

OPERATION OF RECEIVER

RADIO RECEIVER WITH SPECTRUM DISPLAY
MODEL A-2

F. G. MASON ENGINEERING, INC.
FAIRFIELD, CONNECTICUT, U.S.A.



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RADIO RECEIVER WITH SPECTRUM DISPLAY
MODEL A-2
version of A-2 Receiver
version of A-2 Visual Monitor

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SECTION 1 GENERAL DESCRIPTION

1.1 Purpose of Equipment

Spectrum Surveillance

The primary purpose of the A-2 Receiver is to search the radio frequency spectrum for clandestine transmissions. Electronic eavesdropping has become a threat to the integrity of confidential information.

As the frequency spectrum is scanned, both an audio and visual display enables the operator to identify the received signals.

The knowledge of the presence of a listening device may be more important than the discovery of the exact location. A physical search which uncovers a "bug" may alert the perpetrator and prevent his apprehension.

Electromagnetic Compatibility of Equipment

Especially important in airborne systems, electromagnetic compatibility insures the non-interference between equipments within an installation. In aircraft, for instance, the various sub-system components are carefully designed to have minimum spurious outputs, but interaction of legitimate signals may generate false responses in navigation and communications equipment.

The A-2 Receiver system allows an investigation of the frequency spectrum to be carried on while the aircraft is in operation. The portability of the A-2 also permits access to confined areas of the aircraft. The visual display will assist in the identification of the signals which may be present.

Electromagnetic Shielding Investigation

Screen room installations are usually accepted as preventing the entrance of external RF fields. Investigation has shown that there are several paths such as doors, power lines and antenna access ports which permit interfering signals to enter the test area. Tests involving small signal amplification such as noise figure, intermodulation and cross modulation distortion and power gain are susceptible to interfering signals.

Because of its portability, small size and battery operation, the A-2 Receiver is especially useful in surveying electromagnetic enclosures for shielding integrity.

1.2 General Description

1.2.1 Major Components

The A-2 Receiver System is composed of the following components:

- 1) A-2 Basic Receiver (containing internal batteries)
- 2) LFB-1 Adapter for using the low frequency TLF tuners with the A-2 basic unit.
- 3) TLF-1 Tuner covering 2 KHz to 9 KHz
- 4) TLF-2 Tuner covering 9 KHz to 43 KHz
- 5) TLF-3 Tuner covering 43 KHz to 130 KHz
- 6) TLF-4 Tuner covering 130 KHz to 475 KHz
- 7) TLF-5 Tuner covering 475 KHz to 1470 KHz
- 8) TLF-6 Tuner covering 1470 KHz to 4500 KHz
- 9) T-18 Tuner covering 4.5 MHz to 18 MHz
- 10) T-75 Tuner covering 18 MHz to 75 MHz
- 11) T-340 Tuner covering 75 MHz to 340 MHz
- 12) T-650 Tuner covering 340 MHz to 650 MHz
- 13) T-1200 Tuner covering 650 MHz to 1200 MHz
- 14) T-2000 Tuner covering 1200 MHz to 2000 MHz
- 15) BP-3 External Battery Pack (plugs into A-2)
Provides 120 hours additional running time without S-1 Monitor, or 60 hours additional including the S-1 Monitor.
- 16) PS-2 AC Power Supply 95 to 250 volts 50/60 cycles input,
-18 volts output regulated (required for AC operation only).
(Plugs into A-2)
- 17) AC-1 Accessories:

Headset, 3 whip antennas, remote tuner cable, carrying case with molded foam plastic insert, manual, screwdriver, powerline antenna, belt clip, long wire antenna, BNC adaptor.
- 18) S-1 Visual Monitor (provides scanned signal display)

1.2.2. Modes of Operation

The A-2 Receiver System can be operated using its internal batteries for power. Thirty-five (35) hours of operation will be obtained before battery replacement will be necessary (15 hours when S-1 is used). An external battery pack (BP-3) is supplied and can be attached to the basic receiver, providing a total of 120 hours of operation (60 hours when S-1 is used).

If AC operation is desired, the AC power supply is attached to the basic unit. The AC range of 95 to 250 volts, 50/60 Hz can be used.

For maximum ease of portable operation, the A-2 Basic Receiver can be fastened to the belt by threading the belt through the loop supplied on the front surface of the unit. The tuner is then hand held while tuning. A cable is supplied to connect the tuner to the basic unit. The belt loop can be removed by removing two mounting screws, and replacing the screws.

The S-1 Monitor may be mounted either on back of A-2 with thumbscrews, or operated as a separate unit alongside the receiver with joining cables.

SECTION II OPERATION OF RECEIVER

2.1 Assembly of Components to Basic Unit

Any one of the six tuners is assembled to the basic unit by plugging it into the right hand end of the basic unit and tightening the thumbscrew. See Fig. 2. Make certain that the tuner is flush against the mounting surface and that the alignment screw is seated in the hole before tightening the thumbscrew. The external battery pack or AC power supply can be mounted by plugging into the left hand end of the basic unit and tightening the thumbscrew. See Fig. 2. Make certain that the chassis is flush against the mounting surface and that the alignment screw is in the hole before tightening the thumbscrew.

The whip antenna is plugged into the right hand end of the tuner. See Fig. 2. The whip antenna with switch marked "4.5/10/18" is used with the T-18 tuner with switch in "4.5" position for 4.5 MHz to 10 MHz and "18" position for 10 MHz to 18 MHz. The whip antenna without switch is used from 18 to 340 MHz. The whip antenna with BNC connector is used from 340 to 2000 MHz. It should be noted that the loaded coil antenna with switch is a compromise between portability and full 1/4 or 1/2 wave length antennas. The power line antenna should be polarized for maximum signal. Any of the tuners

can be operated remotely from the basic unit by employing the remote cable. When operating remotely, the thumbscrew must be removed from the tuner to prevent the screw from causing electrical noises.

2.2 Operation of A-2 Receiver

(To operate the receiver follow the steps listed below and refer to Fig. 2.)

