SECTION 7
ALIGNMENT PROCEDURE AND PERFORMANCE TESTS

7.1 GENERAL

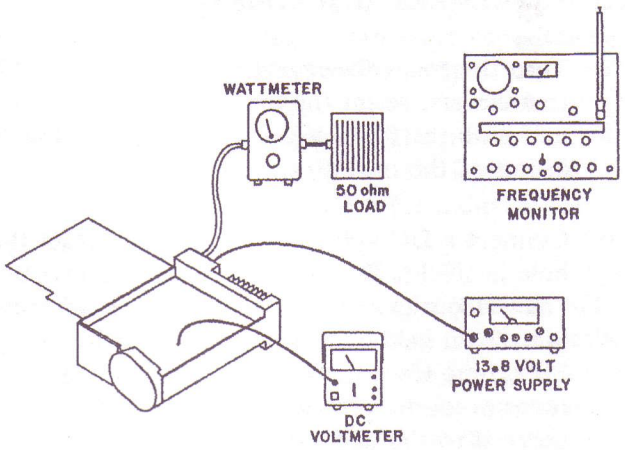
The transceiver alignment described in this section may be required if repairs are made that could affect the factory alignment or if channels are programmed that are outside the frequency bands tuned at the factory. Stocking transceivers are factory aligned for the frequency bands shown in Table 7-1. These transceivers contain programming used for factory testing which is printed on a card that is shipped with the transceiver. Transceivers ordered with factory-programmed channels are factory aligned for those channels.

Even though transceivers are extensively tested at the factory before shipment, it is recommended that the performance checks described in Sections 7.6 and 7.7 be completed before placing the transceiver in service. These tests ensure that the transceiver was not damaged in shipment.

To properly align multichannel transceivers, channels at the center (± 200 kHz) and each end of the transmit and receive bands are required. In addition, if Call Guard squelch is used, the channel on the upper end of the transmit band must be programmed with that feature. If both tone and digital type Call Guard squelch are used, the upper channel must be programmed with the tone type.

TABLE 7-1
FACTORY-PROGRAMMED FREQUENCY BANDS

Range	Low Freq	Center Freq	High Freq
403-430			
Receive	418.100	422.100	426.100
Transmit	417.400	423.400	429.400
450-488			
Receive	459.100	463.100	467.100
Transmit	456.400	462.400	468.400
488-512			
Receive	503.100	507.100	511.100
Transmit	499.400	505.400	511.400



TRANSMITTER TEST SET-UP
FIGURE 7-1

7.2 PRELIMINARY SET-UP

a. Refer to the test setup diagram in Figure 7-1. Connect a DC power supply to power jack J102 and set it to the following voltage. Connect a 50-ohm load to antenna jack J101.

Transceiver	Supply Voltage
7180-7182 (15W)	13.8 VDC
7183-7186 (35W)	13.6 VDC
7187	13.4 VDC

b. Program the transceiver with channel and option information as described in Section 4.

c. Remove the five audio/logic board mounting screws, flip the board over, and hook it on the two pins located on the chassis. Make sure that the two shields on the bottom of the main board are in place.

d. Adjust the RF power control for minimum power output. To do this with all except 7187, rotate R103 index toward the chassis. With the 7187, rotate R163 fully counterclockwise). An alignment point diagram is shown in Figure 7-4.

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NOTE: When the transceiver is operated with the plastic cover removed, make sure that the two mounting screws are replaced. This secures the bottom shield to the board to ensure proper operation.

7.3 SYNTHESIZER ADJUSTMENT

a. Turn the transceiver power on. With 7180–7186 transceivers, select the lowest frequency channel; with the 7187, select a channel near the center of the operating band.

b. Connect a DC voltmeter to TP801 through the hole in shield. Key the transmitter, and with 7180–7186 transceivers, tune C856 for the voltage shown in the following table. With the 7187, tune C856 for 4.5 ± .05 volts. If C856 tunes properly, proceed to step "d". If not, proceed to the next step.

