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## SECTION 1 — INTRODUCTION

### 1-1 GENERAL

The FM/AM-1500 is a microprocessor controlled, digitally synthesized communication service monitor, which integrates the functions of several different test instruments into a single, compact and portable unit. Utilizing such unique features as a keyboard entry system, an LCD display for frequency readout, processor controlled memory functions and a CRT capable of alphanumeric or waveform displays, the FM/AM-1500 incorporates the functions of the following test equipment:

1. Signal Generator (with a selectable offset for duplex testing)
2. Communication Receiver
3. Tracking Generator
4. Spectrum Analyzer
5. Sweep Generator
6. Oscilloscope
7. Two programmable Tone Generators
8. Power Meter
9. Frequency Error Meter
10. Modulation Meter
11. SINAD Meter
12. Audio Frequency Counter
13. Signal Strength Meter

These capabilities enable the FM/AM-1500 to be used for a wide range of communication test functions associated with most types of simplex and duplex transceiving equipment, including mobile telephone systems, AM/FM/SSB transceivers, CB and two-way radio systems, repeaters, etc.

### 1-2 SIGNAL GENERATOR/RECEIVER

The FM/AM-1500 Signal Generator is capable of generating modulated or unmodulated carrier signals within a range of 100 kHz to 999.9999 MHz (in 100 Hz steps), at an output level which is continuously variable from 0 to -128 dBm. The generated carrier signal may be AM or FM modulated by internal modulation signals originating from one or both of the FM/AM-1500 tone generators or by external sources applied through front panel modulation input connectors. The generator may also be voice-modulated and keyed through the front panel microphone input connector. All of the above described modulation sources, or any combination thereof, may be simultaneously applied to the carrier signal. During generator operation, signals being generated can be monitored by the FM/AM-1500 receiver and its associated monitoring devices.

The signal generator also features a selectable offset frequency function to permit testing of duplex equipment, which receives and transmits simultaneously on different frequencies. See paragraph 1-3 for additional information on this feature.

The FM/AM-1500 receiver is a quadruple conversion superheterodyne receiver, capable of monitoring communication signals within a range 300 kHz to 999.9999 MHz, in 100 Hz steps. Signals may be received "off-the-air" using an external antenna or by direct cable connection through the front panel TRANS/40 dB

DUPLEX Connector. Associated receiver monitoring circuits include a frequency error meter, modulation meter, power meter, SINAD meter, signal strength meter, frequency error and demodulated audio counters, spectrum analyzer and oscilloscope.

### 1-3 SIMPLEX/DUPLEX CAPABILITIES

A prime feature of the FM/AM-1500 is the capability of testing both simplex and duplex communication equipment. Simplex operation applies to any equipment that communicates in only one direction at a time, including ordinary transmit-receive or press-to-talk operation, voice operated carrier and other forms of manual or automatic switching from transmit to receive. Duplex operation is characteristic of any equipment which transmits and receives simultaneously between two locations, such as mobile telephone systems and repeaters.

In simplex mode, the FM/AM-1500 will function either as a communication receiver or a signal generator, depending on which function is selected. In simplex receive, the FM/AM-1500 receiver monitors incoming signals received "off-the-air" or applied via direct cable connection through the front panel TRANS/40 dB DUPLEX Connector. In this mode, the FM/AM-1500 signal generator is inactive. In simplex generate mode, the FM/AM-1500 is capable of generating modulated or unmodulated carrier signals, while the receiver circuits are simultaneously monitoring the generated output.

In the duplex mode, the FM/AM-1500 has the capability of generating and receiving signals simultaneously. While the receiver section of the FM/AM-1500 is monitoring incoming signals transmitted by the UUT, the FM/AM-1500 signal generator is simultaneously generating signals to stimulate the receiver section of the UUT. The frequency of the generated signal from the FM/AM-1500 can be offset up to  $\pm 50$  MHz from the transmitting frequency of the UUT, in 10 kHz steps. Three methods of duplex testing are available to the FM/AM-1500 user, depending on the UUT and its associated systems:

1. Duplex Testing Using Separate Transmit/Receive Lines
2. Duplex Testing Using 1 Common Receive/Transmit Line
3. "Off-the-air" Duplex Testing

The methods of duplex testing are described in detail in paragraph 4-9 of SECTION 4.

### 1-4 DATA DISPLAY & CONTROL FEATURES

Operator interaction with the FM/AM-1500 is facilitated through the following primary data display and control features:

1. **Keyboard**

The Keyboard provides a means of entering data into the FM/AM-1500 microprocessor, to control the operation of the signal generator, receiver and tone generator functions. The Keyboard is also used to address the FM/AM-1500 programmable menu functions which utilize the automatic storage, retrieval and execution capabilities of the set.

## 2. LCD Display

The LCD is used to display the current or "real time" operating frequencies associated with the FM/AM-1500 tone generators, signal generator and receiver functions.

## 3. CRT Monitor

The FM/AM-1500 CRT Monitor serves as a multimode CRT, capable of both alphanumeric or waveform displays, as selected by the front panel DISPLAY Switch. The CRT display modes associated with the waveform display capability include the oscilloscope, spectrum analyzer, tracking generator and sweep generator functions; alphanumeric displays include the RF and tone frequency menus, digital meter menu and operator assistance menu.

## 1-5 MENU FUNCTIONS

The FM/AM-1500 has an internal non-volatile memory capability which uses a menu display format to extend the monitoring and automatic testing capabilities of the set. All menus are accessed using the front panel Keyboard and are displayed on the CRT monitor. Available displays include several user-programmable RF and tone frequency menus, as well as several non-programmable utility menus, which are defined as follows:

### RF Frequency Menu

Consisting of the RF MEMORY, RF SCAN and RF SWEEP menus, these menus enable the operating parameters of the RF signal generator and receiver functions to be programmed for use in automatic storage, scanning and sweeping operations. Also included within this group of menus is a CABLE FAULT Menu, used for computing cable fault distances. This menu is normally used in conjunction with the FM/AM-1500 Tracking Generator function.

### Tone Frequency Menu

Associated with the FM/AM-1500 tone generator functions, these menus allow the generators to be programmed for automatic tone sequences, tone sweeping functions, DTMF (Dual Tone Multiple Frequency) testing and DCS (Digitally-Coded Squeich) Testing.

### METER Menu

This menu provides an alphanumeric display of the monitored signal parameters measured by the FM/AM-1500 front panel analog meters. Parameters displayed on this menu include modulation, power, signal strength, frequency error, demodulated audio frequency and SINAD.

### HELP Menu

These menus provide a display of FM/AM-1500 menu operating aids and programming codes for hardware self-test routines.

Detailed instructions for operating the FM/AM-1500 menu functions are contained in Section 5 of this manual.

**1-6 GENERATOR/RECEIVER SUPPORT FUNCTIONS**

The FM/AM-1500 has the following additional operating functions which are primarily used to support the generate/receive capabilities of the set:

- Spectrum Analyzer
- Oscilloscope
- Tracking Generator

- Sweep Generator
- Programmable Tone Generators
- Front Panel Analog Meters

The use and application of these functions are described in detail in Sections 3 and 4 of this manual.

## SECTION 2 — INSTALLATION

### 2-1 GENERAL

Preparing the FM/AM-1500 for operation is a simple procedure which consists of the following basic steps (reference Figures 2-1 and 2-2):

1. Set the FM/AM-1500 into a vertical or horizontal operating position, with cover removed.
2. Connect external antenna to FM/AM-1500 ANTENNA Connector, if "off-the-air" monitoring is desired.
3. Furnish electrical power to FM/AM-1500 as follows:

#### External AC Power

- a) Connect furnished AC power cable between 115/230 VAC power source and AC POWER Input Connector on rear panel of FM/AM-1500.
- b) Place PWR/OFF/BATT Switch to "PWR" position.

#### External DC Power

- a) Connect furnished DC Power Cable between external 11 to 18 VDC power source and DC Power Input Connector on rear panel of FM/AM-1500.
- b) Place PWR/OFF/BATT Switch to "PWR" position.

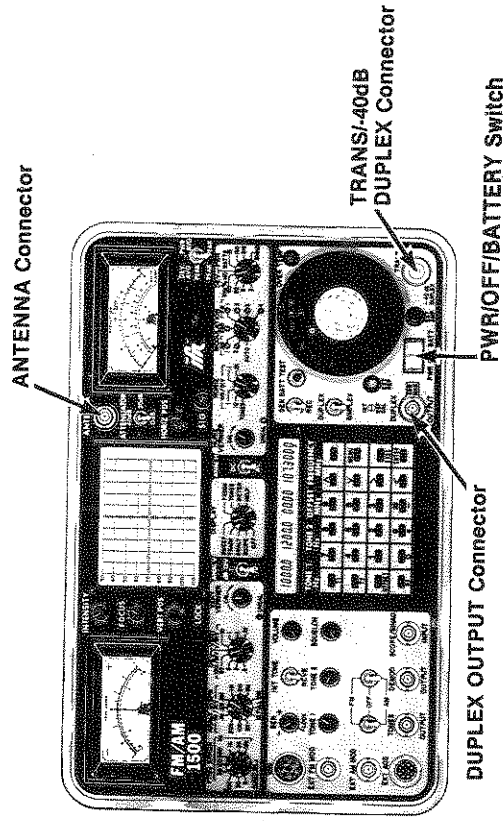
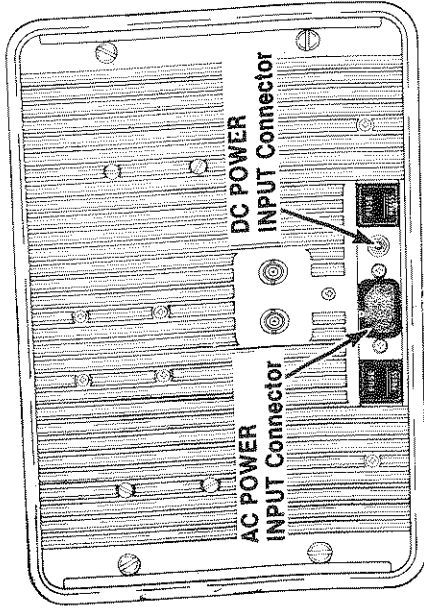


Figure 2-1 FM/AM-1500 Front Panel

### Internal Battery Power

- a) Place PWR/OFF/BATT Switch to "BATT" position, if optional battery is installed. (This is a push on/off switch.) When operating the test set on battery, an internal timer will interrupt power after approximately 10 minutes. Depress PWR/OFF/BATT Switch (13) to "BATT" position to restore power to test set.



**Figure 2-2 FM/AM-1500 Rear Panel**

### NOTE:

The oven oscillator is powered by the internal battery when the test set is switched to battery operation. However, there is no provision for preheating the oven oscillator. A 15 minute warm-up period is required, with the test set at room temperature, in order to stabilize the oven oscillator. The test set will turn on and operate immediately on battery operation, but the oven oscillator frequency will not be within specifications without the required 15 minute warm-up period. It is recommended the test set be connected to an AC or DC power source for the required 15 minute warm-up period.



## 2-2 INSTALLATION & OPERATION PRECAUTIONS

To prevent possible damage to the FM/AM-1500, the following power input and general operating precautions should be observed at all times (see Figure 2-1 for connector locations):

### CAUTION:

#### ANTENNA CONNECTOR

DO NOT TRANSMIT INTO THIS CONNECTOR. MAXIMUM CONTINUOUS INPUT TO ANTENNA CONNECTOR MUST NOT EXCEED 0.25 WATTS, OR DAMAGE TO FM/AM-1500 MAY RESULT.

#### TRANS/-40 dB DUPLEX CONNECTOR

MAXIMUM CONTINUOUS INPUT TO TRANS/-40 dB DUPLEX CONNECTOR MUST NOT EXCEED 150 WATTS. IF OVERTEMP INDICATOR LAMP ILLUMINATES AT ANY TIME, WHEN POWER IS APPLIED TO THIS CONNECTOR, REMOVE POWER IMMEDIATELY. DO NOT REAPPLY POWER UNTIL OVERTEMP INDICATOR LAMP EXTINGUISHES.

#### DUPLEX OUTPUT CONNECTOR

DO NOT TRANSMIT INTO THIS CONNECTOR. THIS CONNECTOR IS NOT PROTECTED FOR POWER INPUTS IN EXCESS OF 2.5 WATTS.

#### CRT INTENSITY

DO NOT OPERATE CRT DISPLAY WITH EXCESSIVE INTENSITY.

#### SCOPE/SINAD INPUT CONNECTOR

DO NOT APPLY MORE THAN 200 VOLTS PEAK-TO-PEAK TO THIS CONNECTOR.

#### POWER ON/OFF SWITCH

TO PROVIDE MAXIMUM PROTECTION OF NON-VOLATILE MEMORY CONTENTS, OBSERVE THE FOLLOWING STEPS:

- 1) Do not rapidly cycle power ON and OFF. Allow a minimum of one second between power ON/OFF cycle.
- 2) Ensure power is not shut off during data entry before ENTER Key is pressed, as the data being entered will be lost.

Do not apply any signals into the FM/AM-1500 other than those defined in the operating instructions. Other than the input power and operating restrictions described above, any combination of front panel control positions will not adversely affect the FM/AM-1500.

# SECTION 3 — DESCRIPTION OF CONTROLS, CONNECTORS & INDICATORS

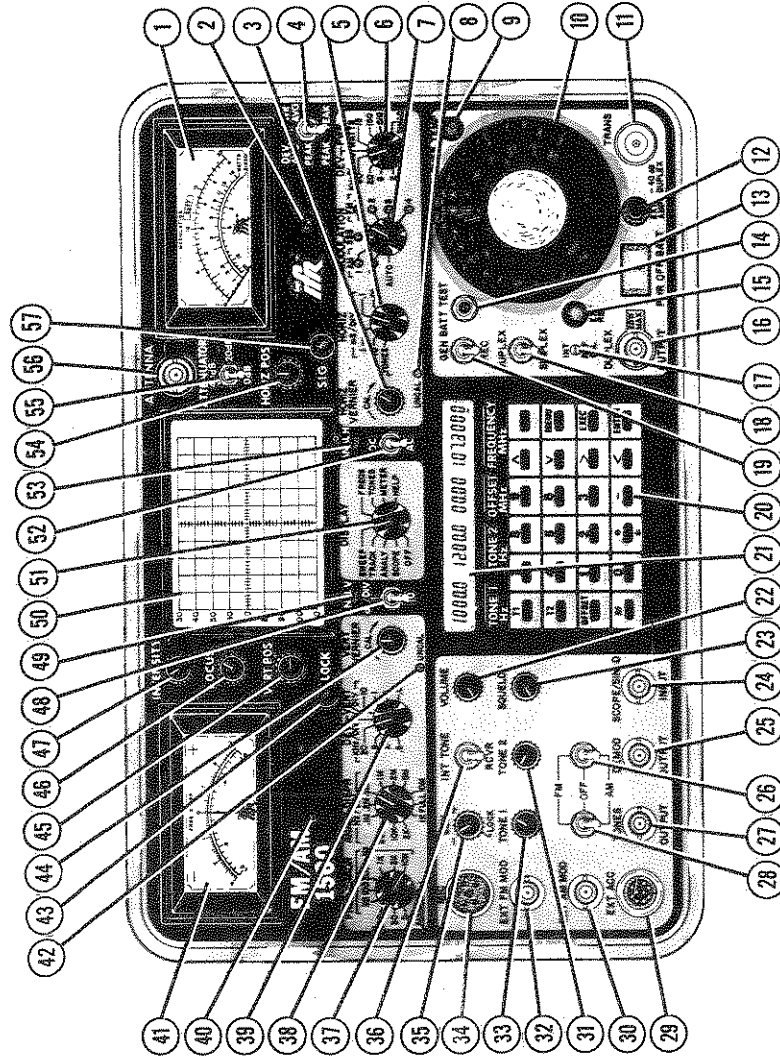


Figure 3-1 FM/AM-1500 Front Panel

1. MODULATION Meter
2. MODULATION Meter Mechanical Zero Adjustment
3. HORIZ VERNIER Control
4. AVG PEAK/PEAK Switch
5. HORIZ Control
6. DEV/PWR Control
7. MODULATION Control
8. UNCAL Indicator Lamp (Horizontal)
9. OVERTEMP Indicator Lamp
10. RF Output Level Control
11. TRANS/40 dB DUPLEX Connector
12. Optional Generate Amplifier Connector
13. PWR/OFF/BATT Switch
14. BATT TEST Button
15. EXT Reference Indicator Lamp
16. DUPLEX OUTPUT Connector
17. INT REF CAL Adjustment
18. DUPLEX/SIMPLEX Switch
19. GEN/REC Switch
20. KEYBOARD
21. LCD
22. VOLUME Control
23. SQUELCH Control
24. SCOPE/SINAD INPUT Connector
25. DEMOD/OUTPUT Connector
26. Tone 2 FM/OFF/AM Switch
27. TONES OUTPUT Connector
28. Tone 1 FM/OFF/AM Switch

29. EXT ACC Connector
30. EXT AM MOD Connector
31. TONE 2 Control
32. EXT FM MOD Connector
33. TONE 1 Control
34. MIC Connector
35. GEN/LOCK Control
36. INT TONE/RCVR Switch
37. FREQ ERROR Control
38. ANALY DISPR Control
39. DEV/VERT Control
40. FREQ ERROR Mechanical Zero Adjustment
41. FREQ ERROR Meter
42. UNCAL INDICATOR LAMP (Vertical)
43. Freq LOCK Indicator Lamp
44. VERT VERNIER Control
45. VERT POS Control
46. FOCUS Control
47. INTENSITY Control
48. dB/DIV Switch
49. Vertical Centering Adjustment (Analyzer)
50. CRT
51. DISPLAY Control
52. DC/AC Switch
53. Horizontal Centering Adjustment (Analyzer)
54. HORIZ POS Control
55. ATTENUATOR Switch (Antenna)
56. ANTENNA Connector
57. SIG Indicator Lamp

### 3-1 FRONT PANEL (Reference Figure 3-1, FM/AM-1500 Front Panel)

#### 1. MODULATION Meter

Provides visual display of modulation levels, power levels, relative signal strength, SINAD and Battery Voltage as determined by setting of DEV/PWR Control (6), MODULATION Control (7) and BATT TEST Button (14).

2. **MODULATION Meter Mechanical Zero Adjustment**  
Adjustment screw used for mechanical zeroing of MODULATION Meter (1) when power to FM/AM-1500 is "OFF".
3. **HORIZ VERNIER Control**  
Provides fine adjustment of oscilloscope horizontal sweep rate. When positioned fully clockwise, sweep is calibrated according to setting of HORIZ Control (5).
4. **AVG PEAK/PEAK Switch**  
Controls power, % Modulation and deviation meter indication on MODULATION Meter (1) as follows:

| MEASUREMENT  | POSITION | INDICATION  |
|--------------|----------|---|
| FM Deviation | Peak     | Meter indicates peak FM deviation.<br><b>NOTE:</b><br>Indication is the highest of the + or - peak deviation, whichever is greater. |
|              | Avg Peak | Meter indicates average FM deviation calibrated to peak deviation for SINE WAVE modulation.   |
|              | Peak     | Meter indicates peak RMS RF envelope power.   |
| RF Power     | Avg      | Meter indicates average RMS RF envelope power.  |

**Table 3-1 AVG PEAK/PEAK Switch Modulation Meter Indications**

Table 3-1 (Cont'd)

| MEASUREMENT     | POSITION | INDICATION  |
|-----------------|----------|---|
| AM % Modulation | Peak     | Indicates peak AM % modulation.<br><b>NOTE:</b><br>Indication is the highest of the + or - peak modulation, whichever is greater. |
|                 | Avg Peak | Meter indicates average AM % modulation calibrated for peak SINE WAVE modulation.   |

Table 3-1 AVG PEAK/PEAK Switch Modulation Meter Indications

5. **HORIZ Control**

Selects horizontal sweep rate of the oscilloscope as follows:

- TONES POSITION — Horizontal sweep is driven by sinusoidal output of Tone Generator #1.
- NUMBERED POSITIONS — Represent oscilloscope sweep rate in milliseconds per division, when HORIZ VERNIER Control (3) is in CAL position (fully clockwise) and UNCAL INDICATOR LAMP (8) is extinguished.

6. **DEVIPWR Control**  
 Selects range and input source for MODULATION METER (1) as follows:

| DEVIPWR CONTROL POSITION      | INPUT SOURCE                  | MODULATION METER RANGE                                       | MODULATION METER SCALE                             |
|-------------------------------|-------------------------------|--|--|
| KHz/% x 10<br>(All positions) | FM/AM-1500 Demodulator        | 2 kHz DEV/20% AM full scale to 60 kHz DEV/600% AM full scale | First (top) and second                             |
| WATTS<br>(15 and 150)         | TRANS/-40 dB DUPLEX Connector | 15 Watts full scale to 150 Watts full scale                  | Third  |
| SIG                           | ANTENNA Connector             | Relative Signal Strength. (Not calibrated)                   | None; observe relative deflection of meter needle. |
| SINAD                         | SCOPE/SINAD INPUT Connector   | 0 dB to 20 dB  | Fourth (bottom)                                    |

Table 3-2 DEVIPWR Control Setting

**7. MODULATION Control**

Selects demodulation mode of FM/AM-1500 receiver for FM, AM, SSB and their associated pre- and post-detection bandwidths, as follows:

| MODULATION CONTROL POSITION  | DEMODULATION MODE   | PRE-DETECTION BANDWIDTH                 | POST-DETECTION BANDWIDTH           |
|--|---|---|------------------------------------|
| AM <sub>1</sub><br>AM <sub>2</sub>                                       | AM<br>AM  | 6 kHz<br>15 kHz                         | 8 kHz<br>8 kHz                     |
| FM <sub>1</sub><br>FM <sub>2</sub><br>FM <sub>3</sub><br>FM <sub>4</sub> | FM<br>FM<br>FM<br>FM  | 15 kHz<br>200 kHz<br>200 kHz<br>200 kHz | 8 kHz<br>8 kHz<br>20 kHz<br>80 kHz |
| SSB  | SSB   | 6 kHz                                   | 8 kHz                              |
| AUTO   | Demodulation mode and bandwidth selection is automatically made by FM/AM-1500 processor, according to demodulation parameters programmed into the appropriate menu functions. |   |                                    |

**Table 3-3 Modulation Control Settings**

**8. UNCAL Indicator Lamp**

Illuminates when HORIZ VERNIER Control (3) is not in the fully clockwise (CAL) position.

**9. OVERTEMP Indicator Lamp**

Illuminates when internal power attenuator becomes excessively hot. Transmitter power applied to TRANS/-40 dB DUPLEX Connector (11) must be removed when OVERTEMP Indicator Lamp is "ON". RF Power may be re-applied when lamp is extinguished.

**CAUTION:**

MAXIMUM CONTINUOUS INPUT TO TRANS/-40 dB DUPLEX CONNECTOR MUST NOT EXCEED 150 WATTS.

10. **RF Output Level Control**  
Controls RF output level of the FM/AM-1500 signal generator (at DUPLEX OUTPUT Connector [16] and TRANS/-40 dB DUPLEX Connector [11]), per indicated dBm and uV SCALES as follows:

| OUTPUT CONNECTOR         | SIMPLEX MODE                                   | DUPLEX MODE                                       |
|--------------------------|--|---|
| TRANS/-40 dB DUPLEX (11) | As indicated on RF Output Level Control Scale. | 40 dB below indication of RF Output Level Control |
| DUPLEX OUTPUT (16)       | N/A  | As indicated of RF Output Level Control           |

**Table 3-4 RF Output Connector Levels**

11. **TRANS/-40 dB DUPLEX Connector**  
Functions as a generator/receiver I/O connector in both the simplex and duplex mode of operation. In simplex mode, generator output level at this connector is equal to setting of RF Output Level Control (10). In duplex mode, output level is 40 dB less than setting of RF Output Level Control (10). When external RF power is applied to this connector, internal switching enables this input as a high level spectrum analyzer input.
- CAUTION:**  
MAXIMUM CONTINUOUS INPUT TO TRANS/-40 dB DUPLEX CONNECTOR MUST NOT EXCEED 150 WATTS. IF OVERTEMP INDICATOR LAMP (9) ILLUMINATES AT ANY TIME WHILE POWER IS APPLIED TO THIS CONNECTOR, REMOVE POWER IMMEDIATELY. DO NOT REAPPLY POWER UNTIL OVERTEMP LAMP EXTINGUISHES.
- NOTE:**  
When using TRANS/-40dB DUPLEX Connector (11) in duplex mode, and there is no UUT connected to the DUPLEX OUTPUT Connector (16), terminate the DUPLEX OUTPUT Connector (16) to maintain level accuracy of the TRANS/-40dB DUPLEX Connector Output.
12. **Optional Generate Amplifier Connector**  
Furnishes +12 VDC power to optional Generate Amplifier, when connected to this connector and to TRANS/-40 dB DUPLEX Connector (11). FM/AM-1500 must be in "generate" mode for this connector to be active.



13. **PWR/OFF/BATT Switch**

Applies/interrupts power to FM/AM-1500 as follows:

- PWR POSITION — FM/AM-1500 is powered by external AC or DC power source.
- OFF POSITION — FM/AM-1500 is "OFF"
- BATT POSITION — FM/AM-1500 is powered by internal battery.

**NOTE:**

Internal FM/AM-1500 battery is continuously charged when external power is connected to set.

14. **BATT TEST Button**

When depressed, reflects internal battery voltage on top scale of MODULATION Meter (1), regardless of position of DEV/PWR Control (6).

15. **EXT Reference Indicator Lamp**

Illuminates when an external 10 MHz reference signal is applied to rear panel 10 MHz REF INPUT Connector (62) and is being accepted by the FM/AM-1500. When EXT Reference Indicator Lamp (15) is extinguished.

16. **DUPLEX OUTPUT Connector**

Output connector for a duplex receiver with a separate receive input. The FM/AM-1500 generator output level at this connector is equal to setting of RF Output Level Control (10), when in generate "DUPLEX" mode. This connector is not active in generate "SIMPLEX" mode.

**CAUTION:**

DO NOT TRANSMIT INTO THIS CONNECTOR. THIS CONNECTOR IS NOT PROTECTED FOR POWER INPUTS IN EXCESS OF 2.5 WATTS.

**NOTE:**

When using TRANS/-40dB DUPLEX Connector (11) in duplex mode, and there is no UUT connected to the DUPLEX OUTPUT Connector (16), terminate the DUPLEX OUTPUT Connector (16) to maintain level accuracy of the TRANS/-40dB DUPLEX Connector Output.

**17. INT REF CAL Adjustment**

10 MHz internal reference adjustment.

**18. DUPLEX/SIMPLEX Switch**

Controls transmit/receive capabilities of FM/AM-1500 as follows:

**SIMPLEX Position** — FM/AM-1500 functions as a receiver or signal generator, depending on position of GEN/REC Switch (19). In this mode, signals can be received through the TRANS/-40 dB DUPLEX Connector (11) or ANTENNA Connector (56) and generated out through the TRANS/-40 dB DUPLEX Connector.

**DUPLEX Position** — FM/AM-1500 functions as a receiver and signal generator simultaneously. In this mode, signals can be received and generated as follows, depending on UUT and its associated systems:

- a. Simultaneous transmission and reception through TRANS/-40 dB DUPLEX Connector (11).
- b. Reception through TRANS/-40 dB DUPLEX Connector (11) and transmission out through DUPLEX OUTPUT Connector (16).
- c. Reception through ANTENNA Connector (56) and transmission out through DUPLEX OUTPUT Connector (16).

**NOTE:**

In "GENERATE SIMPLEX" mode, the RF output level at TRANS/-40 dB DUPLEX Connector (11) is equal to setting of RF Output Level Control (10).

In "GENERATE DUPLEX" mode, the RF output level at TRANS/-40 dB DUPLEX Connector (11) is 40 dB less than setting of RF Output Level Control (10).

In "GENERATE DUPLEX" mode, the RF output level at DUPLEX OUTPUT Connector (16) is equal to setting of RF Output Control (10).

- 19. **GEN/REC Switch**  
Places the FM/AM-1500 into the generate or receive mode.
- 20. **KEYBOARD**  
Used for data entry and control of FM/AM-1500 microprocessor.
- 21. **LCD**  
Provides digital display of selected TONE 1, TONE 2, generator OFFSET and RF FREQUENCY, as entered through operator Keyboard (20).
- 22. **VOLUME Control**  
Controls volume of FM/AM-1500 speaker.
- 23. **SQUELCH Control**  
Controls receiver squelch threshold. Squelch disables audio output, freq error and modulation indicators when RF input at ANTENNA Connector (56) falls below squelch threshold.
- 24. **SCOPE/SINAD INPUT Connector**  
Input connector for oscilloscope and SINAD measurements.  

**CAUTION:**  
DO NOT APPLY MORE THAN 200 VOLTS PEAK-TO-PEAK TO THIS CONNECTOR.
- 25. **DEMOD OUTPUT CONNECTOR**  
Output connector for demodulated audio signals, as selected by MODULATION Control (7).
- 26. **Tone 2 FM/OFF/AM Switch**  
Selects modulation mode of Tone Generator #2. (For manual tone functions only. Automated tone functions directly control level in addition to source.)

27. **TONES OUTPUT Connector**  
Output connector which presents summation of Tone Generators #1 and #2. Mixing levels of output tones are controlled by TONE 1 Control (33) and TONE 2 Control (31) or by FM/AM-1500 processor, if a menu associated tone function is being executed.
28. **Tone 1 FM/OFF/AM/Switch**  
Selects modulation mode of Tone Generator #1. (For manually operated tone functions only. Automated tone functions directly control level in addition to source.)
29. **EXT ACC Connector**  
Output connector used for monitoring purposes and for supplying power to external devices.
30. **EXT AM MOD Connector**  
Input connector for applying external AM modulation signals.
31. **TONE 2 Control**  
Controls output level of Tone Generator #2. Clockwise rotation of control increases output level of tone generator, while counter-clockwise rotation decreases output level. (This control is used for manually operated tone functions only. Automated tone functions directly control output level.)
32. **EXT FM MOD Connector**  
Input connector for applying external FM modulation signals.
33. **TONE 1 Control**  
Controls output level of Tone Generator #1. Clockwise rotation of control increases output level of tone generator, while counter-clockwise rotation decreases output level. (This control is used for manually operated tone functions only. Automated tone functions directly control output level.)

34. **MIC Connector**

Input connector for external microphone. Allows the microphone to AM or FM modulate the RF output, as selected by MODULATION Control (7) and also permits keying of FM/AM-1500 signal generator. When keying the microphone, the FM/AM-1500 will automatically switch to the generate mode, regardless of the position of the GEN/REC Switch (19).

