INSTRUCTION MANUAL FOR INTERFERENCE ANALYZER

MODEL EMC-11

ELECTRO-METRICS ®

A PENRIL COMPANY ®

100 Chu

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SECTION I
INTRODUCTION AND SPECIFICATIONS

1.1 INTRODUCTION

This manual contains the instructions for the operation, maintenance, and repair of the ELECTRO-METRICS MODEL EMC-11 INTERFERENCE ANALYZER.

1.2 EMC-11 INTERFERENCE ANALYZER

The EMC-11 Interference Analyzer is designed to perform emission and susceptibility testing to MIL-STD-461A/B, -462, -285 plus other applicable military, government, and commercial — both domestic and international — standards from 20 Hz to 50 kHz.

The receiver incorporates a differential front end with a Twinax connector to eliminate ground loop problems and permit balanced or floating measurements. In addition, the receiver has four selectable input impedances, nine selectable detection bandwidths plus two selectable low pass and four selectable high pass input filter networks. A voltage controlled oscillator is used for tuning the receiver with the tuned frequency indicated by a liquid crystal display. A dual metering system, with digital and analog output meters, is used to indicate the input signal level. The digital meter (liquid crystal display) circuitry automatically adds the total receiver attenuation to the meter indication. In addition, there is a provision for displaying the actual attenuation level on the same meter when required. Meter functions include AVERAGE (CARRIER), RMS, PEAK, QUASI-PEAK, and SLIDEBACK PEAK. The receiver is amplitude calibrated using an automatic calibration circuit which eliminates the requirement for a manual IF/RF gain control function.

Five OUTPUT functions, available at the front panel OUTPUT connector and selected by the OUTPUT FUNCTION Switch, are BFO, RESTORED, LINEAR VIDEO, IF, and TRACK. Rear panel connectors are provided for the X-Y plotter outputs, REMOTE CONTROL inputs/outputs plus the horizontal and vertical outputs for CRT presentations. The majority of the receiver functions can be remotely controlled using either a programmer or computer/calculator system. An IEEE Interface Bus option is also available on special request.

1.3 UNPACKING

1.3.1 Remove the instrument carefully from the shipping carton and examine thoroughly for shipping damage. If there is any damage, replace the instrument in the shipping carton and immediately inform ELECTRO-METRICS and the shipping company of the nature of the damage, the serial number of the instrument, the delivery date, and the invoice number.

1.3.2 Check contents of the carton against the shipping slip to be sure that all items ordered are present. Notify ELECTRO-METRICS immediately of any missing items.

1.4 ELECTRONIC SHIPPING DAMAGE

Before leaving the factory, this instrument was subjected to a complete operational check. However, it is possible that electronic damage may have occurred in transit. It is desirable, therefore to check the operation of the instrument as soon as possible after unpacking.

To do so, perform the tests outlined in Paragraph 3.4. If the instrument does not perform as per these instructions, inform the ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT, (518) 843-2600, giving the information required in Paragraph 1.3.1.

1.5 INSTALLATION

1.5.1 The EMC-11 is designed for either bench-top operation or installation in a conventional 19-inch equipment rack.

1.5.2 Rack mounting requires a pair of adapter mounting brackets ABM-11. When these brackets are used, install the instrument by the following procedure:

a. Remove the feet from the bottom of the receiver.

b. Using 3/8-inch No. 10-32 screws (6 required), fasten one bracket to each side of the receiver.

c. Install the receiver into the equipment rack.

1.5.3 Optional slide mounts are also available for mounting the receiver in an enclosed rack or equipment cabinet.

1.6 RECEIVER SPECIFICATIONS

The electrical and general specifications for the EMC-11 INTERFERENCE ANALYZER are given in Table 1.1.

1.7 MECHANICAL CONSTRUCTION

The EMC-11 uses the open frame method of construction. Self aligning bars, screwed together, form the main frame of the unit. All major internal components and assemblies (power supply, card rack assembly, etc) are secured to the main frame using machine screws. the front/rear/side panels are also secured to the main frame using machine screws.

1.8 REFERENCES

[1] **ANSI/IEEE STD 268-1982,** American National Standard Metric Practice.

[2] **ANSI/IEEE STD 100-1977,**IEEE Standard Dictionary of Electrical and Electronic Terms.

[3] **IEC, CISPR Pub. 16-1977 (Amendment 1-1980),** Specification for Radio Interference Measuring Apparatus and Measurement Methods.

[4] **MIL-STD-461B, 1 April 1980,** Military Standard Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference.

[5] **MIL-STD-462, 31 July 1967 (including Notices 1, 2, 3, and 4 — 1 Aug. 1968 to 1 Apr. 1980),** Military Standard Measurement of Electromagnetic Interference Characteristics.

[6] **MIL-T-28800C, 23 December 1981,** General Specification for Test Equipment for use with Electrical and Electronic Equipment.

[7] **CCITT RECOMMENDATION,** Psophometric Filter, Telephone, Pg 53, Vol. V, Green Book, Geneva, 1972.

[8] **CCIR RECOMMENDATION, 468-1974,** Psophometric Filter, Program.

TABLE 1.1
EMC-11 SPECIFICATIONS

FREQUENCY RANGE: 20 Hz — 50 kHz.

FREQUENCY INDICATOR: 5 digit Liquid Crystal Display.

FREQUENCY ACCURACY: ± 0.01% ± 1 Hz @ 10 Hz BW.

FREQUENCY RESOLUTION: Hz position: 1 Hz, LCD update 1x/second. kHz position: 10 Hz, LCD update 10x/second.

INTERMEDIATE FREQUENCY: 100 kHz.

VOLTAGE RANGE @ 10 Hz BW

IMPEDANCE	MINIMUM	MAXIMUM (includes 110 dB ATTEN.)
50 ohms	-50 dB(μV)	+120 dB(μV)
600 ohms	-40 dB(μV)	+120 dB(μV)
10 kilohms	-27 dB(μV)	+120 dB(μV)
100 kilohms	-17 dB(μV)	+120 dB(μV)

*** CAUTION ***

*** MAXIMUM ALLOWABLE RMS INPUT VOLTAGE ***

IMPEDANCE	ATTENUATOR SETTING (dB)	
	80 to 110	70 or below
50 ohms	3.00 V	0.25 V
600 ohms	3.00 V	0.85 V
10 kilohms	3.50 V	3.50 V
100 kilomns	3.50 V	3.50 V

VOLTAGE ACCURACY: Selective: ± 1.0 dB, 20 Hz to 50 kHz.
Wide Band: ± 2.0 dB, in accordance with CISPR-16, Subclause 26.7 and 27 [3].

RF INPUT CONNECTOR: TWINAX.

INPUT IMPEDANCE/ACCURACY[1]: 50 ohms ± 16%, 600 ohms ± 16%, 10 kilohms ± 5%, 100 kilohm ± 5%.

INPUT FILTERS (3dB): High Pass: 16 Hz, 200 Hz, 1 kHz, 6 kHz.
Low Pass: 16 kHz, 50 kHz.

IF BANDWIDTHS (6dB): 10 Hz, 40 Hz, 100 Hz, 250 Hz, 500 Hz, 1 kHz, 2.5 kHz, 5 kHz, plus Wide Band (50 kHz).

IF REJECTION: 70 dB.

SPURIOUS REJECTION: 60 dB.

OUTPUT METERS: DIGITAL: Liquid Crystal Display. Input signal level indicated in dB(μV), automatically taking internal attenuation setting into account.
ANALOG: 80 dB range, graduated from -40 to +40 dB(μV). Input signal level is sum of the meter indication and internal attenuation setting.

[1]Except near the cutoff frequencies of the high pass and low pass filters.

TABLE 1.1 (Cont'd)
EMC-11 SPECIFICATIONS

ATTENUATION RANGE: 110 dB in 10 dB steps. Displayed when required on Digital Output Meter. Selectable by front panel push buttons. Provision for overload indication.

CW SENSITIVITY: NARROW BAND dB(μV)

IMPEDANCE	@BANDWIDTH OF (Hz)								
	10	40	100	250	500	1 k	2.5 k	5 k	50 k
50 ohms	-49	-43	-39	-35	-32	-29	-24	-21	-11
600 ohms	-38	-32	-28	-24	-21	-18	-13	-10	0
10 kilohms	-26	-20	-16	-12	-9	-6	-1	+2	+12
100 kilohms	-16	-10	-6	-2	+1	+4	+9	+12	+22

IMPULSE SENSITIVITY WIDE BAND (50 kHz): +15 dB(μV/MHz) or -45 dB (μV/kHz).

DETECTOR FUNCTION CHARACTERISTICS

DETECTOR FUNCTION	T_C	T_D	REMARKS
AVERAGE	100 ms	100 ms	True average of input signal
RMS	100 ms	100 ms	34 dB crest factor
QUASI-PEAK	1 ms	160 ms	CISPR Pub. 16, SECTION 6
PEAK	$<1/B_{IF}$	1 s hold	True peak, automatic dump
SLIDEBACK PEAK	$<1/B_{IF}$	approx. $1/B_V$	Envelope detected, aural threshold bias indicated

CALIBRATION: Built-in calibration circuit.

OUTPUT FUNCTIONS: Controlled by front panel OUTPUT FUNCTION Switch and present at the front panel OUTPUT Connector. All output functions capable of driving 600 ohm load to minimum level of 1 V RMS.

BFO: BFO circuit turned on. Used for aural identification of CW signals. A Linear Video signal is present at the OUTPUT Connector.

RESTORED: The amplified and bandwidth defined representation of the predetected tuned input signal.

LINEAR VIDEO: The linear and BW defined presentation of the envelope detected tuned input signal.

IF: The BW defined IF frequency signal.

TRACK: CW signal at the tuned frequency of the receiver.

AUDIO: The filtered and amplified linear video signal for all detector functions except SLIDEBACK which uses the output of the threshold detector. The AUDIO is monitored at the front panel phone jack. Minimum output level, into 600 ohms, of 10 V P-P before clipping occurs.

AFC: Selectable by front panel switch.

TABLE 1.1 (Cont'd)
EMC-11 SPECIFICATIONS

TUNING: MANUAL: Controlled by front panel TUNING CONTROL and FINE TUNE controls.
REMOTE: Externally controllable via the rear panel REMOTE Connector.
X-Y PLOTTING: Sweep rate controlled by SWEEP RATE Control and IF bandwidth switch settings. Sweep initiated by SWEEP START Switch.
OSCILLOSCOPE FUNCTION (CRT): Sweep automatically initiated, centered about the MANUAL TUNING Control setting. Sweep rate and width controlled by IF bandwidth switch setting and SWEEP WIDTH Control.

PROBE INPUT: Front panel connector used to supply operating voltages to and receive inputs from active accessory devices (active antennas, high impedance probes, slope amplifiers, etc).

REAR PANEL CONNECTORS: SCOPE: Two BNC Connectors-Horizontal, Vertical.
X-Y PLOTTER: 11 pin connector.
REMOTE CONNECTOR: 55 pin MS round connector

POWER REQUIREMENTS: AC: 105-130 VAC, 50-400 Hz, 40 VA
210-230 VAC, 50-400 Hz, 40 VA
DC: External DC supply (40 VDC, 400 mA).
Optional internal rechargeable battery pack — operating time approximately six hours.

SIZE: 178 mm high x 448 mm wide x 444 mm deep (7" x 17⅝" x 17½").

WEIGHT: Approximately 13.5 kg (30 lbs).

ENVIRONMENTAL: Designed to Meet MIL-T-28800C Type III, Class 5 Style E environmental requirements.

TEMPERATURE: Non-operating: -40°C to +75°C.
Operating: 0°C to +50°C.

REL. HUMIDITY: 95%, 75% > 30°C.
45% > 40°C.

ALTITUDE: Non-operating: 12 000 m (40 000 ft)
Operating: 3 050 m (10 000 ft)

VIBRATION: 2 g
SHOCK: 30 g

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SECTION II
OPERATING INSTRUCTIONS

2.1 GENERAL

This section provides information and instructions for the operation of the MODEL EMC-11 INTERFERENCE ANALYZER.

*** * * CAUTION * * ***

Read all information in this section before attempting operation. Improper operation may cause costly damage to the instrument.

2.2 OPERATIONAL PRECAUTIONS

2.2.1 POWER SOURCE SELECTOR

An AC Power Source Selector is incorporated into the AC Power Input Connector on the rear panel. Check that the selector card displays the correct voltage for the AC power source being used. Operation using a "220" VAC power source with the module set for "110" VAC can cause extensive circuit damage.

2.2.2 TUNING MODE SWITCH

The Tuning Mode Switch must be in the MANUAL position to permit manual operation of the frequency tuning control.

2.2.3 INPUT VOLTAGE

Damage to the input circuitry of the receiver may result if signal levels greater than +130 dB(μV) (3.0 VRMS) are applied.

*** * * CAUTION * * ***

The input circuits of this instrument cannot handle high signal levels. **DO NOT** connect the AC power line to the EMC-11 input without an intervening protective circuit such as a power frequency rejection filter and/or attenuator, otherwise serious damage will result! A suitable filter is either the ELECTRO-METRICS Model HPF-10 High Pass Filter or Model NRF-10 Notch Rejection Filter for the 120 V, 60 Hz power line.

2.3 CONTROL FUNCTIONS

All controls for operation of the EMC-11 INTERFERENCE ANALYZER are located on the front panel. The location of each individual control is shown in Figure 2.1 and described in the following paragraphs.

2.3.1 FILTER SWITCHES

2.3.1.1 LOW PASS FILTER SWITCH

Two position switch which selects between two low pass filter networks with cutoff frequencies of 16 kHz at -3 dB or 50 kHz at -3 dB.

2.3.1.2 HIGH PASS FILTER SWITCH

Four position switch which selects between four high pass filter networks with 3 dB cutoff frequencies of 16 Hz (OUT), 200 Hz, 1 kHz, or 6 kHz.

2.3.2 IMPEDANCE SWITCH

Five position switch which selects between four input impedances of 50 ohms, 600 ohms, 10 kilohms, or 100 kilohms plus the probe input position (50 ohms).

2.3.3 FREQUENCY CONTROL

2.3.3.1 TUNING CONTROL

A two speed planetary drive control having a 10:1 ratio between the two knob sections. The outer knob functions as a COARSE TUNE control, with the inner knob used as a MEDIUM TUNE control.

2.3.3.2 FINE TUNE CONTROL

Inner knob (red) of the AFC Switch, used mainly in conjunction with the narrower IF bandwidths (10 Hz to 250 Hz) of the receiver. Its range is approximately 1% of the main TUNING CONTROL range.

2.3.3.3 FREQUENCY DISPLAY

A five digit Liquid Crystal Display which indicates the tuned frequency of the receiver in either Hz or kHz. The accuracy is $\pm 0.01\% \pm$ 1 Hz over the frequency range of the receiver (20 Hz to 50 kHz).

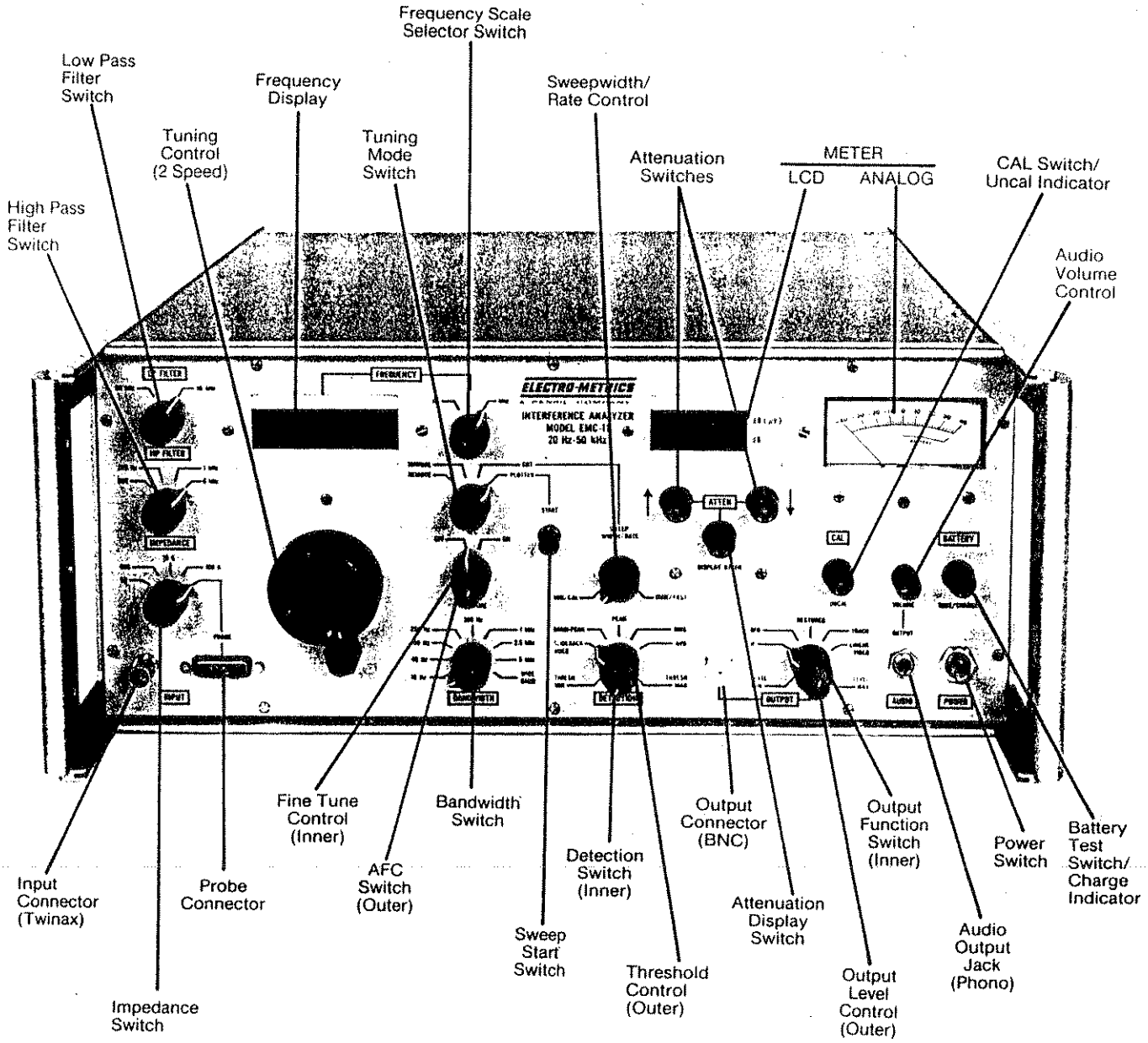


Figure 2.1
EMC-11 — Front Panel

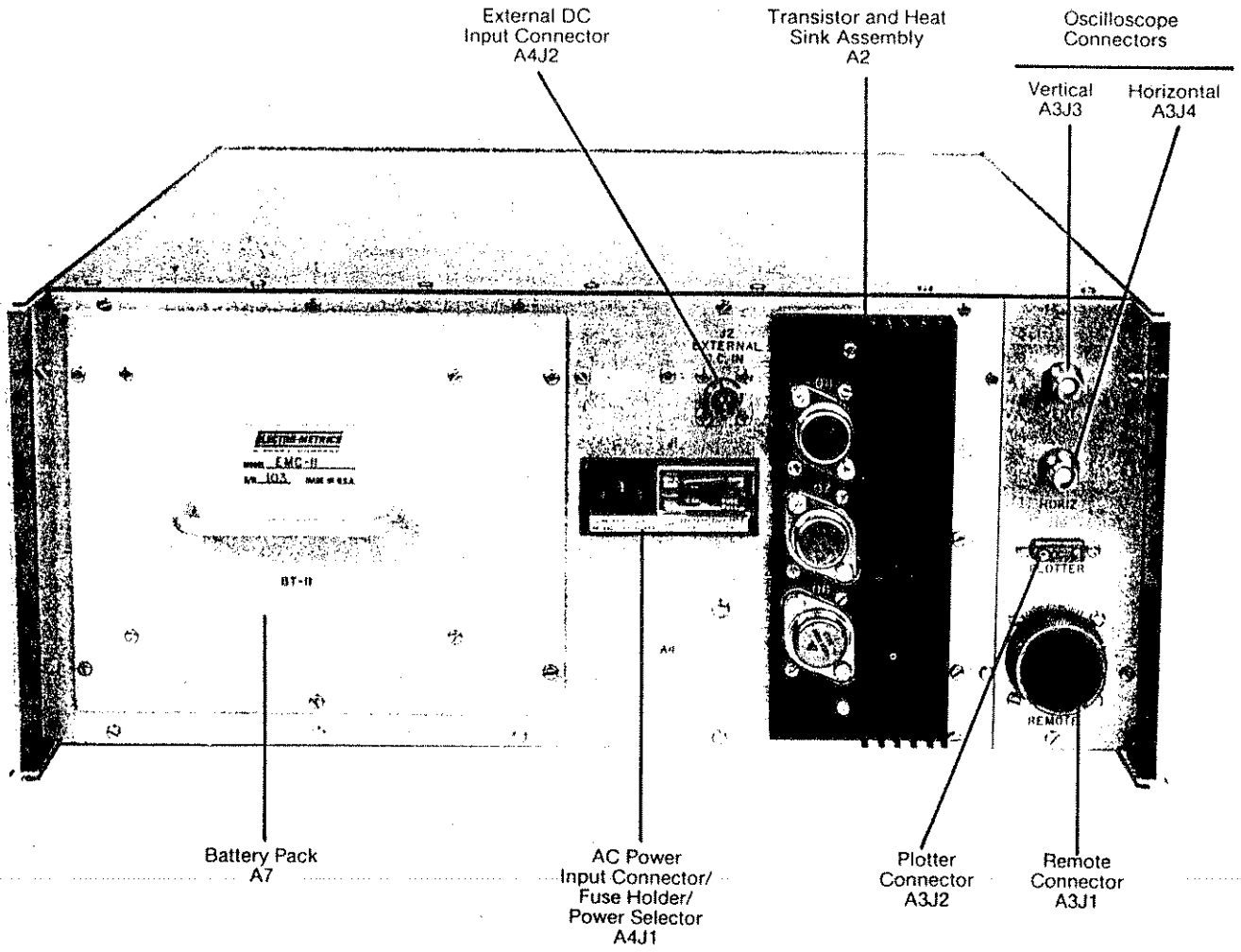


Figure 2.2
EMC-11 — Rear Panel

2.3.3.4 FREQUENCY SCALE SELECTOR SWITCH

Two position switch which determines whether the LCD frequency indication is in Hz or kHz.

RESOLUTION: **Hz position:** 1 Hz, LCD is updated once per second.

kHz position: 10 Hz, LCD is updated 10 times per second.

2.3.3.5 TUNING MODE SWITCH

Four position switch which determines whether frequency tuning is done manually (MANUAL), controlled remotely (REMOTE), or swept automatically in one of two sweep modes (CRT, PLOTTER).

2.3.3.6 AFC SWITCH

Two position switch which determines whether the AFC circuitry is turned ON or OFF.

2.3.4 SWEEP FUNCTION CONTROLS

These controls are utilized whenever an optional external X-Y recorder or oscilloscope is being used to record or present the data obtained by the EMC-11.

2.3.4.1 SWEEP WIDTH/RATE CONTROL

Performs either of two functions, sweep width or rate, depending upon the following TUNING MODE Switch settings:

a. PLOTTER: The CAL and FAST switch positions (red) are used, in conjunction with the BANDWIDTH Switch settings, to determine the X-Y plotter sweep rate.

(1) CAL (FULL CCW): Maximum sweep time/slowest sweep rate (6 minutes @ 10 Hz BW). For this switch position, the sweep circuitry sets an optimum sweep rate (determined by the IF bandwidth selected) which permits the X-Y plotter to accurately record the amplitude level of a detected signal for all IF BANDWIDTH Switch positions.

(2) FAST (FULL CW): Minimum sweep time/fastest sweep rate (12 seconds @ 10 Hz BW). For this switch position, the sweep circuitry produces a sweep rate which is ten (10) times faster than in the CAL position. The X-Y plotter, therefore, *will not* accurately record the amplitude level of a detected signal due to the response time of the plotter, detector and IF bandwidth.

b. CRT: The MIN and MAX switch positions (black) are used, in conjunction with the BANDWIDTH Switch settings, to determine the sweep rate and width of the oscilloscope display centered about the tuned frequency of the receiver.

(1) MIN (FULL CCW): Narrowest sweep width/slowest sweep rate. For this switch position, the sweep width is equal to the selected IF bandwidth.

(2) MAX (FULL CW): Widest sweep width-fastest sweep rate. For this sweep position, the sweep width is equal to ten (10) times the selected IF bandwidth.

2.3.4.2 SWEEP START SWITCH

The SWEEP START Switch, when depressed, starts the sweep cycle. The end of sweep automatically resets the sweep circuit.

NOTE: Whenever an external oscilloscope is being used for data presentation, the sweep is automatically started and continuously repeated.

2.3.5 BANDWIDTH SWITCH

Nine position switch which selects between eight IF bandwidths (6dB) of 10 Hz, 40 Hz, 100 Hz, 250 Hz, 500 Hz, 1 kHz, 2.5 kHz, 5 kHz, plus WIDE BAND (50 kHz).

2.3.6 DETECTION SWITCH

Five position switch which selects one of five detector functions.

2.3.6.1 AVERAGE (CARRIER): In this position, the detector circuit produces the true average value of the input signal level. The charge and discharge time is a nominal 100 ms.

2.3.6.2 RMS: In this position, the RMS detector circuit produces a true RMS measurement value of the input signal level. The charge and discharge time is a nominal 100 ms with a 34 dB crest factor. These characteristics conform to those set forth in CISPR Publication 16 for an audio-frequency rms voltmeter [3].

2.3.6.3 PEAK: In this position, the peak detector circuit produces a true peak response to the input signal in terms of a calibrated RMS sinewave of equivalent peak value. The rise time is less than 10 μs, and automatic dump occurs after a 1-second hold time.

2.3.6.4 QUASI-PEAK: In this position, the detector circuitry has a charge time of 1 ms and a discharge time of 160 ms. These specifications conform to

those set forth in CISPR Publication 16 Section 6 for an audio-frequency quasi-peak voltmeter [3].

2.3.6.5 SLIDEBACK: In this position, a rapid-decay peak detector circuit is selected which, in conjunction with the THRESHOLD Control, provide a variable bias for aural or video extinction of peak level signals.

2.3.6.5.1 THRESHOLD CONTROL: Adjusts the aural or video extinction point for the SLIDEBACK position.

2.3.7 AMPLITUDE INDICATION

The EMC-11 utilizes a dual metering system, with digital and analog meters, to indicate the amplitude level of a detected signal.

2.3.7.1 DIGITAL METER

A 2½ digit Liquid Crystal Display which indicates the input signal amplitude level in dB(μV). The meter circuit automatically adds the attenuation setting of the receiver to the display indication, with a provision for displaying the attenuation setting separately when required. (See 2.3.8.2)

2.3.7.2 ANALOG METER

80 dB range meter, graduated from -40 dB(μV) to +40 dB(μV). Input signal amplitude level is the sum of the meter reading and the attenuation setting of the receiver.

2.3.8 ATTENUATION CIRCUIT

The Attenuation circuit adds attenuation to the receiver in 10 dB steps for a total range of 110 dB. Table 2.1 lists the displayed attenuation range for each input impedance.

