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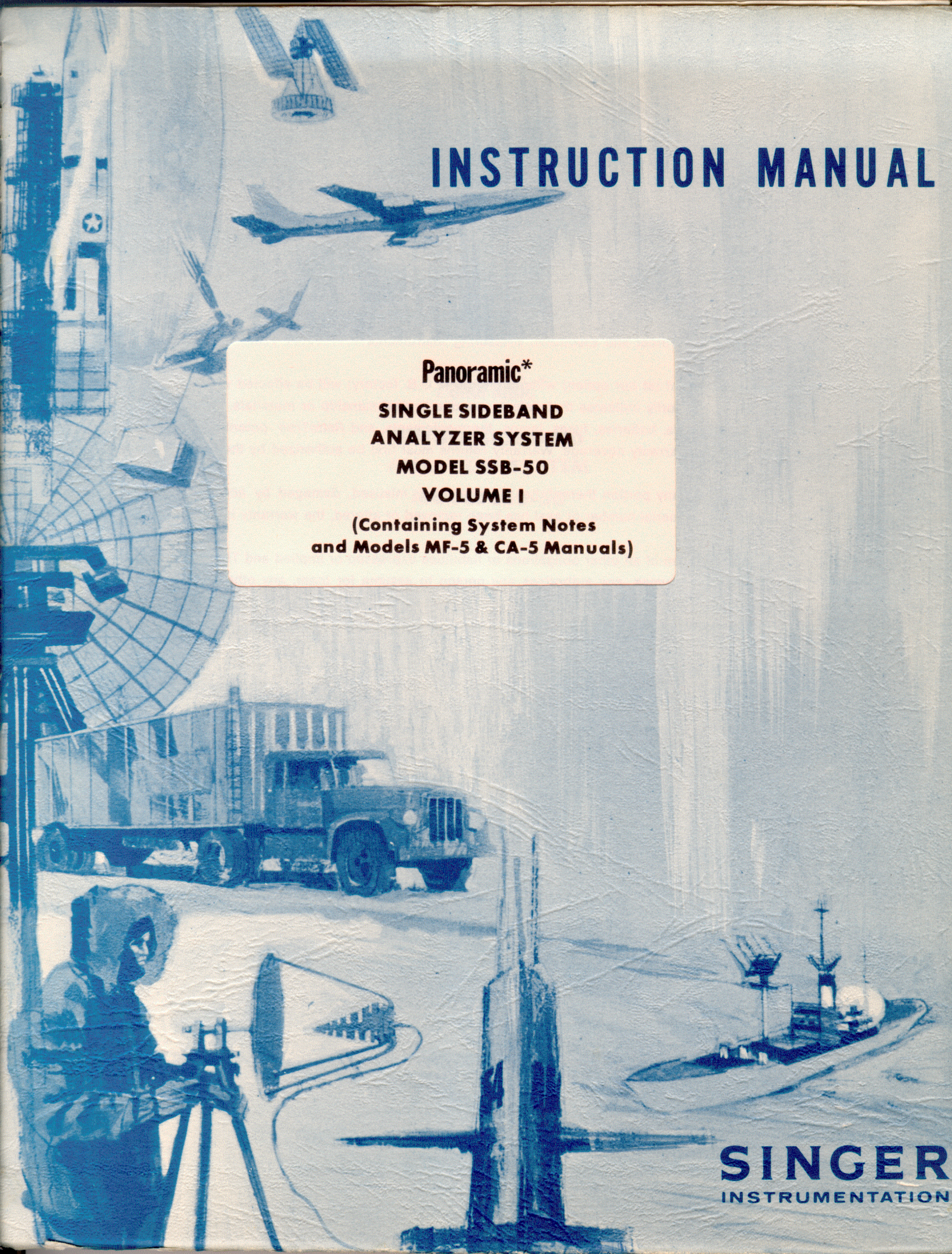

INSTRUCTION MANUAL

Panoramic*

SINGLE SIDEBAND
ANALYZER SYSTEM
MODEL SSB-50
VOLUME I

(Containing System Notes and Models MF-5 & CA-5 Manuals)

SINGER
INSTRUMENTATION

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Figure 1-1. Model SSB-50 Single Sideband Analyzer System

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This instruction manual provides operating and maintenance instructions for the PANORAMIC* Main Frame, Model MF-5 (hereafter referred to as the Main Frame), manufactured by The Singer Company, Metrics Division. Included in this manual are a general description of the Main Frame, installation and operating instructions, theory of operation, maintenance information and data, schematic diagrams and repair parts list. The Main Frame is illustrated in figure 1-1.

1-3. Although the purpose of this manual is to provide coverage on only the Main Frame, the description assumes that the PANORAMIC Model CA-5 Panalyzor is mounted within the frame. Thus, reference to displays produced on the Main Frame CRT assumes a thorough practical knowledge of the CA-5 functions. Coverage similar to that presented herein on the Main Frame is provided in the CA-5 instruction manual.

1-4. The information contained in this manual refers to the standard version of the Main Frame and is current only to the date of publication. Differences in equipment components, specifications, and performance resulting from The Singer Company's continuous production improvement program or individual customer design and application requirements are described in addendum sheets.

1-5. PURPOSE AND USE OF EQUIPMENT.

1-6. The Main Frame is primarily designed to operate with the CA-5 Panalyzor in the PANORAMIC Model SSB-50 Single Sideband Analyzer System to display the level versus frequency plot for input signals to the CA-5. The displays appear on a long persistence CRT with a calibrated overlay graticule contained in the Main Frame. (See figure 1-2.) The Main Frame also provides the CA-5 with the necessary mounting enclosure and operating power. A description of the integrated operation and particular applications or the Main Frame are contained in the CA-5 instruction manual.

1-7. GENERAL DESCRIPTION.

1-8. The Main Frame contains deflection circuits, a CRT, and power supplies. In addition to providing voltages for the deflection circuits and CRT, the power supplies also furnish operating voltages for the CA-5. Since the majority of Main Frame circuits are transistorized, there is very little warm-up time required after turn-on. Solid-state design results in extraordinary display stability in addition to miniaturization.

1-9. The long-persistence CRT used for the Main Frame presentation provides a bright, sharply-focused display for convenient viewing. When permanent recording of the CRT presentation is required, the Polaroid Model SM-200 or GA-200 Oscilloscope Camera may be used. The 5-inch, round CRT used for the Main Frame display is equipped with a standard camera bezel, facilitating the use of the SM-200 and GA-200 cameras.

1-10. The Main Frame is designed to be mounted in a standard 19-inch rack. It operates from either a 95- to 130-volt or 190- to 260-volt, 50- to 400-Hz a-c source.

1-11. SPECIFICATIONS.

1-12. The electrical and physical characteristics of the Main Frame are listed in table 1-1.

1-13. ELECTRON TUBE, TRANSISTOR, CRYSTAL DIODE, AND FUSE COMPLEMENT.

1-14. Table 1-2 lists all tubes, transistors, and crystal diodes used in the Main Frame and table 1-3 lists the fuse complement.

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Panalyzor, the Model RF-8 Tuning Head, the Model REC-2 Range Extending Converter, the Model TTG-3 Two-Tone Audio Generator, interconnecting cabling, extender boards, a service cable, and an instruction manual. (See table 1-1.)

1-13. AVAILABLE OPTIONAL ACCESSORIES.

1-14. Optional accessories for use with the SSB-50 System are available. These accessories are described in paragraphs 1-15 through 1-20.

1-15. MODEL PRB-50 PROBE. The Model PRB-50 probe permits connection of signals from a high impedance source to the CA-5 Panalyzor or the REC-2 Range Extending Converter. The probe operates over the frequency range from 10 Hz to 40 MHz and has an input impedance of 10 megohms.

1-16. MODEL TTG-5 TWO-TONE R-F GENERATOR. The Model TTG-5 Two-Tone R-f Generator is a convenient source of two-tone excitation for SSB receiver distortion and sensitivity measurements, transmitter linearity checks, and linearity tests of other narrow band networks (e.g., filter and amplifiers).

1-17. MODEL GA-200 OR SM-200 POLAROID CAMERA. The Model GA-200 or SM-200 Polaroid Camera is used when permanent recording of the CRT presentation is required.

1-18. MODEL CMF-5 CARRYING CASE (Singer Part No. 102-0086-001). The carrying case permits transportation of the MF-5 unit (with the CA-5 installed) when a change of physical location may damage the equipment.

1-19. MODEL CMF-50 CARRYING CASE (Singer Part No. 102-0086-002). The purpose of this carrying case is identical to the CMF-5 carrying case.

1-20. MF-5 and MF-50 SLIDES. Slides are available for use with the main frames in the standard 19-inch relay rack.

1-21. EQUIPMENT SPECIFICATIONS.

1-22. Table 1-2 lists the technical and physical specifications of the SSB-50 System. Detailed specifications on the individual units of the SSB-50 System are given in the associated technical manuals.

TABLE 1-1. EQUIPMENT SUPPLIED

Nomenclature	Singer Part Number
Model MF-5 Main Frame	101-0004-001
Model MF-50 Main Frame	101-0371-001
Model CA-5 Panalyzor	101-0382-001
Model RF-8 Tuning Head	101-0143-001
Model REC-2 Range Extending Converter	101-0356-001
Model TTG-3 Two-Tone Audio Generator	101-0372-001
Interconnecting cabling (consisting of items 1 through 4)	
1. 5-Inch RF Cable	102-9200-203
2. 8-Inch RF Cable (2)	102-9200-200
3. AC Power Cable	102-9138-001
4. AC Line Cord	556161-066
CA-5 Extender Board (Board A2)	102-0097-001
CA-5 Extender Board (Boards A7 & A8)	102-0098-001
CA-5 Extender Board (Boards A1, A3-A6)	102-0099-001
MF-5 Extender Board	103-0399-001
TTG-3 Extender Board	102-0096-001
Service Cable (1)	556161-661
Instruction Manual	110-5041
No. 4 Allen Wrench	556005-125
No. 6 Allen Wrench	556005-123
No. 4 Spline Wrench	556005-012
No. 6 Spline Wrench	556005-011
Alignment Tool	556005-038
Line Cord Adapter	556010-230