35. **GEN/LOCK Control**

Controls FM/AM-1500 generator frequency and phase lock. When control is fully ccw in detent position, generator will be phase locked to FM/AM-1500 internal 10 MHz reference. When control is out of detent, generator is not phase locked and generator output frequency may deviate above and below selected phase lock frequency.

36. **INT TONE/RCVR Switch**

Selects audio source for FM/AM-1500 speaker as follows:

- INT TONE Position — Speaker audio is supplied by Tone Generators #1 and #2.
- RCR Position — Speaker audio is supplied by FM/AM-1500 demodulator.

37. **FREQ ERROR Control**

Selects full scale sensitivity of FREQ ERROR Meter (41) between RF and audio frequency ranges. The audio frequency error is referenced to Tone Generator #1 frequency.

38. **ANALY DISPR Control**

Selects spectrum analyzer dispersion, tracking generator and sweep generator sweep range as follows:

**NOTE:**

Center frequency is phase locked in all positions except "FULL" scan position.

| POSITION | DISPERSION                        | BANDWIDTH |
|----------|-----------------------------------|-----------|
| 1 k      | 1 kHz/Div.                        | 300 Hz    |
| 2 k      | 2 kHz/Div.                        | 300 Hz    |
| 10 k     | 10 kHz/Div.                       | 3 kHz     |
| 20 k     | 20 kHz/Div.                       | 3 kHz     |
| .1 MHz   | .1 MHz/Div.                       | 30 kHz    |
| .2 MHz   | .2 MHz/Div.                       | 30 kHz    |
| .5 MHz   | .5 MHz/Div.                       | 30 kHz    |
| 1 MHz    | 1 MHz/Div.                        | 30 kHz    |
| 2 MHz    | 2 MHz/Div.                        | 650 kHz   |
| 5 MHz    | 5 MHz/Div.                        | 650 kHz   |
| 10 MHz   | 10 MHz/Div.                       | 650 kHz   |
| FULL     | (0 to 1000 MHz)<br>(100 MHz/Div.) | 650 kHz   |

Table 3-5 Dispersion Control Settings

39. **DEV/VERT Control**  
Controls vertical input and vertical sensitivity of oscilloscope. In "kHz/DIV" positions, vertical input is applied from FM demodulator. In "V/DIV" positions, vertical input is applied through SCOPE/SINAD INPUT Connector (24). When DEV/VERT Control is in any "kHz/DIV" position and AM demodulation mode is selected by MODULATION Control (7), oscilloscope will display the AM IF envelope.
40. **FREQ ERROR Mechanical Zero Adjustment**  
Mechanical zero adjustment for FREQ ERROR Meter (41), when power to FM/AM-1500 is "OFF".
41. **FREQ ERROR Meter**  
Provides visual display of difference between received signal frequency and FM/AM-1500 receiver frequency, as displayed in RF data field of LCD (21). The audio frequency error is referenced to Tone Generator #1 frequency.
42. **UNCAL INDICATOR LAMP**  
Illuminates when VERT VERNIER Control (43) is not in the fully clockwise (CAL) position.

43. **Freq LOCK Indicator Lamp**

Indicates RF synthesizer circuits are phase locked when lamp is "ON". When lamp blinks on and off, RF synthesizer circuits are out of phase lock. This lamp will also blink when GEN/LOCK Control (35) is out of the "LOCK" position.

**NOTE:**

LOCK Lamp will blink on and off when ANALY DISPR Control (38) is in "FULL" scan position. This is a normal operating condition.

44. **VERT VERNIER Control**

Provides fine adjustment of oscilloscope vertical sensitivity. When control is fully clockwise in "CAL" position, vertical sensitivity is equal to setting of DEVVERT Control (35).

45. **VERT POS Control**

Controls vertical position of CRT trace for both oscilloscope and sweep generator functions. Also adjusts reference level of spectrum analyzer over range of vertical axis, when dB/DIV Switch (48) is in "1" dB/DIV position.

46. **FOCUS Control**

Controls focus of CRT trace.

47. **INTENSITY Control**

Controls intensity of CRT trace. Clockwise rotation of control increases trace intensity, while counter-clockwise rotation of control decreases trace intensity.

**CAUTION:**

DO NOT OPERATE CRT DISPLAY WITH EXCESSIVE TRACE INTENSITY.

**48. dB/DIV Switch**

Controls scaling factor of spectrum analyzer graticule:

- 1 dB/DIV Position — Vertical calibration of CRT display is 1 dB per division.
- 10 dB/DIV Position — Vertical calibration of CRT display is 10 dB per division.

**49. Vertical Centering Adjustment**

Spectrum Analyzer adjustment for calibrating major vertical axis of graticule to a known reference level. (NOT A NORMAL OPERATING CONTROL.)

**50. CRT**

Multimode display screen for FM/AM-1500. Display mode is determined by setting of DISPLAY Control (51).

**51. DISPLAY Control**

Selects function of CRT display as follows:

| POSITION | FUNCTION   |
|----------|--|
| OFF      | Power to CRT display is OFF.   |
| SCOPE    | CRT functions as an oscilloscope.  |
| ANALY    | CRT functions as a spectrum analyzer.  |
| TRACK    | CRT functions as a spectrum analyzer. Tracking generator is active.  |
| SWEEP    | CRT functions as an oscilloscope. Sweep generator is active.   |
| FREQS    | CRT will display the following selection of RF Frequency menu displays:<br>RF Memory Menu<br>RF Scan Menu<br>RF Sweep Menu<br>Cable Fault Menu |

**Table 3-6 Display Control Settings**



51. **Table 3-6** (Cont'd)

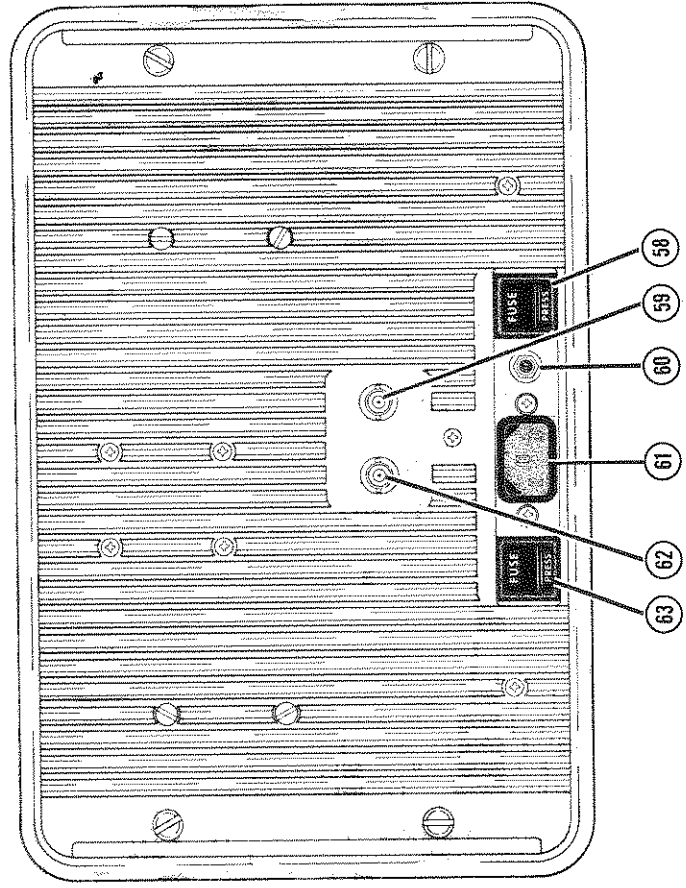
|       |  |
|-------|--|
| TONES | CRT will display the following selection of audio Frequency menu displays:<br>Tone Sequence Menu<br>DTMF Menu<br>Tone Sweep Menu<br>Digitally-Coded Squelch Menu |
| METER | CRT provides alphanumeric readout of power, deviation, % AM modulation, frequency error and demodulated audio frequency, SINAD and signal strength.              |
| HELP  | CRT provides alphanumeric FM/AM-1500 menu operating aids and programming codes for hardware self-test routines.  |

**Table 3-6 Display Control Settings**

- 52. **DC/AC Switch**  
Selects AC or DC input coupling for oscilloscope function.
- 53. **Horizontal Centering Adjustment**  
Spectrum analyzer adjustment for precise centering of analyzer center frequency over major vertical axis of graticule. (NOT A NORMAL OPERATING CONTROL.)
- 54. **HORIZ POS Control**  
Controls horizontal position of scope trace in oscilloscope function.
- 55. **ATTENUATOR Switch**  
Provides attenuation of signals applied to ANTENNA Connector (46), from 0 to 40 dB, in 20 dB steps.

- 56. **ANTENNA Connector**  
External antenna input and low level spectrum analyzer input.  
**CAUTION:**  
MAXIMUM CONTINUOUS INPUT TO ANTENNA CONNECTOR MUST NOT EXCEED 0.25 WATTS.
- 57. **SIG Indicator Lamp**  
When illuminated, indicates input level at ANTENNA CONNECTOR (56) is above squelch threshold of FM/AM-1500 receiver.

**3-2 REAR PANEL**



**Figure 3-2 Rear Panel**

58. **DC Fuse (7.5 Amp)**

59. **X Out Connector**

Provides an output signal proportional to the FM/AM-1500 sweep signal when operating in the processor controlled sweep generator mode (RF Sweep or Tone Sweep Menus). The output amplitude at this connector is 0 to 10 volts, with 0 volts representing the start frequency and 10 volts representing the stop frequency.

60. **DC Power Input Connector**

DC power input connector for 11 to 18 VDC supply.

61. **AC Power Input Connector**

AC power input connector for 106 to 266 VAC supply at 50 to 400 Hz.

62. **10 MHz REF Connector**

Input/output connector for 10 MHz reference signal.

63. **AC Line Fuse (2.5 Amp)**

## 3-3 KEYBOARD OPERATION

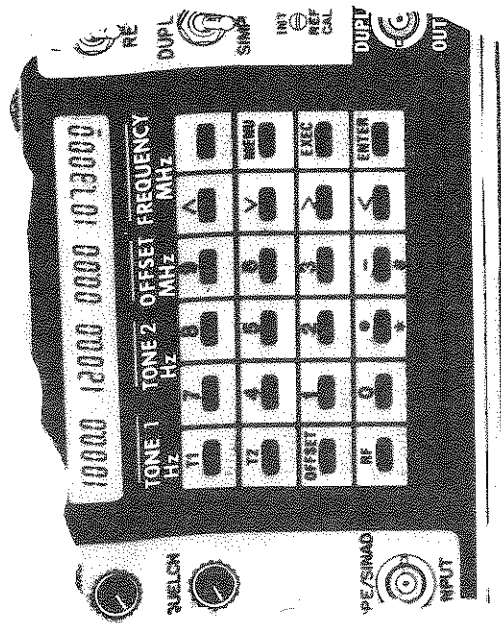


Figure 3-3 Keyboard Layout

The FM/AM-1500 keyboard provides a means of entering frequency data into the microprocessor to control the operation of signal generator, receiver and tone generator functions. Normal keyboard operation involves two basic types of key entry sequences:

1. "Manual" key entries that are immediately executed, without the use of the FM/AM-1500 memory capabilities, or
2. "Automatic" menu associated entries which utilize the storage, retrieval and automatic execution capabilities of the FM/AM-1500 processor.

The primary objective of this subsection is to familiarize the operator with the manual methods of making keyboard entries. Use of the keyboard's menu associated functions are described in detail in Section 5 of this manual.

The keyboard consists of 24 keys which are functionally grouped as shown in Figure 3-3 above and which function as described on the ensuing pages.

### 3-3-1 FUNCTION KEYS

These keys determine what FM/AM-1500 function is being addressed by the operator. These keys are dual function keys which will select either the 1st order functions (T1, T2, OFFSET and RF) or 2nd order functions (DTMF, T.SWP, SCAN, F.SWP, T.SEQ and DCS) as determined by the operator.

### 1st Order Functions

These functions are used to set the operating frequencies of:

- TONE GENERATOR #1 (T1)
- TONE GENERATOR #2 (T2)
- DUPLEX OFFSET GENERATOR (OFFSET)
- RF SIGNAL GENERATOR or RECEIVER (RF)

Any keyboard entry involving a 1st order function is displayed in the appropriate data field of the LCD and is immediately executed by the processor.

#### **NOTE:**

The RF Function Key is also used to address the RF MEMORY MENU function contained in processor memory.

### 2nd Order Functions

These functions are used to address the following programmable menu functions contained in the FM/AM-1500 processor memory:

- DUAL TONE MULTIPLE FREQUENCY Menu (DTMF)
- TONE SWEEP Menu (T.SWP)
- RF SCAN Menu (SCAN)
- RF SWEEP Menu (F.SWP)
- TONE SEQUENCE Menu (T.SEQ)
- DIGITALLY-CODED SQUELCH Menu (DCS)

To display these menus on the CRT monitor, the front panel DISPLAY Control (51) must be positioned to the "TONES" position for DTMF, T.SWP, T.SEQ and DCS functions and to the "FREQ" position for SCAN, F.SWP and RF Memory functions. SEE SECTION 5 FOR KEYBOARD OPERATING INSTRUCTIONS ON MENU FUNCTIONS.

#### **NOTE:**

The DTMF Key is also used to select the manual DTMF operating mode, where the Keyboard will function as a touch tone synthesizer (see paragraph 4-4-3 in Section 4).

### 3-3-2 INSTRUCTION KEYS

These keys instruct the FM/AM-1500 processor to perform a specific operation or function to permit the execution of a key entry sequence. Specific key functions are as follows:

2ND KEY — Conditions the processor for a 2nd function entry; this key entry must precede the 2nd function entry.

MENU KEY — Menu associated instruction key for use in selecting and alternating menu pages.

STEP/EXEC KEY — 1st function EXEC instruction permits:

1. Execution of a menu associated self-test function.
2. Automatic execution of menu associated functions stored in processor memory.

2nd function STEP instruction permits a menu associated function to be manually stepped through, one item at a time.

ENTER KEY — Instructs processor that a key-in sequence has been completed.

### 3-3-3 CURSOR CONTROL KEYS

These keys are used to control the movement and positioning of the LCD and CRT cursor as follows:

#### LCD Cursor Control

The < and > keys will laterally move the cursor within the various LCD data fields for purposes of changing data values. To change a data value, the cursor must be positioned directly under the appropriate data field prior to making the value change. The  $\wedge$  and  $\vee$  keys are used to increment ( $\wedge$ ) or decrement ( $\vee$ ) any value positioned over the cursor and any adjacent values which are affected by "carry" and "borrow" operations.

### CRT Cursor Control

All four cursor control keys are used to move the CRT cursor through the data fields of the various memory stored menu displays. The  $\wedge$  and  $\vee$  keys will move the cursor up (  $\wedge$  ) and down (  $\vee$  ), while the  $<$  and  $>$  keys will move the cursor left (  $<$  ) and right (  $>$  ).

Holding these keys in a depressed position, will allow a continuous movement of cursor or continuous increase/decrease of value.

### 3-3-4 DATA ENTRY KEYS

These keys include standard numerical value keys from 0 through 9, as well as two special symbol keys which are used to enter:

1. Decimal point and negative polarity indication (as 1st function entries).
2. # and \* telephone associated symbols (as 2nd function entries); these symbols are used in conjunction with the DTMF function only.

### 3-3-5 MANUAL DATA ENTRY PROCEDURES

The following procedures describe the methods of making manual keyboard entries to control the operating frequencies of the FM/AM-1500 signal generator, receiver and tone generator functions.

#### TONE 1 or TONE 2 ENTRIES

Example #1: Set Tone Generator #1 frequency to 2900.0 Hz.

| Step | Keys        | Action   | LCD           |
|------|-------------|--|---------------|
| 1.   | T1          | LCD cursor appears under leftmost character field of TONE 1 data field                           | <u>0000.0</u> |
| 2.   | 2,9,0,0,.,0 | 2900.0 entry appears in TONE 1 data field  | <u>2900.0</u> |
| 3.   | ENTER       | 2900.0 entry is stored by processor. Tone Generator #1 is generating an audio tone of 2900.0 Hz. | <u>2900.0</u> |

Example #2: Change Tone Generator #1 frequency from 2900.0 Hz to 2780.2 Hz.

| Step | Keys               | Action   | LCD    |
|------|--------------------|--|--------|
| 1.   | T1                 | LCD cursor appears under leftmost character field of TONE 1 data field                     | 2900.0 |
| 2.   | >                  | LCD cursor moves one character field to right  | 2900.0 |
| 3.   | v,v<br>or v (hold) | Value 9 is decremented to 7  | 2700.0 |
| 4.   | >                  | LCD cursor moves one character field to right  | 2700.0 |
| 5.   | 8                  | TONE 1 data entry is now:  | 2780.0 |
| 6.   | >                  | LCD cursor moves one character field to right  | 2780.0 |
| 7.   | 2                  | TONE 1 data entry is now:  | 2780.2 |
| 8.   | ENTER              | 2780.2 is stored by processor. Tone Generator #1 is generating an audio tone of 2780.2 Hz. | 2780.2 |

Example #3: Change Tone Generator #1 frequency from 2780.2 Hz to 352.0 Hz.

| Step | Keys | Action   | LCD     |
|------|------|--|---------|
| 1.   | T1   | LCD cursor appears under leftmost character field of TONE 1 data field | 2780.2  |
| 2.   | 3    | TONE 1 data entry changes to:  | 3780.2  |
| 3.   | 5    | TONE 1 data entry changes to:  | 3580.2  |
| 4.   | 2    | TONE 1 data entry changes to:  | 352.0.2 |



Example #3 (Cont'd)

| Step | Keys  | Action  | LCD    |
|------|-------|---|--------|
| 5.   | •     | TONE 1 data entry changes to:   | 0352.0 |
| 6.   | ENTER | 352.0 entry is stored by processor.<br>Tone Generator #1 is generating an audio tone of 352.0 Hz. | 0352.0 |

OFFSET & RF ENTRIES

The OFFSET data field is used to set the offset frequency of the RF signal generator, when using the FM/AM-1500 for testing duplex equipment. The RF data field is used for setting the generate frequency or receive frequency of the FM/AM-1500 generator and receiver functions.

The method of making keyboard entries into the OFFSET and RF data fields is the same as the procedures previously described for the TONE 1 and TONE 2 fields, with the following exceptions:

1. To enter the OFFSET field, the DUPLEX/SIMPLEX Switch (18) must be in DUPLEX position, and DISPLAY Control (51) must not be in TRACK or SWEEP position.
2. Instead of beginning a key entry sequence by pressing the T1 or T2 key, press OFFSET or RF, which ever is applicable.
3. Because the offset frequency to be entered may be above or below the RF Signal Generator frequency, an indication of positive or negative polarity is required. To enter a positive offset, enter the numerical data only in the usual manner; to enter a negative offset, the numerical entry must be preceded by a "-" sign which is obtained by the use of the #- Key. Maximum data range for the OFFSET data field is +/-49.99. If a value larger than four is entered into the leftmost data position, a zero will be inserted whenever the ENTER Key is pressed.

Example: Change OFFSET entry from 3.00 MHz to -2.00 MHz.

| Step | Keys      | Action  | LCD    |
|------|-----------|---|--------|
| 1.   | OFFSET    | OFFSET data field is selected and LCD cursor appears under leftmost character field of OFFSET data field.         | 03.00  |
| 2.   | -,2,.,0,0 | -2.00 entry appears in OFFSET data field.   | -02.00 |
| 3.   | ENTER     | -2.00 entry is stored by processor. The offset frequency being generated by the RF Signal Generator is -2.00 MHz. | -02.00 |

**3-3-6 OTHER OPERATIONS**

Other common keyboard operations and features which the operator will use during normal operation include:

**ERROR CORRECTION**

Correction of an entry error is a simple procedure which is performed as follows:

Example: Operator wishes to enter 125.0000 MHz into RF data field; instead, an entry of 126.000 MHz is erroneously made.

| Step | Keys        | Action  | LCD      |
|------|-------------|---|----------|
| 1.   | RF, 1,2,6,. | Data entry into RF data field is as shown at right. | 126.0000 |
| 2.   | >           | LCD cursor moves one character field to left        | 126.0000 |
| 3.   | 5           | RF data field entry is corrected as shown           | 125.0000 |
| 4.   | ENTER       | Corrected entry is accepted by processor            | 125.0000 |

## MANUAL FREQUENCY SLEWING

A useful feature of the FM/AM-1500 keyboard is the ability to manually slew a frequency up or down, in selectable increments (as determined by the position of the LCD cursor.) Any slewing sequence will affect the displayed values directly above and to the left of the cursor. This feature can be used for slewing frequencies in the TONE 1, TONE 2, OFFSET and RF data fields.

**Example #1:** The RF data field presently displays 050.0000 MHz. The operator wishes to slew this frequency up to 100.0000 MHz in 100 kHz increments.

| Step | Keys     | Action  | LCD               |
|------|----------|---|-------------------|
| 1.   | RF       | RF data field is addressed. LCD cursor appears under leftmost character field of RF data field. | <u>0</u> 50.0000  |
| 2.   | >>>      | LCD cursor moves three character fields to right (under 100 kHz digit).                         | 05 <u>0</u> .0000 |
| 3.   | ^ (hold) | 050.0000MHz entry slews up to 100 MHz in 100 kHz steps.   | 1 <u>0</u> 0.0000 |
| 4.   | ENTER    | 100.0000MHz entry is stored by processor.   | 100.0000          |

**NOTE:**

Displayed entry will continue to slew up as long as ^ key is held down. Procedure for slewing down is same as in above procedure, except v key is used in place of ^ key.

When slewing OFFSET data field, it is not possible to slew from a negative value to a positive value or vice versa. The most significant digit of the OFFSET data field can only be slewed up or down to 4. If slewed to a value greater than 4, a 0 is inserted whenever the Enter Key is pressed.



# SECTION 4 — OPERATION

## 4-1 GENERAL

This section contains instructions for operating the following major functions of the FM/AM-1500 Communication Service Monitor:

### GENERAL PURPOSE FUNCTIONS

| Paragraph | Title                       | Page |
|-----------|-----------------------------|------|
| 4-2       | OSCILLOSCOPE OPERATION      | 4-2  |
| 4-3       | SPECTRUM ANALYZER OPERATION | 4-4  |
| 4-4       | tone GENERATOR OPERATION    | 4-8  |

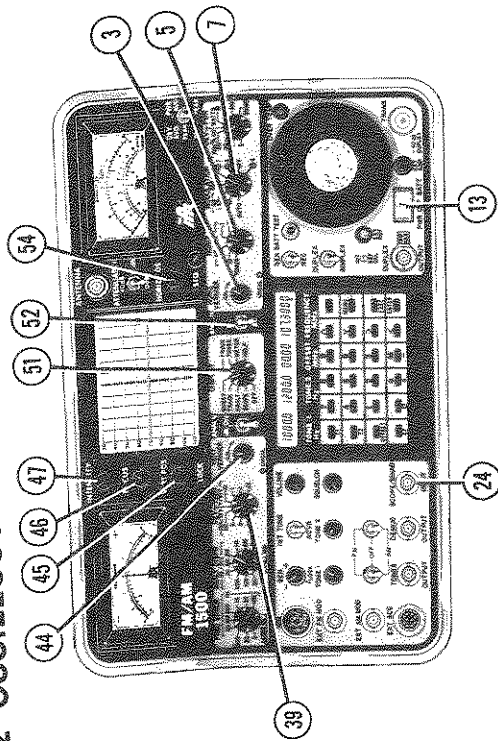
### SIMPLEX FUNCTIONS

| Paragraph | Title                         | Page |
|-----------|-------------------------------|------|
| 4-5       | RECEIVER OPERATION            | 4-15 |
| 4-6       | RF SIGNAL GENERATOR OPERATION | 4-22 |
| 4-7       | SWEEP GENERATOR OPERATION     | 4-27 |
| 4-8       | TRACKING GENERATOR OPERATION  | 4-32 |

### DUPLEX FUNCTIONS

| Paragraph | Title            | Page |
|-----------|------------------|------|
| 4-9       | DUPLEX OPERATION | 4-37 |

## 4-2 OSCILLOSCOPE OPERATION



FM/AM-1500 CONNECTORS AND INDICATORS APPLICABLE TO OSCILLOSCOPE OPERATION:  
24 SCOPE/SINAD INPUT Connector

Figure 4-1 FM/AM-1500 Front Panel Controls Applicable to Oscilloscope Operation

| CONTROL                 | SETTING         | PARAMETER                  |
|-------------------------|-----------------|----------------------------|
| 3 HORIZ VERNIER Control | As req'd        | Sweep Rate (Fine)          |
| 5 HORIZ Control         | As req'd        | Sweep Rate (Coarse)        |
| 7 MODULATION Control    | As req'd        | Modulation Monitoring Mode |
| 13 PWR/OFF/BATT Switch  | "PWR" or "BATT" | AC or DC Power             |
| 39 DEV/VERT Control     | As req'd        | Vertical Sensitivity       |
| 44 VERT VERNIER Control | As req'd        | Vertical Sensitivity       |
| 45 VERT POS Control     | As req'd        | Vertical Trace Position    |
| 46 FOCUS Control        | As req'd        | Trace Focus                |
| 47 INTENSITY Control    | As req'd        | Trace Intensity            |
| 51 DISPLAY Control      | "SCOPE"         | CRT Mode                   |
| 52 AC/DC Switch         | As req'd        | Coupling Mode              |
| 54 HORIZ POS Control    | As req'd        | Horizontal Trace Position  |

Table 4-1 FM/AM-1500 Controls Applicable to Oscilloscope Operation

## 4-2-1 GENERAL

Table 4-1 on the opposite page lists the front panel controls and connectors which are used in the oscilloscope function of the FM/AM-1500. All operating controls (with exception of the DISPLAY Control [51]) are similar to those found on most conventional oscilloscopes and are used to control such parameters as vertical sensitivity, sweep rate, external coupling, trace position, focus, etc. The DISPLAY Control (51) however, must be in the "SCOPE" position for the oscilloscope function to be active. Additional FM/AM-1500 scope functions not normally found on conventional oscilloscopes include:

### 1. Tone Generator Input

The "TONES" position of the HORIZ Control (5) applies the output of Tone Generator #1 to the horizontal deflection circuits of the CRT. This function is useful for measuring the frequencies of externally applied audio signals, using the Lissajou method of frequency comparison.

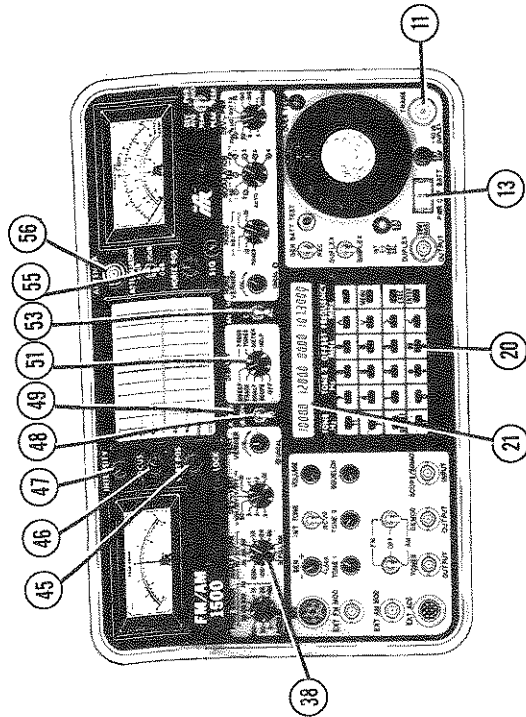
### 2. Modulation Display

The kHz/DIV positions of the DEV/VERT Control (39) enable the scope to be used for monitoring the instantaneous modulation characteristics of FM or AM modulated carriers. The type of modulation signal displayed is dependent on the position of the front panel Modulation Control (7). The oscilloscope will display the demodulated FM signal in the FM mode and the AM IF envelope in the AM mode, enabling the operator to check the signal for limiting and other forms of distortion.

## 4-2-2 APPLICATIONS

The FM/AM-1500 oscilloscope is a general purpose, (DC to 1 MHz Bandwidth) single trace oscilloscope which can be used for most troubleshooting applications. The internal horizontal triggering is AC coupled and in absence of a trigger signal, the scope will internally retrigger after a delay time of approximately 1.5 times the sweep trace time. Any external input to the scope must be applied at the front panel SCOPE/SINAD INPUT Connector (24).

### 4-3 SPECTRUM ANALYZER OPERATION



FM/AM-1500 CONNECTORS AND INDICATORS APPLICABLE TO SPECTRUM ANALYZER OPERATION:

- 11 TRANS/-40 dB DUPLEX Connector
- 21 LCD
- 56 ANTENNA Connector

Figure 4-2 FM/AM-1500 Front Panel Controls Applicable to Spectrum Analyzer Operation

| CONTROL                            | SETTING         | PARAMETER                   |
|------------------------------------|-----------------|-----------------------------|
| 13 PWR/OFF/BATT Switch             | "PWR" or "BATT" | AC or DC Power              |
| 20 KEYBOARD                        | As req'd        | RF Frequency                |
| 38 ANALY DISPR Control             | As req'd        | Analyzer Dispersion         |
| 45 VERT POS Control                | As req'd        | Spectrum Reference Level    |
| 46 FOCUS Control                   | As req'd        | Trace Focus                 |
| 47 INTENSITY Control               | As req'd        | Trace Intensity             |
| 48 dB/DIV Switch                   | As req'd        | CRT Graticule Scaling       |
| 49 Vertical Centering Adjustment   | As req'd        | Fine Reference Level Adjust |
| 51 DISPLAY Control                 | "ANALY"         | CRT Mode                    |
| 53 Horizontal Centering Adjustment | As req'd        | Fine Centering Level Adjust |
| 55 ATTENUATOR Switch               | As req'd        | Input Attenuation           |

Table 4-2 FM/AM-1500 Controls Applicable to Spectrum Analyzer Operation



## 4-3-1 GENERAL

Table 4-2 on the opposite page lists the FM/AM-1500 front panel controls applicable to the spectrum analyzer function. The FM/AM-1500 has several notable operating features associated with the spectrum analyzer controls, which may differ from those (or may not exist) on conventional spectrum analyzers:

### **VERT POS Control (45)**

With the dB/DIV Switch (48) in the 1 dB/DIV position, the VERT POS Control enables the operator to manually shift the reference level of the spectrum analyzer display over the range of the vertical axis on the graticule. This feature assures "on scale" viewing of spectrum displays for optimum resolution.

### **Horizontal & Vertical Centering Adjustments (53 & 49)**

The Horizontal Centering Adjustment allows precise centering of the spectrum analyzer center frequency over center vertical graticule. The Vertical Centering Adjustment is used to calibrate the vertical axis of the analyzer to a known reference level. Both of these controls are not normal operating controls and their use is recommended only in special applications, where precise analyzer graticule alignment is necessary.