- 1) Assemble the tuner with appropriate antenna, battery pack, or power supply - whichever units are to be used. Assembly instructions are given in paragraph 2.1.
- 2) Place OFF-ON-MAN switch in ON position. (If AC supply is being used place both power supply switch and ON-OFF-MAN switch in ON position.) See Step 19.
- 3) Place LO-HI-TEST switch in TEST position. Meter should indicate between 7.5 and 9.0. This procedure tests the condition of batteries or AC supply output. If the meter does not indicate the correct voltage, batteries should be replaced.
- 4) Place HI-LO-TEST switch in LO position. Do not leave on TEST.

- 5) Plug headphones in jack on extreme right of basic unit.
- 6) Rotate AF GAIN knob until noise is heard.
- 7) Tune in signal by rotating tuning knob on top of tuner.
Tune for maximum deflection of S meter.
- 8) Place LO-HI TEST switch in either LO or HI, whichever gives convenient meter deflection (LO-low signal level, HI-high signal level).
- 9) If signal is frequency modulated place FM-AM-CW switch in FM position.
- 10) If signal is amplitude modulated place AM-AM-CW switch in AM position.
- 11) If signal is unmodulated place FM-AM-CW switch in CW position and rotate PITCH knob until desired tone is heard.
- 12) Select bandwidth by placing NAR-MED-WIDE switch in desired position
(NAR - 12 KHz, MED - 100 KHz, WIDE - 350 KHz)
- 13) If manual control of IF gain is desired, place OFF-ON-MAN in MAN position.
- 14) The IF GAIN control is now operative and can be adjusted for desired gain.
- 15) For ease of tuning signal use bandspread control located on front surface of tuner (end surface on T-650, T-1200, and T-2000 tuner)
- 16) Second detector AC and DC outputs are available at the IF test point jack directly under the meter. Use high impedance level only.
- 17) The spurious CW signal at 23.5 MHz will beat with any incoming signal at 23.5 MHz. By detuning slightly at this point, the incoming signal can be received.
- 18) If AC power supply is used and line voltage is not known, place line voltage switch located on top of power supply to the "200-250" position. Set A-2 meter switch to "TEST." Turn power supply on and A-2 Receiver on. If meter reads less than 7.5, set voltage switch to next lower voltage position until meter reaches 7.5. Voltage switch is then in proper position. Always start at highest voltage position when line voltage is unknown, or line fuses will burn out.

2.3 Operation of S-1 Visual Monitor

- 1) The S-1 visual monitor is required only if scanned visual display of r. f. signals is desired.

- 2) For portable operation, mount S-1 on rear of A-2. Orient viewing screen so that it is on same end as tuner. Tighten the two thumbscrews.
- 3) If portable operation is not important the S-1 can be operated on a table or desk in any position. The connecting cables supplied are long enough to allow this method of operation.
- 4) Insert red plug into jack on surface of tuner near antenna. Insert black plug into jack near "S" meter on A-2 chassis. Insert aluminum plug into jack next to IF GAIN knob on A-2 chassis. (The jacks are marked to show the correct color plugs.)
- 5) Operate receiver as described in Section 2.1 and 2.2. Apply S-1 power by placing power switch in ON position. (A-2 receiver power switch must be in ON position when operating S-1 monitor.)
- 6) Always adjust INTENSITY control for minimum brightness required for comfortable viewing (using minimum brightness will conserve battery life considerably).
- 7) Adjust SWP. GAIN control until display fills viewing area.
- 8) Adjust SWP. CENTERING and SIG. CENTERING until display is centered in viewing area.
- 9) Adjust FOC. for clearest display.
- 10) Place SWEEP Switch in ON position.
- 11) Adjust SWP. WIDTH to maximum clockwise position. In this position the largest portion of the spectrum will be viewed. In the crowded signal areas of the frequency spectrum, more detail can be observed with less sweep width. This is accomplished by adjusting the SWP. WIDTH control counterclockwise. Maximum sweep width is useful for signal seeking in areas of the spectrum that are not crowded with signals. After acquiring some experience in operating the S-1 monitor the operator can quickly determine the sweep width that is optimum. When the SWP. WIDTH control is in the maximum counterclockwise position the sweep width will be zero. The system will now accept only the one frequency to which it is tuned. The modulation of the signal can be viewed on the S-1 as well as heard.
- 12) Place A-2 bandwidth switch in NAR position for frequencies of 50 KHz to 50 MHz, MED position for 50 MHz to 500 MHz and WIDE position for 500 MHz up. Other settings than these are useful for special conditions and will become apparent after some skill is acquired.

- 13) Place A-2 FM-AM-CW switch in AM position for AM signals and FM position for FM signals. (AM setting appears as the IF band pass curve on one side of base line. FM setting appears as FM "S" curve on both sides of line.) See Fig. 11.
- 14) Place SWP RATE switch in SPEECH position. In this position a bright indicating spot will appear in the center of the screen. When it is desired to listen to the modulation of a particular signal, center that signal on the spot by tuning the tuner. The modulation of the signal will be heard. Some sweep rate noise will also be heard. If the signal must be heard clearly with no sweep noise, place SWEEP switch in OFF position. When viewing intermittent pulse modulation it may be advantageous to use a faster rate of sweep to reduce the possibility of missing the signal. The faster sweep rate can be obtained by placing the SWP RATE switch in the FAST position. When using the fast sweep rate it will be difficult to listen to the modulation. When listening, place desired signal in center of screen over bright spot and place SWP RATE switch in OFF position.

Place SWEEP switch in LFB-NAR position when using LFB/TLF Set in NARROW Bandwidth position (500 cycle bandwidth).

- 15) The FILT position of the SWEEP switch provides background noise filtering of the signal and is useful in wide and medium band width positions of the A-2 receiver. Though this filter is useful in defining very low level signals against background noise, caution must be used as some signal detail is lost.
- 16) If a large viewing area is desired an external oscilloscope can be used. Connecting cables should be used to connect the jack marked EXT SCOPE SWP to horizontal input of oscilloscope. Internal sweep of oscilloscope should be disabled. Connecting cable should be used to connect EXT SCOPE SIG to vertical input of oscilloscope. The oscilloscope can then be used for viewing the display in the same manner as when using the S-1 Monitor.

SECTION III MAINTENANCE

3.1 Battery Replacement - Basic Unit

- 1) Place OFF-ON-MAN Switch in OFF position.
- 2) Remove the four flathead screws in rear panel of basic unit and remove panel.
- 3) Remove the two 9.8 volt batteries from holders.
- 4) Install fresh batteries in holders. Observe polarity. Burgess H137R, Eveready E137, or Mallory TR137R may be used.
- 5) Replace cover and screws.

