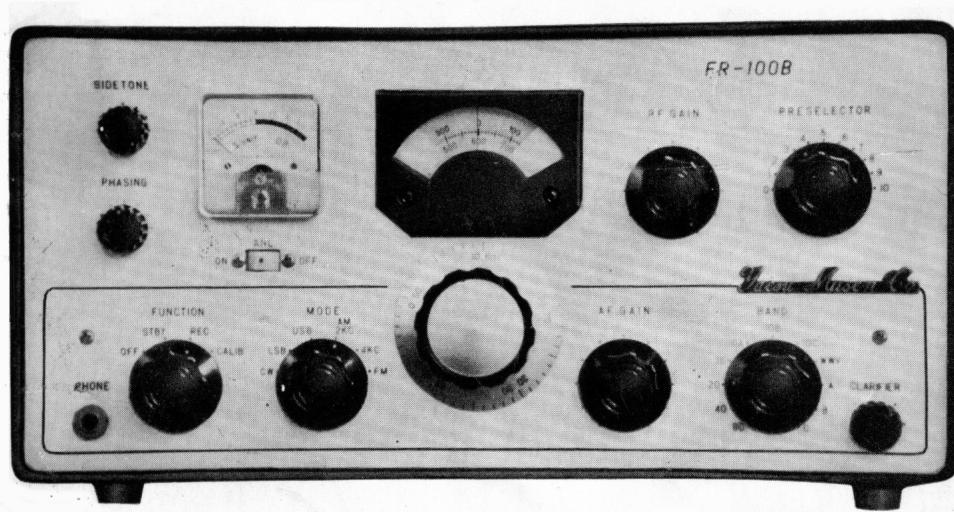


# INSTRUCTION BOOK

## FOR

### FR-100-B COMMUNICATION RECEIVER



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## **FOR**

### **FR-100-B COMMUNICATION RECEIVER**

#### **1. GENERAL :**

The model FR-100-B communication receiver is designed for the amateur bands reception in the frequency range of 3.5 Mc to 30 Mc with 3 extra bands which covers 600 Kc each. This receiver provides top performance for the reception of CW, AM and SSB (upper & lower selectable). FM reception is also possible with optional FM detector unit which makes this receiver a VHF receiver with our crystal converter units.

Basically, it is a double conversion super-heterodyne receiver employing a crystal controlled converter for a first mixer stage; A highly stable variable oscillator is tuning the same range linearly on all bands and a filter assembly consisting of two "MECHANICAL FILTERS". A crystal filter is used for CW reception.

Precise instrument type double gear driven dial together with adjustable scale on the main dial provides easy and accurate frequency readings on all bands with approximately 1 Kc per division.

The receiver provides a wide variety of operations, such as band width, slow and fast AVC time constants, SSB and CW reception with ring demodulator and built in frequency calibrator. And a feature found only in this ham set- a "CLARIFIER",

The FR-100-B communication receiver can be operated as a transceiver in conjunction with FL-100-B SSB transmitter.

## **SPECIFICATIONS**

Mode of operation	Selectable SSB & CW with ring demodulator, AM with diode detector.
Frequency range	3.5 - 4.1 Mc, 6.9 - 7.5 Mc, 13.9 - 14.5 Mc, 20.9 - 21.5 Mc, 27.9 - 28.5 Mc, 28.5 - 29.1 Mc, 28.9 - 29.5 Mc, WWV and band switch provides for addition of 3 bands cover 600 Kc each with optional crystal and circuit modification. Crystal is not equipped for WWV and higher two bands in 10 meters.
Spurious response	Image rejection more than 50 db; internal spurious signals within ham bands less than that from a 1 u-volts antenna input.

Frequency stability	Less than 100 cps for 10% line fluctuation after warm up.
Selectivity	For CW ; .5 Kc at 6 db, 2.5 Kc at 60 db AM ; 4 Kc at 6 db, 7.5 Kc at 25 db 2.1 Kc at 6 db, 2.5 Kc at 60 db SSB ; 2.1 Kc at 6 db, 2.5 Kc at 60 db
Sensitivity	Less than 0.5 micro-Volts for 10 db S/N ratio.
AVC	Delayed AVC having discharge time constants of 0.1 sec. for AM 2 sec. for SSB, and 0.5 sec, for CW.
Audio output	2 watts maximum.
Audio distortion	Less than 5%,
Power requirement	approx. 50 watts, 100/117/220/240, AC 50/60 cps.
Dial calibration	50 Kc main dial division, approximately 1 Kc sub-dial reading.
Dimensions	7-1/8" high, 15" wide, 11-3/4" deep.
Net weight	12 Kgs (24 lbs).

## TUBE AND DIODE COMPLEMENT

6BZ6	1	RF amplifier	6BE6	1	1st mixer
6BA6	1	Crystal oscillator	6BE6	1	2nd mixer
6BA6	2	IF amplifier	6AQ5	1	Audio output
12AT7	1	VFO	1S-1007	1	Harmonic diode
12AU7	1	Audio amplifier	1S-1007	4	Ring demodulator
6BM8	1	Voltage regulator	1S-1007	1	AM detector
6BZ6	1	Calibrator	SH-1	2	CW limiter
IS-1007	1	VFO shift	SH-1	1	Isolation diode
SH-1	1	Noise limiter	SH-1	1	Bias rectifier
SH-1	1	AVC rectifier			
5-GL	2	Rectifier			

### 2. CIRCUIT DESCRIPTION :

#### RF AMPLIFIER :

A 6BZ6 is used as a straight RF amplifier on all bands. This tube is a semi-remote cutoff pentode having high gain, low intermodulation and excellent control characteristics. The antenna terminal is connected to taps of antenna coils which are designed to match 50-75 ohms unbalanced input through a trap circuit which eliminates 1st IF interference. The antenna coils and the plate coils are tuned by a ganged variable capacitor. This variable capacitor is tuned from the front panel and marked "PRESELECTOR". The padding capacitor is so selected that the preselector is electrically spread. For 80 meters only, the double section of the capacitor is used to cover 600 Kc. The output of the RF plate coil is coupled to a grid of the 6BE6, the first mixer.

