710-00-0001	2
P201	HEADER, 6-PIN, STRGHT REF: 2112-24-0000	2112-24-0001	W-I	2112-24-0001	1
P202A P202B P202C P202D P202E P202F P202G P202H P202I P202J P202K P202L	EDGE-CLIP CONNECTOR	75382-001	BER	2112-22-0001	12

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	OSC CTL BD ASSY	1218-00-0021	B
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R201 R221 R222	RES, C, 1/4W, 5%, 6.8K RC103-268	CF1/4-6.8K	ASE	4700-15-6801	3
R202 R203 R211	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	3
R204	RES, C, 1/4W, 5%, 47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
R205 R206	POT, CERMET, 20K-OHM	A4C203	A-B	4610-13-5203	2
R207 R210	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	2
R208	RES, MF, 1/8W, 1%, 2K RF212-200	MF55K-2K	ASE	4701-03-2001	1
R209 R225 R226	RES, C, 1/4W, 5%, 220K RC103-422	CF1/4220K	ASE	4700-15-2203	3
R212	RES, C, 1/8W, 5%, 1K RC101-210	CF1/8-1K	ASE	4700-05-1001	1
R213	POT, CERMET, 5K	A2B502	A-B	4610-13-4502	1
R214	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1
R215	POT, CERMET, 20K-OHM	A2B203	A-B	4610-13-4203	1
R216 R217 R219 R220	RES., 1/8W, 5%, 30K	CF1/8-30K	ASE	4700-05-3002	4
R218	POT, CERMET, 2K-OHM	A2B202	A-B	4610-13-4202	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R223 R224	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	2
R227	RES, C, 1/4W, 5%, 1.2K RC103-212	CF1/4-1.2K	ASE	4700-15-1201	1
R228	RES, C, 1/4W, 5%, 1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C301 C305	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	2
C302 C303 C304	CAP, CER, DISC, .001MF 50V, CD112-210	8101-050-102M	ETP	1510-10-7102	3
C306	CAP, MC, 1.1PF, 10% CG102-211	MC1.1PF	G-C	1510-40-1119	1
CR301 CR302	DIODE DP000-060	MA47047	M-A	4805-02-0003	2
CR303 CR304	DIODE DG000-009	5082-2835	H-P	4809-02-0002	2
L301	FERRITE CHOKE, 1 TURN FROM: 1813-00-0007	LA007-001	W-I	1210-30-0004	1
L302	RF CHOKE	CHOKE	W-I	1819-99-9999	1
R301 R302	RES, C, 1/8W, 5%, 47K RC101-347	CF1/8-47K	ASE	4700-05-4702	2
R303	RES, C, 1/8W, 5%, 390 RC101-139	CF1/8-390	ASE	4700-05-3900	1
T301	RF XFMR FROM: 1813-00-0007	TR001-001	W-I	1210-40-0001	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	MIXER ASSY	1219-00-0117 PAGE: 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C401	CAP, CER, 120PF, 1KV CD102-112	60U121M	MDC	1510-10-1121	1
C402	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	1
C403	CAP, CER, F.T., 39PF CF114-039	4420-39PF	AER	1510-31-0390	1
L401	CHOKE .10MH 10% LA005-R01	08NR10K	ASE	1810-03-0019	1
Q401 Q402	TRANS QA050-530	2N5053	APX	4901-05-0530	2
R401 R407 R408	RES, C, 1/4W, 5%, 820 RC103-182	CF1/4-820	ASE	4700-15-8200	3
R402 R409	RES, C, 1/4W, 5%, 10 RC103-010	CF1/4-10	ASE	4700-15-1009	2
R403 R406	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	2
R404	RES, C, 1/4W, 5%, 3.3K RC103-233	CF1/4-3.3K	ASE	4700-15-3301	1
R405	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	VIDEO AMP ASSY	1219-00-0118 PAGE: 1	A

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C02 C03	CAP, CER, .01MF, 50V CD113-310	CY15C103M	C-L	1510-10-8103	3
C04 C05	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	2
C06 C07 C08 C09 C10 C11 C12 C13 C14 C15 C16 C17 C18	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	13
C19	CAP, F.T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	1
C20 C21	CAP, F.T., 120PF CF102-112	54-794-001-121K	SPEC	1510-30-1121	2
CR01 CR02 CR03 CR04 CR05 CR06 CR07 CR08	DIODE DG109-140	1N4148	T-I	4807-01-0914	8
IC01 IC02 IC07	DUAL OP AMP, RAYTHEON IC000-027	RC4558DN	RAY	7000-45-5801	3
IC03	VOLTAGE REF	REF-01CJ	PMI	7000-00-0100	1
IC04 IC05 IC06	DAC, 2-DIGIT, BCD	DAC-20CQ	PMI	8000-00-0200	3
L01 L02	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	2
Q01	TRANS-QA042-500	2N4250	FCD	4901-04-2500	1
Q02	TRANS QA050-880	2N5088	MOT	4901-05-0880	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q3 Q4	TRANS QA039-040	2N3904	NAT	4901-03-9040	2
R01 R39	RES, MF, 1/8W, 1%, 5.62K RF212-562	MF55K-5.62K	ASE	4701-03-5621	2
R02 R08 R18 R23 R31 R33	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	6
R03 R32	RES, MF, 1/8W, 1%, 11.3K RF213-113	MF55K-11.3K	ASE	4701-03-1132	2
R04 R40	RES, MF, 1/8W, 1%, 4.02K RF212-402	MF55K-4.02K	ASE	4701-03-4021	2
R06 R11 R12 R25	RES, C, 1/4W, 5%, 330K RC103-433	CF1/4-330K	ASE	4700-15-3303	4
R07 R10 R13 R24 R30 R34 R37	POT, 100K, RP130-410	89PR100K	BEK	4610-00-2104	7
R09	RES, MF, 1/8W, 1%, 3.01K RF212-301	MF55K-3.01K	ASE	4701-03-3011	1
R14 R49 R50 R51 R54 R56 R57 R58 R59 R60	RES, MF, 1/8W, 1%, 5.11K RF212-511	MF55K-5.11K	ASE	4701-03-5111	10
R15 R17 R26 R43 R44 R45 R46	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	7
R16	RES, C, 1/4W, 5%, 910K RC103-491	CF1/4-910K	ASE	4700-15-9103	1
R19	RES, MF, 1/8W, 1%, 16.5K RF213-165	MF55K-16.5K	ASE	4701-03-1652	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R20	RES, MF, 1/8W, 1%, 40.2K RF213-402	MF55K-40.2K	ASE	4701-03-4022	1
R21 R47 R48	RES, C, 1/4W, 5%, 270K RC103-427	CF1/4-270K	ASE	4700-15-2703	3
R22 R28	POT, 20K, RP130-320	89PR20K	BEK	4610-00-2203	2
R27	RES, C, 1/4W, 5%, 75K RC103-375	CF1/4-75K	ASE	4700-15-7502	1
R29 R35	RES, C, 1/4W, 5%, 220K RC103-422	CF1/4220K	ASE	4700-15-2203	2
R36	RES, C, 1/4W, 5%, 120K RC103-412	CF1/4-120K	ASE	4700-15-1203	1
R41 R42	RES, C, 1/4W, 5%, 10 RC103-010	CF1/4-10	ASE	4700-15-1009	2
R52 R53	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	2
R55	RES, MF, 1/8W, 1%, 48.7K RF213-487	MF55K-48.7K	ASE	4701-03-4872	1

WAVETEK PARTS LIST	TITLE DAC/SWP DRIVE, M172	ASSEMBLY NO. 1114-00-0320	REV B
		PAGE: 3	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C26 C27	CAP, CER, 10PF, 1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	3
C02 C04	CAP, CHIP, 1000PF, 50V CC101-210	5BN050S102KS	VAR	1510-00-1102	2
C03 C20 C21 C22 C23 C24	CAP., CHIP, .1 MF	51C1209-B104Z	CFI	1510-00-3104	6
C05	CAP, CER, FT, 2200PF, GMV, CF115-222	4420-2200PF	AER	1510-31-1222	1
C06 C07 C08 C09 C10	CAP, MON, 1MF, 50V, 20%	3420-050-E105M	AER	1510-11-3105	5
C11 C12 C13 C14 C25	CAP, F.T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	5
C15 C17 C19	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	3
C16 C18	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	2
IC01	PGM DIVIDER	SP8690B	PLSSY	8000-86-9010	1
IC02	SYNC 4-BIT UP/DN CTR	SN74LS169N	T-I	8007-41-6910	1
IC03 IC04 IC05 IC06	SYNC, UP-DOWN, CTR.	SN74LS168N	T-I	8007-41-6810	4
IC07	PO VOLTAGE REG.	UA7805UC	FCD	7000-78-0523	1
IC08	QUAD POS NAND	SN74LS00N	T-I	8000-74-0010	1

WAVETEK PARTS LIST	TITLE 100 HZ STEPS, M149B	ASSEMBLY NO. 1114-00-0329	REV -
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
IC09	HEX INVERTER	SN74LS04N	T-I	8000-74-0410	1
J01 J02	CONN JF000-005	67JR116-1	S-C	2110-03-0002	2
L01	FERRITE CHOKE LA009-010	T-255-2	HYT	1810-05-0002	1
L02	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0228	1
L03	COIL,7T,30 GA.,.1 ID	1815-00-0021	W-I	1815-00-0021	1
L04	CHOKE,.82MH 10%	08OR82K	ASE	1810-03-0828	1
Q01	TRANS QA050-530	2N5053	APX	4901-05-0530	1
R01	RES,C,1/4W,5%,68K RC103-368	CF1/4-68K	ASE	4700-15-6802	1
R02	RES,C,1/4W,5%,180 RC103-118	CF1/4-180	ASE	4700-15-1800	1
R03	RES,C,1/4W,5%,10 RC103-010	CF1/4-10	ASE	4700-15-1009	1
R04	RES,C,1/8W,5%, 1.8K OHM	CF1/8-1.8K	ASE	4700-05-1801	1
R05 R06 R07 R08 R12	RES,C,1/4W,5%,4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	5
R09	RES,C,1/4W,5%,3K RC103-230	CF1/4-3K	ASE	4700-15-3001	1

WAVETEK PARTS LIST	TITLE 100 HZ STEPS, M149B	ASSEMBLY NO. 1114-00-0329	REV -
		PAGE 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R10	RES,C,1/4W,5%,1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1
R11	RES,C,1/8W,5%,1K RC101-210	CF1/8-1K	ASE	4700-05-1001	1
R13	RES,C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	1

WAVETEK PARTS LIST	TITLE 100 HZ STEPS, M149B	ASSEMBLY NO. 1114-00-0329	REV -
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C02 C03 C04 C05 C06 C07 C08 C09 C10 C11	CAP,F.T.,470PF CF103-147	SS5D-4711	A-B	1510-30-2471	11
C12 C14 C17 C18 C19	CAP.,CHIP,.1 MF	51C1209-B104Z	CFI	1510-00-3104	5
C13	CAP,CHIP,10 PF,10%	100B100KPX500	ATC	1510-00-2100	1
C15	CAP,TANT,10MF,25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	1
C16	CAP.,CHIP 75PF 10%	100B750KP500	ATC	1510-00-2750	1
CR01	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1
CR02	DIODE,MK904	MK904	MTK	4807-03-0004	1
CR03	DIODE DC000-008	BB205B	APX	4803-02-0004	1
CR04	DIODE DG100-341	1N34A	HIT	4807-01-0034	1
J01 J02	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L01 L02 L03 L04 L05 L08 L09	TOROID	LA009-010-1	HYT	1810-05-0004	7
L06	COIL,3T, NO.28, .095 ID	1815-00-0037	W-I	1815-00-0037	1
L07	COIL,AIR,3T,28,.25	1815-00-0050	W-I	1815-00-0050	1
L10	COIL,4T,32,.095 ID	1815-00-0051	W-I	1815-00-0051	1

WAVETEK PARTS LIST	TITLE FREQ DBLR, M164	ASSEMBLY NO. 1114-00-0342 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q01	TRANS QB000-034	BFR94	APX	4902-00-0940	1
R01	RES,C,1/4W,5%,1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R02 R04 R11	RES,C,1/8W,5%, 150-OHM	CF1/8-150	ASE	4700-05-1500	3
R03	RES,C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R05 R06	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	2
R07 R09	RES,C,1/8W,5%,4.7K RC101-247	CF1/8-4.7K	ASE	4700-05-4701	2
R08	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
R10	RES,C,1/4W,5%,4.7 RC103-R47	CF1/4-4.7	ASE	4700-15-4708	1
R12	RES,C,1/8W,5%, 8.2K	CF1/8-8.2K	ASE	4700-05-8201	1
R14	RES,C,1/4W,5%,180 RC103-119	CF1/4-180	ASE	4700-15-1800	1
ZA1	LEVELER ASSY	1218-00-0160	W-I	1218-00-0160	1
ZA2	FREQ DBLR ASSY	1218-00-0990	W-I	1218-00-0990	1

WAVETEK PARTS LIST	TITLE FREQ DBLR, M164	ASSEMBLY NO. 1114-00-0342 PAGE: 2	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C101 C102	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	2
C103	CAP, CER, 270PF, 1KV CD102-127	60U271M	MDC	1510-10-1271	1
C104	CAP, CER, 33PF, 1KV CD101-033	10TCC-Q33	SPR	1510-10-0330	1
IC101	OP AMP LO NOISE	NE5534AN	SIG	7000-55-3401	1
IC102	IC, IC000-005	RC4558NB	RAY	7000-14-5800	1
R101	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
R102	POT, 1M, RP131-510	360T105B	CTS	4610-00-3105	1
R103	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1
R104	POT, 20K, RP131-320	360T203B	CTS	4610-00-3203	1
R105	RES, C, 1/4W, 5%, 820 RC103-182	CF1/4-820	ASE	4700-15-8200	1
R106	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	1
R107 R110	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	2
R108 R109	RES, C, 1/4W, 5%, 560K RC103-456	CF1/4-560K	ASE	4700-15-5603	2

WAVETEK PARTS LIST	TITLE LEVELER ASSY	ASSEMBLY NO. 1218-00-0160 PAGE: 1	REV -

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R111	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
R112 R113	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	2

WAVETEK PARTS LIST	TITLE LEVELER ASSY	ASSEMBLY NO. 1218-00-0160 PAGE: 2	REV -

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C201 C204 C205 C211 C216 C217 C220	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	7
C202	CAP, M.C., .47PF CG102-147	MC-.47PF	Q-C	1510-40-1478	1
C203	CAP, CHIP, 56 PF, 10%	100B560KPX500	ATC	1510-00-2560	1
C206 C207 C208 C209 C213 C219	CAP., CHIP, .1 MF	51C1209-B104Z	CFI	1510-00-3104	6
C210 C215	CAP., CHIP, 360PF, 10%	100B361KP200X	ATC	1510-00-2361	2
C212 C214 C218	CAP, CHIP, 120 PF, PORCELAIN	ATC700A121JP50X	ATC	1510-00-6121	3
C221 C222	CAP, CHIP, 1.5 PF	100B1R5CPX500	ATC	1510-00-2159	2
CR201	DIODE, VARACTOR, GA-AS	4803-02-0009	M-A	4803-02-0009	1
CR202 CR212	DIODE DP000-040	MA47980	M-A	4805-02-0001	2
CR203	DIODE DC000-008	BB205B	APX	4803-02-0004	1
CR204 CR209 CR210 CR211	DIODE PIN	5082-3081	H-P	4805-02-0004	4
CR205 CR206 CR207 CR208	DIODE DG000-009	5082-2835	H-P	4809-02-0002	4
FL201	FILTER, HIGH PASS T8H5PP500	T8H5PP500	W-I	1116-00-0001	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
IC201	WIDE-BAND AMP, HYBRID DC-1000 MHZ, 100 MA	MWA330	MOT	7000-03-3000	1
IC202 IC203	WIDE-BAND AMP, HYBRID DC-1000 MHZ, 55 MA	MWA320	MOT	7000-03-2000	2
L201	TOROID, 4 TURN	LA009-004-1	HYT	1810-05-0003	1
L202 L203 L204 L205 L206 L208 L212 L213	TOROID	LA009-010-1	HYT	1810-05-0004	8
L207 L210	COIL, AIR, 6T, 28, .095	1815-00-0047	W-I	1815-00-0047	2
L209	COIL, 1T, NO. 28, .095 ID	1815-00-0040	W-I	1815-00-0040	1
L211	COIL, AIR, 8T, 28, .095	1815-00-0048	W-I	1815-00-0048	1
L214 L215	RF CHOKE	CHOKE	W-I	1819-99-9999	2
R201*	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R202 R206 R207 R208	RES, C, 1/2W, 5%, 100 RC105-110	CF1/2-100	ASE	4700-25-1000	4
R203	RES, C, 1/8W, 5%, 22 RC101-022	CF1/8-22	ASE	4700-05-2209	1
R204	RES, C, 1/2W, 5%, 47 RC105-047	CF1/2-47	ASE	4700-25-4709	1
R205	RES, C, 1/4W, 5%, 220 RC103-122	CF1/4-220	ASE	4700-15-2200	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R206	POT, 1K, RP129-210	360S102B	CTS	4610-00-1102	1
R209	RES, C, 1/8W, 5%, 47 RC101-047	CF1/8-47	ASE	4700-05-4709	1
T201	RF XFMR, CTR TAP, PER B/P FROM: 1813-00-0007	1210-40-0022	W-I	1210-40-0022	1

WAVETEK PARTS LIST	TITLE FREQ DBLR ASSY	ASSEMBLY NO. 1218-00-0990	REV A
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C02 C03 C18 C57 C58	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	6
C04 C05 C06 C07 C08	CAP, ELECT, 1MF, 25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	5
C09	CAP, ELECT, 100MF, 12V CE119-110	500D107G012CC7	SPR	1510-21-2101	1
C10	CAP, ELECT, 100MF, 6V CE118-110	500D107G006CC7	SPR	1510-21-1101	1
C13	CAP, CER, 47PF, 1KV CD101-047	10TCC-Q47	SPR	1510-10-0470	1
C14	CAP, CER, FACTORY ADJ. 0-15, NPO	1510-99-9997	W-I	1510-99-9997	1
C15	CAP, CER, 470PF, 1KV CD102-147	60U471M	MDC	1510-10-1471	1
C16	CEA, CER, FACTORY ADJ. 20-27, N1500/25, NPO	1510-99-9998	W-I	1510-99-9998	1
C17	CAP, VAR, 1.4/9.2PF CV107-001	189-0563-001	JON	1510-70-6929	1
C19 C50	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	2
C20	CAP, MICA, 180PF, 500V CM101-118	DM15-181J	ARC	1510-50-0181	1
C21 C41 C46	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	3