TABLE 7–2
VCO CONTROL VOLTAGE (7180–7186)

Rx Spread (MHz)	Tx Spread (MHz)	Control Voltage (VDC)
0–2	0–2	4.0
2–6	2–8	3.0
6–8	8–12	2.5

c. The adjustment range of C856 can be changed by cutting or reconnecting jumpers on the PC board. Turn off transceiver power and access these jumpers by removing the plate covering the synthesizer cavity. If the voltage is too low, cut additional jumpers as needed (alternate from side to side). If the voltage is too high, reconnect jumpers as needed by soldering in a small wire.

d. Unkey the transmitter and tune C857 for the same meter reading used in step "b". In some cases, C827 may have to be changed to increase or decrease the adjustment range of C857.

e. Check the control voltage on the high and low channels in both the transmit and receive modes. It should be 2.2–6.7 VDC (2.2–7.5 VDC with 7187).

7.4 REFERENCE OSCILLATOR ADJUSTMENT

7.4.1 PRELIMINARY

The reference oscillator frequency should be adjusted with the ambient temperature near the calibration reference of 25C (77F). This ensures that the frequency stays within tolerance at the temperature extremes.

Capacitor C846 is a compensating capacitor that is specially selected for each crystal. The value of this capacitor is printed on a small sticker on the crystal case. Do not change the crystal without making sure that compensation capacitor C846 is the correct value.

7.4.2 FREQUENCY ADJUSTMENT

a. Select a channel without digital Call Guard (a digital Call Guard may cause improper adjustment). Set the frequency monitor to the channel frequency and key the transmitter.

b. Adjust C847 for the correct frequency.

NOTE: If the correct frequency cannot be obtained, range adjust capacitor C848 can be changed to one of the values shown in Table 7–3 or it can be removed entirely. Increasing the value decreases the adjustment range and vice versa.

TABLE 7–3
C848 VALUES

Value	Part Number
4.7 pF ± 5% NPO submin cer	510–3113–479
10 pF ± 5% NPO submin cer	510–3113–100
15 pF ± 5% NPO submin cer	510–3113–150

7.5 TRANSMITTER TUNE–UP

7.5.1 POWER OUTPUT ADJUSTMENT

Preliminary

Adjust the RF power control for maximum power output. To do this with all except 7187, rotate the R103 index away from the chassis. With the 7187, rotate R163 fully clockwise.

When transmitting, the voltage at the power jack should be as shown in Section 7.2. Proceed to the instructions for the particular transceiver you are aligning.

7180 (2W) Procedure

a. Tune C535 for maximum power output.

b. Adjust R103 for the desired power output from 1–2 watts. If power was set to less than 2 watts, power adjustment is complete. If adjusted for 2 watts, repeak C535 and readjust R103 for 2 watts.

7181, 7182 (15W) Procedure

a. Tune C535 for maximum power output. Power output should be within the following ranges for proper operation of the power control. If not, the value of R106 can be changed within a range of 820–1200 ohms. Increasing the value decreases power output and vice versa. (This resistor is factory selected and should not need to be changed in the field.)

450–488 MHz – 14.5–19.5 watts
488–512 MHz – 12.0–15.0 watts

b. Adjust R103 for the following power output:

450–488 MHz – 15 watts, 7.5 watts minimum
488–512 MHz – 12 watts, 5 watts minimum

c. Check the lowest and highest frequencies and balance power output by tuning C535. Maximum power output on any channel should not be higher than that shown in the preceding step. If it is, readjust R103.

7183–7186 (35W) Procedure

a. Select the lowest-frequency channel. Key the transmitter and adjust C535 and C539 for maximum power output. The power output should be within the following ranges. If not, R106 can be adjusted as shown in step "a" of the preceding procedure.