Sufficient gain is available in the RF amplifier section to assure high S/N ratio. AVC is applied to the signal grid of the 6BZ6, and screen grid supply is regulated for excellent AVC characteristics. The cathode circuit of the 6BZ6 is connected to RF level control potentiometer that is located on front panel.

## **HETERODYNE (1ST) MIXER :**

A 6BE6 is used as the first high frequency mixer on all bands. The plate circuit of this tube is tunable from 5,355 Kc to 5,955 Kc by a ganged capacitor with main VFO tuning capacitor and provides excellent attenuation of spurious responses in the 1st IF range.

## **CRYSTAL OSCILLATOR :**

A 6BA6 pentode tube is used in a crystal oscillator circuit. The frequency of the crystals are listed on the table following. An overtone crystal is not used for the purpose of shifting crystal frequency as a "CLARIFIER" by changing shunt capacity of the crystals. This is necessary to "zero-in" receiver frequency to that of the transmitter for transceive operation. For 3 extra bands, crystal sockets and plate tuning coils are furnished and the coils should be tuned to the frequency required. The output of this oscillator is coupled to the grid circuit of the first mixer tube through a trap coil.

## **VFO :**

A 12AT7 is used as VFO oscillator and buffer tube. Oscillating frequency of VFO covers 600 Kc from 4,900 Kc to 5,500 Kc linearly for all bands. Output from buffer tube is tuned to the center frequency of the bands that is 4,200 Kc with low Q tuned circuit and VFO output is connected to the pin jack marked "VFO OUTPUT" on the rear apron of the chassis for the transceive operation. This output voltage is also supplied to the grid of 2nd mixer to produce 455 Kc IF signal.

## **2ND MIXER :**

A 6BE6 is used as the 2nd mixer which produces 455 Kc 2nd IF frequency, mixing VFO signal and the 1st IF signal. This 455 Kc IF signal on the plate circuit is then fed into the filter assembly through the "MODE" switch.

## **FILTER ASSEMBLY :**

The filter assembly consists of a 2.1 Kc mechanical filter, a 4 Kc mechanical filter and a crystal filter. The mode switch selects the suitable filter for the receiving signal. For AM reception, either 2.1 kc or 4 kc filter is used. For SSB reception, 2.1 kc mechanical filter is selected and the crystal filter is only used for CW reception in conjunction with the 2.1 Kc mechanical filter. Crystal filter phasing control is adjustable from front panel.

## **IF AMPLIFIER :**

Two 6BA6 are used for the straight 455 Kc IF amplifier, tuned by three tuned coils. These two tubes are controlled by AVC voltage and a manual RF GAIN control is placed in the first IF tube cathode circuit in conjunction with the 1st RF amplifier tube.

## **RING DEMODULATOR & BFO OSCILLATOR :**

Four germanium diodes are used as a low distortion ring demodulator circuit for SSB and CW reception. The crystal controlled BFO oscillator provides an extremely stable injection to mix with 455 Kc IF signal from preceding stage. The BFO crystals are selected by the "MODE" switch. For CW reception the LSB crystal is used. This type of reception greatly reduces both intermodulation and harmonic distortion.

## **DIODE DETECTOR & NOISE LIMITER :**

A germanium diode 1S-1007 is used in a conventional diode detector circuit for AM reception. A silicon diode SH-1 is used as a conventional series noise limiter circuit which may provide increased readability under heavy noise conditions. This limiter is placed in the circuit by the ANL switch on the front panel for AM reception.

## **SIDETONE :**

Muting voltage is adjusted from front panel to provide sidetone listening for CW transmission. Muting voltage is reduced by advancing this sidetone control potentiometer and the receiver recovers to listen the transmitted signal. This system can be used to check the audio quality of the transmitting signal in LSB position.

## **AUDIO AMPLIFIER & OUTPUT :**

12AU7 is used as a two stage audio amplifier with a gain control between the two triode sections to cover the low output from the ring demodulator. 6AQ5 is used as power output tube, delivering a full watt of audio to output transformer which provides a correct match to 4 ohms speaker and 600 ohms line at the output terminal on the rear apron of the chassis. The headphone jack on the front panel is circuited in the grid of this tube and avoids speaker output for private listening. Negative feedback in the circuit helps lower distortion.

## **AVC :**

A delayed AVC circuit is employed with a silicon diode SH-1 as an AVC rectifier. AVC discharge time constants are chosen by the "MODE" switch on front panel. Fast AVC is used for AM reception; discharge time is 0.1 u sec., For SSB reception, discharge time is selected to 2 sec., Muting is accomplished by inserting a cutoff bias voltage into AVC line. An isolating diode, SH-1 is used to isolate the discharge capacitor from mute circuit to assure quick recovery of the receiver. This permits almost instantaneous muting and recovery of the receiver.

## **POWER SUPPLY :**

The full-wave rectifier circuit uses two silicon diodes, 5-GL. Condenser input is adopted with 5-H choke coil providing quite adequate filtering. Under load, the power supply delivers B-plus voltage of 180 volts. Regulated supply is used for all oscillator and screen grid circuits of the AVC controlled tubes. For stabilizer, 6BM8 tube is used for better regulation than a gas diode. Power transformer is designed for 100/110/200/220 volts operation. A silicon diode, SH-1 is used for muting voltage -100 volts.

## **3. INSTALLATION AND OPERATION :**

The FR-100-B receiver is designed for 100/110 or 220 volts 50/60 cps AC only and consumes approximately 50 watts.

## **AUDIO OUTPUT :**

A permanent magnet type 4 ohms speaker should be connected to the terminals marked "4" and "G" on the rear apron of the chassis. Our model SP-100 matched speaker is available from your dealer and is a perfect combination for the receiver and FL-100-B transmitter.

