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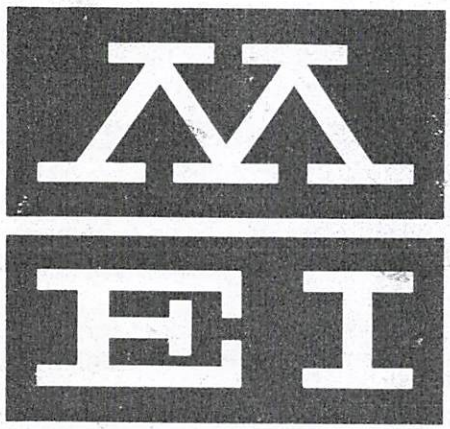

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RADIO RECEIVER WITH SPECTRUM DISPLAY
MODEL A-2

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

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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 perpretrator 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 interferring 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 interferring 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, carrying case with molded foam plastic insert, manual, screwdriver, powerline antenna, long wire antenna, BNC adapter.

18) S-1 Visual Monitor (provides scanned signal display)

1.2.2 Models 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-1) 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.

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.

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 18.

3) Place LO-HI-TEST switch in TEST postion. 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 FM-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 4.5 MHz to 18 MHz and MED POSITION for 18 MHz to 2000 MHz. 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 SWEEP 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 SWEEP 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.

2.4 Specific Instructions for performing Electronic Countermeasures Sweeps.

This portion of the instruction manual is intended to assist the operator in performing sweeps. It should in no way be construed as the best of procedures and the on-the-job experience of the operator will guide him in modifying these suggestions.

Preparation of Area

There are several preliminary things which should be kept in mind before a sweep is started. It should be assured that the busy-bodies who frequent industrial establishments are not apt to wander into the area. Not only are they likely to accidently tip off any possible listener, but they are proficient in "chicken little, they're bugging the place!!!". What you don't need at this point is help.

Remove the phone from the hook, as this will activate any series connected devices. Even if they are hundreds of feet away, a sensitive receiver such as the A2 will pick them up. Keeping the phone off the hook may raise someones curiosity, so prepare an excuse for this.

Record the TV channels in your area, both VHF and UHF and you can use these frequencies to check the operation of Tuners T650 and T1200. The lack of signals in those regions even makes the Professional wonder if his receiver is working. Remember - there is seldom a signal on the T650, T1200 or T2000 bands. Provide an audio source to trigger any audio actuated devices.

A. Operation with T2000 Tuner

1. 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 the the alignment screw is in the hole before tightening the thumbscrew.

2. Plug the T2000 tuner into the right side of the A2. Tighten the thumbscrew on the right side of the T2000. It is preferrable to start a sweeping operation with the highest frequency tuner and work down. This will allow the operator to find harmonics of any "bugs" which may be present. A harmonic is a multiple of the bug frequency and

may be found at 2, 3, 4 or even 50 times the original frequency. Most bugging devices will have harmonics, but legitimate transmitters will not. Since there are very few legitimate signals in the higher frequency ranges, the harmonic is easy to spot.

3. Plug the whip antenna into the BNC Connector on the top of the Tuner. Extend the whip to its full length being careful not to bend the small upper elements.

4. If AC power supply is used and line voltage is not known, place line voltage switch located on the back of the power supply in 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. The line fuses are located in the AC plug.

5. 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.)

6. 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, or AC power supply voltage switch adjusted as in step 4.

7. Place HI-LO-TEST switch in LO position. Do not leave on TEST.

8. Plug headphones in jack on extreme right of A2 basic unit.

9. Rotate AF GAIN knob until noise is heard.

10. Put bandwidth switch on A2 in cent.- Med. position.

11. Place FM-AM-CW switch in FM.

12. For portable operation, mount S-1 on rear of A2. Orient viewing screen so that it is on same end as tuner. Tighten the two thumbscrews.

13. 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.

14. Insert red plug into jack on side bottom of T2000 tuner. Insert black

plug into jack near "S" meter on A-2 chassis. Insert silver plug into jack next to IF GAIN knob on A-2 chassis. (The jacks are marked to show the correct color plugs.)

15. 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.)

16. Always adjust INTENSITY control for minimum brightness required for comfortable viewing (using minimum brightness will conserve battery life considerably).

17. Adjust SWP. GAIN control until display fills viewing area (usually leave at full clockwise position).

18. Place SWEEP Switch in FILT. ON position, to extreme left position.

19. 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.

20. Adjust SIG. GAIN control so that size of display is entirely within the screen. This may have to be readjusted as signal intensity varies.

21. 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. If the modulation of 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.

22. 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.

When a signal is received:

1. Tune in signal by rotating tuning knob on side of tuner. Tune for maximum deflection of S meter.

2. Place LO-HI-TEST switch in either LO or HI, whichever gives convenient meter deflection (LO-low signal level, HI-high signal level).

3. If signal is frequency modulated place FM-AM-CW switch in FM position. Most bugs are frequency modulated.

4. If signal is amplitude modulated place FM-AM-CW switch in AM position. If it cannot be determined if the signal is AM or FM, use the switch position which gives the least audio distortion.

5. If signal is unmodulated place FM-AM-CW switch in CW position and rotate PITCH knob until desired tone is heard.

6. Select bandwidth by placing NAR-MED-WIDE switch in desired position (NAR - 12 KHz, MED - 100 KHz, WIDE - 350 KHz)

7. If manual control of IF gain is desired, place OFF-ON-MAN in MAN position. This control is rarely required and normally it is left in the full counterclockwise position.

8. The IF GAIN control is now operative and can be adjusted for desired gain.

9. 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).

10. Several techniques may be used to find out if a bug is present if the signal is suspicious.

    a. The first and most obvious is the identification of the information being transmitted. The broadcast of an informal, private business conversation sounds quite different from a legitimate

commercial broadcast, and, of course, the topic of conversation can be used to identify the possible participants. Also, one should listen for familiar names, company references, addresses, product names, etc.

b. Another technique is to note the signal level or signal strength of the unidentified transmission. If the signal is quite strong, it means that it is a legitimate transmission which for some reason has not been previously identified, (such as a new F. C. C. broadcast allocation or of a university station broadcasting at irregular hours, etc.) or a clandestine transmission with the bug located in the immediate vicinity. The local transmitter can be identified by watching for a change in its signal level (transmitting strength) as shown on the meter, as the A2 receiver is moved around the area. It may be necessary, if the signal level is high, to move the receiver to a different area of the building, such as down the corridor. If a variation in signal level is noted, it indicates that the clandestine transmitter is a relatively low power one, and is transmitting from the immediate area. Of course, moving the receiver to the area of highest signal level is a standard technique for locating the transmitter.

c. Another useful method in identifying a clandestine transmission is to pin-point its frequency. Multiply that frequency times two and then tune the surveillance receiver to that new frequency, which is known as a harmonic of the broadcast frequency. Inexpensive and poorly built clandestine transmitters will normally transmit harmonics of their designed frequency. These harmonics are multiples of the design frequency. Legitimate broadcasters are required by the F.C.C. to use broadcast equipment especially designed to eliminate harmonic transmissions. Therefore, if a harmonic of an unidentified broadcast transmission is detected, this is an indication that it is an unauthorized or illegal transmission. The harmonic frequency may be two, three or four times the intended broadcast frequency. Another advantage to the surveillance receiver operator in using this technique is that the harmonics of clandestine transmissions are often in a frequency range that is free from heavy broadcast traffic and, therefore, are easier to identify. For instance, a clandestine transmitter broadcasting at 86 MHz, just below the FM broadcast band, could present harmonics at 172 MHz, 258 MHz, and 334 MHz. Traffic (or the number of legitimate broadcasts) from 200 to 350 MHz is less than those found in the F.M. band 88 to 108 MHz.

When using electronic surveillance equipment and following the sweep patterns and techniques mentioned above, it is important to employ the following procedures. It is generally recommended practice, especially when you have reason to believe a room is bugged, to conduct the electronic surveillance from an adjacent room. Normal conversations should continue in the bugged room (of course, nothing confidential should be discussed). If this is not possible, security officers can conduct a synthetic meeting to provide a seemingly legitimate sound source. If this is not possible, a radio or tape recording can be used.

Whatever is used, it must appear to be a legitimate sound source so that the eavesdropper listening won't suspect entrapment. Also, the sound source used must be familiar to the person operating the surveillance equipment so that he can easily identify its clandestine broadcast.

Some surveillance operators prefer to run a sweep in the room which is suspected to contain the bug. During the sweep, the received signals are played through a loudspeaker. When the receiver detects the bug in the room, the rustling noise in the speaker will be picked up by the room bug, rebroadcast and fed back through the speaker producing a screech or howl. This technique is very effective and positively establishes the existance of a bug. However, if the eavesdropper is monitoring his transmission, he will identify this technique and either turn off or abandon the bug to prevent its discovery, or his entrapment. Therefore, where counter-use of the bug (by providing false information) or entrapment of the bugger are contemplated, the feedback technique should not be used.

If these are not the objectives, then the feedback technique can be very helpful in locating the bug in the room. First, tune the receiver to the bug's broadcast frequency and turn the speaker volume control up until the feedback screech is heard. Then, turn down the volume until the screech stops. Move the receiver around the room until the screech is heard again. This means that you are now closer to the bug. Continue this process as often as possible until you have narrowed your search to as small an area of the room as possible. At this point, a physical search procedure should be employed.

B. Operation withT1200 Tuner

1. Replace the T2000 tuner with the T1200 tuner which covers 650 to 1200 MHz. Repeating all steps covered by the T2000.

2. At the lower end of the band, from 890 MHz and down, you may encounter a UHF Television station. The TV signal of a station will appear in 2 parts. The audio signal will be an FM signal and may be received as any other FM signal would. The video or picture portion of the signal will be 4.5 MHz lower in frequency than the audio for that channel. The video is an AM signal which may be identified as a steady buzz. If the receiver is equipped with a visual display unit, it is possible to look at the video signal and the characteristic sync signals will be seen. The TV picture itself cannot be seen on a normal display unit. The TV channels are spaced 6 MHz apart.

3. Between 960 and 1215 MHz a radar signal may be found. Radar signals may be identified by its characteristic buzz. If a rotating antenna is involved at the radar station, the buzz will last for a second or two and be repeated every 15 to 30 seconds as the antenna makes a complete revolution.

C. Operation with the T650 Tuner

1. Replace the T1200 tuner with the T650 Tuner which covers 340 to 650 MHz, repeating all steps covered by the T2000.

2. Interesting signals start appearing especially from UHF Television and/or 2 way mobile radio (taxi, police, garbage trucks, etc.) around 450 to 470 MHz.

D. Operation with the T340 Tuner

1. Replace the T650 Tuner with the T340 tuner which covers 75 to 340 MHz, repeating all steps covered by the T2000, except the antenna mounting is different.

2. Connect the antenna marked 18-340 MHz to the side of the T340.

3. Tuning from 340 MHz down in frequency, the following bands will be encountered in most locations:

   a. Television - 216 to 174 MHz
   b. 2 way Mobile, telephone and paging - 152 to 173 MHz.
   c. Amateur Radio - 148 to 144 MHz
   d. U.S. Government - 144 to 132 MHz
   e. Aircraft to Ground - 132 to 108 MHz
   f. FM Broadcast - 108 to 88 MHz
   g. Television - 88 to 75 MHz

Also the T340 covers a large percentage of the frequencies used by the "non-professional" eavesdropper as well as the harmonics of those frequencies. These and the older types of bugs are to be found between 80 and 88 MHz, and a modified FM receiver may be used by the culprit.

E. Operation with the T75 Tuner

1. Replace the T340 tuner with the T75 tuner which covers 18 to 75 MHz, repeating all steps covered by the T2000, except for antenna mounting.

2. Connect the antenna marked 18-340 MHz to the side of the T75.

3. The legitimate stations encountered in this band will be:

   a. Television - 75 to 54 MHz
   b. Amateur Radio - 54 to 50 MHz
   c. 2 Way Mobile Radio - 30 to 50 MHz
   d. Amateur Radio - 30 to 28 MHz
   e. Citizens Band - 27.25 to 27 MHz
   f. Foreign Broadcast, including teletype, voice, facsimile, code etc; occasional amateur radio - 27 to 18 MHz

F. Operation with the T18 Tuner

1. Replace the T75 tuner with the T18 tuner which covers 4.5 to 18 MHz, repeating all steps covered by the T2000, except for antenna mounting setting the Bandwidth switch to IN-NAR.

2. Connect the antenna with the switch on the side of the block to the T18. Note that the switch should be placed in the frequency range which you are tuning through (either 4.5 to 10 MHz or 10 to 18 MHz.)

3. In this band will be found mostly foreign broadcast, amateur radio and some time stations such as WWV on 5, 10 and 15 MHz which give the time every 5 minutes with a ticking tone in between.

Use of TLF Set

1. Introduction

The TLF (Tuned Low Frequency) portion of the A2 System is used for covering the frequency band from 2 KHz to 4.5 MHz. Although it is certainly possible to build a normal radio transmitter in this frequency range, carrier current operation is more desirable.

When an eavesdropper utilizes the AC power lines which furnishes electrical service to a facility for transmission of information, he uses what is commonly termed a carrier current. This method uses a carrier frequency of from 20 KHz to 200 KHz. The circuitry for the transmitter is similar to that of any other radio transmitter, only the frequency is normally lower. This mode of transmission is very common in the use of so-called "wireless intercoms". The main advantage of this mode of eavesdropping is that the receiver may be placed at any location inside or outside of the building under surveillance. The receiver must, however, be placed on the same side of the power company's line transformer since the transformer will not pass the higher frequencies used for carrier current purposes. Thus a physical search for this type of device is limited to areas serviced by the same line transformer. The transmitters may be very small and are available disguised as wall outlets so that the transmitter is powered from the AC wires connected to the outlet through the normal building wiring.

2. Using the TLF Tuners

A. Setting of A2 Controls (note that all controls are positioned at the yellow dots for TLF use - see Fig. 2A) Connect the S2 and LFB-1 plugs as shown - THIS IS VERY IMPORTANT.

1. OFF-ON-MAN: MAN
2. LO-HI-TEST: LO
3. GAIN: FULLY Counterclockwise
4. FM-AM-CW: AM

B. Setting of S1 Controls (See Fig. 2A)

1. SWP Rate: LFB/NAR
2. SWEEP: FILT. ON
3. All other controls full clockwise;
4. See Figure 2A for the plug connections between the A2 and S1.

C. TLF-1 (2 to 9 KHz)

1. Connect the TLF-1 Tuner to the right hand side of the A2. Align the blue plug and the snap fastener of the TLF-1 with the blue socket and hole of the LFB-1 and push together. Note that there is no holding bolt as there is on the high frequency tuners.

2. Set the Bandwidth Switch on the LFB-1 to IN-NAR.

3. If an external speaker is used, feedback to the TLF-1 may occur due to the low frequency range of this tuner. Do not use an external antenna with the TLF-1.

4. Slowly tune from 2 to 9 KHz. Very seldom will <u>any</u> signal be found with this tuner, but a great deal of man-made and natural noise will be noted. Squawks, squeaks, squeals and impulse type electrical sounds will prevail.

5. If you should find a signal on this tuner, it will be very apparent on the signal strength meter. On the TLF-1, the visual display unit (S1) may not be usable and the signal strength meter will provide adequate indication.

6. Note that the movable antenna on the top of the tuner is directional and may be turned to "peak" the signal on the S meter. At null or minimum signal strength, the antenna axis will be pointing toward the signal source in most cases. Note also that touching the various controls with the hand will affect the signal indication.

7. Remove the tuner by pulling it away from the LFB-1. Prying the tuner off by pulling against the bottom edge is helpful in freeing the fastener. <u>DO NOT</u> use the antenna as a handle for removing the TLF tuners.

D. TLF-2 (9 to 43 KHz)

1. Connect the TLF-2 Tuner to the right hand side of the A2. Align the blue plug and the snap fastener of the TLF-2 with the blue socket and hole of the LFB-1 and push together. Note that there is no holding bolt as there is on the high frequency tuners.

2. Set the Bandwidth Switch on the LFB-1 to CENT.-MED.

3. If an external speaker is used, feedback to the TLF-2 may occur due to the low frequency range of this tuner.
Plug the power line antenna to an AC outlet and the white jack on the bottom side of the TLF-4.

4. Slowly tune from 9 to 43 KHz. Very seldom will any signal be found with this tuner, but a great deal of man-made and natural noise will be noted. Squawks, squeaks, squeals and impulse type electrical sounds will prevail. Some CW (Morse Code) may be found.

5. If you should find a signal on this tuner, it will be very apparent on the signal strength meter. On the TLF-2 the visual display unit (S1) may not be usable and the signal strength meter will provide adequate indication.

6. Note that the movable antenna on the top of the tuner is directional and may be turned to "peak" the signal on the S meter. At null or minimum signal strength, the antenna axis will be pointing toward the signal source in most cases. Note also that touching the various controls with the hand will affect the signal indication.