3.2 Battery Replacement - Battery Pack

- 1) Remove two screws from left cover (cover nearest thumbscrew knob).
- 2) Remove cover.
- 3) Remove batteries from holder.
- 4) Install new batteries. Observe polarity shown on block. Any of the following batteries may be used:

Mallory	RM-12 or RM-12R	Mercury
Burgess	Hg-12	Mercury
Burgess	Hg-12R	Mercury
Burgess	Hg-9	Mercury
Eveready	N46	Nickel-Cadmium
Eveready	E91	Alkaline
Eveready	915	Carbon

- 5) Replace cover, tighten screws evenly. Test immediately by attaching to A-2 and switching Meter Switch to TEST. If meter doesn't read or is low, remove battery pack cover and check polarity carefully.

3.3 Battery Replacement S-1 Monitor

- 1) Turn OFF unit and remove silver plug from A-2. This will eliminate the 1200 volts present on the batteries produced from the high voltage converter.
- 2) Remove two screws in battery cover. Battery cover is located on top of unit near INTENSITY and SWP GAIN controls.
- 3) Remove the two batteries from holders and replace with new ones observing polarity. The same batteries as listed under BATTERY REPLACEMENT - BATTERY PACK can be used.
- 4) Replace battery cover.

3.4 Replacement of Transistors - Basic Unit

- 1) Remove four screws in rear cover and remove cover.
- 2) Replace transistor. Use illustration located on inside of cover as a guide. NOTE: Small alignment tab on transistor must be in proper position.

3.5 Replacement of Fuses - AC Supply

- 1) Push fuses out of AC plug from line cord side with pencil or pointed tool.
- 2) To replace, insert fuses in holes next to plug prongs until recessed.

3.6 Other Components

It is highly recommended that any defective component that is not corrected by the above replacements, be sent directly to F. G. Mason Engineering, Inc. for repair and alignment.

SECTION IV THEORY

4.1 General Theory of Operation - Refer to Fig. 4

The modulated carrier received at the antenna is coupled through a tuned RF filter section and is applied to a transistor mixer (in the T-340, T-650, T-1200 and T-2000 a diode is used). The local oscillator produces a signal tracked at 23.5 MHz above the incoming RF signals which is also applied to the mixer. The resultant 23.5 MHz IF signal is coupled out of the tuner to the first IF stage in the basic unit.

The signal is amplified in three transformer-coupled IF stages and is applied to a switching circuit which selects either a narrow (12 KHz) band width crystal filter, a medium (90 KHz) band width crystal filter, or for wide bandwidth operation, no crystal filter.

In wideband operation the bandwidth is equal to the selectivity of the IF strip (about 350 KHz). The signal is amplified through two additional IF stages and coupled simultaneously to the FM discriminator and the AM-CW detector. A switching circuit then selects the output of either the discriminator, for FM operation, or the diode detector, for AM and CW operation, for application to the audio amplifier. The signal meter, obtaining its current through the detector, indicates relative signal strength in any mode. In CW operation, power is applied to the beat-frequency oscillator, whose output is loosely coupled back to the first IF stage. The detected IF signal is fed through two stages of audio amplification and is transformer-coupled to the phones.

Operating power for the receiver is provided from batteries within the Basic Unit, the BP-3 Battery Pack, or from the PS-2 AC supply. A switching circuit in the power jack disconnects the internal batteries if either of the external power sources are being used. The "S" meter, with the meter switch in TEST position, measures the output under load of the power source employed.

4.2 S-1 Monitor Theory of Operation

Refer to Figure 12. The S-1 Monitor receives demodulated signals from the A-2 Receiver and converts them so that they are adapted for display on a cathode ray tube. As shown in Figure 12, the S-1 Monitor consists of four basic units -- sweep generator, signal amplifier, high voltage supply, and display tube.

The sweep generator provides a sweep voltage which is applied to the deflection plates of the cathode ray tube. A portion of the sweep voltage

is supplied to the tuner for sweeping the oscillator. The sweep voltage is shaped so as to give a bright spot in the center of the display. The bright spot indicates the point in the band to which the tuner is tuned. The signal amplifier increases the amplitude of the signal from the A-2 Receiver to a level sufficient to drive the cathode ray tube. The high voltage supply supplies the anode voltage for the cathode ray tube.

The low voltage supply supplies minus 18 volts DC to the transistor circuitry. This is not located in the S-1 Monitor but is the same power source used to power the A-2 Receiver.

SECTION V LFB/TLF TUNER SET

5.1 Purpose of Equipment:

The purpose of the LFB/TLF tuner set is to extend the frequency range of the A-2 Receiver System downward to 2 kilohertz. It is also a purpose of this equipment to provide radio frequency, tuned, directional, magnetic field, antennas from 2 KHz to 4500 KHz.

5.2 General Description

The LFB/TLF tuner set consists of seven components as follows:

- 1) LFB-1 Basic 455 KHz IF amplifier section
- 2) TLF-1 Tuner, 2 - 9 KHz
- 3) TLF-2 Tuner, 9 - 43 KHz
- 4) TKF-3 Tuner, 43 - 130 KHz
- 5) TLF-4 Tuner, 130 - 475 KHz
- 6) TLF-5 Tuner, 475 - 1470 KHz
- 7) TLF-6 Tuner, 1470 - 4500 KHz

The LFB-1 section bolts on to the A-2 basic receiver and may be left mounted at all times. This LFB-1/A-2 combination will then accept all "TLF" and "T" type tuners. The A-2 provides the LFB-1 with power, audio amplification, S-meter and use of auxiliary components.

The LFB/TLF set provides 3 switchable IF bandwidths; BFO; tape dials; band spread; directional, magnetic, electrostatic, and powerline antennae. When provided with other components of the A-2 system, visual scanning, S-meter, audio output, external AC and battery supplies are also usable over the TLF tuner range.

It may be desirable on certain occasions to operate the LFB/TLF set as a separate receiver. To achieve this, it will be necessary to order an adapter (LFA-1) from F. G. Mason Engineering. The LFA-1 furnishes the power, S meter and audio functions for the LFB/TLF when used as a separate unit. Use as a separate receiver will allow two operators to use the equipment, one scanning the frequencies from

2 KHz to 4500 KHz, while the other operator covers the frequencies from 4.5 MHz to 2000 MHz. The SI monitor cannot be used with the LFB/TLF combination unless an LFA is also used. This use is discussed in Section VIII concerning the LFA.

