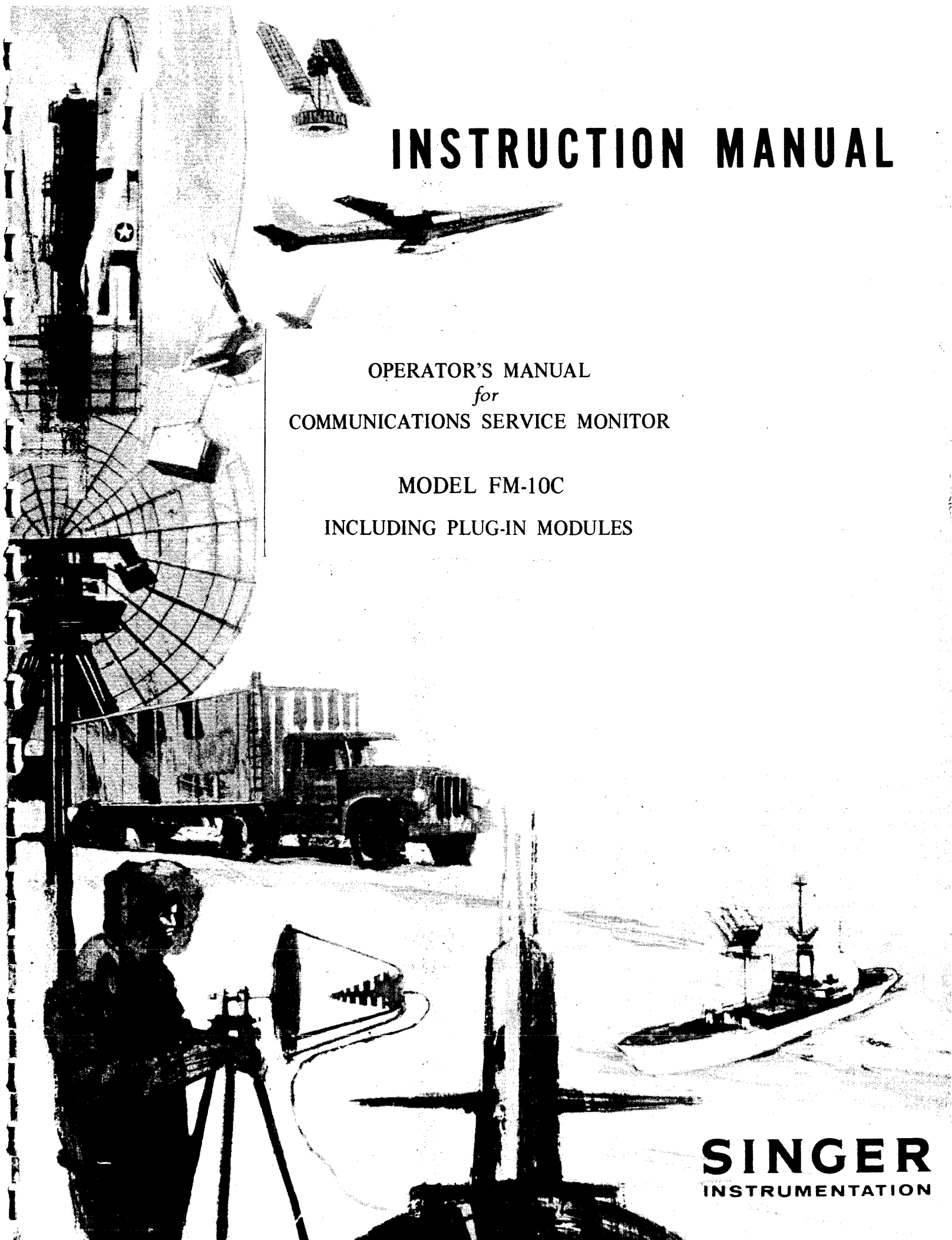


INSTRUCTION MANUAL

OPERATOR'S MANUAL
for
COMMUNICATIONS SERVICE MONITOR

MODEL FM-10C

INCLUDING PLUG-IN MODULES

SINGER
INSTRUMENTATION

OPERATOR'S MANUAL
for
COMMUNICATIONS SERVICE MONITOR

MODEL FM-10C

INCLUDING PLUG-IN MODULES

MAINFRAME SERIAL NO._____

MANUAL NO. 1-500783-258

Reprint 1/74 Lib

For maintenance of the FM-10C system refer to

Maintenance Manual No. 1-500783-259 (Serial Numbers 300 and Below)
or Maintenance Manual No. 1-500783-260 (Serial Numbers 301 and Above)

SINGER
INSTRUMENTATION

The Singer Company, Los Angeles Operation • 5340 Alla Road, Los Angeles, Ca. 90066

CONTENTS

CONTENTS (Cont)

CONTENTS (Cont)

ILLUSTRATIONS

TABLES

TABLES (Cont)

FIGURE 1–1 COMMUNICATIONS SERVICE MONITOR MODEL FM–10C WITH MODULES RFM–10A, FIM–3, and ODM–1

SECTION I

INTRODUCTION

1.1 SCOPE OF MANUAL

This manual is designed to provide operation and maintenance information for the FM-10C (figure 1-1) and its associated plug-in modules. The manual is divided into six sections containing an introduction, operating instructions, theory of operation, maintenance, schematic diagrams, and parts lists. The abbreviation for units in this manual follow the IEEE "Standard Symbols for Units" (IEEE No. 260).

1.2 PURPOSE AND USE OF EQUIPMENT

The Communications Service Monitor Model FM-10C provides the user with the test functions required for the servicing of two-way communications systems: mobile, airborne, marine, and CB. It is available with accessory plug-in modules for the servicing of FM and AM systems operating in the 50 kHz to 512 MHz range. Many SSB tests may also be performed.

The FM-10C has the capabilities of a laboratory standard while, at the same time, its battery operation and portability suit it for field service.

Some typical applications of the FM-10C system are:

a. Perform off-the-air measurements of frequency modulation and deviation.

b. Align transmitters to channel frequencies with 0.0001% accuracy and 1 Hertz resolution.

c. Measure carrier frequencies, local oscillator frequencies, IF's and any frequency in the 50 kHz to 512 MHz range.

d. Locate unknown frequencies with a 1 MHz sweep procedure.

e. Measure receiver sensitivity with 80 dB attenuation range and automatic leveling.

f. Generate IF and local oscillator frequencies for stage gain measurements or trouble analysis procedures.

g. Generate precise audio signals (50 Hz to 5 kHz) for testing tone circuits.

h. Measure bandpass characteristics of filters, amplifiers, and mixers.

i. Calibrate and test discriminators and ratio detectors.

j. Set and monitor modulation limits on AM and FM transmitters and receivers.

k. Monitor demodulated audio visually for noise, spikes, or waveform distortion, both AM and FM.

l. Combine external and internal modulation signals for checking FM decoder circuits.

1.3 GENERAL DESCRIPTION

The FM-10C is a heterodyne signal generator employing direct synthesis as the method of deriving continuous coverage of the frequency spectrum.

The FM-10C has eight frequency decade controls, seven of which give decimal steps and one control which provides continuous frequency variation from 0 to 100 Hz. All frequencies generated by the FM-10C are derived from a single 10 MHz TCXO crystal with 1 ppm accuracy.

A particular frequency is synthesized by a process of dividing, multiplying, mixing, filtering, and amplifying various derivatives of this basic 10 MHz frequency. This method eliminates phase lock loops with their inherent problems and is used for all frequencies which are multiples of 100 Hz. At these frequencies, the full 1 ppm accuracy of the crystal is applied to the output signal. For frequencies which are not exact multiples of 100 Hz, the 0 - 100 Hz control is switched into circuit and the frequency accuracy becomes 0.0001% ± 5 Hz at 25° C.

The 1 ppm accuracy of the TCXO crystal is available immediately when the instrument is switched on. The FM-10C has zero warm-up time and maintains rated accuracy over a temperature range of -5°C to +50°C. Long term drift is 1 ppm per year.

When the FM-10C is used as a frequency meter rather than as a signal generator, the signal of unknown frequency is received via the antenna (on the module Model RFM) and mixed with the variable-frequency signal of the FM-10C. The output of this mixing process is supplied to a discriminator meter (module Model FIM) calibrated in frequency, and to an audio circuit containing a loudspeaker which enables the beat note to be heard. The discriminator meter reads null when the frequency controls are set to the exact frequency of the incoming signal. A third frequency indicator is provided in the form of a beat note indicator light which flashes at the beat frequency. This indicator light enables the FM-10C to measure frequency to within a fraction of 1 Hz.

Operation of the FM-10C is extremely simple and avoids the complicated controls, setups, and calibration procedures characteristic of current communication monitors. A function switch automatically sets all circuits for the following modes: generation, measurement, calibration, and tone generation.

To generate a modulated (FM or AM) carrier, it is only necessary to plug in the appropriate modulation module and set the function switch to the "calibration" mode. The desired degree of modulation is set on the plug-in and the function switch is returned to the "generate" position.

To generate an audio tone, the function switch is set to "tone generation." The frequency controls are then set to the desired tone frequency which is automatically supplied to the audio output connector and to the loudspeaker.

Search sweeps covering 100 Hz, 1 kHz, 100 kHz, and 1 MHz can be set up with only one switch operation.

In addition to its functions of frequency meter and signal generator, the FM-10C uses three types of optional plug-ins, to provide a broad range of capabilities (figure 1-2).

The three types of plug-ins are:

1.3.1 RF Modules

(Operate in the left-hand compartment of the mainframe).

a. **Model RFM-10 Module**

This module gives the mainframe CW generating capability.

A modulation module is required for internal modulation and modulation measurement. To measure frequency, a Frequency Indication Monitor module is required.

b. **Model RFM-10A Module** ✓

This module is the same as the RFM-10 except that is has the additional capability of variable input sensitivity for off-the-air measurements.

1.3.2 Frequency Indication Modules

(Operate in center compartment).

a. **Model FIM-1 Module** ✓

This module provides meter indication of frequency error and beat light indication of sub-audible tones.

b. **Model FIM-3 Module**

This is the same as the FIM-1 except that it also has switchable audio squelch.

1.3.3 Modulation Modules

(Operate in right-hand compartment).

a. **Model ODM-1 Module**

The ODM-1 is the Oscilloscope Deviation Monitor module which equips the FM-10C mainframe to generate and measure FM using a calibrated oscilloscope screen for the display of the modulation waveform.

b. **Model MDM-1 Module**

The MDM-1 is the Meter Deviation Monitor module which equips the FM-10C to generate and measure FM using a meter indication of the modulation peak deviation.

c. **Model OAM-1 Module**

The OAM-1 is the Oscilloscope Amplitude Modulation Monitor module which equips the FM-10C to generate and measure AM using a calibrated oscilloscope screen for the display of the modulation waveform.

d. **Model AFM-2 Module**

This module provides external AM and FM modulation inputs, and time base and IF outputs.

1.4 SELECTION OF APPROPRIATE MODULES

1.4.1 For Signal Generation: To operate the FM-10C as a CW signal generator only, an RF module is required.

1.4.2 For Frequency Measurement: To operate the FM-10C as a frequency meter only, both an RF module and a Frequency Indicator module are required.

1.4.3 For Internal FM Modulation: To generate (or measure) FM modulation, an FM Modulation Monitor module is required.

1.4.4 For Internal AM Modulation: To generate (or measure) AM Modulation, an AM Modulation Monitor module is required.

1.4.5 For Modulation by External Source: To derive an AM or FM output from the FM-10C using an external audio source, an AM module or AM/FM module is required. Also, see Application Note No. 19C.

1.5 OPTIONS

A TCXO is available with an accuracy of 1 part in 10^7 P/N 403095-001.

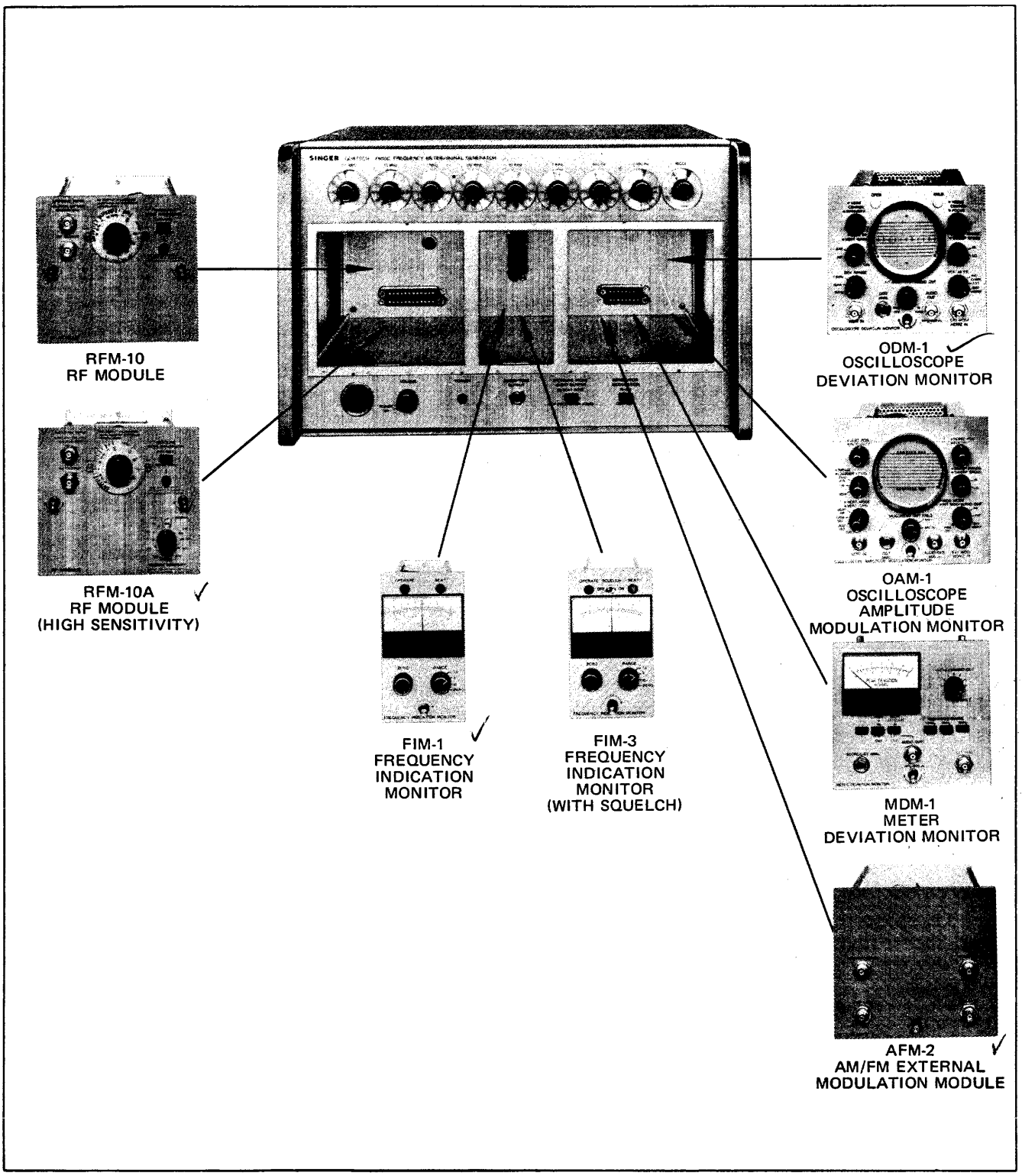


FIGURE 1–2 AVAILABLE PLUG–IN MODULES

1.6 ACCESSORIES

1.6.1 Supplied Accessories

a. Antenna P/N 2-003408-001

b. DC Power Cable (12 ft) P/N 2-004414-001

c. 20 dB Attenuators (2) (Model RFA-20) P/N 2-001355-001

d. RF Cable (3 ft) P/N 1-003159-001

e. Attenuator Repair Kit (Model RFA-20RK) P/N 1-00992-001

f. Mating Connector for Accessory Jack (Model 126-195) P/N 1-910157-005

g. UHF/BNC Adapter (Model UG-273/U) P/N 1-910117-001

h. Instruction Manuals (2) P/N 1-500783-258 and 1-500783-259 (serial numbers 300 and below) or 1-500783-260 (serial numbers 301 and above).

1.6.2 Optional Accessories

a. Universal Tone Burst Generator (Model TG-1) P/N 4-004428-___Universal Tone Burst Generator equips the FM-10C to service tone-actuated equipment. It can generate many configurations of tone bursts and any tone frequencies in the range 0.1 Hz to 9999.9 Hz. The TG-1 is all solid state and eliminates the use of reeds. All tone bursts are precisely calibrated and repeatable in all modes of operation.

b. Broadband Amplifier (Model BBA-1) P/N 4-003983-001
Broadband Amplifier gives amplification of 23 dB from 0.1 to 512 MHz.

c. Variable RF Attenuator (Model VA-1) P/N 1-003278-001
Variable RF Attenautor gives 0 dB to 60 dB attenuation up to 500 MHz and 40 dB of its range is calibrated.

d. Front Panel Cover (Model FMC-3) P/N1-004423-001
Front Panel Cover is available for protection of controls.

e. Transit Case (Model FMC-4) P/N 1-004681-001
Transit Case meets airline specifications for transportation of delicate electronic instruments.

f. 60 dB Pad (Model RFA-60) P/N 1-002517-001
Frequency response is 150-162 MHz. Power rating 60W.

g. 40 dB Pad (Model RFA-40) P/N 1-001355-004
Frequency response is 50 kHz-500 MHz. Power rating 0.25 W.

h. Plug-in Compartment Covers
Right-hand compartment: (Model BP-10) P/N 1-004781-001
Center compartment: (Model BP-11) P/N 1-004781-001

i. Rack Mount Adapter Kit (Model RMA-2) P/N 1-004699-001

j. Extender Cables
Model PC-2652 (24 pin) P/N 1-004324-001
Model PC-2775 (coax) P/N 1-004703-001
Required for RF modules.
Model PC-2653 (16 pin) P/N 1-004325-001
Required for frequency indication and modulation modules.

1.7 SPECIFICATIONS

1.7.1 Mainframe Specifications

Table 1-1 contains specification data for the FM-10C mainframe.

TABLE 1–1

MAINFRAME (MODEL FM-10C) SPECIFICATIONS

1.1	FREQUENCY RANGE	
1.1.1	**Generate:**	100 kHz to 512 MHz (useable from 50 kHz to 600 MHz)
1.1.2	**Tone Generate (Unleveled)**	Less than 50 Hz to above 5 kHz
1.1.3	**Measure:**	50 kHz to 512 MHz (useable to 589 MHz)
1.2	FREQUENCY RESOLUTION	
1.2.1	**Synthesized Mode:**	100 Hz
1.2.2	**Variable Decade:**	1 Hz = ½ div.
1.3	VARIABLE DECADE RANGE	
1.3.1	**Normal**	0 – 100 Hz
1.3.2	**100 Hz Decade:**	0 – 1 kHz
1.3.3	**1 kHz Decade:**	0 – 10 kHz
1.3.4	**10 kHz Decade:**	0 – 100 kHz
1.3.5	**100 kHz Decade:**	0 – 1 MHz
1.4	FREQUENCY ACCURACY	
1.4.1	**Synthesized Mode:**	1×10^{-6} (–5°C to 50°C) (1×10^{-7} optional)
1.4.2	**Variable Decade:**	0.0001% ± 5 Hz at 25°C (TC = 0.2 Hz/°C max) with variable decade in 0-100 Hz decade
1.4.3	**Warm Up Time:**	"Instant On"
1.5	FREQUENCY STABILITY	
1.5.1	**Residual FM:**	Less than 100 Hz (40 kHz BW)
1.5.2	**Long Term Drift (Aging):**	1×10^{-6}/ year
1.6	RF OUTPUT	See specification for particular RFM plug-in module used
1.7	MEASURE INPUT SENSITIVITY	See specification for particular RFM plug-in module used
1.8	FREQUENCY MEASUREMENT INDICATION	See specification for particular FIM plug-in module.

Table 1–1. Mainframe (Model FM-10C) Specifications (Cont.)

1.8.1	**Aural**:	Built-in speaker & phone jack for monitoring beat notes
1.9	MODULATION	
1.9.1	**FM**:	See specification for particular frequency modulation plug-in module used
1.9.2	**AM**:	See specification for particular amplitude modulation plug-in module used
1.10	AUXILIARY INPUTS AND OUTPUTS (REAR PANEL)	
1.10.1	2 MHz IF Output	1.5 mV rms from a 50 ohm source into a 50 ohm load at "operate" sensitivity
1.10.2	Ext VCO Mod & Sweep Input	
	a. Input:	10 kHz ± 10% peak deviation per 100 mV rms input with 100 kHz decade in "V" position
	b. Bandwidth:	50 Hz to 3 kHz
	c. Input Impedance:	600 ohms
1.10.3	1 MHz TCXO Output	2.5 V p-p square wave from a 1 kilohm source
1.10.4	Power Output	9 V dc at 50 mA (max)
1.10.5	10 MHz TCXO Output	0.5 V p-p (min) into a 1 kilohm load
1.10.6	Ext 10 MHz Input	
	a. Input:	Requires 1.1 V p-p ± 10%
	b. Input Impedance:	500 ohms
1.10.7	Remote FIM Meter Output	100-0-100 uA, 230 ohms meter required
1.11	OPERATING VOLTAGE	
1.11.1	Ac:	115/230 V ac 30 to 400 Hz at approx 32 VA
1.11.2	Dc:	11.5 – 15 volts at approx 2.5 amps
1.12	OPERATING TEMPERATURE RANGE	–5°C to +50°C
1.13	WEIGHT	Less than 48 pounds
1.14	DIMENSIONS	10-1/2"H x 16-3/8"W x 16-3/8"D

1.7.2 Radio Frequency Module (Model RFM-10) Specifications

Table 1-2 contains specification data for the RFM-10 plug-in module.

TABLE 1–2

RADIO FREQUENCY MODULE (MODEL RFM-10) SPECIFICATIONS

1.1	RF OUTPUT	
1.1.1	**Range (Calibrated):**	0.05 to 500 uV (50 ohms) with external attenuators supplied
1.1.2	**Range (Uncalibrated):**	500 uV to 2.5 mV (50 ohms)
1.1.3	**Accuracy:**	± 3 dB, 50 kHz to 512 MHz at 50 uV (midrange)
1.1.4	**Leakage:**	Less than 0.15 uV measured 18" from instrument
1.1.5	**Output Impedance**	50 ohms (nom)
1.2	MEASURE INPUT SENSITIVITY*	
1.2.1	**50 kHz to 1 MHz:**	Less than 20 mV rms
1.2.2	**1 MHz to 512 MHz:**	6 mV rms ± 3 dB
1.2.3	**Measure Input Impedance:**	50 ohms (nom)

* Sensitivity is defined as the level required for normal operation

1.7.3 Radio Frequency Module (Model RFM-10A) Specifications

Table 1-3 contains specification data for the RFM-10A plug-in module.

TABLE 1–3

RADIO FREQUENCY MODULE (MODEL RFM-10A) SPECIFICATIONS

1.1	RF OUTPUT	
1.1.1	**Range (Calibrated):**	0.05 to 500 uV (50 ohms) with external attenuators supplied
1.1.2	**Range (Uncalibrated):**	500 uV to 2.5 mV (50 ohms)
1.1.3	Accuracy:	± 3 dB, 50 kHz to 512 MHz at 50 uV (midrange)
1.1.4	Leakage:	Less than 0.15 uV measured 18" from instrument
1.1.5	Output Impedance	50 ohms (nom)
1.2	MEASURE INPUT SENSITIVITY*	
1.2.1	50 kHz to 512 MHz Normal:	Less than 600 uV rms to 14 mV rms min
1.2.2	50 kHz to 512 MHz Hi Sens:	20 uV rms max to greater than 500 uV rms
	Note: Max sensitivity may be limited at various frequencies by spurious signals.	
1.2.3	Measure Input Impedance	50 ohms (nom)

*Sensitivity is defined as the level required for normal operation.

1.7.4 Frequency Indication Monitor (Model FIM-1) Specifications Table 1-4 contains specification data for the FIM-1 plug-in module.

TABLE 1–4

FREQUENCY INDICATION MONITOR (MODEL FIM–1) SPECIFICATIONS

1.1	FREQUENCY MEASUREMENT INDICATION	1) Frequency error meter with ± 1.5 kHz, ± 5 kHz, and ± 15 kHz ranges. Accuracy 5% of full scale deflection. 2) Separate lamp indicator for beat notes less than 5 Hz
1.2	OPERATE SENSITIVITY	Referenced to operate level of RF module
1.3	FREQUENCY ERROR BANDWIDTH	>±5 kHz at operate level of RF module +3dB. >±15 kHz at operate level of RF module +6 dB

1.7.5 Frequency Indication Monitor (Model FIM-3) Specifications

Table 1-5 contains specification data for the FIM-3 plug-in module.

TABLE 1–5

FREQUENCY INDICATION MONITOR (MODEL FIM–3) SPECIFICATIONS

1.1	FREQUENCY MEASUREMENT INDICATION	1) Frequency error meter with ± 1.5 kHz, ± 5 kHz, and ± 15 kHz ranges. Accuracy 5% of full scale deflection. 2) Separate indicator for beat notes less than 5 Hz
1.2	OPERATE SENSITIVITY	Referenced to operate level of RF module
1.3	FREQUENCY ERROR BANDWIDTH	> ± 5 kHz at operate level of RF module + 3 dB. > ± 15 kHz at operate level of RF module + 6 dB

1.7.6 Oscilloscope Amplitude Modulation Monitor (Model OAM-1) Specifications

Table 1-6 contains specification data for the Model OAM-1 plug-in module.

TABLE 1–6

OSCILLOSCOPE AMPLITUDE MODULATION MONITOR (MODEL OAM–1) SPECIFICATIONS

1.1	AS AN AM MONITOR	
1.1.1	**Ranges**:	0 to 30% and 0 to 100% (95% max usable)
1.1.2	**Accuracy**:	± 10% of full scale at 400 Hz and 1 kHz
1.1.3	**Distortion Analyzer Output**:	
	a. Bandwidth:	50 Hz to 3 kHz (3 dB referenced to 1 kHz)
	b. Output Level:	300 mV rms ± 20% for full scale deflection
	c. Source Impedance:	1 kilohm ± 20%
1.1.4	**Sensitivity**	See specification for particular left-hand module used.

Table 1–6. Oscilloscope Amplitude Modulation Monitor (Model OAM–1) Specifications (Cont.)

1.2	AS AN AM MODULATOR	
1.2.1	**Internal Modulation:**	
	a. Modulation Frequencies:	400 Hz ± 5%, and 1 kHz ± 5%
	b. Modulation Range:	0–30%
	c. Distortion due to mainframe	3% (max) at 30% modulation
1.2.2	**External Modulation:**	
	a. Frequency Range:	50 Hz to 20 kHz (1 dB referenced to 1 kHz)
	b. Modulation Range:	0–50%
	c. Distortion at 1 kHz due to mainframe	0–30% AM: 3% (max) 30–50% AM: 10% (max)
	d. Input Impedance:	40 kilohms (min) at 1 kHz
	e. Input Level:	0.5 V rms ± 20% for 30% AM at 1 kHz
1.2.3	**Audio Output:**	
	a. Frequencies:	400 Hz ± 5%, and 1 kHz ± 5%
	b. Voltage:	Variable 0–1 V rms (min) into a 600 ohm load
	c. Source Impedance:	600 ohms ± 20%
	d. Distortion:	1% (max)
1.3	AS AN OSCILLOSCOPE	
1.3.1	**CRT Size:**	3-inch flat face
1.3.2	**External Vertical Input:**	
	a. Sensitivity:	300 mV p-p ± 10% for full scale deflection
	b. Frequency Response:	50 Hz to 30 kHz (3 dB referenced to 1 kHz)
	c. Input Impedance:	100 kilohms ± 20% at 1 kHz
	d. Attenuator:	Continuously variable 100:1

Table 1–6. Oscilloscope Amplitude Modulation Monitor (Model OAM-1) Specifications (Cont.)

1.3.3	**Horizontal:**	
	a. Internal:	
	i. Sweep Range:	Lo = 50 Hz to 500 Hz Hi = 500 Hz to 5 kHz
	ii. Sweep Type:	Recurrent
	iii. Sync Type:	Internal Automatic
	b. External:	
	i. Sensitivity:	0.5 V p-p (max) per inch deflection
	ii. Input Impedance:	500 kilohms (min) at 1 kHz
1.4	MISCELLANEOUS	
1.4.1	**Auxiliary Power Output:**	+ 9 V dc at 50 mA (max)
1.4.2	**Operating Temperature Range:**	–5°C to 50°C (when installed in FM-10C)
1.4.3	**Weight:**	4½ lbs (nominal)
1.4.4	**Power:**	9 V dc at 900 mA max (supplied from FM-10C

1.7.7 Oscilloscope Deviation Monitor (Model ODM-1) Specifications

Table 1-7 contains specification data for the Model ODM-1 plug-in module.

