CANADIAN MARCONI COMPANY

CH 100

SSB TRANSCEIVER

1.6MHz - 9.0MHz. 100W. P.E.P.

MARINE - MOBILE
BASE OPERATION

SERVICE MANUAL

919 797500 001

marconi canada

CH100

SERVICE MANUAL

919 797500 001

INCLUDES

12.3 MHz to 13.2 MHz Frequency
Extension Kit
Publication No. 919-797500-301
As Appendix A

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SECTION 1

GENERAL INFORMATION

1.1 General Description

The CH100 is a Single Sideband solid state radio transceiver which operates in the frequency range 1.6 to 9.0 MHz. It is available as a Canadian model (CH100) meeting D.O.C. requirements or a U.S. model (CH100MA and CH100MB) meeting FCC requirements. The only differences are in the Harmonic filters required to meet FCC specifications for spurious emissions and the crystal filter which, for FCC models, has a narrower bandwidth.

Transceivers may be supplied with an internal Antenna Tuner Unit (ATU) or equipped for use with an external ATU.

All the circuitry of the CH100 operates on 13.6 VDC. An optional internal converter is available to enable operation from 26 or 36 VDC. Models equipped for use with external ATU's may also be supplied with an optional internal Power Supply enabling 115/230 VAC operation. U.S. models are designated CH100 MA with an internal ATU and CH100MB if equipped for use with an external ATU. Canadian models are designated as CH100. Technical specifications of the CH100 Series are detailed in Table 1-1 and, unless otherwise specified, the information given applies to all models.

Part numbers of the four basic models available are as follows:

CH100 equipped with Internal ATU	244-767500-801
CH100 equipped for use with External ATU	244-767500-802
CH100 MA (equipped with Internal ATU)	244-767500-803
CH100 MB (equipped for use with External ATU)	244-767500-804

Any basic model selected may have a variety of optional features fitted. A summary of these options is given in Table 1-2 on page 1-6.

Before operating this radio, the agency should determine that national and local requirements regarding licencing and use of radios are being complied with.

WARNING

The RF power Transistors used in the Transmitter Power Amplifier (Q_1 Q_2 Q_3) and the Bridge Rectifier used on the AC power supply contain Beryllium Oxide, a TOXIC substance. If the ceramic, or other encapsulation is opened, crushed, broken or abraided, the dust may be hazardous if inhaled. Use care in replacing components of this type.

NOTE

For information related to Voice Operated Squelch VOS refer to publication No. 919-797500-401.

TABLE 1-1 TECHNICAL SPECIFICATIONS CH100

HF SSB RADIO TELEPHONE

GENERAL	
Frequency Range	1.6 to 9.0 MHz
Channels	Up to 11 Simplex (20 Simplex optional with A/B switch) Up to 10 Semi-Duplex
Duty Cycle	
Receiver	100 %
Transmitter	20 % (1 minute transmit, 4 minutes receive) on a 2 tone 100 W PEP Practically continuous on voice (see Section 4)
Modes	A3J Single sideband A3H Compatible AM A3A Reduced carrier
Humidity	95 %
Temperature Range	$-30^{\circ}C$ to $+60^{\circ}C$ ($-22^{\circ}F$ to $+140^{\circ}F$)
Vibration	0.030 inch from 10 - 30 Hz
Supply Voltage	13.6 VDC standard 26/36 VDC optional 115/230 VAC optional (Models equipped for use with external ATU only)
Microphone	Dynamic type 470 Ω impedance
Dimensions	H: 3.5 in. / 8.9 cm; W: 12 in. / 30.5 cm; D: 16 in. / 41 cm
Weight	
With 13.6 VDC Power Supply	13 lbs 5.9 Kg
With 26/36 VDC Power Supply	16.3 lbs 7.3 Kg
With 115/230 VAC Power Supply	28.4 lbs 12.8 Kg
Voltage Regulation	Solid State regulators provide 10 VDC to receiver and transmitter circuit boards.
TRANSMITTER	
Power Output	100 watts PEP
Current Drain	150 watts (11.2 A at 13.6 VDC) 2 tone 100 W PEP 109 watts average on voice (8 A at 13.6 VDC)
Intermodulation Products	32 dB below PEP
Carrier Level	A3J 46 dB below PEP A3H 6 dB below PEP A3A 16 dB below PEP

TABLE 1-1 TECHNICAL SPECIFICATIONS CH100 (Cont'd)

HF SSB RADIO TELEPHONE

Frequency Stability	±20 Hz from -30°C to +60°C
Spurious Emission	43 dB below PEP model CH100 63 dB below PEP models CH100MA, CH100MB
Side Band Suppression, 1000Hz	55 dB below Tone or Better.
Noise Level	43 dB below PEP.
RF Output Impedance	50 ohms
RECEIVER	
Current Drain	12 watts (0.88 A at 13.6 VDC)
Sensitivity	AM mode 1.0 μV for 6 dB sinad SSB mode 0.5 μV for 12 dB sinad
Frequency Stability	±20 Hz from -30°C to +60°C
Selectivity	AM mode 6 dB ≥5 KHz 60 dB ≤12 KHz SSB mode CH100 6 dB ≥2.4 KHz 60 dB ≤6 KHz CH100MA and CH100MB 6 dB ≥2.1 KHz 60 dB ≤6 KHz
Spurious Response	60 dB below sensitivity level
Front End Protection	Will take without failure 10 watts of RF power from a 50 Ω source.
AGC Range	Audio output varies less than 10 dB for an input variation of 10 μV to 1 V.
Audio Output	Speaker 3 watts, less than 5 % distortion
Receiver Radiation	1 pico watt maximum
Clarifier Range	Greater than ±150 Hz
EXTERNAL ANTENNA TUNER	
Number of Channels	11
Dimensions	H: 6 in. (15.2 cm); W: 11 in. (28 cm); D: 17 in. (43.2 cm)
Weight	7.5 lbs 3.4 Kg

1.2 Physical Description

The CH100 is enclosed in an aluminum housing as shown in Figure 1-1. The front panel carries the control switches and the rear panel forms the heat sink for the transmitter Power Amplifier.

Loosening two screws at the top of each side of the unit will allow removal of the top cover which gives access to the HFO-BFO Printed Circuit Assembly. Figure 1-2 shows this view and key areas are indicated.

Similarly, removal of the lower cover provides access to the Transmitter/Receiver Printed Circuit Assembly and Figure 1-3 shows this view.

The operating controls which may be seen in Figure 1-1 are located on the front panel and the microphone case. Their functions are as follows :

ON-OFF AF GAIN CONTROL

Turning the knob clockwise switches the equipment ON, and further turning controls the volume.

AM-USB-LSB MODE SWITCH

This is a three-position switch. With the switch in the AM position the receiver performs as a true double sideband (AM) receiver. The transmitter will transmit in A3H mode (compatible AM).

With the switch in USB, the receiver and the transmitter will perform in SSB mode (A3J modulation) on the Upper Sideband.

With the switch in LSB, the receiver and the transmitter will perform in SSB mode on the Lower Sideband if it is equipped with the LSB kit. If the LSB kit is not fitted, the unit will operate on USB.

CLARIFIER

This control operates only on "RECEIVE". Its function is to fine tune the HF oscillator so that the incoming SSB signal will be exactly on frequency for clearest speech. Normally it should be set in mid-position.

CHANNEL SELECTOR

This eleven-position switch determines the channel on which the receiver and transmitter will operate.

Tx INDICATOR

This red LED (Light Emitting Diode) will be lit when unit is transmitting.

VOS/OFF (Voice Operated Squelch)

This is a two-position switch which operates in receive mode. When in the 'VOS' position, the receiver is squelched until a signal is received, at which time the receiver unsquelches. When the switch is in the 'OFF' position the receiver is unsquelched all the time. The 'VOS' kit is optional.

A/B

This is a two-position switch. The purpose of the switch is to have two channels for each Channel Selector position. Up to 20 simplex channels may be obtained this way by using positions 1 to 10 on the Channel Selector. Channel 11 cannot be used with the A/B feature. The A/B 20 channels kit is optional.

METER

The meter reads relative signal strength on receive and relative power output on transmit.

PTT PUSHBUTTON

Located on microphone case, when depressed, this pushbutton puts the transceiver in transmit mode, and in receive mode when released.

1.3 Options and Accessories

Conversions or kits are available to increase the number of channels or provide alternative modes of operation as follows:

a) Semi-duplex operation up to ten channels.

b) Simplex operation up to twenty channels.

c) Lower Sideband operation available as a conversion kit (each kit converts four channels) to a maximum of eleven channels.

d) Automatic selection of A3A or A3H is possible for any channel desired.

A Voice Operated Squelch is optional and, when fitted, it may be switched off or on as required by the front panel switch marked VOS/OFF. Optional Power Supplies are available as outlined in Table 1-2.

Two whip antennas, suitable for different frequency bands, are available as optional equipment.

As an alternative to the standard microphone, a handset and hookswitch or a desk microphone is available.

For units not equipped with an internal ATU, an external remotely operated Antenna Tuner Unit is available. With this unit, the transceiver may be located up to 200 feet from the antenna.

Table 1-2 lists all the available options and accessories.

TABLE 1-2 OPTIONS AND ACCESSORIES

DESCRIPTION	PART NUMBER
Kit, Semi-Duplex single channel	241-717503-701
Kit, LSB 4 channels (3 kits maximum)	241-717504-701
Handset and Hookswitch Assembly	252-737506-701
Kit, Voice Operated Squelch	241-737522-70X
Power Supply, 115/230 V.AC	244-737515-701
Power Supply, 13.6 V.DC	244-737518-701
Power Supply 26/36 V.DC	244-737520-701
Kit, additional channel (specify frequency)	241-717650-701
Kit, A3A (standard on CH100MA and CH100MB)	241-717562-701
Kit, A/B 12-20 Channel Extension	241-737563-701
Antenna Tuner, External (When ordering this option specify the required cable length - 200 feet maximum)	244-767567-701
Antenna 390 (23 foot whip)	201-990073-146
Antenna 208B (23 foot loaded whip)	201 990077-138
Universal mounting kit	241-717532-701
Desk Microphone	278-720025-301
Distress Tone Generator (upon request)	
Dipole Kit	241-188567-002
Kit, CW Conversion	241-717509-701
Kit, Tone Call	241 717525-701

FIGURE 1-1 CH100 TRANSCEIVER UNIT

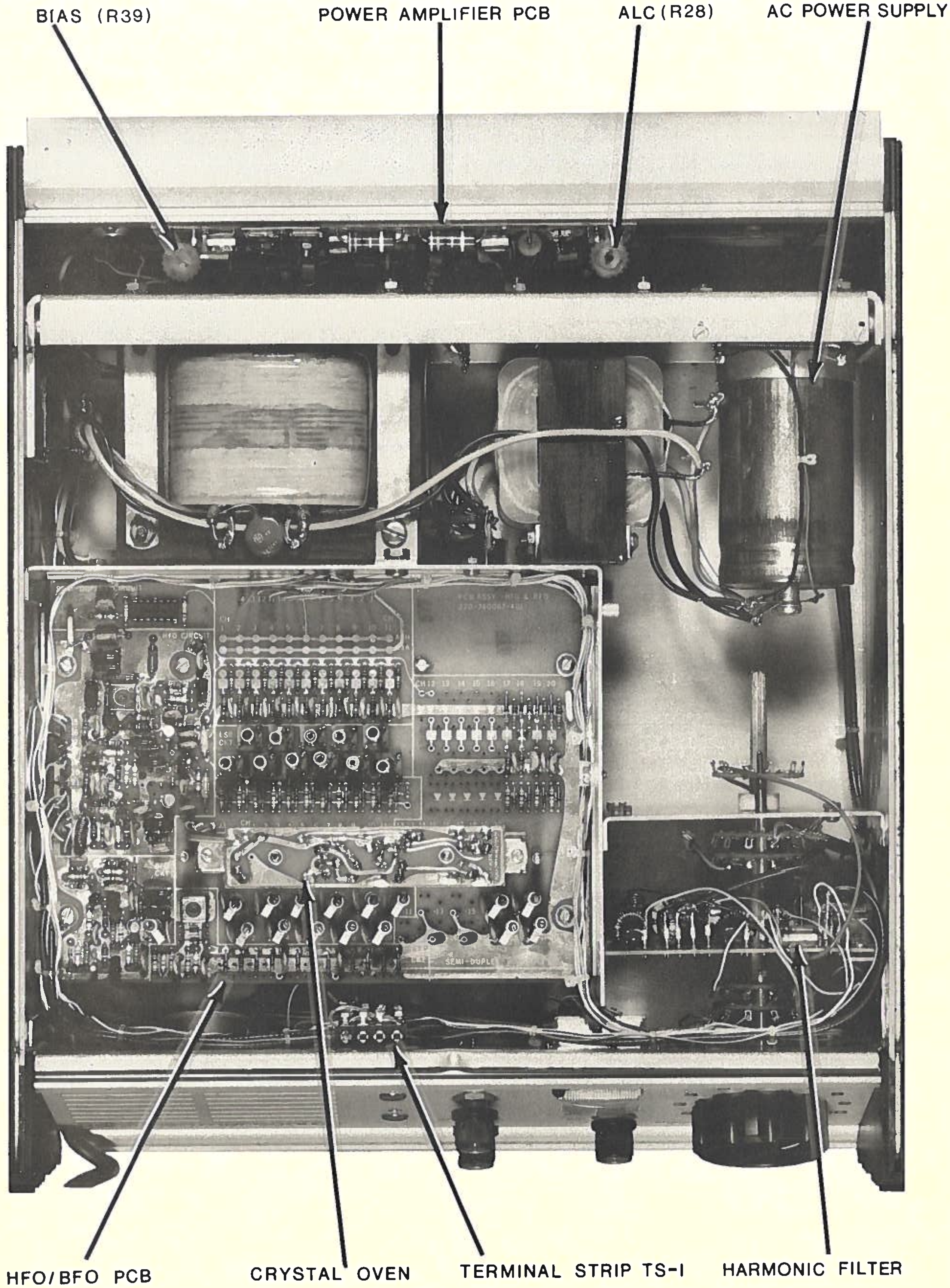


FIGURE 1-2 TRANSCEIVER UNIT INSIDE TOP VIEW

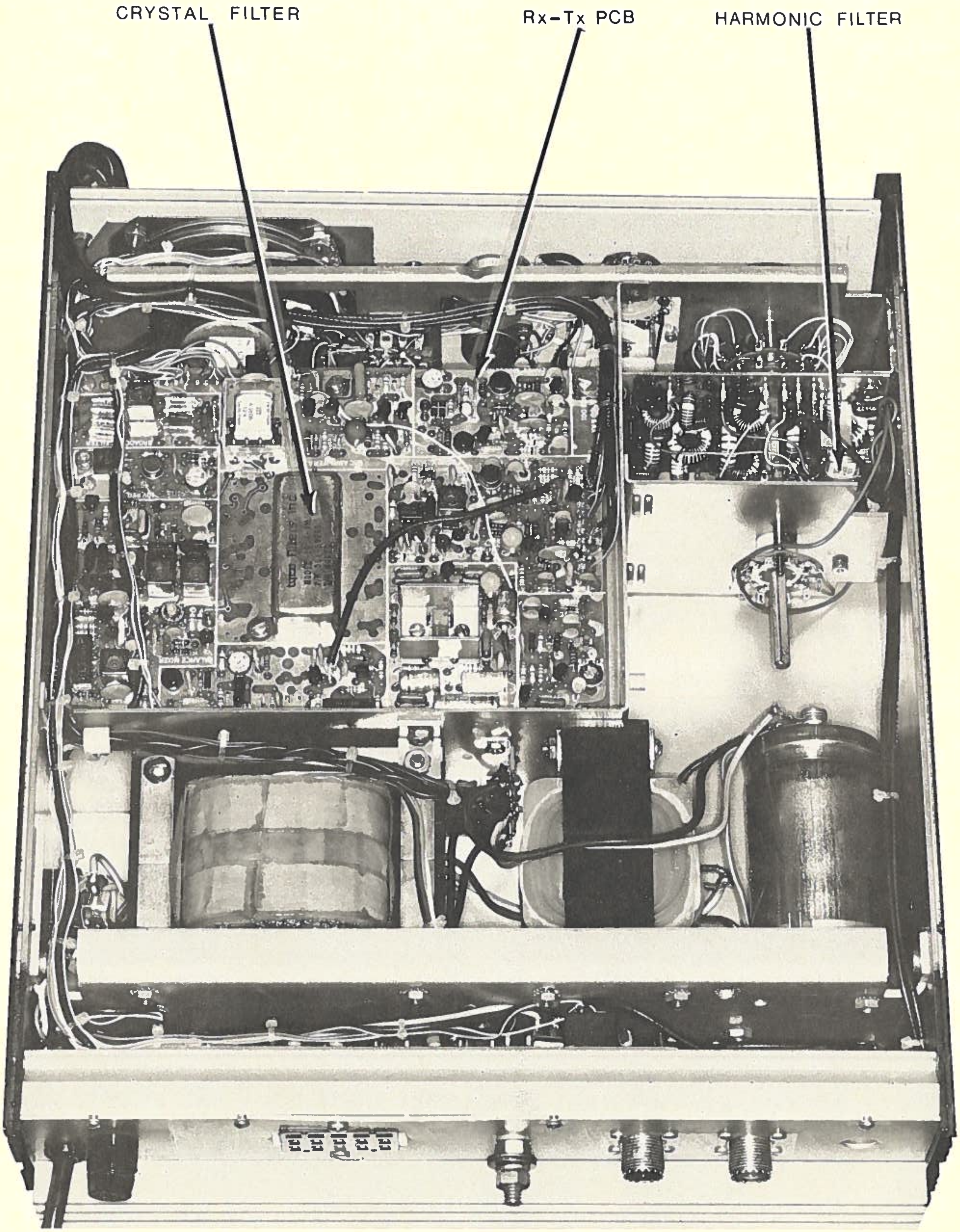


FIGURE 1-3   TRANSCEIVER UNIT INSIDE BOTTOM VIEW

SECTION 2

INSTALLATION

2.1 Installation

A universal mounting kit (CMC Part No.241-717532-701) is normally supplied with the Transceiver. An assembly is shown in Figure 2-1. The kit consists of a tray with a raised edge at one side and a clamp at the opposite side. When the Transceiver is placed in the tray, the clamp fits over the lower or upper rim of the set and tightening the two socket screws provides a rigid installation. Plastic beading on the edges of the clamping surfaces prevent marring of paintwork. Note that the mounting tray must be assembled towards the front of the Transceiver unit so that the back edge of the clamp clears the protruding screw head. The tray should be mounted on a flat surface either vertically or horizontally.

If the set is mounted on deckhead (overhead), the front panel of the radio would normally be angled back towards the deckhead and hence be difficult to see. Provision is therefore made to reverse the inclination of the front panel. To do this, loosen the four cover screws at each side of the unit and remove the top and bottom cover plates. The front panel may now be tipped forward and the cover plates reversed top to bottom.

CAUTION

It is important when choosing the location of the set to ensure that a free flow of air is permitted to the rear heat sink. Do not mount the unit with its back against a wall or otherwise enclose the back of the set.

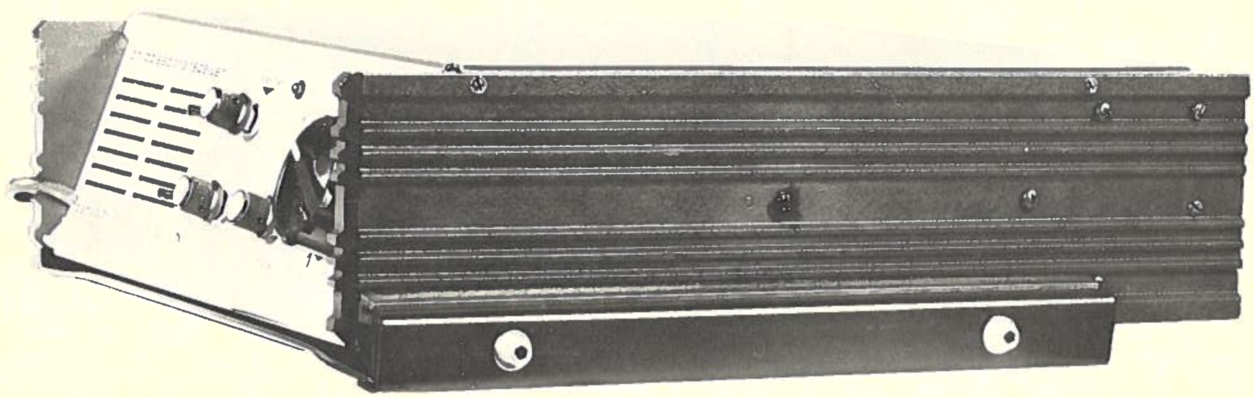
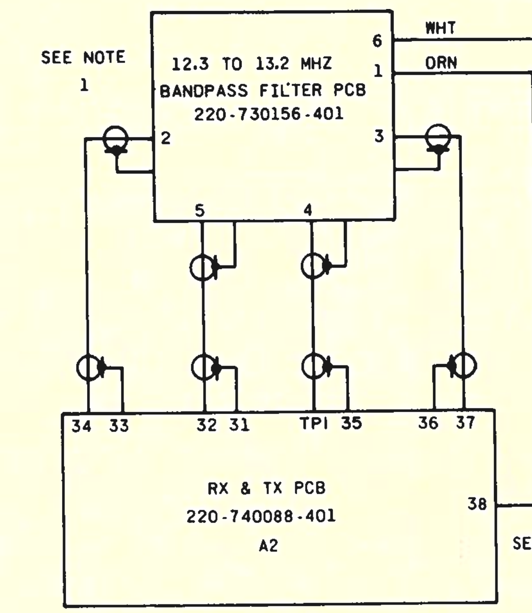


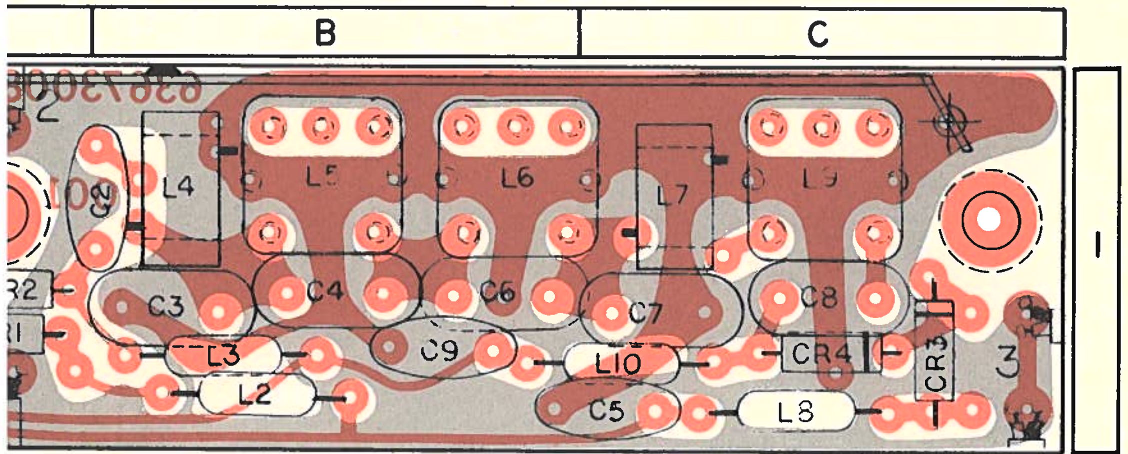
FIGURE 2-1 MOUNTING ASSEMBLY



5. FOR CHANNEL PROGRAMMING REFER TO PARA 6.4.3 OF BASIC MANUAL.
4. CI IS ADDED FROM S6 TERMINAL TO NEAREST CHASSIS GROUND.
3. SEE SCHEMATIC 220-710006-502 FOR CONNECTIO TO 220-737514-401 PCB.
2. SEE SCHEMATIC 220-720020-503 FOR CONNECTIO TO 220-740088-401 PCB.
1. PCB's 220-730156-401, AND 220-720072-401 AR PART OF CH100 12.3 TO 13.2 MHZ FREQUENCY EXTENSION KIT.
   PCB's 220-740088-401, 220-737514-401 AND W SWITCHES S5, S6 AND S7 ARE PART OF TRANSCE ASSEMBLY.