SECTION VI COMPONENT ASSEMBLY

6.1 Removing and Mounting LFB-1 to A-2:

To remove the LFB-1 from the A2, unscrew the flush mounting bolt on the right side of the LFB-1 with the special flat key which is provided. Note that this mounting bolt is hollow and is used to secure the T series tuning heads to the LFB-1. Remove the LFB-1.

To mount LFB-1 to A-2, place coaxial connector on left side of LFB-1, in line with mating coaxial connector on right side of A-2. At the same time line up mounting screw protruding from LFB-1 with threaded hole in A-2. Turn screw with special key provided. Screw head is on right hand side of LFB-1. As screw is tightened, push units together making sure that connector and alignment screw head at bottom are properly seated. When units are tightly mounted, tighten set screw through access hole in back of LFB-1 unit in line with mounting screw. Use hex wrench provided. This locks mounting screw.

Place black plug from LFB-1 into jack on A-2 marked "black." This completes mounting of LFB-1 to A-2. This combination will now operate with all other receiver components without removal.

6.2 Mounting Tuners to LFB-1:

Mounting "T" series tuners (T18, T75, T340, T650, T1200, T2000) is accomplished in the same manner described in Section II of the A-2 manual except that they are now mounted to the LFB-1 right hand surface instead of the A-2 right hand surface.

Mounting TLF tuners to the LFB-1 is accomplished by aligning the blue plug and the snap fastener of the tuner with the blue socket and hole of the LFB-1 and pushing together. Remove by pulling apart. Prying the tuner off by pulling against the bottom edge is helpful in freeing the fastener. DO NOT use the antenna as a handle removing the TLF tuners.

SECTION VII OPERATIONAL INSTRUCTIONS

7.1 TLF Series Tuners:

7.1.1 Select TLF tuner covering range desired and follow mounting instructions in Section 6.2.

7.1.2 * Set A-2 controls as follows whenever using TLF tuners
OFF-ON-MAN: to "MAN."

*IF Gain: Maximum counter clockwise (minimum gain).

WIDE-MED-NAR: To "NAR."

*FM-AM-CS: To AM.

See Figure 2

*NOTE: A-2 units have yellow dots on the panel to indicate proper setting of controls for TLF operation.

7.1.3 The AF gain control LO-HI-TEST switch is used normally as described in Section II of A-2 Manual. Other functions used are, OFF position of OFF-ON-MAN, silver jack, phone jack, and are described in Section II of the A-2 manual. Reduce audio gain at low frequencies to prevent feedback.

7.1.4 LFB Controls:

NAR-MED-WIDE)
IN-CENT-OUT) push in or pull out, to desired B.W.

With TLF-1 and TLF-2 tuners use MED and NAR bandwidths only.

NAR is 500 Hz

MED is 2 KHz

WIDE is 10 KHz

Note that if signal is modulated with speech, the NAR position will seriously limit the intelligibility of the speech.

BFO-PITCH-OFF: Use on carrier wave signals for providing beat tone. Turn c.c.w. for OFF position. Other positions to c.w. will provide pitch adjustment.

Cable to A-2 Black Jack: Plug into "black jack" on A-2.
(Black and red jacks are for use with S-1 monitor.)

7.1.5 TLF Controls and Operation

Main Tuning: Large knob on right hand side. Eight revolutions tune unit through its range. Direct reading dial indicates RF frequency received. Do not force knob against stops at end of rotation as damage will occur.

Band Spread: Smaller knob on right hand side of tuner. $3/4$ revolution fine tunes RF frequency within a small range of dial frequency. (See 7.1.6 for TLF-1 special instructions.)

7.1.6 TLF-1 Special Instructions:

TLF-1 is provided with a dial calibrating system as follows:

- a) Follow general instructions 3.1.1 to 3.1.4, setting Bandwidth in "NAR" position.
- b) Set red mark on dial (found approximately at 3 KHz) on window pointer. If multiple peaks occur, use the middle one.
- c) Push red button and with screwdriver, adjust screw marked "CAL" until "S" meter shows maximum reading.
- d) Tuner is now calibrated and ready to use. Calibrating screw has been substituted for Band Spread control. Band Spread is not required because of the high tuning-knob-turns to frequency ratio. It is important that the operator check to see if meter indicates at the dial calibrate point whenever setting up for use.

7.1.7 Antennas:

TLF tuners are provided with loop antennas mounted on a swivel on top of the unit. In signal searching, it is best to first plug in either the whip antenna (marked 18 - 340 MHz) or the long wire antenna (use bottom banana jack), since these are non-directional at these frequencies. Then search the spectrum desired for signals. When a signal is detected by earphones, "S" meter, or Visual Monitor, then remove external antenna and find direction of signal by rotating loop antenna. At null or minimum signal strength, the antenna axis will be pointing toward signal emission in most cases. Use remote tuner cable to place the tuner in other positions thereby changing the plane of the antenna.

7.1.8 Power Line Pickup:

The power line antenna provided with the A-2 system can be used with TLF tuners in the same manner as described in Section II, 2.1, of the A-2 manual. Use bottom banana jack.

- 7.1.9 Some noise pickup may be experienced when using the AC power supply and tuning to the lower frequencies. It is recommended that the battery supply be used when this occurs.

7.2 Using Visual Monitor with TLF Tuner

7.2.1 Mounting:

Mount visual monitor in same manner as described in Section 2.3 with the exception of the black and red plugs. These are plugged into the corresponding "black" and "red" jacks of the LFB-1.

7.2.2 Operation:

Operation of the S-1 Visual Monitor with TLF tuners is the same as with any other tuners as described under section 2.3 in the A-2 manual, except below 25 KHz. Monitor must be demounted from basic unit to reduce monitor voltage converter radiation into tuner chassis and antenna.

7.3 Operation with components other than TLF Tuners.

7.3.1 Tuners:

All tuners other than TLF tuners are mounted on the right side of the LFB-1 unit in the same manner as when mounted to the A-2. When using "T" type tuners remove black plug on LFB-1 cable from A-2 jack.

