MINI-PROBE RECEIVER
MODEL MPR-5

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IV. DIAGRAMS

I. SPECIFICATIONS

1.) General Description:

The model MPR-5 is a portable, battery operated, miniature, modular, radio receiver consisting of a basic unit with plug in tuner modules, frequency counter, and visual display unit.

2.) Configuration:

2.1 Basic Unit: (Model B-12) contains IF amplifiers, subcarrier detectors, crystal filters, audio amplifier, signal level indicator, and other electrical circuits. It has a compartment for one tuning unit.
Size: 4.1 x 6.4 x 17.8 cm. (1 5/8 x 2 1/2 x 7 inches.)

2.2 11 Tuning Modules: Model TMPR-1 thru 11 contain the necessary circuitry to cover a portion of the total frequency coverage. Each plugs into the basic unit one at a time.

2.3 Visual display unit: Size: (1 5/8 x 2 inches) 4.1 x 6.4 x 17.8 cm. Displays frequency vs. amplitude of signals received, and has an adjustable time base for displaying demodulated signals.

2.4 Digital frequency display counter: 4 digit display of true RF and subcarrier frequency setttings. Size: 4.1 x 3.2 x 17.8 cm. (1 5/8 x 1 1/4 x 7 inches.)

2.5 Mounting basic unit, visual display and frequency counter plug into portable carrier rack for system operation.

3.) Electrical Specifications:

3.1 MPR-5 Receiver Section (including tuners)

3.1.1 RF Tuning Range = 20 KHz to 10 GHz
Useful to 20 GHz

3.1.2 Sensitivity for 6 DB $\frac{S+N}{N}$
for RF 20 KHz/1 GHz = 3 uv or less
for RF 1 GHz/10 GHz = 10 uv or less

3.1.3 IF Bandwidths = 7 KHz (crystal filter)
90 KHz (crystal filter)
1 MHz

3.1.4 Tuning Motion: 10 revolutions of tuning knob for each of 2 bands for each of 10 tuners (a total of 200 turns for .02/1600 MHz). TMPR-11 Tuner has 20 turns.

3.1.5 Dials: For Tuners TMPR-1/10, the 10 turn tuning knob is provided with a clock face logging dial (0 - 10, in .1 turning increments). The frequency counter is used for direct frequency readings. Tuner #11 has a multi turn dial.

3.1.6 Fine Tuning: Provided for T-11 tuner only which is approximately 5 MHz.

3.1.7 Battery operating time with fully charged battery: with scope off: 4-5 hours, with scope on: 2-3 hours. It is recommended that when operating on batteries that the S9 visual monitor not be used or be used only when absolutely necessary. Battery life will be greatly reduced when operating the visual monitor. Charging time: 12 hours.

3.1.8 Detector: AM, FM, CW, Subcarrier AM, Subcarrier FM.

3.1.9 Signal strength indicator:
Column of 20 light emitting diodes indicate relative field strength of signal received.

3.1.10 Spurious response rejection:
RF 20 KHz/1 GHz = 30 DB or more
RF 1/10 GHz image, 2nd & 3rd harmonic no rejection
RF 1/10 GHz all others - 30 DB

3.1.11 Outputs/Inputs
- Audio (earphone level)
- Signal meter
- External power socket (+18 volts) (+9 volts)
- Antenna

3.1.12 Antennas: Whip antenna and microwave antenna mount on case of receiver carrier for use in the portable mode. Other external antennas are provided such as a long wire and telecom adapters.

3.1.13 Controls:
Tuning (10 turns/Band)
Power Switch
IF Gain (3/4 revolution, 50 DB attenuation min.)
Detector (AM/FM/CW)
Audio volume (3/4 revolution)
Battery test switch
Function switch:
1.) Narrow Bandwidth
2.) Medium Bandwidth
3.) Subcarrier FM detection
4.) Subcarrier AM detection
5.) Wide Bandwidth
Subcarrier Frequency Tuning (0 to 300 KHz)

3.1.14 Subcarrier Detection:
Subcarrier operation is selected by the function switch positions 3 (FM) and 4 (AM). When in either of these positions, the audio and frequency display automatically switch to subcarrier audio and frequency. The signal meter indicates RF level at all times. To display subcarrier signals on the visual monitor the function switch of the monitor must also be set on SC (subcarrier) position 2. The wide bandwidth of the primary IF is automatically selected and the primary detector is manually selected with the "AM/FM" switch.

3.1.15 Subcarrier IF Bandwidth: 10 KHz

3.1.16 Subcarrier Tuning: (0-300 KHz) useful down to 15 KHz

3.2 Miniature Probe Display (Model S-9)

3.2.1 Screen Size: 3.9 x 2.9 cm. (1½ x 1 1/8 inches)

3.2.2 Functions:
1.) RF displays frequency base vs. signal amplitude of RF signals with up to a 5 MHz adjustable calibrated dispersion. The audio output is not interrupted, and the resolution is fixed at 4 KHz.

2.) SC displays frequency base vs. signal amplitude of subcarrier signals from 15 KHz to 300 KHz with up to 150 KHz adjustable uncalibrated dispersion. The subcarrier audio is interrupted. (Basic unit function switch must be set to subcarrier position 3 or 4).

3.) T-11 displays frequency base vs. signal amplitude of T-11 RF signals 1.6 - 10 GHz with up to 30 to 50 MHz maximum adjustable uncalibrated dispersion depending on frequency setting. Audio is interrupted.

4.) Time Base displays time base vs. demodulated signal with time base rate settable in 5 overlapping ranges covering 10 Hz to 16 KHz. A continuously adjustable vernier control sets the frequency within the range. The function switches of the monitor and the basic unit select and adjust the vertical signal.

Resolution 7 KHz, 90 KHz and 1 MHz depending on position of receiver bandwidth selected and 10 KHz in subcarrier mode for functions 2 and 3. 4 KHz for function 1.

3.2.3 Panel Controls:
- Power
- Sweepwidth (frequency dispersion)
- Vertical Gain
- Sweep Rate
- Sweep Vernier
- Function
- Swept Converter Centering

3.2.4 Unit is powered from the basic unit (B12) and batteries. It is powered by power mains when B-12 is connected to the PS-11A power supply.

3.2.5 All connections are made through the rear 9 pin connector.

3.2.6 Subpanel Controls:
1.) Intensity
2.) Focus
3.) Horizontal position
4.) Astigmatism
5.) Vertical position
6.) Swept converter level
7.) Subcarrier level
8.) T-11 level
9.) Demodulation level

3.3 Miniature Frequency Counter (Model FC- 6)

3.3.1 Displays RF frequency of the MPR-5 up to 1600 MHz

3.3.2 Displays subcarrier frequency of MPR-5 to 300 KHz (automatically when receiver in subcarrier mode)

3.3.3 Display: 4 digit ½ inch high LCD display

3.3.4 Resolution: from 100 Hz to 100 KHz depending on tuner used. (Maximum resolution obtained when switched to add extra last digit, drops first digit.)

3.3.5 Reads tuned frequency directly (all frequency offsets internally programmed)

3.3.6 Size: 7 x 1 5/8 x 1¼ inches.

3.3.7 Mounting: Mounts between receiver and scope display in carrier pack with display on same surface as scope screen. All connections made through back panel connector.

3.3.8 Power: Is powered from (B12 and battery or external supply.

3.3.9 Lamp: Internal back lighting can be activated by FC-6 power switch for low light level conditions.

3.3.10 Controls: Power: ON/OFF Lamp
Resolution: x 1/ x 10

3.4 Main Frame: The purpose of the main frame (also referred to as the carrier) is to hold and interconnect the basic receiver, scope display, and frequency counter and battery in a convenient manner to be portable or table top operated as a complete system.

3.4.1 Loudspeaker: contains small (1½" dia.) speaker for audio feedback microphone location technique. (When earphones are connected, the speaker is disabled.)

3.4.2 External Power: a connector is provided on the main frame to interconnect the AC supply (Model PS-11A) to all MPR-5 circuits. This connector is also used to connect the rechargeable battery.

3.4.3 Antenna mounts: The adjustable antenna mount accepts the whip antenna and the microwave antenna for bench top or hand carry operation.

3.4.4 Handle: The main frame handle is 2 way adjustable to act as a bench prop, handle and tuner retainer/control protector when being hand carried.