### **ATTENUATOR Switch (55)**

Input attenuation is controlled by the Attenuator Switch in 20 dB steps from 0 dB to 40 dB. This switch alters the reference level of the applied input, so higher level signals may be monitored.

### **ANALY DISPR Control (38)**

The spectrum analyzer bandwidth is automatically selected by the setting of the ANALY DISPR Control (38) (ref. Table 3-5, Section 3). The spectrum analyzer center frequency is phase locked at all times, except in the "FULL SCAN" position.

## 4-3-2 ANALYZER OPERATION

Basic analyzer operation is as follows:

1. Apply power to FM/AM-1500.
2. Place front panel DISPLAY Control (51) to "ANALY" position.

3. If monitoring external signals, apply signal to:
  - a. ANTENNA Connector (56) for low level operation.
  - b. TRANS/40 dB DUPLEX Connector (11) for high level operation.
4. Using Keyboard, set FM/AM-1500 RF frequency to desired center frequency.
5. Adjust ANALY DISPR, ATTENUATOR, dB/DIV and VERT POS controls (38, 55, 48 and 45 respectively) for desired spectrum display.

### 4-3-3 APPLICATIONS

The FM/AM-1500 spectrum analyzer is a general purpose analyzer capable of monitoring high and low level signals within a range of 300 kHz to 999.9999 MHz. Low and high level operation are defined as follows:

#### LOW LEVEL OPERATION

Low level signals between a range of -100 dBm and + 10 dBm must be applied through the front panel ANTENNA Connector.

#### CAUTION:

MAXIMUM CONTINUOUS INPUT TO ANTENNA CONNECTOR MUST NOT EXCEED 0.25 W (+ 24 dBm)!

When monitoring low level signals, the front panel ATTENUATOR Switch (55) can be used to alter the graticule reference level as follows:

| ATTENUATOR Switch Position | Graticule Reference Level |
|----------------------------|---------------------------|
| 0 dB                       | -30 dBm                   |
| 20 dB                      | -10 dBm                   |
| 40 dB                      | + 10 dBm                  |

#### HIGH LEVEL OPERATION

High level signals between a range of + 20 dBm to + 50 dBm must be applied through the front panel TRANS/40 dB DUPLEX Connector (11). When using this input, the reference level of analyzer becomes + 50 dBm.

**CAUTION:**

IF OVERTEMP INDICATOR LAMP (9) ILLUMINATES WHILE INPUT POWER IS APPLIED TO TRANS/-40 dB DUPLEX CONNECTOR, REMOVE INPUT POWER IMMEDIATELY! DO NOT RECONNECT POWER UNTIL OVERTEMP INDICATOR LAMP EXTINGUISHES.

**NOTE:**

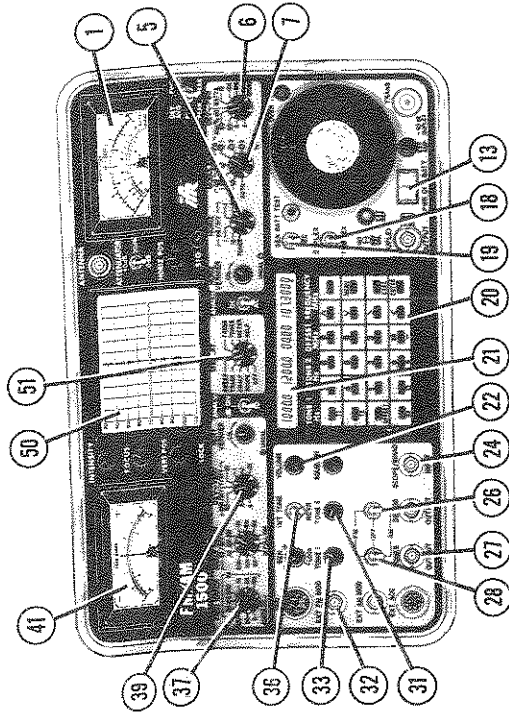
When transmitter power is applied to TRANS/-40 dB DUPLEX Connector (11), the ANTENNA Connector (56) becomes attenuated. However, to prevent possible interference from high level signals being applied to the ANTENNA Connector, the antenna should be disconnected when monitoring transmitter signals directly.

**ANALYZER MONITOR MODE**

The monitor mode of the FM/AM-1500 spectrum analyzer is affected by the front panel SIMPLEX DUPLEX and GEN/REC Switches as follows:

| DUPLEX/SIMPLEX Switch (18)  | GEN/REC Switch (19) | SPECTRUM ANALYZER MONITOR MODE   |
|-----------------------------|---------------------|--|
| SIMPLEX                     | GEN                 | Spectrum Analyzer monitors internal FM/AM-1500 Signal Generator                                      |
| SIMPLEX<br>DUPLEX<br>DUPLEX | REC<br>GEN<br>REC   | Spectrum Analyzer monitors externally applied signals (At Antenna or TRANS/-40 dB DUPLEX Connectors) |

## 4-4 TONE GENERATOR OPERATION



### FM/AM-1500 CONNECTORS AND INDICATORS APPLICABLE TO TONE GENERATOR OPERATION:

- 1 MODULATION Meter
- 21 LCD
- 24 SCOPE/SINAD INPUT Connector
- 27 TONES OUTPUT Connector
- 32 EXT FM MOD Connector
- 41 FREQ ERROR Meter
- 50 CRT

Figure 4-3 FM/AM-1500 Front Panel Controls Applicable to Tone Generator Operation

| CONTROL                    | SETTING                          | PARAMETER                |
|----------------------------|----------------------------------|--------------------------|
| 5 HORIZ Control            | HORIZONTAL SWEEP TIME or "TONES" | Lissajous or Tone Output |
| 6 DEV/PWR Control          | As req'd                         | Deviation                |
| 7 MODULATION Control       | As req'd                         | Demodulation Mode        |
| 13 PWR/OFF/BATT Switch     | "PWR" or "BATT"                  | AC or DC Power           |
| 18 DUPLEX/SIMPLEX Switch   | As req'd                         | Operating Mode           |
| 19 GEN/REC Switch          | As req'd                         | Operating Mode           |
| 20 KEYBOARD                | As req'd                         | Audio Frequency          |
| 22 VOLUME Control          | As req'd                         | Speaker Audio Level      |
| 26 TONE 2 FM/OFF/AM Switch | As req'd                         | Modulation Mode          |

Table 4-3 FM/AM-1500 Controls Applicable to Tone Generator Operation

**Table 4-3 (Cont'd)**

|    | CONTROL                 | SETTING                     | PARAMETER                          |
|----|-------------------------|-----------------------------|------------------------------------|
| 28 | TONE 1 FM/OFF/AM Switch | As req'd                    | Modulation Mode                    |
| 31 | TONE 2 Control          | As req'd                    | Modulation/Audio Level             |
| 33 | TONE 1 Control          | As req'd                    | Modulation/Audio Level             |
| 36 | INT TONE/RCVR Switch    | As req'd                    | Speaker Audio Routing              |
| 37 | FREQ ERROR Control      | As req'd                    | Frequency Error                    |
| 39 | DEV/VERT Control        | As req'd                    | Modulation or Vertical Sensitivity |
| 51 | DISPLAY Control         | "SCOPE", "TONES" or "METER" | CRT Mode                           |

**Table 4-3 FM/AM-1500 Controls Applicable to Tone Generator Operation**

**4-4-1 GENERAL**

The FM/AM-1500 has two independently controlled variable tone generators which are capable of generating modulation signals within a range of 2 Hz to 30 kHz (in 0.1 Hz increments from 2 Hz to 9999.9 Hz and 1.0 Hz increments from 10 kHz to 30 kHz). The frequencies of both generators are keyboard selectable and are displayed in the TONE 1 and TONE 2 data fields of the front panel LCD (21). The output level and modulation mode of each tone generator can be individually controlled by the associated TONE 1 and TONE 2 controls listed in Table 4-3, while the modulation levels can be simultaneously monitored on the CRT (50) or Modulation Meter (1) (see Table 4-4).

**NOTE:**

If both Tone Generators are being used, the MODULATION Meter and CRT will display the composite modulation signal produced by both tone generators. To monitor either individual modulation signal, turn off opposite tone generator.

| Monitoring Device    | Control Position   | Display  |
|----------------------|--|--|
| FM/AM-1500 CRT (50)  | DISPLAY Control (51) to "SCOPE"  | Displays AM% modulation or kHz deviation (per setting of MODULATION Control [7])   |
|                      | (Internal Scope Mode) kHz/DIV positions of DEV/VERT Control (39)<br><br>(External Scope Mode) TONES OUT signal applied to SCOPE/SINAD INPUT Connector (24) | Displays amplitude & frequency characteristics of modulation signal                |
| MODULATION METER (1) | DISPLAY Control (51) to "METER"  | Provides alphanumeric readout of AM% modulation, kHz deviation and demod frequency |
|                      | DEVPWR Control (6) to "kHz/%x10"<br>DEVPWR Control (6) to "kHz/%x10"   | Displays AM% modulation or kHz deviation (per setting of MODULATION Control [7])   |

**Table 4-4 Methods of Monitoring Modulation**

#### 4-4-2 BASIC TONE GENERATOR OPERATION

Basic operation of the FM/AM-1500 tone generators is as follows:

1. Apply power to FM/AM-1500.
2. Enter desired tone generator frequency into TONE 1 and/or TONE 2 data fields, using keyboard. (Additional operating steps will vary depending on application; see paragraph 4-4-3 for further instructions.)

#### 4-4-3 APPLICATIONS

##### A. GENERATING TONES OF KNOWN AMPLITUDE

1. Perform "BASIC TONE GENERATOR OPERATION" steps described in paragraph 4-4-2.

2. Place DISPLAY Control (51) to "SCOPE" position.
3. Using "Tee" Connector and appropriate coax cables, connect TONES OUTPUT Connector (27) to SCOPE/SINAD INPUT Connector (24) and UUT audio injection point.
4. Adjust TONE 1 and/or TONE 2 Control(s) for desired peak-to-peak (pp) amplitude, as displayed on oscilloscope.

**NOTE:**

$$\begin{aligned} \text{Amplitude in Volts (pp)} &= 2 \times (\text{Volts peak}) \\ \text{Volts (pp)} &= 2.828 \times (\text{VRMS}) \end{aligned}$$

**B. USING TONE GENERATOR(S) AS A MODULATION SOURCE**

1. Perform "BASIC TONE GENERATOR OPERATION" steps described in paragraph 4-4-2.
2. Select desired modulation mode for Tone Generator #1 and/or Tone Generator #2, using Tone 1 and/or Tone 2 FM/OFF/AM Switches (28 and 26).

**NOTE:**

If both tone generators are used, the modulation mode of one tone may be selected AM, while the other tone is simultaneously selected FM; or both may be selected the same.

When the FM/AM-1500 is operating under processor control (i.e. when using TONE SEQUENCE and/or DTMF Menu functions), Tone 1 and Tone 2 FM/OFF/AM Switches are disabled and modulation mode is automatically selected by processor. The processor selects the modulation as set on the MODULATION Control (7).

In the manual operating mode, the output levels of both generators are controlled by TONE 1 and TONE 2 Controls (33 and 31). Under processor control, TONE 1 and TONE 2 Controls are disabled and output levels programmed into menu functions are automatically selected.

3. Place GEN/REC Switch (19) to "GEN" position.

4. Place DUPLEX/SIMPLEX Switch (18) to "SIMPLEX" position.
5. Adjust TONE 1 and/or TONE 2 Control(s) (33 and/or 31) for desired modulation level, as indicated on top scales of MODULATION Meter (1) or on CRT METER Menu.

#### C. USING TONE GENERATOR(S) AS AN ACOUSTIC SOURCE

1. Perform "BASIC TONE GENERATOR OPERATION" steps described in paragraph 4-4-2.
2. Place INT TONE/RCVR Switch (36) to "INT TONE" position.
3. Adjust TONE 1 and/or TONE 2 Control(s) (33 and/or 31) and VOLUME Control (22) for a comfortable listening level.

#### NOTE:

Audio tone presently being monitored through FM/AM-1500 speaker, is also present at TONES OUTPUT Connector (27).

#### D. USING TONE GENERATOR DTMF FUNCTION AS A "TOUCH TONE" SYNTHESIZER

1. Apply power to FM/AM-1500.
2. Place DISPLAY Switch (51) to "TONES" position.
3. Using Keyboard (20), depress following keys in sequence given:
  - a. MENU Key
  - b.  $\wedge$  or  $\vee$  Key, to scroll through "TONES" menu pages to display DTMF Menu on CRT.
  - c. ENTER Key
  - d.  $\emptyset$  Key
  - e. ENTER Key (Selects the manual deviation field for entry.)
  - f. Enter desired manual deviation for both tone generators using numeric and decimal point keys (e.g. 10.0, 25.5 etc.).



- g. ENTER Key
- h. 2nd Key
- i. DTMF Key

4. The Keyboard will now function as a touch tone synthesizer (numbered and \*/# keys only).

**NOTE:**

The frequencies of the generated tones will be visible in the TONE 1 AND TONE 2 data fields, while keys are depressed.

To exit from DTMF Manual function, press ENTER Key.

**E. MEASURING AUDIO FREQUENCIES BETWEEN 2 Hz and 30 kHz**

1. Place GEN/REC Switch (19) to "GEN" position.
2. Place SIMPLEX/DUPLEX Switch (18) to "SIMPLEX" position.
3. Place DEV/PWR Control (6) to "60 kHz" position.
4. Using Table 4-5 below, set MODULATION Control (7) to appropriate setting, corresponding to modulation frequency and deviation of signal being measured. This will ensure that the pre- and post-detection bandwidth of the MODULATION Control (7) will accommodate the deviation and modulation characteristics of the signal under test.

| MODULATION FREQUENCY | DEVIATION       | FM/AM-1500 BANDWIDTH SETTING |
|----------------------|-----------------|------------------------------|
| 20 Hz to 8 kHz       | 1 kHz to 80 kHz | FM 2                         |
| 20 Hz to 30 kHz      | 1 kHz to 80 kHz | FM 4                         |
| 20 Hz to 2 kHz       | 1 kHz to 5 kHz  | FM 1                         |

**Table 4-5 FM/AM-1500 Controls Set to Signal Being Measured**

**NOTE:**

If deviation exceeds 100 kHz, audio signal under test must be attenuated to bring deviation under 100 kHz.

5. Connect audio signal under test to EXT FM MOD Connector (32).
6. Place FREQ ERROR Control (37) to 3, 30 or 300 Hz AUDIO position.
7. Using Keyboard (20), slew TONE 1 frequency as close as possible to frequency of audio signal under test, until FREQ ERROR Meter (41) is zeroed.

**NOTE:**

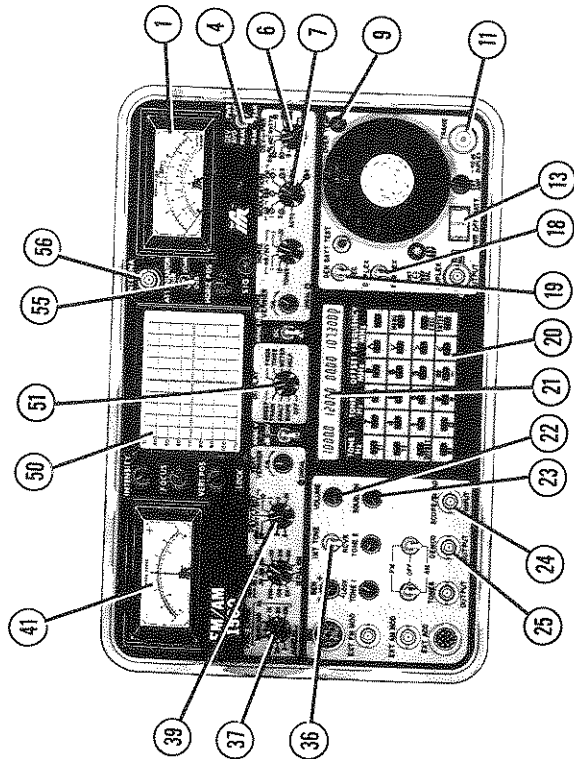
3 Hz position of FREQ ERROR Control (37) will achieve .1 Hz resolution. With DISPLAY Control (51) in "METER" position, CRT (50) will provide an alphanumeric readout of audio signal under test, to 1 Hz resolution with 1 second gate time.

8. Frequency of audio signal under test is equal to frequency displayed in TONE 1 data field plus reading of FREQ ERROR Meter (41).

**F. MEASURING FREQUENCIES ABOVE 30 kHz**

1. Apply audio signal under test to SCOPE/SINAD Input Connector (24).
2. Place DISPLAY Control (51) to "SCOPE" position.
3. Place HORIZ Control (5) to "TONES" position.
4. Slew TONE 1 frequency appropriately using Keyboard (20), to obtain a 2nd, 3rd, 4th, or 5th order Lissajou figure on oscilloscope.
5. Frequency of unknown audio signal is equal to frequency displayed in TONE 1 data field, times the order number of the displayed Lissajou figure.

## 4-5 RECEIVER OPERATION (SIMPLEX)



FM/AM-1500 CONNECTORS AND INDICATORS APPLICABLE TO RECEIVER OPERATION:

- 1 MODULATION Meter
- 9 OVERTEMP Indicator Lamp
- 11 TRANS/-40 dB DUPLEX Connector
- 21 LCD
- 24 SCOPE/SINAD INPUT Connector
- 25 DEMOD OUTPUT Connector
- 41 FREQ ERROR Meter
- 50 CRT
- 56 ANTENNA Connector

Figure 4-4 FM/AM-1500 Front Panel Controls Applicable to Receiver Operation

| CONTROL                  | SETTING            | PARAMETER                                  |
|--------------------------|--------------------|--|
| 4 AVG PEAK/PEAK Switch   | As req'd           | Peak/Average Power or Deviation Indication |
| 6 DEVPWR Control         | As req'd           | Meter Function/Range Selection             |
| 7 MODULATION Control     | As req'd           | Demodulation Mode                          |
| 13 PWR/OFF/BATT Switch   | "PWR" or "BATT"    | AC or DC Power                             |
| 18 DUPLEX/SIMPLEX Switch | "SIMPLEX" or "REC" | RF Input/Output Configuration              |
| 19 GEN/REC Switch        | As req'd           | Operating Mode                             |
| 20 KEYBOARD              | As req'd           | RF Frequency                               |
| 22 VOLUME Control        |                    | Volume                                     |

Table 4-6 FM/AM-1500 Controls Applicable to Receiver Operation

**Table 4-6 (Cont'd)**

| CONTROL                 | SETTING  | PARAMETER                                |
|-------------------------|----------|--|
| 23 SQUELCH Control      | As req'd | Squelch                                  |
| 36 INT TONE/RCVR Switch | "RCVR"   | Speaker Audio Routing                    |
| 37 FREQ ERHOR Control   | As req'd | Frequency Error Meter Scale              |
| 39 DEVERT Control       | As req'd | Vertical Sensitivity of Modulated Signal |
| 51 DISPLAY Control      | As req'd | CRT Mode                                 |
| 55 ATTENUATOR Switch    | As req'd | Input Attenuation                        |

**Table 4-6 FM/AM-1500 Controls Applicable to Receiver Operation**

**4-5-1 GENERAL**

The FM/AM-1500 contains a communications receiver capable of monitoring CW, AM, FM, and SSB signals within a range of 300 kHz and 999.9999 kHz. Signals may be monitored "off-the-air" using an external antenna or by direct cable connection to the front panel TRANS/-40 DUPLEX Connector (11). Table 4-7 defines the signal parameters which can be monitored using the receiver and associated monitoring functions.

| SIGNAL CHARACTERISTIC(S):               | MONITORING DEVICE(S):   | CONTROLS:   |
|---|-------------------------|---|
| AM% Modulation *                        | MODULATION Meter (1)    | DEV/PWR Control (6) to "kHz/%x10".<br>MODULATION Control (7) as req'd.                                      |
| or                                      |                         |   |
| kHz Deviation *                         | CRT (50) (Oscilloscope) | DISPLAY Control (51) to "SCOPE".<br>DEV/VERT Control (39) to "kHz/DIV".                                     |
| Instantaneous Modulation:               | CRT (50) (METER Menu)   | DISPLAY Control (51) to "METER".  |
| AM IF Envelope<br>or<br>kHz Deviation * | CRT (50) (Oscilloscope) | DISPLAY Control (51) to "SCOPE".<br>DEV/VERT Control (39) to "kHz/DIV".<br>MODULATION Control (7) as req'd. |

\* When the received signal input level is below the FM/AM-1500 squelch threshold, these monitoring functions will be disabled.

**Table 4-7 Receiver Monitoring Capabilities**

**Table 4-7 (Cont'd)**

| SIGNAL CHARACTERISTIC(S):                                  | MONITORING DEVICE(S):  | CONTROLS:   |
|--|--|---|
| Frequency Error*<br>and<br>Demodulated Audio*<br>Frequency | FREQ ERROR Meter (41)<br>or<br>CRT (50) (METER Menu)                     | FREQ ERROR Control (37) as req'd.<br>DISPLAY Control (51) to "METER". |
| Signal Power (WATTS)                                       | Power Meter Scale of<br>MODULATION Meter (1) or<br>CRT (50) (METER Menu) | DEV/PWR Control (6) to 15 or 150                                      |
| Signal Power (dB)  | CRT (50) (Spectrum Analyzer)   | DISPLAY Control (51) to "ANALY".                                      |
| SINAD (Distortion)   | SINAD Scale of<br>MODULATION METER (1) or<br>CRT (50) (METER Menu)       | DEV/PWR Control (6) to "SINAD".                                       |
| Demodulated Audio*   | FM/AM-1500 Speaker   | VOLUME (22), SQUELCH (23)<br>Controls as req'd.                       |

\* When the received signal input level is below the FM/AM-1500 squelch threshold, these monitoring functions will be disabled.

**Table 4-7 Receiver Monitoring Capabilities**

**4-5-2 BASIC RECEIVER OPERATION (SIMPLEX MODE)**

Basic operation of the FM/AM-1500 receiver is as follows:

1. Make sure all applicable FM/AM-1500 front panel controls are positioned as indicated in Table 4-6.
2. If signals are to be monitored "off-the-air", connect external antenna to ANTENNA Connector (56); if signals are to be received by direct cable connection, apply signal to TRANSI-40 dB DUPLEX Connector (11).

**CAUTION:**

MAXIMUM CONTINUOUS INPUT TO ANTENNA CONNECTOR (56)  
MUST NOT EXCEED 0.25 WATTS

**CAUTION:**

MAXIMUM INPUT TO TRANS/-40 dB DUPLEX CONNECTOR MUST NOT EXCEED 150 WATTS. IF OVERTEMP INDICATOR LIGHT (9) ILLUMINATES, REMOVE INPUT POWER IMMEDIATELY AND DO NOT REAPPLY UNTIL OVERTEMP LIGHT EXTINGUISHES.

3. Using Keyboard (20), set FM/AM-1500 RF frequency to desired receive frequency. (Additional operating steps will vary depending on the application; see paragraph 4-5-3 for further instructions.)

**4-5-3 APPLICATIONS**

**A. RECEIVING AM or FM SIGNALS (OFF-THE-AIR)**

1. Perform "BASIC RECEIVER OPERATION" steps described in paragraph 4-5-2.
2. Place MODULATION Control (7) to:
  - a. AM1 or AM2 position, if receiving AM signals.
  - b. FM1, FM2, FM3, or FM4 position, if receiving FM signals.

**NOTE:**

If receiver is being operated under processor controlled menu functions, place MODULATION Control (7) to "AUTO" position to select programmed demodulation method.

3. To aurally monitor received audio, adjust VOLUME Control (27) and SQUELCH Control (32) as required.
  4. Use monitoring features outlined in Table 4-7 to monitor desired signal parameters.
- B. RECEIVING SSB SIGNALS (OFF-THE-AIR)**
1. Perform "BASIC RECEIVER OPERATION" steps described in paragraph 4-5-2.

2. Place MODULATION Control (7) to "SSB" position.

**NOTE:**

If receiver is being operated under processor controlled menu functions, place MODULATION Control (7) to "AUTO" position to select programmed demodulation method.

3. To aurally monitor audio, adjust VOLUME Control (27) and SQUELCH Control (32) as required.
4. If necessary, increment or decrement FM/AM-1500 RF frequency in 100 Hz steps to "clarify" signal.

C. RECEIVING WWV TIME STANDARD SIGNAL TO CALIBRATE FM/AM-1500 MASTER OSCILLATOR (OFF-THE-AIR)

1. Perform "BASIC RECEIVER OPERATION" steps described in paragraph 4-5-2.

**NOTE:**

Set FM/AM-1500 RF frequency to 10.0000 MHz.

2. Insert a 2 foot length of 24 gauge wire into center conductor of 10 MHz REF Connector (62) on rear of FM/AM-1500.
3. Place MODULATION Control (7) to "AM1" position.
4. Place DEV/PWR Control (6) to "SIG" position.
5. Adjust position of wire as necessary, to obtain a suitable beat note from FM/AM-1500 speaker.
6. Adjust INT REF CAL Adjustment (17) on FM/AM-1500 front panel as necessary, to obtain a zero beat.

**NOTE:**

Observation of AM envelope on oscilloscope and/or signal strength fluctuation on MODULATION Meter (1) may be helpful in obtaining a zero beat condition.

## D. CALIBRATING FM/AM-1500 MASTER OSCILLATOR USING EXTERNAL FREQUENCY COUNTER

### NOTE:

This procedure is recommended as an alternative for calibrating the FM/AM-1500 master oscillator, in the event a WWV 10 MHz "off-the-air" signal is not available.

1. Connect a calibrated frequency counter (with 1.0 or 0.1 Hz resolution) to 10 MHz REF Connector (62) on rear of FM/AM-1500.
2. Adjust INT CAL REF Adjustment (17) on FM/AM-1500 front panel, to obtain a 10 MHz ( $\pm 0.1$  Hz) reading on frequency counter.

### E. TESTING AM or FM TRANSMITTERS

1. Perform "BASIC RECEIVER OPERATION" steps described in paragraph 4-5-2.

### NOTE:

Connect 50 $\Omega$  coax cable between output of transmitter under test and FM/AM-1500 TRANS/40 dB DUPLEX Connector (11).

2. Place MODULATION Control (7) to:
  - a. AM1 or AM2 position if testing AM transmitters, or
  - b. FM1, FM2, FM3, or FM4 position, if testing FM transmitters.

### NOTE:

If transmitter is being tested under processor controlled menu functions, place MODULATION Control (7) to "AUTO" position to select programmed demodulation method.

3. Use monitoring features outlined in Table 4-7 to monitor desired signal parameters.



F. MEASURING AM or FM TRANSMITTER DISTORTION

1. Perform "BASIC RECEIVER OPERATION" steps described in paragraph 4-5-2.

**NOTE:**

Connect 50  $\Omega$  coax cable between output of transmitter under test and FM/AM-1500 TRANS/-40 dB DUPLEX Connector (11).

**CAUTION:**

MAXIMUM CONTINUOUS INPUT TO TRANS/-40 dB DUPLEX CONNECTOR MUST NOT EXCEED 150 WATTS. IF OVERTEMP INDICATOR LAMP (9) ILLUMINATES, REMOVE INPUT POWER IMMEDIATELY AND DO NOT REAPPLY UNTIL OVERTEMP LAMP EXTINGUISHES.

2. Modulate transmitter under test with a 1 kHz tone.

**NOTE:**

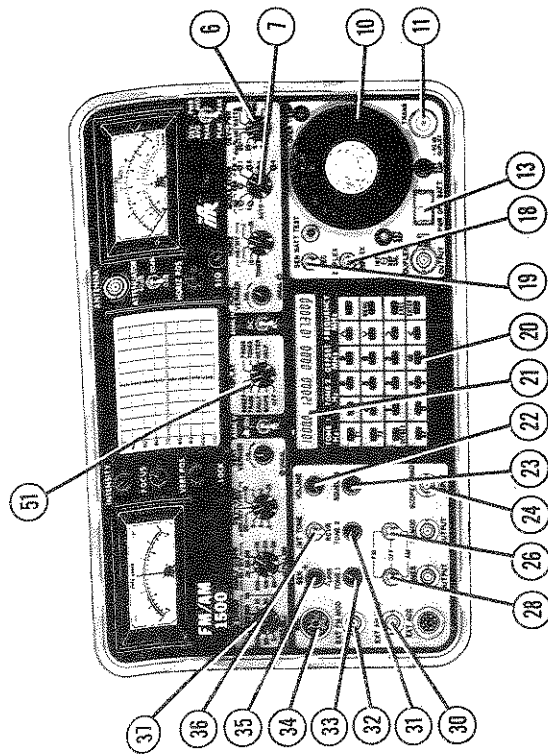
FM/AM-1500 tone generator function may be used as a modulation source (see para. 4-4, "TONE GENERATOR OPERATION").

3. Place DEV/PWR Control (6) to SINAD position.
4. Connect coax cable between FM/AM-1500 DEMOD OUT Connector (25 and SCOPE/SINAD INPUT Connector (24).
5. Monitor SINAD level on bottom scale of Modulation Meter (1).

**NOTE:**

SINAD is typically better than 20 dB.