WAVETEK PARTS LIST	TITLE XTAL REF, M30-5	ASSEMBLY NO. 1114-00-0349	REV B
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REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C22	CAP,CER,20PF,1KV CD101-020	60C0G200J	MDC	1510-10-0200	1
C23 C48	CAP,FT,CER,100PF,20% CF104-110	4420-100PF	AER	1510-30-3101	2
C24 C25 C28 C40 C45	CAP,CER,FT,2200PF, GMV,CF115-222	4420-2200PF	AER	1510-31-1222	5
C26 C34 C36 C39 C42 C47 C60	CAP,VAR,3.5-13PF250V CV101-013	7S-TRIKO-02-3.5-13PF	STR	1510-70-0130	7
C27	CAP,CER,4.7PF,1KV CD101-R47	10TCC-V47	SPR	1510-10-0479	1
C29	CAP,CER,200PF,1KV CD102-120	5GA-T20	SPR	1510-10-1201	1
C30	CAP,CER,15PF,1KV CD101-015	10TCC-Q15	SPR	1510-10-0150	1
C31	CAP,Q-C,2.0PF,10% CG101-220	QC-2.0PF	Q-C	1510-40-0020	1
C32	CAP,M-C,4.7PF,10% CG102-247	QC-4.7PF	Q-C	1510-40-1479	1
C33 C38	CAP,MC,1.1PF,10% CG102-211	MC1.1PF	Q-C	1510-40-1119	2
C35 C37	CAP,M.C.,.47PF CG102-147	MC-.47PF	Q-C	1510-40-1478	2

WAVETEK PARTS LIST	TITLE XTAL REF. M30-S	ASSEMBLY NO. 1114-00-0349 PAGE: 2	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C43	CAP,CER,F.T.,27PF CF114-027	4420-27PF	AER	1510-31-0270	1
C44 C49 C51 C52	CAP,CER,10PF,1KV CD101-010	10TCC-Q10	SPR	1510-10-0100	4
C53 C55	CAP,VARI.,5/3PF CV102-R30	R-TRIKO-107-02-M	STR	1510-70-1030	2
C54	CAP,Q.C.,.1PF CG101-110	QC-.1PF	Q-C	1510-40-0019	1
C56	CAP,M.C.,.75PF CG102-175	MC-.75PF	Q-C	1510-40-1758	1
C59	CAP,Q-C 10PF 10% CG101-310	QC-10PF	Q-C	1510-40-0100	1
CR1 CR2 CR4	DIODE DR000-001	1N4004	P-C	4806-01-4004	3
CR3	DIODE DP000-040	MA47980	M-A	4805-02-0001	1
CR5	DIODE D0100-341	1N34A	HIT	4807-01-0034	1
CR6 CR7	DIODE D0000-012	5082-0180	H-P	4811-02-0001	2
CR8	DIODE D0000-005	BB121A	ITT	4889-00-0001	1
IC1	IC IC000-011	78M05UC	FCD	7000-78-0500	1
IC2	IC IC000-003	N5741CV	SIG	7000-57-4100	1
J1 J2 J3 J4 J5 J6 J7	CONN JF000-005	37JP116-1	S-C	2110-03-0002	7

WAVETEK PARTS LIST	TITLE XTAL REF. M30-S	ASSEMBLY NO. 1114-00-0349 PAGE: 3	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L01 L02 L03	TOROID	LA009-010-1	HYT	1810-05-0004	3
L07	CHOKE .47MH 10% LA005-R04	08NR47K	ASE	1810-03-0478	1
L08 L09 L17	TOROID, 4 TURN	LA009-004-1	HYT	1810-05-0003	3
L10 L11 L21 L23 L24 L25	RF CHOKE	CHOKE	W-I	1819-99-9999	6
L12 L13 L14 L15 L19	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0228	5
L16	FERRITE CHOKE LA009-004	T1255-1	HYT	1810-05-0001	1
L18	CHOKE .10MH 10% LA005-R01	08NR10K	ASE	1810-03-0019	1
L20	CHOKE, 1MH, 10% LA005-R10	08N1R0K	ASE	1810-03-0010	1
L26	GROUND LUG, #6, INT HG102-600	38-111	F-S	2112-03-0003	1
L27	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	1
Q01 Q02 Q06 Q07 Q08 Q09 Q10	TRANS QA050-530	2N5053	APX	4901-05-0530	7
Q03	TRANS QA051-790	2N5179	RCA	4901-05-1790	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
Q4 Q5	TRANS QA039-040	2N3904	NAT	4901-03-9040	2
R04	RES, MF, 1/8W, 1%, 5.11K RF212-511	MF55K-5.11K	ASE	4701-03-5111	1
R05 R50	RES, MF, 1/8W, 1%, 10K RF213-100	MF55K10K	ASE	4701-03-1002	2
R06 R18 R19	RES, MF, 1/8W, 1%, 2K RF212-200	MF55K-2K	ASE	4701-03-2001	3
R07 R14 R23 R41	RES, C, 1/4W, 10%, 100 RC104-110AB	CB1001	A-B	4705-16-1000	4
R08 R29	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	2
R09 R11 R22	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	3
R10	RES, C, 1/4W, 5%, 100K RC103-410	CF1/4-100K	ASE	4700-15-1003	1
R12	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	1
R13	RES, C, 1/4W, 5%, 470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1
R15	RES, MF, 1/8W, 1%, 40.2K RF213-402	MF55K-40.2K	ASE	4701-03-4022	1
R17	RES, C, 1/4W, 5%, 1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R20	RES,C,1/4W,5%,1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	1
R21	RES,C,1/4W,5%,220 RC103-122	CF1/4-220	ASE	4700-15-2200	1
R24	RES,C,1/8W,5%,10 RC101-010	CF1/8-10	ASE	4700-05-1009	1
R25 R26	RES,C,1/8W,5%,100 RC101-110	CF1/8-100	ASE	4700-05-1000	2
R27	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	1
R28	RES,C,1/4W,5%,22K RC103-322	CF1/422K	ASE	4700-15-2202	1
R30 R36 R43	RES,C,1/4W,5%,33K RC103-333	CF1/4-33K	ASE	4700-15-3302	3
R31 R35 R42	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	3
R32 R38 R44 R45	RES,C,1/8W,5%,47 RC101-047	CF1/8-47	ASE	4700-05-4709	4
R33 R39 R49	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	3
R34 R37	RES,C,1/8W,5%,22 RC101-022	CF1/8-22	ASE	4700-05-2209	2

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R40	RES,C,1/4W,5%,82 RC103-082	CF1/4-82	ASE	4700-15-8209	1
R46 R47	RES,C,1/8W,5%,270 RC101-127	CF1/8-270	ASE	4700-05-2700	2
R48	RES,C,1/4W,5%,10 RC103-010	CF1/4-10	ASE	4700-15-1009	1
R51	RES,MF,1/8W,1%,34.0K RF213-340	MF55K-34.0K	ASE	4701-03-3402	1
R52	RES,MF,1/8W,1%,13.0K RF213-130	MF55K-13.0K	ASE	4701-03-1302	1
R53	RES,C,1/4W,5%,47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
T1	RF XFMR FROM 1810-03-0010	TR004-001	W-I	1210-43-0001	1
X1	CRYSTAL X40W XX000-401	X 40W-00.00000	W-I	2310-00-0401	1

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01	CAP, CER, 200PF, 1KV CD102-120	5GA-T20	SPR	1510-10-1201	1
C02	CAP, Q-C, 2.4PF, 10% CG101-224	QC-2.4PF	Q-C	1510-40-0249	1
C03 C20 C22	CAP., CHIP, .1 MF	51C1209-B104Z	CFI	1510-00-3104	3
C07	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	1
C08 C09 C14 C15	CAP, FT, CER, 100PF, 20% CF104-110	4420-100PF	AER	1510-30-3101	4
C11 C12 C16 C24	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	4
C17	CAP, F.T., 6.8PF CF102-R68	54-794-010-6892	SPEC	1510-30-1689	1
C21	CAP, FT, 500PF, 20%250V CF104-150	4420-500PF	AER	1510-30-3501	1
CR02 CR03	DIODE DP000-050	5082-3080	H-P	4805-02-0002	2
CR05	DIODE SELECTED FROM: 4809-02-0001	4889-00-0002	W-I	4889-00-0002	1
J01 J03	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L01	CHOKE, 47MH, 10% LA005-047	08N470K	ASE	1810-03-0470	1

WAVETEK PARTS LIST	TITLE DRIVER AMP, M10W-9	ASSEMBLY NO. 1114-00-0360 PAGE: 1	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L03 L06 L07 L08 L10	TOROID	LA009-010-1	HYT	1810-05-0004	5
L11	CHOKE, 33MH, 10% LA005-033	08N330	ASE	1810-03-0330	1
L22	RF CHOKE	CHOKE	W-I	1819-99-9999	1
Q01	TRANS QB000-034	BFR94	APX	4902-00-0940	1
R01*	RES, C, 1/4W, 5%, 120 RC103-112	CF1/4-120	ASE	4700-15-1200	1
R02	RES, C, 1/4W, 5%, 330 RC103-133	CF1/4-330	ASE	4700-15-3300	1
R05	RES, C, 1/2W, 5%, 470 RC105-147	CF1/2-470	ASE	4700-25-4700	1
R06	RES, C, 1/8W, 5%, 1K RC101-210	CF1/8-1K	ASE	4700-05-1001	1
R07 R08 R09	RES, C, 1/4W, 5%, 56 RC103-056	CF1/4-56	ASE	4700-15-5609	3
R10	RES, C, 1/4W, 5%, 160OHM	CF1/4-160	ASE	4700-15-1600	1
R14	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	1
R16	RES, C, 1/8W, 5%, 100 RC101-110	CF1/8-100	ASE	4700-05-1000	1
R17	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1

WAVETEK PARTS LIST	TITLE DRIVER AMP, M10W-9	ASSEMBLY NO. 1114-00-0360 PAGE: 2	REV

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C101 C105 C109	CAP, CHIP, 1PF, 100V CC101-R10	3BN100S1R0C(S)	VAR	1510-00-0010	3
C102 C103 C106 C107 C110 C111 C115 C116 C117	CAP., CHIP, .1 MF	51C1209-B104Z	CFI	1510-00-3104	9
C104	CAP, CER, 1200PF, 1KV CD102-212	5GA-D12	SPR	1510-10-1122	1
C108 C113 C114	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	3
L101 L102 L103	CHOKE, 33MH, 10% LA005-033	08N330	ASE	1810-03-0330	3
L104	CHOKE .22MH 10% LA005-R02	08NR22K	ASE	1810-03-0228	1
Q101 Q102	TRANS MCRWV	NE02135	NEC	4902-02-1350	2
Q103	TRANS, 200MW, 2GHZ	NE41635D	NEC	4902-41-6354	1
R101 R108 R115	RES, C, 1/8W, 5%, 1K RC101-210	CF1/8-1K	ASE	4700-05-1001	3
R102 R106 R109* R113* R116 R120	RES, C, 1/8W, 5%, 120 RC101-112	CF1/8-120	ASE	4700-05-1200	6
R103 R104 R110 R111 R117 R118	RES. C, 1/8W, 5%, 24-OHM	CF1/8-24	ASE	4700-05-2409	6
R105 R112 R119	RES, C, 1/8W, 5%, 6.8K- OHM	CF1/8-6.8K	ASE	4700-05-6801	3

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	AMP BD	1218-00-0600 PAGE: 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R107 R114	RES, C, 1/4W, 5%, 470 RC103-147	CF1/4-470	ASE	4700-15-4700	2
R121 R122	RES, C, 1/4W, 5%, 390 RC103-139	CF1/4-390	ASE	4700-15-3900	2
R123*	RES, C, 1/4W, 5%, 47 RC103-047	CF1/4-47	ASE	4700-15-4709	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	AMP BD	1218-00-0600 PAGE: 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C201	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	1
C203	CAP, CER, 470PF, 1KV CD102-147	60U471M	MDC	1510-10-1471	1
C204	CAP, CER, 100PF, 1KV CD102-110	60U101M	MDC	1510-10-1101	1
C205 C206	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	2
C207	CAP, MON, 1MF, 50V, 20%	3420-050-E105M	AER	1510-11-3105	1
C208	CAP, CER, .05MF, 100V CD103-350	TG-S50	SPR	1510-10-2503	1
CR201	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1
CR202 CR203 CR204	DIODE DG109-140	1N4148	T-I	4807-01-0914	3
IC201	OP AMP, DUAL, 10 MHZ	NE5533AN	SIG	7000-55-3300	1
Q201	TRANS QA039-060	2N3906	T-I	4901-03-9060	1
R201	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R202 R203	RES, C, 1/4W, 5%, 560K RC103-456	CF1/4-560K	ASE	4700-15-5603	2
R204	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	LEV BD	1218-00-0610	C
		PAGE: 1	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R204 R207 R208 R214	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	4
R204	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	1
R204 R207 R208 R214	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	4
R206	RES, C, 1/4W, 5%, 18K RC103-318	CF1/4-18K	ASE	4700-15-1802	1
R209	RES, C, 1/4W, 5%, 2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	1
R210	RES, C, 1/4W, 5%, 15K RC103-315	CF1/4-15K	ASE	4700-15-1502	1
R211	RES, C, 1W, 5%, 20 OHM	GB2005	AB	4700-35-2009	1
R212	RES, C, 1/4W, 5%, 12K RC103-312	CF1/4-12K	ASE	4700-15-1202	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	LEV BD	1218-00-0610	C
		PAGE: 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
F101	FUSE, SLO BLO, 1 AMP, 250V	MDL-1	BUS	2410-05-0005	1
IC101	POS. VOLTAGE REG.	LM317T	NAT	7000-03-1700	1
J101	CONN, 6-PIN, KONEKTON MC000-076	09-50-3061	MOL	2113-06-0002	1
J201	RECEPTACLE	19-09-1042	MOL	2113-26-0002	1
18	CONTACT, MC000-131	08-50-0106	MOL	2113-07-0002	5
Q101 Q102	PROT PWR DARLINGTON	LM395T	NAT	4902-00-3950	2
S101	SWITCH, SLIDE, DPDT	EPSI-SLI	S-I	5105-00-0011	1
T101	XFMR, PWR	8720	A-M	5610-00-0027	1
23	PC ASSEMBLY, DPS2A	1218-00-0250	W-I	1218-00-0250	1
24	LINE CORD ASSEMBLY	1219-00-0144	W-I	1219-00-0144	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	POWER SUPPLY, DPS2A	1115-00-0011 PAGE: 1	C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C02 C06	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	2
C02 C06	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	2
C03 C05 C07	CAP, ELECT, 1MF, 25V CE120-001	162D105X9025BC2	SPR	1510-21-7010	3
C04 C09	CAP, ELECT, 100MF, 25V CE105-110	TE1211	SPR	1510-20-4101	2
C10	CAP, 10000MF, 16V CE122-310	D76381	SPR	1510-21-4103	1
C11	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	1
CR01	DIODE BRIDGE	MDA101	MOT	4806-02-0003	1
CR02 CR04	DIODE DG109-140	1N4148	FCD	4807-01-0914	2
CR03 CR05 CR08	DIODE DR000-001	1N4004	P-C	4806-01-4004	3
CR06 CR07	DIODE DR000-009	1N5624	G-E	4806-01-5624	2
F01	FUSE, S.B., 2AMP MF000-002	313-002	LIT	2410-05-0001	1
IC01	VOLTAGE REFERENCE	REF-02CJ	PMI	7000-00-0200	1
IC02	DUAL OP AMP	TL082CP	T-I	7000-00-8200	1
J01 J02 J03	CONN., RECEPT., 3-PIN	6-86105-3	AMP	2112-25-0001	3

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	PC ASSEMBLY, DPS2A	1218-00-0250 PAGE. 1	C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
P01	PLUG, 6-PIN KONEKTON MC000-075	09-65-1061	MOL	2112-05-0002	1
Q01	JFET, N-CHANNEL	E232	SCX	4902-00-2320	1
Q02	TRANS GA039-060	2N3906	T-I	4901-03-9060	1
R01 R12 R14	RES, C, 1/4W, 5%, 4.7K RC103-247	CF1/4-4.7K	ASE	4700-15-4701	3
R02	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R03	RES, C, 1/4W, 5%, 39K RC103-339	CF1/4-39K	ASE	4700-15-3902	1
R04	RES, MF, 1/8W, 1%, 4.87K RF212-487	MF55K-4.87K	ASE	4701-03-4871	1
R05	RES, VAR. CERMET, 500	89PR500	BEK	4610-00-2501	1
R06	RES, C, 1/4W, 5%, 3.9K RC103-239	CF1/43.9K	ASE	4700-15-3901	1
R08	RES, MF, 1/8W, 1%, 13.0K RF213-130	MF55K-13.0K	ASE	4701-03-1302	1
R09 R11	RES, MF, 1/8W, 1%, 10K RF213-100	MF55K10K	ASE	4701-03-1002	2
R10	RES., VAR. CERMET 200-OHM	89PR200	BEK	4610-00-2201	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	PC ASSEMBLY, DPS2A	1218-00-0250	C
		PAGE: 2	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R13	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	1
R15	RES, C, 1/4W, 5%, 1.2K RC103-212	CF1/4-1.2K	ASE	4700-15-1201	1
R16	RES., M.F., 1/8W, 1%, 150-OHM	MF55K-150	ASE	4701-03-1500	1
R18	RES., M.F., 1/8W, 1%, 768-OHM	MF55K-768	ASE	4701-03-7680	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	PC ASSEMBLY, DPS2A	1218-00-0250	C
		PAGE: 3	

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
6	TERM. FEMALE MC000-136	02-09-1118	MOL	2113-09-0003	4
P202	CORD SET, 18/3SVT, 6FT GRY, MLD. CAP, UL-APPRV	17237SVT	BEL	6011-80-0001	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	LINE CORD ASSEMBLY	1219-00-0144	C
		PAGE: 1	

SECTION 7
SCHEMATICS

7.1 INTRODUCTION

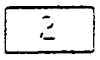
This section contains all schematics for the instrument. A schematic index is given in Section 7.3.

7.2 SCHEMATIC NOTES

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

Unless otherwise noted, resistor values are given in ohms, capacitor values are given in pF, and inductor values are given in μH.

SYMBOL NOTES

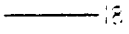


Denotes DC voltage reading unless otherwise specified.

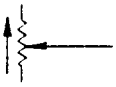
Denotes high-impedance crystal detector reading in volts unless otherwise specified.

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

Signal or voltage source.

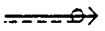


Connects to indicated signal or voltage source.



Arrow indicates clockwise rotation of wiper.

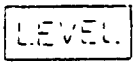
Coaxial jack



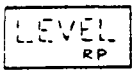
Coaxial plug

Coaxial cable

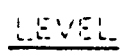
Factory adjusted part.



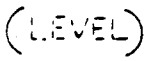
Denotes a front-panel device.



Denotes a rear-panel device.



Denotes a printed circuit board adjustment or accessible module adjustment.



