FIELD INTENSITY METER
MODEL FIM-41
OPERATING INSTRUCTIONS

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SECTION 2. OPERATION

2.1 General

The FIM-21 and FIM-41 operating controls and indicators are described in this section. Also provided are the basic operating instructions which include battery voltage testing, meter calibration, measuring field strength, and use of these instruments as null detectors for RF Bridge measurements.

2.2 Operating Controls and Indicators

All operating controls and indicators are located on the front panel of the FIM-21 and FIM-41 as shown in figure 2-1. Table 2-1 lists these controls and indicators and the associated functions.

Table 2-1. Operating Controls and Indicators

Control or Indicator	Function
FUNCTION selector switch (S2)	Selects the function to be displayed on the front panel meter and connects battery. OFF - battery disconnected from circuit, and direct connection made across meter terminals to protect meter. BATT - battery output voltage FI CAL TUNE - field strength of antenna input developed from detected output of receiver IF amplifier. CAL Null - compares detector outputs from receiver and calibrating oscillator.
FULL SCALE selector switch (S1)	Selects the amount of attenuation in RF and IF stages, in 10 to 1 (20 db) ratio steps. The panel is marked with the full-scale direct-reading field strength value for each position. CAL - applies power to calibrating oscillator, and selects 1 volt range of attenuator.
AUDIO control and switch (R3)	Adjusts level of audio in speaker and headphones. Switch disables audio amplifier in OUT position.

Table 2-1. Operating Controls and Indicators (Cont.)

Control or Indicators	Function
GAIN control (R2)	Adjusts gain of receiver by regulating gain of IF amplifier.
CAL OSC tuning control (Rl)	Fine tunes calibrating oscillator. (Oscillator frequency coarse tuning is pre-set by receiver tuning control.)
RCVR tuning control (C1)	Tunes receiver and calibrating oscillator by rotating capacitors Cl and C2. Frequency of receiver signal is read on dial.
FIELD-STRENGTH meter (Ml)	Indicates field strength in volts per meter, in conjunction with full scale switch.
LIGHT switch (S3)	Illuminates meter and dial.
RF INPUT switch	Switches receiver input to loop antenna (ANT) or external BNC input jack (EXT).
MHz switch (FIM-41 only) (S7)	Selects frequency band: A. .54 to 1.6 MHz B. 1.6 to 5.0 MHz
METER switch (S5)	Provides either logarithnic (LOG) or linear (LIN) relation between meter reading and receiver input, the former for use when the meter is to operate in conjunction with recording equipment or when relative measurements of greater than one decade are desired.

Replacement of batteries is described in the maintenance section of this manual.

2.3 FIM Calibration

The FIM should always be calibrated at the frequency of the signal to be measured. This eliminates any error due to frequency sensitive components in the circuits. Calibrate the meter as follows:

1. Place or hold the field strength meter in a vertical position, with the top surface in a horizontal plane. Open the cover and swing it to a vertical position.