# RF SIGNAL GENERATOR OPERATION (SIMPLEX)



FM/AM-1500 CONNECTORS AND INDICATORS APPLICABLE TO RF SIGNAL GENERATOR OPERATION:

- 11 TRANS/40 dB DUPLEX Connector
- 21 LCD
- 24 SCOPE/SINAD INPUT Connector
- 30 EXT AM MOD Connector
- 32 EXT FM MOD Connector
- 34 MIC Connector

Figure 4-5 FM/AM-1500 Front Panel Controls Applicable to RF Signal Generator Operation

| CONTROL                    | SETTING       | PARAMETER                       |
|----------------------------|---------------|---------------------------------|
| 6 DEV/PWR Control          | "kHz/%x10"    | Modulation Meter Scaling Factor |
| 7 MODULATION Control       | As req'd      | Modulation Monitoring Mode      |
| 10 RF Output Level Control | As req'd      | Generator Output Level          |
| 13 PWR/OFF/BATT Switch     | "PWR or BATT" | AC or DC Power                  |
| 18 DUPLEX/SIMPLEX Switch   | "SIMPLEX"     | RF Input/Output Configuration   |
| 19 GEN/REC Switch          | "GEN"         | Operating Mode                  |
| 20 KEYBOARD                | As req'd      | RF Frequency                    |

Table 4-8 FM/AM-1500 Controls Applicable to RF Signal Generator Operation

**Table 4-8** (Cont'd)

|    | CONTROL                 | SETTING   | PARAMETER                |
|----|-------------------------|-----------|--------------------------|
| 22 | VOLUME Control          | As req'd  | VOLUME                   |
| 23 | SQUELCH Control         | Fully ccw | SQUELCH                  |
| 26 | Tone 2 FM/OFF/AM Switch | As req'd  | Modulation Range         |
| 28 | Tone 1 FM/OFF/AM Switch | As req'd  | Modulation Range         |
| 31 | TONE 2 Control          | As req'd  | Modulation Level         |
| 33 | TONE 1 Control          | As req'd  | Modulation Level         |
| 35 | GEN/LOCK Control        | "LOCK"    | DC Modulation            |
| 36 | INT TONE/RCVR Switch    | "RCVR"    | Speaker Audio Routing    |
| 37 | FREQ ERROR Control      | As req'd  | Freq ERROR Meter Scaling |
| 51 | DISPLAY Control         | As req'd  | CRT Mode                 |

**Table 4-8 FM/AM-1500 Controls Applicable to RF Signal Generator Operation**

#### 4-6-1 GENERAL

The FM/AM-1500 RF signal generator is capable of generating calibrated amplitude signals within a range of 100 kHz of 999.9999 MHz, in 100 Hz steps. In the generate "SIMPLEX" mode, the signal generator can be used to stimulate external devices by generating modulated or unmodulated signals, while the FM/AM-1500 receiver circuits are simultaneously monitoring the generated output. Modulation signals for the generated carrier are available from the FM/AM-1500 internal tone generators or from external AM or FM sources. A microphone input connector is also available for applying voice modulation. All generated signals are transmitted out the front panel TRANS/40 dB DUPLEX Connector (11), at an output level which is continuously variable from 0 to -128 dBm (using the RF Output Control [10]). An internal SINAD meter is active during generator operation, to enable testing of UUT receiver sensitivity.

Table 4-9 outlines the parameters of the generated output, which can be monitored by the FM/AM-1500 receiver circuits during generator operation.

| SIGNAL CHARACTERISTIC(S):             | MONITORING DEVICE(S):   | CONTROLS:   |
|---------------------------------------|-------------------------|---|
| AM% Modulation                        | MODULATION Meter (1)    | DEV/PWR Control (6) to "kHz/%x10".<br>MODULATION Control (7) as req'd.                                      |
| or<br>kHz Deviation                   | CRT (50) (Oscilloscope) | DISPLAY Control (51) to "SCOPE".<br>DEV/VERT Control (39) to "kHz/DIV".                                     |
| Instantaneous Modulation:             |                         |   |
| AM IF Envelope<br>or<br>kHz Deviation | CRT (50) (Oscilloscope) | DISPLAY Control (51) to "SCOPE".<br>DEV/VERT Control (39) to "kHz/DIV".<br>MODULATION Control (7) as req'd. |
| Modulated Audio Frequency             | CRT (METER Menu)        | DISPLAY Control (51) to "METER".  |

**Table 4-9 Receiver Monitoring Capabilities**

**4-6-2 BASIC SIGNAL GENERATOR OPERATION (SIMPLEX MODE)**

1. Make sure all applicable FM/AM-1500 front panel controls are positioned as indicated in Table 4-8.
2. Using Keyboard, set FM/AM-1500 RF frequency to desired generate frequency.
3. Adjust RF Output Level Control (10) for desired output level in uV or dBm, as indicated on control scale. FM/AM-1500 is now generating a carrier signal at selected frequency, and output level.

**NOTE:**

If a signal greater than 100 mW is applied to the TRANS/-40 dB DUPLEX Connector while the FM/AM-1500 is generating, the set will automatically switch to the receive mode and will monitor only the signal(s) applied to this connector.

(Additional operating steps will vary depending on application; see paragraph 4-6-3 for further instructions.)

#### 4-6-3 APPLICATIONS

##### A. GENERATING AM or FM MODULATED RF SIGNALS

1. Perform "BASIC SIGNAL GENERATOR OPERATION" steps described in paragraph 4-6-2.
2. Apply AM or FM modulation signal to carrier as follows:
  - a. Using Keyboard (20), enter desired modulation frequency into TONE 1 and/or TONE 2 data field of LCD.
  - b. Set Tone 1 and/or Tone 2 FM/AM/OFF Switch (28 or 26) to desired modulation mode.
  - c. Adjust TONE 1 and/or TONE 2 Control (33 or 31) for desired modulation level, as displayed on MODULATION Meter (1) or CRT (50) (reference Table 4-7).

**NOTE:**

If both tone generators are used as modulation sources, the MODULATION Meter (1) and CRT (50) will display the composite modulation signal produced by both tone generators. To monitor either individual modulation signal, Tone Generator #1 or #2 must be turned off.

- d. The FM/AM-1500 is now generating a carrier signal with desired modulation characteristics. Use monitoring features outlined in Table 4-7 to monitor desired signal parameters.

##### B. EXTERNALLY MODULATING RF SIGNAL GENERATOR

1. Perform "BASIC SIGNAL GENERATOR OPERATION" steps described in paragraph 4-6-2.
2. Apply external modulation signal to EXT AM MOD Connector (30) or EXT FM MOD Connector (32), whichever is applicable.
3. Adjust output of applied modulation signal to desired modulation level, as reflected on MODULATION Meter (1).

**NOTE:**

To monitor output level of applied modulation signal on MODULATION Meter (1), DEV/PWR Control (6) must be in "kHz/%x10" positions and MODULATION Control (7) must be set to appropriate modulation mode (reference Table 4-7).

##### C. VOICE MODULATING RF SIGNAL GENERATOR

1. Perform "BASIC SIGNAL GENERATOR OPERATION" steps described in paragraph 4-6-2.
2. Connect external microphone to MIC Connector (34).
3. Press PTT (Press-to-Talk) Switch and talk into microphone. Use monitoring features outlined in Table 4-7, to monitor voice modulation characteristics.

**NOTE:**

Diode speech limiting is incorporated for control of peak modulation. Limiter is set for 5 kHz deviation.

Whenever microphone is keyed, the FM/AM-1500 will automatically switch to the generate mode of operation, regardless of the position of the GEN/REC Switch (19).

**D. DC MODULATING RF SIGNAL GENERATOR**

1. Generate desired RF carrier frequency with desired modulation.
2. Offset generated carrier signal from center frequency by rotating GEN LOCK Control (35) out of detent position.
3. Monitor generator offset on FREQ ERROR Meter (41), spectrum analyzer or CRT METER Menu.

**E. MEASURING UUT RECEIVER SINAD SENSITIVITY**

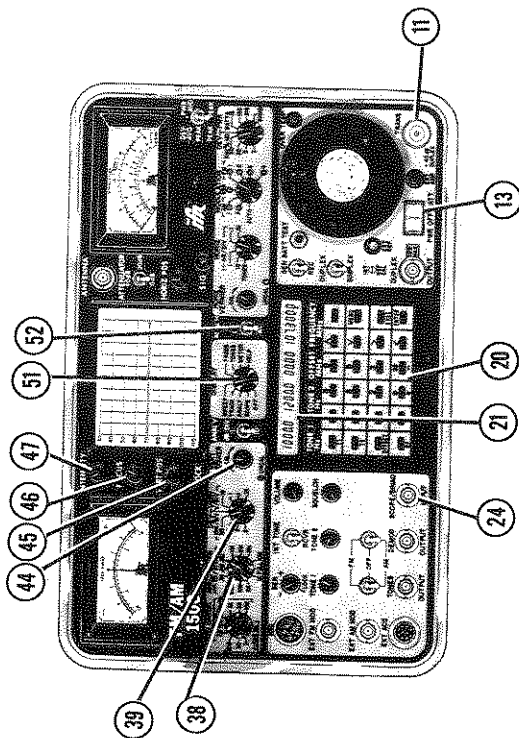
1. Connect 50 $\Omega$  coax cable between FM/AM-1500 TRANS/-40 dB DUPLEX Connector (11) and RF input of receiver under test.

**NOTE:**

For UUT SINAD measurements, the FM/AM-1500 internal tone generators should be used as a modulation source. A modulation frequency of 1000.0 Hz is required.

2. Connect audio output of receiver under test to SCOPE/SINAD INPUT Connector (24) and place DEV/PWR Control (6) to "SINAD" position.
3. Use FM/AM-1500 to generate a 1 kHz AM or FM modulated signal.
4. Adjust RF Level Output Control (10) for an output level of -40 dB.
5. Slowly decrease FM/AM-1500 RF output level until MODULATION Meter (1) displays applicable SINAD value (12 dB typical).
6. Setting of RF LEVEL OUTPUT Control (10) represents SINAD sensitivity of receiver under test.

#### 4-7 SWEEP GENERATOR OPERATION



FM/AM-1500 CONNECTORS AND INDICATORS APPLICABLE TO SWEEP GENERATOR OPERATION:

- 11 TRANS/-40 dB DUPLEX Connector
- 21 LCD
- 24 SCOPE/SINAD INPUT Connector

Figure 4-6 FM/AM-1500 Front Panel Controls Applicable to Sweep Generator

| CONTROL                 | SETTING       | PARAMETER                        |
|-------------------------|---------------|----------------------------------|
| 13 PWRI/OFF/BATT Switch | "PWR or BATT" | AC or DC Power                   |
| 20 KEYBOARD             | As req'd      | RF or IF Frequency               |
| 38 ANALY DISPR Control  | As req'd      | Sweep Span                       |
| 39 DEV/VERT Control     | "V/DIV"       | Vertical Sensitivity             |
| 44 VERT VERNIER Control | As req'd      | Vertical Sensitivity Fine Adjust |
| 45 VERT POS Control     | As req'd      | Vertical Trace Position          |
| 46 FOCUS Control        | As req'd      | Trace Focus                      |
| 47 INTENSITY Control    | As req'd      | Trace Intensity                  |
| 51 DISPLAY Control      | "SWEEP"       | CRT Mode                         |
| 52 AC/DC Switch         | "DC"          | Scope Coupling                   |

**Table 4-10 FM/AM-1500 Controls Applicable to Sweep Generator**

#### 4-7-1 GENERAL

The FM/AM-1500 sweep function can be used to sweep RF and IF systems up through the full range of 1 MHz to 1000 MHz, enabling the frequency response characteristics of the UUT to be displayed on the FM/AM-1500 oscilloscope. When sweeping RF or IF systems, the swept RF output available at the FM/AM-1500 TRANS/40 dB DUPLEX Connector (11) is applied at the insertion point of the UUT, while the sampled output is fed through an appropriate RF detector to the SCOPE/SINAD Input Connector (24). The sweep generator function is also useful in aligning the amplifier IF and demodulator circuits of a UUT, by applying the swept RF output to the UUT injection point and applying the demodulated output to the FM/AM-1500 SCOPE/SINAD Input Connector (24).

#### 4-7-2 BASIC SWEEP GENERATOR OPERATION

Basic sweep generator operation is as follows:

1. Set FM/AM-1500 sweep generator associated controls to positions indicated in Table 4-10.

**NOTE:**

ANALY DISPR Control (38) should be positioned to nearest desired sweep span.

2. Set appropriate FM/AM-1500 front panel controls for RF signal generator operation.



**NOTE:**

FM/AM-1500 RF frequency should be set to normal operating frequency present at UUT injection point.

3. Using appropriate coax cable(s), apply FM/AM-1500 generator output to UUT injection point.

**4-7-3 APPLICATIONS**

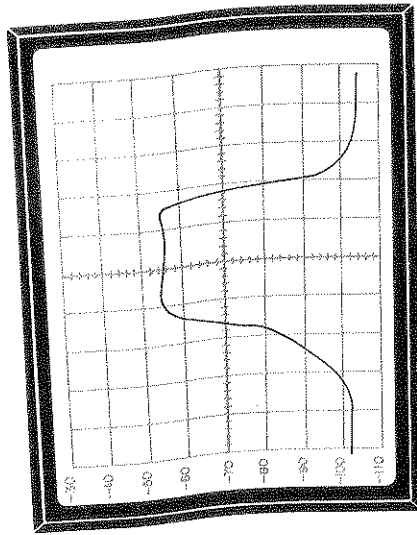
**A. SWEEPING RF and IF SYSTEMS**

1. Perform "BASIC SWEEP GENERATOR OPERATION" steps desired in paragraph 4-7-2.
2. Connect RF detector between FM/AM-1500 SCOPE/SINAD INPUT Connector (24) and sample point of UUT.
3. Adjust FM/AM-1500 RF output level as required, for proper UUT operation.

**NOTE:**

If testing the frequency response of an AM receiver, disable receiver AGC (in accordance with UUT manufacturer's recommendations) before proceeding with Step 4 below.

4. Adjust FM/AM-1500 DEV/VERT Control (39) as required for proper display of UUT characteristics on FM/AM-1500 oscilloscope. (See Figure 4-7.)



**Figure 4-7 Typical Frequency Response Curve**

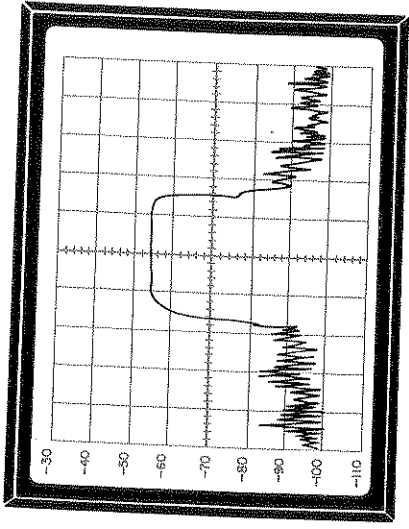
#### B. SWEEPING A DEMODULATOR

1. Perform "BASIC SWEEP GENERATOR OPERATION" steps described in paragraph 4-7-2.
2. Monitor demodulated output at recommended UUT sample point in order to measure demodulation characteristics. (Connect demodulated sample to FM/AM-1500 SCOPE/SINAD Connector [24].)
3. Adjust FM/AM-1500 RF output level as required for proper UUT operation.

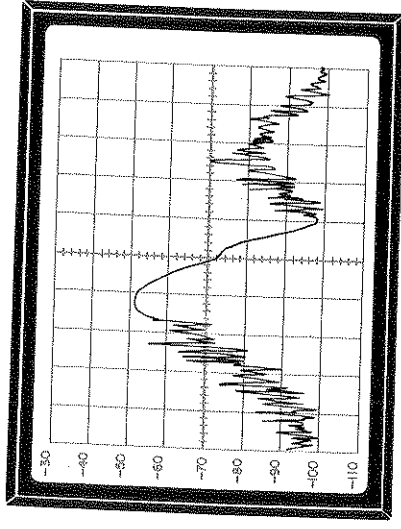
**NOTE:**

If testing the frequency response of an AM receiver, disable receiver AGC (in accordance with UUT manufacturer's recommendations) before proceeding with Step 4.

4. Adjust FM/AM-1500 DEV/VERT Control (39) as required for proper display of UUT characteristics on FM/AM-1500 oscilloscope. (See Figure 4-8 and Figure 4-9.)

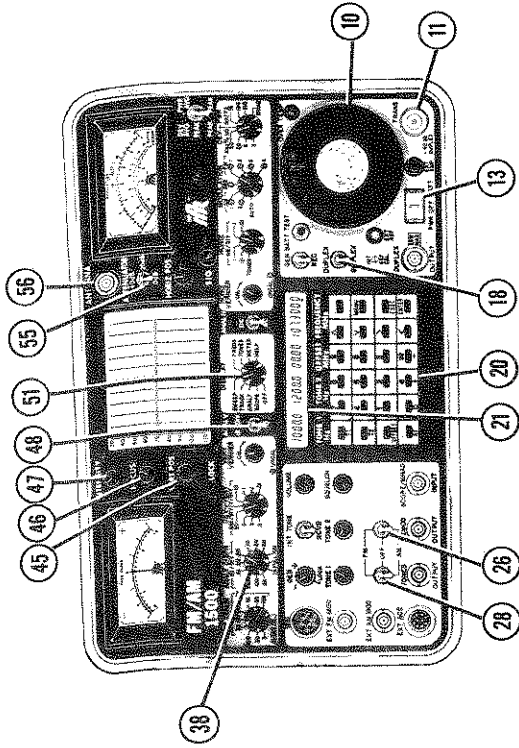


**Figure 4-8 Typical Response Curve (AM)**



**Figure 4-9 Typical Response Curve (FM)**

## 4-8 TRACKING GENERATOR OPERATION



FM/AM-1500 CONNECTORS AND INDICATORS APPLICABLE TO TRACKING GENERATOR OPERATION:

- 11 TRANS/-40 dB DUPLEX Connector
- 21 LCD
- 56 ANTENNA Connector

Figure 4-10 FM/AM-1500 Front Panel Controls Applicable to Tracking Generator Operation

| CONTROL                    | SETTING         | PARAMETER   |
|----------------------------|-----------------|---|
| 10 RF Output Level Control | As req'd        | Generator Output Level  |
| 13 PWR/OFF/BATT Switch     | "PWR" or "BATT" | AC or DC Power  |
| 18 SIMPLEX/DUPLEX Switch   | "SIMPLEX"       | RF Input/Output Configuration                                       |
| 20 KEYBOARD                | As req'd        | RF Frequency  |
| 26 Tone 2 FM/OFF/AM Switch | "OFF"           | n/a   |
| 28 Tone 1 FM/OFF/AM Switch | "OFF"           | n/a   |
| 38 ANALY DISPR Control     | As req'd        | Sweep Span  |
| 45 VERT POS Control        | As req'd        | Vertical Trace Position (N/A with dB/DIV Switch in X10 dB position) |
| 46 FOCUS Control           | As req'd        | Trace Focus   |

Table 4-11 FM/AM-1500 Controls Applicable to Tracking Generator Operation

**Table 4-11 (Cont'd)**

| CONTROL              | SETTING  | PARAMETER             |
|----------------------|----------|-----------------------|
| 47 INTENSITY Control | As req'd | Trace Intensity       |
| 48 dB/DIV Switch     | "10"     | CRT Graticule Scaling |
| 51 DISPLAY Control   | "TRACK"  | CRT Mode              |
| 55 ATTENUATOR Switch | As req'd | Input Attenuation     |

**Table 4-11 FM/AM-1500 Controls Applicable to Tracking Generator Operation**

**4-8-1 GENERAL**

The FM/AM-1500 tracking generator combines the use of the RF signal generator and spectrum analyzer functions to measure the frequency response characteristics of such devices as filters, amplifiers, transmission lines, antenna systems etc. Another feature of the tracking generator is the capability of locating cable faults using the CABLE FAULT MENU function and associated RF "Tee" connectors. The FM/AM-1500 signal generator produces a calibrated RF sweep signal that automatically tracks the spectrum analyzer input frequency, up through the full range of 1 MHz to 1000 MHz. The device under test is connected between the swept RF output presented at the TRANS/-40 dB DUPLEX Connector (11) and the input to the spectrum analyzer at the ANTENNA Connector (56).

**4-8-2 BASIC TRACKING GENERATOR OPERATION**

Basic operation of the FM/AM-1500 tracking generator is as follows:

1. Make sure all applicable tracking generator controls on FM/AM-1500 front panel are positioned as indicated in Table 4-11.
2. Connect input of device under test to TRANS/-40 dB DUPLEX Connector (11).
3. Connect output of device under test to ANTENNA Connector (56).

**CAUTION:**

MAXIMUM CONTINUOUS RF INPUT TO ANTENNA CONNECTOR (56) MUST NOT EXCEED 0.25 WATTS.

**CAUTION:**

WHEN CONNECTING A DEVICE UNDER TEST TO ANTENNA CONNECTOR (56) WHICH HAS AN OUTPUT GREATER THAN + 10 dBm, ADDITIONAL INPUT ATTENUATION MUST BE APPLIED TO ANTENNA CONNECTOR (56) (USING ATTENUATOR SWITCH [55]), TO REDUCE INPUT POWER BELOW + 10 dBm.

4. Using Keyboard (20), set FM/AM-1500 RF frequency to center frequency of desired sweep range.
5. Set ANALY DISPR Control (38) to desired frequency sweep span (frequency sweep span = setting of ANALY DISPR Control X 10).
6. Adjust RF Output Level Control (10) to obtain desired amplitude of frequency response curve on spectrum analyzer.
7. Place ATTENUATOR Switch (55) to appropriate position for desired analyzer input sensitivity.

**NOTE:**

ANTENNA Connector (56) has improved VSWR when ATTENUATOR Switch (55) is in 20 dB or 40 dB position.

8. For increased resolution of frequency response display on spectrum analyzer, place dB/DIV Switch (48) in "1" dB position.

**NOTE:**

With dB/DIV Switch (48) in "1" dB position, VERT POS Control (45) can be used to shift analyzer reference level between -30 and -100 dBm limits, as required.

9. Monitor desired response characteristics of device under test on analyzer display.

## 4-8-3 APPLICATIONS

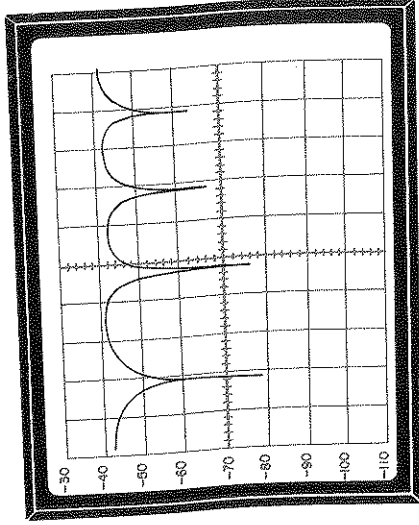
### A. CABLE FAULT TESTING

1. Make sure all applicable tracking generator controls on FM/AM-1500 front panel are positioned as indicated in Table 4-11.
2. Set RF Output Level Control (10) to -30 dBm or as desired.
3. Connect BNC "Tee" Connector to TRANS/40 dB DUPLEX Connector (11).
4. Connect 50  $\Omega$  coax cable between one end of "Tee" connector and FM/AM-1500 ANTENNA Connector (56).
5. Connect cable to be tested to remaining end of "Tee" connector.
6. Using Keyboard (20), set FM/AM-1500 RF frequency to center frequency of 500 MHz.
7. Place ANALY DISPR Control (38) to "FULL SCAN" position.
8. Set or adjust RF Output Level Control (10), ATTENUATOR Switch (55), dB/DIV Switch (48) and VERT POS Control (45) as required for proper display of cable frequency response on spectrum analyzer.
9. While observing analyzer display, perform following steps (refer to sample display shown in Figure 4-11):

- a. Randomly select a response curve dip on spectrum analyzer display.

**NOTE:**

If possible, select a lower frequency dip (deeper dip), to obtain best resolution for frequency measurement.

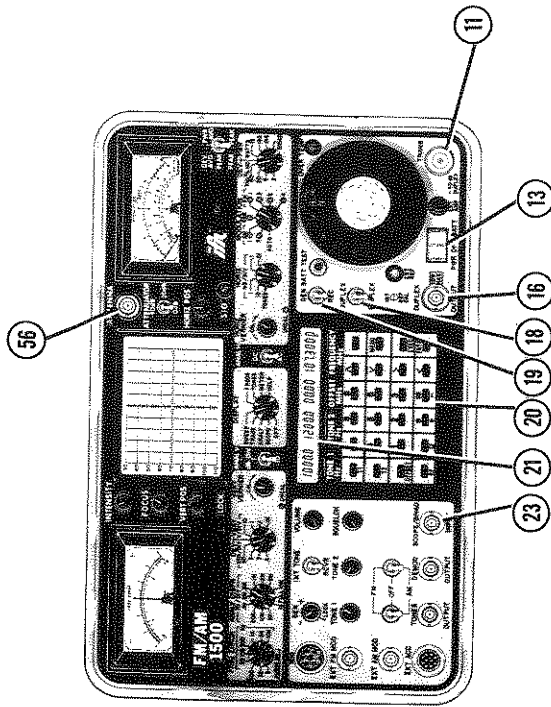


**Figure 4-11 Sample Analyzer Display**

- b. Using Keyboard (20), slew FM/AM-1500 RF frequency as required, until selected dip is centered over major vertical axis.  
**NOTE:**  
For increased display resolution, use ANALY DISPR Control (38) to reduce scan width of the analyzer, while keeping selected dip in view.
- c. Note and record frequency displayed in RF data field of LCD (21). This frequency is referenced as  $F_1$ .
- d. Select the next adjacent dip to right or left of dip previously selected.
- e. Using Keyboard (20), slew FM/AM-1500 RF frequency as required, until selected dip is centered over major vertical axis.
- f. Note and record frequency displayed in RF data field of LCD (21). This frequency is referenced as  $F_2$ .
- g. Refer to SECTION 5, MENU OPERATION, for use of Cable Fault Menu; values  $F_1$  and  $F_2$  obtained in previous steps and cable velocity factor must be programmed into Cable Fault Menu to obtain location of cable fault.



## 4-9 DUPLEX OPERATION



FM/AM-1500 CONNECTORS AND INDICATORS APPLICABLE TO DUPLEX OPERATION:

- 11 TRANS/-40 dB DUPLEX Connector
- 16 DUPLEX OUTPUT Connector
- 21 LCD
- 23 SCOPE/SINAD INPUT Connector
- 56 ANTENNA Connector

**Figure 4-1 FM/AM-1500 Front Panel Controls Applicable to Duplex Operation**

### CONTROL

- 13 PWR/OFF/BATT Switch
- 18 DUPLEX/SIMPLEX Switch
- 19 GEN/REC Switch
- 20 KEYBOARD

All controls associated with receiver, signal generator, tone generator, CRT Monitor, FREQ ERROR Meter and MODULATION Meter functions.

### SETTING

- "PWR or BATT"
- "DUPLEX"
- "GEN"
- As req'd

### PARAMETER

- AC or DC Power
- RF Input/Output Configuration
- Operating Mode
- RF Frequency (Offset and Receive)

**Table 4-12 FM/AM-1500 Controls Applicable to Duplex Operation**

## 4-9-1 GENERAL

In the duplex mode of operation, the FM/AM-1500 has the capability of generating and receiving signals simultaneously, enabling the operator to check the performance of most duplex transceivers. While the FM/AM-1500 receiver is monitoring the power, modulation and frequency characteristics of the UUT transmitter, the FM/AM-1500 offset generator is simultaneously stimulating the UUT receiver with a calibrated signal -40 dB below the setting of the RF Output Level Control (10). This signal is not affected by the operation of the UUT transmitter. This simultaneous receiver/transmit capability enables the operator to check the UUT transmitter/receiver interaction, typical under normal conditions.

Using the FM/AM-1500, three methods of duplex testing are possible:

### 1. Duplex Testing Using Separate Transmit/Receive Lines

In this mode, the UUT transmitter output is applied to the FM/AM-1500 at the TRANS/-40 dB DUPLEX Connector (11), where the signal is attenuated by 80 dB to the spectrum analyzer. The FM/AM-1500 offset generator output (available at the DUPLEX OUTPUT Connector (16) at an output level equal to setting of RF Output Level Control [10]) is applied to the RF input of the UUT receiver.

### CAUTION:

DO NOT TRANSMIT INTO DUPLEX OUTPUT CONNECTOR (16), AS CONNECTOR IS NOT PROTECTED AGAINST RF INPUTS ABOVE 2.5 WATTS.

### 2. Duplex Testing Using Common Transmit/Receive Line

When testing a duplex transceiver with a single transmit/receive I/O port, a common receive/transmit line is connected between the UUT RF I/O port and the FM/AM-1500 TRANS/-40 dB DUPLEX Connector (11). The FM/AM-1500 will transmit and receive simultaneously over this single line.

### NOTE:

The generator output level at the TRANS/-40 dB DUPLEX Connector (11) is 40 dB less than the indication of the RF Output Level Control (10).

### 3. "Off-the-air" Duplex Testing

In this mode, the output of the UUT transmitter is monitored "off-the-air" at the FM/AM-1500 ANTENNA Connector (56), while the FM/AM-1500 offset generator output (available at the TRANS/-40 dB DUPLEX Connector (11) or DUPLEX OUTPUT Connector [16]) is applied to the UUT receiver input.

#### **NOTE:**

The generator output level at the TRANS/-40 dB DUPLEX Connector (11) is 40 dB less than the indication on the RF Output Level Control (10); the generator output level at DUPLEX OUTPUT Connector (16) is equal to setting of RF Output Level Control.

#### **CAUTION:**

DO NOT TRANSMIT INTO DUPLEX OUTPUT CONNECTOR (16) AS CONNECTOR IS NOT PROTECTED AGAINST RF INPUTS ABOVE 2 WATTS.

DO NOT TRANSMIT INTO ANTENNA CONNECTOR (56); RF INPUTS IN EXCESS OF 0.25 WATTS MAY CAUSE DAMAGE TO FM/AM-1500.

### 4-9-2 BASIC DUPLEX OPERATION

Basic operation of the FM/AM-1500 RF signal generator and receiver functions for duplex testing is as follows:

1. Place GEN/REC Switch (19) in "GEN" position and DUPLEX/SIMPLEX Switch (18) in "SIMPLEX" position.
2. Set up FM/AM-1500 RF signal generator to produce an FM and/or AM modulated signal, (as required).

#### **NOTE:**

For UUT SINAD measurements, the FM/AM-1500 internal tone generators should be used as a modulation source. A modulation frequency of 1000.0 Hz is required.

3. Place DUPLEX/SIMPLEX Switch (18) to "DUPLEX" position.
4. Using Keyboard (20), enter UUT transmit frequency into RF data field of LCD (21).
5. Using Keyboard (20), enter offset generator frequency into OFFSET data field of LCD (21).

**NOTE:**

$$\text{OFFSET FREQUENCY} = (\text{UUT RECEIVE FREQ}) - (\text{UUT TRANSMIT FREQ})$$

6. Connect UUT transmit/receive line to FM/AM-1500 according to desired method of duplex testing (reference paragraph 4-8-1).

**4-9-3 APPLICATIONS**

**A. TESTING TRANSMITTER SECTION OF DUPLEX TRANSCEIVER**

1. The following UUT transmitter characteristics can be monitored as follows:

| UUT TRANSMITTER CHARACTERISTICS:  | FM/AM-1500 MONITORING DEVICES:  |
|-----------------------------------|---|
| Frequency                         | Reading of FREQ ERROR Meter (41) plus frequency displayed in RF data field of LCD (21) = UUT Transmitter Frequency. |
| Modulation (AM% or kHz Deviation) | MODULATION Meter (1) or CRT (50) (Oscilloscope)   |
| Demodulated Audio Frequency       | FREQ ERROR Meter (41) in audio function or on CRT METER Menu.   |
| Power (Watts) *                   | Power Meter scale of MODULATION Meter (1)   |

\*Can be monitored only when testing UUT by direct cable connection to the TRANS/40 dB DUPLEX Connector (11).