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

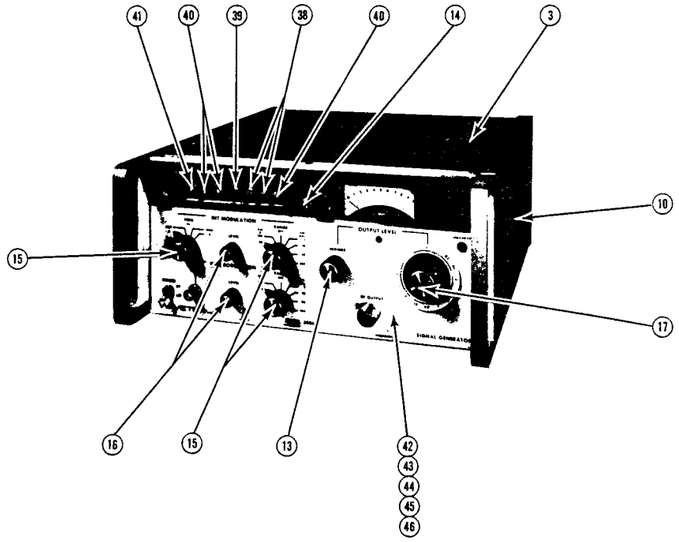
ABBREVIATION CODE

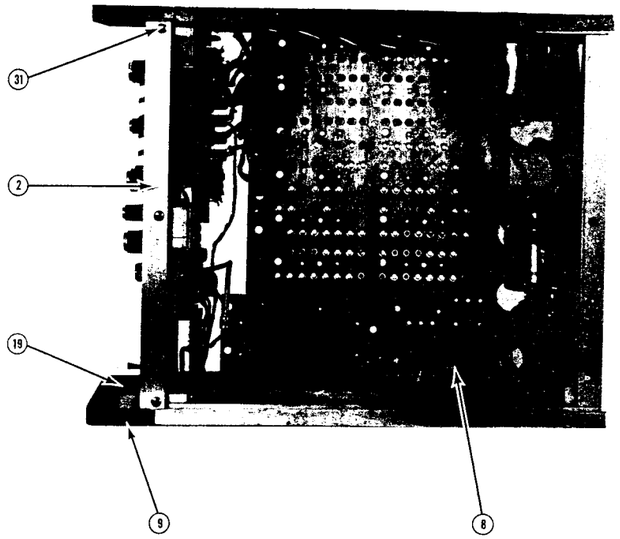
A	ampere	IF	intermediate frequency	Ω	ohm
AC	alternating current	J	jack	OC	opto-coupler
C	capacitor	K	relay	P	plug
ccw	counterclockwise	kHz	kilohertz	p	peak
CR	diode	kΩ	kilohm	pp	peak-to-peak
CW	continuous wave	kV	kilovolt	pF	picofarad
cw	clockwise	kW	kilowatt	Q	transistor
dB	decibel	L	inductor	R	resistor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

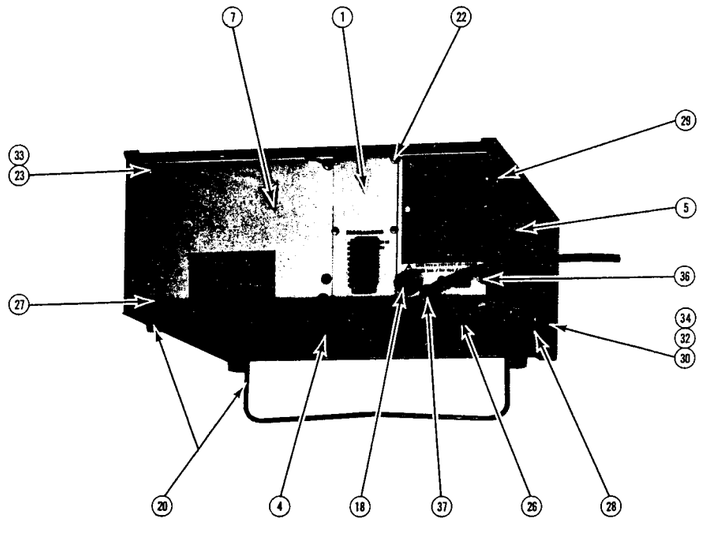
7.3 SCHEMATIC INDEX

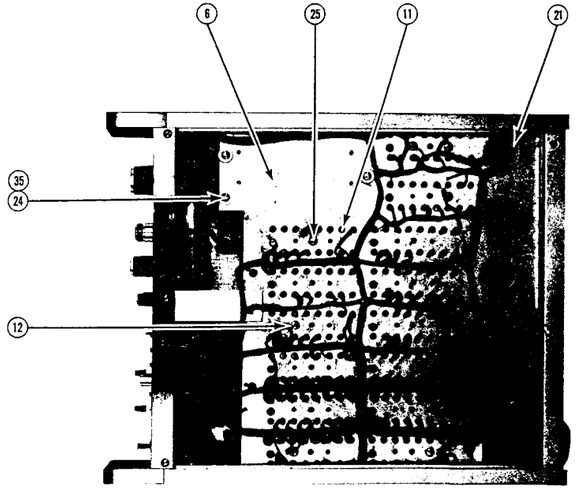
The schematics appear in the following order.

Printed circuit board layouts, where applicable, are shown opposite their corresponding schematics.









ITEM	DESCRIPTION	PART NUMBER	QTY.
46	FRONT PANEL, 3010	1410-60-1740	1
45	FRONT PANEL, 3006	1410-00-9110	1
44	FRONT PANEL, 3005	1410-00-9100	1
43	FRONT PANEL, 3004	1410-00-2110	1
42	FRONT PANEL, 3003	1410-00-8110	1
41	SWITCH	5101-00-0006	1
40	SWITCH	5101-00-0005	3
39	SWITCH	5101-00-0004	1
38	SWITCH	5101-00-0002	2
37	STRAIN RELIEF	2810-37-0001	1
36	RIVET, 1/8 X 5/16	2810-30-0007	2
35	FLATWASHER,#8 1/2 O.D.	2810-26-0010	3
34	WASHER DULITE BK	2810-26-0008	12
33	LOCKWASHER, EXT 6	2810-25-6000	4
32	LOCKWASHER, 8 INT	2810-24-8000	14
31	SCREW,TH,6/32X3/8,0H	2810-21-6106	6
30	SCREW,TH,8/32 X 1/2	2810-20-8108	4
29	SCREW,TH,8/32 X 5/16	2810-20-8105	4
28	SCREW,TH,8/32 X 1/4	2810-20-8104	5
27	SCREW, 8/32 X 3/16	2810-17-8103	2
26	SCREW, 6/32 X 1/2	2810-17-6108	2
25	SCREW, 6/32X5/16,BH	2810-17-6105	18
24	SCREW, 6/32 X 3/16	2810-17-6103	3
23	SCREW, 6/32 X 1/8, BH	2810-17-6102	7
22	SCREW, 4/40 X 3/16	2810-17-4103	6
21	GROMMET, CAT	2810-10-0004	1
20	BAIL, 10", WITH FEET	2810-08-0006	1
19	HANDLE TRIM 4-7/16	2810-07-0005	2
18	FUSEHOLDER	2410-05-0005	1
17	KNOB, SCRN Z250	2410-01-1006	1
16	KNOB, BK	2410-01-0024	2
15	KNOB, 23/32 DIA, BK	2410-01-0018	3
14	KNOB	2410-01-0012	1
13	KNOB	2410-01-0005	1
12	GROUND LUG,#6 INT	2112-03-0003	7
11	PIN SOCKET	2112-00-0002	103
10	PANEL, RIGHT SIDE	1410-60-0480	1
9	HANDLE	1410-30-0710	2
8	GASKET, RFI	1410-01-0440	2
7	CHASSIS, P.S.	1410-00-8340	1
6	UNIT CHASSIS	1410-00-7140	2
5	PANEL, LEFT SIDE	1410-00-6680	1
4	BOTTOM COVER	1410-00-5300	1
3	TOP COVER	1410-00-5290	1
2	TOP SUPPORT RAIL	1410-00-4610	2
1	REAR PANEL	1410-00-3580	1

NO	DESCRIPTION	BY
REVISION		

MATERIAL:

FINISH:

ARTWORK #:

WAVETEK, INDIANA

3003-3006 & 3010
— MECHANICAL —

DRAWN BY: D. J. WATSON | SCALE: | DATE: 11-6-81

RELEASED BY: | DATE:

DRAWING NO: DD-60

MODEL 3010
SIGNAL GENERATOR REV. B

PROGRAMMING RP

J101
1 800
2 400
3 200
4 100
5 80
6 40
7 20
8 10
9 8
10 4
11 2
12 1
13 .8
14 .4
15 .2
16 .1
17 .08
18 .04
19 .02
20 .01
21 .008
22 .004
23 .002
24 .001
25 GND
26 800
27 400
28 200
29 100
30
31
32 +7.3
33
34
35
MOD T.P. 36 TO MOD BD., PIN 5

S101 100 MHZ
S102 10 MHZ
S103 1 MHZ
FREQUENCY
S104 100 KHZ
S105 10 KHZ
S106 1 KHZ
S107 100 HZ
8 4 2 1 C
J103 J104 J105 J106 J107 J108 J111
J113
28 26 24 22 20 18 16 14 12 10 8 6 4 2 29 27 25 23 21 19 17 15 13 11 9 7 5 3

J114 1—36 REMOTE FREQ PLUG

DOUBLER CONTROL CARD

58 56 54 52 50 48 46 44 42 40 38 36 34 35 30 28 26 24 22 20 18 16 14 4 6 8 10 12 2 1
J115

M172
2 4 15 13 11 9 3 16 14 12 10
1MHz (W12)
1440 MHz (W9)
5 6 1 11 7 8 +18 -18

M32A MHZ STEPS
16 1 3 5 2 4 6
9 7 8 14 12 +7.3 +18 -18 T.P.

1KHz (W13)
M31A KHZ STEPS
1 3 16 14 12 11 10 2 4 15 13 11 9
15 TP 12 6 7 8 5 +7.3 +18 -18

M149B 100 HZ STEPS
9 8 7 6 5 2 4 +7.3 -18

(W6) (W4) (W14)
40 COMB (W11)
40 COMB (W10)
M34 WIDE OSC. LOCK
T.P. 2 3 4 14 9 +7.3 +18 -18 T.P.

M9W SWEEP OSC.
8 16 10 12 2 1 5 3 4 +18 -18
(W3) (W5)

M10W-9 OUTPUT AMP
3 4 1 +18 -18

(W21)
M164 DOUBLER
6 10 15 6 3 4 +18 -18

OPTION 3
RF CIRCUIT BREAKER MA173
(W1B) (W1A) RF OUT
12 4 3 2 1 T.P. -18 +18 +7.3
50130-01 STEP ATTEN
(W2)

EXT REF INPUT
5MHz REF OUTPUT
(W18)
(W20)
OPTION 6 M40 HIGH STABILITY REFERENCE 5 MHZ
10 3 2 +27 +18 +7.3

(W19) 10 MHz
OPTION 5 M39 EXT REFERENCE OR OPTION 5A M153 INT/EXT REF
11 9 8 2 4 3 +7.3 -18 +18

M30-5 CRYSTAL REF (W19)
(W13) 1 KHz
(W12) 1 MHz
(W11) 40 COMB
(W10) 10 MHz
(W9) 1440 MHz
(W6) 40 COMB
(W10) 120 COMB
2 3 4 14 +7.3 +18 -18 T.P.

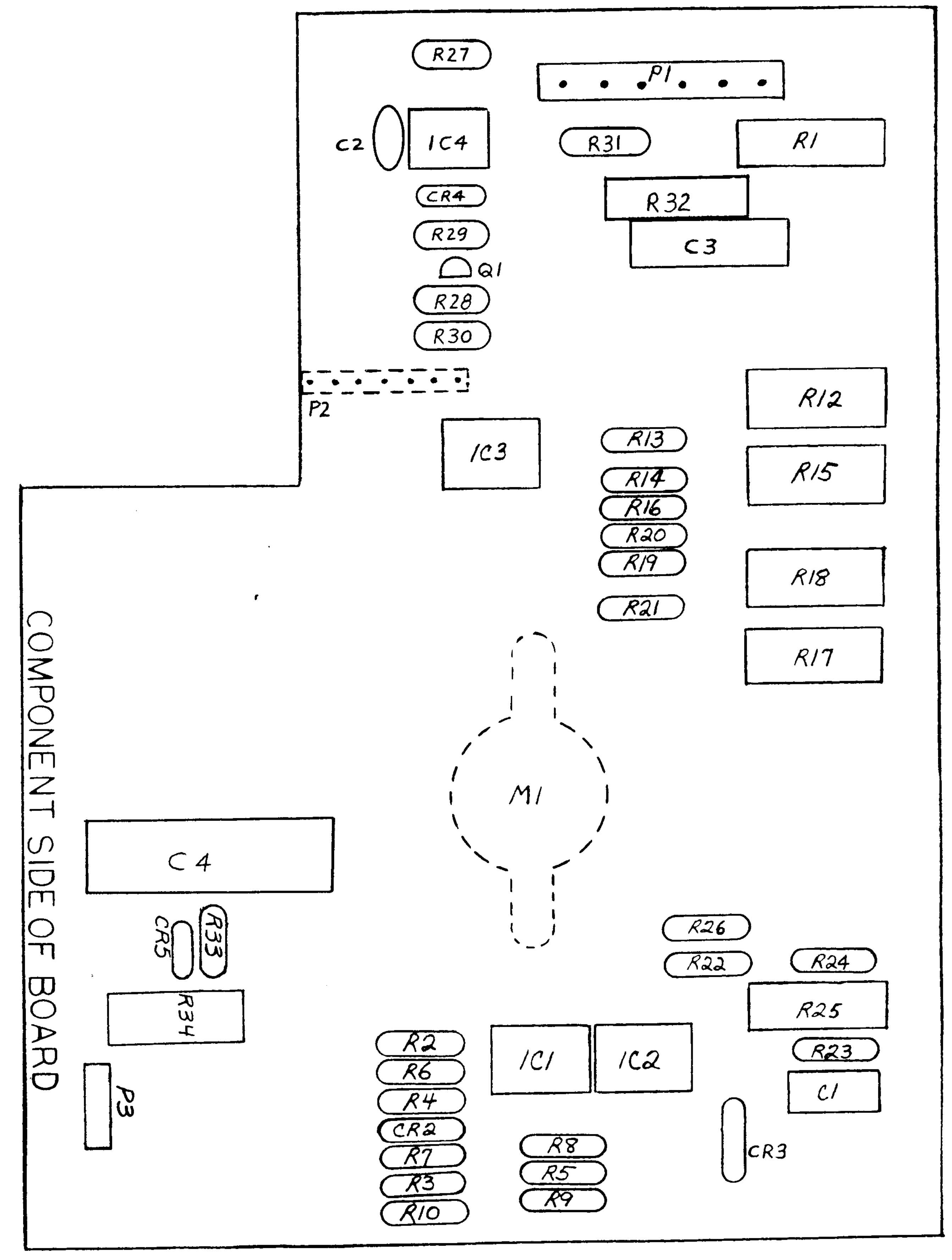
(W15)
120 COMB (W10)
T.P.
M29-2 FM REFERENCE
16 7 6 3 4 +18 -18
(W7)
M33-2 NARROW OSC LOCK
5 9 10 1 2 3 4 14 7.3 +18 -18 T.P.

J109
1 2 3 4 5 6 -18 +18
C 315-2 METER BOARD

J110
+18 -18 1 2 3 4 5 6 7 8 9 10 11 12 +7.3
MODULATION BOARD
TO J101-36
EXT
J112

OFF ON
S201 POWER
4 3 2 1 P201 J201
DPS2A POWER SUPPLY
1 +27V
2 +18V
3 +18V
4 -18V
5 -18V
6 -27V
7 +7.3V
8
9 J102

C315-2


R27
P1
C2
IC4
R31
R1
CR4
R32
R29
C3
Q1
R28
R30
P2
R12
IC3
R13
R15
R14
R16
R20
R19
R18
R21
R17
COMPONENT SIDE OF BOARD
M1
C4
CR5
R33
R26
R22
R24
R34
R25
R2
IC1
IC2
R23
R6
R4
P3
C1
CR2
CR3
R7
R8
R5
R3
R9
R10

REV E

METER BOARD C315-2

J1 P1

+18 — 6 — +18

-18 — 5 — -18

MODULATION INPUT (FROM MOD. BOARD) — 4

UNLEVEL DRIVE (FROM OUTPUT AMP) — 3

TO OUTPUT AMP — 2

1

P2 6

J2

UNLEVELED — CR101

7 J2

P2

% MOD

R1 5K

R2 7.5K

+18

R3 36.5K

R7 20K

R4 33K

CR2

R8 2.74K

R5 10.0K

R6 10.0K

IC1B 1458

-4.9

VERNIER

R9 11.3K

IC1A 1458

-1.3

R10 3.92K

-18

R33 1.2K

R34 100

CR5

P3

J3

3 5 2 1 4

1458 IC2A

-18

+18 1458 IC3A

R13 5.6K

R14 220K

R16 10K

R12 20K

R15 20K

-18 +18

+13 +3

+10 dBm RANGE

C ≅ -2.5

C ≅ -0.7

1v N.O. S101

.3 TO 1.1v

MICRO SWITCH OPERATED BY ARM FASTENED TO ATTENUATOR SHAFT.

MC1458PI

IC3B

R21 33K

R19 1M

R20 10K -18

C ≅ -0.7

C ≅ -0.15

R17 20K

R18 20K

-18 +18

+3 -6

0 dBm RANGE

R23 68K

R25 20K CAL.

R24 100K

C1 .47μF

CR3

+18

R22 20K

IC2B 1458

R26 15K P2 J2

J2 P2 J2 4

M1

C4 2000μF

R31 4.02K

R32 2K P2 J2 1

R29 2.2K

Q1 2N5458

R30 47K

-18V

+18

TO MOD BD P2

J4

1 OUTPUT

2 INT. MOD

J2 EXT. MOD

P2 5

R27 22K

IC4 LM318

CR4

C2 .01μF

+18 -18

R28 100M

-18

C3 .15μF

S102

MODULATION BOARD
3010
REV. C

IC1
XR2206

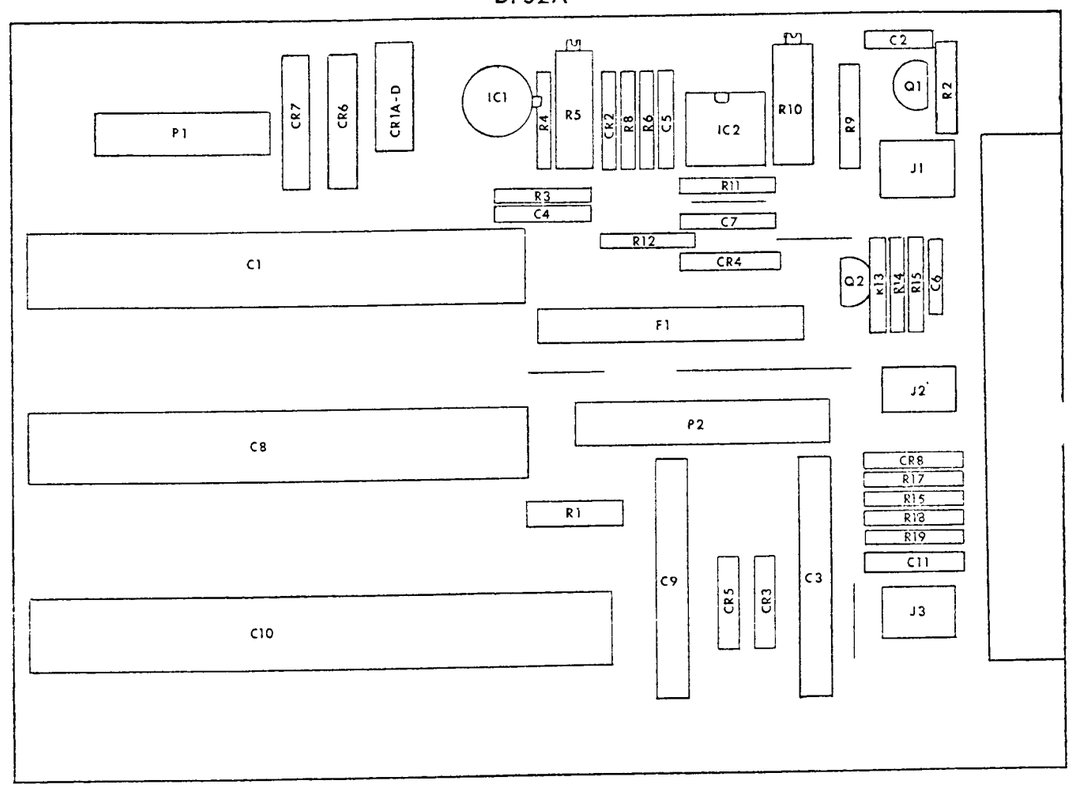
SHAPING
SYMMETRY
SIZE
INT. MOD LEVEL
EXT MOD INPUT
EXT MOD LEVEL
MOD FREQ
INT MOD RANGE
EXT MOD RANGE
FREQ VERNIER
ACCURACY
VERNIER
EXTERNAL

P1
P2

5 MOD T.P.
3 AM
1 +18V
11 TO PIN 1 OF DOUBLER CARD
6 FM
9 TO M29-2 PIN 7
4 TO M33-2 PIN 1
8 +7.3V
2 −18V
10 TO OPT 5/5A PIN 8
7 UNLOCK
12

S1 S2 S3 S4
K1
J1
Q1 Q2 VN10KM
Q2 2N3854A
Q3 2N3854A
Q4 MPS3702
Q5 2N3854A
Q6 MPS3702
Q7 2N3854A
Q8 MPS3702
Q9 2N3854A
IC2 741
IC3A IC3B 1458
IC4A IC4B 1458
IC5 MC1455
CR1 CR2 CR3 CR4 CR5 CR6 CR7 CR8 CR9 CR10

DPS2A


P1
CR7
CR6
CR1A-D
IC1
R4
R5
CR2
R8
R6
C5
IC2
R10
R9
C2
Q1
R2
J1
R3
C4
R11
C7
R12
CR4
C1
Q2
R13
R14
R15
C6
F1
J2
P2
C8
CR8
R17
R15
R18
R19
C11
R1
C9
CR5
CR3
C3
J3
C10

DPS2A
POWER SUPPLY

REV A

AC LINE FUSE R.P.