TABLE 2.1

INPUT IMPEDANCE VS. ATTENUATION RANGE

INPUT IMPEDANCE	ATTENUATION (DISPLAYED)	RANGE TOTAL
50 ohms	-20 dB to +90 dB	110 dB
600 ohms	-10 dB to +100 dB	110 dB
10 kilohms	0 dB to +110 dB	110 dB
100 kilohms	+10 dB to +110 dB	100 dB

2.3.8.1 ATTENUATION SWITCHES

Two pushbutton switches; one to increase, the other to decrease the total receiver attenuation. An integral LED indicator is part of each ATTENUATION Switch and performs the following functions:

a. For the INCREASE ATTENUATION Switch, the LED indicates the need for increased receiver attenuation to avoid overload.

b. For the DECREASE ATTENUATION Switch, the LED indicates the need for decreased receiver attenuation to reduce receiver noise.

2.3.8.2 ATTENUATION DISPLAY SWITCH

A pushbutton switch used to activate the Attenuation Display mode of the front panel Digital Amplitude Meter. The meter indicates the total attenuation level of the receiver in dB.

NOTE: On the Digital Amplitude Meter, there is a black bar which appears next to the unit of measurement e.g. dB(μV) or dB.

2.3.9 CALIBRATION FUNCTION

The EMC-11 employs an internal calibration circuit which automatically calibrates the receiver as follows:

a. During the initial receiver turn on.

b. When the front panel IMPEDANCE Switch position is changed.

c. When the front panel CAL Switch is pushed.

d. By a remote command signal via the rear panel Remote connector.

2.3.9.1 CAL SWITCH

A pushbutton switch used to initiate the automatic calibration sequence manually. The switch incorporates an LED indicator which functions as an UNCAL indicator. Whenever a calibration sequence is initiated (under the conditions noted in Para. 2.3.9 a thru d), the UNCAL indicator will be lighted for the duration of the calibration sequence (approximately 2 seconds).

NOTE: When calibration of the receiver cannot be accomplished, the UNCAL indicator will remain lighted alerting the operator to this fact.

2.3.10 OUTPUT FUNCTION SWITCH

Five position switch which selects one of five output signals presented at the front panel OUTPUT Connector.

2.3.10.1 IF: In this position, the Intermediate Frequency as bandwidth defined, is present at the OUTPUT Connector.

2.3.10.2 BFO: In this position, the BFO circuit is turned on for aural identification of CW signals. The Linear Video signal is present at the OUTPUT Connector.

2.3.10.3 RESTORED: In this position, the amplified and bandwidth defined representation of the pre-detected tuned input signal is present at the OUTPUT Connector.

2.3.10.4 TRACK: In this position, a leveled CW signal at the tuned frequency of the receiver is present at the OUTPUT Connector.

2.3.10.5 LINEAR VIDEO: In this position, the linear and bandwidth defined presentation of the envelope detected tuned input signal is present at the OUTPUT Connector.

2.3.10.6 OUTPUT LEVEL CONTROL: Varies the amplitude output level of the signal present at the OUTPUT Connector.

NOTE: All OUTPUT functions are capable of driving a 600-ohm load to a minimum level of 1 VRMS.

2.3.11 AUDIO FUNCTION

For all Detector Functions except SLIDEBACK, the AUDIO signal is the filtered and amplified Linear Video signal. In SLIDEBACK, the output of the Threshold Detector is heard in the earphones. The AUDIO output is monitored at the front panel PHONE JACK.

2.3.11.1 AUDIO VOLUME CONTROL

Used to adjust the audio output level to the front panel PHONE JACK.

2.3.12 POWER SWITCH

Two cycle lighted pushbutton switch which is used to place the instrument in operation. The switch is lighted when the receiver is ON and extinguished when OFF.

2.3.13 BATTERY INDICATOR

The lower right hand section of the front panel Analog Meter indicates the approximate condition of the optional internal battery pack (BAT-11) whenever the BATTERY TEST Switch is pressed.

2.3.13.1 BATTERY TEST SWITCH

Pushbutton switch, when pressed, disconnects the front panel analog Meter from the internal meter circuitry and places the battery, through a meter protection circuit, across the meter.

2.3.13.2 CHARGE INDICATOR

An integral LED indicator, incorporated into the BATTERY TEST Switch, which is lighted only when the battery is receiving a charging current.

2.4 FRONT PANEL CONNECTORS

2.4.1 INPUT CONNECTOR A1J1

Type: TWINAX. BNC adapter supplied as standard item with unit.

2.4.2 PROBE CONNECTOR A1J2

An 11-pin connector which connects the PEF-10A ELECTRIC FIELD PROBE ANTENNA and other accessories to the EMC-11. Supplies power and calibration signals to and receives input signals from the accessory connected.

2.4.3 OUTPUT CONNECTOR A1J3

Type: BNC. Presents the Output Functions selected by the OUTPUT FUNCTION Switch.

2.4.4 AUDIO OUTPUT A1J4

Phone Jack for the audio output.

2.5 REAR PANEL CONNECTORS

2.5.1 SCOPE CONNECTORS A3J3, A3J4

Type: BNC. Two (2) connectors; Vertical (A3J3) and Horizontal (A3J4).

2.5.2 X-Y PLOTTER CONNECTOR A3J2

An 11-pin connector which connects a single pen X-Y plotter to the EMC-11.

2.5.3 REMOTE CONNECTOR A3J1

A 55-pin PT Pygmy Connector through which the EMC-11 can be remotely controlled.

2.5.4 AC POWER INPUT CONNECTOR A4J1

Connects the EMC-11 via the power cord to the AC power source.

2.5.5 EXTERNAL DC INPUT CONNECTOR A4J2

A 3-pin connector (PTO2A-8-3P) used to connect an external 40 VDC supply to the EMC-11.

2.6 POWER SUPPLY

2.6.1 POWER REQUIREMENTS

a. AC power sources:
   (1) 105-130 VAC, 50-400 Hz, 40 VA.
   (2) 210-230 VAC, 50-400 Hz, 40 VA.

b. External DC supply: 40 VDC, 400 mA.

2.6.2 POWER SOURCE SELECTOR

The Power Source Selector is incorporated as part of the power input connector. The number

visible in the window indicates the nominal AC power source for which the receiver is set. To change the power source setting, perform the following:

a. Remove the power cord from the connector plug.
b. Slide the clear cover to the left.
c. Pull the handle marked FUSE PULL and remove the fuse.
d. Rotate the handle to the left and gently pull the printed circuit voltage selector card from its slot.
e. Orient the card so that the desired operating voltage appears on the top-left side.
f. Firmly push the voltage selector card back into its slot.
g. Rotate the FUSE PULL handle to the right and install the correct rating fuse.
h. Slide the clear cover to the right and reconnect the AC power cord to the connector.

*** * * CAUTION * * ***

Verify that the Power Source Selector setting corresponds to the AC power source being used. Operation on "220"VAC with the module set for "110"VAC can cause extensive circuit damage.

2.6.3 FUSE SPECIFICATIONS

The EMC-11 uses the following fuses:

a. 115 VAC operation: 0.50 AMP 3AG SLO-BLO.
b. 230 VAC operation: 0.25 AMP 3AG SLO-BLO.

2.6.4 BATTERY OPERATION (OPTIONAL)

EMC-11 operation using an internal battery is the same as for operation from an AC power source. The major difference is that the battery has a limited or finite time of operation. The battery charge status should be checked as soon as the power switch is activated by means of the BATTERY TEST Switch. When this switch is pressed, the front panel analog meter will then indicate the approximate state of the battery charge. For operation using the battery as a sole power source, the meter should read between the two markings of the battery test scale. If the meter reads at or below the lower battery scale marking, the battery should be recharged or replaced.

NOTE: To operate the receiver for the nominal six hours using the battery pack as the sole power source, the meter should read at or near the upper battery scale marking.

In addition, during periods of extended or heavy usage, it is advisable to check the battery condition periodically.

A fully charged battery will operate the EMC-11 for a nominal time period of six hours. The actual operating time will vary and is dependent on the type of EMI testing the instrument will be performing.

The instrument should not be stored longer than one week with a discharged battery. During extended storage periods, the battery should be brought up to full charge at least once every three months.

2.6.5 BATTERY POWER SUPPLY

The optional battery pack (BAT-11) incorporates 32-2.2 ampere-hour 1.2 V nickel-cadmium cells.

The battery can be used for a nominal six hours of sustained operation without charging. It will fully recharge after such usage in 10 to 12 hours. To recharge the battery, connect the instrument to an external AC power source. Battery charging is automatically controlled by the instrument and will only occur with the POWER Switch OFF.

2.6.6 CHARGING THE BATTERY

To charge the battery, connect the EMC-11 to the appropriate AC power source for approximately 10 to 12 hours with the POWER Switch "OFF". The charge indicator will be on only when the unit is connected to the AC power source and the battery is receiving a charging current. When the battery is fully charged, the charge indicator will turn off.

If the battery pack will not recharge or operate the unit for six hours, it should be replaced. Battery life is a function of many factors in addition to the charge/discharge ratio. To obtain maximum battery life observe the following:

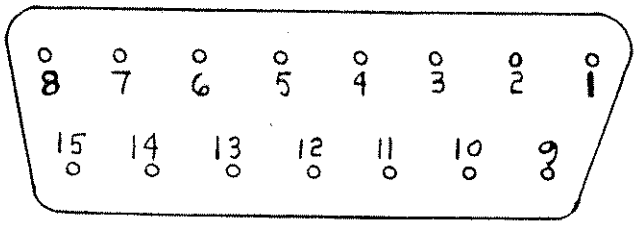
a. Operate using an AC power source whenever possible.
b. As long as the interval between periods of use does not exceed one week, any loss of charge resulting from battery only operation for time (T) can be replenished by recharging with the unit (off) for twice the length of time (2T).
c. When the EMC-11 is being used infrequently, its battery can be kept in an optimum charged condition by connecting the unit to an AC power source (front panel POWER Switch "OFF") for a total of six to eight hours each week.

2.6.7 BATTERY PROTECTION CIRCUITS

2.6.7.1 OVERCHARGING

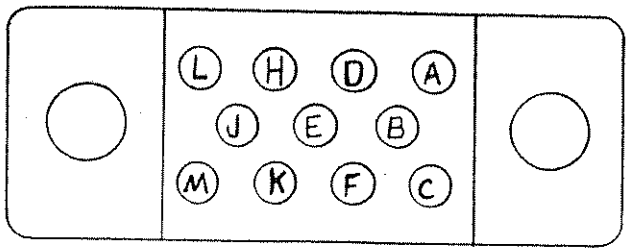
Overcharging will not occur, since the charger circuit automatically reduces charging current as soon as overcharging reaches a significant level.

FIGURE 2.3
FRONT PANEL PROBE CONNECTOR A1J2



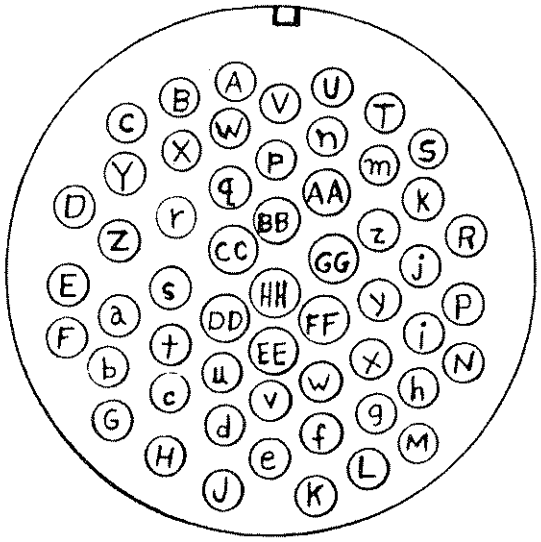
PIN DESIGNATION	FUNCTION
1	PROBE INPUT
2	SPARE
3	PROBE CAL
4	SPARE
5	-15 VDC
6	SPARE
7	SPARE
8	+15 VDC
9	SIGNAL GND
10	SPARE
11	SIGNAL GND
12	SPARE
13	SPARE
14	SPARE
15	GND

FIGURE 2.4
PLOTTER CONNECTOR A3J2



PIN DESIGNATION	FUNCTION
A	PEN COMM.
B	X OUT (+) (0-1.5 V)
C	SHIELD GND
D	PEN LIFT COIL (N0) (+)
E	X COMM. (GND)
F	Y COMM. (GND)
H	SPARE
J	SPARE
K	SPARE
L	SPARE
M	Y OUT (+)

FIGURE 2.5
REAR PANEL REMOTE CONNECTOR A3J1



PIN DESIGNATION	FUNCTION
A	SPARE
B	SPARE
C	SPARE
D	SPARE
E	SPARE
F	SPARE
G	SPARE
H	SPARE
J	+15 VDC
K	-15 VDC
L	+5 VDC
M	-5 VDC
N	GND
P	VCO OUTPUT
R	SPARE
S	SPARE
T	ATTENUATOR A
U	ATTENUATOR B
V	ATTENUATOR C
W	ATTENUATOR D
X	ATTENUATOR E
Y	GND
Z	BANDWIDTH A

PIN DESIGNATION	FUNCTION
a	BANDWIDTH B
b	BANDWIDTH C
c	BANDWIDTH D
d	TUNE INPUT A (+)
e	TUNE INPUT B (-)
f	GND
g	REMOTE DUMP
h	OUTPUT COMMAND A
i	OUTPUT COMMAND B
j	OUTPUT COMMAND C
k	DETECTOR A
m	DETECTOR B
n	DETECTOR C
p	LOW PASS FILTER
q	HIGH PASS FILTER A
r	HIGH PASS FILTER B
s	IMPEDANCE A
t	IMPEDANCE B
u	IMPEDANCE C
v	SPARE
w	SPARE
x	SPARE
y	GND
z	FINE TUNE
AA	SPARE
BB	X OUT (0-10 V)
CC	Y OUT
DD	OVERLOAD
EE	UNCAL
FF	CAL COMMAND
GG	AFC
HH	REMOTE COMMAND

2.6.7.2 EXCESSIVE DISCHARGE

Excessive discharge will not occur since the flow of battery current to all circuits is automatically interrupted as soon as battery voltage drops to a value indicating negligible remaining capacity.

2.6.8 EXTERNAL DC OPERATION

Battery operation beyond the six hour limit established by the internal battery pack of the receiver may be accomplished by using an external battery setup. To operate the EMC-11 using an external battery as the sole power source, perform the following procedure:

a. Turn OFF the unit and remove the optional internal battery pack, if installed, inserting the battery plug into the battery receptacle located inside the power supply.

NOTE: The battery plug must be inserted into the internal battery receptacle in order for the EMC-11 to operate using an external DC power source. The rear panel external DC input is connected via the battery plug receptacle into the EMC-11 power supply.

b. Connect the external battery, minimum voltage level 40 VDC, to the rear panel EXTERNAL DC INPUT Connector (A4J2) using the socket equivalent of the connector (PTO2A-8-3S). The socket is wired as follows:

PIN A: + voltage line.
PIN B: - voltage line.
PIN C: no connection

*** * * CAUTION * * ***

DO NOT GROUND THE BATTERY TERMINALS OR ESTABLISH A REFERENCE GROUND. THE EXTERNAL SUPPLY MUST "FLOAT" ABOVE GROUND.

c. Turn on the EMC-11, the receiver should operate in a manner identical to operation with an internal battery or from an AC power source.

2.7 REMOTE OPERATION

2.7.1 The EMC-11 can be operated remotely using either a computer/calculator system (utilizing a DIGITAL INTERFACE UNIT) or the ESC-125 PROGRAMMER. For either option, the control information is supplied through the REMOTE Connector (A3J1) with the front panel TUNING MODE Switch set for REMOTE.

2.7.2 IEEE 488 BUS OPTION: This option, available on special request, permits the user to integrate the EMC-11 into a control network utilizing the standard IEEE 488 Interface System.

NOTE: The 488 BUS Module displaces the battery pack in the receiver, thus the internal battery option is not available when this option is specified.

2.8 OPERATING PROCEDURES

2.8.1 INITIAL POWER UP PROCEDURE

2.8.1.1 Before applying power to the EMC-11 check the following:

a. Power Source Selector setting should correspond to the AC power source being used.

b. FUSE A4J1-F1 should be correct rating for the AC power source being used.

2.8.1.2 Connect the power cord between the A4J1 POWER Connector and the AC power source. The EMC-11 is turned on by pushing in the front panel POWER Switch. The switch should be lighted when the unit is on. Allow a **minimum warm-up time** of **30 minutes.**

NOTE: When operating the unit using the optional battery pack as the sole power source, the warm-up can be performed using the AC power source to conserve battery power.

2.8.2 CW CALIBRATION

The EMC-11 incorporates an automatic calibration circuit which amplitude calibrates the receiver under the following conditions:

a. During the initial receiver turn on.

b. Whenever the front panel IMPEDANCE Switch position is changed.

c. When the front panel CAL Switch is pushed.

NOTE: The calibration circuit can also be activated remotely.

Whenever a calibration sequence is initiated, the UNCAL indicator (incorporated in the CAL Switch) is lighted for the duration of the sequence-approximately two seconds. If calibration of the receiver cannot be accomplished, the UNCAL indicator will remain lighted alerting the operator to this fact. The receiver does not incorporate a manual IF/RF gain control function. If the receiver will not

calibrate, contact the **ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT (518) 843-2600** or the nearest **ELECTRO-METRICS** representative for any assistance required.

2.8.2.1 CALIBRATION ACCURACY

2.8.2.1.1 SELECTIVE

When calibration of the EMC-11 receiver is being performed, the calibration frequency chosen should be at least twice the IF bandwidth selected (e.g. if the IF bandwidth is 40 Hz, the calibration frequency should be equal to or greater than 80 Hz). This will prevent the calibration amplitude level from being affected by the zero beat of the receiver. In addition, the EMC-11 **SHOULD NOT** be calibrated with the TUNING MODE Switch set to the PLOTTER position. This will cause the receiver calibration to take place at "0" frequency so that the CAL signal is an LO feedthrough and therefore not accurate.

2.8.2.1.2 WIDE BAND

When calibrating the EMC-11 for WIDE BAND measurements, the calibration frequency should be 1 kHz. The accuracy of the EMC-11 will then comply with the CISPR recommendations [3].

2.8.3 SIGNAL MEASUREMENTS

The following section provides information limited to that which is essential for the successful operation of the EMC-11 in making basic signal measurements. More detailed applications information is given elsewhere.

For the majority of signal measurements, unless specifically required for the test being performed, the EMC-11 FUNCTION Switch should NOT be set to the "TRACK" position. This switch position increases the potential for leakage of the tracking signal thereby increasing the possibility of its interference with the measurement of weak signals.

*** * * CAUTION * * ***

USE GREAT CARE WHEN MAKING MEASUREMENTS WITH THE OUTPUT FUNCTION SWITCH SET TO THE "TRACK" POSITION. THIS MAY CAUSE LARGE ERRORS IN THE METER INDICATIONS ESPECIALLY FOR LOW LEVEL SIGNALS. IN ADDITION, THE OUTPUT LEVEL CONTROL SHOULD BE FULL CCW DURING TESTS UNLESS OTHERWISE REQUIRED FOR THE TEST BEING PERFORMED.

2.8.3.1 CONDUCTED SIGNAL MEASUREMENT CONSIDERATIONS

The EMC-11 incorporates a balanced differential input circuit, with high common mode rejection, using a TWINAX input connector to permit differential conducted measurements between two ungrounded sources for all input impedance settings. As explained below, this differential input can be of equal importance for single-ended conducted measurements, since referencing the input ground of the receiver at the source avoids spurious responses due to ground loops, ground current coupling, and differences in ground potential. To completely break the ground loop and prevent undesired ground currents, either the EMC-11 or the source must be operated using either battery power or through an isolation transformer with AC power. The only ground connection to the receiver and the source must be the one established in the test setup.

NOTE: Radiated measurements using ungrounded antennas do not usually require special interconnection considerations since the receiver is normally the reference ground point for these measurements.

When making single-ended measurements the physical and electrical arrangements plus the interconnections between the source and the EMC-11 will have major effects on both the accuracy and effective sensitivity of the measurements. The problem is more complicated in the case of the EMC-11 than for most higher frequency receivers, because this receiver covers a range of frequencies which includes the power frequency and its major harmonics. The conclusion is that the interconnection approaches taken must be very carefully planned if the full capabilities of the EMC-11 are to be realized.

One of the most significant factors is cable length, and thus the distance, between the source and the receiver. Obviously, the dividing line can be placed at any of a wide range of distances depending upon the specific measurement to be made and the circumstances surrounding it. ELECTRO-METRICS has chosen to suggest an arbitrary cable length or distance of 150 mm (six inches) as a dividing line between two source-receiver interconnection approaches. These two approaches are discussed below.

To help the user of the EMC-11 obtain its best performance, several standard accessories are supplied to provide various interconnection possibilities. These are:

1: TBA-11, TWINAX PLUG-TO-BNC PLUG Adapter cable.

2: CA-11, 150 mm TWINAX PLUG-TO-CLIP LEAD Adapter cable.

3: BC-11, 150 mm BNC (PLUG-TO-PLUG) cable.

4: TAC-11, 1.8 m TWINAX (PLUG-TO-PLUG) cable.

5: AB-11, TWINAX RECEPTACLE-TO-RECEPTACLE Adapter box.

6: BT-11, 50-ohm : 50-ohm BALUN Transformer with BNC JACK-TO-TWINAX RECEPTACLE connectors.

The BT-11 50-ohm BALUN transformer is recommended for single-ended 50-ohm measurements under circumstances where the power frequency and its harmonics could cause interference. This transformer will improve the effective sensitivity of the receiver and reduce spurious responses.

*** * * CAUTION * * ***

This BALUN transformer cannot handle high signal levels at low frequencies. The MAXIMUM signal level at 60 Hz must be limited to NOT MORE THAN 0.6 VRMS or 7 mW, otherwise extensive damage to the transformer may result.

(Refer to Figure 6.1 for the BT-11 BALUN transformer specifications.)

An optional IT-11 10-kilohm transformer is also available for single ended conducted measurements at the 10-kilohm input impedance of the receiver. This will enable the user to obtain the optimum performance from the receiver when measuring in a 10-kilohm system.

The two approaches for conducted measurements recommended by ELECTRO-METRICS are for CASE 1, signal source close to or nearby the receiver; and CASE 2, signal source distant or far from the receiver. As mentioned before, 150 mm is defined as the dividing line between "nearby" and "distant".

a. CASE 1, NEARBY SIGNAL SOURCE:

In this case, the short BNC cable, BC-11, 150 mm (six inches) in length may be used to connect the signal source to the receiver using the TWINAX PLUG-TO-BNC PLUG Adapter, TBA-11, on the front panel input connector. As an alternative, the TWINAX PLUG-TO-CLIP LEAD Adapter cable, CA-11, can also be used and is suitable for both single-ended and differential conducted measurements. In any event, to avoid ground loops and ground differential problems an unbalanced cable longer than 150 mm should not be used. When making single-ended measurements, cable, lead, and adapter lengths must be short to avoid unwanted pickup, common ground current coupling, and high circulating ground currents.

b. CASE 2, DISTANT SIGNAL SOURCE:

In this case, the TWINAX cable, TAC-11, is used which, by moving the ground reference to its input end, avoids spurious responses due to ground loops. If single-ended measurements are required, the BALUN transformer, BT-11, and the short BNC cable can be connected to the TWINAX cable using the TWINAX PLUG-TO-BNC PLUG Adapter, TBA-11. In the same manner, the Clip Lead Adapter, CA-11, can be connected through the AB-11 to the TWINAX cable and used for either single-ended or differential measurements. The 1.8 m (six-foot) TWINAX cable is supplied as a standard accessory with the receiver, and longer or shorter TWINAX cables are available on request.

2.8.3.1.1 DEFINITIONS

a. COMMON MODE:

In phase signals at the differential input to the receiver.

b. COMMON MODE REJECTION:

The ability of the input circuit of a receiver to suppress a common mode input.

c. GROUND LOOP:

A magnetic loop formed by having more than one ground path in a system. The current flowing in the ground return of a single ended input cable will appear as a spurious signal in the receiver. With a differential input to the receiver and a properly designed input cable system, ground currents in the input circuit are common mode and are rejected by the input amplifier.

d. GROUND DIFFERENTIAL:

A difference in ground potential between the source and receiver, caused by ground loops, ground lead currents from more than one source, or a difference in ground conductivity.

e. SPURIOUS RESPONSE:

A receiver output caused by something other than the actual two terminal voltage at the source. Ground loops, image responses, IF responses, harmonic responses, and mixer product responses are examples of spurious responses.

2.8.3.2 ELECTRIC FIELD STRENGTH MEASUREMENT

Electric field strength measurements may be made from 20 Hz to 50 kHz using the PEF-10A ELECTRIC FIELD PROBE ANTENNA with the EMC-11 INTERFERENCE ANALYZER. Before making measurements, calibrate the PEF-10A using the procedure in 2.8.3.2.2, and then make the measurements as described in 2.8.3.2.1.

2.8.3.2.1 PEF-10A OPERATIONAL USE

Make two-terminal voltage measurements with the EMC-11 using the PEF-10A as the transducer.

a. Set the EMC-11 front panel controls as follows:

DETECTOR Switch	As required
IMPEDANCE Switch	PROBE
HIGH PASS FILTER Switch	As required
LOW PASS FILTER Switch	As required
TUNING MODE Switch	As required
BANDWIDTH Switch	As required
FREQUENCY INDICATION	As required
ATTENUATION Setting	As required
OUTPUT FUNCTION Switch	VIDEO or IF[1]
OUTPUT LEVEL Control	FULL CCW[1]
AUDIO LEVEL Control	FULL CCW[1]

[1]Unless otherwise required for the tests being made.

*** * * CAUTION * * ***

USE GREAT CARE WHEN MAKING MEASUREMENTS WITH THE OUTPUT FUNCTION SWITCH SET TO THE "TRACK" POSITION. THIS MAY CAUSE LARGE ERRORS IN THE METER INDICATIONS ESPECIALLY FOR LOW LEVEL SIGNALS.

NOTE: The PEF-10A will measure correctly electric field strengths having PEAK values of 20 V/m (146 dB(μV)/m) or less. Fields stronger than this will produce overload conditions in the input circuitry of the EMC-11.

*** * * CAUTION * * ***

THE PEF-10A IS NOT INTENDED FOR MAKING MEASUREMENTS IN ULTRA-HIGH STRENGTH ELECTRIC FIELDS. DO NOT SUBJECT IT TO ELECTRIC FIELDS HAVING PEAK STRENGTHS GREATER THAN 61 V/m (156 dB(μV)/m). THE OUTPUT FROM THE PEF-10A MAY DAMAGE THE INPUT CIRCUITS OF THE EMC-11. THE PEF-10A MAY ITSELF BE DAMAGED BY FIELDS STRONGER THAN 80 V/m (158 dB(μV/m) PEAK.

b. Data Reduction:

Add 23 dB(m^{-1}) to the measured two-terminal voltage (meter reading) in dB(μV) or dB(μV/kHz) to obtain the electric field strength in dB(μV/m) or dB(μV/m/kHz).

2.8.3.2.2 PEF-10A CALIBRATION PROCEDURE

This procedure covers the calibration of the PEF-10A with the EMC-11. No external test equipment is required to perform this procedure.

