

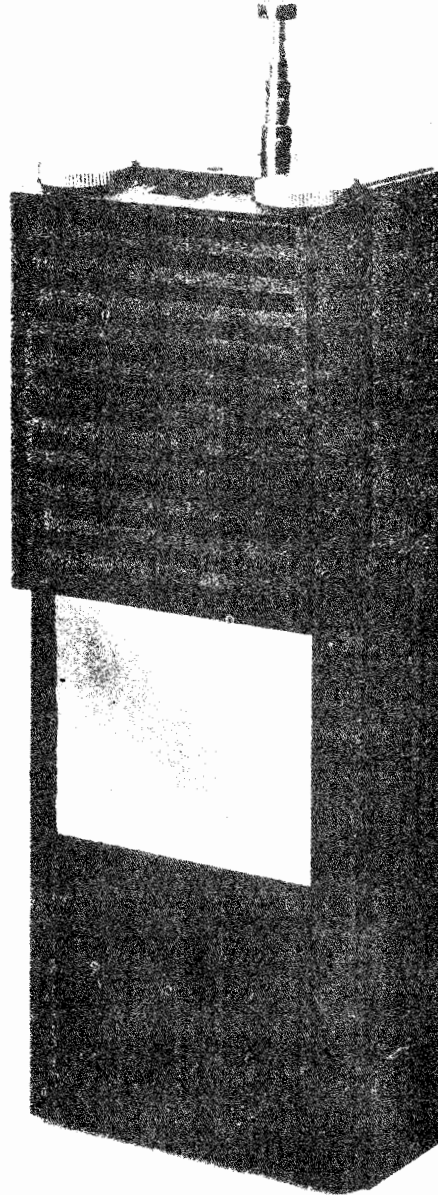
NAVSHIPS 0969-023-1000

INSTRUCTION MANUAL

MODEL BB-1001-1 PORTABLE TWO-WAY RADIO

RADIO SET
AN/PRC-73

23383



501 COMMONWEALTH AVENUE / ORLANDO, FLORIDA

NAVSHIPS 0969-023-1000

INSTRUCTION MANUAL

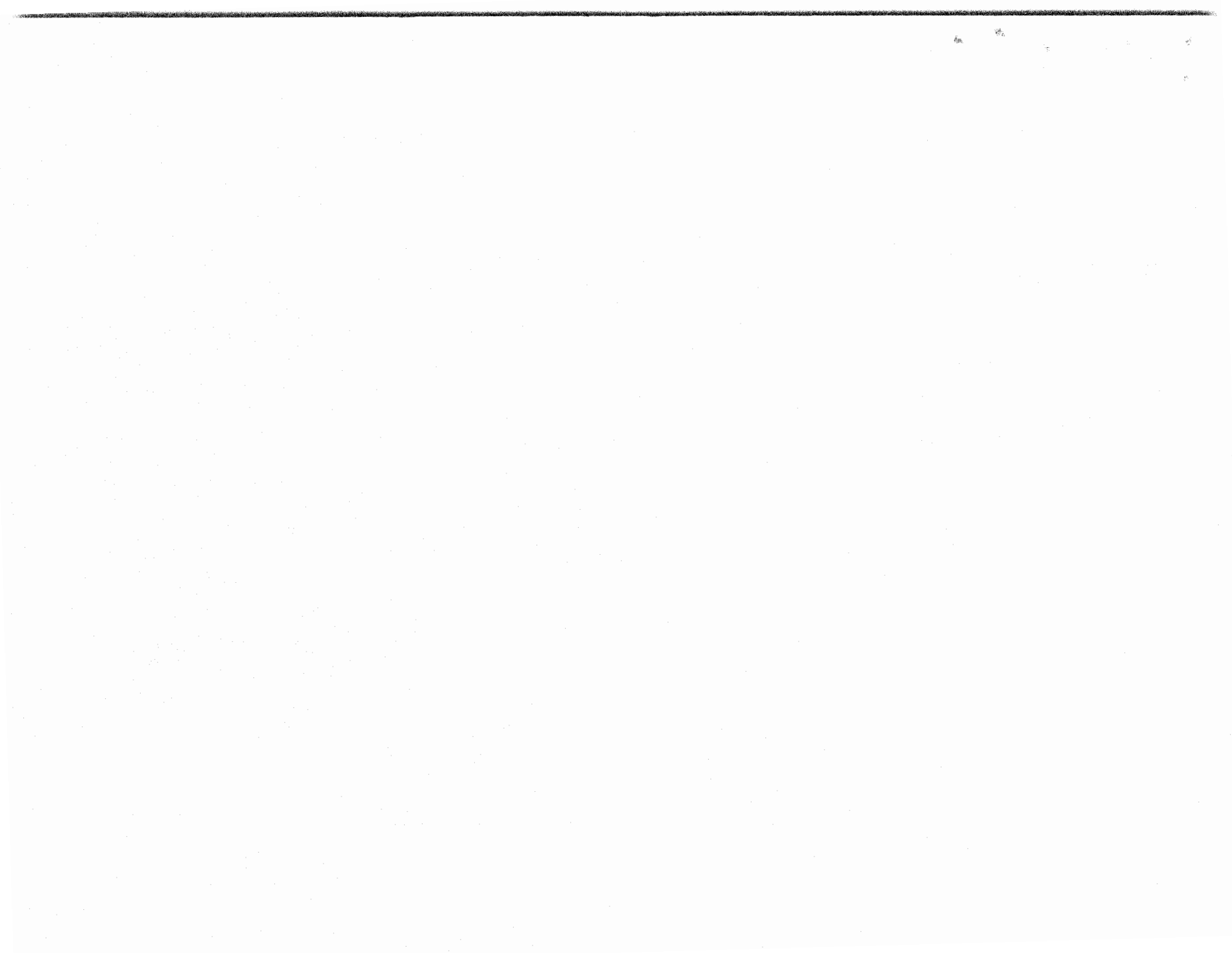
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501 COMMONWEALTH AVENUE / ORLANDO, FLORIDA



This addendum is intended for use in installing frequency determining crystals and transceiver alignment only. It is not intended for use for any level of maintenance.

ADDENDUM FOR AN/PRC-73

Para 1: Check the frequency label for indicated operating frequencies. If the frequency label is blank, the unit has been aligned at the factory for satisfactory operation at 144 MCS. If no frequencies are indicated, four crystals will have to be installed in the unit before use. If the frequency label is marked with operating frequencies, then the unit is already aligned and can be used on the indicated frequencies without any further adjustments. To install the crystals and align the unit, follow the instructions below.

Para 2: This procedure is written around the Motorola test set S-1059A or the Motorola test set TU 546(S1056) plus a peaking generator SLN6057A, a deviation meter SLN 100CA, a wattmeter load P-7208A, and accessories furnished.

The tuning procedure is preferred when installing the crystals and aligning the transceiver, however, the tuning procedures and test equipment prescribed on pages 17 through 30 in this manual may be used in the event that the Motorola test set S-1059A is not available.

Four crystals for each channel aligned are required, one transmit, one receive, one type AUL Motorola for carrier alignment with the peaking generator and one type AULX Motorola for deviation alignment.

Para 3: 3.1 The frequency of a transmit crystal may be computed if the operating frequency is substituted for f_c in the following formula.

$$f_{\text{xtal}} = \frac{f_c - 0.036 \text{ MC}}{12}$$

Example: if f_c is 151.925 MC

$$f_x = \frac{151.925 - 0.036}{12} = \frac{151.889}{12}$$

$$f_x = 12.6574 \text{ MC}$$

3.2 The frequency of a receive crystal may be computed if the operating frequency is substituted for f_o in the following formula.

$$f_x = \frac{f_o - 8.7 \text{ MC}}{3}$$

example if $f_o = 151.925$

$$f_x = \frac{151.925 - 8.7}{3} = \frac{143.225}{3}$$

$$= 47.7416 \text{ MC}$$

3.3 The frequency of a peaking generator crystal may be computed if the operating frequency is substituted for f_c in the Table 1, page 4 in the Peaking Generator manual.

3.4 The frequency of a deviation function crystal may be computed if the operating frequency is substituted for f_c in Table 1, page 3 in the Deviation Meter Panel manual.

Section 1 - Crystal Installation

Step 1 -

Remove the two circular knobs on either side of the ON-OFF switch. These knobs are located on the top of the unit, the end opposite the battery case opening. Grasp the knobs firmly between thumb and forefinger and pull outward from the top of the radio case. If the knob fit is too tight to be removed in this manner, place a large blade screwdriver beneath the knob and pry gently outward while pulling with the other hand.

Step 2 -

Remove the screw between the VOLUME AND SQUELCH controls and the metal plate that was being held by the screw.

Step 3 -

Place the radio set flat on the table with the speaker grill down.

Lift up on the antenna to remove the back. This back houses the antenna.

Step 4 -

Place all the parts removed in a container to prevent loss.

Step 5 -

Remove the rubber gasket on the push to talk switch, the rubber covered nut and the cylindrical spacer.

Step 6 -

Locate module 1003. Grasp the loop attached to 1003 with one hand and depress the harness board with the other. Pull up on module 1003 and remove it.

Step 7 -

Locate the screw beneath module 1003. Remove this screw, and the harness board from the radio case by lifting up on module 1010A with one hand and holding the radio case with the other

Step 8 -

Refer to Figure 2, on page 12. Find the sockets for the channel two transmit crystal and the channel two receive crystal. Plug the appropriate crystal into the appropriate socket. The lower frequency crystal is the transmit crystal.

Step 9 -

Refer to Figure 1, page 12, and install the channel one transmit crystal and the channel one receive in their proper sockets.

Step 10 -

Place the harness board in the radio case by inserting the end containing the volume and squelch controls first and sliding the harness board forward toward the top end of the transceiver. Then push the rear of the harness board down into the case. No great amount of force is needed to get the harness board to drop into the case. If it doesn't fit easily into the case, check to see if the speaker is in the hole provided.

Step 11 -

Replace the mounting screw located beneath module 1003. Replace module 1003, being careful to have the arrow pointing in the same direction, as 1002, etc.

Step 12 -

Replace the cylindrical spacer into the push to talk opening. The round end is pointed out toward the side of the transceiver. Replace the rubber covered nut and tighten firmly.

Step 13 -

Check the battery board as viewed from the battery opening. The bottom of the battery board should be down in the slot provided. If it has raised, push down on the top of the battery board while exerting pressure against the bottom of the battery board FROM THE BATTERY END OF THE TRANSCEIVER. The board will drop into the slot provided.

Step 14 -

Check the channel select (Channel 1 or 2) switch on the front of the transceiver to be sure the switch is protruding through the plate. (The movement of the harness board when pressure is applied on module 1010A toward the front of the case is normal and is caused by the mounting grommet.)

This completes the installation of the crystals.

Section 2 - Module Alignment and Frequency Adjustment

CAUTION

CAUTION

CAUTION

THE ONLY MODULES THAT REQUIRE ANY ADJUSTMENT FOR THIS PROCEDURE ARE 1001, 1002 IN THE RECEIVER AND 1011, 1012, AND 1013 IN THE TRANSMITTER. DO NOT ATTEMPT ADJUSTMENTS ON ANY OTHER MODULES. (Use the test pins supplied for making all connections to the AN/PRC-73.)

A. RECEIVER ALIGNMENT

Step 1 -

Use the Motorola SLN6057A Peaking Generator (Part of S1059A Test Set) for adjusting the two slugs in 1001 and the two slugs in 1002. Insert the proper crystal, AUL, for the channel frequency into the Peaking Generator crystal socket. Turn the Peaking Generator on and adjust the frequency of the Peaking Generator to the proper frequency. (Zero beat the Peaking Generator frequency to the base station frequency.) (See Portable Test Set Manual S1059A.)

Step 2 -

Insert a battery into the AN/PRC-73 battery receptacle and tighten the screw. Turn the ON-OFF switch to the ON position. Turn the squelch control fully counter-clockwise and advance the audio control clockwise until a comfortable level of noise is heard. Set the channel selector switch to the proper channel position.

Step 3 -

Connect the RF output of the Peaking Generator to the antenna connector on the AN/PRC-73 and the -12V buss. (Use a coax cable with BNC connector on one end and two alligator clips on the other.) See figure 1 for antenna connector and minus 12 volt buss.

Step 4 -

Adjust the slugs in 1002, and 1001 for minimum noise output. Reduce the output from the Peaking Generator with the output attenuator to keep the noise quieting to a minimum. Touch up all four slugs in 1001 and 1002 for maximum quieting (minimum noise output).

Step 5 -

If desired, a meter with a 10,000 ohm AC input impedance can be connected between pins 3 and 1 of module 1010A (Figure 1) and the audio output can be monitored directly on the meter. Pin 3 of module 1010A has +10 volts DC with the audio output superimposed on it. The ground side of

the meter should be connected to pin 1 and the "hot" side of the meter should be connected to pin 3. Care should be exercised to not create a short between pins 1 and 3.

CAUTION

CAUTION

CAUTION

DO NOT ATTEMPT TO USE THE METER IN THE S1059A FOR THIS PURPOSE BECAUSE IT WILL DAMAGE THE METER AND DESTROY MODULE 1010A.