TABLE 1-2. SPECIFICATIONS

Frequency range:	10Hz to 40MHz.
Sensitivity:	20-microvolt input produces at least a full-scale linear deflection on the CRT. Minimum measurable signal (at least one division) is approximately 2 microvolts.
Sweep width:	Preset: 150Hz, 500Hz, 3.5kHz, 7kHz, and 14kHz. Variable: 0 to 100kHz.
Sweep rate:	0.1Hz for 150- and 500-Hz preset sweep widths (may be increased to 1Hz with front panel control); 1Hz for 3.5-, 7-, and 14-kHz preset sweep widths; and 0.1 to 30Hz for variable sweep width; or manually controlled.
Resolution (3dB down):	10Hz to 3kHz adjustable. Automatic optimum resolution for the 5 preset ranges, with 50-Hz skirt selectivity at -60dB point for 150-Hz preset sweep width.
Dynamic range:	All in-band (odd order) intermodulation products at least 60 dB down.
Input impedance:	50 or 600 ohms, (switch selectable), 10Hz to 2MHz; 50 ohms, 2MHz to 40MHz; and 10 megohms, when optionally available PRB-50 Probe is used.
Two-Tone Audio Test Signals:	
Frequencies:	20Hz to 20kHz, continuously adjustable
Frequency accuracy:	±3 percent
Output level:	+10 dBm maximum into 600 ohms.
Output Attenuators:	0-70 dB in 1 dB steps, accuracy 0.05 dB/dB.
Distortion:	All harmonics and IM products less than -60dB below single tone between 100Hz and 10KHz. Less than -55dB from 20Hz to 20kHz.
Amplitude Uniformity:	±0.5dB
Hum and noise:	Better than -66dB below single tone level.
Self-test features:	
Two-tone test:	Two crystal-controlled r-f tones (3MHz and 3.002MHz).
Calibrating oscillator:	500-kHz crystal-controlled oscillator for checking center frequency.
Internal marker:	5-kHz oscillator modulates 500-kHz crystal-controlled oscillator to provide 5-kHz markers for sweep width calibrations to 100kHz.
Input power requirements:	95 to 130 volts or 190 to 260 volts (switch selectable), 50 to 400Hz single phase.
Power consumption:	50 watts maximum
Operating temperature range:	0 to +55°C (32 to 131°F)
Physical characteristics:	
Height:	12-7/32 inches
Width:	19 inches
Depth:	21-15/16 inches (Behind front panel)
Weight:	62 pounds

SECTION II

OPERATION

2-1. GENERAL.

2-2. This section contains installation and operating instructions for the SSB-50 System. The SSB-50 System has been factory tested and aligned and is shipped in a ready-to-operate condition. However, no attempt should be made to install or operate the equipment until the operator is thoroughly familiar with the contents of this section. Figure 2-1 is an outline dimension drawing of the SSB-50 System.

2-3. INSTALLATION.

2-4. To install the SSB-50 System in a standard 19-inch relay rack, place the Models MF-5 and MF-50 Main Frames (with plug-in modules installed) in the position desired and secure the front panel of each main frame to the vertical members of the rack with four screws. The MF-50 should be installed below the MF-5. Then determine whether the supply voltage is 110- or 220-volts ac and set the primary power select switch on each main frame to the appropriate position. On the MF-5, use a 3/4 (Delay) amp primary power fuse for 120-volt operation and a 3/8 (Delay) amp fuse for 220-volt operation. On the MF-50, use a 3/8-amp delay fuse for 120-volt operation and a 3/16-amp, delay fuse for 220-volt operation.

2-5. After the main frames have been installed in the rack, and power considerations have been accomplished, interconnect the system as shown in figure 2-2 and connect the a-c line cord from the MF-50 Main Frame to the power source.

2-6. INTERPRETATION OF TYPICAL SCREEN PRESENTATIONS.

2-7. Paragraphs 2-8 through 2-13 provide a description of the various types of signals displayed on the CRT of the SSB-50 System. Within a short period of time, the operator should be able to

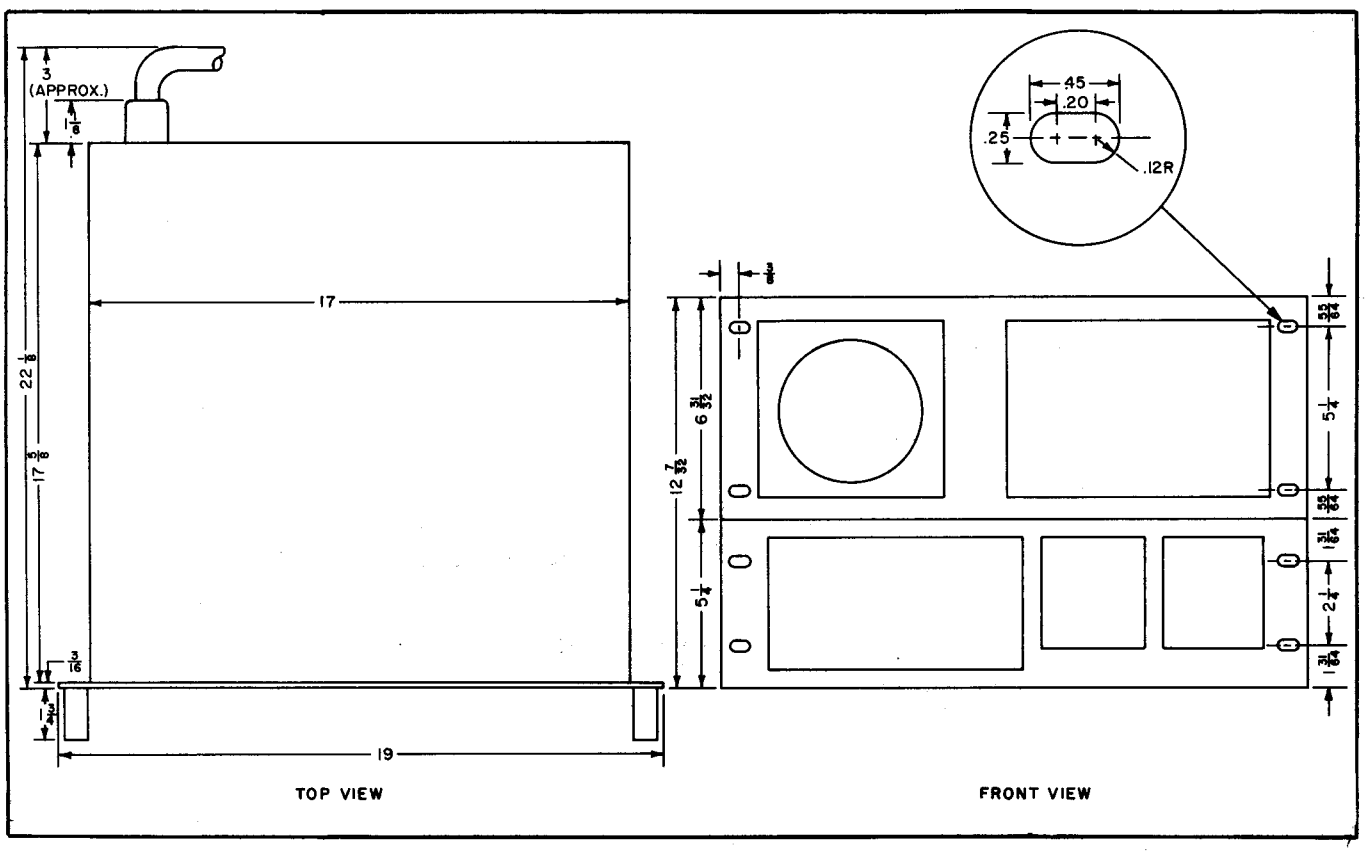


Figure 2-1. Outline Dimension Drawing, SSB-50 System

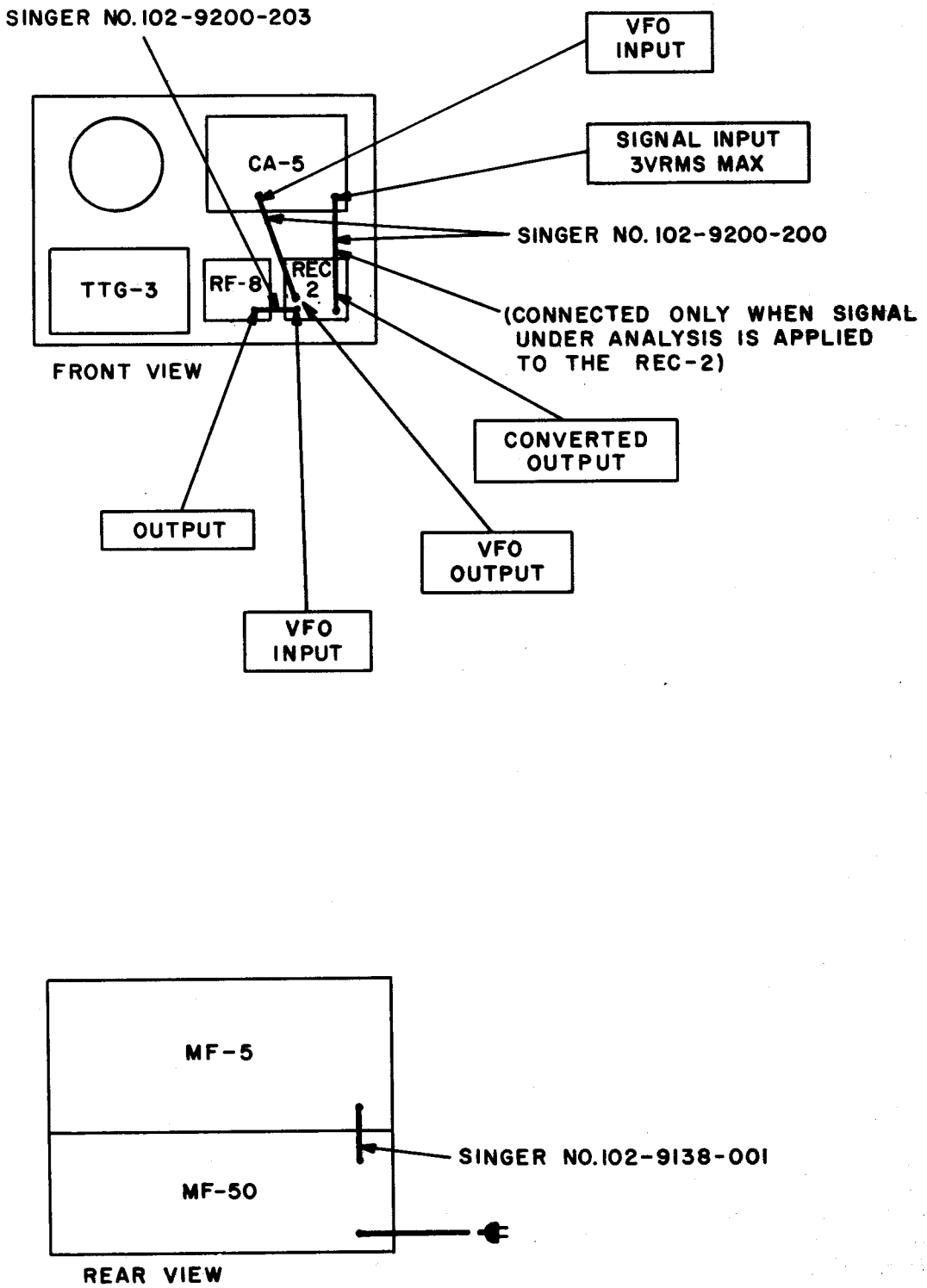


Figure 2-2. SSB-50 System, Interconnection Diagram

visually recognize the character of these various types of signals.