TABLE 1–7

OSCILLOSCOPE DEVIATION MONITOR (ODM–1) SPECIFICATIONS

1.1	AS A DEVIATION MONITOR	
1.1.1	**Peak Deviation Ranges:**	0 to 1.5 kHz, 5 kHz and 15 kHz
1.1.2	**Accuracy:**	
	a. At 1 kHz modulation:	100 Hz ± 5% of full scale
	b. At 50 Hz and 3 kHz:	100 Hz ± 7% of full scale

Table 1–7. Oscilloscope Deviation Monitor (ODM-1) Specifications (Cont.)

1.1.3	**Sensitivity:**	
	a. Operate:	See specification for particular left-hand module used
	b. Overload:	20 dB above nominal operate level of left-hand module (± 3 dB)
1.1.4	**Distortion Analyzer Output:**	
	a. Bandwidth:	50 Hz to 3 kHz (3 dB referenced to 1 kHz)
	b. Output Level:	1.5 V p-p ± 10% at 5 kHz deviation; dc level of 4.5 V dc ± 10%
	c. Source Impedance:	1 kilohm ± 20%
1.2	AS AN FM MODULATOR	
1.2.1	**Internal Modulation:**	
	a. Modulation Frequency:	1 kHz ± 5%
	b. Deviation Range:	0 to 15 kHz (min)
	c. Distortion due to mainframe	3% (max) for 15 kHz peak deviation
1.2.2	**External Modulation:**	
	a. Frequency Range:	300 Hz to 3 kHz
	b. Deviation Range:	0 to 15 kHz (min)
	c. Distortion due to mainframe:	3% (max) at 1 kHz for 15 kHz peak deviation
	d. Input Impedance:	600 ohms ± 20%
	e. Input Level:	80 mV rms ± 20% for 5 kHz peak deviation at 400 Hz
	Note: For peak deviations up to 60 kHz and modulation frequencies as low as 50 Hz, external VCO input on rear of FM-10C may be used (see FM-10C application note No. 19C).	
1.2.3	**Combined Modulation (Internal and External Combined):**	
	a. Modulation Frequency:	
	i. External:	300 Hz to 3 kHz (3 dB referenced to 400 Hz)
	ii. Internal:	1 kHz ± 5%

Table 1–7. Oscilloscope Deviation Monitor (ODM-1) Specifications (Cont.)

1.2.3	**Combined Modulation (Internal and External Combined): (Cont.)**	
	b. Peak Deviation Range:	0 to 15 kHz (min)
1.2.4	**Audio Output:**	
	a; Frequency:	1 kHz ± 5%
	b. Voltage:	Variable 0–1 V rms (min) into a 600 ohm load
	c. Source Impedance:	600 ohms ± 20%
	d. Distortion:	1% (max)
1.3	AS AN OSCILLOSCOPE	
1.3.1	**CRT Size:** 3-inch flat face	
1.3.2	**External Vertical Input:**	
	a. Sensitivity:	70 mV p-p ± 10% for full scale deflection
	b. Frequency Response	50 Hz to 30 kHz (3 dB referenced to 1 kHz)
	c. Input Impedance:	25 kilohms ± 20%
	d. Attenuator:	Continuously variable 100:1
1.3.3	**Horizontal:**	
	a. Internal:	
	i. Sweep Range:	Lo = 50 Hz to 500 Hz Hi = 500 Hz to 5 kHz
	ii. Sweep Type:	Recurrent
	iii. Sync Type:	Internal Automatic
	b. External:	
	i. Sensitivity:	0.5 V p-p (max) per inch deflection
	ii. Input Impedance	500 kilohms (min) at 1 kHz
1.4	MISCELLANEOUS	
1.4.1	**Auxiliary Power Output:**	+ 9 V dc at 50 mA (max)
1.4.2	**Operating Temperature Range:**	–5°C to 50°C (when installed in FM-10C)
1.4.3	**Weight:**	4½ lbs (nominal)
1.4.4	**Power:**	9 V dc at 900 mA max (supplied by FM-10C

1.7.8 Meter Deviation Monitor (Model MDM-1) Specifications

Table 1-8 contains specification data for the Model MDM-1 plug-in module.

TABLE 1–8

METER DEVIATION MONITOR (MODEL MDM–1) SPECIFICATIONS

1.1	AS A DEVIATION MONITOR	
1.1.1	**Peak Deviation Ranges:**	0 to 1.8 kHz, 6 kHz and 18 kHz
1.1.2	**Accuracy:**	
	a. At 1 kHz Modulation:	100 Hz ± 5% of full scale
	b. At 50 Hz and 3 kHz:	100 Hz ± 7% of full scale
1.1.3	**Sensitivity:**	
	a. Operate:	See specification for particular left-hand module used
	b. Overload:	20 dB (min) above operate level of left-hand module
1.1.4	**Scope/Distortion Analyzer Output:**	
	a. Bandwidth:	50 Hz to 3 kHz (3 dB referenced to 1 kHz)
	b. Output Level:	280 mV p-p ± 10% for 5 kHz deviation; dc level of 4.5 V dc ± 10%
	c. Source Impedance:	120 ohms ± 20%
1.2	AS AN FM MODULATOR	
1.2.1	**Internal Modulation:**	
	a. Modulation Frequency:	1 kHz ± 5%
	b. Deviation Range:	0 to 18 kHz (min)
	c. Distortion due to mainframe:	3% (max) at 18 kHz peak deviation
1.2.2	**External Modulation:**	
	a. Frequency Range:	300 Hz to 3 kHz (3 dB referenced to 400 Hz)
	b. Deviation Range:	0 to 18 kHz (min)
	c. Distortion due to mainframe:	3% (max) at 1 kHz rate for 18 kHz peak deviation

Table 1–8. Meter Deviation Monitor (Model MDM-1) Specifications (Cont.)

1.2.2	**External Modulation: (Cont.)**	
	d. Input Impedance:	5 kilohms (nom)
	e. Input Level:	100 mV rms ± 20% for 5 kHz peak deviation at 400 Hz
	Note: For peak deviations up to 60 kHz and modulation frequencies as low as 50 Hz, external VCO input on rear of FM-10C may be used. (See FM-10C Application Note No. 19C.)	
1.2.3	**Combined Modulation (Internal & External Combined):**	
	a. Modulation Frequency:	
	i. External:	300 Hz to 3 kHz (3 dB referenced to 400 Hz)
	ii. Internal:	1 kHz ± 5%
1.2.4	**Deviation Range:**	0 to 18 kHz (min)
1.2.5	**External Input Impedance:**	1 kilohm (nom)
1.2.6	**Audio Output:**	
	a. Frequency:	1 kHz ± 5%
	b. Voltage:	Variable 0–1 V rms (min) into a 600 ohm load
	c. Source Impedance:	600 ohms ± 20%
	d. Distortion:	1% (max)
1.3	MISCELLANEOUS	
1.3.1	**Auxiliary Power Output:**	+ 9 V dc at 50 mA (max)
1.3.2	**Operating Temperature Range:**	–5°C to 50°C (when installed in FM-10C)
1.3.3	**Weight:**	2½ lbs (nominal)
1.3.4	**Power:**	9 V dc at 110 mA max (supplied by FM-10C)

1.7.9 AM/FM External Modulation Module (Model AFM-1) Specifications

Table 1-9 contains specification data for the model AFM-1 plug-in module.

TABLE 1–9

AM/FM EXTERNAL MODULATION MODULE (MODEL AFM–1) SPECIFICATIONS

1.1	AMPLITUDE MODULATION	
1.1.1	**Sensitivity:**	Input to amplitude modulator requires a level of 75 mV rms ± 20% to produce 30% modulation at 3% (max) distortion
1.1.2	**Input Impedance:**	500 ohms (nominal) at 1 kHz
1.1.3	**Bandwidth:**	50 Hz to 20 kHz ± 1 dB referenced to 1 kHz
1.2	FREQUENCY MODULATION	
1.2.1	**Sensitivity:**	Input to frequency modulator (phase modulator) requires a level of 100 mV rms ± 10% to produce a peak deviation of 5 kHz (max) at a 400 Hz rate
1.2.2	**Input Impedance:**	5 kilohms (nom)
1.2.3	**Bandwidth:**	300 Hz to 3 kHz (3 dB referenced to 400 Hz)

1.7.10 AM/FM External Modulation Module (Model AFM-2) Specifications

Table 1-10 contains specification data for the Model AFM-2 plug-in module.

TABLE 1–10

AM/FM EXTERNAL MODULATION MODULE (MODEL AFM–2) SPECIFICATION

1.1	AMPLITUDE MODULATION	
1.1.1	**Sensitivity:**	Input to amplitude modulator requires a level of 75 mV rms ± 20% to produce 30% modulation at 3% (max) distortion
1.1.2	**Input Impedance:**	500 ohms (nominal) at 1 kHz
1.1.3	**Bandwidth:**	50 Hz to 20 kHz ± 1 dB referenced to 1 kHz

Table 1–10. AM/FM External Modulation Module (Model AFM-2) Specifications (Cont.)

1.2	FREQUENCY MODULATION	
1.2.1	**Sensitivity:**	Input to frequency modulator (phase modulator) requires a level of 100 mV rms ± 10% to produce a peak deviation of 5 kHz (max) at a 400 Hz rate
1.2.2	**Input Impedance:**	5 kilohms (nom)
1.2.3	**Bandwidth:**	300 Hz to 3 kHz (3 dB referenced to 400 Hz)
1.3	IF OUTPUT	2 MHz IF at 2.5 mV ± 10% into a load impedance of 200 ohms at "operate" sensitivity
1.3.1	**Source Impedance:**	50 ohms (nominal)
1.3.2	**Bandwidth:**	Selected at RF module
1.4	10 MHz OUTPUT	10 MHz time base signal at a level of 100 mV rms (min) from a source impedance of 1000 ohms (nominal)

1.7.11 Radio Frequency Module (Model RFM-10D Specifications

Table 1-11 contains specification data for the RFM-10D plug-in module.

TABLE 1-11

RADIO FREQUENCY MODULE (MODEL RFM-10D SPECIFICATIONS)

1.1	RF OUTPUT	
1.1.1	Frequency Range	50 kHz to 512 MHz
1.1.2	Output Level	-110 dBm to 0 dBm (0.7 uV to 224 mV) into 50 ohms in 1 dB steps
1.1.3	Output Level Accuracy	
	0 dBm to -110 dBm 50 kHz to 512 MHz	±3 dB
1.1.4	Output Impedance	50 ohms nominal
1.2	MEASURE INPUT	
1.2.1	Frequency Range	50 kHz to 512 MHz
1.2.2	Sensitivity*	Variable in 2 ranges and better than 3.0 uV at max sensitivity position of MEASURE SENSITIVITY switch
	Normal Hi Sens	64 uV to 2 mV nominal 2 uV to 64 uV nominal
		NOTE: Max sensitivity may be limited at various frequencies by spurious signals.
1.2.3	IF Bandwidth (-3 dB)	
	Narrow Wide	32.5 kHz ±2.5 kHz 200 kHz nominal
1.2.4	Input Impedance	50 ohms nominal

*Sensitivity is defined as the level required for normal operation.

1.7.12 Radio Frequency Module (Model RFM-11A) Specifications

Table 1-12 contains specification data for the RFM-11A plug-in module.

TABLE 1-12

RADIO FREQUENCY MODULE (MODEL RFM-11A) SPECIFICATIONS

1.1	RF OUTPUT	
1.1.1	Frequency Range	50 kHz to 600 MHz 800 MHz to 1.30 GHz
1.1.2	Output Level	-120 dBm to -20 dBm (0.22 uV to 22 mV) into 50 ohms in 1 dB steps
1.1.3	Output Level Accuracy	
	-20 dBm to -120 dBm 50 kHz to 512 MHz 800 MHz to 1300 MHz	 ±4 dB ±5 dB
1.1.4	Output Impedance	50 ohms nominal
1.2	MEASURE INPUT	
1.2.1	Frequency Range	50 kHz to 588 MHz 800 MHz to 1.288 GHz
1.2.2	Sensitivity* Variable in 2 ranges: Normal Hi Sens	 640 uV to 20 mV nominal 20 uV to 640 uV nominal
	At max sensitivity position of MEASURE SENSITIVITY switch: 50 kHz to 588 MHz 800 MHz to 1.288 GHz	 Better than 30 uV Better than 35 uV
		NOTE: Max sensitivity may be limited at various frequencies by spurious signals.
1.2.3	IF Bandwidth (-3 dB)	
	Narrow Wide	32.5 kHz ±2.5 kHz 200 kHz nominal
1.2.4	Input Impedance	50 ohms nominal

*Sensitivity is defined as the level required for normal operation.

1.7.13 Radio Frequency Module (Model RFM-10B Specifications)

The Model RFM-10B specifications are the same as the specifications for the Model RFM-10A with the following exceptions (refer to Table 1-3):

MEASURE INPUT SENSITIVITY*

a)	50 kHz to 512 MHz Normal:	Less than 60 uV rms to 1.4 mV rms min.
b)	50 kHz to 512 MHz Hi Sens:	2 uV rms max to greater than 50 uV rms

*Sensitivity is defined as the level required for normal operation.

1.7.14 Radio Frequency Module (Model RFM-10A and RFM-10B Specifications)

Table 1-13 contains specifications data for the RFM-10A and RFM-10B plug-in modules.

TABLE 1-13

RADIO FREQUENCY MODULE (MODEL RFM-10A AND RFM-10B) SPECIFICATIONS

1.1	RF OUTPUT	
1.1.1	Frequency Range	50 kHz to 512 MHz
1.1.2	Output Level	
	a. Calibrated	-133 dBm to -53 dBm (0.05 uV to 500 uV) with 40 dB external attenuation
	b. Uncalibrated	-53 dBm to approximately -39 dBm (500 uV to 2.5 mV)
1.1.3	Output Level Accuracy with attenuator dial at .5 uV (50 uV output level)	±3 dB (50 kHz to 512 MHz)
1.1.4	Output Impedance	50 ohms nominal
1.2	MEASURE INPUT	
1.2.1	Frequency Range	50 kHz to 512 MHz
1.2.2	Sensitivity*	RFM-10A) Variable in 2 ranges and better than 30 uV at max sensitivity position of MEASURE SENSITIVITY switch RFM-10B) Variable in 2 ranges and better than 3.0 uV at max sensitivity position of MEASURE SENSITIVITY switch
	Normal	RFM-10A) 0.64 mV to 20 mV nominal RFM-10B) 64 uV to 2 mV nominal
	Hi Sens	RFM-10A) 20 uV to 640 uV nominal RFM-10B) 2 uV to 64 uV nominal
		NOTE: Max sensitivity may be limited at various frequencies by spurious signals.

*Sensitivity is defined as the level required for normal operation.

Table 1-13. Radio Frequency Module (Model RFM-10A and RFM-10B) Specifications, Cont.

1.2.3	IF Bandwidth (-3 dB)	
	Narrow	32.5 kHz ±2.5 kHz
	Wide	200 kHz nominal
1.2.4	Input Impedance	50 ohms nominal

SECTION II

OPERATING INSTRUCTIONS

2.1 GENERAL

Instructions and information for preparing the FM-10C for use, functional description of controls and receptacles, and operating instructions for the mainframe and all plug-in modules are presented in this section of the manual. Operation of Model FM-10C is extremely simple and does not involve calibration or locking procedures. Any desired frequency is obtained with full rated accuracy when the power is switched on and the frequency switches are set to the specified value.

2.2 FM-10C MAINFRAME

2.2.1 Controls, Indicators, and Receptacles (Mainframe)

Table 2-1 explains the functions of all controls, indicators, and receptacles of the mainframe. Figure 2-1 illustrates the location of these controls, etc.

TABLE 2–1

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MAINFRAME)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	**100 MHz** Dial Marking 0-1-2-3-4-5	Switch rotary, 6 positions	Controls the frequency in five steps of 100 MHz
2	**10 MHz** Dial Marking 0-1-2-3-4-5-6-7-8-9	Switch rotary, 10 positions	Controls the frequency in ten steps of 10 MHz
3	**1 MHz** Dial Marking 0-1-2-3-4-5-6-7-8-9	Switch rotary, 10 positions	Controls the frequency in ten steps of 1 MHz
4	**100 kHz** Dial Marking 0-1-2-3-4-5-6-7-8 -9-V	Switch rotary, 11 positions	Controls the frequency in ten steps of 100 kHz. "V" position switches 0–100 Hz control (item 8) into circuit with continuous control over the range of 1 MHz
5	**10 kHz** Dial Marking 0-1-2-3-4-5-6-7-8 -9-V	Switch, rotary, 11 positions	Controls the frequency in ten steps of 10 kHz. "V" position switches the 0–100 Hz control into the circuit with continuous control over the range of 100 kHz
6	**1 kHz** Dial Marking 0-1-2-3-4-5-6-7-8 -9-V	Switch rotary, 11 positions	Controls the frequency in ten steps of 1 kHz. "V" position switches the 0–100 Hz control into the circuit with continuous control over the range of 10 kHz

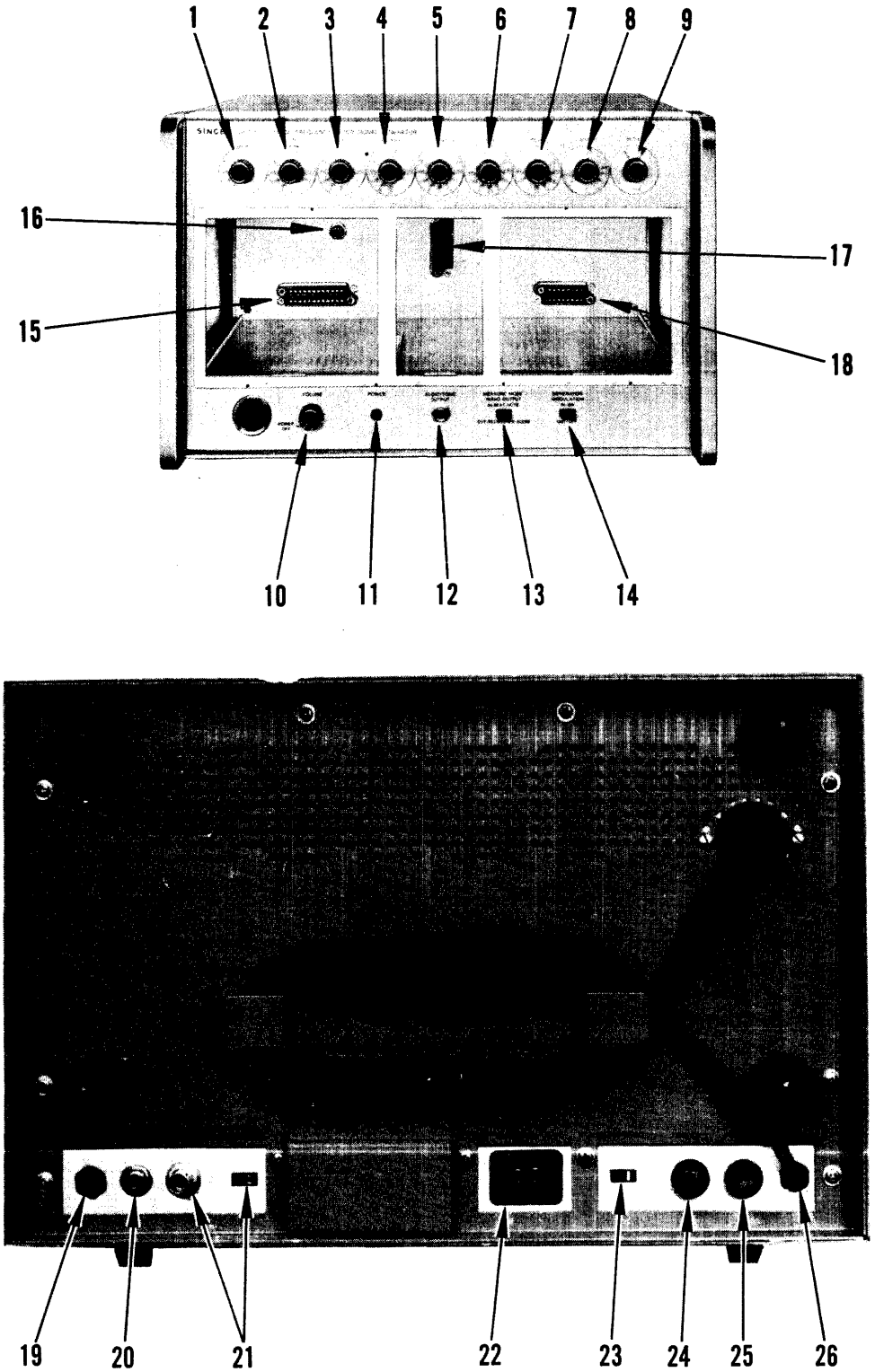


FIGURE 2-1 OPERATING CONTROLS, INDICATORS, and RECEPTACLES (MAINFRAME)

Table 2–1. Operating Controls, Indicators and Receptacles (Mainframe) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
7	**100 Hz** Dial Marking 0-1-2-3-4-5-6-7-8 -9-V	Switch, rotary, 11 positions	Controls the frequency in ten steps of 100 Hz. "V" position switches the 0–100 Hz control into the circuit with continuous control over the range of 1 kHz
8	**0–100 Hz** Dial Marking 0-1-2-3-4-5-6-7-8 -9-10-OUT	Potentiometer/ Switch, rotary, 2 positions	Controls the frequency continuously over five ranges: 0–100 Hz 0–1 kHz (100 Hz switch in V position) 0–10 kHz (1 kHz switch in V position) 0–100 kHz (10 kHz switch in V position) 0–1 MHz (100 kHz switch in V position) Frequency range of this potentiometer is 0–100 Hz when no switch is in the "V" position.
9	MODE Dial Marking MEAS-GEN-GEN MOD CAL-TONE GEN	Switch, rotary, 4 positions	Provides proper mode of operation by switching the functions in the mainframe and plug-ins.
10	VOLUME/Power Off	Potentiometer/ Switch rotary, 2 positions	Control audio tone output level (speaker volume) and power
11	POWER	Light, indicator	Indicates when primary power is applied to the power supply
12	AUDIO/TONE OUTPUT	Connector, phone jack	Provides audio and tone outputs (disables internal speaker)
13	MEASURE MODE AUDIO OUTPUT IN-BEAT NOTE OUT-RECOVERED AUDIO	Switch, push-push	Selects source of signal to audio circuit; either recovered modulation from the carrier or the beat note difference between the carrier and the FM-10C frequency (with MODE switch in "MEAS" position)
14	GENERATOR MODULATION IN-ON OUT-OFF	Switch, push-push	Applies the modulation signal from the right-hand module to the modulation circuits in the mainframe
15	(R.F. MODULE CONNECTOR J-6) Pin 1 Pin 2	Connector, 24 pin	 2 MHz IF input to mainframe into a load impedance of 50 ohms nominal. Level is set to give 2.5 mV rms into 200 ohms at J8-16 and J9-16 at the "operate" sensitivity of R.F. module Not connected

Table 2–1. Operating Controls, Indicators and Receptacles (Mainframe) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
15	(R.F. MODULE CONNECTOR J-6) (Cont.)	Connector, 24 pin	
	Pin 3		ALC detector voltage input to ALC amp. Nom –20 mV dc into a load impedance of 10 k ohm ± 20%
	Pin 4		Not connected
	Pin 5		10 MHz from A1A2 board at a level of 100 mV rms min from a source impedance of 50 ohm nom, also jumpered from this point to A1A6 and J9-1
	Pin 6		Not connected
	Pin 7		9 Vdc switched. On when the 100 MHz decade switch, S1 is in positions "0" through "5"
	Pin 8		Not connected
	Pin 9		9 Vdc regulated from the 9 V power supply via TB3-3,4
	Pin 10		9 Vdc switched. On when MODE switch, S9, is in the "MEAS" position
	Pin 11		9 Vdc switched. On when 100 MHz decade switch, S1, is in position "9"
	Pin 12		Ground
	Pin 13		Ground
	Pin 14		9 Vdc switched. On when 100 MHz decade switch, S1, is in position "6"
	Pin 15		Ground
	Pin 16		9 Vdc switched. On when 100 MHz decade switch, S1, is in position "7"
	Pin 17		Ground
	Pin 18		9 Vdc switched. On when 100 MHz decade switch, S1, is in position "8"
	Pin 19		Not connected
	Pin 20		9 Vdc switched. On when the MODE switch, S9, is in the GEN MOD CAL or TONE GEN position
	Pin 21		Ground
	Pin 22		Not connected

Table 2–1. Operating Controls, Indicators and Receptacles (Mainframe) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
15	(R.F. MODULE CONNECTOR J-6) (Cont.)	Connector, 24 pin	
	Pin 23		9 Vdc switched. On when 100 MHz decade switch, S1, is in position "10"
	Pin 24		9 MHz output at 100 mV rms ± 20% from A3D-7. Source impedance is 50 ohms nom
16	(R.F. MODULE CONNECTOR J-7)	Connector, push-on	50 kHz to 600 MHz R.F. output from synthesizer via low-pass filter FL3. Source impedance is 50 ohms nominal. Level is –33 dBm ± 3 dB in a closed loop condition with level being controlled by ALC voltage at J6-3
17	(FREQUENCY INDICATING MODULE CONNECTOR J-8)	Connector, 16 pin	
	Pin 1		Beat note audio input at a nominal level of 0.45 V rms into a load impedance of 5 k ohms
	Pin 2		Ground
	Pin 3		Connected to J4-3 on rear panel for remote meter
	Pin 4		Ground
	Pin 5		Connected to J4-1 on rear panel for remote meter
	Pin 6		Ground
	Pin 7		Not connected
	Pin 8		Ground
	Pin 9		9 Vdc switched. On when MODE switch is in the MEAS or TONE GEN position
	Pin 10		Ground
	Pin 11		Connected to J4-2 on rear panel for remote meter
	Pin 12		4.2 MHz output from A15 board. Level is 200 mV rms ± 20% from a source impedance of 75 ohms nom
	Pin 13		+12 Vdc unregulated from A1A3 board
	Pin 14		100 kHz output from A1A2 board. Level is 4 V p-p ± 20% from a source impedance of 470 ohms
	Pin 15		Input to recovered audio enable/disable circuitry
	Pin 16		2 MHz IF output from A1A5 board. Level is set to 2.5 mV rms at operate sensitivity. Source impedance is 50 ohms ± 20%

Table 2–1. Operating Controls, Indicators and Receptacles (Mainframe) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
18	(MODULATION MODULE CONNECTOR J-9)	Connector, 16 pin	
	Pin 1		10 MHz from A1A2 board via J6-5. Level is 100 mV rms min from a source impedance of 50 ohms nom
	Pin 2		Ground
	Pin 3		Ground
	Pin 4		Ground
	Pin 5		Not connected
	Pin 6		Ground
	Pin 7		Not connected
	Pin 8		Ground
	Pin 9		+9 Vdc regulated from A1A3 via TB3-3,4
	Pin 10		Ground
	Pin 11		Audio signal input to amplitude modulator. Requires 75 mV rms ± 10% to produce 30% modulation. input impedance to 500 ohms ± 20%
	Pin 12		Audio signal input to frequency modulator (phase modulator). Load impedance is 5 k ohms nominal. Requires level of 100 mV rms ± 10% to produce a peak deviation of 5 kHz at a 400 Hz rate
	Pin 13		Not connected
	Pin 14		Recovered audio input to audio amplifier circuit. Load impedance is 5 k ohm nom. Requires 50 to 100 mV rms for fully rated audio output (0.5 watts)
	Pin 15		Not connected
	Pin 16		2 MHz IF output, set at a level of 2.5 mV rms at "operate" sensitivity. Source impedance is 50 ohms ± 20%
19	ACC	Connector, 7 pin	
	Pin A		2 MHz IF output. Level is set at 1.5 mV rms into a 50 ohm load at "operate" sensitivity. Source impedance is approximately 50 ohms. Dynamic range is greater than 20 dB above 1.5 mV rms

Table 2–1. Operating Controls, Indicators and Receptacles (Mainframe) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
	Pin B		Audio signal input to VCO. Bandwidth is less than 50 Hz to greater than 3 kHz. Requires 100 mV ± 10% for 10 kHz peak deviation with "V" in 100 kHz decade. See Application Note #19C. Input Z = 600 ohms
	Pin C		Not connected
	Pin D		1 MHz square wave output at approximately 2.5 V p-p from a source impedance of 1 k ohms. Time base output for comparison and/or calibration
	Pin E		9 Vdc ± 1%. Less than 2 mV rms ripple at 50 mA maximum current
	Pin F		Not connected
	Pin H		Ground
20	REM. METER	Connector, phone jack	To drive 100 – 0 – 100 uA meter with 230 ohms dc resistance. Full scale range selected by Frequency Indicating module RANGE switch
	Term #1		Negative side of external meter
	Term #2		Positive side of external meter
21	TIME BASE	Connector, BNC	Provides connection for external time base and supplies internal time base output when switch in in INT position
	EXT ⟷ INT	Switch, slide	
			INT: 10 MHz output from internal time base at a level of 0.5V p-p min into a 1 k ohm load
			EXT: 10 MHz external time base input. Requires 1.1 V p-p±10%. Input impedance is 500 ohms ± 20%
22	12 VDC	Connector, 4 pin	Provides connection for external 12 Vdc power
23	DC ⟷ AC	Switch, slide	Selects ac or dc operation
24	DC 4A	Fuse, 4A	12 Vdc fuse
25	AC 0.75A	Fuse, 0.75A	115/230 Vac fuse
26	AC POWER	Power cord, 3 pin	Applies primary ac power to the unit. Both sides of ac line isolated from chassis ground. Third wire connected to chassis ground

2.2.2 Power Supply Connections Using an 11.5 to 15 Vdc Source

a. Set AC/DC rear panel switch to DC.

b. Connect power to the 12 V DC connector on rear panel.

c. Use the special dc cable assembly provided to connect to a car or truck battery.

