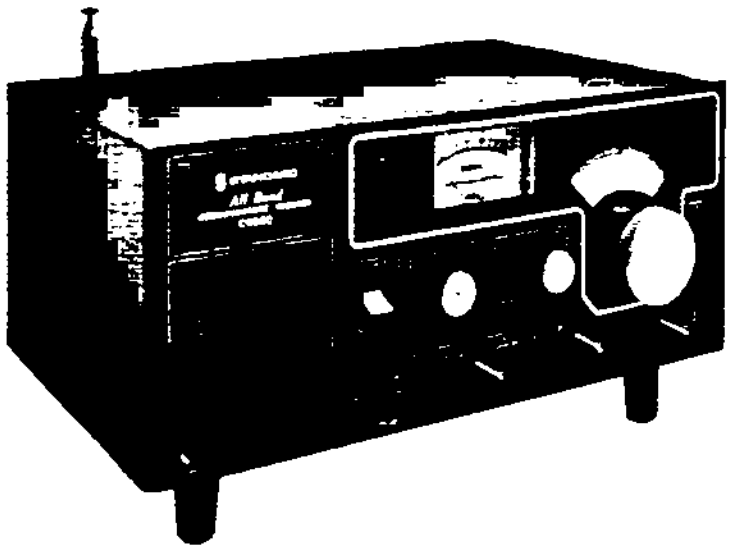
240

# C6500

## GENERAL COMMUNICATIONS RECEIVER



# INSTRUCTION MANUAL

STANDARD
COMMUNICATIONS CORP.

3/78

U240551001

# SPECIFICATIONS

FREQUENCY COVERAGE: 0.5 to 30 megahertz in 30 ranges tuneable over a one megahertz range. Dial has 10 kilohertz scale graduations. Readout within 5 kilohertz.

RECEPTION MODES: AM, CW, USB and LSB.

SENSITIVITY: Not less than 10 dB Signal plus N/N under the following conditions:

| MODE | FREQUENCY | INPUT LEVEL |
|---|---|---|
| AM | 0.5-2 MHz | 3.0 Microvolts |
| | 2-30 MHz | 1.0 Microvolts |
| SSB | 0.5-2 MHz | 1.0 Microvolts |
| | 2-30 MHz | 0.3 Microvolts |

(AM: 1000 Hz at 30% modulation)

OUTPUT: 200 milliwatts output of SSB at 2 MHz with a signal of 0.5 microvolts and 2 watts output with a 5 microvolt input.

AUDIO DISTORTION: Less than 5% at 2 watts.

DIAL ACCURACY: Within five (5) kilohertz on all bands.

| SELECTIVITY | BANDWIDTH (6 dB) |
|---|---|
| SSB | 3 kHz plus or minus 25% |
| AM | 5.5 kHz plus or minus 25% |

IMAGE REJECTION: Greater than 50 dB.

MUTING PROVISION: External muting jack controlled by transmitter relay contacts to silence receiver when transmitting.

AUDIO OUTPUT: Receiver includes internal 8 ohm speaker. Speaker is disabled when headphones or external speaker are plugged in.

ANTENNA: Self contained telescoping whip through top of case. Rear panel connections for unbalanced antennas, 52-72 ohms impedance, such as dipoles, ground planes and beams.

CIRCUITRY: All solid-state.

CURRENT DRAIN: Less than 100 mA quiescent at 12 VDC.

CIRCUIT PROTECTION: 500 mA.

POWER REQUIREMENTS: AC operation requires 117 VAC, 50-60 cycles. Will also operate on eight (8) "D" size flashlight cells installed in inside compartment, or any external 12 VDC source.

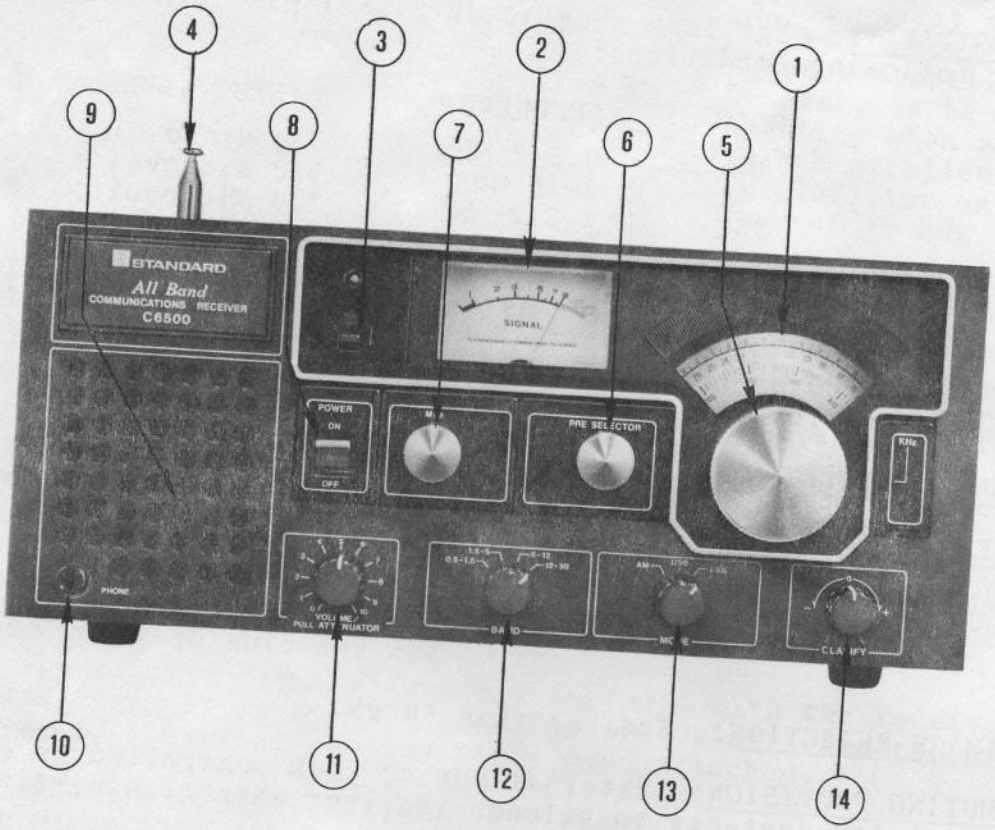
SIZE: 13 1/2" W x 6" H x 12 1/4" D, including controls.