NOTE: If a PEF-10A or other probe has not been used with this EMC-11 before, check the calibration signal level at Pin 3 of the PROBE CONNECTOR using the procedure in Paragraph 2.8.3.2.3.

a. Connect the PEF-10A to the 11-pin PROBE CONNECTOR on the front panel of the EMC-11.

b. Set the front panel controls as follows:

DETECTION Switch	RMS
IMPEDANCE Switch	PROBE
HIGH PASS FILTER Switch	OUT
LOW PASS FILTER Switch	50 kHz
TUNING MODE Switch	MANUAL
BANDWIDTH Switch	250 Hz
FREQUENCY INDICATION	10 kHz
ATTENUATION Setting	+20 dB
OUTPUT FUNCTION Switch	TRACK
OUTPUT LEVEL Control	FULL CCW
AUDIO LEVEL Control	FULL CCW

c. Turn on the EMC-11 and allow a minimum warm-up period of 30 minutes before proceding to Step d.

d. Unscrew the dipole elements from the probe assembly. Connect the calibration cables provided between the dipole element sockets (J2, J4) and the red calibration banana jacks (J1, J5).

e. Adjust the ATTENUATION Setting to obtain the highest on-scale (no overload indication present) analog meter indication.

f. Adjust the PEF-10A BALANCE Control until a null is obtained on the analog meter. Readjust the ATTENUATION Setting, if necessary, to verify that a null has been reached.

g. Disconnect one calibration cable from the red calibration jack and connect it to the ground jack.

h. Reset the ATTENUATION to +40 dB. Adjust the PEF-10A GAIN Control for a reading on the digital meter of 58 dB(μV).

i. Repeat Steps d thru h until no further adjustments are necessary. The depth of the null should be at least 40 dB.

j. Disconnect the calibration cables and screw on the dipole elements. The PEF-10A is now calibrated with the EMC-11 being used.

2.8.3.2.3 CALIBRATION SIGNAL LEVEL CHECK

The calibration signal level at Pin 3 of the front panel PROBE CONNECTOR may be easily checked by measuring the signal level between either red calibration banana jack and the ground jack on the PEF-10A. This may be done using the following procedure.

a. Perform Steps a thru c of the procedure in Paragraph 2.8.3.2.2 (PEF-10A CALIBRATION PROCEDURE).

b. Connect one of the calibration cables to either red calibration jack, J1 or J5, and the other to the ground jack.

c. Set the EMC-11 front panel IMPEDANCE Switch to the 10 kilohm position.

d. Using the CA-11 (TWINAX PLUG-TO-CLIP LEAD) Adapter Cable, connect between the two calibration banana plug cables and the EMC-11 INPUT CONNECTOR.

e. The front panel meter on the EMC-11 should indicate an open circuit calibration voltage of 66 dB(μV) $\pm$0.5 dB. If not, refer to Section IV (SERVICE, MAINTENANCE, AND CALIBRATION), Paragraph 4.7.12 Step g.

f. After performing the above procedure, set the EMC-11 front panel IMPEDANCE Switch to the PROBE position and continue with Step d of the PEF-10A CALIBRATION PROCEDURE.

2.8.3.3 OVERLOAD AND NOISE INDICATIONS

The INCREASE ATTENUATION and DECREASE ATTENUATION Switches each have an integral LED indicator to show that a condition of either overload or excessive receiver noise exists. When the receiver is first powered up, the attenuator is automatically set to maximum attenuation, and if no large signals are present at the input, the "excessive noise" LED is illuminated. The DECREASE ATTENUATION Switch should be pushed successively until the LED is extinguished. After this, if a large signal having an amplitude close to the overload level at any point in the receiver is encountered the "overload" LED will be illuminated. The INCREASE ATTENUATION Switch should be pushed successively until the LED is extinguished. Normally only one LED or the other (or neither) is simultaneously illuminated. However, there will sometimes be a situation in which both LEDs will be illuminated. This apparently ambiguous situation will result when the overload sensors in the front end of the receiver detect a large signal or noise which is at a frequency far removed from that to which the receiver is tuned, which the receiver noise sensor will not detect.

In the event that both LEDs are illuminated, try the following:

a. Narrow the front-end bandwidth by selecting one of the high pass filters and/or the 16 kHz low pass filter.

b. If this does not remedy the situation, disconnect the input signal cable from the receiver and ascertain that only the "excessive noise" indicator is illuminated at all attenuator settings. If this is not true, the receiver may be malfunctioning and should be referred to competent service personnel.

c. If the receiver is functioning properly, as indicated in Step b, reconnect the input signal cable and step the attenuator one or more steps in each direction. Note the analog meter response to see that the indicated noise and signal level changes by 10 dB for each step, indicating linear operation of the receiver. Make measurements only at an attenuator setting where linear operation is observed.

d. It may also be possible to remedy the situation by the use of additional external filters.

2.8.4 TUNING THE EMC-11

The following procedure should be used when tuning the EMC-11 in the "MANUAL" position of the TUNING MODE Switch.

2.8.4.1 SIGNAL AMPLITUDE MEASUREMENT

When measuring the amplitude of an input signal (and indirectly its frequency) the EMC-11 digital meter should be used to obtain this reading. However, since the response time of the digital meter is slow compared to the analog meter, the following procedure should be employed:

a. Tune the receiver for a maximum indication on the EMC-11 analog meter. Increase/decrease attenuation of the receiver to keep the signal on scale.

b. After the signal is peaked for maximum on the analog meter, read the level indicated by the digital meter.

The analog meter is meant for relative amplitude indication only and does not have the accuracy of the digital meter.

2.8.4.2 SIGNAL FREQUENCY MEASUREMENT

The procedure in 2.8.4.1 should also be used when determining the frequency of an unknown signal. However, to obtain the best possible accuracy in this indirect measurement of the signal frequency, the narrowest bandwidth should be used.

2.8.4.3 TUNING A SPECIFIC FREQUENCY

When setting the EMC-11 to a specific tuned frequency, the update-rate of the frequency display causes a delay between the instant when the tuning control is adjusted and the instant when the new tuned frequency of the receiver is displayed. To ease the tuning of the EMC-11 to a specific frequency, the following steps are recommended. Clockwise (CW) rotation of the tuning controls increases the frequency.

a. First set the FREQUENCY SCALE SELECTOR Switch to the kHz position and center the FINE TUNE Control.

b. Next set the EMC-11 at the specific frequency to the nearest 0.01 kHz (10 Hz) using the COARSE TUNE and MEDIUM TUNE controls. The delay in displaying these tuning adjustments is approximately 0.1 second. The COARSE TUNE Control span is approximately 5 kHz per turn and the MEDIUM TUNE Control span is approximately 500 Hz per turn.

c. Set the FREQUENCY SCALE SELECTOR Switch to the Hz position and allow the display to settle. This may take up to two seconds.

d. Adjust the FINE TUNE Control in small increments, pausing between increments to allow the display to change, until the specific frequency is reached. The total range of the FINE TUNE Control is approximately 35 Hz, stop-to-stop.

2.8.5 EMC-11/X-Y RECORDER OPERATION

2.8.5.1 GENERAL

The EMC-11 can drive only a single pen of an X-Y recorder. All connections to the X-Y recorder are through the rear panel 11-pin Plotter Connector (A3J2).

2.8.5.2 EMC-11/X-Y RECORDER CALIBRATION

NOTE: For the following procedure it is assumed that the controls of the X-Y recorder have been adjusted for normal operating conditions.

a. Set the EMC-11 front panel controls as follows:

TUNING MODE Switch ..... MANUAL
DETECTION Switch ..... SLIDEBACK
THRESHOLD Control ..... FULL CCW
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING CONTROL ..... 20 Hz
FINE TUNE Control ..... Mechanical center
AFC Control ..... OFF
ATTENUATION ..... 0 dB
BANDWIDTH Switch ..... 10 Hz

b. With the EMC-11 tuned to 20 Hz, adjust the X-ZERO Control of the recorder to position the recorder pen over the left hand margin of the chart paper.

c. Tune the EMC-11 to 50 kHz. Adjust the X-GAIN Control of the recorder to position the recorder pen over the right hand margin of the chart paper.

d. Repeat steps b & c until no further adjustments are necessary.

e. Tune the EMC-11 to 20 kHz. Adjust the Y-ZERO Control of the recorder to position the recorder pen so that the noise level is slightly above the bottom margin of the chart paper.

f. Adjust the THRESHOLD bias level for a full scale reading (+40 dB) on the front panel analog meter.

g. Adjust the Y-GAIN Control of the recorder to position the recorder pen over the top margin of the chart paper.

h. Repeat steps e thru g until no further adjustments are necessary.

2.8.5.3 EMC-11/X-Y RECORDER OPERATION

a. Set the EMC-11 front panel controls as required for the test being performed e.g. BANDWIDTH, DETECTION, IMPEDANCE, etc.

*** * * CAUTION * * ***

DO NOT CALIBRATE THE EMC-11 WITH THE TUNING MODE SWITCH SET TO THE PLOTTER POSITION. THIS WILL CAUSE RECEIVER CALIBRATION TO TAKE PLACE AT "0"FREQUENCY SO THAT THE CAL SIGNAL IS AN "LO" FEEDTHROUGH AND THEREFORE NOT ACCURATE.

b. Set the SWEEP WIDTH/RATE Control at the setting desired:

FULL CCW (CAL), an intermediate setting, or FULL CW (FAST). In conjunction with the BANDWIDTH Switch setting, the SWEEP WIDTH/RATE Control determines the sweep speed of the recorder as follows:

(1) CAL (FULL CCW): Produces the maximum sweep time/slowest rate. The sweep circuitry sets an optimum sweep rate, determined by the

IF bandwidth selected, which permits the X-Y recorder to accurately record the amplitude level of a detected signal.

(2) FAST (FULL CW): Produces the minimum sweep time/fastest sweep rate. The sweep circuitry produces a sweep rate which is ten (10) times faster than in the CAL position. The X-Y recorder, therefore, will not accurately record the amplitude level of a detected signal due to the response times of the recorder, detector, and IF bandwidth.

c. Set the TUNING MODE Switch to the PLOTTER position. The recorder pen will be automatically positioned over the left hand margin of the chart paper.

d. Push the SWEEP START Switch. This starts the sweep voltage ramp and drops the recorder pen.

e. When the sweep voltage reaches the upper frequency limit (50 kHz), the pen will automatically lift and return to the left hand margin of the chart paper.

The noise and various slideback levels can be plotted on the chart paper to produce convenient calibration lines.

2.8.6 EMC-11/OSCILLOSCOPE OPERATION

2.8.6.1 GENERAL

The EMC-11 has the capability and provision for using an external oscilloscope to produce a spectrum analyzer type display covering the frequency range of the receiver.

2.8.6.2 OPERATION

The two following EMC-11 outputs are used for oscilloscope presentation:

a. **A3J3 (HORIZONTAL OUTPUT):** Horizontal (X) output to the horizontal amplifier of the oscilloscope..

NOTE: The oscilloscope used **must have provision** for an external horizontal input of 8-10 V.

b. **A3J4 (VERTICAL OUTPUT):** Vertical (Y) output to the vertical amplifier of the oscilloscope.

NOTE: A BLANKING input to the oscilloscope is not required, since a trace/retrace feature is incorporated into the sweep circuitry of the receiver. This feature allows the oscilloscope to display the EMC-11 output spectrum on the CRT during the normal retrace cycle.

Connect the EMC-11 to the oscilloscope with both the vertical and horizontal inputs DC coupled. Set the oscilloscope for EXTERNAL HORIZONTAL or X-AXIS (**NOT EXTERNAL TRIGGER**). The oscilloscope must have an external input to the horizontal amplifier-refer to the oscilloscope instruction manual.

Set the EMC-11 front panel controls as follows:

DETECTION Switch ..... SLIDEBACK
THRESHOLD Control..... FULL CCW
TUNING Control 20kHz
FINE TUNE Control ..... Mechanical center
AFC Switch.....OFF
TUNING MODE Switch ..... CRT

When the controls are set as described, a display equivalent to the frequency range of the EMC-11 will appear on the CRT of the oscilloscope.

NOTE: When the TUNING MODE Switch is set for CRT, the sweep is automatically started and continuously repeated.

Use the MIN and MAX functions (black) of the SWEEP WIDTH/RATE Control to set the sweep rate. In conjunction with the BANDWIDTH Switch settings, the SWEEP WIDTH/RATE Control determines the sweep rate and width of the oscilloscope display centered about the tuned frequency of the receiver as follows:

(1) MIN (FULL CCW): Produces the narrowest sweep width/slowest sweep rate. The sweep width is equal to the IF bandwidth selected.

(2) MAX (FULL CW): Produces the widest sweep width/fastestsweep rate. The sweep width is equal to ten (10) times the IF bandwidth selected.

The frequency of signals appearing on the CRT can be determined by tuning the receiver and in conjunction with the IF BANDWIDTH Switch, placing the signal in question at the center of the CRT display.

NOTE: For the narrower bandwidths of the EMC-11 (10 Hz to 100 Hz) a storage scope, such as the ELECTRO-METRICS MODEL SPD-111, is required to visually see the waveform on the CRT display due to the slower sweep speeds.

Since the CRT sweep is centered about the tuned frequency of the receiver, the frequency of the signal can be read directly from the EMC-11

FREQUENCY DISPLAY. The amplitude of signals appearing on the CRT can be determined by using the THRESHOLD Control (SLIDEBACK position only) of the receiver in conjunction with the front panel digital meter indication. Starting with the THRESHOLD Control FULL CCW, rotate the THRESHOLD Control CW (trace line will move up the CRT display) until the trace line intersects the peak of the signal in question. Since the digital indication of the receiver matches the trace level increase on the CRT display, the amplitude level of the signal in question will be indicated by the digital meter. The other positions of the DETECTION Switch — AVERAGE, RMS, PEAK, QUASI-PEAK — will also produce valid displays on the CRT. However, the indication of signal amplitude level cannot be determined as accurately for these positions.

SECTION III
PERFORMANCE CHECK

3.1 GENERAL

The test procedures in Section 3.4 are designed to produce information on the operational status of the EMC-11 receiver. The results of the tests should indicate whether the receiver is performing within specification limits and if repair or recalibration is required.

Table 3.1 is a listing of the recommended test equipment and specifications.

TABLE 3.1

RECOMMENDED TEST EQUIPMENT

EQUIPMENT	PERFORMANCE RATINGS	RECOMMENDATIONS
SIGNAL GENERATOR (FUNCTION GENERATOR)	FREQ. RANGE: 1 Hz — 100 kHz FREQ. RESOLUTION: 1 μHz AMP. RANGE: 1 mV — 10.0 V AMP. ACCURACY: **Sinewave** ± 0.1 dB IMPEDANCE: 50 ohms.	HEWLETT PACKARD MODEL 3325A
STEP ATTENUATOR	**10 dB** ATTEN. RANGE: 0 — 120 dB ACCURACY: ± 0.5 dB IMPEDANCE: 50 ohms **1 dB** ATTEN. RANGE: 0 — 12 dB ACCURACY: ± 0.25 dB IMPEDANCE: 50 ohms	HEWLETT PACKARD MODEL 355C (1 dB) MODEL 355D (10 dB)
VIDEO VOLTMETER	VOLTAGE RANGE: WITH PROBE: 10 mV — 1000 V DIRECT: 1 mV — 100 V ACCURACY: ± 1.0 dB IMPEDANCE: 50 ohms	BALLANTINE LABORATORIES MODEL 314A
OSCILLOSCOPE	FREQ. RANGE: DC — 100 MHz IMPEDANCE: 1 Megohm	TEKTRONIX MODEL 466

3.2 WHEN TO USE TEST PROCEDURES

The test procedures can be used as follows:

a. As part of the incoming Q.C. inspection check, with results recorded for future reference.

b. As part of the periodic maintenance/calibration check after every 2000 hours of operation.

c. As part of the repair procedure to locate and isolate malfunctioning circuits.

3.3 PRELIMINARY

3.3.1 PRECAUTIONS

a. Check that the Power Source selector card is set for the AC power source being used.

b. Allow a minimum warm-up period of 30 minutes before proceeding with the Performance Test Procedures.

c. Caution should be taken to avoid or minimize ground loops between the test equipment and the EMC-11.

d. Accuracy of the test equipment must be equal to or greater than that of the parameter being measured.

NOTE: The accuracy of the test equipment should ideally be much better, usually at least ten times better, than that of the parameter being measured, e.g., if the error allowable in the parameter is ± 1 V, the error allowable in the test equipment is no more than ± 0.1 V. For practical purposes this 10:1 ratio is relaxed to 4:1, e.g., if the parameter error is ± 1 V, the test instrument error should be no more than ± 0.25 V. When this cannot be achieved, as in many RF amplitude measurements, the test instrument accuracy must be no worse than that of the parameter being measured.

3.3.2 CONTROL SETTINGS

For each test, set the listed front panel controls for the settings indicated. The following front panel controls will remain at the settings indicated throughout the performance tests of Section 3.4.

AFC Switch ..... OFF
FINE TUNE Control ..... Mechanical center
FREQUENCY RANGE
SELECTOR Switch ..... Hz
THRESHOLD Control ..... FULL CCW

3.3.3 FREQUENCY CHECK POINTS

The majority of the test procedures in Section 3.4 require that the procedure be repeated at several frequency check points. The selection of the actual test frequencies is not critical, but in order to obtain an overall performance evaluation of the receiver, the frequency spread should cover the frequency range (20 Hz — 50 kHz) of the receiver.

3.3.4 SIGNAL AMPLITUDE AND FREQUENCY ACCURACY

To reduce the risk of error when performing the procedures in Section 3.4, use the following method to determine the amplitude and frequency of the input signal:

a. Tune the signal source/receiver for a maximum indication on the Analog Meter.

b. After the signal is peaked for maximum on the Analog Meter, read the level indicated on the Digital Meter.

c. With the signal peaked for maximum, the frequency of the signal will be indicated on the FREQUENCY DISPLAY with the accuracy specified in Table 1.1.

3.4 PERFORMANCE TEST PROCEDURES

3.4.1 CW VOLTAGE ACCURACY

Specification: ± 1.0 dB
Equipment required: Signal Generator

NOTE: This procedure is performed at several frequency check points selected by the operator.

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT FUNCTION Switch ..... IF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Set the receiver for the first test frequency selected and initiate the calibration sequence by pushing the front panel CAL Switch. The UNCAL indicator will be lighted for the duration of the calibration sequence (approximately 2-3 seconds). If the UNCAL indicator remains lighted beyond 3 seconds, check the front panel control settings for possible errors (e.g. attempting to calibrate the receiver at 25 kHz with the LOW PASS FILTER set for 16 kHz).

c. Apply a CW signal at the test frequency selected to the INPUT of the EMC-11. Set the signal input level at 100 dB(μV) (100 mV).

d. Peak the signal for a maximum indication on the front panel analog meter (use the method described in Paragraph 3.3.4). Verify that the digital meter reads 100 dB(μV) ± 1.0 dB.

e. Repeat steps b thru d for each of the frequency test points selected.

3.4.2 FREQUENCY ACCURACY

Specification: ± 0.01% ± 1 Hz @ 10 Hz BW
Equipment required: Signal Generator

NOTE: This procedure is performed at several frequency check points selected by the operator.

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT FUNCTION Switch ..... IF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Perform the calibration sequence described in 3.4.1 step b.

c. Apply a CW signal at the test frequency selected to the INPUT of the EMC-11. Set the signal input level at 100 dB(μV) (100 mV).

d. Peak the signal source for a maximum indication on the front panel analog meter (use the method described in Paragraph 3.3.4). The digital meter should indicate 100 dB(μV).

e. The frequency indication of the receiver should be within $\pm$ 0.01% $\pm$ 1 Hz of the signal source frequency.

f. Repeat steps b thru e for each of the frequency test points selected.

3.4.3 ATTENUATION ACCURACY

Specification: $\pm$ 1.0 dB
Equipment required: Signal Generator
10 dB Step Attenuator

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
BANDWIDTH Switch ..... 100 Hz
ATTENUATION Setting .....-20 dB
OUTPUT FUNCTION Switch ..... IF

b. Apply a 25 kHz CW signal via a 10 dB Step Attenuator to the EMC-11 INPUT connector. Set the external Step Attenuator for 120 dB of attenuation and the Signal Generator output level at 120 dB(μV) (1.0 V).

c. Peak the signal for a maximum indication on the front panel analog meter. Verify that the digital meter reads 0 dB(μV). If not, calibrate the receiver.

d. Starting with the external Step Attenuator set for 120 dB of attenuation and the internal EMC-11 ATTENUATION set for -20 dB, decrease the external attenuation in 10 dB steps while simultaneously increasing the EMC-11 ATTENUATION in 10 dB steps. The front panel digital meter should indicate from 0 dB(μV) to +120 dB(μV) $\pm$ 1.0 dB in 10 dB steps.

NOTE: For the last step on the external Step Attenuator, 10 to 0 dB, there is no corresponding step increase for the EMC-11 ATTENUATION.

3.4.4 CW SENSITIVITY

Specification: Refer to SECTION I TABLE 1.1 EMC-11 Specifications.
Equipment required: Signal Generator
1 dB & 10 dB
Step Attenuators

NOTE: This procedure is performed at several frequency check points selected by the operator. In addition, the following should be noted:

1. At 50 kHz, sensitivity will be degraded by approx. 3 dB due to attenuation caused by the LOW PASS FILTER network.
2. At 20 Hz, sensitivity will be degraded by approx. 20 dB due to the closeness of the LO and intermediate frequencies.

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch..... 6 kHz
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting .....-20 dB
OUTPUT FUNCTION Switch ..... IF

b. Set the receiver for the first test frequency selected and perform the calibration sequence described in 3.4.1 step b.

c. With no signal applied to the receiver, record the residual noise level displayed on the digital meter.

d. Apply a CW signal at the test frequency selected to the EMC-11 INPUT connector via the Step Attenuators. Set the signal input level approximately 10 dB above the residual noise level noted in step c. Peak the signal for a maximum indication on the front panel analog meter.

e. Decrease the input signal level until the digital meter reads 3 dB above the residual noise level. Record the level of the signal generator, in dB(μV), minus all external attenuation required to obtain the 3 dB meter reading. This is the CW sensitivity at the input impedance and IF bandwidth selected, e.g., 50 ohms and 10 Hz. Sensi-

tivity specifications may be obtained from SECTION I TABLE 1.1.

f. Repeat steps b thru e for the remaining IF bandwidths

g. OPERATOR'S OPTION: Repeat steps b thru f for the 600 ohm, 10 kilohm, and 100 kilohm input impedances.

NOTE: The receiver will automatically initiate the calibration sequence for each change in input impedance.

h. Repeat steps b thru g for each of the frequency test points selected.

3.4.5 INPUT FILTER CHECK

Specification: As noted

Equipment required: Signal Generator

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
TUNING MODE Switch ..... MANUAL
BANDWIDTH Switch ..... WIDE
ATTENUATION Switch ..... 90 dB
OUTPUT FUNCTION Switch ..... IF

3.4.5.1 LOW PASS FILTER CHECK

Specification:

Flatness: ± 1.0 dB

Cutoff frequency: 16 kHz ± 2.0 kHz
50 kHz ± 2.0 kHz

a. Set the LOW PASS FILTER Switch to 50 kHz.

b. Apply a 100 Hz CW signal at an input level of 1 V to the EMC-11 INPUT connector, the front panel digital meter should read 120 dB(μV). If not, adjust the Signal Generator output level to obtain this reading. This sets the amplitude reference level for this procedure.

c. Vary the CW signal frequency from 100 Hz to 60 kHz, noting the following:

1. 100 Hz to 40 kHz: amplitude level flatness is ± 1.0 dB.
2. 3 dB cutoff frequency is 50 kHz ± 2.0 kHz.

d. Set the LOW PASS FILTER Switch to 16 kHz and repeat steps b and c except for the following:

1. Vary the CW signal frequency from 100 Hz to 30 kHz.
2. 100 Hz to 12 kHz: amplitude level flatness is ± 1.0 dB.
3. 3 dB cutoff frequency is 16 kHz ± 2.0 kHz.

3.4.5.2 HIGH PASS FILTER CHECK

Specification:

Flatness: ± 1.0 dB

Cutoff frequency: 16 Hz ± 1.6 Hz
200 Hz ± 20 Hz
1.0 kHz ± 100 Hz
6.0 kHz ± 600 Hz

a. Set the HIGH PASS FILTER Switch to 200 Hz.

b. Apply a 40 kHz CW signal at an input level of 1 V to the EMC-11 INPUT connector, the front panel digital meter should read 120 dB(μV). If not, adjust the Signal Generator output level to obtain this reading. This sets the amplitude reference level for this procedure.

c. Vary the CW signal frequency from 40 kHz to 100 Hz, noting the following:

1. 40 kHz to 1.0 kHz: amplitude level flatness is ± 1.0 dB.
2. 3 dB cutoff frequency is 200 Hz ± 20 Hz.

d. Repeat steps b and c for the 1 kHz and 6 kHz positions of the HIGH PASS FILTER Switch except for the following:

1. 1 kHz position: 40 kHz to 2 kHz: amplitude level flatness ± 1.0 dB.
   3 dB cutoff frequency: 1.0 kHz ± 100 Hz.
2. 6 kHz position: 40 kHz to 10 kHz: amplitude level flatness ± 1.0 dB.
   3 dB cutoff frequency: 6.0 kHz ± 600 Hz.

e. Repeat steps b and c for the 16 Hz (OUT) position of the HIGH PASS FILTER Switch except for the following:

1. 40 kHz to 250 Hz: amplitude level flatness ± 1.0 dB.
2. 3 dB cutoff frequency is 16 Hz ± 1.6 Hz.

3.4.6 BANDWIDTH (6 dB)

Specification:

10 Hz ± 2 Hz	500 Hz ± 50 Hz
40 Hz ± 4 Hz	1.0 kHz ± 100 Hz
100 Hz ± 10 Hz	2.5 kHz ± 250 Hz
250 Hz ± 25 Hz	5.0 kHz ± 500 Hz

Equipment required: Signal Generator

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
FREQUENCY Indication ..... 20000 Hz
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT FUNCTION Switch ..... IF

b. Apply a 20 kHz CW signal at an input level of 100 mV to the EMC-11 INPUT connector. Peak the signal for a maximum indication on the front panel analog meter, the digital meter should read 120 dB(μV). If not, adjust the Signal Generator output level to obtain this reading. This sets the reference point for the following procedure.

c. Using the front panel TUNING CONTROL, increase the tuned frequency of the receiver until the digital meter reads 6 dB down from the reference point. Record the frequency at this point.

d. Decrease the tuned frequency of the receiver until the digital meter again reads 6 dB down from the reference point. Record the frequency at this point.

e. Subtract the frequency reading in step c from the reading in step d, the difference should equal 10 Hz $\pm$ 2 Hz.

f. Repeat steps b thru e for the remaining seven IF bandwidthsof the receiver — 40 Hz, 100 Hz, 250 Hz, 500 Hz, 1 kHz, 2.5 kHz, and 5 kHz. Refer to the specification chart at the beginning of this procedure to obtain the specification limits for each bandwidth.

3.4.7 IF REJECTION

Specification: 70 dB minimum
Equipment required: Signal Generator

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
FREQUENCY Indication ..... 36 kHz
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting ..... 0 dB
OUTPUT FUNCTION Switch ..... IF

b. Apply a 100 kHz CW signal at an input level of 100 mV to the EMC-11 INPUT connector.

c. Peak the Signal Generator for a maximum indication on the front panel analog meter, the digital meter should indicate a reading less than or equal to +30 dB(μV). This reading indicates an IF Rejection equal to or greater than 70 dB.