NOTE: Make certain that the external source provides a negative ground. Reverse polarity will blow the dc fuse. (FM-10C case is connected to the dc negative line.)

2.2.3 Power Supply Connections Using a 115 Vac Source

a. Set AC/DC rear panel switch to AC.

b. Plug power cord into 115 Vac 3-pin type source.

NOTE: The FM-10C is supplied preset to 115 Vac for use in North America, unless otherwise indicated by a decal over the AC/DC switch. Power cord supplied is 3-pin for use with 115V grounded mains supply.

2.2.4 Power Supply Connections Using a 230 Vac Source

a. Remove instrument cover by removing eleven (11) screws on the back.

b. Set voltage switch marked "115" to 230 V setting. (This switch is located on rear of left panel.)

c. Replace cover.

d. Plug into source.

2.2.5 Audio Tone Generation (without right-hand plug-in module)

a. Set mainframe MODE switch to TONE GEN position.

b. Set decade frequency switches and 0-100 Hz control to the tone frequency required.

c. Connect test unit to FM-10C AUDIO/TONE OUTPUT connector.

d. Adjust VOLUME control for desired output level.

2.2.6 Rear Panel ACC Connector Functions

A variety of auxiliary functions are available at the ACC connector on mainframe rear panel: 2 MHz IF output; external VCO sweep input; 1 MHz high-level output; +9 Vdc output.

a. 2MHz IF Output (Pin A)

This output may be used for narrowband spectral analysis of the input signal. See Application Note number 16C for method.

b. External VCO Input (Pin B)

This input may be used to frequency modulate the FM-10C up to 60 kHz peak deviation and modulating rates from 50 Hz to 3 kHz. See Application Note number 19C for method. This also may be used to convert the FM-10C to a sweep generator.

c. 1 MHz High Level Output (Pin D)

This output facilitates calibration of the FM-10C. See Application Note number 15C.

d. +9 Vdc Output (Pin E)

+9 Vdc at 50 mA (maximum) is available at this terminal.

2.2.7 Rear Panel External/Internal Time Base Functions

The TIME BASE connector on the rear panel supplies the output of the FM-10C TCXO time base (10 MHz) when the TIME BASE switch is in the INT position. This internal time base is disconnected when the switch is at EXT position and the connector may be used to operate the FM-10C from an external high-accuracy 10 MHz source.

2.3 RFM-10 PLUG-IN MODULE

2.3.1 Controls, Indicators, and Receptacles (RFM-10)

Table 2-2 explains the functions of all controls, indicators and receptacles of the RFM-10 plug-in module. Figure 2-2 illustrates the location of these controls, etc.

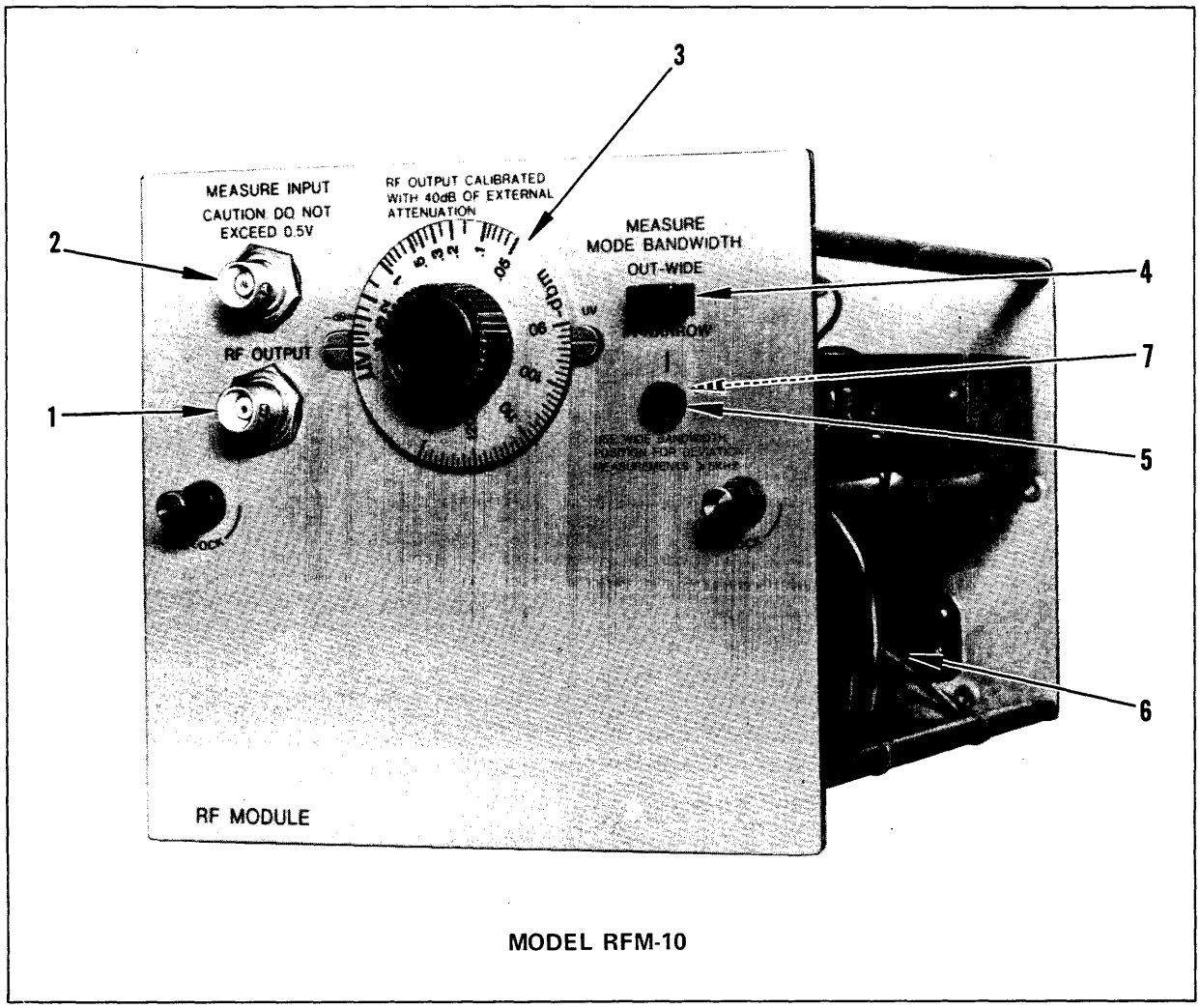


FIGURE 2–2 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL RFM–10)

TABLE 2–2

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL RFM-10)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	RF OUTPUT	Connector, BNC	RF output at frequency of signal from mainframe when mainframe is in generate mode. Level controlled by item number 3
2	MEASURE INPUT CAUTION: DO NOT EXCEED 0.5V	Connector, BNC	Applies signal to be measured to the beat detector (circuit completed only when mainframe is in measure mode)
3	RF OUTPUT CALIBRATED WITH 40 dB OF EXTERNAL ATTENUATION	Attenuator, variable	Controls level of RF output. Calibrated in microvolts and dBm
4	MEASURE MODE BANDWIDTH OUT – WIDE IN – NARROW (USE WIDE BAND-WIDTH POSITION FOR DEVIATION MEASUREMENTS $\geq$ 5 kHz)	Switch, push-push	Selects bandwidth of the IF amplifier in the measure mode
5	IN – NARROW	Light, indicator, red	On when in narrow bandwidth
6	(REAR PANEL CONNECTOR P-2)	Connector, 24 pin	
	Pin 1		2 MHz IF output from a source impedance of 350 ohms ± 20%. Level is set at 2.5 mV into a 50 ohm-load with 6 mV signal into MEASURE INPUT jack
	Pin 3		ALC detector voltage. Proportional to RF level into AT2. –20 mV dc ± 3 mV for –23 dBm at 150 MHz into AT2. Source impedance is 4.7 k ohms ± 20%. Load impedance is 10 k ohms ± 20%
	Pin 9		9 Vdc ± 10% regulated input at 95 mA ± 20%. Switched on in measure mode only. Closes "MEASURE INPUT" switch and supplies B+ for IF amplifier
	Pin 12		Shield ground for Pin 24
	Pin 13		Shield ground for Pin 1
	Pin 15		Shield ground for Pin 3
	Pin 20		9 Vdc ± 10% regulated input at 25 mA ± 20%. Switched on in "TONE GEN" and "GEN MOD CAL" modes in FM-10C mainframe. Automatically selects wide bandwidth in IF amplifier and supplies B+ for IF amplifier

Table 2–2. Operating Controls, Indicators and Receptacles (Model RFM-10) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
6	(REAR PANEL CONNECTOR P-2) (Cont.)	Connector, 24 pin	
	Pin 21		Chassis ground
	Pin 24		9 MHz input to second mixer at level of 100 mV rms ± 20%. Input impedance is 50 ohms ± 20%
7	(REAR PANEL CONNECTOR P-1)	Connector, push-on	Applies RF signal from mainframe to A1A4 module at level of –33 dBm ± 3 dB. Input impedance is 50 ohms ± 20% at 150 MHz

2.3.2 CW Signal Generation

NOTE: The only plug-in module required for CW signal generation is the left-hand module. The levels scribed on the RF OUTPUT dial represent the RFM-10 output level with 40 dB of external attenuation. Without 40 dB of external attenuation, multiply the indicated output voltage by 100 or add 40 dB to the output power indication.

a. Set MODE switch to GEN.

b. Set frequency switches and 0-100 Hz control to desired frequency.

c. Set RF OUTPUT level control on RFM-10 to desired output.

NOTE: Use external pads as required. See Figure 2-3 for set-up.

d. The desired RF output signal appears at the RF OUTPUT connector on the RFM-10.

CAUTION: Do not key the transmitter while directly connected to FM-10C. If the RFA-60 attenuation is not used and the transmitter is accidentally keyed, a built-in pad (RFA-10) behind the RF OUTPUT connector of the RFM-10 will be destroyed.

2.3.3 Manually-Swept Frequency Generation or Measurement

a. Set up FM-10C for measurement or generation as described elsewhere. (See Table of Contents.)

b. To manually sweep 1 MHz:

Set 100 kHz switch to V. Rotate 0–100 Hz control throughout it full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 kHz switch) and 1 MHz higher in frequency.

c. To manually sweep 100 kHz:

Set 10 kHz switch to V and 100 kHz switch not to V. Rotate 0–100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 10 kHz switch) and 100 kHz higher in frequency.

d. To manually sweep 10 kHz:

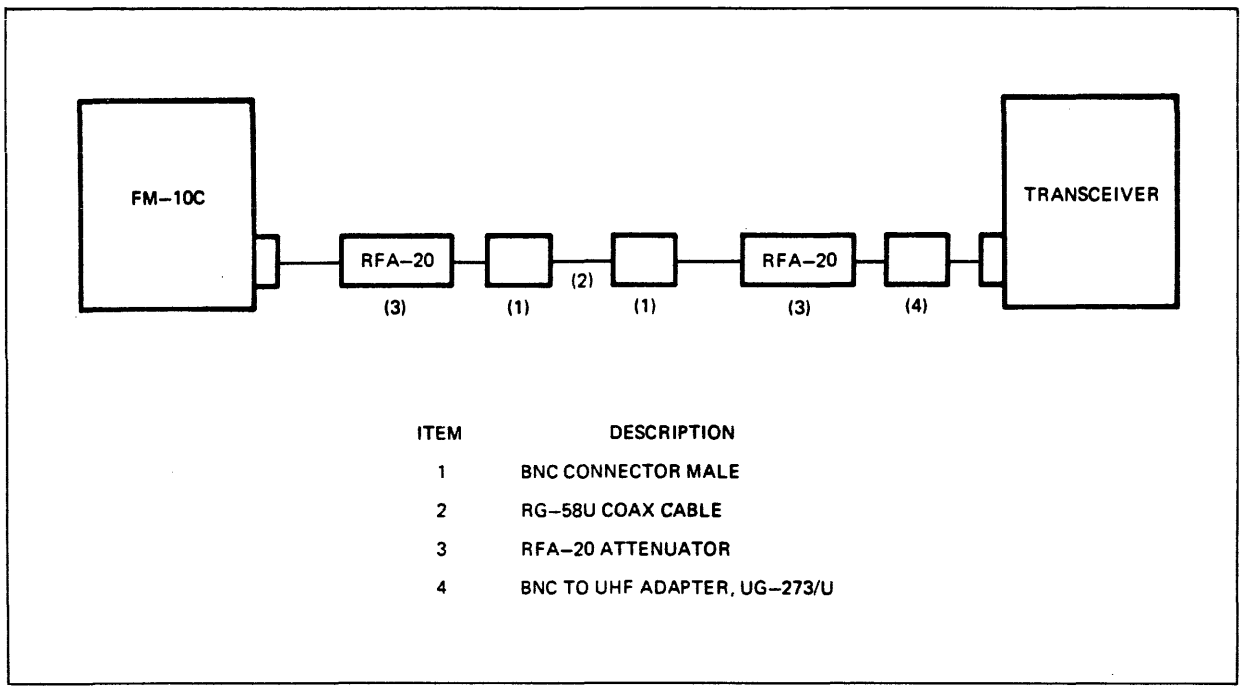
Set 1 kHz switch to V and 100 kHz and 10 kHz switch not to V. Rotate 0–100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 1 kHz switch) and 10 kHz higher in frequency.

e. To manually sweep 1 kHz:

Set 100 Hz switch to V and all switches to the left not to V. Rotate 0–100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 Hz switch) and 1 kHz higher in frequency.

f. To manually sweep 100 Hz:

Assure that no frequency switches are in the V position. Rotate 0–100 Hz throughout its full range. The output frequency will vary between the frequency set by the frequency switches and 100 Hz higher in frequency.



ITEM	DESCRIPTION
1	BNC CONNECTOR MALE
2	RG-58U COAX CABLE
3	RFA-20 ATTENUATOR
4	BNC TO UHF ADAPTER, UG-273/U

FIGURE 2–3 CONNECTIONS FOR SIGNAL GENERATOR MODE, USING TWO RFA-20'S (MODEL RFM–10)

2.3.4 Electronically-Swept Frequency Generation

a. Electronically-swept frequency generation may be accomplished by supplying a sawtooth input via rear panel ACC connector.

b. Connect sawtooth generator to FM-10C as shown in Figure 2-4.

c. Set sawtooth generator for output voltage and repetition rate as required.

d. Set the frequency sweep range by referring to Table 2-3 and setting the appropriate decade to the V position. (Refer to paragraph 2.3.3 for explanation of the function of the decade switch V positions.)

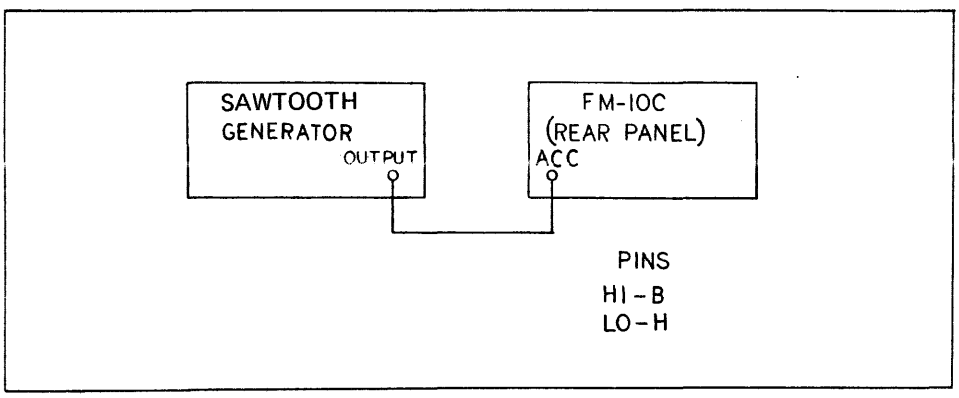


FIGURE 2–4 ELECTRONICALLY SWEPT FREQUENCY GENERATION (MODEL RFM–10)

TABLE 2–3.

SWEEP RANGES (MODEL RFM-10)

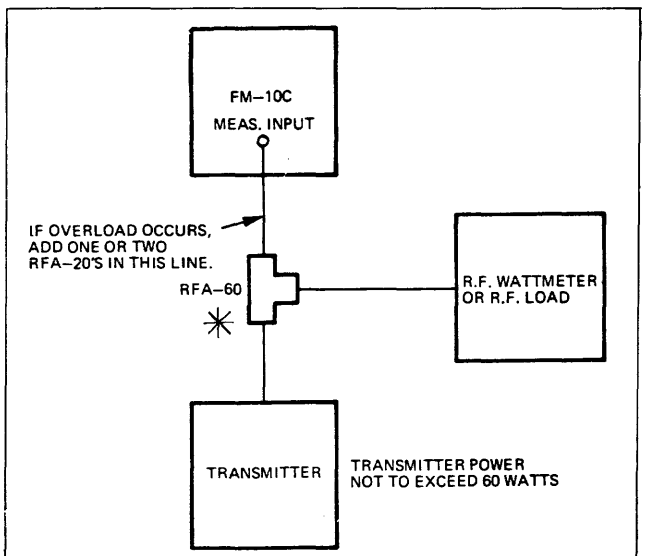
Decade Switch at V position*	Frequency Range of 0-100 Hz Control
None	0-100 Hz
100 Hz	0-1 kHz
1 kHz	0-10 kHz
10 kHz	0-100 kHz
100 kHz	0-1 MHz

*No higher decade switch should be at V position.

2.3.5 Frequency Measurement (with Model FIM)

NOTE: For frequency measurement, a left-hand and a center module are required. For antenna set-up, connect antenna provided to MEAS INPUT jack. For direct connection set-up, connect RFA-60, load and unit under test as shown in Figure 2-5.

CAUTION: The transmitter power should not exceed 60 watts.



*The RFA-60 frequency response is 150–162 MHz.

FIGURE 2–5 DIRECT CONNECTION, FREQUENCY MEASURING MODE (MODEL RFM–10)

Set MEASURE MODE BANDWIDTH switch of the RFM-10 module to OUT-WIDE position. Adjust input level until OPERATE indicator on the FIM lights. If the FM-10C is overloaded, (OPERATE indicator will not turn off) connect RFA-20 in line between FM-10C and RFA-60.

a. Set MODE switch of the mainframe to MEAS.

b. Set frequency switches and 0-100 Hz control of the mainframe to the transmitter frequency.

c. Adjust input level until OPERATE indicator of the FIM module lights.

d. Set MEASURE MODE AUDIO OUTPUT switch of the mainframe to IN-BEAT NOTE.

e. Set FIM RANGE switch to ZERO and adjust ZERO control for zero on meter.

f. Set FIM RANGE switch to appropriate position.

NOTE: For remote presentation of beat note, connect a speaker or headphone to the AUDIO/TONE OUTPUT jack. Use VOLUME control to adjust beat note level. Internal speaker is disconnected when an external unit is connected into the AUDIO/TONE OUTPUT jack.

g. Observe the error frequency on the FIM module meter. Adjust FM-10C frequency for zero FIM meter reading. As zero beat condition is approached the BEAT indicator will flash at the beat frequency. Continue adjusting the FM-10C frequency to the minimum flashing rate.

The frequency on the dial is the transmitter frequency.

NOTE: Some interfering signals may be eliminated by switching the MEASURE SENSITIVITY switch on the RFM-10 module to IN-NARROW.

2.4 RFM-10A PLUG-IN MODULE

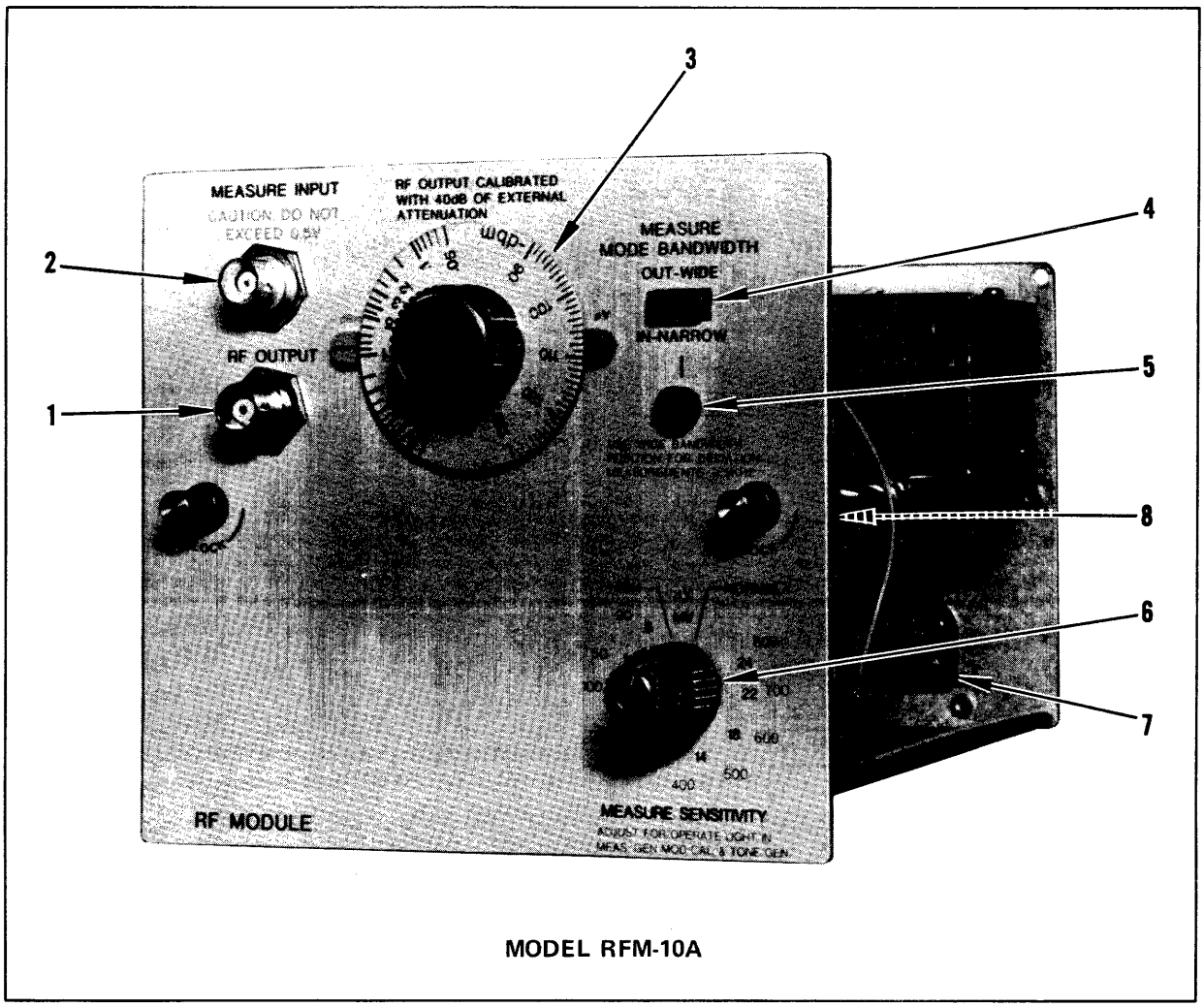
2.4.1 Controls, Indicators, and Receptacles (RFM-10A)

Table 2-4 explains the functions of all controls, indicators and receptacles of the RFM-10A plug-in module. Figure 2-6 illustrates the location of these controls, etc.

TABLE 2–4

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL RFM-10A)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	RF OUTPUT	Connector, BNC	RF output at frequency of signal from mainframe when mainframe is in generate mode. Level controlled by item number 3
2	MEASURE INPUT CAUTION: DO NOT EXCEED 0.5V	Connector, BNC	Applies signal to be measured to input mixer (circuit completed only when mainframe is in measure mode)
3	RF OUTPUT CALIBRATED WITH 40 dB OF EXTERNAL ATTENUATION	Attenuator, variable	Controls level of RF output. Calibrated in microvolts and dBm
4	MEASURE MODE BANDWIDTH OUT – WIDE IN – NARROW (USE WIDE BAND-WIDTH POSITION FOR DEVIATION MEASUREMENTS >5 kHz)	Switch, push, push	Selects bandwidth of the IF amplifier in the measure mode
5	IN – NARROW	Light, indicator, red	On when in narrow bandwidth
6	MEASURE SENSITIVITY uV – mV (inner knob) (Adjust for operate light in MEAS, GEN MOD CAL and TONE GEN.)	Resistor, variable	Variable control of "operate" sensitivity. Calibrated in relative input levels
	HIGH – NORMAL (outer knob)	Switch, rotary, 2 position	Selects sensitivity range. Switches a fixed gain reduction in and out of IF amplifier
7	(REAR PANEL CONNECTOR P-2)	Connector, 24 pin	
	Pin 1		2 MHz IF output from a source impedance of 350 ohms ± 20%. Level is set at 2.5 mV into a 50 ohm load at the desired operate sensivity. i.e. 2.5 mV with "MEASURE SENSITIVITY"at"HIGH" and "20 uV" and apply 20 uV signal into "MEASURE INPUT"
	Pin 3		ALC detector voltage. Proportional to RF level into AT 2. –20 mV dc ± 3 mV for –23 dBm at 150 MHz into AT 2. Source impedance is 4.7 k ohms ± 20%. Load impedance is 10 k ohms ± 20%



MODEL RFM-10A

FIGURE 2–6 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL RFM–10A)

Table 2–4. Operating Controls, Indicators and Receptacles (Model RFM-10A) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
7	(REAR PANEL CONNECTOR P-2) (Cont.)	Connector, 24 pin	
	Pin 9		9 Vdc ±10% regulated input at 95 mA± 20%. Switched on in measure mode only. Closes "MEASURE INPUT" switch and supplies B+ for IF amplifier
	Pin 12		Shield ground for Pin 24
	Pin 13		Shield ground for Pin 1
	Pin 15		Shield ground for Pin 3
	Pin 20		9 Vdc ± 10% regulated input at 25 mA ± 20%. Switched on in "TONE GEN" and "GEN MOD CAL" in FM-10C mainframe. Automatically selects wide bandwidth in IF and supplies B+ for IF amplifier
	Pin 21		Chassis ground
	Pin 24		9 MHz input to second mixer at level of 100 mV rms ± 20%. Input impedance is 50 ohms ± 20%
8	(REAR PANEL CONNECTOR P-1)	Connector, push-on	Applies RF signal from mainframe to A1A4 module at level of –33 dBm ± 3 dB. Input impedance is 50 ohms ± 20% at 150 MHz

2.4.2 CW Signal Generation

NOTE: The only plug-in module required for CW signal generation is the left-hand module. The levels scribed on the RF OUTPUT dial represent the RFM-10A output level with 40 dB of external attenuation. Without 40 dB of external attenuation the indicated output voltage is multiplied by 100 or 40 dB should be added to the indicated output power.

a. Set MODE switch to GEN.

b. Set frequency switches and 0-100 Hz control to desired frequency.