7. Remove the tuner by pulling it away from the LFB-1. Prying the tuner off by pulling against the bottom edge is helpful in freeing the fastener. DO NOT use the antenna as a handle for removing the TLF tuners.

E. TLF-3 (43 to 130 KHz)

1. Connect the TLF-3 Tuner to the right hand side of the A2. Align the blue plug and the snap fastener of the TLF-3 with the blue socket and hole of the LFB-1 and push together. Note that there is no holding bolt as there is on the high frequency tuners.

2. Set the Bandwidth Switch on the LFB-1 to OUT-WIDE.

3. If an external speaker is used, feedback to the TLF-1 may occur due to the low frequency range of this tuner. Plug the power line antenna to an AC outlet and the white jack on the bottom side of the TLF-4.

4. Slowly tune from 43 to 130 KHz. Very seldom will any signal be found with this tuner, but a great deal of man-made and natural noise will be noted. Squawks, squeaks, squeals and impulse type electrical sound will prevail. Some CW (Morse Code) signals will be found. At about 100 KHz you may find navigational signals which have either an intermittent or constant tone.

5. If you should find a signal on this tuner, it will be very apparent on the signal strength meter.

6. Note that the movable antenna on the top of the tuner is directional and may be turned to "peak" the signal on the S meter. At null or minimum signal strength, the antenna axis will be pointing toward the signal source in most cases. Note also that touching the various controls with the hand will affect the signal indication.

7. Remove the tuner by pulling it away from the LFB-1. Prying the tuner off by pulling against the bottom edge is helpful in freeing the fastener. DO NOT use the antenna as a handle for removing the TLF tuners.

F. TLF-4 (130 to 475 KHz)

1. The TLF-4, which tunes 130 to 475 KHz will cover the operating range of all KNOWN carrier current devices, but don't become overconfident and neglect the other tuners.

2. Connect the TLF-4 Tuner to the right hand side of the A2. Align the blue plug and the snap fastener of the TLF-4 with the blue socket and hole of the LFB-1 and push together. Note that there is no holding bolt as there is on the high frequency tuners.

3. Set the Bandwidth Switch on the LFB-1 to out-wide.

4. Plug the power line antenna to an AC outlet and the white jack on the bottom side of the TLF-4.

5. If an external speaker is used, feedback to the TLF-4 may occur due to the low frequency range of this tuner.

6. Slowly tune from 130 to 475 KHz. You may start noticing legitimate signals in this band, depending on vour location. Use of the BFO on the LFB-1 may aid in their reception. They may appear as on-off tones, teletype, facsimile, CW code or voice. Most of these legitimate stations will be received better if no external antenna is used, but the carrier current devices will be received better by using the power line antenna. As you tune through 455 KHz, you may find a "birdie". This is a false signal generated within the A2 Receiver.

7. If you should find a signal on this tuner, it will be very apparent on the signal strength meter, or on the S1 visual display unit when the SIG. GAIN Control is in it's fully clockwise position.

8. Note that the movable antenna on the top of the tuner is directional and may be turned to "peak" the signal on the S meter. At null or minimum signal strength, the antenna axis will be pointing toward the signal source in most cases. Note also that touching the various controls with the hand will affect the signal indication.

9. Remove the tuner by pulling it away from the LFB-1. Prying the tuner off by pulling against the bottom edge is helpful in freeing the fastener. DO NOT use the antenna as a handle for removing the TLF tuners.

G. TLF-5 (475 to 1470 KHz)

1. Connect the TLF-5 Tuner to the right hand side of the A2. Align the blue plug and the snap fastener of the TLF-5 with the blue socket and hole of the LFB-1 and push together. Note that there is no holding bolt as there is on the high frequency tuners.

2. Set the Bandwidth Switch on the LFB-1 to out-wide. If there is interference between two stations very close to each other, put the Bandwidth switch to CENT.-MED.

3. The S1 Visual Display is suggested for use in this band. Place the controls as follows: (see Figure 2A):

   a. SWP. Rate - SPEECH
   b. Power - ON
   c. SWEEP - FILT. ON
   d. INT., SWP. WIDTH AND SWP. GAIN - fully clockwise
   e. SIG. GAIN - as needed for full screen vertical display.

   When a signal is found, the SWEEP may be turned off so that any audio on the signal may be identified.

4. Slowly tune from 475 to 1470. The TLF-5 covers the AM Broadcast band. An external antenna is not necessary.

5. Note that the movable antenna on the top of the tuner is directional and may be turned to "peak" the signal on the S meter. At null or minimum signal strength, the antenna axis will be pointing toward the signal source in most cases. Note also that touching the various controls with the hand will affect the signal indication.

6. Remove the tuner by pulling it away from the LFB-1. Prying the tuner off by pulling against the bottom edge is helpful in freeing the fastener. DO NOT use the antenna as a handle for removing the TLF tuners.

H. TLF-6 (1.47 to 4.5 MHz)

1. Connect the TLF-6 Tuner to the right hand side of the A2. Align the blue plug and the snap fastener of the TLF-6 with the blue socket and hole of the LFB-1 and push together. Note that there is no holding bolt as there is on the high frequency tuners.

2. Set the Bandwidth Switch on the LFB-1 to out-wide. If there is interference between two stations very close to each other, put the Bandwidth Switch to CENT.-MED.

3. The S1 Visual Display is suggested for use in this band. Place the controls as follows (see Figure 2A):

   a. SWP. Rate - SPEECH
   b. Power - ON
   c. SWEEP - FILT. ON
   d. INT., SWP. WIDTH AND SWP. GAIN - fully clockwise
   e. SIG. GAIN - as needed for full screen vertical display.

   When a signal is found, the SWEEP may be turned off so that any audio on the signal may be identified.

4. Slowly tune from 1.47 to 4.5 MHz. The TLF-6 covers the top of the AM Broadcast band and some of the foreign broadcast short-wave bands. An external antenna is not necessary.

5. Note that the movable antenna on the top of the tuner is directional and may be turned to "peak" the signal on the S meter. At null or minimum signal strength, the antenna axis will be pointing toward the signal source in most cases. Note also that touching the various controls with the hand will affect the signal indication.

6. Remove the tuner by pulling it away from the LFB-1. Prying the tuner off by pulling against the bottom edge is helpful in freeing the fastener. DO NOT use the antenna as a handle for removing the TLF tuners.

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) Remove cover of AC supply.

2) Fuse is located in fuse clip in bottom section of power supply.

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) TLF-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 S1 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. The TLF-1 does not have a Band Spread Control.

7.1.6 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.

7.1.7 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.

7.1.8 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 7/8D
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" meter 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 right hand cover (cover next to meter) 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)

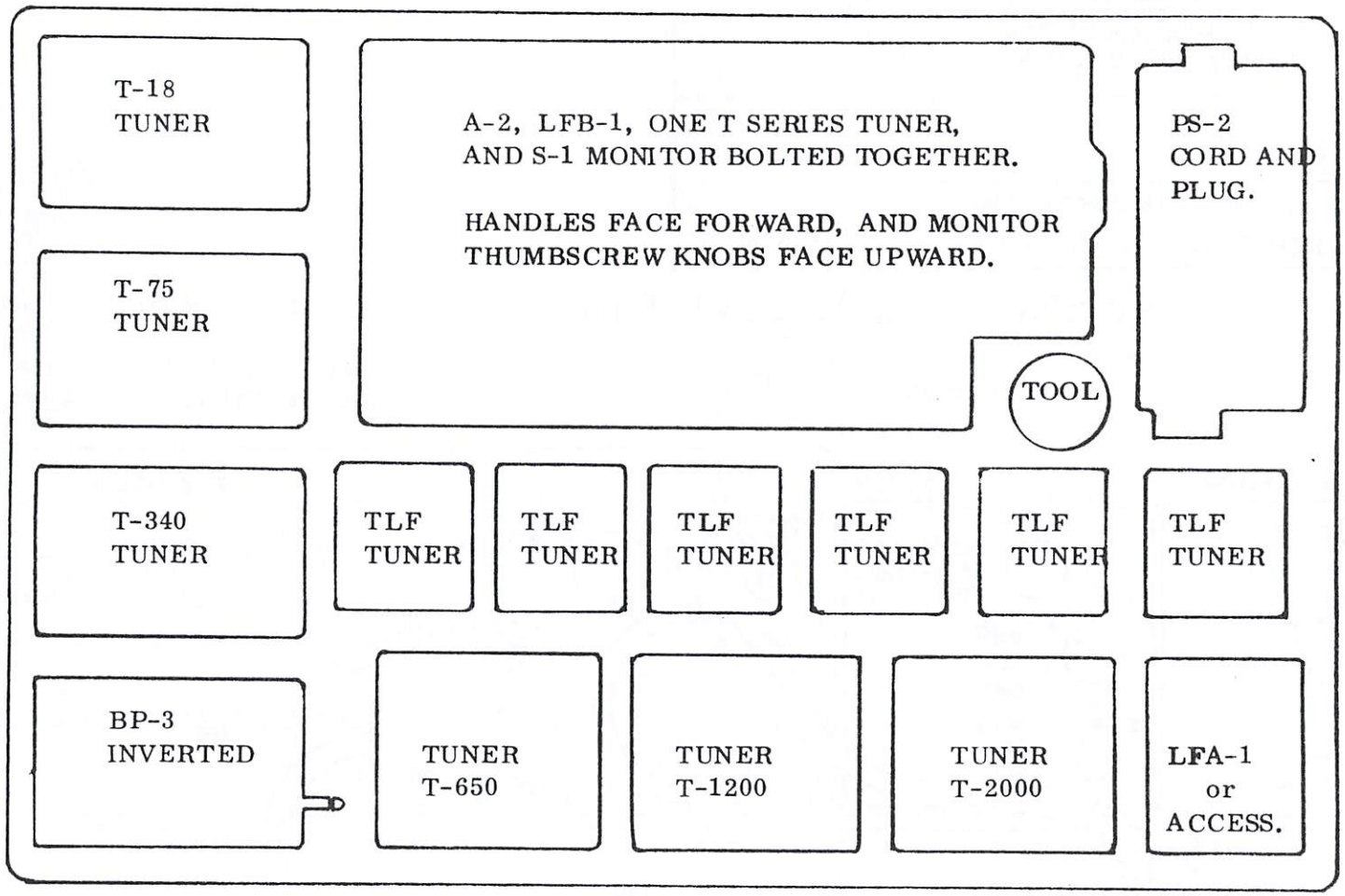
5) Replace cover and install screws. Tighten screws evenly. Test immediately by placing Low-High-Test switch to Test and turning audio control on. If meter does not read properly, remove cover to check for correct polarity and that the springs are fully down to the bottom of the holes.

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.



	MASON ENGINEERING INC. 1700 POST RD. FAIRFIELD, CONN.		
	TITLE CASE INSERT DIAGRAM		
		FIGURE 1	ISSUE

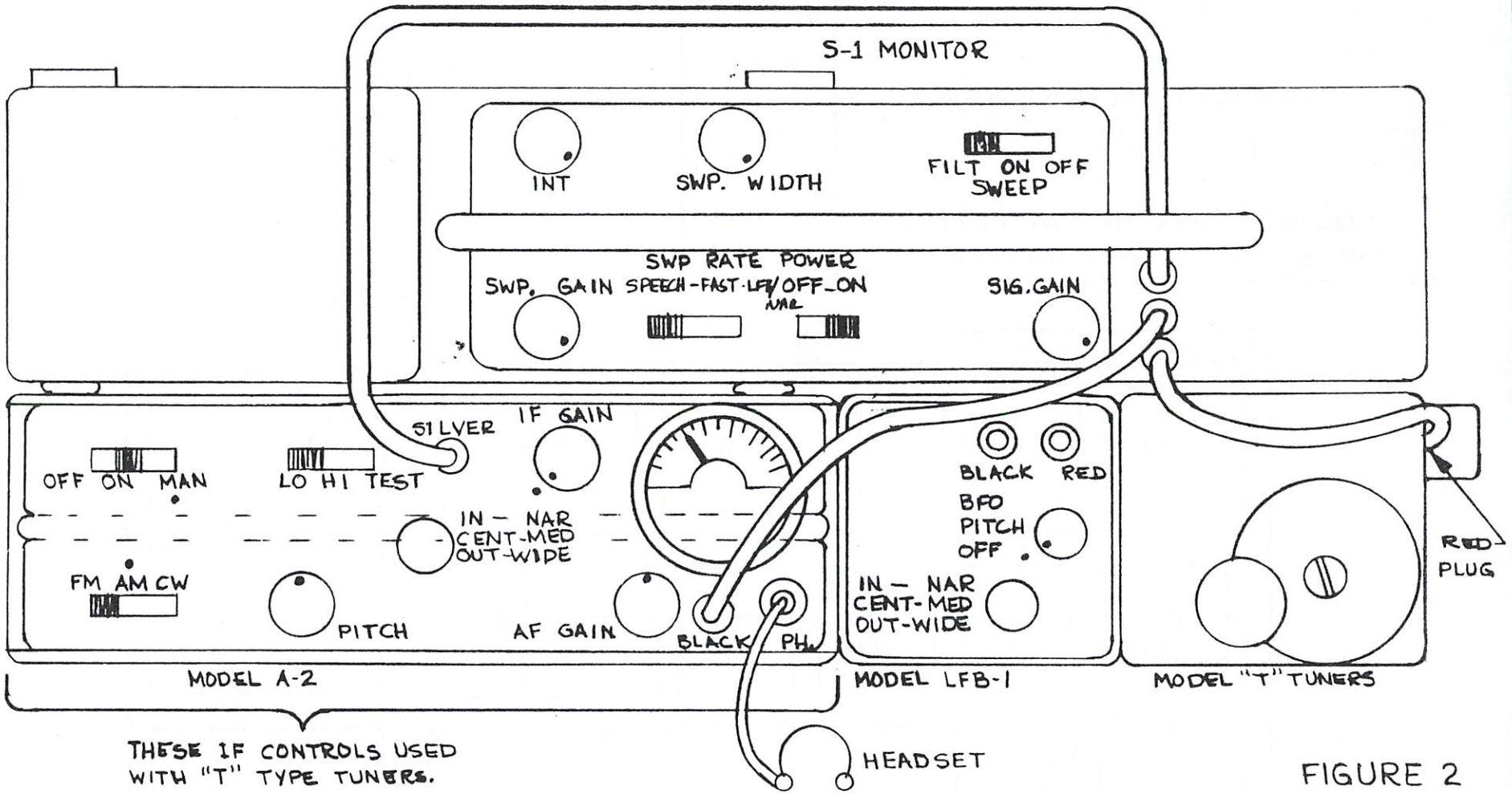


FIGURE 2

CONFIGURATION WHEN USING MODEL "T" TUNERS

TOLERANCES (EXCEPT AS NOTED)	MASON ENGINEERING INC. 1700 POST RD. FAIRFIELD, CONN.		
DECIMAL ±		SCALE 1:1	DRAWN BY S.P.M. / APPROVED BY
FRACTIONAL ±	TITLE OUTLINE DRAWING SHOWING A-2, LFB-1, "T" TUNER, AND S-1 MOUNTED TOGETHER.		
ANGULAR ±	DATE 1-19-71	DRAWING NUMBER FIGURE 2	ISSUE 1

MADE IN U. S. A.