3.4.8 OUTPUT FUNCTION CHECK

Specification: The specification limit for each OUTPUT FUNCTION is noted in the test procedure used to verify the function in question.

Equipment required:
Signal Generator
Oscilloscope
Video Voltmeter
600 ohm resistive load

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
BANDWIDTH Switch ..... 100 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Connect an Oscilloscope, Video Voltmeter, and 600 ohm resistive load to the front panel OUTPUT Connector.

c. Set the OUTPUT FUNCTION Switch to TRACK (TRACKING OUTPUT) and perform the following:

1. Tune the EMC-11 to 1 kHz and increase the OUTPUT LEVEL Control CW The Video Voltmeter should indicate a minimum level of 1 V RMS for the TRACKING Output before clipping occurs. Set the control at the 1 v RMS level.

2. Tune the receiver from 20 Hz to 50 kHz, the TRACKING Output voltage level should constant within $\pm$ 1.0 dB.

d. Set the OUTPUT FUNCTION Switch to RESTORED and perform the following:

1. Apply a 10 kHz CW signal at an input level of +100 dB (μV) (100 mV) to the EMC-11 INPUT Connector. Peak the receiver for a maximum indication on the front panel analog meter.

2. The OUTPUT signal present should be a 10 kHz restored presentation of the CW input signal. Vary the OUTPUT LEVEL Control from FULL CCW to FULL CW, the Video Voltmeter should indicate a minimum level of 1 V RMS before clipping occurs.

e. Set the OUTPUT FUNCTION Switch to IF and perform the following:

1. Repeat step d-1.

2. The OUTPUT signal present should be the 100 kHz signal obtained from the IF Amplifier circuit. Vary the OUTPUT LEVEL Control from FULL CCW to FULL CW. For the FULL CCW position, the Video Voltmeter should indicate a reading equal to or less than 0.05 V RMS. As the control is increased towards FULL CW, the Video Voltmeter should indicate

a minimum level of 1 V RMS before clipping occurs.

f. Set the OUTPUT FUNCTION Switch to LINEAR VIDEO, the BANDWIDTH Switch to WIDE BAND and the signal input level to 120 dB(μV). Perform the following:

1. Repeat step d-1, except that the signal does not need to be peaked for maximum on the analog meter.
2. The OUTPUT signal present should be a half-wave rectified presentation of the 100 kHz IF signal. Vary the OUTPUT LEVEL Control from FULL CCW to FULL CW, the Video Voltmeter should indicate a minimum level of 1 V RMS before clipping occurs (on upper portion of the waveform).

g. Connect an oscilloscope with a 600 ohm resistive load to the front panel AUDIO OUTPUT JACK and set the BANDWIDTH Switch to the 100 Hz position.

h. Apply a 1 kHz CW signal at an input level of +100 dB(μV) (100 mV) to the EMC-11 INPUT Connector. Peak the receiver for a maximum indication on the front panel analog meter.

i. Set the OUTPUT FUNCTION Switch to TRACK and vary the AUDIO LEVEL Control from FULL CCW to FULL CW, the Oscilloscope should present a video representation of the audio output signal with a minimum level of 10 V P-P before clipping occurs.

j. Tune the receiver from 20 Hz to 50 kHz, note the frequency points where the audio signal decreases 3 dB. The specification limits are:

Lower frequency: 100 Hz maximum.
Upper frequency: 10 kHz minimum.

k. Set the OUTPUT FUNCTION Switch to BFO. Repeak the receiver for a maximum indication on the front panel analog meter at 1 kHz.

l. A beat note, ranging in frequency from 300 to 2000 Hz, should be present on the oscilloscope presentation of the audio output.

3.4.9 SPURIOUS RESPONSE

Specifications: With external signal input: 60 dB minimum rejection. With no external signal input: 3 dB maximum above residual noise level.

Equipment required: Signal Generator

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 16 kHz
TUNING MODE Switch ..... MANUAL
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting .....-20 dB
OUTPUT FUNCTION Switch ..... IF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Apply an 15 kHz CW signal at an input level of +10 dB(μV) (3μV) to the EMC-11 INPUT Connector. Tune the receiver to 30 kHz, the front panel digital meter should read no more than 3 dB above the residual noise level of the receiver indicating a minimum rejection of 60 dB.

c. With all input signals disconnected, slowly tune the receiver from 20 Hz to 50 kHz. Record the frequency and level above the sensitivity of the receiver of all spurious responses.

NOTE: Caution is required to distinguish between internally generated spurious responses and responses due to externally generated fields especially at or near the power line frequencies.

3.4.10 SWEEP FUNCTION CHECK

Specifications:

Plotter Sweep Time:

Bandwidth	**Time** (minutes ± 20%)
10 Hz	6.0
40 Hz	6.0
100 Hz	6.0
250 Hz	2.5
500 Hz	1.5
1.0 kHz	1.0
2.5 kHz	0.5
5.0 kHz	0.5

CRT X Sweep Waveform Frequency:

Bandwidth	**Time** (seconds-minimum)
10 Hz	10.0
40 Hz	10.0
100 Hz	2.0
250 Hz	1.0
500 Hz	0.5
1.0 kHz	0.5
2.5 kHz	0.5
5.0 kHz	0.5

Equipment required: Oscilloscope

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
ATTENUATION Switch ..... 90 dB
OUTPUT FUNCTION Switch ..... IF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Set the BANDWIDTH Switch to 5 kHz, SWEEP WIDTH/RATE Switch FULL CCW (CAL), TUNING MODE Switch to PLOTTER, and push the SWEEP START Switch. Note the front panel FREQUENCY DISPLAY, the receiver should sweep from below 20 Hz to approximately 50 kHz in 30 seconds ± 20%.

c. Repeat Step b for the remaining IF bandwidths. Refer to the specification chart at the beginning of this procedure to obtain the sweep time for each bandwidth.

NOTE: To verify the longer sweep times use a time ratio method. EXAMPLE: For a 6 minute scantime, to scan 25% of the total frequency range, approx. 12500 Hz, will take approx. 1.5 minutes.

d. Connect the rear panel X OUTPUT to the vertical input of an Oscilloscope.

e. Set the BANDWIDTH Switch to 5 kHz, SWEEP WIDTH/RATE Switch FULL CCW, and the TUNING MODE Switch to CRT. The X Sweep waveform (triangle shape) should appear on the scope, verify that its time period is 0.5 seconds (minimum).

f. Repeat Step e for the remaining IF bandwidths. Refer to the specification chart at the beginning of this procedure to obtain the waveform time period for each bandwidth.

SECTION IV
SERVICE, MAINTENANCE, AND CALIBRATION

4.1 GENERAL

This section contains the information and procedures necessary for the proper maintenance, calibration, troubleshooting, and repair of the EMC-11 INTERFERENCE ANALYZER. Failure to follow these procedures could violate the terms of the manufacturer's warranty plus compromise the reliability, operation, and integrity of the receiver.

4.2 MAINTENANCE/CALIBRATION/REPAIR

4.2.1 MAINTENANCE

Maintenance and service on the EMC-11 should be scheduled on the basis of every six months or 1000 hours of operational use. The performance test procedures of SECTION III should be included as part of the maintenance procedure to assess the overall performance of the receiver.

4.2.2 CALIBRATION

The calibration/alignment procedures of Section 4.7 are used in the following manner:

a. To align and recalibrate the receiver after repair work has taken place.

b. As part of the periodic maintenance schedule to maintain the accuracy of the receiver to the required specification limits.

4.2.3 REPAIR

Repair of the receiver should be undertaken when one of the following conditions exists:

a. There is an obvious fault in the operation of the receiver.

b. Operation is outside the specification limits and cannot be restored by recalibrating the receiver.

4.2.4 TEST EQUIPMENT REQUIRED

TABLE 4.1 lists the test equipment required for troubleshooting and performing the calibration/alignment procedures.

4.3 PRECAUTIONS

a. Check that the Power Source selector card is correct for the AC power source being used (120/220 VAC). Operation on 220 VAC with the selector card set for 120 VAC can cause extensive circuit damage.

b. Use caution when making "power on" measurements to prevent inadvertent shorts and possible damage to circuit components.

c. To prevent possible damage to circuitry and components, always turn off and disconnect the AC power source and the optional battery (if installed) whenever removing/replacing/servicing modules, subassemblies, PC boards, or components within the instrument.

4.4 TROUBLESHOOTING

4.4.1 TROUBLESHOOTING PROCEDURE

The procedure for troubleshooting the EMC-11 is similar to that employed for other electronic equipment. This consists of pinpointing the source/cause of the malfunction by the process of logically eliminating alternate possibilities. By eliminating the greatest number of possibilities with one check, this process will quickly narrow the remaining choices until the defective component or circuitry is isolated.

For any assistance required, contact the ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT, (518) 843-2600.

4.4.2 OTHER CONSIDERATIONS

4.4.2.1 CONTROL SETTINGS

Always check that the front panel control settings are correct for the procedures and measurements being performed.

TABLE 4.1
RECOMMENDED TEST EQUIPMENT

EQUIPMENT	PERFORMANCE RATINGS	RECOMMENDATIONS[1]
FUNCTION GENERATOR/ FREQUENCY SYNTHESIZER (SIGNAL GENERATOR)	FREQ. RANGE: 1 Hz to 100 kHz FREQ. RESOLUTION: 1 μHz AMP. RANGE: 1 mV to 10.0 V AMP. ACCURACY: Sinewave $\pm$ 0.1 dB IMPEDANCE: 50 ohms.	HEWLETT PACKARD MODEL 3325A
STEP ATTENUATOR	10 dB ATTEN. RANGE: 0 — 120 dB ACCURACY: $\pm$ 0.5 dB IMPEDANCE: 50 ohms 1 dB ATTEN. RANGE: 0 — 12 dB ACCURACY: $\pm$ 0.25 dB IMPEDANCE: 50 ohms	HEWLETT PACKARD MODEL 355C (1 dB) MODEL 355D (10 dB)
VIDEO VOLTMETER	VOLTAGE RANGE: WITH PROBE: 10 mV to 1000 V DIRECT: 1 mV to 100 V ACCURACY: $\pm$ 1.0 dB IMPEDANCE: 50 ohms	BALLANTINE LABORATORIES MODEL 314A
OSCILLOSCOPE	FREQ. RANGE: DC TO 100 MHz IMPEDANCE: 1 Megaohm	TEKTRONIX MODEL 466
DIGITAL VOLTMETER	RANGE: 0 to 1000 VDC ACCURACY: $\pm$ 0.1% INPUT IMPEDANCE:$\geq$ 10 Megaohm	DATA-TECH MODEL 40

[1]Equivalent equipment can be substituted for those recommended.

4.4.2.2 OPERATIONAL ERRORS

Operational errors can be avoided or minimized through a thorough familiarization with the operating instructions and explanations in SECTION II.

4.4.2.3 TEST EQUIPMENT ACCURACY

Test equipment accuracy must be equal to or greater than the parameter being measured. In addition, all sources of error should be carefully noted.

NOTE: The accuracy of the test equipment should ideally be much better, usually at least ten times better, than that of the parameter being measured, e.g., if the error allowable in the parameter is $\pm$1 V, the error allowable in the test equipment is no more than $\pm$0.1 V. For practical purposes this 10:1 ratio is relaxed to 4:1, e.g., if the parameter error is $\pm$1 V, the test instrument error should be no more than $\pm$0.25 V. When this cannot be achieved, as in many RF amplitude measurements, the test instrument accuracy must be no worse than that of the parameter being measured.

4.4.2.4 BATTERY TEST (OPTIONAL)

EMC-11 operation using the optional battery module as a sole power source should have the battery charge status checked periodically. The battery status is checked, with the receiver turned on and the AC power source disconnected, by pushing the front panel BATTERY TEST Switch. If the front panel analog meter reads within the two markings of the battery test scale, the battery charge is sufficient to operate the receiver. If the meter reads at or below the lower battery scale marking, the battery requires recharging as per SECTION 2.6.6.

4.4.2.5 REMOTE CONNECTOR VOLTAGES

To verify whether the internal voltage regulators are functioning correctly, check the voltages on the following REMOTE Connector (A3J1) pins:

A3J1 PIN No.	DC VOLTAGES
J	+15.0 VDC ±0.1 VDC
K	-15.0 VDC ±0.1 VDC
L	+5.0 VDC ±0.1 VDC
M	-5.0 VDC ±0.1 VDC

4.5 REPAIR PROCEDURES

4.5.1 METHOD

a. Isolate the area of receiver malfunction thru the procedures in Sections III-IV and the reference data in Section VIII.

b. Use the information obtained to determine the level of service required.

c. If the level of service is replacement of defective modules/subassemblies/PC boards: All modules, subassemblies, and PC boards are replaceable without affecting the overall characteristics and specification limits of the EMC-11 provided that alignment and calibration are performed in accordance with the procedures in Section 4.7.

d. If the level of service is repair of the defective modules/subassemblies/PC boards: Use the procedures in Section 4.7 and the reference data in Section VIII to isolate the malfunction down to an individual component/components.

After all repair functions have taken place, align and calibrate the EMC-11 using the procedures in Section 4.7.

e. After completion of the alignment and calibration procedures, use the performance test procedures of Section III to verify that the EMC-11 is operating within specification limits.

4.5.2 PRINTED CIRCUIT BOARD PRECAUTIONS

a. Do not remove PC boards (or any other components) while power is applied to the receiver. Always turn off and disconnect the AC power source and optional battery module (if installed) before proceeding.

b. Never touch the printed surface with bare fingers, skin oils can create leakage paths.

c. Use a grounded soldering iron (20 to 30 watts) to avoid destruction of integrated circuits and semiconductors.

d. Avoid excessive heat when repairing a PC board.

e. After all repair work has been completed, clean the printed surface of all contaminants, excess solder, and resin using a freon-base cleaner. Check that excess solder has not created new circuit paths.

NOTE: After any general repair work, clean the repaired area with a freon-based or similar cleaner.

4.6 INSTRUMENT ACCESS/DISASSEMBLY/ASSEMBLY

(Refer to Figures 8.1, 8.2, & 8.3)

*** * * CAUTION * * ***

Before proceeding with any of the procedures listed below, turn OFF and disconnect the AC power source. If an optional battery pack is installed, its battery plug should be removed from the battery jack and inserted into the receptacle provided.

4.6.1 TOP/BOTTOM COVER REMOVAL

4.6.1.1 TOP COVER REMOVAL

a. The unit is placed top side up.

b. Remove the seven retaining screws (4-40 x 3/16) which secures the cover to the unit.

c. Slide the cover back and out of the slots holding the cover in place.

d. To replace the cover, reverse the above procedure.

4.6.1.2 BOTTOM COVER REMOVAL

a. The unit is placed bottom side up.

b. Remove the four feet from the bottom cover.

c. Remove the seven retaining screws (4-40 x 3/16) which secures the cover to the unit.

d. Slide the cover back and out of the slots holding the cover in place.

e. To replace the cover, reverse the above procedure.

4.6.2 CARD RACK ASSEMBLY (A2) COVER REMOVAL

a. Remove the top cover.

b. Remove the eight retaining screws (4-40 x 1/4) which secures the cover to the card rack assembly.

c. The cover is now free for removal.

d. To replace the cover, reverse the above procedure.

4.6.3 BATTERY (A7) REMOVAL

a. Remove the five retaining screws (4-40 x 3/16), located around the outside edge of the battery retainer plate, which secures the battery pack into the Power Supply Module (A4).

b. Carefully slide the battery packout of the power supply module. When the battery pack is far enough out, remove the battery plug from the battery pack and insert it into the battery receptacle located inside the power supply. The battery pack is now free of the unit.

c. To install a battery pack, reverse the above procedure.

4.6.4 POWER SUPPLY MODULE (A4) REMOVAL

a. Remove the ten retaining screws (4-40 x 3/16), located around the outside edge of the module, which secures the power supply module into the rear of the unit.

b. Carefully pull the Power Supply Module away and out from the compartment at the rear of the unit until the 34 pin power connector (A4J3) on the module is accessible.

c. Remove the power connector from the module. The Power Supply Module is now free for removal.

d. To install the Power Supply Module, reverse the above procedure.

4.6.5 FRONT PANEL ASSEMBLY (A1)

Removal of the Front Panel Assembly (A1) is not required for routine maintenance, service, and calibration. If removal is required, contact the Electro-Metrics Customer Service Department at (518) 843-2600 or your nearest Electro-Metrics representative for assistance and instructions.

4.7 CALIBRATION/ALIGNMENT PROCEDURES

4.7.1 GENERAL

This section contains the calibration/alignment procedures which are normally used to recalibrate/align the EMC-11 after repair/replacement work has been performed or when the performance test procedures of Section III indicates the performance of the receiver is outside specification limits.

4.7.1.1 The following procedures are performed with the POWER SOURCE MODULE set for 110 VAC and the receiver connected to a 110 VAC, 50-60 Hz AC power source.

4.7.1.2 The following will be useful during the performance of the calibration/alignment procedures:

a. The information in Section V (THEORY OF OPERATION) — explanation of circuitry operation and function.

b. The information in Section VIII (REFERENCE DATA) — location guides, schematics, and PC board layout diagrams (major components only).

4.7.1.3 The following conditions are in effect during the calibration/alignment procedures of Section 4.7:

a. The top, bottom, and Card Rack Assembly covers are removed from the receiver.

b. Unless otherwise indicated, all DC voltage measurements are taken with respect to ground.

c. Disconnect instructions are not included.

d. Power turn off instructions are not included.

4.7.2 CONTROL SETTINGS

For each procedure, set the listed front panel controls for the settings indicated. The following front panel controls will remain at the settings indicated throughout the calibration/alignment procedures for Section 4.7 unless otherwise noted.

AFC Switch ..... OFF
FINE TUNE Control ..... Mechanical center

4.7.3 PRELIMINARY PRECAUTIONS

a. When the unit is connected to the AC power source, 110/220 VAC is present on the front panel power switch, frequency display module, and DVM module.

b. Never remove PC boards, modules, or assemblies with the unit turned on and operating.

4.7.4 POWER SUPPLY VERIFICATION

Equipment required:
Digital Voltmeter
36 pin double-sided extension board (ECB-11), one (1) required.

TABLE 4.2

CARD RACK ASSEMBLY PC BOARD DESIGNATIONS VS CONNECTOR DESIGNATION

PC BOARD NOMENCLATURE	DESIGNATION	CONNECTOR DESIGNATION
INPUT SWITCHING	A2A1	A2J11
LOW PASS FILTER	A2A2	A2J12
HIGH PASS FILTER	A2A3	A2J13
PREAMPLIFIER/ATTENUATOR	A2A4	A2J14
IF AMPLIFIER #1	A2A5	A2J15
IF AMPLIFIER #2	A2A6	A2J16
IF AMPLIFIER #3	A2A7	A2J17
CALIBRATION CIRCUIT	A2A8	A2J18
DETECTOR	A2A9	A2J19
VCO	A2A10	A2J20
SWITCHING LOGIC	A2A11	A2J21
SWEEP	A2A12	A2J22
SWEEP CONTROL	A2A13	A2J23
AUDIO AMPLIFIER	A2A14	A2J24
CAL/TRACKING	A2A15	A2J25

4.7.4.1 REGULATED DC VOLTAGE CHECKS

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT FUNCTION Switch ..... IF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Measure the voltage on the following pins of A2J11:

A2J11-11/12: +15.00 ±0.10 VDC
A2J11-25/26: +5.00 ±0.20 VDC
A2J11-45/46: -5.00 ±0.20 VDC
A2J11-61/62: -15.00 ±0.10 VDC

c. The voltmeter should indicate the readings noted. If not, proceed to Section 4.7.4.2.

4.7.4.2 POWER SUPPLY BOARD A4A1 ADJUSTMENTS

a. Remove the Power Supply Module (A4) by following the procedure given in Section 4.6.4. Leave the Power Connector Plug A4P3 connected to A4J3 on the module to provide the proper loading factor for the power supply regulators.

b. With AC power applied and the receiver turned on, measure the voltage between A4J4-31/32 and A4J4-53/54. The voltmeter should indicate 30.00 ±0.05 VDC. If not, adjust A4A1-R30.

c. Measure the voltage on A4J4-31/32, the voltmeter should indicate -15.00 ±0.10 VDC. If not, adjust A4A1-R35.

NOTE: The +5.0 & -5.0 VDC regulators do not have external adjustments. If these supplies do not meet the stated specification limits, check for the following:

1. Excessive loading on the individual regulators.

2. Excessive loading on the entire power supply.

3. Component failure comprising either the regulators in question or other components within the power supply circuitry.

4.7.4.3 BATTERY CHARGER ADJUSTMENT

NOTE: 1. Allow the battery to attain the normal ambient air temperature before proceeding with the procedure. This can be accomplished by disconnecting the battery for a minimal time period of eight hours.

2. The Power Supply Module must be removed from the rear of the receiver to perform this procedure. Follow the procedure given in 4.7.4.2 Step a for removal of the Power Supply Module.

a. Turn off and disconnect the unit from the AC power source.

b. (Note: Disconnect the battery during this step.) Remove the Power Supply Board (A4A1) from its connector in the Power Supply module. Insert the 36 pin double-sided extension board, with a 68 kilohm resistor between pin 13/14 and pin 23, into the connector.

c. Insert the Power Supply board into the extension board and monitor the voltage across resistor A4A1-R10 (47 ohms, 2 watts).

d. Reconnect the battery into the power supply module and the receiver to the AC power source. The receiver is turned OFF during the performance of this procedure.

e. Adjust A4A1-R3 for a voltmeter indication of 0.65 VDC across A4A1-R10. The charger circuit is now set for normal operation.

f. After the above adjustment has been completed, disconnect the battery from the power supply module and the receiver from the AC power source. Remove the extension board and reinsert the Power Supply Board back into its connector.

4.7.5 SWEEP CIRCUITRY ADJUSTMENT/VERIFICATION

Equipment required:
- Digital Voltmeter
- Oscilloscope
- 36 pin double-sided extension board (ECB-11), two (2) required.

4.7.5.1 MANUAL TUNE FUNCTION ADJUSTMENT/VERIFICATION

a. Set the front panel controls as follows:

DETECTION Switch	RMS
IMPEDANCE Switch	50 ohms
HIGH PASS FILTER Switch	OUT
LOW PASS FILTER Switch	50 kHz
TUNING MODE Switch	MANUAL
BANDWIDTH Switch	40 Hz
ATTENUATION Setting	90 dB
OUTPUT FUNCTION Switch	IF
OUTPUT LEVEL Control	FULL CCW
AUDIO LEVEL Control	FULL CCW

b. Place the Sweep Control Board (A2A13) onto a 36 pin double-sided extension board.

c. Set the MAIN TUNING CONTROL Full CW. Monitoring the voltage on A2A13U3-13, adjust A2A13-R28 for a voltmeter indication of 1.500 ±0.050 VDC.

d. Monitoring the voltage on A2A13-43/44; verify that as the MAIN TUNING CONTROL is varied from Full CCW to Full CW, the voltmeter indication varies from 0.00 to +1.500 ±0.050 VDC. If not, adjust A2A13-R15.

e. Repeat Steps c and d until no further adjustments are necessary. Leave the Sweep Control Board on the extension board for now.

4.7.5.2 PLOTTER FUNCTION ADJUSTMENT/VERIFICATION

a. Place the Sweep Board (A2A12) onto a 36 pin double-sided extension board.

b. Monitoring the voltage on A2A13-43/44, set the TUNING MODE Switch to the PLOTTER position and the SWEEP WIDTH/RATE Control approximately mid-range. The voltmeter should indicate 0.00 V.

c. Monitoring the voltage on A2A12-21/22, press the SWEEP START Switch. The voltmeter should indicate a voltage varying from 0.0 V to approximately +10.0 V. If not, adjust A2A12-R41.

d. Verify that the voltage on A2A13-69/70 varies from 0.0 to +10 V (approx.) when the SWEEP START Switch is pressed.

e. Monitoring the voltage on A2A13-67/68, press the SWEEP START Switch. The voltmeter should indicate a voltage varying from 0.000 to +1.500 ±0.050 VDC. If not, adjust A2A13-R25.

f. Monitoring the voltage on A2A13-43/44, press the SWEEP START Switch. The voltmeter should indicate a voltage varying from 0.000 to +1.500 ±0.050 VDC. If not, adjust A2A13-R18.

4.7.5.3 CRT FUNCTION ADJUSTMENT/VERIFICATION

NOTE: Unless otherwise indicated, all measurements for the following procedure are taken using an Oscilloscope. Inputs to the Oscilloscope are DC coupled, with all measurements centered about a ground reference trace on the CRT display.

a. Monitoring the waveform on A2A12-21/22, set the TUNING MODE Switch to the CRT position and the SWEEP WIDTH/RATE Control FULL CW. The Oscilloscope should indicate a symmetrical sawtooth waveform. If not, adjust A2A12-R26.

b. Monitoring the voltage on A2A12-5/6, the Oscilloscope should indicate a sweep voltage going from -5 to +5 VDC (approx.). If not, adjust A2A12-R36.

c. Monitor the voltage on A2A13-43/44 (Sweep Control Bd.) using a voltmeter. Set the TUNING MODE Switch to the MANUAL position and using the MAIN TUNING CONTROL, set the voltmeter for an indication of 0.75 V.

d. Set the SWEEP WIDTH/RATE Control FULL CCW (CAL position) and the BANDWIDTH Switch to the 5 kHz position.

e. Monitoring the voltage on A2A13-43/44, set the TUNING MODE Switch to the CRT position. The oscilloscope should indicate a peak to peak voltage of 0.150 V. If not, adjust A2A13-R10.

4.7.6 FREQUENCY DISPLAY MODULE VERIFICATION/ADJUSTMENT

Equipment required:
- Signal Generator
- Frequency Counter
- Alignment Tool

NOTE: The capacitor alignment tool should made of a nonmetallic material to prevent changes in the "Q" of the circuit.

a. Remove the cable from Connector A1A2-J1 on the Frequency Display Module. Set the FREQUENCY SCALE SELECTOR Switch to the "Hz" position and apply a 150.000 kHz CW signal at an input level of 300 mV RMS to A1A2-J1.

b. The FREQUENCY DISPLAY MODULE indicator should read 50 000. If not, adjust A1A2-C5 (available through an access hole on the side of the module).

4.7.7 VCO ADJUSTMENT/VERIFICATION

Equipment required: None

a. Set the front panel controls as follows:

DETECTION Switch	RMS
IMPEDANCE Switch	50 ohms
HIGH PASS FILTER Switch	OUT
LOW PASS FILTER Switch	50 kHz
TUNING MODE Switch	MANUAL
FREQUENCY SCALE SELECTOR Switch	kHz
BANDWIDTH Switch	40 Hz
ATTENUATION Setting	90 dB
OUTPUT FUNCTION Switch	IF
OUTPUT LEVEL Control	FULL CCW
AUDIO LEVEL Control	FULL CCW

b. Set the MAIN TUNING CONTROL FULL CCW, the FREQUENCY DISPLAY should indicate 199.900. If not, adjust A2A10-R20.

c. Set the MAIN TUNING CONTROL FULL CW, verify that the FREQUENCY DISPLAY upper limit is greater than 50.000.