403–430 MHz – 35W minimum, 45W typical
450–470 MHz – 35W minimum, 44W typical
470–488 MHz – 32W minimum, 40W typical
488–512 MHz – 28W minimum, 36W typical

b. Adjust R103 for the following power output:

403–430 MHz – 35 watts, 15 watts minimum
450–470 MHz – 35 watts, 15 watts minimum
470–488 MHz – 32 watts, 15 watts minimum
488–512 MHz – 28 watts, 12.5 watts minimum

c. Repeak C539 (adjust toward more capacitance) and then repeat the preceding step.

d. Connect a DC voltmeter to the power control line (Q103, collector). Select the lowest frequency channel. Tune C535 for a dip in the meter reading.

e. Check the lowest and highest frequencies and balance power output by tuning C539 (typically by increasing capacitance on the lowest frequency channel). Maximum power output on any channel should not be higher than that shown in step "b". If it is, readjust R103.

7187 (80W) Procedure

CAUTION

Since power output is maximum in the following step, key the transmitter only briefly to prevent damage to the power amplifier.

a. Select a channel near the center of the operating band. Key the transmitter and adjust C535 and C582 for maximum power output.

b. With R163, C535, and C582 set for maximum power output, the output power should be 85 watts minimum. If not, change R161 to one of the following values. Decreasing the value increases power output and vice versa.

Value	Part Number
4.7k ohm	569–0115–472
5.6k ohm	569–0115–562
6.2k ohm	569–0115–622
6.8k ohm	569–0115–682
7.5k ohm	569–0115–752
8.2k ohm	569–0115–822
10k ohm	569–0115–103

c. Set R163 for 80 watts power output.

d. Connect a DC voltmeter to TP502 (input to fuse F551 in power amplifier assembly). Tune C582 for a peak meter reading at TP502.

e. Connect a DC voltmeter to the power control line at TP501 (Q152 collector). Tune C535 for a dip in the meter reading. The voltage at TP501 should be less than 10 VDC (typically 5-6 VDC). If not, retune C535.

f. With multichannel transceivers, check the power output on the highest and lowest frequencies. Balance the power output by tuning C582 (typically by increasing the capacitance on the lowest frequency channel).

g. Adjust R163 for the desired power output (40 watts minimum, 80 watts maximum). Maximum power output on any channel should be 82 watts (readjust R163 if necessary).

7.5.2 BALANCE AND DEVIATION ADJUSTMENT

Proceed as follows:

a. Turn off transceiver power. Preset to midrange R337 (deviation limiting), R330 (Call Guard deviation), and R811 (balance). Select the lowest frequency channel.

b. Connect a jumper from TP401 to TP402.

c. Connect a nonpolarized capacitor with a value of 22 µF or greater between TP403 and TP404. (A nonpolarized capacitor can be formed using polarized capacitors by connecting two 44 µF or larger capacitors in series with either the + or - sides connected together.)

d. Turn the power back on and key the transmitter (no audio signal should be applied to pin 2 of microphone connector J103).

e. Tune R811 so that the demodulated signal when viewed on the CRT of a service monitor is a square wave with minimum tilt and overshoot.

NOTE: The service monitor must be capable of displaying frequencies down to 10 Hz.

f. Turn the transceiver off, remove the jumper and capacitor, then turn the transceiver back on.

g. Select the channel on the upper end of the transmit band. If Call Guard squelch is used, this channel must also be programmed with Call Guard squelch. If both tone and digital type are used, it must be a tone type. If Call Guard squelch is not used, this channel does not have to be programmed with Call Guard squelch and the next step can be omitted.

h. To set Call Guard deviation, key the transmitter and adjust R330 for a deviation of ± 600 Hz (no audio should be applied to pin 2 of microphone connector J103).

i. Apply a 1000 Hz tone at 1.25 volts rms to pin 2 of microphone jack J103 (a microphone substitution fixture is shown in Figure 7-2). Adjust R337 for a deviation of 4.5 kHz ± 100 Hz.

j. Check the deviation on all channels. Maximum deviation on any channel with or without Call Guard squelch should be 4.5 kHz. Readjust R337 if necessary.

NOTE: Deviation should not be adjusted so that channels with Call Guard squelch have a deviation of ± 5 kHz.