Step 6 -

Remove module 1009. Refer to Figure 1 and adjust the associated channel rubberizing control for maximum quieting. Be sure to press the harness board firmly down into the case when making this adjustment.

Step 7 -

Switch channel selector to other channel. Insert proper crystal, AUL type, for this channel frequency into the Peaking Generator crystal socket. Zero beat against standard. Adjust associated rubberizing control in radio set for maximum quieting with minimum signal. Turn radio set "off"

B. TRANSMITTER ADJUSTMENT

Note the slug positions and material, also capacitor position on Table 111 in instruction manual. These positions can be used as a guide in tuning the transmitter near the correct frequency. Using the S1059A and the P-7208A dummy load, the transmitter output power, frequency and deviation can be adjusted.

Step 1 -

Connect one end of a coax cable to the dummy load (P-7208A) and the other end of the coax cable with clip leads to the ant. connector test point, and the -12 volt buss, Figure 1 page 12. Connect the S-1059A accessory cable, red plug to meter jack, black plug to dummy load.

Step 2 -

Remove the battery. Connect an external 24V battery (observe polarity) to the outside battery springs through a 0-500 ma meter. Turn the unit on, depress the push to talk switch, and adjust the slugs in 1011 and 1012 for maximum meter reading on the wattmeter in the S-1059A. Adjust the slugs and the capacitor in 1013 for maximum power output with minimum current through the ma meter.

NOTE

To adjust the transmitter to the proper frequency a type AULX Motorola crystal must be plugged into the peaking generator. The frequency of this crystal must be calculated from the table on page 3 of the S1059A instruction book. Connect the output of the peaking generator through a coax cable to the oscillator input on the deviation meter. Loosely couple the transmitter to the ant. connector on the deviation meter. Refer to instruction manual S1059A for warping AULX crystal to channel frequency. Warp to within ± 500 cycles.

Step 3 -

Turn the ON-OFF switch to the ON position. Press the push to talk switch, and adjust the proper channel rubberizing capacitor that is located beneath module 1009 for minimum deviation. Release the press to talk switch. See Figure 2 for the exact location of this capacitor. (If the proper frequency cannot be obtained, proceed to C. TRANSMITTER ADJUSTMENT.)

Step 4 -

Replace the AUXL crystal in the peaking generator with the one for the other channel. Warp crystal. Change the channel switch to the other channel. Press the push to talk switch and adjust the other transmitter rubberizing control for frequency as indicated on the S1059A discriminator meter, minimum deviation.

Step 5 -

Turn the AN/PRC-73 OFF and remove all connections and replace module 1009. Reassemble the radio set and turn ON check operation. If ok turn OFF. CAUTION - DO NOT KEY THE TRANSMITTER without a RF load or antenna connected.

C. TRANSMITTER ADJUSTMENT (To be used if B does not result in success).

The transmitter adjustment can be accomplished by use of the Motorola S1059A, associate equipment and an AM Signal Generator. Since there are three discreet frequencies in the AN/PRC-73, a signal generator must be available that covers the frequency range of the three frequencies. The three frequencies in the AN/PRC-73 are f_0 , (where f_0 is the desired operating frequency), $\frac{f_0}{12}$ and $\frac{f_0}{3}$. Module 1011 contains an oscillator at $\frac{f_0}{12}$ and a quadrupier that operates at $\frac{f_0}{3}$. Module 1012 contains a frequency tripler that multiplies $\frac{f_0}{3} \times 3$ to give f_0 .

Step 1 -

Turn OFF radio set. Remove modules 1013, 1012A and 1007 and 101CA. For the purposes of this procedure, the Deviation Meter Panels ONLY will be used as both a frequency and amplitude indicating device. (See the S1059A Instruction Book.)

Step 2 -

Connect a 0-50 milliampere DC current meter between pin C, module 1008 and pin C, module 1011. Connect the positive lead pin C module 1008 and the negative lead to pin C, module 1011. Turn radio set ON. When this connection is made the transmitter is keyed and the meter reads the current (13 ma to 25 ma) to module 1011. To turn off the transmitter with the meter connected, use the ON-OFF switch.

Step 3 -

Using small clip leads on coax test cable connect center conductor to pin F, module 1011, shield conductor to pin H, module 1011. Connect other end of coax test cable to attenuator. SLN6080A "in". Connect attenuator "out" to ant. jack on Deviation meter panel. Connect the external signal generator to the osc. jack on test set. Set the output level between 10 and 15 millivolts. Set the Deviation Meter function switch to "LIM" position. Adjust the signal to approximately four times crystal frequency, $f_c/3$. The test meter will peak when the signal generator is set at the correct frequency.

Step 4 -

Adjust the slugs in module 1011 for maximum reading on the test set meter. Re-adjust signal generator for maximum meter reading.

Step 5 -

When proper harmonic is verified on the S1059A, $f_c/3$, the output of module 1011 can be monitored with a wattmeter P7208A and S1059A, or a video detector. The RF output at four times the crystal frequency should be between 30 milliwatts and 70 milliwatts.

Step 6 -

Turn the ON-OFF switch to the OFF position. Disconnect the coax on the Test Set ant. jack. Replace the 0 to 50 milliampere meter with a 0 to 500 milliampere DC meter. Connect this meter to the same points as the 0-50 ma meter in 2 above.

Step 7 -

Insert module 1012A. With a coax cable connect the output of module 1012A (Ground side, pin H, hot side, pin E) through a small capacitor (10pfd to 20 pfd) into the wattmeter load, P7208A, see S1059 Instruction Manual. Turn the set ON and adjust the tripler coil (Slug #1, 1012, page 29 of instruction book) for maximum current as indicated on the 0-500 meter. Adjust coil #2 in 1012A for maximum power output as indicated on the wattmeter.

Step 8 -

Connect a test antenna to the ANT jack of the test set. Loosely couple to radio set. Adjust the output frequency of the signal generator to the desired channel frequency, f_o . If the modules are properly tuned the test set meter should peak. If they do not, re-adjust the slugs in module 1012 for power and frequency until both steps 7 and 8 are met. Touchup the coils in 1011 and 1012A for maximum power output (150-400 milliwatts).

Step 9 -

Turn the set OFF. Remove meter connections. Install modules 1013, 1007, and 1010A. Turn the set ON. Connect the wattmeter to the antenna connector. Depress the push to talk switch. Touchup slug #2 in module 1012A for maximum power output.

Step 10 -

Go back to (B) and make final adjustments.

D. DEVIATION ADJUSTMENT

The unit is adjusted for the proper deviation at the factory and normally does not have to be re-adjusted. The deviation can be checked by using the procedure in S1059A Instruction Manual. Deviation can be adjusted by turning the deviation control shown in Figure 1 of this Instruction Manual. This potentiometer is a twenty turn control and the deviation will adjust to a maximum and abruptly fall off to zero. If this happens, it is better to turn the control in the opposite direction about one turn and leave this as a maximum deviation setting.

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SPECIFICATIONS

GENERAL

Dimensions	3 1/8" x 10 1/8" x 1 1/4"
Weight	64 oz. with rechargeable battery
Frequency range	132-174 mc

- CIRCUITRY SEALED IN PLASTIC PLUG-IN MODULES

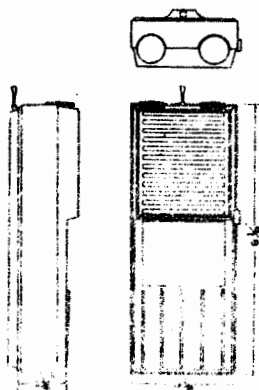
TRANSMITTER

RF Power output	1.0 watt minimum
Spurious emissions	-45 db
Frequency stability	± .002% -30°C to +50°C
Modulation	± 5 KC (NB) or ± 15 KC (WB)

RECEIVER

Sensitivity	.5 uv for 20 db quieting
Selectivity	-55 db at adjacent channel
Spurious-image rejection	more than 55 db
Squelch	Adjustable - will open at .25 uv
Audio output	500 MW at less than 10% distortion
Frequency stability	± .002% -30°C to +50°C
Modulation	± 5 KC (NB) or ± 15 KC (WB)

● NOTE: Specifications subject to change without notice.



OUTSIDE DIMENSIONS

INTRODUCTION

ACCEPTANCE

The portable radio transceiver is being widely used in those applications where close personal communication is important to effective and professional performance of critical duties.

Its compact design and new reliable modular circuitry make the unit a constant companion for those in active field work.

DISTRIBUTION

Dealers and Distributors for the unit are found in all major neighborhoods and availability is fast to support the new flexibility found when using the unit in your day to day communication problems.

Your dealer is fully equipped and trained to service your transceivers and supply the necessary spare parts which might be needed to fully support your operations program.

SERVICE

Service problems have been greatly simplified with the units new modular approach to packaging high frequency communications equipment.

Each section of the transistorized circuitry is broken down into low cost non-repairable modules, which in the event of discrepant operation may be easily isolated and replaced.

Complex circuits can now be reliably serviced by just unplugging the defective circuit block and plugging in a new replacement module.

MODIFICATIONS

From time to time changes will be made in this manual. Changes shall be distributed to your dealer and he in turn will make them available to you.

If a dealer is not conveniently near you, you may write to your distributor who will gladly mail you any amendments which may have been issued.

COMMUNICATIONS

If it becomes necessary to write to your manufacturer regarding this equipment, please be assured that your comments will be welcomed and replies will be forthcoming promptly.

In order to assure the complete coordination of information, always refer to your radio's serial number in all communications.

IDENTIFICATION CODE

CODE SYMBOL

I T E M

T	TRANSCEIVER (basic unit less optional batteries, retractable antenna)
---	---

SPECIFY one:

N	Narrow Band (+5KC)
W	Wide Band (+15KC)

SPECIFY one:

H	152-174 MC
M	132-152 MC
L	25-54 MC

SPECIFY one:

11	One frequency transmit, one frequency receive
12	One frequency transmit, two frequencies receive
21	Two frequencies transmit, one frequency receive
22	Two frequencies transmit, two frequencies receive
33	Three frequencies transmit, three frequencies receive
44	Four frequencies transmit, four frequencies receive

SPECIFY:

R	Rechargeable (nickle-cadmium) Battery Pack
---	--

SPECIFY as desired:

A	External Antenna Option (incl. PL-259 adapter cable, less Antenna)
K	Whip Antenna instead of Retractable Antenna
E	Earphone Option (incl. earpiece)
S	Tone Squelch
C	Selective Call

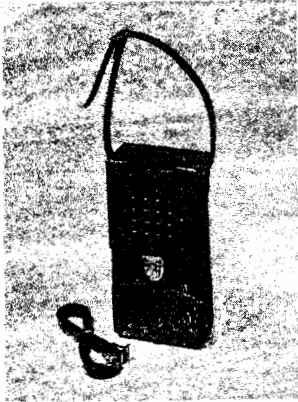
ACCESSORIES

051	Leather Carrying Case
052	Leather Belt Holster
053	Whip Antenna
054	Battery Charger (w/one charging cord)
054A	Extra Charging Cords (charger will handle up to four batteries at once)
055	Ear Piece Only
056	Extra, Rechargeable (Nickle-cad) battery
057	Extra, Dry (Mercury) Battery Set
058	External Antenna w/gutter clip, 8' cable
059	External Gain Antenna w/gutter clip, 8' cable

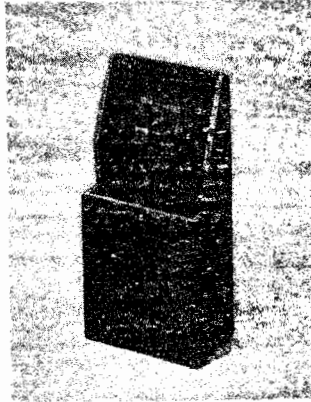
EXAMPLE:

A TNH12RA would be the basic unit, narrow band 152-174 MC, one frequency transmit and two frequencies receive with rechargeable batteries and external antenna option.

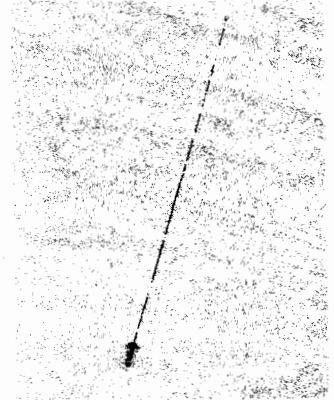
Accessories



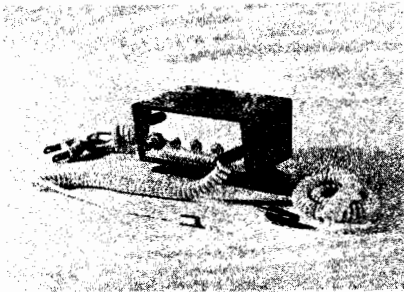
051
Leather Carrying Case



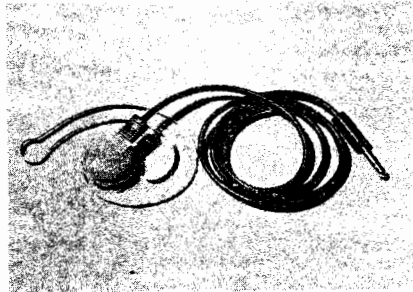
052
Leather Belt Holster



053
Whip Antenna



054
Battery Charger
w/Extra 054a Charging Cord



055
Ear Piece



059
3 db Gain Antenna
w/Gutter Clip

DESCRIPTION

The radio transceiver is designed for FM operation in the VHF range of 132-174 MC.