## **ANTENNA :**

The antenna input impedance of the FR-100-B receiver is designed for 50 to 70 ohms. Coaxial terminal is provided on the rear of the chassis. It is recommended that when the FR-100-B is used with a transmitter, a transmitting antenna be used, change-over being accomplished by an antenna relay which is already installed in our FL-100-B transmitter.

## **MUTING :**

While a normal stand-by switch is provided on the front panel as function switch, much smoother station operation can be accomplished by the use of an external muting control in conjunction with transmitter. To use this feature, only a relay contact which closes in receiving and open in transmitting period is required. FL-100-B transmitter provides this relay contact in accessory socket on rear apron for smooth VOX and CW break-in operation.

## **CONTORLS :**

### **PRESELECTOR :**

The dial in the upper right corner marked "PRESELECTOR" tunes a ganged capacitor in the grid and plate circuits of the RF stage of the receiver. Careful peaking of this control on all bands is necessary, though the tuning will not be much sharper than a conventional receivers. The ham bands are centered on the tuning dial and 0 to 10 division is provided for the tuning of any extra bands that may be added.

### **BAND :**

On the right side is the band switch. Ham bands are marked from 80 to 10 meters. Ten meter bands are divided into 3 bands 10A, 10B and 10C. Note that the crystal is only furnished on 10A as original equipment in the receiver. The other 10 meters, WWV and 3 extra bands require the addition of auxiliary crystals.

### **FUNCTION :**

This controls power to the receiver, send-and-receive and calibrator on-off. In the OFF, the receiver is completely turned off. In the ST-BY, all powers are turned on, and the receiver works by the connecting the mute terminal to the ground. In the REC, the receiver works independently. In the CALIB, the cathode circuit of the calibrator tube is connected to the ground and antenna input is disconnected from antenna coil.

## **MODE :**

In the CW, this control turns on BFO for LSB, and crystal filter and 2.1 Kc mechanical filter is placed in the circuit. In USB and LSB, the crystal filter is removed from the circuit and appropriate BFO crystal is operated for SSB reception with a ring demodulator circuit. In the AM, BFO oscillator circuit is disconnected and AVC time constants are changed to shorter time constants. Either 2.1 Kc or 4 Kc. mechanical filter can be used for AM reception. In the FM, all filters are removed from the circuit, and optional FM limiter & detector units is supplied to install on the cutout of the chassis.

## **RF GAIN :**

This control is connected in the cathode circuit of the RF and 1st IF stage and is used to control the receiver gain in all classes of the operation.

## **AF GAIN :**

The audio gain control is used to control the audio amplification of the receiver.

## **SIDETON :**

The SIDETONE control is used to adjust a muting voltage for the receiver. Rotation toward clockwise direction will reduce muting voltage and the receiver starts to operate to hear transmitting signal. If this is not wanted, the control should be placed in the fully counterclockwise position.

## **PHASING :**

The phasing control is used to assist in rejecting interfering heterodyne in CW reception.

## **ANL :**

In the On, this control turns the automatic noise limiter which is only placed in the circuit for AM reception.

## **CLARIFIER :**

This control is used to shift the receiving frequency slightly by varying the shunt capacity of the heterodyne crystals. For SSB reception, "ZERO-IN" is very easy with this control, which is also used to compensate the tolerance of heterodyne crystals of receiver and transmitter for the perfect transceive operation. For CW reception, this can be used as pitch control.

## **OPERATION :**

It will be assumed all connections are in place as illustrated. An outline of recommended control setting will be described here and more detailed operation will be understood with the explanation of the function of each control described in the preceding pages.

## A. AM RECEPTION :

Set the controls as follows ;

FUNCTION	REC.
MODE	AM 4 KC.
ANL	OFF
BAND	Desired band.
RF GAIN	Fully clockwise
PRESELECTOR	Center
AF GAIN	Desired audio volume
SIDETONE	Fully counterclockwise
CLARIFIER	Center

Tune in signal with main tuning dial and then peak the "PRESELECTOR" for maximum S-meter reading. For AM, the 4 Kc, mechanical filter is adequate for normal use, however, under crowded band conditions the narrower 2.1 Kc filter may be more desirable. Tuning is more critical using the 2.1 Kc filter. Tune for pleasing voice quality. This will not correspond with maximum S-meter reading. Clarifier can be used as a fine tuning adjustment to select the sideband having less interference. Under heavy noise conditions, ANL can be used to reduce noise interference.

## B. CW RECEPTION :

Set the controls as follows ;

FUNCTION	REC
MODE	CW
ANL	OFF
BAND	Desired band
RF GAIN	Fully clockwise
PRESELECTOR	Center
AF GAIN	Desired audio gain
SIDETONE	Point at which sidetone signal is heard.
CLARIFIER	Center
PHASING	Center

Tune in signal with main tuning dial and then carefully peak "PRESELECTOR". Phasing control can be adjusted for minimum interference and maximum signal strength for desired signal. The clarifier can be used as pitch control for audio beat tone.

## C. SSB RECEPTION :

Set the controls as follows :

FUNCTION	REC
MODE	Desired sideband.
ANL	OFF
BAND	Desired band
RF GAIN	fully clockwise
PRESELECTOR	Center
AF GAIN	desired audio volume
SIDETONE	Fully counterclockwise
CLARIFIER	Center
PHASING	Center

Tune in signal carefully for natural voice quality and peak the "PRESELECTOR" and adjust AF gain control to wanted level. Clarifier can be used as a fine tuning adjustment. This device permits "Zero-In" with a minimum of efforts. For very strong signal, RF GAIN control should be reduced to avoid distortion.

## D. TRANSCEIVE OPERATION :

Perfect transceive operation can be accomplished by utilizing our FL-100-B transmitter. For this operation, connect FR-100-B and FL-100-B as illustrated in figures following. VFO cable (Coaxial only) should be short as possible to avoid excessive loss of injection voltage to the transmitter. Turn VFO switch to transceive. For the older sets, this switch is located on the VFO box inside of the cabinet and in this case, you can change the transmitter cabinet with receiver cabinet which has a cutout for the switch operation on top. Carefully check your transmitter before buying a receiver.