F101

115V-1A AT
230V-.5A AT

AC LINE 115/230 R.P.

115

VIOLET

S102

BROWN

230

TO POWER SWITCH

J201
3
4

1
2

BN BU GN/YL

P202

AC LINE PLUG R.P.

T101

BLACK

WHITE

GRAY

J101 P1

RD

GN

RD/YL

GN

YL

1

3

5

2

4

CR1A-D

R1
4.7K

F1
2A. AT.

C1
1500μF

C2
.005μF

R2
1K

Q1
E232

Q101
LM395

J1
3
C

E
2

J1-1

25.7

18.9

C3
100μF

CR3

IC1
REF02

+18

6
R3
39K

C4
1μF

3
IC2A
TL082
2
8
1

R6
3.9K

CR2

C5
1μF

R8
13.0K

R9
10.0K

R4
4.87K

R5
500
(+18 ADJ)

R10
200
(-18 ADJ.)

TL082
IC2B
6
5
7
4
-18

CR4

R12
4.7K

2N3906
Q2

R13
10K

R14
4.7K

C6
.005μF

C7
1μF

R11
10.0K

CR5

R15
1.2K

J2-1

J2
2
E

Q102
LM395

C
J2
3

C9
100μF

C8
1500μF

2

CR6

4

CR7

J3
3

C10
10,000μF

IC101
LM317

J3
2

J3-1

C11
10μF

R16
150

R17
*

R18
768

R19
*

CR8

P2

8 AC
1 +27
2 +18
3 +18
4 -18
5 -18
6 -27
7 +7.3
9 GND

MODEL 3010
DOUBLER
CONTROL CARD REV.

BCD INPUTS FROM F.R. SWITCHES P1
AND REMOTE JACK P2

MHz

KHz

Hz

IC5 74LS04

IC4 74LS04

IC3 74LS04

IC2 74LS04

IC1 74LS04

IC22 74LS02

IC11 74LS283

IC10 74LS283

IC9 74LS283

IC8 74LS283

IC7 74LS283

IC6 MC14560

IC18 74LS158

IC17 74LS158

IC16 74LS158

IC15 74LS158

IC14 74LS158

IC13 74LS158

IC12 74LS04

IC20A

IC20C

IC20D 74LS00

IC20B

IC19B

IC19C

IC19A 74LS10

IC21 78M05

C2 10µF

C1 10µF

+7.3V

MHz

KHz

Hz

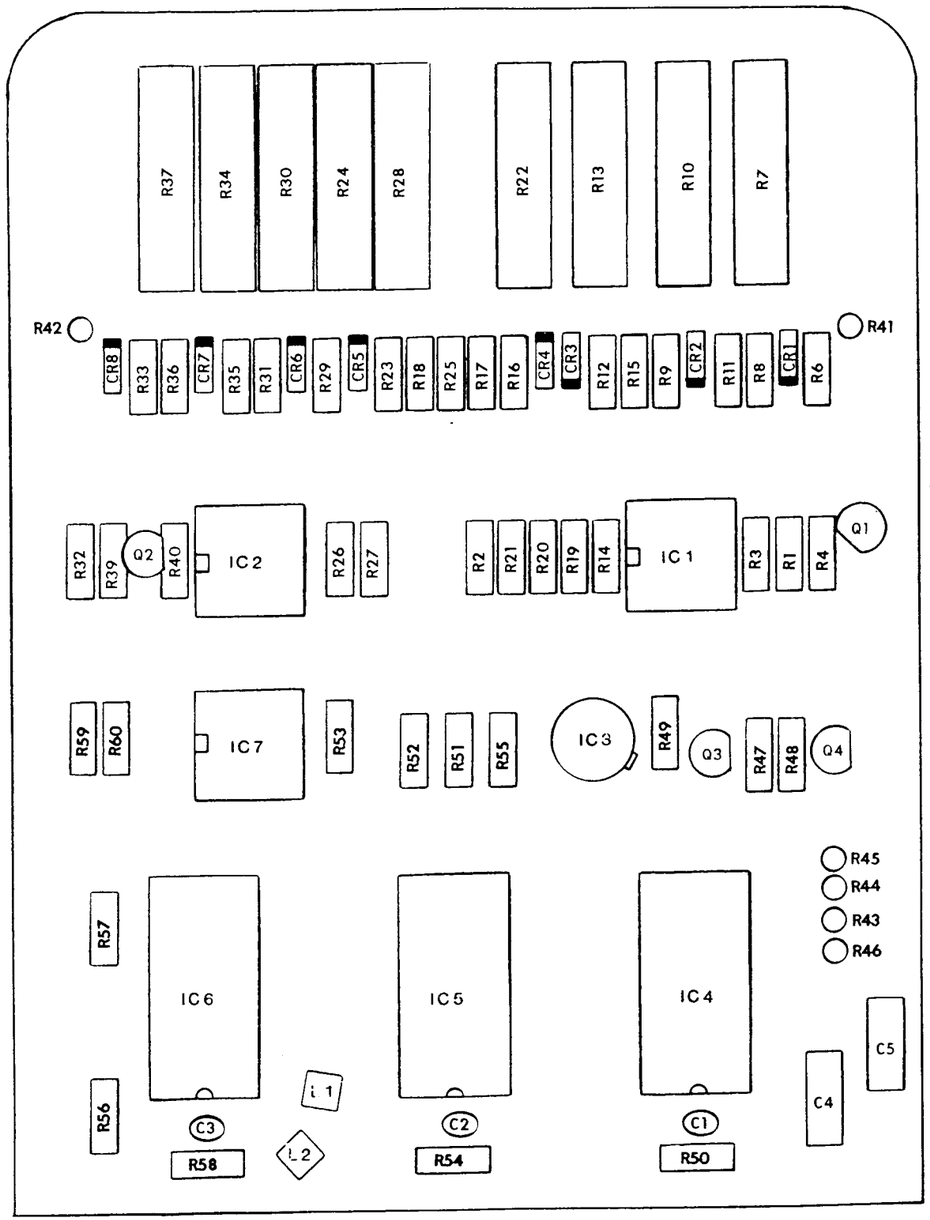
TO PIN 11 OF MOD BOARD

TO PIN 8 DOUBLER MODULE

BCD OUTPUTS P3

94281

M172


R37
R34
R30
R24
R28
R22
R13
R10
R7
R42
R41
CR8
R33
R36
CR7
R35
R31
CR6
R29
CR5
R23
R18
R25
R17
R16
CR4
CR3
R12
R15
R9
CR2
R11
R8
CR1
R6
R32
R39
Q2
R40
IC 2
R26
R27
R2
R21
R20
R19
R14
IC 1
R3
R1
R4
Q1
R59
R60
IC 7
R53
R52
R51
R55
IC 3
R49
Q3
R47
R48
Q4
R45
R44
R43
R46
R57
IC 6
IC 5
IC 4
C5
C4
R56
L 1
L 2
C3
C2
C1
R58
R54
R50

M 172
SWEEP DRIVE / DAC

REV A

TO SWEEP OSC.

C20 120

+18V

R4 402K

R1 562K

IC1A RC4558

Q1 2N4250

R3 11.3K

-18

R41 10 — T.P.2

CR1

R7 100K (0 MHz) R6 330K

R8 1K

CR2

R10 100K (50 MHz) R11 330K

R9 3.01K

CR3

R13 100K (100 MHz) R12 330K

TO OUTPUT AMP

C21 120

R2 1K

R14 5.11K

+18V

IC1B RC4558

R15 100K

CR4

R16 910K

R17 100K

R18 1K

+18V

R20 402K

R19 16.5K

R21 270K

R22 20K (250 MHz)

CR5

R24 100K (350 MHz) R25 330K

R23 1K

CR6

R30 100K (400 MHz) R29 220K

R31 1K

CR7

R34 100K (450 MHz) R35 220K

R33 1K

R32 11.3K

R42 10 — T.P.1

CR8

R37 100K (500 MHz) R36 120K

+18V

IC2A RC4558

Q2 2N5068

R39 5.62K

R40 402K

-18V

IC2B RC4558

-18V

R26 100K

R27 75K (300 MHz)

R28 20K

200 400 100

2 3 4

C18 C17 C16

80 40 20 10

16 15 14 13

C15 C14 C13 C12

8 4 2 1

12 11 10 9

C11 C10 C9 C8

1000 (TYP)