NOTE: Use external pads as required. See Figure 2-7 for set-up.

d. The desired RF output signal appears at the RF OUTPUT connector on the RFM-10A.

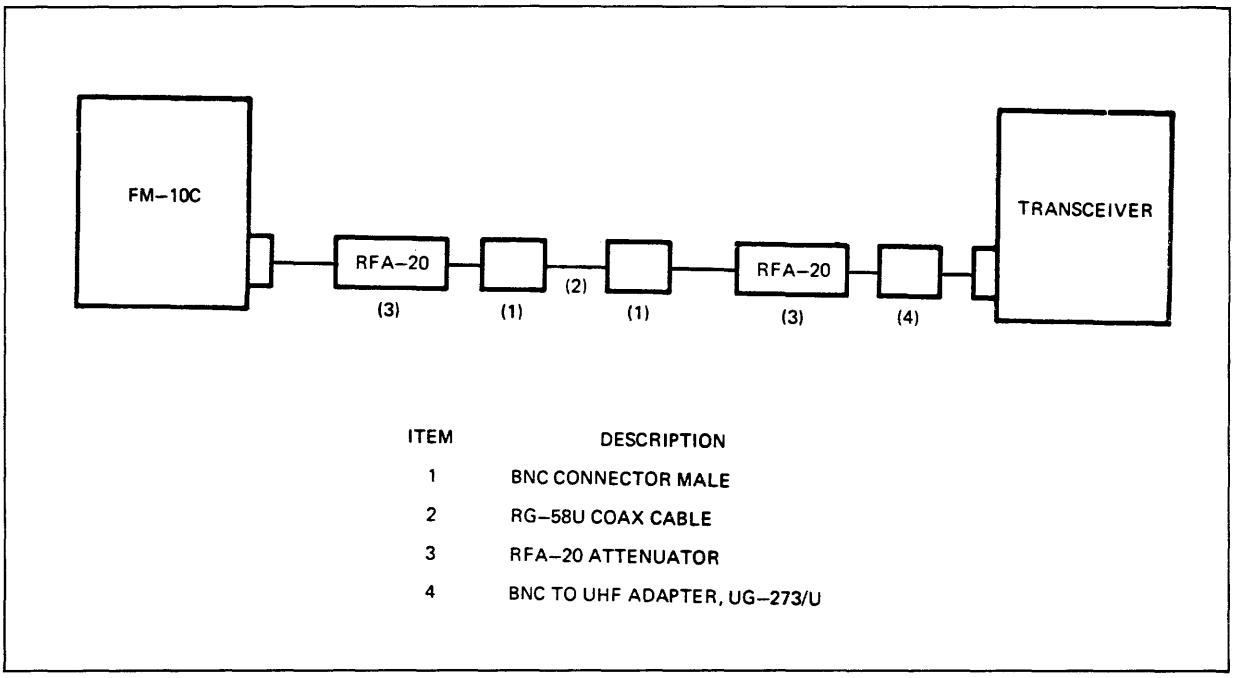
CAUTION: Do not key the transmitter while directly connected to FM-10C. If the RFA-60 attenuator is not used and the transmitter is accidentally keyed, a built-in pad (RFA-10) behind the RF OUTPUT connector of the RFM-10A will be destroyed.

2.4.3 Manually-Swept Frequency Generation and Measurement

a. Set up FM-10C for measurement or generation as described elsewhere. (See Table of Contents.)

b. To manually sweep 1 MHz:

Set 100 kHz switch to V. Rotate 0–100 Hz control throughout it full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 kHz switch) and 1 MHz higher in frequency.



ITEM	DESCRIPTION
1	BNC CONNECTOR MALE
2	RG–58U COAX CABLE
3	RFA–20 ATTENUATOR
4	BNC TO UHF ADAPTER, UG–273/U

FIGURE 2–7 CONNECTIONS FOR SIGNAL GENERATOR MODE, USING TWO RFA–20'S (MODEL RFM–10A)

c. To manually sweep 100 kHz:

Set 10 kHz switch to V and 100 kHz switch not to V. Rotate 0–100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 10 kHz switch) and 100 kHz higher in frequency.

d. To manually sweep 10 kHz:

Set 1 kHz switch to V and 100 kHz and 10 kHz switch not to V. Rotate 0–100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 1 kHz switch) and 10 kHz higher in frequency.

e. To manually sweep 1 kHz:

Set 100 Hz switch to V and all switches to the left not to V. Rotate 0–100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 Hz switch) and 1 kHz higher in frequency.

f. To manually sweep 100 Hz:

Assure that no frequency switches are in the V position. Rotate 0–100 Hz throughout its full range. The output frequency will vary between the frequency set by the frequency switches and 100 Hz higher in frequency.

2.4.4 Electronically-Swept Frequency Generation

a. Electronically-swept frequency generation may be accomplished by supplying a sawtooth input via rear panel ACC connector.

b. Connect sawtooth generator to FM-10C as shown in Figure 2-8.

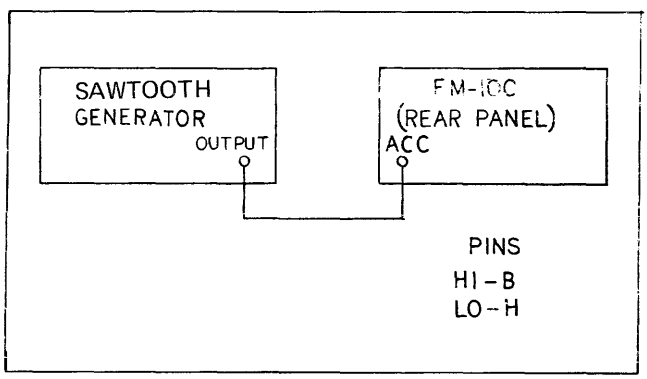


FIGURE 2–8 ELECTRONICALLY SWEPT FREQUENCY GENERATION (MODEL RFM–10A)

c. Set sawtooth generator for output voltage and repetition rate as required.

d. Set the frequency sweep range by referring to Table 2-5 and setting the appropriate decade to the V position. (Refer to paragraph 2.4.3 for explanation of the function of the decade switch V positions.)

TABLE 2–5.

SWEEP RANGES (MODEL RFM–10A)

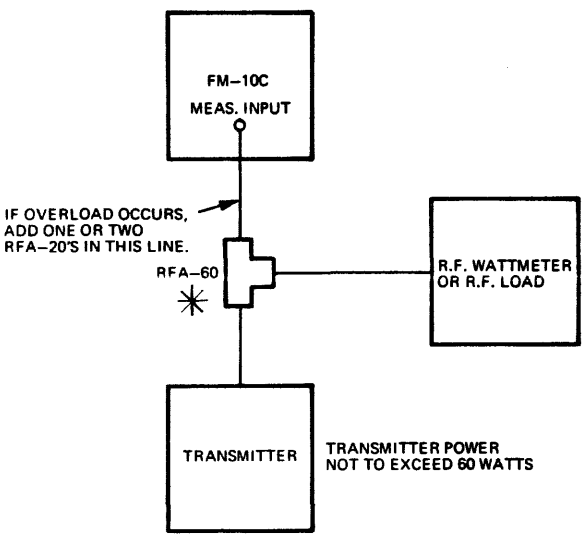
Decade Switch at V position*	Frequency range of 1-100 Hz control
None	0-100 Hz
100 Hz	0-1 kHz
1 kHz	0-10 kHz
10 kHz	0-100 kHz
100 kHz	0-1 MHz

*No higher decade switch should be at V position.

2.4.5 Frequency Measurement (with Model FIM)

NOTE: For frequency measurement, a left-hand and a center module are required. For antenna set-up, connect antenna provided to MEAS INPUT jack. For direct connection set-up, connect RFA-60, load and unit under test as shown in Figure 2-9.

CAUTION: The transmitter power should not exceed 60 watts.



*The RFA-60 frequency response is 150-162 MHz.

FIGURE 2–9 DIRECT CONNECTION, FREQUENCY MEASURING MODE (MODEL RFM–10A)

Set MEASURE MODE BANDWIDTH switch of the RFA-10A module to the OUT – WIDE position. Adjust input level and MEASURE SENSITIVITY controls until OPERATE indicator on the FIM lights. If the FM-10C is overloaded, (OPERATE lamp will not turn off) connect RFA-20 in line between FM-10C and RFA-60.

Set MODE switch of the mainframe to MEAS.

b. Set frequency switches and 0-100 Hz control of the mainframe to the transmitter frequency.

c. Adjust input level slightly above the level necessary to light the OPERATE indicator of the FIM module.

d. Set MEASURE MODE AUDIO OUTPUT switch of the mainframe to IN-BEAT NOTE.

e. Set FIM RANGE switch to ZERO and adjust ZERO control for zero on meter.

f. Set FIM RANGE switch to appropriate position.

NOTE: For remote presentation of beat note, connect a speaker or headphone to the AUDIO/TONE OUTPUT jack. Use VOLUME control to adjust beat note level. Internal speaker is disconnected when an external unit is connected into the AUDIO/TONE OUTPUT jack.

g. Observe the error frequency on the FIM module meter. Adjust FM-10C mainframe frequency for zero FIM meter reading. As zero beat condition is approached the BEAT indicator will flash at the beat frequency. Continue adjusting the FM-10C mainframe frequency to the minimum flashing rate. The frequency on the dial is the transmitter frequency.

NOTE: Some interfering signals may be eliminated by switching the MEASURE SENSITIVITY switch on the RFM-10A module to IN-NARROW.

2.4.6 Operating Notes

The RFM-10A contains a wide band, high level, doubly balanced mixer with no preselection or preamplification. This provides protection against overload by strong interfering signals, and allows high sensitivity at minimum cost across the entire frequency operating range of the FM-10C.

At various frequencies, however, the usable sensitivity may be less than 20 uV, because of the spurious content of the synthesizer (typically 40 dB). These spurious responses sometimes appear as a measured signal to the Modulation Monitor modules and Frequency Indicator module. These responses are very limited in number and probably will occur at only a few discrete frequencies (±some bandwidth) across the operating frequency range. Spurious responses are more likely to occur when the hi-sensitivity range is employed.

Following is a list of recommended procedures when using the RFM-10A:

a. Always operate with the input sensitivity set just above the operate level required.

b. If a spurious response is suspected, disconnect the measure input; if the indication remains it is a spurious response.

c. Always use the narrow measure mode bandwidth whenever possible.

d. If it is necessary to measure a signal where too much spurious interference exists use a broadband amplifier (Singer Model BBA-1) ahead of the measure input and reduce the measure sensitivity.

e. The frequency of a signal may be measured on the FIM in the presence of strong spurs even though these spurs may be too large to provide a modulation measurement. Spurious responses will normally cause less of a problem on the FM deviation plug-ins (MDM and ODM), than on the AM plug-in (OAM).

f. The operating note beneath the MEASURE SENSITIVITY control on the RFM-10A's S/N 101 through 200 states: "Adjust for OPERATE light in MEAS, GEN MOD CAL and TONE GEN". This refers to the OPERATE light on the FIM in MEAS and TONE GEN modes. For GEN MOD CAL mode it refers to limiter current on the MDM, OPER light on the ODM, and CARRIER SET on the OAM.

2.5 FIM-1 PLUG-IN MODULE

2.5.1 Contols, Indicators, and Receptacles (FIM-1)

Table 2-6 explains the functions of all controls, indicators, and receptacles of the FIM-1 plug-in module. Figure 2-10 illustrates the location of these controls, etc.

TABLE 2–6

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL FIM-1)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	OPERATE	Light, indicator, green	Indicates when signal level is sufficient for proper measurement
2	BEAT	Light, indicator, amber	Flashes at the rate of the frequency error signal
3	kHz FREQUENCY ERROR	Meter, center-zero	Indicates frequency error between the measured signal and the mainframe signal. Scale range selected by Item 4. Electronically zeroed by Item 5

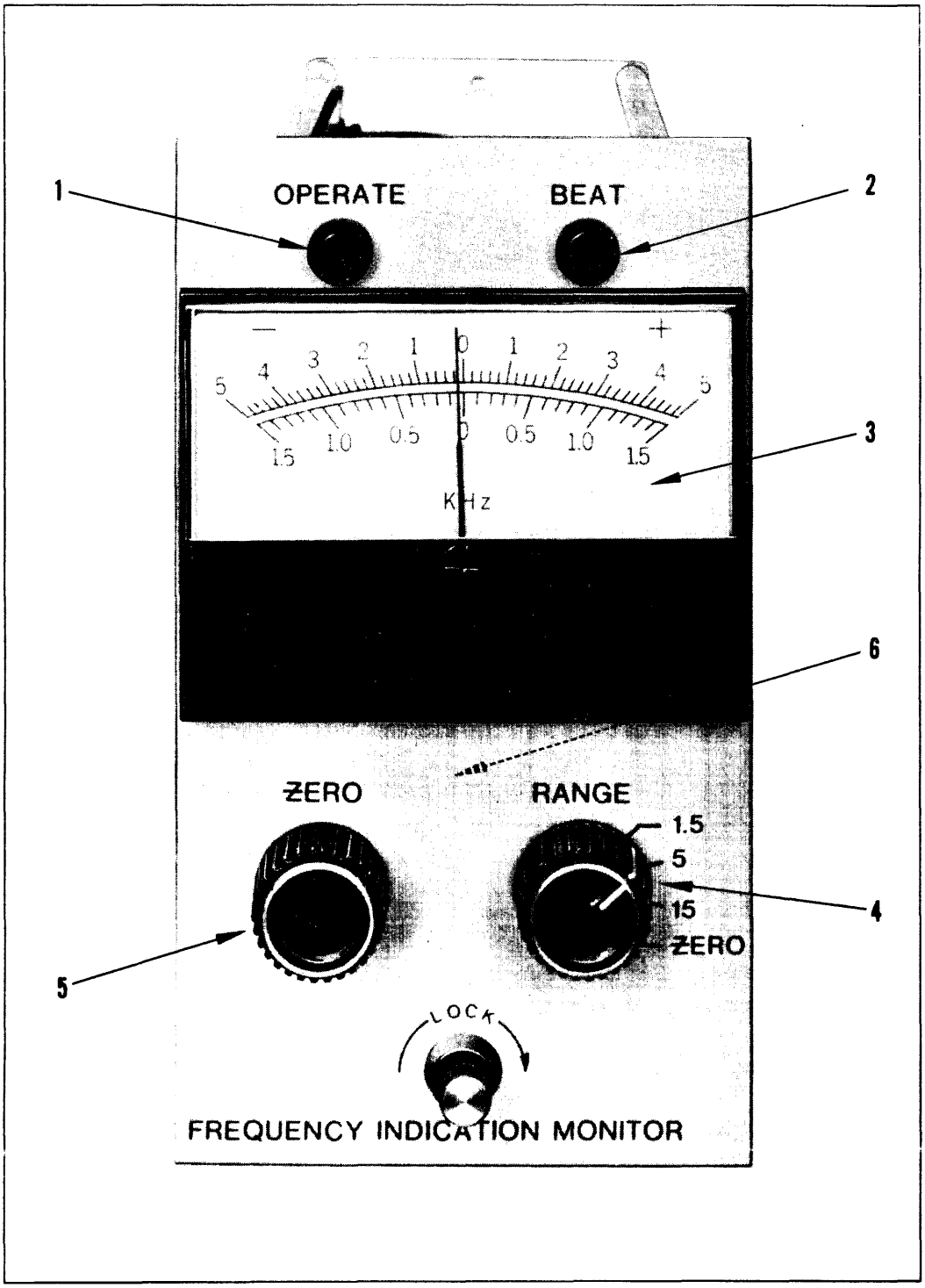


FIGURE 2–10 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL FIM–1)

Table 2–6. Operating Controls, Indicators and Receptacles (Model FIM-1) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
4	RANGE 1.5, 5, 15 ZERO	Switch, rotary, 2 pole, 4 position	Selects full scale range of Item 3 in kHz from 1.5, 5 to 15. In ZERO allows Item 3 to be balanced by Item 5
5	ZERO	Potentiometer, 5 turn	Electronically zeros the driving circuit for the meter, Item 3, when selected by placing switch, Item 4, in zero position
6	(REAR PANEL CONNECTOR P-1)	Connector, 16 pin	
	Pin 1		Audio output from beat detector to audio amplifier in mainframe. Source impedance 12.5 k ohm ± 20%. Level 0.45 V rms ± 10% into a load impedance of 5 k ohms at "OPERATE" sensitivity
	Pin 2		Chassis ground
	Pin 3		Connected to wiper of section of RANGE switch and returned to meter positive terminal, Pin 11, through REMOTE METER jack on mainframe. Selects proper series resistance to calibrate full scale readings of internal or external meter. In ZERO position, switches meter to most sensitive scale
	Pin 4		Shield ground for Pin 12
	Pin 5		Negative side of meter output to REMOTE METER jack
	Pin 6		Shield ground for Pin 14
	Pin 7		Connected to Pin 15
	Pin 8		Shield ground for Pin 16
	Pin 9		+9 V dc ± 10% at 150 mA max., regulated with less than 1 mV rms ripple
	Pin 10		Shield ground for pin 1
	Pin 11		Positive side of meter output to REMOTE METER jack. Connected through jack, back to Pin 3 when remote meter is not plugged in. Open circuited at jack when remote meter is used
	Pin 12		4.2 MHz signal input. Load impedance: 200Ω ± 20%. Level 200 mV rms ± 20% from a source impedance of 75 ohms
	Pin 13		+ 12 V dc unregulated at 25 mA. max

Table 2–6. Operating Controls, Indicators and Receptacles (Model FIM-1) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
6	(REAR PANEL CONNECTOR P-1) (Cont.)	Connector 16 pin	
	Pin 14		100 kHz input. Load impedance: 1 k ohm ± 20%. Level 2.2 V rms ± 20% from a source impedance of 470 ohms
	Pin 15		Connected to Pin 7
	Pin 16		2 MHz IF input at level of 2.5 mV rms ± 3 dB at rated sensitivity of mainframe. Source impedance is 50 ohms ± 20%

2.5.2 FREQUENCY MEASUREMENT (WITH MODEL RFM)

NOTE: For frequency measurement, a left-hand and a center module are required. For antenna set-up, connect antenna provided to MEASURE INPUT jack of RFM module. For direct connection setup, connect RFA-60, load and unit under test as shown in Figure 2-11. (CAUTION: The transmitter power should not exceed 60 watts.) Set MEAS MODE BANDWIDTH switch of the RFM module to OUT-WIDE position. Adjust input level until OPERATE indicator of the FIM-1 module lights.

If the FM-10C is overloaded, (OPERATE lamp will not go out) connect RFA-20 in line between FM-10C and RFA-60.

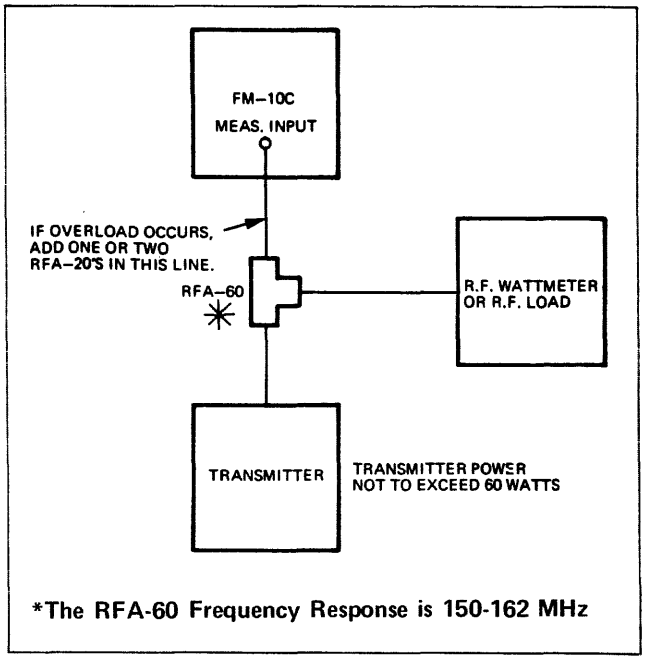


FIGURE 2–11 DIRECT CONNECTION, FREQUENCY MEASURING MODE (MODEL FIM–1)

a. Set MODE switch of the mainframe to MEAS.

b. Set frequency switches and 0-100 Hz control of mainframe to the transmitter frequency.

c. Adjust input level until OPERATE indicator on the RFM module lights.

d. Set MEASURE MODE AUDIO OUTPUT switch on mainframe to IN-BEAT NOTE position.

e. Set FIM-1 RANGE switch to ZERO and adjust ZERO control for zero on meter.

f. Set FIM-1 to appropriate RANGE switch position.

NOTE: For remote presentation of beat note, connect a speaker or headphone to the AUDIO/TONE OUTPUT jack.

g. Observe the error frequency on the FIM-1 meter. Adjust FM-10C frequency for zero FIM-1 meter reading. As zero beat condition is approached the BEAT indicator will flash at the beat frequency. Continue adjusting the FM-10C frequency to the minimum flashing rate. The frequency on the dial is the transmitter frequency.

NOTE: Some interfering signals may be eliminated by switching to the MEASURE MODE BANDWIDTH switch on the RFM module to IN-NARROW.

2.5.3 Remote Meter Connector on Mainframe

This output may be used with an extension cable and meter for a remote display on frequency error. It is the same level supplied to the FIM-1 meter.

2.6 FIM-3 PLUG-IN MODULE

2.6.1 Controls, Indicators, and Receptacles (FIM-3)

Table 2-7 explains the functions of all controls, indicators, and receptacles of the FIM-3 plug-in module. Figure 2-12 illustrates the location of these controls, etc.

TABLE 2–7

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL FIM-3)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	OPERATE	Light, indicator, green	Indicates when signal is above level required for proper measurement
2	BEAT	Light, indicator, amber	Flashes at the rate of the frequency error signal
3	kHz FREQUENCY ERROR	Meter, center-zero	Indicates frequency error between the measured signal and the mainframe signal. Scale range selected by Item 4. Electronically zero by Item 5
4	RANGE 1.5, 5, 15 ZERO	Switch, rotary, 2 pole, 4 position	Selects full scale range of Item 3 in kHz from 1.5, 5, to 15. In ZERO allows Item 3 to be balanced by Item 4
5	ZERO	Potentiometer, 5 turn	Electronically zeros the driving circuit for meter, Item 3, when selected by placing switch, Item 4, in zero position
6	SQUELCH ON – OFF	Switch, toggle	In "ON" position recovered audio is applied to the speaker only when the "OPERATE" light, Item 1, is on. In "OFF" position the speaker circuit is active at all times
7	(REAR PANEL CONNECTOR P-1)	Connector 16 pin	
	Pin 1		Audio output from beat detector to audio amplifier in mainframe. Source impedance 12.5 k ohms ± 20%. Level 0.45 V rms ± 10% into a load impedance of 5 k ohms at "OPERATE" sensitivity
	Pin 2		Chassis ground
	Pin 3		Connected to wiper of section of range switch and returned to meter positive terminal, Pin 11, through remote meter jack on mainframe. Selects proper series resistance to calibrate full scale readings of internal or external meter. In ZERO position, switches meter to most sensitive scale

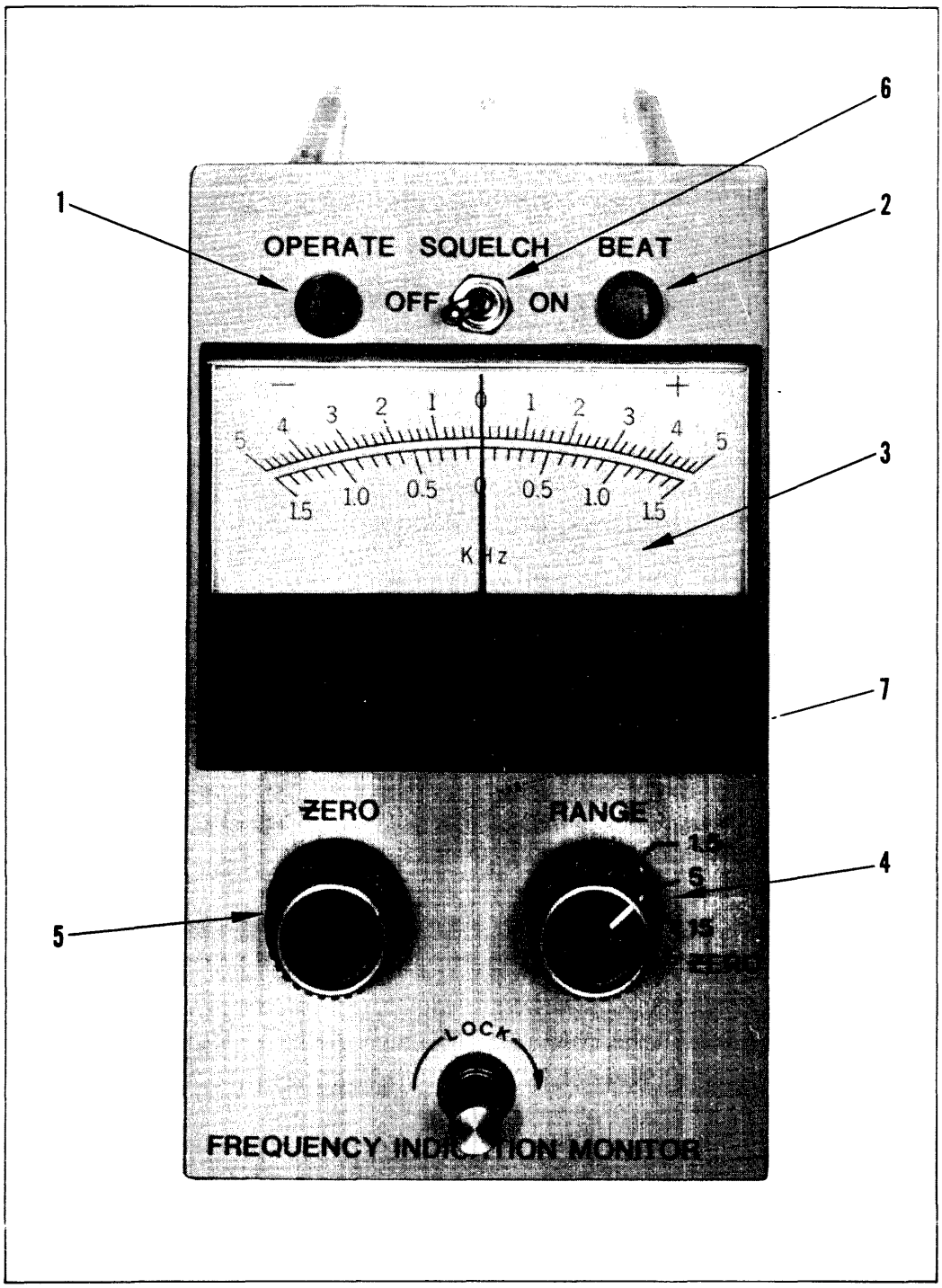


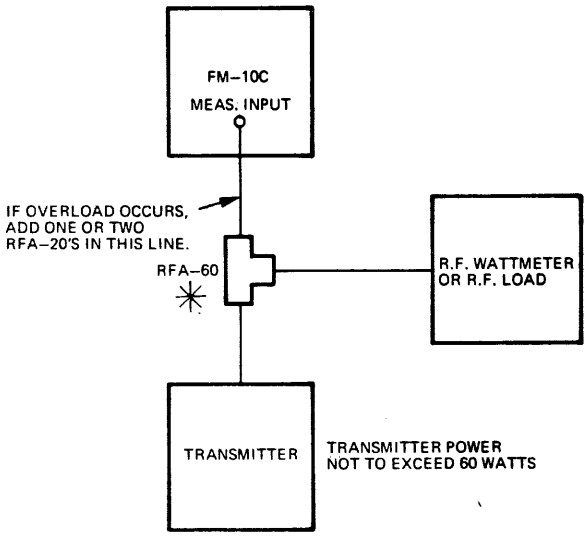
FIGURE 2–12 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL FIM–3)

Table 2–7. Operating Controls, Indicators and Receptacles (Model FIM-3) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
7	(Rear panel connector P-1) (Cont.)	Connector, 16 pin	
	Pin 4		Shield ground for Pin 12
	Pin 5		Negative side of meter output to REMOTE METER jack
	Pin 6		Shield ground for Pin 14
	Pin 7		Not used
	Pin 8		Shield ground for Pin 16
	Pin 9		+9 V dc ± 10% at 150 mA max, regulated with less than 1 mV rms ripple
	Pin 10		Shield ground for Pin 1
	Pin 11		Positive side of meter output to REMOTE METER jack. Connected through jack, back to Pin 3 when remote meter is not plugged in. Open circuited at jack when remote meter is used
	Pin 12		4.2 MHz signal input. Load impedance: 200 ohm ± 20%. Level 200 mV ± 20% from a source impedance of 75 ohms
	Pin 13		+12 V dc unregulated at 25 mA max
	Pin 14		100 kHz input. Load impedance: 1 k ohm ± 20% Level 2.2 V rms ± 20% from a source impedance of 470 ohms
	Pin 15		Disables audio circuitry in mainframe when SQUELCH switch is ON and OPERATE lamp is off
	Pin 16		2 MHz IF input at level at 2.5 mV rms ± 3 dB at rated sensitivity of mainframe. Source impedance is 50 ohms ± 20%

2.6.2 Frequency Measurement (with Model RFM)

NOTE: For frequency measurement, a left-hand and a center module are required. For antenna set-up, connect antenna provided to MEAS INPUT jack of RFM module. For direct connection set-up, connect RFA 60, load and unit under test as shown in Figure 2-13.