3.4.5 Component Mounting: Each of the 3 components (basic receiver, frequency counter, and scope display) independently plug in and are thumbscrew fastened to the frame. The basic receiver is required but the other two are optional for system operation. The rechargeable battery pack is mounted via thumbscrews on the bottom of the carrier for portable operation.

3.5 Battery: The battery pack contains rechargeable Gell cells, battery condition meter and test switch. The battery is charged from the PS-11A AC power supply by plugging it directly to the battery. Full charging takes approximately 12 hours. The receiver is not operable during charging. Size: 7.688 x 6.843 x 1.187 inches. (19.5 x 17.4 x 3 cm.)

II. OPERATING INSTRUCTIONS

1.) Rechargeable Battery (OPTIONAL)

The battery pack is made up of 4 each 6 volt Gell cells which allow about 2-3 hours operation of all circuits and 4-6 hour operation when frequency counter and visual display unit are shut off. To test battery condition, attach cable between battery and receiver system and turn all units on. Then press battery test switch. The meter should be off scale on the green side for usable operation. If indication is on red side, the battery is discharged. To charge, remove battery to carrier power cable and insert PS-11A AC power supply output cable in battery pack socket. Make sure power supply 115/230 volt switch is in proper position for local voltage. Connect to power mains. Full charging will take approximately 10 hours. CAUTION: DO NOT charge for more than 10 hours as overcharging may result and cause shortened battery life. The receiver is inoperable while charging the battery except of course with a second battery of AC supply.

2.) Portable Operation

2.1 Portable Operation - General

In the portable mode, the basic receiver (B-12) frequency counter (FC-6) visual display unit (S-9) and battery pack (BP-10) are assembled to the carrier. With the addition of antenna and one tuner, the complete system can be easily hand carried to physically locate transmitting sources.

2.2 Setup of Main Frame Carrier

Setting up the main frame carrier. (Refer to Figure #1) The purpose of the carrier is to join the basic receiver (B-12) with the visual display unit (S-9), frequency counter (FC-6), battery pack (BP-10) and various antennas so that the system may be conveniently carried about. To mount the basic (B-12) unit in the carrier, place it in the left side and slide it back such that the rear blue connectors mate with the corresponding connectors of the carrier. The silver rf connector on the white wire protruding from the carrier must be pushed on the mating connector on the back of the B-12 first before mating the blue connectors. This should be done carefully to avoid damage. Long nose pliers may be required. Thumbscrew on bottom of B-12 should fit through large portion of "key hole" in frame, slide back, and tighten. The basic unit is now fully mounted. Next mount the frequency counter unit in thesame manner on the center of the carrier. Next place visual display unit S-9 in righ hand position and lock thumbscrew. Next attach fully charged battery pack.

Place carrier with mounted B-12, FC-6, S-9 upside down on table. Remove FC-6 thumbscrew completely. This is the center bottom one. Also remove 2 side thumbscrews located near rear of carrier. Place battery pack on bottom of carrier so that side holes line up with carrier side threaded holes and front bracket hole aligns with front FC-6 threaded hole. Now insert and tighten 3 thumbscrews. Insert battery pack to carrier power cable between sockets on back surfaces.

Next adjust the handle by loosening the wing nuts on each side of the carrier and swing it around to the front so that when it is held by the handle it hangs down with controls up. Tighten right hand thumbscrew only now rotate "U" shaped antenna mounting bracket located under left hand wing nut until the antenna mounting connector points toward the handle. Tighten left hand thumbscrew. Next mount whip antenna to connector. Now connect the wire from the antenna bracket to the antenna connector on the side of the basic unit. If other antennas such as the short or long wire are to be used, connect them directly to the basic receiver and disregard direction of the antenna bracket but be sure to tighten the left hand thumbscrew to hold the handle in place. If the T11 microwave unit is to be used, remove whip antenna and rotate antenna bracket so that the side opposite the screw faces the "S" meter surface of the B-9. Now mount the triangular microwave antenna on the bracket with the thumbscrew provided so that the antenna protrudes away from the left side of the carrier. Then attach microwave antenna cable protruding from the front of the T-11 tuner to the antenna with the matching gold connectors. For added convenience and equipment safety in hand held operations, loosen handle wing nuts after tuner has been inserted and slide handle down very close to tuner knob and retighten handle. Unit may now be tuned and held "single handed" and tuner cannot accidently fall out.

The antenna connector on the B12 is inactive when the T11 tuner is used so that the other antennas may be left connected.

Switch power on by sliding switch (located bottom left front of B-12) towards front. Select tuner unit that covers the frequency range desired. Insert tuner carefully in front opening of B-12 so that panel markings are "right side up". When the tuner is correctly engaged, its panel is almost flush (except for TMPR-11) with the B-12 front face. The tuner knob and dial can be used as a handle to insert and withdraw the tuner. The tuner is held in by the connector and side spring tension only. Be careful not to drop tuner out by rough handling. Make sure antenna is mounted and connected. Set controls as follows:

IF Gain: Maximum clockwise. Adjust counter clockwise if "S" meter is off scale to observe level changes.

AM/FM: To match modulation of incoming signal. If unknown, place in position that gives least audio distortion. When searching, set to AM up to 35 MHz (T1, 2, 3, 4) then FM to 1.6 GHz (T5, 6, 7, 8) and AM then to 10 GHz (T11).

Function: Position 1 (7 KHz) BW to an RF of 40 T1, 2, 3, 4); position 2 (90 KHz BW) to an RF of 625 (T5, 6, 7, 8, 9) and position 5 (1000 KHz BW) to 10 GHz RF (10A, 10, 11). Use position 3 and 4 for subcarrier FM and AM.

Volume Control: Set for audio level desired. (Earphone may be plugged into bottom outlet if desired) Turn frequency counter on without lamp if visable and place in X1 position.

Tuner Knob: Set tuner bandswitch in band position desired and tune clock knob so that frequency shown on LCD display is that desired.

If a subcarrier signal transmitter is to be located, set function switch to S.C. AM or S.C. FM and AM/FM switch to AM or FM such that the combination results in the highest audio output of the subcarrier. Make sure RF "S" meter is peaked and that the subcarrier is tuned in with the subcarrier frequency control (0 to 300 KHz).

Now walk in direction which increases the sound level and the "S" meter of the signal. As you approach the transmitting source, the sound may reach a constant limited level and all of the lamps of the "S" meter may be lit. At this point reduce the "IF" gain by rotating the control counter clockwise until "S" meter is at ½ scale or less and proceed to move in a direction to increase the "S" meter level again. Repeat this procedure until transmitting source is found physically. It may be necessary to retune the tuner frequency to keep signal on peak adjustment.

2.3 Special Operating Instructions for the TMPR-11 Tuner 1.6-10 GHz

2.3.1 See paragraph 2.2 for setup of the tuner and antenna

2.3.2 This tuner operates on fundamental second and third harmonic of the local oscillator. This means that as the dial is turned across the tuning range of 1.6 to 3.3 GHz (Band 1) the tuner will also be tuning across 3.2 to 6.6 (Band 2) and 4.8 to 10 GHz (Band 3) at the same time. Since very few signals are transmitted above 1 GHz, the few signals that may be encountered can easily be identified.

2.3.3 Place bandwidth in 1000 KHz, and use AM detect. Tune slowly across the band. DO NOT FORCE KNOB AGAINST STOPS AT EITHER END OF BAND. This may damage the mechanism. When a signal is heard and it is necessary to identify its frequency, proceed as follows:

2.3.4 Any signal picked up by the T-11 will appear twice within a close spacing. These are the fundamental and image frequencies. The spacing between them indicates the harmonic of the local oscillator being used to mix with the incoming signal. The operator need know only the upper most dial reading of the pair of signals and the signal spacing to determine the unknown frequency as follows:

2.3.5 Fundamental band (1.6-3.3 GHz) - Scan the band starting at the top of the dial 3.3 GHz and go down. Note the dial reading "a" where the signal first appears. Then time to the next lower signal "b". If "B" is about 2½ division (47 MHz) down from 'a' on the dial go to table #1 in this manual. Find your "a" reading in column "a" and the true frequency in column "f". The dial and the tables have been calibrated every 20 MHz. Greater accuracy is unlikely. The true reading is determined from the formula:

True signal frequency = Dial reading "a" -.0235 GHz.