It has been uniquely packaged using thirteen rugged, highly reliable transistorized modules, which can be easily replaced in the event of failure.

The transceiver is operated from a rechargeable nickel-cadmium battery which mounts with the use of a battery compartment adapter smoothly integrated into the overall case design. A battery charger is also available.

As a further convenience to the owner, a provision for an external earphone jack is available as well as rugged whip antenna. An external antenna jack can be provided so that the radio can be used with outside antennas such as the optional clamp on whip antenna.

Flexibility and servicability have been paramount consideration through out the design and manufacture of the transceiver, so that the user will enjoy many economical hours of reliable operation.

OPERATING INSTRUCTIONS

TO OPERATE the radio, extend the antenna to its full length. Slide the "on-off" switch located at the top of the radio to the "on" position. Now turn the squelch control (top right hand knob) counter-clockwise until you hear squelch noise. Adjust volume to a comfortable listening level and then back squelch control off until the noise stops. You are now ready to transmit and receive.

TO TRANSMIT, use the radio as you would a handheld microphone. Press the "push-to-talk" button, on the right side of unit, talk across the "microphone-speaker" grill, not directly into it. Talk in a normal conversational voice. When the "push-to-talk" switch is pressed, the radio is switched to its transmit position. When released it is switched back to its receive position.

OPERATIONAL THEORY

The radio set is designed as a crystal controlled transmitter, and receiver, which operates completely independent of each other, except for the power supply.

The receiver portion of the transceiver is based on a dual conversion sequence of frequency reduction and amplification utilizing nine (9) discreet modular stages as follows: antenna coupler, R.F. amplifier, 1st oscillator mixer, 8.7 MC IF amplifier, 2nd oscillator mixer, wide band filter and 455 KC IF, discriminator, squelch and audio.

The transmitter portion of the set consists of oscillator quadrupler, tripler amplifier, final RF output and audio modulator.

Multi-channel operation is obtained by switching between different 1st oscillator crystals in the receiver and different oscillator quadrupler crystals in the transmitter.

RECEIVER - TRANSMITTER

a. Antenna Coupler - Module 1001

This module couples the received signal from the antenna via the transmit-receive relay, to module 1002, the RF Amplifier. The antenna coupler consists of a capacitively top coupled resonant circuit that is resonated to the desired received frequency. The input and output impedances are both near fifty ohms. In addition to the top coupled circuit, this module contains the bias resistors for the RF Amplifier, module number two. Tuning is accomplished by slugs available from the top of the module.

b. RF Amplifier - Module 1002

This module contains a transistor for amplification of the received signal. The transistor is connected as a grounded emitter amplifier and has approximately eighteen db of gain at the received frequency. The tuned circuits contained in the RF Amplifier are connected as a capacitively coupled resonant circuit. This module contains the bias resistors for the following module, the first oscillator mixer. The combined selectivity of the antenna coupler and the RF Amplifier provides an attenuation of approximately 60 db to frequencies removed 17.4 megacycles from the desired carrier. Tuning is accomplished by slugs available from the top of the module.

c. First Oscillator Mixer - Module 1003

The receiver portion of the transceiver employs double conversion. That is, the received signal is changed in frequency two times. The first frequency change occurs in the first oscillator mixer module. Since the first intermediate frequency is 8.7 megacycles, the first oscillator must operate at a frequency 8.7 megacycles below the

desired receiving frequency. Thus if the desired received frequency were 151.925 megacycles, the first oscillator frequency would have to be 143.225 megacycles. That is accomplished by operating the oscillator at one third of the desired frequency (47.7416 megacycles in this example), and tuning the output for the third harmonic of the basic oscillator frequency. The oscillator circuit employs a third overtone crystal operating in the series resonant mode. The crystal for this module is not contained in the module but is plugged into the motherboard for easy change of frequency when desired. A rubberizing control is provided on the motherboard to compensate for the calibration error of the first oscillator crystal. Tuning is accomplished by a slug available from the top of the module.

The first oscillator mixer module also contains the mixer to mix the input signal with the injection frequency and produce an output of 8.7 megacycles. This mixer circuit employs a grounded emitter transistor with both the input frequency and the injection frequency applied to the base. The collector of the mixer is tuned to 8.7 megacycles with a tap on the coil to provide a low output impedance for driving the following module. The bias network for the following module is contained in this module.

d. 8.7 MC IF Amplifier - Module 1004

The output signal from the first oscillator mixer is fed to the 8.7 megacycle intermediate frequency amplifier. This module contains a grounded emitter amplifier to amplify the signal prior to its application to the second oscillator mixer. This amplifier contains a capacitively top coupled resonant circuit similar to the RF amplifier but tuned to 8.7 megacycles. The bias network for the second oscillator mixer is contained in this module. Tuning is accomplished by slugs available from the top of the module.

e. 2nd Oscillator Mixer - Module 1005W

The second oscillator mixer contains two transistors. One is used for the second oscillator and the other is used for the mixer. The second conversion mentioned in C above takes place in this module. The 8.7 megacycles is too high in frequency for wide band filtering and it must be translated down to 455 kilocycles. Since the input to this module is always 8.7 megacycles, the injection frequency is always constant at 8.245 megacycles. This frequency is necessary because the desired output frequency is 455 KC and the difference frequency obtained is correct. The crystal for this oscillator is soldered into the harness board assembly. The output of the mixer is tuned to 455 KC and this resonant circuit is part of the wide band filter. Tuning is accomplished by tuning the transformers.

f. Wide Band Filter

The wide band filter is used to provide sufficient rejection of adjacent channels. The wide band filter used in the transceiver is a five pole top coupled filter, all elements being tuned to the same frequency. The bandwidth of this filter is 15 KC between the half power points and the skirt rejection 60 KC from the center is in excess of 60 db. The filter can be tuned for netting purposes and to offset calibration errors of the first oscillator crystal, if necessary. The rubberizing control discussed in (c) allows the wide band filter to be tuned to 455 KC. Tuning of this filter can be accomplished from the top of the harness board assembly.

g. 455 KC Amplifier - Module 1006

This module contains three transistors connected as voltage amplifiers. Each stage has a gain of 30 db providing a total voltage gain of approximately 80 db. Two diode limiters are also incorporated in module 1006 to provide the necessary limiting.

h. Voltage Regulator - Module 1007

The regulator module, module 7, contains a plus regulator and a minus regulator. This module is required to keep a constant voltage on all receiver modules for the duration of the battery life. A variation would cause a variation of sensitivity and therefore the regulators are needed to provide a constant module voltage of 10 volts. The voltage regulation also serves to isolate the audio module from the remainder of the receiver modules. The audio module causes severe ripple on the batteries because of the relative high impedance of the batteries and the high current drawn by the audio module.

i. Discriminator - Module 1008

In an FM system, the intelligence is contained in the changing frequency of the carrier. In this case, the 455 KC signal coming from the wide band filter contains the original frequency modulation of the received signal. The discriminator serves to convert the frequency modulation on the carrier (455 KC) to intelligible audio information. This is accomplished by using a double tuned transformer. One transformer is tuned approximately 10 KC above the carrier and the other transformer is tuned approximately 10 KC below the carrier frequency. The result of this is a fairly linear audio output versus frequency change. The audio detected by the discriminator is passed through a de-emphasis network to restore the audio frequency to the proper amplitude relationship. (See Transmitter Section.) The output of the de-emphasis network drives an emitter follower to provide a low driving impedance for the audio input.

Squelch noise is obtained by rectifying the noise envelope on the collector of the discriminator transistor. This rectified noise contains frequencies from six to ten kilocycles and is used to drive the squelch module via the squelch control. Tuning is accomplished by tuning the transformers.

j. Squelch - Module 1009

The squelch module contains four transistors and is connected as an AC amplifier with a peak response in the frequency range of six to ten KC. The purpose of the squelch in an FM system is to monitor the noise coming from the discriminator and to keep the audio output cut off during the absence of a signal. The phenomenon of quieting causes a reduction of noise when there is a signal present in the 455 KC frequency range. The output from the squelch is a DC signal that prevents the audio amplifier from producing any sound in the speaker. Thus, noise present in the discriminator is amplified in the squelch circuitry and prevents audio output. When a signal is present in the 455 KC IF, the squelch noise is removed from the audio and the audio amplifier can produce an output to the speaker. When the squelch control is set to the minimum value that prevents audio an input signal of less than 0.5 microvolts will turn on the audio.

k. Audio - Module 1010B

This module contains seven transistors and serves two purposes. When the transceiver is in the Receive condition, it amplifies the output from the discriminator via the volume control. (Note that the useable audio output from the discriminator is on a different line than the squelch output from the discriminator.) When the transceiver is in the Transmit condition, a separate audio amplifier amplifies the output from the microphone and the audio output modulates the transmitter, via the deviation control. The deviation control can be adjusted to produce a 5 kilocycles deviation or increased to produce a 15 kilocycles deviation.

The receive audio amplifier is connected as a single voltage amplifier with approximately 60 db of voltage gain followed by four transistors connected as a complimentary emitter follower output working directly into the speaker.

l. Oscillator Quadrupler - Module 1011

The oscillator quadrupler module contains three transistors. One transistor is used for the transmitter oscillator and the other two are used for multiplying the frequency to get the desired output frequency. The oscillator operates at one twelfth of output frequency. However, because of the series capacitance introduced by the transmitting rubberizing control, the crystal frequency is one twelfth the output frequency minus 2.5 kilocycles. For example, if the desired output frequency is 151.925 megacycles, the oscillator

frequency would be 12.6604 megacycles, but the crystal frequency would be 12.6579 megacycles. Modulation of the oscillator is accomplished by applying audio from the audio module (1010B) to a variable capacitance diode. The necessary pre-emphasis of the audio voltage is accomplished by the response of the microphone.

It should be noted that in a FM system, the deviation obtained in the oscillator circuit will be multiplied by the same factor as the oscillator center frequency. Therefore, the deviation of the oscillator will be one twelfth of the output frequency deviation.

m. Tripler Amplifier - Module 1012A

The tripler amplifier module accepts the drive from module 1011 and multiplies this frequency by three. This module contains two transistors. The first transistor functions as a tripler and the second transistor functions as a buffer amplifier. In the example stated above, the output of the tripler would be 50.642×3 or approximately 151.925 megacycles. The amplifier transistor provides an output of 200 milliwatts to the output module, module 1013.

n. RF Output - Module 1013

This module contains one transistor operating in the grounded emitter mode. Also, the output network for spurious and harmonic rejection is contained in this module. The 200 milliwatts of drive from module 1012 is amplified to 1.5 watts in this module. Tuning is accomplished by two slugs and a variable capacitor, all available from the top of the module.

SWITCHING

Switching is accomplished by the use of a four pole double throw push-to-talk switch. This switch provides the following functions:

1. Antenna switched from 1001 to 1013.
2. +12.5V switched from 1007 to 1011, 1012A and 1013.
3. Neutral switched from 1007 to receive disable.

The receive disable function consists of a 0.1 mfd capacitor connected between switched neutral and pin B, module 1008. This action prevents transmit RF from actuating the discriminator before the receiver is completely disabled.

POWER SUPPLY

The rechargeable battery supplies 22.5 volts. The battery has a center tap because the receiver circuitry operates off a nominal 10 volts and the transmitter operates from full battery voltage. Receiver modules one through five are operated off the plus side of the battery and receiver modules six through nine are operated off the negative half of the battery. The audio module is on all the time, whether in transmit or receive condition, and is operated off the full battery voltage.

TO CHANGE BATTERIES

Loosen the screw in the bottom of the radio and slide the battery out. The construction of the battery pack is such that reverse polarity is impossible.

TO RECHARGE BATTERY

To recharge the nickel-cadmium battery, plug the charging cord of the Model 054 charger into the polarized receptacle in the bottom of the battery compartment. Plug the electric cord of the charger into an electric outlet (117 VAC 60 cycles) and push the "on-off" switch to "on". The radio can be operated without harm during the charging. From a fully discharged state the recharge time is fourteen hours. When using the Tek 10/6 multiple charger the batteries can be inserted into the charger battery well upside down. Contact is automatically made. On the Tek 10/6 charger there is also provision for four charging cords.