WEIGHT: 14 lbs.

SPEAKER IMPEDANCE: 8 ohms

# CONTROLS AND CONNECTIONS

Before operating your C6500 receiver, you should become familiar with the following controls to assure optimum reception. Refer to the front and rear panel photographs for location of each control.




FRONT PANEL

1. Frequency Readout: Indicates tuned frequency. Large outer dial reads in MHz, small inner dial reads in kHz.

2. Signal Meter: Indicates relative RF input signal level.

3. Dial Light Switch: Pilot lights are normally off when using batteries to conserve battery life. Switch provides momentary "on" (Lights are always on during AC or external DC operation).

4. Collapsible Antenna: Self-contained telescoping whip antenna through top of case.

5. kHz Knob: Controls the kilohertz range as read on the small inner readout dial. Scale is graduated from 000 to 1000, and is read as 0 to 1000 kHz or .000 to 1.000 MHz.

6. Pre-Selector: Peaks incoming signal for maximum strength as observed on the Signal Meter.

7. MHz Knob: Controls the megahertz range as read on the large outer readout dial.

8. Power Switch: Turns power to the unit off and on, for AC or DC operation.

9. Speaker: 8 ohm internal speaker.

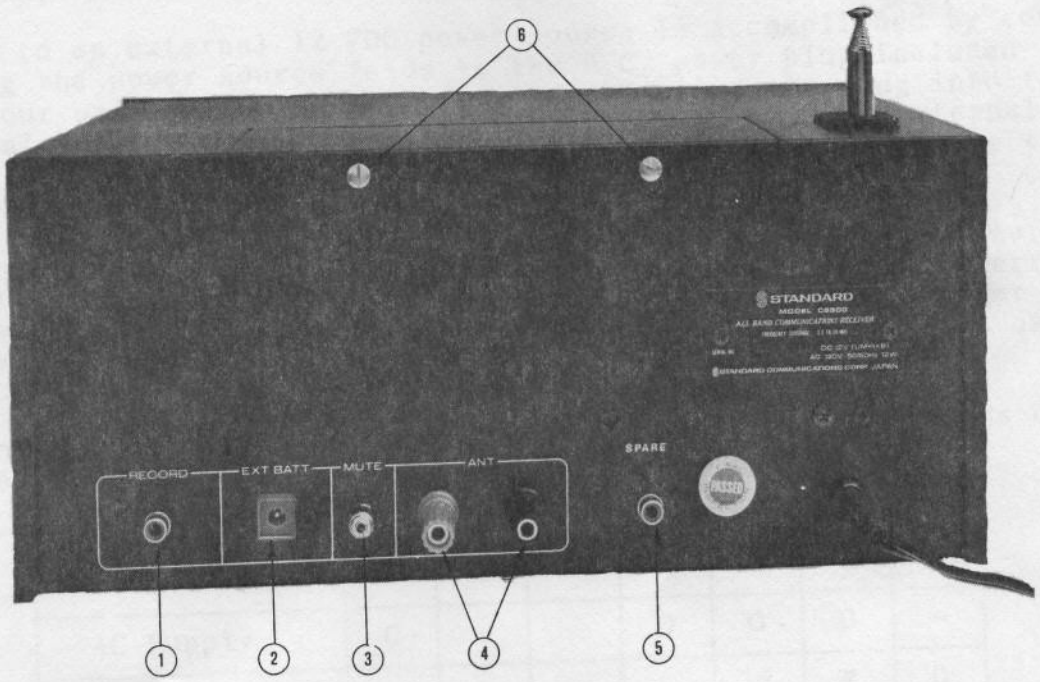
10. Phone Jack: Provides input for headphones or connection to an external speaker. Mutes internal speaker when used.

11. Volume/Attenuator: Turning knob to right or left adjusts volume. Pulling knob out attenuates extremely strong signals.

12. Band Selector: Selects a specific tuning range (0.5-1.5, 1.5-5, 5-12 or 12-30 MHz).

13. Mode Selector: Selects AM, Upper Sideband, Lower Sideband or CW signals (for CW reception, use one of the sideband filters).