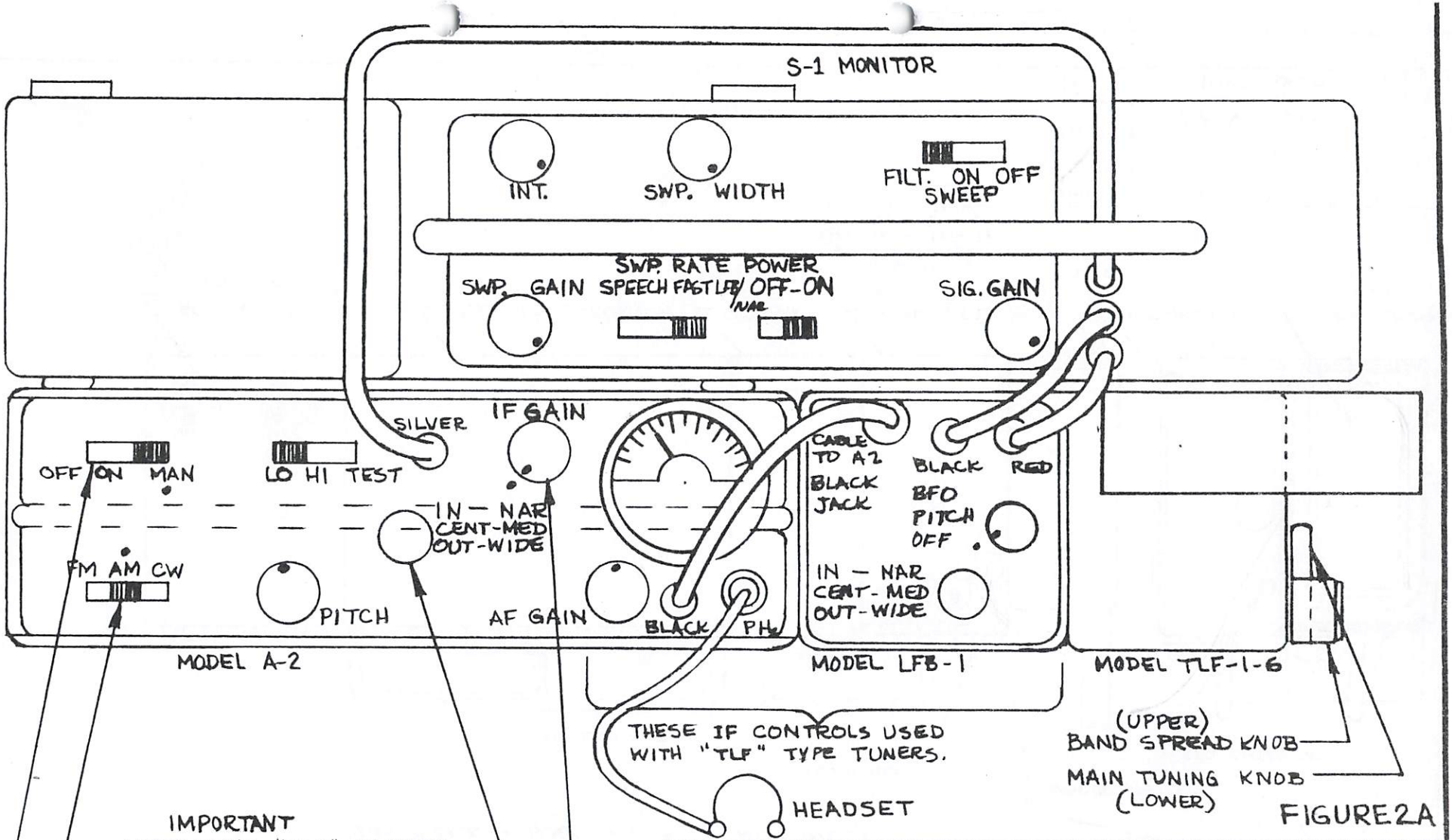
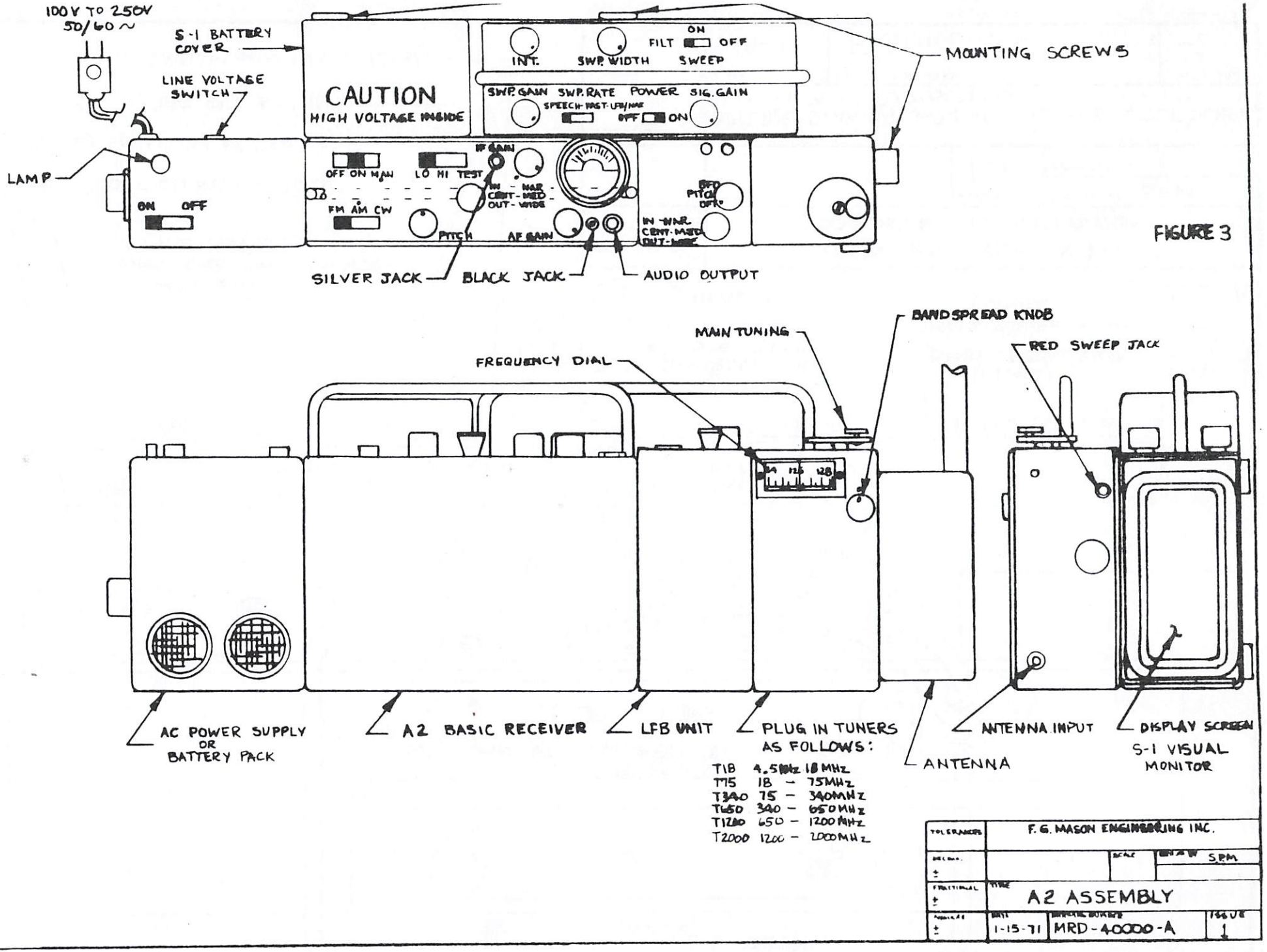


FIGURE 2A

IMPORTANT
WHEN USING "TLF" TUNERS
SET A-2 CONTROLS AS FOLLOWS:

1) OFF ON MAN AT "MAN"
2) FM AM CW AT "AM"
3) IN CENT OUT AT "IN"
4) IF GAIN AT MIN. GAIN (CCW)

TOLERANCES (EXCEPT AS NOTED)	MASON ENGINEERING INC. 1700 POST RD. FAIRFIELD, CONN.		
DECIMAL ±		SCALE 1:1	DRAWN BY S.P.M. / APPROVED BY
FRACTIONAL ±	TITLE: OUTLINE DRAWING SHOWING A-2, LFB-1, TLF TUNER, AND S-1 MOUNTED TOGETHER.		
ANGULAR ±	DATE 1-18-71	DRAWING NUMBER FIGURE 2A	ISSUE 1


100 V TO 250V
50/60 ~
S-1 BATTERY COVER
LINE VOLTAGE SWITCH
CAUTION
HIGH VOLTAGE INSIDE
ON
FILT
OFF
INT.
SWP. WIDTH
SWEEP
SWP. GAIN
SWP. RATE
POWER
SIG. GAIN
SPEECH-FAST-LFB/MAN
OFF
ON
MOUNTING SCREWS
LAMP
ON
OFF
OFF ON MAN
LO HI TEST
IF GAIN
FM AM CW
PITCH
AF GAIN
IN - NAR.
CENT - MED.
OUT - WIDE
SILVER JACK
BLACK JACK
AUDIO OUTPUT
FIGURE 3
BANDSPREAD KNOB
MAIN TUNING
RED SWEEP JACK
FREQUENCY DIAL
AC POWER SUPPLY OR BATTERY PACK
A2 BASIC RECEIVER
LFB UNIT
PLUG IN TUNERS AS FOLLOWS:
T1B 4.5MHz 18 MHz
T75 18 - 75MHz
T340 75 - 340MHz
T650 340 - 650MHz
T1200 650 - 1200MHz
T2000 1200 - 2000MHz
ANTENNA
ANTENNA INPUT
DISPLAY SCREEN
S-1 VISUAL MONITOR
F. G. MASON ENGINEERING INC.
A2 ASSEMBLY
1-15-71
MRD-40000-A
1

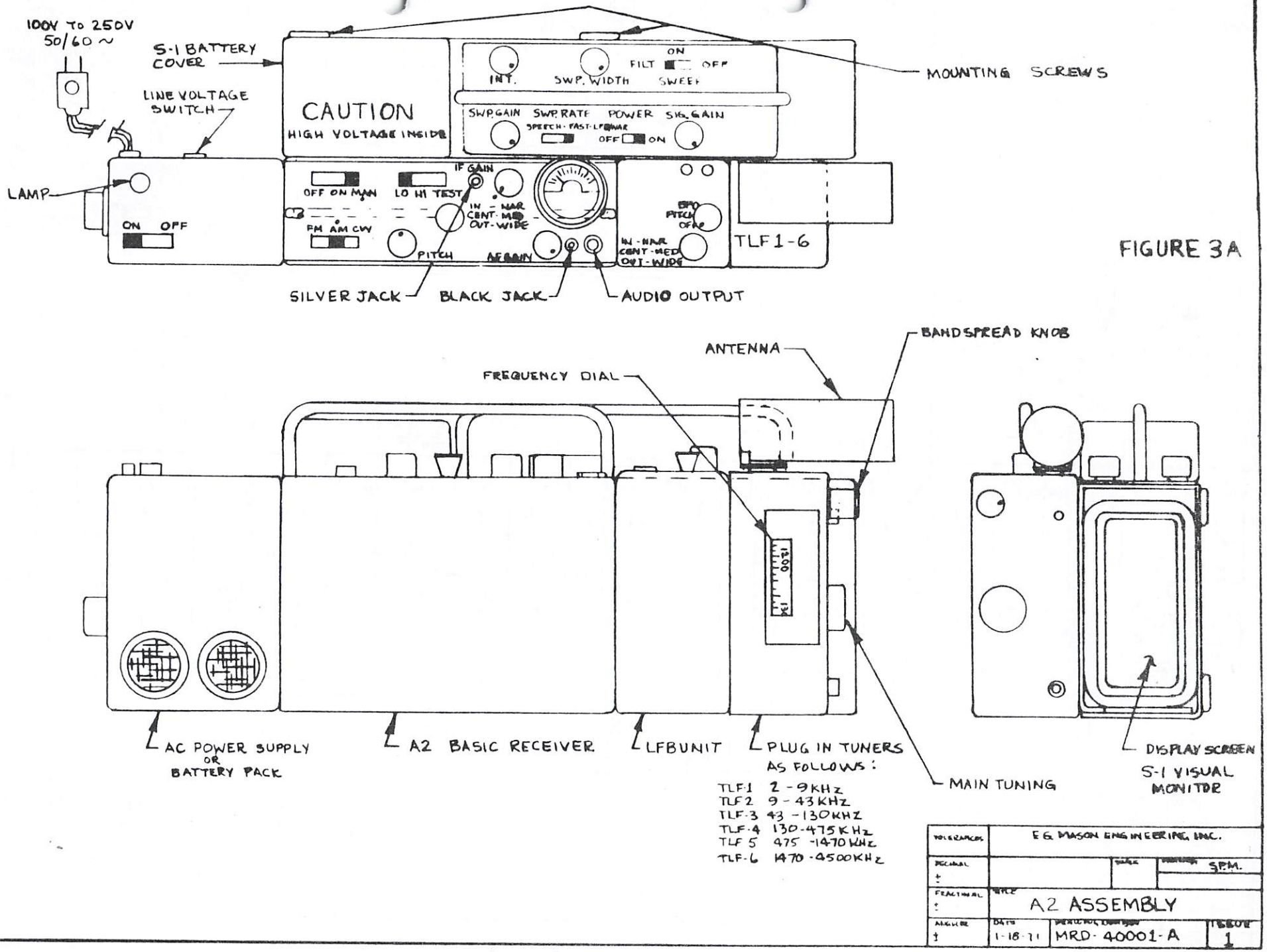
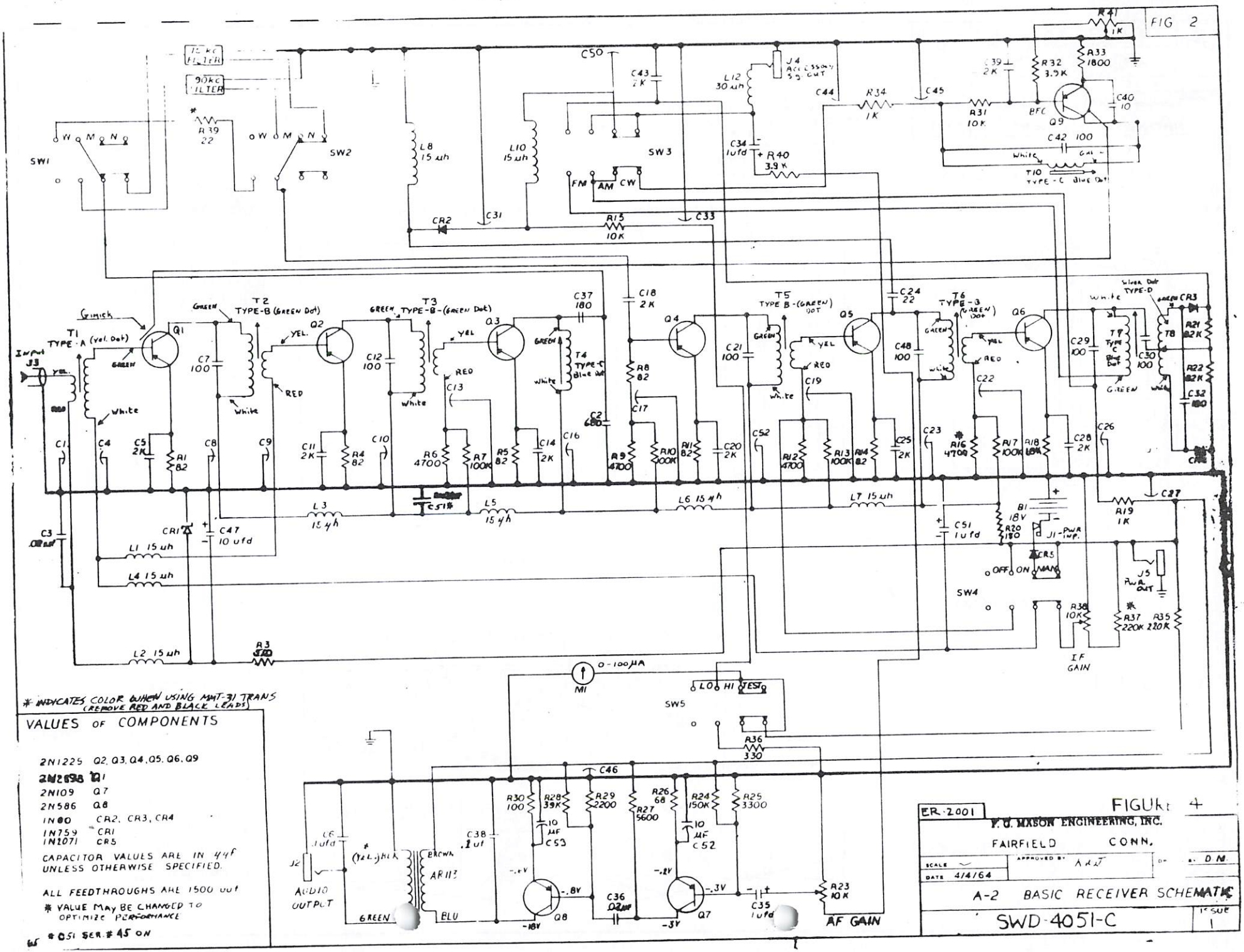


FIGURE 3A

TOLERANCES	E.G. MASON ENGINEERING, INC.		
DECIMAL ±		DRAWN	APPROVED S.P.M.
FRACTIONAL ±	SIZE A2 ASSEMBLY		
ANGULAR ±	DATE 1-18-71	DRAWING NO. MRD-40001-A	ISSUE 1

FIG 2



* INDICATES COLOR WHEN USING MMT-31 TRANS (REMOVE RED AND BLACK LEADS)

VALUES OF COMPONENTS

2N1225	Q2, Q3, Q4, Q5, Q6, Q9
2N2698	Q1
2N109	Q7
2N586	Q8
IN80	CR2, CR3, CR4
IN759	CR1
IN1071	CR5

CAPACITOR VALUES ARE IN μμf UNLESS OTHERWISE SPECIFIED.