MAINTENANCE

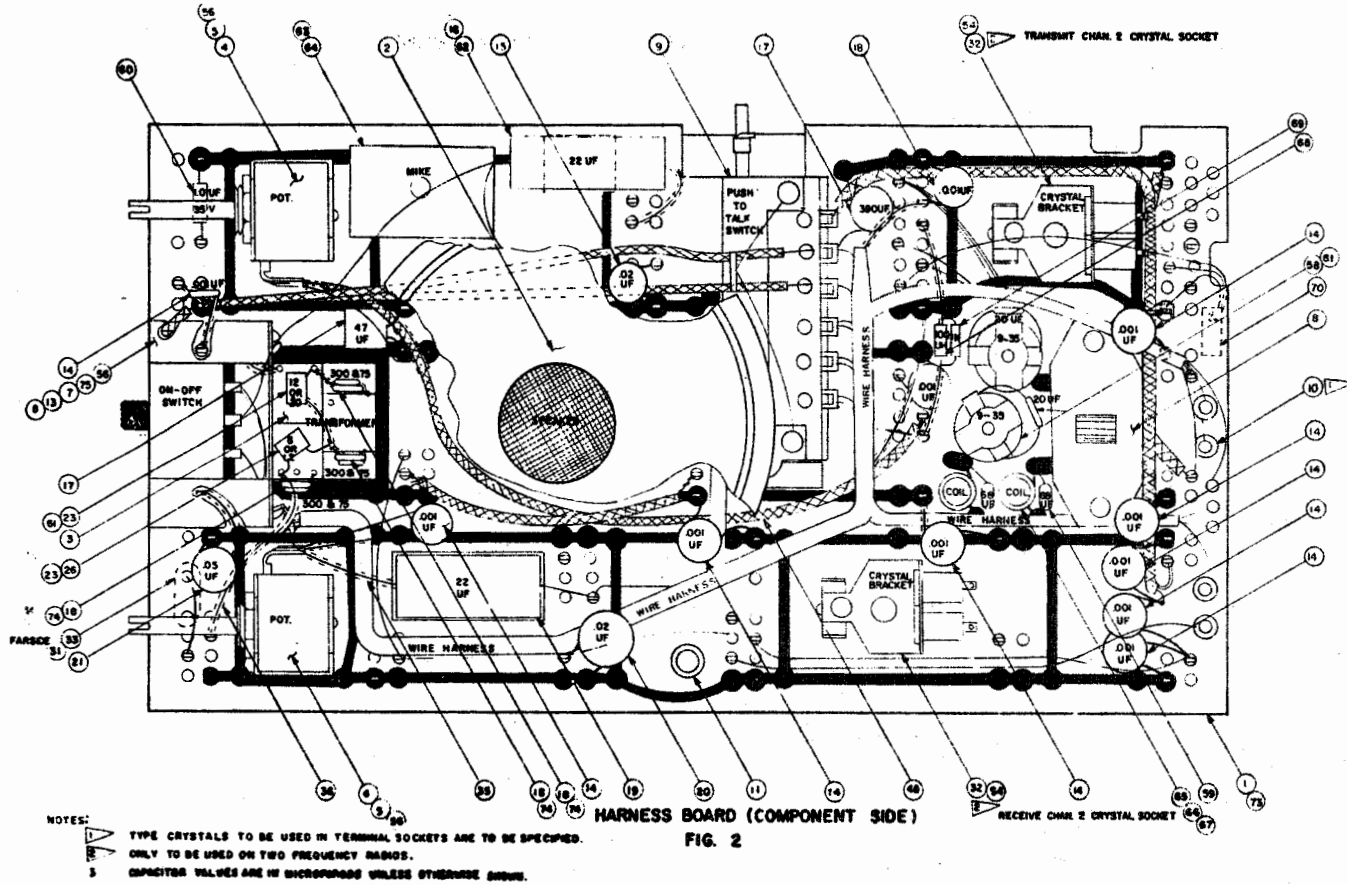
This section describes the maintenance procedure and tuning procedure for repairing a faulty radio set. The use of specific test equipment and the required test points and acceptable voltage levels are outlined. Two methods of tuning are presented. Method I uses a minimum of test equipment and Method II makes use of more sophisticated test equipment when available. Figure 1 is supplied to show location of test points. Figure 2 shows component location. Figure 3 is a block diagram of circuit with test points.

The radio is completely modularized. All active electronic circuitry is contained in thirteen plug-in, nonrepairable modules. In the event that the trouble is not caused by a module but is being caused by a component not contained in a module, the harness board can be removed by removing the two hold down screws located under modules 1003 and 1010B. On radios using more than one channel, the hold down screw is only under module 1003.

(Text continued on page 17)

RECHARGEABLE BATTERY
NICKEL-CADMNIUM 22.5V

RECOMMENDED CHARGE RATE 14 TO 16 HR
AT A CONSTANT CURRENT OF 50 MA.
PART NO 1084



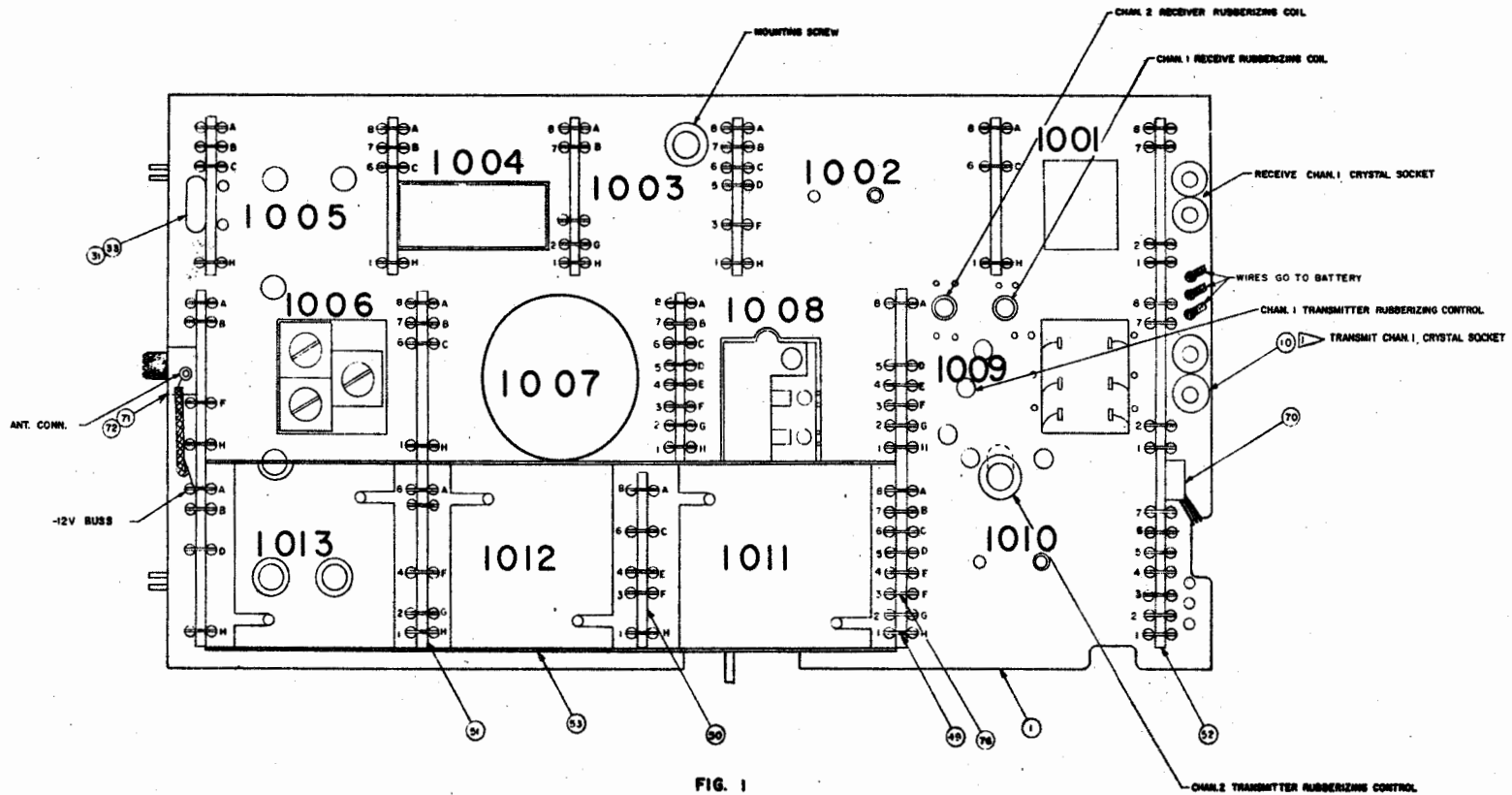


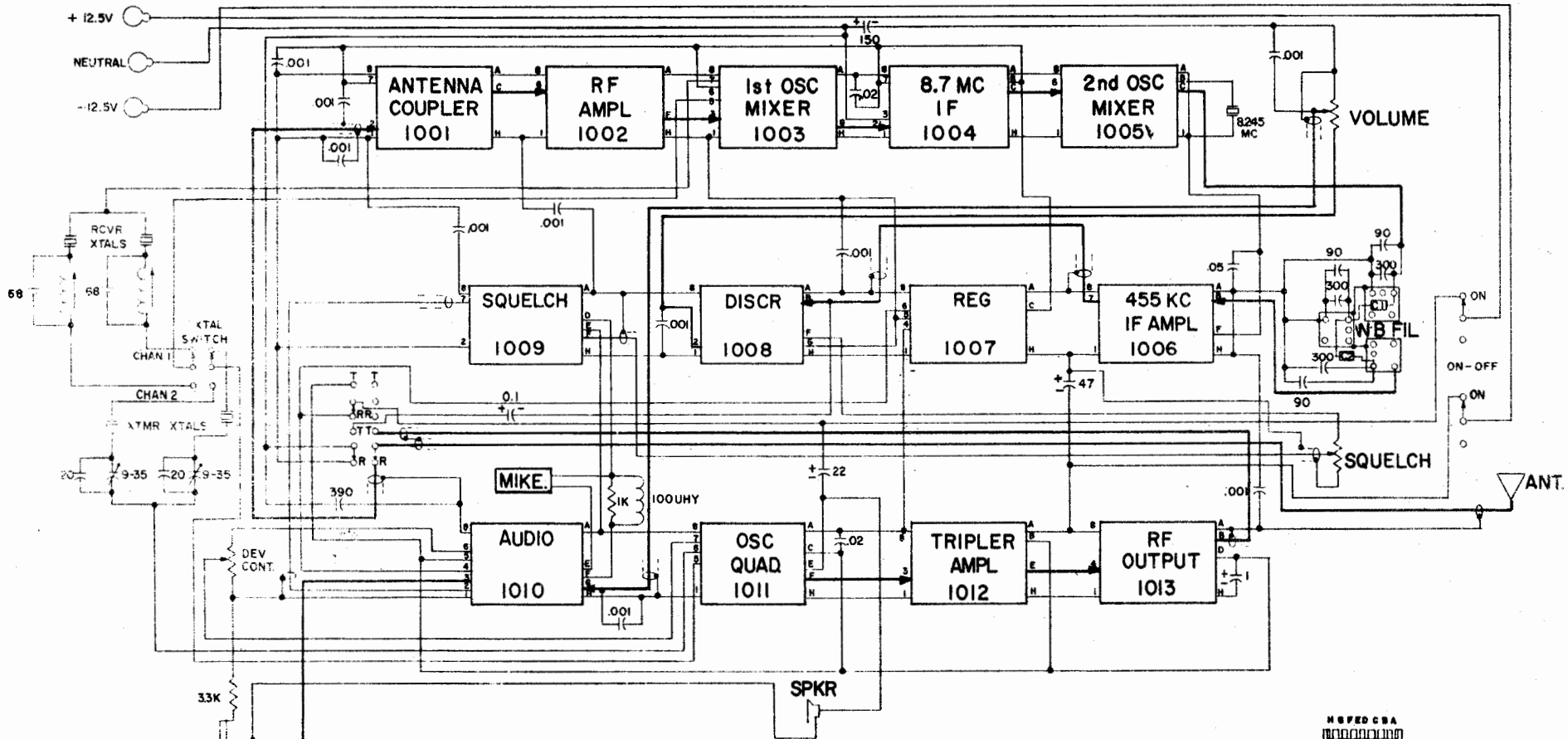
FIG. 1
HARNESS BOARD (MODULE SIDE)

HARNES BOARD PIN DESIGNATIONS

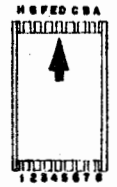
Table IA

(Reference Figure 1)

1001-2	Ant. Input	1008-B	Discriminator Input
1001-7	Reg. +10V	1008-E	-12.5V
1001-C	Ant. Coupler Out.	1008-F	Squelch Voltage
1002-6	RF Amp. In.	1008-G	Neutral
1002-F	RF Amp. Out	1009-2	Neutral
1003-5	1st. Osc. Crystal	1009-7	Squelch Output
1003-6	Reg. +10V	1009-F	Squelch Input
1003-7	1st. Osc. Crystal	1010B-4	+12.5V
1003-G	1st. Osc. Mix. Out.	1010B-2	Squelch Input
1004-7	Reg. +10V	1010B-3	Audio Out. to Spkr.
1004-C	8.7 MC Amp. Out	1010B-G	Rec. Audio Input
1005W-7	Reg. +10V	1011-4	+12.5V
1005W-B	8.245 MC Xtal (Base)	1011-5	Trans. Xtal
1005W-C	2nd. Mixer Out. (455 KC)	1011-6	Trans. Xtal
1005W-H	Neutral	1011-7	Transmit Audio
1006-6	Reg. +10V	1011-F	Osc. Quadrupler Out.
1006-A	Reg. -10V	1012-6	Transmit Plus
1006-B	WBF Out	1012-E	Tripler Amplifier Out.
1006-F	Neutral	1013-B	RF Output
1007-5	Neutral	1013-D	Transmit Plus
1007-6	+12.5V	1013-H	-12.5V
1007-H	Reg. -10V		
1008-2	Disc. Output		
1006-7	455 KC Amp. Out.		



- NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL CAPACITOR VALUES ARE EXPRESSED IN MICROFARADS.
 2. NARROWBAND C1=8UUF, C2=12UUF. WIDEBAND. C1=12UUF, C2=20UUF.
 3. NARROWBAND USE 1005 MODULE. WIDEBAND USE 1005W MODULE.
 4. MODULES 1001 THRU 1005 PINS A,H,I,B ARE ALL COMMON AND ARE NEUTRAL.
 5. MODULES 1006 THRU 1009 PINS A,H,I,B ARE ALL COMMON AND ARE REG -10V.
 6. MODULES 1010 THRU 1013 PINS A,H,I,B ARE ALL COMMON AND ARE -12.5V.
 7. HEAVY LINES INDICATE SIGNAL FLOW.



TYP MODULE

FIG. 3
FUNCTIONAL BLOCK DIAGRAM

-14-

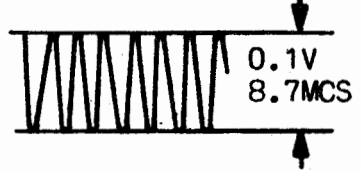

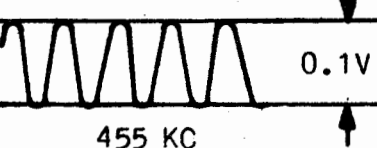
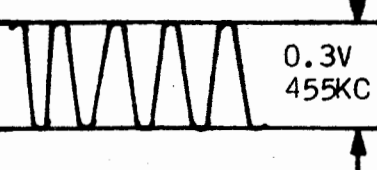
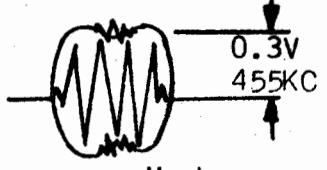
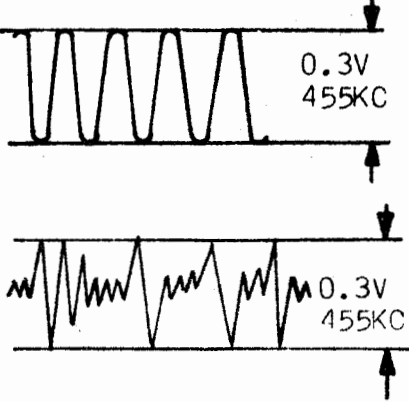
TABLE I

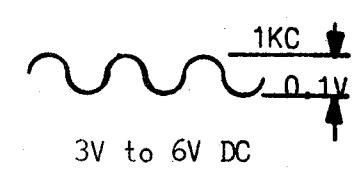
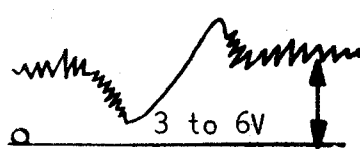
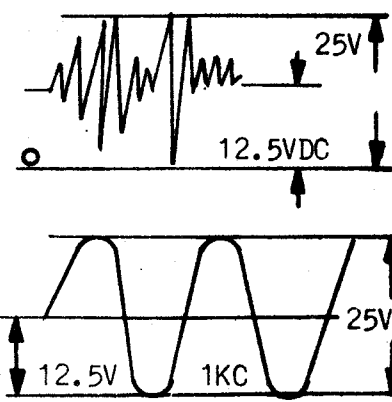
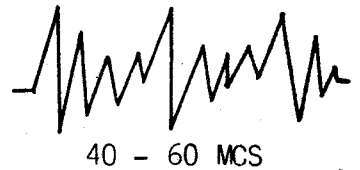
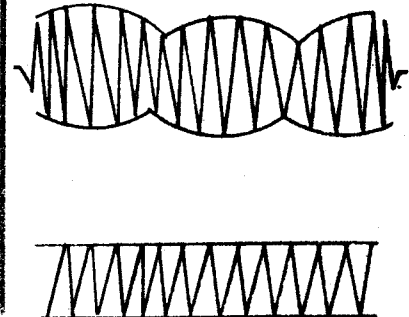
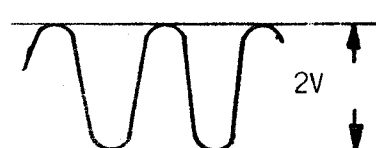
D.C. OPERATING VOLTAGES

(External power supply or battery 22 to 25 volts)

PUSH TO TALK SWITCH POSITION	FROM	TO	CORRECT VOLTAGE
Receive	Pin 1, Mod 1001	Pin 7, Mod 1001	Plus 9 to 11 volts
Receive	Pin 1, Mod 1001	Pin C, Mod 1002	Plus 9 to 11 volts
Receive	Pin 1, Mod 1001	Pin 7, Mod 1004	Plus 9 to 11 volts
Receive	Pin 1, Mod 1001	Pin 7, Mod 1005W	Plus 9 to 11 volts
Receive	Pin H, Mod 1009	Pin 2, Mod 1009	Plus 8 to 10 volts
Receive	Pin H, Mod 1009	Pin G, Mod 1008	Plus 8 to 10 volts
Receive	Pin H, Mod 1009	Pin F, Mod 1006	Plus 8 to 10 volts
Receive	Pin 1, Mod 1010B	Pin 1, Mod 1009	Plus 2 to 4 volts
Receive	Pin 1, Mod 1010B	Pin 4, Mod 1010B	Plus 22 to 25 volts
Transmit	Pin 1, Mod 1010B	Pin C, Mod 1011	Plus 22 to 25 volts
Transmit	Pin 1, Mod 1010B	Pin D, Mod 1013	Plus 22 to 25 volts

TABLE II
AC OPERATING VOLTAGES

PUSH TO TALK SWITCH POSITION	FROM	TO	VOLTAGE	WAVE SHAPE
Receive (1)	Pin 1, Mod 1001	Pin G Mod 1003	30 Millivolts RMS antenna input less than 4 millivolts	 <p>0.1V 8.7MCS</p>
Receive (2)	Pin 1, Mod 1001	Pin C Mod 1004	30 Millivolts RMS antenna input less than 300 microvolts	 <p>0.1V 8.245 MCS Envelope 455 KCS</p>
Receive (3)	Pin 1, Mod 1005W	Pin C Mod 1005W	30 Millivolts RMS antenna input less than 5 microvolts	 <p>0.1V 455 KC</p>
Receive (4)	Pin 1, Mod 1006	Pin B Mod 1006	100 Millivolts RMS antenna input at least 300 milli- volts peak to peak	 <p>0.3V 455KC</p>
Receive (5)	Pin 1, Mod 1013	Pin B Mod 1006	Filter output while being swept with signal generator	 <p>0.3V 455KC Marker</p>
Receive (7)	Pin 1, Mod 1010B	Pin 7 Mod 1007	100 Millivolts RMS with 1.0 microvolts on antenna No input Signal	 <p>0.3V 455KC 0.3V 455KC</p>

PUSH TO TALK SWITCH POSITION	FROM	TO	VOLTAGE	WAVE SHAPE
Receive (8)	Pin 1, Mod 1001B	Pin 2 Mod 1008	Plus 3 to plus 6	D.C.
Receive (9)	Pin 1, Mod 1010B	Pin 2 Mod 1008	30 Millivolts RMS	
Receive (10)	Pin 1, Mod 1010B	Pin 2 Mod 1008	Discriminator Output with Swept Input	
Receive (10)	Pin A, Mod 1010B	Pin 3 Mod 1010B	No Input (Squelch Off) Signal Input	
Transmit (11)	Pin A, Mod 1010B	Pin F Mod 1011	Qsc. Quadrupler Output	
Transmit (12)	Pin A, Mod 1013	Pin B Mod 1013	R.F. Output Detuned Tuned Properly	
Transmit (13)	Pin 1, Mod 1010B	Pin 6 Mod 1010B	Transmit Audio set for 15KC deviation	

CAUTION

CAUTION

CAUTION

Because of the split battery arrangement, there is a possibility of creating a short across one or both sides of the regulators when connecting test equipment to the radio set. The following precautions should be observed to prevent accidental shorts caused by common grounds through test equipment and other destructive effects during test.

1. All test equipment should be isolated from power line ground (third wire) with a three to two prong adapter plug.
2. If possible, remove the regulator module when performing tests and replace with a passive jumper. The regulator can be destroyed if a sustained short is placed across any of the DC voltage lines in the radio.
3. Never turn on the transmitter unless the antenna or a 50 ohm load is connected to the antenna connector. Large voltages generated on the RF output stage could cause transistor damage. Note that the transmitter plus is controlled by the "push-to-talk" switch.
4. Always turn off set when replacing modules.

RECEIVER VOLTAGE TEST

METHODS I and II

Using the Hewlett Packard Voltmeter 410B or equal, check all DC voltages as shown in Table I. If possible use 0.500 milliampere meters in series with +12.5V and -12.5V from an external power supply. The normal idle current should be approximately 10 milliamperes and excess current would indicate a faulty module. If a short is observed on the meter in the plus line, the short would be in modules 1001, 1002, 1003, 1004 or 1005W. A short in the negative line would be caused by one or more of modules 1006, 1007, 1008 or 1009. A short on both plus and minus meters would be caused by module 1010B.

Check all DC voltages and verify that all are within the limits as shown in Table I. If the radio set is still inoperative, continue with Step 1, Method I or II.

Method I - Equipment Required:

1. A DC, VTVM with a 0-1 volt scale and an input resistance of one megohm or higher.
2. A detector probe as per Figure 4A.
3. A Ballentine Model 300 AC, VTVM or equivalent
4. A grid dip meter with a range up to 200 MC.
5. A Measurements Corp., Model FM560 Signal Generator.
6. A Lavoie Model LA70A Frequency Meter or equivalent.
7. Wattmeter 0-1 watts.
8. Deviation Meter

Method I - Receiver Tuning Procedure:

CAUTION: The receiver rubberizing control on single channel receivers, located beneath module 1009, is provided to allow small calibration errors to be removed from the first oscillator crystal. However, care should be exercised when adjusting this control. It should be noted that the slug is sealed in the coil form to prevent accidental shift of the receive frequency. If it becomes necessary to adjust this control, remove the sealing compound from the slug and monitor the first oscillator frequency with a pickup loop and feed this into the frequency meter or counter. Adjust the control slowly until the frequency is correct. If the crystal cannot be adjusted exactly on the desired crystal frequency, the wideband filter can be adjusted to compensate for errors of less than 10 KC (at the receiving frequency). On models using the fixed tuned wide band filter, the crystal must operate at exactly (to within plus or minus 0.5 KC) the calculated frequency or the receiver will be off frequency.

Two frequency receivers have two receiver rubberizing controls, both located beneath module 1009. Radios with three or more channels have rubberizing controls located beneath the front label. The wide band filter should be adjusted to 455 KC and the first oscillators should be adjusted to the exact calculated value of the crystal.

STEP 1 - Connect detector ground side to pin 8 of module 1012A and hot side to pin 2 of module 1004, the first oscillator mixer output. (See Figure 4 for details on module pin numbers, and Figure 4A for Detector Schematic). Connect a Measurements FM560 signal generator to the antenna terminal of the transceiver. (The Accessory antenna connector can be used or clip leads.) A one millivolt signal (1000 microvolt) at the antenna should give a slight deflection on the VTVM one volt scale. The approximate reading at this point is .05 volts. For a 10 millivolt signal at the antenna terminals the VTVM reading should be approximately .16 volts. If the above readings are obtained at this point, modules 1001, 1002, and 1003 may be considered to be functioning correctly.

STEP 2 - Connect the detector hot side to module 1004 terminal "C" and ground side to pin 8 of module 1012A (this is the -12.5 volt bus). A 200 microvolt signal at the antenna will give a slight meter deflection.

STEP 3 - Connect the detector to pin "C" of module 1005W and pin "A" of module 1013, (output of second oscillator mixer). A 20 microvolt signal at the antenna will give a slight meter deflection.

STEP 4 - Connect detector hot side to pin "B" of module 1006, the 455 KC IF amplifier/limiter input (or output of 455 KC filter) and ground side to pin "A" of module 1013. A 200 microvolt signal at the antenna will give a slight meter deflection. NOTE: The 455 KC IF filter has an insertion loss of approximately 15 db.