2-8. A constant carrier signal appears as a deflection of fixed height with the nature of presentation depending upon the sweep width. (See figures 2-3A and B.) Deviations of the signal from true cw will result in displays which will indicate the character of the signal as follows:

a. Oscillator drift - deflection moves slowly across the screen.

b. Periodic drift - deflection moves back and forth across the screen.

c. Squegging - interruption of an oscillator at a-f or i-f rate will result in a spectrum display resembling that of a pulse modulated signal. Sideband components will be present in addition to the oscillating frequency.

d. Keying - a cw signal appears and disappears in step with the keying of the signal source. During the moments when the signal is off, the frequency sweep axis is closed at the base of the signal. In very rapidly keyed signals the deflection and the baseline are seen simultaneously (on different sweeps). On narrow, highly resolved sweeps, keying sidebands may be visible as discrete signal components.

2-9. Two cw signals which are so close in frequency as to cause aural interference (beats) may appear on the screen as a single signal whose height varies with modulation. As the frequency separation is increased, the signal appears to be modulated on one side only. Further separation will cause a "break" in the apex of the deflection. By reducing the sweep width of the CA-5 Panalyzor, the two signals will gradually separate. Reducing the sweep width, reducing the sweep rate, and/or narrowing the i-f bandwidth may result in separation into two distinct pips. (See figure 2-3C.)

2-10. An amplitude-modulated carrier appears as a deflection of variable height, when the modulating frequency is very low. Non-constant tone modulation of low frequency will produce a series of convolutions varying in height along the side of the carrier pip. The nature of the presentation will depend upon the sweep width. As the modulation frequency increases, the convolutions move toward the two sides of the deflection, and the sidebands become visible. When the modulation frequency is increased, it becomes possible to separate the sidebands by reducing the sweep width of the CA-5 Panalyzor. The IF BANDWIDTH control will enable further separation. The higher the frequency of modulation, the farther away those sidebands will move from the center deflection, which represents the carrier. (See figure 2-3D.)

2-11. The appearance of single-sideband signals depends upon the type of modulation employed. Tone-modulated single-sideband signals appear as a carrier (for a single tone), or a series of carriers (for multi-tones) of slightly different frequency. Voice or music-modulated single-sideband signals appear as a "smear" of rapidly varying signals which occupy finite bandwidth. A typical screen presentation of an amplitude-modulated single-sideband signal without carrier suppression is shown in figure 2-3E.

2-12. Frequency-modulated carriers appear as a series of vertical deflections. (See figure 2-3F.) A carrier that is frequency-modulated at a low rate appears as a carrier which wobbles sideways. The vertical deflections shift rapidly when the carrier is modulated by voice or music. (See figure 2-3G.)

2-13. A pulse-modulated signal (figure 2-3H) will consist of a pattern of vertical spikes. The number of spikes is dependent on the pulse repetition rate, and the i-f bandwidth and the sweep rate of the CA-5 Panalyzor. The amplitude of each spike represents the amount of energy present at that particular frequency during one of the pulses. The peak envelope of all the spikes represents the energy-distribution pattern of the signal.

2-14. OPERATION.

2-15. OPERATING CONTROLS, INDICATORS, AND CONNECTORS. The operating controls, indicators, and connectors of the SSB-50 System are described in table 2-1 and shown in figure 2-4.

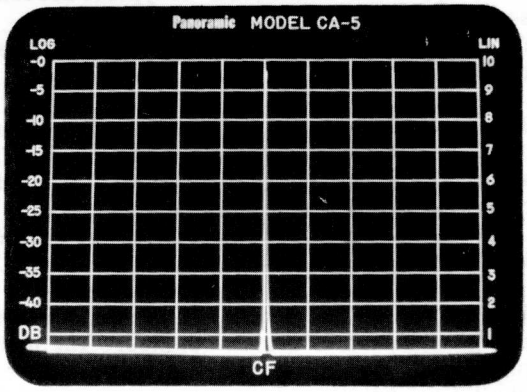
2-16. POWER APPLICATION AND PRELIMINARY ADJUSTMENTS. To prepare the SSB-50 System for operation, follow the procedures outlined in paragraphs 2-17 through 2-19.

2-17. Initial Control Settings. Set the controls of the SSB-50 System as indicated in table 2-2 before applying power to the equipment. Controls not specifically referenced in the table may be set to any arbitrary position.

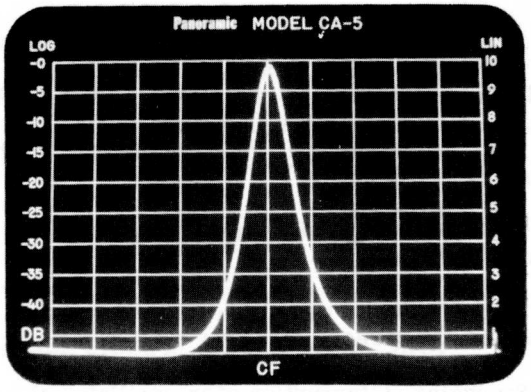
2-18. Power Application. With the SSB-50 interconnected as illustrated in figure 2-2, set the POWER switch on the MF-50 Main Frame to ON and the SCALE ILLUMINATION control on the MF-5 Main Frame clockwise until the CRT graticule illuminates. Then wait 30 seconds, and slowly turn the BRIGHTNESS control on the MF-5 clockwise until a trace is displayed on the CRT. Adjust the BRIGHTNESS and FOCUS controls on the MF-5 to obtain the desired trace.

2-19. Preliminary Adjustments. After the equipment has warmed up for at least 15 minutes, perform the preliminary adjustments described below.

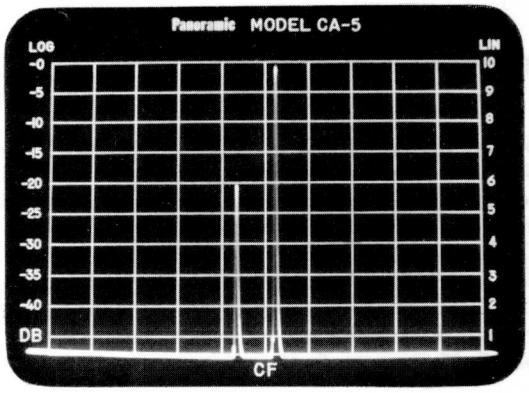
a. On the MF-5, adjust the VERT and HORIZ positioning controls so that the CRT trace appears exactly under the bottom horizontal line engraved on the CRT graticule. Then, if necessary, adjust the H SIZE screwdriver control to obtain a trace extending approximately 1/8-inch beyond each end of the engraved graticule markings. (Readjust the HORIZ positioning control, as required, when making the H SIZE adjustment.)



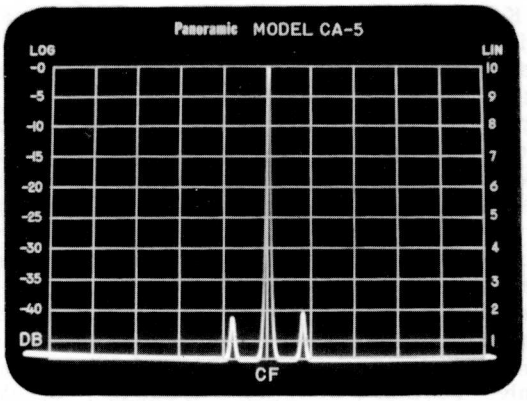
A. Constant carrier signal at approximately maximum sweep width



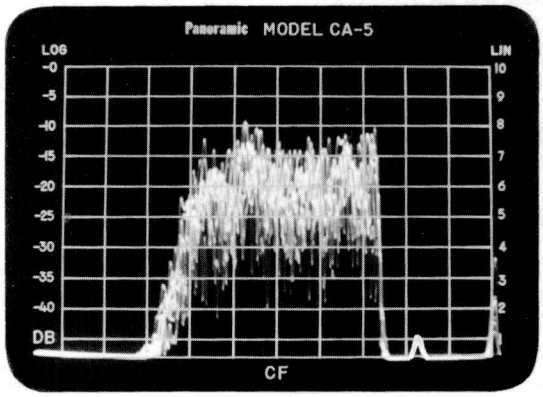
B. Same signal as "A" at reduced sweep width



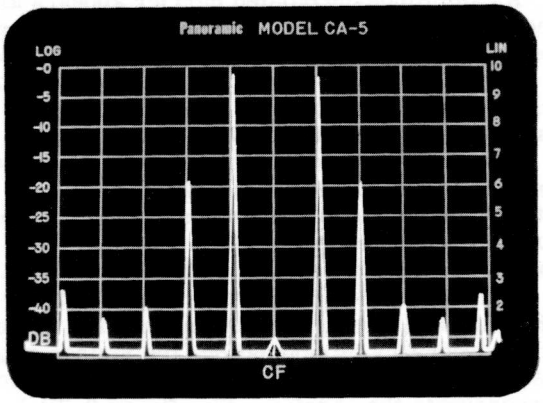
C. Two interfering carriers at optimum resolution



D. Amplitude-modulated signal showing carrier at the center and two sidebands

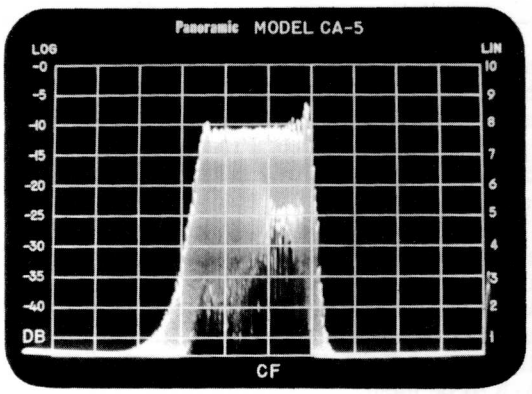


E. Single sideband signal without carrier suppression

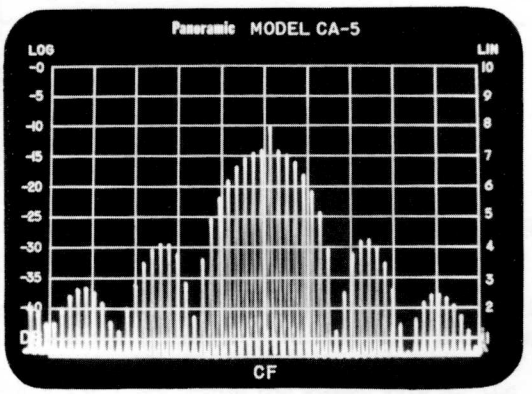


F. Frequency-modulated signal with carrier null

Figure 2-3. Typical CRT Presentations of Discrete Signals (Sheet 1 of 2)



G. Typical sideband energy of f-m signal, speech modulated. (Slow sweep and/or extended exposure photography are used to display envelope averages.)