2.3.6 Second harmonic Band (3.2-6.6 GHz) - Proceed as in paragraph 3. If the "b" reading is about 1¼ divisions (23 MHz) from the "a" reading then go to table #2 to find the true frequency. This table is based on the formula:

True signal frequency = [(Dial reading "a") x 2] -.0235

2.3.7 Third harmonic band (4.8-10 GHz) - Proceed as in ph. 3. If the "b" reading is about 2/3 of a division (16 MHz) from the "a" reading, go to table 3 to find the true frequency. This table is based on the formula:

True signal frequency = [(Dial reading "a") x 3] -.0235

2.3.8 Because of the overlap of the second and third harmonic bands (4.8 to 6.6 GHz), dial readings below 2.2 are not tabulated in table 3. If a pair of signals below 2.20 with 2/3 div. spacing are detected go higher on the dial to find the same pair with 1 ¼ div. spacing (band 2).

2.3.9 If signals are found near the top of the dial with less than 2/3 div. spacing, the signal is above 10 GHz. Again start at the top of the dial 3.3 and work down. To determine the frequency record the dial reading "a" of the uppermost pair of closely spaced signals (less than 2/3 division apart). Now tune dial down to the NEXT PAIR of closely spaced signals and record the upper most dial reading "c" of this pair of signals. The true frequency is then determined by the formula:

$$\text{True RF frequency} = \frac{(ac)}{a-c} - .0235$$

When signals are above 10 GHz they will appear many times on the dial. The above formula applies to any ADJACENT PAIRS of these signals.

Example: Upper most of a pair reads 2.92 on the dial (reading "a" upper most of the next lower pair reads 2.50 on the dial (reading "c").

Then RF = $\frac{[\ (2.9)\ (2.5)\ ]}{2.9-2.5}$ - .0235 = 17.36 GHz

Dial accuracy is such that frequency calculations for signals above 10 GHz may be ± 1 GHz in error.

2.4 S-9 Visual Monitor Section:

The S-9 should only be turned on when needed so as to conserve battery power. When using AC power, it can be operated continuously. To operate the S-9 visual monitor proceed as follows with one of the four S-9 functions:

2.4.1 Function 1 - "RF". The purpose of the mode is to provide a calibrated frequency vs. RF signal amplitude display without interruption of the audio signal. It is especially useful for searching the spectrum for unknown signals and is an aid in tuning and signal identification. Place controls as follows:

Function - "1 RF"
Power - toward Front (found under S-9)
V Gain - Clockwise until noise appears on base line
Swp. Width - Mid position
Rate - Position "1" (10-50 Hz)
Vernier - Maximum clockwise
(See section on maintenance and calibration for controls under top panel if necessary)

Adjustment of swpt. converter signal centering: Allow receiver to warm up for about five minutes. Place FM/AM/CW switch in CW position. Observe display. If a signal is not seen in the center of screen, adjust swept conv. centering control until it is centered. Adjust vertical gain if signal display is off screen. Rotate sweepwidth knob counter clockwise until display fills approximately ½ of the screen while adjusting the centering control as necessary. Return FM/AM/CW switch to desired position. The above procedure should be followed when operating the receiver and a signal is heard in the speaker and the display is not in the center of the screen.

As the tuner is adjusted, the signals received will appear on the screen. To listen to the audio of a particular signal, center the display on the screen. The vertical gain may be adjusted downward to bring the signal level "on screen". The IF gain control of the basic unit may also be reduced in a high signal area, however, both of thes methods will reduce sensitivity to low level signals. When searching for unknown

signals, note that the maximum useful sweep width setting depends on the RF frequency being covered. This maximum sweep width setting is approximately 10% of the RF frequency. Thus for tuners 4, 3, 2, and 1 the sweep width control must be reduced more and more as lower frequencies are tuned. Tuners 5 thru 11 can all use the maximum capability of the sweep width control of 5 MHz. Now back down on the sweep width control to reduce the portion of the spectrum displayed and effectively magnify the area for more precise tuning of the tuner control or fine tune control. If sweep width is reduced so that only the one signal is observed spread out across the screen, the type of modulation can also be investigated. Up and down variations are AM. Sideways vibrations are FM. Rapid ON/OFF of non vibrating signals indicates CW or keyed transmissions. Extra fixed position small "pips" on each side of the main large signal indicate subcarrier type side bands.

2.4.2 Function 2 - "Subcarrier". The purpose of this mode of the S-9 visual monitor is to provide a frequency vs. amplitude display of subcarriers as received and separated out of the Rf signals by the basic receiver. In this mode the subcarrier audio is interrupted and a chopping noise will occur. Set controls in following positions:

Basic Unit as per previous instructions for sub-carrier. (Function switch position 3 or 4)
Function - "2" subcarrier
Power - toward rear (found under S-9)
V Gain - maximum CW
Sweepwidth - maximum
Rate - position "1' (10-50 Hz)
Vernier - maximum CW

The display is similar to that of the Function 1 (RF) mode except that the base line tunes from 0 to 300 KHz with the basic unit S.C. tune control and the bandwidth is 10 KHz. If a subcarrier appears therefore, it can be adjusted side to side (frequency) with the S.C. tune control. The magnitude should be maximised with the main and fine tune controls of the tuner and basic unit. Also the main AM/FM switch should be in position for maximum subcarrier level on the display. To listen to the subcarrier audio, center the signal on the screen as before only with the s.c. tune control (basic unit). Then back down on sweep width and recenter. Now switch S-9 function switch to 4. This position will discontinue the subcarrier frequency display and audio interruption and display time base audio of the subcarrier.

2.4.3 Function 3 - "T11 Tuner". The purpose of this mode of the S-9 visual monitor is to provide a much wider dispersion frequency base vs. amplitude display needed for the microwave RF coverage of the T11 Tuner (1.6-10 GHz). The maximum sweep width varies depending on tuned RF freuqncy. Approximately 35-55 MHz for band I (1.6-3.3 GHz), 70-110 MHz for band II (3.1 to 6.6 GHz) and 90-160 for band III (6.6-10 GHz). The audio output is interrupted in this mode. Set controls of basic unit and tuner following the special T11 instructions on page 10.

Basic Unit Function Switch to "5" (wide bandwidth)
S-9 Function Switch to "3" (T-11 sweep)
S-9 Power towards back (found under S-9)
S-9 Vert. gain to Max. C.W.
S-9 Swp. width to Max. C.W.
S-9 Rate to position "1" (10-50 Hz)
S-9 Vern. to Max. C.W.

Now proceed to turn T-11 tuning knob through its range. When signals appear, refer to T11 special instructions to determine true frequency. Otherwise display is adjusted and analyzed inthe same manner as function position 2. In position 3, however, the basic unit function switch can be used to adjust the RF bandwidth or resolution, (the width of the signal appearing on the screen). Normally the widest bandwidth is used (1 MHz) since the narrow bandwidths are hard to see with such wide sweep widths (50 MHz).

2.4.4 Function 4 - "Time Base". The purpose of this S-9 visual monitor mode is to provide a variable time base to analyze the demodulated signals as selected and controlled by the basic unit and RF tuner. These selections include RF frequency; bandwidth, first demodulation of AM, FM, CW, SSB; and double demodulation with combinations of first demodulation and subcarrier demodulations of AM and FM. In any case the vertical input signal in this mode is the same as presented to the audio amplifier and phones or loudspeaker of the basic receiver. Set basic receiver as per previous instructions to select and adjust the signal under investigation. First set controls as follows:

B9 Volume control to min. CCW (this control becomes the vertical Gain control)
S9 Function switch to 4 "time base"
S9 Power towards back (found under S-9)
S9 Vertical gain to set base line in the center of the screen. (This control becomes the vertical position control in this mode)
S9 Sweep width to any position (no effect)
S9 Rate to any (set later)
S9 Vern to any (set later)

As mentioned above, the volume control sets the volume level of the phones or loudspeaker therefore if the loudspeaker level becomes objectionable, plug earphones in to shut it off. Lack of space prevents additional controls.

Now adjust volume control C.W. until signal just fills the screen. The vertical gain control may need to be reset to position the center of a non vertical symetrical signal such as a composited video signal (more negative going modulation than positive). Now adjust the "rate" and "vern" controls to synchronize the signal or portion of the signal desired time wise. It may be necessary to continuously "ride" or adjust the vernier control to hold the signal in synchronization.

2.5. Loudspeaker Operation:

The carrier has a small loudspeaker internally mounted. If the earphones are removed the audio will be heard from this loudspeaker instead of the phones. The main purpose of the speaker is to locate transmitting microphones by the feedback technique. The hidden microphone picks up the speaker sound and starts up a howling sound in the same manner as a maladjusted public address system.