## INITIAL ALIGNMENT FOR TRANSCEIVE ORERATON :

Connect both sets as illustrated and connect transmitter to a dummy load.

Set the controls as follows ;

### FL-100-B TRANSMITTER :

OPERTAION SW.	STBY
BAND	80meters.
MIC GAIN	OFF
MODE	LSB
VOX SENS.	OFF
VOX DELAY	Fully counterclockwise.
ANTITRIP	"
VFO SW.	Transceive.
LOADING	Fully counterclockwise.
PLATE	80 meter area.
CLARIFIER	OFF

### FR-100-B RECEIVER

FUNCTION	REC.
MODE	LSB
ANL	OFF
BAND	80 meters.
RF GAIN	Fully clockwise.
PRESELECTOR	Center
AF GAIN	Desired audio volume.
SIDETONE	Fully counterclockwise.
CLARIFIER	Center.
PHASING	Center.

Turn on power for both sets and wait for warm up. Tune the receiver main tuning dial to 3,800 Kc. Throw the operation switch to "OPER". Tune the transmitter to this frequency with carrier inserted. Adjust a slug on rear apron on the receiver chassis for maximum transmitter output. This slug is located close to VFO OUTOUT jack of the receiver and initially adjusted in factory to maximum output without cable connection. When VFO cable is connected, it is necessary to adjust for maximum VFO output, and it is also necessary when cable is removed from the jack to readjust this slug for maximum VFO output at jack. These adjustment should be done at the center of VFO

scale. Now the receiver VFO controls transmitting frequency. For the transceive operation, the clarifier only shift receiving frequency to set a receiver exactly on transmitting frequency.

For transmitters bearing series No. smaller than 6502100, minor transmitter circuit modifications may be required for a perfect transceive operation. Main modification is to add 20 meter crystal for heterodyne mixer circuit as illustrated. For the parts required and modification instruction, your dealer will give you full informations.

### **LSB TRANSCEIVE OPERATION :**

Make sure that all connections are in place for transceive operation, Tune in signal and spot transmitter frequency in SPOT position with CLARIFIER to zero beat. Do not touch CLARIFIER knob any more and tune in signal with main tuning knob.

### **USB TRANSCEIVE OPERATION :**

Tune in signal in USB position, and set a operation switch of FL-100-B to SPOT position. Change the MODE switch of the receiver to LSB, and tune the CLARIFIER for zero beat with spot signal form the transmitter. Change receiver mode switch to USB, you are ready for USB transceive operation. With this method, you can operate in 50 cps tolerance, however you may adjust as follows for very accurate frequency setting of perfect transceive operation :

Tune in signal and switch to transmitter VFO and spot this VFO frequency to zero beat with incomming signal. Switch to LSB reception, and tune main receiver dial zero beat with transmitter VFO signal. Switch to USB and tune a CLARIFIER into zero beat. Switch transceive switch to TRANSCEIVE position. You are now exactly on incomming signal.

## **4. MAINTENANCE :**

The FR-100-B receiver has been aligned and calibrated at the factory with proper test equipments and will not require realignment for long period of operation. Service or replacement of a major component may require subsequent realignment, but do not attempt to make any adjustment unless operation of this receiver is fully understood.

### **CHASSIS REMOVAL FROM THE CABINET :**

Remove the four screws on the side of the cabinet and a screw on the bottom of the cabinet and carefully slide the chassis and panel assembly out from the front of the cabinet.

### **TEST EQUIPMENT REQUIRED :**

- Recommended service equipments for alignment are ;
- Vacume tube Volt-Ohm-Meter with a RF probe.
  - Signal generator covering 455 Kc to 30 Mc.

### **TUBE REPLACEMENT :**

Most trouble encountered in radio equipments is due to tube failure rather than component failure. The FR-100-B has been designed so that its tubes may be replaced without need for realignment. The best check on tubes is direct substitution in the receiving set rather than reliance check on a tube checker. All tubes are clearly identified on the VFO case and care should be taken to put the tubes in the correct socket.

## **VOLTAGE AND RESISTANCE MEASUREMENT :**

Refer to the table of resistance and voltage measurements to determine the circuit in which the trouble is located. Regulated supply should be set at 100 volts by a potentiometer located close to 6BM8 tube.

## **BFO ALIGNMENT :**

Connect a RF probe of VTVM to either pin of output terminal of L23. Set mode switch to USB and adjust bottom slug for maximum output, then top slug for maximum output, VTVM reading is approximately 0.5 volts.

## **455 KC IF ALIGNMENT :**

To align the 455 Kc IF amplifier stage, set function switch to "CALIB" and use 100 Kc marker as signal source. Tune it with the receiver and peak both slugs of L21 and L22 for maximum S-meter reading or maximum negative voltage measured with a VTVM at the AVC line.

## **FILTER ASSEMBLY ALIGNMENT :**

Set the controls as follows:

Function switch to "CALIB".

Mode switch to "CW"

Band switch to "80"

Phasing to center

Tune in marker signal for maximum S-meter reading. Adjust T1 for maximum S-meter reading. Change mode switch to "AM 2KC" and peak T2 and T3 for maximum S-meter reading, then "AM 4KC" for maximum S-meter reading with top slug adjustment of 4 Kc mechanical filter.

## **VFO ALIGNMENT :**

Tune in 100 Kc marker signal at 80 meter band. Tune in 4.0 Mc, and set sub-dial to 0 holding knob tightly. Adjust L20 for zero beat. precise adjustment is required for adjustment of these coils and capacitors. Set main tuning dial to exactly 3.5 Mc and adjust TC6 for zero beat. One or two degree of rotation may be enough for TC6 adjustment. Repeat this procedure until dial is accurately calibrated.