H. Pulsed r-f signal

Figure 2-3. Typical CRT Presentations of Discrete Signals (Sheet 2 of 2)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS

Index No. (Figure 2-4)	Name	Function
1	V and H SIZE screwdriver controls	Control the vertical and horizontal size of the CRT display.
2	CRT	Displays level versus frequency of signal input(s) to the SSB-50 System. CRT graticule contains a LOG amplitude scale calibrated from 0 to 40 DB, in 5 dB increments; and a LIN amplitude scale calibrated from 10 to 0, in 10 equal divisions.
3	VERT and HORIZ POS controls	Control the vertical and horizontal position of the CRT display.
4	FOCUS control	Controls sharpness and definition of display on CRT.
5	BRIGHTNESS control	Controls brightness of display on CRT.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Index No. (Figure 2-4)	Name	Function
6	SCALE ILLUMINATION control	Combination power switch and variable control When turned clockwise from PWR OFF position (audible click can be heard), applies a-c power to the Model MF-5 Main Frame. Further clockwise rotation increases brilliance of CRT graticule illumination lights.
7	IF ATTENUATOR switch	Inserts either 20 dB or 0 dB of attenuation in the i-f amplifier of the CA-5. The switch must always be in the 0 dB position when making low level distortion measurements, thereby permitting the full 60 dB dynamic range of the CA-5 to be used.
8	VIDEO FILTER switch	Provides two degrees of video filtering (MIN and MAX) to suppress such unwanted effects as noise, spurious beating between closely spaced signals, hum, etc., on the signal(s) displayed on the CRT. Usable only in VAR position of FREQ SCALE Hz/DIV switch.
9	AMPLITUDE SCALE switch	Selects either LIN (linear) or LOG (logarithmic) voltage-amplitude scale of CRT display.
10	EXT CF MOD jack	Connects an external modulation (frequency markers) to the CA-5 for the CF position of the TEST SIGNAL-Hz switch.
11	TEST SIGNAL-Hz switch	Provides test signals to the CA-5 Panalyzor. In the CF position of the switch, a 500-kHz test signal is applied to the input of the CA-5 to locate the center frequency of the Panalyzor. In the 5K position, a 5-kHz signal (rich in harmonics) modulates the 500-kHz test signal to provide 5-kHz markers on the CRT for setting up sweep width. In the 3.0M & 3.002M position, a two-tone r-f test signal (3.0 and 3.002MHz) is mixed with the VFO input from the RF-8 tuning Head (3.5 MHz) to display a two-tone signal on the CRT. This position of the switch is used to check the odd-order distortion products of the CA-5.
12	CENTER FREQ LEVEL control	Adjusts the level of the 500-kHz test signal applied to the CA-5.
13	CENTER FREQ 1 control	Determines the center frequency of the CA-5 when the FREQ SCALE-Hz/DIV switch is either in the 15 or 50 position.
14	MANUAL SWEEP control	Permits manual control of the CRT sweep when the SWEEP MODE switch is set to MANUAL.
15	FREQ SCALE control	Adjusts the sweep width of the CA-5 from 0 to 100 kHz when the FREQ SCALE-Hz/DIV switch is set to VAR.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Index No. (Figure 2-4)	Name	Function
16	IF BANDWIDTH control	Adjusts the i-f bandwidth of the CA-5 when the FREQ SCALE-Hz/DIV switch is set to VAR. CCW rotation of the control narrows the i-f bandwidth and CW rotation broadens the i-f bandwidth.
17	FREQ SCALE-Hz/ DIV switch	Provides either five preset sweep widths (150 Hz, 500 Hz, 3.5 kHz, 7 kHz, and 14 kHz) or variable sweep width (VAR) in the CA-5. In the preset positions, the i-f bandwidth is automatically set for optimum resolution; and the sweep rate for the 150-Hz and 500-Hz preset sweep width is 0.1 Hz, while the sweep rate for the other preset positions is 1 Hz. In the VAR position of the switch, the i-f bandwidth, sweep width, and sweep rate are variable.
18	SWEEP MODE switch	Selects either the normal sweep rate for the five preset sweep width positions of the FREQ SCALE-Hz/DIV switch, a faster sweep rate (1 Hz) for the 150-Hz and 50-Hz preset sweep width positions of the FREQ SCALE-Hz/DIV switch, or a manual sweep for all the positions of this switch.
19	SWEEP RATE-Hz switch	Selects either a 0.1 to 1.5-Hz or 1.5 to 30-Hz sweep rate range in the CA-5 for the VAR position of the FREQ SCALE-Hz/DIV switch.
20	VARIABLE control	Operates in conjunction with the SWEEP RATE-Hz switch to vary the sweep rate on the CRT, when the FREQ SCALE-Hz/DIV switch is set to VAR.
21	CENTER FREQ 2 COARSE and FINE controls	Determines the center frequency of the CA-5 when the FREQ SCALE-Hz/DIV switch is set to either 350, 700, 1.4K or VAR.
22	GAIN control	Adjusts the amplitude of the indication on the CRT. Maximum gain is obtained with the control set to the maximum CW position. This control should be operated near maximum for measurements requiring the full 60 dB dynamic range of the CA-5.
23	ATTENUATOR switches	Provide attenuations of 1, 2, 4, 8, 15, 20, and 20 dB at the input of the CA-5. When the switches are in the IN position, the indicated attenuation is inserted.
24	VFO INPUT	Connects the VFO signal from either the REC-2 or RF-8 (obtained from the VFO OUTPUT jack on the REC-2) to the CA-5.
25	PROBE jack	Provides operating power to the optionally available PRB-50 Probe when in use.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Index No. (Figure 2-4)	Name	Function
26	SIGNAL INPUT-3 VRMS MAX jack	Connects signal(s) in the 2 to 40 MHz frequency range to the SSB-50 System. The signal(s) are either applied directly to this jack (when the MODE switch on the REC-2 is set to DIRECT) or indirectly via the REC-2 (when the MODE switch is set to CONVERTED 10 Hz-2MHz).
27	C and R BAL screwdriver controls	Suppress VFO leakage through the REC-2 at zero input frequency.
28	50 Ω -600 Ω switch	Sets input impedance of the SSB-50 System to 50 or 600 ohms when signal(s) under analysis are being applied to the SIGNAL INPUT 10 Hz - 2MHz jack on the REC-2 via the supplied coaxial cable. (When the optionally available PRB-50 Probe is used, the input impedance of the system is 10 megohms.)
29	SIGNAL INPUT 10 Hz - 2MHz jack	Connects signal(s) in the 10 Hz to 2 MHz frequency range to the SSB-50 System.
30	CONVERTED OUTPUT jack	Provides a 2.5-MHz converted output to the CA-5 when signal(s) in the 10 Hz to 2MHz frequency range are being applied to the SSB-50 System.
31	ATTEN DB switches	Provide attenuations of 5, 10, 20, and 20 dB at the input of the REC-2. When the switches are in the up position, the indicated attenuation is inserted.
32	VFO INPUT Jack	Connects the VFO signal from the RF-8 to the REC-2. This signal is either mixed with the 10Hz-2MHz input to the REC-2 to obtain the 2.5 converted output (MODE switch at CONVERTED 10 Hz2MHz) or applied to the CA-5 (MODE switch at DIRECT).
33	VFO OUTPUT jack	Connect either the VFO signal from the RF-8 or the REC-2 (whichever is selected by the MODE switch) to the CA-5.
34	MODE switch	Selects either the VFO signal from the REC-2 (3MHz) or RF-8 (2.5 to 40.5MHz) and energizes the REC-2 when analyzing signal(s) in the 10Hz to 2MHz frequency range. When in the DIRECT position of the switch, the VFO signal from the RF-8 is selected. When in the CONVERTED 10 Hz-2MHz position, the REC-2 is energized and its internal 3MHz signal replaces the RF-8 at the VFO output jack.
35	OUTPUT jack	Provides a VFO signal (2.5 to 40.5MHz) to the CA-5, via the REC-2.
36	Tuning Dial, MHz	Indicates the center frequency of the signal(s) displayed on the CA-5 CRT screen.

(Cont'd)

TABLE 2-1. OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Index No. (Figure 2-4)	Name	Function
37	Tuning control	Permits the SSB-50 System to operate over the 10Hz to 40MHz frequency range by selecting the VFO signal that will be applied to REC-2 or CA-5. A FINE tuning rate is selected by pressing in the tuning control.
38	POWER INDICATOR lamp	Illuminates when a-c power is applied to the SSB-50 System.
39	POWER switch	When placed to the ON position, applies a-c power to the SSB-50 System.
40	RANGE selector switch	Selects the frequency range of the VFO signal from the RF-8.
41	600Ω TERMINATION switch	Inserts 600 -ohm termination (when set to IN) to maintain output level calibration accuracy when operating into high impedance loads.
42	ATTENUATOR DB units switch	Attenuates the two-tone a-f test signal up to 10 dB, in 1-dB steps.
43	ATTENUATOR DB decade switch	Attenuates the two-tone a-f test signal up to 60 dB, in 10-dB steps.
44	OUTPUT +10 dbm MAX jack	Connects the two-tone a-f test signal from the SSB-50 System to the unit under measurement(s).
45	LEVEL B screwdriver control	Adjusts output level of tone B of the two-tone a-f test signal at +10dBm into 600 ohms.
46	FREQ B multiplier switch	Decade range multiplier for tone B of two-tone a-f test signal.
47	FREQ B control and dial	In conjunction with FREQ B multiplier switch, determines frequency of tone B of two-tone a-f test signal.
48	OUTPUT selector switch	Selects either a single-tone or two-tone a-f test signal. In the SSB-50 System, the two-tone test signal is normally selected to check out SSB exciters and transmitters. If one tone is required (as for frequency response or harmonic distortion measurement), tone A should be used.
49	FREQ A multiplier switch	Decade range multiplier for tone A of two-tone a-f test signal.
50	FREQ A control and dial	In conjunction with FREQ A multiplier switch, determines frequency of tone A of two-tone a-f test signal.
51	LEVEL A screwdriver control	Adjusts output level of tone A of the two-tone a-f test signal at +10dBm into 600 ohms.