2.6 Frequency Counter Operation:

To operate the Frequency Counter (FC-6) switch the power switch to "ON" or "Lamp". (The lamp position should only be used in very low ambient light conditions for observation of the L.C.D. display since it draws more power from the battery.) Switch the resolution switch to "X1" position. The frequency counter will now read directly the radio frequency tuned by the tuner selected. The tuner plugged in will automatically program the counter for proper IF offset and scale. All tuner frequencies operate the counter except the T-11 tuner (1.6-10 GHz). When the basic receiver function switch is set to a subcarrier function, the frequency counter automatically reads the subcarrier frequency setting (0-.3 MHz). All readings are in megahertz including the subcarrier, therefore strict attention must be paid to the decimal point position. Example: 0.070 Megahertz may also be thought of as 70 Kilohertz. If the subcarrier or the TMPR-1 tuner are tuned "below zero" (when the local oscillator crosses the IF) the counter will read the complimentary number such as 99.99. This tuner position is meaningless and is to be avoided. The "X10" resolution position is used when an additional significant digit of frequency accuracy is desired. In this

position the first digit is lost and a least significant digit is gained. The counter "gate time" is several seconds in this mode therefore allow 5 seconds for the reading to settle down. The first several readings may be inaccurate. The "X10" resolution position is usually used to read the frequency of a signal already centered accurately by the operator. (Use minimum bandwidth and RF meter to center accurately.) The function positions of the visual monitor of 2 (subcarrier) and 3 (T11) may cause irratic and erroneous readings. of the frequency display. Switch to 4 (time base) to correct the frequency. As with the scope display, do not turn the counter on when using batteries unless needed. The FC-6 may cause a spurious response. Turn it off if this is suspected.

2.5.7 Detection of Carrier Current Signals

Use cable provided with the accessories to connect from the antenna jack on the B12 side panel to power line antenna jack on power supply. (See Fig. 4) Plug in tuner No. 1. Using narrow bandwidth tune thru the tuning range of tuner No. 1 searching for carrier current transmitters. Adjust volume as necessary. Power line noise will be heard. The level of the noise will depend on the condition of the power line and the noise of appliances connected to the line.

2.8 Pocket Operation

2.8.1 Pocket Operation - General

By "pocket operation" we are refering to the most portable minimum size configuration of the MPR-5 allowing use while being carried in an outside or inside coat pocket. This leaves hands free allowing unobtrusive radio monitoring and transmitting source location.

2.8.2 Battery Installation

First remove B-12 basic unit from the carrying frame, if it is so mounted, by backing out bottom thumbscrew and pulling B-12 forward to disengage it from the rear connectors. It will be necessary to remove rechargeable battery pack from bottom if it is mounted. Disconnect RF connector from rear of B12. Locate B12 battery pack assembly among accessories. It can be identified by the eight battery clips. Load assembly with four, nine volt batteries as indicated in list below.

Eveready	- E146X	Mercury	*
Mallory	- MN1604	Alkaline	*
Eveready	- 216	Carbon	
Eveready	- N88	Nicad Rechargeable	

* Preferred for longest running time.

Some Nicad rechargeable batteries even when fully charged will deliver less than the 7.5 volts minimum required to operate the MPR-5. Read battery labels before using. Some low cost carbon batteries will give the least running time.

Assemble battery pack assembly on rear of module B12 by mating with two "D" connectors. Slide battery pack cover over the batteries and fasten to the B12 with the thumbscrew. It is highly recommended that all batteries be removed from radio equipment when not in use to prevent corrosive damage and accidental discharge.

2.8.3 Pocket Operation

Only the basic B12 unit, one tuning unit, one antenna and earphone are used. The receiver is activated by a Tuner/Power interlock switch that automatically turns power on when tuner is inserted. Place the power switch to "on". With tuner inserted, a few "S" meter lamps will light. Select tuner unit that covers the frequency range desired. Insert tuner carefully in front opening of B12 so that panel markings are "right side up". When the tuner is

correctly engaged, its panel is almost flush (except for TMPR-11) with the B12 front face. The tuner knob can be used as a handle to insert and withdraw the tuner. The tuner is held in by the connector only. Be careful not to drop tuner out by rough handling. Connect short wire or other antenna to the antenna connector on the side of the B12. Connect the earphone to the phone jack on bottom of B12. Set controls as follows:

IF Gain: Maximum clockwise. Back off counter clockwise if "S" meter is off scale to observe level changes.

AM/FM: To match modulation of incoming signal. If unknown, place in position that gives least audio distortion. If searching, set to AM up to 35 MHz (T1, 2, 3, 4) then FM to 1.6 GHz (T5, 6, 7, 8) and AM then to 10 GHz (T11).

Function: General position 1 (7 KHz) BW to an RF of 40 (T1, 2, 3, 4); position 2 (90 KHz BW) to an RF of 625 (T5, 6, 7, 8, 9) and position 5 (1000 KHz BW) to 10 GHz RF (10A, 10, 11). Use position 3 and 4 for subcarrier FM and AM.

Volume Control: Set for earphone level desired.

Tuner Knob: Adjust tuner knob by rotating until desired frequency is obtained. Tune signal in for maximum "S" meter reading.

If a subcarrier signal transmitter is to be located, set function switch to S.C. AM or S.C. FM and AM/FM switch to AM or FM such that the combination results in the highest audio output of the subcarrier. Make sure RF "S" meter is peaked and that the subcarrier is tuned in with the subcarrier frequency control (0 to 300 KHz).

Now place unit in inside or outside jacket or coat pocket and walk in direction which increases the sound level and the "S" meter of the signal. As you approach the transmitting source, the sound may reach a constant limited level and all of the lamps of the "S" meter may be lit. At this point, reduce the "IF" gain by rotating the control counter clockwise until "S" meter is an ½ scale or less and proceed to move in a direction to increase the "S" meter level again.

III. MAINTENANCE, CALIBRATION AND REPAIR

1.) It is highly recommended that should malfunction occur, the entire system with all components be returned to F. G. Mason Engineering, Inc., 1700 Post Road, Fairfield, Conn. 06430 for repair and calibration.

2.) If this is inconvenient, then only the component requiring repair need be returned. The malfunctioning component may be determined best by substituting known functioning components if a second system is available. If not and test instruments are not available try to test by tuning in a known broadcast station.

3.) There should be some signals on each tuner band except the microwave area. If only one tuner seems to be bad, that tuner only requires repair. If all tuners are low in sensitivity or inoperative, then the trouble is in the B12 basic unit 23.5 MHz IF section.

4.) If poor or no sensitivity occurs with all tuning heads make sure first that operating instructions have been followed carefully. The following is a list of common operator errors:

a.) PS-11A line switch not set to local voltage.
b.) Connectors not fully engaged. Tuner not fully inserted, earphone connector loose, etc.
c.) I.F. Gain control not maximum
d.) Bandwidth and AM/FM switch improperly set.
e.) Antenna not connected. Wrong antenna connected.
f.) Batteries exhausted.
g.) Battery connectors corroded or loose.

5.) If it is absolutely necessary to field repair the MPR-5, contact the manufacturer for information as per paragraph 2. Schematics and pictorial drawings may be ordered.

6.) Disassembly/Alignment/Assembly

6.1 Tuners TMPR-1 thru TMPR-10

Remove screw located at the rear of the tuner with the large diameter head near to the connector. Leave other screw in place. Carefully pull cover off tuner by holding knob in one hand and remove cover with other. Cover should be pulled away from front panel.

If the problem with tuner is that the band frequencies fall short of the required range, proceed as follows to realign:

1.) Plug tuner extension cable between tuner socket in B-12 basic unit and tuner so that the tuner (cover removed) is external to the basic unit.

portions of the B12, be sure that no wires are pinched or cut and that the alignment tabs are all in proper position.

6.3 S-9 Visual Display Unit

To adjust internal controls, remove 4 small screws from top panel and remove panel. The control potentiometers are now accessible and are identified by the cover graphics nearby. All of these potentiometers are 20 turn type with slip clutches at travel limits. Clicking noise is heard when limit is reached.