R43 100K

R44 100K

+18V

R45 100K

R46 100K

+18V

R47 270K

Q3 2N3904

R48 270K

Q4 2N3904

REF-01 IC3

+18V

-18V

C1 .01μF

DAC-20CQ IC4

C2 .01μF

DAC-20CQ

C3 .01μF

DAC-20CQ

R49 5.11K

R50 5.11K

R51 5.11K

R52 48.7K

R53 5.11K

R54 5.11K

R55 48.7K

R56 5.11K

R57 5.11K

R58 5.11K

R59 2.7K

IC3A/4 RC4558

-18

T.P. 3

R59 5.11K

R60 5.11K

IC3B/4 RC4558

+18V

-18V

+18V

L1

C4 10μF

L2

C5 10μF

C6 1000

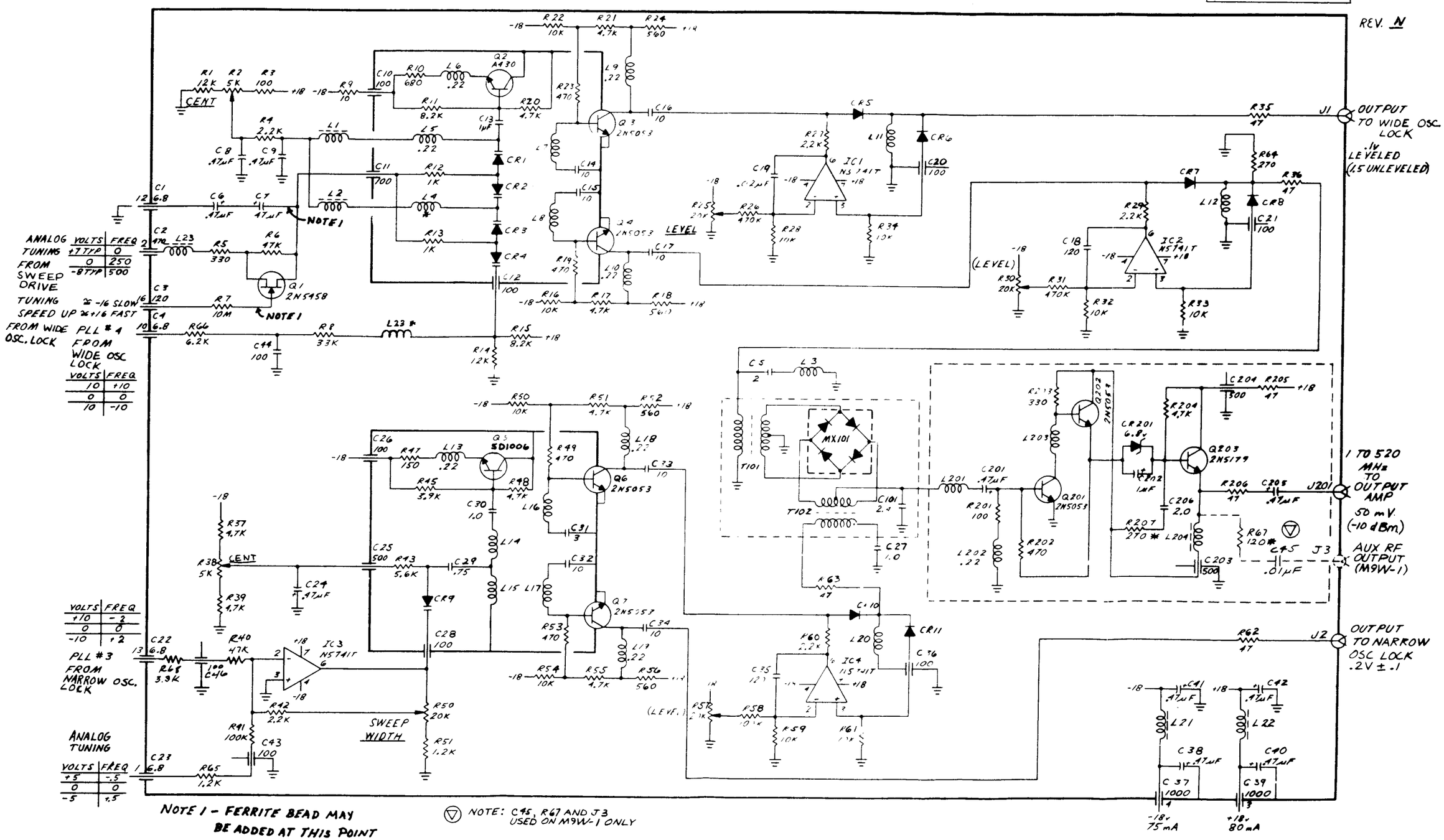
C7 1000

C19 16.8

10 MHZ STEPS

M9W/M9W-1 SWEEP OSCILLATOR

REV. N



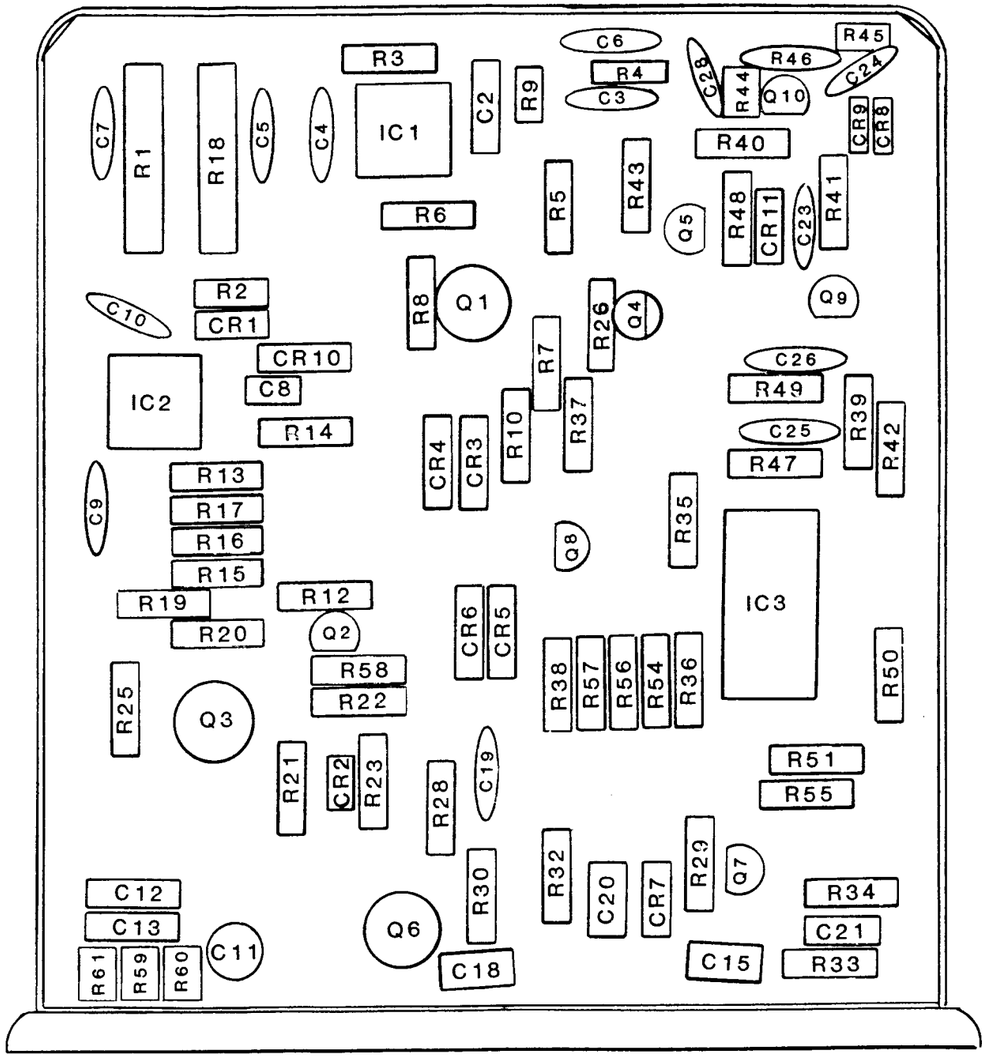
NOTE 1 – FERRITE BEAD MAY BE ADDED AT THIS POINT

▽ NOTE: C45, R67 AND J3 USED ON M9W-1 ONLY

M10W-9
DRIVER AMP
REV. B

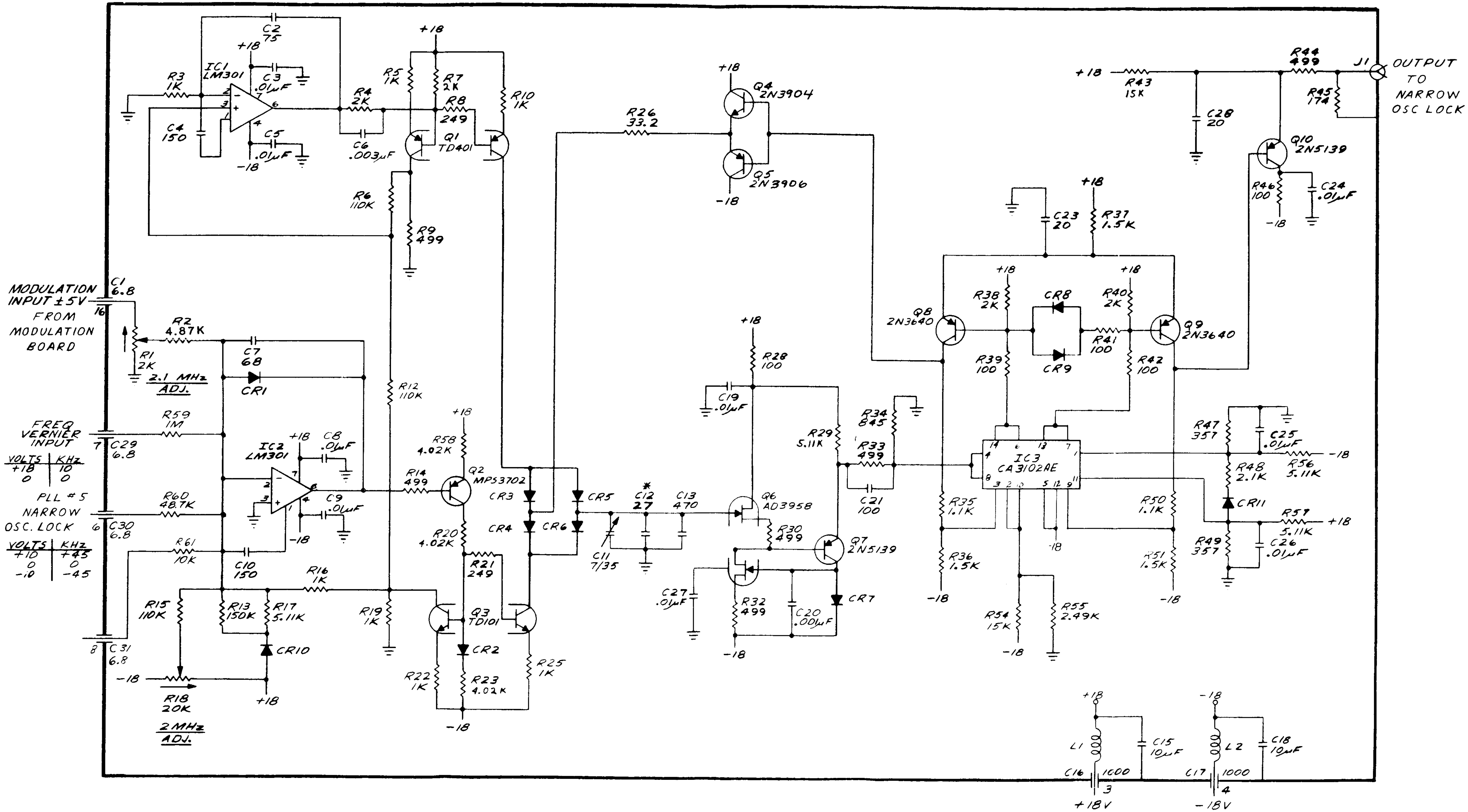
RF IN J1
L1 47
R1 120 *
CR2
CR3
R2 330
L3 10T
L22 3T
C2 2.4
C1 200
R123* 47
L104 .22
C13 .01µF
R101 1K
L101 33
C115 .1µF
C102 .1µF
R105 6.8K
R106 120
Q101 NEC2135
C101 1.0
R102 120
R104 24
R103 24
R107 470
C103 .1µF
C104 1200
R108 1K
R109* 120
L102 33
C116 .1µF
C106 .1µF
R112* 6.8K
Q102 NEC2135
C105 1.0
R110 24
R111 24
R113* 120
R114 470
C107 .1µF
C105 .01µF
R115 1K
R116 120
C114 .01µF
L103 33
C117 .1µF
C110 .1µF
R119 6.8K
Q103 NE41635
C109 .1
R117 24
R118 24
R120 120
R121 390
R122 390
C113 .1µF
R47 56
R44 56
R9 56
B+
R14 47
J3 RF OUT
C22 .1µF
R10 160
C3 .1µF
R17 2.7K
Q1 BFR94
L10 10T
L11 33
C20 .1µF
CR5
R16 100
C21 500
LEVEL CIRCUIT
C204 100
IC201A NE5534N
R201 1K
C201 1000
R202 560K
R203 560K
R204 10K
R210 15K
CR201
R213 22K
C203 47C
R206 16K
R207 22K
CR202
CR203
IC201B NE5534AN
CR204
C208 1C/25V
R214 22K
R208 22K
C207 1µF
C206 1C/25V
R209 2.2K
R211 20
R212 12K
Q201 2N3904
C208 .05µF
B+
C7 10µF
L6 10T
+18
-18
C8 100
C9 100
C14 100
C15 100
L7 10T
L6 10T
R5 47C
R6 1K
C11 1000
C12 1000
C16 1000
C24 1000
NC
C17 1000
4
3
1
6
15
-18
+18
UNLEVELED
UNLEVELED
LEVELER INPUT

M29-2


R3
C6
R4
C3
R45
R46
C24
C28
R44
Q10
C2
R9
IC1
C7
R1
R18
C5
C4
R40
CR9
CR8
R43
R5
R6
R48
CR11
C23
R41
Q5
Q9
R2
CR1
C10
R8
Q1
R26
Q4
R7
CR10
C8
IC2
C26
R49
R14
R37
R10
CR4
CR3
C25
R39
R42
R47
C9
R13
R17
R16
R15
R35
Q8
IC3
R19
R20
R12
Q2
CR6
CR5
R38
R57
R56
R54
R36
R50
R25
Q3
R58
R22
R21
CR2
R23
R28
C19
R51
R55
R32
C20
CR7
R29
Q7
R34
C12
C13
C11
Q6
R30
C21
R33
C15
C18
R61
R59
R60

M29-213
FM REFERENCE

REV. D



CRYSTAL REFERENCE
M30-1/M30-4/M30-5

REV E

10 MHz
J1

+7.3V 110mA
-18V 53mA
+18V 11mA

C1 1000
C2 1000
C3 1000
C4 1µF
C5 1µF
C6 1µF
C7 1µF
C8 1µF
L1
L2
L3
C9 100µF
IC1 78M05
C10 100µF
+5V
L101
C101 1µF
R101 390
L102
R102 100
Q1 2N5053
R103 1.8K
C102 .01µF
L103
C103 1µF
L104
C104 1µF
L105
C105 1µF
L106
C106 1µF
L107
C107 1µF
IC101 74S74
IC102 74LS196
IC103 74LS196
IC104 74LS196
IC105 74LS196
J2 1KHz
J3 1MHz
J4 2KHz (M30-1) 40MHz COMB (M30-4)
SEE NOTE
R53
J5 40 MHz COMB

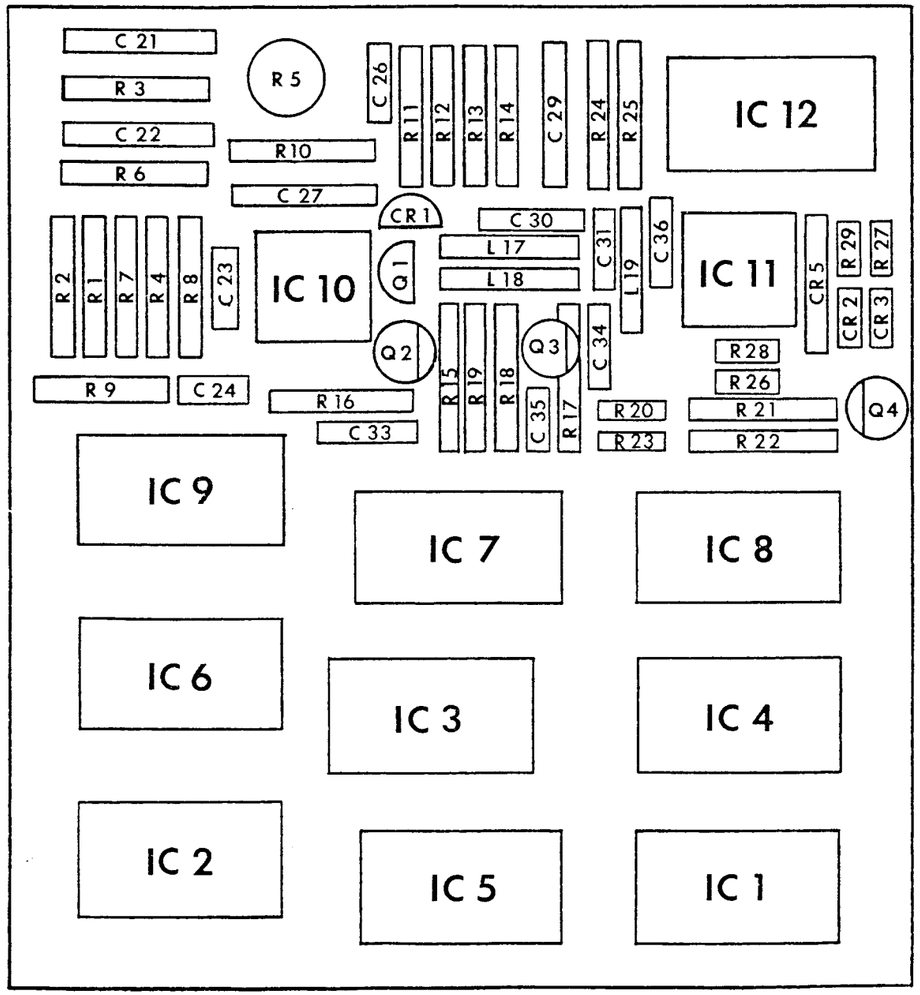
C29 200
R22 1K
R23 100
C28 2200
T1
C30 15
R25 100
C32 4.7
C34 3.5/13
C36 3.5/13
C39 3.5/13
C43 27
C57 35/13
L15 .22
L19 .22
L20 1
R30 33K
R31 22
C42 3.5/13
R36 33K
R37 22
C47 3.5/13
C53 .5/3
C54 .1
C55 .5/3
L10
L11
C33 1.1
C35 47
C37 .47
C38 1.1
L12 .22
L13 .22
L14 .22
2N5055
R26 100
C31
R28 22K
R27 47K
R29 2.2K
CR6
R24 10
R18 2.00K
R15 40.2K
Q4 2N3654A
Q3 2N5179
C26 3.5/13
C27 4.7*
Q5 2N3654A
R16 15.0K
R17 1.5K
C23 100
R19 2.00K
R21 220
C24 2200
R20 1.8K
C25 2200
L9
R50 10.0K
C57 1000
L27
C59
CR8
R4 511K
C13 47
X1 40 MHz
L7 .47µH
C14 0-15 pf
C16 0-27 pf
C17 1.4/9.2
C20 180
L8
C22 20
R14 106
R7 100
REF
(5)
C58 1000
R51 34.0K
R52 13.0K
Q2 2N5053
R5 10.0K
R6 2K
CR1
CR2
CR3
C15 470
R8 2.2K
IC2 741
R12 4.7K
R11 1K
R13 470K
C19 .005
CR4
R10 100K
R9 1K
C18 1000
CR5
C21 500
LEVELER TEST POINT

C48 100
R40 82
CR7
C49 10
R42 10K
R41 100
L21
R43 33K
R44 47
R45 47
R46 270
Q9 2N5053
C52 10
L23
L24
J6 1440 MHz
Q10 2N5053
C51 10
L22.5
R47 270
C56 .75
J7 120 MHz COMB
R49 470
C50 .005µF

R31 10K
C40 2200
R32 47
C41 500
R33 470
L17
L16
C45 2200
R35 10K
C44 10
R48 10
L18 .1
Q8 2N5053
R38 47
C46 500
R39 470

NOTE: FOR M30-1, DELETE R53
FOR M30-4, DELETE COAX TO J4, R53 = 390
FOR M30-5, DELETE COAX TO J4, R53 = 47

M31A


C 21
R 3
C 22
R 6
R 5
C 26
R 11
R 12
R 13
R 14
C 29
R 24
R 25
IC 12
R10
C 27
CR1
C 30
L 17
L 18
C 31
L 19
C 36
IC 11
CR 5
R 29
R 27
CR 2
CR 3
R 2
R 1
R 7
R 4
R 8
C 23
IC 10
Q1
Q2
Q3
C 34
R 28
R 26
R 15
R 19
R 18
C 35
R 17
R 20
R 21
Q4
R 9
C 24
R 16
C 33
R 23
R 22
IC 9
IC 7
IC 8
IC 6
IC 3
IC 4
IC 2
IC 5
IC 1

M31A
KHz STEPS

REV A

FROM CRYSTAL REF.
1KHz REFERENCE
INPUT
J1

BCD KHz FREQ PROGRAM

800 KHz
400 KHz
200 KHz
100 KHz
80 KHz
40 KHz
20 KHz
10 KHz
8 KHz
4 KHz
2 KHz
1 KHz

C1 1000 L1
C2 1000 L2
C3 1000 L3
C4 1000 L4
C5 1000 L5
C6 1000 L6
C7 1000 L7
C8 1000 L8
C9 1000 L9
C10 1000 L10
C11 1000 L11
C12 1000 L12

IC1 7404
IC2 7404
IC3 74LS196
IC4 74LS196
IC5 74LS196
IC6 74LS196
IC7 74H102
IC8 74H11
IC9 11C44
IC10A 4558
IC10B 4558
IC11 741
IC12 7404
IC13 78M05

R1 4.7K
R2 4.7K
R3 30K
R4 30K
R5 2K
R6 30K
R7 30K
R8 47K
R9 68K
R10 6.8K
R11 6.8K
R12 3.3K
R13 10K
R14 6.8K
R15 30.1K
R16 4.32K
R17 19.6K
R18 19.6K
R19 2.10K
R20 1.8K
R21 1K
R22 10K
R23 15K
R24 2.7K
R25 10K
R26 30K
R27 47K
R28 160K
R29 20K
R30 1.8K

C21 .12μF
C22 .12μF
C23 1μF
C24 1μF
C25 10μF
C26 1μF
C27 .12μF
C28 10μF
C29 .12μF
C30 1000
C31 10
C32 10μF
C33 180
C34 180
C35 .001μF
C36 .01μF
C37 10μF
C13 1000
C14 1000
C15 1000
C16 1000
C17 100μF
C18 100μF
C19 10μF
C20 10μF

L13
L14
L15
L16
L17 2.2
L18 .47
L19 .22

Q1 2N5458
Q2 2N5306
Q3 2N3854A
Q4 2N3859A

CR1 MV2301
CR2
CR3
CR4
CR5

+5
+18
-18

PIN 6 +7.3v
PIN 7 +18v
PIN 8 -18v
PIN 5 UNLOCK OUTPUT

TO WIDE OSC. LOCK J2

10.000 TO 9.001 MHz OUTPUT

UNLOCK INDICATOR

M32A
1 MHz STEPS
REV G

1448 - 1487 OUTPUT TO WIDE OSC LOCK
0dBm

UNLOCK INDICATOR

1440 MHz FROM CRYSTAL REF.

1 MHz FROM CRYSTAL REF.

MIXER

VIDEO AMPLIFIER

OSCILLATOR CONTROL BOARD

DIGITAL DIVIDER BOARD

BCD MHz
(10)
(100)
(20)
(8)
(4)
(2)
(1)

L2 - L8 10T (TYP.)

1000 (TYP.)

SWEEPWIDTH

CENTERING

(MIN. GAIN ADJ.)

(MAX. GAIN ADJ)

VIDEO T.P.

LEVELEP T.P.

0/-7.8 ANALOG PROGRAM

PLL T.P.

UNLOCK OUTPUT

100HZ STEPS
M149B
REV.

40MHZ COMB LINE FROM XTAL REF J1

IC1 SP8690B
R1 68K
C1 10
R9 3K
R10 1.5K
R11 1K
IC9E 74LS04

L3 7T
R13 47
C26 10
L4 .82
C27 10
R3 10
Q1 2N5053
C4 1000
L2 .22
R2 180
C2 1000
C3 .1µF
R4 1.8K
L1 10T
C5 2200
-18V

J2 NARROW OSC LOCK

IC8A 74LS00
IC8B
IC8C
IC8D

IC2 74LS169
IC3 74LS168
IC4 74LS168
IC5 74LS168
IC6 74LS168
C6 1µF
C7 1µF
C8 1µF
C9 1µF
C10 1µF
LSD
MSD

IC9A-D 74LS04
IC9F 74LS04
R5-8 4.7K TYP.
R12 4.7K

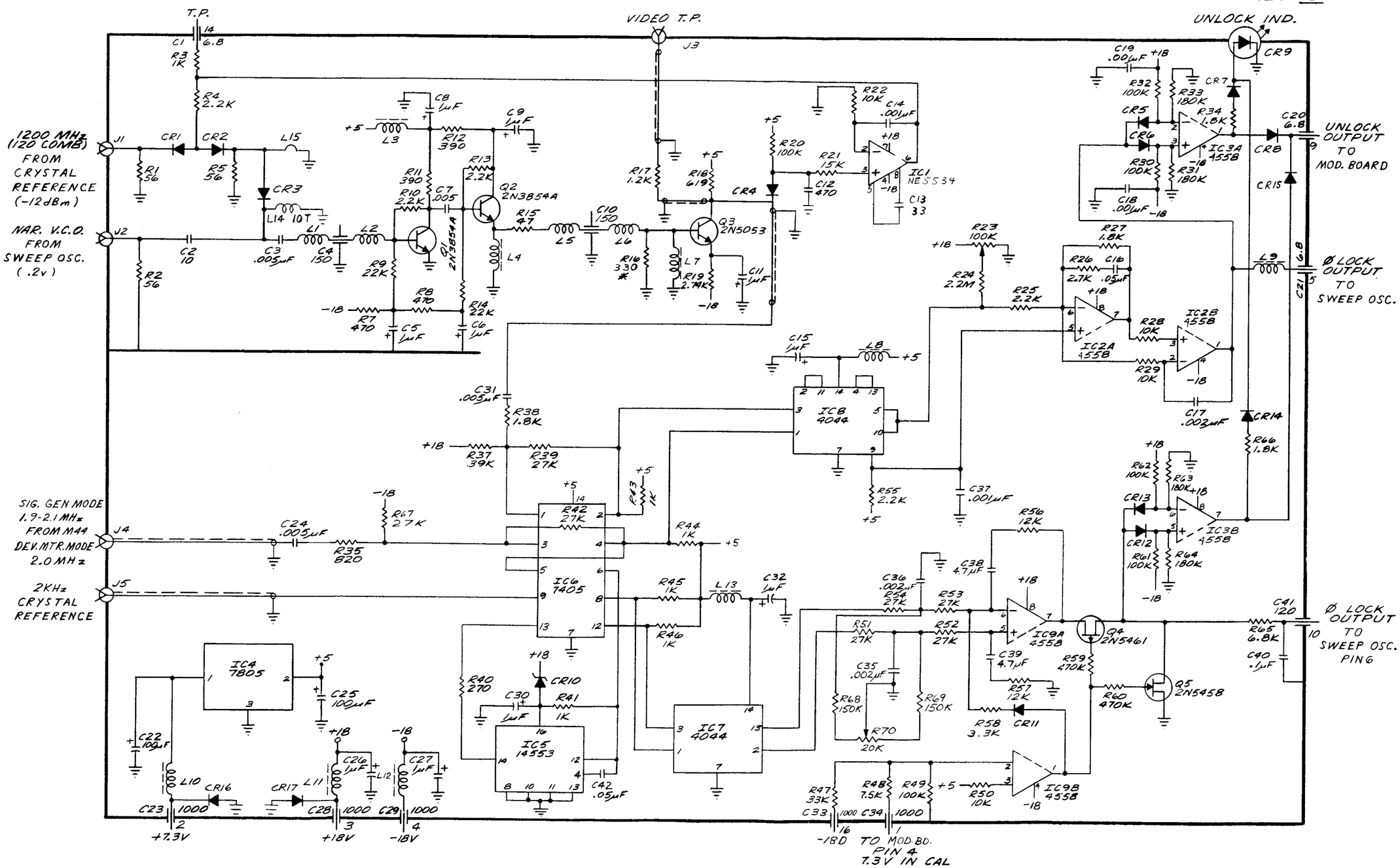
C20 .1µF
C21 .1µF
C22 .1µF
C23 .1µF
C24 .1µF
C11 6.8
C12 6.8
C13 6.8
C14 6.8
C25 6.8
C15 10µF
C16 1000
C17 10µF
C18 1000

