

Alignment

Chapter Overview

This chapter describes how to align an *MSF 5000* base station. The chapter contents are listed in Table 4-1.

Table 4-1 *Chapter contents*

| Section | Page | Description |
|----------------------------|------|---|
| Recommended Test Equipment | 4-1 | A list of recommended tools and test equipment needed to properly align an <i>MSF 5000</i> station. |
| General Guidelines | 4-2 | Things to consider before aligning a station. |
| Alignment Procedures | 4-4 | Detailed procedures for aligning a station. |

Recommended Test Equipment

The following test equipment is required to align the *MSF 5000* station:

- ☐ R2000 Service Monitor (or equivalent)
- ☐ Diagnostic Metering Panel or Radio Metering Panel (both are referred to as *metering panel*)
- ☐ HP3552A Transmission Test Set (or equivalent)
- ☐ 50 Ω RF terminating load (two times the rated power; dependent on transmitter output)
- ☐ Wattmeter (two times the rated power; dependent on transmitter output)
- ☐ Voltmeter
- ☐ Frequency measuring device
- ☐ Tuning tool kit (supplied with station)
- ☐ Torx driver

The following test equipment is optional:

- ☐ Radio Service Software (RSS)
- ☐ Service computer

General Guidelines

The following procedures require the service technician or installer to have a basic knowledge of the *MSF 5000* operation. Refer to Chapter 2 - Operation for additional information.

NOTE

Most of the following procedures apply to stations containing the *Simulcast Option (C777)*, however, specific Simulcast procedures are included in Appendix H - Simulcast. Refer to the trunked station dual path and digital path simulcast manual (68P81081E60) for system setup information using this option.

MSF 5000 Alignment Requirements

- ☐ Check all deviation levels by measuring the highest positive or negative peak deviation.
- ☐ Terminate all 600 Ω /900 Ω wireline inputs and outputs with a 600 Ω /900 Ω terminating load before taking measurements.
- ☐ For trunking stations, if the *MSF 5000* is connected to an operational Trunked Radio Central Controller, disable the station from the system only through the central controller.
- ☐ To activate/deactivate Muxbus bits, either use the DMP and RSS or the equivalent jumper settings provided throughout the procedure.
- ☐ Most adjustments in the alignment procedure are made from the tuning channel (channel 0/mode 0).

Channel 0 is the tuning channel. This is the average of the highest and lowest programmed frequencies. The channel is displayed in the **Chan** digit (i.e., last digit on the left-hand side) of the **Status** display.

Mode 0 disables PL/DPL and opens squelch. The mode is displayed in the **Mode** digit (center) of the **Status** display.

- ☐ If available, use RSS to determine the programmed receive and transmit frequencies for each channel.
- ☐ While tuning filters for a maximum or minimum reading, adjust the tuning screw an additional 1/2 turn to ensure a true maximum or minimum level.
- ☐ When using a frequency measuring device, ensure the accuracy rating is equal to at least 10 times that of the station stability.
- ☐ The typical maximum phone line input level is from 0 dBm to -10 dBm.
- ☐ The *MSF 5000* EEPOTs provide the functions listed in Table 4-2. Refer to Chapter 2 - Operation for additional information on adjusting EEPOTs.

Table 4-2 *EEPOT Definitions*

| EEPOT # | Function | EEPOT Location |
|---|---|----------------|
| 0 | coded RX level † | Secure board |
| 1 | <i>Flutter Fighter</i> level (900 MHz only) | SSCB |
| 2 | repeater squelch level | SSCB |
| 3 | receiver squelch level | SSCB |
| 4 | maximum deviation level | SSCB |
| 5 | RX level (for repeater deviation) | SSCB |
| 6 | coded deviation level | SSCB |
| 7 | TX audio level | TTRC board |
| 8 | status tone level | TTRC board |
| 9 | high-end equalization level | TTRC board |
| A | low-end equalization level | TTRC board |
| b | trunking data level | TTRC board |
| C | line 2 output level | TTRC board |
| d | line 4 output level | TTRC board |
| E | coarse line level adjust | TTRC board |
| F | SAM encoder level ‡ | SAM |
| † Only with optional Secure board. ‡ Only with optional SAM board. | | |

Alignment Procedures

Motorola recommends performing alignment procedures after installing the *MSF 5000*, six months after installation, and every twelve months thereafter. If the *MSF 5000* is equipped with the *Battery Revert Option (C28)*, verify its performance as well.

Always perform the procedures in the order presented. Some of the adjustments are presented for stations containing specific options. Perform only those procedures applying to the specific *MSF 5000* configuration.

Power Supply Voltage

The following procedure is only performed when a station is equipped with the *Battery Revert Option (C28)*. This procedure adjusts the voltage set potentiometer which sets the battery charge voltage at the Junction Box battery connection.

1. Verify the station is dekeyed.
2. On the Junction Box, disconnect the battery cable from the station.
3. Set the FL ↓/EQ ↑ switch (S650) to FL ↓ (Float).

The FL ↓/EQ ↑ switch is located on the Power Supply board. Refer to Figure 4-1 for the location of this switch.