4.7.8 PREAMPLIFIER/ATTENUATOR ADJUSTMENT/VERIFICATION

Equipment required:
- Signal Generator
- Video Voltmeter
- 36 pin double-sided extension board (ECB-11)

a. Set the front panel controls as follows:

DETECTION Switch	RMS
IMPEDANCE Switch	50 ohms
HIGH PASS FILTER Switch	OUT
LOW PASS FILTER Switch	50 kHz
TUNING MODE Switch	MANUAL
FREQUENCY SCALE SELECTOR Switch	kHz
BANDWIDTH Switch	40 Hz
ATTENUATION Setting	90 dB
OUTPUT FUNCTION Switch	IF
OUTPUT LEVEL Control	FULL CCW
AUDIO LEVEL Control	FULL CCW

b. Place the Preamplifier/Attenuator Board (A2A4) onto the 36 pin double-sided extension board.

c. Apply a 25 kHz CW signal at an input level of 3 mV RMS (+70 dB(μV)) to the INPUT Connector of the EMC-11.

d. Using a Video Voltmeter, measure the signal level on A2A4U2-7. The voltmeter should indicate approximately 1.0 V RMS.

e. Measure the signal level on A2A4U6-7, the voltmeter should indicate a level 40 dB $\pm$0.5 dB less than the level measured on A2A4U2-7 in Step d. If not, adjust A2A4-R4.

f. Set the EMC-11 front panel ATTENUATION Setting to -20 dB and the input CW signal level to 1.0 μV (0 dB(μV)).

g. Monitoring the signal level on A2A4U7-1, adjust A2A4-R19 for a signal null. If necessary, increase the CW input signal level by 10 dB and readjust A2A4-R19. Repeat until the deepest possible null is obtained.

h. Set the EMC-11 front panel IMPEDANCE Switch to the 100 kilohms position. Adjust A2A1-R33, located on the Input Switching Board, for a signal null on A2A4U7-1.

4.7.9 IF AMPLIFIER ADJUSTMENT/VERIFICATION

Equipment required:
- Function Generator/Frequency Synthesizer
- Video Voltmeter
- Oscilloscope-storage
- 0-120 dB Step Attenuator
- Alignment Tool
- 36 pin double-sided extension board (ECB-11)

4.7.9.1 IF #1 BOARD A2A5 ADJUSTMENT/VERIFICATION

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
FREQUENCY DISPLAY Setting ..... 25 kHz
BANDWIDTH Switch ..... 5 kHz
ATTENUATION Setting .....-20 dB
OUTPUT FUNCTION Switch ..... IF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Place the IF #1 Board onto the 36 pin double-sided extension board.

NOTE: The alignment tool should made of a nonmetallic material to prevent changes in the "Q" of the circuits.

c. Using a Video Voltmeter, measure the Local Oscillator signal on A2A5U1-8. The Voltmeter should indicate a 200 mV RMS LO output level. If not, adjust A2A5-R1.

d. Apply a 25 kHz CW signal at an input level of 1 μV RMS (0 dB(μV)) to the INPUT Connector of the EMC-11.

e. Using an Oscilloscope, monitor the IF signal waveform at the junction of C11 and C12. Adjust A2A5-L1, L2 for a peak indication on the Oscilloscope.

f. Monitoring the IF signal waveform at the junction of C12 and C13, adjust A2A5-L3 for a peak indication on the Oscilloscope.

g. Monitoring the IF signal waveform on Connector A2J17-9/10 (IF #3 Board), adjust A2A5-L4 for peak indication on the Oscilloscope.

h. With the EMC-11 tuned to 25 kHz, sweep the signal source from 20 kHz to 30 kHz. A symmetrical display, centered at 100 kHz, should appear on the Oscilloscope. If not, adjust A2A5-L1 thru L4.

i. Set the signal source to 25 kHz at an input level of 1 μV RMS (0 dB(μV)) and monitor the IF signal voltage level on A2J17-9/10 using a Video Voltmeter.

j. Tune the EMC-11 for a peak indication on the Video Voltmeter. Tune the signal source 2.5 kHz $\pm$250 Hz to either side of the 25 kHz center frequency, e.g. 22.5-27.5 kHz, the Video Voltmeter should read 6 dB down from its peak indication. If not, adjust A2A5-R22.

k. Tune the signal source for a peak indication on the Video voltmeter and adjust A2A5-R24 for a maximum indication on the Video Voltmeter.

l. Set the BANDWIDTH Switch to WIDE BAND and increase the input signal level to 10 μV RMS (+20 dB(μV)). Note the Video Voltmeter reading and switch back to the 5 kHz bandwidth position. Decrease the input signal level by 10 dB, the Video Voltmeter should indicate a reading identical to the one for the WIDE BAND position $\pm$0.25 dB. If not, adjust A2A5-R41.

m. Set the BANDWIDTH Switch to 2.5 kHz and decrease the input signal level to 1 μV RMS (0 dB(μV)). Monitor the IF signal waveform on A2J17-9/10 using an Oscilloscope and with the EMC-11 tuned to 25 kHz, sweep the signal source from 22.5 kHz to 27.5 kHz. A symmetrical display, centered at 100 kHz, should appear on the Oscilloscope. If not, adjust A2A5-L5.

n. Monitor the IF signal voltage on A2J17-9/10 using the Video Voltmeter and set the signal source frequency to 25 kHz. Tune the EMC-11 for a peak indication on the Video Voltmeter. Tune the signal source 1.25 kHz $\pm$125 Hz to either side of the 25 kHz center frequency, e.g. 23.75-26.25 kHz, the Video Voltmeter should read 6 dB down from its peak indication. If not, adjust A2A5-R27.

o. Tune the signal source for a peak indication on the Video voltmeter and adjust A2A5-R32 for an indication on the Video Voltmeter 3.5 $\pm$0.25 dB above the reading for the 5 kHz bandwidth position. Switch the BANDWIDTH Switch between the 5 and 2.5 kHz positions to verify the specification limit stated.

4.7.9.2 IF #2 BOARD A2A6 ADJUSTMENT/VERIFICATION

a. Set the front panel controls as in Section 4.7.9.1 except for the following: BANDWIDTH Switch set to 1 kHz.

b. Place the IF #2 Board onto the 36 pin double-sided extension board.

c. Set the signal source frequency to 25 kHz at an input level of 1 μV RMS (0 dB(μV)). Monitor the IF signal waveform on A2J17-9/10 using an Oscilloscope and with the EMC-11 tuned to 25 kHz, sweep the signal source from 24 kHz to 26 kHz. A symmetrical display, centered at 100 kHz, should appear on the Oscilloscope. If not, adjust A2A6-L1 and L2.

d. Monitor the IF signal voltage on A2J17-9/10 using the Video Voltmeter and set the signal source frequency to 25 kHz. Tune the EMC-11 for a peak indication on the Video Voltmeter.

Tune the signal source 500 Hz ±50 Hz to either side of the 25 kHz center frequency, e.g. 24.5-25.5 kHz, the Video Voltmeter should read 6 dB down from its peak indication. If not, adjust A2A6-R3.

e. Tune the signal source for a peak indication on the Video Voltmeter and adjust A2A6-R7 for an indication on the Video Voltmeter 3.5 ±0.25 dB above the reading for the 2.5 kHz bandwidth position. Switch the BANDWIDTH Switch between the 2.5 and 1 kHz positions to verify the specification limit stated.

f. Set the BANDWIDTH Switch to 500 Hz and monitor the IF signal waveform on A2J17-9/10 using an Oscilloscope. With the EMC-11 tuned to 25 kHz, sweep the signal source from 24.5 kHz to 25.5 kHz. A symmetrical display, centered at 100 kHz, should appear on the Oscilloscope. If not, adjust A2A6-L3.

g. Monitor the IF signal voltage on A2J17-9/10 using the Video Voltmeter and set the signal source frequency to 25 kHz. Tune the EMC-11 for a peak indication on the Video Voltmeter. Tune the signal source 250 Hz ±25 Hz to either side of the 25 kHz center frequency, e.g. 24.75-25.25 kHz, the Video Voltmeter should read 6 dB down from its peak indication. If not, adjust A2A6-R12.

h. Tune the signal source for a peak indication on the Video voltmeter and adjust A2A6-R15 for an indication on the Video Voltmeter 3.5 ±0.25 dB above the reading for the 1 kHz bandwidth position. Switch the BANDWIDTH Switch between the 1 and 500 Hz positions to verify the specification limit stated.

i. Set the BANDWIDTH Switch to 250 Hz and monitor the IF signal waveform on A2J17-9/10 using an Oscilloscope. With the EMC-11 tuned to 25 kHz, sweep the signal source from 24.75 kHz to 25.25 kHz. A symmetrical display, centered at 100 kHz, should appear on the Oscilloscope. If not, adjust A2A6-L4 and L5.

j. Monitor the IF signal voltage on A2J17-9/10 using the Video Voltmeter and set the signal source frequency to 25 kHz. Tune the EMC-11 for a peak indication on the Video Voltmeter and adjust A2A6-R26 for an indication on the Video Voltmeter 3.5 ±0.25 dB above the reading for the 500 Hz bandwidth position. Switch the BANDWIDTH Switch between the 500 and 250 Hz positions to verify the specification limit stated. Tune the signal source 125 Hz ±12 Hz to either side of the 25 kHz center frequency, e.g. 24.875 -25.125 kHz, the Video Voltmeter should read 6 dB down from its peak indication.

4.7.9.3 IF #3 BOARD A2A7 ADJUSTMENT/VERIFICATION

a. Set the front panel controls as in Section 4.7.9.1 except for the following:

ATTENUATION Setting .....-10 dB
BANDWIDTH Switch ..... 100 Hz

b. Place the IF #3 Board onto the 36 pin double-sided extension board.

c. c. Set the signal source frequency to 25 kHz at an input level of 1 μV RMS (0 dB(μV)). Monitor the IF signal voltage on A2J17-9/10 using the Video Voltmeter and set the signal source frequency to 25 kHz. Tune the EMC-11 for a peak indication on the Video Voltmeter. Tune the signal source 50 Hz ±5 Hz to either side of the 25 kHz center frequency, e.g. 24.950-25.050 kHz, the Video Voltmeter should read 6 dB down from its peak indication. If not, adjust A2A7-C1 for an equidistant frequency swing on either side of the center frequency and then A2A7-R2 to set the 6 dB point.

d. Tune the signal source above and below the 25 kHz center frequency until the Video Voltmeter indication is 3 dB down from the peak reading. Verify that the frequency swing is 50 Hz ±10 Hz.

e. Tune the signal source for a peak indication on the Video Voltmeter and adjust A2A7-R6 for an indication on the Video Voltmeter 3.5 ±0.25 dB above the reading for the 250 Hz bandwidth position. Switch the BANDWIDTH Switch between the 250 Hz and 100 Hz positions to verify the specification limit stated.

f. Set the BANDWIDTH Switch to 40 Hz, the signal source frequency to 25 kHz at an input level of 1 μV RMS (0 dB(μV)), and monitor the IF signal voltage on A2A7U3-6 using the Video Voltmeter. Tune the EMC-11 for a peak indication on the Video Voltmeter. Tune the signal source above and below the 25 kHz center frequency until the Video Voltmeter indication is 3 dB down from the peak reading, the frequency swing should be 40 Hz ±4 Hz. If not, adjust A2A7-C6 for an equidistant frequency swing on either side of the center frequency and then A2A7-R13 to set the 3 dB points for 20 Hz ±2 Hz.

g. Monitor the IF signal voltage on A2AJ17-9/10, using the Video Voltmeter, and tune the EMC-11 for a peak indication on the Video Voltmeter. Tune the signal source above and below the 25 kHz center frequency until the Video Voltmeter indication is 6 dB down from the peak reading, the frequency swing should be 40 Hz ±4 Hz. If not, adjust A2A7-C9 for an equidistant frequency swing on either side of the center frequency and then A2A7-R21 to set the 6 dB points for 20 Hz ±2 Hz.

h. Tune the signal source for a peak indication on the Video Voltmeter and adjust A2A7-R15, R23 for an indication on the Video Voltmeter 3.5 ±0.25 dB above the reading for the 100 Hz bandwidth position.

NOTE: A2A7-R15, R23 should be adjusted equally to balance the gain for the two sections of the crystal filter circuit.

Switch the BANDWIDTH Switch between the 100 Hz and 40 Hz positions to verify the specification limit stated.

i. Set the BANDWIDTH Switch to 10 Hz, and monitor the IF signal voltage on A2A7U6-6 using the Video Voltmeter. Tune the EMC-11 for a peak indication on the Video Voltmeter. Tune the signal source above and below the 25 kHz center frequency until the Video Voltmeter indication is 4 dB down from the peak reading, the frequency swing should be 10 Hz ±1 Hz. If not, adjust A2A7-C14 for an equidistant frequency swing on either side of the center frequency and then A2A7-R32 to set the 4 dB points for 5 Hz ±1 Hz.

j. Monitor the IF signal voltage on A2AJ17-9/10, using the Video Voltmeter, and tune the EMC-11 for a peak indication on the Video Voltmeter. Tune the signal source above and below the 25 kHz center frequency until the Video Voltmeter indication is 6 dB down from the peak reading, the frequency swing should be 10 Hz ±1 Hz. If not, adjust A2A7-C27 for an equidistant frequency swing on either side of the center frequency and then A2A7-R39 to set the 6 dB points for 10 Hz ±1 Hz.

k. Tune the signal source for a peak indication on the Video Voltmeter and adjust A2A7-R41 for an indication on the Video Voltmeter 6.0 ±0.25 dB above the reading for the 40 Hz bandwidth position.

l. Set the BANDWIDTH Switch to 250 Hz and monitor the IF signal level on A2J17-9/10 using an oscilloscope. Set the EMC-11 FREQUENCY DISPLAY to 00000 Hz and adjust A2A5-R5, R11 for a null on the oscilloscope CRT display. Go back and forth between R5 and R11 until both are at mid-range and a suitable null is produced.

4.7.10 DETECTOR BOARD A2A9 ADJUSTMENT/VERIFICATION

Equipment required:
- Signal Generator
- Digital Voltmeter
- Oscilloscope

a. Set the front panel controls as follows:

DETECTION Switch	RMS
IMPEDANCE Switch	50 ohms
HIGH PASS FILTER Switch	OUT
LOW PASS FILTER Switch	50 kHz
TUNING MODE Switch	MANUAL
FREQUENCY DISPLAY Setting	25 kHz
BANDWIDTH Switch	WIDEBAND
ATTENUATION Setting	90 dB
OUTPUT FUNCTION Switch	IF
OUTPUT LEVEL Control	FULL CCW
AUDIO LEVEL Control	FULL CCW

b. Remove the IF #3 Board (A2A7) from the A2 Card Rack Assembly and place the Detector Board (A2A9) onto the 36 pin double-sided extension board.

c. After tuning ON the unit, wait approximately 10 seconds before starting the following procedure to allow for completion of the calibration sequence.

NOTE: Since the signal path is "broken" with the removal of the IF #3 Board, the UNCAL indicator will remain "ON" during the performance of this procedure. To determine when the calibration sequence has been completed, listen for the "clicking" of relays which will occur when the sequence has ended.

d. Using a Digital Voltmeter, monitor the voltage on A2A9U5-7. Apply a 1 kHz CW signal at an input level of 1 mV to A2A9-9/10. Increase the input signal level until the voltmeter indicates approximately 2 VDC, adjust A2A9-R10 for a maximum indication on the voltmeter. Reduce the input signal level until the voltmeter again indicates 2.0 VDC.

e. Monitor the waveform on A2A9U5-7 using an Oscilloscope, the Oscilloscope should indicate a full wave rectified version of the 1 kHz CW input signal with all peaks at the same amplitude level. If not, adjust A2A9-R6.

f. Remove the CW input signal from A2A9-9/10, ground A2A9U5-2, and monitor the voltage on A2A9-29/30 using a Digital Voltmeter. The voltmeter should indicate 0.000 VDC. If not, adjust A2A9-R32.

g. Remove the ground from A2A9U5-2, ground A2A9U9-3, and monitor the voltage on A2A9-33/34. The voltmeter should indicate 0.00 VDC. If not, adjust A2A9-R49.

h. Remove the ground from A2A9U9-3 and ground A2A9U8-3, the voltmeter should indicate 0.00 VDC. If not, adjust A2A9-R45.

i. Remove the ground from A2A9U8-3 and ground A2A9U13-3, the voltmeter should indicate 0.00 VDC. If not, adjust A2A9-R22.

j. Remove the ground from A2A9U13-3, ground A2A9U11-3, and monitor the voltage on A2A9-5/6. The voltmeter should indicate 0.000 VDC. If not, adjust A2A9-R65.

k. Remove the ground from A2A9U11-3 and ground A2A9U12-3, the voltmeter should indicate 0.000 VDC. If not, adjust A2A9-R68.

l. Remove the ground from A2A9U12-3, set the BANDWIDTH Switch to 5 kHz, and apply a 100 kHz CW signal at an input level of 1 mV to A2A9-9/10. Increase the input signal level until the voltmeter indicates +5.000 VDC.

m. Monitor the voltage on A2A9-33/34, the voltmeter should indicate +5.000 VDC. If not, adjust A2A9-R52.

n. Monitor the voltage on A2A9-29/30, the voltmeter should indicate +5.000 VDC. If not, adjust A2A9-R29.

o. Decrease the signal input level by 60 dB, the voltmeter should indicate 5.0 mV. If not, adjust A2A9-R9.

4.7.11 LOG CIRCUITRY ADJUSTMENT/VERIFICATION

NOTE: The Log Circuitry is located on the Cal Board A2A8.

Equipment required:
Power Supply: 20 VDC @ 500 mA
0-120 dB Step Attenuator
Digital Voltmeter
Material to build Log Test Circuit shown below:

NOTE: Check the test circuit below by performing the following:

1. Connect the Digital Voltmeter across the 50 ohm 1/2 W resistor.
2. Set the 10 dB Step Attenuator to 0 dB.
3. Adjust the output level of the Power Supply for a 5.000 VDC indication on the voltmeter.
4. Increasing the Step Attenuator attenuation level in 10 dB steps should also cause the voltmeter indication to also change in 10 dB steps. If not, the tolerance level of the 50 ohm resistor may be out of the stated specification limit.

a. Set the front panel controls as follows:

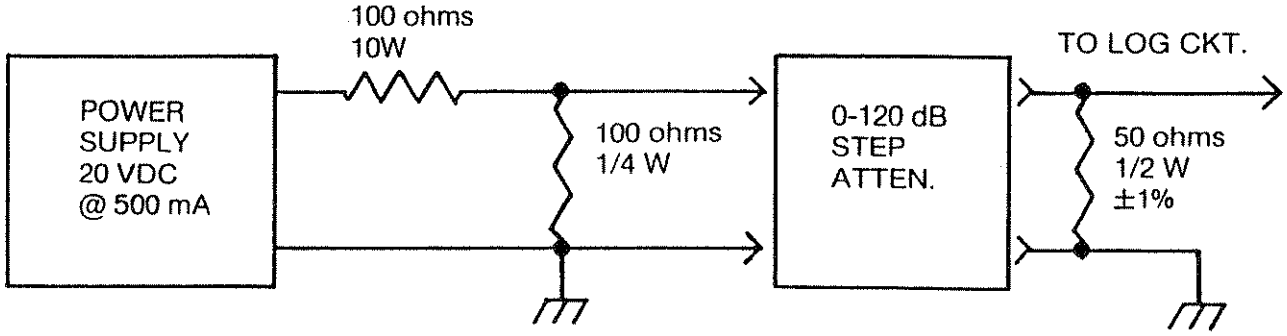
DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch .....50 kHz
TUNING MODE Switch ..... MANUAL
FREQUENCY DISPLAY Setting ..... 25 kHz
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT FUNCTION Switch .....IF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Remove the Detector Board (A2A9) from the A2 Card Rack Assembly and place the Cal Board (A2A8) onto the 36 pin double-sided extension board.

c. Connect the ground side of the 50 ohm resistor in the test circuit to the EMC-11 chassis ground and the output side to A2A8-29/30.

d. Carefully remove A2A8-U3 from its socket and replace itwith a 16 pin dual-inline IC header with a 10 kilohm 1/4 W resistor between PINS 1 & 2. (NOTE: This connects the 10 kilohm resistor between the current source output and ground.)

Log Amplifier Test Circuit



e. Using a Digital Voltmeter, monitor the DC voltage across the 10 kilohm resistor. Set the external attenuation to 0 dB, turn on the EMC-11 and the external power supply. The voltmeter should indicate approximately 1.00 VDC.

f. Set the external attenuation to 60 dB, the voltmeter should indicate approximately 1.0 mV or 60 dB less than the reading in Step e. If not, adjust A2A8-R1.

NOTE: If these voltages are not present or are ±20% outside the limits given, contact the ELECTRO-METRICS CUSTOMER SERVICE DEPARTMENT at (518) 843-2600 or your nearest ELECTRO-METRICS representative for assistance.

g. Turn off the EMC-11 and removing the IC header, carefully reinsert A2A8-U3 back into its socket. Turn the unit back on and set the external attenuation to 40 dB.

h. Monitoring the DC voltage on A2A8-37/38, switch the external attenuation between 40 and 30 dB. The difference between the 40 dB and the 30 dB step voltage readings should be 188 mVDC (0.188 VDC). If not, adjust A2A8-R3.

i. Set the external attenuation to 60 dB and measure the voltage on A2A8U3-10, the voltmeter should indicate 0.000 VDC. If not, adjust A2A8-R2.

j. Measure the voltage on A2A8-37/38, the voltmeter should indicate 0.000 VDC. If not, adjust A2A8-R4.

k. Change the external attenuation in 10 dB steps from 60 dB to 0 dB, the voltmeter should indicate the voltages in the table below:

EXTERNAL ATTENUATION	VOLTMETER INDICATION	
60 dB	0.000 VDC	SPECIFICATION
50 dB	0.188 VDC	LIMIT
40 dB	0.375 VDC	±8 mV
30 dB	0.563 VDC	
20 dB	0.750 VDC	
10 dB	0.938 VDC	
0 dB	1.125 VDC	

NOTE: 1. The step size averages 0.1875 VDC/10 dB.

2. Deviations greater than the 8 mV limit stated indicates that further adjustment is required.

3. The Log Amplifier circuitry potentiometer adjustments control the following:

A2A8-R3: Adjusts the step size.
A2A8-R4: Adjusts the log circuitry range offset.
A2A8-R1: Sets the 60 dB log position. Non-linearity in the 50-60 dB positions may requires careful adjustment of A2A8-R1.

4.7.12 CAL/TRACKING BOARD A2A15 ADJUSTMENT/VERIFICATION

Equipment required:
Signal Generator
Oscilloscope

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
FREQUENCY DISPLAY Setting ..... 1 kHz
BANDWIDTH Switch ..... 100 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT FUNCTION Switch ..... BFO
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Place the Cal/Tracking Board onto the 36 pin double-sided extension board.

c. Apply a 1 kHz CW signal at an input level of 100 mV (+100 dB(μV)) to the INPUT Connector of the EMC-11.

d. Monitor the BFO signal on the OUTPUT Connector, using an Oscilloscope, and tune the EMC-11 for a maximum indication on the front panel analog meter. The Oscilloscope should indicate a sinewave at a frequency of 1.000 kHz ±200 Hz. If not, adjust A2A15-C3.

e. Set the OUTPUT FUNCTION Switch to TRACK, the OUTPUT LEVEL Control FULL CCW, and the IMPEDANCE Switch to 600 ohms. Connect the TRACKING OUTPUT signal on the OUTPUT Connector to the EMC-11 INPUT Connector.

NOTE: The above connection requires going from a BNC receptacle to a TWINAX receptacle. This can be accomplished using several methods, one is as follows:

1. Connect a BC-11 Cable (BNC-BNC plug) to the OUTPUT Connector.
2. Connect a BNC-BNC receptacle adapter to the other end of the BC-11 Cable.
3. Connect a TBA-11 Cable (TWINAX-BNC plug) to the BNC-BNC adapter and the TWINAX end to the EMC-11 INPUT Connector.

f. Set the OUTPUT LEVEL Control for a mid-range indication on the front panel analog meter. Set the BANDWIDTH Switch for 10 Hz and adjust A2A15-C7 for a maximum analog meter indiction.

g. Using the Oscilloscope, monitor the signal on A2A15-39/40. The Oscilloscope should indicate 5.7 mV P-P. If not, adjust A2A15-R5.

4.7.13 CAL CIRCUIT BOARD A2A8 ADJUSTMENT/VERIFICATION

Equipment required:
Signal Generator
Digital Voltmeter
Oscilloscope

NOTE: The Cal Circuit adjustments should not be performed until the following procedures have been performed:

1. Power Supply Verification
2. Preamplifier/Attenuator Adjustment/Verification
3. IF Amplifier Adjustment/Verification
4. Detector Adjustment/Verification
5. Log Amplifier Adjustment/Verification

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 16 kHz
TUNING MODE Switch ..... MANUAL
FREQUENCY DISPLAY Setting ..... 25 kHz
BANDWIDTH Switch ..... 500 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT FUNCTION Switch ..... IF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Place the Cal Circuit Board onto the 36 pin double-sided extension board.

c. Monitor the signal on A2A8U11-15, using an Oscilloscope, and push the CAL Switch.

NOTE: The UNCAL indicator will remain on since the unit is being calibrated at 25 kHz with the LOW PASS FILTER Switch to 16 kHz. This introduces an error condition into the calibration circuitry.

The Oscilloscope should indicate a 5 V pulse with a time period of approximately 100 msec. If not, adjust A2A8-R6 to set the time period.

d. Carefully remove A2A8-U11 and ground A2A8-23/24, 27/28, and 65/66. Connect A2A8-67/68 to A2A8-25/26 (+5 VDC INPUT).

e. Turn on the receiver and set the LOW PASS FILTER Switch to 50 kHz. Apply a 10 kHz CW signal at an input level of 100 mV (+100 dB(μV)) to the EMC-11 INPUT Connector. Tune the receiver for a maximum indication on the front panel Digital Display, the Digital Display should indicate +100 dB(μV). If not, adjust A2A9-R20.

NOTE: This adjustment is located on the Detector Board A2A9. The board must be placed onto a 36 pin double-sided extension board to perform this adjustment.

f. Remove the ground and +5 VDC connections and carefully reinsert A2A8-U11 into its socket.

g. Turn on the receiver and push the CAL Switch, the UNCAL indicator will come on and may remain lighted beyond the 2-3 seconds required for the calibration sequence. The front panel Digital Display should indicate +100 dB(μV) after the calibration sequence has been completed. If not, adjust A2A8-R5.

h. Repeat Step g until no further adjustment is required.

4.7.14 AFC CIRCUITRY ADJUSTMENT/VERIFICATION

NOTE: The AFC circuitry is located on the Audio Amplifier Board A2A14.