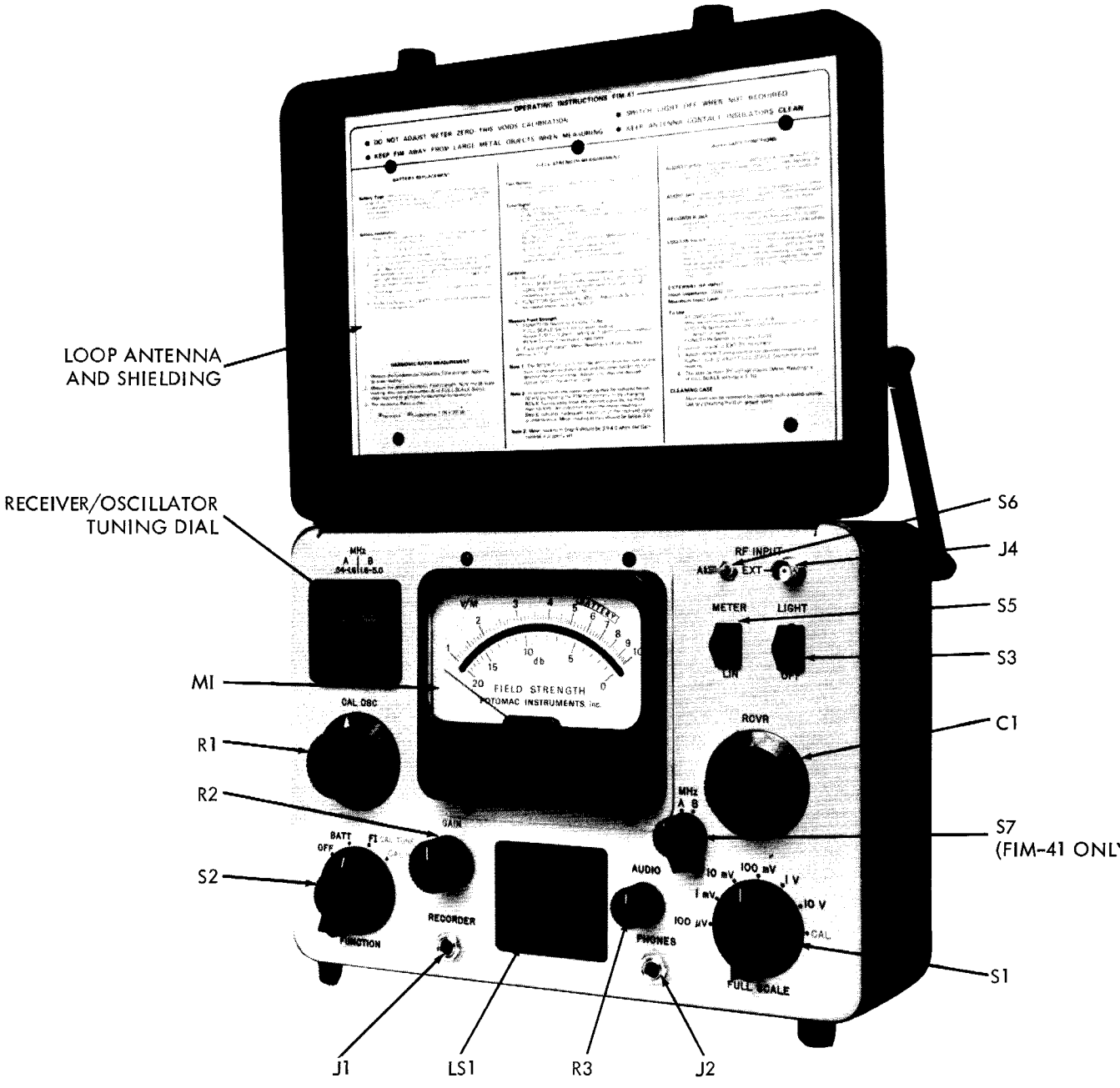

Figure 2-1 Operating Controls and Indicators

2.3 FIM Calibration (Cont.)

2. Rotate the FUNCTION switch to the BATT position and see that the reading is above 5.0.

3. Rotate the FUNCTION switch to the FI position.

4. Switch LOG-LIN switch to LIN position.

5. Set the FULL SCALE switch to the range which covers the expected value of field strength.

6. Turn on the AUDIO control and tune the RECEIVER dial to the signal to be measured. Use the meter indication to obtain peak tuning, adjusting the GAIN control and FULL SCALE switch, and rotating the instrument to obtain a reading within the range of the meter. Use the audio signal to identify the station. The RCVR Tuning Control has vernier drive for 3/4th of one turn; it changes to direct drive and becomes harder to turn beyond the vernier range. Adjust it so that the desired station falls in the vernier range.

7. Rotate the instrument to obtain reading below 10 mV. In strong fields the meter reading may be reduced below 10 mV by holding the FIM horizontally or by changing RCVR TUNING away from the desired signal by no more than 10 KHz. (This is permissible because the receiver gain variation with frequency is very gradual.) An indistinct dip in the meter reading in Step 8 indicates inadequate reduction of the received signal, or interference.

8. Place the FULL-SCALE switch in the CAL position: adjust CAL OSC Tuning for highest meter reading, or an audio beat note low enough in frequency to be inaudible. (The meter reading should be 3.5 - 4.8 when the Gain control is properly set.)

9. Rotate FUNCTION switch to CAL NULL position: adjust GAIN control for lowest meter reading. The meter reading should be below 3.0.

10. Return FUNCTION switch to FI-CAL-TUNE. Retune RCVR tuning for maximum meter reading on the desired signal. The Field Strength Meter is now calibrated at the frequency to which it was originally tuned.