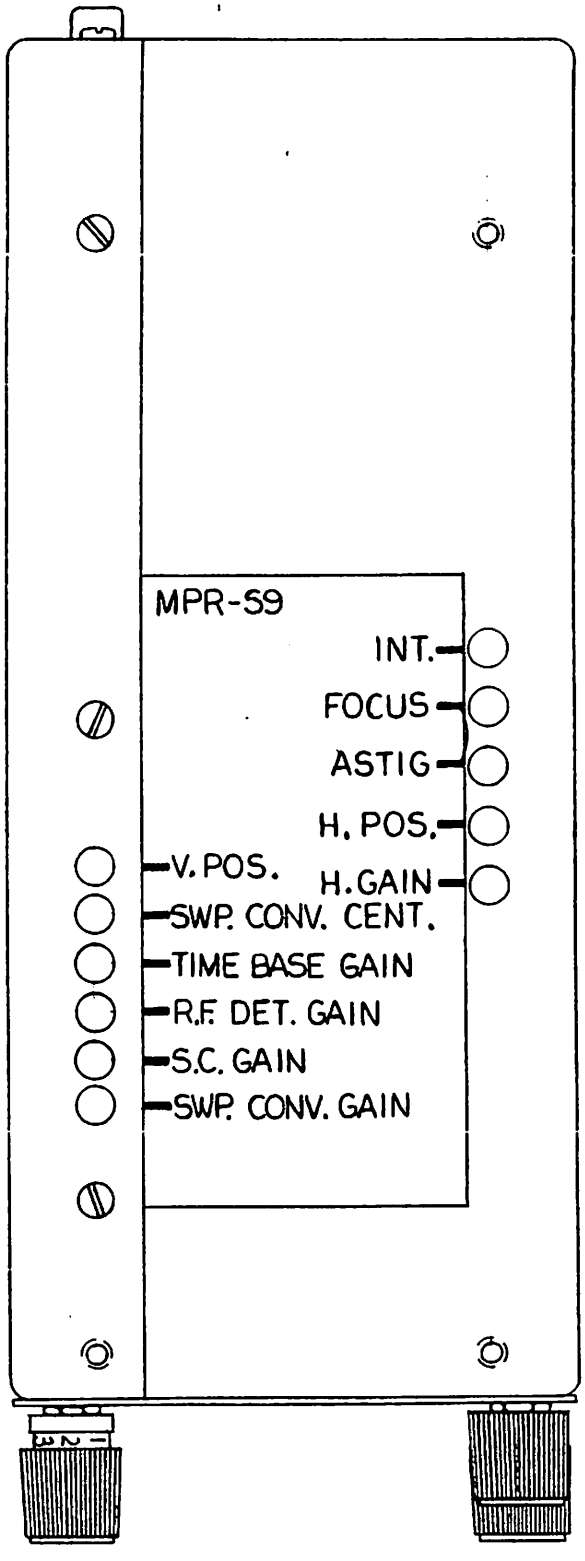
20.) We will now try the operation of the television picture display. Place the function switch in the TV-PIC position. Note that the red lights on the panel have changed and make sure that the controls are set to the red lights. Tune to a television station. The approximate frequency of the video or picture portion of the TV signal is as follows (the audio is 4.5 MHz above the video):

Ch. #	Video Carrier	Ch. #	Video Carrier	Ch. #	Video Carrier
2	55.25	29	561.25	56	723.25
3	61.25	30	567.25	57	729.25
4	67.25	31	573.25	58	735.25
5	77.25	32	579.25	59	741.25
6	83.25	33	585.25	60	747.25
7	175.25	34	591.25	61	753.25
8	181.25	35	597.25	62	759.25
9	187.25	36	603.25	63	765.25
10	193.25	37	609.25	64	771.25
11	199.25	38	615.25	65	777.25
12	205.25	39	621.25	66	783.25
13	211.25	40	627.25	67	789.25
14	471.25	41	633.25	68	795.25
15	477.25	42	639.25	69	801.25
16	483.25	43	645.25	70	807.25
17	489.25	44	651.25	71	813.25
18	495.25	45	657.25	72	819.25
19	501.25	46	663.25	73	825.25
20	507.25	47	669.25	74	831.25
21	513.25	48	675.25	75	837.25
22	519.25	49	681.25	76	843.25
23	525.25	50	687.25	77	849.25
24	531.25	51	693.25	78	855.25
25	537.25	52	699.25	79	861.25
26	543.25	53	705.25	80	867.25
27	549.25	54	711.25	81	873.25
28	555.25	55	717.25	82	879.25
				83	885.25

When you have tuned in the video signal note that there is a buzzing sound which indicates that you are in the correct frequency. This may change tones slightly as the black and white content in the picture changes. Adjust the V gain control on the VLF/SC display so that the vertically lighted portion just fills the screen. It may be necessary to shade the display or dim the room lights in some cases. Adjustment of the rate vern. (vernier)

Repeat this procedure until transmitting source is found physically. It may be necessary to retune the tuner frequency to keep signal on peak adjustment.

6.3.1) S-9 with top panel removed



6.3.2) Setting intensity, focus and astigmatism - (always use AC power (PS-11A) when making any of the following settings)

a.) Set S-9 to time base (4) with basic unit volume at minimum (CCW) and vertical gain so line appears on screen.

b.) Set rate and vernier for minimum CCW (slowest speed)

c.) Set intensity for maximum brightness

d.) Set focus and astigmatism for sharpest, roundest, dot when it crosses the center.

e.) Brightness may be backed off for use in darkened ambient light. Other controls may have to be reset.

6.3.3) Horizontal Gain and center settings -

a.) Now set vernier maximum with rate switch still at minimum (50 Hz)

b.) Set H gain and H centering so that line just fills screen side to side and is centered.

6.3.4) Vertical Position setting -

a.) Set S-9 function to T11 (3)

b.) Set B-12 IF gain to minimum (CCW)

c.) Set S-9 vertical gain to minimum (CCW)

d.) Now adjust vertical position so that the base line is slightly above the bottom edge of the screen.

6.3.5) Swept Converter Gain Setting -

a.) Set S-9 function switch to "RF" (1)

b.) Remove antenna from B9

c.) Insert T10 tuner at any frequency

d.) Set S-9 vertical gain to maximum (CW)

e.) Now adjust "swept conv gain" so that a small amount of "grass" or noise appears on the base line. This base line average will rise up slightly.

6.3.6) Subcarrier gain setting

a.) Set S-9 function switch to "sc" (2)

b.) Set B-12 function switch to SCFM (3)

c.) Remove antenna from B12

d.) Set B-12 IF gain to maximum CW

e.) Insert T-6 tuner at any frequency so long as NO signals appear on screen

f.) Set B-12 subcarrier tuning control to about 250 KHz

g.) Set S-9 vertical gain to maximum (CW)

h.) Now set subcarrier gain so that noise fills about ½ the vertical area of the screen. (This is set much higher than the "RF" and "T-11" modes because when signals are tuned in on RF-FM they quiet the IF noise to the subcarrier amplifiers thus reducing the noise on the display.)

6.3.7) RF Detector Gain Setting (T11)

a.) Set S-9 function switch to "T11" (3)

b.) Insert T-11 tuner into basic unit and set dial at about 2.5 GHz

c.) Set B-12 IF gain to maximum CW

d.) Set B-12 function switch to Wide bandwidth (5)

e.) Set S-9 vertical gain to maximum (CW)

f.) Now set RF detector gain so that about 1/8 inch of noise appears onthe base line.

6.3.8 Time Base Gain Setting -

a.) Set S-9 function switch to "Time base" (4)

b.) Set B-12 Volume control to minimum (CCW)

c.) Set S-9 vertical gain control to maximum (CW)

d.) Now set time base gain so that base line is about one vertical division from TOP of screen. (This is so that signals with more negative going than positive going components can utilize the whole

screen area. Remember that in the time base mode the vertical gain control is used more for positioning and the basic unit volume control is used for vertical gain.

6.3.9 Swept Converter Centering Setting -

a.) Set S-9 function to "RF" (1). (The swept converter centering control is a fine tune adjustment to set the one signal tuned in, heard, and seen on the "S" meter, to the center of the S-9 base line thus identifying the proper signal by location on the base line.)

b.) Set all other controls as per paragraph 5.4.1, the instructions on the S-9 RF mode.

c.) Select a steady fairly high level signal that has no near by signals to use for alignment. AM signals are best since their frequency is stationary. Try around 1 MHz. If an uncrowded area is hard to find, try the sound channel of a TV station even though it is FM, it is spaced from nearby signals.

d.) Set the B-12 to narrow bandwidth (1) and very accurately tune the signal for loudest noise and highest "S" meter reading even if distorted.

e.) Now set the S-9 visual signal to the exact center of the screen with the swept converter signal centering trimmer. Be sure the horizontal centering and gain have been preadjusted according to 6.3.3. If the center cannot be reached, return the trimmer to the mechanical center (10 turns from end) and set internal coil (L 10) of the vertical P.C. board for the center. Then fine tune with the trimmer adjustment.