NOTES: (UNLESS OTHERWISE SPECIFIED)

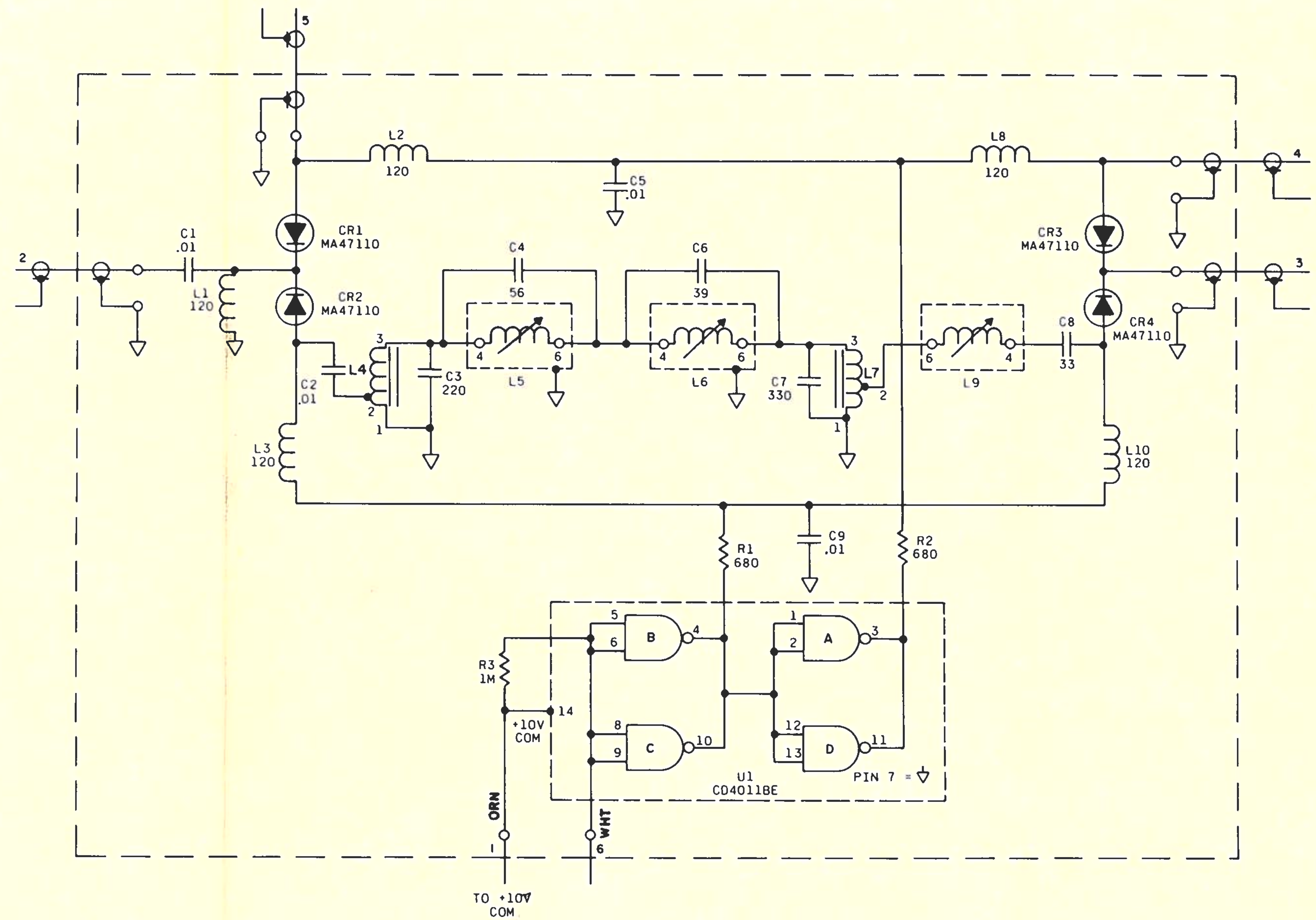
VIEWED FROM COMPONENTS SIDE



SOLDER SIDE SHOWN IN PINK, COMPONENT SIDE IN GREY

COMPONENTS LOCATION INDEX

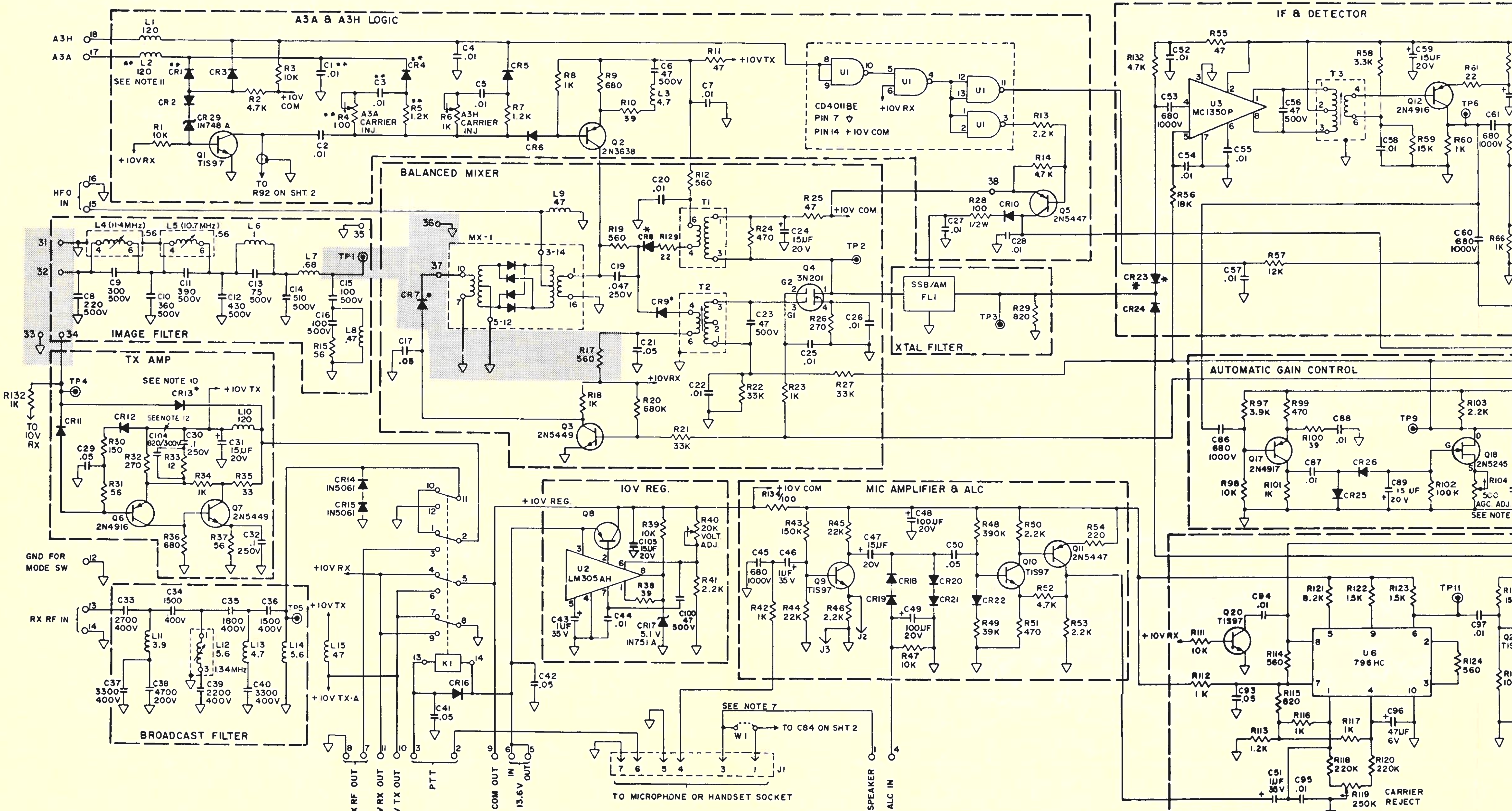
COMP	LOC	COMP	LOC
C1	A1	L2	B1
C2	A1	L3	B1
C3	B1	L4	B1
C4	B1	L5	B1
C5	C1	L6	B1
C6	B1	L7	C1
C7	C1	L8	C1
C8	C1	L9	C1
C9	B1	L10	C1
CR1	A1	R1	A1
CR2	A1	R2	A1
CR3	C1	R3	A1
CR4	C1		
		U1	A1
L1	A1		



5. ⏚ INDICATES FLOATING GROUND.
4. ALL COILS ARE IN MICROHENRIES.
3. ALL RESISTORS ARE 0.25 WATT, 5%.
2. ALL CAPACITORS > 1 ARE IN PICOFARADS.
1. ALL CAPACITORS < 1 ARE IN MICROFARADS.

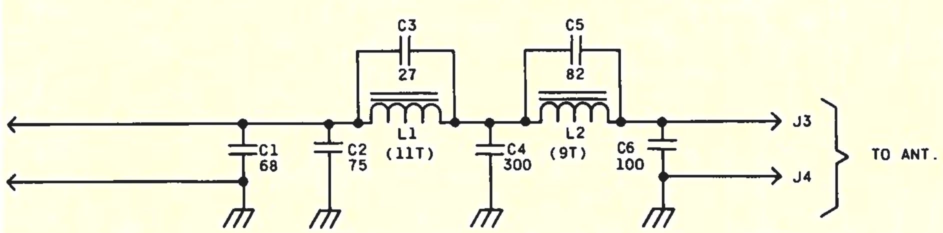
NOTES: (UNLESS OTHERWISE SPECIFIED)

Figure 2-2. Schematic Diagram & Component Location Data, 12.3 to 13.2 MHz Bandpass Filter PCB.



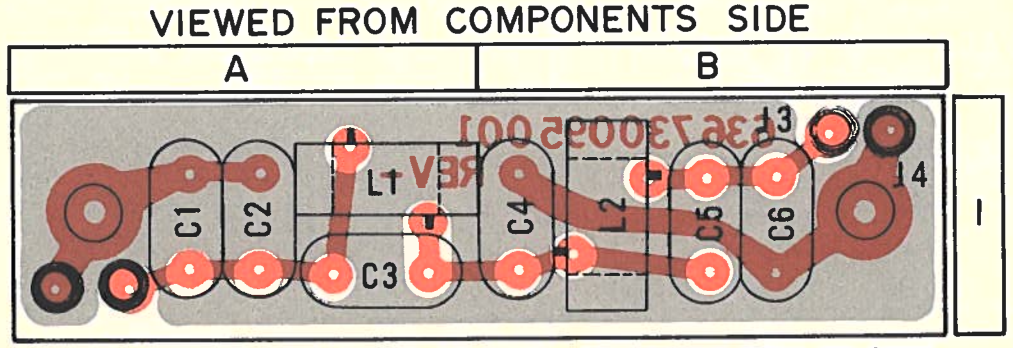
SHADED AREAS INDICATE THE CHANGES TO THE BOARD. REFER TO FIGURE 7-5 OF CH100 MANUAL (919-797500-001) FOR SCHEMATIC DIAGRAM PRIOR TO MODIFICATION.

12.3 — 13.2 MHz HARMONIC FILTER



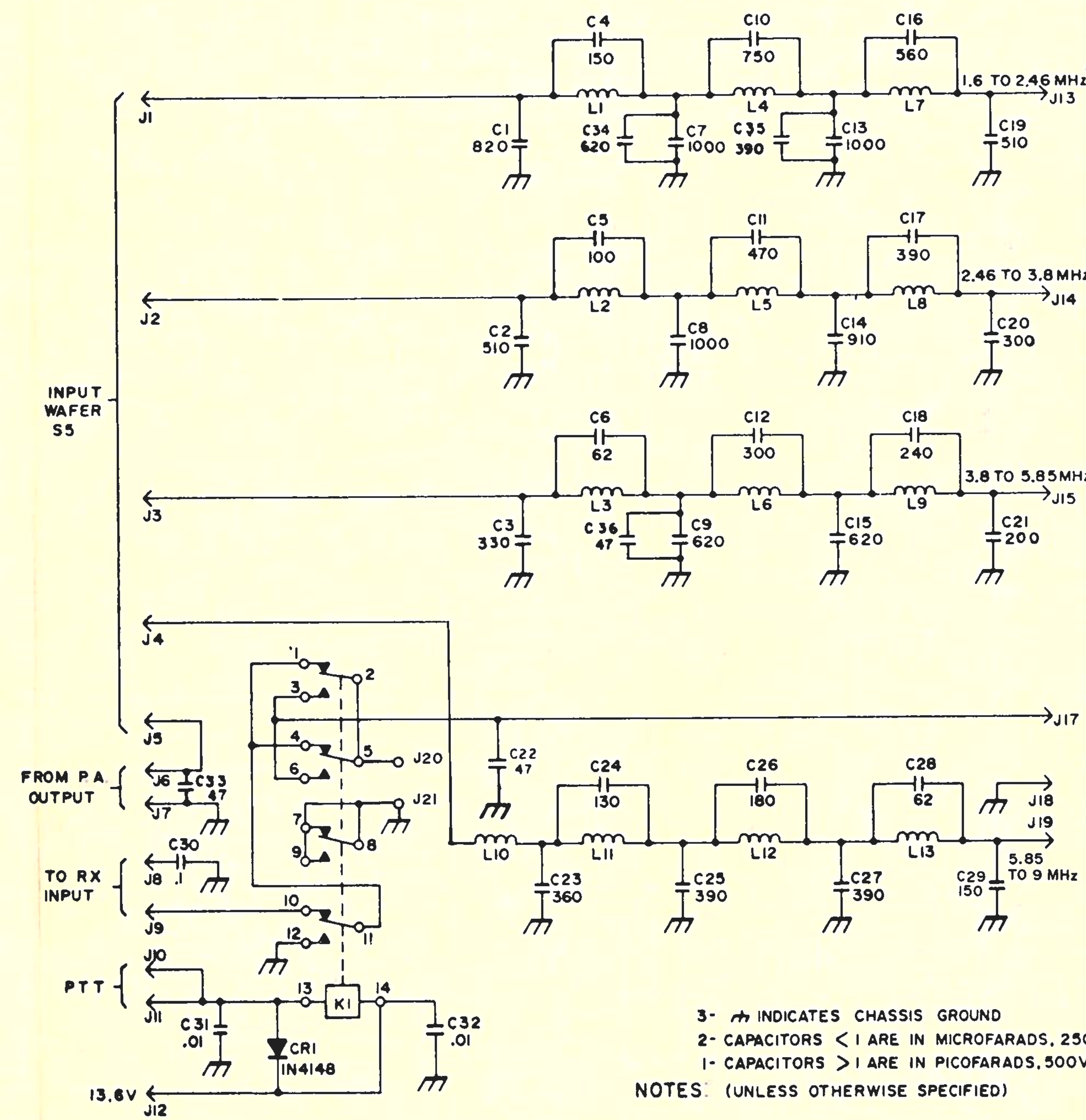
NOTES: (UNLESS OTHERWISE SPECIFIED)
1. ALL CAPACITORS > 1 ARE IN PICOFARADS.
2. ⏚ INDICATES CHASSIS GROUND.

VIEWED FROM COMPONENTS SIDE



NOTE: SOLDER SIDE SHOWN IN PINK, COMPONENT SIDE IN GREY

CH100MC / CH100MD HARMONIC FILTER (FCC)



NOTES: (UNLESS OTHERWISE SPECIFIED)
1- CAPACITORS >1 ARE IN PICOFARADS, 500V
2- CAPACITORS <1 ARE IN MICROFARADS, 250V
3- ⏚ INDICATES CHASSIS GROUND

Figure 2-4. Schematic Diagram & Component Location Data, 12.3 to 13.2 MHz Harmonic Filter PCB.

SECTION 3

ANTENNAS AND ANTENNA TUNING

3.1 General

The Transceiver may be connected directly to any 50Ω antenna such as a tuned matched dipole or a 1/4 wave length vertical antenna. Such an antenna, however, would only be tuned at a single frequency and a different antenna would be required for each channel. If a single antenna is to be used for a range of frequencies, an Antenna Tuner Unit (ATU) will be required. The ATU provides a set of matching networks, one of which is selected for each position of the CHANNEL selector switch. An ATU may be fitted internally or supplied as an external unit. Figure 3-1 shows a CH100 fitted with an internal ATU and Figure 3-5 shows the separate external ATU. The external ATU may be located up to 200 feet from the Transceiver. Once the Transceiver unit is correctly aligned and the crystal frequencies properly netted, the ATU must be tuned to match the antenna. Procedures are given in Section 3.3.1 for the internal ATU and in Section 3.4.1 for the external ATU.

3.2 Antennas

There are two whip antennas available from Canadian Marconi Company which are suitable for the CH100 Series. Each is designed for marine use and moulded in glass reinforced epoxy resin. The following table gives basic data for these two antennas. The frequency range given may vary somewhat depending on the length of lead-in and ground wire.

MODEL NO.	ANTENNA LENGTH	FREQUENCY RANGE	
		Internal ATU (MHz)	External ATU (MHz)
208B (loaded whip)	23 ft with 9 ft lead-in	1.95 - 2.85 3.8 - 9	1.6 - 2.8 3.8 - 9
390 (whip)	23 ft with 9 ft lead-in	2.45 - 7.4	2.45 - 7.4

General information for the frequency range of other suitable end fed wire antennas is given in the following table.

ANTENNA TYPE	FREQUENCY RANGE (MHz) (with Internal or External ATU)
25 ft wire including lead-in	2.7 - 9
35 ft wire including lead-in	2.3 - 6.8
50 ft wire including lead-in	1.9 - 4.7
75 ft wire including lead-in	1.6 - 3.2

The choice of antenna in marine installations is usually governed by consideration of available space. The ideal length of antenna depends on the operating frequencies required and may be calculated from

$$\text{Antenna Length} = \frac{234}{\text{Frequency (MHz)}} \text{ ft} \quad \text{(L.E. for 1/4 wavelength).}$$

Clearly the lower frequencies will require longer antennas, e.g. 2.1 MHz requires approximately 110 ft. As may be seen from the foregoing data the ATU can be used to tune shorter antennas to cover the lower frequencies. A 50 ft wire antenna for example can be tuned as low as 1.9 MHz. If a wire antenna of more than 45 ft can be installed this is a preferred choice for marine frequencies. A centre loaded whip antenna will otherwise prove effective if space limitations prohibit such a long run of wire.

The lead-in wire which runs from the base of the antenna to the Transceiver unit forms part of the overall antenna length. The lead-in should be supported with stand off insulators over its run and cup insulators should be used where it passes through a bulkhead. The wire used should be well insulated high tension cable.

In measuring the length of the antenna include the entire run from the tip of the antenna to the antenna terminal on the Transceiver unit. The principal portion of the antenna should be located more than 20 ft above the pilot house or other major superstructure. Capacitive coupling to adjacent metallic rigging should be kept to a minimum by running the antenna across rather than parallel with rigging wire. If parallel runs cannot be avoided they should be as short as possible and separated by several feet. Losses due to parallel runs are caused because the capacitively coupled power is shunted to ground through adjacent rigging wire. This effect may also be minimized by installing insulators in rigging wires near the antenna.

If the Transceiver is used on land a tuned dipole (CMC 241-188567-002) antenna may sometimes be used. The dipole, when mounted a quarter wavelength above ground has an impedance of 75 Ω balanced. This impedance is matched to the 50 Ω output impedance of the CH100 using the Balun Transformer CMC 322-990078-760. The length of the dipole is calculated from the relationship

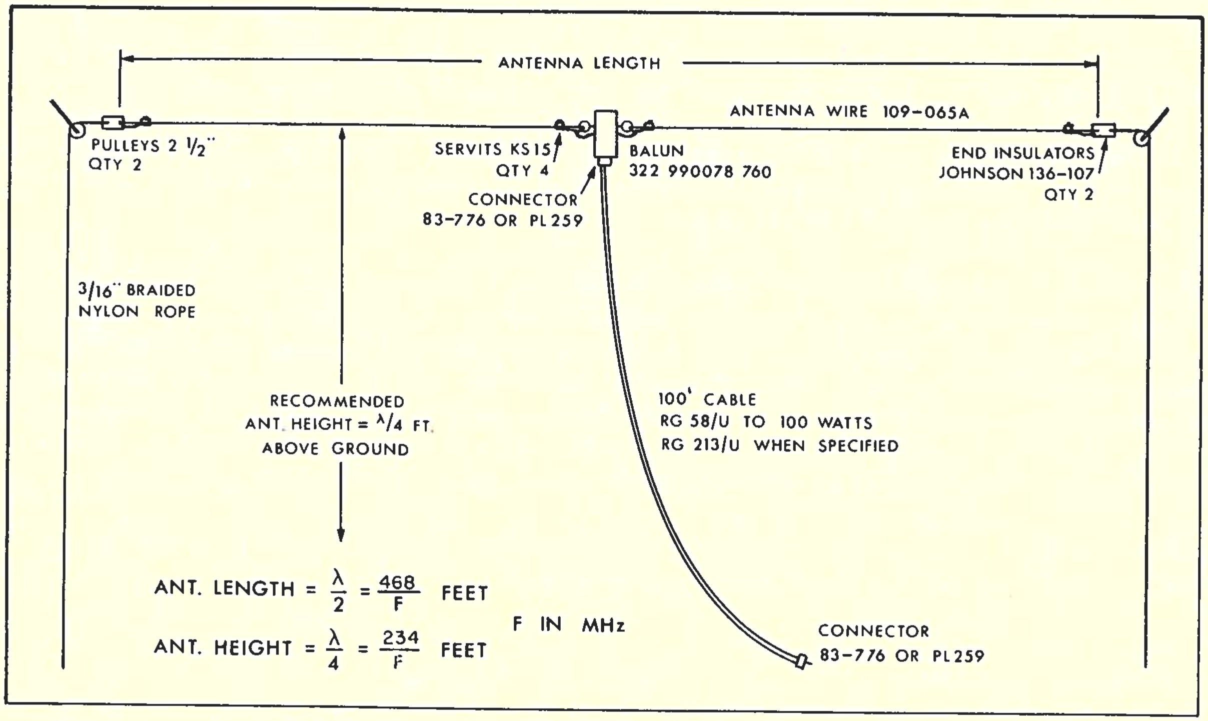
$$L = \frac{468}{\text{Frequency (MHz)}} \text{ ft.}$$

The general arrangement of the dipole and Balun Transformer is shown in the figure on the following page.

As a safety measure the CH100 should be grounded to protect the operator and the equipment from lightning.

With this type of antenna the ATU is not used. Connections are made directly to the antenna from J2 and the antenna will only be useful at one working frequency. If required, a second antenna may be connected at J3 and the wafer switch S7, which is operated by the Channel Selector switch, must be wired to switch to J2 or J3 as needed. (See note 5 of Internal Connection Diagram Figure 7-1.)

Other antennas are available for special applications of the CH100 and for more information contact the nearest CMC or KAAR dealer.



DIPOLE ANTENNA

3.2.1 Grounding

The efficiency with which the transceiver radiates and receives power is completely dependant on the antenna and its grounding system. A badly installed antenna or an inadequate grounding system may easily reduce the radiated power to as little as one tenth of the nominal rating.

The ground on a marine installation is the water outside the boat and the purpose of the grounding system is to provide a low impedance coupling between the ground terminal on the transceiver unit and the water. This is achieved in practice by having the ground terminal of the transceiver connected to a large conductive surface area outside the hull. This may be a copper plate (approximately 100sq. ft.) or as a practical substitute, because of its small size, a DYNAPLATE may be used. The 'giant' or 'super' are recommended, with the 'super' giving the best results. The DYNAPLATE is available from your CMC or Kaar dealer. The DYNAPLATE must be installed outside the hull, in the water.

The conductive surface provides capacitive coupling to the water with an impedance inversely proportional to its surface area. The minimum surface area used should be 1 sq. ft. per watt of transmitted power. In the case of a metal hull, the hull itself is the grounding plate. On non-metalic hulls there are often metal surfaces such as fuel tanks, drip pans, reinforcing bars inside the vessel, close to the hull which will be capacitively coupled to the water outside the hull. If the total surface area of these objects is great enough, they may be strapped together with 2 inch wide copper strap to form a common ground plate. The ground connection from the transceiver to the ground plate is very important. It should be made from at least 2 inch wide copper strap (or 2 or 3 in parallel) and securely fastened under one common ground stud. The ground connection must be as short as possible as the vertical antenna always starts at its electrical ground-plane. If the ground connection is too long, the radio becomes part of the antenna and tuning becomes difficult or impossible. A 10 foot ground connection is considered long, but will work if 2 or 3 copper straps, 2 inches wide, connected in parallel are used. All ground connections should be made with solid copper strapping rather than copper braid, especially in marine environments, as corrosion in the braid will greatly increase the resistance.

3.3 Internal ATU

An internal ATU may be fitted to any unit except those with the optional AC power supply.

The ATU assembly is shown in Figure 3-1 and the schematic diagram is Figure 3-2. The ATU is designed to match an end fed, capacitively reactive antenna system of less than a quarter wavelength with a resistive component in the range of 4 to 147 ohms.

As the schematic shows, there is a toroidal impedance matching transformer with taps at 4 to 147 ohms. The transformer is mounted on a small printed circuit board, indicated in Figure 3-1, and the impedance taps are connected through a rotary switch to the loading coil L1 which is mounted as shown in Figure 3-1. The rotary switch is actuated by the same shaft as the channel selector switch so that different matching networks may be selected for each channel. The correct matching network for each channel is obtained by selecting the proper inductive reactance and proper impedance transformation ratio for each channel. This is accomplished by following the procedure in 3.3.1.

The RF signal from the Transceiver at J2 is connected through a link cable to J3 which is the input to the internal ATU. J1 connects the signal from the internal ATU to the antenna.

3.3.1 Internal ATU Tuning Procedure

Equipment Required

Bird "Thruline" wattmeter (Model 43) with 50 watt HF element or equivalent.

Refer to Figure 3-1 and schematic diagram Figure 3-2.

ENSURE THAT POWER IS OFF.

Remove the short cable linking J2 and J3.

Connect the RF power output at J2 through the Bird "Thruline" wattmeter to the internal ATU at J3.

Connect the antenna to the porcelain connector J1. These connectors are all located at the rear of the set, see Figure 3-1.

Connect the ground wire to the ground terminal on the rear panel.

Connect all the impedance taps from the switch S9 to the 4Ω point on the transformer. The impedance points are marked on the transformer PCB. Connect the taps according to channel frequency so that the highest frequency channel tap is on top. Figures 3-3 and 3-4 have been prepared for selected antennas showing the number of turns on L1 required to tune a range of frequencies. Refer to these Figures and, for the antenna being used, estimate the approximate number of turns in L1 required for each channel frequency. For example, if channel 1 were 2.6 MHz and CMC Antenna 390 (23 ft whip) were connected with 12 ft of lead-in, refer to Figure 3-3 and use graph 3 to deduce that 76 turns of L1 will be required.

Connect the tap for each channel to the estimated turn number on L1. In the above example, the tap for channel 1 would be connected to turn number 76. The turns are numbered from the back of the Transceiver.

Every tap must be connected, taps corresponding to unused channels should be connected to any turn at the end of L1 near the wafer switch.

CAUTION

During this procedure, clip leads or coils carrying RF power must be handled using insulated tools. AVOID PHYSICAL CONTACT WITH LIVE CONNECTIONS.

Switch on the Transceiver, and allow 5 minutes warmup. Set the channel selector switch to the highest frequency channel. Select AM.

Turn AM injection control, R6, on the T/R P.C.Board, fully CW, then back it off about 1/8 turn. When the desired VSWR is reached, adjust R6 for 25 to 30 watts output.

Switch the diode on the wattmeter to measure reflected power. Operate the PTT switch and, while watching the reflected power level, move the clip on L1, corresponding to this channel, a half turn more or less until a minimum power is observed. Lightly tighten the clip. By removing both top and bottom covers from the Transceiver access to L1 may be obtained all around enabling half turn increments for the clips. Now remove the impedance tap for this channel from the 4Ω point and select the impedance point on the transformer which gives the minimum reflected power.

Reverse the diode on the wattmeter and measure the forward power. If the reflected power is 8% or less of the forward power (VSWR 1.8:1) tuning is satisfactory. However, the tuning process must be repeated if this ratio is too high.

The procedure should be repeated for each channel in descending order of channel frequency.

When all channels have been adjusted, re-check the VSWR on every channel and readjust any channel which does not meet the 8% specification.

3.4 External ATU

The external ATU is an optional assembly which may be used with CH100 Transceiver units not equipped with internal ATU's. It is packaged in an aluminum case with an ABS Plastic cover with overall dimensions of 17" (43.2 cm) x 11" (28 cm) x 6" (15.2 cm).

A coaxial cable connects RF to J1 and an eleven conductor cable connects channel switching logic to TB1 from the CH100 Transceiver Unit, see Schematic Diagram External ATU Figure 3-6. These cables may be up to 200 feet long. Connectors ANT 1 and ANT 2 allow connections to two separate antennas, provision being made within the ATU to switch selected channels to either antenna.

Figure 3-5 shows the external ATU assembly with the top cover removed. The unit consists of the toroidal matching transformer T1 and a fine tuning coil L2 mounted on a PCB with the loading coil L1 mounted separately.

Refer to the External ATU schematic diagram Figure 3-6. RF power is fed into the external ATU at J1 passing to the matching transformer T1. A clip lead connects the output from the transformer through wafer switch S4 to L2. A second clip lead connects the output from L2 through S3 to the loading coil L1. A tap from L1 through S2 shunts part of L1 depending on the channel selected. Wafer switch S1 connects the output from each channel to either ANT 1 or ANT 2 as desired.

Wafer switches S1 to S5 are mounted on a common shaft which is operated by the 12 VDC Motor B1. Power is connected to the motor when the relay coil K1 is energized from switch S5. When a new channel is selected, the contacts of J4, connected to TB1 in the external ATU, are switched through a wafer switch S8 (see Figure 3-7) in the Transceiver Unit. The motor will now run until S5 reaches the new channel position.

A resistor R2 is connected across the motor when it switches off. This damps the motor rotation and causes it to stop with the switch segments centered on their contacts.

NOTE

The PTT switch is also connected through the relay contacts of the external ATU preventing transmission while this motor is running, i.e. during the time required to switch channels.

If, therefore, the connector to the external ATU is removed, Transmit Mode cannot be selected. When testing on the bench a jumper may be added to short pin 7 to pin 8 of J4 if Transmit Mode is required.

3.4.1 External ATU Tuning Procedure

Refer to External ATU schematic Figure 3-6.

ENSURE THAT POWER IS OFF.

Connect the Bird "Thruline" wattmeter at the External ATU in the coaxial cable between J1 and P1.

Connect the antennas to ANT 1 and ANT 2.

Ground wires should be fastened to the ATU case under the wing nut.

Impedance taps from S4 should all be connected to the 4 Ω point of T1 in ascending order of channel frequency so that the highest frequency channel is on top.

Refer to Figures 3-8 and 3-9 and, for the antenna type being used, determine the number of turns required in L1 for each channel frequency being used. If two antennas are being used, be careful to use a different curve for those channels using the second antenna.

In Section 3.3.1 Internal ATU Tuning Procedure, the text provides more detail on interpreting the graphs if required.

Connect each tap from the wafer switch S2 to the appropriate turn number on L1. Turns are counted in ascending order from the end near wafer switch S1. It is important to connect all taps, unused channels should be connected to the top two or three turns at the end of L1 near the PCB.

Connect the taps from S3 to approximately mid range on the fine tuning coil L2.

Select the highest frequency channel. Switch on the Transceiver and allow at least 5 minutes warmup.

CAUTION

During this procedure, clip leads on coils carrying RF power must be handled using insulated tools. AVOID PHYSICAL CONTACT WITH LIVE CONNECTIONS

Operate the PTT located in the external ATU on the motor bracket. (This switch is provided especially for the tuning process since the Transceiver could be 200 feet away.)

Select AM Mode.

Move the clip on L1, corresponding to the selected channel up or down a turn until a minimum reflected power is observed on the "Thruline" wattmeter. Lightly fasten the screw clip in this position.

Take the clip on the fine tuning coil L2 corresponding to this channel and find the tap on L2 which further reduces the reflected power.

Take the impedance tap for this channel from the 4Ω point of the transformer T1 and select the impedance point which gives the minimum reflected power.

Switch the diode on the wattmeter and measure the forward power.

If the reflected power is 4% or less of the forward power (VSWR 1.5:1) proceed with the next channel tuning.

Tune the channels in descending order of frequency to minimize interaction between channels.

When all channels have been tuned, re-check the VSWR on every channel. If any channel does not meet 1.5:1 VSWR, repeat the tuning.

WARNING

In mobile installations where the antenna is mounted near the gas tank inlet, ensure that the transmitter is not activated during refuelling operation.