7.3.2 Visual Monitor:

All operations same as described in Section 2.3. Note that the red plug from the monitor must be plugged into the tuner jack and black plug from monitor must be plugged into the A-2 black jack, not the LFB-1 when using "T" type tuners.

7.3.3 Other Components:

All other components may be used in their normal manner with the LFB-1/A-2 combination as described previously. This includes the PS-2 AC power supply, BP-3 external battery pack, earphones, antennas, and the A-2 itself.

SECTION VIII LFA ACCESSORY

PURPOSE

The LFA is a combination "S" meter, Audio Amplifier, and Battery Pack, designed for use with the Model LFB (455 KHz IF Amplifier). It is not furnished with the A2 system, but may be ordered as an accessory.

The LFA, LFB, and a TLF set combine to form a low frequency receiver system which allows an operator to scan the low frequency range while a second operator scans the high frequency range.

SPECIFICATIONS

Size: $4\frac{1}{2}$ "H x $2\frac{1}{2}$ "W x 1 7/8"D
Weight: with five 4.05 VDC TR133R Mercury batteries - 19 oz.
Battery: 35 hour continuous operation; 15 hours with S-1
Output: 1000 ohms audio - 30 mw

MOUNTING THE LFA TO THE LFB

To mount the LFA to LFB, place coaxial connector on left side of LFB in line with mating coaxial connector on right side of LFA. At the same time, line up mounting screw protruding from LFB with threaded hole in LFA. Turn screw with special key provided. (Screw head is on right hand side of LFB). As screw is tightened, push units together making sure that connector and alignment screw head at the bottom are properly seated. When units are tightly mounted, tighten set screw through access hole in back of LFB unit in line with mounting screw. (Use hex wrench provided). This locks mounting screw. Place black plug from LFB into jack on LFA marked "black". This completes mounting of LFB to LFA. This combination will now operate with any TLF tuner.

EXTERNAL POWER SOURCE

The BP-3 Battery Pack or the PS-2 AC power supply can be connected on left side of LFA to provide additional operating time. Connect the BP-3 or PS-2 supply by plugging into left hand end of the LFA unit and tightening the thumbscrew.

OPERATION OF LFA/LFB UNIT

- 1) With the LFA and LFB joined together, connect any TLF tuner to the LFB.
- 2) Turn Audio Gain control clockwise to turn unit on.

- 3) Place Low-High-Test in Test position. "S" meter should read between 70 and 90. This procedure tests the condition of batteries. If meter does not indicate the correct voltage, batteries should be replaced. (When using external supplies, the test position indicates the condition of the supply).
- 4) Place Low-High-Test switch in Low position. (Do not leave in Test because this causes distortion and eliminates signal indication on the meter).
- 5) Plug headphones in jack on extreme right of basic unit.
- 6) Rotate AF gain knob until desired audio level is obtained.
- 7) Tune in signals using "S" meters as indication. If meter goes off scale, switch to High position to attenuate the signal reading.
- 8) If signal is unmodulated, turn BFO pitch control clockwise until desired tone is heard. (BFO control is located on LFB unit).
- 9) The S-1 visual monitor may be used as described in the operation manual. Plug the silver plug into the jack marked "Silver" on the LFA and insert the black and red plugs into their receptacles on the LFB.

STORAGE

The LFA-LFB combination may be left bolted together for use as a separate receiver. In this case, it may be carried in the attache' case alongside the A2 main unit. It will be necessary to remove any tuner from the A2 and LFA-LFB and store the tuners in the pockets in the foam rubber insert.

MAINTENANCE

Battery Replacement

- 1) Remove left hand cover (cover by Low-High-Test switch) by removal of three 8-32 screws and two 4-40 screws.
- 2) Tip unit to let batteries slide out.
- 3) Check each battery hole to ensure that the spring is still seated at the bottom.
- 4) Install new batteries with (+) side out in the holes marked with white.
 Use: Mallory TR133R
 Burgess H133R
 Eveready E133N
 (4.05 VDC Mercury Battery)

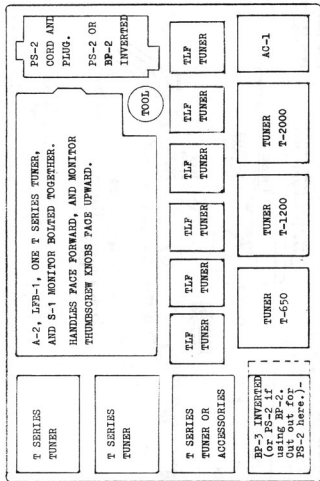
- 5) Replace cover and install screws. Tighten screws evenly. Test immediately by placing Low-High-Test switch to Test and turning audio control on. If meter does not read properly, remove cover to check for correct polarity and that the springs are fully down to the bottom of the holes.

Transistor Replacement

Remove six 4-40 screws on both front side and backside of LFA and slide top half upward. This operation will expose the 2N217 (next to the transformer) and the 2N109. (Note: do not replace transistors with unit energized).

SECTION IX MAINTENANCE

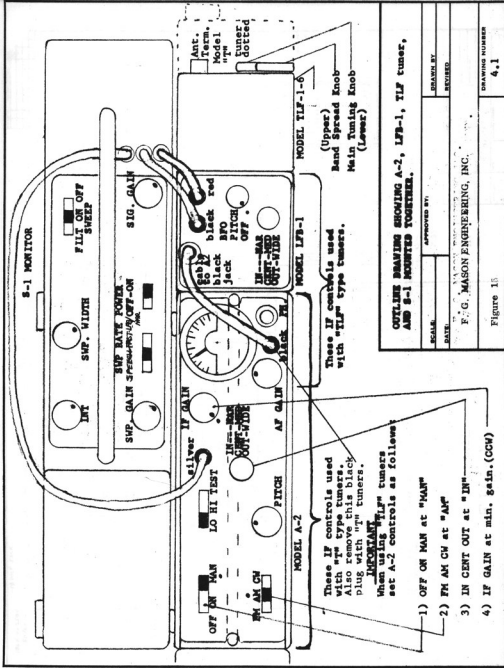
- 9.1 Should the LFB-1 Basic Control Unit or TLF series tuners become inoperative it is recommended that they be returned to the factory for repair. If only one tuner is exhibiting trouble only that tuner need be returned for repair, allowing the remainder of the system to be used.