**Table 4-13 Transmitter Monitoring Function**

## B. TESTING RECEIVER SECTION OF DUPLEX TRANSCIEVER

1. Connect demodulated audio output from UUT to FM/AM-1500 SCOPE/SINAD INPUT Connector (24).
2. Place DEV/PWR Control (6) to "SINAD" position.
3. Adjust RF Output Level Control (10) appropriately until desired SINAD reading is present on SINAD scale of MODULATION Meter (1).
4. Setting of RF Output Level Control (10) represents SINAD Sensitivity of UUT receiver.
5. For detailed testing of UUT receiver bandwidth and center frequencies, refer to use of FM/AM-1500 Sweep and Tracking Generator functions (paragraphs 4-7 and 4-8).

### NOTE:

When the DUPLEX/SIMPLEX Switch (18) is placed in the SIMPLEX position, a value of 00.00 MHz is set for DUPLEX OFFSET. When the DUPLEX/SIMPLEX Switch (18) is placed in the DUPLEX position, the previous DUPLEX OFFSET entry is restored.

When the DISPLAY Control (51) is placed in the TRACK or SWEEP position, the DUPLEX OFFSET is set to 00.00 MHz, the GEN/REC Switch (19) is over-ridden and set to receive and the DUPLEX/SIMPLEX Switch (18) is over-ridden and set to SIMPLEX. This is done as a convenience to the operator, as these conditions must be set when in TRACK or SWEEP Mode. The original settings of DUPLEX OFFSET, GEN/REC Switch (19) and DUPLEX/SIMPLEX Switch (18) are restored when the DISPLAY Control (51) is moved from the TRACK or SWEEP positions.



## SECTION 5 — MENU OPERATION

### 5-1 GENERAL

This section contains instructions for operating the FM/AM-1500 menu display functions. Using these menus, the operator can display, store, retrieve, and automatically execute test data according to the parameters displayed on the selected menus. Two basic types of menus are available to the FM/AM-1500 operator:

#### 1. **Programmable RF and Tone Menus**

These menus can be programmed by the operator with variable test data to control the operation of the FM/AM-1500 signal generator, receiver, and tone generator functions. These menus include the:

- a. RF MEMORY Menu
- b. RF SCAN Menu
- c. RF SWEEP Menu
- d. TONE SEQUENCE Menu
- e. DTMF Menu
- f. TONE SWEEP Menu
- g. DCS Menu
- h. CABLE FAULT Menu

#### 2. **Non-programmable Utility/Informational Menus**

These menus are non-programmable and can be selected for display only. These menus include the:

- b. HELP Menu
- a. METER Menu

## 5-2 DATA RETRIEVAL & EXECUTION

Once the various FM/AM-1500 menu functions have been programmed with the desired operating parameters, the operator can retrieve or execute the programmed data using the automatic execution function. This function involves the use of EXECUTION STRINGS, in which a sequence of specific keystrokes are entered to allow the FM/AM-1500 to perform the selected operation(s), as defined in the execution string. Two types of execution strings can be entered into the FM/AM-1500.

### 1. SIMPLE EXECUTION STRING

With this type of entry, the string is sequentially executed through the last item, at which time the execution is terminated.

### 2. LOOPING EXECUTION STRING

A looping execution string will continuously execute the selected item(s) in a sequential manner until the operator intervenes to stop or alter the execution string.

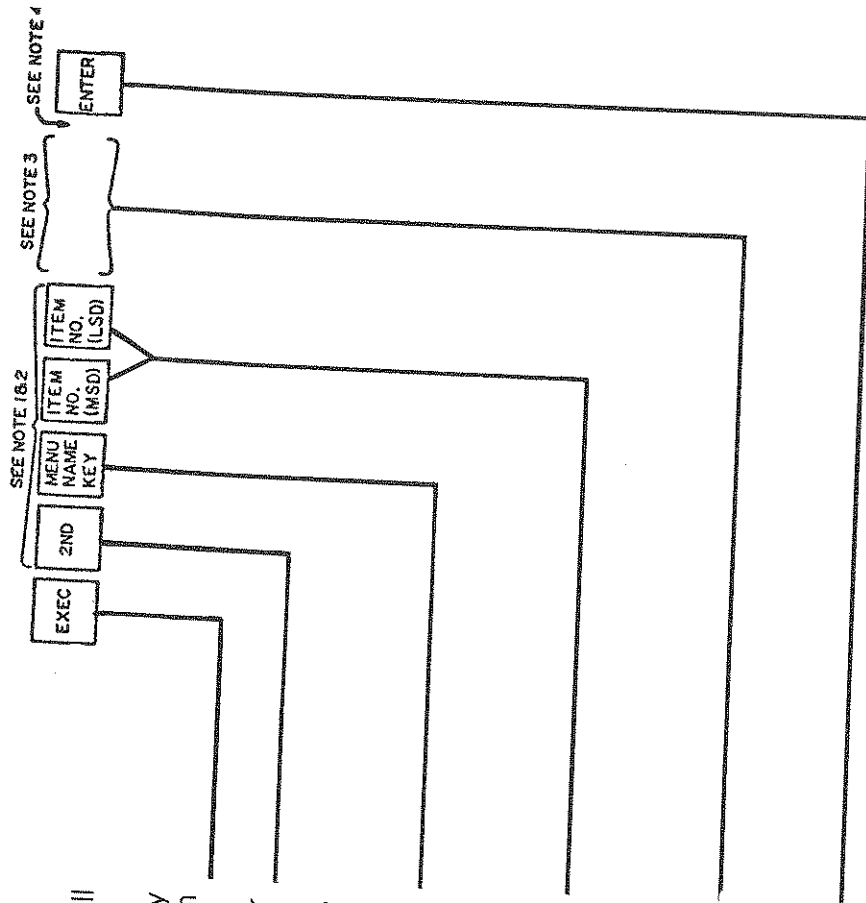
A maximum of 128 keystrokes may be used in any given execution string. The key entry sequence for both types of execution strings (as applicable to all menu functions) is as follows:



### A. SIMPLE EXECUTION STRING

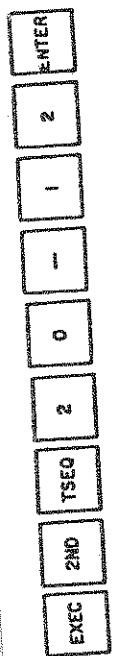
Key entry sequence:

1. Press ENTER Key. Clears all previous entered data.
2. Press EXEC Key. This entry defines the beginning of an execution string.
3. Press 2ND Key (Except for RF MEMORY Menu).
4. Press desired menu name key. Choices are:  
 RF DTMF DCS  
 F. SWP SCAN (Ref Note 2)  
 T. SWP T. SEQ. (Ref Note 2)
5. Key in desired menu item number (or line number) corresponding to desired operation. (MSD is most significant digit of item number, LSD is least significant digit.
6. Additional menu names and item numbers to be included in execution string (if desired) may be inserted here.
7. Press ENTER Key to start execution of string.



### NOTES:

1. This entry sequence sets the operating parameters of the FM/AM-1500 generator, receiver, or tone generator functions to the mode and/or values programmed into the selected menu.
2. A start and stop number separated by the “\_” Key is required whenever entering menu item numbers for the RF SCAN or TSEQ menus. The FM/AM-1500 will execute item numbers sequentially from the start number to the stop number.



Example:

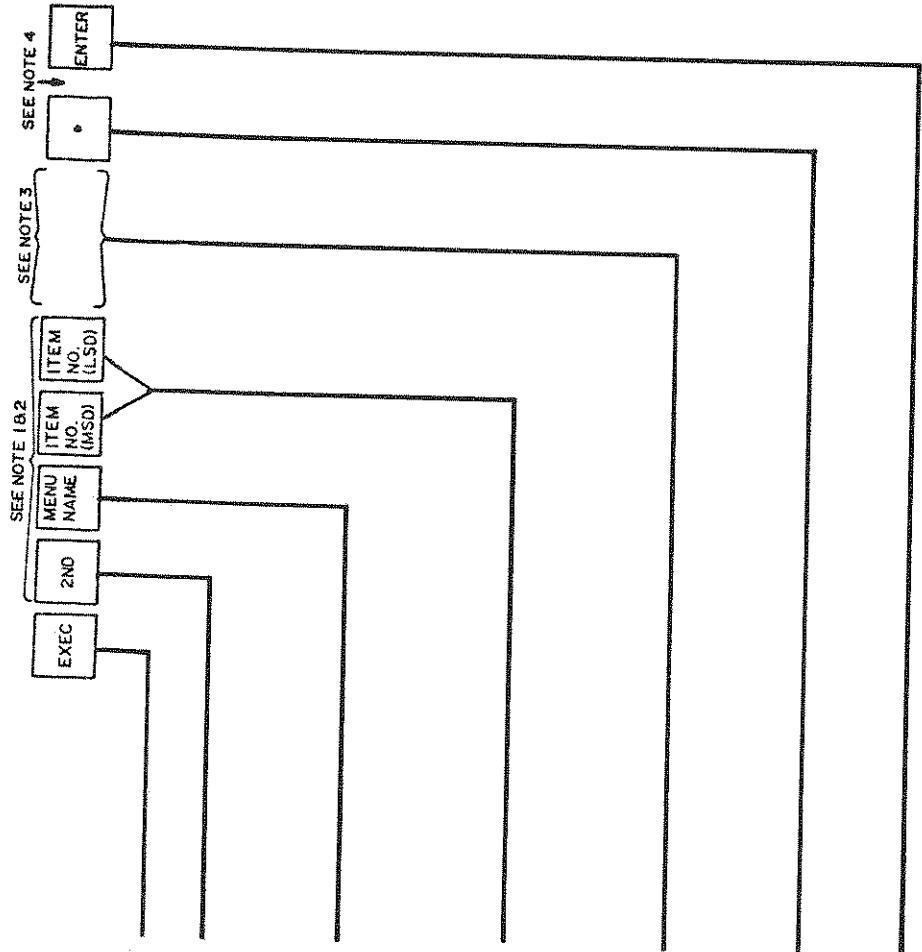
The above sequence will allow the FM/AM-1500 to execute item numbers sequentially from 20 to 12.

3. Additional operations on the same menu or on other menus may be entered into the string at this point, by keying in the appropriate menu name(s) and item number(s). (Maximum number of key-strokes allowable is 128.)
4. If an entry error is made prior to this point, the operator may use the < Key to backspace as necessary, for purposes of correcting errors (pressing the < Key once will delete the previous key entry.)
5. Timed execution (the time interval between updates by the microprocessor) items allows entry of time intervals from 1 mS to 9999 mSecs. The maximum rate the microprocessor can perform this task dictates the minimum time interval any given time execution can operate. If the microprocessor time interval limit is set too fast (less than 10 mSec), the rate of operation may not be correct. Complexity of operation and microprocessor tasks during execution determine this minimum rate. For instance, the minimum time interval required will increase (require a greater time interval for valid updates) if the oscilloscope is used to display CRT Menus.

**B. LOOPING EXECUTION STRING**

Key entry sequence:

1. Press EXEC Key. This entry defines the beginning of an execution string.
2. Press 2ND Key (Except for RF MEMORY Menu).
3. Press desired menu name key. Choices are:  
 RF   DTMF   DCS  
 F. SWP   SCAN (Ref Note 4)  
 T. SWP   T. SEQ (Ref Note 4)
4. Key in desired menu item number (or line number) corresponding to desired operation. (MSD is most significant digit of item number, LSD is least significant digit.
5. Additional menu names and item numbers to be included in execution string (if desired) may be inserted here.
6. Press decimal point key. This entry will allow the FM/AM-1500 to continuously repeat the execution string.
7. Press ENTER Key to begin execution.
8. To stop looping execution, press any Function Key (T1, T2 or RF), or enter another execution string.



## 5-2-1 OPERATOR INTERVENTION

Once the automatic execution function has been initiated, the operator can intervene in a sequence for purposes of stopping, and/or manually stepping through the remainder of the execution string. The following keystrokes are used for intervening in an execution string:

A key entry of 2ND, STEP causes the execution sequence to stop; control of the execution string is now transferred to the cursor  $\wedge$ ,  $\vee$  and  $>$ ,  $<$  Keys as follows:

1. A  $\wedge$  Key entry allows the FM/AM-1500 to step to the next operation in the execution string. (For example, if the a DTMF execution string is stopped and the  $\wedge$  Key is pressed, the next "number" in the sequence will be executed.)
2. A  $\vee$  Key entry allows the FM/AM-1500 to step the preceding operation in the execution string (SWEEPS, SCAN, DTMF and TONE SEQUENCE). (For example, if the DTMF execution string is stopped and the  $\vee$  is pressed, the preceding "number" in the sequence will be executed.)
3. A  $>$  Key entry allows the FM/AM-1500 to continue execution **as long as the  $>$  Key is held in a depressed position**. Releasing the  $>$  Key will stop the execution sequence.
4. A  $<$  Key entry allows the FM/AM-1500 to continue execution in reverse order **as long as the  $<$  Key is held in a depressed position**. Releasing the  $<$  Key will stop the execution sequence.
5. Press ENTER Key to resume execution.
6. When using DCS MENU, halt execution of menu by pressing T1, T2, OFST or RF Key. (This differs from all other automatic functions in that it is not time dependent.)
7. When using DCS MENU, stop code may be generated by pressing 2nd Step. The  $>$  or  $<$  Key may be used to turn the selected code on or off when either  $>$  or  $<$  is pressed. Press ENTER Key to restore normal operation.

## 5-2-2 DISPLAYING HELP MENUS

| STEP | ACTION   |
|------|--|
| 1.   | Place front panel DISPLAY Control (51) to "HELP" position.   |
| 2.   | Press MENU Key, followed by $\wedge$ or $\vee$ Key, to scroll through the selection of available HELP menus previously described. Stop scrolling when desired menu is displayed. Press ENTER Key when desired menu is displayed. |

Table 5-1 Displaying HELP Menu

## 5-3 MENU DESCRIPTION

A brief description of the individual menu operation as well as a detailed description for each data field within a menu is covered in paragraphs 5-3-1 thru 5-3-9. A quick reference of menu parameter boundaries for the respective data field is listed in paragraph 5-3-11.

### 5-3-1 RF MEMORY MENU

The RF MEMORY Menu is used for storing frequency, offset and modulation/demodulation data, associated with the receiver and signal generator functions of the FM/AM-1500. Using this menu, the operator can program the FM/AM-1500 to automatically receive or generate up to 30 frequencies, which can be stored and retrieved as required by the operator. The contents of this menu can only be executed one line at a time. When testing a UUT, the menu can be programmed to receive the UUT transmit frequency or to generate an offset frequency to be received by the UUT. (The FM/AM-1500 GEN/REC and DUPLEX/SIMPLEX Switches determine the operating mode of the FM/AM-1500.) The parameters of the RF MEMORY Menu are defined as follows (reference Figure 5-1):

| XXX RF MEMORY MENU XXX |          |          |        |     |
|------------------------|----------|----------|--------|-----|
| ITEM                   | ITEMS    | FREQ     | OFFSET | MOD |
| 01                     | 30       | 010.0000 | +00.00 | AM1 |
| 02                     | 144.2250 | -01.00   |        | FM1 |
| 03                     | 000.6900 | +00.00   |        | AM2 |
| 04                     | 007.3000 | +00.00   |        | FM4 |
| 05                     | 096.7000 | +00.00   |        | FM3 |
| 06                     | 125.1500 | +00.00   |        | AM1 |
| 07                     | 095.0000 | +00.00   |        | FM4 |
| 08                     | 001.4100 | +00.00   |        | AM2 |

**Figure 5-1 RF MEMORY Menu**

- A. ITEM NUMBER**  
Identifies each line entry by number. A total of 30 line entries are possible on this menu.
- B. FREQUENCY**  
Programmable data field for entering receive or generate frequency of FM/AM-1500. Selectable frequency range is 000.0000 MHz to 999.9999 MHz.
- C. OFFSET**  
Programmable data field for entering FM/AM-1500 duplex offset frequency. Selectable offset range is -49.99 MHz to +49.99 MHz.
- D. MODULATION/DEMODULATION**  
Programmable data field for entering modulation/demodulation mode for FM/AM-1500. In the receive mode, demodulation mode can be programmed for AM1, AM2, FM1, FM2, FM3, FM4 or SSB. When executing an RF Memory Menu function, the front panel MODULATION CONTROL (7) must be in "AUTO" position to enable automatic modulation control. In the generate mode, the modulation parameters must be manually entered using the front panel FM/AM Switches (26 & 28) and Tone Controls (31 & 33). Any generate modulation functions must be set with the FM/AM-1500 in the "SIMPLEX" mode of operation (as described in procedure "A. GENERATING AM or FM MODULATED RF SIGNALS" in para. 4-6-3 of this manual).

### 5-3-2 RF SCAN MENU

The RF SCAN Menu allows the FM/AM-1500 receiver function to be used as a channel scanner, for monitoring "off-the-air" signals. This function enables the operator to program the FM/AM-1500 to automatically scan a sequence of up to 30 frequencies, with selectable demodulation and scan rate parameters. The parameters of the RF SCAN Menu are defined as follows (reference Figure 5-2):

| ITEM | RESUME TIME | FREQ | MOD |
|------|-------------|------|-----|
| 01   | 001.3000    | FM4  |     |
| 02   | 005.1000    | FM3  |     |
| 03   | 106.5000    | FM2  |     |
| 04   | 107.3000    | FM1  |     |
| 05   | 092.3000    | SSB  |     |
| 06   | 125.1500    | AMI  |     |
| 07   | 001.2400    | AM2  |     |

Figure 5-2 RF SCAN Menu

**A. 00 ITEM NUMBER**

Identifies the line entry for the RESUME TIME.

**B. RESUME TIME**

Programmable data field for entering the "resume time" of the FM/AM-1500 scanning function. Resume time is defined as the amount of time the FM/AM-1500 receiver will stay on the active channel. The resume time can be programmed from 0.0 seconds to 9.9 seconds and this time applies to all scan frequencies entered in the RF SCAN Menu. If a channel goes inactive before the resume time has expired, the FM/AM-1500 will automatically continue the scan sequence.

**C. ITEM NUMBER**

Identifies each line entry by number. A total of 30 line entries are possible on this menu.

**D. FREQUENCY**

Programmable data field for entering the receive frequency of the FM/AM-1500. Selectable frequency range is 000.0000 MHz to 999.9999 MHz.

**E. MODULATION/DEMULATION**

Programmable data field for entering modulation/demodulation mode for FM/AM-1500. In the receive mode, demodulation mode can be programmed for AM1, AM2, FM1, FM2, FM3, FM4 or SSB. When executing an RF SCAN Menu function, the front panel MODULATION Control (7) must be in "AUTO" position to enable automatic modulation control. In the generate mode, the modulation parameters must be manually entered using the front panel FM/OFF/AM Switches (26 & 28) and Tone Controls (31 & 33). Any generate modulation functions must be set with the FM/AM-1500 in the "SIMPLEX" mode of operation (as described in procedure "A. GENERATING AM or FM MODULATED RF SIGNALS" in para. 4-6-3 of this manual).

**5-3-3 RF SWEEP MENU**

The RF SWEEP Menu enables the operator to program the FM/AM-1500 to automatically sweep a selected RF frequency range, associated with the FM/AM-1500 receiver or generator functions. Programmable sweep parameters include sweep start and stop frequencies, increment step and increment rate. When an RF SWEEP Menu function is selected, the FM/AM-1500 will sweep from the START frequency to the STOP frequency in accordance with the preset step and rate parameters.

The RF SWEEP Menu consists of four menu subsets, each of which is preceded by an item number and which can be programmed with a separate set of sweep parameters. Only one menu subset can be executed at a given time. The parameters of the RF SWEEP Menu are defined as follows:



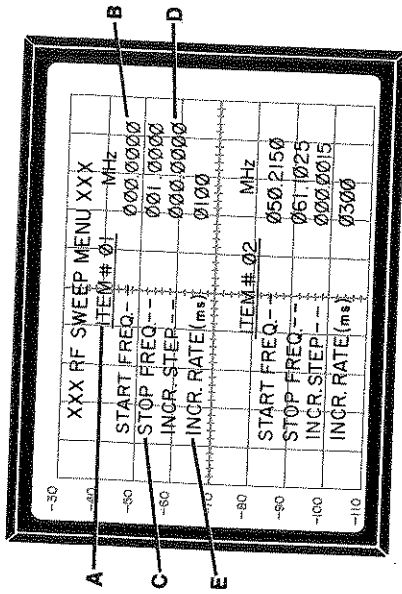


Figure 5-3 RF SWEEP Menu

- A. **ITEM NUMBER**  
Identifies each programmable menu subset.
- B. **START FREQUENCY**  
Programmable data field for entering sweep start frequency. Selectable START frequency range is 000.0000 MHz to 999.9999 MHz.
- C. **STOP FREQUENCY**  
Programmable data field for entering sweep stop frequency. Selectable STOP frequency range is 000.0000 MHz to 999.9999 MHz.
- D. **INCR STEP**  
Programmable data field for entering sweep step size. Minimum sweep step size is 0.0001 MHz (or 100 Hz) and maximum step size is 999.9999 MHz.
- E. **INCR RATE**  
Programmable data field for entering sweep increment rate. Selectable INCR RATE range is 1 mSec to 9999 mSec.

**5-3-4 TONE SEQUENCE MENU**  
 The TONE SEQUENCE Menu enables the operator to program the FM/AM-1500 tone generators to generate up to 99 successive single or dual tone sequences, with variable frequency, deviation and time parameters. The parameters of the TONE SEQUENCE Menu are defined as follows:

| XXX TONE SEQUENCE MENU XXX |               |             |              |
|----------------------------|---------------|-------------|--------------|
| ITEM<br>(1-99)             | -TONES-<br>Hz | DEV.<br>KHz | TIME<br>mSec |
| 01                         | T1 01200.0    | 10.0        | 0200         |
| 02                         | T1 00045.0    | 00.0        | 0060         |
|                            | T2 00200.0    | 00.0        | 0060         |
|                            | T2 00400.0    | 00.0        | 0060         |
| 03                         | T1 01600.0    | 10.0        | 0500         |
|                            | T2 00500.0    | 00.0        | 0060         |
| 04                         | T1 00400.0    | 00.0        | 0060         |
|                            | T2 00800.0    | 00.0        | 0060         |

**Figure 5-4 TONE SEQUENCE Menu**

- A. ITEM NUMBER**  
 Non-programmable data field which identifies each line entry by number. A total of 99 line entries are possible on this menu.
- B. TONE 1 & TONE 2 FREQUENCY**  
 Programmable data fields for entering frequency of Tone Generator #1 (T1) and Tone Generator #2 (T2). Selectable frequency range for each tone generator is 00000.0 to 29999.9 Hz.
- C. TONE 1 & TONE 2 DEVIATION**  
 Programmable data fields for entering desired deviation and amplitude of Tone Generator #1 and Tone Generator #2. Selectable deviation range for each field is 00.0 kHz to 25.5 kHz. When AM is selected on MODULATION Control (7) the automatic modulation switches to AM. The level of AM is displayed as 10 kHz which equals 100% AM modulation.

### D. TONE 1 & TONE 2 TIME

Programmable data field for entering the time interval that the generated tones will be active. Selectable time limits are 1 mSec to 9999 mSec.

### 5-3-5 DTMF MENU

The DTMF Menu is used for storing and synthesizing "touch-tone" telephone numbers. The parameters of the DTMF Menu are defined as follows:

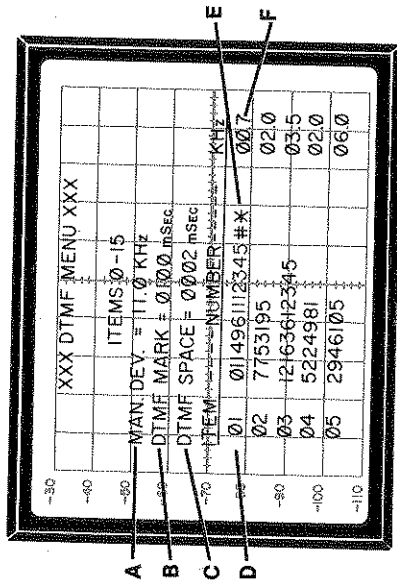


Figure 5-5 DTMF Menu

### A. MANUAL DEVIATION

Programmable data field for entering deviation and amplitude parameters for Tone Generator #1 and Tone Generator #2. Selectable deviation range is from 0.0 kHz to 25.5 kHz. This field used only when the DTMF manual function is active (see para. 4-4-3, D. USING TONE GENERATOR DTMF MANUAL FUNCTION AS A "TOUCH-TONE" SYNTHESIZER in Section 4 of this manual.) When AM is selected on MODULATION Control (7) the automatic modulation switches to AM. The level of AM is displayed as 10 kHz which equals 100% AM modulation.

### B. DTMF MARK

Programmable data field for entering the time each digit of a telephone number is active. Selectable DTMF mark time ranges is 0001 mSec to 9999 mSec.

### C. DTMF SPACE

Programmable data field for entering the "dead time" between each digit of the telephone number. Selectable DTMF space time range is 0001 mSec to 9999 mSec.

### D. ITEM NUMBER

Identifies each line entry by number. A maximum of 15 line entries is possible on this menu.

### E. TELEPHONE NUMBER

Programmable data field for entering DTMF telephone number. A maximum of 15 digits may be entered into this field. Usable keys include all numeric keys and #/\* keys (2nd function accessible).

### F. DTMF DEVIATION

Programmable data field for entering deviation and amplitude parameters for Tone Generator #1 and Tone Generator #2. Selectable deviation range is from 0.0 kHz to 25.5 kHz. When AM is selected on MODULATION Control (7), the automatic modulation switches to AM. The level of AM is displayed as 10 kHz which equals 100% AM modulation.

## 5-3-6 TONE SWEEP MENU

The TONE SWEEP Menu enables the operator to program the FM/AM-1500 Tone Generator #1 to automatically sweep a selected audio frequency range according to the preset sweep parameters. Programmable sweep parameters include start and stop frequencies, increment rate, increment step and sweep mode (linear vs. logarithmic). In the linear sweep mode, the FM/AM-1500 will sweep in a linear progression from the START frequency to the STOP frequency, in accordance with the preset INCR STEP and INCR RATE parameters. If STOP frequency is above the START frequency, the INCR STEP will be added to the current frequency; if STOP frequency is below the START frequency, the INCR step will be subtracted from the current frequency. In the logarithmic sweep mode, the FM/AM-1500 will sweep in a logarithmic progression according to the value of the INCR STEP multiplier. If the value of the INCR STEP multiplier is less than 1, the FM/AM-1500 will sweep to a value below the START frequency, which may be the STOP frequency (if less than the START frequency) or the minimum sweep limit of 1.0 Hz. Conversely, if the multiplier is greater than 1, the direction of sweep is to a value above the START frequency, which may be the STOP frequency (if greater than the START frequency) or the maximum sweep limit of 99,999.9 Hz. In the logarithmic sweep mode, each successive sweep step is obtained by multiplying the current frequency by the INCR STEP multiplier.

The TONE SWEEP Menu consists of four menu subsets, each of which is preceded by an item number and which can be programmed with a separate set of sweep parameters. The parameters of the TONE SWEEP Menu are defined as follows

| ITEM# | START FREQ. (Hz) | STOP FREQ. (Hz) | INCR. RATE (ms) |
|-------|------------------|-----------------|-----------------|
| 01    | 00001.0          | 20000.0         | 00001.0         |
| 02    | 00100.0          | 01500.0         | 00100.0         |

Figure 5-6 TONE SWEEP Menu

- A. ITEM NUMBER**  
Identifies each programmable menu subset. A total of 4 menu subsets are available for programming.
- B. START FREQUENCY**  
Programmable data field for entering sweep start frequency. Selectable frequency range for START FREQUENCY is 00000.0 Hz to 29999.9 Hz.
- C. STOP FREQUENCY**  
Programmable data field for entering sweep stop frequency. Selectable frequency range for STOP FREQUENCY is 00000.0 Hz to 29999.9 Hz.
- D. SWEEP MODE**  
Programmable data field for selecting the FM/AM-1500 sweep mode. A "+" in this field will produce a linear sweep, while an "x" will produce a logarithmic sweep.

#### **E. INCR STEP**

Programmable data field for entering sweep step size. The INCR STEP ranges are 00000.0 to 29999.9 for linear sweep and 0.00 to 2.00 for logarithmic sweep. (Although a higher value than 2 can be entered into the INCR STEP data field, the maximum permissible multiplier for the logarithmic sweep is 2.00.)

#### **F. INCR RATE**

Programmable data field for entering sweep increment rate. Selectable sweep INCR RATE is 1 mSec to 9999 mSec.

#### **5-3-7 DCS MENU**

The DCS (DIGITALLY-CODED SQUELCH) Menu allows the FM/AM-1500 to perform as a DCS generator and receiver. The DCS Menu allows data entry for generate item parameters and receive display locations for valid octal code numbers. Valid DCS octal code numbers are non-programmable data fields, which consist of a maximum of six octal code numbers decoded from a single DCS word. All valid DCS octal codes within the data word are displayed. The display of the received octal code numbers occurs whenever the DCS Menu is recalled, and will remain displayed until reception has stopped for one second or the DCS "STOP CODE" is received.

The DCS generate function is recalled in the same manner as other automatic functions (i.e. Tone Sequence, etc.) The DCS function begins when the ENTER Key is pressed, and will continue until the operator halts execution. (This differs from other automatic functions, as it must be halted manually by the operator.) The parameters of the DCS Menu are defined as follows:

| DIGITALLY-CODED SQUELCH |        |      |     |
|-------------------------|--------|------|-----|
| GENERATE                | KF#    | POL  | DEV |
| ITEM                    | CODE # |      |     |
| 01                      | 223    | NORM | 0.7 |
| 02                      | 107    | NORM | 0.7 |
| 03                      | 667    | INVT | 0.6 |
| 04                      | 106    | NORM | 0.5 |
| RECEIVE                 |        |      |     |
| DATA POLARITY           | NORM   |      |     |
| --VALID CODE NUMBERS    |        |      |     |
| #1-                     | #2-    | #3-  |     |
| #4-                     | #5-    | #6-  |     |

**A. ITEM NUMBER**

Identifies each line entry by number. A maximum of ten line entries are possible on this menu.

**B. CODE NUMBER**

Programmable data field used to display the DCS data number. Data is a three digit octal number from 000(0) to 777 (7).

**C. POLARITY**

Programmable data field used to display the DCS data word polarity. Data is displayed as either NORM (Normal Polarity) or INVT (Inverted Polarity).

**D. DEVIATION**

Programmable data field used to display the DCS deviation. Selectable deviation range is from 0.0 kHz to 9.9 kHz.