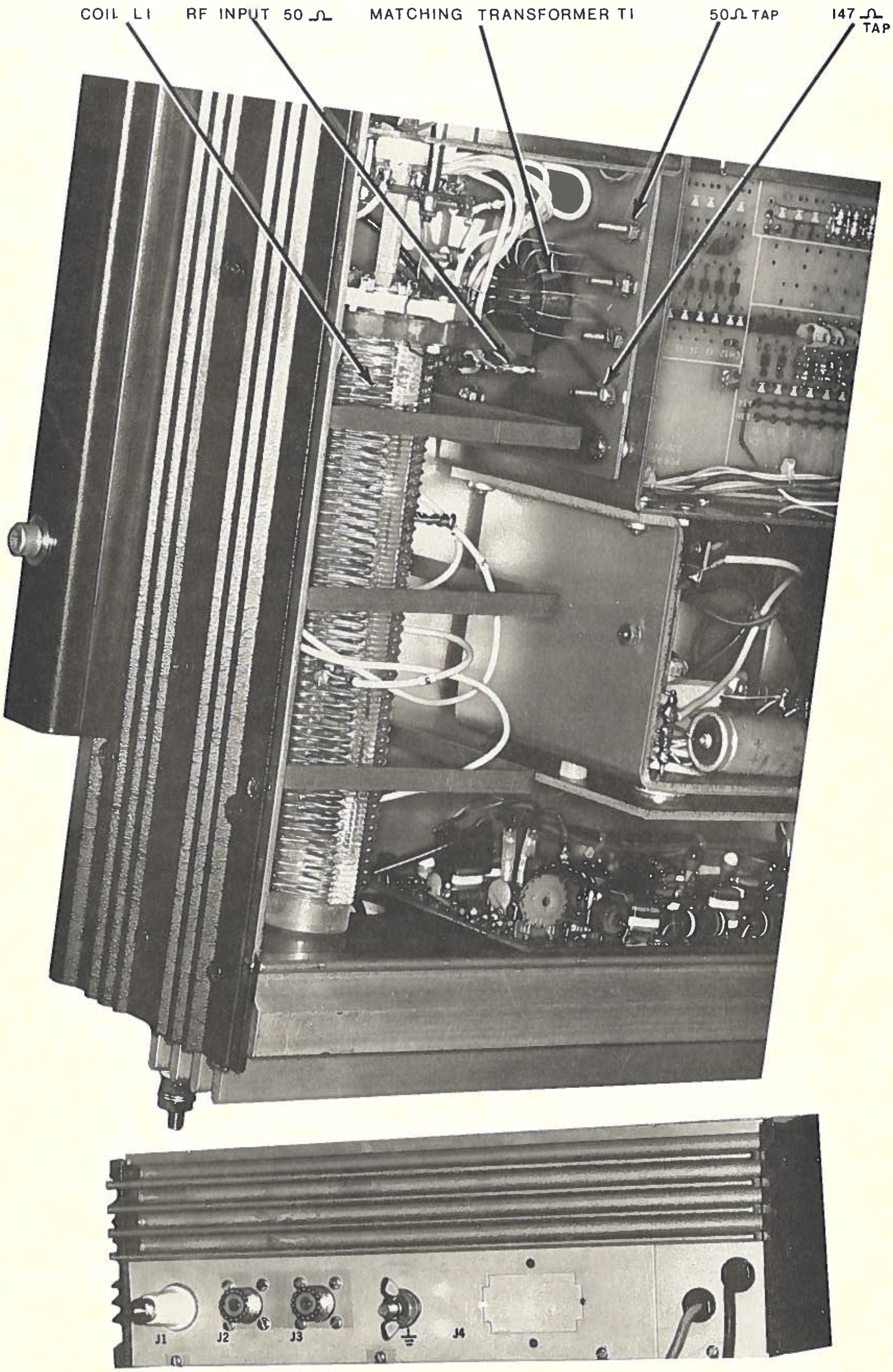


FIGURE 3-1 INTERNAL ATU ASSEMBLY

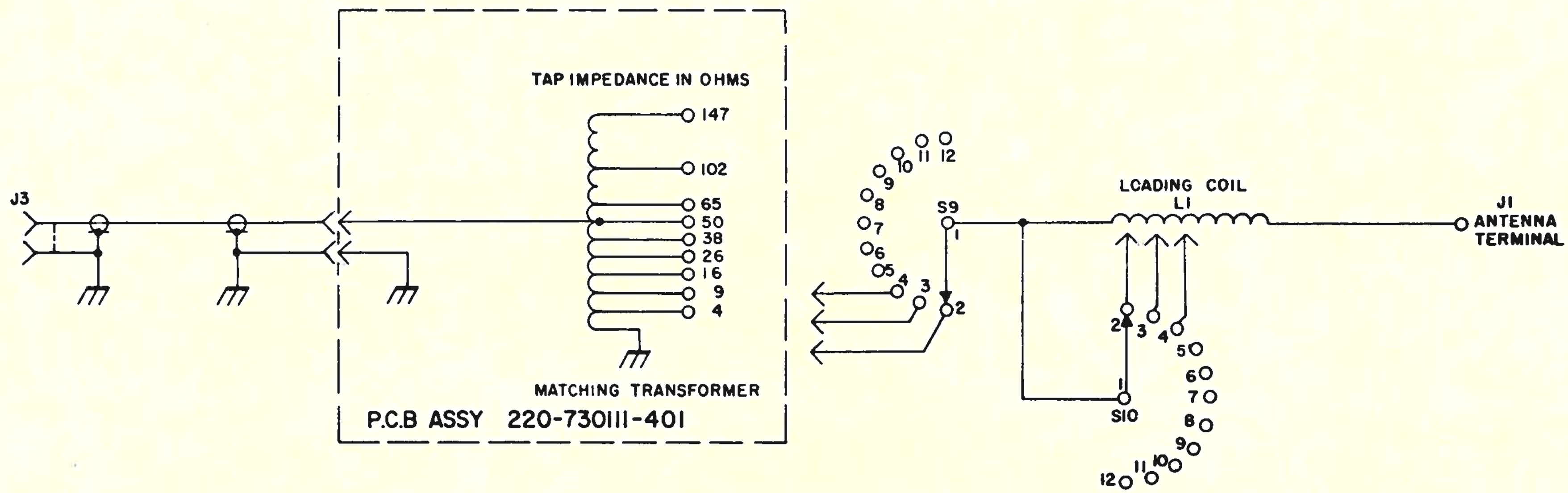


FIGURE 3-2 INTERNAL ATU SCHEMATIC DIAGRAM

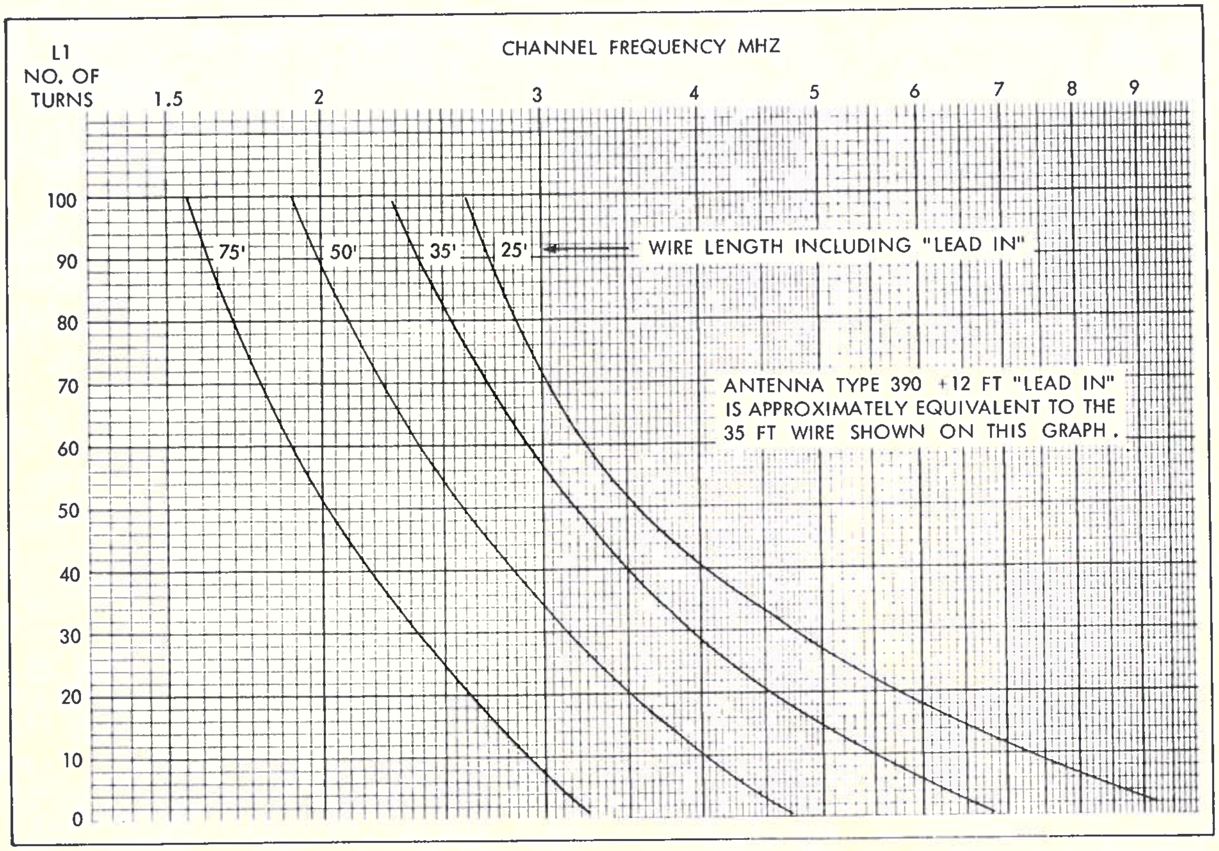


Figure 3-3 Internal ATU Tuning Graphs, Wire Antennas

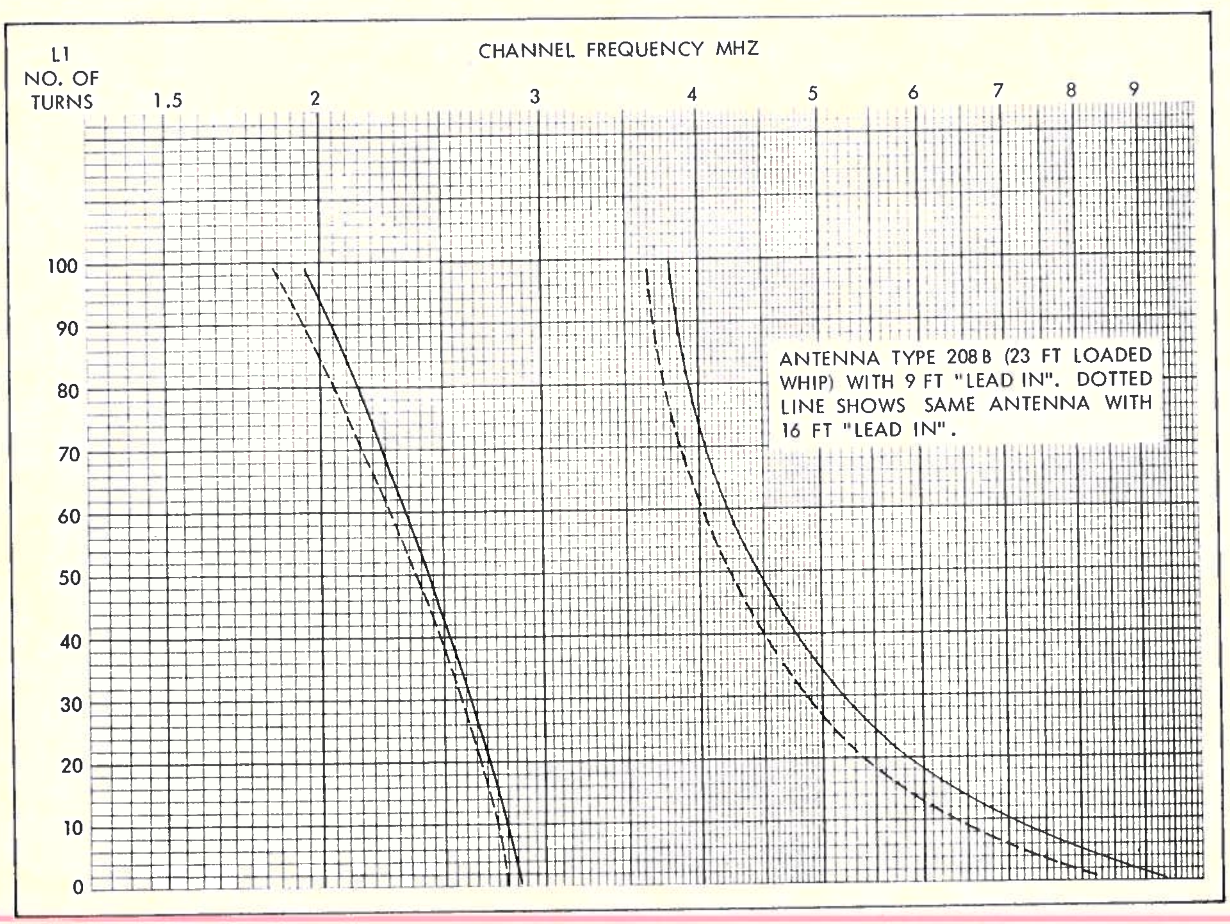


Figure 3-4 Internal ATU Tuning Graphs, Whip Antenna

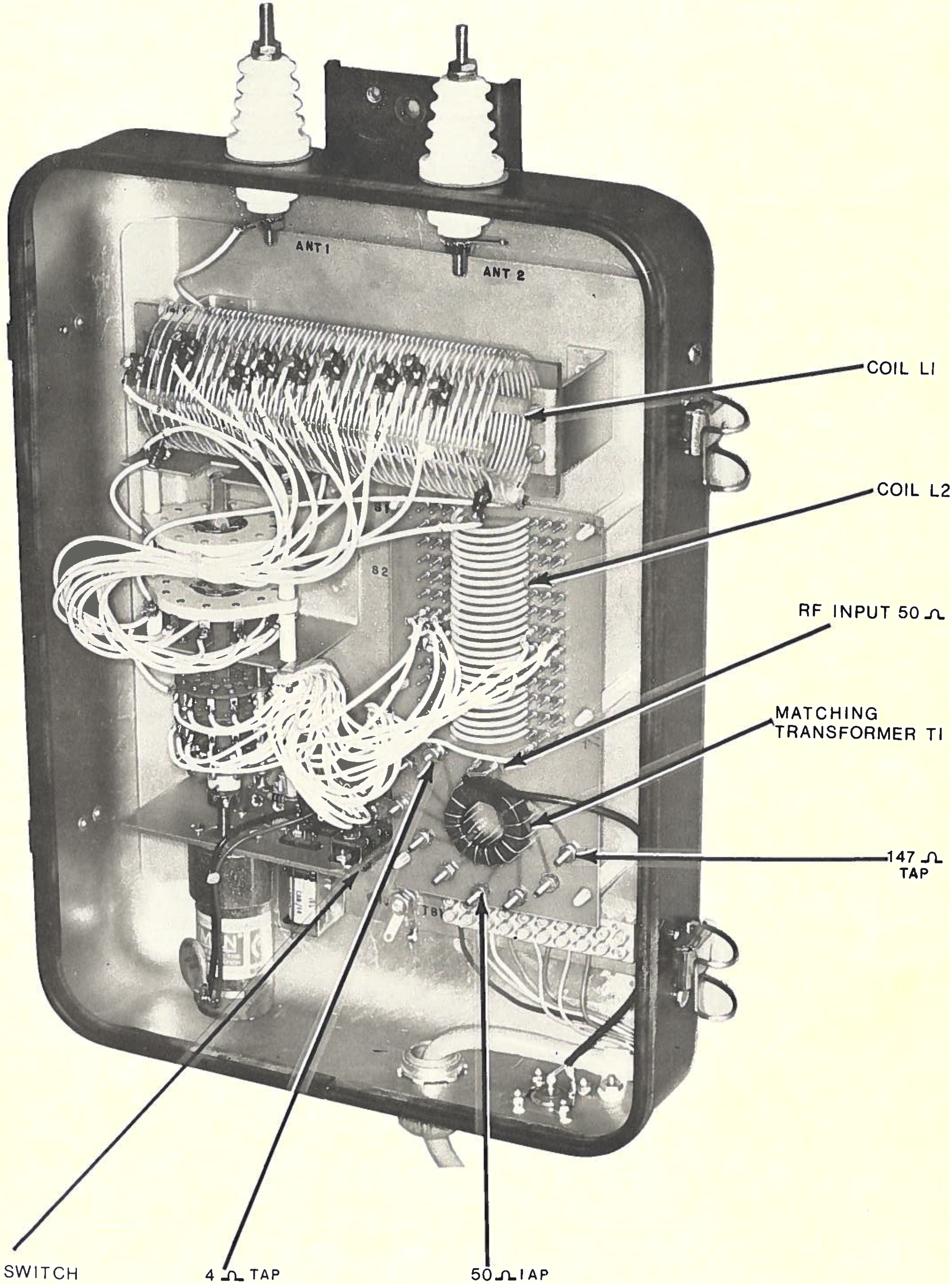
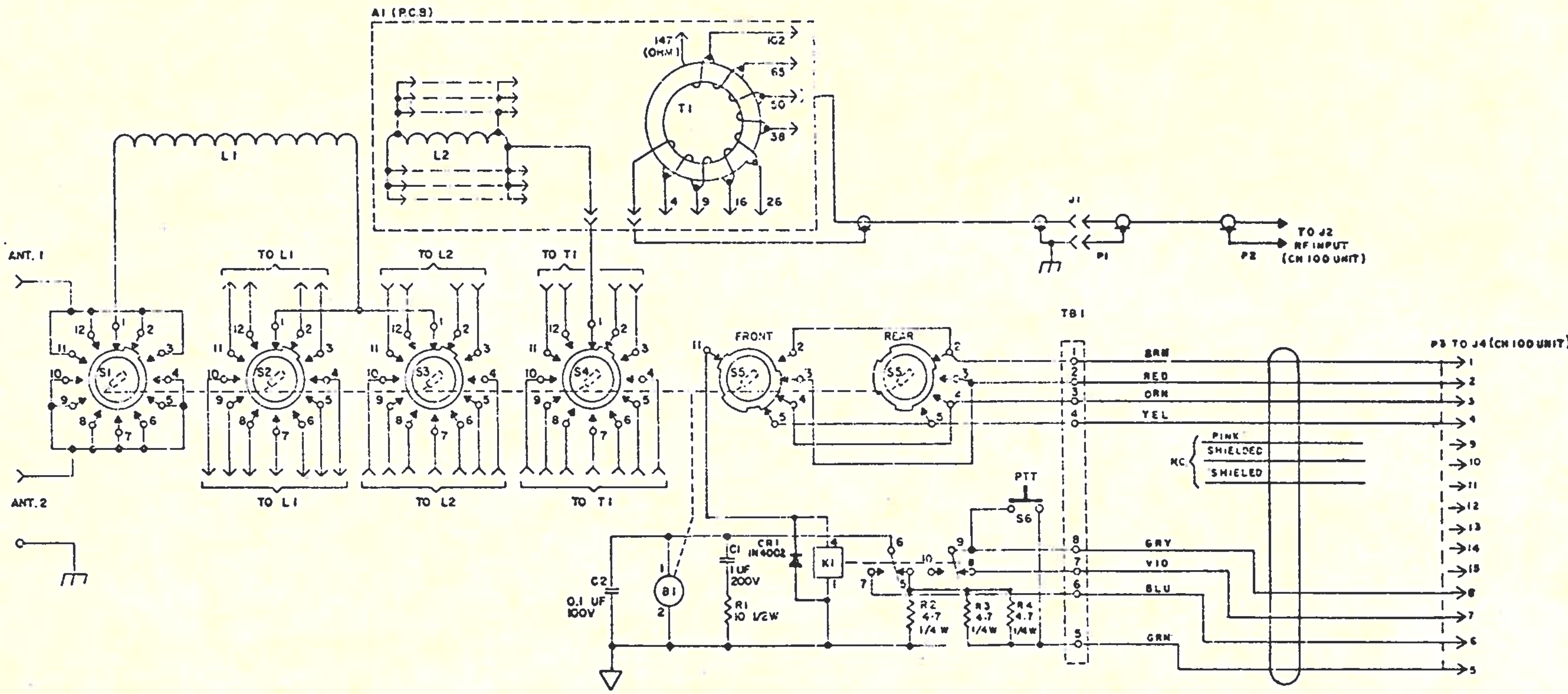


FIGURE 3-5 EXTERNAL ATU ASSEMBLY



NOTES:

1. (chassis ground symbol) DENOTES CHASSIS GROUND.
2. (floating ground symbol) INDICATES FLOATING GROUND.
3. RESISTOR VALUES ARE IN OHMS.
4. ALL WAFER SWITCHES ARE SHOWN IN CHANNEL 1 POSITION.
5. LAYOUT OF TERMINALS ON WAFER SWITCHES AS VIEWED FROM THE MOTOR END, WITH THE UNIT LAYING FLAT.
6. COMBINED VALUE OF R2, R3, R4 IS SELECTED TO POSITION THE WAFER SWITCH CONTACTS AFTER THE MOTOR IS DE-ENERGIZED. THERE MAY BE ONE, TWO, THREE RESISTORS OR EVEN A JUMPER.

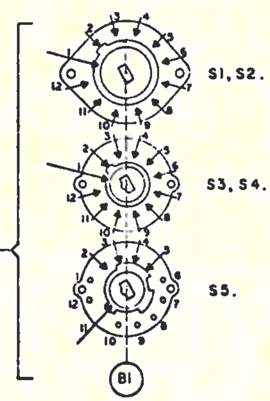
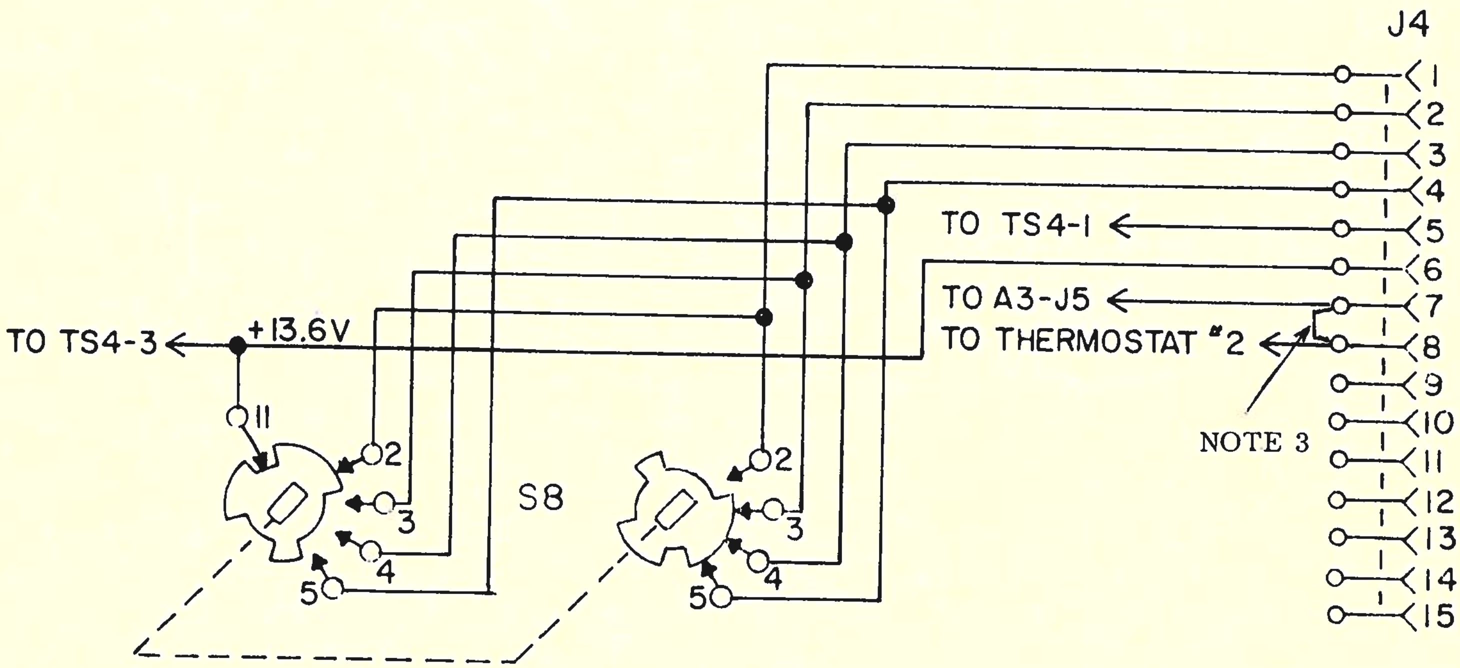


FIGURE 3-6 EXTERNAL ATU SCHEMATIC

NOTES: 1. WAFER SWITCH IN CHANNEL 1 POSITION, SHOWN AS VIEWED FROM THE KNOB END WITH UNIT LAYING FLAT.

2. IN TRANSCEIVER 244-767501-701 LEAD BETWEEN THERMOSTAT #2 AND A3A-J5 IS DELETED.

3. CUT OFF JUMPER WHEN EXTERNAL ATU IS USED. CH100 PTT CIRCUIT WILL NOT OPERATE UNLESS PINS 7 & 8 OF J4 ARE CONNECTED TOGETHER IF EXTERNAL ATU PLUG IS REMOVED.