IC7 7805
C19 10µF

50 Hz
100HZ DIGITS
-18V
+7.3V
+5V

NARROW OSCILLATOR LOCK M33-2

REV. G



M34
WIDE OSC. LOCK
REV. G

WIDE VCO
1448 /487 FROM MHz STEPS
40 MHz COMB FROM CRYSTAL REFERENCE
10-9 MHz FROM KHz STEPS
VIDEO T.P.
LEVELER T.P.
PHASE DETECTOR OUTPUT TO SWEEP OSC.
UNLOCK OUTPUT
TO SPEED-UP CKT. SWEEP OSC.
+7.3v 61 mA
-18v 23 mA
+18v 36 mA

M164
FREQ. DOUBLER REV A

RF IN FROM OUTPUT AMP
J1
R14 180
R201 47
C19 .1μF
L202 10T
CR204
L206 10T
*C223 .01μF
C220 500
B
CR209
L208 10T
CR211
L205 10T
C204 500
CR212
C
L211 8T
C205 500
A
CR210
10T L212
C206 .1μF
C222* 1.5
L213 10T
R204 47
C209 .1μF
F
IC201 MWA330
C208 .1μF
R2 150
L6 3T
C12 .1μF
Q1 BFR94
C13 10
R7 4.7K
CR3
L5 10T
CR4
E
C18 .1μF
R8 47K
C17 .1μF
L7 3T
R10 4.7
R6 100
L9 10T
C14 .1μF
L214 ½ IN LOOP
R3 47
J2
RF OUT TO ATTEN
L8 10T
R11 150
*R13
CR2
R4 150 *
C16 75
R5 100
C217 500
D
L203 10 T
C201 500
A
CR202
T201
4T
4T
4T
CR205-CR208
R203 22
L201 4T
C203 56
C202 .47
FL201
L 10 4T
R12 8.2K
CR203
C214 120
L 215 3T
R209 47
R205 220
R206 1K
C15 10μF
C219 .1μF
100 R 206
R207 100
+18
C207 .1μF
E
C
D
R102 1M
+18
R101 100K
IC102A RC4558
C2 500
L10 10T
C1 470
6
SWEEP DRIVE
R105 820
+18 -18
IC101 RC5534
C103 270
C104 33
R107 22K
R109 560K
+18
R108 560K
R106 10K
R103 15K
-18
R104 20K
-18
+18
C101 10μF
C102 10μF
IC102B RC4558
R112 470
R113 470
R110 22K
R111 2.7K
+ 18
A
B
R1 1K
CR1
G
C4 500
C7 500
C9 500
C20 500
C21 500
C22 500
L1 10T
L2 10T
L3 10T
L4 10T
L11 10T
L12 10T
C3 470
C5 470
C6 470
C8 470
C10 470
C11 470
10
4
-18
3
+18
15
7
+7.3
8
TO OUTPUT AMP
TO METER BD.
TO CONTROL CARD
IC202 MWA320
IC203 MWA320
C213 .1μF
C218 120
C221* 1.5
L210 6T
C212 120
L209 1T
L207 6T
C210 360
R202 100
C211 500
R9 4.7K
CR 201
E
C215 360
R208 100
L204 10T
C216 500
G
F

SECTION 8
MANUAL CHANGES & OPTIONS

8.1 INTRODUCTION

This section contains descriptions of engineering updates as well as corrections to any errors in the manual. Also in this section is the necessary information to document the options which have been ordered with the instrument.

8.2 MANUAL CHANGES

Wavetek's product improvement program incorporates the latest electronic developments into these instruments as rapidly as developement and testing permit. Due to the time required to document and print these instruction manuals, it is not always possible to include the changes in the original printing. Change information, if any, appears at the end of this section.

8.3 OPTIONS

Refer to Section 1.3 for a list of the options available with this instrument. The option documentation includes the operation, theory of operation, maintenance, replaceable parts list and schematics.

OPTION 3

REVERSE POWER PROTECTION

INTRODUCTION

Option 3 is a circuit breaker in the RF output system of the instrument. This prevents damage to the RF output system in the event that large RF signals are fed into the signal generator while testing a transceiver. In addition to the RF protection, the option contains a DC block which will prevent damage to the Attenuator if the RF output is connected to a circuit operating at a DC potential.

SPECIFICATIONS

Frequency Range	1 to 1000 MHz
VSWR*	<1.15
Trip Time	<2 msec
RF Trip Level	~7 W
Max RF	50 W
DC Blocking Voltage	100 Volts

* The VSWR of the generator is increased to <1.25 when this option is installed.

OPERATING INSTRUCTIONS

If an external RF voltage of approximately 6 VRMS or more is accidentally applied to the instrument's RF output connector, an internal switch in series with the RF output will open. This prevents damage to the instrument's Attenuator or Output Amplifier. This open switch will be indicated on the front panel by the flashing of the UNLEVELED light. Once the switch is tripped, it will latch in the open position and remain open until reset. Also, a combination of a high mismatch, high output level (over .1 V) and changing frequency can cause the circuit breaker to trip.

After removing the RF signal causing the overload, the switch can be reset by momentarily turning the front-panel AC POWER switch off.

NOTE

Normal operation of the UNLEVELED light is a steady glow if the instrument is unleveled. If the circuit breaker is tripped while the instrument is unleveled, the UNLEVELED light will vary in intensity instead of flashing on and off.

THEORY OF OPERATION

When the RF level is below the trip point, the output of IC1A is positive. This holds the output of IC1B negative, so the Unleveled light on the Meter Board is not lit. C4 charges to a positive voltage.

RF voltage is detected by CR1. (CR2 compensates for the low reverse voltage of CR1.) When the output of IC1A is high, R7 is effectively in parallel with R4; this combination in series with R6 sets the trip voltage. When the detected RF exceeds this, the output of IC1A goes negative. This charges the trip voltage to a negative value, so the circuit stays latched. When the signal generator is turned off then on the circuit resets.

CR3 isolates IC1B from the negative output of IC1A. C4 discharges; when its voltage is less than the voltage at the + input of IC1B, the output goes positive, turning on the Unleveled lamp. This also changes the voltage at the + input of IC1B. C4 begins to charge; when it exceeds the voltage at the + input the output of IC1B goes negative and the cycle repeats. Thus the Unleveled lamp flashes until the IC1A circuit is reset.

OPERATION CHECK

The following procedure is recommended to insure proper operation of the protection device. The top cover must be removed from the instrument.

With the instrument operating normally in the CW mode, set the output level to +5 dBm. Connect a 50 ohm detector to the output of the signal generator. The DC output of the detector should be monitored on a suitable oscilloscope. Set the output frequency to 100 MHz.

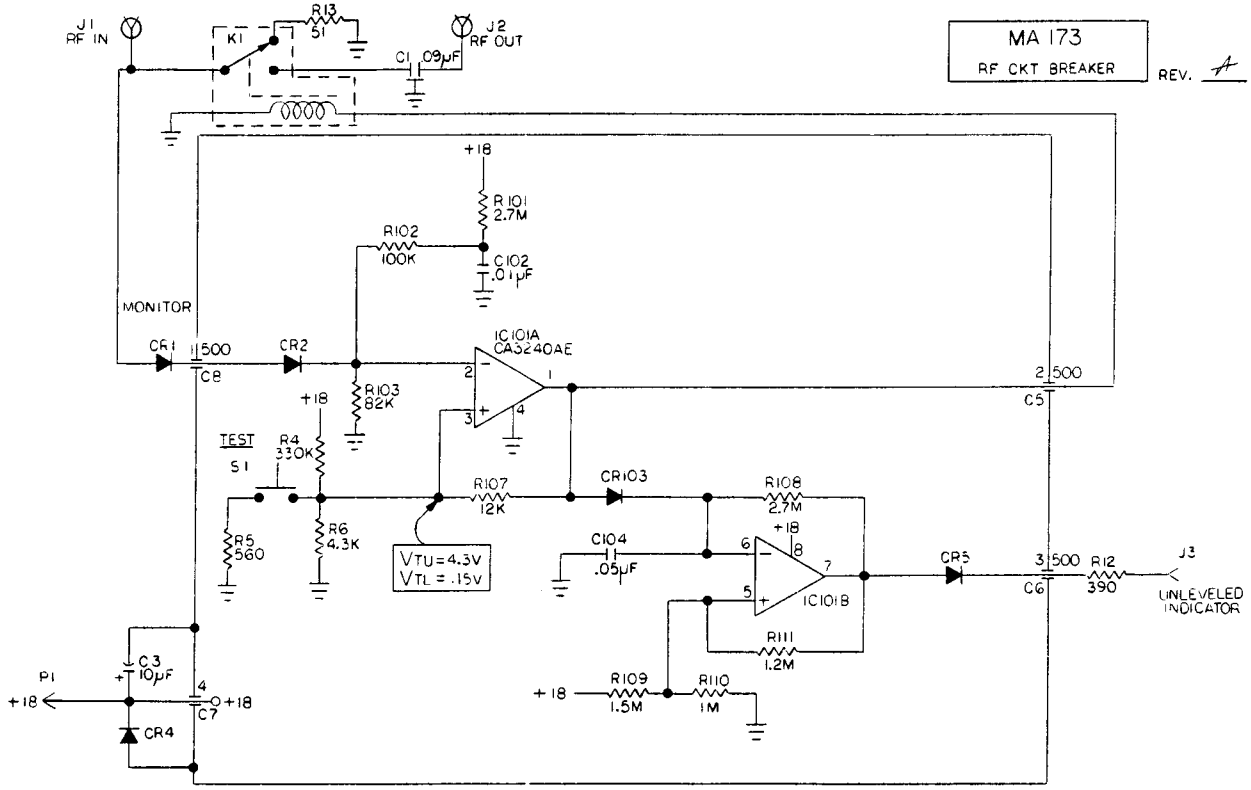
The circuitry in the MA173 is checked by pushing the momentary switch located on top of the module. This switch lowers the trip level of the module. While holding down the switch, slowly increase the output of the unit using the OUTPUT VERNIER until the MA173 trips. This causes the circuit breaker to open and latch, the UNLEVELED light to flash, and the detected output displayed on the oscilloscope to go to zero. The circuit breaker can then be reset by momentarily turning the AC POWER switch off. The MA173 should have tripped at

+7.5 dBm ±1 dB. Perform the same test at 500 MHz. It should then trip at an output level of +10.5 dBm ±2 dB.

The above procedure, while not a complete performance check, is considered adequate for most applications. Additional tests can be perfomed as desired. For example, insertion loss and VSWR can be checked in the same manner as any passive device. Also, if available, a high power RF signal source, set for an output of slightly over 0.7 W can be used to verify circuit breaker operation

MAINTENANCE

The frequency range of the MA173 necessitates very compact construction. For this reason the module is not repairable; if it malfunctions it must be replaced at the factory.



OPTION 5

EXTERNAL REFERENCE

GENERAL INFORMATION

Option 5 includes the circuitry necessary to enable the instrument to be driven by an external reference frequency, thus improving the accuracy of the signal generator. The reference input requirements are as follows:

FREQUENCY - 1, 2, 2.5, 5, or 10 MHz

ACCURACY - within 1 ppm of above frequencies.

LEVEL RANGE - 50 mV to 5 V (RMS)

IMPEDANCE - 1 kilohm

INSTALLATION

To add this option to the instrument, first remove top and bottom covers as explained in Section 5.2 of this manual. The module plugs into the open socket adjacent to the M30-1/4 (refer to Figures 5-5 and 5-6). The additional RF cables connect the M39 to the M30-1/4 and the instrument rear panel.

OPERATION

When an external signal is connected to the rear-panel BNC connector, the instrument is ready to use with increased accuracy. The front-panel ACCURACY lights should indicate "EXTERNAL" unless the FREQUENCY VERNIER is out of the CAL position.

THEORY OF OPERATION

The purpose of this circuit is to phase lock the Crystal Reference in the instrument to a higher accuracy reference. The circuit functions include: "phase detection" to compare the variable frequency to the reference and supply a reference voltage, "harmonic generation" to allow the external reference to be any of several frequencies, "unlock indication" to tell the operator when this loop is unlocked, and "reference monitoring" to disengage this loop from this instrument when the refernce input is disconnected.

Refer to Figure 8/5-1 for a block diagram of the circuit.

PHASE DETECTION

The reference (10 MHz) input to the phase detector is supplied from an external source via the harmonic generator. The signal is fed through a pair of inverters to make the signal level more compatible with the phase detector. The variable (10 MHz) signal from the voltage controlled oscillator is fed through inverters for the same reason. The phase detector output is filtered by an integrator circuit and applied to a varactor diode in the oscillator in the Crystal Reference module. The 40 MHz oscillator frequency is divided by four and fed to the phase detector. A certain voltage to the VCO will tune the variable input to the phase detector to the exact frequency of the reference input. If the variable input frequency shifts high or low, the phase detector output voltage changes and tunes the varactor oscillator in the opposite direction, thus keeping the variable input locked to the reference input.

UNLOCK INDICATION

The integrator output (phase detection circuit) is fed to a window detector. When this tuning voltage goes outside the normal operating range (too positive or negative), a DC voltage is applied to both an LED on top of the module and to the flasher circuitry in the Modulation Board assembly to cause the front-panel ACCURACY light to flash.

HARMONIC GENERATION

The external reference is fed into a circuit which generates harmonics. The output is fed to a 10 MHz filter to eliminate undesired harmonics. This signal is then fed to an amplifier with automatic gain control.

The AGC circuit includes a detector and a comparator. The detector produces a DC level proportional to the RF signal level. This is then "compared" to a DC reference. The comparator output is applied to the AGC input of the amplifier to complete the AGC loop. If the amplifier output level starts to change (increase, for example), the detector output changes (goes more positive) and the comparator output changes the voltage (more negative) on the AGC input to the amplifier. The gain of the amplifier is thus changed (decreased), and the output returns (decreases) to its original level.

REFERENCE MONITOR

This circuit monitors the amplitude of the 10 MHz reference by looking at the detector output in the AGC circuit of the 10 MHz amplifier stage. This level is compared to a fixed DC level. When the reference falls below a level necessary to drive the phase detector, the comparator switches three transistors which eliminate the tuning output to the VCO and also prevent the unlock indicator from being activated.

SCHEMATICS AND PARTS LISTS

Included in this section is a schematic diagram of the M39 module and corresponding parts list. The instrument Wiring Diagram (Schematic 1 in Section 7) shows the incorporation of this option into the instrument.

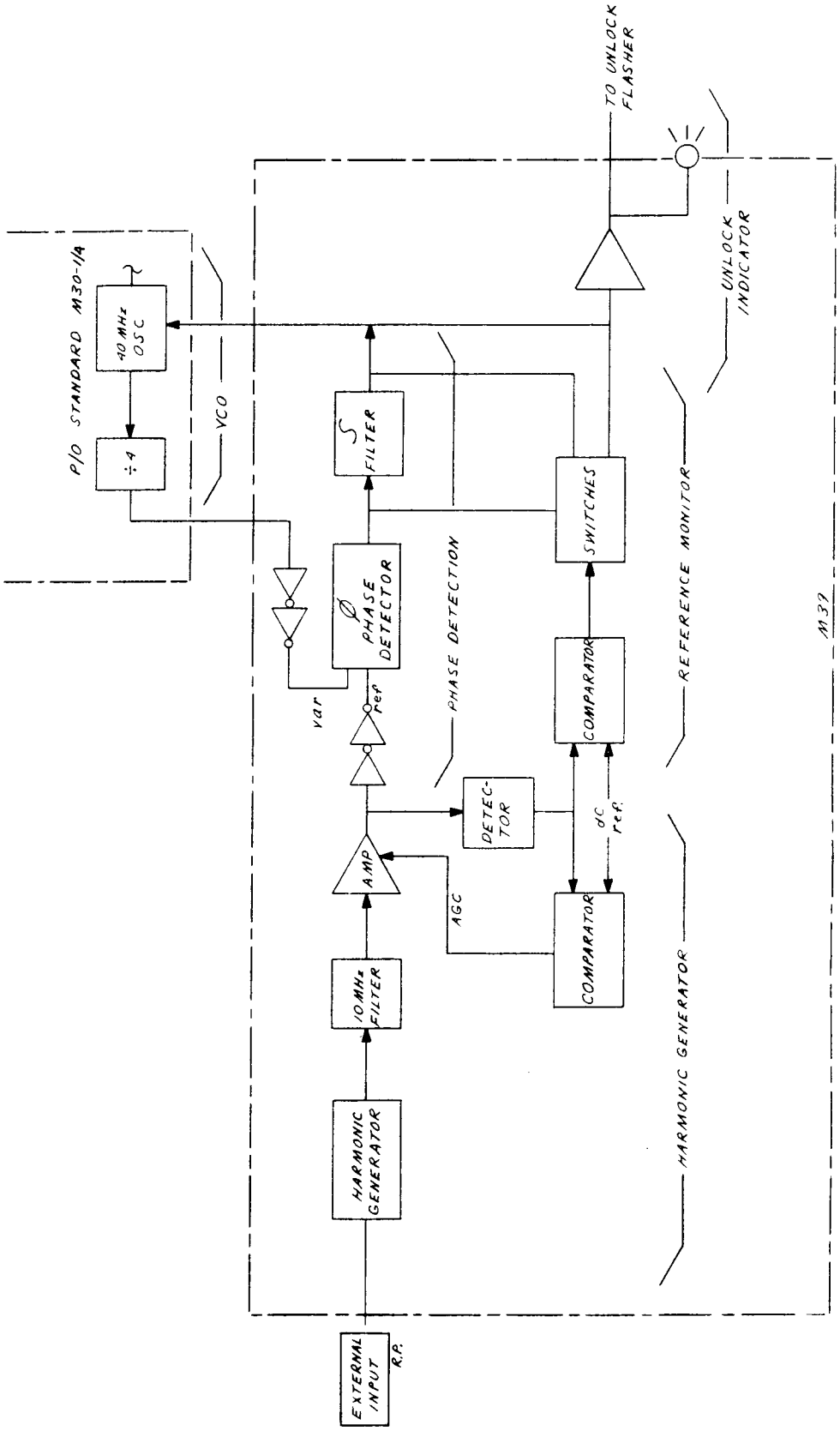


Figure 8/5-1. Block Diagram

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1 C13 C15 C18 C2 C29	CAP,CER,.005MF,1KV CD103-250	TG-D50	SPR	1510-10-2502	6
C3	CAP,CER,200PF,1KV CD102-120	SGA-T20	SPR	1510-10-1201	1
C4 C6 C8	CAP,VAR,3.5-13PF250V CV101-013	78-TRIKO-02-3.5-13PF	STR	1510-70-0130	3
C5 C7	CAP,M.C.,.75PF CG102-175	MC-.75PF	U-C	1510-40-1758	2
C10 C11 C9	CAP,CER,270PF,1KV CD102-127	60J271M	MDC	1510-10-1271	3
C12	CAP,VAR,10-60PF,250V CV104-060	10S-TRIKO-24-10-60PF	STR	1510-70-3600	1
C14 C16 C33	CAP,CER,.001MFD,1KV CD102-210	SGAD10	SPR	1510-10-1102	3
C17 C36 C37	CAP,F.T.,6.8PF CF102-R68	FASC-6892	A-M	1510-30-1689	3
C19 C22 C25	CAP,CER,F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-A102	3
C20 C21 C31 C32 C34 C35	CAP,TANT,10MF,25V CE120-010	1620106X0025DD2	SPR	1510-21-7100	6
C23 C26	CAP,F.T.,470PF CF101-147	FASC-4712	A-M	1510-30-0471	2