*The RFA-60 Frequency Response is 150-162 MHz

FIGURE 2–13 DIRECT CONNECTION, FREQUENCY MEASURING MODE (MODEL FIM–3)

CAUTION: The transmitter power should not exceed 60 watts.

Set MEASURE MODE BANDWIDTH switch of the RFM module to OUT-WIDE position. Adjust input level and MEASURE SENSITIVITY controls (if an RFM-10A is used) until OPERATE indicator of the FIM-3 module lights. If the FM-10C is overloaded (OPERATE lamp will not go out), connect RFA-20 in line between FM-10C and RFA-60.

a. Set MODE switch of the mainframe to MEAS.

b. Set frequency switches and 0-100 Hz control of the mainframe to the transmitter frequency.

c. Adjust input level until OPERATE indicator on the RFM module lights.

d. Set MEASURE MODE AUDIO OUTPUT switch on mainframe to IN-BEAT NOTE.

e. Set FIM-3 RANGE switch to ZERO and adjust ZERO control for zero on meter.

f. Set FIM-3 RANGE switch to appropriate position.

NOTE: For remote presentation of beat note, connect a speaker or headphone to the AUDIO/TONE OUTPUT jack. Use VOLUME control to adjust beat note level. Internal speaker is disconnected when an external unit is connected into the AUDIO/TONE OUTPUT jack.

g. Observe the error frequency on the FIM-3 module meter. Adjust mainframe frequency for zero FIM-3 meter reading. As zero beat condition is approached the BEAT indicator will flash at the beat frequency. Continue adjusting the mainframe frequency to the minimum flashing rate. The frequency on the dial is the transmitter frequency.

NOTE: Some interfering signals may be eliminated by switching the MEASURE MODE BANDWIDTH switch on the RFM module to IN-NARROW. Also, the SQUELCH switch may be used with low level signals to stop any annoying noise when the signal level drops below the sensitivity level of the RFM module.

2.6.3 Remote Meter Connector on Mainframe

This output may be used with an extension cable and meter for a remote display of frequency error. It is the same level supplied to the FIM-3 meter.

2.7 OAM-1 PLUG-IN MODULE

2.7.1 Controls, Indicators, and Receptacles (OAM-1)

Table 2-8 explains the functions of all controls, indicators and receptacles of the OAM-1 plug-in module. Figure 2-14 illustrates the location of these controls, etc.

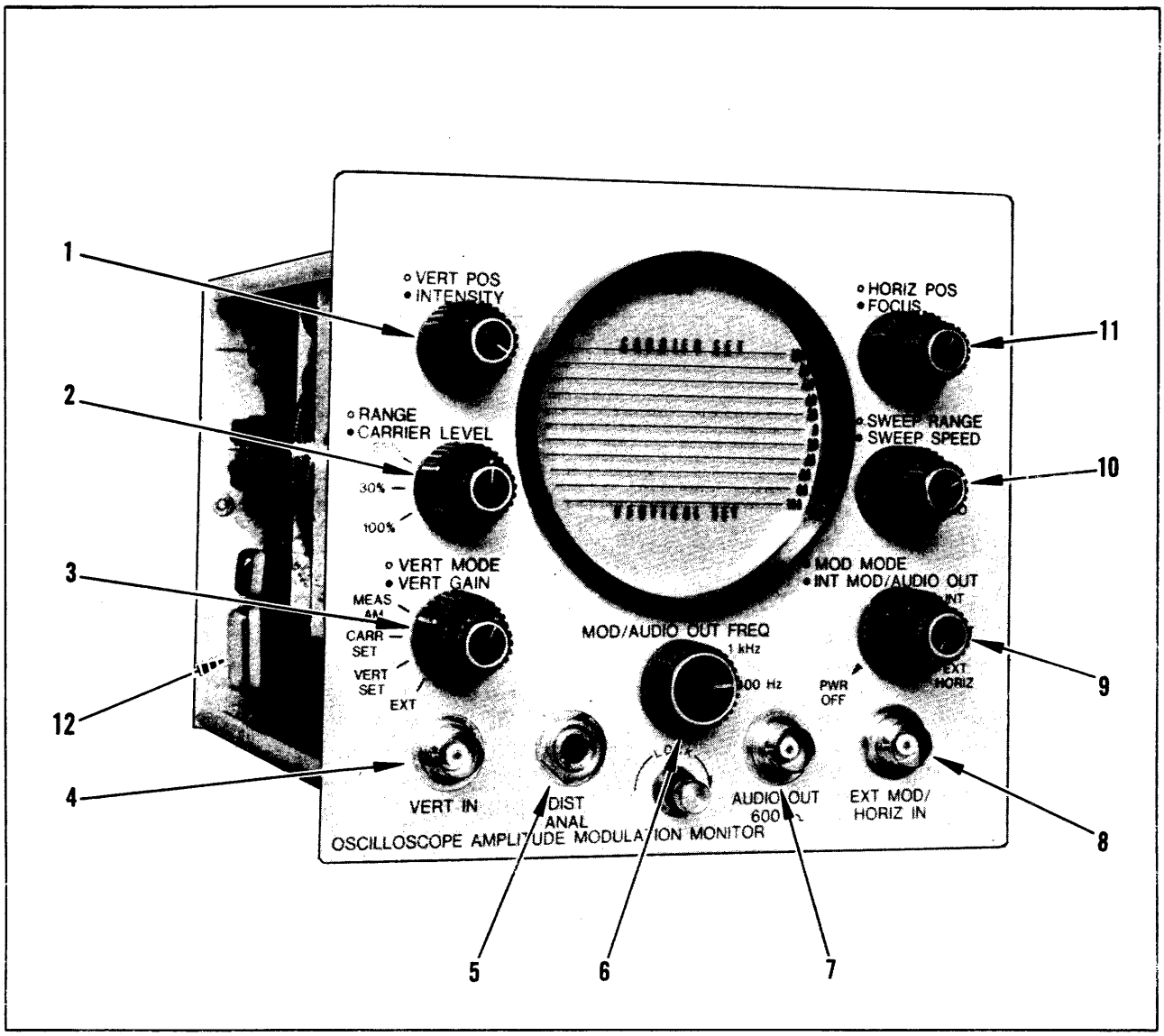


FIGURE 2–14 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL OAM–1)

TABLE 2–8

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL OAM-1)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	VERT POS (Outer Knob)	Resistor, variable	Controls vertical position of trace on CRT screen
	INTENSITY (Inner Knob)	Resistor, variable	Controls brightness of CRT trace. Used with FOCUS control to obtain clear trace
2	RANGE (Outer Knob) GEN 30% 30% 100%	Switch, rotary, 3 position	GEN 30% position: Enables internal or external modulation of the FM-10 carrier up to 30% 30% position: Provides oscilloscope sensitivity for measuring of modulated carriers up to 30% 100% position: Provides oscilloscope sensitivity for measuring of modulated carriers up to 100%
	CARRIER LEVEL (Inner Knob)	Resistor, variable	Calibrates modulation sensitivity
3	VERT MODE (Outer Knob) MEAS AM CARR SET VERT SET EXT	Switch, rotary, 4 position	MEAS AM position: Modulated signal to be measured is applied to the oscilloscope vertical amplifier input CARRIER SET position: Carrier, minus modulation, applied to the oscilloscope vertical amplifier input VERT SET position: Zero signal (ground) is applied to the oscilloscope vertical amplifier input EXT position: In this position the oscilloscope vertical amplifier input is switched to the VERT IN connector
	VERT GAIN (Inner Knob)	Resistor, variable	Varies level of external signal applied to the VERT IN connector. Effective when the VERT MODE switch is in EXT position only
4	VERT IN	Connector, BNC	Vertical input jack provides connection to the oscilloscope vertical amplifier input when VERT MODE switch is in EXT position. External input signal level is controlled with the VERT GAIN control
5	DIST ANAL	Connector, phone jack	Demodulated audio available at this jack for output to a distortion analyzer. Also regulated +9 V dc at 50 mA (max) available for FM accessory items

Table 2–8. Operating Controls, Indicators and Receptacles (Model OAM-1) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
6	MOD/AUDIO OUT FREQ 1 kHz 400 Hz	Switch, rotary,	Controls frequency of the internal modulation oscillator
7	AUDIO OUT 600 ohm	Connector, BNC	400 Hz or 1 kHz signal output available at this jack. Level controlled from < 10 mV rms to > 1 V rms by INT MOD/AUDIO OUT control
8	EXT MOD/ HORIZ IN	Connector, BNC	This jack is used: 1) to provide an external modulation tone to the modulation circuit when the MOD MODE switch is in the EXT position 2) to provide an external horizontal drive when the MOD MODE switch is in the EXT HORIZ position (no internal sync from oscilloscope vertical amplifier)
9	MOD MODE (Outer Knob) INT EXT	Switch, rotary,	INT position: Connects the internal sweep generator (synchronized by the oscilloscope vertical amplifier signal) to the oscilloscope horizontal amplifier input. Also connects the internal modulation oscillator (400 Hz or 1 kHz) output (level controlled by the INT MOD/AUDIO OUT control) to the internal AM modulation amplifier of the mainframe EXT position: Connects the internal sweep generator (synchronized by the oscilloscope vertical amplifier signal) to the oscilloscope horizontal amplifier input. Also connects the EXT MOD/HORIZ IN connector to the input of the internal AM modulation amplifier to the mainframe EXT HORIZ position: Connects the oscilloscope horizontal amplifier to the EXT MOD/HORIZ IN connector to enable external sweep of the oscilloscope. Also disconnects the input to the internal AM modulation amplifier
	INT MOD/ AUDIO OUT (Inner Knob) PWR OFF	Resistor, variable/ switch, rotary, 2 position	Controls internal modulation level when MOD MODE switch in in INT position. Also controls level of 400 Hz and 1 kHz tone (available at AUDIO OUT connector) from < 10 mV rms to > 1 V rms. Also contols power to OAM-1 module
10	SWEEP RANGE HI–LO (Outer Knob)	Switch, rotary, 2 position	Provides coarse control of sweep speed. Is switched out of circuit when an external horizontal input signal is used and MOD MODE switch in in EXT HORIZ position

Table 2–8. Operating Controls, Indicators and Receptacles, (Model OAM-1) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
10 (cont.)	SWEEP SPEED (Inner Knob)	Resistor, variable	Provides fine control of sweep speed
11	HORIZ POS (Outer Knob)	Resistor, variable	Controls horizontal position of trace on CRT screen
	FOCUS (Inner Knob)	Resistor, variable	Controls dispersion of beam on CRT screen. Used with INTENSITY control to obtain sharp trace
12	(REAR CONNECTOR P-1)	Connector, 16 pin	
	Pin 2		Chassis ground
	Pin 3		Cable shield for Pin 11
	Pin 6		Cable shield for Pin 14
	Pin 8		Cable shield for Pin 16
	Pin 9		+9 Vdc ± 10% at 900 mA max (regulated)
	Pin 11		Audio modulation signal to AM modulator in mainframe. 80 mV rms min with R2 fully cw and S6 in INT position. With S6 in EXT position, level is proportional to level applied to J4, (15 mV rms ± 10% for 100 mV rms at J4 with 500 ohm load). Output impedance 10 ohms ± 20%
	Pin 14		Recovered audio out to audio amplifier in mainframe. Output impedance is 120 ohms ± 20% at 1 kHz with level proportional to % of modulation. 100 mV rms ± 10% for full scale modulation, i.e., 30% and 100%
	Pin 16		2 MHz IF input from mainframe at level of 4.2 mV rms ± 3 dB with input impedance of 200 ohms ± 20%

2.7.2 Preliminary Oscilloscope Set-up

a. Apply power to mainframe.

b. Apply power to OAM-1 module by rotating INT MOD/AUDIO OUT control fully cw.

c. Set AUDIO switch on mainframe to OUT/MOD.

d. Allow approximately 1 minute for warm-up.

e. Set OAM-1 controls as follows:

MOD MODE	INT
VERT POS	to position trace
HORIZ POS	to position trace
INTENSITY	as required
FOCUS	for sharpest trace
VERT GAIN	fully ccw

2.7.3 AM Signal Measurement

a. Set mainframe frequency switches to frequency of transmitter.

b. Set mainframe MODE switch to MEAS position.

c. Couple transmitter output to left-hand module MEASURE INPUT connector via the antenna provided, or use RF cable input with an RFA-60 attenuator in the line (see paragraph 2.3.2 or paragraph 2.4.2).

d. Set VERT MODE switch to VERT SET position.

e. Adjust VERT POS control to position the trace on VERTICAL SET line of graticule.

f. Set VERT MODE switch to CARR SET.

g. Adjust transmitter coupling to mainframe and/or CARRIER LEVEL control to position trace on CARRIER SET line of graticule.

h. Set RANGE switch to desired range (30% or 100% full scale).

j. Set VERT MODE switch to MEAS AM. Adjust transmitter modulation to desired percentage as indicated by scope calibration scale.

k. To check distortion connect distortion analyzer to DIST ANAL output and obtain distortion measurement.

2.7.4 Internally-Modulated AM Signal Generation

a. Set mainframe frequency switches to 000.0000 MHz.

b. Set mainframe MODE switch to GEN MOD CAL position.

c. Set mainframe GENERATOR MODULATION switch to IN-ON position.

d. Set OAM-1 VERT MODE switch to VERT SET position.

e. Adjust VERT POS control to position trace on VERTICAL SET line of graticule.

f. Set VERT MODE switch to CARR SET.

g. Adjust CARRIER LEVEL control to position trace on CARRIER SET line of graticule.

h. Set RANGE switch to GEN 30%.

j. Set VERT MODE switch to MEAS AM.

k. Set MOD/AUDIO OUT FREQ switch to desired modulation frequency (400 or 1000 Hz) and adjust INT MOD/AUDIO OUT control for desired percentage of modulation (30% maximum).

l. Set MODE switch to GEN and frequency switches to desired frequency.

NOTE: The FM-10C is modulated at the percentage set in step 2.7.4-k ± 10% for any frequency selected by the frequency controls.

2.7.5 Externally-Modulated AM Signal Generation

a. Connect external modulating source to OAM-1 EXT MOD/HORIZ IN connector (500 mV rms ± 20% for 30% modulation, < 50 Hz to > 20 kHz).

b. Set mainframe frequency switches to 000.0000 MHz.

c. Set mainframe MODE switch to GEN MOD CAL position.

d. Set mainframe GENERATOR MODULATION switch to IN-ON position.

e. Set OAM-1 VERT MODE switch to VERT SET position.

f. Adjust VERT POS control to position trace on VERTICAL SET line of graticule.

g. Set VERT MODE switch to CARR SET position.

h. Adjust CARRIER LEVEL control to position trace on CARRIER SET line of graticule.

j. Set RANGE switch to GEN 30% position.

k. Set VERT MODE switch to MEAS AM position.

l. Set MOD MODE switch to EXT position.

m. Set level of external modulating source for desired percentage of modulation (30% maximum at 3% distortion). Increasing modulating source level to 830 mV rms produces approximately 50% modulation at 10% maximum distortion.

NOTE: The FM-10C is externally modulated at the percentage set in step 2.7.5-m ± 10% for any frequency set by the frequency controls.

2.7.6 Audio Test Tone Generation

Either 400 Hz or 1 kHz tone modulation developed by the mainframe/OAM-1 is available at all times at the AUDIO OUT 600 OHM connector for testing of transmitters or repeaters.

a. Set MOD/AUDIO FREQ switch to desired tone modulation frequency, 400 Hz or 1 kHz.

b. Set INT MOD/AUDIO OUT control to level desired (a maximum of 1 V rms into 600 ohms is available).

c. Mainframe/OAM-1 is now supplying a 400 Hz or 1 kHz tone with 600 ohms output impedance at the AUDIO OUT 600 OHM connector.

2.7.7 Internally-Horizontal-Swept General Purpose Oscilloscope

a. Set MOD MODE switch to either INT or EXT.

b. Set VERT MODE switch to EXT.

c. For maximum sensitivity set VERT GAIN control fully cw.

d. Connect signal to be displayed on CRT to the VERT IN connector.

NOTE: The nominal frequency response to the vertical amplifier is 50 Hz to 30 kHz.

e. Adjust VERT GAIN control for suitable trace amplitude.

f. Set SWEEP RANGE switch to HI or LO for coarse adjustment of horizontal display.

g. Adjust SWEEP SPEED control for number of displayed cycles.

2.7.8 Externally-Horizontal-Swept General Purpose Oscilloscope

a. Set MOD MODE switch to EXT HORIZ.

b. Connect an external sweep source to EXT MOD/HORIZ IN connector and adjust for desired oscilloscope sweep width (less than 175 mV rms per inch of deflection).

c. Set VERT MODE switch to EXT.

d. For maximum sensitivity, rotate VERT GAIN control fully cw.

e. Connect signal to be displayed on CRT to VERT IN connector.

NOTE: The nominal frequency response to the vertical amplifier is 50 Hz to 30 kHz.

f. Adjust VERT GAIN control for suitable trace amplitude.

2.7.9 X-Y Mode of Operation of General Purpose Oscilloscope

In some applications, it is desirable to display one signal versus another (X-Y) rather than against time (internal or external sweep).

a. Set VERT MODE switch to EXT.

b. Set MOD MODE switch to EXT HORIZ.

c. Apply signal for X-axis display to EXT MOD/HORIZ IN connector.

d. Apply signal for Y-axis display to VERT IN connector.

e. Adjust VERT GAIN control for suitable trace amplitude.

f. Adjust X-axis signal level externally for desired trace width (less than 175 mV rms per inch width).

2.8 ODM-1 PLUG-IN MODULE

2.8.1 Controls, Indicators, and Receptacles (ODM-1)

Table 2-9 explains the functions of all controls, indicators and receptacles of the ODM-1 plug-in module. Figure 2-15 illustrates the location of these controls, etc.

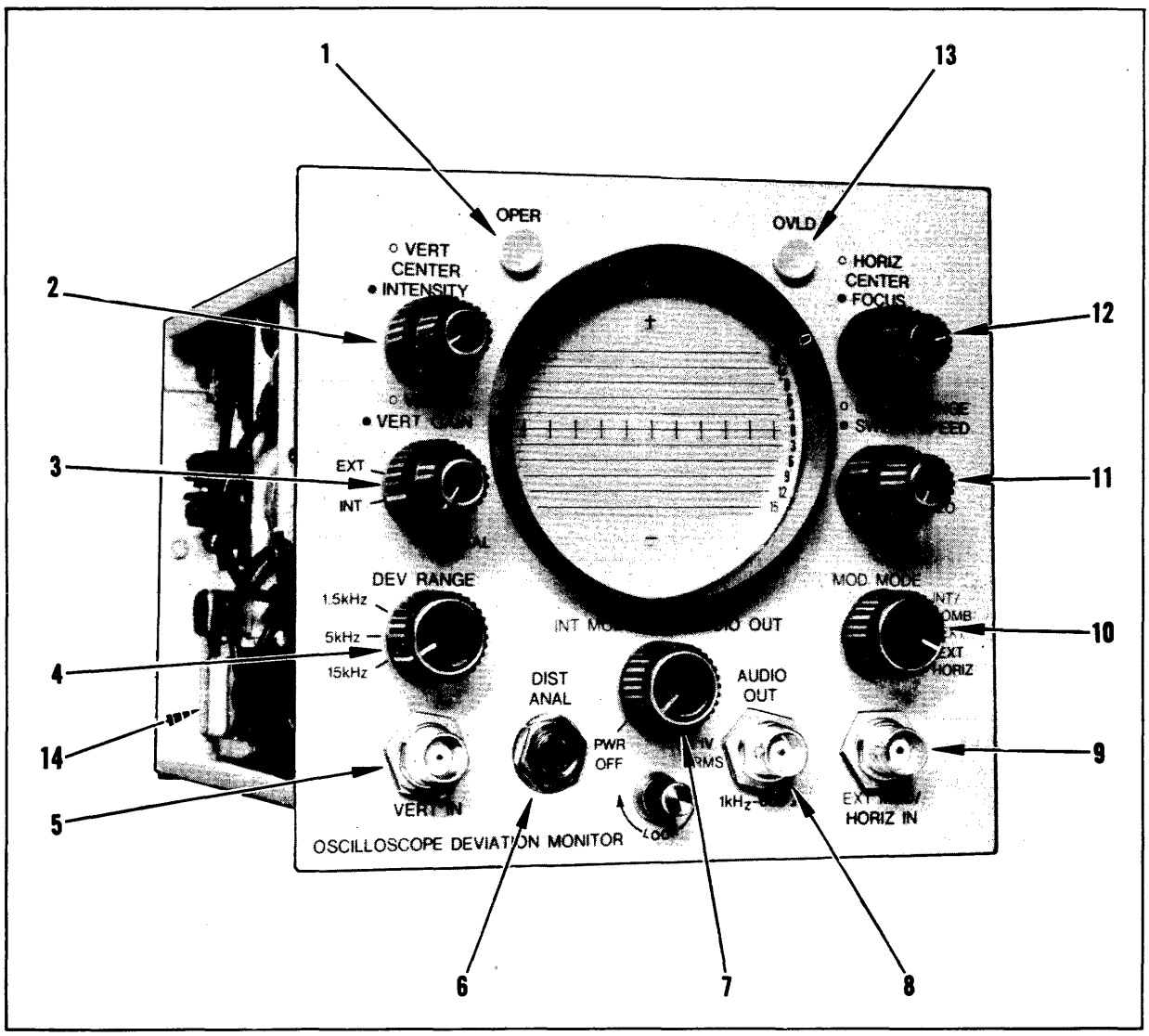


FIGURE 2–15 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL ODM–1)

TABLE 2–9

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL ODM-1)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	OPER	Light, indicator, white	Light is off when insufficient or excessive IF signal is applied to the input of the ODM-1. Light is on when IF signal level is in the acceptable range NOTE: Oper Light is interlocked with OVLD indicator so that both lights are not lit at the same time
2	VERT CENTER (Outer Knob)	Resistor, variable	Controls vertical position of trace on CRT screen
	INTENSITY (Inner Knob)	Resistor, variable	Controls brightness of CRT trace. Used with FOCUS control to obtain clear trace
3	VERT IN (Outer Knob) EXT INT	Switch, rotary, 2 position	INT position: In this position, the vertical input of the oscilloscope is switched to the output of the internal demodulator EXT position: In this position, the vertical input of the oscilloscope is switched to the VERT IN connector
	VERT GAIN (Inner Knob) CAL	Resistor, variable	Varies vertical gain in external vertical input condition
4	DEV RANGE 1.5, 5, 15 kHz	Switch, rotary, 3 position	Selects calibrated vertical input ranges. Calibration for 5 kHz range is at left of CRT screen and calibration for 1.5 and 15 kHz ranges is at right
5	VERT IN	Connector, BNC	-- Vertical input jack
6	DIST ANAL	Connector, phone jack	Demodulated audio available at this jack for output to a distortion analyzer. Also supplies output to DFM-1
7	INT MOD/AUDIO OUT PWR OFF 1 V rms	Resistor, variable/ switch, rotary, 2 position	Controls internal modulation level when MOD MODE switch is at INT/COMB. Also controls level of 1 kHz tone (available at AUDIO OUT connector) from 0 to 1 V rms. Also controls power to ODM-1 module
8	AUDIO OUT 1 kHz–600 ohm	Connector, BNC	1 kHz signal output available at this jack. Level controlled from 0 to 1 V rms by INT MOD/AUDIO OUT control

Table 2–9. Operating Controls, Indicators and Receptacles (Model ODM-1) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
9	EXT MOD/ HORIZ IN	Connector, BNC	This jack is used: 1) to provide an external modulation tone to the modulation circuit when the MOD MODE switch is at INT/COMB or EXT 2) to provide an external horizontal drive when the MOD MODE switch is at EXT HORIZ
10	MOD MODE INT/COMB EXT EXT HORIZ	Switch, rotary, 3 position	INT/COMB position: In this position, the internal 1 kHz modulation tone (controlled by INT MOD/AUDIO OUT control) and the EXT MOD/HORIZ IN connector is switched into the modulation circuit An external modulation tone supplied to the EXT MOD/HORIZ IN connector is combined with the internal 1 kHz tone EXT position: In this position, the internal 1 kHz is removed from the modulation circuit and only the EXT MOD/HORIZ IN connector is in circuit EXT HORIZ position: In this position EXT MOD/HORIZ IN connector is switched into the horizontal drive circuit for external horizontal drive
11	SWEEP RANGE HI – LO (Outer Knob)	Switch, rotary, 2 position	Provides coarse control of sweep speed. Is switched out of cirucit when an external horizontal input signal is used and MOD MODE switch is at EXT HORIZ
	SWEEP SPEED (Inner Knob)	Resistor, variable	Provides fine control of sweep speed
12	HORIZ CENTER (Outer Knob)	Resistor, variable	Controls horizontal position of trace on CRT screen
	FOCUS	Resistor, variable	Controls dispersion of beam on CRT screen. Used with INTENSITY control to obtain sharp trace
13	OVLD	Light, indicator, white	Light is off at all times except when IF signal is excessive. OVLD goes off and OPER comes on when IF signal is decreased to proper level
14	(REAR PANEL CONNECTOR P-1) Pin 2 Pin 4	Connector, 16 pin	 Chassis ground Cable shield for Pin 12

Table 2–9. Controls, Indicators and Receptacles (ODM-1) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
14	(REAR PANEL CONNECTOR P-1) (Cont.)	Connector, 16 pin	
	Pin 5		Same as DIST ANAL output
	Pin 6		Cable shield for Pin 14
	Pin 8		Cable shield for Pin 16
	Pin 9		+9 Vdc ± 10% at 900 mA max (regulated)
	Pin 12		Audio signal from internal 1 kHz oscillator or from 50 Hz to 3 kHz external modulation source. Source impedance is 180 ohm ± 20%. Level set at 500 mV rms with 400 mV rms ± 5% into EXT MOD jack or greater than 500 mV rms from internal modulation source with audio out level at max. Levels are set into 5.6 k ohm load
	Pin 13		Cable shield for Pin 5
	Pin 14		Recovered audio out to audio amplifier in mainframe. Should be greater than 40 mV rms into a 100 ohm load for full scale deflection. 3 dB bandwidth should be greater than 50 Hz to 3 kHz. Output impedance 10 ohm max at 1 kHz with level proportional to % of modulation
	Pin 16		2 MHz IF input from mainframe at level of 2.5 mV rms ± 3 dB at rated sensitivity of mainframe. Input impedance is 200 ohm ± 20%

2.8.2 Preliminary Oscilloscope Set-Up

a. Switch on power to FM-10C mainframe.

b. Turn on power to ODM-1 module by rotating INT MOD/AUDIO OUT control fully cw.

c. Allow approximately 1 minute for warm-up.

d. Position other ODM-1 controls as follows:

MOD MODE	INT
INTENSITY	Fully cw
VERT CENTER	To mid-range
HORIZ CENTER	To mid-range
VERT GAIN	CAL

The trace should now be visible on the screen.

e. Adjust FOCUS & INTENSITY for sharpest trace.

2.8.3 Peak Deviation Measurement

a. Set mainframe frequency decade switches and 0-100 Hz control to frequency of transmitter.

b. Couple transmitter FM output to MEAS INPUT connector via antenna provided or use cable input, with an RFA-60 attenuator in the line.

c. Set FM-10C controls as follows:

VERT IN	INT
VERT GAIN	CAL (fully cw)
DEV RANGE	As required

e. Key transmitter.

f. Increase RF input until OPER indicator is lit.

g. If OVLD indicator lights, decrease RF input until OPER indicator lights and OVLD goes out.

h. Adjust VERT centering to align trace in center of CRT screen.

i. Modulate transmitter by voice or tone.