### **E. DATA POLARITY**

Programmable data field for selecting the received data polarity. Selections are NORM and INVERT by use of the  $\wedge$  or  $\vee$  keys.

### **F. 00 ITEM NUMBER**

Identifies the line entry for the data polarity.

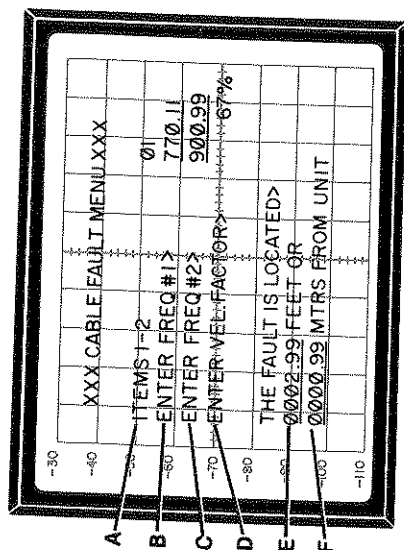
### **G. VALID CODE NUMBERS**

Non-programmable data fields used to display all valid DCS codes contained in the received DCS word. Data fields are blank if no code is received or DCS "STOP" code is received. Data is a three digit octal number from 000<sub>(8)</sub> to 777<sub>(8)</sub>.

### **5-3-8 CABLE FAULT MENU**

The CABLE FAULT Menu is intended for use in conjunction with the FM/AM-1500 Tracking Generator function, in order to calculate cable fault distances. By performing the "CABLE FAULT TESTING" procedure in paragraph 4-8-3 of Section 4 of this manual, the operator will obtain two frequency values ( $F_1$  and  $F_2$ ), which are associated with the frequency response of the cable under test. These values, along with the cable velocity factor (available from the cable manufacturer's specifications) can be entered into the CABLE FAULT Menu, to automatically compute the distance of the cable fault. The CABLE FAULT Menu consists of two identical menu subsets, which enable the operator to enter two sets of cable fault variables. The parameters of the CABLE FAULT Menu are defined as follows:





**Figure 5-8 CABLE FAULT Menu**

**A. ITEM NUMBER**

Programmable data field for selecting CABLE FAULT Menu subset 1 or 2.

**B. FREQ #1**

Programmable data field for entering frequency  $F_1$  (as obtained in CABLE FAULT TESTING procedure in Section 4, para. 4-10-3). Selectable frequency range for  $F_1$  is 000.00 to 999.99 MHz.

**C. FREQ #2**

Programmable data field for entering frequency  $F_2$  (as obtained in CABLE FAULT TESTING procedure in Section 4, para. 4-10-3). Selectable frequency range for  $F_2$  is 000.00 to 999.99 MHz.

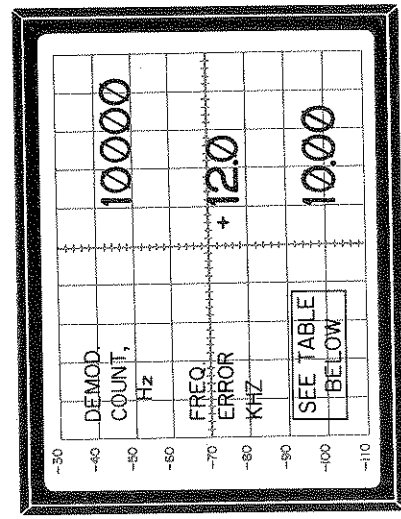
**D. VEL FACTOR**

Programmable data field for entering cable velocity factor. Selectable range for this data field is 0 to 99%.

- E. **CABLE FAULT DISTANCE (FEET)**  
 Non-programmable data field where the calculated cable fault distance (in feet) is displayed. Displayed result will be within a range of 000.0 ft to 999.9 ft.
- F. **CABLE FAULT DISTANCE (METERS)**  
 Non-programmable data field where the calculated cable fault distance (in meters) is displayed. Displayed result will be within a range of 000.0 meters to 999.9 meters.

**5-3-9 METER MENU**

The FM/AM-1500 METER Menu is a non-programmable menu, which provides an alphanumeric display of signal parameters monitored by the FM/AM-1500 front panel meters. To display the METER Menu, place the DISPLAY Control (51) to the "METER" position. Displayed parameters include demodulated audio frequency, frequency error, deviation, % AM modulation, power, signal strength (%) and SINAD. A sample display of the METER Menu is shown in Figure 5-9. The top two data fields of the menu will always display the demodulated audio frequency and frequency error. The information displayed in the bottom data field will vary, depending on the positions of the front panel MODULATION Control (7) and DEV/PWR Control (6); (see Table 5-2).



**Figure 5-9 METER Menu**

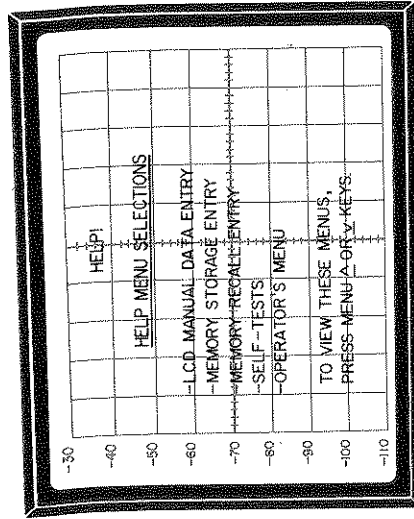
| POSITION OF MODULATION CONTROL | POSITION OF DEV/PWR CONTROL | DATA DISPLAYED IN BOTTOM DATA FIELD OF METER MENU |
|--------------------------------|-----------------------------|---|
| AM1<br>AM2<br>OR<br>SSB        | kHz/DIV                     | MODULATION<br>% AM                                |
| FM1<br>FM2<br>FM3<br>OR<br>FM4 | kHz/DEV                     | DEV,<br>kHz                                       |
| (IRRELEVANT)                   | POWER                       | POWER,<br>WATTS                                   |
| (IRRELEVANT)                   | SIG                         | SIGNAL,<br>%                                      |
| (IRRELEVANT)                   | SINAD                       | SINAD,<br>-dB                                     |

**Table 5-2 Meter Menu Variations**

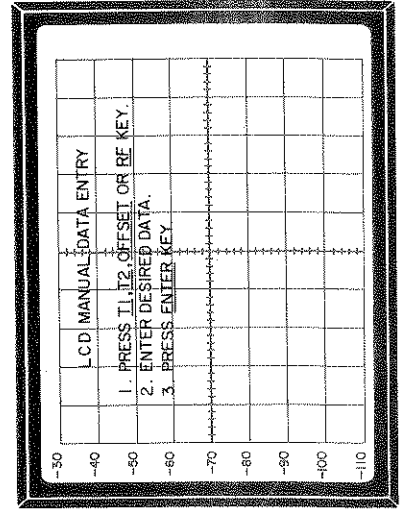
**5-3-10 HELP MENUS**

The FM/AM-1500 HELP Menus consist of the following utility menus which contain operator assistance and FM/AM-1500 self-test information:

1. **HELP Master Menu**  
Provides an index of available HELP Menus.



2. **LCD Manual Data Entry Menu**  
Provides a quick reference on how to enter operating data into the FM/AM-1500 LCD, using the Keyboard. (See para. 3-3 of Section 3 for detailed instructions on this procedure.)





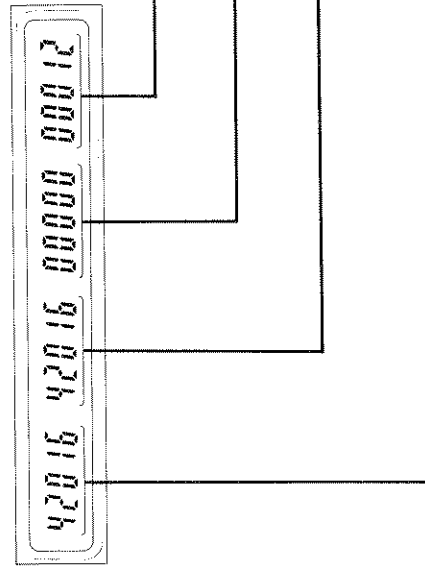
5. **Self-Test**

Provides a quick reference on how to call-up a particular self-test function on the FM/AM-1500.

- a. Code 1 MEMORY TEST (EXEC, 1, ENTER)

The MEMORY Test is initiated by entering: EXEC, 1, ENTER. The LCD displays the results of the test as shown below. This test will run until the operator depresses and holds down the ENTER Key through end of test cycle, restoring original field settings.

LCD READOUT



COUNT #1 — VALID TEST COUNT. (INCREMENTS FOR EACH VALID MEMORY TEST CYCLE.)

COUNT #2 — FAIL TEST COUNT. (INCREMENTS EACH TIME THE MEMORY TEST CYCLE FAILS.)

NON-VOLATILE CHECKSUM (COMPUTED) — (16 BIT CHECKSUM OF NON-VOLATILE MEMORY AS COMPUTED AT TIME OF TEST.)

NON-VOLATILE CHECKSUM (STORED) — (16 BIT CHECKSUM OF NON-VOLATILE MEMORY AS STORED IN MEMORY LAST TIME POWER WAS TURNED OFF.)

|      |                     |
|------|---------------------|
| -30  | XX SELF TEST XX     |
| -40  | 1. PRESS EXEC KEY   |
| -50  | 2. SELECT TEST CODE |
| -60  | 3. PRESS ENTER KEY  |
| -70  | CODE                |
| -80  | DESCRIPTION         |
| -90  | 1. MEMORY TEST      |
| -100 | 2. CRT TEST         |
| -110 | 3. LCD TEST         |
|      | 4. CPU TEST         |
|      | 5. OPERATOR'S MENU  |

b. Code 2 CRT TEST (EXEC, 2, ENTER)

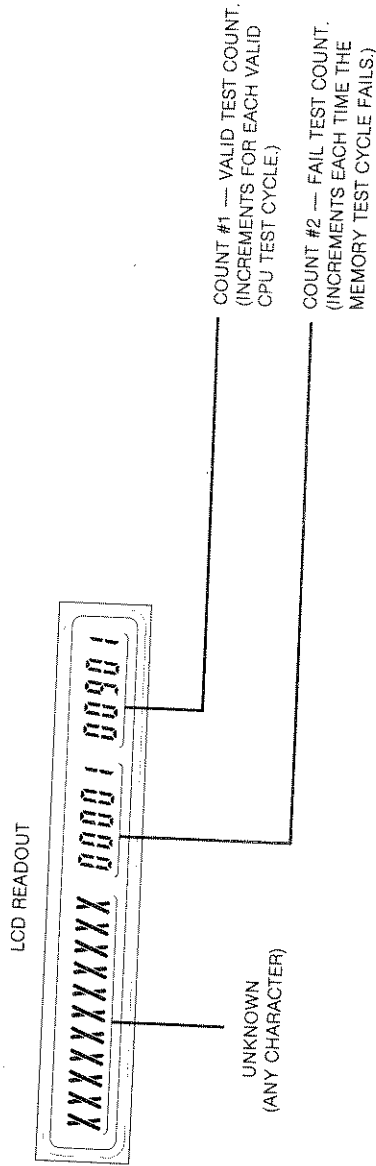
The CRT Test allows the operator to check each displayed character by using the  $\wedge$  or v keys. By depressing the  $\wedge$  Key, the next character code will be displayed; and by depressing the v Key, the previous character code will be displayed. The ENTER Key exits the CRT Test and returns the set to normal operation.

c. Code 3 LCD TEST (EXEC, 3, ENTER)

The LCD Test allows the operator to check each displayed character of the LCD. This test increments and shifts the characters from left to right, and will run continuously until the operator depresses and holds down the ENTER Key, restoring original field settings.

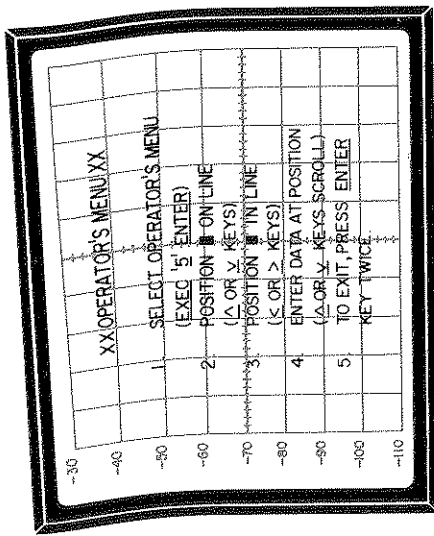
d. Code 4 CPU TEST (EXEC, 4, ENTER)

The CPU Test exercises all the CPU BUS lines within the internal bus connection. All data, address and control lines are checked for shorts, opens, etc. This test causes the LCD to flicker, internal relays to chatter and various LED's to blink, and will run in this mode until an error occurs, causing the LCD to display the following:



Depressing the ENTER Key after an error restarts the test. Depressing the ENTER Key during the test exits this test function, restoring original field settings.

- e. Code 5 OPERATOR'S MENU  
(EXEC, 5, ENTER)  
Provides a quick reference explanation on how to enter data into a user defined page on the CRT.



The OPERATOR'S Menu describes how to enter data, into a screen of data, which is stored for later recall by entering: EXEC, 5, ENTER. The last stored menu is recalled and screen editing is allowed. The cursor may be moved along the left edge of the screen by using the ^ or v keys, to move up and down for line selection. When the desired line is selected, the > Key will move the cursor to the right, into the line, and the < Key will move the cursor backward (to the left). When the cursor is positioned over the character to be changed, the ^ and v keys now slew the character to the next or previous ASCII character. After the desired ASCII character is found, the < or > Key may be used to select other characters.

When all editing is complete, depress the ENTER Key. This stores the screen in non-volatile memory. Depressing the ENTER Key again exits the OPERATOR Menu function and returns to the IFR LOGO start-up mode. Pressing any other key returns the test set to the operator's menu, with data saved.



### 5-3-11 SUMMARY OF MENU PARAMETER BOUNDARIES

The following table provides a list of parameter boundaries for the FREQ and TONE MENUS in the FM/AM-1500:

| MENU          | DISPLAY SWITCH POSITION | ITEM NO.                 | FIELD  | PARAMETER BOUNDARIES  |
|---------------|-------------------------|--------------------------|--|---|
| RF Memory     | FREQS                   | 1 thru 30                | Frequency Offset Mod   | 000.0000 to 999.9999 MHz<br>-49.99 to + 49.99<br>AM1, AM2, FM1, FM2, FM3,<br>FM4, or SSB  |
| RF Scan       | FREQS                   | Resume Time<br>0 thru 30 | 0.0 to 9.9 seconds<br>Frequency Mod  | 000.0000 to 999.999 MHz<br>AM1, AM2, FM1, FM2, FM3,<br>FM4, or SSB  |
| RF Sweep      | FREQS                   | 1 thru 4                 | Start Freq.<br>Stop Freq.<br>Incr. Step<br>Incr. Rate                                    | 000.0000 to 999.9999 MHz<br>000.0000 to 999.9999 MHz<br>000.0001 to 999.9999 MHz<br>0.001 to 9.999 seconds  |
| Tone Sequence | TONES                   | 1 thru 99                | Tone 1 Freq.<br>Tone 1<br>Deviation<br>Time<br>Tone 2 Freq.<br>Tone 2<br>Deviation       | 0000.0 to 29999.9 Hz<br><br>00.0 to 25.5 kHz<br>0.001 to 9.999 seconds<br>0000.0 to 29999.9 Hz<br><br>00.0 to 25.5 kHz                                  |
| DTMF          | TONES                   | 0 thru 15                | Manual<br>Deviation<br>DTMF Mark<br>DTMF Space<br>Telephone No.<br><br>DTMF<br>Deviation | 00.0 to 25.5 kHz<br>0.001 to 9.999 seconds<br>0.001 to 9.999 seconds<br>15 digits consisting of 0,1,<br>2,3,4,5,6,7,8,9 * and #<br><br>00.0 to 25.5 kHz |

Table 5-3 Summary of Menu Parameter Boundaries

|             |                         |           | PARAMETER BOUNDARIES   |  |
|-------------|-------------------------|-----------|--|--|
| MENU        | DISPLAY SWITCH POSITION | ITEM NO.  | FIELD  |  |
| Tone Sweep  | TONES                   | 1 thru 4  | Start Freq.<br>Stop Freq.<br>Sweep Mode<br>Incr. Step<br>Incr. Rate                                    | 00000.0 to 29999.9 Hz<br>00000.0 to 29999.9 Hz<br>Linear (+) or log (x)<br>00000.0 to 29999.9 Hz<br>0.001 to 9.999 seconds                       |
| DCS         | TONES                   | 0 thru 10 | Code Number<br>Polarity<br>kHz Deviation<br>6 Receive Fields<br>Receive Polarity                       | 000 <sup>(e)</sup> to 777 <sup>(e)</sup><br>Normal/Inverted<br>0.0 kHz to 9.9 kHz<br>000 <sup>(e)</sup> to 777 <sup>(e)</sup><br>Normal/Inverted |
| Cable Fault | FREQS                   | 1 & 2     | Freq. 1<br>Freq. 2<br>Vel Factor<br>Cable Fault<br>Distance (Feet)<br>Cable Fault<br>Distance (Meters) | 000.0000 to 999.99 MHz<br>000.0000 to 999.99 MHz<br>0 to 99%<br>000.0 to 999.9 feet<br>000.0 to 999.9 meters                                     |

Table 5-3 Summary of Menu Parameter Boundaries (Cont'd)

#### 5-4 DATA STORAGE

Data may be stored in the FM/AM-1500 by altering the data fields within the TONES or FREQ Menus. The steps listed below must be performed to alter data:

1. Select appropriate menu.
2. Select item number to be programmed.
3. Program data field(s).
4. If desired, special character fields may be altered.

### 5-4-1 SELECTING APPROPRIATE MENU

Selecting the menu to be programmed is accomplished as follows:

| STEP             | ACTION  |
|------------------|---|
| 1A.<br>or<br>1B. | Place front panel DISPLAY Control (51) to "FREQS" position for RF MEMORY, RF SCAN, RF SWEEP or CABLE FAULT MENU.  |
| 2.               | Place front panel DISPLAY Switch (51) to "TONES" position for TONE SEQUENCE, DTMF, TONE SWEEP or DCS MENU.  |
| 3.               | If the menu of interest is now displayed, proceed directly to Section 5-4-2; otherwise press MENU Key.  |
| 4.               | Press $\wedge$ or $\vee$ Key to scroll through menu pages, to display desired menu on CRT. Press ENTER Key. Desired menu is now selected and ready for programming. |

**Table 5-4 Selecting Desired Menu**

### 5-4-2 SELECTING ITEM NUMBER

Selecting the item number to be programmed is accomplished as follows:

| STEP | ACTION  |
|------|---|
| 1.   | Press $\wedge$ or $\vee$ Key to scroll through this menu's line numbers. Stop scrolling when desired line number is positioned on top line of item numbers.<br>----- Alternate Method -----<br>a. Enter desired line number using numbered keys.<br>b. Press ENTER Key. |

**Table 5-5 Selecting Menu Item Number**

### 5-4-3 PROGRAMMING DATA FIELDS

Programming data fields for each menu is accomplished as follows:

#### A. RF MEMORY MENU

| STEP | ACTION   |
|------|--|
| 1.   | Press > Key to position CRT cursor to FREQ data field.   |
| 2.   | Enter desired frequency, using numeric and decimal point keys.   |
| 3.   | Press > Key to position CRT cursor to OFFSET (Polarity) data field.  |
| 4.   | Press $\wedge$ or $\vee$ Key to enter desired polarity.  |
| 5.   | Press > Key to position CRT cursor to next character field of OFFSET data field.   |
| 6.   | Enter desired offset frequency, using numeric and decimal point keys.  |
| 7.   | Press > Key to position CRT cursor to MOD data field.  |
| 8.   | Press $\wedge$ or $\vee$ Key to scroll through the selection of demodulation modes (AM1, AM2, SSB, FM1, FM2, FM3, FM4). Stop scrolling when desired demodulation mode appears in MOD data field.   |
|      | <b>ERROR CORRECTION</b>  |
|      | Before the FREQ, OFFSET & MOD parameters are entered into memory, any entry errors can be corrected as follows:  |
|      | Press < Key as necessary to return CRT cursor to data field where error is located in order to make error correction. If CRT cursor is returned under ITEM NO., the existing entry will be cancelled and will be replaced by previously stored data. |
| 9.   | Press ENTER Key to enter programmed data into user memory.   |

| STEP | ACTION  |
|------|---|
| 10.  | If additional lines in the RF MEMORY Menu are to be programmed, repeat step 1 in table 5-5. |

**Table 5-6 Programming Frequency, Offset & Mod Data Fields**

**B. RF SCAN MENU**

| STEP | ACTION   |
|------|--|
| 1.   | Press > Key to position CRT cursor to FREQ data field.   |
| 2.   | Enter desired frequency, using numeric and decimal point keys.   |
| 3.   | Press > Key to position CRT cursor to MOD data field.  |
| 4.   | Press ^ or v Key to scroll through the selection of demodulation modes (AM1, AM2, SSB, FM1, FM2, FM3, FM4). Stop scrolling when desired demodulation mode appears in MOD data field.   |
|      | <b>ERROR CORRECTION</b>  |
|      | Before the FREQ and MOD parameters are entered into memory, any entry errors can be corrected as follows:  |
|      | Press < Key as necessary to return CRT cursor to data field where error is located in order to make error correction. If CRT cursor is returned under ITEM NO., the existing entry will be cancelled and will be replaced by previously stored data. |
| 5.   | Press ENTER Key to enter programmed data into user memory.   |
| 6.   | If additional lines in the RF SCAN Menu are to be programmed, repeat step 1 in table 5-5.  |

**Table 5-7 Programming Frequency and Modulation Data Fields**

### C. RF SWEEP MENU

| STEP | ACTION  |
|------|---|
| 1.   | Press > Key to position CRT cursor under to START FREQ data field.  |
| 2.   | Enter desired start frequency, using numeric and decimal point keys.  |
| 3.   | Press > Key to position CRT cursor to STOP FREQ data field.   |
| 4.   | Enter desired stop frequency, using numeric and decimal point keys.   |
| 5.   | Press > Key to position CRT cursor to INCR STEP data field.   |
| 6.   | Enter desired increment step, using numeric keys and decimal point keys.  |
| 7.   | Press > Key to position CRT cursor to INCR RATE data field.   |
| 8.   | Enter desired increment rate, using numeric keys.   |
|      | <p style="text-align: center;">ERROR CORRECTION</p> <p>Before the START FREQ, STOP FREQ, INCR STEP &amp; INCR RATE parameters are entered into memory, any entry errors can be corrected as follows:</p> <p>Press &lt; Key as necessary to return CRT cursor to data field where error is located in order to make error correction. If CRT cursor is returned under ITEM NO., the existing entry will be cancelled and will be replaced by previously stored data.</p> |
| 9.   | Press ENTER Key to enter programmed data into user memory.  |
| 10.  | If any additional menu subsets in the RF SWEEP Menu are to be programmed, repeat step 1 in table 5-5.   |

**Table 5-8 Programming Start Freq, Stop Freq, Incr Step & Incr Rate Fields**

### D. CABLE FAULT MENU

| STEP | ACTION   |
|------|--|
| 1.   | Press > Key to position CRT cursor to FREQ #1 data field.  |
| 2.   | Enter FREQ #1 frequency, using numeric and decimal point keys.   |
| 3.   | Press > Key to position CRT cursor to FREQ #2 data field.  |
| 4.   | Enter desired FREQ #2 frequency, using numeric and decimal point keys.   |
| 5.   | Press > Key to position CRT cursor to VEL FACTOR data field.   |
| 6.   | Enter cable velocity factor, using numeric keys.   |
|      | ERROR CORRECTION   |
|      | Before the FREQ #1, FREQ #2 & VEL FACTOR parameters are entered into memory, any entry errors can be corrected as follows: |
|      | Press < Key as necessary to return CRT cursor to data field where error is located in order to make error correction.      |
| 7.   | Press ENTER Key to display computed cable fault distances.   |

**Table 5-9 Programming Freq 1, Freq 2 & VEL Factor Fields**

### E. TONE SEQUENCE MENU

| STEP | ACTION  |
|------|---|
| 1.   | Press > Key to position CRT cursor to T1 TONES data field.        |
| 2.   | Enter desired T1 frequency, using numeric and decimal point keys. |
| 3.   | Press > Key to position CRT cursor to T1 DEV data field.          |
| 4.   | Enter desired T1 deviation, using numeric and decimal point keys. |
| 5.   | Press > Key to position CRT cursor to TIME data field.            |

| STEP | ACTION   |
|------|--|
| 6.   | Enter desired TIME, using numeric keys.<br>Repeat steps 1 through 4 for T2 data fields.  |
| 7.   | ERROR CORRECTION<br><br>Before the T1 and T2 TONES, DEV & TIME parameters are entered into memory, any entry errors can be corrected as follows:<br>Press < Key as necessary to return CRT cursor to data field where error is located in order to make error correction. If CRT cursor is returned under ITEM NO., the existing entry will be cancelled and will be replaced by previously stored data.<br>Press ENTER Key to enter programmed data into user memory. |
| 8.   | If additional lines in the TONE SEQUENCE Menu are to be programmed, repeat step 1 in table 5-5.  |
| 9.   |  |

**Table 5-10 Programming Tones, Deviation & Time Data Fields**

**F. DTMF MENU**

| STEP | ACTION   |
|------|--|
| 1.   | Press > Key to position CRT cursor to TELEPHONE NUMBER data field.   |
| 2.   | Enter desired telephone number, using numeric, 2ND/* and 2ND/# Keys.   |
| 3.   | Press > Key to position CRT cursor to DEVIATION data field.  |
| 4.   | Enter desired deviation using numeric and decimal point keys.<br>ERROR CORRECTION                                      |
|      | Before the TELEPHONE NO. & DEVIATION parameters are entered into memory, any entry errors can be corrected as follows: |



| STEP | ACTION  |
|------|---|
|      | <p style="text-align: center;"><b>ERROR CORRECTION</b></p> <p>Press &lt; Key as necessary to return CRT cursor to data field where error is located in order to make error correction. If CRT cursor is returned under ITEM NO., the existing entry will be cancelled and will be replaced by previously stored data.</p> <p>Press ENTER Key to enter programmed data into user memory.</p> <p>If additional lines in the DTMF Menu are to be programmed, repeat step 1 in table 5-5.</p> |
| 5.   |   |
| 6.   |   |

**Table 5-11 Programming Telephone Number & Deviation Data Fields**

**G. TONE SWEEP MENU**

| STEP | ACTION  |
|------|---|
| 1.   | Press > Key to position CRT cursor to START FREQ data field.                  |
| 2.   | Enter desired start frequency, using numeric and decimal point keys.          |
| 3.   | Press > Key to position CRT cursor to STOP FREQ data field.                   |
| 4.   | Enter desired stop frequency, using numeric and decimal point keys.           |
| 5.   | Press > Key to position CRT cursor to MODE data field.                        |
| 6.   | Enter desired sweep mode (+ for linear, x for logarithmic) using ^ or v Keys. |
| 7.   | Press > Key to position CRT cursor to INCR STEP data field                    |
| 8.   | Enter desired increment step, using numeric keys.                             |
| 9.   | Press > Key to position CRT cursor to INCR RATE data field.                   |

| STEP       | ACTION   |
|------------|--|
| 11.<br>12. | <p data-bbox="365 430 397 1144"><b>ERROR CORRECTION</b></p> <p data-bbox="414 430 462 1596">Before the START FREQ, STOP FREQ, MODE, INCR STEP &amp; INCR RATE parameters are entered into memory, any entry errors can be corrected as follows:</p> <p data-bbox="479 577 625 1596">Press &lt; Key as necessary to return CRT cursor to data field where error is located in order to make error correction. If CRT cursor is returned under ITEM NO., the existing entry will be cancelled and will be replaced by previously stored data.</p> <p data-bbox="641 735 657 1585">Press ENTER Key to enter programmed data into user memory.</p> <p data-bbox="673 504 722 1585">If any additional menu subsets in the TONE SWEEP Menu are to be programmed, repeat step 1 in table 5-5.</p> |

**Table 5-12 Programming Start Freq, Stop, Freq, Mode, Incr Step & Incr Rate Data Fields**

**H. DCS MENU**

| STEP                                   | ACTION  |
|--|---|
| 1.<br>2.<br>3.<br>4.<br>5.<br>6.<br>7. | <p data-bbox="1063 703 1079 1585">Press &gt; Key to position CRT cursor to CODE NUMBER data field.</p> <p data-bbox="1096 850 1112 1585">Enter desired code number using numeric key 0 thru 7.</p> <p data-bbox="1128 777 1144 1585">Press &gt; Key to position CRT cursor to POLARITY data field.</p> <p data-bbox="1161 640 1226 1585">Enter desired polarity (NORM for normal polarity and INVT for inverted polarity) using ^ Key or v Key.</p> <p data-bbox="1242 714 1258 1585">Press &gt; Key to position CRT cursor to kHz DEVIATION data field.</p> <p data-bbox="1274 829 1291 1585">Enter desired deviation using numeric and decimal keys.</p> <p data-bbox="1307 682 1323 1585">Press ENTER Key to enter PROGRAMMED DATA into user memory.</p> |

**Table 5-13 Programming Code Number, Polarity & kHz Deviation Data Fields**

### 5-4-4 PROGRAMMING SPECIAL CHARACTER FIELDS

The RF SCAN, DTMF and DCS Menus have special character fields. Once the menu is selected, these special character fields may be programmed as follows:

#### A. RF SCAN MENU SPECIAL CHARACTER FIELD

| STEP | ACTION   |
|------|--|
| 1.   | Press $\emptyset$ Key, followed by ENTER Key.  |
| 2.   | Enter desired resume time, using numeric and decimal point keys (0.0 to 9.9).  |
| 3.   | Press ENTER Key to save data. RF SCAN Menu resume time is now programmed into memory. > Key will return to resume time field if further editing is required. Press ENTER Key again to return to Item #1.   |
| 4.   | <p>ERROR CORRECTION</p> <p>Before the RESUME TIME parameter is entered into memory, any entry errors can be corrected as follows:</p> <p>Press &lt; Key to restore original data or press &gt; Key to return CRT cursor to beginning of resume time field. Then re-enter correct data.</p> <p>Press ENTER Key to enter programmed data into user memory.</p> |

**Table 5-14 Programming Resume Time**

#### B. DTMF MENU SPECIAL CHARACTER FIELDS

| STEP | ACTION   |
|------|--|
| 1.   | Press $\emptyset$ Key, followed by ENTER Key.                                      |
| 2.   | Press > Key to position CRT cursor to MANUAL DEV data field.                       |
| 3.   | Enter desired manual deviation, if required, using numeric and decimal point keys. |

| STEP   | ACTION  |
|--|---|
| 4.   | Press > Key to position CRT cursor to DTMF Mark data field.               |
| 5.   | Enter desired mark time using numeric and decimal point keys.             |
| 6.   | Press > Key to position CRT cursor to DTMF SPACE data field.              |
| 7.   | Enter desired space time using numeric and decimal point keys.            |
| 8.   | Press ENTER Key to save data. Press ENTER Key again to return to item #1. |
| <p style="text-align: center;"><b>ERROR CORRECTION</b></p> <p>Before the MANUAL DEV, DTMF Mark &amp; DTMF Space parameters are entered into memory any entry errors can be corrected as follows:</p> <p>Press &lt; Key as necessary to return CRT cursor to data field where error is located in order to make error correction. If CRT cursor is returned under ITEM NO., the existing entry will be cancelled and will be replaced by previously stored data. &gt; Key will return to Ø field editing if further changes are needed.</p> |   |

**Table 5-15 Programming Manual Dev, DTMF Mark & DTMF Space Fields**

**C. DCS MENU SPECIAL CHARACTER FIELD**

| STEP | ACTION  |
|------|---|
| 1.   | Press Ø Key, followed by ENTER Key.   |
| 2.   | Enter desired polarity (NORM for normal polarity and INVT for inverted polarity) using ^ or v Keys. |
| 3.   | Press ENTER Key to save data. Press ENTER Key again to return to item #1.                           |

| STEP | ACTION  |
|------|---|
| 4.   | <p data-bbox="164 758 207 1052"><b>ERROR CORRECTION</b></p> <p data-bbox="185 348 253 1514">Before the DATA POLARITY is entered into memory, any entry errors can be corrected as follows:</p> <p data-bbox="253 478 342 1514">Press &lt; Key to restore original data or press &gt; Key to return CRT cursor to beginning of resume time field. Then re-enter correct data.</p> <p data-bbox="326 667 380 1514">Press ENTER Key to enter programmed data into user memory.</p> |

**Table 5-16 Programming Data Polarity**



# APPENDIX A -- FM/AM-1500 SPECIFICATIONS

## A-1 RF SIGNAL GENERATOR

- Frequency Range: 100 kHz to 999.9999 MHz in 100 Hz increments.  
Frequency Accuracy: (See TCXO Master Oscillator)  
Residual FM: < 50 Hz (typical 30 Hz RMS) (Post detection 50-300 Hz)  
RF Output Power: 0 dBm to -128 dBm continuously adjustable into 50 $\Omega$ .  
(No range changing)  
Accuracy:  $\pm 2$  dB, -10 to -80 dBm  
 $\pm 2.5$  dB, -80 to 128 dBm  
(-80 to -120 on IEEE version)  
Attenuator Dial: One continuous dial with  $\mu$ V and dBm.  
Modulation: FM: 2 Hz to 30 kHz rate at 0 to  $\pm 25$  kHz deviation.  
For external inputs DC to 30 kHz rate. (DC, if generated lock control is in the variable position).  
Flat to  $\pm 2$  dB DC to 30 kHz  
6 Vp-p  $\pm 2$  Vp-p produce  $\pm 15$  kHz deviation  
AM: 10 Hz to 5 kHz rate at 0-90%  
6 kHz to 30 kHz rate at 0-30%  
3 Vp-p  $\pm 1$  Vp-p produces 90% modulation  
External Mod impedance 600 $\Omega$

**NOTE:**

FM<sub>1</sub>, FM<sub>2</sub>, FM<sub>3</sub> and FM<sub>4</sub> are all FM modulation.  
SSB, AM<sub>1</sub>, and AM<sub>2</sub> are AM modulation. SSB has no function other than AM in the generator mode.