WAVETEK PARTS LIST	TITLE EXT REF,M39	ASSEMBLY NO. 1114-00-0053 PAGE: 1	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C24 C27 C30	CAP,CER,.01MF,100V CD103-310	6AU103M	MDC	1510-10-2103	3
C38	CAP,FT,CER,100PF,20% CF104-110	4420-100PF	AER	1510-30-3101	1
CR1 CR2 CR3 CR6	DIODE DG100-A21	1N82AG	G-I	4807-01-0082	4
CR4	DIODE DG000-012	5082-0180	H-P	4811-02-0001	1
CR5 CR7 CR8	DIODE DR000-001	1N4004	P-C	4806-01-4004	3
CR10 CR9	DIODE DG109-140	1N4148	FCD	4807-01-0914	2
CR11	LED DL000-001	NSL5046	NAT	4810-02-0001	1
IC1	IC,IC000-023	SN7805N	T-I	8000-74-0500	1
IC2 IC4	IC,IC000-005	RC4558DN	RAY	7000-14-5800	2
IC3	IC,IC000-011	78M05UC	FCD	7000-78-0500	1
IC5	IC,IC000-013	MC4044P	MOT	8000-40-4400	1
J1 J2	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L1 L12 L13 L5	CHOKE, 1MH, 10% LA005-R10	08N1R0K	ASE	1810-03-0010	4
L2 L3 L4	CHOKE,33MH,10% LA005-033	08N330	ASE	1810-03-0330	3
L6	CHOKE, 10.0MH,10% LA005-010	08N100K	ASE	1810-03-0100	1

WAVETEK PARTS LIST	TITLE EXT REF,M39	ASSEMBLY NO. 1114-00-0053 PAGE: 2	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
L10 L11 L7 L8 L9	FERRITE CHOKE LA009-010	T1255-2	HYT	1410-05-0002	5
Q1 Q3 Q4 Q5 Q6 Q7 Q8	TRANS QA038-541	2N3854A	G-E	4901-03-A541	7
Q2	TRANS QB000-020	40841	RCA	4902-40-A410	1
R1 R10 R15 R16 R34 R35 R42	RES,C,1/4W,5%,1K RC103-210	CF1/4-1K	ASE	4700-15-1001	7
R2 R22	RES,C,1/4W,5%,47K RC103-347	CF1/4-47K	ASE	4700-15-4702	2
R3	RES,C,1/4W,5%,12K RC103-312	CF1/4-12K	ASE	4700-15-1202	1
R4	RES,C,1/4W,5%,1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	1
R5	RES,C,1/4W,5%,1M RC103-510	CF1/4-1M	ASE	4700-15-1004	1
R6	RES,C,1/4W,5%,470 RC103-147	CF1/4-470	ASE	4700-15-4700	1
R7	RES,C,1/4W,5%,1.8M RC103-518	CF1/4-1.8M	ASE	4700-15-1804	1
R8	RES,C,1/4W,5%,1.5M RC103-515	CF1/4-1.5M	ASE	4700-15-1504	1
R9	RES,C,1/4W,5%,470K RC103-447	CF1/4-470K	ASE	4700-15-4703	1

WAVETEK PARTS LIST	TITLE EXT REF,M39	ASSEMBLY NO. 1114-00-0053 PAGE: 3	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R11	RES,C,1/4W,5%,100 RC103-110	CF1/4-100	ASE	4700-15-1000	1
R12 R36	RES,C,1/4W,5%,2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	2
R13 R24 R32	RES,C,1/4W,5%,39K RC103-339	CF1/4-39K	ASE	4700-15-3902	3
R14 R33	RES,C,1/4W,5%,27K RC103-327	CF1/4-27K	ASE	4700-15-2702	2
R17 R19 R46	RES,MF,1/8W,1%,237K RF214-237	MF55K-237K	ASE	4701-03-2373	3
R18 R20	RES,MF,1/8W,1%,110K RF214-110	MF55K-110K	ASE	4701-03-1103	2
R21	RES,C,1/4W,5%,1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	1
R23 R47	RES,C,1/4W,5%,330 RC103-133	CF1/4-330	ASE	4700-15-3300	2
R25	RES,MF,1/8W,1%,1.78M RF215-178	MF55K-1.78K	ASE	4701-03-1784	1
R26	RES,MF,1/8W,1%,56.2K RF213-562	MF55K-56.2K	ASE	4701-03-5622	1
R27	RES,C,1/4W,5%,2.2K RC103-222	CF1/4-2.2K	ASE	4700-15-2201	1

WAVETEK PARTS LIST	TITLE EXT REF,M39	ASSEMBLY NO. 1114-00-0053 PAGE: 4	REV B

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R28 R38	RES,C,1/4W,5%,100K RC103-410	CF1/4-100K	ASE	4700-15-1003	2
R29	RES,C,1/4W,5%,6.8K RC103-268	CF1/4-6.8K	ASE	4700-15-6801	1
R30 R37	RES,C,1/4W,5%,10K RC103-310	CF1/4-10K	ASE	4700-15-1002	2
R31	RES,C,1/4W,5%,10M RC103-610	CB1065	A-B	4700-15-1005	1
R39	RES,MF,1/8W,1%,15K RF213-150	MF55K-15K	ASE	4701-03-1502	1
R40 R41 R43	RES,C,1/4W,5%,22K RC103-322	CF1/422K	ASE	4700-15-2202	3
R44 R45	RES,MF,1/8W,1%,10K RF213-100	MF55K10K	ASE	4701-03-1002	2
T1	RF XFMR FROM:1813-00-0007	TR001-009	A-I	1210-40-0004	1

WAVETEK PARTS LIST	TITLE EXT REF,A39	ASSEMBLY NO. 1114-00-0053 PAGE: 5	REV B

EXTERNAL REFERENCE
M39

REV. B

EXT INPUT J1
R1 1K
C1 .005 μF
R2 47K
R3 12K
R42 1K
Q6 2N3854A
Q1 2N3854A
CR1
CR2
CR3
CR4
L1 1
L2 33
C3 200
T1
C2 .005 μF
R4 1.5K
+18
C5 .75
C7 .75
L3 33
L4 33
L5 1
C4 3.5/13
C6 3.5/13
C8 3.5/13
C9 270
C10 270
C11 270
R6 470
R5 1M
R7 1.8M
R8 1.5M
R9 470K
R10 1K
C13 .005 μF
L6 10
Q2 40841
C12 10/160
R12 2.7K
L7
R11 100
C15 .005μ
Q3 2N3854A
C14 .001 μF
CR5
CR6
C16 .001 μ
R13 39K
-18
R43 22K
A
2N3854A Q7
Q8 2N3854A
R44 10.0K
R45 10.0K
R14 2TK
IC1A 7405
IC1B 7405
+5
R15 1K
R16 1K
R17 237 K
R18 110K
R19 237K
R20 110K
R22 47K
CR7
CR8
CR9
CR10
CR11
R21 1.8K
L8
C17 6.8
IC2A 1458
UNLOCK OUTPUT

R24 39K
C29 .005 μF
IC4A 1458
R27 2.2K
R29 6.8K
R28 100K
R30 10K
C30 .01 μF
C33 .001μF
IC4B 1458
R25 1.78M
R26 56.2K
R31 10M

IC5 4044
R36 2.7K
R37 10K
C39 .025μF
IC 2B 1458
R46 237K
R39 15.0K
C31 10μF
R38 100K
C32 10μF
C36 6.8
C34 10μF
C35 10μF
Ø LOCK

10 MHZ INPUT J2
R23 330
L12
C38 100
L13
C18 .005
R47 330
R33 27K
IC1C 7405
R34 1K
R35 1K
IC1D 7405
R32 39K

R40 22K
Q4 2N3854 A
R41
Q5 2N3854 A

L9
IC3 78M05
C19 1000
C20 10 μF
C21 10 μF
+5V
+7.2V
L10
C22 1000
C23 470
C24 .01 μF
+18 V
L11
C25 1000
C26 470
C27 .01 μF
-18 V
C37 6.8
ACCURACY INDICATOR

OPTION 5A

INTERNAL/EXTERNAL REFERENCE

INTRODUCTION

Option 5A includes the circuitry necessary to enable the instrument to be driven by an external reference frequency, and also provides an internal reference from a temperature-compensated crystal oscillator (TCXO). The accuracy of the instrument may be improved by using either the internal or external reference. In addition, the internal TCXO may be used as a reference for other instruments.

SPECIFICATIONS

INTERNAL	
Frequency Accuracy	±1 ppm
Temperature Range	25° ±5° C
Aging	1 ppm/year
Stability	<0.2 ppm/hour after 3 hour warm-up (Typically after 2 hour warm-up)
Reference Output	10 MHz TTL
EXTERNAL	
Frequency Accuracy	Equal to external source
External Input	
Frequency	5 or 10 MHz
Accuracy	±1 ppm
Input Level	TTL or .5 to 5 VRMS into 2 kohm (sine or square wave)
INPUT/OUTPUT CONNECTOR	Rear-panel BNC

INSTALLATION

The circuitry for Option 5A includes the M153 Internal/External Reference module and two RF cable assemblies. To install Option 5A, remove the instrument top and bottom covers (refer to instruction manual Section 5.2) and plug module M153 into the open module socket next to the M30-5 Crystal Reference module. Install the module hold-down screw underneath the instrument chassis. Connect the RF cable assemblies as shown in Figure 8/5A-1.

OPERATION

When the Int/Ext switch on top of module M153 is in the "Int" position, the instrument is phase locked to the TCXO in the M153 and the instrument accuracy is ±1 ppm (.0001%). The TCXO signal is also output at the rear-panel connector for use in driving other devices.

When the M153 switch is in the "Ext" position, the instrument is phase locked to the external source. If no external source is present, Option 5A is non-functional, and the instrument accuracy is returned to the standard (±10 ppm (.001%)).

The front-panel EXT ACCURACY lamp will light when the instrument is phase locked to either the external source or the internal TCXO.

WARM-UP TIME

When the instrument is turned on from a cold start, the front-panel ACCURACY indicator may flash, indicating an unlocked condition. As soon as the ACCURACY indicator stops flashing, the instrument is warmed up and has an accuracy of ±1 ppm. The warm-up time is typically less than 5 minutes at 25° C ambient temperature.

NOTE

If the front-panel FREQ VERNIER is not in its CAL position, Option 5A is non-functional.

THEORY OF OPERATION

Refer to Figure 8/5A-2.

The purpose of Option 5A is to phase lock the M30-5 Crystal Reference to a higher accuracy reference. The option circuitry is contained in the M153 Internal/External Reference module, and includes a tuned amplifier, a phase detector, a filter, a comparator, a reference monitor, and a TCXO.

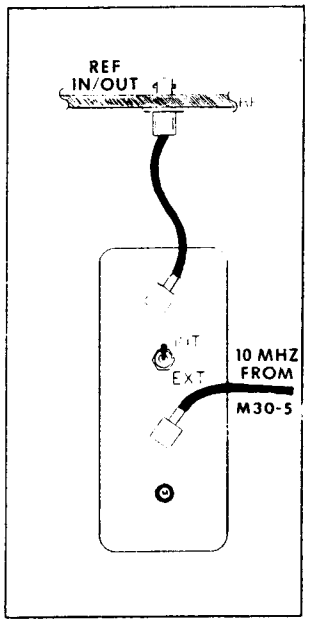


Figure 8/5A-1. Top View

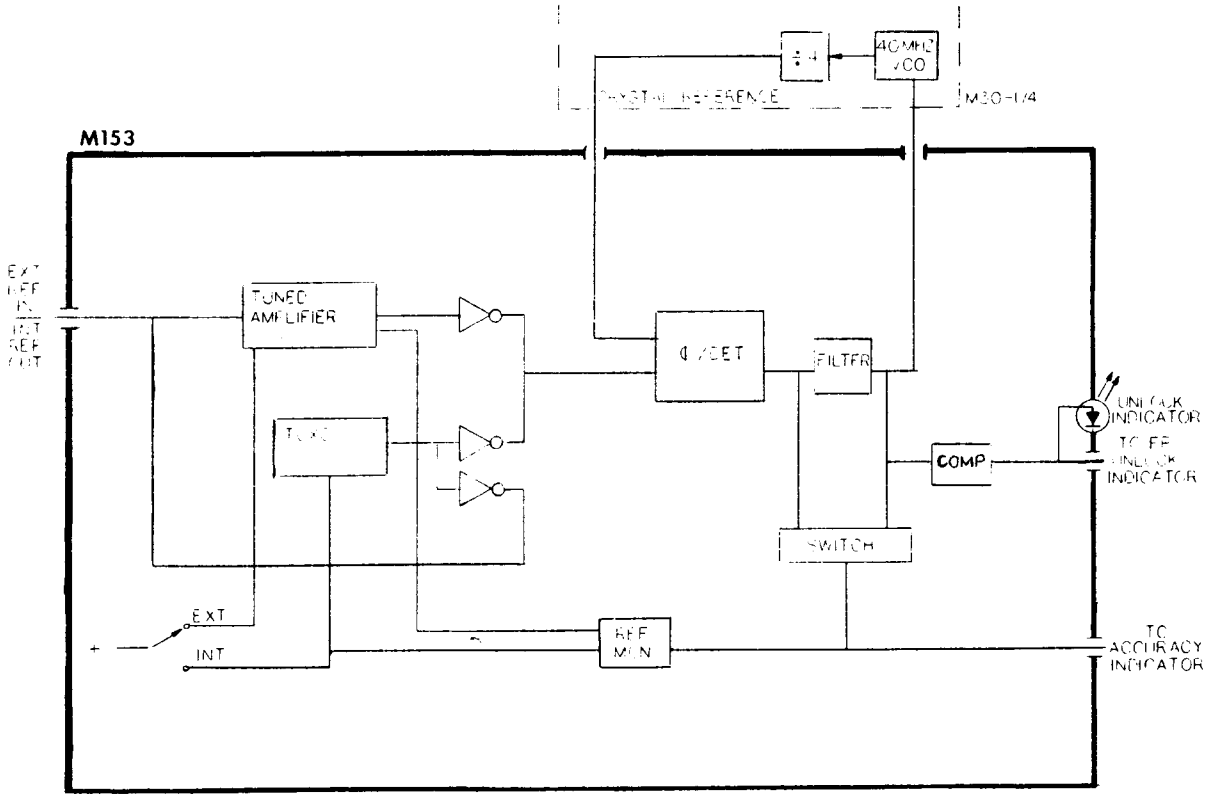


Figure 8/5A-2. Block Diagram

When the M153 switch is set to "Int", the TCXO is energized. The TCXO output is input to a phase detector, the other input of which is derived from the M30-1/4 Crystal Reference, which serves as the VCO in the phase-locked loop. Any difference in frequency or phase produces an error voltage which corrects the M30-1/4 Crystal Reference frequency to keep it phase locked to the TCXO.

When the M153 switch is set to "Ext", the tuned amplifier is energized and the TCXO is turned off. The tuned amplifier accepts the external reference signal, amplifies it (if the external reference is 5 MHz, the tuned amplifier converts it to 10 MHz), and inputs it to the phase detector. The phase-locked loop then operates in the same manner as it did for the TCXO, and the M30-1/4 Crystal Reference is phase locked to the external reference source.

If the external reference is not within accuracy specifications, the phase-locked loop will not be able to lock onto the external signal. When this occurs, the comparator senses the excessive error voltage from the phase detector and activates the module and instrument unlock indicators.

If the M153 switch is set to "Ext" but no (or insufficient) external signal is available, the reference monitor senses the condition and disables the phase-locked loop.

CALIBRATION

Tank circuit L4/C12 is broad-tuned at the factory, and should require no adjustment.

An adjustment trimmer is provided on the TCXO to adjust the 10 MHz reference frequency. This adjustment should be performed at 3 to 6 month intervals to compensate for aging of the TCXO.

To adjust the TCXO frequency, first ensure the instrument has been turned off for at least 3 hours and has stabilized in a ~ 25° C ambient temperature. Remove the instrument's top cover and the M153 module cover. Set the Int/Ext switch to "Int" and connect a frequency counter to the rear-panel REF IN/OUT connector. (Ensure that the counter is properly warmed up and has at least 0.1 ppm accuracy with 1 Hz resolution at 10 MHz.) Turn the instrument on and adjust the TCXO Frequency Adjustment to 10.000000 MHz ± the offset indicated on the calibration tag adjacent to the Frequency Adjustment. (Example— If the tag reads "Freq Set at 25° -3.0 Hz", adjust the frequency to 9.999997 MHz). This adjustment should be performed within 5 minutes after turn-on. Replace the module and instrument covers.

TROUBLESHOOTING

If the M153 unlock indicator is lit, the fault may be in the M153, but may also be in the M30-1/4 Crystal Reference module or in the external source. If either the M30-1/4 or the external source is not within its prescribed specification limits, the M153 may not be able to accomplish phase lock, and the unlock indicator will light. If the unlock occurs only when the M153 switch is set to "Ext", suspect the external source or the tuned amplifier in the M153. If the unlock occurs only when the M153 switch is set to "Int", recalibrate the TCXO. If the unlock occurs in both switch positions (with external source present), the problem is probably a defective M153 or an out-of-specification M30-1/4.

Calibrate the M30-1/4 as follows: Check the DC voltage present on pin 11 of module M153. This is the PLL correction voltage. The unlock indicator will light when this voltage exceeds ~ ±4 V. If the instrument is unlocked after a 5 minute warm-up period, immediately set the PLL correction voltage to -3.5 V using the M30-1/4 Frequency Adjust. If the instrument becomes unlocked after 15 minutes, allow the instrument to warm up until it has been on for at least 2 hours and set the PLL correction voltage to +3.5 V.