ALL FEEDTHROUGHS ARE 1500 OUT

* VALUE MAY BE CHANGED TO OPTIMIZE PERFORMANCE

* C51 SER. # 45 ON

FIGURE 4

ER-2001

P. O. MASON ENGINEERING, INC.

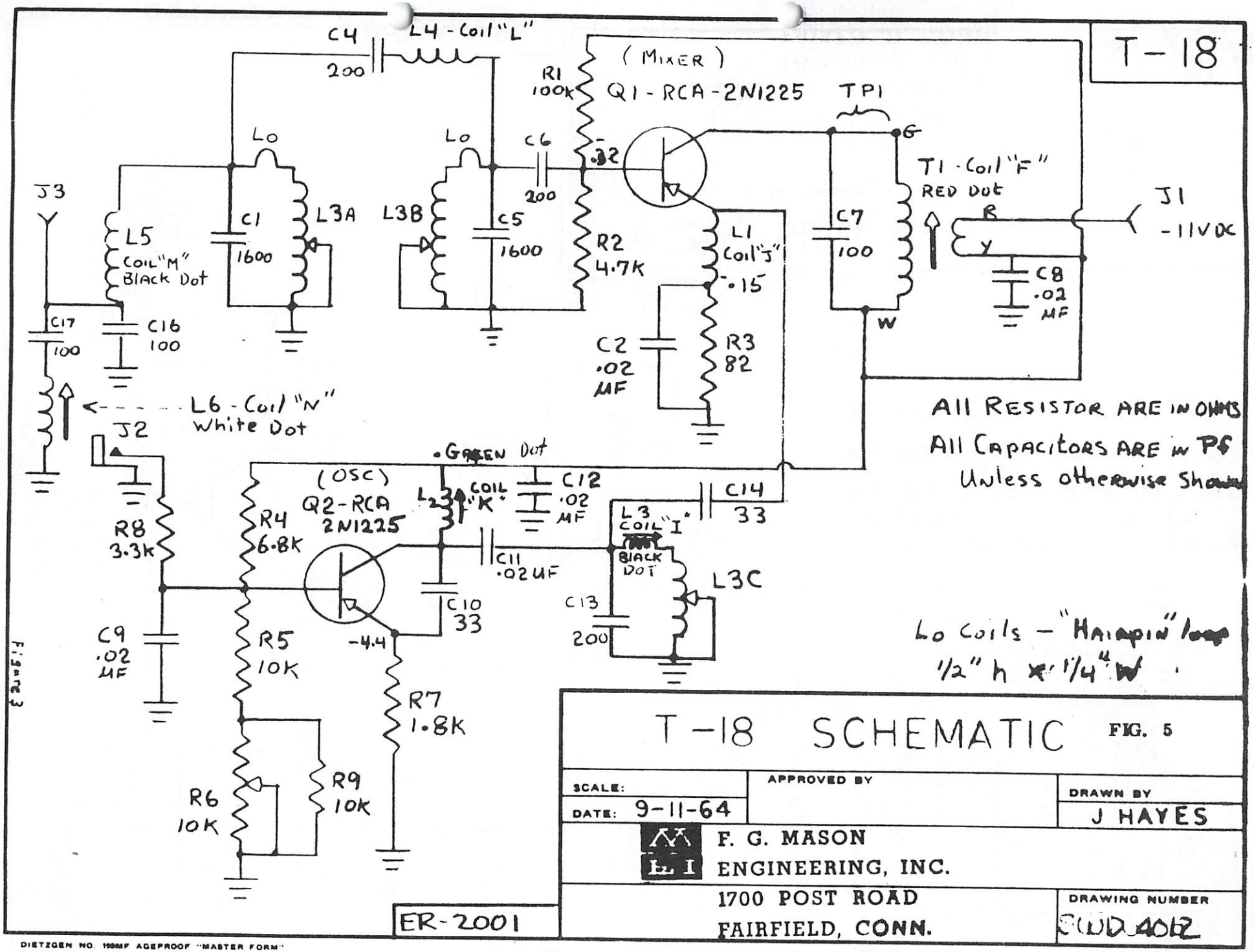
FAIRFIELD CONN.

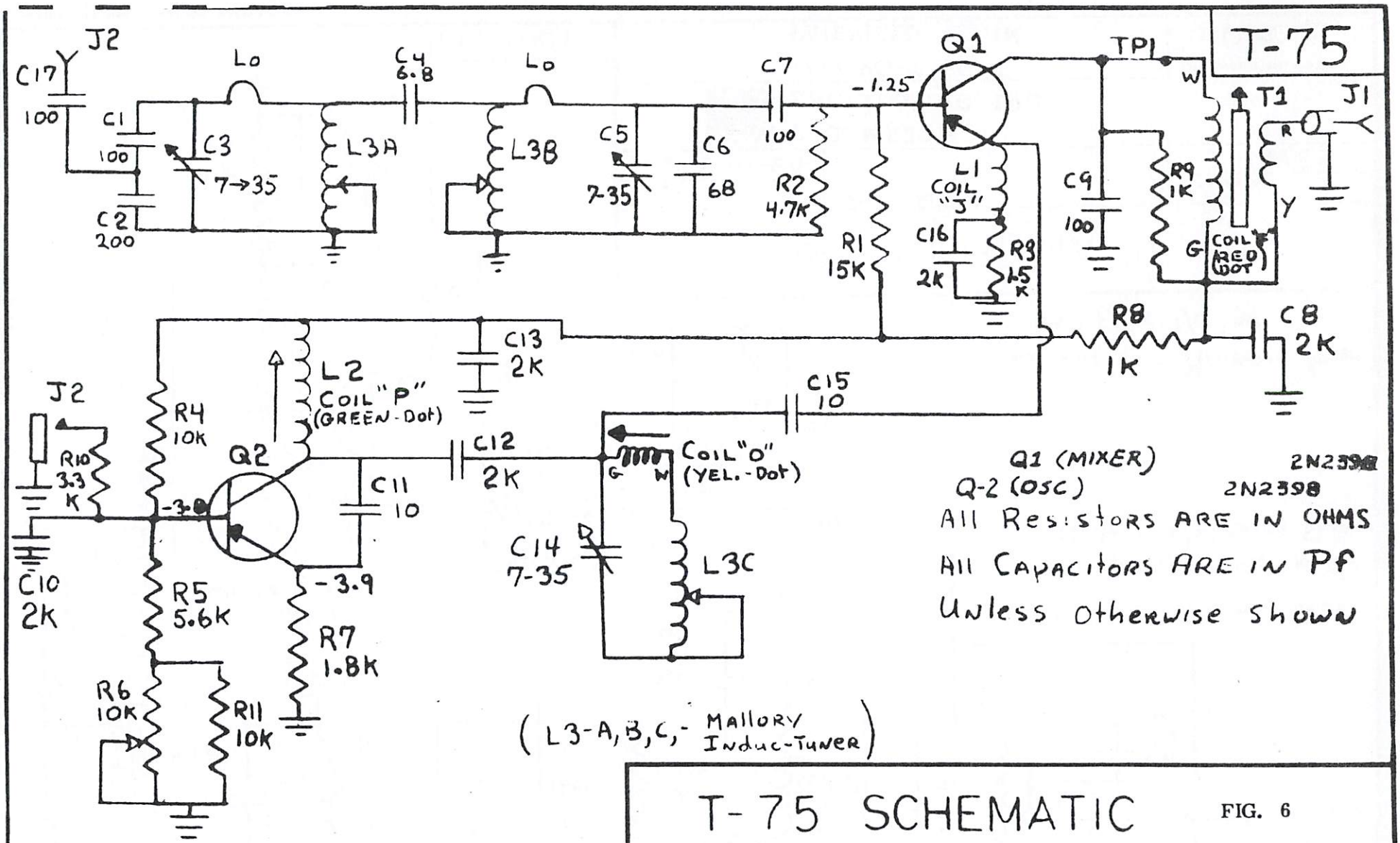
SCALE ~ APPROVED BY A.A.J. BY D.M.

DATE 4/4/64

A-2 BASIC RECEIVER SCHEMATIC

SWD-4051-C ISSUE 1





T-75 SCHEMATIC

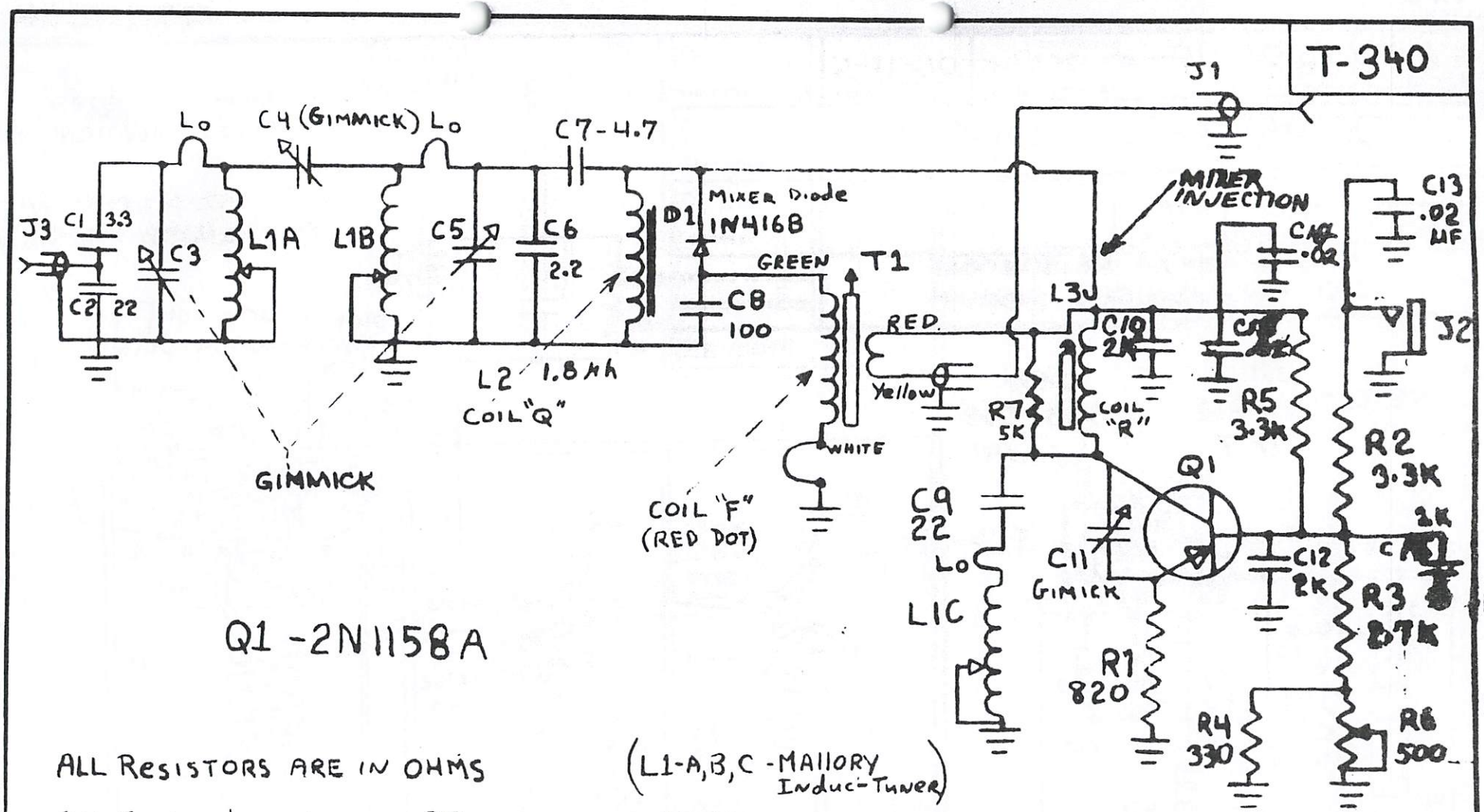
FIG. 6

SCALE:	APPROVED BY	DRAWN BY
DATE: 9-11-64		J. HAYES

F. G. MASON ENGINEERING, INC.
1700 POST ROAD
FAIRFIELD, CONN.

DRAWING NUMBER SWD 40F3-A

FR-2001



MASON ENGINEERING INC.
1700 POST RD. FAIRFIELD. CONN.