6.3.10) If further adjustment or repair is required, proceed as follows:

a.) Remove 4 top panel screws and top panel.

b.) Remove 5 nuts holding the controls on front panel and remove front panel.

c.) Now remove the 2 screws nearest the rear on the left side of the box. These are long 2-56 screws. Remove remaining screws from top and bottom of box and pull the left and right box covers apart. A screwdriver may be necessary to pry them apart.

d.) If further dismantling is required the PC boards may be removed by removing their associated mounting screws.

e.) The CRT socket bracket may also be removed.

f.) Reassemble in reverse order of disassembly. Remember to replace the long 2-56 screws in the holes on the left cover towards the rear. These must be fed through the brass PC board standoffs and into the threads of the CRT bracket. It helps to position these 2 screws first when remounting the 2 covers.

g.) Make sure when replacing the control nuts that the controls do not rotate causing wire breakage.

h.) Also be careful not to pinch or cut wires while covers are being reassembled.

i.) DANGER: HIGH VOLTAGE (1200 volts) exists in the wiring of this unit and is exposed when the covers are removed.

6.4) FC-6 Frequency Counter

The FC-6 has no internal adjustments. To replace components dismantle as follows:

a.) Remove 4 top panel screws and panel.

b.) Remove 2 upper front panel screws and 2 control nuts and remove front panel.

c.) Now remove remaining top and bottom screws and pull left and right covers apart. A screwdriver may be needed to pry them apart. The display and resolution control will remain with the right cover. The power switch and rear plug will remain with the left cover. The male/male jumper connector between the 2 boards may remain in either socket. Be sure you do not bend these pins when separating the 2 halves.

d.) The 2 PC boards may be removed from their covers by removing the 4 mounting screws and the rear plug screws and nuts and the resolution control nut.

e.) If the display must be replaced, remove the 3 3-56 flat head screws from the clear plastic LCD retainer and remove display. The display itself is further contained within a molded box with 2 "zebra" contact strips. Observe carefully the dismantling of this assembly before attempting reassembly. Note polarity of pin alignment. Important: be sure the PC board contacts are absolutely free of dirt and moisture when reassembly is made. Do not tighten 3 retaining screws too tight but evenly causing a slight bow inthe clear plastic retainer.

f.) Removal and replacement of IC's can cause bent and damaged pins. Appropriate care must be taken.

g.) When re-engaging the 2 halves of the box make sure the male/male jumper connector between the two P.C. boards is properly aligned.

TABLE 1 - All Frequencies in GHz

Use This Table for Signal Pairs Separated by 47 MHz (2+ division)

Dial Reading "a"	frequency f	a	f	a	f	a	f
1.60	1.58	2.10	2.08	2.60	2.58	3.10	3.08
2	1.60	2	2.10	2	2.60	2	3.10
4	1.62	4	2.12	4	2.62	4	3.12
6	1.64	6	2.14	6	2.64	6	3.14
8	1.66	8	2.16	8	2.66	8	3.16
1.70	1.68	2.20	2.18	2.70	2.68	3.20	3.18
2	1.70	2	2.20	2	2.70	2	3.20
4	1.72	4	2.22	4	2.72	4	3.22
6	1.74	6	2.24	6	2.74	6	3.24
8	1.76	8	2.26	8	2.76	8	3.26
1.80	1.78	2.30	2.28	2.80	2.78	3.30	3.28
2	1.80	2	2.30	2	2.80	2	3.30
4	1.82	4	2.32	4	2.82	4	3.32
6	1.84	6	2.34	6	2.84	6	
8	1.86	8	2.36	8	2.86	8	
1.90	1.88	2.40	2.38	2.90	2.88		
2	1.90	2	2.40	2	2.90		
4	1.92	4	2.42	4	2.92		
6	1.94	6	2.44	6	2.94		
8	1.96	8	2.46	8	2.96		
2.00	1.98	2.50	2.48	3.00	2.98		
2	2.00	2	2.50	2	3.00		
4	2.02	4	2.52	4	3.02		
6	2.04	6	2.54	6	3.04		
8	2.06	8	2.56	8	3.06		

TABLE 2 - All Frequency Readings in GHz

Use This Table if Signal Pairs are 23.5 MHz Apart (1+ divisions)

Dial reading "a"	frequency "f"	dial reading "a"	frequency "f"	dial reading "a"	frequency "f"	dial reading "a"	frequency "f"
1.60	3.18	2.00	3.98	2.50	4.98	3.00	5.98
2	3.22	2	4.02	2	5.02	2	6.02
4	3.26	4	4.06	4	5.06	4	6.06
6	3.30	6	4.10	6	5.10	6	6.10
8	3.34	8	4.14	8	5.14	8	6.14
1.70	3.38	2.10	4.18	2.60	5.18	3.10	6.18
2	3.42	2	4.22	2	5.22	2	6.22
4	3.46	4	4.26	4	5.26	4	6.26
6	3.50	6	4.30	6	5.30	6	6.30
8	3.54	8	4.34	8	5.34	8	6.34
1.80	3.58	2.20	4.38	2.70	5.38	3.20	6.38
2	3.62	2	4.42	2	5.42	2	6.42
4	3.66	4	4.46	4	5.46	4	6.46
6	3.70	6	4.50	6	5.50	6	6.50
8	3.74	8	4.54	8	5.54	8	6.54
1.90	3.78	2.30	4.58	2.80	5.58	3.30	6.58
2	3.82	2	4.62	2	5.62	2	6.62
4	3.86	4	4.66	4	5.66	4	6.66
6	3.90	6	4.70	6	5.70		
8	3.94	8	4.74	8	5.74		
		2.40	4.78	2.90	5.78		
		2	4.82	2	5.82		
		4	4.86	4	5.86		
		6	4.90	6	5.90		
		8	4.94	8			

TABLE 3

Use This Table if the Signal Pairs are 16 MHz Apart (1- division)