## A-1 RF SIGNAL GENERATOR (Cont'd)

Freq. Shift with Modulation:

When the generator is in the "lock" position, the center frequency is phase-locked to the system clock.

Modulation Distortion:

The FM modulation distortion plus noise at  $\pm 25$  kHz deviation is less than 2% from 200 Hz to 20 kHz.

Generator Freq. Control:

When in the "locked" position, the generator is phase-locked to the master clock. When switched off from the "locked" position, the generator may be varied  $\pm 10$  kHz. The FM modulation input is DC coupled for this unlocked function. (Internal or external modulation.)

Microphone Input:

Generator can be switched on by an external microphone. It has internal preamp with adjustable level.

SSB Noise:

90 dBc/Hz at  $\pm 20$  kHz from carrier.

Deviation Accuracy of Processor controlled audio levels:

$\pm 5\%$  from 20 Hz to 5 kHz and  $\pm 10\%$  from 5 kHz to 20 kHz.

Generator Spurious:

> 25 dBc

Harmonics:

> 40 dBc

Non Harmonics:

> 60 dBc

Typically:

> 70 dBc

In-Band, typically:



## A-2 DUPLEX GENERATOR

Freq Range:

$\pm 49.99$  MHz from receive frequency (as indicated on front panel (LCD) in 10 kHz increments.)  
See TXCO Master Oscillator.

Freq Accuracy:

Output Level:

DUPLEX Connector:

0 dBm to -128 dBm continuously adjustable into 50 $\Omega$ . (No range changing.)

TRANS Connector:

40 dB ( $\pm 1$  dB) below Duplex Connector.

## A-3 RECEIVER/MONITOR

Frequency Range:

300 kHz to 999.9999 MHz.  
100 Hz

Resolution:

10 dB Sinad

Sensitivity

(typical):

2  $\mu$ V (1 MHz to 1 GHz). Sensitivity reduced below 1 MHz (for 15 kHz RF bandwidth and 8 kHz post detection bandwidth)

Selectivity:

(3 dB):

6 kHz; SSB and AM<sub>1</sub>  
15 kHz; AM<sub>2</sub> and FM<sub>1</sub>,  
200 kHz; FM<sub>2</sub>, FM<sub>3</sub> and FM<sub>4</sub>  
FM<sub>1</sub> and FM<sub>2</sub> has post demodulation bandwidth of 8 kHz. FM<sub>3</sub> has a post demodulation bandwidth of 20 kHz. FM<sub>4</sub> has a post demodulation bandwidth of 80 kHz.  
FM<sub>4</sub> has a demodulation flatness of  $\pm 2$  dB referenced to 1 kHz from 10 Hz to 20 kHz.

### A-3 RECEIVER/MONITOR (Cont'd)

AM<sub>1</sub> and SSB have an RF bandwidth of 6 kHz and post detection bandwidth of 8 kHz. AM<sub>2</sub> has an RF bandwidth of 15 kHz and a post detection bandwidth of 8 kHz.

Antenna  
Attenuator:  
Quietting:

Selectable 0, -20 dB, and -40 dB ( $\pm$  2dB each)

Deviation measurements can be made down to 0.1 kHz in post detection bandwidth of 8 kHz.

Adjacent Channel  
Rejection:

> 25 dB at  $\pm$  25 kHz (when on 15 kHz RF bandwidth)  
> 40 dB at  $\pm$  50 kHz (when on 15 kHz RF bandwidth)

Beat Frequency  
Oscillator (BFO):  
Demodulation  
Output Level:  
(600  $\Omega$  Load)

Fixed at center frequency.

AM: 100% = 0.5 Vp-p nominal (selectable by modulation switch)

FM:  $\pm$  10 kHz deviation = 1.0 Vp-p nominal

Demodulation Output  
Level Impedance:

600 ohms

Receiver Antenna  
Input Protection:

0.25 Watts maximum level without damage

FM Demodulation  
Noise + Distortion:

Less than 2% at  $\pm$  25 kHz deviation for modulation frequencies from 200 Hz to 20 kHz with a receiver input level of -50 dBm.  
(RF bandwidth = 200 kHz, post detection bandwidth = 80 kHz)

Image Rejection:

+ 1.4 MHz, 50 dB  
+ 21.4 MHz, 50 dB  
+ 238.6 MHz, 50 dB  
+ 2500 MHz  $\pm$  10 MHz, 5 dB

### A-3 RECEIVER/MONITOR (Cont'd)

Deviation  
Monitor Meter:  
(max peak either  
polarity)  
AM Modulation  
Digital Display:  
(max peak,  
positive or  
negative  
Digital  
Deviation Display  
(CRT):

Scales: 2 kHz, 6 kHz, 20 kHz, 60 kHz  
Accuracy  $\pm 5\%$  full scale for modulation frequencies of 30 Hz  
to 10 kHz at a signal level of -50 dBm.

0.1% resolution on 20% and 60% ranges, 1% on 200% and  
600% ranges. Accuracy 5% reading  $\pm 20$  counts at received  
signal of -50 dBm for modulation frequencies 300 Hz to 10 kHz.  
(10% to 90% depth)

Range is 0.00 to 60.0 Hz

Accuracy is  $\pm 3\%$  at these two points:

1. 6 kHz rate at  $\pm 2$  kHz with 8 kHz post detection BW.
2. 10 kHz rate at  $\pm 8$  kHz with 20 kHz post detection BW.

Scales 0-20%, 0-60%, 0-200%

Accuracy  $\pm 7\%$  of reading,  $\pm 5\%$  full scale.

AM Modulation  
Monitor Meter:

### A-4 SPECTRUM ANALYZER

Inputs:

Transmitter: Transmitter under test when power exceeds 0.1  
watt. A 100 watt signal produces a top graticule  
reading. (marked -30 dBm)

Antenna Jack: The log scale is marked for dBm for this input  
when the antenna attenuator is set for "0". The  
signal can be attenuated by 20 dB or 40 dB by the  
antenna attenuator switch.

Log Scale:

Within  $\pm 2$  dB linearity from -30 dBm to -90 dBm indication.  
Switchable between 1 dB/DIV and 10 dB/DIV.  
70 dB, additional 40 dB selectable by input attenuator.

Dynamic Range:

#### A-4 SPECTRUM ANALYZER (Cont'd)

##### Modes:

|               |   |
|---------------|---|
| Full Scan:    | 1 MHz to 1000 MHz; 650 kHz bandwidth            |
| 10 MHz/DIV:   | Center frequency as selected; 650 kHz bandwidth |
| 5 MHz/DIV:    | Center frequency as selected; 650 kHz bandwidth |
| 2 MHz/DIV:    | Center frequency as selected; 650 kHz bandwidth |
| *1 MHz/DIV:   | Center frequency as selected; 30 kHz bandwidth  |
| *0.5 MHz/DIV: | Center frequency as selected; 30 kHz bandwidth  |
| *0.2 MHz/DIV: | Center frequency as selected; 30 kHz bandwidth  |
| *0.1 MHz/DIV: | Center frequency as selected; 30 kHz bandwidth  |
| *20 kHz/DIV:  | Center frequency as selected; 3 kHz bandwidth   |
| *10 kHz/DIV:  | Center frequency as selected; 3 kHz bandwidth   |
| *2 kHz/DIV:   | Center frequency as selected; 300 Hz bandwidth  |
| *1 kHz/DIV:   | Center frequency as selected; 300 Hz bandwidth  |

\* The receiver is fixed on the center frequency for monitoring while the analyzer scans as specified. On wider scans, the receiver and monitor portion are not usable.

#### A-5 TRACKING GENERATOR

|                  |   |
|------------------|---|
| Frequency Range: | 1.0 MHz to 1000 MHz as selected by the frequency control.                                     |
| Output Level:    | Same as RF generator; 0 dBm to -128 dBm.  |
| Sweep Mode:      | The oscilloscope is switchable to external vertical input when in the tracking generate mode. |

## A-6 OSCILLOSCOPE

- Display Size: 2" x 2½"
- Vertical Bandwidth: DC to 1 MHz (at 3 dB bandwidth)
- External Vertical Input Ranges: 10 MV, 100 MV, 1 V, 10 V per division
- Horizontal Sweep Rate: 10 mSec, 1 mSec, 100 uSec, 10 uSec per division

## A-7 AUDIO GENERATORS

- Operating Modes: Internal: Variable frequency generators, one or both.  
External plus Internal: Any external tone(s) plus either or both internal tones simultaneously.  
Variable from 2 Hz to 30 kHz.  
0.01 %
- Frequency Range: 0.1 Hz; 2 Hz to 9999.9 Hz; 1 Hz, 10.000 kHz to 30 kHz.
- Accuracy: Variable from 0 to 2.5 VRMS minimum either tone into 150Ω.
- Resolution: < 2% (10 Hz to 100 Hz)
- Output Level: < 0.7% typical 100 Hz to 30 kHz
- Distortion: Some frequencies have a measured distortion of less than 1.5% as measured on a typical null type distortion analyzer.
- Output Distribution: Each tone selectable OFF or into either AM or FM modulator when not under processor sequence control. Each tone level variable through "Tones Out" jack regardless of selection of "FM", "AM" or "OFF" by the manual switches.  
Selectable from receiver or same signal as "Tone Out" jack.
- Speaker:

**A-8 FREQUENCY ERROR METER MEASUREMENT CAPABILITY**

**RF Signals**

Sensitivity:  
Ranges:  
Resolution:

Typically 1.5 uV above 1 MHz (sensitivity is reduced below 1 MHz)  
 $\pm 30$  Hz,  $\pm 100$  Hz,  $\pm 300$  Hz,  $\pm 1$  kHz,  $\pm 3$  kHz,  $\pm 10$  kHz  
 $\pm 1$  Hz on the  $\pm 30$  Hz and  $\pm 100$  Hz ranges

**Demodulated Audio Signals**

Ranges:  
Resolution:  
Frequency Range:

$\pm 3$  Hz,  $\pm 30$  Hz,  $\pm 300$  Hz as referenced to frequency of Tone Generator #1.  
 $\pm 0.1$  Hz on  $\pm 3$  Hz scale  
20 Hz to 10 kHz

**A-9 DEMODULATED AUDIO FREQUENCY COUNTER**

Range:  
Resolution:  
Accuracy:

10 Hz to 20 kHz  
1 Hz  
 $\pm 2$  counts

**A-10 INTERNAL SINAD METER**

Input:  
Frequency:  
Range:  
Accuracy:

0.5 to 10 VRMS  
1 kHz  
0 to 20 dB  
 $\pm 1.5$  dB at 12 dB reading

**A-11 POWER MONITOR**

Frequency Range: 1 MHz to 1000.00 MHz (wideband detector circuit)

Power Ranges:  
Accuracy:

- 0 to 15 and 0 to 150 Watts
- 1 to 600 MHz,  $\pm 7\%$  of reading  
 $\pm 3\%$  of full scale.
- 600 to 1000 MHz  $\pm 17\%$  of reading  
 $\pm 3\%$  of full scale
- 821 MHz to 896 MHz  $\pm 7\%$  reading,  $\pm 3\%$  of full scale
- 50 watts continuous
- 150 watts until "over temp" lamp illuminates

Input Power:

Changeover from generate to monitor mode occurs at nominally 100 mW input level to the TRANS/-40 dB DUPLEX Connector.

### A-12 TCXO MASTER OSCILLATOR

- Accuracy:  $5 \times 10^{-7} = 0.00005\%$  (typically  $2 \times 10^{-7}$ ). Greater accuracy is attainable with front panel adjustment.
- Aging Stability: 2 to 3 PPM during first year . . . 1 PPM per year thereafter.
- EXT. Clock: BNC Connector for EXT 10 MHz STD.

### A-13 PHYSICAL CHARACTERISTICS

- Dimensions: 12.5" wide, 9" high, 19.5" deep  
(31.8 cm W, 22.9 cm H, 49.5 cm D)
- Weight: 46 lbs. (20.9 kg)
- Temperature Range: 0° to 50° C

**A-14 POWER**  
Self-contained battery automatically recharges when AC line is connected. Operates conveniently portable. Typical DC currents 6.0 A at 12 V. on 106 to 266 VAC without switching, 50-400 Hz, 85 watts, or 11 to 18 VDC.



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## SECTION 1 — INITIAL SET-UP

### 1-1 GENERAL

This supplement is designed to be used in conjunction with the FM/AM-1500 Operator's Guide. The technician should refer to the Operator's Guide for general operating instructions and use this supplement as a source of information on GPIB control.

The FM/AM-1500 GPIB is designed with partial local lockout capabilities. Therefore, a distinction must be made between those controls that are controlled by the GPIB and those that are not. Controls that are not controllable by GPIB must be set manually by the technician. It is good practice, when writing a software program for the FM/AM-1500, to include prompts in the software to tell the technician where or when to set the non-GPIB controls.

### 1-2 FRONT PANEL CONTROLS CONTROLLED BY GPIB

The front panel controls listed in Figure 1-1 are controlled by the GPIB and thus may be in any position at initial set-up, with the exception of the DISPLAY Control. The DISPLAY Control must be in "ANALY" whenever GPIB control is selected. This position allows "ANALY", "TRACK", "FREQS", "TONES" and "METER" functions to be controlled by the GPIB.

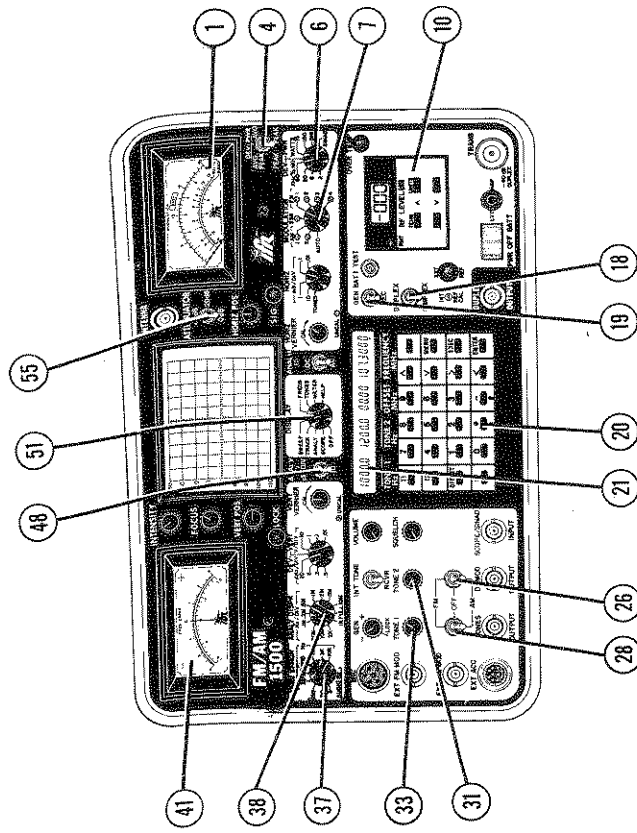
#### NOTE:

"OFF", "SCOPE", "SWEEP" and "HELP" positions of the DISPLAY Control must be manually selected.

### 1-3 FRONT PANEL CONTROLS NOT CONTROLLED BY GPIB

The front panel controls listed in Figure 1-2 are not controllable by the GPIB and therefore must be controlled manually by the technician, with the exception of the DISPLAY Control. The DISPLAY Control is manually selected for "OFF", "SCOPE", "SWEEP" and "HELP" positions, but must be in "ANALY" for GPIB control, as noted in Paragraph 1-2.

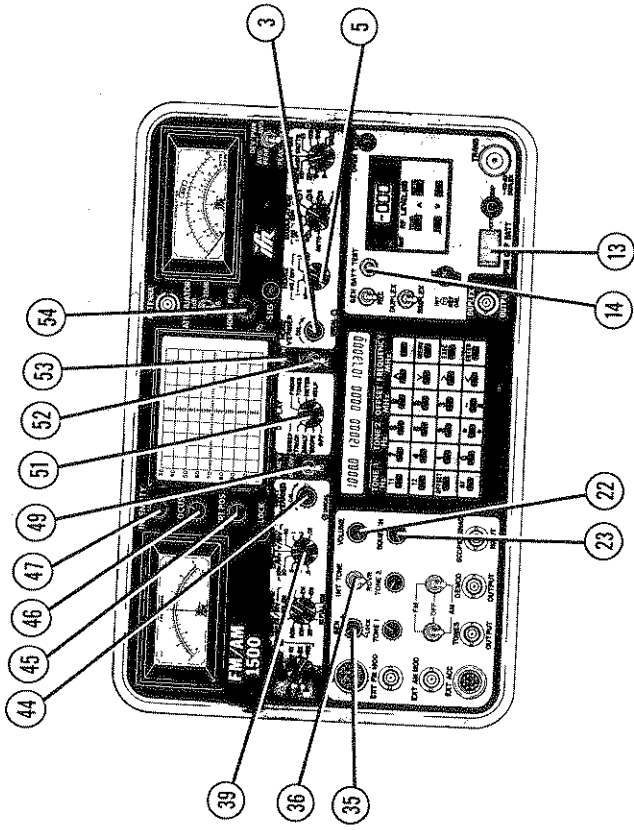
**NOTE:** Ref. Nos. correspond to Figure 3-1 in Operator's Guide.



- |                             |                                |
|-----------------------------|--------------------------------|
| 1. MODULATION Meter         | 28. Tone 1 FM/OFF/AM Switch    |
| 4. AVG PEAK/PEAK Switch     | 31. TONE 2 Control             |
| 6. DEV/PWR Control          | 33. TONE 1 Control             |
| 7. MODULATION Control       | 37. FREQ ERROR Control         |
| 10. RF Output Level Control | 38. ANALY DISPR Control        |
| 18. DUPLEX/SIMPLEX Switch   | 41. FREQ ERROR Meter           |
| 19. GEN/REC Switch          | 48. db/DIV Switch              |
| 20. KEYBOARD                | 51. DISPLAY Control (see text) |
| 21. LCD                     | 55. ATTENUATOR Switch          |
| 26. Tone 2 FM/OFF/AM Switch |                                |

**Figure 1-1 FM/AM-1500 Controls Controlled by GPIB**

**NOTE:** Ref. Nos. correspond to Figure 3-1 in Operator's Guide.



- 3. HORIZ VERNIER Control
- 5. HORIZ Control
- 13. PWR/OFF/BATT Switch
- 14. BATT TEST Button
- 22. VOLUME Control
- 23. SQUELCH Control
- 35. GEN/LOCK Control
- 36. INT TONE/RCLR Switch
- 39. DEV/VERT Control

- 44. VERT VERNIER Control
- 45. VERT POS Control
- 46. FOCUS Control
- 47. INTENSITY Control
- 49. Vertical Centering Adjustment (Analyzer)
- 51. DISPLAY Control (see text)
- 52. DC/AC Switch
- 53. Horizontal Centering Adjustment (Analyzer)
- 54. HORIZ POS Control

**Figure 1-2 FM/AM-1500 Controls NOT Controlled by GPIB**

## 1-4 REAR PANEL GPIB CONNECTIONS AND SWITCHES

### 1. GPIB Connector

The GPIB Connector (J5902), on the Rear Panel of the FM/AM-1500, conforms to IEEE-Standard-488-1978 configuration as shown in Figure 1-3.

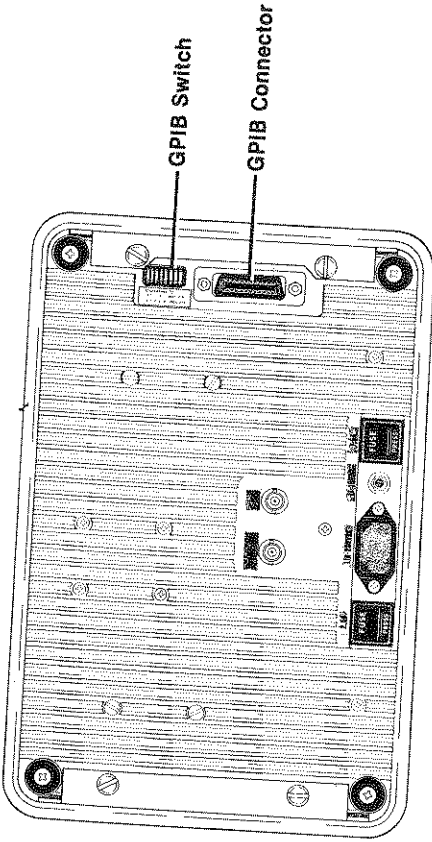
### 2. GPIB Switch

The GPIB Switch (SW5901), on the Rear Panel of the FM/AM-1500, must be set in the desired configuration prior to powering up the FM/AM-1500. This is necessary since the microprocessor in the FM/AM-1500, once initialized, cannot read a change of a switch setting on the GPIB Switch until it is powered down and then powered back up again.

Dip switches A1 thru A5 are used for the user-selected address of the FM/AM-1500. The DIP switches are coded in binary, with A1 being the least significant digit. For example, if the user desired the address of the FM/AM-1500 to be 9, switches A1 thru A5 would be configured as:

|    |   |     |   |   |
|----|---|-----|---|---|
| A1 | = | ON  | = | 1 |
| A2 | = | OFF | = | 0 |
| A3 | = | OFF | = | 0 |
| A4 | = | ON  | = | 8 |
| A5 | = | OFF | = | 0 |

DIP Switch A8 on the GPIB Switch is the ENABLE/DISABLE Switch for GPIB operation. When A8 is ON, the GPIB control is operable. When A8 is OFF, the GPIB control is not operable.



**GPIB Switch (SW5901)**

- A1
- A2
- A3 } User-Selected Address
- A4 }
- A5 }
- A6 } Not Used
- A7 } ENABLE/DISABLE GPIB
- A8 }

**GPIB Connector (J5902)**

- 1. DIO 1
- 2. DIO 2
- 3. DIO 3
- 4. DIO 4
- 5. EOI
- 6. DAV
- 7. NFRD
- 8. NDAC
- 9. IFC
- 10. SRQ
- 11. ATN
- 12. GND
- 13. DIO 5
- 14. DIO 6
- 15. DIO 7
- 16. DIO 8
- 17. REN
- 18. GND
- 19. GND
- 20. GND
- 21. GND
- 22. GND
- 23. GND
- 24. GND

**Figure 1-3 Rear Panel Connections and Switches for GPIB**

## SECTION 2 — GPIB OPERATION

### 2-1 REMOTE CONTROL (GPIB) OPERATIONS

Remote communication with the FM/AM-1500 is provided by use of the General Purpose Interface Bus (GPIB) which conforms to the latest IEEE-Standard-488-1978. The test set will perform to the following IEEE-488-1978 Subsets: SH1, AH1, T2, TEØ, L2, LEØ, SR1, RL2, PPØ, DC1, DT1 and CØ. These subsets mean the FM/AM-1500 has the following capabilities using ASCII encoded character strings.

- a. Complete Source and Acceptor Handshake
- b. Talker with Serial Poll
- c. Listener
- d. Service Request
- e. Remote/Local (Partial Local Lockout Capability)
- f. Device Clear
- g. Device Trigger

Communication with the FM/AM-1500 over the GPIB is implemented with ASCII encoded character strings. Invalid or improperly formatted characters are discarded and an error status flag will be set. The exceptions to this rule are the IEEE-488 bus messages defined in Table 2-1. Any of these messages will cause an immediate response within the FM/AM-1500. The coding for these messages is defined in Table 2-1. The ASCII String Commands are stored in a 128 Byte Buffer until receipt of a carriage return, line feed, null character or an "END", "IDY" or "GET" message. At this time, all commands will be executed and measurements made or initiated.



3 BUS SIGNAL LINES AND CODING FOR TRUE VALUE OF MESSAGE

2 CLASS

1 TYPE

| MNEMONIC | FUNCTION              | TYPE | CLASS | DATA ON DIO 1-8 (HEX)       | D A V | N R D A C | N R F A N C | A T N | E O I | S R Q | I F C | R E E N |
|----------|-----------------------|------|-------|-----------------------------|-------|-----------|-------------|-------|-------|-------|-------|---------|
| ATN      | ATTENTION             | S    | UC    | N/A                         | X     | X         | X           | 1     | X     | X     | X     | X       |
| DAB      | DATA BYTE             | M    | DD    | 00-FF                       | X     | X         | X           | 0     | X     | X     | X     | X       |
| DAC      | DATA ACCEPTED         | S    | HS    | N/A                         | X     | X         | X           | X     | X     | X     | X     | X       |
| DAV      | DATA VALID            | S    | HS    | N/A                         | X     | X         | X           | X     | X     | X     | X     | X       |
| DCL      | DEVICE CLEAR          | M    | UC    | 14                          | 1     | X         | X           | 1     | X     | X     | X     | X       |
| END      | END                   | S    | ST    | N/A                         | X     | X         | X           | 0     | X     | X     | X     | X       |
| GET      | GROUP EXECUTE TRIGGER | M    | AC    | 08                          | X     | X         | X           | 1     | X     | X     | X     | X       |
| GTL      | GO TO LOCAL           | M    | AC    | 01                          | X     | X         | X           | 1     | X     | X     | X     | X       |
| IDY      | IDENTIFY              | S    | UC    | N/A                         | X     | X         | X           | 1     | X     | X     | X     | X       |
| IFC      | INTERFACE CLEAR       | S    | UC    | N/A                         | X     | X         | X           | 1     | X     | X     | X     | X       |
| LLO      | LOCAL LOCK OUT        | S    | UC    | N/A                         | X     | X         | X           | 1     | X     | X     | X     | X       |
| MLA      | MY LISTEN ADDRESS     | M    | UC    | N/A                         | X     | X         | X           | 1     | X     | X     | X     | X       |
| MTA      | MY TALK ADDRESS       | M    | UC    | N/A                         | X     | X         | X           | 1     | X     | X     | X     | X       |
| REN      | REMOTE ENABLE         | M    | AD    | NO RESPONSE TO THIS MESSAGE | X     | X         | X           | 1     | X     | X     | X     | X       |
| RFD      | READY FOR DATA        | S    | UC    | 20-3F                       | X     | X         | X           | 1     | X     | X     | X     | X       |
| SPD      | SERIAL POLL DISABLE   | S    | UC    | 40-5F                       | X     | X         | X           | 1     | X     | X     | X     | X       |
| SPE      | SERIAL POLL ENABLE    | S    | HS    | N/A                         | X     | X         | X           | 1     | X     | X     | X     | X       |
| SRQ      | SERVICE REQUEST       | M    | UC    | N/A                         | X     | X         | X           | 0     | X     | X     | X     | X       |
| STB      | STATUS BYTE           | M    | UC    | 19                          | X     | X         | X           | 1     | X     | X     | X     | X       |
| UNL      | UNLISTEN              | S    | ST    | 18                          | X     | X         | X           | 1     | X     | X     | X     | X       |
| UNT      | UNTALK                | M    | AD    | N/A                         | X     | X         | X           | 0     | X     | X     | X     | X       |
|          |                       | M    | AD    | 3F                          | X     | X         | X           | 1     | X     | X     | X     | X       |
|          |                       | M    | AD    | 5F                          | X     | X         | X           | 1     | X     | X     | X     | X       |

NOTES:

1 TYPE: S = SINGLE LINE MESSAGE  
M = MULTILINE MESSAGE

2 CLASS: AC = ADDRESSED COMMAND  
AD = ADDRESS (TALK OR LISTEN)  
DD = DEVICE DEPENDENT  
HS = HANDSHAKE  
UC = UNIVERSAL COMMAND  
ST = STATUS

3 LEVEL: 0 = HIGH STATE SIGNAL LEVEL  
1 = LOW STATE SIGNAL LEVEL

4 REFER TO IEEE STD. 488-1978 FOR FURTHER INFORMATION.

Table 2-1 Remote Message Coding

## 2-1-1 FM/AM-1500 AND GPIB MESSAGE INTERFACE DEFINITIONS

The FM/AM-1500 GPIB I/O device responds immediately to process the incoming GPIB Controller commands.