14. Clarify Knob: Fine tuning control, varies reception by $\pm$4 kHz from dial readout.




REAR PANEL

1. Record Jack: Allows recording of any audio output of your receiver. Provides a constant output voltage (60 mV) with a constant output impedance (5000 ohms) regardless of the volume control.

tery circuitry when used.

3. Mute Jack: When the C6500 is combined with a transmitter to obtain complete radio station operation, this serves to mute the receiver during transmission.

4. External Antenna Connection: Contains two terminals, one for the antenna connection (red) and one for grounding (black).

5. Spare Jack: Not connected to the internal circuitry. May be used if you wish to add additional circuitry to your receiver.

6. Battery Case Mounting Screws: Two (2) screws secure the internal battery case in place.

# INSTALLATION

## GENERAL

Before operating your C6500, careful consideration should be given to the location of the receiver (and the transmitter, external speaker and external antenna, if used). The receiver should be located on a level, sturdy table or shelf, in a position that renders the controls visible and easily accessible. For marine installation, locate the unit where it will be protected from direct exposure to water spray or rain. Do not locate the radio or external speaker close to the compass, as both contain magnets which could cause erroneous compass readings.

## POWER SOURCE

As indicated, the C6500 will operate on 117 VAC/50-60 Hz, eight (8) internal size "D" flashlight batteries, or any external 12 VDC source.

To insert the internal batteries, remove the two (2) battery case mounting screws on the rear panel of the receiver. Pull out the battery case, and insert the eight (8) dry cells, taking care to observe proper polarity. Replace the case and secure it to the rear panel.

Hookup to an external 12 VDC power source is accomplished by connecting the power source leads to the D.C. power plug included with your unit (negative ground), and inserting the plug into the external battery jack. When the plug is inserted, the external DC power source overrides the internal batteries. Input voltage to the C6500 should <u>never</u> exceed 15 VDC.

AC operation is accomplished by connecting the plug at the rear of the receiver to a suitable receptacle. AC operation will override both modes of DC operation. As explained, should the AC power fail or be disconnected, the receiver automatically switches over to DC operation.

The following chart illustrates the power source combinations of the C6500:

| Power Source | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| AC Supply | O | – | – | O | O | O | – |
| External DC | – | O | – | X | – | X | O |
| Internal DC | – | – | O | – | X | X | X |

O Power source in use

X Power source connected but not in use

– Power source not connected

## EXTERNAL ANTENNA

Although the attached telescoping antenna is suitable for reception of AM broadcasts and strong SW stations, a full scale outdoor antenna is recommended to greatly improve your reception range. For best results build the antenna as high as possible, utilizing poles, trees or whatever is available. Connection to the receiver is accomplished by simply loosening the Red antenna terminal cap on the rear panel, inserting the antenna lead through the small hole of the terminal, and tightening the terminal cap.

Care should be taken not to stretch the antenna too tight, as this can cause defective insulation or cracking and even snapping of the antenna wire. Standard safety precautions should be followed when installing your outdoor antenna, especially in regard to insulators, supports and lightning protection.

## GROUNDING

You can operate your C6500 receiver without grounding it; however, by grounding it you will largely improve the efficiency and noise rejection ratio of the outdoor antenna. The ground connection is at the Black terminal on the rear panel of the receiver, and is made by loosening the terminal cap, inserting the ground wire through the hole of the terminal, and tightening the cap.

To establish the best ground, bury the earthing rod in the ground. If no appropriate space for earthing is available, connect the ground to a suitable plumbing (water) pipe. Never connect the ground to a gas pipe.

# OPERATION

## GENERAL

After installing your C6500 and becoming familiar with its controls and connections, receiver operation is as follows:

1. Turn the POWER switch to "ON".
2. Adjust the VOLUME control to the desired level.
3. Set the CLARIFY knob to "0".
4. Set the MODE selector to the desired position (AM, USB, or LSB). Use USB or LSB for CW reception. In addition, most amateurs use LSB for signals below 10 MHz, and USB for signals above 10 MHz.
5. Set the BAND selector to the desired frequency range.
6. Turn the MHz knob until the large, outer readout dial is set at the desired MHz frequency (for example, if a listening frequency of 14.235 MHz is desired, you would turn the knob until the MHz dial reads "14").
7. Turn the kHz knob until the small, inner readout dial is set at the desired kHz frequency (using the same example of 14.235 MHz, you would turn the knob until the kHz dial reads "235", since 235 kHz equals 0.235 MHz).
8. Turn the PRE-SELECTOR to obtain the optimum receiving condition of the signal. When there is no signal at the frequency desired, turn this knob for maximum white-noise.
9. Fine tune the signal received by adjusting the MHz and kHz knobs.
10. Carry out further fine tuning by turning the CLARIFY knob (this is chiefly effective in SSB and CW operation, but can also be helpful for AM reception). Pull out the ATTENUATE knob if the signal is extremely strong.

## HEADPHONES OR EXTERNAL SPEAKER

If desired, headphones or an eight (8) ohm external speaker may be used. Simply insert the headphone or speaker plug into the PHONE jack. This will mute the internal speaker.

## RECORDER OR TRANSMITTER OPERATION

As indicated, you may record the audio output of your receiver by utilizing the RECORD jack at the rear of the C6500. The internal speaker still operates when recording.

In addition, you may set up a relay if combining transmitter operation with your receiver, serving to cut off audio reception while transmitting. This is accomplished through the MUTE jack, also on the rear panel of your receiver.