## **VFO SHIFT ADJUSTMENT :**

Tune in 3.8 Mc on 80 meter band in LSB mode for zero beat. Turn mode switch to USB, and adjust TC7 for zero beat. Repeat this Procedure until zero beat is obtained in both sideband.

## **1 ST (VARIABLE) IF ALIGNMENT :**

Set mode switch to AM 4 Kc. Tune in 3.5 Mc marker signal. Adjust TC3 and TC4 for maximum S-meter reading. Tune in 4.0 Mc, and adjust L8 & L9 for maximum S-meter reading. Repeat this procedures several times for perfect tracking.

## **CRYSTAL OSCILLATOR ALIGNMENT :**

Connect a RF probe of VTVM to pin 1 of V2, 6BE6. Place band switch on 80 meters. Adjust L11 for maximum VTVM reading. Successively change band switch to 40, 20, 15, 10 meter bands, and adjust L12, L13 etc. for maximum VTVM reading. In the case that crystals are equipped for the other bands, repeat this procedure for each band. For this alignment, the clarifier should be set at a center position.

## **RF ALIGNMENT :**

Set the mode switch AM 4 Kc and RF-gain fully clockwise. Connect signal generator to antenna connector and set a frequency to 3.5 Mc. Set "PRESELECTOR" to fully counterclockwise and advance one scale. Tune in 3.5 Mc signal generator signal with main dial. Adjust L2 and L5 for maximum S-meter reading. Turn band switch to 40 meter and set signal generator to 7.2 Mc, and tune in with Main dial. Set the "PRESELECTOR" to center. Adjust TC1a and TC2a for maximum S-meter reading. Turn band switch to WWV and set signal generator to 10,200 Kc. Tune in this signal and adjust L3 and L6 for maximum S-meter reading. If WWV crystal is not equipped, omit this procedure. Turn band switch to 20 meter, and signal generator to 14,200 Kc. Tune in this signal and adjust TC1b and TC2b for maximum S-meter reading. Turn band switch to 10A, and signal generator to 28,500 Kc, and tune in this signal and adjust L4 and L7 for maximum S-meter reading. Turn band switch to 15 meter, set signal generator to 21,200 Kc, and tune in this signal. Adjust TC1c and TC2c for maximum S-meter reading. Turn band switch to 40 meter and set signal generator to 5,650 Kc and adjust a trap coil which is installed in input circuit for minimum S-meter reading with maximum signal generator output.

## **S-METER ALIGNMENT :**

Set signal generator to 14,200 Kc 50 uV output, and tune in this signal. Set S-Meter adjust potentiometer on rear apron of chassis to S9.

## **TROUBLE SHOOTING :**

Charts showing both resistance and voltage measurement are following. This is a best aid in any trouble shooting. Bear in mind that any of these value will vary slightly due to line voltage and normal tolerance differences in components and measuring equipments.

**TUBE AND DIAL LIGHT OUT;** Blown fuse is probable case. Usually indicates short on the heater string or B circuit or silicon rectifier damage.

**TUBE LIGHT BUT NO AUDIO;** Check B at filter condenser. If normal, check pin 6 and 1 of V9 and pin 5 of V10. Check headphone jack and leads to speaker. If OK this far, switch detector and ring demodulator. If the output from one is OK but not the other, check diodes.

**AUDIO OK BUT STILL NO OUTPUT;** For troubles in the RF and IF stages, you can use S-meter as well as the audio to check troubles. Check on several positions of both band switch and mode switch. If the set works normally on some mode but no others, the troubles is confined to the filter assembly. If the set works normally on some bands but not on other, the troubles may be in RF amplifier, 1st mixer or x-tal oscillator. If its behavior is the same on all mode and bands it may be in either RF or IF stages. Touch pin 1 of V7 with VTVM lead tip. Should produce click from the speaker? If this is OK, troubles may be in RF stages. If this is not, troubles is in IF stages. Check V7 and V8. Check VFO injection voltage at pin 1 of V3 with RF probe.

This is about 2 volts. Touch test lead to pin 1 of V3. Using this lead as an antenna, you should hear noise. If not, check voltages of V3 and V6. If the noise does come up at this point, the troubles are in RF stages.

If the troubles are nearer the front end of the receiver than V3, you should be hearing some tube noise even if no signals. While listening to this noise, pull out V2 from socket. If this stage working normally, there should be a marked decrease in the noise. If there is not, check voltages in this stages. A test lead attached to pin 7 of V2 should bring in some of the stronger signal if the stage is working normally. In this case, troubles must be in RF amplifier stage.

This stage by stage technique should enable you to isolate the trouble in almost all cases where the receiver is dead. If the complaint is lack of sensitivity though the set is still operative, a similar retracing from the audio stage back to front end should be used. Remember that troubles confined to one of two bands must be in V1, V2 or V3.

If the S-meter fails to read correctly, check AVC circuit.

## 5. ACCESSORY BANDS:

Band switching in this receiver dose not affect any of the circuit following the 1st mixer, the problem of extended coverage has been greatly simplyfied. Such additional coverage may be desired for covering MARS frequencies, the citizens band and broadcast of other applications.

The general formula for calculating the crystal frequency required to cover a given band of frequencies is as follows;

$$\text{XTAL} = \text{Lowest desired frequency} + 5,955 \text{ Kc.}$$

For example; find crystal frequency for band coverage of 8 to 8.6 Mc.

$$\text{Crystal frequency is } 8,000 + 5,955 = 13,955 \text{ Kc.}$$

In this example, VFO dial is 100 Kc higher. To read receiving frequency direct from the dial, it is desired to select lowest frequency at 900 Kc. That is like 7,900 Kc or 10,900 Kc. Oscillator plate coil should be tuned to crystal frequency given from above formular. Overtone crystal is not recommended. See crystal table following.

To use extra bands, it is necessary to connect bands switch to appropriate coils as shown in figures.

The use of frequency range between 4,000 Kc and 7,000 Kc is not recommended.