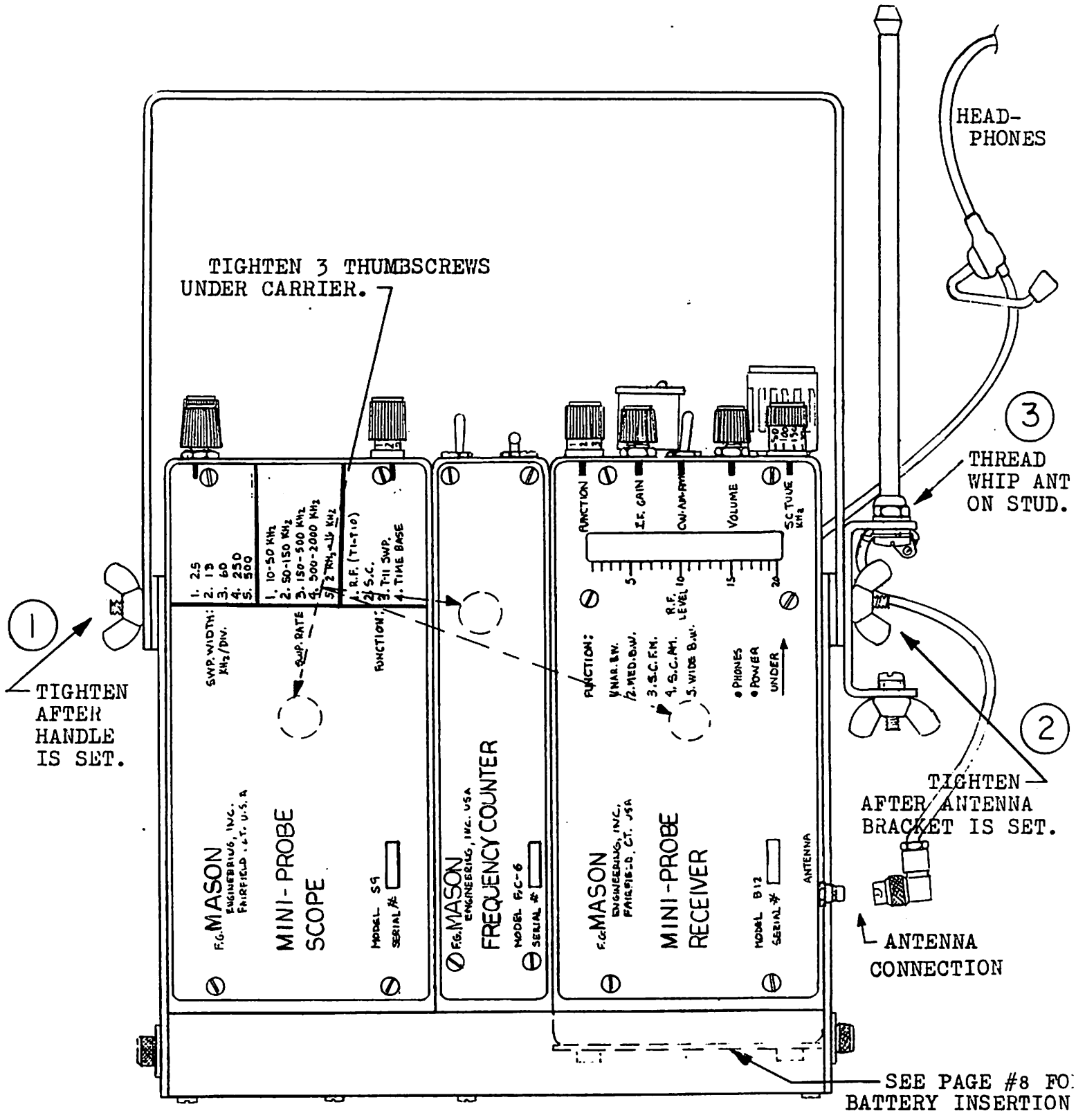
Dial "a"	frequency "f"	Dial "a"	frequency "f"	Dial "a"	frequency "f"	Dial "a"	frequency "f"
2.20	6.58	2.50	7.48	2.80	8.38	3.10	9.28
2	6.64	2	7.54	2	8.44	2	9.34
4	6.70	4	7.60	4	8.50	4	9.40
6	6.76	6	7.66	6	8.56	6	9.46
8	6.82	8	7.72	8	8.62	8	9.52
2.30	6.88	2.60	7.78	2.90	8.68	3.20	9.58
2	6.94	2	7.84	2	8.74	2	9.64
4	7.00	4	7.90	4	8.80	4	9.70
6	7.06	6	7.96	6	8.86	6	9.76
8	7.12	8	8.02	8	8.92	8	9.82
2.40	7.18	2.70	8.08	3.00	8.98	3.30	9.88
2	7.24	2	8.14	2	9.04	2	9.94
4	7.30	4	8.20	4	9.10	4	10.00
6	7.36	6	8.26	6	9.16		
8	7.42	8	8.32	8	9.22		

COMPONENT CHECK LIST

Part No.	Model No.	Item
30876	B-12	Basic MPR
30881	TMPR-1	Tuner .02-16 MHz
30882	TMPR-2	Tuner 16-100 MHz
30883	TMPR-3	Tuner 100-200 MHz
30884	TMPR-4	Tuner 200-300 MHz
30885	TMPR-5	Tuner 300-400 MHz
30886	TMPR-6	Tuner 400-500 MHz
30887	TMPR-7	Tuner 500-600 MHz
30888	TMPR-8	Tuner 600-790 MHz
30889	TMPR-9	Tuner 790-1000 MHz
30890	TMPR-10	Tuner 1000-1600 MHz
30557	TMPR-11	Tuner 1.6-10 GHz
30655	S-9	Visual Display
30949	FC-6	Frequency Counter
30880	BP-10	Rechargeable Battery Pack
30412-D	PS-11B	AC Power Supply

ACCESSORIES

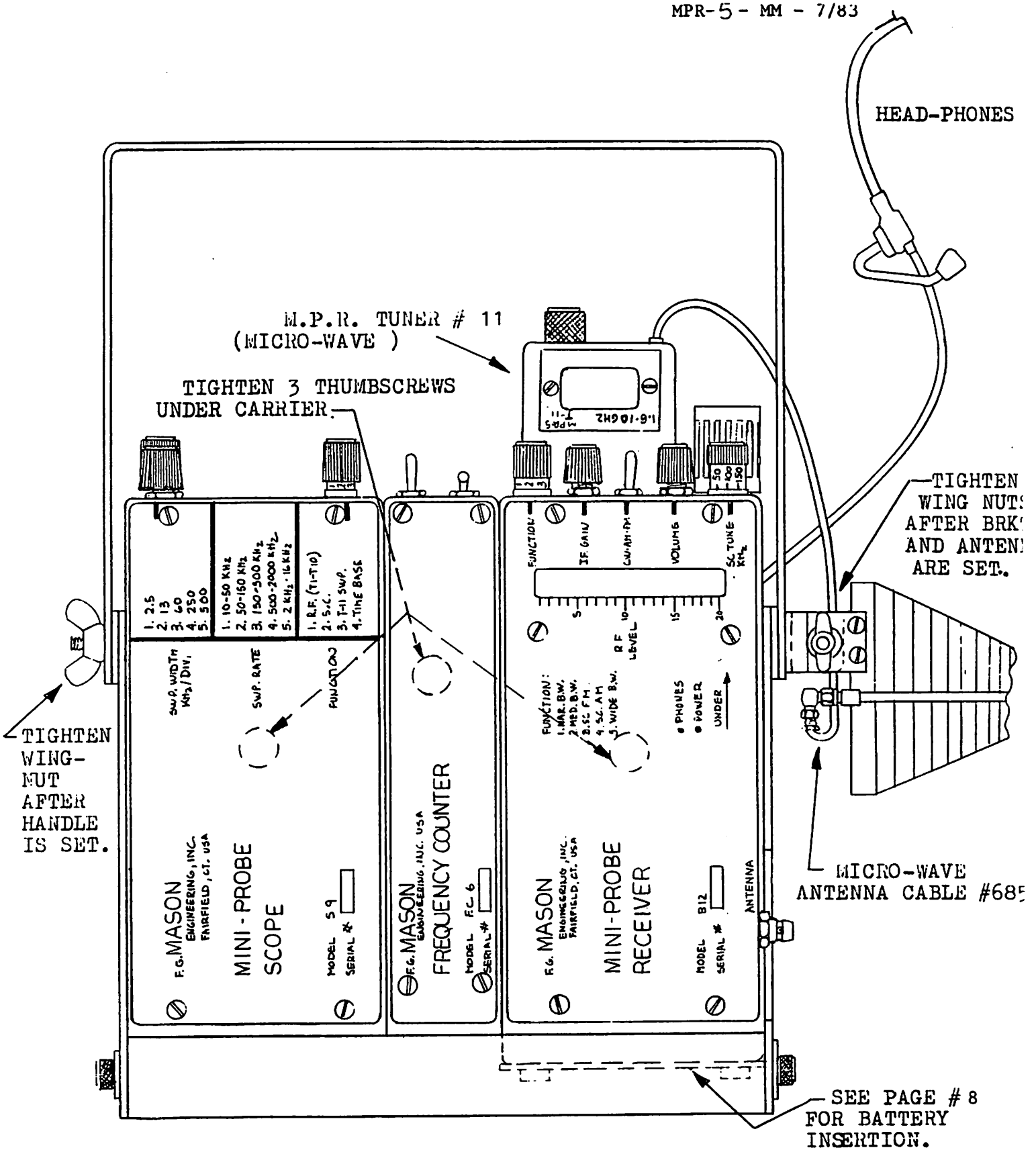
Part No.	Quantity	Item
6206	2	Fuse
6317	1	Whip Antenna
6858	1	Ant. Cable
6860	1	Gator Clip Ass'y.
7807	1	Headset
7832	1	Headset Cord (R-7833)
7838	1	Adaptor
30558	1	Long Wire Ant.
30561	1	Microwave Ant.
30562	1	Blocking Capacitor
30568	1	Short Wire Ant. Ass'y.
30879-D	1	3-Pack Carrier
6865	1	Battery Pack Output Cable
6866	1	Remote Tuner Cable (MPR-5)