Both RECORD and MUTE connections are standard RCA phono jacks.

NOTE: The MUTE jack of your C6500 is factory equipped with an RCA phono jack with its center conductor shorted to ground. This allows audio reception at all times, and should not be removed unless you are combining your receiver with a transmitter and setting up an associated relay.

# THEORY OF OPERATION

Functional flow operation of the C6500 Receiver is illustrated in the block diagram and is outlined in the following text.

The C6500 is a triple conversion super-heterodyne receiver, designed to operate within the frequency range of 0.5 to 29.9 MHz. The unit will receive and process signals in both the AM and SSB modes.

The RF signal is picked up at the antenna and fed into a bandpass filter tuned to the operating frequency, as selected by the band selector switch. A front panel, adjustable Preselector is in parallel with the band pass filter for additional selectivity, The signal is then amplified by the RF Amplifier (Q5), and filtered through another bandpass filter which allows only the desired operating frequency to pass.

After this initial amplification and filtering, the signal is applied to the first mixer (D9 & D10) where it is heterodyned along with the signal from the Variable Frequency Oscillator (VFO Q6). The VFO generates a frequency between 44-75.5 MHz, adjustable by the MHz knob located on the receiver front panel.

The heterodyning action of the first mixer produces an intermediate frequency (1st IF) between 44.5-45.5 MHz that is directed to the 1st IF Amplifier (Q7). This 1st IF is then sent through a bandpass filter (TC8, C74, L15) to another mixer where the second conversion of the RF signal takes place.

The 1st IF at the 2nd Mixer (D5 & D6) is heterodyned with the 42.5 MHz signal from the Synthesizer circuits. The result of this heterodyning process is the 2nd IF of 2-3 MHz.

The Synthesizer oscillator (IC1A) is crystal controlled, producing an output of 10 MHz. This 10 MHz signal is divided by the Decimal Counter (IC3) and applied to the multivibrator (IC1B). The multivibrator produces harmonics between 2.5-32 MHz that are passed through the Buffer amplifier (Q1) to the Pre-Mixer (D3, D4).

The synthesized signal is heterodyned with the signal from the VFO (Q6), resulting in a beat frequency of 42.5 MHz. This output from the pre-mixer is sent through three selective amplifiers (Q2, Q3, Q4) that effectively eliminate all other frequencies except the 42.5 MHz signal.

The IF signal from the 2nd mixer is sent through the 2nd IF amplifier (Q8) to the 3rd Mixer (Q9). There are bandpass filters at the input and output of Q8, and they are turnable by the kHz knob located on the receiver front panel.

The 2nd IF signal is heterodyned with the signal from the VFO (Q13), producing the 3rd IF signal (455 KC). The receiver is fine tuned at this point by the clarifier control (located on front panel) that varies the VFO output frequency.

The 3rd IF is then passed through two 455 KC bandpass filters (F1, F2) to the 3rd IF amplifier (Q11). The signal will then be directed to the AM Detector (D13, D14) and the SSB Detector (D25-D28).

The signal is then demodulated by the AM or SSB detector to recover the audio (AF) signal. The carrier reinsertion for SSB detection is accomplished by the BFO (Q17). The audio signal is then increased in amplitude by the AF amplifier (IC2) and sent to the speaker. A volume control (VR4), located between the detector and the AF amplifier, controls the audio output level.

# MAINTENANCE

## GENERAL

The inherent life of the solid-state components used in the C6500 Receiver will provide many years of continuous use without failure, assuming the radio is treated with reasonable care.

Operational maintenance should be performed in the following sequence:

1. Performance Test - These tests are conducted to check the overall performance of the receiver. If the unit performs these tests satisfactorily, additional maintenance is not required.

2. Troubleshooting - To be used only by qualified radio technicians to isolate and repair a fault in the receiver.

3. Alignment/Adjustment - To be conducted if the receiver fails the PERFORMANCE TEST and/or a critical electrical component has been replaced in the receiver.

## TEST EQUIPMENT REQUIRED

1. RF Signal Generator - Hewlett-Packard Model 606B or equivalent

2. Voltmeter AC/DC - Hewlett-Packard Model 427A with Model 11096A Probe or equivalent

3. Sweep Generator - Hewlett-Packard Model 8698B or equivalent

4. Oscilloscope - Hewlett-Packard Model 182T with Hewlett-Packard Model 180 Spectrum Analyzer or equivalent

## TROUBLESHOOTING

Once an abnormal indication is observed at a test point, conventional signal tracing techniques can be used to isolate a fault within a particular circuit of the receiver unit. An oscilloscope or VM provides the simplest method of such signal tracing.

Once the malfunction has been isolated to a particular circuit, voltage and resistance measurements may be used to isolate a defective component. Reference to the Schematic Diagram and P.C. Board drawings will assist in the operation.