Equipment required:
Signal Generator
Oscilloscope
0-120 dB Step Attenuator

a. Set the front panel controls as follows:

DETECTION Switch ..... RMS
IMPEDANCE Switch ..... 50 ohms
HIGH PASS FILTER Switch ..... OUT
LOW PASS FILTER Switch ..... 50 kHz
TUNING MODE Switch ..... MANUAL
FREQUENCY DISPLAY Setting ..... 25 kHz
BANDWIDTH Switch ..... 10 Hz
ATTENUATION Setting ..... 90 dB
OUTPUT FUNCTION Switch ..... IF
AFC Switch ..... OFF
OUTPUT LEVEL Control ..... FULL CCW
AUDIO LEVEL Control ..... FULL CCW

b. Remove the IF #2 Board (A2A6) from the A2 Card Rack Assembly and place the Audio Amplifier Board (A2A14) onto the 36 pin double-sided extension board.

c. Apply a 100 kHz CW signal at an input level of 100 mV to A2A14-20. Monitoring the 100 kHz signal on A2A14U7-1, using and Oscilloscope, adjust A2A14-L1 for a maximum indication on the Oscilloscope.

d. Monitoring the 100 kHz signal on A2A14U8-1, decrease the signal input level to 300 μV. Adjust A2A14-L2, L3 for a maximum indication on the Oscilloscope.

e. Vary the signal input level between 3.5 V RMS and 1 mV RMS (these levels differ from the actual signal voltage levels on A2A14-20 by approximately 6 dB), signal voltage levels on A2A14U8-1 should not vary by more than ±2.0 dB. If not, adjust A2A14-L1, L2, L3 until the signal voltage level is flat over the range given.

f. Reinsert the IF #2 Board A2A6 into the A2 Card Rack Assembly and apply a 25 kHz CW signal at an input level of 100 mV RMS to the EMC-11 INPUT Connector.

g. Tune the receiver to 25.000 kHz, the front panel analog meter should be peaked for a maximum indication. If not, adjust the signal source for a peak indication at exactly 25.000 kHz ±1 Hz.

h. Turn on the AFC Switch, the receiver should lock onto the input signal and remained peaked. Set signal source frequency to 25.100 kHz, EMC-11 should follow and indicate a frequency of 25.100 kHz ±5 Hz. If not, repeat Steps b thru e until no further adjustments are necessary.

SECTION V
THEORY OF OPERATION

5.1 GENERAL

This section describes the major circuitry of the EMC-11 INTERFERENCE ANALYZER and provides a brief description of unit and circuitry function.

5.2 EMC-11 DESIGN CRITERIA

The EMC-11 circuitry was designed for optimum performance from 20 Hz to 50 kHz. Measurement requirements in this range are represented by such widely varying tasks as examination of a single harmonic of the power line frequency to broadband measurements of the entire audio range. These requirements and associated EMC measurement requirements are specified by military and government standards, CISPR recommendations, standards for the protection of electronic data, plus various national and international laws, regulations, and agreements.

In order to accommodate these diverse standards, nine detection bandwidths ranging from 10 Hz to 50 kHz at -6 dB are required. Another requisite is linear signal processing, including detection. Weighting of the detected video to provide such detector functions as RMS, average, quasi-peak, etc., must occur after linear amplification. Logging to provide wide ranging (many decades) signal output metering must occur last, after detection and weighting.

Any detector has a limited range of signal amplitudes which can be rectified; thus, if the detector is to limit dynamic range, then maximum instantaneous measurement range occurs when the noise due to the receiver front end components is amplified to a level at the detector input which is comparable to the minimum signal which can be detected. In the more conventional IF design, shown in Figure 5.1, with switched filters and constant gain, the noise level varies with the bandwidth. If this type of IF filter were used by the EMC-11, the noise level variation would amount to 37 dB with a ratio between bandwidth extremes of 5000 to 1. The gain distribution is adjusted so that the front-end noise output from the IF stages is within the range of the detector in the narrowest bandwidth. Thus for the EMC-11, the front-end noise power input to the detector would be 37 dB higher in the widest bandwidth resulting in significantly reduced dynamic range. The EMC-11 uses a cascaded IF structure, shown in Figure 5.2, in which each successively narrower filter follows in cascade and allows the easy addition of gain changes with bandwidth. The gain associated with each filter is chosen equal to the ratio between the bandwidths of the two adjacent filters, resulting in constant noise power input to the detector regardless of the bandwidth selected. If this noise level is close to the minimum signal level which can be detected, the overall instrument dynamic range may be virtually that of the linear detector. An added benefit of this design is the addition of the skirt rejection of each cascaded filter resulting in good selectivity and ultimate rejection with relatively simple filters. To maintain the calibration accuracy of the receiver with changes in the IF gain, offsets are added to the metering circuitry.

5.3 SYNOPSIS OF RECEIVER OPERATION

(Refer to Figure 5.3: Block Diagram of the Basic Signal Path of the EMC-11.)

The EMC-11 INTERFERENCE ANALYZER is a low frequency receiver operating over a frequency of 20 Hz to 50 kHz. The receiver can be divided into three major sections: Input Circuitry, IF Amplifier Circuitry, and Detection Circuitry.

The Input Circuitry incorporates a differential front end with a Twinax connector to eliminate ground loop problems and permit balanced or floating measurements. The signal from the input connector is applied to an impedance matching network which allows the selection of four input impedances. The signal is next applied through the following series of circuits; a selectable 40 dB attenuator, two selectable low pass and four selectable high pass filter networks, a preamplifier circuit, and a final series of selectable attenuators with a total range of 70 dB. The attenuators provide

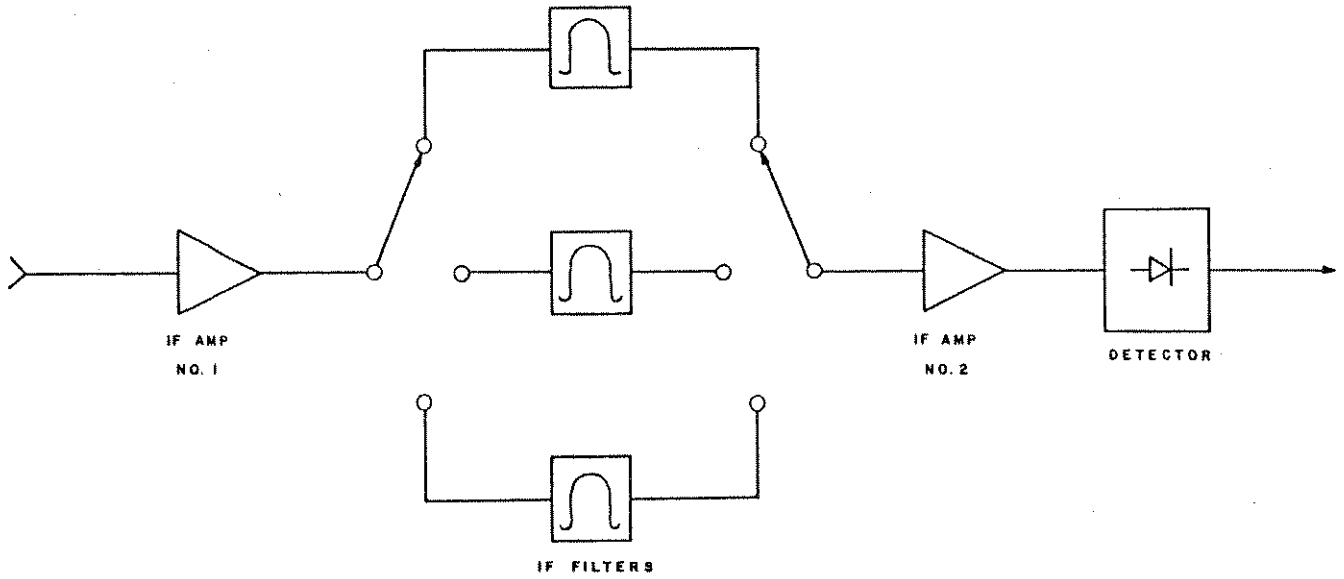


FIGURE 5.1
CONVENTIONAL IF ARCHITECTURE

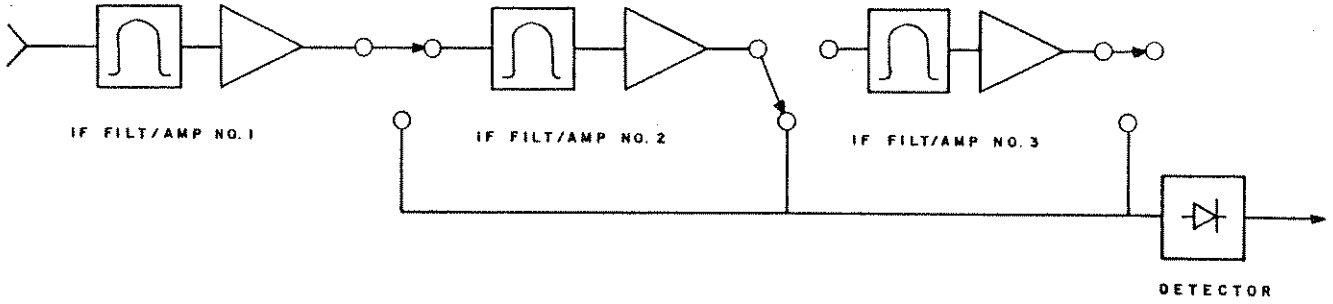


FIGURE 5.2
CASCADE IF ARCHITECTURE

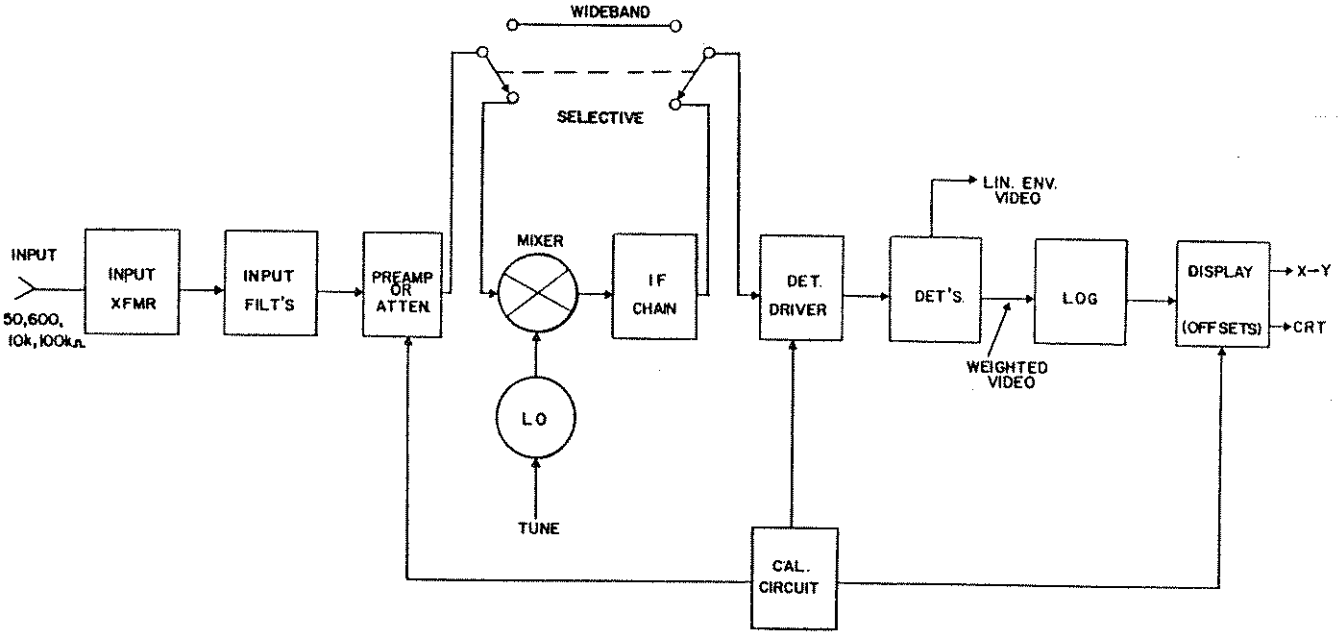


FIGURE 5.3
BLOCK DIAGRAM OF THE BASIC SIGNAL PATH OF THE EMC-11

110 dB of selectable attenuation, the selectable high and low pass filter networks set the upper and lower bandpass limits, and the preamplifier provides amplification of the signal before it is applied to the IF circuitry.

In the IF Circuitry, the input signal and the LO signal from the Tuning Circuitry are applied to a mixer circuit. The resultant 100 kHz Intermediate Frequency is applied to a cascaded IF filter chain composed of eight selectable filters with 6 dB bandwidths ranging from 5 kHz to 10 Hz. When the WIDE BAND position is selected, an IF bypass circuit is activated which routes the input signal directly to the output of the IF. The IF output is then applied to the Detection Circuitry.

The Detection Circuitry incorporates the Detector Driver, Linear Detector, RMS Detector, Quasi-Peak/Carrier, and Peak Detector circuits. The IF output is applied to the Detector Driver which in turn drives the Linear Detector. The output of the Linear Detector is applied to the RMS, Quasi-Peak/Carrier, and Peak Detector circuits. Logic inputs select which function is activated. The output from each of the three detectors is then applied to the Log Amplifier circuit.

The Log Circuit produces the logged output of the selected detector signal which is applied to the front panel digital and analog meters. In addition, the same output is used as the "X" output to the X-Y plotter and the vertical output for oscilloscope presentations.

5.4 CIRCUIT DESCRIPTION

The following is a brief description of the EMC-11 circuitry proceeding in the following order: Card Rack Assembly A2, Frequency Display A1A2, DVM Module A1A3, Power Supply A4.

5.4.1 CARD RACK ASSEMBLY A2

The Card Rack Assembly has a total of 15 PC boards containingthe majority of receiver circuitry. Each PC board, in turn, will be briefly described as to function and purpose.

5.4.1.1 A2A1 INPUT SWITCHING BOARD
(Refer to Figure 8.4)

The Input Switching Board controls the switching of the RF input signal between the four input impedances — 50 ohms, 600 ohms, 10 kilohms, 100 kilohms — and the Low Pass Filter Board (A2A2). A series of logic activated multiplexers and FET switches are used to select the input impedance desired. Other circuitry is used to switch the calibration signal or the probe signal into the RF signal path. The calibration signal is switchable between the four input impedances, while the probe signal input impedance is fixed at 50 ohms.

The 50 ohms and 600 ohms positions use an impedance matching transformer to match the external load impedance to the internal 10 kilohms impedance. The 10 kilohms position thus requires no matching network, while the 100 kilohms position uses an amplifier circuit to perform the impedance matching operation.

The output of the impedance matching network passes through a switchable 40 dB attenuator and is then applied to the Low Pass Filter Board (A2A2). In addition, the ground return for the RF signal path is not terminated on the Input Switching Board and is also applied to the Low Pass Filter Board.

5.4.1.2 A2A2 LOW PASS FILTER BOARD
(Refer to Figure 8.5)

The Low Pass Filter Board contains the 16 kHz and 50 kHz (3 dB) low pass filter networks. Logic activated multiplexers switch the RF input signal and the RF ground return, from the Input Switching Board (A2A1), between the two filter networks. The filter networks use passive components to obtain the required low pass cutoff frequencies. The RF signal and the unterminated RF ground return are next applied to the High Pass Filter Board (A2A3).

5.4.1.3 A2A3 HIGH PASS FILTER BOARD
(Refer to Figure 8.6)

The High Pass Filter Board contains the 200 Hz, 1 kHz, and 6 kHz (3 dB) high pass filter networks. Logic activated multiplexers switch the RF input signal and the RF ground return, from the Low Pass Filter Board (A2A2), between the three filter networks and a filter bypass path. The bypass path is selected when the front panel HIGH PASS FILTER Switch is set to the OUT position. The filter networks use passive components to obtain the required high pass cutoff frequencies. The RF signal and the unterminated RF ground return are next applied to the Preamplifier/Attenuator Board (A2A4).

5.4.1.4 A2A4 PREAMPLIFIER/ ATTENUATOR BOARD
(Refer to Figure 8.7)

The Preamplifier/Attenuator Board contains the preamplifier circuit, the attenuator circuit, and the overload circuit.

The RF input signal and the RF ground return, from the High Pass Filter Board (A2A3), are applied to a preamplifier circuit with an input impedance of 10 kilohms and an overall gain of 80 dB. In addition, the preamplifier circuit also references the RF ground return to the internal ground of the receiver.

The output from the preamplifier circuit is applied through a variable attenuator network with a total value of 70 dB. The output of the attenuator network is applied to a 50 kHz active low pass filter which limits the frequency response of the preamplifier to 50 kHz. The output of the filter network is applied to the IF #1 Board (A2A5).

In addition, the board also contains the overload circuitry for the receiver. The circuit receives inputs from the preamplifier circuit, the Input Switching Board (A2A1), and the Detector Board (A2A9). The front panel OVERLOAD LED indicator is driven by an output from the circuit and when activated indicates the need for additional attenuation.

5.4.1.5 IF AMPLIFIER BOARDS: A2A5 IF #1, A2A6 IF #2, A2A7 IF #3

NOTE: On all of the IF boards, the filter succession is from the widest filter noted to the narrowest.

5.4.1.5.1 A2A5 IF #1 BOARD
(Refer to Figure 8.8)

The IF #1 Board contains the 5 kHz and 2.5 kHz (6 dB) filter stages plus the IF mixer circuit. The mixer circuit mixes the RF signal from the Preamplifier/Attenuator Board (A2A4) and the local oscillator signal from the VCO Board (A2A10) to produce the 100 kHz Intermediate Frequency.

The 5 kHz filter uses four coupled resonator circuits and has a Bessel characteristic, as do the succeeding filters, to avoid creating "overshoot" and other extraneous responses to impulsive signals. The amplification gain for the 5 kHz filter stage is 10 dB. The 2.5 kHz filter has a single resonator circuit with an amplification gain of 3 dB.

Multiplexers are used to switch the two filter stages into or out of the IF circuit path. In the WIDEBAND position of the front panel BANDWIDTH Switch a direct path is activated which bypasses the entire IF filter and mixer circuitry. The output of the IF #1 Board is applied to the IF #2 Board.

5.4.1.5.2 A2A6 IF #2 BOARD
(Refer to Figure 8.9)

The IF #2 Board contains the 1 kHz, 500 Hz, and 250 Hz (6 dB) filter stages plus associated switching circuitry.

The 1 kHz filter uses two coupled resonator circuits with an amplification gain of 4 dB. The 500 Hz filter has a single resonator circuit with an amplification gain of 3 dB. The 250 Hz filter uses two coupled resonator circuits with an amplification gain of 3-dB.

Again, as in the IF #1 Board, multiplexers are used to switch the three filter stages into or out of the IF circuit path or activate the bypass path around the filter stages. The output of the IF #2 Board is applied to the IF #3 Board.

5.4.1.5.3 A2A7 IF #3 BOARD
(Re (Refer to Figure 8.10)

The IF #3 Board contains the 100 Hz, 40 Hz, and 10 Hz (6 dB) filter stages plus associated switching circuitry.

The 100 Hz filter has a single crystal resonator circuit with an amplification gain of 4 dB. The 40 Hz filter uses two cascaded crystal resonator circuits with amplification gain of 4 dB. The 10 Hz filter uses three cascaded crystal resonator circuits with an amplification gain of 6 dB.

Again, as in the previous two IF boards, multiplexers are used to switch the three IF filter stages into or out of the IF filter path or activate the bypass path around the filter stages. The output of the IF #3 Board is applied to the Detector Board (A2A9). A buffered IF output is used by the Cal/Tracking Board (A2A15) for the RESTORED function and for the IF OUTPUT function.

5.4.1.6 A2A8 CALIBRATION CIRCUIT BOARD
(Refer to Figure 8.23)

The Calibration Circuit Board contains the calibration circuitry and the Log Amplifier circuit. The Log Amplifier circuit will be described separately in Section 5.4.1.8. The Calibration circuitry can be divided into three subsections: Cal Control Logic, Cal Level Control, and Gain Level Control.

The Cal Control Logic circuit uses multiplexers, multivibrators, and other logic circuitry to control the operation of the EMC-11 calibration system. A logic input from the Switching Logic Board (A2A11) activates the calibration signal oscillator, located on the Cal/Tracking Board (A2A15), and applies the resulting calibration signal to the Input Switching Board (A2A1) for amplitude calibration of the receiver through the RF signal path. In addition, the circuit also controls the operation of the front panel LED UNCAL indicator.

The Cal Level Control circuit varies the output level of the calibration signal depending on the IF bandwidth and input impedance selected. A logic input from the Switching Logic Board controls the functioning of this circuitry.

The Gain Level Control circuit uses feedback from the Linear Detector circuit on the Detector Board (A2A9) to control gain of the detector driver circuit on the Detector Board. This is accomplished using a counter circuit to generate binary logic levels which drives a multiplexer in the detector driver circuit.

5.4.1.7 A2A9 DETECTOR BOARD
(Refer to Figure 8.11)

The Detector Board produces the RMS, QP/ CARRIER, PEAK, and SLIDEBACK outputs. The board is divided into five subcircuits: Detector Driver, Linear Detector, RMS Detector, Quasi-Peak/ Carrier Detector, and Peak Detector/Slideback.

The Detector Driver circuit establishes the overall amplitude gain of the receiver and drives the Linear Detector circuit. The 100 kHz IF signal, from the IF #3 Board (A2A7), is applied to a variable gain amplifier circuit which supplies the necessary signal level for driving the Linear Detector across its full dynamic range. The gain of the amplifier is varied according to binary logic inputs obtained from the Calibration Circuit Board (A2A8).

The Linear Detector circuit envelope detects the amplified IF signal to produce a DC video output. The video signal is then applied to the three detector circuits, to the Audio Amplifier Board (A2A14), and to the Calibration Circuit Board (A2A8) as part of the gain control feedback loop.

Each of the three detector circuits — RMS, Quasi-Peak/Carrier, Peak/Slideback — weights the detected video to obtain the time constants (charge/discharge times) required for each detector function. For the Slideback function, additional circuitry is switched into the Peak circuit to produce a rapid-decay peak detector whose bias level can be varied using the front panel THRESHOLD Control. Each of the three detector circuits has a separate output line to the Log Amplifier circuit. In addition, the board circuitry includes the logic circuits required to switch on the detector circuit selected.

5.4.1.8 LOG AMPLIFIER CIRCUIT
(Refer to Figure 8.12)

NOTE: The Log Amplifier circuit is located on the Calibration Circuit Board (A2A8).

The Log Amplifier circuit produces a logged presentation of the video input signal for use by the front panel digital and analog meters. The Log Amplifier circuit is divided into the following three subcircuits: Input Switching, Logging Amplifier, and Bandwidth Offset circuit.

Each of the three detector outputs — RMS, QP/Carrier, Peak/ Slideback — is separately applied to the Log Amplifier circuit with a logic activated multiplexer used to switch the detector function desired into the logging amplifier.

The logging amplifier comprises a current operated microcircuit device driven by a current source. The output of the logging amplifier is applied to a buffer amplifier which drives the front panel digital and analog meters.

The Bandwidth Offset circuit adds a fixed offset voltage to the logged DC output of the logging amplifier. The amplitude of the offset voltage is determined by the IF bandwidth selected.

5.4.1.9 A2A10 VOLTAGE CONTROLLED OSCILLATOR (VCO) BOARD
(Refer to Figure 8.21)

The Voltage Controlled Oscillator Board contains the circuitry which produces the local oscillator signal for the receiver.

The oscillator is an astable multivibrator whose output frequency, 100 kHz to 150 kHz, is proportional to an applied 0 to 1.5 volts DC tuning voltage which is obtained from the Sweep Control Board (A2A13). The oscillator output is applied to the Frequency Display Module (A1A2), IF #1 Board (A2A5), and the Cal/ Tracking Board (A2A15). Each output uses a buffer amplifier and a subminiature coaxial cable to prevent pickup, crosstalk, and circuit common coupling from occurring on the local oscillator lines.

5.4.1.10 A2A11 SWITCHING LOGIC BOARD
(Refer to Figures 8.13 and 8.14)

The Switching Logic Board is the interface between the majority of front panel switches and controls (except for the Power Switch, Battery Test Switch, Tuning Mode Switch, Tuning Control, and Frequency Display Switch) and the function or circuitry they activate. The remote logic for control of these functions is also interfaced through this board.

The Switching Logic circuitry is basically a network of inverters activated by logic low commands from the front panel switches. In the remote mode, the logic common to the switches is turned off which deactivates the front panel switches and allows the logic inputs from the Remote Connector (A3J1) to control the operation of the receiver.

5.4.1.11 A2A12 SWEEP BOARD
(Refer to Figure 8.19)

The Sweep Board circuitry controls the various sweep functions of the receiver.

A sweep generator circuit produces the 0-10 V linear ramp voltage required for sweeping across the frequency range of the receiver. Multiplexers are used to select the mode of circuitry operation (e.g. MANUAL, PLOTTER, CRT, or REMOTE) and vary the sweep rate of the circuit depending on the

IF bandwidth selected. The 0-10 V sweep voltage is applied to the Sweep Control Board A2A13.

Sweep comparators are used to determine the following:

a. Plotter Mode
   1. Sweep start — pen drop.
   2. End of sweep — pen lift.

b. CRT Mode
   1. Sweep start — trace activated.
   2. End of sweep — retrace activated.
   3. End of retrace — sweep start initiated.

The Trace/Retrace circuit permits the external oscilloscope to retrace the spectrum display from right to left and eliminates the need for a blanking circuit.

The Auto Sweep circuit is automatically activated in the Plotter Mode and slows the sweep rate when a signal is encountered permitting the amplitude of the signal to be accurately plotted. It has the most effect at the slowest sweep speed and little or no effect at the fastest sweep speed. The Auto Sweep circuit uses the AFC Voltage produced by the Discriminator circuit located on the Auto Amplifier Board A2A14.

5.4.1.12 A2A13 SWEEP CONTROL BOARD
(Refer to Figure 8.20)

The Sweep Control Board sets the mode of operation for the receiver: MANUAL, PLOTTER, CRT, or REMOTE. Logic controlled multiplexers are used to determine circuitry functions.

In the MANUAL Mode, a 0 to +15 V voltage from the front panel Main Tune Control is applied to the Manual Tune circuit. The output from this circuit is applied to an output amplifier/buffer circuit whose output, 0 to 1.5 V, is applied to the VCO Board A2A10. The circuit also produces a 0 to 1.5 V output for use by the X-Y plotter and a 0 to 10 V output for use by an external oscilloscope.

In the PLOTTER Mode, the 0 to 10 V sweep voltage from the Sweep Board A2A12 is applied to the output amplifier/buffer circuit. A sweep rate adjust circuit modifies the sweep rate depending on the IF bandwidth selected. In the CRT Mode, the circuit operates in the same manner with the exception that the modified sweep voltage is applied back to the Sweep Board A2A12 for use in triggering the sweep trace/retrace circuit.

In the REMOTE Mode, an external 0 to 15 V is applied to the Manual Tune circuit to control the frequency tuning of the receiver.

When the AFC function is turned on, the AFC voltage from the Discriminator circuit, located on the Audio Amplifier Board A2A14, is applied to the Manual Tune circuit thru a logic activated multiplexer switch.

5.4.1.13 A2A14 AUDIO AMPLIFIER BOARD
(Refer to Figure 8.25)

The Audio Amplifier Board contains the audio amplifier, automatic volume control, video output, and discriminator circuits for the receiver.

The audio amplifier circuit uses the filtered and amplified linear video signal from the Detector Board A2A9 for all Detector Functions except SLIDEBACK. The SLIDEBACK Function uses the threshold detector output of the peak detector circuit which is then applied to the audio output amplifier. The output of the audio amplifier circuit is applied to the front panel Audio Jack A1J4. An automatic volume control circuit is used to control the audio level applied to the Audio Jack.

The video output amplifier uses the buffered IF output from the IF #3 Board A2A7 plus four outputs from the Cal Tracking Board A2A15. The output of the video output amplifier is applied to the Video Output Connector A1J3. Logic commands from the Sweep Control Board A2A12 are used to select the OUTPUT FUNCTIONS (BFO, RESTORED, TRACKING, IF, LINEAR VIDEO) required. A front panel Video Level Control is used to vary the level of the video output signal.