The following table shows crystal frequencies required to obtain coverage of any band between 7 Mc and 30 Mc. Coil and shunt capacitor are also shown.

## RESISTANCE MEASUREMENT FOR FR-100-B

TUBE \n	PIN NUMBER									
	1	2	3	4	5	6	7	8	9	
V 1	4.3M	150 ~10K	0	0		18K	0			
	22K	170	0	0			100K			
	22K	170	0	0	15K	38K	470K			
	50K	∞	0	0	260K	180K	∞			
	50K	0	0	0	18K	28K	0			
		75K	470	0	0		47K	0	0	
	1.1M	100 ~10K	0	0		17K	100 ~10K			
	0.9M	100	0	0		17K	100			
		0~500K	2.2K	0	0		1.2M	2.2K	0	
	600K	390	0	0			600K			
		50K	470~∞	0	0		50 K	470~∞	0	
	18K	17K	1.4M	0	0		∞	1.4M		

Value are measured by VTVM.

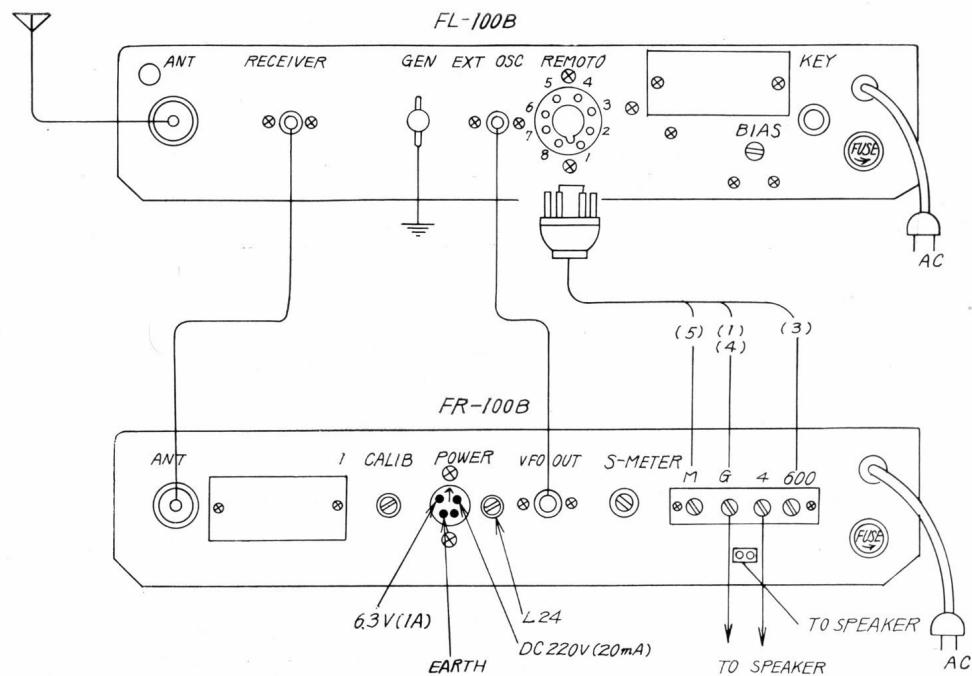
ALL RESISTORS VALUES ARE IN OHMS (K=1,000 M=1,000K)

## VOLTAGE MEASUREMENT FOR FR-100-B

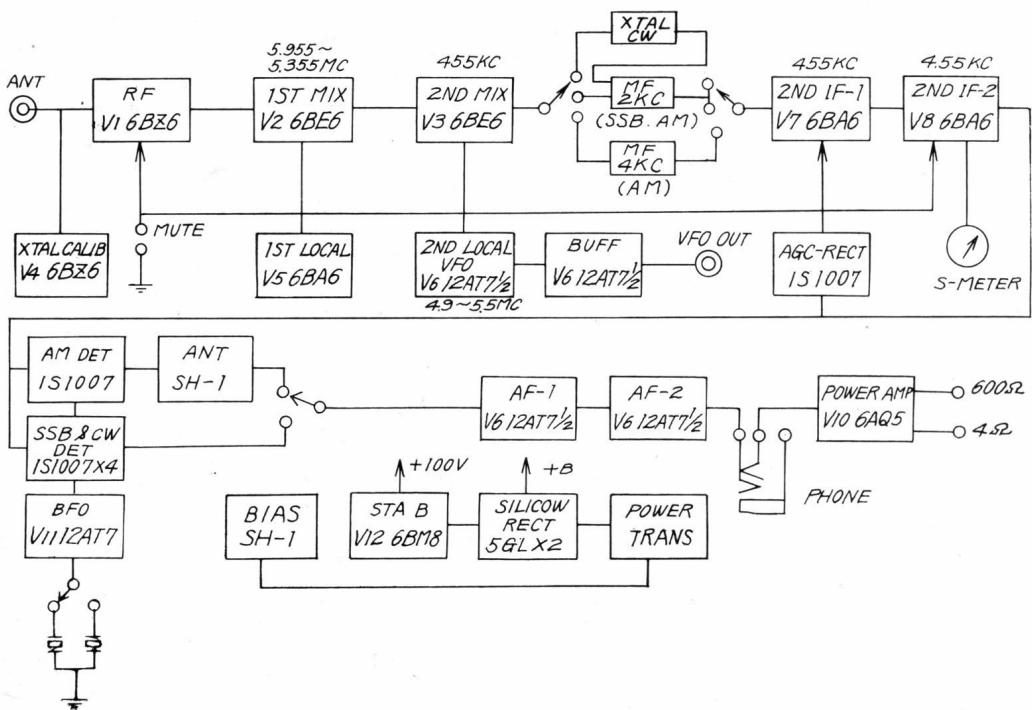
TUBE	PIN NUMBER								
	1	2	3	4	5	6	7	8	9
V 1	G1	0.9~6.9	H	E	215V	100V	E		
2	G1	2.2	H	E	215	75	G3		
3	G1	2.2	H	E	215	70	G3		
4	G1	0.4	H	E	50	18	0.4 /10		
5	G1	E	H	E	94	82	E		
6	215	G	3.2	E	E	87	G	2K	H
7	G1	1.5~13	H	E	213	100	1.5~13		
8	G1	1.5	H	E	213	100	1.5		
9	85	G1	3.5	E	E	60	G1	2.7	H
10	G1	13	H	E	212	215	G1		
11	150 /USB	G1	2/USB	E	E	150 /LSB	G1	2/USB	H
12	50	100	75	E	H	215	215	54	75

VALUE ARE MEASURED BY VTVM.