STEP 5 - Connect detector as in Step 4. Set the Measurements 560 signal generator exactly on frequency with a frequency meter before making the following adjustments:

Remove module 1006 and install a 1006 test module Part Number 1118-1. This will expose the three 455 KC slugs in the IF filter for tuning. Peak the three tuning slugs for maximum indication on the VTVM. A 600 microvolt signal at the antenna should give approximately .1 volt deflection on the VTVM. Peak the two slugs in module 1005W, (455 KC IF tuning) for maximum indication on the VTVM.

STEP 6 - Replace Module 1006. Connect the detector hot side to module 1008 pin "B" and ground side to module 1011 pin "A". A noise voltage of .1 volts should be seen at this point. With an "on frequency" signal from the Measurements 560 repeak all tuning slugs in modules 1001 through 1005W. NOTE - Keep the signal level below saturation while making the above adjustments and listen to the receiver noise. Tune for maximum voltage on the VTVM and minimum voltage on the Ballentine Model 300 AC VTVM. Connect the Ballentine Model 300 across the audio output. The hot side connects to module 1010B pin 3 and the ground side to module 1010B pin H. NOTE - Use caution in making connections to the audio module as it is possible to damage this module if a short occurs in the connection.

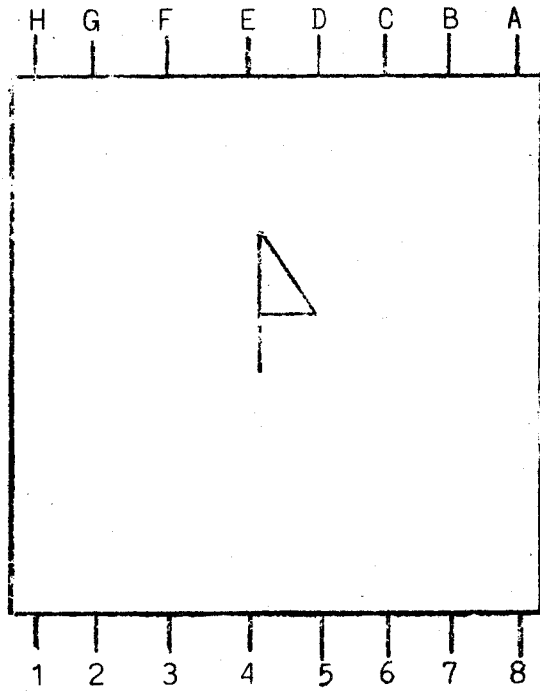
STEP 7 - Discriminator check. Remove module 1006. Connect the DC VTVM directly (without detector) to pin 2 of module 1008 and pin H of module 1010B. (12.5V) A reading of 2 to 4 volts should be indicated by the VTVM. This is your bias point or effective zero for discriminator readings.

Re-install module 1006. Connect the Measurements 560 to the antenna and set exactly on frequency. Set the signal generator for 1000 cycle modulation and 13 KC deviation.

Tune the slugs in module 1008, the discriminator module, for maximum modulated signal on the Ballentine meter connected to the audio output as in Step 7, and a DC VTVM reading approximately the same as the DC bias setting determined above. This procedure will set the discriminator exactly on frequency and for the best signal to noise ratio.

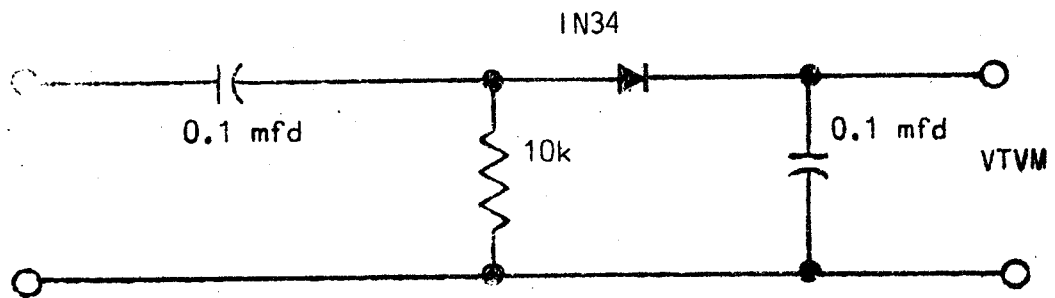
STEP 8 - Make the standard 20 db quieting check as follows:

1. Move the signal generator off frequency.
2. Open up the receiver squelch.
3. Set the volume control for a 3 volt reading on the Ballentine.
4. Set the signal generator on frequency and 20 db quieting. A good receiver will have a sensitivity of 0.5 microvolts for 20 db of quieting.



MODULE PIN DESIGNATIONS

Figure 4



DETECTOR SCHEMATIC

Figure 4A

Method 1 - Transmitter Tuning Procedure:

STEP 1 - To check for transmit audio connect Ballentine hot side to pin 7 module 1011 and ground side to pin 1 of module 1012A. The reading on the Ballentine should be .8 to .9 volts for +5 KC deviation.

To check transmit audio from microphone, connect meter as above. Terminate transmitter with a wattmeter or dummy load. Depress PTT switch and talk into microphone and note reading on the Ballentine AC VTVM. A whistle into the microphone should give a meter deflection of approximately 3 volts. To set transmitter for maximum deviation: Connect Ballentine meter hot side to pin 7 module 1011 and ground side to pin 1 of module 1012A. With the unit in the Transmit position, adjust the deviation control on the harness board for maximum reading on the meter.

STEP 2 - Remove modules 1012A and 1013. Connect a 0-1 wattmeter to the transmitter oscillator/quadrupler module 1011. Connect the hot side to terminal "F" and ground side to terminal "A". Tune the two slugs in module 1011 for maximum power and correct frequency. The power output from module 1011 is approximately 50 to 70 milliwatts. To set oscillator/quadrupler on frequency set the frequency meter on 4 times the crystal frequency, (approximately 50 MC) and tune the slugs for power output and correct frequency.

A grid dip meter may be used in lieu of the frequency meter for this step. NOTE - Because of the wide frequency range of the transmitter, it is possible to triple, quadruple, or tune to the fifth harmonic when tuning the quadrupler module and CAUTION must be used when tuning this stage.

STEP 3 - Plug in module 1012A and "dummy feed-thru" test module (part number 1118-3) in place of module 1013. If a brass slug is in the last slug position in 1012A it may have to be replaced with an iron slug to operate 1012A into the test module. Connect wattmeter to antenna terminals. Tune the two slugs in module 1012A for maximum power on the wattmeter. The power output from this stage should be approximately 200 to 400 milliwatts. 100 milliwatts is sufficient power to drive the output module. Check the frequency of module 1012A with a frequency meter. The output frequency should be the operating frequency. A check can also be made using a grid dip meter to determine the output frequency of module 1012A.

STEP 4 - Remove test module and plug in module 1013. Connect wattmeter to antenna terminals. Tune the three slugs in module 1013 for maximum power and minimum current drain.

To measure current drain use a DC transistor power supply with a 0-500 MA meter in series with the load. Tune all slugs in transmitter RF modules 1011, 1012A and 1013, for a maximum power on wattmeter. A current reading of 160 MA should give a power output of approximately 1.5 watts.

STEP 5 - Connect the RF output, through a suitable attenuator, to the deviation meter. Adjust the deviation meter to the proper frequency and talk in a loud voice into the speaker grill on the front of the transceiver. Note the peak deviation. Adjust the deviation control located at the bottom end of the harness board, for the desired deviation. A 1 KC signal can be injected into the audio module between pin 1, 1010B (GND) and pin E, 1010 for sustained measurements if desired.

STEP 6 - To adjust transmitter frequency, remove module 1009 and key the transmitter. Adjust the capacitor until the transmit frequency is the proper value.

Method II - Equipment Required:

<u>TEST EQUIPMENT</u>	<u>CHARACTERISTICS</u>
Signal Generator, Marconi TF1066B or Boonton 525A	FM Signal Generator with leakage less than 0.1 microvolt
Ballentine Model 320A Voltmeter	Voltmeter, True RMS reading
Electronic Counter, Hewlett Packard Model 524C, with 525C Frequency Converter	Counter capable of counting frequencies of at least 174 megacycles
VHF Attenuator, Hewlett Packard 355D or equal	VHF Attenuator, stepped in 10 db steps
Wattmeter, Bird Model 5254 or equal	Wattmeter, accurate to 200 megacycles
Modulation Deviation Meter, Measurements Corp. 140 or equal	Modulation Deviation Meter
Voltmeter, RF Hewlett Packard Model 411 or equal	Radio Frequency Voltmeter, accurate up to 200 megacycles
Oscilloscope, Tektronix Model 317 or equal	Oscilloscope, accurate up to 10 megacycles
Oscilloscope, Tektronix Model 585 or equal	Oscilloscope, capable of measuring up to 200 megacycles
Voltmeter Hewlett Packard 410B or equal	Vacuum Tube Voltmeter
Test Module 1118-3	Feed Thru Module

Method II - Receiver Tuning Procedure:

If a complete alignment is desired, the following step by step procedure may be followed.

STEP 1 - Connect detector ground side to pin 8 of module 1012A and hot side to pin 2 of module 1004, the first oscillator mixer output. (See Figure 4 for details on module pin numbers.) Connect a Marconi TF1066B signal generator to the antenna terminal of the transceiver. (The accessory antenna connector can be used or clip leads.) A one millivolt signal (1000 microvolt) at the antenna should give a slight deflection on the VTVM one volt scale. The approximate reading at this point is .05 volts. For a 10 millivolt signal at the antenna terminals the VTVM reading should be approximately .16 volts. If the above readings are obtained at this point, modules 1001, 1002, and 1003 may be considered to be functioning correctly.

STEP 2 - Connect a signal generator to the antenna connector and adjust the signal generator to the desired operating frequency. The desired operating frequency can be calculated by multiplying the receiver crystal frequency by three and adding 8.7 megacycles. For example, if the receiver crystal frequency were 51.5875 megacycles, the receive frequency would be 163.4625 megacycles. Monitor between pin 1, module 1001 and pin G, module 1003 with the RF voltmeter or an oscilloscope. (The frequency at this test point is 8.7 megacycles.) Adjust the signal generator attenuator until 30 millivolts RMS (100 millivolts peak to peak) is observed at the test point. The input level to the antenna should be less than four millivolts. Again check the counter frequency to be certain it is on the desired frequency and adjust all slugs in module 1001, 1002, and 1003 until the maximum output is obtained. (See Table II for AC Operating Voltages)

If 30 millivolts cannot be obtained for four millivolts input, then replace module 1001 and see if the desired output can be obtained. If a new 1001 module does not result in the proper output, then remove the new 1001 module and replace with the old one. Next replace 1002 and see if the output is satisfactory. Continue this operation until the proper output at pin G, module 1003 is obtained.

STEP 3 - With the signal generator connected as in Step 2, move the monitor to between pin 1, module 1001 and pin C, module 1004. The frequency at this point is 8.7 megacycles and the level is approximately 30 millivolts. It should be noted that the 8.245 megacycle oscillator is present at this test point. If an oscilloscope is used to monitor this voltage, the 8.245 megacycle oscillator will be observed with the input signal superimposed on top and bottom of the oscillator voltage.

Decrease the attenuator setting to the level of 100 microvolts to 300 microvolts. The presence of the input signal should be observed with this level of input signal. If not, retune 1004 or replace it, whichever is necessary.

STEP 4 - With the signal generator connected as in Step 3, move the monitoring device to measure between pin 1, module 1005W and pin C, module 1005W. Once again the signal generator should be rechecked to see if it is on the proper frequency. An input of 5 microvolts or less should produce 30 millivolts of output at this test point. The frequency at this test point is 455 KC. If the proper output cannot be obtained at this test point, try adjusting the two transformers in module 1005W. If the output still cannot be obtained, change module 1005W.