## PERFORMANCE

Connect the RF output of the signal generator to the receiver antenna receptacle (J1 no attn.). Connect a voltmeter (set to read AC volts) to the speaker. Connect an oscilloscope to the same point. Perform the receiver AM/SSB sensitivity as follows:

AM

1. Turn the Band selector switch to the 5-12 MHz position.
2. Set the other receiver controls to receive a 8500 kHz signal.
3. Set the signal generator to an output frequency of 8500 kHz, with a 1 kHz, 30% modulation.
4. Set the signal generator level output for 1 uV and obtain a peak signal as indicated on the oscilloscope.
5. Record the audio output voltage as indicated on the VTVM.
6. Remove the 1 kHz modulation from the signal generator output signal.
7. Adjust the signal generator output until a 10 dB S/N is obtained on the VTVM.
8. Read the level output of the signal generator. It should indicate approximately 2 uV.
9. Check the sensitivity on the other bands as indicated in the Table 1 below.

SSB

1. Turn the Mode switch to LSB.
2. Turn the Band selector switch to the 5-12 MHz position.
3. Set the other receiver controls to receive a 8500 kHz signal.
4. Set the signal generator to an output frequency of 8500 kHz, with a 1 kHz, 30% modulation.
5. Connect an audio generator to the Horizontal input jack of the oscilloscope. Set the Generator for a 1.5 kHz signal output.
6. Adjust the controls of the receiver for a 1.5 kHz audio signal output. A circle lissajous figure should be seen on the oscilloscope.
7. Set the signal generator level output for 1 uV and obtain a peak signal as indicated on the oscilloscope.
8. Record the audio output voltage as indicated on the VTVM.
9. Remove the 1 kHz modulation from the signal generator output signal.
10. Adjust the input signal for a 10 dB S/N as indicated on the VTVM.

11. Read the signal generator output at this point. It should read approximately 0.8 uV.

12. Check the sensitivity on the other bands as indicated in the table below.

13. Place the Mode switch in USB and repeat Steps 1 thru 12.

| BAND SELECTOR SWITCH POSITION | dB | |
|---|---|---|
| | AM | SSB |
| 0.5-1.5 MHz | ≤ 20 | ≤ 16 |
| 1.5-4.5 MHz | ≤ 16 | ≤ 6 |
| 4.5-30 MHz | ≤ 10 | ≤ 0 |

# C6500 RECEIVER ALIGNMENT PROCEDURE CHART

SHEET 1 OF 4

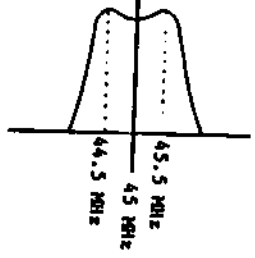
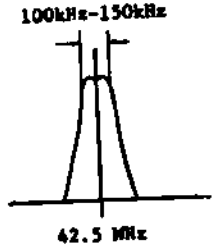
| STEP | TEST | TEST INSTRUMENTS | | | | UUT CONTROL | INDICATION | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | INPUT | TEST POINT | OUTPUT | TEST POINT | | | |
| 1 | 1st Balanced Mixer | Internal noise (no Signal input) | - | S-Meter | - | TC7 | Minimum S-Meter Indication | (a) Set the BAND switch to 0.5 MHz position and the MHz dial to zero.<br>(b) Tune the receiver to the internal noise by setting the tuning dial to 910 kHz.<br>(c) Adjust capacitor TC7 for minimum indication on the S-Meter. |
| 2 | 1st IF Amplifier (Q7) | Sweep Generator (center freq. 55 MHz) | 1st Mixer Input | Oscilloscope | 2nd Mixer Output | TC8 | Response curve indicated in remarks | (a) Set the BAND switch to the 30.0 MHz position and the MHz dial to 20 MHz.<br>(b) Connect the sweep generator output to the 1st Mixer input.<br>(c) Connect the oscilloscope to the output of 2nd Mixer.<br>(d) Set the center frequency of the sweep generator to 45 MHz.<br>(e) Adjust TC8 until the scope indicates the response curve shown below:<br>  |
| 3 | RF Filter | SG (a)0.5 MHz (b)1uV | ANT (J1) ATTN OFF | S-Meter | - | L8, L9, L10, L11 (See table 1) | Maximum S-Meter Indication | (a) Connect the signal generator to the antenna jack (J1). The antenna attenuator switch should be in the OFF position.<br>(b) Set the signal generator to a frequency of 0.5 MHz.<br>(c) Set the receiver controls for 0.5 MHz setting.<br>(d) Set preselector to the center position.<br>(e) Adjust L8 for a maximum reading on the S-Meter.<br>(f) Repeat STEPS 1 thru 4 for each band of frequencies as indicated in TABLE 1, and adjust appropriate coil. |

TABLE 1: RF FILTER ADJUSTMENT

| FREQUENCY RANGE | ADJUSTMENT |
|---|---|
| 0.5-1.5 MHz | L8 |
| 1.5-5 MHz | L9 |
| 5-12 MHz | L10 |
| 12-30 MHz | L11 |