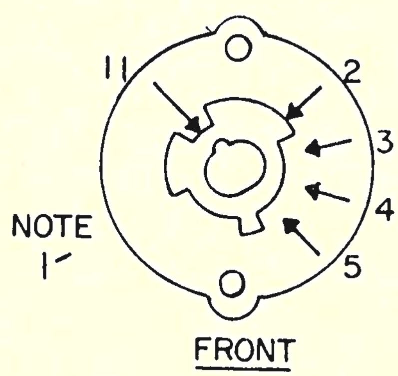


FIGURE 3-7 EXTERNAL ATU INTERFACE SCHEMATIC

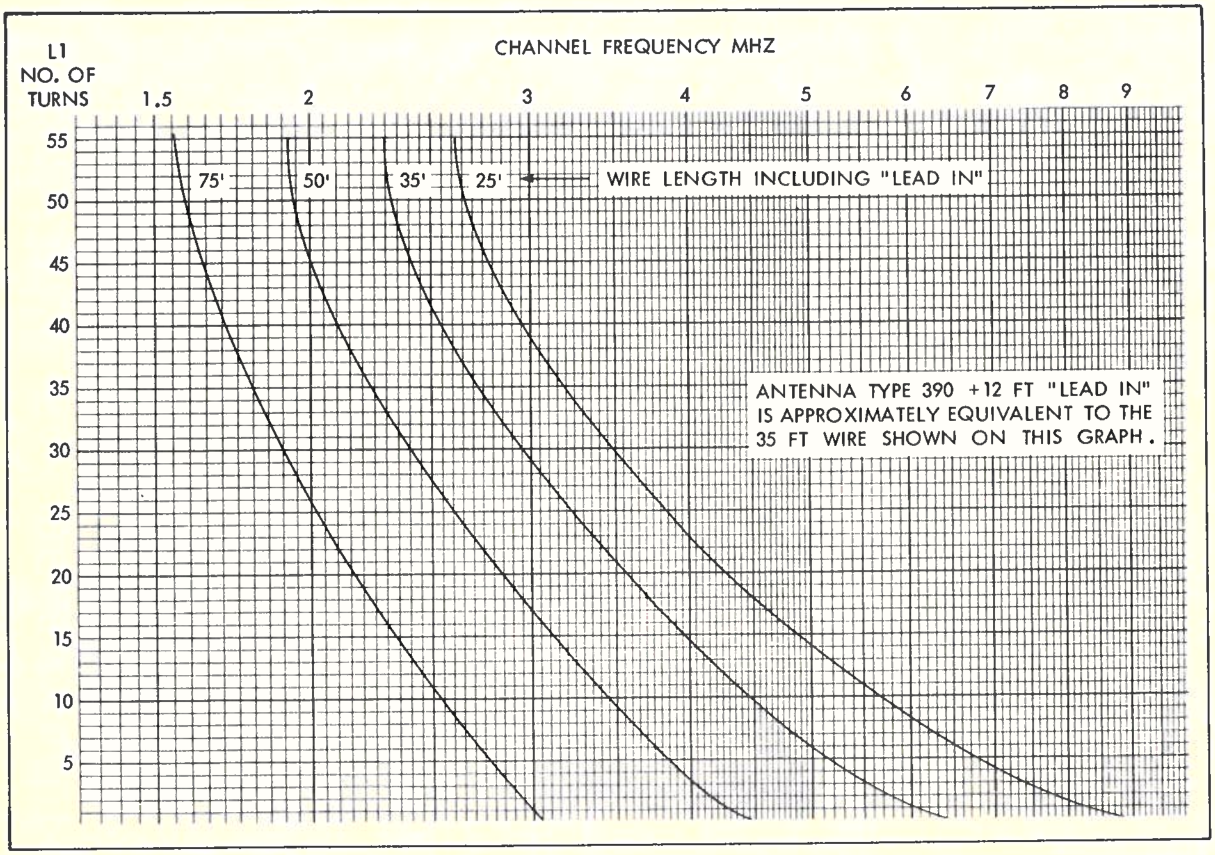


Figure 3-8 External ATU Tuning Graphs, Wire Antennas

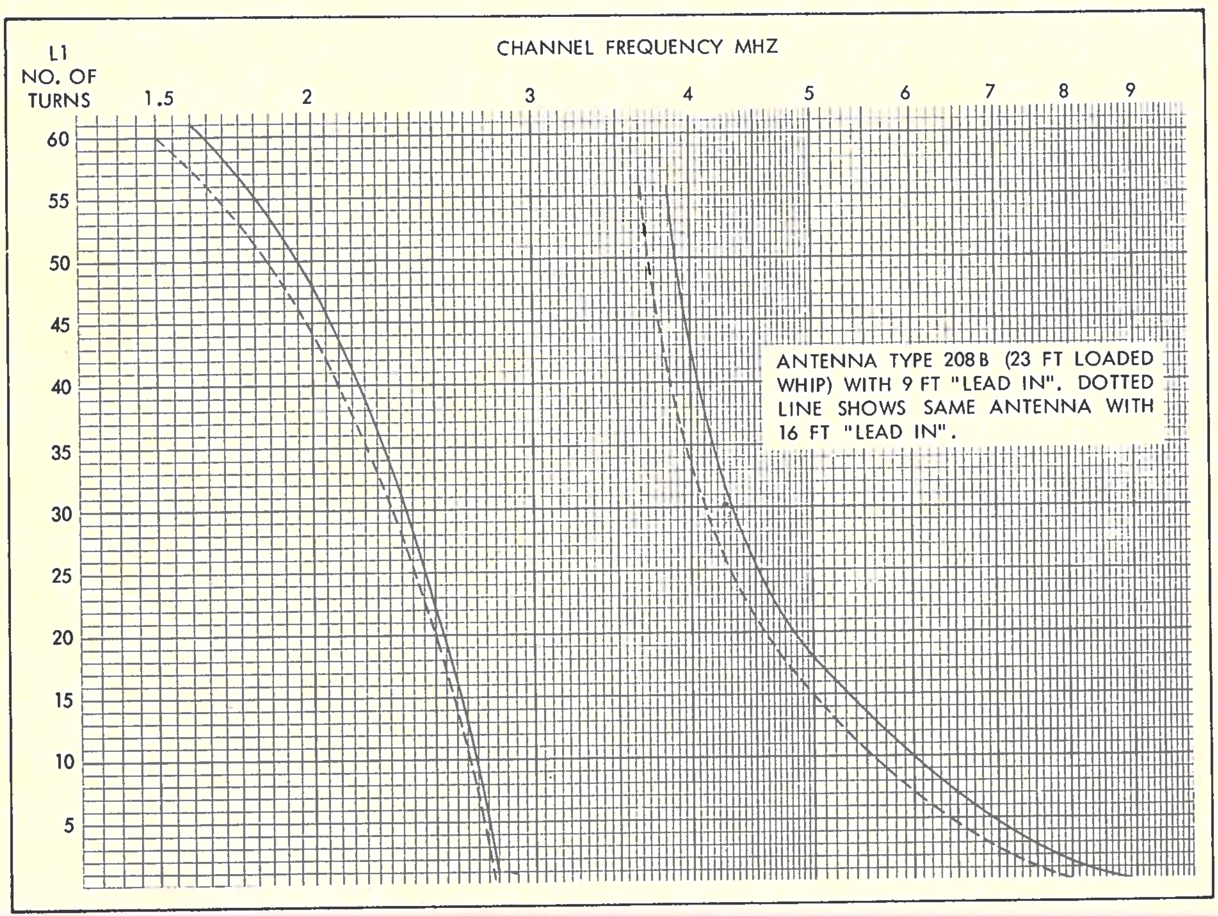
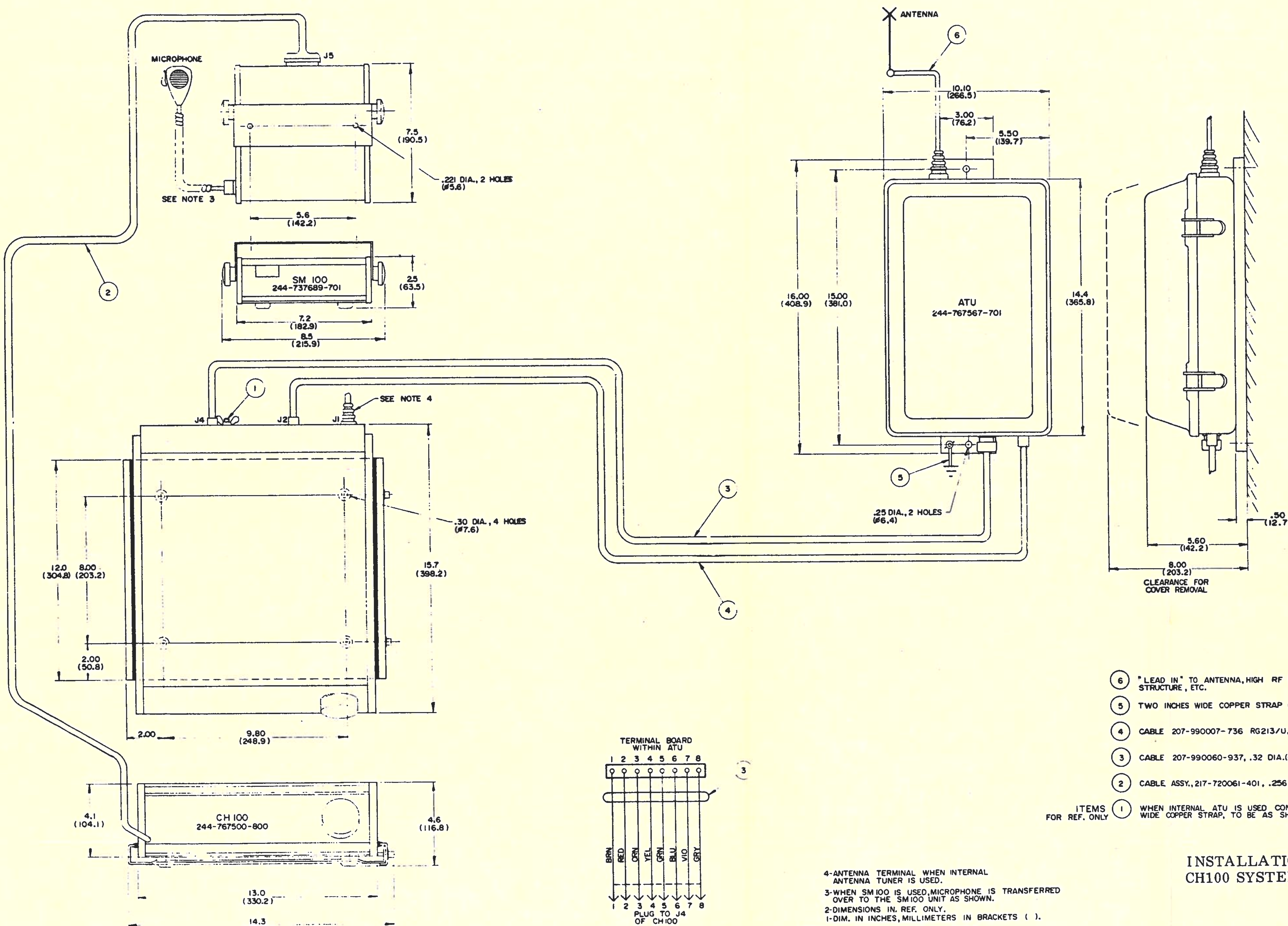


Figure 3-9 External ATU Tuning Graphs, Whip Antenna



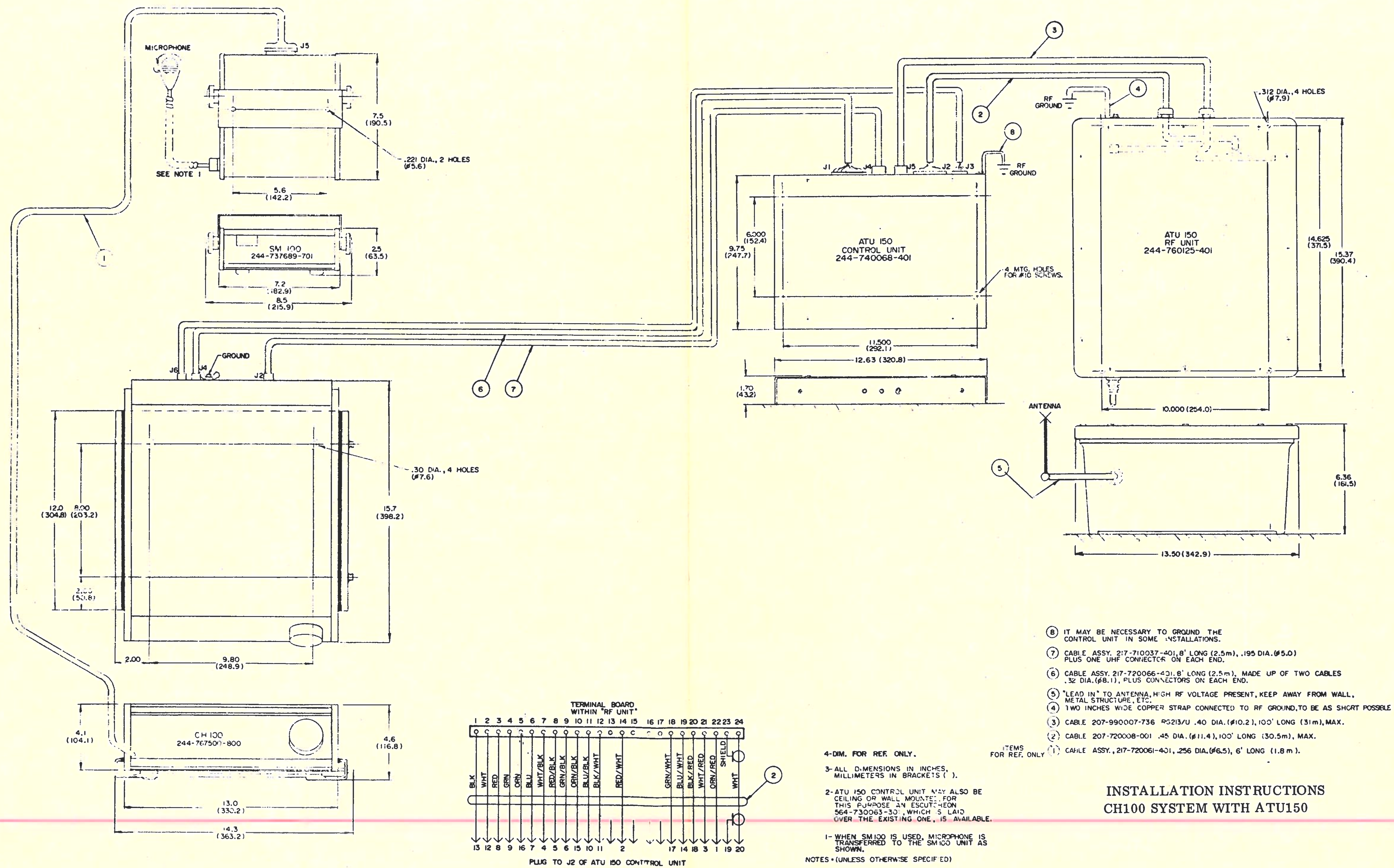
ITEMS FOR REF. ONLY

6. "LEAD IN" TO ANTENNA, HIGH RF VOLTAGE PRESENT, KEEP AWAY FROM WALL, METAL STRUCTURE, ETC.
5. TWO INCHES WIDE COPPER STRAP CONNECTED RF GROUND, TO BE AS SHORT AS POSSIBLE.
4. CABLE 207-990007-736 RG213/U, .40 DIA. (⌀10.2), 200' LONG (61.0m), MAX..
3. CABLE 207-990060-937, .32 DIA. (⌀8.1), 200' LONG (61.0m), MAX..
2. CABLE ASSY., 217-720061-401, .256 DIA (⌀6.5), 6' LONG (1.8m), MAX..
1. WHEN INTERNAL ATU IS USED CONNECT TO GROUND WITH 2-INCH WIDE COPPER STRAP, TO BE AS SHORT AS POSSIBLE.

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. DIM. IN INCHES, MILLIMETERS IN BRACKETS ( ).
2. DIMENSIONS IN. REF. ONLY.
3. WHEN SM100 IS USED, MICROPHONE IS TRANSFERRED OVER TO THE SM100 UNIT AS SHOWN.
4. ANTENNA TERMINAL WHEN INTERNAL ANTENNA TUNER IS USED.

INSTALLATION INSTRUCTIONS
CH100 SYSTEM



(8) IT MAY BE NECESSARY TO GROUND THE CONTROL UNIT IN SOME INSTALLATIONS.

(7) CABLE ASSY. 217-710037-401, 8' LONG (2.5m), .195 DIA. (⌀5.0) PLUS ONE UHF CONNECTOR ON EACH END.

(6) CABLE ASSY. 217-720066-401, 8' LONG (2.5m), MADE UP OF TWO CABLES .32 DIA. (⌀8.1), PLUS CONNECTORS ON EACH END.

(5) "LEAD IN" TO ANTENNA, HIGH RF VOLTAGE PRESENT, KEEP AWAY FROM WALL, METAL STRUCTURE, ETC.

(4) TWO INCHES WIDE COPPER STRAP CONNECTED TO RF GROUND, TO BE AS SHORT POSSIBLE

(3) CABLE 207-990007-736 RG213/U .40 DIA. (⌀10.2), 100' LONG (31m), MAX.

(2) CABLE 207-720008-001 .45 DIA. (⌀11.4), 100' LONG (30.5m), MAX.

ITEMS FOR REF. ONLY (1) CABLE ASSY., 217-720061-401, .256 DIA. (⌀6.5), 6' LONG (1.8 m).

4- DIM. FOR REF. ONLY.

3- ALL DIMENSIONS IN INCHES, MILLIMETERS IN BRACKETS ( ).

2- ATU 150 CONTROL UNIT MAY ALSO BE CEILING OR WALL MOUNTED. FOR THIS PURPOSE AN ESCUTCHEON 564-730063-301, WHICH IS LAID OVER THE EXISTING ONE, IS AVAILABLE.

1- WHEN SM100 IS USED, MICROPHONE IS TRANSFERRED TO THE SM100 UNIT AS SHOWN.

NOTES: (UNLESS OTHERWISE SPECIFIED)

INSTALLATION INSTRUCTIONS CH100 SYSTEM WITH ATU150

SECTION 4

OPERATION

4.1 General

With the exception of the press-to-talk (PTT) switch, all the controls for operation of the CH100 are located on the front panel and may be seen in Figure 1-1. The PTT switch is built into the side of the microphone case.

When the unit is first switched on, a warmup period of at least fifteen minutes is required before transmitting, to enable the crystal oven to reach its stable operating temperature.

Under normal voice communication, the unit may be used practically without restriction because voice modulation produces a relatively low, average power output. If, however, a continuous power output of 50 watts RMS is obtained by using some other type of modulation, then a duty cycle of 1 minute transmit 4 minutes receive must be observed in order to prevent overheating of the power amplifier heat sink. If this duty cycle is exceeded, a thermostat, mounted in the heat sink, automatically switches the unit to receive mode until it cools sufficiently.

4.2 Operation

Comments related to optional features are enclosed within brackets.

TO TURN SET ON

Turn OFF/AF GAIN control clockwise and adjust for desired sound level.

Wait 15 minutes for warmup.

(Switch on Voice Operated Squelch as required.)

TO MAKE A CALL

Select the channel required.

(Use A/B switch in combination with CHANNEL selector switch positions 1 through 10 only.)

Select the mode AM, USB (or LSB).

Pick up the microphone and hold it about one inch from the mouth.

Press the PTT switch on the side of the microphone and speak normally. The red Tx lamp will be on during transmit and the relative power output level will be indicated visually on the meter.

When your message is complete, release the PTT switch and listen for an answer.

Use the CLARIFIER control to obtain the best reception.

SECTION 5

THEORY AND CIRCUIT DESCRIPTION

5.1 Introduction

This section describes the operation of the main circuit assemblies including the oscillator section, the Receiver/Transmitter circuit and the Power Amplifier. A brief description of the Crystal Oven, the available Power Supplies, the Harmonic Filter Assembly and the optional Voice Operated Squelch circuit is also given. The functional layout of the CH100 is shown in block diagram form in Figure 5-1

5.2 HFO/BFO Circuits

Refer to Schematic Diagram HFO/BFO Figure 7-2 and HFO/BFO PCB Assembly Figure 7-3.

The basic oscillator circuit is a Colpitts oscillator formed by either Q1 or Q4. A selection of frequencies is obtained when the selected crystal network is switched into the oscillator circuit. Crystals in positions 1 through 11 normally work with Q1 and those in positions 12 through 20 work with Q4.

5.2.1 Simplex Operation

In Simplex, transmission and reception take place on the same frequency. In operation, if Channel 1 is selected, pin 11 on the HFO/BFO PCB is connected via the CHANNEL control switch S4 through an externally mounted coil L1 to ground pin 21 on the PCB, causing diode CR1-1 in the CH 1 network to be forward biased. There is now an RF connection to the base of Q1 through the Y1-1 crystal which determines the frequency output at the emitter of Q1. This output is amplified by the circuit comprising Q2 and Q3. An AGC is provided by using the rectified HFO level from CR10 to control the base current of Q5. If this current increases, Q5 conducts more, and its collector voltage is pulled down. This reduces the DC bias at the bases of Q1 and Q4 via R4 and R25 respectively reducing oscillator output. This AGC action maintains a constant output level from the HFO throughout the frequency range of the oscillator.

The HFO signal (from the collector of Q3) is filtered by a high pass filter and a rejection filter with a notch at 10.7 MHz and is output at pin 17 on the circuit card. The filter is made up of passive components and the coil L7 is tuned to provide the notch at 10.7 MHz (see Section 6.4.1).

In the transmit mode, there is 10 VDC on pin 19 at the top of R8 thus putting a fixed voltage, determine by the ratio of R7 to R8, across the varactor CR7. This fixes the capacitance of CR7 and makes the transmit frequency independent of the CLARIFIER control setting. When the receive mode is being used there is no DC voltage on pin 19 and the voltage on pin 20 is varied by the CLARIFIER control. This puts a variable, reverse bias level on varactor diode CR7 and provides variable capacity shunt across C14 which changes the oscillator output frequency by a small amount (approximately ±150 Hz).

5.2.2 Semi-Duplex Operation

In semi-duplex operation the transmission and reception frequencies are different. In Figure 7-2, channel 3 is semi-duplexed with channel 20 by the connection shown as a broken line between the square pads. When channel 3 is selected the crystal network for channel 3 makes an RF connection to the base of Q1 and the crystal network for channel 20 makes an RF connection to the base of Q4. At the same time diode CR4-20 becomes forward biased and in the semi-duplex logic, pins 1 and 2 of U1 are pulled LO which makes pins 3 and 5 HI. If the transmit mode is selected, pin 6 of U1 is also HI and pins 4, 9 and 8 of U1 will be LO. This makes the output at pin 10 HI and the oscillator Q4 will be switched on. Pin 11 of U1 is driven LO by pin 10 being HI, therefore oscillator Q1 will be off. The transmission frequency is now determined by the crystal network in channel 20 and the oscillator Q4. When the receive mode is selected pin 6 of U1 is made LO, pins 4, 9 and 8 are HI while pins 10, 13 and 12 go LO. Q4 is now switched off and, with pin 11 HI, Q1 is switched on. Reception frequency therefore is determined by the crystal network in channel 3 and the oscillator Q1. In this mode the clarifier is operational because pin 19 on the PCB is grounded and bias on CR7 depends on the CLARIFIER control setting.

This explanation assumes that the optional A/B switch is not present.

.2.3 A/B 20 Channel Option

With this option, it is possible to have up to twenty simplex channels. If semi-duplex channels are fitted, the number of simplex channels which can be obtained with this option will be reduced by two channels for each semi-duplex channel. The semi-duplex option is quite compatible with the A/B switch option because selecting a semi-duplex channel automatically overrides the A/B switch function. This is accomplished by leaving any of the CR4 diodes (see Figure 7-2) corresponding to a semi-duplex channel in place, while for the A/B option all the remaining diodes CR4-11 through CR4-20 are removed. A jumper W2 is removed and W3 is connected so that channels 1 through 10 work with oscillator Q1 and channels 11 through 20 work with oscillator Q4. CLARIFIER control components are added to the oscillator circuit around Q4 with C25 being removed and R24, C21, C23 and CR8 being added. Jumpers are added between the square pads to connect CH1 with CH20, CH2 with CH19, etc. When the CHANNEL selector switch is in position 1, the crystal network for channel 1 determines the frequency output from the oscillator Q1, and the crystal network in channel 20 determines the frequency output from the oscillator Q4. The semi-duplex logic U1 now works with inputs from the A/B switch so that in the A position the frequency output from Q1 is selected, while in the B position, the frequency output from Q4 is selected. Following the logic in U1 with this option the first gate input at pins 1 and 2 will always be HI because diodes CR4 are not present. This means that pin 3 of U1 is always LO and therefore pins 4 and 8 of U1 are always HI.

When the A position is selected, pin 15 of the PCB is made HI so that pin 10 is LO, i.e. Q4 is off and pin 11 is HI, which switches on Q1 (channel 1). When B position is selected, pin 3 and pin 9 of U1 are shorted together making pin 10 HI, turning Q4 on (channel 20) and pin 11 LO turning Q1 off.

CAUTION
(before specifying crystal frequencies)

An important limitation with the A/B option is that the CHANNEL selector switch selects one of the four sections on the harmonic filter assembly (see Section 5.7 and internal connection diagram Figure 7-1), it also selects a particular tuned position of the antenna tuner. This means that the bandwidth seen by the transmitter power amplifier may be quite narrow, and that the A and B frequencies must be contained within this bandwidth. The antenna tuner along with the antenna has the most selectivity and therefore presents the most serious limitation in frequency selection between A and B.

The following table may be used as a guide. When tuning the ATU a compromise adjustment between the A and B frequencies must be made.

ANTENNA SYSTEM	FREQUENCY RANGE	DIFFERENCE BETWEEN "A" AND "B" FREQUENCIES, assuming that "A" and "B" are within the same harmonic filter bandwidth.
208B 23 ft loaded whip with 9 ft lead-in	2 to 2.4 MHz and 3.8 to 5 MHz 2.4 to 2.9 MHz and 5 to 9 MHz	1/2 % 1 %
390 23 ft whip with 9 ft lead-in	2.45 to 3.6 MHz 3.6 to 7.4 MHz	1/2 % 1 %
Tuned dipole	2 to 9 MHz	2.5 %
Broadband dipole*	2 to 9 MHz	Limited only by harmonic filter bandwidth.
* Consult your CMC dealer for availability of broadband dipole.		

5.2.4 BFO

This oscillator is of a similar design to that of the HFO and provides the constant amplitude, fixed frequency signal at 10.7 MHz. The oscillator is Q6 with the crystal Y2 and a netting capacitor C37. The oscillator output from the emitter of Q6 is amplified via Q7 and Q8. The AGC circuit uses the rectified BFO signal from CR14 to control the base current of Q9. The collector voltage on Q9 thus controls the base bias of Q6 to regulate the BFO amplitude in a similar way to that described for the HFO. The output at the collector of Q8 then passes the tuned ceramic filter FL1 and the BFO signal appears on pin 26 of the HFO/BFO PCB.

5.2.5 Lower Sideband

If LSB operation is intended on any channel the components shown in Box '2' together with extra components in the appropriate HFO crystal network will be present. (See Note 14 on Figure 7-2) Jumper W4 will be removed as well as one or more of the jumpers W1-1 through W1-11 in the crystal network. When the mode switch is in LSB, pin 27 is grounded and voltage at the anodes of CR11 and CR13 is pulled down, back biasing both diodes. The diode CR2-1 is also back biased via the connectic marked E on the schematic; CR13 and CR2-1 are now switched OFF which switches L1-1 in series with the HFO crystal and L9 in series with the BFO crystal. The effect of these coils is to shift down the frequency of the BFO and HFO by 3 KHz each. However, this does not change the carrier frequency (suppressed SSB) since, carrier = HFO - BFO. The BFO now lies on the opposite slope of the crystal filter which will make the unit operate in Lower Sideband mode.

Since L1 and L9 do not exhibit such stable properties as the quartz crystal, the oscillator frequency may not be as stable when LSB mode is used. (Typically ±80 Hz from $-30^{o}C$ to $+60^{o}C$.)

Provision for LSB operation is made for channels 1 through 11 only. Semi-duplex channels 12 through 20 cannot be fitted for LSB.

.3 Transmitter Receiver PCB

Refer to Schematic Diagram, Figure 7-5.

.3.1 Receive Mode

A received signal passes through a low-pass 9 MHz filter on the harmonic filter board to the broadcast filter, a 1.6 MHz high-pass. Diodes CR14 and CR15 provide receiver front end protection from very high RF signals picked up at the antenna (as high as 10 watts from a 50 Ω source for several seconds). In receive, CR13 is forward biased and the signal bypasses the Tx amplifier and, after passing the image filter, it is mixed with the HFO signal in MX1. The forward bias on CR7 is determined by the AGC and controls the signal level to the input of the balanced mixer. At the output of MX-1, CR9 is forward biased on receive and the signal passes through T2 and is amplified by Q4. The crystal filter has a bandwidth of 2.4 KHz and selects the IF component (10.7 MHz) of the mixed signal. CR23 is forward biased on receive and the IF signal is amplified through U3 and Q2 and is input to pin 1 of the product detector U4. On SSB the BFO carrier is input to pin 8 of U4 from Q15.

On AM, pin 18 on the PCB is grounded. This makes pins 8 and 9 of logic IC U1 LO, which switches pins 10 and 5 of U1 HI. In Receive mode, pin 6 of U1 is HI, therefore pins 4, 12, 13, 1 and 2 are LO and pin 11 and pin 3 of U1 are both HI. This will cut off Q5 thereby turning OFF the BFO oscillator located on HFO/BFO PCB via PCB connection 27. This also removes the DC bias to the crystal filter FL1 which doubles its bandwidth. The IF signal now includes the received carrier, and part of this is fed to pin 8 of the product detector through Q13 which is now turned ON because pin 11 of U1 is HI.

The product of the IF signal at pin 1 and the BFO (on SSB) or carrier signal (on AM) at pin 8 is output from pin 9 of U4 and filtered through Q14 which is a low-pass active filter with a cut-off of 3 KHz. This is the audio signal which is taken from the emitter of Q14 to the audio amplifier through the AF GAIN control via pins 22 and 20 on the Rx - Tx PCB.

.3.2 Automatic Gain Control

The AGC circuit monitors the IF signal from the collector of Q12 and derives a DC voltage at the drain of Q18 proportional to the IF signal level. This DC level controls the gain of U3 at pin 5 and partly the gain of Q4 at pin 3. A further DC control signal is also derived at the collector of Q19 where it is fed to pin 2 of Q4 controlling its gain and to the base of Q3. Q3 sets the forward bias on CR7 and limits the signal level input to mixer MX-1.

.3.3 Transmit Mode

Audio from the microphone is amplified in the microphone amplifier and the output at the collector of Q11 is fed to the balanced modulator where it modulates the BFO signal coming in on pin 8 of U6. The modulated signal is amplified and passes through CR24, through the crystal filter, through T1 and CR8 and then to the balanced mixer circuit where it is mixed with the HFO signal. The output from the mixer at pin 10 of MX-1 is filtered by the image filter and passes through CR11 to the Tx amplifier. CR11 is forward biased on transmit. The amplified signal passes through the relay switch via pin 7 on this board to the power amplifier.