HAND CARRY SET-UP

MPR- 5

FIG. 1



HAND CARRY SET-UP

FOR MICROWAVE TUNER T11

FIG. 2

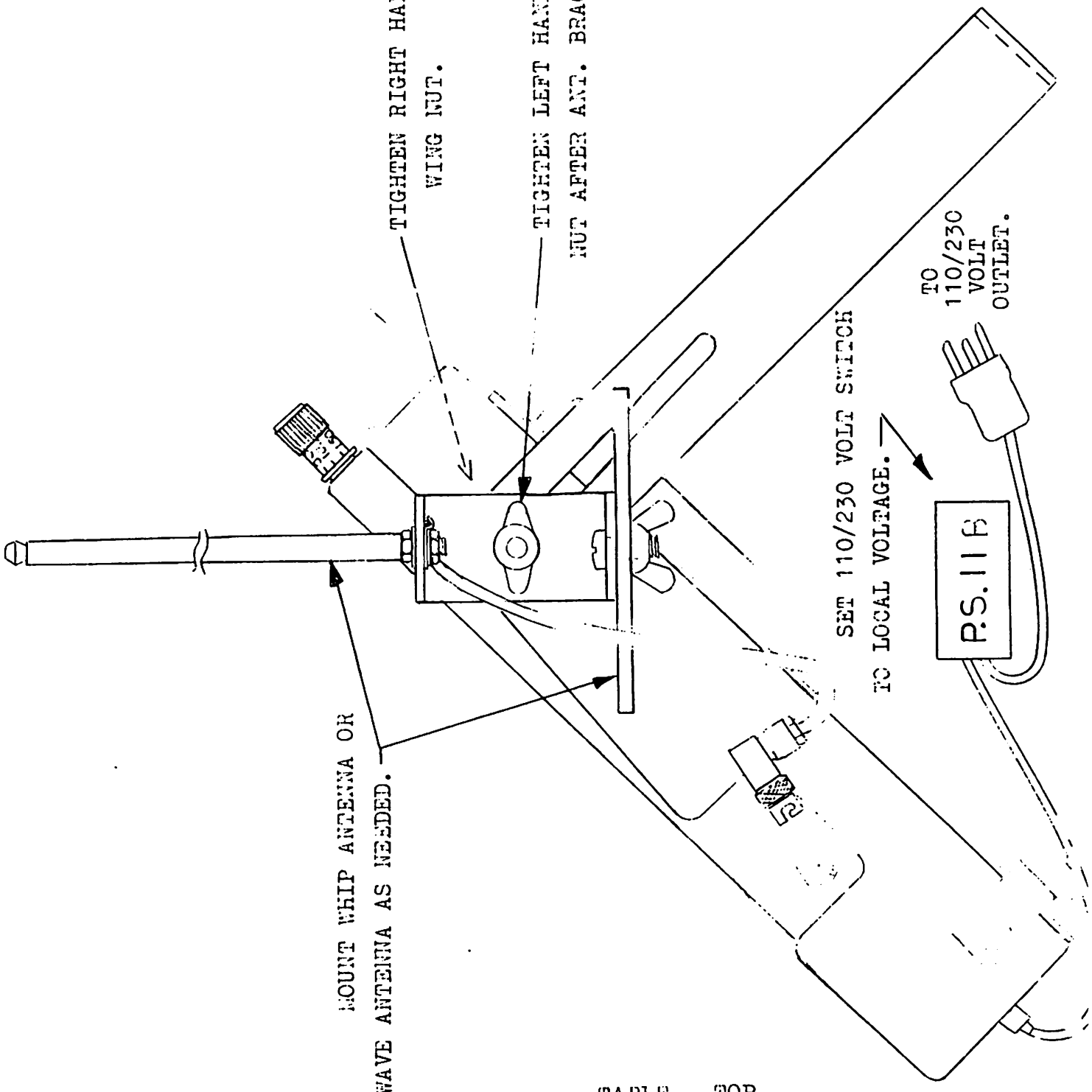


TABLE - TOP
SET - UP SIDE VIEW

FIG. 3

FIG. 4

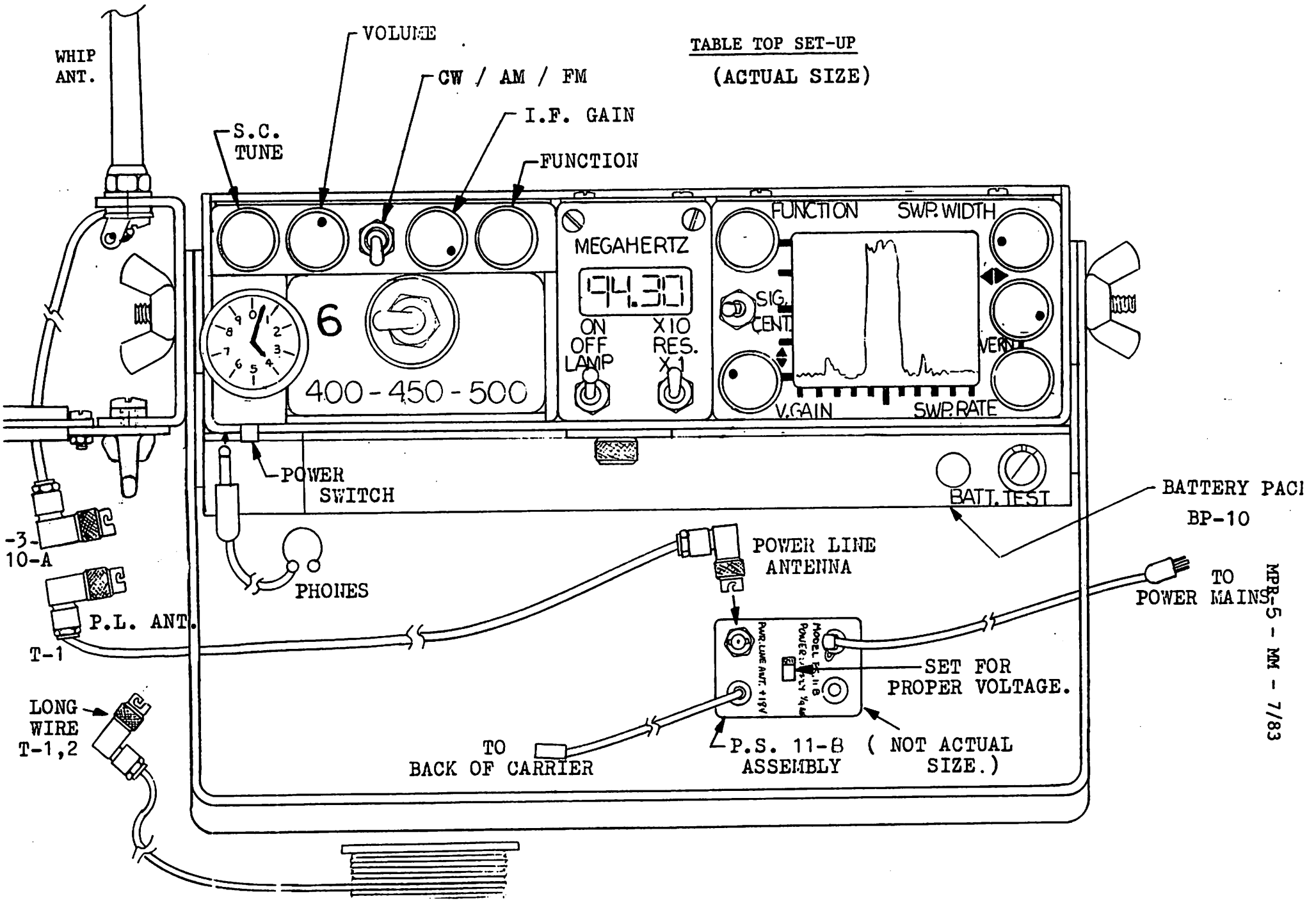


TABLE TOP SET-UP
(ACTUAL SIZE)
WHIP ANT.
VOLUME
CW / AM / FM
I.F. GAIN
FUNCTION
S.C. TUNE
MEGAHERTZ
FUNCTION
SWP. WIDTH
SIG. CENT.
ON OFF LAMP
X10 RES. X1
V.GAIN
SWP. RATE
400 - 450 - 500
POWER SWITCH
BATT. TEST
BATTERY PACK BP-10
-3-10-A
PHONES
POWER LINE ANTENNA
TO POWER MAINS
P.L. ANT.
T-1
SET FOR PROPER VOLTAGE.
LONG WIRE T-1,2
TO BACK OF CARRIER
P.S. 11-B ASSEMBLY
(NOT ACTUAL SIZE.)
MPR-5 - MM - 7/83