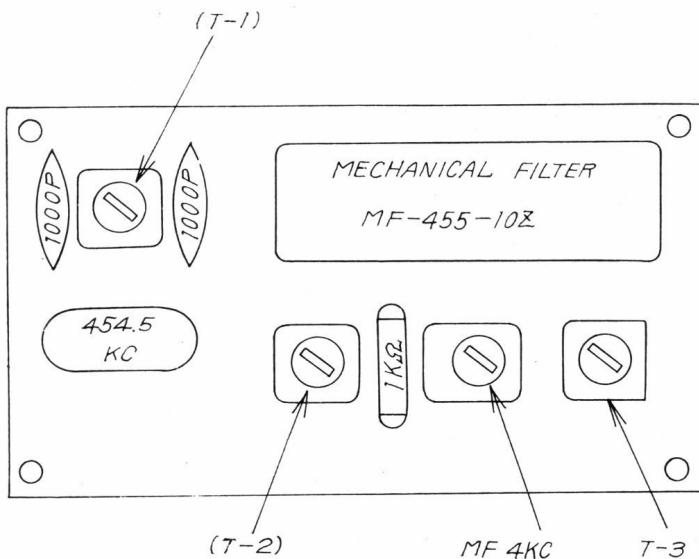
## CONNECTION OF FL-100-B TRANSMITTER & FR-100-B RECEIVER FOR TRANSCEIVE OPERATION