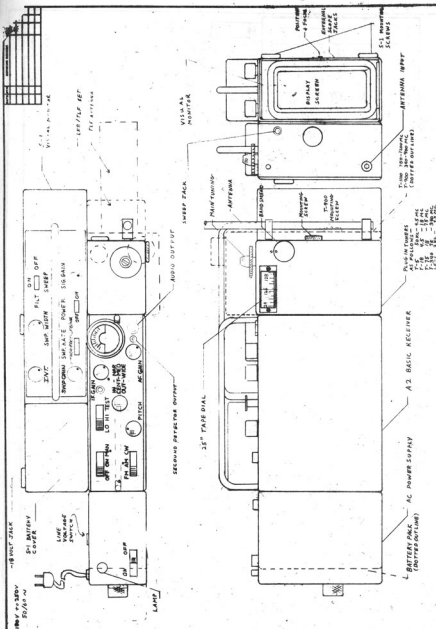


F. G. MASON ENGINEERING, INC.
FAIRFIELD, CONN.

TOLERANCES (EXCEPT AS NOTED)						PAGE 2 OF 2	
DECIMAL	\pm	SCALE		DRAWN BY			
FRACTIONAL	\pm	TITLE		APPROVED BY			
		CASE INSERT DIAGRAM					
ANGULAR	\pm	DATE		DRAWING NUMBER		FILE 14	
				2.2			

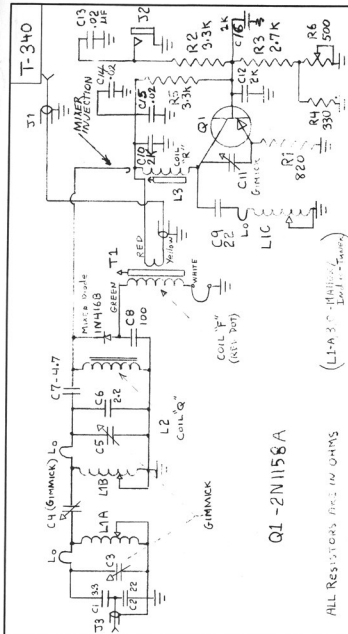
FILE 14





ACTUAL SIZE
FIG 1

[illegible]



Q1-2N1158A

ALL RESISTORS ARE IN OHMS

ALL CAPACITORS ARE IN PF
UNLESS OTHERWISE SHOWN

T340 SCHEMATIC DIAGRAM FIG. 7

SCALE:

SCALE: 9-10-64

APPROVED BY

DRAWN BY

J. HAYES

AA **F. C. MASON**
DET **ENGINEERING INC**

1700 POST ROAD
FAIRFIELD, CONN

DRAWING NUMBER
300 40514

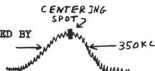
ER-2001

FIGURE 11A

MONITOR DISPLAYS:

1) DISPLAYS OF CONTINUOUS WAVE SIGNALS AS VARIED BY CONTROL POSITIONS.

1.1 Wide position, AM, Max. sweep width-



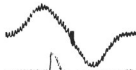
1.2 Medium " " " " " -



1.3 Narrow " " " " " -



1.4 Wide position, FM, Max. sweep width-



1.5 Medium " " " " " -



1.6 Narrow position, AM, $\frac{1}{2}$ sweep width -



2) DISPLAYS OF TWO CONTINUOUS WAVE SIGNALS 15 Kc. APART.

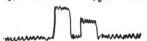
2.1 Wide position, AM, Max. sweep width-



2.2 Medium position, " " " " -

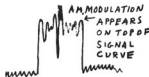


2.3 Narrow position, AM, $\frac{1}{2}$ sweep width -



3) DISPLAYS OF AMPLITUDE MODULATED CARRIER.

3.1 Medium position, AM, sweep on -
(To listen, center spot on curve)



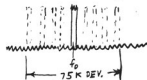
3.2 Medium position, AM, sweep off -
(Modulation only is seen and heard)



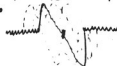
MONITOR DISPLAYS CONTINUED:

4) DISPLAYS OF FREQUENCY MODULATED CARRIER. (75 Kc. Deviation) (F_0 150mc.)

- 4.1 Narrow position, AM, sweep width approx. 150 kc.

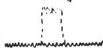


- 4.2 Listening purposes, Medium position, sweep rate slow, $\frac{1}{2}$ sweep width.
(place center spot on crossover.)



5) DISPLAY OF KEYED CONTINUOUS WAVE SIGNAL.

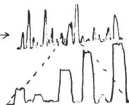
- 5.1 Narrow position, AM, $\frac{1}{2}$ sweep width fast rate. Curve intermittently appears and disappears as keyed.



6) DISPLAYS OF CROWDED SIGNAL AREAS.

- 6.1 Narrow position, Max. sweep width, AM-

18 SIGNALS
SHOWING



- 6.2 Center area of above signals expanded by lowering the sweep width.

EXPANDED TO SHOW ONLY 7 SIGNALS

7) DISPLAYS USING FILTER POSITION. (FILT.)

- 7.1 Wide position, AM, Max sweep width, low level incoming signal, sweep switch in "ON" position.



- 7.2 Same as above only sweep switch in "FILT" position.



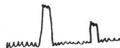
MONITOR DISPLAYS CONTINUED:

8) HIGH LEVEL SIGNAL DISPLAYS.

8.1 Narrow position, AM, Max. signal gain-

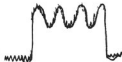


8.1 Same as above only signal gain lowered to avoid clipping.



9) SOME OTHER TYPICAL DISPLAYS.

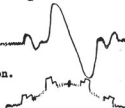
9.1 Carrier with single tone modulation (AM)-



9.2 FM MULTIPLEX, receiver in FM position-



9.3 Television picture carrier with modulation. Receiver in AM, Wide, Max sweep width.



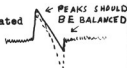
9.3 Same as above with sweep in "OFF" position to show modulation only

10) USING MONITOR TO TROUBLE SHOOT RECEIVER.
(CORRECT CURVES SHOWN DOTTED.)

10.1 Medium position, AM, 5 uv signal applied at antenna unmodulated. Noise shows gain OK but signal to noise ratio poor. TUNER or first stage IF is defective.