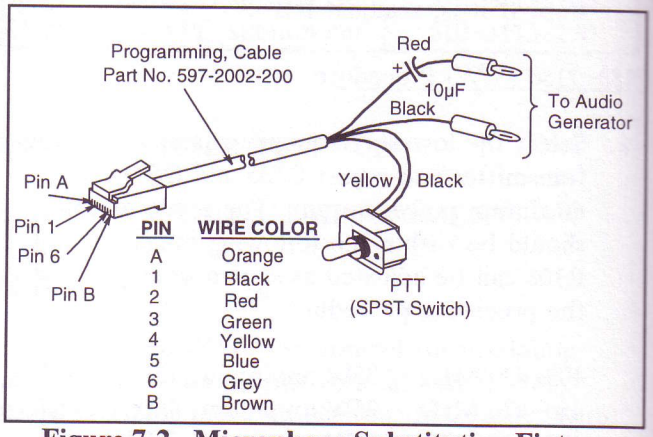


Figure 7-2 Microphone Substitution Fixture

7.6 RECEIVER ALIGNMENT

CAUTION

Do not transmit with the signal generator connected to the antenna jack because severe damage to the generator may result.

7.6.1 PRELIMINARY SET-UP

a. Preset the T201–T205 tuning screws six turns up from the helical casting.

b. Refer to the test set-up diagram in Figure 7-3. Connect a 3.0-ohm load to the external speaker jack (the load should be attached directly to the plug). The speaker jack is located on the junction box with remote mount units. Connect a distortion analyzer and SINAD meter to the load.

c. With multichannel transceivers, channels on each end of the operating band are required. In addition, a channel within 500 kHz of the center of the band is required (if the receive band is greater than 6 MHz, this channel must be within 200 kHz).

d. Connect a 13.8-volt power supply to power connector J102 and turn the transceiver power on. Unsquelch the transceiver by adjusting the squelch control counterclockwise (with remote mount transceivers, the squelch control is R239 on the main board).

e. Connect the signal generator to the antenna jack. A 6 dB or greater pad should be used between the generator and transceiver to ensure that there is a 50-ohm impedance into the transceiver.

7.6.2 IF ALIGNMENT

a. Select the center channel and set the signal generator to the center channel frequency, modulated with 1 kHz at ± 3 kHz deviation.

b. Increase the generator output to obtain a reading on the distortion analyzer. Tune T213 for maximum audio output. (Readjust the volume control as required to keep the audio level below the clipping point which is less than approximately 3 volts rms.)

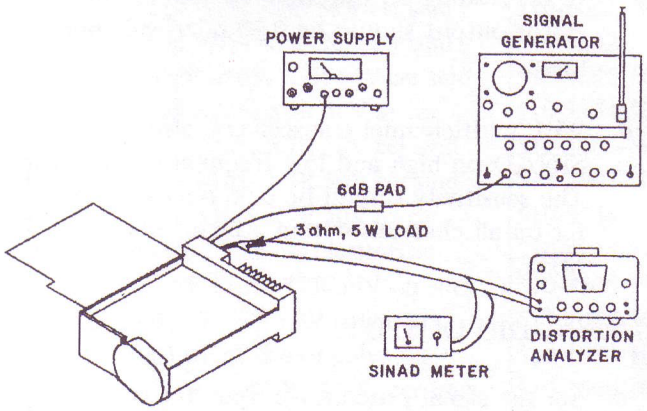
c. Tune, in order, T201–T205 for best SINAD (readjust the generator output level as necessary).

d. Set the generator output level for 1 millivolt and adjust the transceiver audio output level for 3.2 V rms. Tune L209 and L212 for minimum distortion. Repeat. Readjust L212 only 1/2-turn counterclockwise.