The discriminator circuit uses the 250 Hz bandwidth 100 kHz IF output from the IF #2 Board A2A6 to obtain the AFC (Automatic Frequency Control) voltage for the receiver. The output of the discriminator circuit is applied to the Sweep Board A2A13 and Sweep Control Board A2A12.

5.4.1.14 A2A15 CAL/TRACKING BOARD
(Refer to Figure 8.24)

The Cal/Tracking Board contains the calibration/tracking oscillator, BFO oscillator, and function mixer circuits for the receiver.

The calibration/tracking oscillator circuit produces a 100.000 kHz signal which is used as the basis for the calibration and restored receiver functions. When the calibration mode of the receiver is activated, the 0 to 50 kHz calibration signal for the receiver is produced by mixing the 100 kHz signal with the 100 to 150 kHz LO signal from the VCO Board A2A10. This is applied to the Cal Board A2A8 via the Audio Amplifier Board A2A14. The Tracking Output function is produced in the same way, with the signal applied to the video amplifier circuit on the Audio Amplifier Board A2A14.

The Restored Output function is produced by mixing the 100 kHz IF signal with the LO output

from the VCO Board A2A10. The signal presentation is at the frequency of the input signal and is applied to the video amplifier circuit on the Audio Amplifier Board. The BFO function is produced by mixing the output of the BFO circuit with the 100 kHz IF signal. The resultant signal, at a frequency of approximately 1 kHz, is applied to the audio and video amplifiers on the Audio Amplifier Board.

A 50 kHz low pass filter network is located after the mixer circuit and limits the bandpass of the output signals to 50 kHz and below. A multiplexer is used to switch the various inputs to the mixer circuit thus controlling the output functions. A logic command circuit controls the operation of the multiplexer and activates the calibration/tracking and BFO circuits.

5.4.2 A1A2 FREQUENCY DISPLAY MODULE
(Refer to Figure 8.23)

The Frequency Display Module indicates the tuned frequency of the receiver in either Hz or kHz and is mounted on the front panel of the EMC-11 above the main Tuning Control.

The module uses a five digit liquid crystal display driven by two counter/decoder/driver microcircuits. The microcircuits use the 100 to 150 kHz LO output from the VCO Board A2A10 to determine the display setting. A variable oscillator circuit controls the resolution of the display to either Hz, or kHz.

5.4.3 A1A3 DIGITAL VOLTMETER MODULE
(Refer to Figures 8.15-8.18)

The DVM Module indicates the amplitude level of the input signal in dB(μV) and, when required, the level of receiver attenuation in dB. The module is mounted on the front panel of the EMC-11 next to the analog meter and above the Attenuation Control and Display switches. The circuitry within the DVM Module can be divided into three subcircuits: Attenuation Logic circuit, Pulse Generator circuit, and Counter/Display Driver circuit.

The Attenuation Logic circuit provides the attenuation logic commands for use by the DVM counter circuits and the Preamplifier/Attenuator Board A2A4. The front panel Attenuation Step Up and Step Down switches provides for manual control of the receiver attenuation level. A switch closure to ground triggers a binary counter circuit whose outputs are applied to a switching network. The switching network uses two AND/OR SELECT GATES connected in series. One gate switches between the manual and remote mode of attenuator control. The other gate is activated when the calibration mode of the receiver is enabled and sets a preselected level of attenuation for the cal mode. The switching network outputs are applied as follows:

a. To the Preamplifier/Attenuator Board A2A4 for control of the attenuator circuits.

b. To a PROM circuit producing the attenuation preset logic used by the counter/display circuitry.

The Pulse Generator circuit converts the DC voltage level from the Log Amplifier circuit into a corresponding number of clock pulses to the counter/display circuitry. The log output is applied to a sweep generator circuit whose output ramp level depends on the amplitude of the log voltage. Any change in the log voltage level produces an increase in the ramp level. This change in ramp level triggers a clock circuit whose output is applied to the counter/display circuitry. A timing circuit provides the reset control for the clock and sweep generator circuits plus four similar logic functions to the counter/display circuitry.

The Counter/Display circuitry contains the decimal counter network and the liquid crystal display drive circuits. The decimal counter network includes three BCD up/down counter microcircuits, a comparator circuit, and a PROM circuit. The clock pulses, representing the input signal amplitude level and the attenuation preset logic is applied to the inputs of the up/down counters. The outputs from the decimal counter network are applied to three liquid crystal display drivers. One driver controls the one's digit, another the ten's digit while a third driver controls the half digit. A fourth driver controls whether the display is showing signal amplitude level or the attenuation level for the receiver. The attenuation level for the receiver is added to the BCD input to the ten's display driver. A 50 Hz backplane oscillator is used to drive the actual liquid crystal display since a liquid crystal display deteriorates due to electrolysis when driven from a DC source.

5.4.4 A4 POWER SUPPLY MODULE
(Refer to Figure 8.26)

The Power Supply module supplies the regulated voltages used by the receiver and is located at the rear of the unit. The circuitry within the module can be divided into four subcircuits: rectifier circuit, charge circuit, low voltage cutoff circuit, and regulator circuit.

The rectifier circuitry provides the "raw" DC voltages for the charge and regulator circuits. The circuit consists of a power select module, power transformer, rectifier diodes, and filter capacitor.

The power select module combines the power connector, fuse holder, and AC voltage selector into one unit.

The charge circuit provides the charging current required to maintain the optional internal battery pack of the receiver at a nominal operating voltage level of 1.2 volt per cell. The current source for the circuit is a power darlington controlled by a differential amplifier circuit. The plus and minus inputs of the differential amplifier are connected to a bridge circuit which includes a pair of thermistors. These are located within the battery assembly, with one thermistor mounted to the battery case and the other at the center of the cell assembly. The thermistors monitor the temperature differential between the battery case and the center of the battery cell assembly. As the battery approaches its full charge condition, internal heating will occur which will cause an inbalance in the bridge circuit due to changes in the thermistor resistance. These inbalances cause the amplifier to turn off the current source, removing the charge current to the battery cells. When the battery assembly cools down, the inbalance will disappear allowing the amplifier to turn on the current source again. Since the temperature differential is held to within 1.5 C°, the charge cycle can continue indefinitely without damaging the battery cells.

The low voltage cutoff circuit shuts off the receiver whenever the battery voltage falls below a critical level. For the EMC-11 battery this value is approximately 1 volt per cell or 32 volts. The circuit consists of a darlington pass transistor controlled by a sensing circuit. The sensing circuit uses a 33 v zener diode to set the threshold level required to turn on the pass transistor and thus apply power to the regulator circuits. Whenever the threshold level drops below the approximate 33 volt level set by the zener, the pass transistor is turned off which removes the power from the regulator circuits. The circuit will remain off even if the battery voltage climbs back above the 33 volt level since the sensing circuit is on the applied power side of the cutoff circuit. The front panel power switch must be cycled to turn on the unit again.

The regulator circuit provides the +15 VDC, -15 VDC, +5 VDC, -5 VDC regulated voltages for the receiver. A series regulator, operating at 30 volts, supplies the -15 VDC shunt regulator. The shunt regulator consists of an integrated microcircuit with a current shunt transistor to ground from the negative line (-15 V). This equalizes the current drain between the positive and negative 15 volt supplies. The +5 and -5 VDC supplies are produced by regulator circuits operating from the + & -15 volt lines. Each regulator consists of an integrated circuit module plus bypass capacitors.

SECTION VI
ACCESSORY DATA

6.1 INTRODUCTION

This section contains information and data on the accessory items which are applicable for use with the EMC-11 INTERFERENCE ANALYZER.

6.2 EMC-11 STANDARD ACCESSORY ITEMS

The following accessories are provided as standard equipment with each EMC-11.

a. **TBA-11:** 150 mm (6 inches) TWINAX PLUG-TO-BNC PLUG Adapter cable.

b. **CA-11:** 150 mm (6 inches) TWINAX PLUG-TO-CLIP LEAD Adapter cable.

c. **BC-11:** 150 mm (6 inches) BNC (PLUG-TO-PLUG) cable.

d. **TAC-11:** 1.8m (72 inches) TWINAX (PLUG-TO-PLUG) cable.

e. **AB-11:** TWINAX RECEPTACLE-TO-RECEPTACLE Adapter box.

f. **CAC-10:** 7.6 m (25 feet) BNC (PLUG-TO-PLUG) 50 ohm cable.

g. **BT-11:** 50 ohm to 50 ohm BALUN Transformer with BNC JACK-TO-TWINAX RECEPTACLE connectors. (Refer to Figure 6.1 for the complete BT-11 BALUN transformer specifications.)

h. **PCD-11:** 1.8m (72 inches) AC Power Cord.

i. **BAT-11:** BATTERY PACK, 32-2.2 ampere-hour 1.2 VDC nickel-cadmium cells. Nominal six (6) hour operating time.

6.3 EMC-11 OPTIONAL ACCESSORY ITEMS

The following optional accessory items are available for use with the EMC-11.

a. **ALP-10 LOOP ANTENNA**

SPECIFICATIONS

Electrical:
Frequency Range (calibrated): 20 Hz-50 kHz.
(Refer to Figure 6.2 for the Antenna Factor Chart)
Shielded from electric fields
Impedance: Calibrated for use into 50 ohms.
Output Connector: BNC.

Mechanical:
Outside Diameter: 635 mm (25").
Height: 685.8 mm (27").
Weight: 0.5 kg (1.1 lbs).

GENERAL DESCRIPTION

The ALP-10 Loop Antenna is designed specifically for use with the Electro-Metrics Model EMC-11 Interference Analyzer and used to obtain magnetic field measurements from 20 Hz to 50 kHz. It can be used up to 500 kHz with other 50-ohm instruments since it is designed and calibrated for use in a 50-ohm system. The antenna has a balanced faraday shield that reduces its response to electric fields to a vanishingly small amount so that it can produce practically pure magnetic field measurements.

APPLICATIONS

The ALP-10 is suited for use in compliance testing to REO1 of MIL-STD-461B, REO4 of MIL-STD-461A, CISPR recommendations, plus other government and federal standards. The antenna is designed to work into a 50-ohm system and its calibration chart is based on this use. The calibration chart gives values of antenna factor for finding both magnetic field strength H (on the left hand scale) and magnetic induction or flux density B (on the right hand scale). To find the field strength H in dB(μA/m), add the factor from the left-hand scale in dB(S/m) to the measured two-terminal input voltage on the EMC-11 in dB(μV). To find the flux density B in dB(pT), add the factor from the right-hand scale in dB(pT/μV) to the measured two-terminal input voltage on the EMC-11 in dB(μV). The ALP-10 Loop Antenna is, electrically, a magnetic dipole and thus having a dipole pattern must be oriented for best sensitivity.

FIGURE 6.1
BT-11 50-OHM BALUN TRANSFORMER SPECIFICATIONS

Electrical:

Impedance: PRIMARY: 50 ohms unbalanced.
SECONDARY: *50 ohms balanced.*

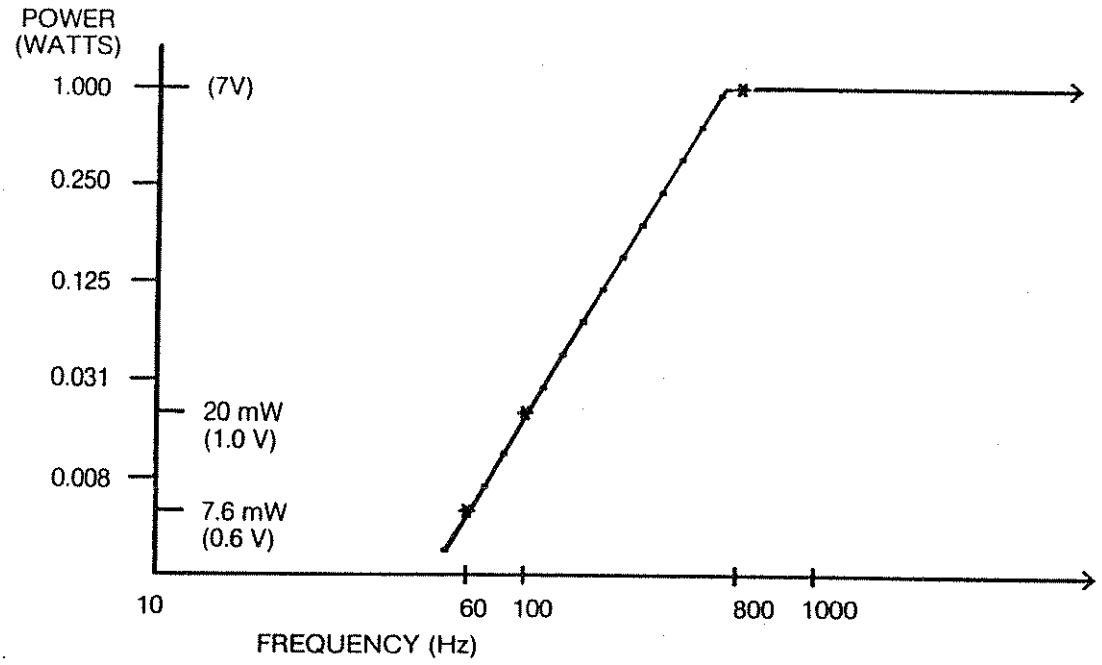
NOTE: Windings are isolated from each other.

Frequency Response: 20 Hz at -3 dB to 6 MHz @ VSWR = 1.25 maximum.

MAXIMUM INPUT LEVEL

FREQUENCY	POWER	VOLTAGE IN (50 ohms)
800 Hz	1.000 W	7.0 V
100 Hz	20.0 mW	1.0 V
60 Hz	7.6 mW	0.6 V

Derating below 800 Hz at 6 dB per octave as shown below:



*** * * CAUTION * * ***

This BALUN transformer cannot handle high signal levels at low frequencies. The MAXIMUM signal level at 60 Hz must be limited to NOT MORE THAN 0.6 VRMS or 7 mW, otherwise extensive damage to the transformer may result.

Mechanical:

Dimensions: 87.4 mm high x 70 mm wide x 155.6 mm deep
(3.4" x 2.75" x 6.125")
Weight: 227 g (0.5 lbs).

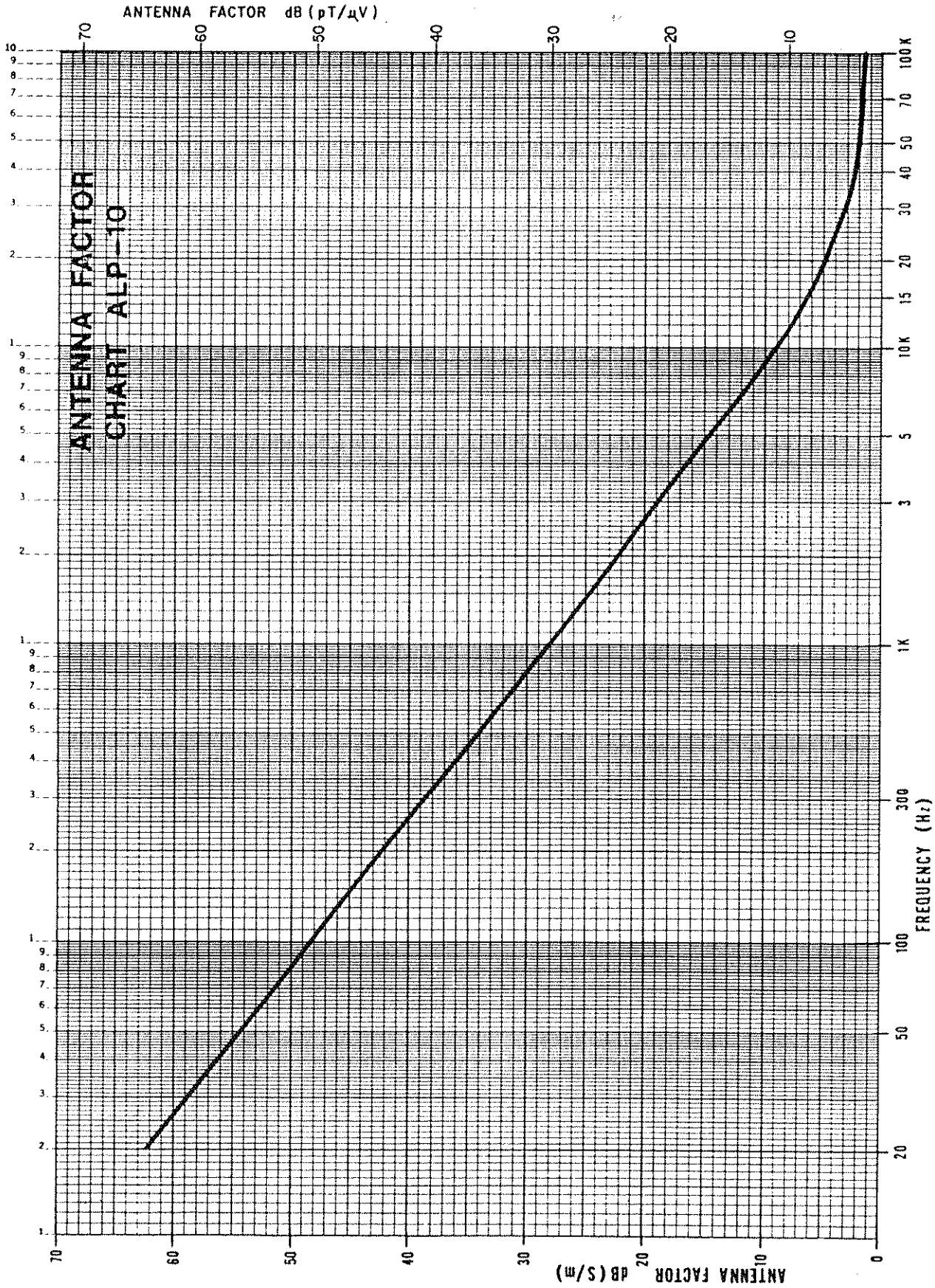


FIGURE 6.2
ALP-10 ANTENNA FACTOR CHART

b. ELS-10 LOOP SENSOR ANTENNA

SPECIFICATIONS

Electrical:

Frequency Range (calibrated): 20 Hz-50 kHz.
(Refer to Figure 6.3 for Conversion Factor Chart)
Impedance: As per MIL-STD-461A, Figure 1B.
Output Connector: BNC.

Mechanical:

Boom Length: 578 mm (22.75").
Probe Tip Length: 60 mm (2.36") 7 cm from coil center.
Loop Sensor Diameter: 146 mm (5.75").
Weight: 795 g (1.75 lbs).

GENERAL DESCRIPTION

The ELS-10 Loop Sensor Antenna uses passive circuits to transform magnetic field components from 20 Hz to 50 kHz to an equivalent open circuit two-terminal voltage on the EMC-11 meter. Use of the Conversion Factor Chart will yield the strength of the magnetic induction field referenced to a uniform field. The loop is electrostatically shielded and therefore is sensitive only to the magnetic component (B-Field) of the electromagnetic fields.

APPLICATIONS

The ELS-10 is designed, constructed, and tested in exact accordance with the requirements of MIL-STD-461A. The Loop Sensor Antenna fully meets the magnetic field radiated emission test requirements, REO1 of MIL-STD-461A.

The ELS-10 must used only with a receiver having an input impedance of 10 kilohms or greater, otherwise the conversion factors stated in MIL-STD-461A are not valid.

c. PEF-10A ELECTRIC FIELD PROBE ANTENNA SPECIFICATIONS

Electrical:

Frequency Range (calibrated): 20 Hz-50 kHz.
Impedance: Calibrated in a 50-ohm system.
Antenna Factor: 23 dB(m^{-1}), constant.
Output: Multi-conductor cable with 11-pin male connector.
(Cable also provides the power, grounding, and calibration signal inputs to the PEF-10A from the EMC-11.)

Mechanical:

Length, Antenna Assembly: 894 mm (35.2".
Width, Dipole (Tip-Tip): 914.4 mm (36").
Multi-conductor Cable Length: 7.6 m (25 feet)
Weight: 2.7 kg (6 lbs).

GENERAL DESCRIPTION

The PEF-10A Electric Field Probe Antenna is designed specially for use with the Electro-Metrics Model EMC-11 Interference Analyzer and is used to obtain electric field measurements. The probe is a half-meter capacitive dipole connected to a high impedance differential amplifier. The low impedance output of the amplifier is applied to the EMC-11 via a 7.6 m (25 foot) multi-conductor cable. The EMC-11 supplies the power, grounding, and calibration signal inputs to the PEF-10A.

The PEF-10A also includes a TMT-10 Tripod Mount for mounting the antenna plus two calibration cables for antenna calibration with the EMC-11.

APPLICATIONS

The PEF-10A is suited for use in compliance testing to MIL-E-8884, NSA 65-6, plus other federal standards. In addition, the PEF-10A will function properly and can be calibrated up to 1 MHz with any 50-ohm instrument which can tune above 50 kHz.

d. PCL-10 CURRENT PROBE

SPECIFICATIONS

Electrical:

Frequency Range (calibrated): 20 Hz-50 kHz.
(Refer to Figure 6.4 for typical transfer impedance factor chart)
Impedance: Calibrated in a 50-ohm system.
Output Connector: BNC.

Mechanical:

Conductor Opening: Up to and including 25.4 mm (1").
Weight: 454 g (1 lbs).

GENERAL DESCRIPTION

The PCL-10 Current Probe is an instrument type transformer which utilizes the conductor under test as a single turn primary winding with the probe, clamped around the conductor, as the secondary. The outside case of the probe is specially constructed to form an electrostatic shield which minimizes the effects of stray fields, while a core of ferrous materials improves its response to conducted currents. Intermodulation and saturation effects on the current probe output are negligible for primary currents up to but not exceeding 300 A.

The PCL-10 is connected to the EMC-11 via a 50-ohm coaxial cable.

APPLICATIONS

The PCL-10 is suited for use in compliance testing to MIL-STD-461B/462, plus other government and federal standards.

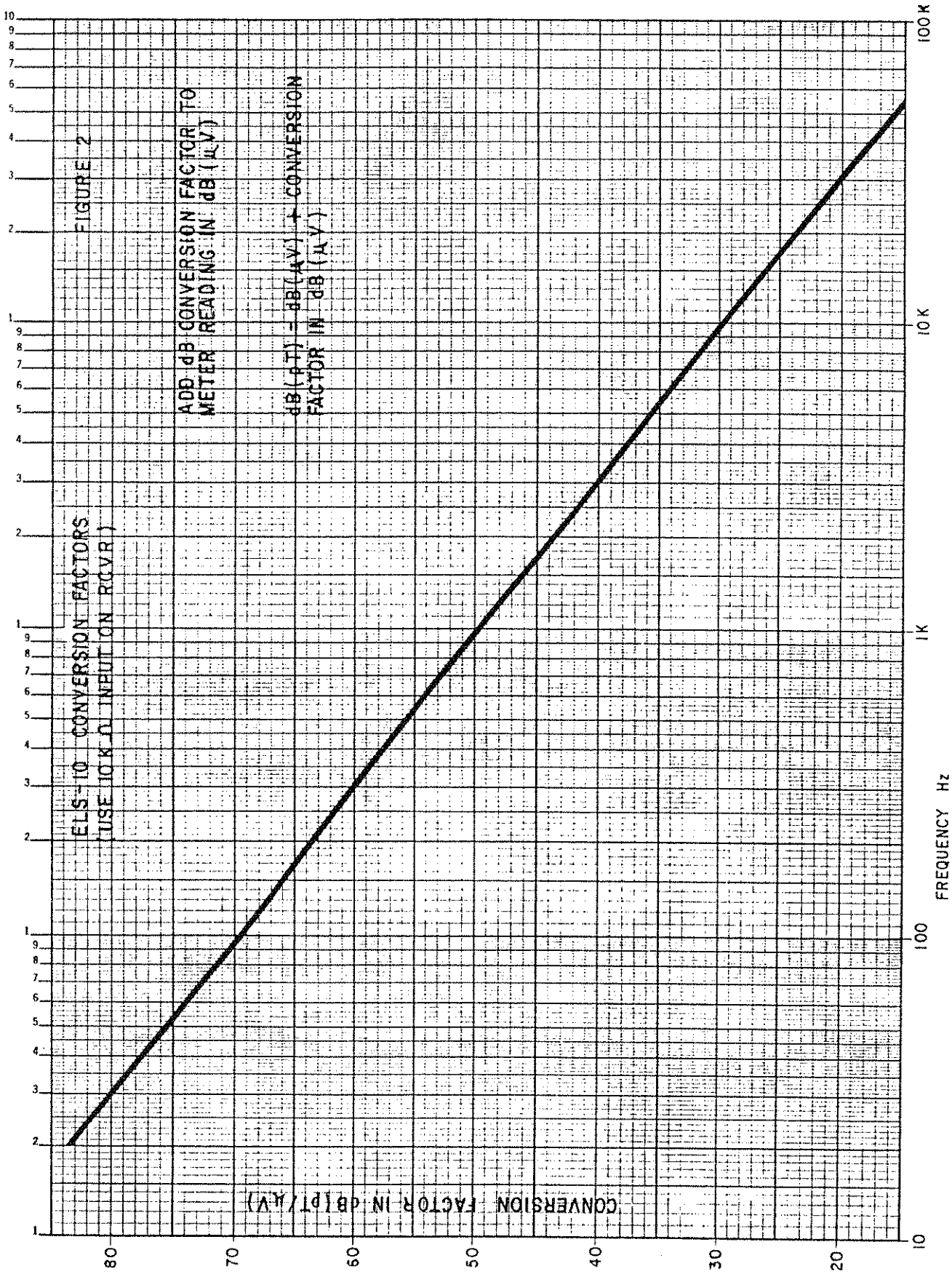


FIGURE 6.3
ELS-10 CONVERSION FACTOR CHART

e. PCA-10 CURRENT PROBE AMPLIFIER SPECIFICATIONS

Electrical:
Frequency Range: 20 Hz-50 kHz.
Input Impedance: 50 ohms.
Output Impedance: 10 kilohms.
Input Connector: BNC.
Output: Coaxial cable-BNC PLUG.

Mechanical:
Dimensions:
38 mm high x 83 mm wide x 151 mm deep
(1.5" x 3.275" x 6.25")
Power/Signal Cable Length: 457 mm (18").
Weight: 2.7 kg (6 lbs).

GENERAL DESCRIPTION

The PCA-10 Current Probe Amplifier is used in conjunction with the PCL-10 Current Probe for measuring current flow through a conductor. The circuitry of the PCA-10 allows the current measured by the PCL-10 to be indicated directly on the digital/analog meters of the EMC-11. No calculations or conversion factors are required. The output of the PCL-10 is connected to the input of the PCA-10, whose output is then connected to the input of the EMC-11. The IMPEDANCE Switch of the EMC-11 is set to the 10 kilohm position when the PCA-10 is being used, which produces a constant 1 ohm transfer impedance between the EMC-11 and the PCA-10. Power is supplied to the PCA-10 from the Probe Connector of the EMC-11.

APPLICATIONS

The PCA-10 is suited for use in compliance testing to MIL-STD-461B/462, plus other government and federal standards. When used with the PCL-10, it produces an integrated response to pulsed conducted currents. It may also be used with the ALP-10 and ELS-10 to produce an integrated response to pulse-type magnetic fields.