## RECEIVER ALIGNMENT PROCEDURE CHART (CONT.)



| STEP | TEST | TEST INSTRUMENTS | | | | UUT CONTROL | INDICATION | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | INPUT | TEST POINT | OUTPUT | TEST POINT | | | |
| 4 | 42.5 MHz Selective Filters | Sweep Generator (a)42.5 MHz | 1st Mixer Input | Oscilloscope | Q4 Output | TC3,TC4, TC5,TC6 | Response curve Indicated in Remarks | (a) Disconnect the VFO input to the 1st mixer.<br>(b) Connect the sweep generator to the 1st mixer input.<br>(c) Connect the oscilloscope to the 42.5 MHz amp (Q4) output.<br>(d) Set the center frequency of the sweep generator to 52.5 MHz.<br>(e) Adjust TC3, thru TC6 until the oscilloscope indicates the response curve shown below.<br>  <br><br>(f) Replace the VPO input to the 1st Mixer. |
| 5 | MHz Setting | SG (a)3.5 MHz (b)27.5 MHz | Antenna (J1) (No ATTN) | S-Meter | - | TC10 | Maximum S-Meter Indication | (a) Connect the signal generator to the antenna jack (J1). The antenna attenuator should be in the OFF position.<br>(b) Set the signal generator frequency for 3.5 MHz.<br>(c) Set the receiver controls for 3.5 MHz setting.<br>(d) Adjust TC10 for a maximum indication on the S-Meter.<br>(e) Set the signal generator frequency for 27.5 MHz.<br>(f) Adjust TC10 for a maximum indication on the S-Meter.<br>(g) Repeat the adjustment of TC10 several times alternally on 3.5 MHz and 27.5 MHz until maximum S-Meter indication is obtained. |

## RECEIVER ALIGNMENT PROCEDURE CHART (CONT.)



| STEP | TEST | TEST INSTRUMENTS | | | | UUT CONTROL | INDICATION | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | INPUT | TEST POINT | OUTPUT | TEST POINT | | | |
| 6 | kHz Setting | - | - | Speaker Audio | - | L21 | | (a) Set the MODE switch to LSB.<br>(b) Set the MHz dial to 0 and the main tuning dial (kHz) to 1000.<br>(c) A zero beat should be heard from the speaker.<br>(d) Adjust L21 for a maximum zero beat.<br>(e) Set the kHz dial to 0. A zero beat should be heard from the speaker.<br>(f) Adjust L21 for a maximum zero beat.<br>(g) Repeat the adjustment of L21 several times alternately on 1000 and 0 position of the kHz dial until maximum zero beat is obtained on both settings. |
| 7 | 2nd IF Tracking | SG (a)7.1 MHz<br>(b)7.9 MHz | Antenna (J1) No Atten. | S-Meter | - | L16,L17 | Maximum S-Meter Indication | (a) Connect the signal generator to the antenna jack (J1).<br>(b) Set the signal generator to a frequency of 7.1 MHz.<br>(c) Set the receiver controls for a 7.1 MHz signal.<br>(d) Set the signal generator output level for an S3 indication on the S-Meter.<br>(e) Adjust L16, and L17 for a maximum indication on the S-Meter.<br>(f) Repeat STEPS 1 thru.5 with the signal generator set for 7.9 MHz.<br>(g) Repeat the adjustment fo L16 and L17 alternately on 7.1 MHz and 7.9 MHz setting of th signal generator until maximum indication on the S-Meter is obtained. |
| 8 | 3rd IF | SG (a)7.5 MHz | Antenna (J1) No Atten. | S-Meter | - | L19, L20 | Maximum S-Meter Indication | (a) Connect the signal generator to the antenna (J1).<br>(b) Set the signal generator for a frequency of 7.5 MHz.<br>(c) Set the receiver controls for a frequency of 7.5 MHz.<br>(d) Adjust L19, L20 for a maximum indication on the S-Meter. (signal generator output level may have to be decreased to obtain an on scale reading on the S-Meter). |

## RECEIVER ALIGNMENT PROCEDURE CHART (CONT.)

SHEET 4 OF 4

| STEP | TEST | TEST INSTRUMENTS | | | | UUT CONTROL | INDICATION | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | | INPUT | TEST POINT | OUTPUT | TEST POINT | | | |
| 9 | BFO Frequency | - | - | Frequency Counter | BFO OUTPUT | TC1 , L22 | 457 kHz (LSB) 453 kHz (USB) | (a) Connect a frequency counter to BFO output.<br>(b) Set the MODE switch to LSB.<br>(c) Adjust L22 for a reading of 45 kHz on the frequency counter.<br>(d) Set the MODE switch to USB.<br>(e) Adjust TC1 for a reading of 453 kHz. |