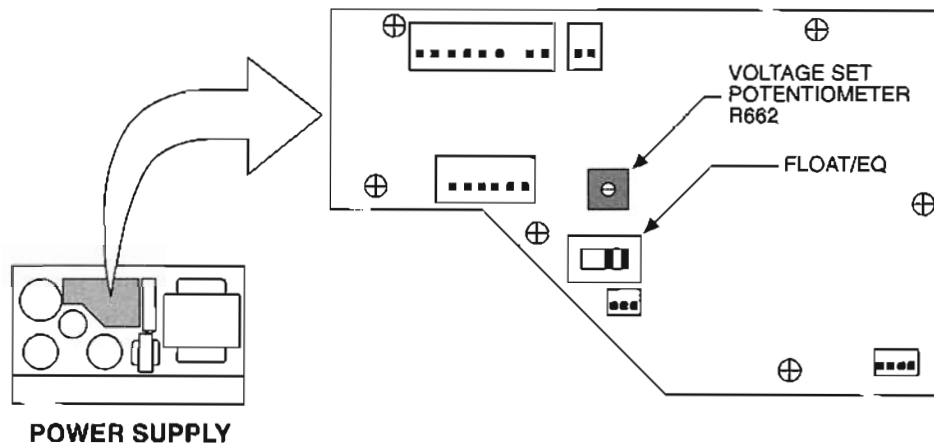


Figure 4-1 **Power Supply Board (top View)**

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4. Adjust the **VOLTAGE SET** potentiometer (R662) to set the battery charge voltage at the battery connector on the Junction Box.

For optimum performance, set R662 to the manufacturer's recommended battery charging voltage listed in Table 4-3.

Table 4-3 **Recommended Battery Charging Voltages**

| Battery Type | Voltage |
|---|----------------------|
| Lead Acid | 13.25 Vdc (26.5 Vdc) |
| NI-CAD™ | 14.25 Vdc (28.5 Vdc) |
| GEL-CELL™ | 13.5 Vdc (27 Vdc) |
| No Batteries | 14.25 Vdc (28.5 Vdc) |
| Note: Voltages represented in parenthesis () are for VHF stations using the 24 Vdc output post. All voltages represented are at room temperature conditions. | |

NOTE

Only connect fully charged batteries to the station. Allow discharged batteries to charge for at least three hours before connecting them to the station. Keying the station without fully charged batteries reduces station performance.

NOTE

Motorola recommends periodically setting the FL ↓/ EQ ↑ switch to EQ ↑ (i.e., every 3 - 4 months or after heavy usage). Leave this switch in the EQ ↑ (equalize) position until the batteries' cells are fully equalized.

5. Connect the batteries to the Junction Box. Observe polarity of the connector.

VCO Adjustments

The following procedure adjusts the Transmit and Receive Voltage Controlled Oscillators (VCOs). The VCOs are adjusted through the use of the Rx Lock and Tx Lock LEDs, the VCO locking cams, and a metering panel. This procedure does not apply to VHF stations since they do not require fine tuning for proper operation.

Alignment Procedures

NOTE

The Transmit and Receive VCO adjustment should only be performed for *UHF, 800 MHz, and 900 MHz Analog Plus stations*. This procedure does not apply to *VHF stations*.

1. On the top of the RF Tray, rotate both VCO locking cams to **Transit**.
The **Transit** position secures the VCOs in place while adjusting or moving the station. Refer to Figure 4-2 for the location and rotation of the VCO locking cams.

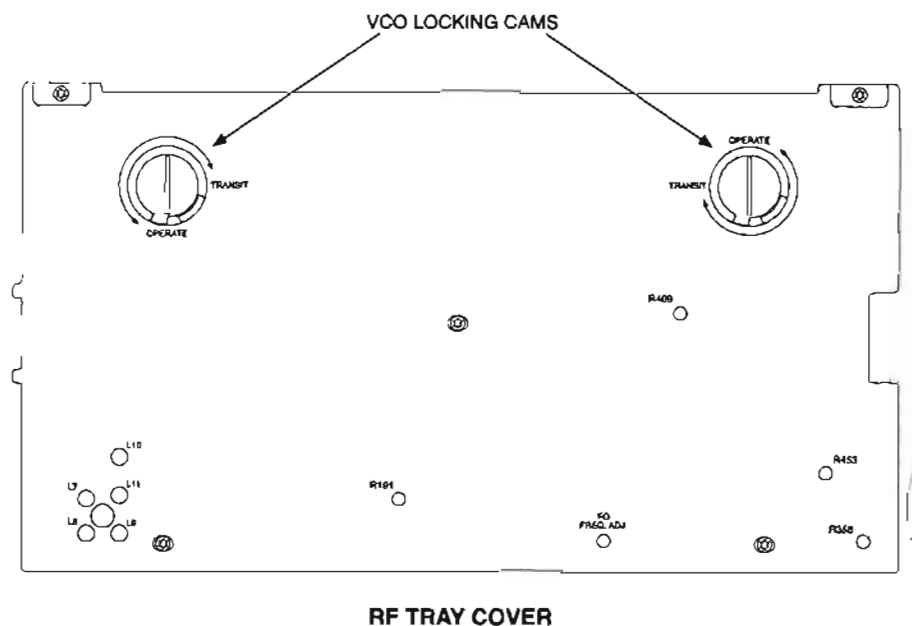
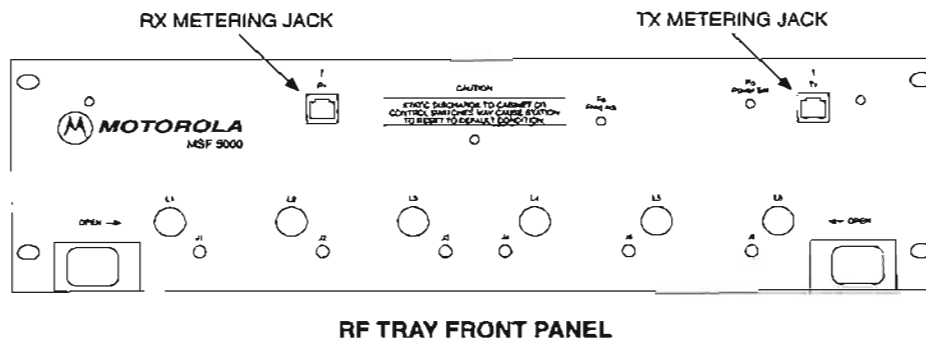