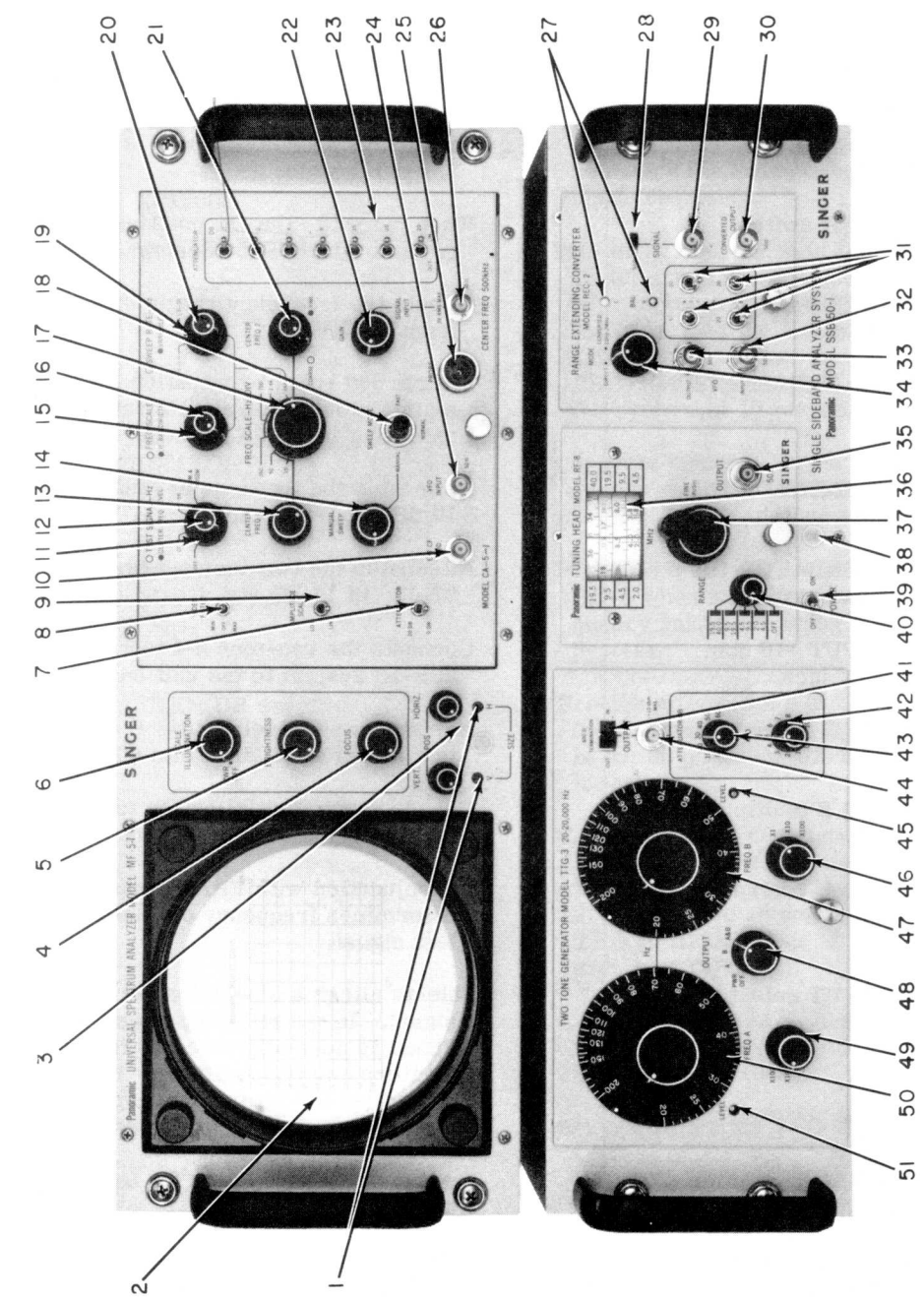


Figure 2-4. Operating Controls, Indicators, and Connectors

TABLE 2-2. INITIAL CONTROL SETTINGS

Control	Setting
MF-5	
SCALE ILLUMINATION control	PWR OFF (fully CCW)
BRIGHTNESS control	Fully CCW
CA-5	
FREQ SCALE-Hz/DIV switch	VAR
SWEEP RATE-Hz switch	1.5 - 30
VARIABLE control	Fully CW
ATTENUATOR switches	OUT position
GAIN control	Fully CW
IF ATTENUATOR switch	20 db
AMPLITUDE SCALE switch	LOG
TEST SIGNAL-Hz switch	OFF
SWEEP MODE switch	NORMAL
MF-50	
Power switch	OFF
TTG-3	
OUTPUT switch	PWR OFF
600Ω TERMINATION switch	IN
ATTENUATOR DB decade and ATTENUATOR DB ADD switches	0
FREQ A and B controls	100
FREQ A and B range multiplier switches	X10
REC-2	
MODE switch	CONVERTED 10Hz - 2MHz
50Ω -600 Ω switch	50 Ω
ATTEN DB switches	All in down position
RF-8	
RANGE switch	2.0 - 4.5
TUNING control	Rotated until a 0.0 tuning dial MHz indication is obtained on yellow band of 2.0 - 4.5 frequency scale.

b. On the REC-2, adjust the BAL C and R screwdriver controls to minimize the zero pip deflection on the CRT.

c. On the TTG-3, set the OUTPUT selector switch to A and connect a Hewlett-Packard Model 400D VTVM (or equivalent) to the OUTPUT +10 dBm MAX jack. Carefully adjust the LEVEL A screwdriver control until the VTVM indicates 2.45 volts. Then set the OUTPUT selector switch to B and carefully adjust the LEVEL B screwdriver control for the same indication on the VTVM. Disconnect the VTVM after the completion of this step.

2-20. SINGLE SIDEBAND ANALYSIS. The SSB-50 System checks out SSB exciters, transmitters, and receivers using the two-tone test method. During checkout of an SSB transmission system, a two-tone modulation signal is supplied to the exciter by the TTG-3 Two-Tone Generator. The signals present at various test points in the exciter and transmitter (see figure 2-5) are then analyzed by the CA-5 Panalyzor for intermodulation products, harmonic distortions, hum and noise, or other spurious signals. To check out an SSB receiver with the SSB-50 System, the optionally available Model TTG-5 Two-Tone R-f Generator is added to the system to provide an r-f two-tone input to the receiver. Similarly, the various test points in the receiver (figure 2-6) are then analyzed by the CA-5 to check distortion and sensitivity, gain, etc. The optionally available high impedance probe, Model PRB-50, may be used for measurements where low impedance (50 to 600 ohms) test points are not available. The following procedure outlines how to use the SSB-50 System for single sideband analysis. (For the procedure on how to monitor the various test points on the particular equipment on hand, refer to the equipment technical manual.)

a. Set the front panel controls as follows:

MF-5	
SCALE ILLUMINATION control	Rotated CW until CRT graticule illuminates
BRIGHTNESS & FOCUS controls	Adjusted for suitable trace on CRT
CA-5	
FREQ SCALE-Hz/DIV switch	VAR
SWEEP RATE-Hz switch	1.5-30
VARIABLE control	Fully CW
ATTENUATOR switches	IN position
GAIN control	Fully CW
IF ATTENUATOR switch	O db
AMPLITUDE SCALE switch	LOG
TEST SIGNAL-Hz switch	OFF
SWEEP MODE switch	NORMAL
MF-50	
POWER switch	ON
RF-8	
RANGE switch	As required
Tuning control	As required
REC-2	
MODE switch	As required

50Ω - 600Ω switch	As required
ATTEN DB switches	All in the up position
TTG-3	
OUTPUT switch	A & B
FREQ A control FREQ A multiplier FREQ B control FREQ B multiplier	70 X10 25 X100 Typical frequencies. Any desired combination may be used
600 Ω TERMINATION switch	As required
ATTENUATOR DB decade and ATTENUATOR DB ADD units controls	For suitable modulation level of the transmitter
TTG-5	
OUTPUT FREQUENCY-MC control	12.0 Typical frequency. Any other desired frequency may be used.
TONE SPACING control	As required
OUTPUT SELECTOR switch	A + B
TONE A LEVEL and TONE B LEVEL controls	Each adjusted so that needle on OUTPUT meter coincides with red line labeled SET A OR B when OUTPUT SELECTOR switch is set to TONE A and then TONE B
OUTPUT LEVEL-DB BELOW 0.1 V (-7 DBM) switches	For suitable input to receiver

b. Before using the CA-5, set it to its 500-kHz center frequency as follows:

(1) Set the TEST SIGNAL-Hz switch to CF and adjust the CENTER FREQ LEVEL control until a full-scale signal pip is displayed on the CRT. (The GAIN control and ATTENUATOR switches may be used to reduce the CF signal level, if necessary.)

(2) Rotate the FREQ SCALE control in a CCW direction until the pip opens up into a horizontal line. Adjust the CENTER FREQ 2 COARSE and FINE controls, as required, for maximum height of the trace.

(3) Rotate the FREQ SCALE control to the fully CW position. Set the FREQ SCALE-Hz/DIV switch to the 1.4K position and adjust the CENTER FREQ 2 controls, if necessary, to position the signal pip under the CF line.

(4) Set the FREQ SCALE-Hz/DIV switch to 350. Readjust the CENTER FREQ 2 controls, if necessary, to position the signal pip under the CF line.

(5) Set the FREQ SCALE-Hz/DIV switch to the 350, 700, 1.4K and then VAR position and note that the signal pip is approximately at the same point on the horizontal scale for each of these switch positions. Adjust the HORIZ POS control on the MF-5, as necessary, to place the signal pip under the CF line. At the conclusion of this step, set the TEST SIGNAL-Hz control to OFF and the FREQ SCALE-Hz/DIV control to VAR.

c. Couple the signal to be monitored to either the SIGNAL INPUT jack on the CA-5 (when the RF-8 is providing the VFO input to the CA-5 and the MODE switch on the REC-2 is set to DIRECT) or the SIGNAL INPUT 10Hz-2MHz jack on the REC-2 (when the REC-2 is providing the VFO input and the MODE switch is set to CONVERTED 10 Hz-2MHz), using either the supplied coaxial cable or the optionally available PRB-50 Probe (when a high input impedance is required).