5.4 Power Amplifier

Refer to Schematic Diagram Figure 7-8.

5.4.1 The Amplifier

The amplifier section is wideband and comprises Q1, Q2 and Q3 in push-pull. A stable DC bias voltage to bases of Q2 and Q3 is derived from the regulating circuit formed by Q11 and Q10. Q10 and Q11 are heated by the rear heatsink and the bias voltage is compensated to allow for variation of VBE in Q2 and Q3 with temperature. If the voltage across R10 rises, Q11 conducts more, pulling down the base of Q10. This reduces the voltage across R10 and restores the original bias condition.

When the Transceiver is in Receive mode, pin J4 is connected to 13.6 volts through the PTT relay coil. This switches on Q8 and Q9 cutting off the bias to the power amplifier transistors Q1, Q2 and Q3.

Operating the PTT switch shunts J5 to ground through the thermal switch S1. Q8 and Q9 are now turned off and normal bias conditions are restored. S1 is mounted on the heat sink as a protection against overheating. If the duty cycle of the power amplifier is exceeded, the temperature of the heat sink will cause S1 to open, switching the Transceiver to Receive mode until the temperature falls again.

5.4.2 Automatic Level Control

The circuit formed by T5, Q4, Q5, Q6 and Q7 senses the forward and reflected power delivered to the load. In normal operation when the load is non reactive and near 50Ω, the forward power generates a current through Q4 and Q6 which is proportional to this power. This current coming out at J11 forward biases attenuator diodes CR19, CR18, CR20 and CR21 located on the Rx - Tx PCB (Figure 7-5), shunting part of the microphone signal. Thus, as forward power increases more of the microphone signal is shunted, automatically controlling the power output level.

5.4.3 VSWR Protection

This circuit protects the amplifier output transistors against a severe mismatched load. When a severe mismatch of 5:1 or worse occurs, the phase relationship of the signals from T5 pin 1 and from the resistor voltage divider formed by R40 and R41 is such as to cause some base current in Q5. This will increase current through Q6 to the point where 5.5 VDC is reached at its collector. At this point, CR6 conducts and turns on Q7 which increases the current through attenautor diode CR1 at the input of the power amplifier, shunting the input signal and reducing the drive level to Q2 and Q3. This action protects Q2 and Q3. The power output under this abnormal condition is reduced by 6 to 10 dB. Note that attenuator diode CR1 is always OFF when the power amplifier is properly matched. Normal ALC action is accomplished by attenuator diodes CR18 to CR21 located on the Rx - Tx PCB as described in 5.4.2.

5.5 Crystal Oven

The Crystal Oven assembly, (mounted on the HFO/BFO PCB) is covered by a thin metal shielding cover which may be removed after undoing two nuts to expose the Crystal Oven assembly. This cover has been removed in Figure 1-2 and the Crystal Oven assembly is shown in position on the HFO/BFO PCB. The Crystal Oven assembly consists of a PCB and a metal case. Three wires from the oven PCB make push socket connections to pins on the HFO/BFO PCB supplying power to the oven. Two nuts, one at each end of the metal case, may be removed and the complete oven assembly lifts off to expose the crystals plugged into their respective sockets. Figure 5-2 shows a photograph of the crystals with the oven removed to one side.

The function of the Crystal Oven is to keep the HFO and BFO quartz crystals at a constant temperature ($85^{\circ}C \pm 2^{\circ}C$) and thus maintain the frequency stability of the oscillators.

The Schematic Diagram of the oven is shown in Figure 7-10 and the PCB assembly is Figure 7-11. In operation, a temperature sensitive resistor R1 mounted near the bottom of the metal case, controls the current flowing in two power transistors Q3 and Q4. These transistors heat the top of the metal case until the temperature within the enclosed space approaches $85^{\circ}C$. This causes R1 to decrease and the heating current reduces. The oven is calibrated in the factory to maintain $85^{\circ}C$ by choosing the value of R2.

Maximum current flow in Q3 and Q4 is limited to 1.6 Amps by using the voltage across R9 to turn on Q5 and shunt the base of Q1. Should a malfunction occur and the oven temperature reaches $109^{\circ}C$, a thermal cut off R10 will become open circuit, shutting off the current flow in Q3 and Q4. If this occurs R10 will not reset. It must be replaced.

It should be noted that the crystal oven case is grounded. If the oven is removed and power is switched ON, precautions should be taken to keep the oven case out of contact with any components on the HFO/BFO PCB.

5.6 Power Supplies

5.6.1 13.6 VDC Power Supply

The circuit for this power supply is on the Internal Connection Diagram, Figure 7-1. Two 20 Amp in-line fuses are used. If the supply is inadvertently connected with reversed polarity the diode CR1 will conduct and blow the fuse, thus protecting the Transceiver circuits.

5.6.2 26/36 VDC Power Supply

This 26/36 VDC Power Supply assembly consists of a PCB and a heat sink assembly. Figure 7-14 shows the complete assembly.

The function of this assembly is to convert 26 or 36 VDC to 13.6 VDC. The Power Supply circuit which is shown in Figure 7-12 is a switching regulator using U1 to control the duty cycle of the signal driving Q3. The voltage output at pin 6 on the PCB may be adjusted using R11. For 36V supplies, two 10 A fuses are used, and for 26 V, two 15 A fuses. If the supply leads are reversed, CR3 will conduct and cause the fuses to blow, thus protecting the Transceiver circuits. A silicon controlled rectifier CR4 protects against a rise in supply output voltage. If a fault occurs, and the supply output voltage increases, CR4 will be switched on and the fuses will blow. If a short circuit occurs across the output, the power supply will automatically shut off without blowing the fuses. It will be necessary, after removing the short circuit, to switch the supply off for ten seconds and switch on again to restore operation.

NOTE

Both the 13.6V and the 26/36V.DC power supplies have a floating ground and may be used with either a negative or positive ground system.

5.6.3 115/230 VAC Power Supply

This power supply can only be fitted to Transceiver Units equipped for use with the external ATU since it fits partly in the space normally occupied by the internal tuner.

The circuit Schematic is shown in Figure 7-15.

Figures 1-2 and 1-3 show this Power Supply assembled in the Transceiver Unit.

5.7 Harmonic Filter Assembly

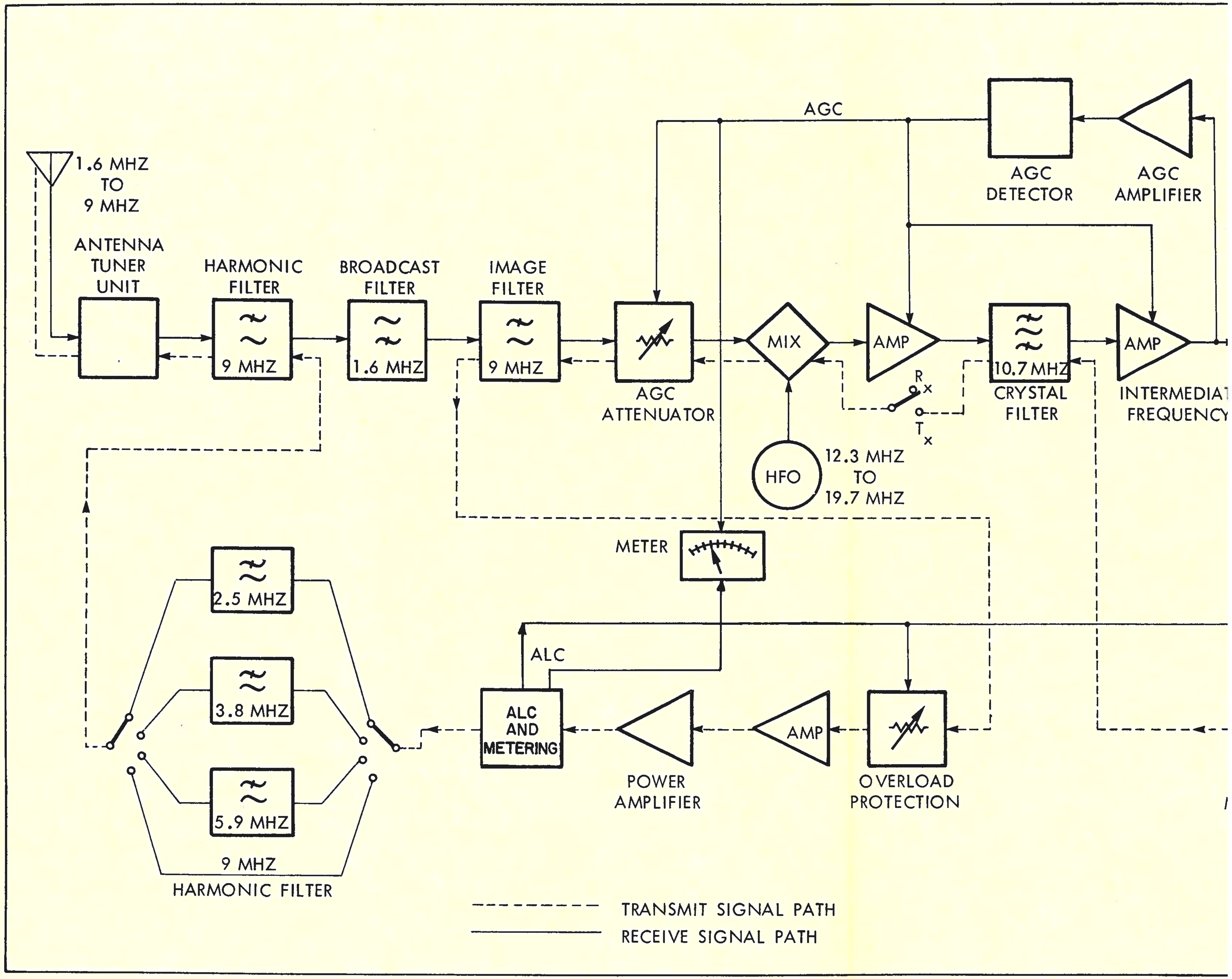
The Harmonic Filter assembly consists of four lowpass filters and a relay switch assembled on a PCB. Figure 1-2 shows the filter located behind the Channel Selector switch. The purpose of the Harmonic Filter is to reduce the level of spurious harmonic frequency signals which are generated in the power amplifier and might otherwise be transmitted to cause RF interference. The correct bandwidth filter for each channel frequency is pre-wired to wafer switch segments S5 and S6 so that selecting the channel automatically selects the Harmonic Filter. Whenever a new channel is fitted the output from that channel must be connected through the correct filter section. This procedure is described in 6.4.:

The level of attenuation required for spurious signal radiation is legally defined in Canada by the Department of Communications (DOC) and in the U.S.A. by the Federal Communications Commission (FCC). Two different Harmonic Filter assemblies are made to meet these different requirements (Schematic Diagrams Figure 7-18 and Figure 7-19). Those Transceiver Units sold in Canada are fitted with the DOC Harmonic Filter assembly part number 220-737513-701 and Transceivers sold in the U.S.A. are fitted with the FCC Harmonic Filter part number 220-737514-701. These filters are factor adjusted and will not normally require further attention. If the filter assembly is damaged it must be replaced as an assembly.

5.8 Voice Operated Sc lch

This is an opt . kit (CMC Part No. 241-737510-701) which interr he audio signal to t eake until a sig received. Whe audio signal s received the V . Operated Squelch (.S.) circuit d rs this signal and matically sw es it to the s er. This feature the suppresse anno ium and hissing n otherwise h when the re r is on standby, uns ning only wh signal is receive

e V.O.S. kit cor of a separa B which is m d above the HFO/B CB on four standoff spacers. These spa s are suppli ith the V.O t and are used to re four of the HFO/BFO PCB mounting screws.


1.6 MHZ TO 9 MHZ
ANTENNA TUNER UNIT
HARMONIC FILTER
9 MHZ
BROADCAST FILTER
1.6 MHZ
IMAGE FILTER
9 MHZ
AGC
AGC ATTENUATOR
MIX
HFO
12.3 MHZ TO 19.7 MHZ
AMP
R
x
T
x
10.7 MHZ
CRYSTAL FILTER
AMP
INTERMEDIAT
FREQUENCY
AGC DETECTOR
AGC AMPLIFIER
METER
2.5 MHZ
3.8 MHZ
5.9 MHZ
9 MHZ
HARMONIC FILTER
ALC
ALC AND METERING
POWER AMPLIFIER
AMP
OVERLOAD PROTECTION
TRANSMIT SIGNAL PATH
RECEIVE SIGNAL PATH

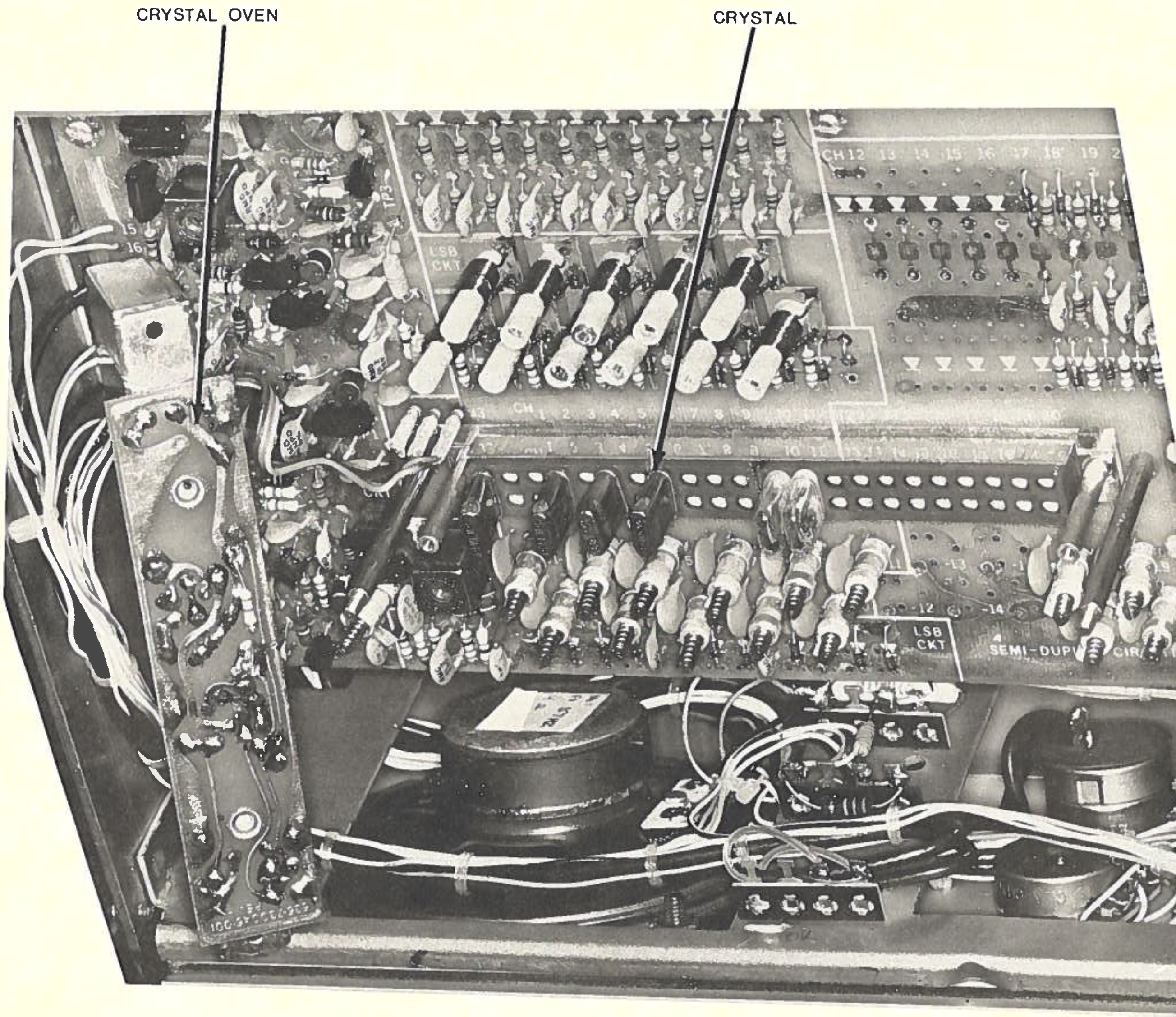


FIGURE 5-2 CRYSTAL MOUNTING

SECTION 6

ALIGNMENT, ADJUSTMENTS, PROGRAMMING

6.1 Introduction

This section describes the alignment, adjustments or programming procedures required on the transmitter receiver board, the HFO/BFO board and the power amplifier. These adjustments were all done at the factory and should not be performed unless a component belonging to the circuit involved has been changed.

6.2 Test Equipment

The following test equipment is recommended:

a) 50 ohm 100 watt RF power Meter, Marconi Instrument TF2503

b) Two tone audio generator, Marconi Instrument TF2005R

c) Spectrum analyzer, Marconi Instrument TF2370 or Hewlett Packard Spectrum Analyzer with:

- i) Display Unit 141T
- ii) RF Section 8553B
- iii) IF Section 8552B

d) Frequency Counter, Marconi Instrument TF2430

e) Oscilloscope, Tektronix Type 547 with plug-in unit 1A1

f) RF Voltmeter Boonton 92C

g) Voltmeter 20 Kohm/volt, 1% accuracy

h) RF signal generator, Marconi Instrument TF2002B

i) Audio wattmeter (3 ohm), Marconi Instrument TF893A

6.3 Receiver/Transmitter Board

Refer to Schematic Diagram Figure 7-5 and PCB layout Transmitter Receiver Figure 7-6. The alignment procedure should be carried out in the sequence given.

6.3.1 10 VDC Regulated DC Supply

Turn the AF GAIN control to minimum.

Switch to Receive mode.

Connect a voltmeter to measure the DC output between pin 9 and ground (pin 8).

Adjust R4 to give 10 VDC ±1% on the voltmeter.

6.3.2 Automatic Gain Control

Connect a voltmeter to measure the DC voltage between TP9 and ground (drain of Q18).

Switch to AM Receive mode.

Connect a 0.01 µF capacitor between TP3 (crystal filter) and ground.

Adjust R104 to give 2 VDC ±10% at TP9.

6.3.3 Broadcast Rejection Filter

This adjustment should be done with no HFO input. Select an unused channel or select one channel and remove its HFO crystal.

Connect the RF Signal Generator between pins 13 and 14, or at J2 on the rear panel and set the signal level to 0.5 V approximately.

Monitor the voltage output at TP1 (image filter) with the RF voltmeter.

Set the RF Signal Generator to 1.340 MHz.

Adjust L12 to minimize the output at TP1.

NOTE

The oscillator frequency used in Section 6.3.3 and 6.3.4 must be accurate to ±3 KHz.

6.3.4 Image Filter

With the same test set-up as described for the Broadcast Rejection Filter above.

Set the RF Signal Generator to 11.400 MHz.

Adjust L4 to minimize the output at TP1.

Set the oscillator signal to 10.700 MHz.

Adjust L5 to minimize the output at TP1.

Adjusting L5 will affect the null previously obtained with L4 so these adjustments should be repeated until an optimum null is obtained at both frequencies.

6.3.5 Mixer and IF Alignment

Adjustment of T2 in the balanced mixer circuit and T3 in the IF amplifier section are carried out as follows:

Set the A-F GAIN control to mid-range.

Switch to SSB Receive mode.

Select a channel equipped with an HFO crystal.

Connect the RF Signal Generator between pins 13 and 14 on the Rx - Tx PCB or at J2 on the rear panel and inject a signal at the channel frequency selected. Fine tune the oscillator until a beat is heard from the speaker.

Turn down the RF Signal Generator level until noise can be heard from the speaker.

Adjust T2 and T3 to minimize the noise and restore the beat signal.

Turn down the RF Signal Generator level further until the noise reappears and once again adjust T2 and T3 to restore the beat. This procedure should be repeated until no further improvement can be obtained.

6.3.6 Balanced Modulator

The carrier reject control R119 in the balanced modulator circuit is adjusted as follows:

Connect the 50 ohm RF dummy load to the coaxial output connector J2 at the back of the set.

Short the microphone input, pins 4 to 5 of connector J1 on the Transmitter Receiver Board.

Connect the oscilloscope across the dummy load.

Switch to USB transmit.

Adjust R119 to obtain a null in the signal amplitude as seen on the oscilloscope.

6.3.7 A3H and A3A Carrier Levels

a) <u>A3H Carrier</u>

Load the transmitter output at J2 into a 50 ohm 100 watt RF power meter.

Select AM mode.

Short the microphone input pins 4 to 5 of J1 on the PCB.

Switch to transmit and check the carrier power output from each channel. Select the channel which has the lowest power output and using R6, adjust A3H carrier injection for a power output of 25 watts. Check the carrier power level on every channel. The power level from other channels may be as high as 40 watts due to variation in amplifier gain with channel frequency.

b) A3A Carrier

This mode is optional. Selecting any channel fitted with the option will cause automatic reversion to A3A mode regardless of the mode switch setting. To check the carrier level of these channels, use the same test set-up described for A3H.

Select the A3A channel which has the lowest carrier power level.

Adjust R4 to give a power level of 1.6 watts.

Again the power level from other channels will vary and may be as high as 4 watts. If there is only one A3A channel, adjust the power level to 2.5 watts.

6.4 HFO/BFO Alignment, Crystal Netting and Programming

Refer to Schematic diagram Figure 7-2 and PCB layout Figure 7-3.

6.4.1 Adjustment of L7

L7 is a 10.7 MHz trap in the HFO output. Field adjustment may be carried out as follows:

Switch off the power.

Remove the crystal oven cover and unplug the BFO crystal Y2.

Remove the HFO crystal from channel 1 (Y1-1) and replace it with the BFO crystal, Y2.

Set the channel control switch to position 1.

Monitor the HFO output from pin 17 with the RF voltmeter.

Adjust L7 for a null.

6.4.2 BFO Crystal

a) Upper Sideband Mode

Restore the crystals removed in 6.4.1 to their original sockets. Replace the oven and its cover.

Switch on the set and allow it to warm up 15 minutes.

Select USB mode.

Monitor the BFO frequency and RF voltage output at pin 26. Adjust C37 until the BFO frequency is 10,700 MHz ±10 Hz.

The voltage level is 440 mV ±66 mV.

b) LSB

If the set is equipped with this optional kit, L9 and other components in Box 2 will be fitted. See 5.2.5.

Switch to LSB mode.

Adjust L9 until the BFO frequency is 10,697 KHz ±10 Hz.

The RF voltage level is 420 mV ±63 mV.

6.4.3 HFO Crystals, Ordering, and Harmonic Filter Programming

These crystals will normally require netting after the new crystal has been in operation for six months or more due to aging of the crystal. The crystal frequency will become progressively more stable, however, with age. If new channels are to be fitted, a kit containing the necessary components, will be ordered including a new crystal whose frequency must be specified at time of ordering. The new crystals must be netted after the kit is properly installed. Whenever a new channel is installed, the transmit signal must be connected through the correct section of the Harmonic Filter. To do this, refer to the Internal Connection Diagram (the Harmonic Filter Schematic Figure 7-18 or 7-19 gives details on internal circuits of the Harmonic Filter for reference if desired). The RF signal in Transmit mode is fed via a coaxial wire to pins J6 and J7 on the Harmonic Filter PCB. The signal passes directly out from J5 via a black wire to the wiper (terminal no.1) of wafer switch S5 and the signal is switched with the Channel Selector switch to terminal no. 2 for CH1, terminal no.3 for CH2, etc. For any new channels, the appropriate terminal on S5 must be connected to the correct section of the Harmonic Filter either J1, J2, J3 or J4. Similarly, the output from that section of the Harmonic Filter must be wired to the same number terminal on S6 which connects the signal back through the relay switch on the PCB to the antenna output connector at J2. The S5 wafer is located immediately in front of the Harmonic Filter PCB and wafer S6 is directly behind the PCB. Terminal connection numbers and layout of the wafer switches are shown on the Internal Connection Diagram (Figure 7-1). As an example, suppose a semi-duplex channel has been fitted for CHANNEL 2 and the new transmit crystal which might be installed, say in CH16, has a frequency of 2.206 MHz. The correct filter section to use will be the 1.6 to 2.46 MHz section. The terminal no.3 on S5 must therefore be wired to J1 on the Harmonic Filter PCB and J13 must be wired to terminal no.3 on S6.

Details are given for installing and netting Simplex Channels, Semi-duplex Channels and the A/B 20 channel option in the following sections.

Any channel may be pre-programmed to transmit automatically in A3A or A3H mode if required and this is explained in 6.4.3.5.

6.4.3.1 Simplex Channels Installation and Netting

On simplex channels the same crystal frequency is used for both Transmit and Receive modes. At least eight simplex channels are installed as standard (but may not all be fitted with HFO crystals) although some of these may be converted to semi-duplex mode (see 6.4.3.2). A maximum of eleven simplex channels only may be fitted to the standard transceiver in channel positions CH1 to CH11 unless the optional A/B switch is used (see 6.4.3.3). If the Transceiver already has channel components fitted but lacks a crystal, or if it is required to change channel frequencies, it is only necessary to order an HFO crystal 238-710001-001. Specify channel carrier frequency when ordering the crystal. If space exists and an extra simplex channel is required, order the Channel Kit (CMC Part 241-717560-701) and referring to the HFO/BFO Schematic Diagram Figure 7-2 and the HFO/BFO PCB Assembly Figure 7-3, fit the components in the empty channel position between CH9 and CH11. The HFO crystal specified will be channel carrier frequency.

Remove the light metal cover and the Crystal Oven assembly to expose the crystal plug socket and install the new crystal in the appropriate socket.

Connect the correct section of the Harmonic Filter as described in 6.4.3.

NETTING PROCEDURE

Ensure that power is OFF.

Replace the Crystal Oven assembly and the oven cover.

Switch on the Transceiver and allow at least 15 minutes warmup.

Make sure BFO is correctly adjusted. Refer to 6.4.2. Load the transmitter output into the 50 ohm RF dummy load (connector J2 at the rear of the set).

Set the CHANNEL selector to the new channel.

Select the AM mode.

Switch to transmit and measure the output frequency at J2 using the frequency counter.

Net this frequency using the appropriate capacitor C1-1 through C1-11 (C1-1 through C1-20 for A/B 20 channel). The frequency must be adjusted to within $\pm$10 Hz of the nominal value.

6.4.3.2 Semi-Duplex Channels Installation and Netting

Refer to HFO/BFO PCB Assembly Figure 7-3 and HFO/BFO Schematic Figure 7-2.

Each semi-duplex channel requires two crystals. The first is installed in a socket between CH1 and CH11 and determines the received frequency. The second crystal is installed in a socket between CH12 and CH20 and determines the transmit frequency. In most CH100 Transceivers, 4 semi-duplex channels are installed as standard and the components for the transmit mode will normally be installed in Box 'I' in channel positions CH17, CH18, CH19 and CH20. At least eight of the channels in positions CH1 to CH11 will have been factory equipped (but may not all be fitted with HFO crystals) and each of the transmit crystals in the semi-duplex box 'I' will have a corresponding receive crystal between CH1 and CH11. These are indicated by a jumper wire soldered between the square pads of corresponding channels. See Figure 7-2, note 8 (b).

If the Transceiver already has channel components fitted, but lacks the required HFO crystals, order two crystals (part number 238-710001-001) specifying the channel carrier frequency for both receive and transmit.

If an additional semi-duplex channel is required, order the Semi-duplex Kit (CMC Part 241-717503-701) which will contain the necessary components to complete one more channel in Box 'I'. Specify receive and transmit carrier frequency. These components should be installed following the instructions given on the HFO/BFO Schematic Diagram Figure 7-2 and a jumper wire must be connected on the HFO/BFO PCB between the square pad corresponding to the new transmit crystal in Box 'I' and its corresponding receive channel between CH1 and CH11. Referring to the Schematic Diagram Figure 7-2, a jumper shown dotted indicates the required connection when CH3 is semi-duplex with CH20. The semi-duplex kit therefore will convert a simplex channel to semi-duplex. Up to 10 semi-duplex channels may be obtained in this way although additional simplex channels may be required to do this (Order Kit No. 241-717560-701). It will also be necessary to remove the jumper W2 and add jumper W3 per note 11 on Figure 7-2 to obtain the tenth channel. Remember to connect the correct section of the Harmonic Filter as described in Section 6.4.3.

To net the transmit crystal in a semi-duplex channel follow Netting Procedure described for the simplex channel in 6.4.3.1.