FIG. 7

SCALE:	APPROVED BY	DRAWN BY
DATE: 9-10-64		J. HAYES

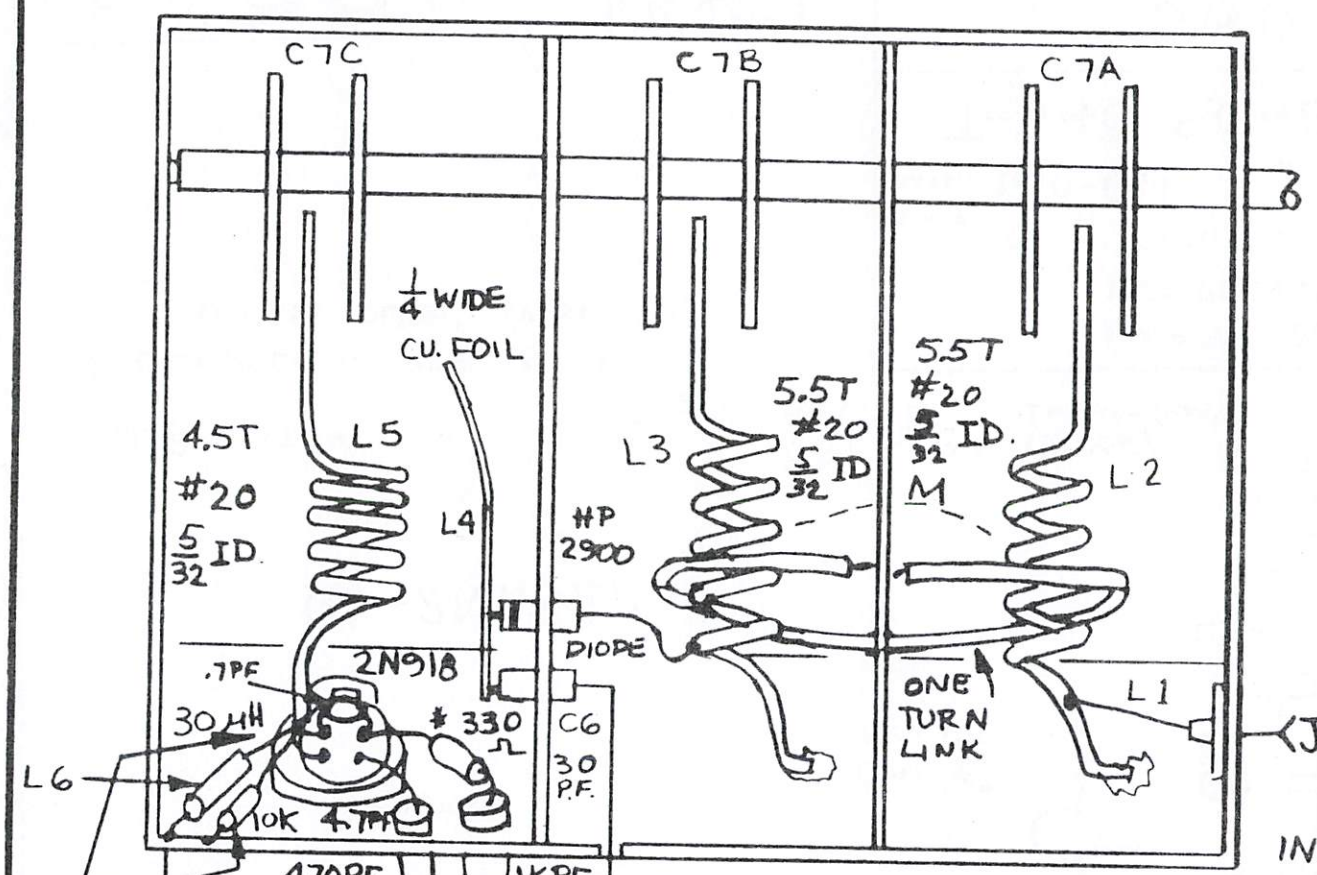
T-340 SCHEMATIC DIAGRAM

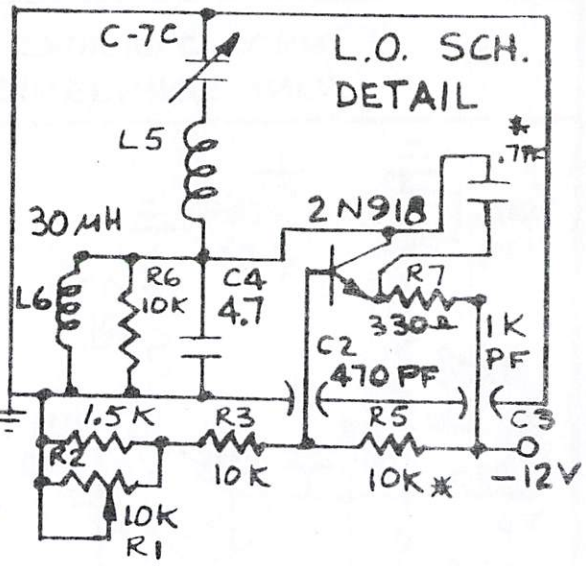
SWD-4014-A

ISSUE 2

67-71	SEE ER-515		ER-2001

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
6 24 71		SEE ER-525			FB





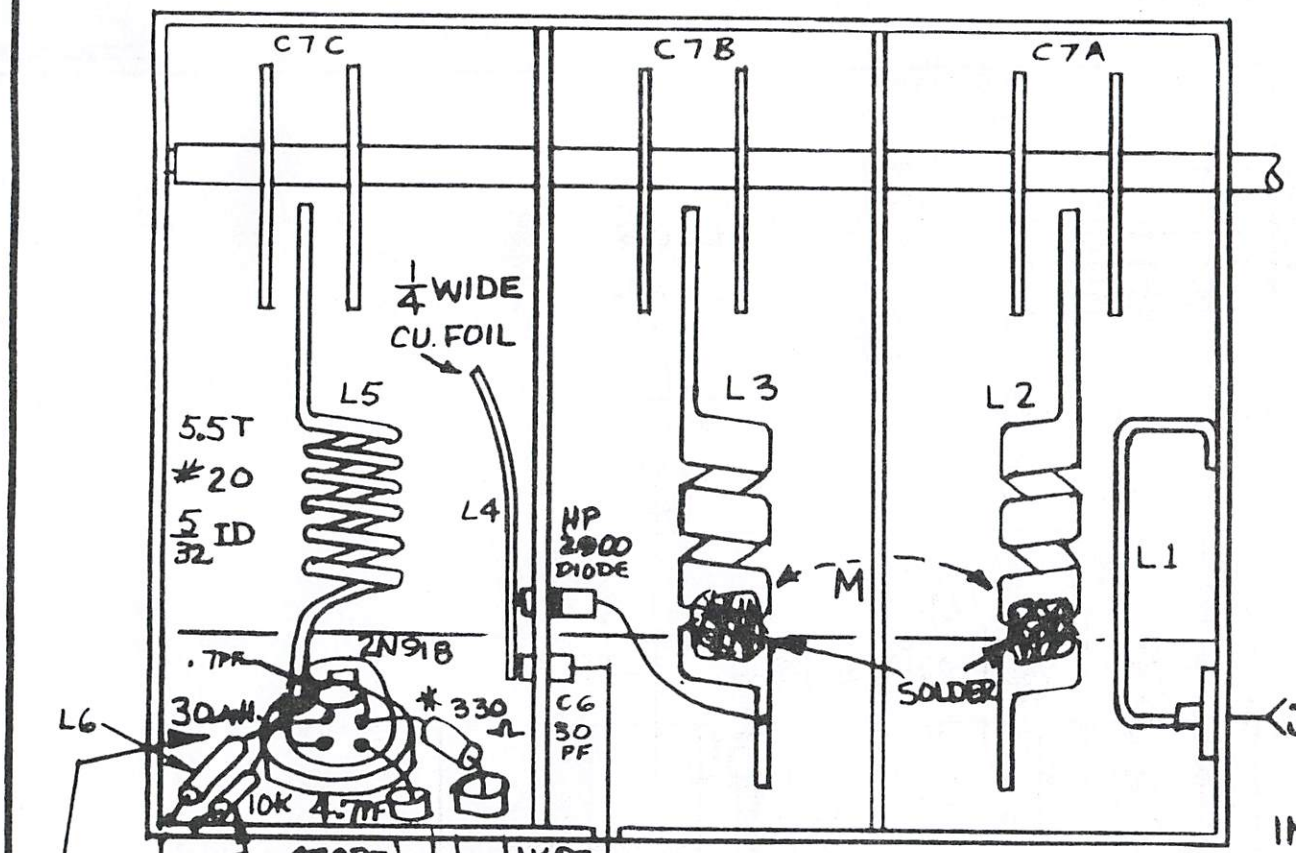
INPUT
340-650
MHZ

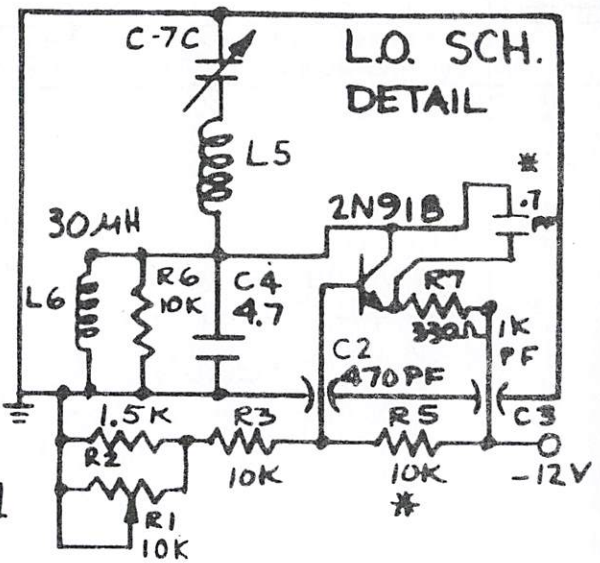
L.O.
373.5-672.35
MHZ

ER-2001

TOLERANCES (EXCEPT AS NOTED)	MASON ENGINEERING INC. 1700 POST RD. FAIRFIELD, CONN.			
DECIMAL ±		SCALE NONE	DRAWN BY S.P.M.	
			APPROVED BY	
FRACTIONAL ±	TITLE T650 SCHEMATIC			
ANGULAR ±	DATE 5-11-70	DRAWING NUMBER FIG-8 ◆ SWD-4072-A		ISSUE 2

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
6 29 -71		SEE ER-525			FB





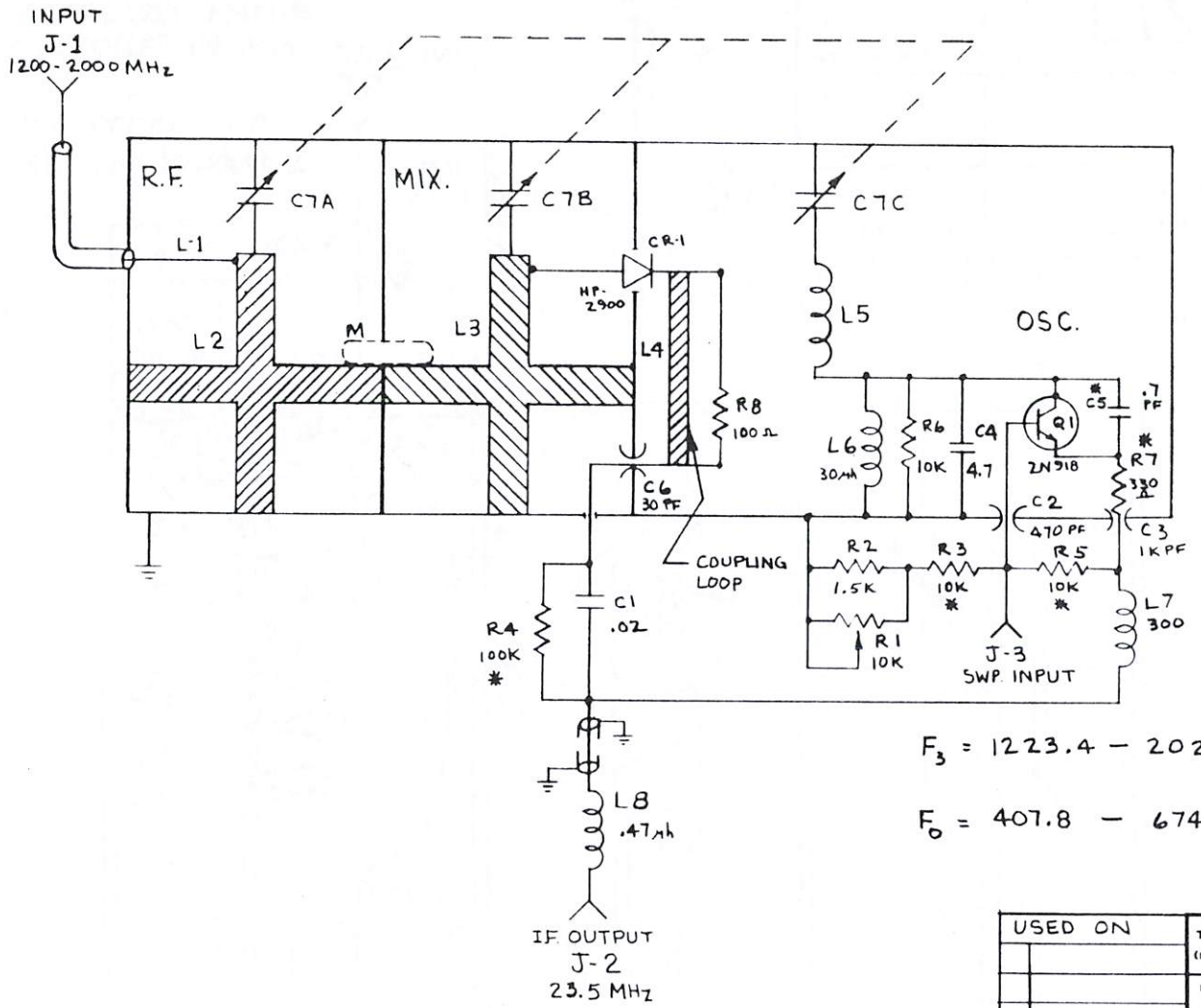
INPUT 650-1200 MHZ

L.O. f_2 673.5 - 1223.5
f_o 336.75 - 611.75

ER-2001

TOLERANCES (EXCEPT AS NOTED)	MASON ENGINEERING INC. 1700 POST RD. FAIRFIELD, CONN.		
DECIMAL ±		SCALE NONE	DRAWN BY S.P.M.
FRACTIONAL ±	TITLE T1200 SCHEMATIC		APPROVED BY
ANGULAR ±	DATE 5-11-70	DRAWING NUMBER FIG-9 ◇ SWD-4071-A	ISSUE 1

DATE	BY	REVISION RECORD	AUTH	DR	CK



F_3 = 1223.4 – 2023.5

F_o = 407.8 – 674.5

NOTE÷

1) "*" INDICATES FACTORY SELECTED VALUE.

FIG. 10

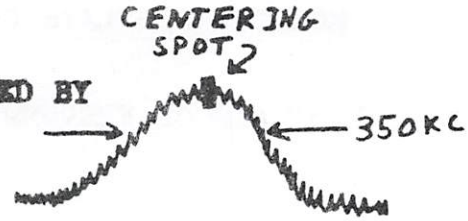
USED ON	TOLERANCES (EXCEPT AS NOTED)	MASON ENGINEERING INC. 1700 POST RD. FAIRFIELD, CONN.		
	DECIMAL ±		SCALE	DRAWN BY S.P.M.
				APPROVED BY
	FRACTIONAL ±	TITLE SCHEMATIC WIRING DIAGRAM T-2000		
ER-2001	ANGULAR ±	DATE 9-16-70	DRAWING NUMBER SWD-4019-B	ISSUE 1

FIGURE 11A

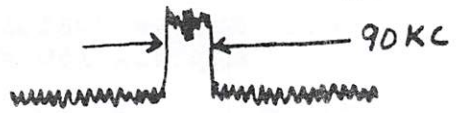
MONITOR DISPLAYS:

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

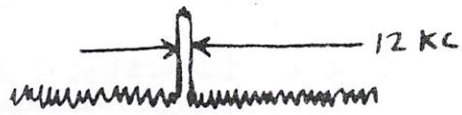
1.1 Wide position, AM, Max. sweep width-



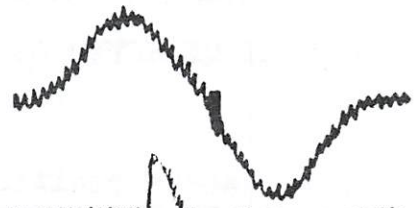
1.2 Medium " " " " " -



1.3 Narrow " " " " " -



1.4 Wide position, FM, Max. sweep width-



1.5 Medium " " " " " -

1.6 Narrow position, AM, ½ sweep width -

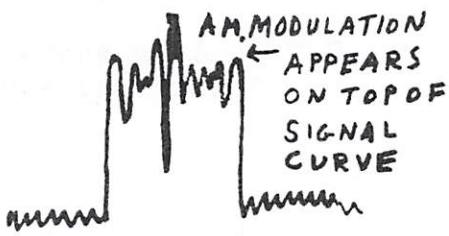
2) **DISPLAYS OF TWO CONTINUOUS WAVE SIGNALS 15 Ko. APART.**

2.1 Wide position, AM, Max. sweep width-

2.2 Medium position, " " " " -

2.3 Narrow position, AM, ½ sweep width -

3) **DISPLAYS OF AMPLITUDE MODULATED CARRIER.**



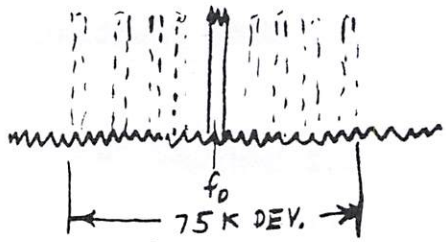
3.1 Medium position, AM, sweep on -
(To listen, center spot on curve)

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

FIGURE 11B

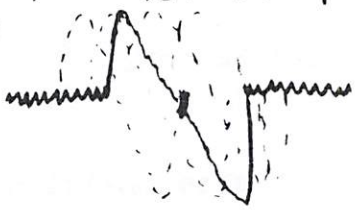
MONITOR DISPLAYS CONTINUED:

4) DISPLAYS OF FREQUENCY MODULATED CARRIER.(75 Kc. Deviation)(F_o150mc.)



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

4.2 Listening purposes, Medium position, sweep rate slow, ½ sweep width. (place center spot on crossover.)



5) DISPLAY OF KEYED CONTINUOUS WAVE SIGNAL.

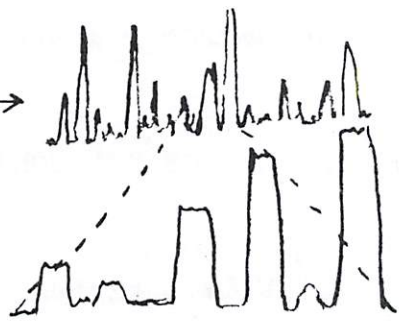
5.1 Narrow position, AM, ½ sweep width fast rate. Curve intermittently appears and disappears as keyed.

6) DISPLAYS OF CROWDED SIGNAL AREAS.

18 SIGNALS SHOWING →

6.1 Narrow position, Max. sweep width, AM-

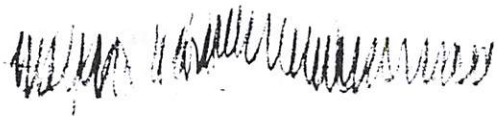
6.2 Center area of above signals expanded by lowering the sweep width.



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.

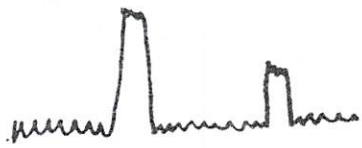
FIGURE 11C

MONITOR DISPLAYS CONTINUED:

8) HIGH LEVEL SIGNAL DISPLAYS.

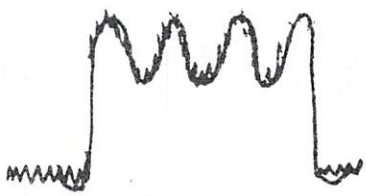
8.1 Narrow position, AM, Max. signal gain-

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

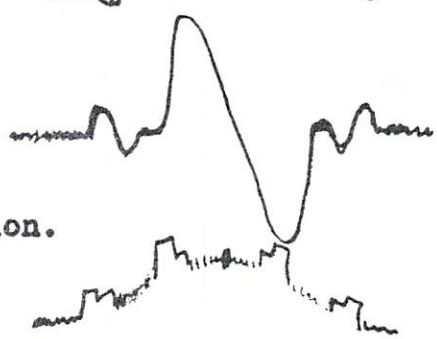


9) SOME OTHER TYPICAL DISPLAYS.

9.1 Carrier with single tone modulatinn (AM)-



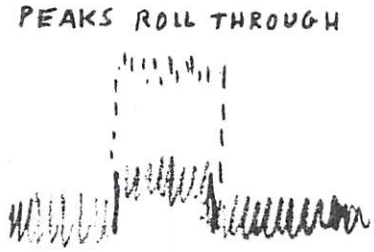
9.2 FM MULTIPLEX, receiver in FM position-



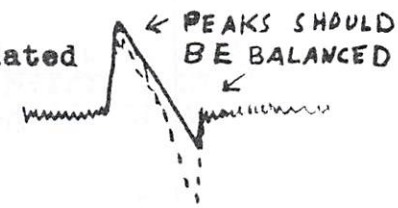
9.3 Television picture carrier with modulation. Receiver in AM, Wide, Max sweep width.