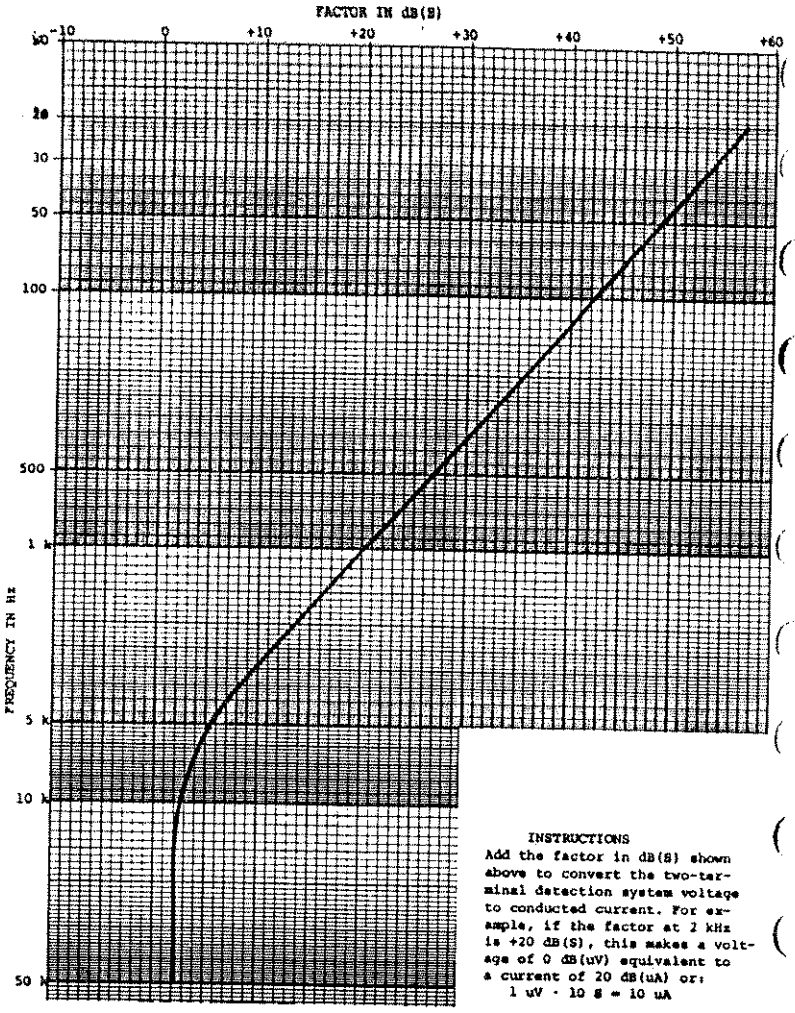


FIGURE 6.4
PCL-10 TYPICAL TRANSFER IMPEDANCE FACTOR CHART

f. IT-11 IMPEDANCE TRANSFORMER SPECIFICATIONS

Electrical:
Impedance: Primary: 10 kilohms.
Secondary: 600 ohms.
Frequency Range: 20 Hz-50 kHz ±0.25 dB.
Input Voltage (maximum): 12 VRMS.

NOTE: The transformer can handle higher input levels but these levels will then exceed the maximum input levels for the EMC-11.

Connectors: BNC.

Mechanical:
Dimensions:
87.4 mm high x 70 mm wide x 155.6 mm deep
(3.4" x 2.75" x 6.125")
Weight: 227 g (0.5 lbs).

GENERAL DESCRIPTION

The IT-11 Impedance Transformer is designed to perform single-ended conducted measurements in a 10 kilohm impedance physically remote from

the EMC-11. This enables the user to eliminate return circuit coupling problems (ground loops) and thus obtain the optimum performance from the EMC-11 when measuring in a 10 kilohm system.

g. **FILTERS**

The following is a short description of the various high pass and notch rejection filters which can be used with the EMC-11.

1. **HPF-10, HPG-10, HPH-10, HPK-10, HPL-10 HIGH PASS FILTERS**

The Electro-Metrics HPF-10, HPG-10, HPH-10, HPK-10, AND HPL-10 High Pass Filters enhance the performance of the EMC-11 Interference Analyzer by suppressing all frequencies below the specified frequency of the filter. This prevents spurious responses which are frequently encountered in radio noise meters when testing to MIL-STD-461 and other power line conducted emanation standards.

The specified cutoff frequencies for each high pass filter are as follows:

HPF-10:
attenuates all frequencies below 120 Hz.

HPG-10:
attenuates all frequencies below 240 Hz.

HPH-10:
attenuates all frequencies below 1600 Hz.

HPK-10:
attenuates all frequencies below 300 Hz.

HPL-10:
attenuates all frequencies below 2000 Hz.

Refer to Figure 6.5 for a typical response curve.

2. **NRE-10, NRF-10, NRG-10 NOTCH REJECTION FILTERS**

The Electro-Metrics NRE-10, NRF-10 and NRG-10 Notch Rejection Filters enhance the performance of the EMC-11 Interference Analyzer by eliminating the 50 Hz, 60 Hz and 400 Hz power line frequencies.

The NRE-10 eliminates 50 Hz frequencies, the NRF-10 eliminates 60 Hz frequencies, while the NRG-10 eliminates 400 Hz frequencies. This prevents spurious responses frequently encountered in radio noise meters when testing to MIL-STD-461. Refer to Figure 6.6 and 6.7 for typical response curves.

NRE-10, NRF-10, NRG-10 Input Levels:
10 VRMS (Typical), 20 VRMS (Maximum).

NRE-10 Notch Rejection Filter
Notch Frequency: Equals 50 Hz.
Rejection: 40 dB minimum @ 50 Hz.
Notch Width: Less than 20 Hz @ 20 dB down.

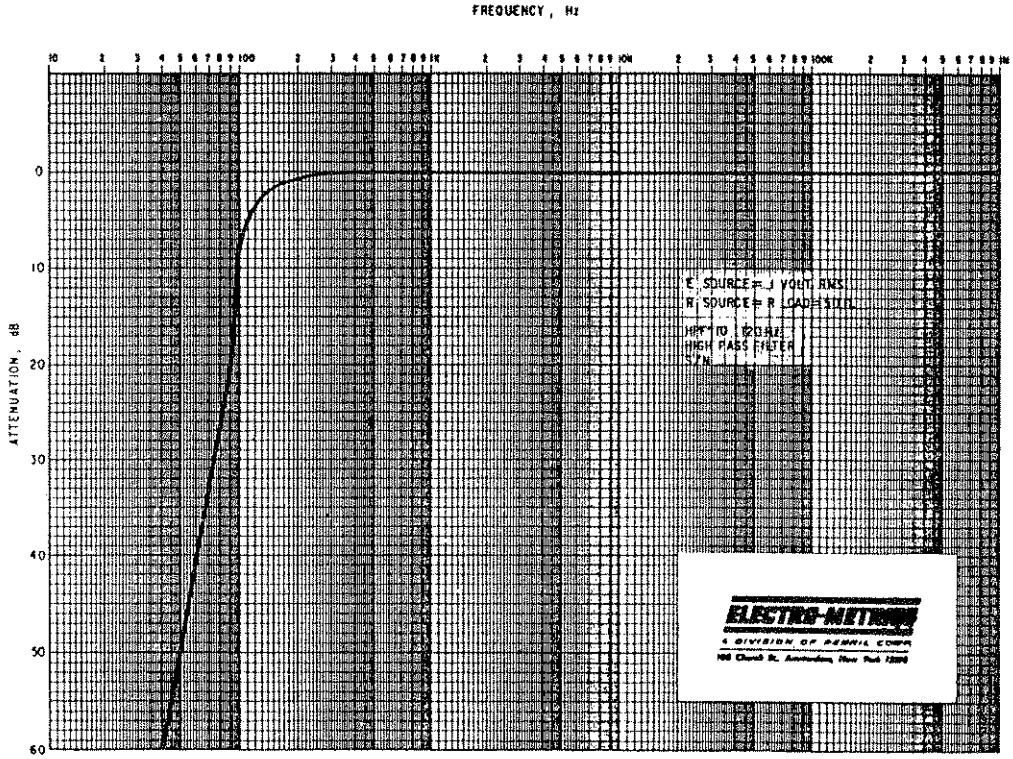


FIGURE 6.5
HPF-10 HIGH PASS FILTER TYPICAL RESPONSE CURVE

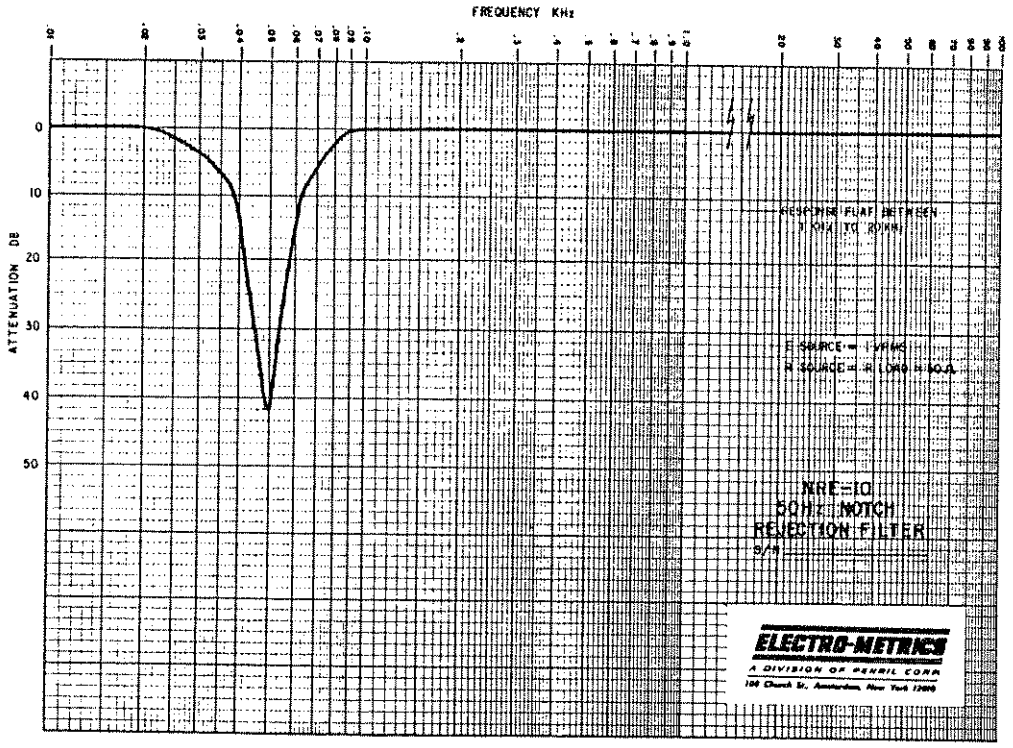


FIGURE 6.6
NRE-10 NOTCH REJECTION FILTER (50 Hz) TYPICAL RESPONSE CURVE

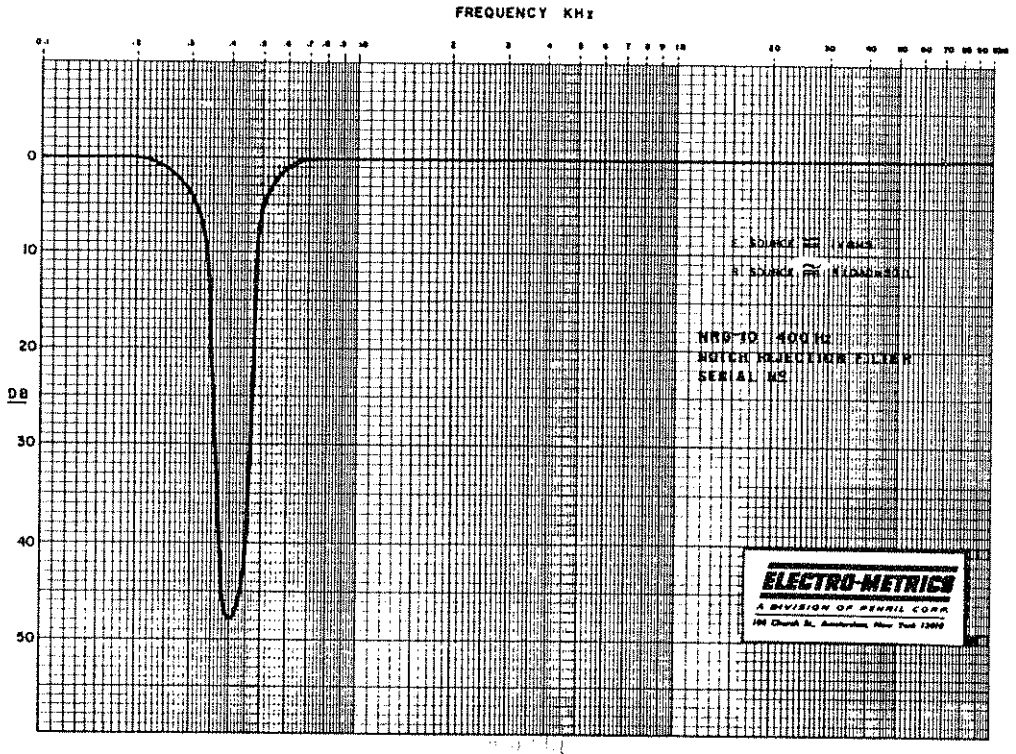


FIGURE 6.7
NRG-10 NOTCH REJECTION FILTER (400 Hz) TYPICAL RESPONSE CURVE

h. **CCITT-11 AND CCIR-11 PSOPHOMETRIC WEIGHTING NETWORKS**

SPECIFICATIONS

Electrical (each network):
Frequency Range: 16 Hz-16 kHz.
Calibration: Refer to Figures 6.8 and 6.9 for frequency weighting characteristic curves.
Impedance: 600 ohms.
Connectors: TWINAX.

Mechanical (each network):
Dimensions:
87.4 mm high x 70 mm wide x 155.6 mm deep (3.4" x 2.75" x 6.125")
Weight: 227 g (0.5 lbs).

NRF-10 Notch Rejection Filter
Notch Frequency: Equals 60 Hz.
Rejection: 35 dB minimum @ 60 Hz.
Notch Width: Less than 20 Hz @ 20 dB down.

NRG-10 Notch Rejection Filter
Notch Frequency: Equals 400 Hz.
Rejection: 45 dB minimum @ 400 Hz.
Notch Width: Less than 180 Hz @ 20 dB down.

GENERAL DESCRIPTION

The Electro-Metrics CCITT-11 and CCIR-11 Psophometric Weighting Networks provide audio frequency measurement capabilities recommended by various international telecommunications standards organizations as reflected in CISPR Pub. 16 [3].

The CCITT-11 network provides for measurements as recommended by the Fifth Plenary Assembly of the CCITT [7]. The characteristic curve of this network is shown in Figure 6.8. The CCIR-11 network provides for measurements as recommended by CCIR [8]. The characteristic curve of this network is shown in Figure 6.9.

APPLICATIONS

The CCITT-11 and CCIR-11 networks are applied, as shown in Figure 6.10, as input filters in front of the EMC-11.

The CCITT-11 Psophometric Filter Network is used for measurements at the terminals of a commercial trunk telephone circuit as recommended by the CCITT. The CCIR-11 Psophometric Filter Network is used for measurements of noise at the outputs of radio receivers used for voice communications.

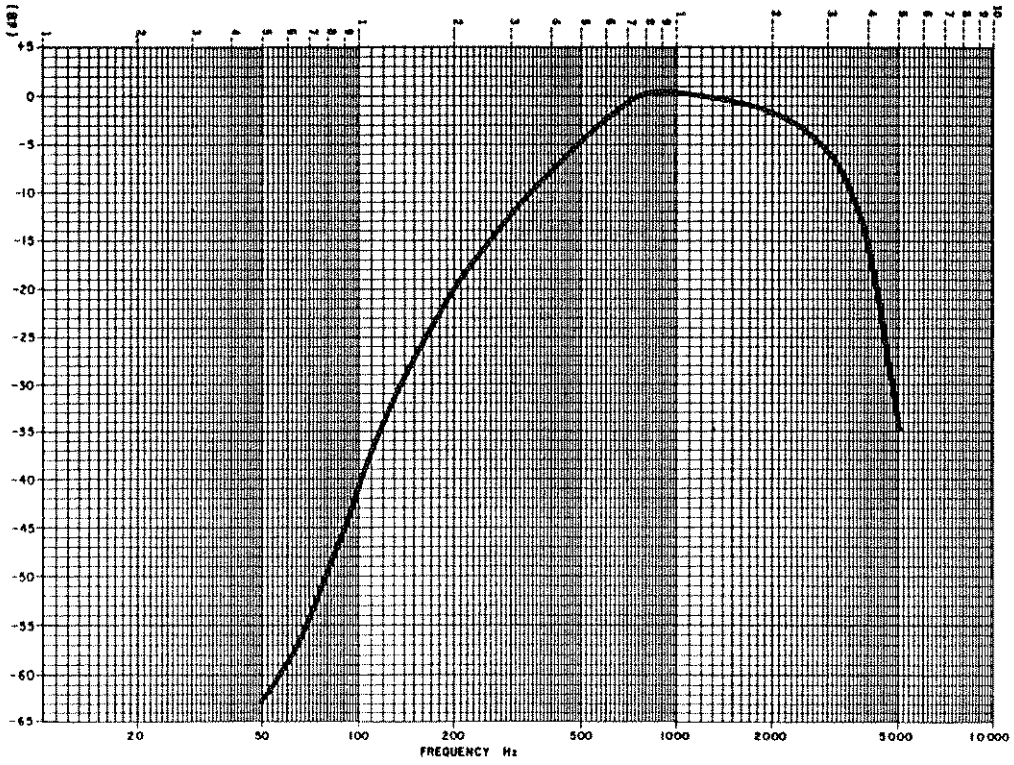


FIGURE 6.8
CHARACTERISTIC CURVE OF THE CCITT-11 PSOPHOMETRIC FILTER NETWORK USED FOR MEASUREMENTS AT THE TERMINALS OF A COMMERCIAL TRUNK TELEPHONE CIRCUIT

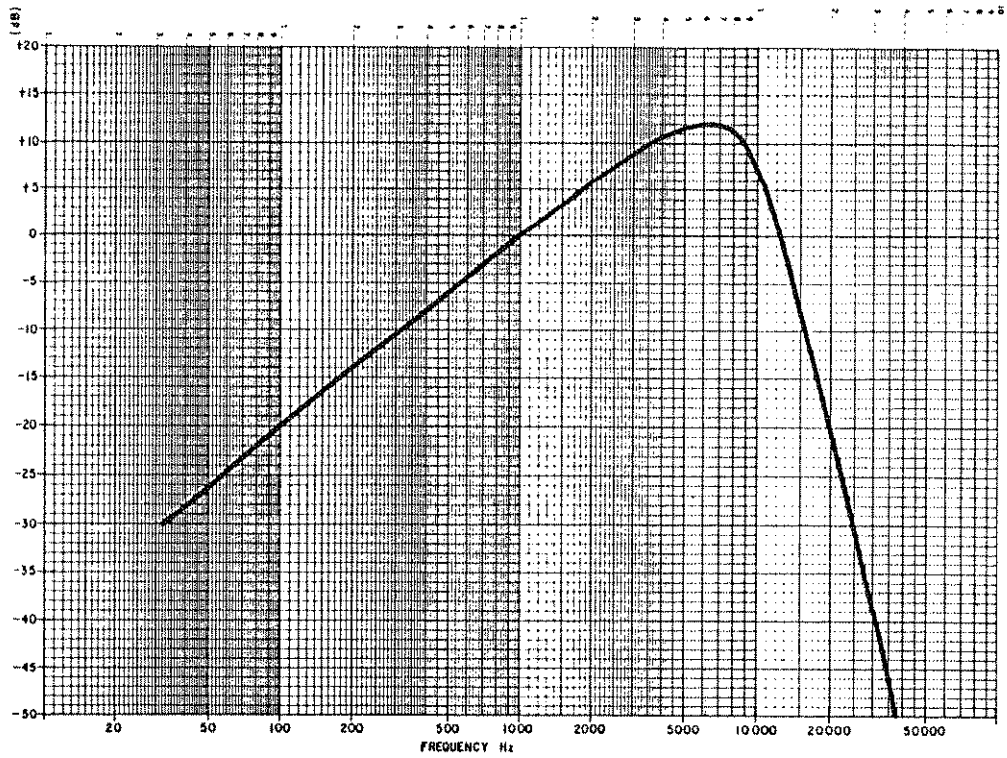


FIGURE 6.9
RESPONSE CURVE FOR CCIR-11 PSOPHOMETRIC FILTER WEIGHTING NETWORK FOR PROGRAM MEASUREMENTS

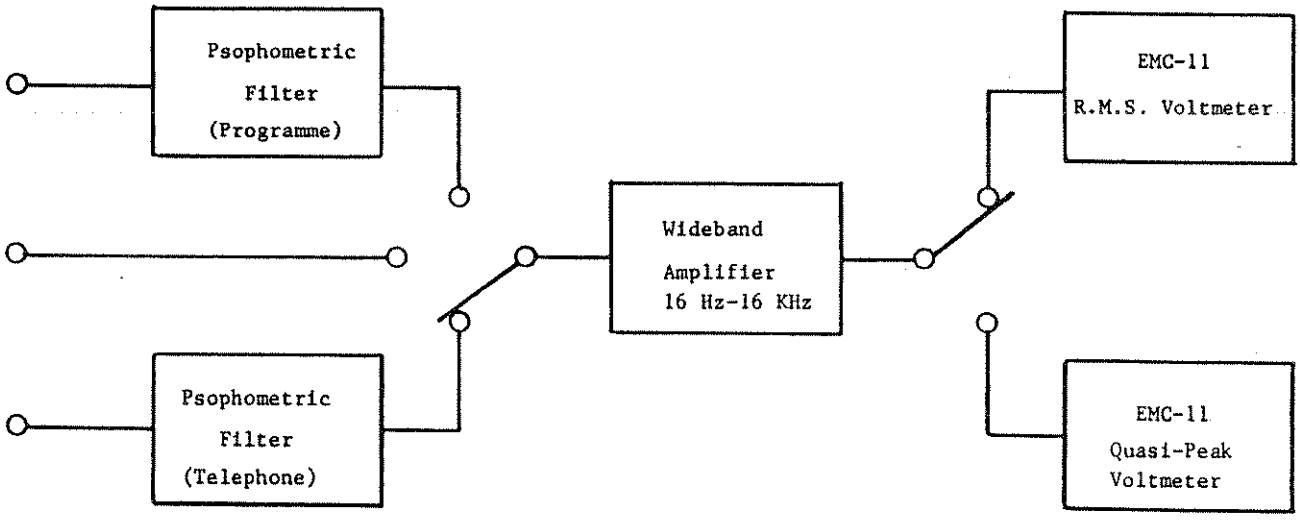


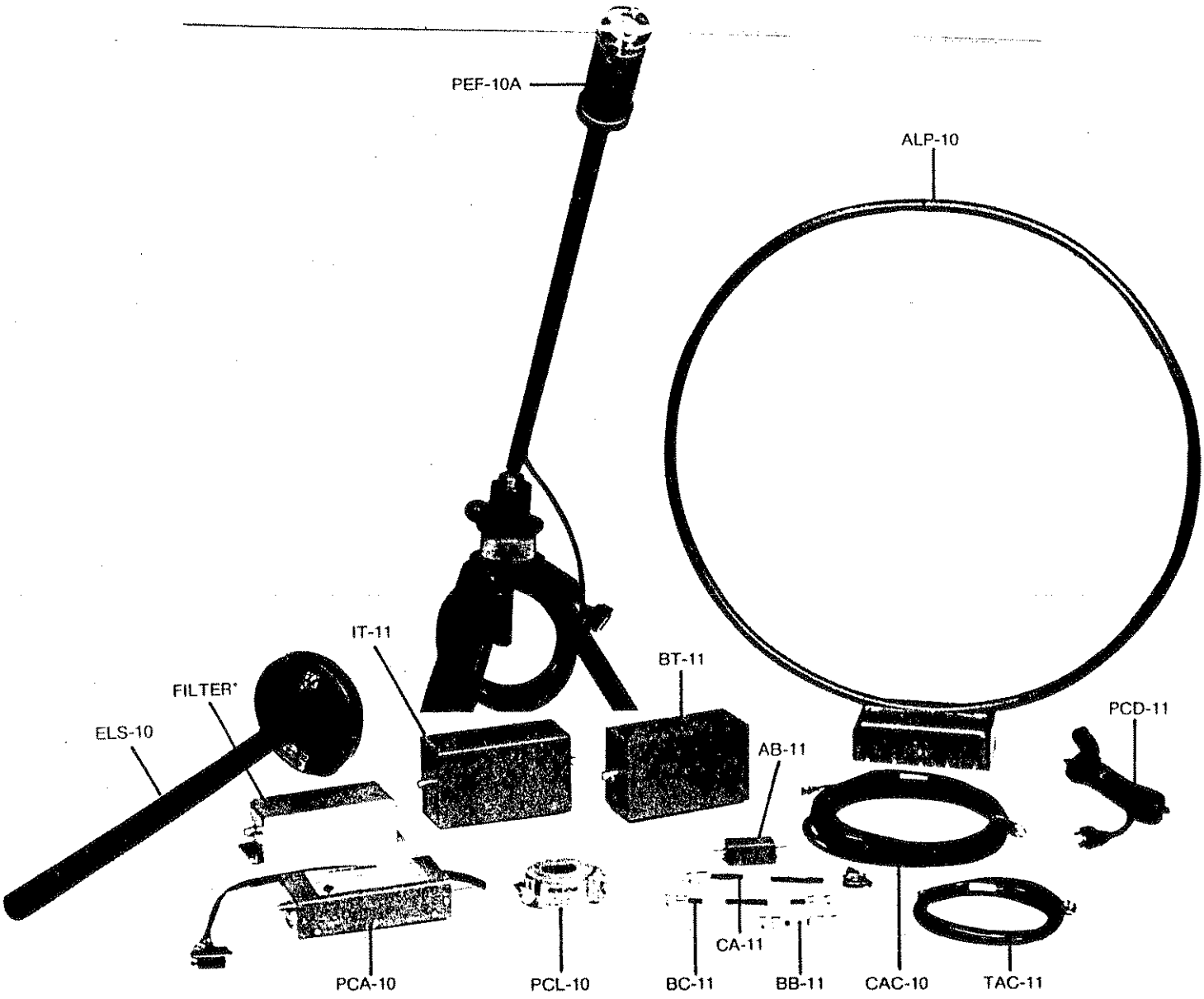
FIGURE 6.10
BLOCK DIAGRAM FOR CCITT AND CCIR RECOMMENDED MEASUREMENTS USING THE EMC-11 INTERFERENCE ANALYZER AND PSOPHOMETRIC NETWORKS AS AN AUDIO-FREQUENCY INTERFERENCE VOLTMETER

i. **ADDITIONAL OPTIONAL ACCESSORY ITEMS**

In addition to the optional accessory items described in Section 6.3 a-h, the following accessory items are also available.

1. BB-11: BNC JACK-TO-JACK Adapter.
2. CEC-10: 7.6 m (25 feet) Multi-conductor Extension Cable for the PEF-10A.
3. EXY-125: Single Pen X-Y Plotter.
4. ABM-11: Adapter Brackets for mounting in standard 19-inch instrument rack.
5. EHF-25: High Intelligibility Earphones.
6. TRI-25: Tripod, Rugged.
6. TRB-25: Tripod, Rugged with Bag.
8. LAC-10: Loop Antenna Case.

ALL SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.



*Typical case for notch and pass filters.

FIGURE 6.11
EMC-11 ACCESSORIES