CAUTION

Do not apply a signal exceeding 3 volts (rms) to the equipment. If necessary, use suitable external attenuator pads to keep the input signal below this level.

d. Tune the RF-8 to the signal frequency and center the display on the CRT screen.

e. Set the FREQ SCALE-Hz/DIV switch on the CA-5 to either the 700 or 1.4K position. Center the display with the RF-8 tuning control.

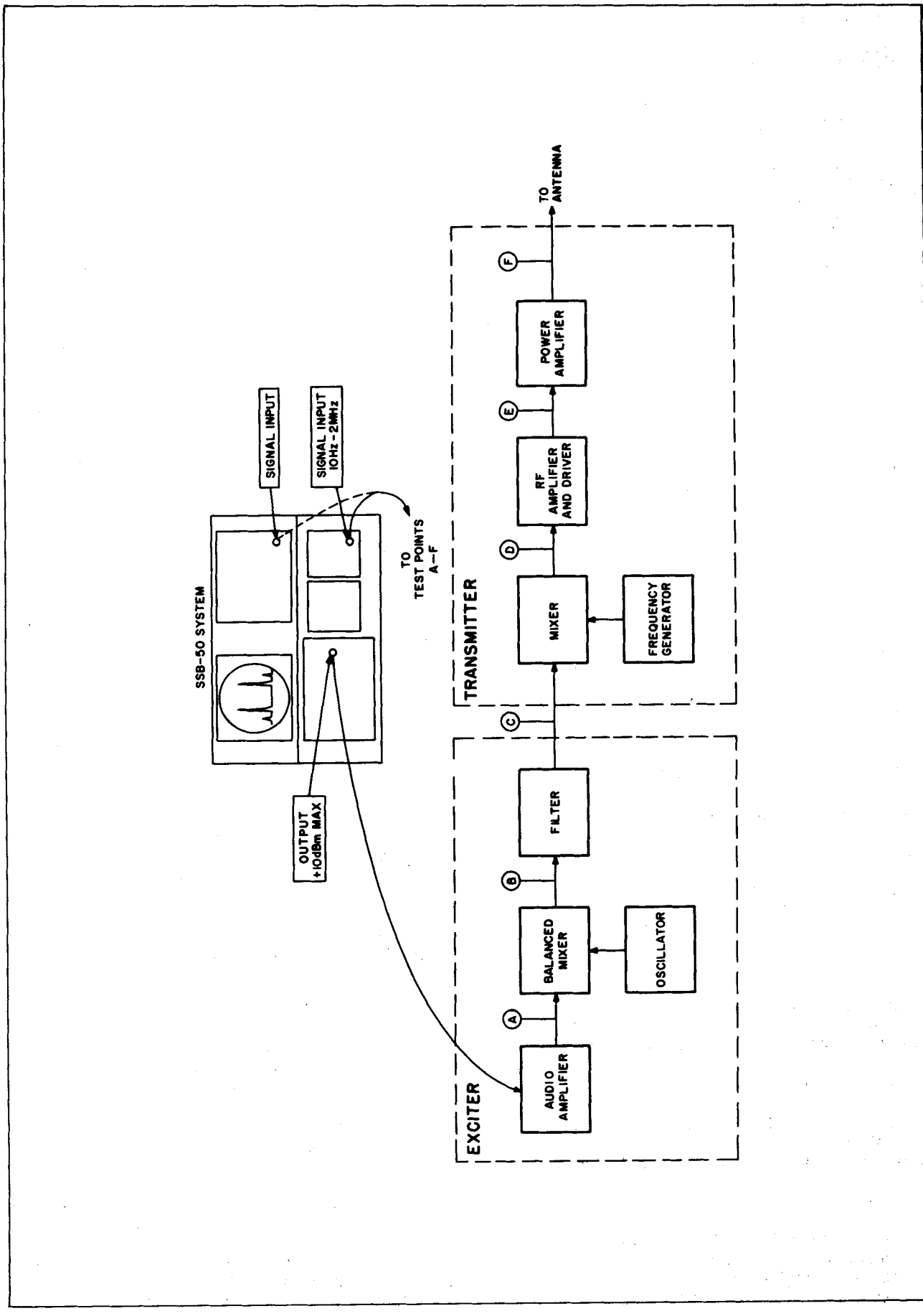


Figure 2-5. Testing of an SSB Transmission System with the SSB-50 System

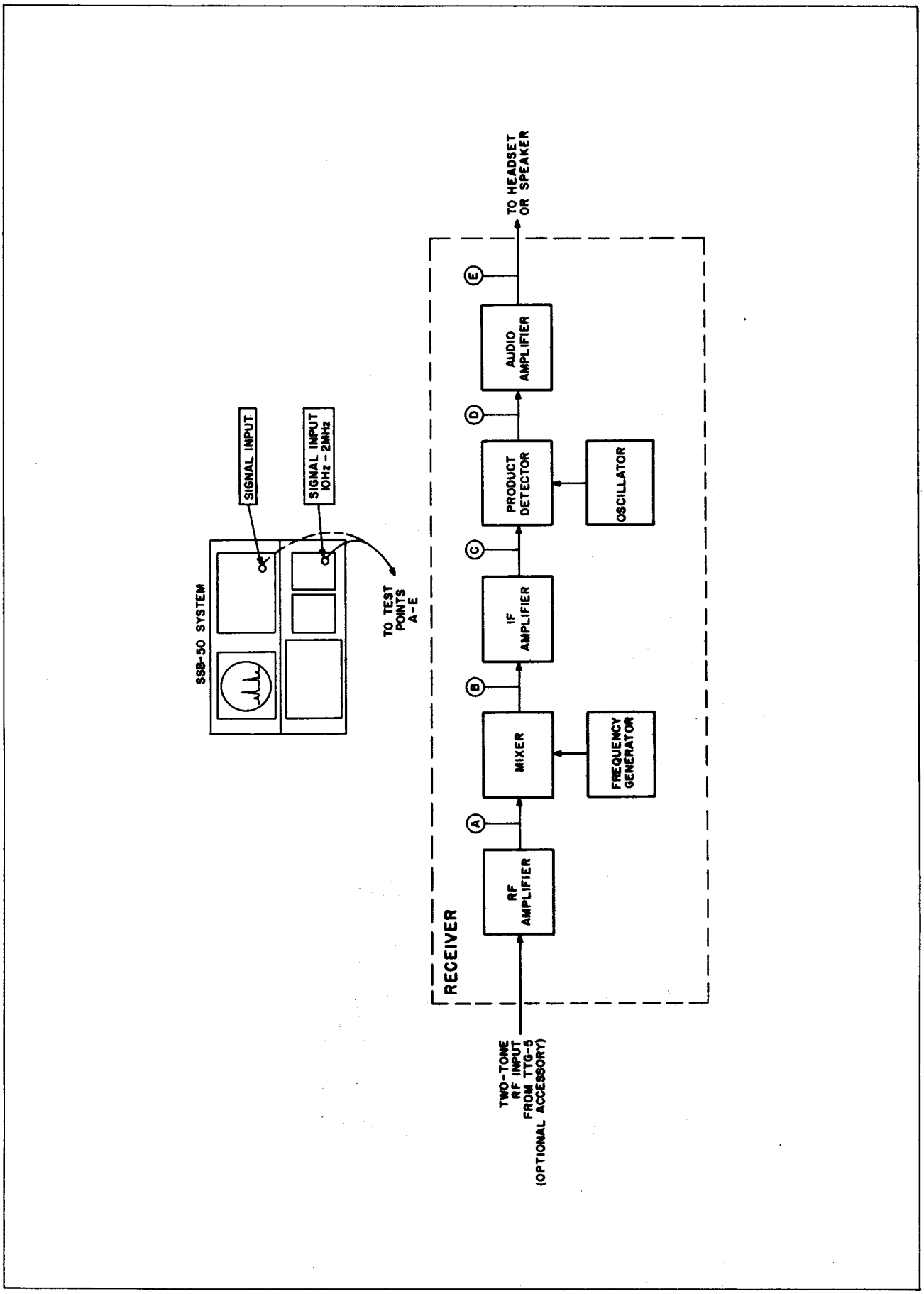


Figure 2-6. Testing of an SSB Receiver with the SSB-50 System

f. Set the IF ATTENUATOR switch on the CA-5 to 20 db. Set the ATTENUATOR switches on the CA-5 (and the ATTEN DB switches on the REC-2 if being used), as required, to bring the highest pip on the screen to just over full-scale deflection. Then, adjust the Panalyzor GAIN control to obtain exactly a full-scale deflection of the highest pip on the CRT graticule.

g. Major in-band intermodulation components may now be read in reference to the level of the two tones. The two-tone level is considered the 0 dB reference amplitude for comparison over a 40 dB range. The calibrations on the left side of the CRT graticule (0 to 40 DB, in 5-dB increments) are read directly in terms of dB down. To examine distortion products from 40dB to 60dB below the signal level, set the IF ATTENUATOR switch to 0 db. The upper dB portion of the display is now deflected off screen and the -20dB to -60dB portion is now displayed. Add 20 dB to the indicated reading to obtain the correct amplitude of the signals.

h. Odd-order distortion components are distributed symmetrically on either side of the main output signals and are located at separations equal to the frequency difference between them. The distortion components may be readily read as "dB down" from the reference levels. The third-order distortion components (first distortion pips) are usually the largest. Figure 2-7 illustrates a typical CRT presentation of a two-tone test. For a two-tone test, the CA-5 sweep width should encompass three to six times the difference between the two-tone input signals. If the sweep width is too narrow, it may not be possible to display both the primary r-f signals and their distortion products on a single sweep. When the sweep width is too wide, the two-tone pips merge and the distortion products cannot be resolved.

Note

In general, the two-tone pips should not intersect at a higher level than that of the distortion products (i.e., -60 dB for the full 60 dB range of the SSB-50 System). If the pips intersect, there may be an increase in the internal distortion of the CA 5 Panalyzor. Also, low level sidebands may not be adequately resolved under this condition.

2-21. NARROW BAND ANALYSIS. When signals or a carrier and its sidebands are so closely spaced in frequency that at full sweep width their corresponding deflections on the CRT tend to merge into each other or mask one another, it may be possible to separate or resolve the signals by either: sharpening the i-f bandwidth and reducing the sweep width; reducing the sweep rate; or by doing both of the foregoing. The following procedure applies for the VAR position of the FREQ SCALE-HZ/DIV switch on the CA-5.

a. To increase the resolution capabilities by sharpening the i-f bandwidth and reducing the sweep width, proceed as follows:

(1) Set the IF BANDWIDTH control maximum CW and center the band of signals of interest using the RF-8 tuning control.