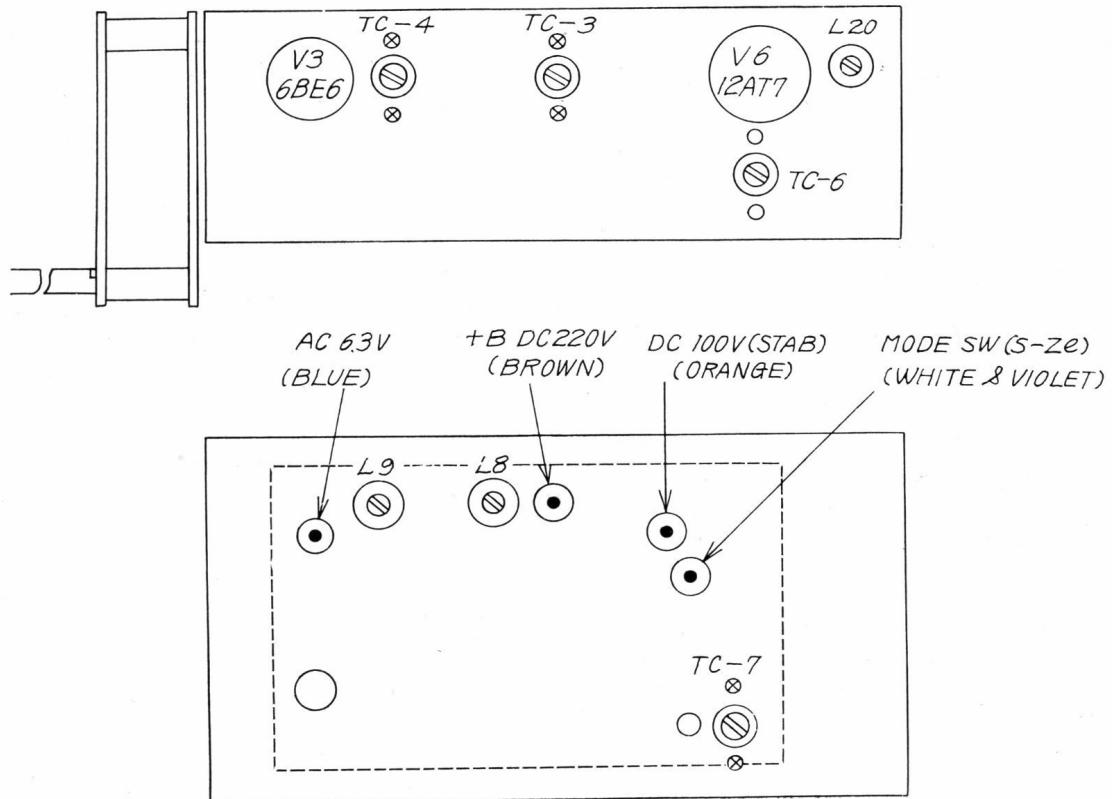
## BLOCK DIAGRAM FOR FR-100-B RECEIVER



# FILTER ASSEMBLY



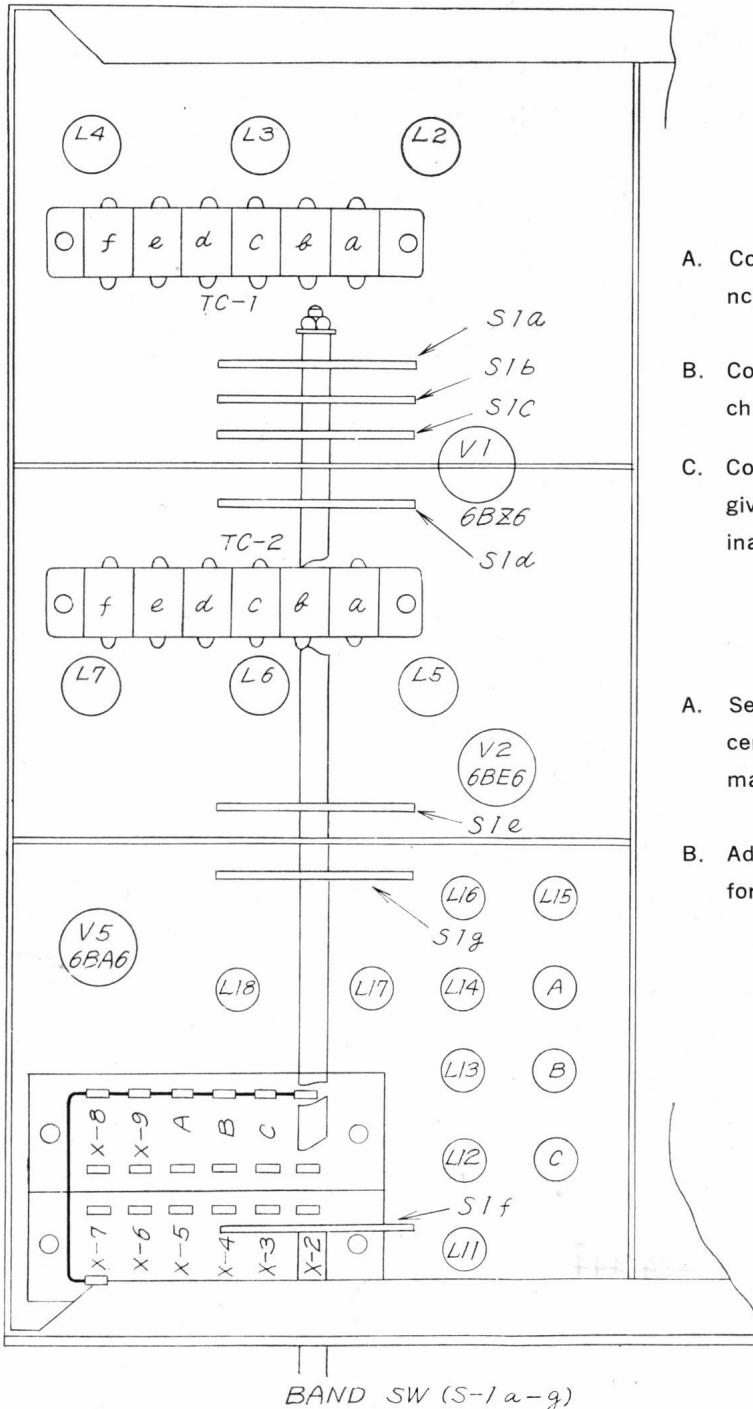
# VFO BOX & IF STAGE



BAND COVERAGE IN MC.,	X-TAL REQUIRED IN MC.	RF COILS	SHUNT CAP. IN PF.		
			RF	IN PF.	OSC.
7.5 - 8.1	13.455	L3 & L6	110	plus trimmer	50
7.9 - 8.5	13.855	"	100	"	"
8.5 - 9.1	14.455	"	80	"	"
8.9 - 9.5	14.855	"	70	"	"
9.5 - 10.1	15.455	"	60	"	40
9.9 - 10.5	15.855	"	50	"	"
10.5 - 11.1	16.455	"	40	"	"
10.9 - 11.5	16.855	"	30	"	"
11.5 - 12.1	17.455	"	20	"	"
11.9 - 12.5	17.855	"	20	"	20
12.5 - 13.1	18.455	"	15	"	"
12.9 - 13.5	18.855	"	10	"	"
13.5 - 14.1	19.455	"		"	"
13.9 - 14.5	19.855	"		"	"
14.5 - 15.1	20.455	"		"	"
14.9 - 15.5	20.855	L4 & L7	60	"	"
15.5 - 16.1	21.455	"	50	"	"
15.9 - 16.5	21.855	"	30	"	"
16.5 - 17.1	22.455	"	"	"	10
16.9 - 17.5	22.855	"	20	"	"
17.5 - 18.1	23.455	"	"	"	"
17.9 - 18.5	23.855	"	10	"	"
18.5 - 19.1	24.455	"	"	"	"
18.9 - 19.5	24.855	"	"	"	"
19.5 - 20.1	25.455	"		"	"
19.9 - 20.5	25.855	"		"	"
20.5 - 21.1	26.455	"		"	5
20.9 - 21.5	26.855	"		"	"
21.5 - 22.1	27.455	"	15		"
21.9 - 22.5	27.855	"	"		"
22.5 - 23.1	28.455	"	"		"
22.9 - 23.5	28.855	"	10		"
23.5 - 24.1	29.455	"	"		"
23.9 - 24.5	29.855	"	"		"
24.5 - 25.1	30.455	"	5		"
24.9 - 25.5	30.855	"	"		"
25.5 - 26.1	31.455	"	"		"
25.9 - 26.5	31.855	"	"		"
26.5 - 27.1	32.455	"			
26.9 - 27.5	32.855	"			
27.5 - 28.1	33.455	"			
27.9 - 28.5	33.855	"			
28.5 - 29.1	34.455	"		remove 3T from	
28.9 - 29.5	34.855	"		oscillator coil.	
29.5 - 30.1	35.455	"		"	

As described, overtone crystal is not recommended. For the crystals higher than 15 Mc., fundamental crystal frequency should be 1/2 or 1/3 of above listed value. Bands between 4,100 and 6,900 Kc are not recommended to use. The group starting from 500 Kc corresponds to red scale of dial: group starting from 900 Kc to black scale.

# EXTRA BANDS MODIFICATION



- Connect the coils given from frequency chart to S1a, S1c, and S1d.
- Connect the capacitor given from the chart between S1b S1e and ground.
- Connect coils to S1g, and capacitor given from the chart between terminals of coil.

## ALIGNMENT

- Set the "PRESELECTOR" to the center, and adjust a trimmer for maximum S-meter reading.
- Adjust a slug of a appropriate coil for 1.5V injection to mixer grid 1.