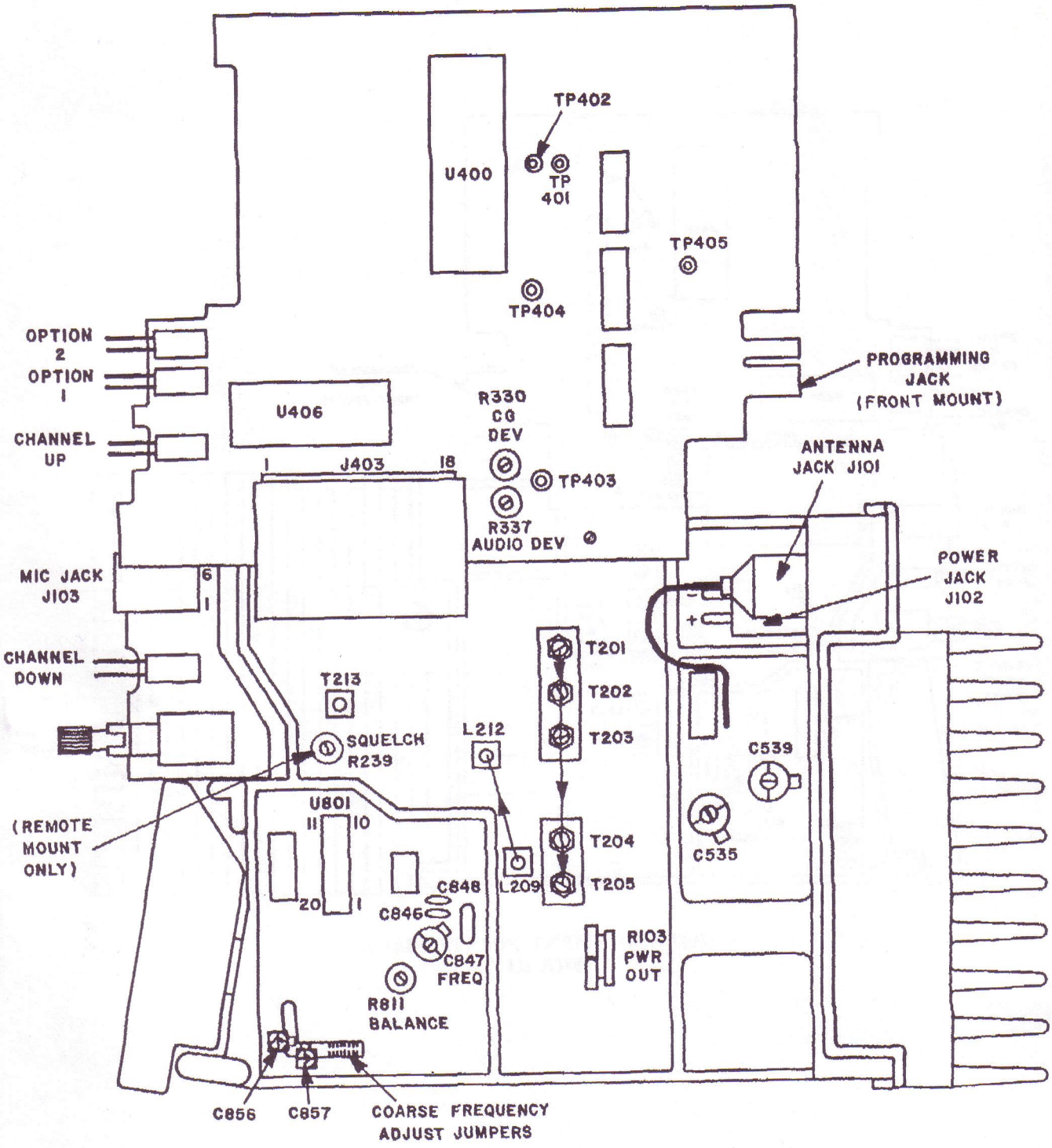
e. Retune T201–T205 for best SINAD.

f. Adjust T202 for a balance in sensitivity on the channels on the low and high end of the operating band. It may sometimes be necessary to also adjust T205.

g. With remote mount units, squelch is set internally by R239. Adjust the signal generator output for 8 dB SINAD and then adjust R239 so that the transceiver just squelches at this level. Unsquelching should occur at 10–18 dB SINAD.



RECEIVER TEST SET-UP
FIGURE 7-3



7180–7186 ALIGNMENT POINTS DIAGRAM
FIGURE 7–4