1. ATN The FM/AM-1500 microprocessor responds by status testing of the GPIB I/O device to accept the data byte.
2. DAB The FM/AM-1500 GPIB I/O device responds immediately to signal the talker that it has accepted the data byte.
3. DAC The FM/AM-1500 GPIB I/O device responds immediately to signal the interceptor that it has put valid data on the bus.
4. DAV The FM/AM-1500 processor responds to clear the input buffer and halt all command executions.
5. DCL The FM/AM-1500 responds to terminate the command input from the source and begin processing the commands available up to the last valid delimiter.
6. END The FM/AM-1500 responds to terminate any further inputs and to execute the commands available up to the last available delimiter.
7. GET The FM/AM-1500 processor responds to remove itself from control over the FM/AM-1500, therefore returning control to the FM/AM-1500 front panel.
8. GTL Same as "END".
9. IDY The FM/AM-1500 processor responds by returning the GPIB to its quiescent state.
10. IFC No response to this message.
11. LLO The FM/AM-1500 GPIB I/O device responds immediately by comparing its address with the listen address given. If the two are the same, it instructs the processor to listen.

- 13. MTA      The FM/AM-1500 GPIB I/O device compares its address with the talk address given. If the two are the same, it instructs the processor to talk.
- 14. REN      The FM/AM-1500 processor responds from the interface to put the FM/AM-1500 into remote, which partially disables front panel operation and clears all status commands' buffers except "CG1?", "CG2?" and "CG3?".
- 15. RFD      The FM/AM-1500 GPIB I/O device signals the source that it is ready for data to be transmitted on the bus.
- 16. SPD      The FM/AM-1500 GPIB I/O device terminates the service request operation by disabling the Serial Poll.
- 17. SPE      The FM/AM-1500 GPIB I/O device places the Status Byte on the bus addressed to talk.
- 18. SRQ      The FM/AM-1500 processor instructs the interface to signal the Controller that servicing is desired. (This is done under FM/AM-1500 Software Control.)
- 19. STB      The FM/AM-1500 GPIB I/O device responds immediately after the SPE and MTA messages by placing the Status Byte on the Bus.
- 20. UNL      The FM/AM-1500 GPIB I/O device and the processor respond to unlisten the FM/AM-1500.
- 21. UNT      The FM/AM-1500 GPIB I/O device and the processor respond to untalk the FM/AM-1500.

**2-1-2 GPIB TRANSACTIONS**

Two examples of GPIB transactions showing the ASCII Character String to be transmitted followed by the necessary BUS operations to complete the transactions are shown below. These examples were generated and executed using a GPIB Controller that uses an ANSI Standard Basic Interpreter with enhancements allowing direct communication over GPIB using special GPIB interface hardware. In the examples, the ASCII Character String to be transmitted is shown first and followed by the bus operations required to complete the transaction.

**EXAMPLE No. 1**

Instruct the FM/AM-1500 to set Generator/Receiver Frequency to 123.4567 MHz.

Instruct the FM/AM-1500 to set Generator/Receiver Frequency to 123.4567 MHz. (followed by Carriage Return and Line Feed.)

- a. ASCII String: "RFF = 123.4567" (followed by Carriage Return and Line Feed.)
- b. Bus Transaction: UNT, UNL, MLA, MTA, DAB"R", DAB"F", DAB"=", DAB"1",  
"DAB"2", DAB"3", DAB"4", DAB"5", DAB"6", DAB"7", DAB"CR, DAB LF.

**EXAMPLE No. 2**

Instruct the FM/AM-1500 to return the Generator/Receiver Frequency. (123.4567 MHz)

- a. ASCII String: "RFF?"
- b. Bus Transactions:
  1. Output Cycle — UNT, UNL, MLA, MTA, DAB"R", DAB"F", DAB"?", DAB"CR, DAB LF.
  2. Input Cycle — UNT, UNL, MLA, MTA, DAB"1", DAB"2", DAB"3", DAB"4", DAB"5", DAB"6", DAB"7", DAB"CR, DAB LF.

**2-1-3 STATUS AND SERVICE REQUEST TRANSACTIONS**

The FM/AM-1500 has the capability to trigger a service request, based on one to six trigger conditions which can be enabled by the user with the FM/AM-1500 "SRQ =" Command. After the FM/AM-1500 is placed in remote operation mode, it may be interrogated for the one byte status information. If an internal error or status condition becomes true and the matching trigger bit of the SRQ Trigger Byte (Bits 0 through 5) has been set, Bit 6 will also be set. Bit 6 is generally used as the service request bit, signaling a GPIB Controller that the FM/AM-1500 desires servicing.

**NOTE:**

Bit 7 of the Status Byte is not used.

## 2-2 COMMAND AND DATA STRUCTURE

All FM/AM-1500 Functional Commands and data information are transferred over the GPIB as Uppercase ASCII Alphanumeric Character Strings and are designed to replace the front panel controls.

### 2-2-1 ASCII OUTPUT COMMANDS TO FM/AM-1500

All output commands sent to the FM/AM-1500 are placed on an Internal Stack that will accommodate up to 128 bytes of data. Command Strings may be packed together, but the individual commands must be separated by delimiters. The delimiters are:

1. ASCII COLON ":"
2. ASCII PERIOD "."
3. ASCII QUESTION MARK "?"
4. ASCII SLASH "/"

**NOTE:**

The Question Mark ("?") will be accepted at any time and ignored unless it follows a command.

The Colon (":") and the Slash ("/") are general delimiters and may be used after the Period or Question Mark. Care must be exercised in using the Period or Question Mark at the end of a command as they may change the interpretation of that command.

The following ASCII Characters will terminate the output command or series of commands.

1. ASCII Carriage Return (ØD) — CR
2. ASCII Line Feed (ØA) — LF
3. NULL Character (Ø) — NL
4. GPIB EOI Command
5. Mnemonic GET Message

The FM/AM-1500 terminator may be selected by the command "TERM = n" to be CRLF, LFCR, CROR, or LFLF. EOI will be asserted on the second ASCII character sent (i.e., CR or LF).

#### 2-2-2 ASCII OUTPUT COMMAND DATA FORMAT

All spaces will be ignored. Below are some examples of commands which are valid:

```
"RFF = 123.4567:RFF?"  
"AFF1 = 1ØØØØ:Ø/AFF1/"  
"INIT.:RFF = 123.4567"  
"AFF2?RF?RFL?:STAT?"
```

#### NOTE:

If no CR, LF, NL, GET or EOI is included, then the line may be continued and the commands will not be executed until one of the above is received.

Maximum command string length, including spaces and delimiters, is 128 characters. If the command string exceeds 128 characters, everything up to the most recent delimiter will be accepted and the rest ignored. The Error Status Condition "I/O OVERFLOW" will be set in this case.

EXAMPLE:

```
COMMAND: "INIT.RFF?TR?STAT?RID = ON:BLANK?"
```

```
RESPONSES: "Ø1Ø.ØØØØ:REC:OK:BLANK = ON"
```

**NOTE:**

Commands ending with an ASCII Question Mark ("?") would normally require the GPIB Controller to perform an ASCII String input command after issuing the output command.

The above commands set the Reply Identifier Flag which caused the command label following "RID = ON" to be attached to the response.

**2-2-3 RETURN DATA FORMAT**

The returned data format convention is similar to the Output Command Data Format in that all returns will be packed together and separated by ASCII Colon (":") delimiters. The number of responses returned is determined by the number of commands transferred in one block. If the number of responses required causes the internal response buffer to overflow by being larger than 128 bytes, then only the responses up to the most recent delimiter will be returned and the Error Status Condition "/O OVERFLOW" will be set. For an example of a response, see paragraph 2-2-2.

Data inputs that are out of specific range will generally default to the minimum values or initial condition values.

**2-2-4 COMMAND GROUPS**

The command mnemonics used in the FM/AM-1500 are longer than normally seen in GPIB controlled equipment. This process is used to give the unfamiliar programmer a clear understanding of the functions he or she will be executing. Because the possibility exists that the long transmission time required for these commands could seriously impede overall ATE systems performance, three command group buffers and associated commands: "CGX = ", "CGX?", and "CGX." have been included (X = 1, 2 or 3). These groups will allow the programmer to input up to 124 characters (128 - "CGX = ") to one of three command buffers for later execution by the "CGX." command. The "CGX." commands may be stacked as long as not more than one "CGX." command is included at the end of another "CGX = " input. As soon as the command input interpreter sees the "CGX." command, it will immediately execute that command group buffer before proceeding with normal command interpretation and execution.

An example of the proper usage of command buffer stacking would be:

```
"CG1 = RID = ON:AFF1?"  
"CG2 = RFF?CG1."  
"CG3 = TR?CG2."
```

Executing a "CG3." command will return:

```
GEN:123.4567:AFF1 = 10000.0"
```

### 2-2-5 REPLY IDENTIFIER

When the Reply Identifier is activated by the command "RID = ON", the returned information for data or status requests will be preceded by the command mnemonic and an "=" character. This will continue until the command "RID = OFF".

### 2-3 FM/AM-1500 INSTRUCTION SET

The following paragraphs define the commands used to control the FM/AM-1500 under GPIB operation. The commands are grouped under paragraph headings according to the applicable function of each command.

Qualifiers for each command are used throughout the following paragraphs and are defined as follows:

- a. An "=" represents a "set" operation for that command.
- b. A "?" represents a "get" operation for that command.
- c. A "." represents an "enable" operation for that command.

Symbols accompanying commands in the following paragraphs are defined as follows:

- a. A "." is a delimiter that separates fields of data from each other.
- b. An "n" indicates a data item number.
- c. An "s" indicates a sign (+, - or X).
- d. An "X" indicates an alphanumeric character which is to be entered into a data field as explained in the description following each command.



## 2-3-1 RF CONTROL GROUP

|                |  |
|----------------|--|
| REC.           | Enables the FM/AM-1500 receiver mode. (Generator off, simplex mode.)   |
| GEN.           | Enables the FM/AM-1500 generator mode. (Receiver monitoring internal generator, simplex mode.)                               |
| DUP.           | Enables the FM/AM-1500 duplex mode. (Receives selected frequency. Generates on selected frequency plus duplex offset value.) |
| TR?            | Returns the transmit/receive mode status (i.e., REC, GEN, or DUP).   |
| RFF = xxx.xxxx | Sets the FM/AM-1500 to the specified frequency:<br>Range: 0.1 to 999.9999 MHz<br>Step: 0.0001 MHz                            |
| RFF?           | Returns the FM/AM-1500 frequency status.   |
| DPX = sxx.xx   | Sets the duplex offset value.<br>Range: -49.99 to +49.99 MHz<br>Step: 0.01 MHz   |
| DPX?           | Returns the duplex offset status.  |
| RFL = xxx      | Sets the RF output level in -dBm:<br>Range: 0 to 127 (-dBm)<br>Step: 1 (-dBm)  |
| RFL?           | Returns the status of the RF level.  |

## 2-3-2 MODULATION AND BANDWIDTH CONTROL GROUP

|      | DEMODULATION | PREDETECTION | POSTDETECTION |
|------|--------------|--------------|---------------|
| AM1. | AM           | 6 kHz        | 8 kHz         |
| AM2. | AM           | 15 kHz       | 8 kHz         |
| FM1. | FM           | 15 kHz       | 8 kHz         |
| FM2. | FM           | 200 kHz      | 8 kHz         |
| FM3. | FM           | 200 kHz      | 200 kHz       |
| FM4. | FM           | 200 kHz      | 800 kHz       |
| SSB. | SSB          | 6 kHz        | 8 kHz         |

MAUTO. Selects the stored modulation associated with a menu execution item (i.e., RF SCAN or RF MEMORY).

MBW? Returns the status of the modulation and bandwidth (i.e., AM1, FM2, etc.).

## 2-3-3 TONE GENERATOR CONTROL GROUP

AFF1 = xxxxx.x Sets audio tone generator number one to the specified frequency.

Range: 0000.1 to 29,999 Hz  
 Step: 0000.1 to 9999 Hz - 0000.1 Hz  
 10,000 to 29,999 Hz - 00001 Hz

AFF2 = xxxxx.x Sets audio tone generator number two to the specified frequency.

Range: 0000.1 to 29,999 Hz  
 Step: 0000.1 to 9999.9 Hz - 0000.1 Hz  
 10,000 to 29,999 Hz - 00001 Hz

|             |   |
|-------------|---|
| AFF1?       | Returns the status of the AFF1 setting.   |
| AFF2?       | Returns the status of the AFF2 setting.   |
| AM%1 = xxx  | Sets the percentage of AM specified for tone generator #1.<br>Range: 000 to 127%<br>Step: 001%        |
| AM%2 = xxx  | Sets the percentage of AM specified for tone generator #2.<br>Range: 000% to 127%<br>Step: 001%       |
| AM%1?       | Returns the status of tone generator #1's percentage of AM or "OFF" if #1 has been routed to FM.      |
| AM%2?       | Returns the status of tone generator #2's percentage of AM or "OFF" if #2 has been routed to FM.      |
| DEV1 = xx.x | Sets the FM deviation specified using tone generator #1.<br>Range: 00.0 to 25.5 kHz<br>Step: 00.1 kHz |
| DEV2 = xx.x | Sets the FM deviation specified using tone generator #2.<br>Range: 00.0 to 25.5 kHz<br>Step: 00.1 kHz |
| DEV1?       | Returns the FM deviation specified with tone generator #1 or "OFF" if #1 has been routed to AM.       |
| DEV2?       | Returns the FM deviation specified with tone generator #2 or "OFF" if #2 has been routed to AM.       |

### 2-3-4 DISPLAY CONTROL GROUP

|             |   |
|-------------|---|
| BLANK = ON  | Blanks Alphanumeric menu displays.                                      |
| BLANK = OFF | Enables display of alphanumeric menu displays.                          |
| BLANK?      | Returns Blank status (ON/OFF).  |
| DAL.        | Selects the Spectrum Analyzer display mode.                             |
| DTK.        | Selects the Tracking Generator display mode.                            |
| DMT.        | Displays the digital meter readout of power, deviation, or demod audio. |
| DSP?        | Returns the status of the display control switch.                       |
| AL1K.       | Selects the 1 kHz/Division scale on the Spectrum Analyzer.              |
| AL2K.       | Selects the 2 kHz/Division scale on the Spectrum Analyzer.              |
| AL1ØK.      | Selects the 1Ø kHz/Division scale on the Spectrum Analyzer.             |
| AL2ØK.      | Selects the 2Ø kHz/Division scale on the Spectrum Analyzer.             |
| AL1ØØK.     | Selects the 1ØØ kHz/Division scale on the Spectrum Analyzer.            |
| AL2ØØK.     | Selects the 2ØØ kHz/Division scale on the Spectrum Analyzer.            |
| AL5ØØK.     | Selects the 5ØØ kHz/Division scale on the Spectrum Analyzer.            |
| AL1M.       | Selects the 1 MHz/Division scale on the Spectrum Analyzer.              |
| AL2M.       | Selects the 2 MHz/Division scale on the Spectrum Analyzer.              |

- AL5M. Selects the 5 MHz/Division scale on the Spectrum Analyzer.
- AL10M. Selects the 10 MHz/Division scale on the Spectrum Analyzer.
- ALFULL. Selects the FULL SCAN (0-1000 MHz) scale on the Spectrum Analyzer.
- AL?. Returns the status of the Spectrum Analyzer dispersion range setting.
- ADB1. Selects 1 dB per division on the Spectrum Analyzer.
- ADB10. Selects 10 dB per division on the Spectrum Analyzer.
- ADBS?. Returns the 1 dB/10 dB status.
- DIGTZ. Digitizes one Spectrum Analyzer frame.
- DIGTZ(X)?. Returns one (1) hundred (100) byte segment of HEX-ASCII data, of the digitized spectrum data. "X" range is 1 through 10 (100 bytes total).
- DGPEAK?. Returns six characters of HEX-ASCII data in the format xx:xxxx. The first character pair is the maximum digitized data point value. The second and third character pairs represent the horizontal position of the peak point (0000-01F3).

**2-3-5 RF SIGNAL FUNCTIONS GROUP**

- RFE1. Enables the RF frequency error measurement in range #1.
- RFE2. Enables the RF frequency error measurement in range #2.
- RFE3. Enables the RF frequency error measurement in range #3.
- AFE1. Enables the AF frequency error measurement in range #1.
- AFE2. Enables the AF frequency error measurement in range #2.
- AFE3. Enables the AF frequency error measurement in range #3.

ERRM? Returns the status of the frequency error counter's mode (i.e., RFE1, RFE2, RFE3, AFE1, AFE2, or AFE3).

ERR? Returns the frequency error measurement, either the error from the RF center frequency or the difference between the demodulated audio signal and the tone generator #1 value, depending upon whether an RFE or an AFE mode is selected.

|      | <u>FULL SCALE</u> | <u>UNIT</u> | <u>FULL SCALE</u> | <u>UNIT</u> |
|------|-------------------|-------------|-------------------|-------------|
| RFE1 | + 127/-126        | HZ          | + 12.7/-12.6      | HZ          |
| RFE2 | + 1.27/-1.26      | KHZ         | + 127/-126        | HZ          |
| RFE3 | + 12.7/-12.6      | KHZ         | + 1.27/-1.26      | KHZ         |

If signal is not present (squelched), "NOSIG" is returned. If frequency error is out of range, an "UNDER" or "OVER" indication will be returned.

R2. Enables the modulation meter to measure modulation on the 2 kHz or 20% scale, depending upon the mode of modulation (FM or AM).

R6. Enables the modulation meter to measure modulation on the 6 kHz or 60% scale, depending upon the mode of modulation (FM or AM).

R20. Enables the modulation meter to measure modulation on the 20 kHz or 200% scale, depending upon the mode of modulation (FM or AM).

R60. Enables the modulation meter to measure modulation on the 60 kHz or 600% scale, depending upon the mode of modulation (FM or AM).

R15. Enables the modulation meter to measure power on the 15 Watt scale.

R150. Enables the modulation meter to measure power on the 150 Watt scale.

RSIG.

Enables the modulation meter to measure signal strength in a relative value from 0 to 100, where 0 represents an **APPROXIMATE** value of -100 dBm and 100 represents an **APPROXIMATE** value of -30 dBm.

RSID.

Enables the modulation meter to measure SINAD in dB. (0-24.0 dB, .1 dB resolution; 25-56 dB, 1 dB resolution).

RNG?

Returns the modulation meter range status (R2, R6, R20, R150, RSIG, RSID).

MTR?

Returns the selected modulation meter function value and label:

| <u>RNG</u> | <u>VALUE</u> | <u>LABEL</u> |
|------------|--------------|--------------|
| R2         | xxx.xx       | KHz/%        |
| R6         | xxx.xx       | KHz/%        |
| R20        | xxx.xx       | KHz/%        |
| R60        | xxx.xx       | KHz/%        |
| R15        | xx.xx        | WAT          |
| R150       | xxx.x        | WAT          |
| RSIG       | xxx.x        | SIG          |
| RSID       | xx.x         | -dB          |

If signal is not present (squelched), "NOSIG" is returned. If range value is out of limits, "OVER" or "UNDER" will be returned.

AVG.

Selects the DEV., % AM and power meters to "AVERAGE" mode.

PEAK.

Selects the DEV., % AM and power meters to "PEAK" mode.

PKAV?

Returns the Peak/Average meter-select status (AVG or PEAK).

DMOD?

Returns the value of the demodulated audio signal.

Range: 1Ø Hz through 2Ø kHz  
Resolution: 1 Hz

If no signal is present (squelched), "NO SIG" is returned.

DBØ. Selects the Ø dB antenna attenuator switch position.

DB2Ø. Selects the 2Ø dB antenna attenuator switch position.

DB4Ø. Selects the 4Ø dB antenna attenuator switch position.

DBS? Returns the antenna attenuator switch status.

### 2-3-6 STORED CONTROL FUNCTIONS GROUP

DTMFZ = xx.x;xxxx;xxxx

Field 3 sets the space time (Ø to 9999 mS).

Field 2 sets the mark time (Ø to 9999 mS).

Field 1 sets the DTMF item Ø manual deviation (Ø to 25.5 kHz).

DTMFZ? Returns the status of DTMFZ.

DTMF(nn) = xxxxxxxxxxxxxxx;xx.x

Field 2 sets the deviation (Ø to 25.5 kHz).

Field 1 sets the 15 digit DTMF code (Ø to 9 and # or \* characters). Sets the DTMF item number (1 to 15).

DTMF(nn)? Returns the status of the DTMF item number requested.

DTMF(nn). Executes DTMF item number nn.



FSWP(n) = xxx.xxxx;xxx.xxxx;xxx.xxxx;xxxx

Field 4 sets the increment rate (0000 to 9999 mS).

Field 3 sets the step frequency (0.0000 to 999.9999 MHz).

Field 2 sets the stop frequency (0.0000 to 999.9999 MHz).

Field 1 sets the start sweep frequency (0.0000 to 999.9999 MHz).

Sets the RF sweep item number (1 to 4).

FSWP(n)? Returns the sweep status for the item number selected.

FSWP(n). Executes frequency sweep item number (n).

RFM(nn) = xxx.xxxx;s.xx.xx;xxx

Field 4 sets the type of modulation and bandwidth (AM1, AM2, FM1, FM2, FM3, FM4, or SSB).

Field 3 sets the offset (0 to 49.99 MHz).

Field 2 sets the sign for offset (either + or -).

Field 1 sets the RF frequency (0 to 999.9999 MHz).

Sets the RF memory data item number (1 to 30).

RFM(nn)? Returns the status of the RF memory item selected.

RFM(nn). Executes the RF memory item number nn.

SCANZ = x.x Sets the RF scan's resume time (0 to 9.9 seconds).

SCANZ? Returns the status of the RF scan resume time.

SCAN(nn) = xxx.xxxx;xxx  
 Field 2 sets the type of modulation and bandwidth (AM1, AM2, FM1, FM2, FM3, FM4, or SSB).  
 Field 1 sets the RF frequency (∅ to 999.9999 MHz).  
 Sets the RF scan item number (1 to 3∅).

SCAN(nn)? Returns the status of the RF scan item number nn, (1 to 3∅).

SCAN(nn). Executes RF scan item number nn.

SCAN(nn-nn). Executes RF scan items nn through nn.

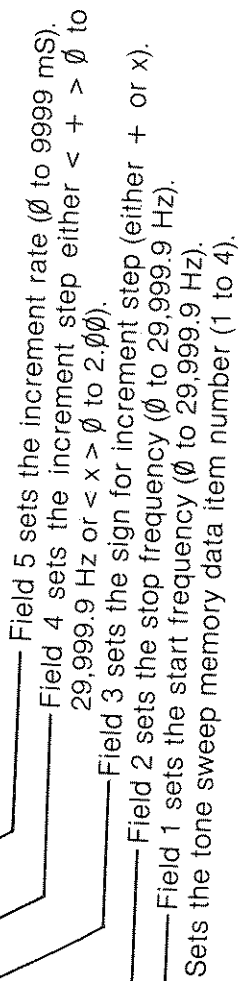
TSEQ(nn) = xxxxx.x;xx.x;xxxx;xxxxx.x;xx.x  
 Field 5 sets Tone 2 modulation level (∅ to 25.5 kHz deviation).  
 Field 4 sets Tone 2 frequency (∅ to 29,999.9 Hz).  
 Field 3 sets interval (∅∅∅ to 9999 mS).  
 Field 2 sets Tone 1 modulation level (∅ to 25.5 kHz).  
 Field 1 sets Tone 1 frequency (∅ to 29,999.9 Hz).  
 Sets the tone sequence memory data item number (1 to 99).

TSEQ(nn)? Returns the status of the tone sequence item number selected.

TSEQ(nn). Executes tone sequence item number nn.

TSEQ(nn-nn). Executes tone sequence items nn through nn.

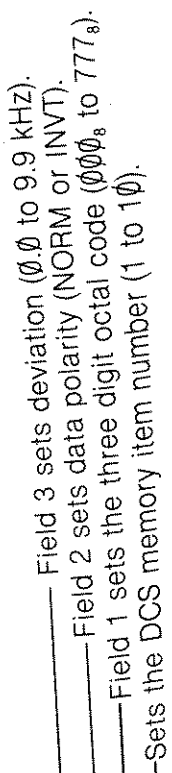
TSWP(n) = xxxxx.x;xxxxx.x;s;xxxxx.x;xxxx



Field 5 sets the increment rate (∅ to 9999 mS).  
Field 4 sets the increment step either < + > ∅ to 29,999.9 Hz or < x > ∅ to 2.∅∅).  
Field 3 sets the sign for increment step (either + or x).  
Field 2 sets the stop frequency (∅ to 29,999.9 Hz).  
Field 1 sets the start frequency (∅ to 29,999.9 Hz).  
Sets the tone sweep memory data item number (1 to 4).

- TSWP(n)? Returns the status of the tone sweep item selected.
- TSWP(n). Executes tone sweep item number n.
- DCSZ = NORM Sets the digital coded squelch (DCS) received data polarity field to NORM (normal).
- DCSZ = INVT Sets the digital coded squelch (DCS) received data polarity field to INVT (inverted).
- DCSZ? Returns the status of the DCS received data polarity field.
- DCSR? Returns the status of the DCS received data codes. Data is up to six (6) three-digit ASCII octal numbers, or if none are received, "NO CODE" is returned.

DCS(nn) = xxx;xxxx;x.x



DCS(nn)? Returns the status of the DCS item number selected.

DCS(nn). Executes the DCS memory item selected.

EXEC = x...x Sets the stored functions (x...x) into a string of commands to be executed sequentially and stored for later recall. Items allowed include "DTMF(nn).", "FSWP(n).", "RFM(nn).", "SCAN(nn-nn).", "TSEQ(nn-nn).", "TSWP(n).", and "DCS(nn).". Any or all may be used in any order, up to a maximum of 123 (128-"EXEC=") total characters. The "LOOP." command may be appended the end of the string to allow continuous execution (looping) of the command string. Execution of loop commands begins at reception of last command.

EXEC? Returns status of stored execution command buffer contents.

EXEC. Executes the stored execution command buffer contents. Any "AFF1 =", "AFF2 =", "DUP =", "RFF =" or "RFF =" commands following the "EXEC." command in the same input string will disable this function.

### 2-3-7 MISCELLANEOUS COMMANDS GROUP

LOOP. This command is used at the end of an "EXEC." command statement to create an internal continual re-execution of the command string until another command string is sent.

CG1 = xxx...xxx This command allows a 124 character command string to be stored internally for execution by the "CG1." command.

CG1? Returns the status of command group 1.

CG1. Executes command group 1.

CG2 = xxxx...xxx This command allows a 124 character command string to be stored internally for execution by the "CG2." command.

CG2? Returns the status of command group 2.

CG2. Executes command group 2.

CG3 = xxxx...xxx This command allows a 124 character command string to be stored internally for execution by the "CG3." command.

CG3? Returns the status of command group 3.

CG3. Executes command group 3.

INIT. Reinitializes the FM/AM-1500 to the cold start condition.

LOC. Commands the FM/AM-1500 to return to local mode of operation. This command will erase all internally stored status conditions except "CG1?", "CG2?", and "CG3?".

RID = ON or RID = OFF Controls the reply identifier switch (ON or OFF), which, when ON, will add the command name followed by "=" as a prefix to a command's response.

RID? Returns reply identifier switch status.

TERM = n This command allows the operator to specify the desired terminator for the end of string output of the FM/AM-1500. Selections for terminator are as follows (default is n = 1):

| <u>n</u> | <u>Hexidecimal Value</u> | <u>ASCII</u> |
|----------|--------------------------|--------------|
| 1        | 0A0A                     | CRLF         |
| 2        | 0A0D                     | LFCR         |
| 3        | 0D0D                     | CRCR         |
| 4        | 0A0A                     | LFLF         |

TERM? Returns the status of the Terminator setting.  
 SRQ = xxxxxx Sets one (1) to six (6) bits of an SRQ interrupt service mask to trigger a serial poll of the FM/AM-1500.

| <u>BIT POSITION</u> | <u>CONDITION</u>            |
|---------------------|-----------------------------|
| xxxxx1              | Command entry/execute error |
| xxxx1x              | Self-test error             |
| xxx1xx              | System operation error      |
| xx1xxx              | GPIB interface error        |
| x1xxxx              | Not defined                 |
| 1xxxxx              | Not defined                 |

SRQ? Returns the status of the SRQ mask.  
 STAT? Returns command error status. Returns up to 128 characters which describe all errors that have occurred since last "STAT?" command. Multiple status messages will be appended until the buffer overflows unless this command is periodically executed. Returned responses include:

| <u>RELATED SRQ BIT</u> | <u>RESPONSE</u>  | <u>DESCRIPTION</u>   |
|------------------------|--|--|
| N/A                    | FM/AM-1500 CSM<br>VER.X.X, MM/DD/YY,<br>NO ERRORS DETECTED | Power-up response. Gives firmware version, date and self-test results. |
| N/A                    | OK   | No errors detected on last command(s) executed.                        |
| ∅                      | SYNTAX ERROR   | Improper command format.   |
| ∅                      | DATA FIELD ERROR   | Invalid data used on last command.                                     |

RELATED  
SRQ BIT

RESPONSE

DESCRIPTION

|   |                         |   |
|---|-------------------------|---|
| ∅ | ITEM FIELD ERROR        | Invalid item number.                            |
| ∅ | FUNCTION ERROR          | Invalid execution item.                         |
| ∅ | I/O OVERFLOW            | Input or output buffer exceeds 128 characters.  |
| 1 | SYSTEM RAM ERROR        | ROM failure.                                    |
| 1 | N.V. RAM CHECKSUM ERROR | Non-volatile memory failure.                    |
| 1 | I/O BUS ERROR           | Interface device failure.                       |
| 2 | OVER POWER              | Too much power is being applied to FM/AM-1500.  |
| 2 | NO PHASE LOCK           | Synthesizer in FM/AM-1500 is out of phase lock. |
| 3 | GPIO INTERFACE ERROR    | GPIO I/O device failure.                        |