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.)

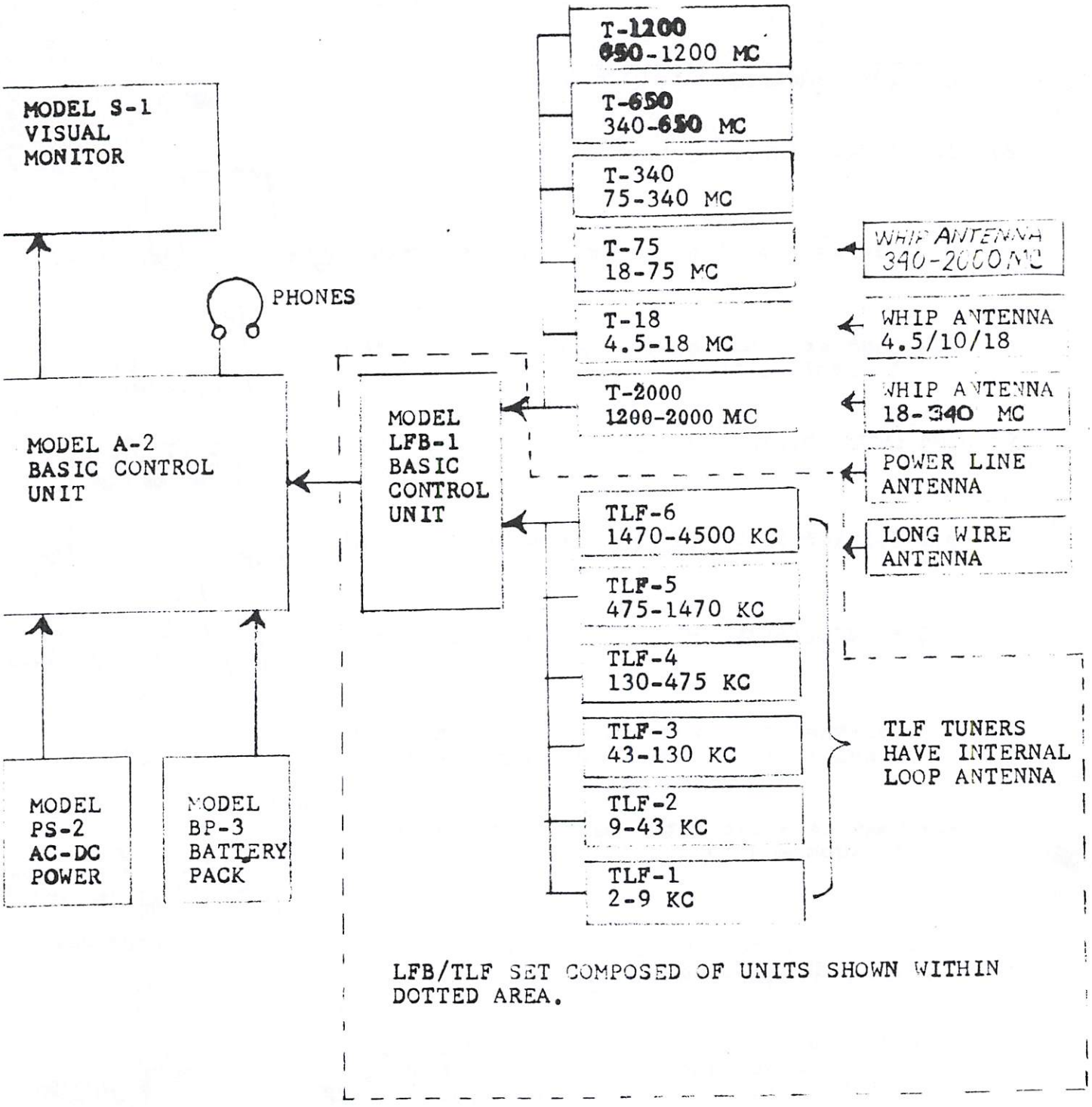


10.1 Medium position, AM, 5 uv signal applied at antenna unmodulated. Noise shows gain OK but signal to noise ratio poor. TUNER or first stage IF is defective.



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

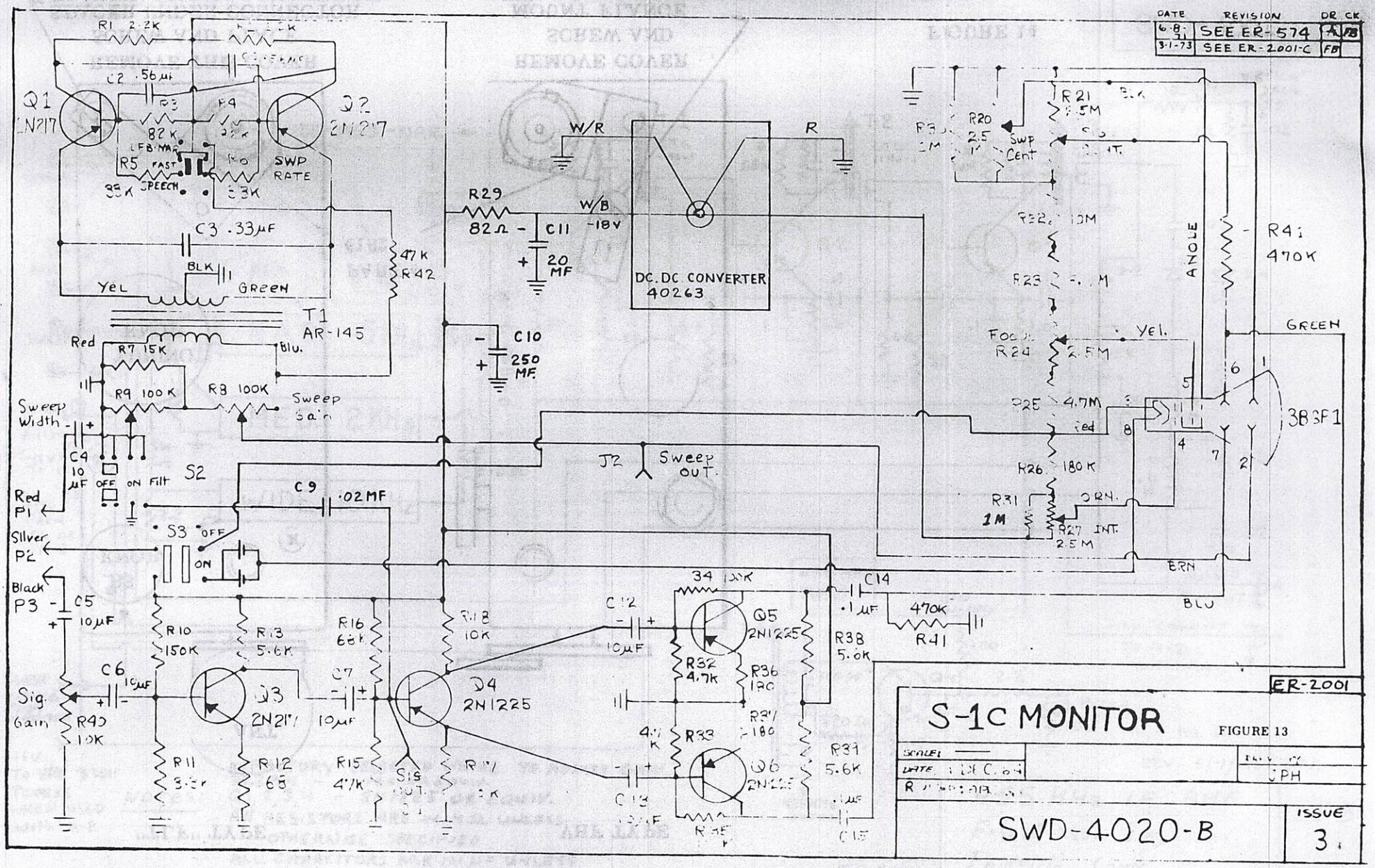
10.3 Medium position, AM, 5 uv signal, unmodulated shows IF amplifier strip missaligned. Tune T-2 through T-6 for correct curve.



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


DATE
REVISION
DR CK
6-8-71
SEE ER-574
A
3-1-73
SEE ER-2001-C
FB
R1 2.2K
C2 .56µf
Q1
2N217
Q2
2N217
R3
82K
R4
R5 FAST SPEECH
SWP RATE
C3 .33µF
47K R42
BLK
YEL
GREEN
T1
AR-145
Red
R7 15K
Blu.
R9 100K
R8 100K
Sweep Width
Sweep Gain
C4 10 µF
OFF ON FILT
S2
Red P1
Silver P2
Black P3
S3 OFF ON
C5 10µF
C6 10µF
Sig. Gain
R40 10K
R10 150K
R11 3.3K
Q3 2N217
R12 68
R13 5.6K
C7 10µF
R15 4.7K
R16 68K
S1B OUT
R17 2K
R18 10K
Q4 2N1225
C9 .02MF
R29 82Ω
C11 20 MF
W/B -18V
W/R
R
DC.DC CONVERTER 40263
C10 250 MF.
J2 Sweep OUT.
R20 2.5M
Swp Cent
R21 2.5M
R22 1M
R23 2.5M
ANGLE
R40 470K
Foc. R24 2.5M
Yel.
GREEN
R25 4.7M
Red
R26 180K
R31 1M
ORN.
R27 INT. 2.5M
3BP1
BRN
BLU
C12 10µF
34 10K
Q5 2N1225
R32 4.7K
R36 120
R37 180
R33 4.7K
Q6 2N1225
R38 5.6K
R39 5.6K
C13
C14 .1µF
470K R41
C15
ER-2001
S-1C MONITOR
FIGURE 13
SCALE:
DATE: 12 C. 64
DRAWN BY JPH
SWD-4020-B
ISSUE 3

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

"TLF" TYPE

VHF TYPE

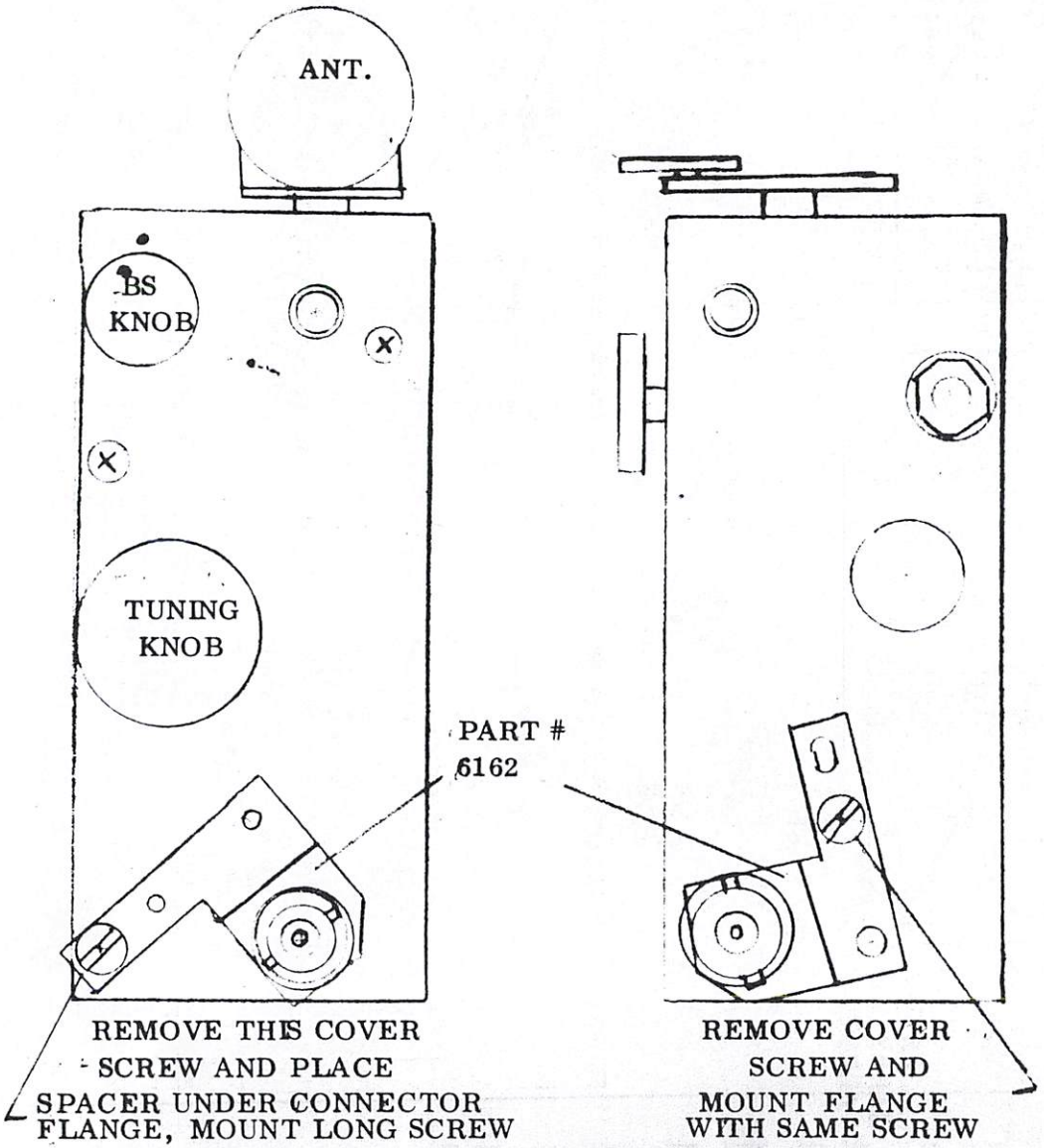


FIGURE 14

SWD-4001

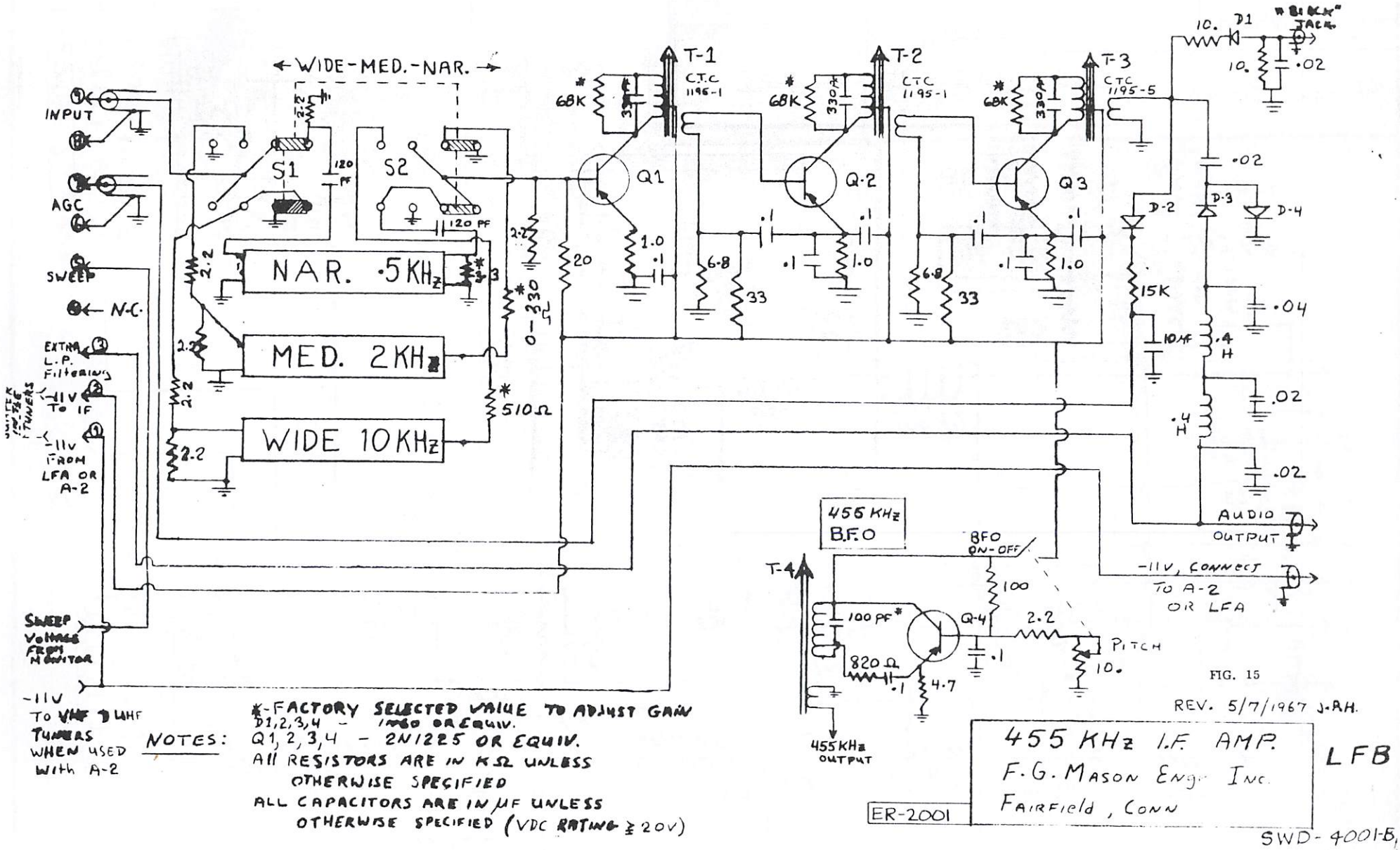


FIG. 15

NOTES:

*-FACTORY SELECTED VALUE TO ADJUST GAIN

D1,2,3,4 - 1N60 OR EQUIV.