(Note: 1 kHz tone variable from 0-1 Vrms is available at AUDIO OUT 600 OHM jack).

j. Adjust sweep range and sweep speed for the number of cycles to be displayed.

k. Use appropriate kHz scale on screen to measure peak height of wave.

l. Check waveform visually for presence of distortion or connect a distortion analyzer to the DIST ANAL output jack.

m. Monitor the modulation aurally by adjusting VOLUME control to desired listening level.

2.8.4 Internally-Modulated FM Signal Generation

a. Set mainframe MODE switch to GEN MOD CAL (Note: Frequency switches may be in any position).

b. OPER light on ODM-1 should be lit.

c. Set ODM-1 controls as follows:

MOD MODE	INT/COMB
VERT IN	INT
VERT GAIN	CAL (fully cw)
DEV RANGE	As required

d. Set mainframe controls as follows:

MEASURE MODE	OUT-RECOVERED
AUDIO OUTPUT	AUDIO
GENERATOR MOD	IN-ON

e. Adjust ODM-1 VERT CENTER control to align trace at center of screen.

f. Turn ODM-1 INT MOD/AUDIO OUT control for desired peak deviation shown on CRT screen.

g. Set mainframe MODE switch to GEN.

h. Set mainframe frequency switches and 0-100 Hz control to desired carrier frequency.

NOTE: The FM-10C is now generating the required carrier frequency and the internal 1 kHz modulating tone modulates the carrier to the desired peak deviation.

NOTE: For combined (two tone) internal (1 kHz) and external modulation, connect an external oscillator to EXT MOD/AUDIO IN connector and set level for the required peak deviation as measured on the CRT screen.

NOTE: Internal 1 kHz oscillator is out of the modulation circuit when MOD MODE switch is at EXT. The GENERATOR MODULATION switch of mainframe must be in the IN-ON position to modulate the FM-10C. The FM-10C can be modulated only when the MODE switch is in the GEN or GEN MOD CAL position.

2.8.5 Externally-Modulated FM Signal Generation

The FM-10C output signal can be modulated by an external signal via the EXT MOD/HORIZ IN connector on the ODM-1 when the ODM-1 MOD MODE switch is at either the INT/COMB or EXT positions.

a. Connect external modulating source to the ODM-1 EXT MOD/HORIZ IN connector.

b. Set mainframe MODE switch to GEN MOD CAL.

c. Check that OPER light is lit on ODM-1.

d. Set ODM-1 controls as follows:

MOD MODE	EXT
VERT IN	INT
VERT GAIN	CAL (fully cw)
DEV RANGE	As required

e. Set mainframe controls as follows:

MEASURE MODE	OUT-RECOVERED
AUDIO OUTPUT	AUDIO
GENERATOR MOD	IN-ON

f. Adjust ODM-1 VERT CENTER control to align trace at center of screen.

g. Adjust external modulation source for desired peak deviation as displayed on ODM-1 screen.

h. Set mainframe MODE switch to GEN.

i. set mainframe frequency switches and 0-100 Hz control to desired carrier frequency.

j. The FM-10C is now generating the required carrier frequency plus the modulation at the desired peak deviation.

2.8.6 Audio Test Tone Generation

NOTE: The 1 kHz modulation tone developed by mainframe ODM-1 is available at all times at the AUDIO OUT connector for testing of transmitters and repeaters.

a. Rotate INT MOD/AUDIO OUT control to level desired (a maximum of 1 V rms into 600 ohms is available).

b. The mainframe/ODM-1 is now supplying a 1 kHz tone with 600 ohms output impedance at the AUDIO OUT connector.

2.8.7 Internally-Horizontal-Swept General Purpose Oscilloscope

a. Set the ODM-1 MOD MODE switch to the EXT position.

b. Set the VERT IN switch to the EXT position.

c. For maximum sensitivity rotate the VERT GAIN control fully cw.

d. Connect the signal to be displayed to the ODM-1 VERT IN connector, and adjust the VERT GAIN control for suitable trace amplitude.

e. Set SWEEP RANGE switch to HI or LO for coarse horizontal adjustment of the display.

f. Adjust the SWEEP SPEED control for the number of cycles to be displayed.

2.8.8 Externally-Horizontal-Swept General Purpose Oscilloscope

a. Connect an external sweep source to the ODM-1 EXT MOD/HORIZ IN connector (approximately 500 millivolts peak-to-peak per inch across 10 megohms). Adjust for desired oscilloscope sweep width.

b. Set the MOD MODE switch to the EXT HORIZ position.

c. Set the VERT IN switch to the EXT position.

d. For maximum sensitivity rotate the VERT GAIN control fully cw.

e. Connect the signal to be displayed on the CRT to the VERT IN connector.

NOTE: The nominal frequency response of the vertical amplifier is 50 Hz to 30 kHz.

f. Adjust the VERT GAIN control for suitable trace amplitude.

2.8.9 X – Y Mode of Operation of General Purpose Oscilloscope

In some applications, it is desirable to display one signal versus another (X–Y) rather than against time (internal or external sweep).

a. Set the VERT MODE switch to EXT position.

b. Set the MOD MODE switch to EXT HORIZ position.

c. Apply the signal for X – axis display to the EXT MOD/HORIZ IN connector.

d. Apply the signal for Y – axis display to the VERT IN connector.

e. Adjust the VERT GAIN control for suitable trace amplitude.

f. Adjust the X – axis signal level externally for desired trace width (approximately 300 millivolts peak-to-peak across 100k ohms).

2.9 MDM-1 PLUG-IN MODULE

2.9.1 Controls, Indicators, and Receptacles (MDM-1)

Table 2-10 explains the functions of all controls, indicators and receptacles of the MDM-1 plug-in module. Figure 2-16 illustrates the location of these controls, etc.

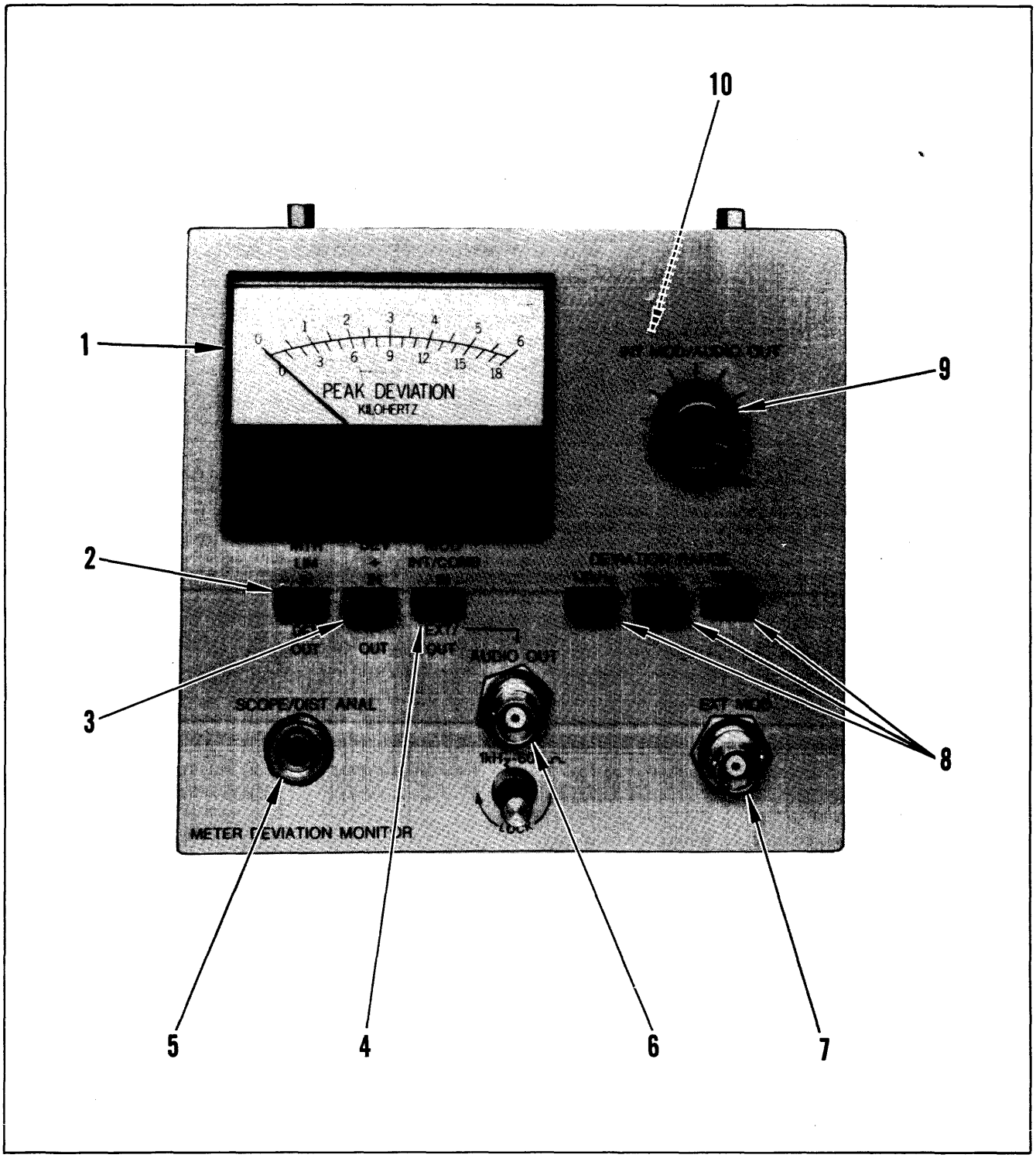


FIGURE 2–16 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL MDM–1)

TABLE 2–10

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL MDM-1)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	PEAK DEVIATION KILOHERTZ	Meter	Has two functions controlled by meter switch (MTR): 1) indicates limiter current 2) indicates frequency deviation in kHz. The limiter current mode indicates whether sufficient IF signal is present to obtain deviation measurement. A red line on the scale labeled "LIM CUR" indicates minimum limiter current necessary to obtain a deviation reading. The scale markings are in kHz
2	MTR LIM/IN DEV/OUT	Switch, push-push	Controls function of PEAK DEVIATION meter IN position: Meter reads limiter current OUT position: Meter reads peak deviation in kHz
3	DEV + IN – OUT	Switch, push-push	Selects positive or negative half waves of recovered modulation. Provides a means of checking distortion of an FM input signal. A difference in peak deviation meter readings in the IN and OUT positions indicates presence of distortion
4	MOD INT/COMB IN EXT OUT	Switch, push-push	1. In the IN position, the internal 1 kHz modulation tone and any external tone connected to the external modulation (EXT MOD) connector frequency modulates the RF output. The level of the internal tone is controlled by the INT MOD/AUDIO OUT variable control 2. In the OUT position, the internal 1 kHz tone is eliminated from the modulation circuit and only the external tone modulates the RF output. In the OUT position, the 1 kHz internally generated tone is available at the AUDIO OUT 1 kHz, 600 OHM connector
5	SCOPE/DIST ANAL	Connector, phone jack	Provides demodulated signal output for oscilloscope display or analysis by a distortion analyzer. Also regulated +9 Vdc at 50 mA (max) available for FM accessory items
6	AUDIO OUT 1 kHz – 600 ohms	Connector, BNC	Provides 1 kHz output when modulation switch (MOD) is in the OUT (EXT) position. Output level is 10 mV rms to 1 V rms controlled by INT MOD/AUDIO OUT variable control

Table 2–10. Operating Controls, Indicators and Receptacles, Model MDM-1. (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
7	EXT MOD	Connector, BNC	An external modulation tone may be applied to this connector. A modulation signal applied to this connector will modulate the mainframe when the modulation switch (MOD) is in both the IN (INT MOD/COMB) position and the OUT (EXT) position
8	DEV, RANGE, 1.8 kHz, 6 kHz, 18 kHz	Switches, push-push	Switches set frequency peak deviation range of meter in the deviation mode
9	INT MOD/ AUDIO OUT 1 V rms	Resistor variable	Has two functions controlled by modulation switch (MOD): 1) varies amount of frequency deviation when modulation switch is in IN (INT/COMB) position 2) varies voltage of 1 kHz tone output from 10 mV rms to 1 V rms. When modulation is in OUT (EXT) position
10	(REAR PANEL CONNECTOR P-1)	Connector, 16 pin	
	Pin 2		Chassis ground
	Pin 4		Cable shield for Pin 12
	Pin 5		Same as DIST ANAL output
	Pin 6		Cable shield for Pin 14
	Pin 8		Cable shield for Pin 16
	Pin 9		+9 Vdc ± 10% at 110 mA max (regulated)
	Pin 12		Audio signal from internal 1 kHz oscillator or from 50 Hz to 3 kHz external modulation source. Source impedance is 560 ohm in the EXTERNAL position and varies with setting of audio out level control. Greater than 600 mV rms from internal modulation source with aduio out level at max and 5.6 k ohm load
	Pin 13		Cable shield for Pin 5
	Pin 14		Recovered audio output to audio amplifier in mainframe. Should be greater than 40 mV rms into a 100 ohm load for full scale deflection. 3 dB bandwidth should be greater than 50 Hz to 3 kHz. Output impedance 10 ohm max at 1 kHz with level proportional to percent of modulation.
	Pin 16		2 MHz IF input from mainframe at level of 2.5 mV rms ± 3 dB with load impedance of 100 ohms ± 20%

2.9.2 FM Peak Deviation Measurement

a. Set mainframe frequency switches and 0-100 Hz control to frequency of test transmitter.

b. Set mainframe MODE switch to MEAS.

c. Couple transmitter RF output to mainframe MEAS INPUT jack via antenna provided or use cable input with an RFA-60 attenuator in the line.

d. Position MDM-1 controls as follows:

MTR	LIM (IN)
DEVIATION RANGE	As required

e. Position mainframe controls as follows:

MEASURE SELECTIVITY	OUT-WIDE
MEASURE MODE	OUT-RECOVERED
AUDIO OUTPUT	AUDIO

f. Key transmitter

g. Increase coupling between transmitter and FM-10C until the limiter current reading on the MDM-1 meter is in acceptable range (see figure 2-17).

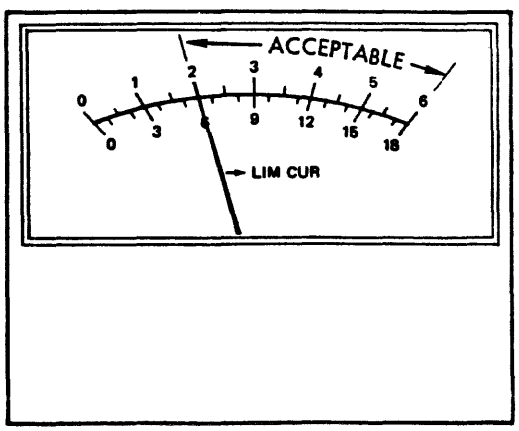


FIGURE 2–17 MDM–1 ACCEPTABLE LIMITER CURRENT RANGE

h. Set MDM-1 MTR switch to DEV (OUT).

j. Modulate transmitter by voice or tone.

NOTE: 1 kHz tone variable from 0-1 V rms is available at AUDIO OUT 600 OHM connector.

k. Select appropriate DEVIATION RANGE switch for on-scale reading on MDM-1 meter.

l. Push DEV to +(IN) and –(OUT). If there is noticeable difference in the meter readings between the IN and OUT positions, there is a possibility of distortion in the transmitter modulator.

m. Adjust VOLUME control to desired listening level.

NOTE: To investigate audio distortion further, connect an oscilloscope distortion analyzer to SCOPE/DIST ANAL output.

2.9.3 Internally-Modulated FM Signal Generation

a. Set mainframe MODE switch to GEN MOD CAL.

b. Set GENERATOR MODULATION switch to IN-ON.

c. With MDM-1 MTR switch in LIM (IN) position, observe acceptable limiter current reading.

d. Set MDM-1 controls as follows:

MOD	INT/COMB (IN)
MTR	DEV (OUT)
DEVIATION RANGE	As required

e. Adjust MDM-1 INT MOD/AUDIO OUT control for desired peak deviation as read on MDM-1 meter.

f. Set mainframe MODE switch to GEN position.

g. Set mainframe switches and 0-100 Hz control to desired frequency. The FM-10C is now generating the required carrier frequency with the desired peak deviation.

NOTE: For combined (two-tone) internal (1 kHz) and external modulation, connect an external oscillator to EXT MOD/HORIZ IN connector and set level for the required total peak deviation as measured on the MDM-1 meter.

2.9.4 Externally-Modulated FM Signal Generation

The FM-10C output signal can be modulated by an external source via the MDM-1 EXT MOD input connector when the MDM-1 MOD switch is at either the INT/COMB (IN) position or the EXT (OUT) position.

a. Connect external modulation source to MDM-1 EXT MOD input connector.

b. Set mainframe frequency switches and 0-100 Hz control to desired output carrier frequency and turn on power to mainframe.

c. Set MODE switch to GEN MOD CAL.

d. Set MDM-1 MTR switch to LIM (IN) position and check that the limiter current is in the acceptable range on the meter (see figure 2-17).

e. Set MDM-1 controls as follows:

MOD	EXT (OUT)
MTR	DEV (OUT)
DEVIATION RANGE	As required
INT MOD/ AUDIO OUT	Fully cw

f. Adjust external modulation source for desired peak deviation on MDM-1 meter.

g. Set mainframe MODE switch to GEN position. The FM-10C is now generating the required carrier frequency with the desired peak deviation.

h. Adjust the left-hand module RF OUTPUT control for desired carrier output level.

2.9.5 Audio Test Tone Generation

A 1 kHz test tone output is available at the MDM-1 AUDIO OUT connector when the MDM-1 is plugged into the mainframe and when the mainframe power is turned on. The output level may be varied from 0 to 1 V rms with the MDM-1 INT MOD/AUDIO OUT control. The tone is useful for transmitter modulation tests. The mainframe/MDM-1 is now supplying a 1 kHz tone with 600 ohms output impedance at the AUDIO OUT connector.

2.10 AFM-1 PLUG-IN MODULE

2.10.1 Controls, Indicators, and Receptacles (AFM-1)

Table 2-11 explains the functions of all controls, indicators, and receptacles of the AFM-1 plug-in module. Figure 2-18 illustrates the location of these controls, etc.

TABLE 2–11

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL AFM-1)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	AM MOD	Connector, BNC	To provide an external modulation tone to the AM circuit of the mainframe
2	FM MOD	Connector, BNC	To provide an external modulation tone to the FM circuit of the mainframe
3	(REAR PANEL CONNECTOR P-1)	Connector, 16 pin	
	Pin 3		Cable shield for Pin 11
	Pin 4		Cable shield for Pin 12
	Pin 11		Audio modulation signal to AM modulator in mainframe
	Pin 12		Frequency modulation signal to FM modulator in mainframe

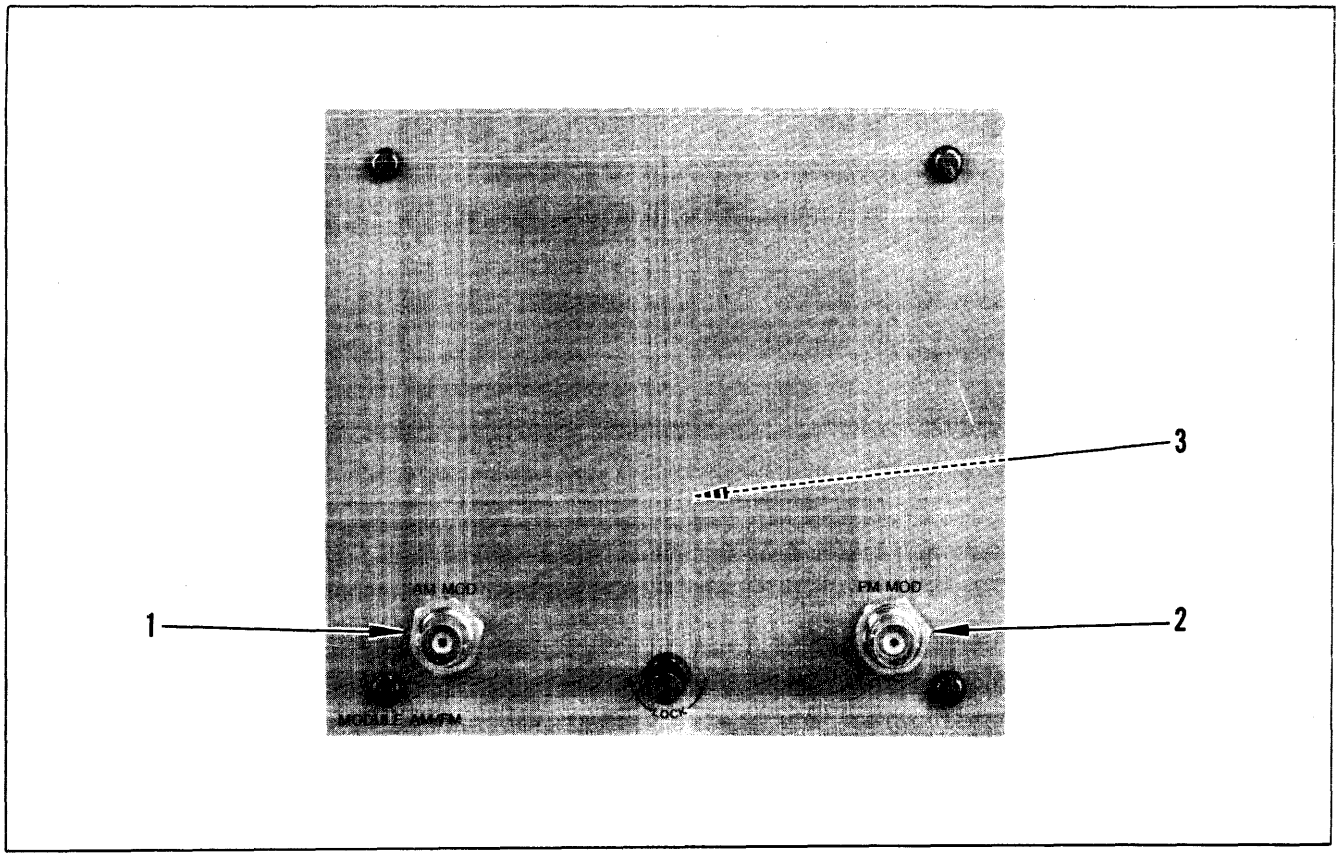


FIGURE 2–18 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL AFM–1)

2.10.2 AM Signal Generation

a. Connect external modulating source and ac VTVM to AFM-1 AM MOD jack (75 mV rms ± 20% to produce 30% modulation at 3% maximum distortion)

b. Set mainframe frequency switches to 000.0000 MHz

c. Set mainframe controls as follows:

MODE GENERATOR	GEN
MODULATION	IN-ON

d. Set frequency of external modulating source for desired modulating frequency (50 Hz to 20 kHz nominal)

e. Set level of external modulating source for 75 mV rms on the ac VTVM. Note – the FM-10C is externally modulated at 27 to 33% for any frequency set by the frequency switches and 0-100 Hz control.

2.10.3 FM Signal Generation

a. Connect external modulating source and ac VTVM to AFM-1 FM MOD jack (100 mV rms ± 10% produces a peak deviation of 5 kHz max. at a 400 Hz rate)

b. Set mainframe frequency switches to 000.0000 MHz

c. Set mainframe controls as follows:

MODE GENERATOR	GEN
MODULATION	IN-ON

d. Set frequency of external modulating source for desired deviation rate (300 Hz to 3 kHz nominal)

e. Set level of external modulating source for 100 mV rms on the ac VTVM. Note – The FM-10C is externally modulated at 5 kHz ± 500 Hz peak deviation for any carrier frequency set up by the frequency switches and 0-100 Hz control.

2.11 AFM-2 PLUG-IN MODULE

2.11.1 Controls, Indicators and Receptacles (AFM-2)

Table 2-12 explains the functions of all controls, indicators and receptacles of the AFM-2 plug-in module. Figure 2-19 illustrates the location of these controls, etc.

2.11.2 AM Signal Generation

a. Connect external modulating source and ac VTVM to AFM-2 AM MOD jack (75 mV rms ± 20% to produce 30% modulation at 3% maximum distortion).

b. Set mainframe frequency switches to 000.0000 MHz

c. Set mainframe controls as follows:

MODE GENERATOR	GEN
MODULATION	IN-ON

TABLE 2–12

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL AFM-2)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	10 MHz OUTPUT	Connector, BNC	10 MHz time base output for calibration purposes
2	AM MOD	Connector, BNC	To provide an external modulation tone to the AM circuit of the mainframe
3	FM MOD	Connector, BNC	To provide an external modulation tone to the FM circuit of the mainframe
4	IF OUTPUT	Connector, BNC	IF output for spectrum analysis
5	(REAR PANEL CONNECTOR P-1)	Connector, 16 pin	
	Pin 1		10 MHz from A1A2 board via J6-5. Level is 100 mV rms min from a source impedance of 50 ohms (nom)
	Pin 3		Cable shield for Pin 11
	Pin 4		Cable shield for Pin 12
	Pin 8		Cable shield for Pin 16
	Pin 10		Cable shield for Pin 1
	Pin 11		Audio modulation signal to AM modulator in mainframe
	Pin 12		Frequency modulation signal to FM modulator in mainframe
	Pin 16		2 MHz IF input at a level of 2.5 mV rms ±3 dB at rated sensitivity of mainframe. Source impedance is 50 ohm ±20%

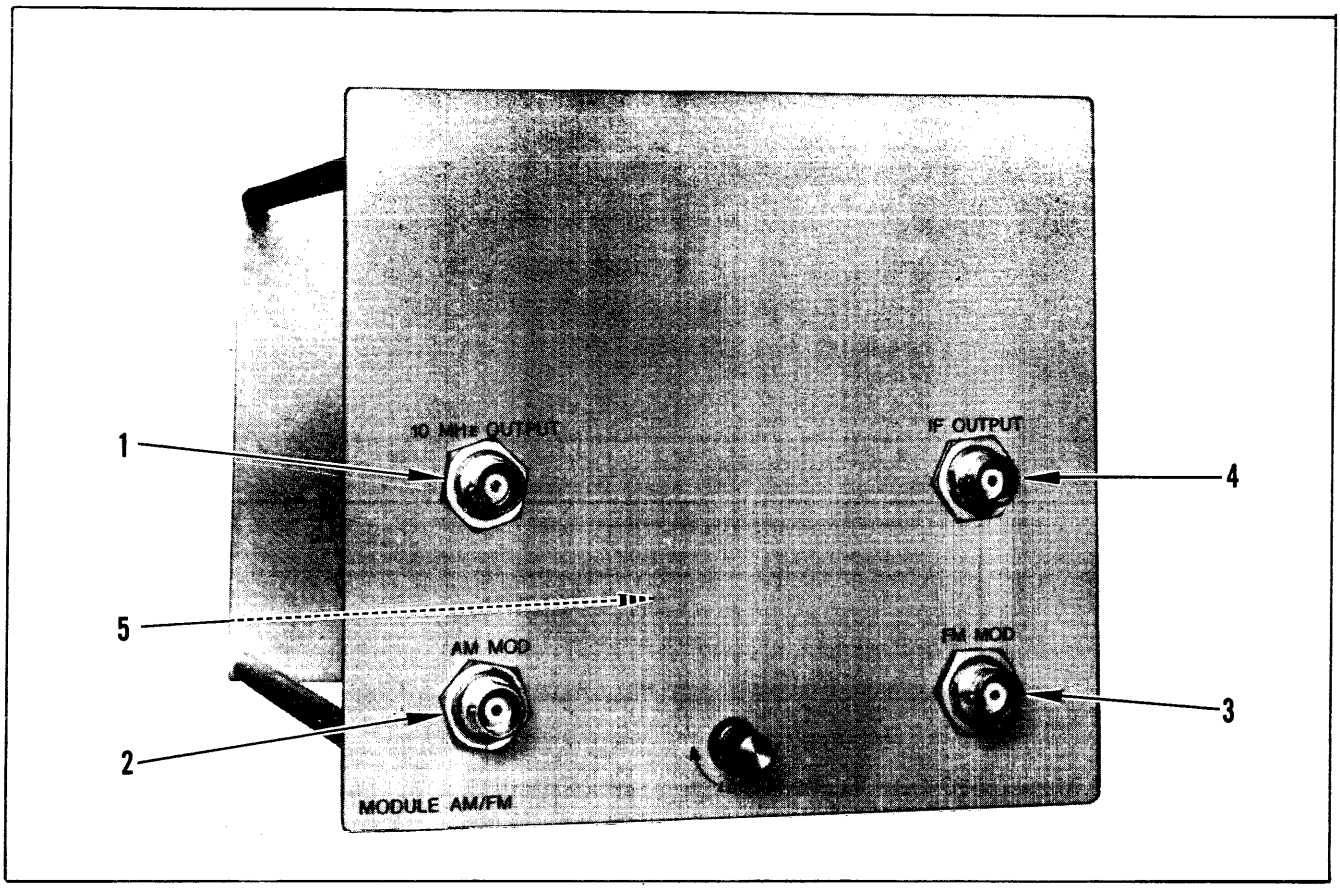


FIGURE 2–19 OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL AFM–2)

MODE GENERATOR	GEN
MODULATION	IN-ON

d. Set frequency of external modulating source for desired modulating frequency (50 Hz to 20 kHz nominal)

e. Set level of external modulating source for 75 mV rms on the ac VTVM. Note – The FM-10C is externally modulated at 27 to 33% for any frequency set by the frequency switches and 0-100 Hz control.