For the receive channel, set the CLARIFIER control to mid-position and monitor the oscillator frequency at connection 17 of the HFO/BFO PCB. Use the appropriate netting capacitor C1-1 through C1-11 to adjust this frequency to nominal channel frequency +10,700 KHz ±10 Hz.

6.4.3.3 A/B 12-20 Channel Extension Installation and Netting

This kit, Part No.241-737563-701 includes all the components necessary to complete the full twenty channel positions and the A/B switch may be used to give two simplex channels for each channel position selected from CH1 to CH10. The channel 11 switch position will not be used if this option is fitted. If semi-duplex channels are fitted, the diodes CR4 in the Box 'I' (see Figure 7-2) corresponding to the semi-duplex channels will be left in position. This will cause the semi-duplex logic to override the A/B switch input and the semi-duplex channel will function normally. (See Section 5.2.3.)

To fit the kit, push out the blanking plate from the mounting hole in the front panel and assemble the A/B switch in position.

Wire the switch per the Internal Connection Diagram, Figure 7-1, to the HFO/BFO PCB pins 15 and 16.

Referring to the HFO/BFO schematic, remove the diodes on Box 'I' CR4-11 through CR4-20, except those on semi-duplex channels. Fit the components R24, C21, CR8 and C23 and remove C25.

Remove jumper W2 and add jumper W3 if the full 20 channels are to be used. Add jumper wires to connect the square pads of CH1 to CH20, CH2 to CH19, etc. as required.

To net the crystals select the transmit mode of each channel and follow the Netting Procedure given in Section 6.4.3.1. Before ordering HFO crystals, refer to Section 5.2.3.

6.4.3.4 LSB HFO Crystals Installation and Netting

Lower sideband operation is possible on simplex channels only, CH1 through CH11. Order the optional kit (CMC Part 241-717504-701) which contains the necessary parts to convert four channels. If more than 4 channels are needed, order 2 kits for up to 8 channels, 3 kits for up to 11 channels.

Refer to the HFO/BFO Schematic Figure 7-2 and fit the components following note 14.

In each LSB channel adjust L1 as follows:

Switch on the set and allow 15 minutes warmup.

Select LSB mode.

Set the CHANNEL selector to an LSB channel.

Monitor the HFO frequency at pin 17.

Adjust the appropriate L1 until the HFO frequency is 3 KHz lower than the USB frequency. (Check USB HFO frequency by switching to USB mode if required.)

It will also be necessary to adjust L9 in the BFO circuit per the instructions in Section 6.4.2 (b). More information on LSB operation is given in Section 5.2.5.

NOTE

Only one HFO crystal per channel is needed for USB/LSB operation, but should a new crystal be ordered use the regular HFO crystal CMC 238-710001-001 specifying channel carrier frequency.

6.4.3.5 A3A Kit Installation and Programming

Any channel may be converted to switch automatically to A3A mode if required by fitting the A3A kit (CMC Part 241-717562-701). This kit includes the components required to complete the A3A logic circuit on the Transmitter-Receiver PCB and a diode which must be installed in the appropriate channel on the HFO/BFO PCB. Fit the components for the A3A logic referring to the Transmitter Receiver Schematic Diagram Figure 7-5. Components which will be fitted are marked in the A3A-A3H logic box with ** and their location can be found on the Transmitter-Receiver PCB by referring to the PCB Assembly Figure 7-6. On the HFO/BFO PCB Figure 7-3 refer to the schematic diagram, Figure 7-2, note 10, and install the diode CR3 between the A3A pad and the required A3A channel as indicated (observe polarity of diode). When this channel is selected the A3A mode will now be automatically switched in when the mode switch is on USB or LSB.

6.4.3.6 Automatic Mode Reversion to A3H, Installation and Programming

If required, any channel may be made to automatically switch to A3H mode whenever that channel is selected. This is achieved in a similar way to the A3A reversion described earlier by adding a diode between the A3H pad and the required channel pad on the HFO/BFO PCB. Refer to the HFO/BFO Schematic Figure 7-2, note 10.

6.5 Power Amplifier Adjustments

Refer to Power Amplifier Schematic Diagram Figure 7-8 and Power Amplifier PCB Assembly Figure 7-9.

There are two adjustments on the Power Amplifier, a Bias Adjustment R39 and the Automatic Level Control (ALC) adjustment R28. Both of these controls are located on the top edge of the Power

Amplifier PCB, the bias adjustment R39 being on the left end of the PCB and the ALC adjustment on the right end. Ready access to these adjustments may be obtained by removing the top cover of the Transceiver Unit. Figure 1-2 shows the adjustment points.

a) Bias Adjustment

Connect the 50 ohm RF dummy load to the power output connector J2 at the rear of the Transceiver.

Disconnect the microphone input pins 4 and 5 on the Receiver-Transmitter PCB and inject two 9 mV audio signals, one at 400 Hz and the other at 1800 Hz.

Select an operational channel.

Switch to USB mode.

Adjust R39 completely counter-clockwise reducing bias current to a minimum.

Adjust the ALC adjustment R28 fully counter-clockwise to give minimum power output.

Switch on the Transceiver and operate the PTT switch.

Monitor the output across the 50 ohm RF dummy load with the oscilloscope. The oscilloscope will show a two tone pattern with symmetrical waveform and severe crossover distortion, as shown in Figure 6-1 a. Increase the bias current by turning R39 clockwise until the crossover distortion is just eliminated, and the two tone pattern appears as shown in Figure 6-1 b.

b) Automatic Level Control Adjustment

This adjustment follows on from the Bias adjustment just performed using the same test set-up.

Connect the Power meter and monitor the RF power in the 50 ohm load.

Adjust R28 to give 100 W PEP output.

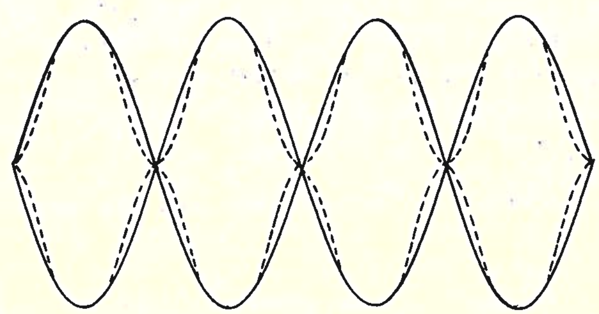
Reduce level of the two tones at the input until the output power level falls to 50 W PEP. Note the input signal level and increase this by 13 dB.

Readjust R28 to give an output power level of 105 W PEP.

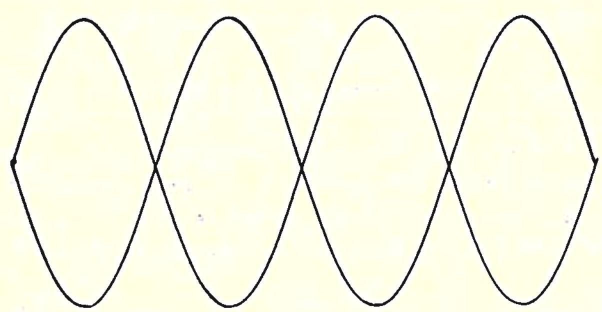
Feed a sample of the output to the Spectrum Analyzer and check the relative level of the third order, intermodulation product of each tone. These should be at least 22 dB below the level of one of the two tones and if necessary, R28 should be readjusted to reduce the power output until this specification is met.

For U.S. Models (CH100MA and CH100MB) check the relative power level of eleventh and thirteenth intermodulation products. These should be 57 dB below the fundamental level of each tone. If this specification is not met, increase the bias current slightly by turning R39 clockwise. Power output level may also be reduced, using R28, down to 100 W PEP if necessary to meet the 57 dB specification. Figure 6-1 c shows the two tone pattern which will be seen on the oscilloscope if the ALC is set high.

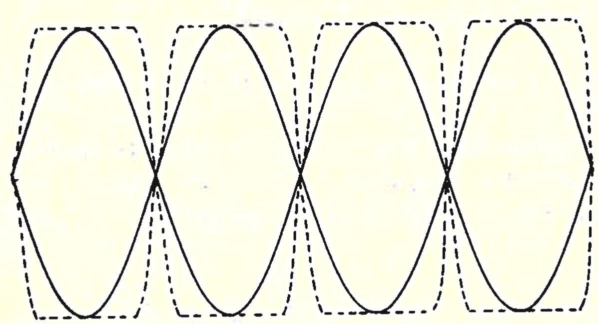
NOTE: 100W PEP for two equal tone condition equals 50W average (actual power).



A. DOTTED LINES SHOW CROSS OVER DISTORTION CAUSED BY LOW BIAS CURRENT IN OUTPUT STAGE.



B. OUTPUT PATTERN ADJUSTED CORRECTLY FOR MINIMUM DISTORTION.



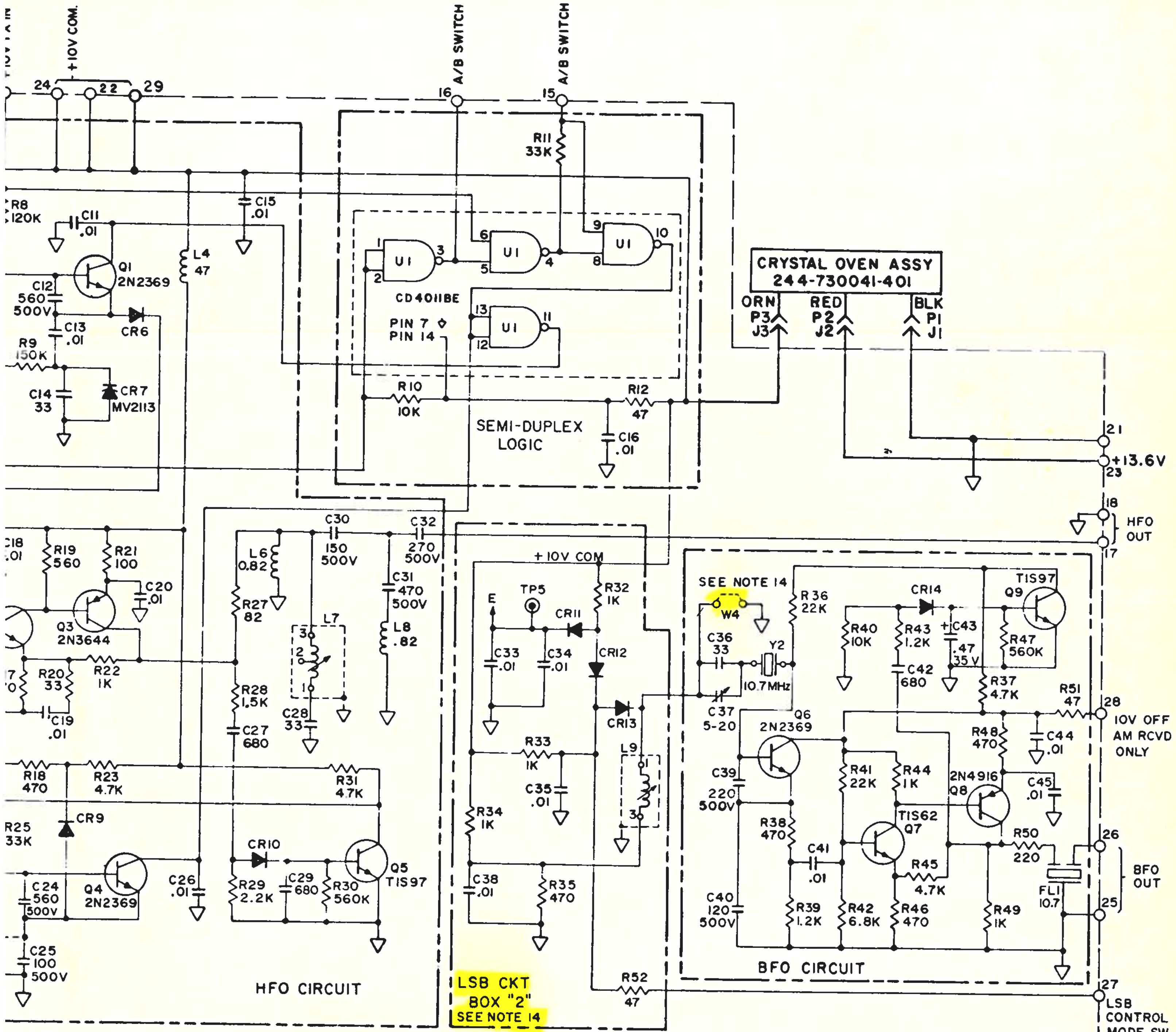
C. ALC CONTROL R28 SET TOO HIGH WILL PRODUCE OVERLOADING PATTERN OUTPUT SHOWN.

FIGURE 6-1 TWO TONE PATTERNS, POWER AMPLIFIER OUTPUT

7.1

7.2

7.3



E REVERSION TO A3A OR A3H 241-717562-701

E TO A3A OR A3H IS OBTAINED BY
BETWEEN THE CHANNEL PAD AND
OR A3H LINE. IN EX. SHOWN HERE
IC MODE TO A3H AND CH2 TO A3A
NNELS ARE USB OR AS DETERMINED
PANEL MODE SWITCH

EL OPERATION (241-737563-701)

S SHOWN IN DOTTED LINE PLUS ALL
IENTS NECESSARY FOR SEMI-DUPLEX
FOR 20 CHANNEL OPERATION

ETED

O DIODES ARE DELETED ON ALL
EXCEPT THOSE REQUIRED FOR
EX OPERATION

14 LSB OPERATION (241-717504-701)
a) COMP. IN BOX "2" PLUS L1-1 TO L1-11 & CR2-1 TO CR2-11 ARE FOR LSB OPERATION
b) CUT-OFF W1-1 WHEN CH1 IS LSB
CUT-OFF W1-2 WHEN CH2 IS LSB, ETC
c) CUT-OFF W4 FOR LSB OPERATION

13 LSB, A/B 20 CHANNELS AND SEMI-DUPLEX ARE OPTIONAL

12 UNITS MAY NOT BE FULLY EQUIPPED FOR 11 CHANNELS, EXTRA CHANNELS ARE AVAILABLE AS "CHANNEL KIT CMC 241-717560-701"

11 JUMPER W2 IS DELETED & JUMPER W3 IS ADDED ONLY WHEN A 10th SEMI-DUPLEX CHANNEL OR WHEN A 10 CHANNEL POSITION WITH A/B 20 CHANNEL KIT IS NEEDED. SIMILARLY CR4-11 DIODE IS ADDED ONLY IF A 10 SEMI-DUPLEX CHANNEL IS NEEDED. THIS IS A SILICON DIODE SUCH AS IN4151, IN4148, IN914 ETC

TYPICAL AC VOLTAGES, HFO/BFO PCB

The following table shows typical AC voltages measured with a Tektronix scope type 547 and plug-in 1A1, probe 10X, 8.5 pF 10 Mohm. The measurements are in volts peak to peak unless otherwise specified.

TEST POINTS	VOLTAGE LEVEL	REMARKS
TP1	560 mV p-p	HFO frequency = 12.882 MHz
TP2	285 mV p-p	
TP3	3.6 VDC 8.4 VDC	Voltage depends on crystal used. Voltage with no HFO crystal.
Connection 17	1.5 V p-p	BFO output
Q6 Base	1.4 V p-p	BFO = 10.7 MHz
Q7 Base	600 mV p-p	BFO
Connection 26	1.1 V p-p	BFO output
Collector Q9	2 VDC	Voltage depends on crystal used.

TYPICAL DC VOLTAGES

The following tables show typical DC voltages taken with a 20 Kohm per volt voltmeter. All readings are taken to ground (⏚) in no signal condition when on receive, and no modulation when on transmit unless otherwise specified. The input voltage was 13.6 VDC for unit with 13.6 VDC power supply, adjusted to 13.6 VDC for unit with 26/36 VDC power supply and 115 VAC for unit with 115 VAC power supply. Specific conditions under which each reading was taken is shown in the following legend:

A = Receive SSB
B = Receive AM
C = Receive SSB or AM
D = Transmit SSB
E = Transmit SSB or AM
F = Transmit AM
G = Transmit or Receive SSB
H = Transmit or Receive AM
I = Transmit or Receive SSB or AM

A similar table appears in front of each schematic diagram and the symbol appearing under the column "CONDITIONS" follows the same legend.

TRANSISTORS	TEST POINTS, VDC			CONDITIONS	REMARKS
	EMITTER	BASE	COLLECTOR		
Q1	2.0	2.7	9.7	C	
Q2	3.1	3.9	6.0	C	
Q3	6.8	6.0	2.7	C	
Q4	1.7	2.2	9.7	E	
Q5	0	0.6	* 3.8	C	*Depends on crystal
Q6	1.5	1.0	9.3	A	
Q7	1.3	2.0	7.1	A	
Q8	7.8	7.1	2.9	A	
Q9	0	0.7	2.0	A	

All measurements taken with a 120uH choke in series with the meter probe except when measuring U1.

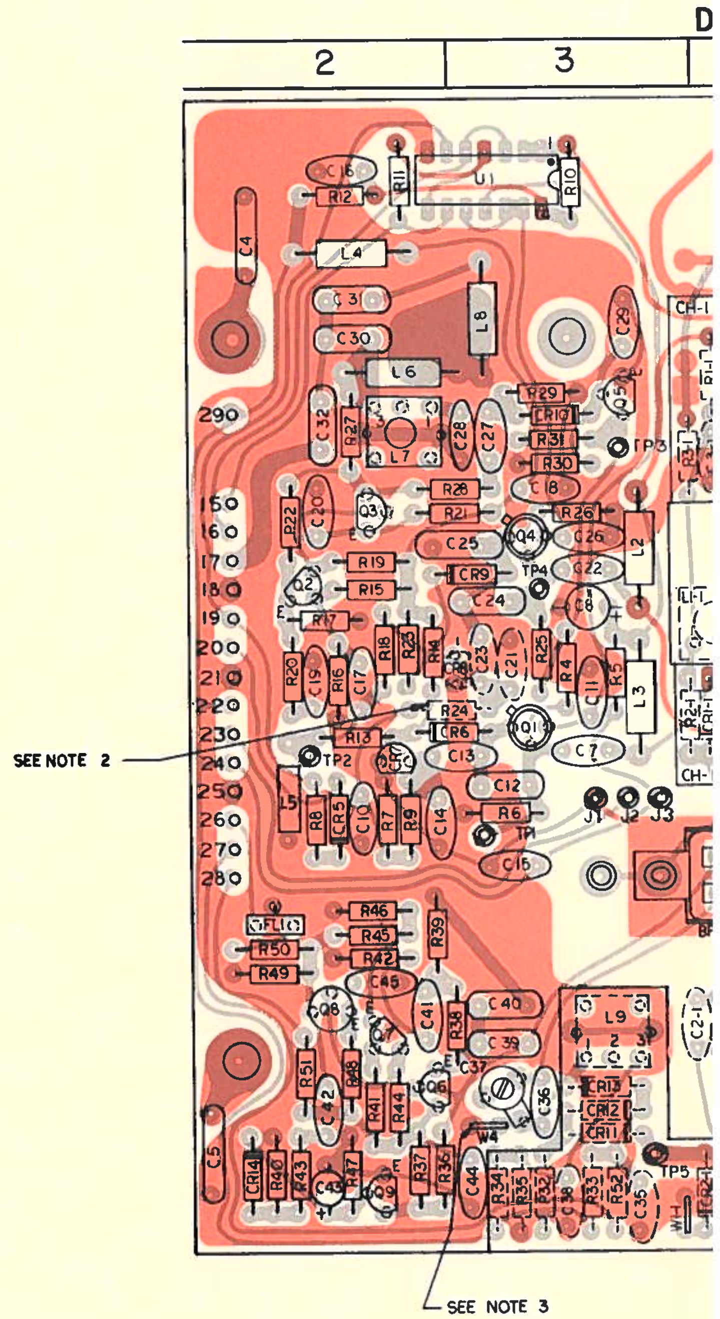
INTEGRATED CIRCUIT	TEST POINT	DC VOLTAGE	CONDITIONS	REMARKS
U1	1,2	10	I	Simplex Operation
	3,5	0	I	
	6	0	C	
	6	10	E	
	4,8	10	I	
	9	9.6	I	
	10, 12, 13	0	I	
	11	10	I	
U1	1,2	0.6	I	Semi-Duplex Operation
	3,5	10	I	
	6	0	C	
	6	10	E	
	4,8	10	C	
	4,8	0	E	
	9	9.6	C	
	9	0	E	
	10, 12, 13	0	C	
	10, 12, 13	10	E	
	11	10	C	
	11	0	E	

INTEGRATED CIRCUIT	TEST POINT	DC VOLTAGE	CONDITIONS	REMARKS
U1	1,2	10	I	With A/B 20 Channel Kit in A Position
	3,5	0	I	
	6	0	C	
	6	10	E	
	4,8	10	I	
	9	10	I	
	10, 12, 13	0	I	
	11	10	I	

INTEGRATED CIRCUIT	TEST POINT	DC VOLTAGE	CONDITIONS	REMARKS
U1	1,2	10	I	With A/B 20 Channel Kit in B Position
	3,5	0	I	
	6	0	C	
	6	10	E	
	4,8	10	I	
	9	0	I	
	10, 12, 13	10	I	
	11	0	I	

INDEX TO COMPONENT LOCATIONS, HFO/BFO PCB

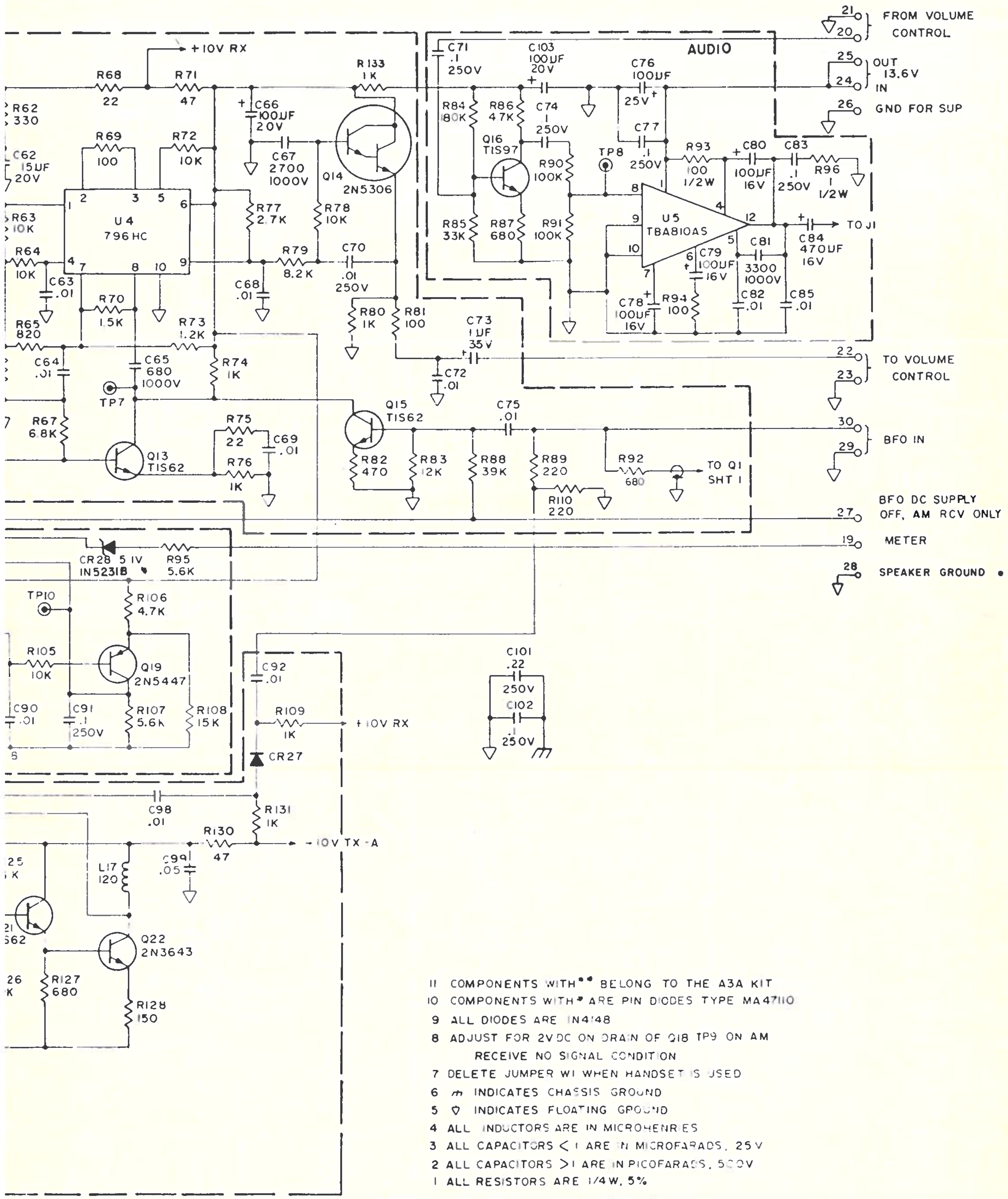
COMPONENT	LOCATION	COMPONENT	LOCATION	COMPONENT	LOCATION
C1-1 to C1-20	D4 to D7	R1-1 to R1-11	A3 to A5	R44	D2
C2-1 to C2-20	D4 to D7	R1-12 to R1-20	A6 to B7	R45	D2
C3-1 to C3-11	B4 to B5	R2-1 to R2-20	C3 to C7	R46	C2
C4	A2	R3-1 to R3-11	A3 to A5	R47	D2
C5	D2	R3-12 to R3-20	B6 to B7	R48	D2
C6	B7	R4	B3	R49	D2
C7	C3	R5	B3	R50	D2
C8	B3	R6	C3	R51	D2
C9	-	R7	C2	R52	D3
C10	C2	R8	C2		
C11	C3	R9	C2	CR1-1 to CR1-20	C4 to C7
C12	C3	R10	A3	CR2-1 to CR2-11	D4 to D5
C13	C3	R11	A2	CR3	A5 to A7
C14	C2	R12	A2	CR4-11 to CR4-20	B6 to B7
C15	C3	R13	C2	CR5	C2
C16	A2	R14	B2	CR6	C2
C17	C2	R15	B2	CR7	C2
C18	B3	R16	C2	CR8	B3
C19	C2	R17	B2	CR9	B3
C20	B2	R18	B2	CR10	B3
C21	B3	R19	B2	CR11	D3
C 2	B3	R20	C2	CR12	D3
C23	B3	R21	B2	CR13	D3
C24	B3	R22	B2	CR14	D2
C25	B3	R23	B2		
C26	B3	R24	C2	L1-1 to L1-11	B4 to B5
C27	B3	R25	B3	L2	B3
C28	B3	R26	B3	L3	C8
C29	A3	R27	B2	L4	A2
C30	A2	R28	B2	L5	C2
C31	A2	R29	B3	L6	A2
C32	B2	R30	B3	L7	B2
C33	D4	R31	B3	L8	A3
C34	D4	R32	D3	L9	D3
C35	D3	R33	D3		
C36	D3	R34	D3	Q1	C3
C37	D3	R35	D3	Q2	B2
C38	D3	R36	D2	Q3	B2
C39	D3	R37	D2	Q4	B3
C40	D3	R38	D2	Q5	B3
C41	D2	R39	D2	Q6	D2
C42	C2	R40	D2	Q7	D2
C43	D2	R41	D2	Q8	D2
C44	D3	R42	D2	Q9	D2
C45	D2	R43	D2	U1	A3