2.4 Measuring Field Strength

In use, the field meter is generally held in the hand, or mounted on a tripod or unipod. Of the latter two, the unipod is preferred, since it can be easily rotated , and can remain attached to the instrument. A plate having a hole tapped for a 1/4 - 20 screw is fastened to the bottom of the case, for attachment to a support.

2.4 Measuring Field Strength (Cont.)

The field meter should always be operated in a vertical position when making field strength measurements.

After calibrating as described in the previous section, proceed as follows:

1. Set the FULL SCALE switch to the range approximating the signal strength expected.

2. With the FUNCTION switch set at FI, rotate the unit to orient the loop antenna and obtain maximum deflection on the panel meter, changing the position of the FULL SCALE switch if necessary to keep the panel meter indication on scale.

3. Read the field intensity directly from the panel meter, using the position of the FULL SCALE switch as a guide. For example, with the FULL SCALE switch on 100 mv, a full scale reading of 10 on the meter means 100 millivolts per meter, and a reading of 5.6 indicates a field strength of 56 millivolts per meter.

4. Multiply the reading obtained in step 3 by the K factor for the operating frequency given on the calibration certificate for the instrument. This procedure is followed when it is necessary to make full use of the specified accuracy of the field meter.

5. To de-energize the field meter, rotate the FUNCTION switch to the OFF position. This disconnects the batteries from the circuit. Closing the cover also removes the battery power.

2.5 Measuring Harmonic Ratio in Decibels

Field Strength Ratios may be measured directly in decibels by reading the db scale of the meter in conjunction with the FULL-SCALE range indicator. Since each step of the FULL-SCALE switch corresponds to one (1) decade or twenty (20) db, the ratio is determined by the following formula:

$$db_1 - db_2 + N \times 20 = \text{Ratio in db}$$

where:

db_1 = Harmonic field strength
db_2 = Fundamental field strength
N = Number of FULL SCALE steps between fundamental and harmonic

2.5 Measuring Harmonic Ratio in Decibels (Cont.)

Example:

Let us say that we want to measure the field strength and the second and third harmonic suppression of a transmitter with an operating frequency of 1500 KHz.

1. Measure field strength of fundamental as outlined in section 2.4 of this manual; note db scale.
   Example: 560 mV/M & 5 db.

2. Measure field strength of second harmonic as above at 3.0 MHz.
   Example: 0.35 mV/M & 9 db.

3. Measure field strength of third harmonic as above at 4.5 MHz.
   Example: 79 uV/M & 2 db.

Calculate harmonic suppression:

$db_1 - db_2 + 20 \times N = \text{ratio (db)}$

second harmonic suppression = 9-5 + 60 = 64 db
third harmonic suppression = 2-5 + 80 = 77 db

It is not the purpose of this manual to describe the techniques of locating radial measurement points and plotting the field data required by the FCC. For this type of information, and for a more detailed description of operating techniques, the user is referred to the current edition of the NAB Handbook.

2.6 R. F. Bridge Measurements

The receiver section of the FIM-21 and FIM-41 may be used as a tuned voltmeter for applications such as R. F. Bridge null detection. As a tuned voltmeter, these instruments exhibit an input impedance of 2500 ohms shunted by less than 2 picofarads.

To use the FIM as a relative indicator of RF voltage, proceed as follows:

1. RF INPUT switch	switch to EXT position
2. METER switch	LOG or LIN - the LOG mode is helpful for RF null detection work
3. FUNCTION switch	set to FI-CAL TUNE
4. FULL SCALE switch	set to l0V position or as required for meter indication

2.6 R. F. Bridge Measurements (Tuned Voltmeter) (Cont.)

Connect RF source to EXT RF input on FIM front panel. Adjust RCVR tuning for desired frequency and highest reading: adjust FULL SCALE switch for an on-scale reading.

To calibrate the FIM for absolute voltage measurements; set RCVR tuning to desired frequency with signal source connected to EXT RF input switch settings as in steps 1, 3 & 4 above. The LOG-LIN switch must be set to the LIN position for absolute readings. Switch the RF INPUT switch to ANT and calibrate meter as described in Section 2.3. Return RF INPUT switch to EXT and read meter. The correct voltage is obtained by correlating the meter indication and the FULL SCALE attenuator setting as previously described.

IMPORTANT NOTE

When operating the FIM as a tuned voltmeter, it is necessary to guard against severe overload at the EXT RF input. For this reason, start all measurements in the l0V FULL SCALE switch position. The maximum input level which can be applied to EXT input without causing damage is 25 volts RMS.