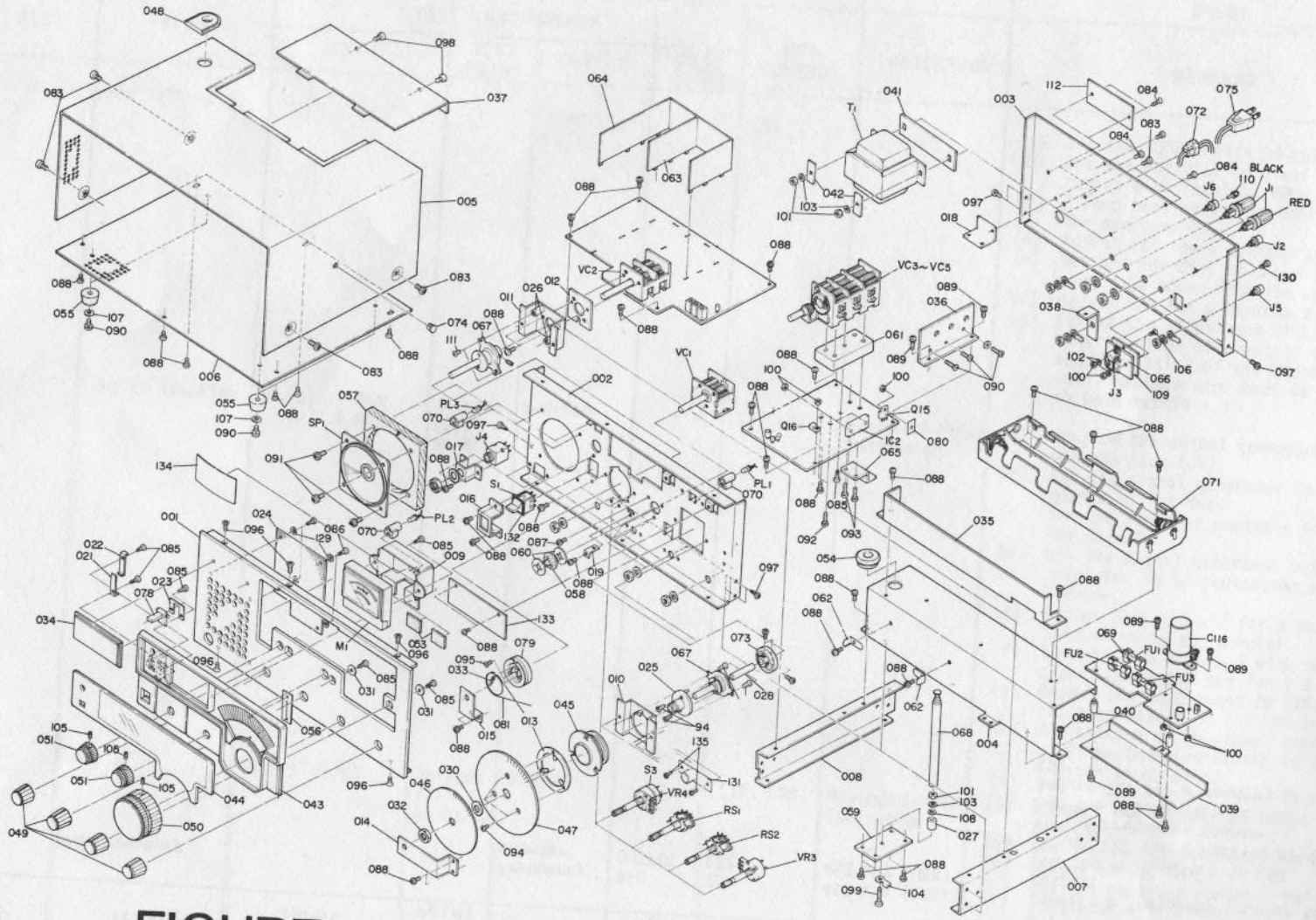



FIGURE 1: EXPLODED PARTS VIEW

3-78

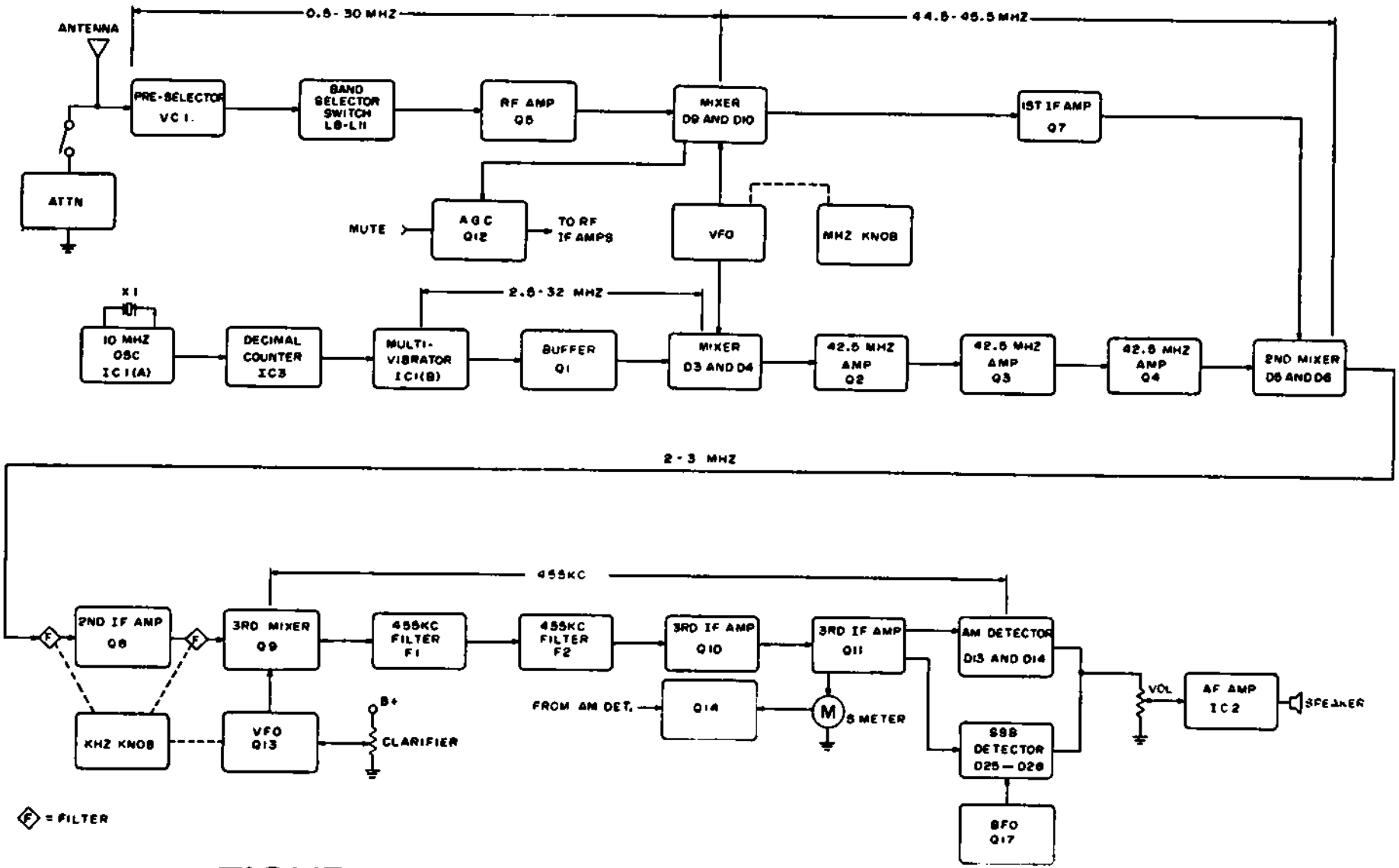