(2) Spread the band of signals across the screen by turning the FREQ SCALE control in a CCW direction. Note that at reduced scanning width each frequency calibration mark represents a frequency separation equal to one-tenth of the reduced sweep width. Keep the band centered with the RF-8 tuning control. The CENTER FREQ 2 COARSE and FINE controls may be used for fine

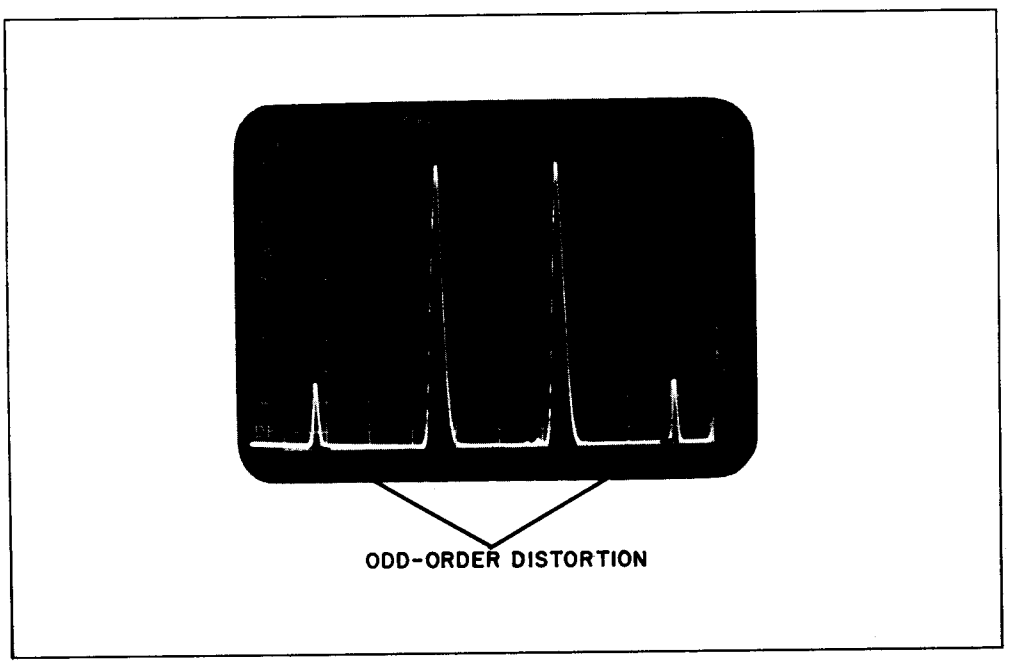


Figure 2-7. Typical CRT Presentation of Two-Tone Test

adjustments. However, avoid unnecessary changes of these control settings as this may result in loss of display when going to narrower sweep widths.

(3) Rotate the IF BANDWIDTH control in a CCW direction until individual signals are most clearly resolved.

Note

1. Rotation of the IF BANDWIDTH control may result in increased or decreased pip height. When this occurs, return the pip amplitude to a suitable level with the GAIN control.
2. Optimum resolution can be recognized by the presence of "ringing" on one side of the signal pip as illustrated in figure 2-8. ("Ringing" can be seen more easily with the VIDEO FILTER switch set to OFF.) Turning the IF BANDWIDTH control in a CCW direction, after optimum resolution is obtained, will decrease the resolving capability and result in greatly reduced sensitivity.

b. To obtain better resolution by reducing the sweep rate, set the SWEEP RATE switch to either 0.1-1.5 or 1.5-30 (switch position selected determined by desired degree of frequency separation and nature of signals). Rotate the VARIABLE CONTROL in a CCW direction until optimum resolution is obtained.

c. To obtain better resolution by sharpening the i-f bandwidth and reducing both the sweep width and sweep rate, proceed as follows:

(1) Repeat step a above.

(2) Turn the IF BANDWIDTH and FREQ SCALE controls in a CCW direction and set the SWEEP RATE-Hz switch to either the 0.1-1.5 or 1.5-30 position. Rotate the VARIABLE control in a CCW direction until optimum resolution is obtained.

Note

If it is necessary to observe a given bandwidth at one time and the signals involved are so closely spaced that they cannot be completely resolved, maximum resolution is recognized by the appearance of the clearest screen presentation. Further counterclockwise rotation of the IF BANDWIDTH control will result in lessened resolution and loss of signal amptitude.

2-22. LOCATION OF SIGNALS ON NARROW SWEEP WIDTHS. The following procedure is recommended for the acquisition of signals to be displayed on the CRT for the 15 and 50 positions of the FREQ SCALE-Hz/DIV switch.

a. Set the FREQ SCALE-Hz/DIV switch to 15.

b. Set the TEST SIGNAL-Hz switch to CF and adjust the CENTER FREQ LEVEL control to approximately its mid-position.

c. Set the SWEEP MODE switch to MANUAL. With the MANUAL control, position the CRT dot at the CF mark on the screen. Carefully adjust the CENTER FREQ 1 control until the dot deflects upward and returns to the baseline. Then slowly turn the CENTER FREQ 1 control in the opposite direction until the dot is at its maximum vertical deflection. Adjust CENTER FREQ LEVEL or GAIN controls for approximately full-scale deflection of the dot.

d. Hold the SWEEP MODE switch in the FAST position and trim the CENTER FREQ 1 control until the pip (which will be broadened and distorted) is about 2 divisions to the left of the CF line. (In the NORMAL position of the SWEEP MODE switch, the pip should appear near the CF screen calibration).

e. Set the FREQ SCALE-Hz/DIV switch to 50. The pip should appear near the CF screen calibration. Turn the TEST SIGNAL Hz switch to OFF.

f. If the CENTER FREQ 2 controls have been set correctly, according to the procedure outlined in step b of Paragraph 2-20, it should now be possible to tune the RF-8 to display a centered signal pip on the VAR position of the FREQ SCALE-Hz/DIV switch, and to successively reduce sweep width while retaining the signal on the CRT screen. When going to the 50 and 15 positions of the switch, it may be necessary to readjust the CENTER FREQ 1 control to maintain a signal display. Avoid excessive adjustment of this control to prevent loss of display when changing frequency scale.

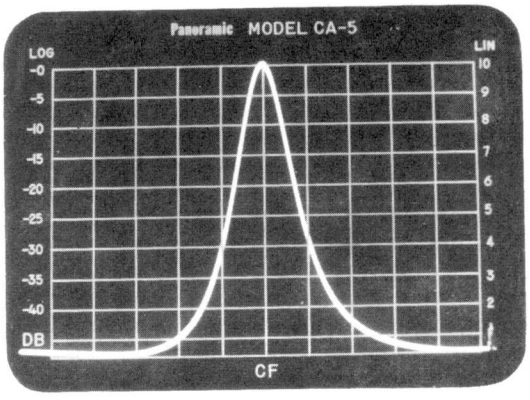
2-23. TURN OFF PROCEDURE. To turn off the SSB-50 System, set the POWER switch on the MF-50 Main Frame to the OFF position.

2-24. PACKAGING INSTRUCTIONS.

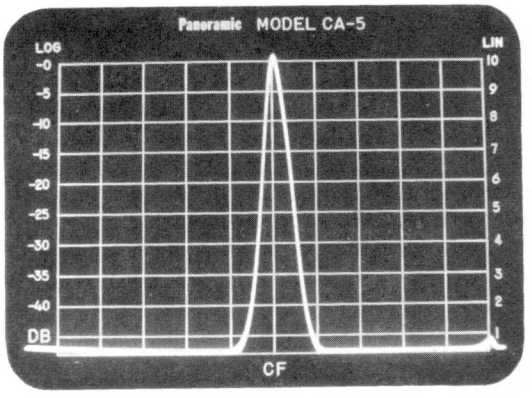
2-25. The following packaging instructions provide information for short-term and long term storage and shipping of the SSB-50 System.

2-26. SHORT-TERM PACKAGING. For short-term packaging, the SSB-50 System should be enclosed in a polyethylene bag and placed in a suitable carton for protection. The carton should be in a clean and moisture-free area. All accessories and literature should be securely fastened to the equipment.

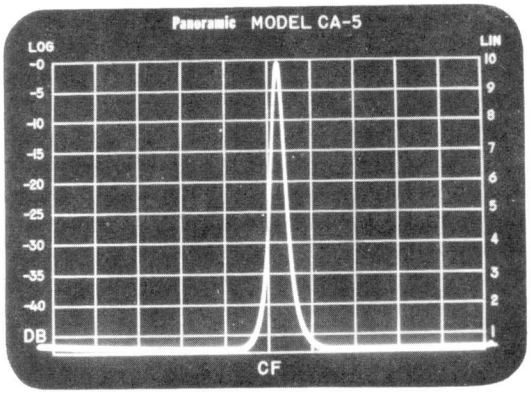
2-27. LONG-TERM PACKAGING AND PACKING FOR SHIPMENT. Figure 2-9 illustrates the packaging procedure for the SSB-50 System.



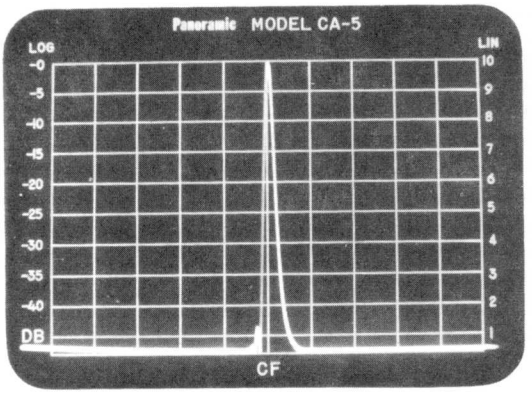
A. Narrow sweep width without resolution (no ringing)



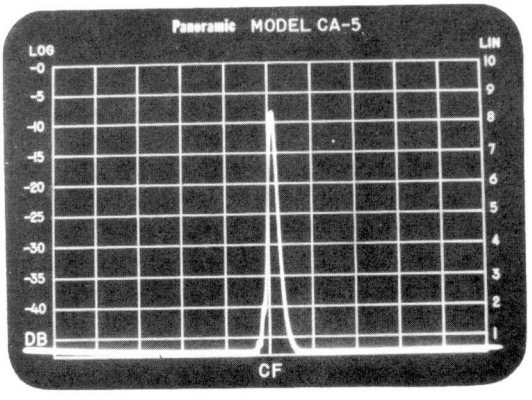
B. Wider sweep width without resolution (no ringing)