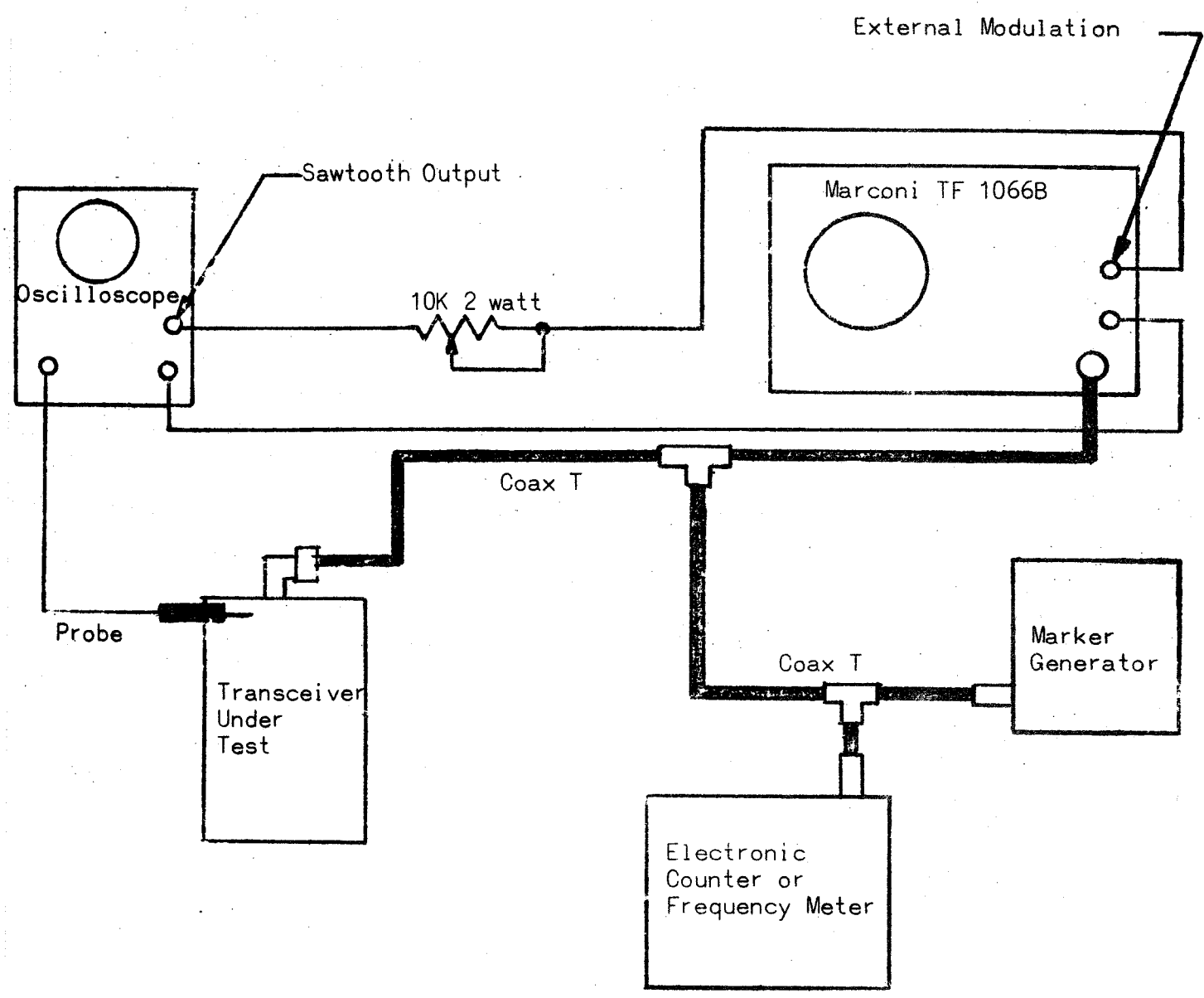
STEP 5 - Move the monitoring device to measure between pin 1, module 1006 and pin B, module 1006. Recheck the frequency of the signal generator and make sure it is on the desired receiving frequency. Increase the output of the signal generator to 10 millivolts and note the output on pin B of module 1006. This test point is the output of the wideband filter. With 10 millivolts input to the antenna, the output should be at least 300 millivolts peak to peak or approximately 100 millivolts RMS.

The wideband filter consists of 5 top coupled transformers. Three are on the harness board assembly and the other two are located in module 1005W. The wideband filter is stagger tuned to obtain the proper bandpass for modulation acceptance bandwidth. Should module 1005W be replaced or any of the three transformers on the harness board assembly, it then becomes necessary to realign the wideband filter to obtain the proper passband.

Alignment of the wideband filter is accomplished with the aid of Figure 5. The signal generator must be swept through the passband of the radio in order to get an amplitude vs. time presentation. The sweep is accomplished by feeding the sawtooth output from the oscilloscope to the external modulation terminals on the signal generator. CAUTION: CARE SHOULD BE EXERCISED WHEN CONNECTING THE SWEEP VOLTAGE TO THE SIGNAL GENERATOR. THE PEAK VOLTAGE OF THE SAWTOOTH EXCEEDS 200V. When this connection is made, the frequency of the signal generator is determined by the amplitude of the sawtooth. An auxiliary marker generator is coupled into the input of the receiver as shown in Figure 5.

Adjust the oscilloscope sensitivity for 0.1 volt per centimeter and connect between pin 1, module 1013 and pin B, module 1006. Adjust the Marconi Signal Generator to maximum RF output. Adjust the sweep on the oscilloscope to 10 milliseconds per centimeter. Adjust the frequency dial of the signal generator until a signal is seen on the oscilloscope. If the audio section of the receiver is operating, the signal can be heard sweeping through the passband of the receiver. Reduce the audio control to the maximum counterclockwise position. Using the 10 K, 2 watt external potentiometer, adjust the sweep width until a convenient display is observed on the oscilloscope.

CAUTION - TURN OFF OSCILLOSCOPE WHEN CONNECTING SWEEP VOLTAGE TO SIGNAL GENERATOR



Test Set Up
For WBF Alignment
Figure 5

Turn the marker generator on the desired frequency as indicated by the counter. Adjust the level until a convenient marker is seen on the pattern (see Table II). Remove module 1009 and adjust the receiver rubberizing control to see the maximum range of pull of this control. Set the rubberizing control to the middle of the range of adjustment and align the wideband filter centered upon this frequency marker.

Emphasis should be placed on getting the most balanced passband with a minimum of ripple in the passband.

The method presented above is an exact method of wideband filter alignment. An alternate method of alignment that results in satisfactory operation but more ripple in the passband is presented below.

Alternate method of wideband filter alignment: Connect the RF voltmeter or oscilloscope between pin 1, module 1010B and pin B, module 1006. Set the signal generator on frequency and increase the output until a signal is observed at test point pin B of module 1006. Adjust the rubberizing control to determine the mid range of operation. Set the rubberizing control to the mid range and then, with the signal generator on center frequency, adjust all transformers in the wideband filter for maximum output signal. This tuning method results in a more narrow bandwidth but can be used if the test equipment is not available to accurately align the wideband filter.

STEP 6 - After proper operation of the wideband filter is established, the signal generator should again be set on the proper frequency (external sweep voltage disconnected) and the attenuator adjusted to 1.0 microvolt input to the antenna. The waveshape observed between pin 1, module 1010B and pin 7, module 1007 should be in full limiting as shown in Table II. When the signal generator is moved out of the passband, the noise at this test point should be about 300 millivolts peak to peak.

If the required output voltage cannot be obtained at pin 7, module 7 replace module 1006.

STEP 7 - Remove module 1006. Place the measuring device between pin 1, module 1010 and pin 2, module 1008. The voltage of this test point should be three to six volts positive. (See Table II) If this voltage is not in these limits, replace 1008. Replace 1006 and adjust the signal generator to 10 microvolts input and on frequency. Modulate the signal generator for 3 KC deviation at 1 KC modulation. Monitor pin 2, module 1008 with the oscilloscope and adjust the two transformers in module 1008 for maximum output centered about the D.C. level observed with module 1006 removed. See Table II for the proper waveshape. NOTE - The discriminator may also be aligned when the wideband filter is aligned. However, aligning the discriminator with an FM signal is entirely equal.

After alignment of the discriminator it can be checked for balance by adjusting the frequency vernier on the signal generator and noting the D.C. change at pin 2, module 1008. Increasing the frequency should cause the pin 2 voltage to increase, decreasing the frequency should cause the

pin 2 voltage to decrease by the same amount. NOTE - The discriminator can be aligned so that increasing the input frequency results in pin 2 voltage decreasing and decreasing the frequency causes the pin 2 voltage to increase. This means that the slope of the "S" wave is just opposite and satisfactory operation can be obtained using either slope.

STEP 8 - Check the audio module, 1010B, by measuring the output between pin H, module 1010 and pin 3, module 1010B. Table II shows the proper audio output with signal input and without signal input. If these waveshapes are limited at less than plus or minus 12.5V on the positive excursion or the negative excursion, then the audio module should be replaced. When the volume control is turned to maximum, the modulated signal will square off on both top and bottom, running full saturation to plus or minus 12.5V.

STEP 9 - Check squelch operation by inserting the squelch module, 1009 and removing the input signal. Advance the squelch control on the control unit clockwise until the audio output is turned off. Set the signal generator to 1.0 microvolts and modulate with 1 KC and deviate 13 KC. Slowly move the input signal into the passband and the squelch should break. If the squelch fails to function replace module 1009.

Steps 1 through 9 are designed to prove each function in the entire receiver. When all are operating properly, the following final alignment is recommended.

STEP 10 - Set the signal generator on the exact receive frequency and adjust until 0.5 microvolt is applied to the antenna. Connect the audio meter between pin H, module 1010B, and pin 3, module 1010B. Move the generator off 50 K from center frequency and adjust the volume control until the meter reads 3.0 volts. Again adjust the signal generator on frequency and adjust the slugs in 1001 and 1002 for maximum quieting, that is, maximum drop of noise as indicated by the meter. There should be at least 20 db of quieting for 0.5 microvolt input. If the receiver fails to meet this requirement, monitor pin 7, module 1007 and adjust all slugs in 1003 and 1004 for maximum output voltage with 0.5 microvolt input. If the receiver still does not meet the quieting specifications, modulate the signal generator to 13 KC deviation with 1 KC and adjust the receiver rubberizing control for maximum audio output. Remove the modulation and again check the quieting. Failure to meet the quieting specification after these final adjustments indicates a marginal module and Steps 1 through 9 should be repeated.

CAUTION: DO NOT ATTEMPT TO ADJUST THE SLUGS IN 1003 OR 1004 FOR MAXIMUM QUIETING WITHOUT MONITORING PIN 7, MODULE 1007 FOR MAXIMUM OUTPUT. IMPROPER ALIGNMENT OF THESE SLUGS CAN RESULT IN AN APPARENT INCREASE IN QUIETING BUT REALLY IT IS A TOTAL LOSS OF SIGNAL.

STEP 11 - If Steps 1 through 10 fail to isolate the problem in the receiver, then normal trouble shooting techniques looking for shorted capacitors, open noise, shorted wire, open cable, etc., would yield a solution. Also, all the modules could be removed from a defective receiver and placed in an operating receiver to determine if the problem is in the harness board assembly or the modules.

Method II - Transmitter Tuning:

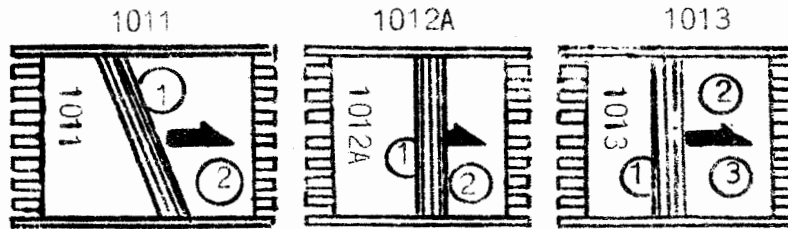
STEP 1 - Determine the proper output frequency by multiplying the transmit crystal frequency by 12 and adding 36 KC. For example, if the crystal frequency were 12.657 MCS, then the output frequency would be $(12.657) \times 12$ plus 36 KC or 151.920. The transmit rubberizing control, located beneath module 1009, can change the output frequency by plus or minus 10 KC. On two channel radios the rubberizers are both under module 1009A. On radios using more than two channels the rubberizers are located under the front label.

After determining the proper output frequency, connect the wattmeter to the antenna connector and key the transmitter on. Note the current being drawn from the battery or power supply and the power output. If the power output is up to 1.5 watts with 25 volts (+12.5V and -12.5V) then adjust to the proper frequency. If the power output is down, then proceed to Step 2.

STEP 2 - Remove module 1012A. Connect the Tektronix 585 between pin H, module 1010B and pin F, module 1011. Pin F is the Oscillator Quadrupler output. (Use the 20:1 attenuator on the oscilloscope probe.) Adjust slug 1 and slug 2 until the proper waveshape is observed on the oscilloscope (See Table II). The four cycle presentation shows that the oscillator quadrupler is multiplying by four. Because of the wide frequency range covered by the transmitter, it is possible to tune the oscillator quadrupler to the third harmonic, fourth harmonic and in some low frequency applications, the fifth harmonic. If a high frequency oscilloscope is not available, then a grid dip meter or a frequency meter can be used equally well.

STEP 3 - Having established that 1011 is on the correct frequency, insert 1012A and adjust the slugs in 1012A until power is indicated on the wattmeter. Adjust the slugs in 1011 slightly for maximum power output. Monitor the output with a counter or a frequency meter to determine if the transmitter is running on the proper frequency. Care should be exercised in coupling the RF from the wattmeter into the counter. When the transmitter is not completely tuned (all circuits not quite resonated) a ripple will appear on the output voltage and if too much signal is coupled into the counter, erroneous readings will be indicated. It is suggested that the attenuator be connected between the wattmeter and the counter and adjusted so the counter is getting just enough to count and no more.