FIGURE 2: FUNCTIONAL BLOCK DIAGRAM

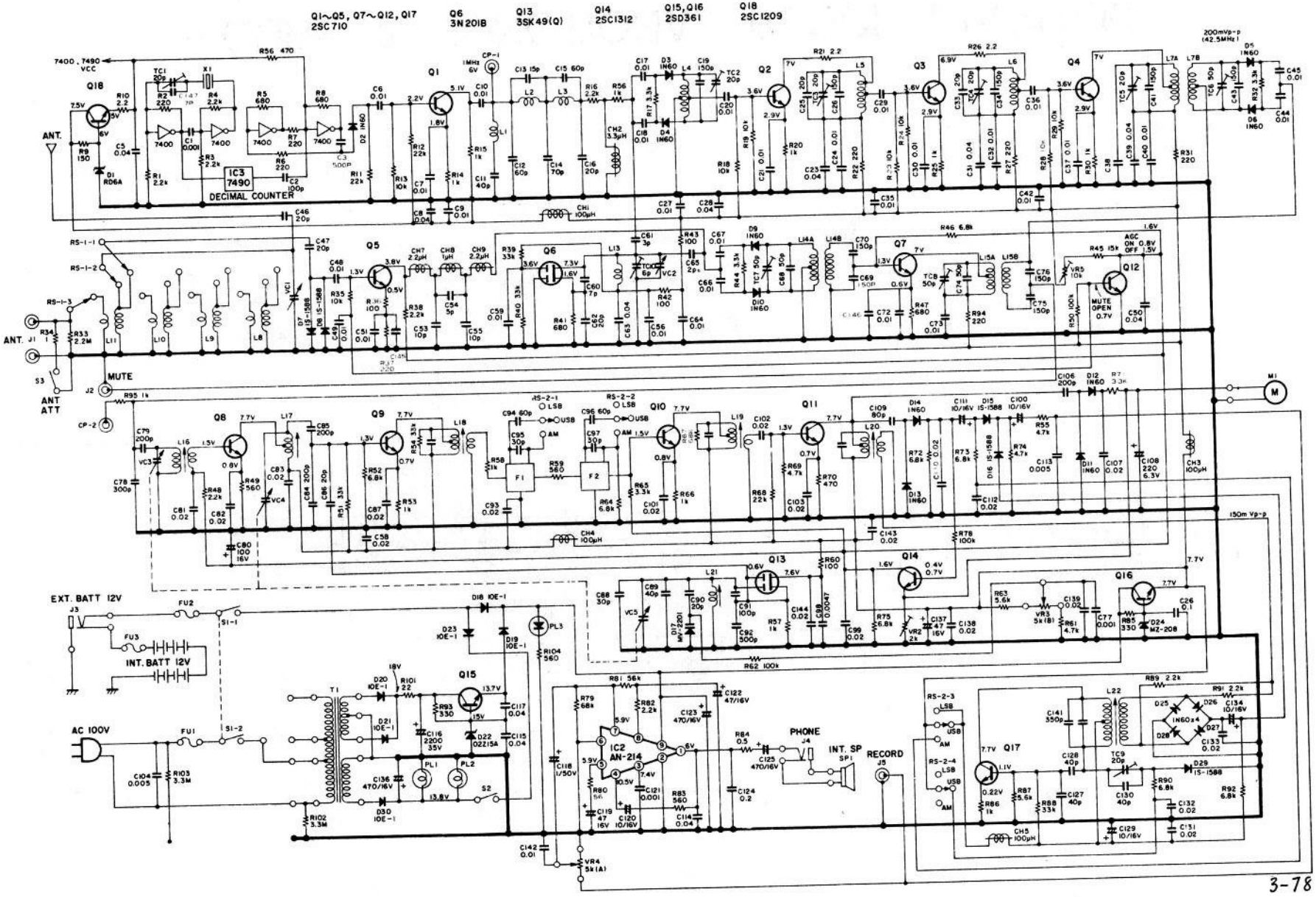



FIGURE 3: SCHEMATIC DIAGRAM