2.11.3 FM Signal Generation

a. Connect external modulating source and ac VTVM to AFM-2 FM MOD jack (100 mV rms ± 10% produces a peak deviation of 5 kHz max at a 400 Hz rate)

b. Set mainframe frequency switches to 000.0000 MHz

c. Set mainframe controls as follows:

MODE GENERATOR	GEN
MODULATION	IN-ON

d. Set frequency of external modulating source for desired deviation rate (300 Hz to 3 kHz nominal)

e. Set level of external modulating source for 100 mV rms on the ac VTVM. Note– The FM-10C is externally modulated at 5 kHz ± 500 Hz peak deviation for any carrier frequency set up by the frequency switches and 0-100 Hz control.

2.11.4 Spectral Analysis Using the IF Output

See application note # 16C for the spectral analysis procedure.

2.11.5 Calibration Using the 10 MHz Output

Application note #15C may readily be adapted to the use of this output jack.

2.12 RFM-10D PLUG-IN MODULE

2.12.1 Controls, Indicators, and Receptacles (RFM-10D)

Table 2-13 explains the functions of all controls, indicators and receptacles of the RFM-10D plug-in module. Figure 2-20 illustrates the location of these controls, etc.

TABLE 2-13

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL RFM-10D)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	RF OUTPUT 50 Ω	Connector, BNC	RF output at frequency of signal from mainframe when mainframe is in generate mode. Level controlled by item number 3
2	MEASURE INPUT 50 Ω CAUTION: DO NOT EXCEED 0.5V INPUT	Connector, BNC	Applies signal to be measured to input mixer (circuit completed only when mainframe is in measure mode)
3	RF OUTPUT - dBm	Attenuator, step	Controls level of RF output. Calibrated in dBm
4	MEASURE MODE BANDWIDTH WIDE (OUT) NARROW (IN) (USE WIDE BANDWIDTH POSITION FOR DEVIATION MEASUREMENTS ≥ 5 kHz)	Switch, push, push	Selects bandwidth of the IF amplifier in the measure mode
5	NARROW (IN)	Light, indicator, red	On when in narrow bandwidth
6	MEASURE SENSITIVITY uV - mV (inner knob) Adjust for operate light in MEAS MODE	Resistor, variable	Variable control of "operate" sensitivity. Calibrated in relative input levels
	HIGH - NORMAL (outer knob)	Switch, rotary, 2 position	Selects sensitivity range. Switches a fixed gain in and out of the IF amplifier

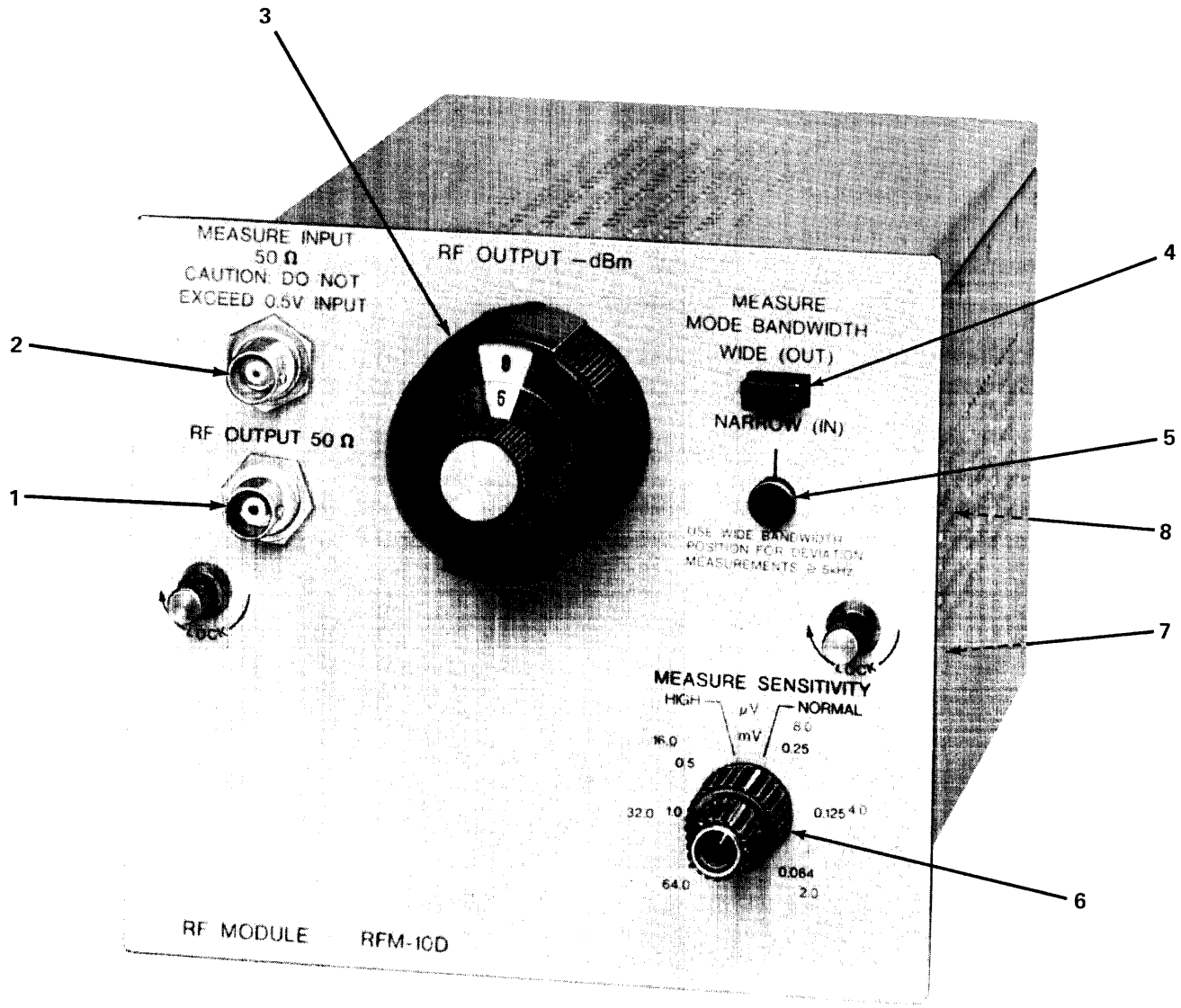


Figure 2-20
OPERATING CONTROLS, INDICATORS, AND RECEPTACLES
(MODEL RFM-10D)

Table 2-13: Operating Controls, Indicators and Receptacles (Model RFM-10D)(Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
7	(REAR PANEL CONNECTOR P2)	Connector, 24 pin	
	Pin 1		2 MHz IF output from a source impedance of 5 ohms ±20%. Level is set at 2.5 mV into a 50 ohm load at the desired operate sensitivity, i.e. 2.5 mV with "MEASURE SENSITIVITY" at "HIGH" and "2uV" and apply 2 uV signal into "MEASURE INPUT"
	Pin 3		ALC detector voltage. Proportional to RF level into AT1. -20 mV dc ±3 mV for 0 dBm at 150 MHz into AT1. Source impedance is 4.7 kilohms ±20%. Load impedance is 10 kilohms ±20%.
	Pin 9		9 Vdc ±10% regulated input at 140 mA ±20%. Supplies Vcc to the A1A4 broadband amplifier.
	Pin 10		+9 Vdc ±1% regulated input at 150 mA ±20%. Switch on in the measure mode. Supplies Vcc to A1A2 broadband amplifier and A1A3 IF amplifier and the 4 dB broadband amplifier in A1A4.
	Pin 12		Shield ground for Pin 24
	Pin 13		Shield ground for Pin 1
	Pin 15		Shield ground for Pin 3
	Pin 20		9 Vdc ±10% regulated input at 50 mA ±20%. Switched on in "TONE GEN" and "GEN MOD CAL" in FM-10C mainframe. Automatically selects wide bandwidth in IF and supplies B+ for IF amplifier
	Pin 21		Chassis ground
	Pin 24		9 MHz input from mainframe at level of 100 mV rms.

Table 2-13: Operating Controls, Indicators and Receptacles (Model RFM-10D) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
8	(REAR PANEL CONNECTOR P1)	Connector, push-on	Applies RF signal from mainframe to A1A4 module at level of -33 dBm ±3 dB. Input impedance is 50 ohms ±20% at 150 MHz.

2.12.2 CW Signal Generation

NOTE:
The only plug-in module required for CW signal generation is the left-hand module.

a. Set MODE switch to GEN.

b. Set frequency switches and 0-100 Hz control to desired frequency.

c. The desired RF output signal appears at the RF OUTPUT connector on the RFM-10D.

2.12.3 Manually-Swept Frequency Generation and Measurement

a. Set up FM-10C for measurement or generation as described elsewhere. (See Table of Contents.)

b. To manually sweep 1 MHz:

Set 100 kHz switch to V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 kHz switch) and 1 MHz higher in frequency.

c. To manually sweep 100 kHz:

Set 10 kHz switch to V and 100 kHz switch not to V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 10 kHz switch) and 100 kHz higher in frequency.

d. To manually sweep 10 kHz:

Set 1 kHz switch to V and 100 kHz and 10 kHz switch not to V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 1 kHz switch) and 10 kHz higher in frequency.

e. To manually sweep 1 kHz:

Set 100 Hz switch to V and all switches to the left not to V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 Hz switch) and 1 kHz higher in frequency.

f. To manually sweep 100 Hz:

Assure that no frequency switches are in the V position. Rotate 0-100 Hz throughout its full range. The output frequency will vary between the frequency set by the frequency switches and 100 Hz higher in frequency.

2.12.4 Electronically-Swept Frequency Generation

a. Electronically-swept frequency generation may be accomplished by supplying a sawtooth input via rear panel ACC connector.

b. Connect sawtooth generator to FM-10C as shown in Figure 2-21.

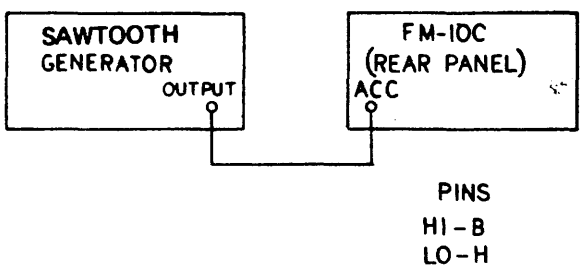


FIGURE 2-21
ELECTRONICALLY SWEPT FREQUENCY GENERATION
(MODEL RFM-10D)

c. Set sawtooth generator for output voltage and repetition rate as required.

d. Set the frequency sweep range by referring to Table 2-14 and setting the appropriate decade to the V position. (Refer to paragraph 2.12.3 for explanation of the function of the decade switch V positions.)

TABLE 2-14

SWEEP RANGES (MODEL RFM-10D)

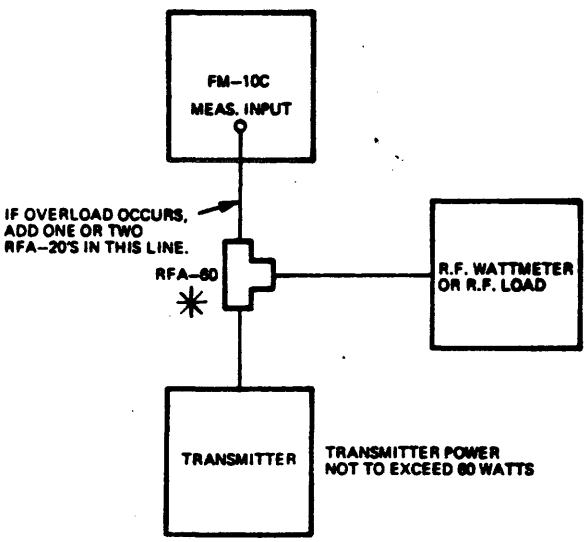
Decade Switch at V Position*	Frequency Range of 1-100 Hz Control
None	0-100 Hz
100 Hz	0-1 kHz
1 kHz	0-10 kHz
10 kHz	0-100 kHz
100 kHz	0-1 MHz

*No higher decade switch should be at V position.

2.12.5 Frequency Measurement (with Model FIM)

NOTE:
For frequency measurement, a left-hand and a center module are required. For antenna set-up, connect antenna provided to MEAS INPUT jack. For direct connection set-up, connect RFA-60, load and unit under test as shown in Figure 2-22.

CAUTION
The transmitter powershould not exceed 60 watts.



*The RFA-60 frequency response is 150-162 MHz.

FIGURE 2-22
DIRECT CONNECTION, FREQUENCY MEASURING MODE
(MODEL RFM-10D)

a. Set MEASURE MODE BANDWIDTH switch of the RFM-10D module to the OUT - WIDE position. Adjust input level and MEASURE SENSITIVITY controls until OPERATE indicator on the FIM lights. If the FM-10C is overloaded, (OPERATE lamp will not turn off) connect RFA-20 in line between FM-10C and RFA-60.

b. Set MODE switch of the mainframe to MEAS.

c. Set frequency switches and 0-100 Hz control of the mainframe to the transmitter frequency.

d. Adjust input level slightly above the level necessary to light the OPERATE indicator of the FIM module.

e. Set MEASURE MODE AUDIO OUTPUT switch of the mainframe to IN-BEAT NOTE.

f. Set FIM RANGE switch to ZERO and adjust ZERO control for zero on meter.

g. Set FIM RANGE switch to appropriate position.

NOTE:
For remote presentation of beat note, connect a speaker or headphone to the AUDIO/TONE OUTPUT jack. Use VOLUME control to adjust beat note level. Internal speaker is disconnected when an external unit is connected into the AUDIO/TONE OUTPUT jack.

h. Observe the error frequency on the FIM module meter. Adjust FM-10C mainframe frequency for zero FIM meter reading. As zero beat condition is approached the BEAT indicator will flash at the beat frequency. Continue adjusting the FM-10C mainframe frequency to the minimum flashing rate. The frequency on the dial is the transmitter frequency.

NOTE:
Some interfering signals may be eliminated by switching the MEASURE MODE BANDWIDTH switch on the RFM-10D module to IN-NARROW.

2.12.6 Operating Notes

The RFM-10D contains a wide band, high level, doubly balanced mixer with no preselection. This provides protection against overload by strong interfering signals, and allows high sensitivity at minimum cost across the

entire operating range of the FM-10C.

At various frequencies, however, the usable sensitivity may be less than 2 uV, because of the spurious content of the synthesizer (typically -40 dB). These spurious responses sometimes appear as a measured signal to the Modulation Monitor modules and Frequency Indicator module. These responses are very limited in number and probably will occur at only a few discrete frequencies (± some bandwidth) across the operating frequency range. Spurious responses are more likely to occur when the hi-sensitivity range is employed.

Following is a list of recommended procedures when using the RFM-10D in the MEASURE mode:

a. Always operate with the input sensitivity set just above the operate level required.

b. If a spurious response is suspected, disconnect the measure input; if the indication remains it is a spurious response.

c. Always use the narrow measure mode bandwidth whenever possible.

d. If it is necessary to measure a signal where too much spurious interference exists, use a broadband amplifier (Singer Model BBA-1) ahead of the measure input and reduce the measure sensitivity.

e. The frequency of a signal may be measured on the FIM in the presence of strong spurs even though these spurs may be too large to provide a modulation measurement. Spurious responses will normally cause less of a problem on the FM deviation plug-ins (MDM and ODM), than on the AM plug-in (OAM).

f. The operating note beneath the MEASURE SENSITIVITY control on the RFM states: "Adjust for operate level in MEAS mode." This refers to the OPERATE light on the FIM.

2.13 RFM-11A PLUG-IN MODULE

2.13.1 Controls, Indicators, and Receptacles (RFM-11A)

Table 2-15 explains the functions of all controls, indicators and receptacles of the RFM-11A plug-in module. Figure 2-23 illustrates the location of these controls, etc.

TABLE 2-15

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL RFM-11A)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	MEASURE INPUT/RF OUTPUT 50Ω 800-1288 MHz	Connector, BNC (J1)	1. Applies the signal to be measured through the bandpass filter, FL1, to the high band mixer, Z1. The signal is converted down in frequency and applied to the RF switch, A1A2. 2. The RF output signal is the mainframe signal frequency applied through step attenuator, AT1, and RF switch, A1A2, to high band mixer, Z1, and is converted up in frequency and applied through the bandpass filter, FL1. Level is controlled by item number 3.
2	0.05-588 MHz CAUTION: DO NOT EXCEED 0.5 V INPUT	Connector, BNC (J2)	1. Applies signal to be measured to RF switch, A1A2. 2. The RF output signal is the mainframe signal frequency applied through the step attenuator AT1 and RF switch, A1A2.
3	RF OUTPUT - dBm	Step attenuator, scaled in -dBm (-20 to -120 in 1 dB steps)(AT1)	Controls RF output and reads directly in dBm into 50 ohms.
4	MEASURE MODE BANDWIDTH WIDE(OUT) NARROW(IN) "USE WIDE BANDWIDTH POSITION FOR DEVIATION MEASUREMENTS ≥ 5 kHz"	Switch, push-button (S2)	Selects bandwidth of the IF amplifier in the MEAS mode.

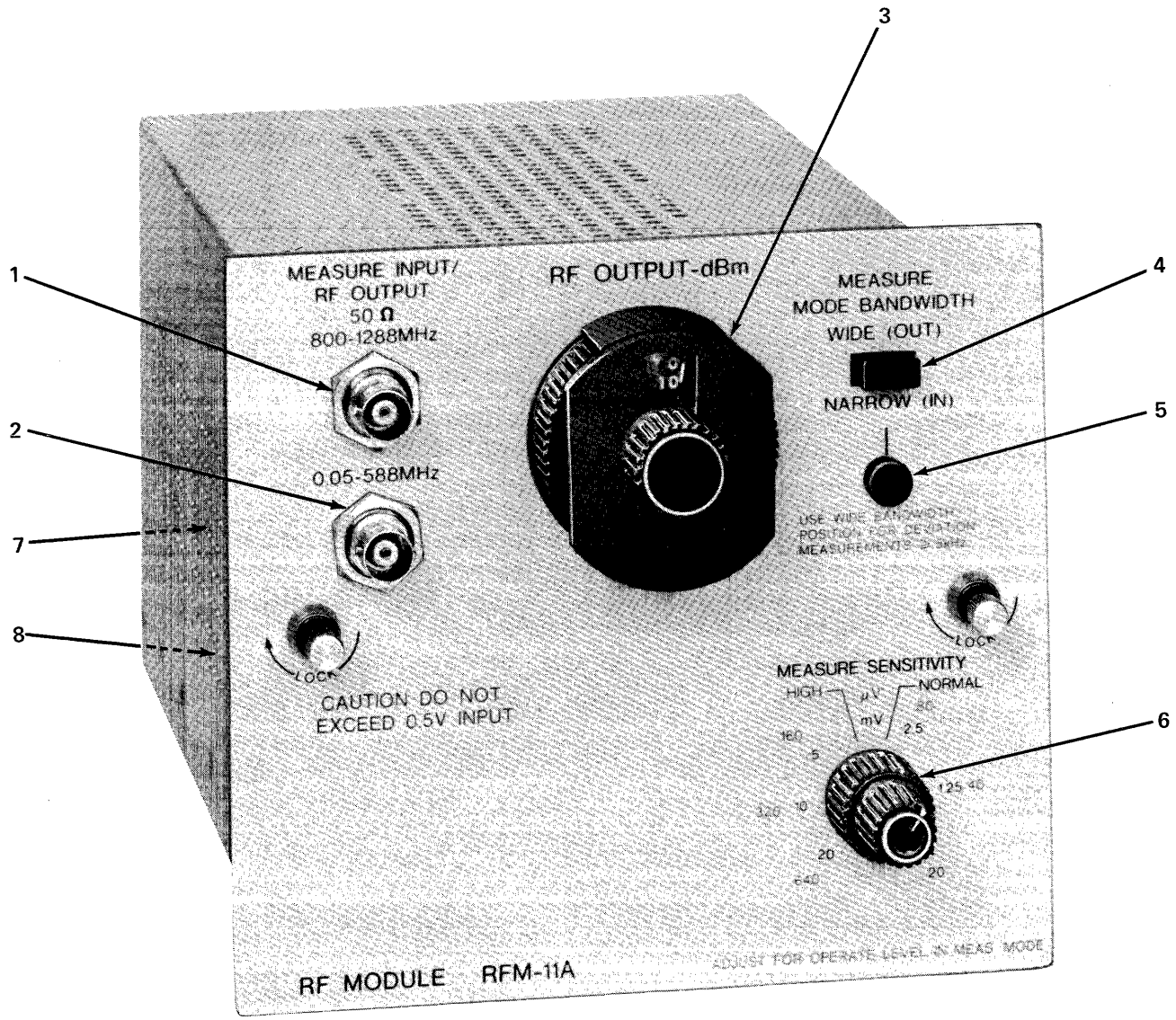


Figure 2-23. Operating Controls, Indicators, and Receptacles, Model RFM-11A

Table 2-15: Operating Controls, Indicators and Receptacles (Model RFM-11A)(Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
5	(Narrow-In)	Indicator light-red (DS1)	On when in narrow bandwidth
6	MEASURE SENSITIVITY uV - mV (Inner Knob)	Variable resistor (R1)	Variable control of "operate" sensitivity. 30 dB range with calibrated 6 dB points relative to input levels.
	HIGH - NORMAL (Outer Knob) ADJUST FOR OPERATE LEVEL IN MEAS MODE	Switch, rotary 2 position (S1)	Selects sensitivity range. Switches a fixed 30 dB gain in and out of the IF signal path.
7	(Rear Panel Connector)	Connector, plug, 24 pins (P2)	
	Pin 1:		2 MHz IF output from a source impedance of 5 Ω ±20%. Level is set at 2.5 mV rms into a 200 ohm load at the desired operate sensitivity; i.e., 2.5 mV rms with "MEASURE SENSITIVITY" at "HIGH" and "20 uV" and a 20 uV signal into either "MEASURE INPUT/RF OUTPUT" jack.
	Pin 2:		Not used.
	Pin 3:		ALC detector voltage. Proportional to RF level into AT1. -20 mV dc ±3 mV for 0 dBm at 150 MHz into AT1. (Pin 3 open circuit). Source impedance is 4.7 kilohm ±20%. Load impedance is 10 kΩ ±20%.
	Pin 4:		Not used.
	Pin 5:		10 MHz input from mainframe at a level of 100 mV rms min. Applied to 700 MHz multiplier board.
	Pin 6:		Not used.
	Pin 7:		+9 Vdc switched. On when the mainframe 100 MHz decade switch, S1, is in positions "0" thru "5". Supplies Vcc to diode switch low band pole.
	Pin 8:		Not used.

Table 2-15. Operating Controls, Indicators and Receptacles (Model RFM-11A)(Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTION
7 (Cont.)	Pin 9		+9 Vdc ±1% regulated input at 150 mA ±20%. Supplies Vcc to RF switch "generate" pole and broadband amplifier/mixer/detector.
	Pin 10		+9 Vdc ±1% regulated input at 180 mA ±20%. Switch on in "MEAS" mode in mainframe. Supplies Vcc to RF switch "measure" pole, measure broadband amplifier, broadband amplifier/mixer/detector and IF amplifier board.
	Pin 11		+9 Vdc switched. On when the mainframe 100 MHz decade switch, S1, is in position 6 through 10. Supplies Vcc to 700 MHz multiplier board and RF switch high band pole. Also jumpered to P2 pins 14, 16, 18 and 23.
	Pin 12		Shield ground for pin 24.
	Pin 13		Shield ground for pin 1.
	Pin 14		+9 Vdc switched. On when the mainframe 100 MHz decade switch, S1, is in position 6 through 10. Also jumpered to pins 11, 16, 18 and 23.
	Pin 15		Shield ground for pin 3.
	Pin 16		+9 Vdc switched. On when the mainframe 100 MHz decade switch, S1, is in position 6 through 10. Also jumpered to pins 11, 14, 18 and 23.
	Pin 17		Shield ground for pin 5.
	Pin 18		+9 Vdc switched. On when the mainframe 100 MHz decade switch, S1, is in position 6 through 10. Also jumpered to pins 11, 14, 16 and 23.
	Pin 19		Not used.

Table 2-15. OperatingControls, Indicators and Receptacles (Model RFM-11A)(Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTION
7(Cont)	Pin 20		+9 Vdc ±1% regulated input at 80 mA ±20%. Switched on in "GEN MOD CAL" and "TONE GEN" modes of mainframe. Supplies Vcc to IF amplifier and the broadband amplifier/mixer/detector.
	Pin 21		Chassis ground.
	Pin 22		Not used.
	Pin 23		+9 Vdc switched. On when the mainframe 100 MHz switch, S1, is in position 6 through 10. Also jumpered to pins 11, 14, 16 and 18.
	Pin 24:		9 MHz input from mainframe at a level of 100 mV rms min. Signal is applied to IF mixer.
8	(REAR PANEL CONNECTOR)	Connector, push-on (P1)	Applies RF signal from mainframe to A1A4 module at level of -33 dBm nominal.

2.13.2 CW Signal Generation

NOTE:
The only plug-in module required for CW signal generation is the left-hand module.

a. Set MODE switch to GEN.

b. Set frequency switches and 0-100 Hz control to desired frequency.

c. The desired RF output signal appears at the appropriate RF OUTPUT connector on the RFM-11A.

d. Set the RF OUTPUT attenuator to the desired level.

2.13.3 Manually-Swept Frequency Generation and Measurement

a. Set up mainframe for measurement or generation as described elsewhere. (See Table of Contents.)

b. To manually sweep 1 MHz:

Set 100 kHz switch to V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 kHz switch) and 1 MHz higher in frequency.

c. To manually sweep 100 kHz:

Set 10 kHz switch to V and 100 kHz switch to any position except V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 10 kHz switch) and 100 kHz higher in frequency.

d. To manually sweep 10 kHz:

Set 1 kHz switch to V and 100 kHz and 10 kHz switch to any position except V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 1 kHz switch) and 10 kHz higher in frequency.

e. To manually sweep 1 kHz:

Set 100 Hz switch to V and all switches to the left to any position except V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 Hz switch) and 1 kHz higher in frequency.

f. To manually sweep 100 Hz:

Assure that no frequency switches are in the V position. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches and 100 Hz higher in frequency.

2.13.4 Electronically-Swept Frequency Generation

a. Electronically-swept frequency generation may be accomplished by supplying a sawtooth input via rear panel ACC connector.

b. Connect sawtooth generator to FM-10C as shown in Figure 2-24.

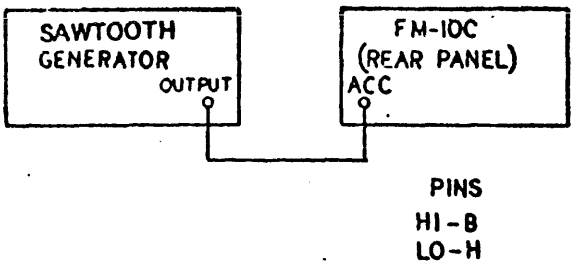


FIGURE 2-24
ELECTRONICALLY SWEPT FREQUENCY GENERATION
(MODEL RFM-11A)

c. Set sawtooth generator for output voltage and repetition rate as required.

d. Set the frequency sweep range by referring to Table 2-16 and setting the appropriate decade to the V position. (Refer to paragraph 2.13.3 for explanation of the function of the decade switch V positions.)