–COMPONEN

INDEX TO COMPONENT LOCATIONS, HFO/BFO PCB

COMPONENT	LOCATION	COMPONENT	LOCATION	COMPONENT	LOCATION
C1-1 to C1-20	D4 to D7	R1-1 to R1-11	A3 to A5	R44	D2
C2-1 to C2-20	D4 to D7	R1-12 to R1-20	A6 to B7	R45	D2
C3-1 to C3-11	B4 to B5	R2-1 to R2-20	C3 to C7	R46	C2
C4	A2	R3-1 to R3-11	A3 to A5	R47	D2
C5	D2	R3-12 to R3-20	B6 to B7	R48	D2
C6	B7	R4	B3	R49	D2
C7	C3	R5	B3	R50	D2
C8	B3	R6	C3	R51	D2
C9	-	R7	C2	R52	D3
C10	C2	R8	C2		
C11	C3	R9	C2	CR1-1 to CR1-20	C4 to C7
C12	C3	R10	A3	CR2-1 to CR2-11	D4 to D5
C13	C3	R11	A2	CR3	A5 to A7
C14	C2	R12	A2	CR4-11 to CR4-20	B6 to B7
C15	C3	R13	C2	CR5	C2
C16	A2	R14	B2	CR6	C2
C17	C2	R15	B2	CR7	C2
C18	B3	R16	C2	CR8	B3
C19	C2	R17	B2	CR9	B3
C20	B2	R18	B2	CR10	B3
C21	B3	R19	B2	CR11	D3
C 2	B3	R20	C2	CR12	D3
C23	B3	R21	B2	CR13	D3
C24	B3	R22	B2	CR14	D2
C25	B3	R23	B2		
C26	B3	R24	C2	L1-1 to L1-11	B4 to B5
C27	B3	R25	B3	L2	B3
C28	B3	R26	B3	L3	C8
C29	A3	R27	B2	L4	A2
C30	A2	R28	B2	L5	C2
C31	A2	R29	B3	L6	A2
C32	B2	R30	B3	L7	B2
C33	D4	R31	B3	L8	A3
C34	D4	R32	D3	L9	D3
C35	D3	R33	D3		
C36	D3	R34	D3	Q1	C3
C37	D3	R35	D3	Q2	B2
C38	D3	R36	D2	Q3	B2
C39	D3	R37	D2	Q4	B3
C40	D3	R38	D2	Q5	B3
C41	D2	R39	D2	Q6	D2
C42	C2	R40	D2	Q7	D2
C43	D2	R41	D2	Q8	D2
C44	D3	R42	D2	Q9	D2
C45	D2	R43	D2	U1	A3



11 COMPONENTS WITH** BELONG TO THE A3A KIT
10 COMPONENTS WITH* ARE PIN DIODES TYPE MA47110
9 ALL DIODES ARE IN4148
8 ADJUST FOR 2VDC ON DRAIN OF Q18 TP9 ON AM RECEIVE NO SIGNAL CONDITION
7 DELETE JUMPER W1 WHEN HANDSET IS USED
6 ⫽ INDICATES CHASSIS GROUND
5 ▽ INDICATES FLOATING GROUND
4 ALL INDUCTORS ARE IN MICROHENRIES
3 ALL CAPACITORS < 1 ARE IN MICROFARADS, 25V
2 ALL CAPACITORS > 1 ARE IN PICOFARADS, 500V
1 ALL RESISTORS ARE 1/4W, 5%

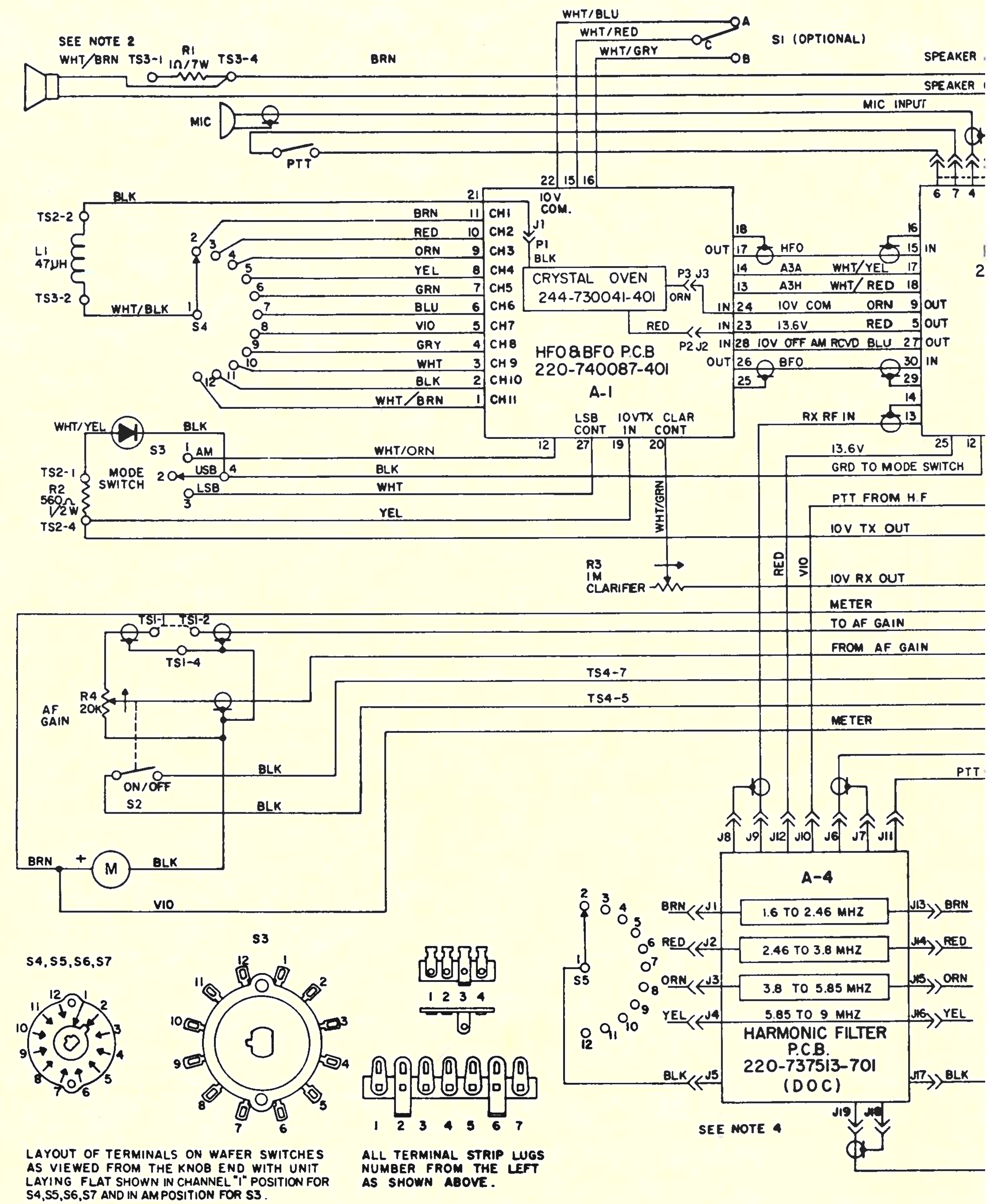
NOTES (UNLESS OTHERWISE SPECIFIED)

TYPICAL DC VOLTAGES

The following tables show typical DC voltages taken with a 20 Kohm per volt voltmeter. All readings are taken to ground (▽) in no signal condition when on receive, and no modulation when on transmit unless otherwise specified. The input voltage was 13.6 VDC for unit with 13.6 VDC power supply, adjusted to 13.6 VDC for unit with 26/36 VDC power supply and 115 VAC for unit with 115 VAC power supply. Specific conditions under which each reading was taken is shown in the following legend:

A = Receive SSB
B = Receive AM
C = Receive SSB or AM
D = Transmit SSB
E = Transmit SSB or AM
F = Transmit AM
G = Transmit or Receive SSB
H = Transmit or Receive AM
I = Transmit or Receive SSB or AM

A similar table appears in front of each schematic diagram and the symbol appearing under the column "CONDITIONS" follows the same legend.



SEE NOTE 2
WHT/BRN TS3-1
R1 1Ω/7W
TS3-4
BRN
WHT/BLU
WHT/RED
WHT/GRY
S1 (OPTIONAL)
SPEAKER
MIC INPUT
MIC
PTT
TS2-2
L1 47μH
TS3-2
BLK
WHT/BLK
S4
BRN
RED
ORN
YEL
GRN
BLU
VIO
GRY
WHT
BLK
WHT/BRN
CH1
CH2
CH3
CH4
CH5
CH6
CH7
CH8
CH9
CH10
CH11
10V COM.
J1 P1 BLK
CRYSTAL OVEN 244-730041-401
P3 J3
ORN
RED
P2 J2
HFO&BFO P.C.B 220-740087-401
A-1
LSB CONT
10VTX IN
CLAR CONT
OUT
HFO
A3A
A3H
WHT/YEL
WHT/RED
10V COM
13.6V
10V OFF AM RCVD BLU
BFO
IN
RX RF IN
13.6V
GRD TO MODE SWITCH
PTT FROM H.F
10V TX OUT
10V RX OUT
METER
TO AF GAIN
FROM AF GAIN
TS4-7
TS4-5
METER
WHT/YEL
S3
AM
USB
LSB
MODE SWITCH
TS2-1
R2 560Ω 1/2W
TS2-4
WHT/ORN
WHT
YEL
WHT/GRN
R3 1M CLARIFER
RED
VIO
TS1-1
TS1-2
TS1-4
AF GAIN
R4 20K
ON/OFF
S2
BRN
M
VIO
PTT
J8
J9
J12
J10
J6
J7
J11
A-4
S5
BRN J1
RED J2
ORN J3
YEL J4
BLK J5
1.6 TO 2.46 MHZ
2.46 TO 3.8 MHZ
3.8 TO 5.85 MHZ
5.85 TO 9 MHZ
HARMONIC FILTER P.C.B. 220-737513-701 (DOC)
J13 BRN
J14 RED
J15 ORN
J16 YEL
J17 BLK
J19
J18
SEE NOTE 4
S4,S5,S6,S7
S3
LAYOUT OF TERMINALS ON WAFER SWITCHES AS VIEWED FROM THE KNOB END WITH UNIT LAYING FLAT SHOWN IN CHANNEL "1" POSITION FOR S4,S5,S6,S7 AND IN AM POSITION FOR S3.
ALL TERMINAL STRIP LUGS NUMBER FROM THE LEFT AS SHOWN ABOVE.

SECTION 8

PARTS LISTS

8.1 General

When ordering replacement items specify the description and 12 digit part number. The parts lists which follow do not include resistors 1/4 W ±5% because these are included on the relevant schemat diagrams and if ordering it is not necessary to specify a part number.

HFO/BFO PCB ASSEMBLY (A1)

Complete HFO and BFO PCB Assembly may be ordered as follows:

HFO and BFO PCB Assembly including 8 Channels and 4 Semi-duplex	220-740087-401
HFO and BFO PCB Assembly including 11 Channels and 4 Semi-duplex	220-740087-402

For Schematic Diagram and PCB layouts see Figures 7-2 and 7-3.

DESIGNATION	DESCRIPTION	PART NUMBER
C36	Capacitor, Ceramic 33 pF ±5% 1000 VDC	209-990060-503
C14, C28, C17	Capacitor, Ceramic 33 pF ±5% 1000 VDC	209-990071-140
C27, C42, C29	Capacitor, Ceramic 680 pF ±20% 1000 VDC	209-990071-340
C7, C10, C11, C13, C15, C16, C19, C20, C22, C26, C41, C44, C45	Capacitor, Ceramic 0.01 μF +80 -20% 25 VDC	209-990070-367
C43	Capacitor, Electrolytic Tantalum 0.47 μF ±20% 35 VDC	211-990070-856
C8	Capacitor, Electrolytic Tantalum 15 μF ±20% 20 VDC	211-990074-727
C25	Capacitor, Mica 100 pF ±2% 500 VDC	212-990070-404
C40	Capacitor, Mica 120 pF ±2% 500 VDC	212-990071-356
C30	Capacitor, Mica 150 pF ±2% 500 VDC	212-990071-357
C39	Capacitor, Mica 220 pF ±2% 500 VDC	212-990074-742
C32	Capacitor, Mica 270 pF ±2% 500 VDC	212-990070-416
C31	Capacitor, Mica 470 pF ±2% 500 VDC	212-990060-401
C12, C24	Capacitor, Mica 560 pF ±2% 500 VDC	212-990060-402
C4, C5, C6	Capacitor, Metalized Film 0.047 μF ±10% 250 VDC	213-990074-512
C37	Capacitor, Variable 5-20 pF 250 VDC	216-990060-403
FL1	Filter, Ceramic 10.7 MHz	246-990060-404
L6, L8	Choke, RF 0.082 μH ±5%	260-990060-398
L4	Choke, RF 47 μH ±5%	260-990074-487
L2, L3	Coil, RF 120 μH ±5%	260-990074-649
U1	Integrated Circuit, CMOS Gate CD4011BE	264-990060-639
L5	Transformer Toroidal	322-720055-001

HFO/BFO PCB ASSEMBLY (A1) Cont'd

DESIGNATION	DESCRIPTION	PART NUMBER
--	Socket Crystal Holder	308-990060-410
L7	Transformer IF	322-720049-001
CR5, CR6, CR9, CR10, CR14	Diode, Switching 1N4151	294-990060-408
CR7	Diode, Varactor MV2113	294-990060-409
Q3	Transistor, 2N3644	324-990070-744
Q8	Transistor, 2N4916	324-990071-026
Q5, Q9	Transistor, T1S97	324-990070-749
Q2, Q7	Transistor, T1S62	324-990060-395
Q1, Q4, Q6	Transistor, 2N2369	334-990016-744
Y2	Crystal BFO 10.7 MHz	238-710002-001

Components in one additional Channel Kit (Typical)		241-717560-701
DESIGNATION	DESCRIPTION	PART NUMBER
C3-1 *	Capacitor, Ceramic 0.01 +80 -20% 25 VDC	209-990070-367
C2-1	Capacitor, Ceramic 27 pF ±5% 1000 VDC	209-990071-626
C1-1	Capacitor, Variable 5-20 pF 250 VDC	216-990060-403
CR1-1	Diode Switching 1N4151	294-990060-408
Y1-1	Crystal HFO (Specify Channel Carrier Frequency)	238-710001-001

* Designations shown for Channel 1 as typical.

Semi-duplex Channel Kit (One additional channel)	241-717503-701

This kit includes the same components as Channel Kit plus Diode CR4 and HFO Crystal specified for the Transmit Frequency to be installed in Box 'I'. See Section 6.4.3.

Kit LSB (4 Channels)		241-717504-701

This kit contains the following components, enough for 4 channels. More than one kit is necessary if more than 4 LSB channels are needed.

DESIGNATION	DESCRIPTION	PART NUMBER
C33, C34, C35, C38	Capacitor, Ceramic 0.01 µF +80 -20% 25 V	209-990070-367
L1-1, L1-2, L1-3, L1-4	Inductor, Variable	262-720051-001
CR2-1, CR2-2, CR2-3, CR2-4, CR11, CR12, CR13	Diode, Switching 1N4151	294-990060-408
L9	Transformer IF	322-720049-001

Kit, A/B 12-20 Channel Extension This kit contains Channel Kit Components as specified to complete the required Channels CH1 through CH20, plus the following:		241-737563-701
DESIGNATION	DESCRIPTION	PART NUMBER
C23	Capacitor, Ceramic 0.01 μF +80 -20% 25 VDC	209-990070-367
C21	Capacitor, Ceramic 33 pF ±5% 1000 VDC	209-990071-140
CR8	Diode, Varactor MV2113	294-990060-409
S1	Switch	312-990071-304
--	Switch Cap (Black)	550-990074-774
XTAL	All HFO Crystals (Specify Channel Carrier Frequency)	238-710001-001

Kit, A3A Automatic Mode Reversion For Schematic Diagram see Figure 7-5.		241-717562-701
DESIGNATION	DESCRIPTION	PART NUMBER
C1, C3	Capacitor, Ceramic 0.01 μF +80 -20% 25 V	209-990070-367
L2	Coil RF 120 μH ±5%	260-990074-649
R4	Resistor, Variable 100 ohms ±20% 1/2 W	292-990074-768

TRANSMITTER/RECEIVER PCB (A2)

Complete Transmitter/Receiver PCB Assembly may be ordered as follows:

Transmitter/Receiver PCB Assembly	220-740088-401
Transmitter/Receiver PCB Assembly including A3A Kit	220-740088-402

For Schematic Diagram and PCB Assembly see Figures 7-5 and 7-6.

DESIGNATION	DESCRIPTION	PART NUMBER
U3	Integrated Circuit, IF AMP MC1350P	264-990074-760
U4, U6	Integrated Circuit, Balanced Modulator 796 HC	264-990074-734
U5	Integrated Circuit, Audio Amp, TBA810DAS	264-990060-206
U1	Integrated Circuit, CMOS Gate CD4011BE	264-990060-639
U2	Integrated Circuit, Voltage Regulator LM305AH	264-990060-382
C45, C53, C60 C61, C65, C86	Capacitor, Ceramic 680 pF ±20% 1000 VDC	209-990071-340
C67	Capacitor, Ceramic 2700 pF ±10% 1000 VDC	209-990070-355
C81	Capacitor, Ceramic 3300 pF ±10% 1000 VDC	209-990060-383
C2, 4, 5, 7, 20, 22, 26, 25, 27, 28, 44, 52, 54, 55, 57, 58, 63, 64, 68, 69, 72, 75, 82, 85, 87, 88, 90, 92, 94, 95, 97, 98, C1, C3.	Capacitor, Ceramic 0.01 μF +80 -20% 25 VDC	209-990070-367

DESIGNATION	DESCRIPTION	PART NUMBER
C21, 29, 41, 42, 50, 93, 99, 17	Capacitor, Ceramic Dielectric 0.05 µF, ±20% 25 VDC	209-990074-609
C43, 46, 51, 73	Capacitor, Electrolytic Tantalum 1 µF ±20% 35 VDC	211-990071-213
C18, 24, 31, 47, 59, 62, C89	Capacitor, Electrolytic Tantalum 15 µF ±20% 20 VDC	211-990074-727
C96	Capacitor, Electrolytic Tantalum 47 µF ±20% 6 VDC	211-990074-737
C49, 66, 103, 48	Capacitor, Electrolytic Tantalum 100 µF ±20% 20 VDC	211-990071-874
C78, 79, 80	Capacitor, Electrolytic 100 µF +50 -10% 16 V	211-990074-037
C76	Capacitor, Electrolytic 100 µF +50 -10% 25 V	211-990074-341
C84	Capacitor, Electrolytic 470 µF +50 -10% 16 V	211-990071-517
C6, 23, 56, 100	Capacitor, Mica 47 pF ±2% 500 VDC	212-990070-428
C13	Capacitor, Mica 75 pF ±2% 500 VDC	212-990060-385
C15, C16	Capacitor, Mica 100 pF ±2% 500 VDC	2-2-990070-404
C8	Capacitor, Mica 220 pF ±2% 500 VDC	212-990074-742
C9	Capacitor, Mica 300 pF ±2% 500 VDC	212-990074-743
C10	Capacitor, Mica 360 pF ±2% 500 V	212-990060-361
C11	Capacitor, Mica 390 pF ±2% 500 V	212-990074-646
C12	Capacitor, Mica 430 pF ±2% 500 V	212-990060-386
C14	Capacitor, Mica 510 pF ±2% 500 V	212-990060-387
C34, C36	Capacitor, Polypropylene 1500 pF ±2% 400 V	213-990060-369
C35	Capacitor, Polypropylene 1800 pF ±2% 400 V	213-990060-370
C39	Capacitor, Polypropylene 2200 pF ±2% 400 V	213-990060-371
C33	Capacitor, Polypropylene 2700 pF ±2% 400 V	213-990060-373
C37, C40	Capacitor, Polypropylene 3300 pF ±2% 400 V	213-990060-372
C38	Capacitor, Polypropylene 4700 pF ±2% 200 V	213-990060-374
C70	Capacitor, Metalized Film 0.01 µF ±10% 250 VDCW	213-990074-511
C19	Capacitor, Metalized Film 0.047 µF ±10% 250 VDC	213-990074-512
C30, 32, 71, 74, 77, 83, 91, 102	Capacitor, Metalized Film 0.1 µF ±10% 250 VDCW	213-990074-509
C101	Capacitor, Polyester 0.22 µF ±10% 250 VDCW	213-990071-863
C104	Capacitor, Mica 820 pF ±2% 300 VDC	212-990060-422
J1	Connector, Receptacle (KK-100) 7 contact, male	230-990060-388
	*Filter Crystal (Dual Mode) DOC	246-730005-001
FL1	*Filter, Crystal (Dual Mode) FCC	246-730006-001
L8	Choke, RF 0.47 µH ±5%	260-990060-375
L7	Choke, RF 0.68 µH ±5%	260-990060-376
L6	Choke, RF 1 µH ±5%	260-990060-377
L11	Choke, RF 3.9 µH ±	260-990060-378
L3, L13	Choke, RF 4.7 µH ±5%	260-990060-379
L14	Choke, RF 5.6 µH ±5%	260-990060-380
L9, L15	Choke, RF 47 µH ±5%	260-990074-487
L1, L10, L17	Coil, Radio Frequency 120 µH ±5%	260-990074-649
L4, L5	Inductor, Variable	262-720052-001

TRANSMITTER/RECEIVER PCB (A2) Cont'd

DESIGNATION	DESCRIPTION	PART NUMBER
K1	Relay, C/W Top Lid 4PDT 12 V	284-990060-389
R104	Resistor, Variable 500 ohms ±30% 1/4 W	292-990060-391
R6	Resistor, Variable 1 K ±30% 1/4 W	292-990060-392
R40	Resistor, Variable 20 K ±30% 1/4 W	292-990060-393
R119	Resistor, Variable 250 K ±30% 1/4 W	292-990060-394
CR2, 3, 5, 6, 10, 26, 11, 12, 16, 18, 19, 20, 21, 22, 24, 25, 27	Diode Switching 1N4148	294-990070-649
CR28	Diode, zener, 1N5231B	294-990060-849
CR14, 15	Diode 1N5061	296-990074-016
CR7, 8, 9, 13, 23	Diode Pin MA 47110	294-990060-390
CR17,	Diode, Zener 1N751A	304-990070-672
CR29	Diode, Zener 1N748A	304-990070-673
Q6, 12	Transistor, NPN 2N4916	324-990071-026
Q5, 11, 19	Transistor 2N5447	324-990060-160
Q3, 7	Transistor 2N5449	324-990060-097
Q14	Transistor 2N5306	324-990071-656
Q2	Transistor 2N3638	324-990074-480
Q17	Transistor 2N4917	324-990074-296
Q22	Transistor, NPN 2N3643	324-990070-740
Q1, 9, 10, 16, 20	Transistor, T1S97	324-990070-749
Q13, 15, 21	Transistor, T1S62	324-990060-395
Q4	Transistor, FET N-Channel 3N201	324-990060-396
Q18	Transistor, FET 2N5245	328-990070-986
Q8	Transistor, Power	324-710005-001
T2, T3, L12	Transformer, IF	322-720049-001
T1	Transformer, Tx	322-720050-001
MX1	Double, Balanced Mixer	244-720025-001

* ALTERNATIVE CRYSTAL FILTER ASSEMBLY

This applies only to units not fitted with the Dual Mode Crystal Filter. In such cases the Dual Mode Crystal Filter is replaced by two Single Mode Filters and other components. In this case, the Schematic Diagram is shown in Figure 7-20 and the components are as follows. Performance is identical to the Dual Mode Filter.

DESIGNATION	DESCRIPTION	PART NUMBER
1FL1	Crystal Filter SSB (DOC)	246-730007-001
1FL2	Crystal Filter AM	246-730008-001
1FL1	Crystal Filter SSB (FCC)	246-730009-001
1C1 to 1C7	Capacitor, Ceramic 0.01 μF +80 -20% 25 V	209-990070-367
1L1, 1L2, 1L3, 1L4	Coil, Radio Frequency 120 μH ±5%	260-990074-649
1CR1 to 1CR6	Diode, Switching 1N4148	294-990070-649
1Q1	Transistor 2N5449	324-990060-097

VOICE OPERATED SQUELCH 241-737510-701

Complete V.O.S. PCB Assembly 220-740090-401

For Schematic Diagram and PCB layout see Figures 7-16 and 7-17.

DESIGNATION	DESCRIPTION	PART NUMBER
C6, C21, C24	Capacitor, Fixed, Electrolytic Tantalum 0.33 μF ±10% 35 VDCW	211-990060-500
C5, C23	Capacitor, Fixed, Electrolytic Tantalum 0.47 μF ±10% 35 VDCW	211-990060-501
C1, C2, C9, C27	Capacitor, Fixed, Electrolytic Tantalum 0.47 μF ±20% 35 VDCW	211-990070-856
C25	Capacitor, Fixed, Electrolytic Tantalum 1 μF ±20% 35 VDCW	211-990071-213
C22	Capacitor, Fixed, Electrolytic Tantalum 1 μF ±10% 35 VDCW	211-990060-502
C13	Capacitor, Electrolytic, Tantalum 10 μF ±20% 25 VDC	211-990071-214
C12, C15, C14, C16	Capacitor, Fixed, Electrolytic Tantalum 4.7 μF ±20% 35 VDCW	211-990070-857
C3, C4, C11, C17, C20, C26	Capacitor, Fixed, Electrolytic Tantalum 15 μF ±20% 20 VDCW	211-990074-727
C19	Capacitor, Fixed, Electrolytic 100 μF +50 -10% 16 V	211-990074-037
C7	Capacitor, Fixed, Metalized Film 0.033 μF ±10% 250 VDC	213-990074-513
C8	Capacitor, Fixed, Metalized Film 0.047 μF ±10% 250 VDC	213-990074-512
C18	Capacitor, Fixed, Metalized Film 0.01 μF ±10% 250 VDCW	213-990074-511
C10	Capacitor, Fixed, Metalized Film 0.1 μF ±10% 250 VDCW	213-990074-509
J1	Connector, Receptacle (KK-100) 7 Contacts Male	230-990060-388
L1, L4	Choke, 55 mH	260-720032-001
L2	Choke, 6.3 mH	260-720033-001
L3	Choke, 105 mH	260-720034-001
U1	Integrated Ckt. C/MOS, CD4011BE	264-990060-639
K1	Relay, Optelectronic 1 pole	284-990060-499
R4	Resistor, Variable, Composition 1K ±30% 1/4 W	292-990060-392
R11, R28	Resistor, Variable, Composition 5K ±30% 1/4 W	292-990060-498
R38	Resistor, Variable, Composition 20K ±30% 1/4 W	292-990060-393
R41, R42	Resistor, Variable, Composition 250K ±30% 1/4 W	292-990060-394
CR1, CR2	Diode, Switching 1N4148	294-990070-649
Q4, Q5	Transistor, PNP, Silicon 2N3644	324-990070-744
Q1, Q2, Q3, Q7, Q8, Q9, Q13	Transistor, NPN Silicon 2N3565	324-990070-739
Q10	Transistor, NPN Silicon 2N3643	324-990070-740
Q6	Transistor, Dual TD101	326-990072-275
Q11, Q12	Transistor, FET P-Channel, Silicon, Planar 2N4342	328-990070-981
S11	Switch	312-990071-304
--	Switch Cap (Black)	550-990074-774
P1	Kit, Connector, 7 Contacts	241-710029-401

POWER AMPLIFIER (A3)

Complete Power Amplifier PCB Assembly (Q1, Q2, Q3 & S1 are ordered separately) 220-740086-401

For Schematic Diagram and PCB layout see Figures 7-8 and 7-9.

DESIGNATION	DESCRIPTION	PART NUMBER
C21, C20	Capacitor, Ceramic 22 pF ±5% 1000 VDC	209-990071-196
C27	Capacitor, Ceramic 0.01 µF +80 -20% 25 VDC	209-990070-367
C10, C22, C23, C29	Capacitor, Electrolytic Tantalum 1 µF ±20% 35 VDC	211-990071-213
C4	Capacitor, Electrolytic Tantalum 4.7 µF ±20% 35 VDC	211-990070-857
C1, C36	Capacitor, Electrolytic Tantalum 15 µF ±20% 20 VDC	211-990074-727
C28	Capacitor, Electrolytic Tantalum 47 µF ±20% 6 VDC	211-990074-737
C31	Capacitor, Electrolytic Tantalum 47 µF ±20% 20 VDC	211-990074-736
C9	Capacitor, Mica 150 pF ±2% 500 VDC	212-990070-409
C18	Capacitor, Mica 180 pF ±2% 500 VDC	212-990074-645
C16	Capacitor, Electrolytic Tantalum 33µF ±20% 35 VDC	211-990074-554
C11	Capacitor, Mica 1500 pF ±2% 500 VDC	212-990060-427
C17	Capacitor, Mica 4300 pF ±2% 500 VDC	212-990060-625
C7, C37, C19	Capacitor, Metalized Film 0.01 µF ±10% 250 VDC	213-990074-511
C30	Capacitor, Metalized Film 0.047 µF ±10% 250 VDC	213-990074-512
C2, C3, C5, C6, C8, C12, C13, C14, C15, C26, C32, C33, C34, C35	Capacitor, Metalized Film 0.1 µF ±10% 250 VDC	213-990074-509
L4	Choke, RF 0.56 µH ±5%	260-990060-413
L1	Choke, RF 4.7 µF ±5%	260-990060-379
L5	Choke, RF 15 µH ±5%	260-990060-414
L6	Choke, RF 1000 µH ±10%	260-990074-747
L2, L3	Choke, RF	260-990060-415
R8, R9, R11, R12	Resistor, Fixed, Composition 43 ohms ±5% 2 W	286-990060-418
R36	Resistor, Wire Wound 27 ohms ±10% 5 W	288-990060-419
R39	Resistor, Variable 100 ohms ±20% 1/4 W	292-990060-521
R28	Resistor, Variable 5 K ±10% 1/4 W	292-990070-578
CR2, CR3, CR4, CR7, CR8	Diode, Switching 1N4148	294-990070-649
CR1	Diode Pin MA47110	294-990060-390
CR6	Diode, Zener 1N748A	304-990070-673
CR5	Diode, Zener 1N752A	304-990070-671
T1	Transformer, Toroidal	322-720051-001
T3	Transformer, Toroidal	322-720052-001
T2	Transformer, Toroidal	322-720053-001
T4	Transformer, Toroidal	322-720054-001
T5	Transformer, Toroidal	322-720055-001

POWER AMPLIFIER (A3) Cont'd

DESIGNATION	DESCRIPTION	PART NUMBER
Q4, Q5, Q7, Q8	Transistor T1S97	324-990070-749
Q9		
Q6	Transistor 2N5447	324-990060-160
Q10, Q11	Transistor, Power	324-710004-001
Q1	Transistor, RF-Power } Not part of	324-710008-001
Q2, Q3	Transistor, RF-Power (Matched Pair) } PCB. Order	324-730000-001
S1	Thermostat } separately	306-720002-001

DOC HARMONIC FILTER ASSEMBLY (CH100) 220-737513-701

For Schematic Diagram see Figure 7-18.