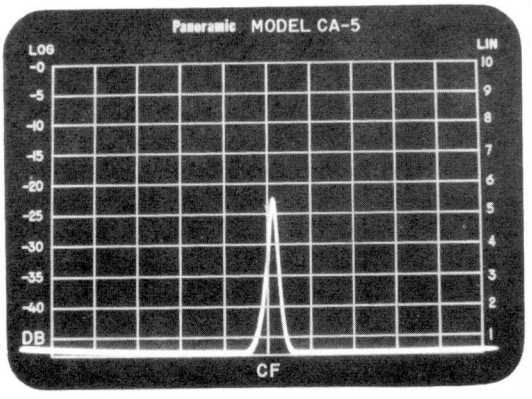
C. Under-resolved



D. Optimum resolution



E. Over-resolved



F. Completely over-resolved

Figure 2-8. Ringing as an Indication of Optimum Resolution

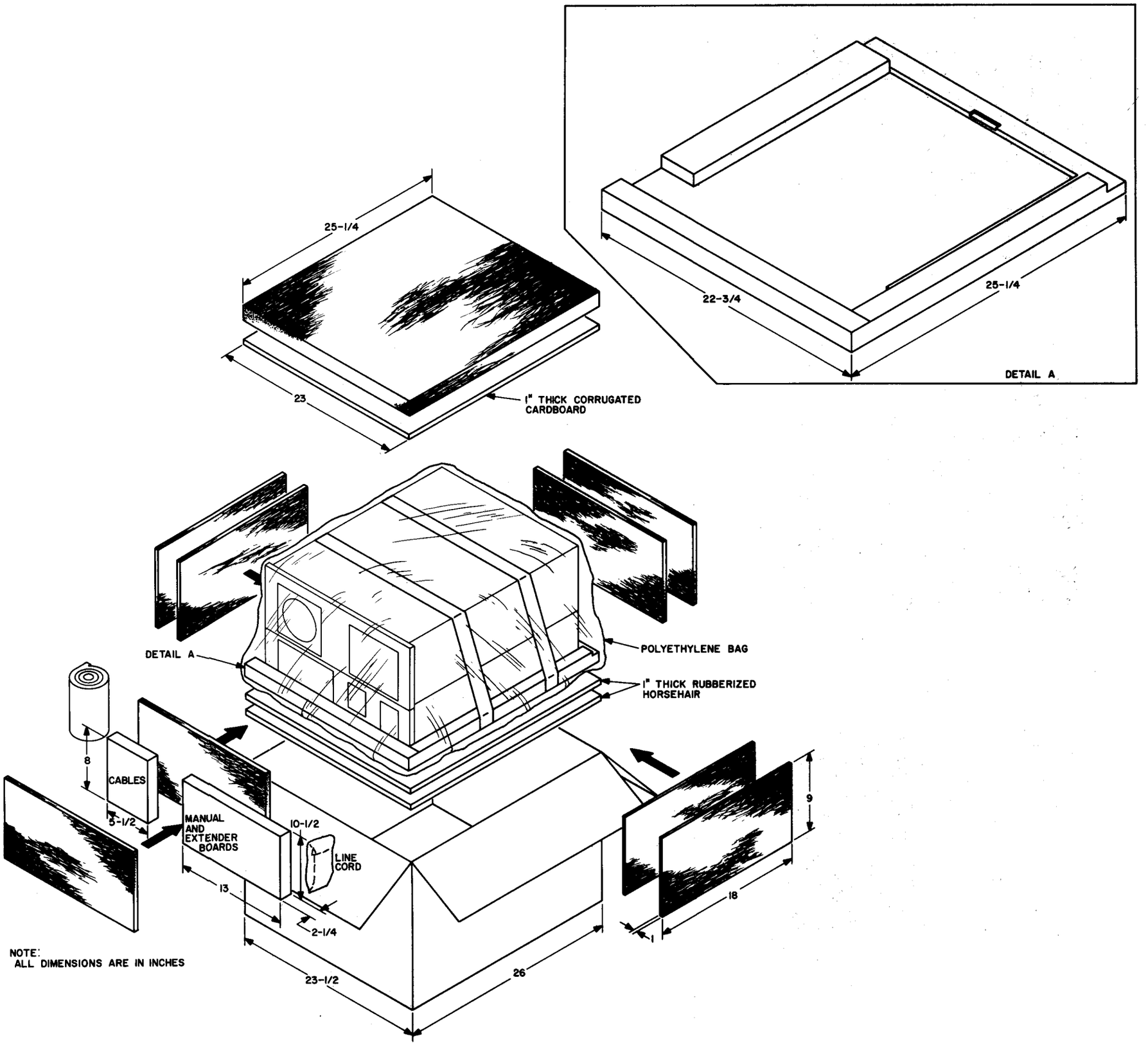


Figure 2-9. Packaging the SSB-50 System

SECTION III
SYSTEM CHECKOUT

3-1. GENERAL.

3-2. This section contains a checkout procedure for the SSB-50 System. This procedure provides a quick and reliable method for determining whether the SSB-50 System is operating properly. Also included in this section is a troubleshooting procedure to isolate a trouble in the SSB-50 System to a unit or units. Detailed checkout and troubleshooting procedures for the various units are contained in their respective technical manuals.

3-3. CHECKOUT PROCEDURE.

3-4. To checkout the SSB-50 System, interconnect the equipment as illustrated in figure 2-2 and perform steps a through i below.

a. Set the front panel controls of the SSB-50 System as follows:

MF-50	
SCALE ILLUMINATION control	Rotated CW until CRT graticule illuminates
BRIGHTNESS & FOCUS control	Adjusted for suitable trace on CRT
CA-5	
FREQ SCALE-Hz/DIV switch	1.4K
ATTENUATOR switches	OUT position
GAIN control	Fully CW
IF ATTENUATOR switch	20 db
AMPLITUDE SCALE switch	LOG
TEST SIGNAL-Hz control	OFF
SWEEP MODE switch	NORMAL
VIDEO FILTER switch	OFF
REC-2	
MODE switch	CONVERTED 10 Hz-2MHz
ATTEN DB switches	All in the down position
50 Ω - 600 Ω switch	600 Ω
RF-8	
RANGE switch	2.0 - 4.5
TTG-3	
ATTENUATOR DB decade and ATTENUATOR DB ADD units switches	0
600 Ω TERMINATION switch	IN

FREQ A and FREQ B controls	100
FREQ A and FREQ B multiplier switches	X10
OUTPUT control	A

b. Rotate the tuning control on the RF-8 until the zero pip appears under the CF line engraved on the CRT graticule. The amplitude of the zero pip should be half-scale LOG or less. If not, adjust the BAL C and R screwdriver controls on the REC-2 to minimize the zero pip deflection.

c. Connect a VTVM to the OUTPUT +10 dbm MAX jack on the TTG-3 and adjust the LEVEL A screwdriver control to obtain a VTVM indication of 2.45 volts.

d. Set the OUTPUT switch on the TTG-3 to B and adjust the LEVEL B screwdriver control until the VTVM indicates 2.45 volts. Disconnect the VTVM after performing this step.

e. Set the OUTPUT switch on the TTG-3 to A & B, the ATTENUATOR DB decade switch to 50, the ATTENUATOR DB units switch to 8, the FREQ B control to 30, and the FREQ B multiplier to X100.

f. Connect the +10 dbm MAX jack on the TTG-3 to the SIGNAL INPUT 10Hz - 2MHz jack on the REC-2.

g. Carefully adjust the tuning control on the RF-8 (and the CENTER FREQ 2 COARSE and FINE controls, as required on the CA-5) until the two-tones are centered on the CRT display; observe that a full-scale or better deflection is obtained on the CRT.

h. Adjust the GAIN control on CA-5, as required, until a full-scale deflection is obtained on the CRT.

i. Set the IF ATTENUATOR switch to 0 db and observe that all odd-order distortion products are below the -40DB line on the CRT graticule.

3-5. SYSTEM TROUBLESHOOTING.

3-6. System troubleshooting utilizes the checkout procedure outlined in paragraph 3-4 to isolate a trouble to a unit or units of the SSB-50 System. This procedure assumes that the interconnecting cabling is not defective. To troubleshoot the SSB-50 System, proceed as follows:

a. If the CRT graticule does not illuminate when performing step a of paragraph 3-4, the MF-5 or MF-50 is defective. To isolate the trouble further, observe whether the Power indicator lamp on the MF-50 is illuminated. If it is, the trouble is in the MF-5. If it isn't illuminated, the MF-50 is defective.

b. If a trace cannot be obtained on the CRT when performing step a of paragraph 3-4, the MF-5 or CA-5 is defective.

c. If no zero pip deflection is obtained on the CRT when performing step b of paragraph 3-4, the REC-2, RF-8 or MF-50 is defective. To isolate the trouble further, note whether the TTG-3 is operating properly. If it is, the trouble is in the REC-2 or RF-8. If the TTG-3 is not operating properly, the trouble is in the MF-50.

d. If the proper zero pip deflection cannot be obtained on the CRT when performing step b of paragraph 3-4, the REC-2 is defective.

e. If a 2.45-volt indication cannot be obtained on the VTVM when performing either step c or d of paragraph 3-4, the TTG-3 is defective.

f. If the two-tone test signal cannot be obtained on the CRT when performing step g of paragraph 3-4, the REC-2, RF-8, CA-5 or MF-5 is defective. To isolate the trouble further, set the TEST SIGNAL-Hz switch on the CA-5 to CF and the CENTER FREQ LEVEL control to its midposition. If a signal pip deflection is obtained on the CRT, the trouble is in the REC-2 or RF-8. If a signal pip deflection is not obtained on the CRT, the trouble is in the CA-5 or MF-5.

g. If the odd-order distortion products are not below the -40DB line on the CRT graticule when performing step i of paragraph 3-4, the TTG-3, REC-2, or CA-5 is defective.

ADDENDUM

for

MODEL SSB-50 SYSTEM

I. PURPOSE.

To correct existing error in the handbook.

II. ADDENDUM.

Page 2-3, paragraph 2-19a should read:

"On the MF-5, adjust the VERT and HORIZ POS controls so that the CRT trace appears exactly under the bottom horizontal line engraved on the CRT graticule. If the trace extends beyond the calibrated screen limits, but not beyond the CRT screen area, no adjustment of the H SIZE control is necessary. If the trace does not reach the calibrated screen limits, adjust the H SIZE control as directed in paragraph 4-21 of the MF-5 manual. (Note: Adjustment of the H SIZE control affects interchangeability of the CA-5 with other PANORAMIC spectrum analyzer modules, and therefore is not recommended if other than a CA-5 is to be used with the MF-5.)

Addendum No. 517