NOTE

It may be necessary to repeat the above procedure several times in order to phase lock the M30-1/4 at all temperatures. Do not adjust the M30-1/4 Frequency Adjust for 0 V, since this could produce an unlocked condition at extreme temperatures.

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C01 C02 C03 C04 C14 C15 C16 C17 C28 C31	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	10
C05 C07 C09	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	3
C06	CAP, CER, .001MFD, 1KV CD102-210	5GAD10	SPR	1510-10-1102	1
C08 C10 C13 C30	CAP, CER, .005MF, 100V	TG-D50	SPR	1510-10-2502	4
C11	CAP, CER, 200PF, 1KV CD102-120	5GA-T20	SPR	1510-10-1201	1
C12	CAP, VAR, 3.5-13PF250V CV101-013	7S-TRIK0-02-3.5-13PF	STR	1510-70-0130	1
C18 C20 C21 C22 C23 C24 C25 C27	CAP, F.T., 470PF CF101-147	FA5C-4712	A-B	1510-30-0471	8
C29	CAP, CER, 6.8PF, 1KV CD101-R68	60C0H6R8D	MDC	1510-10-0689	1
CR01	LED DL000-001	NSL5046	NAT	4810-02-0001	1
CR02 CR03 CR04 CR05 CR06 CR07 CR08 CR12 CR13	DIODE DG109-140	1N4148	FCD	4807-01-0914	9
CR09	DIODE DG000-007	5082-2800	H-P	4809-02-0001	1

WAVETEK PARTS LIST	TITLE INT/EXT REF,M153	ASSEMBLY NO. 1114-00-0314 PAGE: 1	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
CR10 CR11 CR14	DIODE DG100-821	1N82AG	G-I	4807-01-0082	3
G01	TCXO, 10 MHZ	K1087A-1T13	MSN	2310-00-0002	1
IC01	IC, IC000-023	SN7405N	T-I	8000-74-0500	1
IC02	IC, IC000-013	MC4044P	MOT	8000-40-4400	1
IC03 IC04	IC, IC000-005	RC4558DN	RAY	7000-14-5800	2
IC05	IC, IC000-011	78M05UC	FCD	7000-78-0500	1
J01 J02	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L01 L05 L07 L08	FERRITE CHOKE LA009-010	T1255-2	HYT	1810-05-0002	4
L03	CHOKE, 1MH, 10% LA005-R10	08N1R0K	ASE	1810-03-0010	1
L04	CHOKE, 10.0MH, 10% LA005-010	08N100K	ASE	1810-03-0100	1
L09	CHOKE, 2.2MH, 10% LA005-R22	08N2R2K	ASE	1810-03-0229	1
Q01 Q02 Q03 Q04 Q05 Q06 Q07 Q08 Q10	TRANS QA038-541	2N3854A	G-E	4901-03-8541	9
Q09	XSTOR, POWER, NPN	92PU01A	NAT	4902-09-2011	1
R01 R31 R35	RES, C, 1/8W, 5%, 1K RC101-210	CF1/8-1K	ASE	4700-05-1001	3

WAVETEK PARTS LIST	TITLE INT/EXT REF,M153	ASSEMBLY NO. 1114-00-0314 PAGE: 2	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R02 R20 R21 R38 R41	RES, C, 1/4W, 5%, 10K RC103-310	CF1/4-10K	ASE	4700-15-1002	5
R03	RES, C, 1/4W, 5%, 2.7K RC103-227	CF1/4-2.7K	ASE	4700-15-2701	1
R04 R08 R10	RES, C, 1/4W, 5%, 22K RC103-322	CF1/422K	ASE	4700-15-2202	3
R05	RES, C, 1/8W, 5%, 100K RC101-410	CF1/8-100K	ASE	4700-05-1003	1
R06 R14 R15	RES, MF, 1/8W, 1%, 237K RF214-237	MF55K-237K	ASE	4701-03-2373	3
R07	RES, MF, 1/8W, 1%, 15K RF213-150	MF55K-15K	ASE	4701-03-1502	1
R11 R12	RES, MF, 1/8W, 1%, 10K RF213-100	MF55K10K	ASE	4701-03-1002	2
R13 R26	RES, C, 1/8W, 5%, 47K RC101-347	CF1/8-47K	ASE	4700-05-4702	2
R16 R17	RES, MF, 1/8W, 1%, 110K RF214-110	MF55K-110K	ASE	4701-03-1103	2
R19	RES, C, 1/8W, 5%, 10K -OHM	CF1/8-10K	ASE	4700-05-1002	1
R22	RES, MF, 1/8W, 1%, 1.78M RF215-178	RN60D-1.78M	MILSP	4701-03-1784	1

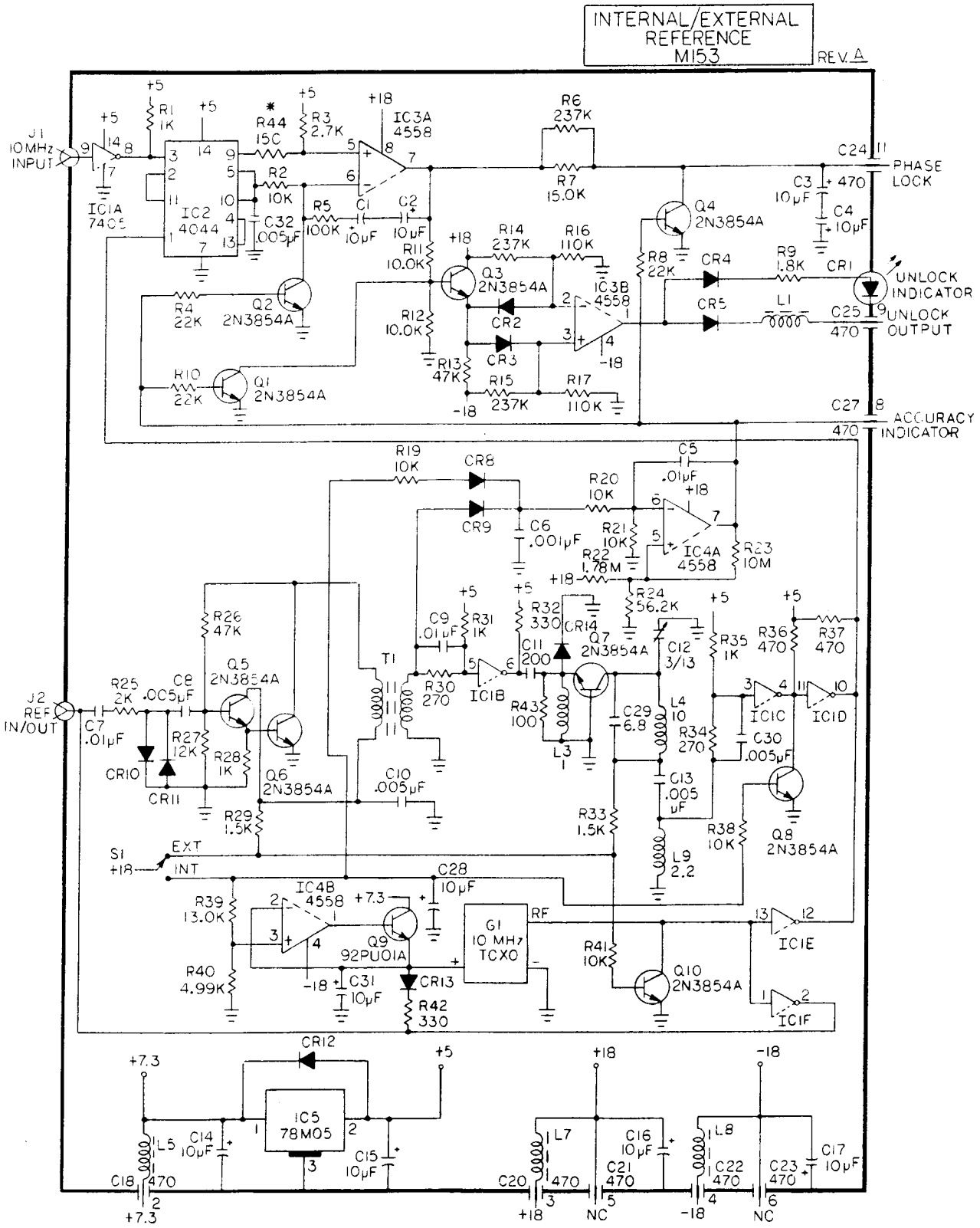
WAVETEK PARTS LIST	TITLE INT/EXT REF,M153	ASSEMBLY NO. 1114-00-0314 PAGE: 3	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R23	RES, C, 1/4W, 5%, 10M RC103-610	CB1065	A-B	4700-15-1005	1
R24	RES, MF, 1/8W, 1%, 56.2K RF213-562	MF55K-56.2K	ASE	4701-03-5622	1
R25	RES, C, 1/4W, 5%, 2K RC103-220	CF1/4-2K	ASE	4700-15-2001	1
R27	RES, C, 1/4W, 5%, 12K RC103-312	CF1/4-12K	ASE	4700-15-1202	1
R28	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	1
R29 R33	RES, C, 1/4W, 5%, 1.5K RC103-215	CF1/4-1.5K	ASE	4700-15-1501	2
R30 R34	RES, C, 1/4W, 5%, 270 RC103-127	CF1/4-270	ASE	4700-15-2700	2
R32 R42	RES, 1/8W, 5, 330-OHM	CF1/8-330	ASE	4700-05-3300	2
R36 R37	RES, C, 1/8W 5% 470	CF1/8-470	ASE	4700-05-4700	2
R39	RES, MF, 1/8W, 1%, 13.0K RF213-130	MF55K-13.0K	ASE	4701-03-1302	1
R40	RES, MF, 1/8W, 1%, 4.99K RF212-499	MF55K-4.99K	ASE	4701-03-4991	1
R43	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	1

WAVETEK PARTS LIST	TITLE INT/EXT REF,M153	ASSEMBLY NO. 1114-00-0314 PAGE: 4	REV C

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
R44*	RES, C, 1/4W, 5%, 150 RC103-115	CF1/4-150	ASE	4700-15-1500	1
S01	SWITCH, TOGGLE ST000-003	MTA106D	ALC	5106-00-0002	1
T01	RF XFMR FROM: 1813-00-0007	1210-40-0018	W-I	1210-40-0018	1

WAVETEK PARTS LIST	TITLE INT/EXT REF,M153	ASSEMBLY NO. 1114-00-0314 PAGE: 5	REV C


INTERNAL/EXTERNAL REFERENCE M153
REV. A
J1 10MHz INPUT
IC1A 7405
IC2 4044
IC3A 4558
IC3B 4558
IC4A 4558
IC4B 4558
R1 1K
R2 10K
R3 2.7K
R4 22K
R5 100K
R6 237K
R7 15.0K
R8 22K
R9 1.8K
R10 22K
R11 10.0K
R12 10.0K
R13 47K
R14 237K
R15 237K
R16 110K
R17 110K
R19 10K
R20 10K
R21 10K
R22 1.78M
R23 10M
R24 56.2K
R25 2K
R26 47K
R27 12K
R28 1K
R29 1.5K
R30 270
R31 1K
R32 330
R33 1.5K
R34 270
R35 1K
R36 470
R37 470
R38 10K
R39 13.0K
R40 4.99K
R41 10K
R42 330
R44 15C
C1 10µF
C2 10µF
C3 10µF
C4 10µF
C5 .01µF
C6 .001µF
C7 .01µF
C8 .005µF
C9 .01µF
C10 .005µF
C11 200
C12 3/13
C13 .005 µF
C24
C25 470
C27 470
C28 10µF
C29 6.8
C30 .005µF
C31 10µF
C32 .005µF
L1
L3 1
L4 10
L9 2.2
T1
Q1 2N3854A
Q2 2N3854A
Q3 2N3854A
Q4 2N3854A
Q5 2N3854A
Q6 2N3854A
Q7 2N3854A
Q8 2N3854A
Q9 92PU01A
Q10 2N3854A
CR1
CR2
CR3
CR4
CR5
CR8
CR9
CR10
CR11
CR12
CR13
CR14
G1 10 MHz TCXO
IC5 78M05
IC1B
IC1C
IC1D
IC1E
IC1F
S1
EXT
INT
RF
PHASE LOCK
UNLOCK INDICATOR
UNLOCK OUTPUT
ACCURACY INDICATOR
J2 REF IN/OUT
+5
+18
-18
+7.3
NC

OPTION 6

HIGH-STABILITY REFERENCE

INTRODUCTION

Option 6 provides a high-stability rear-panel output which can be used to drive the rear-panel input of Option 5. This high-stability TTL output can also be used to drive other devices which require a high-stability reference input. Maximum fan-out is four.

SPECIFICATIONS

Output Frequency	5 MHz
Output Level	TTL
Temp Stability (1 hr. warm-up over 10° to 40° C range.	0.05 ppm
Aging	0.005 ppm/day 0.05 ppm/mo. 0.3 ppm/yr.
Typical Overall Accuracy (within 3 months of calibration)	0.2 ppm

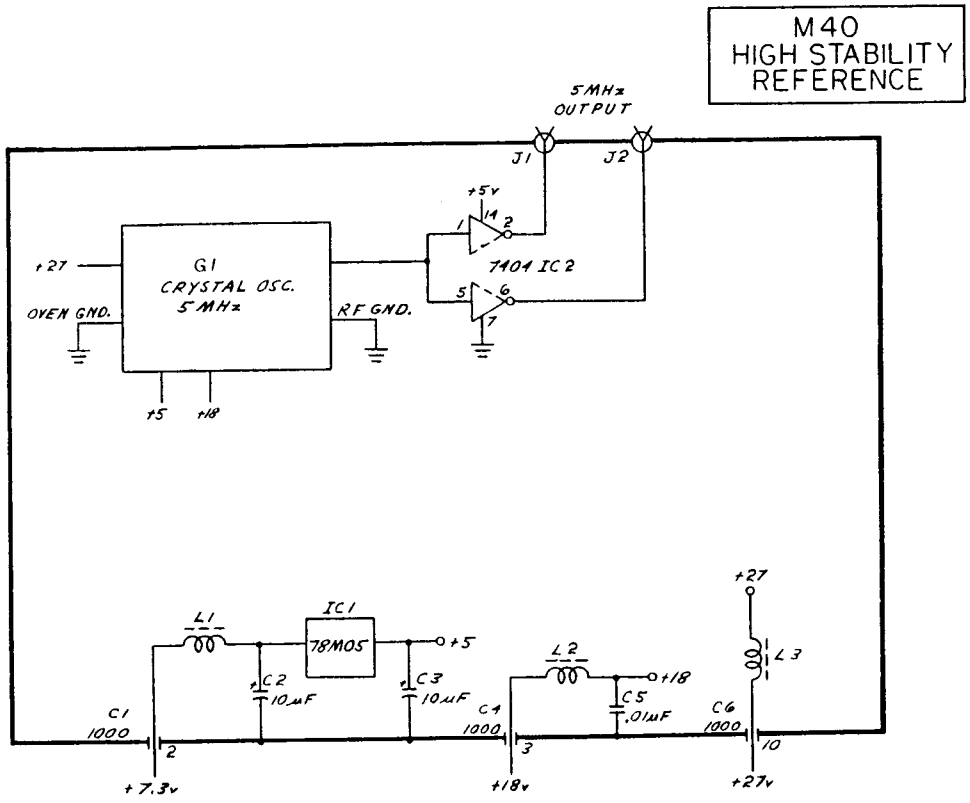
OPERATION

Option 5 (External Reference) is necessary for driving a Wavetek 3000 Series instrument with this High Stability Reference. The instrument Wiring Diagram (Schematic 1) and the instrument Top View (Figure 5-6 shows the incorporation of this option into the unit. The necessary circuitry is housed in the M40 module.

An RF cable takes the High Stability Reference output (5 MHz) to a rear-panel BNC connector. Another cable connects this output to the External Reference input of Option 5, thus referencing the instrument's Crystal Reference to the High Stability Reference.

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C1 C4 C6	CAP, CER, F.T. 1000PF CF112-210	54-794-010-102P	SPEC	1510-30-8102	3
C2 C3	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	2
C5	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	1
IC1	IC, IC000-011	78M05U1C	FCD	7000-78-0500	1
IC2	IC, IC000-012	SN7404N	T-I	8000-74-0400	1
J1 J2	CONN JF000-005	37JR116-1	S-C	2110-03-0002	2
L01 L02	TOROID, 10 TURN	LA009-010-2	HYT	1810-05-0005	2
L03	TOROID	LA009-010-1	HYT	1810-05-0004	1
G1	OSC, XTAL, 5MHZ	JKTO-88-5	CKI	2310-00-0001	1

WAVETEK PARTS LIST	TITLE	ASSEMBLY NO.	REV
	HI STAB REF, M40	1114-00-0056	E
		PAGE: 1	



MANUAL CHANGES - MODEL 3010

PTR	Line 17; Minimum Specification should be -1.5 dB, Maximum Specification should be +1.5 dB.
M10W-9	L10 is now 47 uH, W-I PN 1810-03-0470. R16 is now 120 ohm, *value.
M164	R102 is changed to BOU 3386R-1-105, W-I PN 4610-01-9105. R104 is changed to BOU 3386R-1-203, W-I PN 4610-01-9203.
Sec. 3.7.2	The reference to "M22" should be to "M172".
M30-5	The parts list for the PC subassembly (1218-00-0192) was omitted. It is given below.

REFERENCE DESIGNATORS	PART DESCRIPTION	ORIG-MFGR-PART-NO	MFGR	WAVETEK NO.	QTY
C101 C103 C104 C105 C106 C107	CAP, TANT, 10MF, 25V CE120-010	162D106X0025DD2	SPR	1510-21-7100	6
C102	CAP, CER, .01MF, 100V CD103-310	68U103M	MDC	1510-10-2103	1
IC101	IC, IC000-015	74S74N	T-I	8000-82-7401	1
IC102	DECADE COUNTER	SN74196N	T-I	8007-41-9600	1
IC103 IC104 IC105	DECADE CTR PRESET LS	SN74LS196N	T-I	8007-41-9610	3
L101 L102 L104 L105 L106 L107	TOROID	LA009-010-1	HYT	1810-05-0004	6
L103	TOROID, 10 TURN	LA009-010-2	HYT	1810-05-0005	1
Q101	TRANS GA039-040	2N3904	NAT	4901-03-9040	1
R101	RES, C, 1/4W, 5%, 390 RC103-139	CF1/4-390	ASE	4700-15-3900	1
R102	RES, C, 1/4W, 5%, 100 RC103-110	CF1/4-100	ASE	4700-15-1000	1
R103	RES, C, 1/4W, 5%, 1.8K RC103-218	CF1/4-1.8K	ASE	4700-15-1801	1
R104	RES, C, 1/4W, 5%, 2K RC103-220	CF1/4-2K	ASE	4700-15-2001	1
R105 R106	RES, C, 1/4W, 5%, 1K RC103-210	CF1/4-1K	ASE	4700-15-1001	2

WAVETEK PARTS LIST	TITLE PC ASSY	ASSEMBLY NO. 1218-00-0192	REV A
		PAGE: 1	