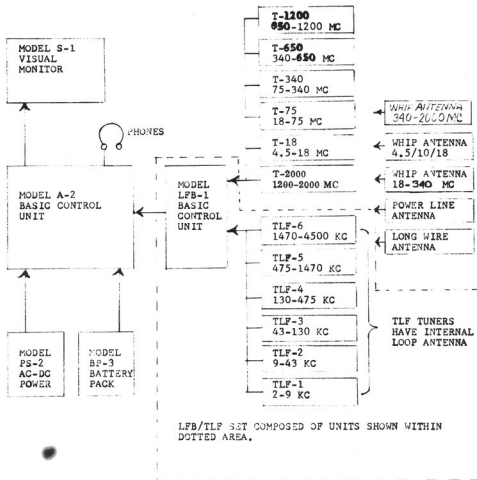


10.2 Medium position, FM, 5 uv signal, unmodulated shows unbalanced FM detector curve. Tune "T 8" in Basic unit, A-2. for balance.



10.3 Medium position, AM, 5 uv signal, unmodulated shows IF amplifier strip misaligned. Tune T-2 through T-6 for correct curve.

TOP SHOULD BE
AS LEVEL AS
POSSIBLE

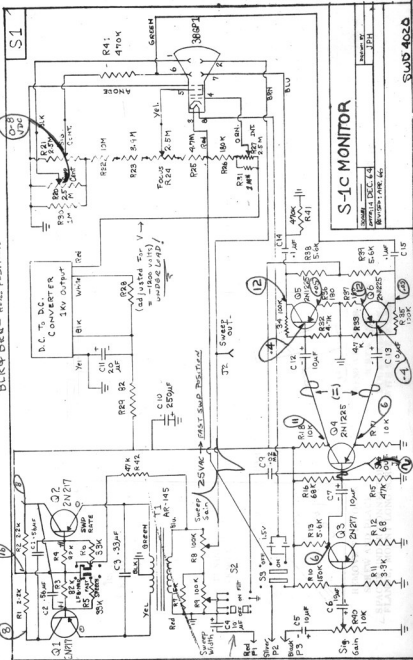


BLOCK DIAGRAM OF A-2 RECEIVER SYSTEM WITH LFB-1/TLF SET.
THIS SYSTEM ACCEPTS ALL TUNERS WITHOUT REMOVAL OF LFB-1
BASIC CONTROL UNIT FROM THE A-2 BASIC CONTROL UNIT.

FIGURE 12

F.G. MASON ENGINEERING INC.
FAIRFIELD, CONNECTICUT

IF S16 CANNOT BE CENTERED REV. DETECTION 68005
 BLUE+GREEN-LEFT POSITION
 BLUE+RED- RIGHT POSITION



S-1C MONITOR

Model	Serial 14 DEC. 64	Designed by	JPH
Version	Rev. 1.0	Divided by	66

SWD 4020

MOUNTING DIAGRAM FOR B. N. C. ANTENNA ADAPTER
F. G. MASON ENGINEERING, INC.
FAIRFIELD, CONN.

"TLF" TYPE

VHF TYPE

ANT.

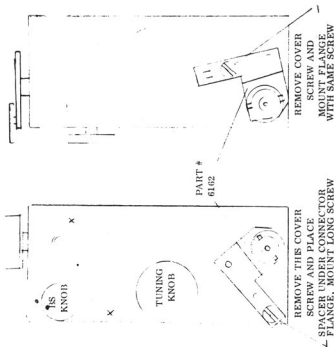
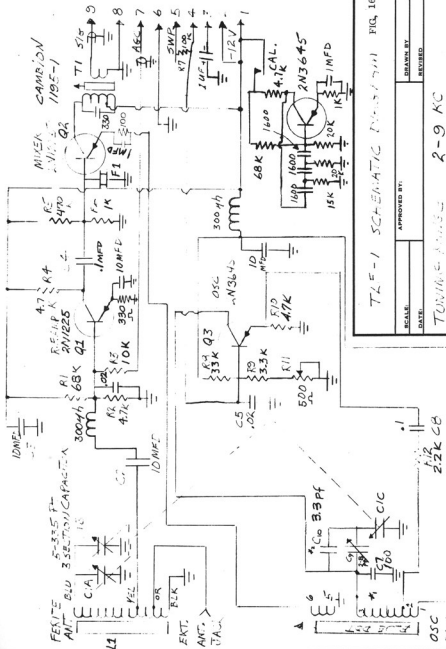


FIGURE 14



TL^E-1 SCHEMATIC DRAWING FIG. 16

FIG. 16

APPROVED BY:

DRAWING BY

REVIEWED

TONING PAGE 2-9 KC

F. G. MASON ENGINEERING INC.
FAIRFIELD, CONNECTICUT.

DRAWING NUMBER
SWD 4000-1

ER-2001

THREE REMOVED 1/16/47

T2 (5850)

4 1/2 x 11 PRINTED ON MD, 100% CLEANSY

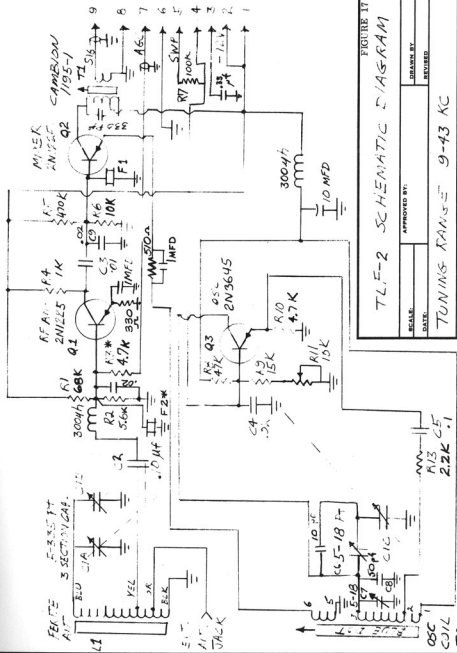


FIGURE 17

TLF-2 SCHEMATIC DIAGRAM

APPROVED BY:

MCAL-17:

CONAVALIN B

REVISED

TUNING RANGE 9-43 KC

ER-2001

F. G. MASON ENGINEERING INC.
FAIRFIELD, CONNECTICUT

DRAWING NUMBER

SWD 4000-2

* FACTORY SELECTED VALUE

PRINTED ON NO. 1000H CLEARCUT

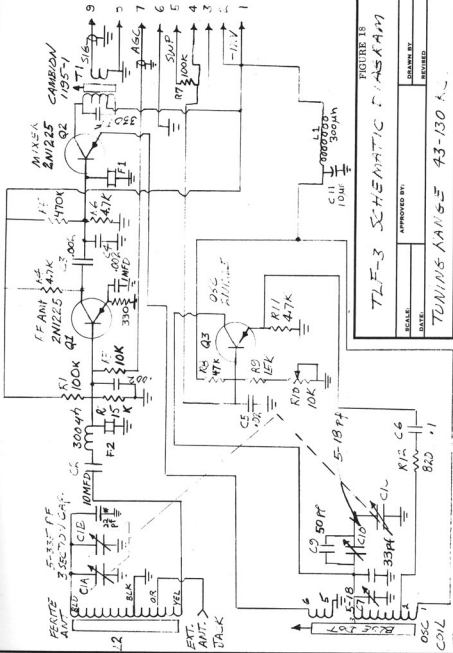


FIGURE 18

TLF-3 SCHEMATIC DIAGRAM

SCALE: _____ APPROVED BY: _____

DATE: _____

DRAWN BY: _____

REVISED: _____

TUNING RANGE 43-130 KC

F. G. MASON ENGINEERING INC.
FAIRFIELD, CONNECTICUT.

DRAWING NUMBER
9WD 4900-3

* FACTOR SELECTED VALUE

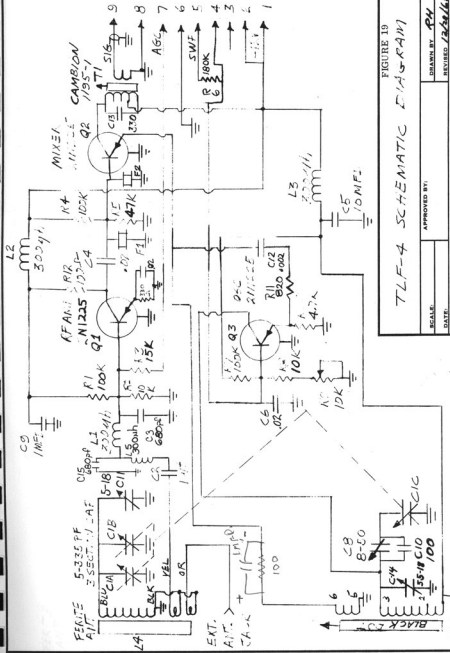


FIGURE 19

TLF-4 SCHEMATIC DIAGRAM

APPROVED BY:

SCALE:

DATE:

DRAWN BY: PH

REVISED: 12/24/66

TUNING RANGE 130-475 KC

FAIRCHILD ENGINEERING INC.
FAIRFIELD, CONNECTICUT.

ER-2001

DRAWING NUMBER
SWD 4000-4

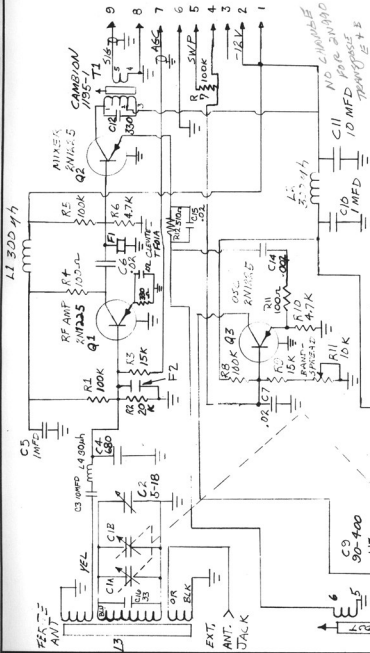


FIGURE 20

TLF-5 SCHEMATIC DIAGRAM

APPROVED BY:

DATE: _____
SCALE: _____

FOR A YEAR BY

REVISED 12/29/66

TUNING RANGE 475-1470 KC

F. G. MASON ENGINEERING INC.
FAIRFIELD, CONNECTICUT.

DRAWING NUMBER
SWD-4000-5

ER-2001

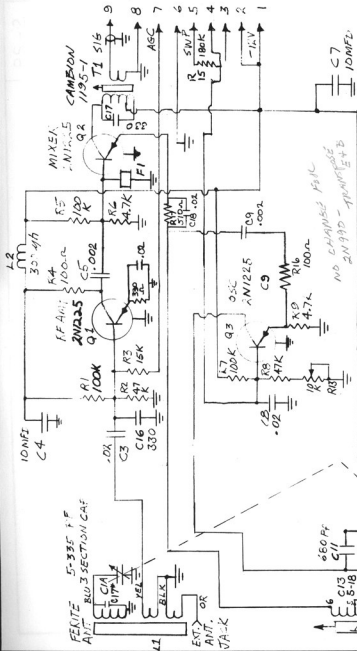


FIGURE 21

TLF-6 SCHEMATIC DIAGRAM

SCALE	APPROVED BY	DRAWN BY
		RH

DATE

REVISOR

TUNING RANGE 1.47-4.5 MC

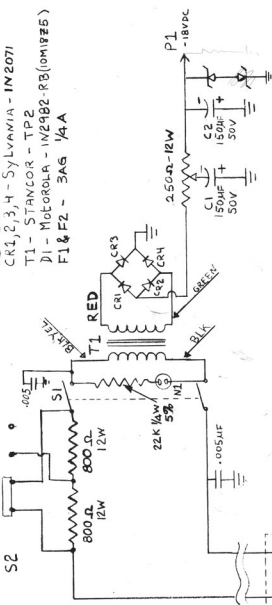
DRAWING NUMBER

SWD 4000-6

* FACTORY SELECTED (6.8-10PF)

ER-2001

PS-2

VAC
95-128 128-170 170-250

N1 - LAMP NEON

CR1,2,3,4 - SYLVANIA - 1N2071

T1 - STANCOR - TP2

DI - MOTOROLA - 1N2982-RB (10M1825)

F1 & F2 - 3AG 1/4A

POWER SUPPLY

FIGURE 22

SCALE: APPROVED BY

DRAWN BY

DATE: 9-12-64

J HAYES

F. G. MASON
ENGINEERING, INC.

1700 POST ROAD

FAIRFIELD, CONN.

DRAWING NUMBER

ER-2001

To Power Line