Q1,2,3,4 - 2N1225 OR EQUIV.

ALL RESISTORS ARE IN KΩ UNLESS OTHERWISE SPECIFIED

ALL CAPACITORS ARE IN μF UNLESS OTHERWISE SPECIFIED (VDC RATING ≥ 20V)

REV. 5/7/1967 J.R.H.

455 KHz I.F. AMP.

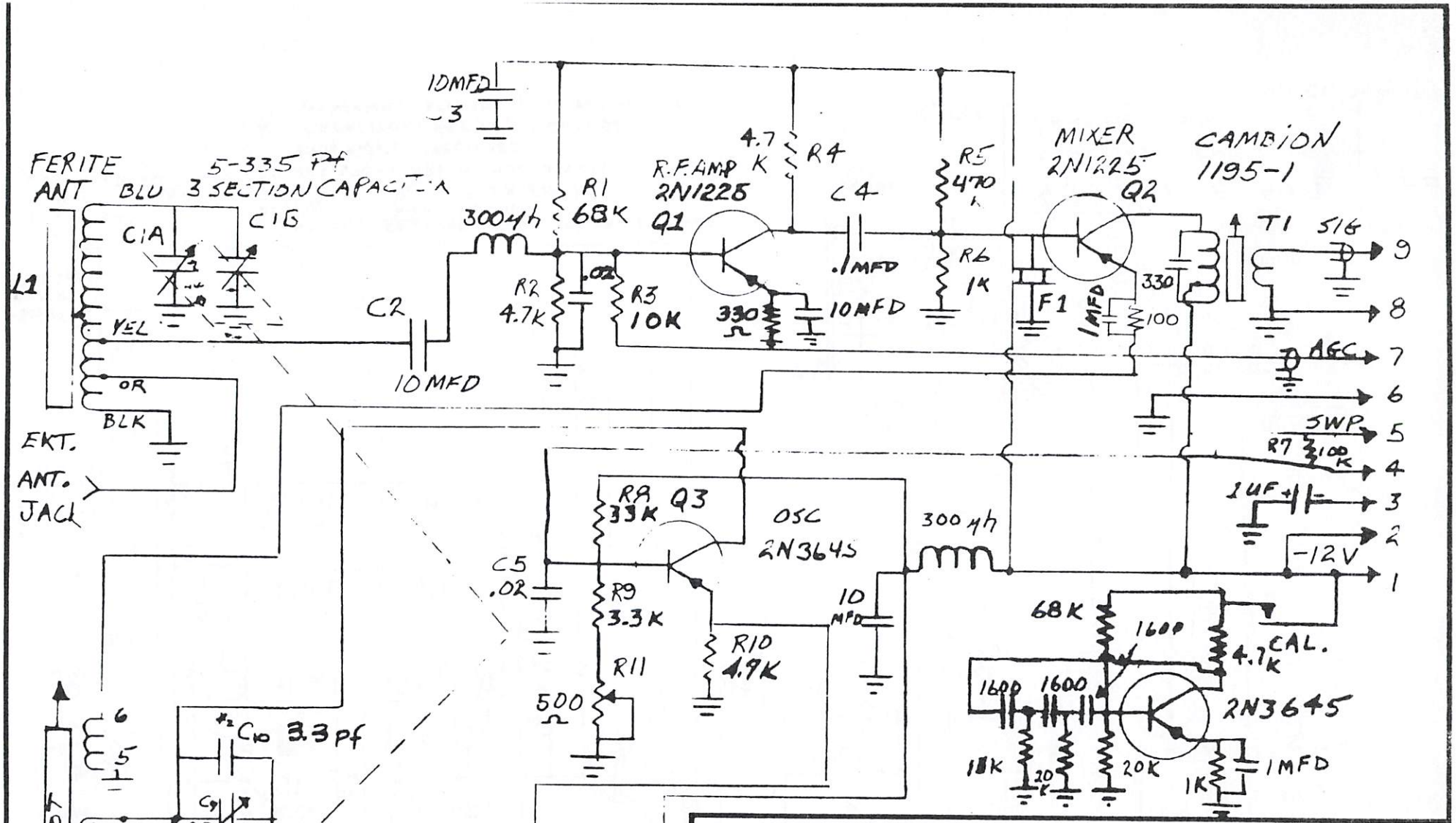
F.G. MASON ENG. INC.