TABLE 2-16

SWEEP RANGES (MODEL RFM-11A)

Decade Switch at V Position	Frequency Range of 1-100 Hz Control
None	0-100 Hz
100 Hz*	0-1 kHz
1 kHz*	0-10 kHz
10 kHz*	0-100 kHz
100 kHz	0-1 MHz

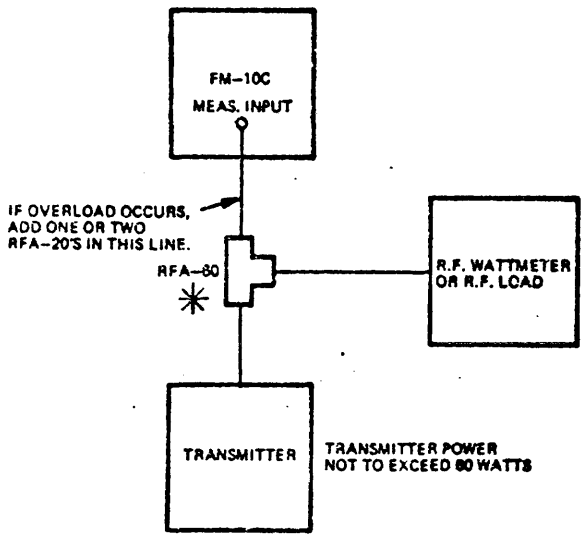
*No higher decade switch should be at V position.

2.13.5 Frequency Measurement (with Model FIM)

NOTE:

For frequency measurement, a left-hand module and a center module are required. For antenna set-up, connect antenna provided to MEAS INPUT jack. For direct connection set-up, connect RFA-60, load and unit under test as shown in Figure 2-25.

CAUTION
The transmitter power should not exceed 60 watts.



*The RFA-60 frequency response is 150-162 MHz.

FIGURE 2-25
DIRECT CONNECTION, FREQUENCY MEASURING MODE
(MODEL RFM-11A)

a. Set MEASURE MODE BANDWIDTH switch of the RFM-11A module to the OUT - WIDE position. Adjust input level and MEASURE SENSITIVITY controls until OPERATE indicator on the FIM lights. If the FM-10C is overloaded, (OPERATE lamp will not turn off), connect RFA-20 in line between FM-10C and RFA-60.

b. Set MODE switch of the mainframe to MEAS.

c. Set frequency switches and 0-100 Hz control of the mainframe to the transmitter frequency.

d. Adjust input level slightly above the level necessary to light the OPERATE indicator of the FIM module.

e. Set MEASURE MODE AUDIO OUTPUT switch of the mainframe to IN-BEAT NOTE.

f. Set FIM RANGE switch to ZERO and adjust ZERO control for zero on meter.

g. Set FIM RANGE switch to appropriate position.

NOTE:
For remote presentation of beat note, connect a speaker or headphone to the AUDIO/TONE OUTPUT jack. Use VOLUME control to adjust beat note level. Internal speaker is disconnected when an external unit is connected into the AUDIO/TONE OUTPUT jack.

h. Observe the error frequency on the FIM module meter. Adjust FM-10C mainframe frequency for zero FIM meter reading. As zero beat condition is approached the BEAT indicator will flash at the beat frequency. Continue adjustment the FM-10C mainframe frequency to the minimum flashing rate. The frequency on the dial is the transmitter frequency.

NOTE:
Some interfering signals may be eliminated by setting the MEASURE SENSITIVITY switch on the RFM-11A module to IN-NARROW.

2.13.6 Operating Notes

The RFM-11A contains a wide band, high level, doubly balanced mixer with no preselection or preamplification. This provides protection against overload by

strong interfering signals, and allows high sensitivity at minimum cost across the entire operating range of the FM-10C.

At various frequencies, however, the usable sensitivity may be less than 20 uV because of the spurious content of the synthesizer (typically -40 dB). These spurious responses sometimes appear as a measured signal to the Modulation Monitor modules and Frequency Indicator module. These responses are very limited in number and probably will occur at only a few discrete frequencies (± some bandwidth) across the operating frequency range. Spurious responses are more likely to occur when the hi-sensitivity range is employed.

Following is a list of recommended procedures when using the RFM-11A in the MEASURE mode:

a. Always operate with the input sensitivity set just above the operate level required.

b. If a spurious response is suspected, disconnect the measure input; if the indications remains it is a spurious response.

c. Use the narrow measure mode bandwidth whenever possible.

d. If it is necessary to measure a signal where too much spurious interference exists, use a broadband amplifier (Singer Model BB A-1) ahead of the measure input and reduce the measure sensitivity.

e. The frequency of a signal may be measured on the FIM in the presence of strong spurs even though these spurs may be too large to provide a modulation measurement. Spurious responses will normally cause less of a problem on the FM deviation plug-ins (MDM and ODM), than on the AM plug-in (OAM).

f. The operating note beneath the MEASURE SENSITIVITY control on the RFM states: "Adjust for operate level in MEAS mode." This refers to the OPERATE light on the FIM.

2.14 RFM-10B PLUG-IN MODULE

2.14.1 Controls, Indicators and Receptacles (RFM-10B)

The Model RFM-10B controls, indicators and receptacles are the same as those on the Model RFM-10A with the following exceptions (refer to Table 2-4):

a) The MEASURE SENSITIVITY on the Model RFM-10B is greater by a factor of 10.

b) Item 7, pin 1, FUNCTION, should refer to 2 uV rather than 20 uV.

c) Item 7, pin 15 is not used.

2.14.2 CW Signal Generation

The procedure for the Model RFM-10B is identical to the procedure for the Model RFM-10A (refer to Paragraph 2.4.2).

2.14.3 Manually-Swept Frequency Generation and Measurement

The procedure for the Model RFM-10B is identical to the procedure for the Model RFM-10A (refer to Paragraph 2.4.3).

2.14.4 Electronically-Swept Frequency Generation

The procedure for the Model RFM-10B is identical to the procedure for the Model RFM-10A (refer to Paragraph 2.4.4).

2.14.5 Frequency Measurement (with Model FIM)

The procedure for the Model RFM-10B is identical to the procedure for the Model RFM-10A (refer to Paragraph 2.4.5).

2.14.6 Operating Notes

The operating notes for the Model RFM-10B are the same as those for the Model

RFM-10A with the following exception (refer to Paragraph 2.4.6):

a) The second paragraph should refer to 2 uV rather than 20 uV.

2.15 RFM-10A AND RFM-10B PLUG-IN MODULES

2.15.1 Controls, Indicators, and Receptacles (RFM-10A and RFM-10B)

Table 2-17 explains the functions of all controls, indicators and receptacles of the RFM-10A and RFM-10B plug-in modules. Figure 2-26 illustrates the location of these controls, etc.

TABLE 2-17

OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODELS RFM-10A AND RFM-10B)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
1	RF OUTPUT 50 Ω	Connector, BNC	RF output at frequency of signal from mainframe when mainframe is in generate mode. Level controlled by item number 3
2	MEASURE INPUT 50 Ω CAUTION: DO NOT EXCEED 0.5V INPUT	Connector, BNC	Applies signal to be measured to input mixer (circuit completed only when mainframe is in measure mode)
3	RF OUTPUT - dBm	Attenuator, step	Controls level of RF output. Calibrated in dBm
4	MEASURE MODE BANDWIDTH WIDE (OUT) NARROW (IN) (USE WIDE BANDWIDTH POSITION FOR DEVIATION MEASUREMENTS ≥ 5 kHz)	Switch, push, push	Selects bandwidth of the IF amplifier in the measure mode
5	NARROW (IN)	Light, indicator, red	On when in narrow bandwidth
6	MEASURE SENSITIVITY uV - mV (inner knob) Adjust for operate light in MEAS MODE	Resistor, variable	Variable control of "operate" sensitivity. Calibrated in relative input levels
	HIGH - NORMAL (outer knob)	Switch, rotary, 2 position	Selects sensitivity range. Switches a fixed gain in and out of the IF amplifier

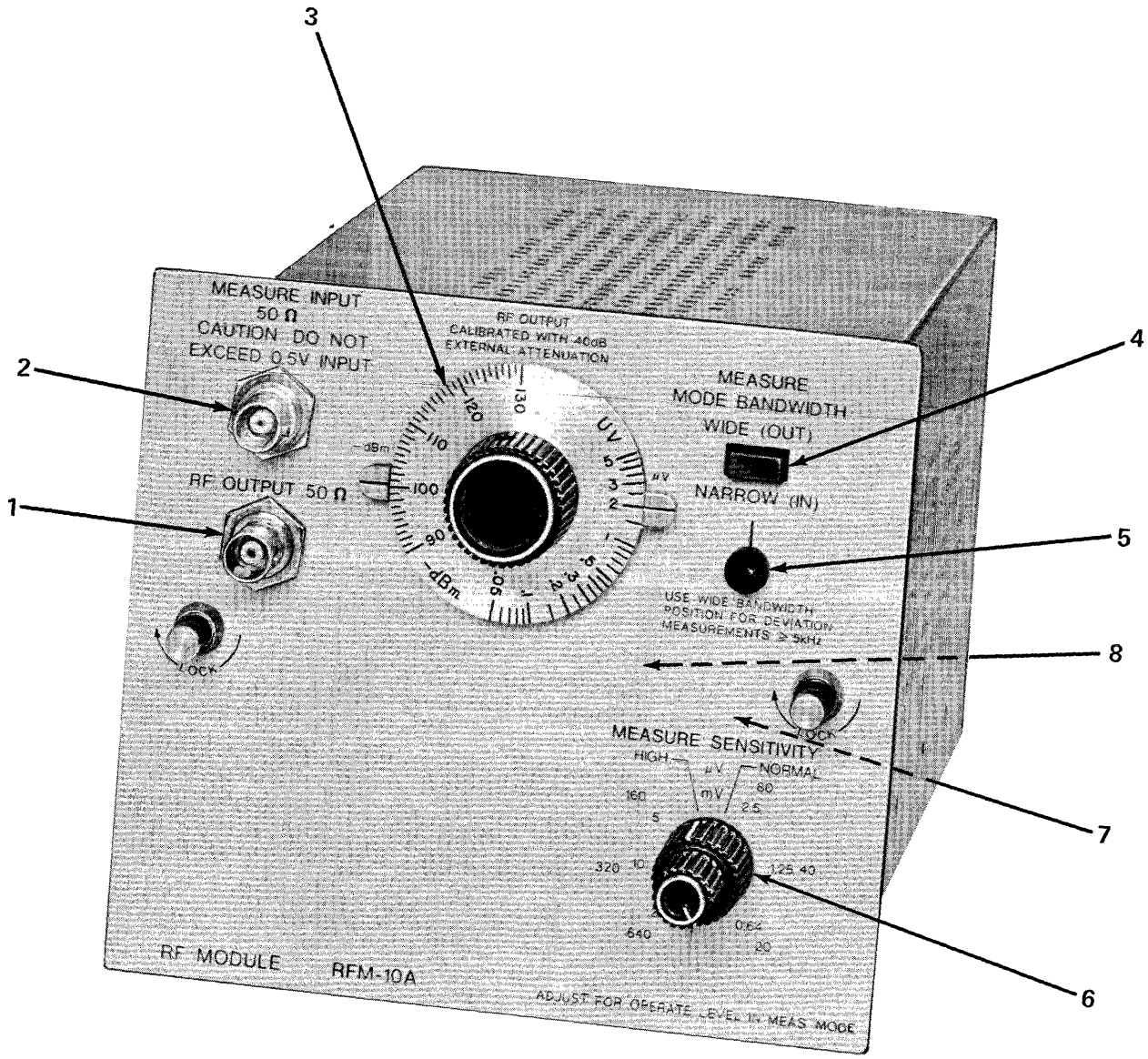


FIGURE 2-26
OPERATING CONTROLS, INDICATORS, AND RECEPTACLES
(MODELS RFM-10A AND RFM-10B)

NOTE: The difference between the RFM-10A and RFM-10B follow: the MEASURE SENSITIVITY values on the RFM-10B are greater by a factor of 10.

Table 2-17: Operating Controls, Indicators and Receptacles (Models RFM-10A and RFM-10B) (Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
7	(REAR PANEL CONNECTOR P2)	Connector, 24 pin	
	Pin 1		2 MHz IF output from a source impedance of 5 ohms ±20%. Level is set at 2.5 mV into a 50 ohm load at the desired operate sensitivity, i.e. 2.5 mV with "MEASURE SENSITIVITY" at "HIGH" and "2uV" and apply 2 uV signal into "MEASURE INPUT"
	Pin 3		ALC detector voltage. Proportional to RF level into AT1. -20 mV dc ±3 mV for 0 dBm at 150 MHz into AT1. Source impedance is 4.7 kilohms ±20%. Load impedance is 10 kilohms ±20%.
	Pin 9		9 Vdc ±10% regulated input at 140 mA ±20%. Supplies Vcc to the A1A4 broadband amplifier.
	Pin 10		+9 Vdc ±1% regulated input at 150 mA ±20%. Switch on in the measure mode. Supplies Vcc to A1A2 broadband amplifier in the RFM-10B only and A1A3 IF amplifier and the 4 dB broadband amplifier in A1A4 in both models.
	Pin 12		Shield ground for Pin 24
	Pin 13		Shield ground for Pin 1
	Pin 15		Shield ground for Pin 3
	Pin 20		9 Vdc ±10% regulated input at 50 mA ±20%. Switched on in "TONE GEN" and "GEN MOD CAL" in FM-10C mainframe. Automatically selects wide bandwidth in IF and supplies B+ for IF amplifier
	Pin 21		Chassis ground
	Pin 24		9 MHz input from mainframe at level of 100 mV rms.

Table 2-17: Operating Controls, Indicators and Receptacles (Models RFM-10A and RFM-10B)(Cont.)

ITEM	PANEL MARKING	TYPE	FUNCTIONS
8	(REAR PANEL CONNECTOR P1)	Connector, push-on	Applies RF signal from mainframe to A1A4 module at level of -33 dBm ±3 dB. Input impedance is 50 ohms ±20% at 150 MHz.

2.15.2 CW Signal Generation

NOTE:
The only plug-in module required for CW signal generation is the left-hand module.

a. Set MODE switch to GEN.

b. Set frequency switches and 0-100 Hz control to desired frequency.

c. The desired RF output signal appears at the RF OUTPUT connector on the RFM-10A or RFM-10B.

2.15.3 Manually-Swept Frequency Generation and Measurement

a. Set up FM-10C for measurement or generation as described elsewhere. (See Table of Contents.)

b. To manually sweep 1 MHz:

Set 100 kHz switch to V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 kHz switch) and 1 MHz higher in frequency.

c. To manually sweep 100 kHz:

Set 10 kHz switch to V and 100 kHz switch to any position except V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 10 kHz switch) and 100 kHz higher in frequency.

d. To manually sweep 10 kHz:

Set 1 kHz switch to V and 100 kHz and 10 kHz switch to any position except V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 1 kHz switch) and 10 kHz higher in frequency.

e. To manually sweep 1 kHz:

Set 100 Hz switch to V and all switches to the left to any position except V. Rotate 0-100 Hz control throughout its full range. The output frequency will vary between the frequency set by the frequency switches (to the left of the 100 Hz switch) and 1 kHz higher in frequency.

f. To manually sweep 100 Hz:

Assure that no frequency switches are in the V position. Rotate 0-100 Hz throughout its full range. The output frequency will vary between the frequency set by the frequency switches and 100 Hz higher in frequency.

2.15.4 Electronically-Swept Frequency Generation

a. Electronically-swept frequency generation may be accomplished by supplying a sawtooth input via rear panel ACC connector.

b. Connect sawtooth generator to FM-10C as shown in Figure 2-27.

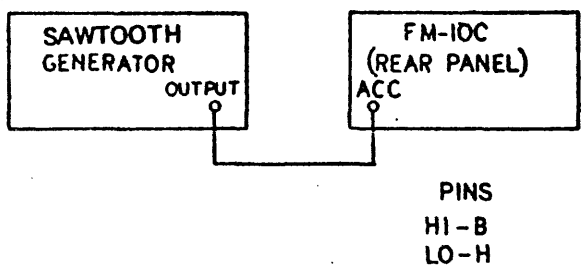


FIGURE 2-27
ELECTRONICALLY SWEPT FREQUENCY GENERATION
(MODELS RFM-10A AND RFM-10B)

c. Set the sawtooth generator for the output voltage and repetition rate as required.

d. Set the frequency sweep range by referring to Table 2-18 and setting the appropriate decade to the V position. (Refer to paragraph 2.15.3 for explanation of the function of the decade switch V positions.)

TABLE 2-18

SWEEP RANGES (MODELS RFM-10A AND RFM-10B)

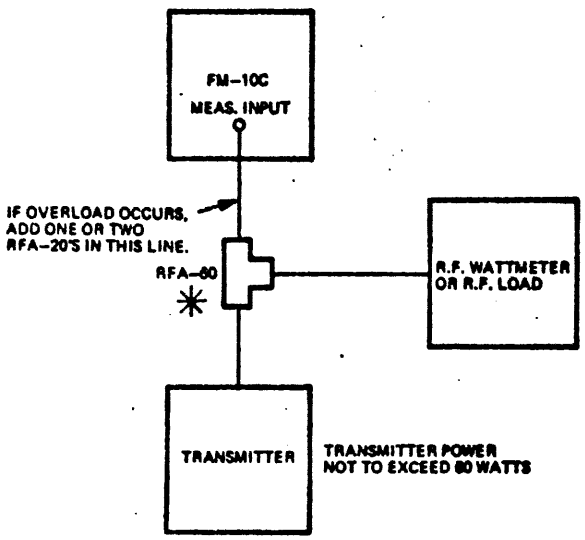
Decade Switch at V Position	Frequency Range of 1-100 Hz Control
None	0-100 Hz
100 Hz*	0-1 kHz
1 kHz*	0-10 kHz
10 kHz*	0-100 kHz
100 kHz	0-1 MHz

*No higher decade switch should be in the V position.

2.15.5 Frequency Measurement (with Model FIM)

NOTE:
For frequency measurement, a left-hand and a center module are required. For antenna set-up, connect antenna provided to MEAS INPUT jack. For direct connection set-up, connect RFA-60, load and unit under test as shown in Figure 2-28.

CAUTION
The transmitter power should not exceed 60 watts.



*The RFA-60 frequency response is 150-162 MHz.

FIGURE 2-28
DIRECT CONNECTION, FREQUENCY MEASURING MODE
(MODELS RFM-10A and RFM-10B)

a. Set MEASURE MODE BANDWIDTH switch of either the RFM-10A or RFM-10B module to the OUT - WIDE position. Adjust input level and MEASURE SENSITIVITY controls until OPERATE indicator on the FIM lights. If the FM-10C is overloaded, (OPERATE lamp will not turn off) connect RFA-20 in line between FM-10C and RFA-60.

b. Set MODE switch of the mainframe to MEAS.

c. Set frequency switches and 0-100 Hz control of the mainframe to the transmitter frequency.

d. Adjust input level slightly above the level necessary to light the OPERATE indicator of the FIM module.

e. Set MEASURE MODE AUDIO OUTPUT switch of the mainframe to IN-BEAT NOTE.

f. Set FIM RANGE switch to ZERO and adjust ZERO control for zero on meter.

g. Set FIM RANGE switch to appropriate position.

NOTE:
For remote presentation of beat note, connect a speaker or headphone to the AUDIO/TONE OUTPUT jack. Use VOLUME control to adjust beat note level. Internal speaker is disconnected when an external unit is connected into the AUDIO/TONE OUTPUT jack.

h. Observe the error frequency on the FIM module meter. Adjust FM-10C mainframe frequency for zero FIM meter reading. As zero beat condition is approached the BEAT indicator will flash at the beat frequency. Continue adjusting the FM-10C mainframe frequency to the minimum flashing rate. The frequency on the dial is the transmitter frequency.

NOTE:
Some interfering signals may be eliminated by switching the MEASURE MODE BANDWIDTH switch on either the RFM-10A or RFM-10B module to IN-NARROW.

2.15.6 Operating Notes

The RFM-10A and RFM-10B contain a wide band, high level, doubly balanced mixer with no preselection. This provides protection against overload by strong interfering signals, and allows high sensitivity at minimum cost across the

entire operating range of the FM-10C.

At various frequencies, however, the usable sensitivity may be less than 2 uV, because of the spurious content of the synthesizer (typically -40 dB). These spurious responses sometimes appear as a measured signal to the Modulation Monitor modules and Frequency Indicator module. These responses are very limited in number and probably will occur at only a few discrete frequencies (± some bandwidth) across the operating frequency range. Spurious responses are more likely to occur when the hi-sensitivity range is employed.

Following is a list of recommended procedures when using either the RFM-10A or RFM-10B in the MEASURE mode:

a. Always operate with the input sensitivity set just above the operate level required.

b. If a spurious response is suspected, disconnect the measure input; if the indication remains it is a spurious response.

c. Use the narrow measure mode bandwidth whenever possible.

d. If it is necessary to measure a signal where too much spurious interference exists, use a broadband amplifier (Singer Model BBA-1) ahead of the measure input and reduce the measure sensitivity.

e. The frequency of a signal may be measured on the FIM in the presence of strong spurs even though these spurs may be too large to provide a modulation measurement. Spurious responses will normally cause less of a problem on the FM deviation plug-ins (MDM and ODM), than on the AM plug-in (OAM).

f. The operating note beneath the MEASURE SENSITIVITY control on the RFM states: "Adjust for operate level in MEAS mode." This refers to the OPERATE light on the FIM.

APPENDIX A

FM-10C APPLICATION NOTES LIST

1C	Adjustment of Transmitter Frequency
2C	Measurement of Unknown Frequency
3C	Deviation Measurement, Oscilloscope Indication
4C	Deviation Measurement, Meter Indication
5C	AM Modulation Measurement
6C	FM Transmitter Audio Distortion Test (Meter Indication)
7C	FM Transmitter Audio Distortion Test (Oscilloscope Indication)
8C	20 dB Quieting Sensitivity Measurement
9C	12 dB Sinad Sensitivity Measurement
10C	Squelch Sensitivity Measurement
11C	FM Receiver Audio Distortion Measurement
12C	Modulation Acceptance Bandwidth Test
13C	Receiver Tone Coded Squelch Decoder Test
14C	Frequency Measurement of Selective Calling Tones
15C	Calibrating The FM-10C Master Oscillator
16C	Spectrum Analysis Using The FM-10C with Heathkit Model SB–620 Scanalyzer
17C	SSB Transmitter Tests
18C	SSB Receiver Tests
19C (Rev. A)	Special Input for Large Deviations and Low Modulation Rates
20C	Signal Generation and Measurements with FM-10C Using Harmonics

ADDENDUM
FOR
MANUAL NO. 1-500783-258 (Rev. A)
MODEL FM-10C

ERRATA

There are no known errors (errata) in this manual. Proceed to the running changes.

Revision	Initials	Date	Approved	Initials
A		10-10-73		

CLASS CODE		
SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL FM-10C	DWG NO. I- 500783-258(A) SHEET 1.1

MAINFRAME RUNNING CHANGES

Perform the following changes to the above manual up to the serial number effectivity of your instrument.

Effective serial number: Serial numbers suffixed with 04049 and above.

Page 2-2: FIGURE 2-1: OPERATING CONTROLS, INDICATORS, and RECEPTACLES (MAINFRAME)

Number 25, Was: AC . 75A Is: 115 Vac 1A SB. 230 Vac . 5A SB

Page 2-7: Table 2-1. Operating Controls, Indicators and Receptacles (Mainframe) (Cont)

Item 25, Was: AC 0. 75A Fuse, 0. 75A 115/230 Vac fuse

Is: 115 Vac 1A SB Fuse, 1A SB 115 Vac fuse

230 Vac 0. 5 A SB Fuse, 0. 5A SB 230 Vac fuse

REVISED

APPROVED

CLASS CODE		
SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM MODEL FM-10C	DWG NO. I-500783-258(A) SHEET 2. 1

FORM NO. 160 1M 3-70 D-H

OAM-1 RUNNING CHANGES

Effective serial number: OAM-1 serial numbers prefixed with 566 and above.

Page 1-9: TABLE 1-6. OSCILLOSCOPE AMPLITUDE MODULATION MONITOR (MODEL OAM-1) SPECIFICATIONS

Paragraph 1.1.1 Ranges, Delete: (95% max usable)

Page 1-10: Table 1-6. Oscilloscope Amplitude Modulation Monitor (Model OAM-1) Specifications (Cont.)

Paragraph 1.2.1-b Modulation Range, Was: 0-30% Is: 0-100%

-c Distortion due to mainframe, Add: 10% (max) at 90% modulation

Paragraph 1.2.2-b Modulation Range, Was 0-50% Is: 0-100%

-c Distortion at 1 kHz due to mainframe,

Was: 30-50% AM: 10% (max)

Is: 30- 90% AM: 10% (max)

Page 2-27: Figure 2-14. OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL OAM-1)

Item 2, Range, Was: GEN 30%, 30%, 100% Is: GEN 30%, MEAS 30%, MEAS/GEN 100%

Page 2-28: TABLE 2-8. OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL OAM-1)

Item 2, RANGE (Outer Knob), Was: GEN 30%, 30%, 100%

Is: GEN 30%, MEAS 30%, MEAS/GEN 100%

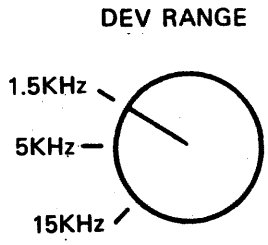
100% position, Add: Provides internal or external amplitude modulation of the mainframe carrier up to 100%.

ODM-1 RUNNING CHANGES

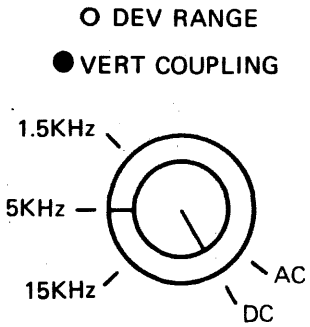
Effective ODM-1 serial number: Serial numbers suffixed with 04058 and above.

Page 2-33: FIGURE 2-15. OPERATING CONTROLS, INDICATORS, AND RECEPTACLES (MODEL ODM-1)

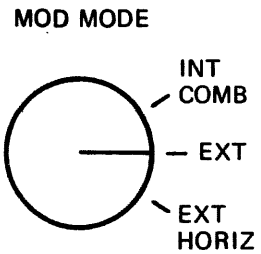
4, Was:



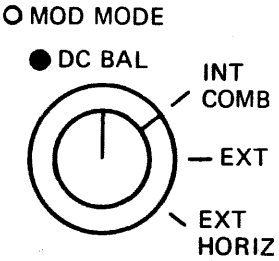
Is:



10, Was:



Is:



Page 2-34: TABLE 2-9. OPERATING CONTROLS, INDICATORS AND RECEPTACLES (MODEL ODM-1)

Item 4, Was:	DEV RANGE 1.5, 5, 15 kHz		Is: DEV RANGE 1.5, 5, 15 kHz (Outer Knob)
Item 4, Add:	VERT COUPLING AC, DC (Inner Knob)	Switch rotary, 2 position	Selects ac or dc coupling to the VERT IN jack. AC is used for general operation and DC is primarily designed for calibration purposes.
Item 10, Was:	MOD MODE INT/COMB EXT EXT HORIZ		Is: MOD MODE INT/COMP EXT EXT HORIZ (Outer Knob)

REVISED

APPROVED

CLASS CODE		
SINGER INSTRUMENTATION LOS ANGELES, CALIF.	TITLE ADDENDUM Model FM-10C	DWG NO. I-500783-258(A) SHEET 2.7.1

FORM NO. 160 1M 3-70 D-H

Item 10, Add: DC BAL (Inner Knob) Resistor, variable — Adjusts the dc balance of the FM discriminator when making direct-coupled deviation measurements. The DC BAL control permits vertical shift of the trace position only when the VERT IN switch is in the INT position and the VERT COUPLING switch is in the DC position.

Page 2-37, Paragraphs 2.8.4 and 2.8.5:
ODM-1 control positions, Add: VERT COUPLING AC

Page 2-37: Paragraph 2.8.3:
Step c, Add: VERT COUPLING DC
Delete: Step h and replace with the following:

To adjust the DC BAL, set the VERT IN switch to the EXT position (without signal input) and verify that the trace position is on the zero graticule line. Adjust the VERT CENTER control as necessary. Set the VERT IN switch to the INT position and the mainframe MODE switch to the GEN MOD CAL position. Adjust the DC BAL control to center the trace position on the zero graticule line. Set the DEV RANGE switch to each position and verify that there is no trace shift.

Page 2-38: Paragraphs 2.8.7 thru 2.8.9:
Step b.: Delete the period and Add: and the VERT COUPLING switch to AC.