DESIGNATION	DESCRIPTION	PART NUMBER
C15	Capacitor, Mica 82 pF ±2% 500 VDC	212-990074-739
C19, C25	Capacitor, Mica 47 pF ±2% 500 VDC	212-990070-428
C23,	Capacitor, Mica 120 pF ±2% 500 VDC	212-990071-356
C6, C24	Capacitor, Mica 130 pF ±2% 500 VDC	212-990070-407
C14	Capacitor, Mica 180 pF ±2% 500 VDC	212-990074-645
C5	Capacitor, Mica 200 pF ±2% 500 VDC	212-990074-740
C3, C4, C13	Capacitor, Mica 300 pF ±2% 500 VDC	212-990074-743
C20	Capacitor, Mica 330 pF ±2% 500 VDC	212-990060-360
C22	Capacitor, Mica 360 pF ±2% 500 VDC	212-990060-361
C2	Capacitor, Mica 470 pF ±2% 500 VDC	212-990060-401
C9	Capacitor, Mica 620 pF ±2% 500 VDC	212-990071-764
C1	Capacitor, Mica 750 pF ±2% 500 VDC	212-990060-428
C8	Capacitor, Mica 1000 pF ±2% 500 VDC	212-990074-726
C21	Capacitor, Mica 220 pF ±2% 500 VDC	212-990060-429
C12	Capacitor, Mica 470 pF ±2% 500 VDC	212-990060-426
C11	Capacitor, Mica 750 pF ±2% 500 VDC	212-990070-424
C10	Capacitor, Mica 1200 pF ±2% 500 VDC	212-990060-430
C7	Capacitor, Mica 1500 pF ±2% 500 VDC	212-990060-427
C17, C18	Capacitor, Metalized Film 0.01 µF ±10% 250 VDC	213-990074-511
C16	Capacitor, Metalized Film 0.1 µF ±10% 250 VDC	213-990074-509
K1	Relay, C/W Top Lid 4 PDT 12 V	284-990060-389
CR1	Diode, Switching 1N4148	294-990070-649
L1 thru L9	Coil, toroid*	

* Should replacement ever be necessary, it must be done at the factory.

FCC HARMONIC FILTER ASSEMBLY (CH100MA and CH100MB)

220-737514-701

For Schematic Diagram see Figure 7-19.

DESIGNATION	DESCRIPTION	PART NUMBER
C6, C28	Capacitor, Mica 62 pF ±2% 500 VDC	212-990060-421
C5	Capacitor, Mica 100 pF ±2% 500 VDC	212-990070-404
C24	Capacitor, Mica 130 pF ±2% 500 VDC	212-990070-407
C4, C29	Capacitor, Mica 150 pF ±2% 500 VDC	212-990070-409
C22, C33, C36	Capacitor, Mica 47 pF ±2% 500 VDC	212-990070-428
C21	Capacitor, Mica 200 pF ±2% 500 VDC	212-990074-740
C18	Capacitor, Mica 240 pF ±2% 500 VDC	212-990070-415
C3	Capacitor, Mica 330 pF ±2% 500 VDC	212-990060-360
C3,	Capacitor, Mica 360 pF ±2% 500 VDC	212-990060-361
C17, C25, C27, C35	Capacitor, Mica 390 pF ±2% 500 VDC	212-990074-646
C2, C19	Capacitor, Mica 510 pF ±2% 500 VDC	212-990060-387
C16	Capacitor, Mica 560 pF ±2% 500 VDC	212-990060-402
C9, C15, C34	Capacitor, Mica 620 pF ±2% 500 VDC	212-990071-764
C1	Capacitor, Mica 820 pF ±2% 300 VDC	212-990060-422
C14	Capacitor, Mica 910 pF ±2% 300 VDC	212-990060-423
C8, C7, C13	Capacitor, Mica 1000 pF ±2% 300 VDC	212-990074-726
C26	Capacitor, Mica 180 pF ±2% 500 VDC	212-990060-424
C12	Capacitor, Mica 300 pF ±2% 500 VDC	212-990060-425
C11	Capacitor, Mica 470 pF ±2% 500 VDC	212-990060-426
C10	Capacitor, Mica 750 pF ±2% 500 VDC	212-990070-424
C31, C32	Capacitor, Metalized Film 0.01 μF ±10% 250 VDC	213-990074-511
C30	Capacitor, Metalized Film 0.1 μF ±10% 250 VDC	213-990074-509
K1	Relay, C/W Top Lid 4PDT 12 V	284-990060-389
CR1	Diode, Switching 1N4148	294-990070-649
L1 thru L13	Coil, toroid*	

CH100 TRANSCEIVER CHASSIS PARTS

	DESCRIPTION	PART NUMBER
	Side Cover Panel Moulding	550-720035-001
	Terminal Strip 4 Lug (Used for TS1, TS2, TS3)	666-990070-223
	Terminal Strip 7 Lug (Used for TS4)	666-131065-010
	Front Panel CH100	622-730062-001
	Front Panel CH100MA, CH100MB	622-730062-002
	Loudspeaker	268-720003-001
	Speaker Baffle	554-710001-001
	Grill Cloth for Speaker Baffle	590-710004-001
	* Clarifier Control	292-710028-001
	* OFF/AF Gain Control	292-710027-001
	* Mode Switch	312-710026-001
	Knob (For Items Marked *)	610-710011-002
	Tx Lamp (Red LED) with Mounting Clip	294-990060-319

* Should replacement ever be necessary, it must be done at the factory.

CH100 TRANSCEIVER CHASSIS PARTS (Cont'd)

	DESCRIPTION	PART NUMBER
	Wafer Switch (S4, S5, S6, S7)	312-710025-001
	Channel Selector Shaft Assembly with Knob	654-720009-401
	Bushing (Shaft)	530-710018-001
	Choke, RF 47 μH ±5% (L1)	260-990074-487
	Meter	272-720004-001
	Mobile Hand Microphone with Connector	278-737508-701
	7 Contact Microphone Connector	241-710029-401
	Cover Plate Top	550-730076-001
	Cover Plate Bottom	550-730077-001
	Crystal Oven Cover Box	550-720040-001
	Coaxial Connector Receptacle (J2, J3)	230-131058-002
	Channel Designator Label	612-720008-001
	Clear Acrylic Window	671-710001-001

POWER SUPPLY 13.6 VDC 244-737518-701

For Schematic Diagram see Figure 7-1.

DESIGNATION	DESCRIPTION	PART NUMBER
F1, F2	Fuse, 3 AB 20A 250V	248-990070-542
CR1	Diode 1N248B, Rectifier C/W Mounting Hardware	294-990060-472
C1	Capacitor, Electrolytic 4700 μF 25 VDC	211-990060-461
C2, C3	Capacitor, Ceramic 0.02 μF +80 -20 % 100 VDC	209-990070-369
--	Cable Assembly, Cap (Black)	217-710052-401
--	Cable Assembly, Housing (Black)	217-710053-401
--	Cable Assembly, Cap (Red)	217-710054-401
--	Cable Assembly, Housing (Red)	217-710055-401
--	Label, Fuse	624-730004-003
--	Plate (Fuse)	626-710056-001

POWER SUPPLY 115/230 VAC 244-737515-701

For Schematic Diagram see Figure 7-15

DESIGNATION	DESCRIPTION	PART NUMBER
1/43	Bracket, Capacitor Mounting Mallory VR8	524-990060-476
	Plate (Fuse)	626-710056-001
	Power Cord Assembly	217-730029-317
T101	Transformer 50/60 Hz 115/230 VAC	322-730026-001
L101	Choke (Swinging)	260-720047-001
R101	Resistor 470 Kohms ±10% 1 W	286-932474-001
R102	Varistor, GE V47ZA7	291-990060-473

POWER SUPPLY 115/230 VAC (Cont'd)

DESIGNATION	DESCRIPTION	PART NUMBER
R1	Resistor, Fixed, Wire Wound, Power 1.0 ohm ±10% 7 W	288-990060-459
R103	Resistor, Fixed, Wire Wound, Power 40 ohms ±5% 20 W	288-990060-474
C101	Capacitor, Fixed, Metalized Film 0.047 µF ±10% 250 VDC	213-990074-512
C102	Capacitor, Fixed, Electrolytic 20,000 µF +75 -10% 25 V	211-990060-475
CR101	Semiconductor Device, Rectifier Bridge 25 Amps 100 PIV	294-990060-467
6/43	Terminal, Plain, Brass No. 10	316-990072-285
--	Fuse Holder	308-990071-694
F1	Fuse 3 AG 3 A 250 V	248-990070-548
F1	Fuse 3 AG 2 A 250 V	248-990071-495
	Terminal Strip 7 Lug	666-131065-010
	Bushing, Strain Relief	530-990070-170
	Label, Fuse (115 VAC)	624-730004-001
	Label, Fuse (230 VAC)	624-730004-002

POWER SUPPLY 26/36 VDC 244-737520-701

For Schematic Diagram and PCB Assembly see Figures 7-12 and 7-13. A photograph of the complete assembly is shown in Figure 7-14.

Complete Bracket Assembly (including Power Components) components used on Bracket Assembly are as follows: 524-730068-401

DESIGNATION	DESCRIPTION	PART NUMBER
--	Cable Assembly, Cap (Black)	217-710052-401
--	Cable Assembly, Housing (Black)	217-710058-401
--	Cable Assembly, Cap (Red)	217-710059-401
--	Cable Assembly, Housing (Red)	217-710055-401
L1	Choke 2.6 mH	260-720048-001
	Label, Fuse	624-730004-004
	Plate (Fuse)	626-710056-001
C6, C10	Capacitor, Polyester 0.22 µF ±10% 250 VDCW	213-990071-863
C8	Capacitor, Metalized Film 0.01 µF ±10% 250 VDCW	213-990074-511
C7	Capacitor, Electrolytic 470 µF +50 -10% 63 V	211-990060-460
C9	Capacitor, Electrolytic, 4700uF, +50 -10%, 25V.	211-990060-461 211-990060-461
CR3, CR5	Semiconductor Device, Diode 25 Amps 50 V	296-990074-370
CR4	Semiconductor Device, Controlled Rectifier	294-990060-462
R13, R14 in parallel or one R13	Resistor, Fixed, Wire Wound, Power 1.0 ohms ±10% 7 W (Preferred 0.5 ohms ±10% 20 W	288-990060-459 288-990060-616

POWER SUPPLY 26/36 VDC (Cont'd)

DESIGNATION	DESCRIPTION	PART NUMBER
R15	Resistor 2.2 Kohm ±10% 2 W	286-934222-001
Q3	Transistor Power	324-710005-001
Q4	Transistor, Power c/w Mounting Hardware, 2N5302	332-990074-225
	Terminal Strip 7 Lug	666-131065-010
	Bushing Strain Relief	530-990071-493
F1, F2	Fuse 3 AG 15 A 32 V	248-990074-078
F1, F2	Fuse 10 A 125 V	248-990060-458

COMPLETE PCB ASSEMBLY 26/36 VDC POWER SUPPLY 220-720023-401

Components used on PCB are as follows:

DESIGNATION	DESCRIPTION	PART NUMBER
C1	Capacitor, Ceramic 0.01 µF +80 -20% 25 V	209-990070-367
C3	Capacitor, Electrolytic, Tantalum 10 µF ±20% 25 VDC	211-990071-214
C4	Capacitor, Mica 47 pF ±2% 500 VDCW	212-990070-428
C2, C5	Capacitor, Metalized Film 0.1 uF ±10% 250 VDCW	213-990074-509
U1	Integrated Ckt. Lin., Voltage Regulator LM305AH	264-990060-382
R11	Resistor, Variable, Composition 20 K ±30% 1/4 W	292-990060-393
CR2	Diode, 1N5061	296-990074-016
CR1	Diode, Zener 1N5248B	294-990060-446
Q1, Q2	Transistor, T1S97	324-990070-749

EXTERNAL ANTENNA TUNER 244-767567-701

For Schematic Diagram and Assembly Photograph see Figures 3-6 and 3-5.

DESIGNATION	DESCRIPTION	PART NUMBER
T1/L2	Transformer and Coil PCB Assembly	220-740089-401
L1	Loading Coil	260-156710-001
ANT1/ANT2	Ceramic Insulator Feed Thru	606-990074-548
--	Socket, Relay with Hold Down Spring	308-990060-487
K1	Relay 12 VDC 185 ohms	284-990060-484
S1, S2	Wafer Switch, ceramic	312-710024-001
S5	Wafer Switch, slave	312-710027-001
S3, S4	Wafer Switch, phenolic	312-710025-001
--	Coupling Flexible	504-990060-027
J1	Connector Receptacle	230-131058-002
TB1	Terminal Block	666-710010-301
--	Cover ATU External	550-740018-001
CR1	Diode, Switching 1N4148	294-990070-649

EXTERNAL ANTENNA TUNER (Con't)

DESIGNATION	DESCRIPTION	PART NUMBER
B1	Motor 12 VDC	281-990060-485
C1	Capacitor, Polyester 1 μF ±10% 160 V	213-990060-488
C2	Capacitor, Ceramic 0.1 μF +80 -20% 100 V	209-990071-152
	Lead Assembly, Loading Coil	217-710057-401
	Cable Multicore	207-186343-001
	Cable Coaxial RG-213	207-990007-736
P1	Connector Plug	230-131058-001
P4	Connector Plug 15 Contact, Male	230-990060-550
When the External Antenna Tuner is used, the CH100 is fitted with an External ATU Interface Kit. For Schematic Diagram see Figure 3-7.		241-737569-701

DESIGNATION	DESCRIPTION	PART NUMBER
S8	Wafer Switch, Master Segment	312-710028-001
J4	Connector Receptacle, 15 Contact, Female	230-990060-364

INTERNAL ANTENNA TUNER 241-737565-701

For Schematic Diagram and Assembly Photograph see Figures 3-2 and 3-1.

DESIGNATION	DESCRIPTION	PART NUMBER
T1	Transformer PCB Assembly	220-730111-401
S10	Wafer Switch	312-710024-001
L1/S10	Coil Assembly	262-720053-401
	Lead Assembly, Transformer	217-710056-401
	Lead Assembly, Loading Coil	217-710057-401
S9	Wafer Switch, Transceiver	312-710025-001
	Cable Link Assembly	217-710005-001
J1	Connector, Porcelain	606-990070-191

HANDSET AND HOOKSWITCH ASSEMBLY 252-730004-401

For Schematic Diagram see Figure 7-21.

	DESCRIPTION	PART NUMBER
	Handset Assembly	252-730003-001
	Cradle and Hookswitch Assembly	552-710001-301
	Cable Assembly	217-720035-401
	Kit, Connector, 7 Contacts	241-710029-401

CRYSTAL OVEN ASSEMBLY 244-730041-401

DESIGNATION	DESCRIPTION	PART NUMBER
	P.C. Board Assembly, Crystal oven	220-730012-401
	Transistor, power,	324-710004-001
	Resistor, thermal, 10.64K ohms, 25°C	291-990070-577

P.C. BOARD ASSEMBLY, CRYSTAL OVEN 220-730112-401

DESIGNATION	DESCRIPTION	PART NUMBER
C1	Capacitor, ceramic, 0.01uF, +80 -20%, 25V.DC	209-990070-367
CR1	Diode, switching, 1N1451	294-990060-408
R9	Resistor, fixed, wire-wound, 0.51 ohms, 2W,5%	288-990070-596
R10	Thermal cut-off, 109°C	291-990060-443
Q1,Q5,Q6	Transistor, 2N5449	324-990060-097
Q2	Transistor, 2N5447	324-990060-160

KIT, CW CONVERSION 241-717509-701

DESIGNATION	DESCRIPTION	PART NUMBER
	P.C. Board Assembly	220-720031-401
	Connector, receptacle, 3 contacts	230-990060-665
	Headset	254-990072-537
	Key	312-990073-150
	Cable, Single phone cord	207-990072-497
	Connector, plug, 3 contact	230-990060-654
	Ear cushion	500-990072-936

KIT, TONE CALL 241-717525-701

DESIGNATION	DESCRIPTION	PART NUMBER
	P.C. Board Assembly	220-720031-401
	Switch, push-on type, DPDT	312-990070-701

P.C. BOARD ASSEMBLY, TONE OSCILLATOR 220-720031-401

C1	Capacitor, electrolytic, 4.7uF, 20%, 35V.DC	211-990070-857
C2	Capacitor, metal film, 0.047uF, 10%, 250V.DC	213-990074-512
C3	Capacitor, ceramic, 0.01uF, +80 -20%, 25V.DC	209-990070-367
C4	Capacitor, ceramic, 1000pF, 10%, 1000V. Z5F	209-990070-356
CR1	Diode, switching 1N4148	294-990070-649
U 1	Integrated circuit, CD4011BE.	264-990060-639
P1	Contact, receptacle	232-990072-029
P2	Contact, receptacle	232-990074-551
	Cable, coaxial	207-187615-001
Q1	Transistor 2N5449	324-990060-097

APPENDIX A

OPERATION AND MAINTENANCE DATA

FOR

12.3 TO 13.2 MHz FREQUENCY EXTENSION KIT

(241-717536-716)

PUBLICATION NO: 919-797500-301

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marconi canada

SEPTEMBER, 1979

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INTRODUCTION

This supplement provides the necessary operation and maintenance data for the 12.3 to 13.2 MHz frequency extension kit 241-717536-716, used on the CH100 Transceiver. This supplement should be used in conjunction with the technical manual for the CH100 Transceiver, publication no. 919-797500-001.

SECTION I

INSTALLATION AND OPERATION

1-1. INTRODUCTION.

The 12.3 to 13.2 MHz frequency extension kit has been specifically designed for the CH100 Transceiver permitting it to operate in the Marine band (12.3 to 13.2 MHz). When a CH100 with an internal antenna tuner is fitted with this frequency extension kit, its designation becomes CH100MC. When a CH100 with an external antenna tuner is modified to incorporate the 12.3 to 13.2 MHz frequency extension kit, its designation is changed to CH100MD.

The 12.3 to 13.2 MHz frequency extension kit consists of a bandpass filter PCB 220-730156-401, a harmonic filter PCB 220-720072-401 and the necessary mounting hardware. These two boards are connected in the CH100 as per figure 2-1.

1-2. INSTALLATIONS.

FCC regulations prohibit field installation of the 12.3 to 13.2 MHz kit by the operating activity. Field installation is authorized only if the kit is installed under direct supervision of Canadian Marconi personnel. However, because of the complexity of installation and post-installation adjustments, it is recommended that the unit be returned to CMC for modification work.

1-3. PRIMARY SUPPLY VOLTAGE REQUIREMENTS. In order to comply with the FCC requirement for 'occupied bandwidth', the primary voltage to the CH100MC or CH100MD must be maintained above the following minimum levels during transmit mode.

NOTE

> The user activity is responsible for ensuring that the following standards are met.

a. When the unit is used with the 13.6 Vdc power module, the input voltage to the set during transmit must not be less than 11.6 Vdc.

b. When the unit is used with the 26/36 Vdc power module, the input voltage to the set during transmit must not be less than 20 Vdc.

c. When the unit is used with the 115 Vac power module, the input voltage to the set during transmit must not be less than 99 Vac.

Note that the above minimum voltage limits are measured at the input side of the power cables provided with the equipment. The cables are:

- 10 ft., 10 awg; for 13.6 Vdc power module.

- 10 ft, 12 awg; for 26/36 Vdc power module.

- 8 ft, 18 awg, for 115 Vac power module.

1-4. REFERENCES. Parts list for the 12.3 to 13.2 MHz frequency extension kit is given in table 1-1. Modification instructions are detailed in drawings no. 919-710086-001.

REF DESG	DESCRIPTION	PART NUMBER
	12.3 TO 13.2 MHZ FREQUENCY EXTENSION KIT	241-717536-701
	. 12.3 TO 13.2 MHZ BANDPASS FILTER PCB; REFER TO TABLE 2-1.	220-730156-401
	. 12.3 TO 13.2 MHZ HARMONIC FILTER PCB; REFER TO TABLE 2-2.	220-720072-401
	. NAMEPLATE	624-710255-001
	. NAMEPLATE	624-710256-001
	. SCREW, MACHINE, 4-40 x 1/4	724-990070-032
	. LOCKWASHER, NO. 4	738-990070-146

Table 1-1. Parts List, 12.3 to 13.2 MHZ Frequency Extension Kit, CH100.

SECTION II

MAINTENANCE DATA

2-1. GENERAL.

This section contains the theory of operation, parts list and maintenance data for the 12.3 MHz to 13.2 MHz frequency extension option. Also included in this section are schematic diagrams, interconnection diagrams, and the components location information.

2-2. THEORY OF OPERATION.

Figure 2-1 is the connection diagram for the 12.3 to 13.2 MHz frequency extension circuitry. For each channel operating in the 12.3 to 13.2 MHz range, the bandpass filter and the harmonic filter must be switched 'IN'. The bandpass filter is switched 'IN' by adding a diode from S2 to TS5-1 (terminal strip TS5 is located on the partition near S2). In figure 2-1, diodes CR1 and CR2 are added to permit channels 3 and 4 to be operated in the 12.3 to 13.2 MHz marine band. It can be seen that a separate diode is needed for each channel operating in the 12.3 to 13.2 MHz band.

Assume that channel 3 has been selected. This means that cathode of CR1 is grounded by the wiper of switch S2. As a result, pin 6 of the bandpass filter is grounded via CR1. In the bandpass filter (figure 2-2), the ground at pin 6 causes nand-gates U1-B and U1-C to produce a high output which forward biases CR2 and CR4. At the same time, diodes CR1 and CR3 are turned off by the low output from nand gates U1-A and U1-D. Under this condition, the signal at TP4 (figure 2-3) is routed via terminals 34 through the bandpass filter and then connected to terminal 37.

From the aforementioned it can be seen (figure 2-2) that when pin 6 of the bandpass filter is high (selected channel is not in the 12.3 to 13.2 MHz range), diodes CR2 and CR4 are off and the bandpass filter is effectively switched 'OUT'. However, because CR1 and CR3 are now turned on, the unit operates in the normal manner; refer to figure 2-3 in conjunction with figures 2-1 and 2-2 to see how CR1 and CR3 complete the signal path.

Refer to figure 2-4. The 12.3 to 13.2 MHz harmonic filter operates as follows: The output from the power amplifier is received at J6 and connected to the wiper of S5 via J5 (figure 2-1). Assuming CH3 is selected, the PA output is connected to J17 via S5 (1-4) and S6 (1-4). From J17 the PA output is brought to J20, via the PTT relay K1 (figure 2-4), and then to J1 of the 12.3 to 13.2 MHz harmonic filter (figure 2-1). The output from the harmonic filter is taken at J3 and fed to the antenna.

From the above referenced diagrams, it can be seen that regardless of the channel selection, the 12.3 to 13.2 MHz filter is always in series with the RF path to the antenna. For example, if a channel operating at, say 2.5 MHz is selected, the PA output at J5 (figure 2-1) is routed via S5 and J2 to select the 2.46 to 3.8 MHz harmonic filter. The output from this filter at J14 is connected to J17 via S6 and, subsequently, passed through the 12.3 to 13.2 MHz harmonic filter in a manner identical to that described in the preceding paragraph.

2-3. MAINTENANCE DATA.

Schematic diagrams, interconnection data and components location information for 12.3 to 13.2 MHz frequency extension option are detailed in figures 2-1 thru 2-4. Figure 2-3 also highlights the area which is modified in the Transmitter/Receiver PCB assembly.

2-4. PARTS LIST.

Tables 2-1 and 2-2 detail the parts list for the bandpass filter PCB and the harmonic filter PCB (respectively) used in the 12.3 to 13.2 MHz frequency extension option.

REF DESG	DESCRIPTION	PART NUMBER
	12.3 TO 13.2 MHZ BANDPASS FILTER PCB	220-730156-401
C1	. CAPACITOR, CERAMIC, 0.01UF, +80-20%, 25V	209-990070-367
C2	. SAME AS C1	
C3	. CAPACITOR, MICA, 220PF, ±2%, 500V	212-990074-742
C4	. CAPACITOR, MICA, 56PF, ±2%, 500V	212-990016-022
C5	. SAME AS C1	
C6	. CAPACITOR, MICA, 39PF, ±2%, 500V	212-990072-060
C7	. CAPACITOR, MICA, 330PF, ±2%, 500V	212-990060-360
C8	. CAPACITOR, MICA, 33PF, ±2%, 500V	212-990060-914
C9	. SAME AS C1	
CR1	. PIN DIODE, MA47110	294-990060-390
CR2	. SAME AS CR1	
CR3	. SAME AS CR1	
CR4	. SAME AS CR1	
L1	. COIL, RF, 120UH, ±5%	260-990071-181
L2	. SAME AS L1	
L3	. SAME AS L1	

Table 2-1. Parts List, 12.3 to 13.2 MHz Bandpass Filter PCB (Sheet 1 of 2).

REF DESG	DESCRIPTION	PART NUMBER
L4	. TRANSFORMER, TOROID	322-720082-001
L5	. COIL, VARIABLE	262-720058-001
L6	. SAME AS L5	
L7	. TRANSFORMER, TOROID	322-720083-001
L8	. SAME AS L1	
L9	. SAME AS L5	
L10	. SAME AS L1	
U1	. IC, QUAD TWO-INPUT NAND GATE, CD4011BE	264-990060-639
	. SOCKET (FOR U1)	308-990061-067
	. SPACER	734-186605-003

Table 2-1. Parts List, 12.3 to 13.2 MHz Bandpass Filter PCB (Sheet 2 of 2).

REF DESG	DESCRIPTION	PART NUMBER
	12.3 TO 13.2 MHZ HARMONIC FILTER PCB	220-720072-401
C1	. CAPACITOR, MICA, 68PF, ±2%, 500V	212-990071-203
C2	. CAPACITOR, MICA, 75PF, ±2%, 500V	212-990060-385
C3	. CAPACITOR, MICA, 27PF, ±2%, 500V	212-990071-351
C4	. CAPACITOR, MICA, 300PF, ±2%, 500V	212-990074-743
C5	. CAPACITOR, MICA, 82PF, ±2%, 500V	212-990074-739
C6	. CAPACITOR, MICA, 100PF, ±2%, 500V	212-990070-404
J1	. CONTACT, PIN	232-990070-528
J2	. SAME AS J1	
J3	. SAME AS J1	
J4	. SAME AS J1	
L1	. INDUCTOR, VARIABLE	262-730002-001
L2	. INDUCTOR, VARIABLE	262-730002-012
L3	. SPACER	734-186605-003
C1	. CAPACITOR, CERAMIC, 140PF, ±5%, 1000V (NOTE: C1 IS SHOWN ON FIG. 2-1).	209-990072-055

Table 2-2. Parts List, 12.3 to 13.2 MHz Harmonic Filter PCB.

RECORD OF REVISIONS

CHANGE NO.	DATE	DESCRIPTION