TABLE III
TRANSMITTER SLUG POSITION CHART



FREQUENCY RANGE	1011		1012A-M		1013		
	#1	#2	#1	#2	#1	#2	#3
MEDIUM							
132 MCS	Green Dot 5 1/2t	Green Dot 3 1/2t	White Dot 8t	White Dot 9t	Capacitor	White Dot	White Dot
139 MCS	Green Dot 3 1/2t	Green Dot 2 3/4t	White Dot 7t	White Dot 7 1/2t	Capacitor	White Dot	White Dot
152 MCS	Green Dot 3t	Green Dot 1 3/4t	White Dot 10t	White Dot 5 1/2t	Capacitor	White Dot	White Dot
FREQUENCY RANGE	1011		1012A		1013		
HIGH	#1	#2	#1	#2	#1	#2	#3
160 MCS	White Dot Min. L	White Dot Min. L	White Dot Min. L	Brass	Capacitor	White Dot or Brass	Brass Min. L
174 MCS	White Dot Min. L	White Dot Min. L	White Dot Min. L	Brass	Capacitor	White Dot or Brass	Brass Min. L

NOTES:

The turns indicated on Medium modules mean: Turn slug clockwise until it bottoms out. Turn the slug counter-clockwise the indicated number of turns. This will be approximately the correct frequency.

For frequencies above 160 megacycles, always start with minimum inductance and tune toward more inductance for a peak.

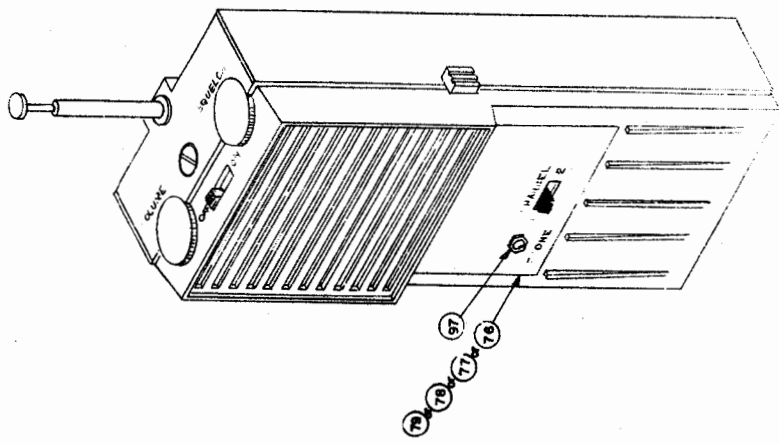
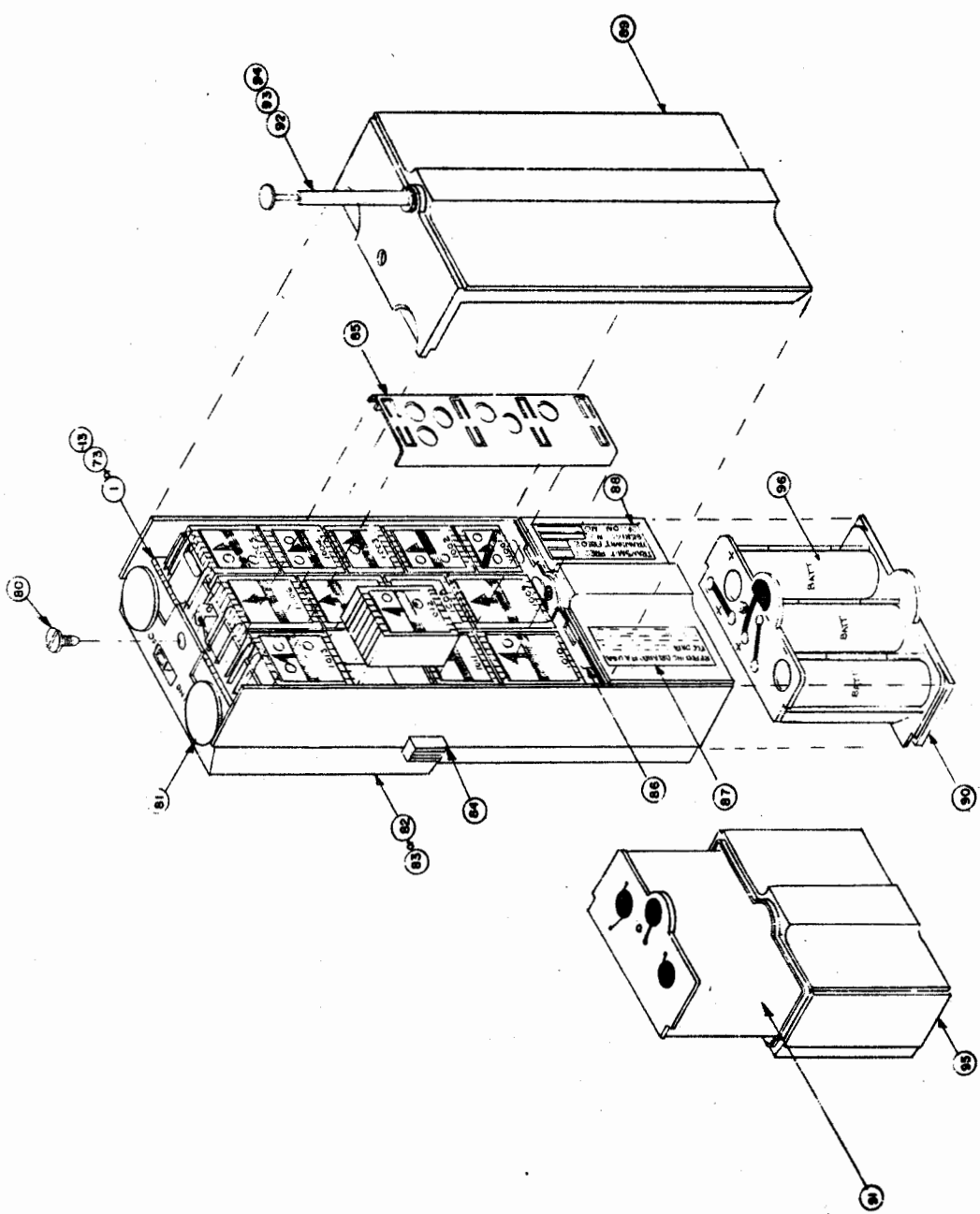
Initially adjust all slugs for maximum power output on frequency. Then adjust slugs #1 and #2 in 1013 for best power output with minimum current. The capacitor setting in 1013 effects the power output/current and should be adjusted for maximum power output for minimum current. 1.5 watts should be available for 200 ma current drain.

If the counter counts the correct frequency, (within 10 KC because the rubberizing control can pull it exactly on frequency) peak all slugs for maximum power output, being careful to reduce the attenuator to the counter. If the counter indicates an incorrect frequency, refer to Table III for some typical slug positions and check the positions of the slugs.

STEP 4 - Remove the squelch module, 1009, and adjust the frequency to within 250 cycles of the desired operating frequency. Replace module 1009.

STEP 5 - Connect the 317 oscilloscope between pin H, 1010B, and pin 3, 1010B. Adjust the sensitivity to 5 volts per centimeter. Adjust the volume control to maximum clockwise position and depress the push-to-talk switch. Whistle or talk in a normal to loud voice and note the waveshape on the oscilloscope. The audio voltage at pin 3 should be limiting to 20 to 25 volts peak to peak. If the audio voltage does not limit or go to full audio, adjust the sensitivity to 1.0 volts and measure the input voltage on pin F, module 1010B. This voltage should be 3 volts peak to peak with a loud whistle into the microphone.

STEP 6 - If the proper audio is observed on pin 3, module 1010B, the deviation can be adjusted. Connect the deviation meter to the wattmeter (through a suitable attenuator) and depress the push-to-talk switch. Whistle or talk until the audio goes into full limiting and observe the peak deviation. Adjust the deviation control on the harness board, until the peak deviation for full limiting is the desired value. (Normally 15 KC). Then talk in a normal to loud voice. The deviation for speech should be between 13 and 15 KC. See Table II for a typical waveshape of the transmit audio. If no audio voltage appears at pin 7, module 1011, then the deviation control is defective and must be replaced.



TRANSCIVER ASSEMBLY
FIG 6

<u>PART DESCRIPTION</u>	<u>MANUFACT. PART NO.</u>	<u>MAN. REF. NO.</u>
Antenna, retractable	1028	93
Back Cover, Plastic Assy. (less antenna)	1032	89
Battery Assy. (Dry) w/1040-5 screw	1041	90
Battery Buss Plate Assy.	1053	86
Battery Cover, rechargeable w/1088 screw	07C-1001-01	95
Battery (Dry), 4.2V, Mercury	Eveready E-133 or equal	96
Battery, rechargeable, pack	1084	91
Bracket, Potentiometer	1098	4
Bracket, Switch, DPDT	1097	75
Bushing, Antenna	1049	92
Capacitor	538-002-E2P094R	58
Capacitor	MIN-R-68K	59
Capacitor	CS13AF010K	60
Capacitor	CD6-200J	61
Capacitor	TC-N5600, 75 pf	74
Capacitor (for NB radio)	CD6-080J	26
Capacitor (for WB radio)	CD6-120J	23
Capacitor	CD7-301J	18
Capacitor	CS13AF220M	16
Capacitor	RMC M12-05	21
Capacitor	RMC SM .001 GMV	14
Capacitor	RMC TA .02 +80-20	20
Capacitor	C.I. S 47	17
Capacitor	CS13AD151K	19
Choke	1326-7	68
Clip, Antenna	1081	94
Coil	2114	66
Contact Block	1036	71
Contact Spring	N100	72
Core	9645-2	65
Cover, RF Shield	1043	85
Crystal, 8.245 MC	23-09-001	31
Crystal, Receive (specify freq)	23-10-001	--
Crystal, Receive (specify freq)	23-10-002	--
Earpiece	Telex 5TY-04, 2000 ohms	--
Eyelet	Sealectro SE-33	56
Freq. Label, Back	39-B-1001-01	88
Harness Board Assy. (less mike, speaker, pots, and crystals)	1060-1	1
Insert, 4-40	Ban-Lock N41B-440	comes with 1031
Insert, 6-32	Ban-Lock N41B250-632	comes with 1031
Jack (for ext. ant. or earpiece)	1117	97
Knob, Control	35A-1001-01	81

<u>PART DESCRIPTION</u>	<u>MANUFACT. PART NO.</u>	<u>MAN. REF. NO.</u>
MFG. FCC Label, Back	39-B-1001-02	87
Microphone	A0-1457	63
Microphone Bracket	1106	64
Nameplate, w/earphone or ext. ant. hole	38-B-1001-03	78
Nameplate, 2 freq. and earphone or ext. ant. hole	38-B-1001-01	79
Nameplate, plain	38-B-1001-04	76
Potentiometer	1037	5
Potentiometer, Deviation	200-66-10KH	70
Protective covering, crystal	1116	33
Push-to-talk Actuator Assy.	1107	--
Radio Case, Plastic Assy.	1031-1	82
Resistor	RC07GF102J	69
Screw, Pan Head	4-40 X $\frac{1}{4}$ BNP	comes with 1031
Screw, Pan Head	6-32 X $\frac{1}{4}$ BNP	80
Screw, Round Head	4-40 X 17/32 BNP	13
Separator, Module	2111	50
Separator, Module	2112	51
Separator, Module	2113	52
Series Blade, with tab	AMP 85072-3	49
Series Blade, without tab	AMP 85172-3	76
Shield, RF	1042	53
Sleeving, Teflon	22	35
Sleeving, Teflon	24	36
Slug	9642-L1	67
Spacer $\frac{1}{2}$ X $\frac{1}{4}$	Herman Smith 2337	7
Speaker	Oaktron S-8307	2
Sponge Rubber Block		62
Switch DPDT, On-Off	Continental-wirt G-126 w/4-40 tap	8
Switch 4PDT, PTT	Lafayette SW 92	9
Terminal, crystal, Teflon	Sealectro SKT 14	10
Transformer, Filter	Merit Coil BC-573	3
Washer, fiber	Herman Smith 2161	11

MODULES:

Antenna Coupler	1001		--
R.F. Amplifier	1002	FSN5820-911-0974	--
1st. Oscillator Mixer	1003	FSN5820-911-0971	--
8.7 MC IF Amplifier	1004	FSN5820-911-0973	--
2nd. Oscillator Mixer	1005-W	FSN5820-911-0970	--
455 KC IF Amplifier	1006	FSN5820-911-2484	--
Regulator	1007	FSN5820-911-0972	--
Discriminator	1008	FSN5820-911-2463	--
Squelch	1009	FSN5820-911-0969	--
Audio	1010B	FSN5820-911-1000	--
Oscillator Quadrupler	1011	FSN5820-911-1608	--
Tripler Amplifier	1012A	FSN5820-911-1609	--
		FSN5820-911-1610	--

MODULES:

R.F. Output
 Test Module 1013
 Test Module 1006

MANUFACT. PART NO.MAN. REF. NO.

1013 FSN5820-911-1611
 1118-3 FSN5820-911-3052
 1118-1 FSN5820-911-2738

For 2 channel radio only

Capacitor	538-002-E2P094R	58
Capacitor	CD6-200J	61
Capacitor	MIN-R-68K	59
Coil	2114	66
Core	9645-2	65
Crystal, bracket.	Augat 8004	32
Harness board (less mike, speaker, pots and crystals)	1060-2	73
Nameplate, 2 frequency	38-B-1001-02	77
Radio Case, Plastic Assy.	1031-2	83
Rivet	Sealectro SE 34	54
Slug	9642-L1	67
Switch	Continental-wirt G-126, w/4-40 tap	8

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