FAIRFIELD, CONN

LFB

ER-2001

SWD-4001-B



TLF-1 SCHEMATIC DIAGRAM

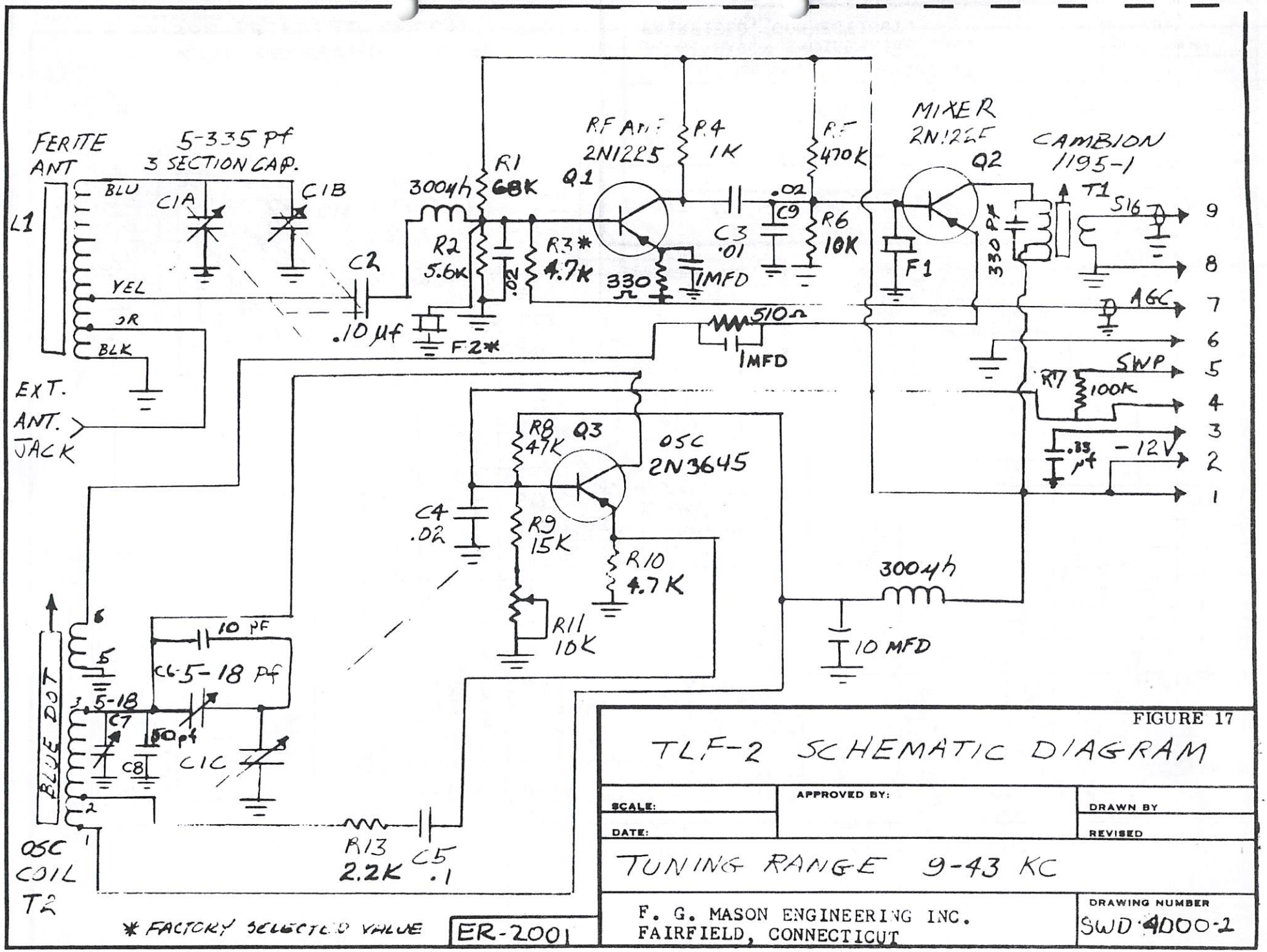
FIG. 16

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED

TUNING RANGE 2-9 KC

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

DRAWING NUMBER
SWD 4000-1



8½ X 11 PRINTED ON NO. 1000H CLEARPRINT

* SER. NO. 30 # ON

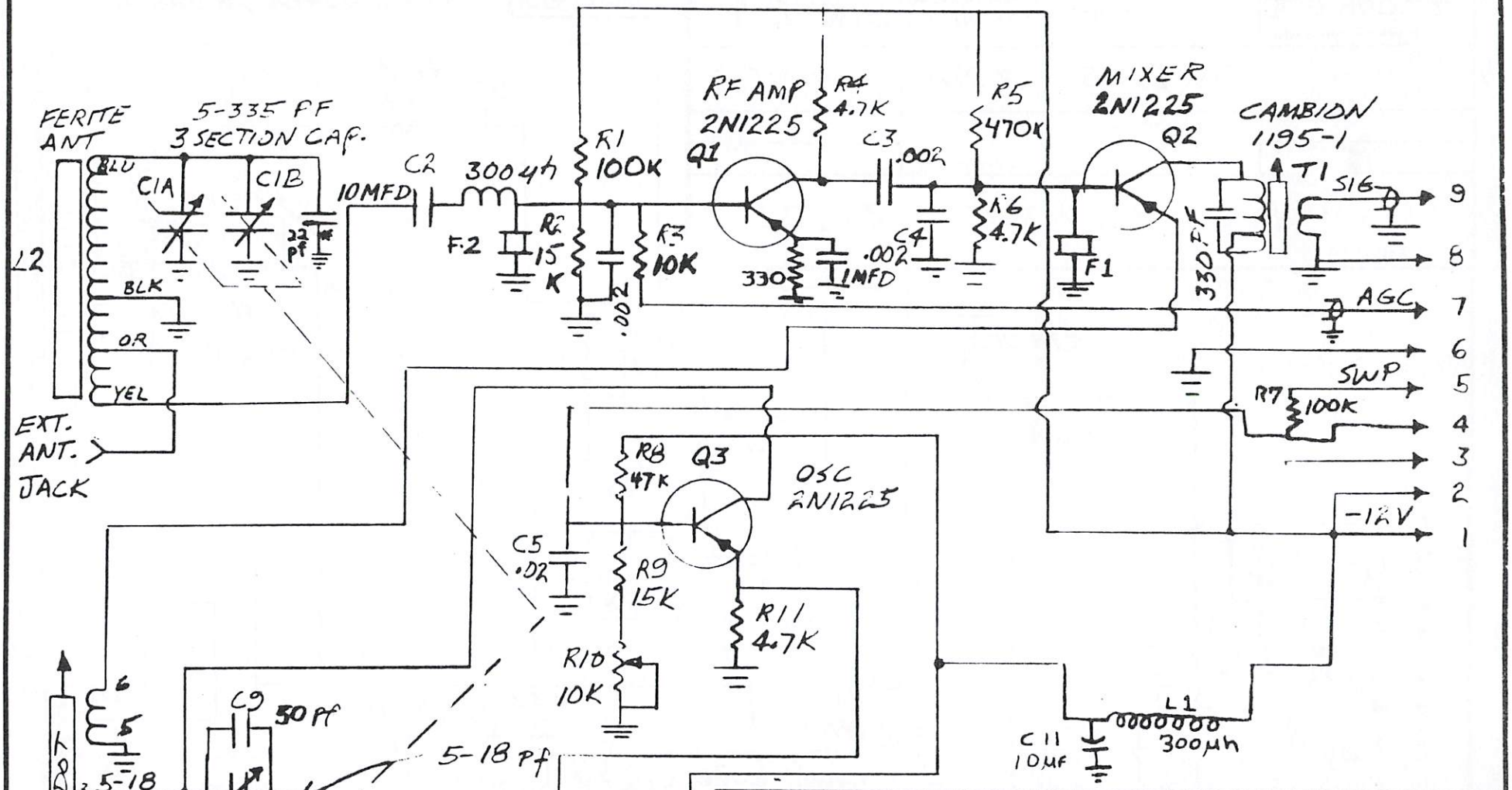


FIGURE 18

TLF-3 SCHEMATIC DIAGRAM

SCALE:	APPROVED BY:	DRAWN BY
DATE:		REVISED

TUNING RANGE 43-130 K

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

DRAWING NUMBER
SWD 4000-3

* FACTOR SELECTED VALUE

8½ X 11 PRINTED ON NO. 1000H CLEARPRINT

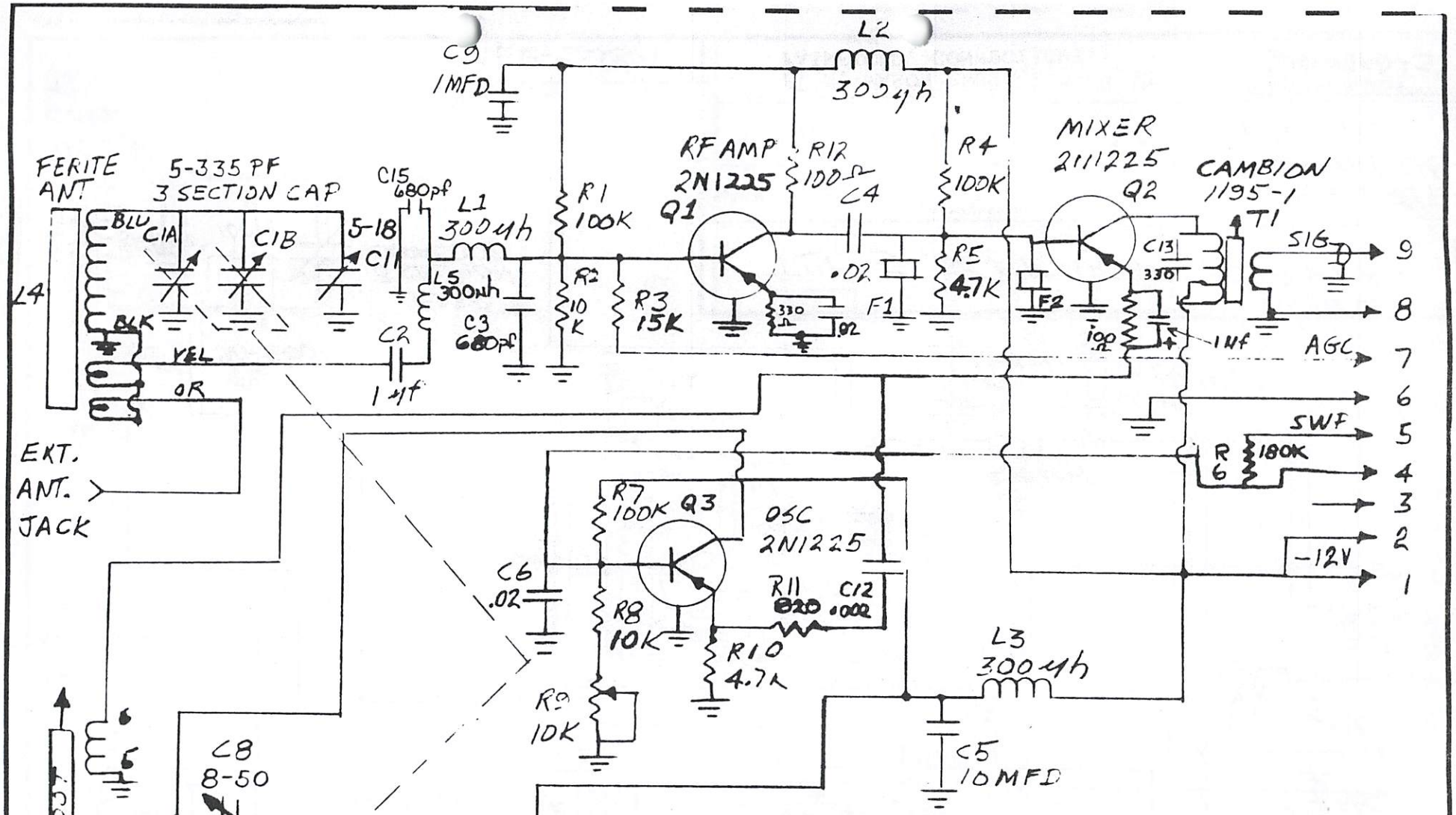


FIGURE 19

TLF-4 SCHEMATIC DIAGRAM

SCALE:	APPROVED BY:	DRAWN BY RH
DATE:		REVISED 12/30/66

TUNING RANGE 130 - 475 KC

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

DRAWING NUMBER
SWD 4000-4

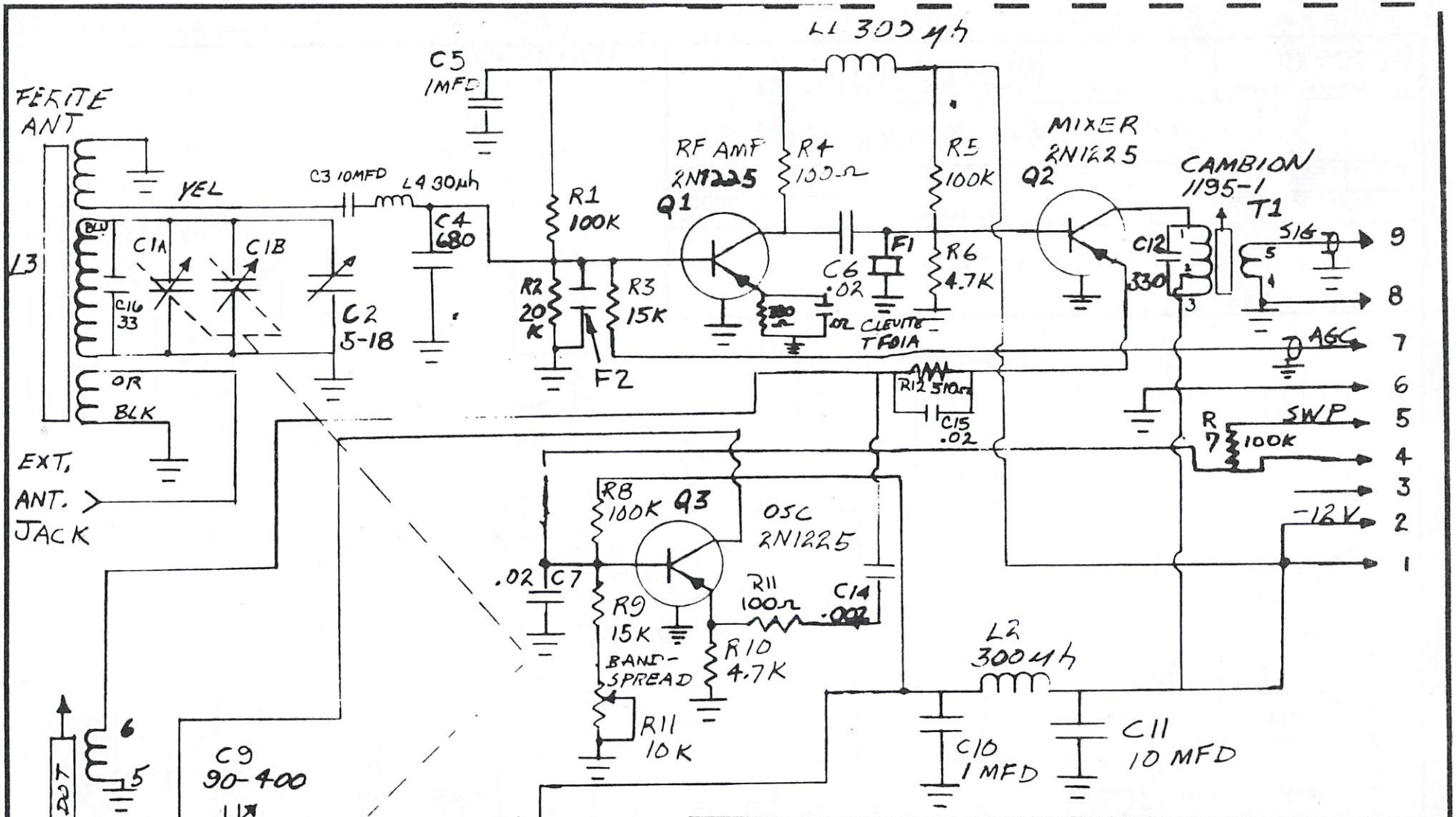


FIGURE 20

TLF-5 SCHEMATIC DIAGRAM

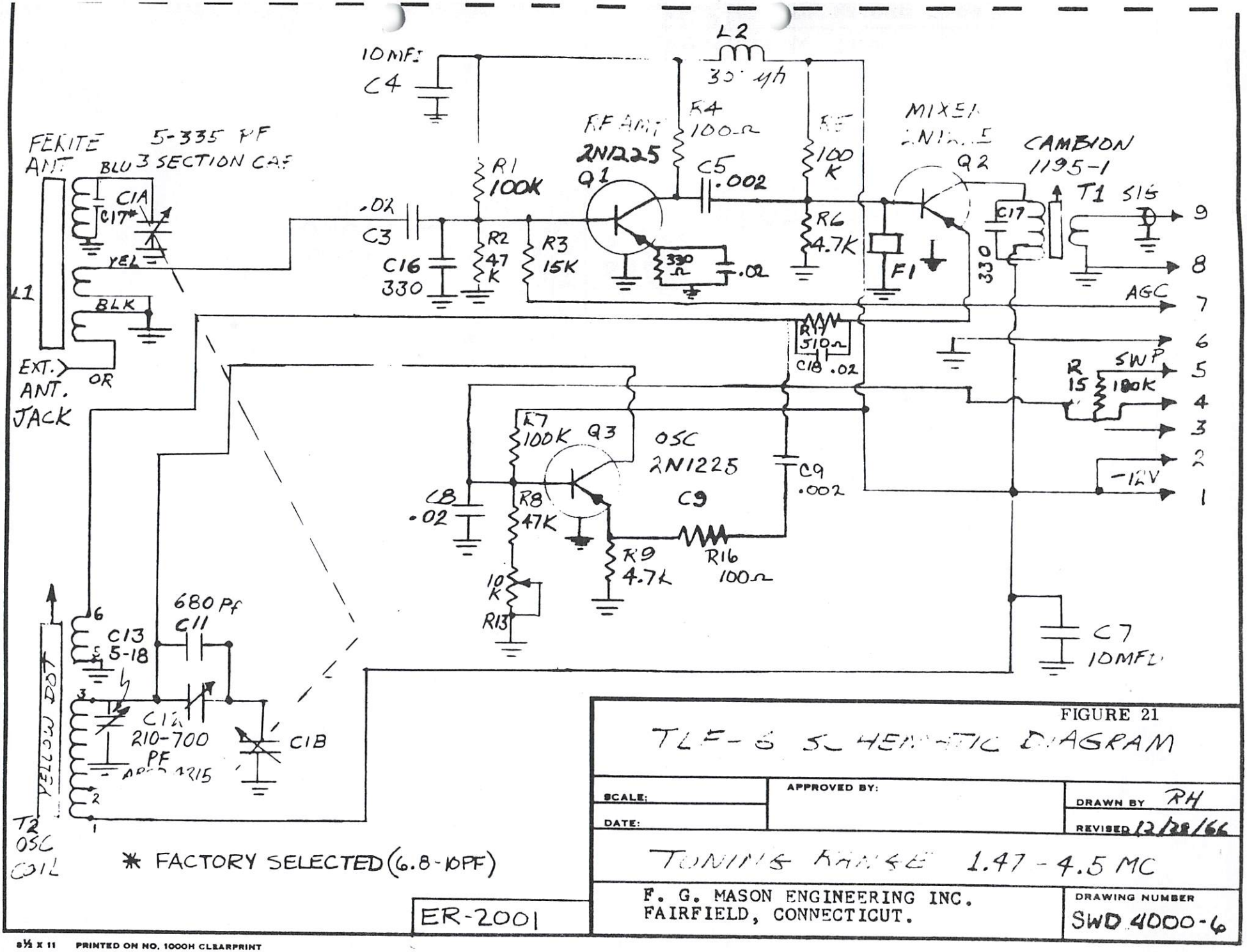
SCALE:	APPROVED BY:	DRAWN BY:
DATE:		REVISED 12 by 166

TUNING RANGE 475 - 1470 KC

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

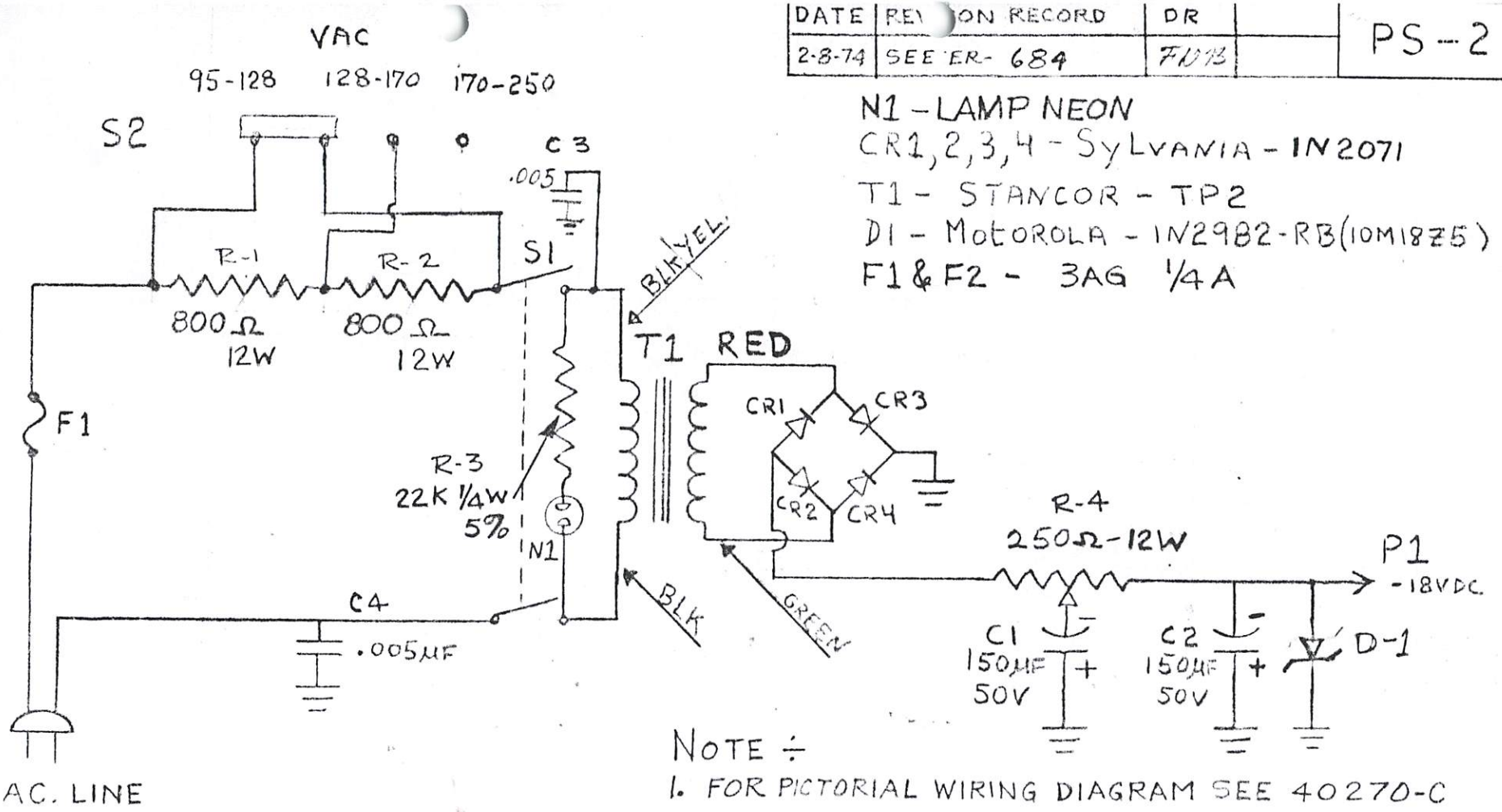
DRAWING NUMBER SWD 4000-5

ER-2001



8½ X 11 PRINTED ON NO. 1000H CLEARPRINT

DATE	REVISION RECORD	DR		PS-2
2-8-74	SEE ER- 684	FDB		



N1 - LAMP NEON
CR1,2,3,4 - SYLVANIA - 1N2071
T1 - STANCOR - TP2
D1 - MOTOROLA - 1N2982-RB(10M18Z5)
F1 & F2 - 3AG 1/4A

NOTE :
1. FOR PICTORIAL WIRING DIAGRAM SEE 40270-C

MASON ENGINEERING INC.
1700 POST RD. FAIRFIELD, CONN.

FIGURE 22

SCALE:	APPROVED BY	DRAWN BY
DATE: 9-12-64	KJ	J HAYES

POWER SUPPLY

SWD-4067-A

ISSUE 2

ER-2001

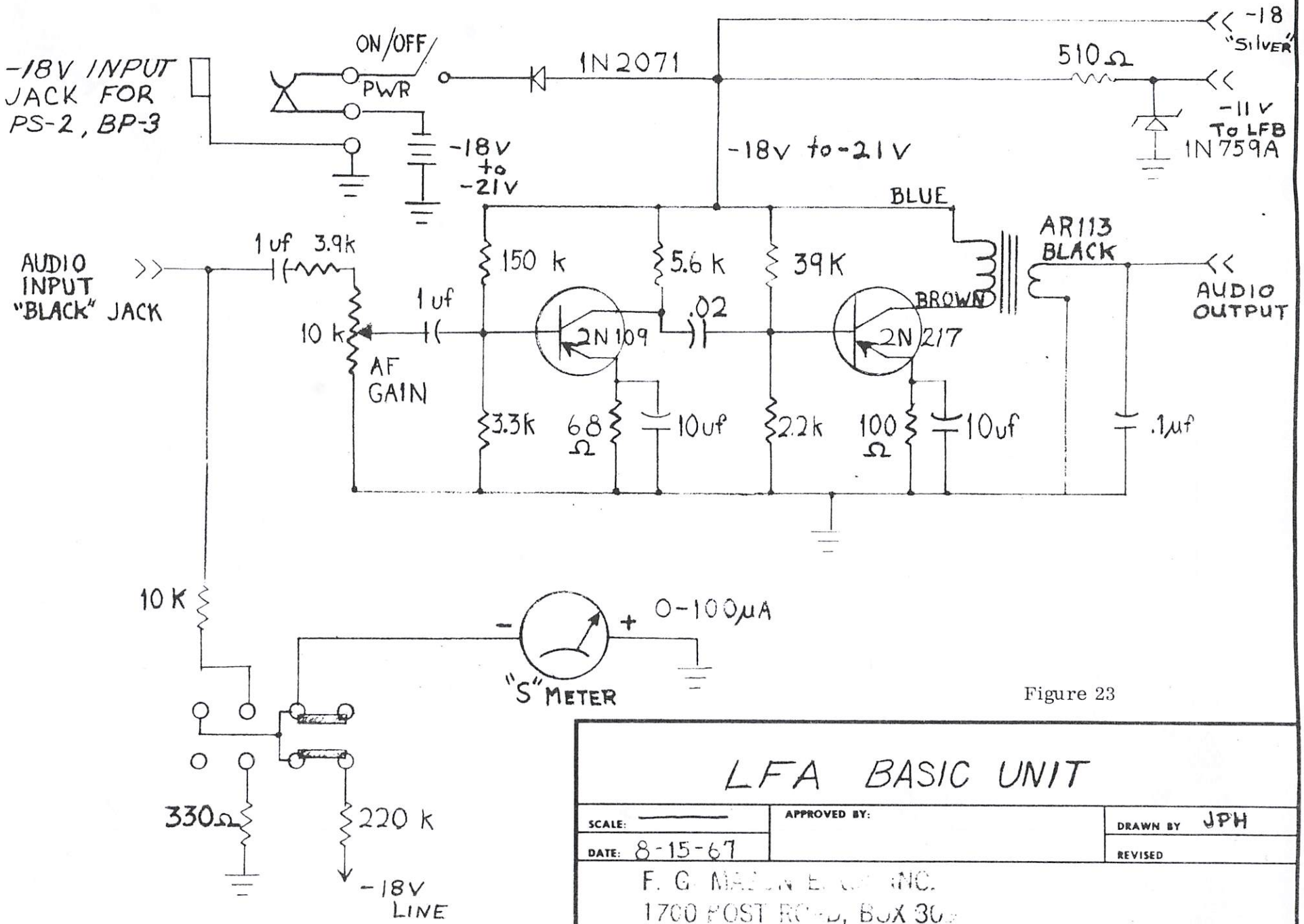


Figure 23

LFA BASIC UNIT

SCALE: ———	APPROVED BY:	DRAWN BY JPH
DATE: 8-15-67		REVISED

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