Figure 4-2 VCO Locking Cams

2. On the control tray, set the station to the channel with the highest programmed operating frequency.
The channel is displayed in the **Chan** digit (i.e., last digit on the left-hand side) of the **Status** display.

Transmit VCO Adjustment

3. Connect a metering panel to the Tx metering jack located on the front right-hand side of the RF Tray using the metering cable.
Refer to Figure 4-3 for the location of the RF Tray metering jacks.



NOTE: L1 - L6, J1 - J6 and Fo Freq Adj are not found on VHF models.
Access requires the removal of the front panel.

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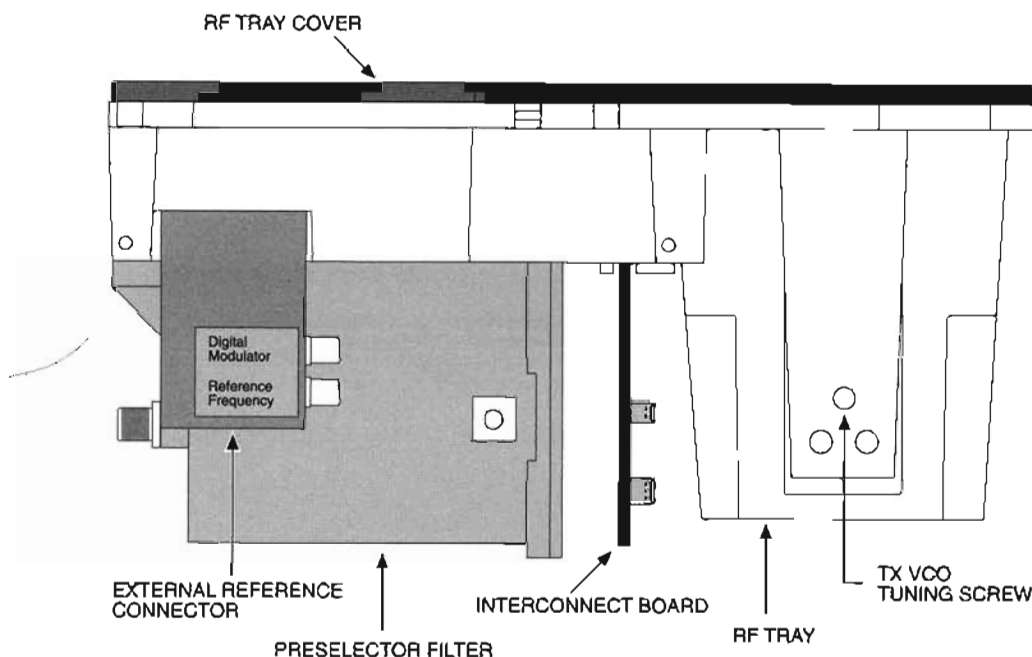
Figure 4-3 Metering Jacks

4. On the metering panel, set the Meter switch to 5 and set the reversing switch (\pm) to + (positive).
Meter 5 should read $38 \pm 2 \mu\text{A}$. If the meter indicates this value, proceed to the Receive VCO Adjustment.
5. Adjust the TX VCO tuning screw until the Tx Lock indicator on the control tray illuminates.
Access the TX VCO tuning screw from the upper hole on the right-hand side of the RF Tray. Turning the TX VCO clockwise (CW) increases the level; turning it counter-clockwise (CCW) decreases the level. Refer to Figure 4-4 for the location and rotation of the VCOs.
6. Adjust the TX VCO tuning screw until Meter 5 on the metering panel indicates $38 \pm 2 \mu\text{A}$.

Receive VCO Adjustment

7. Connect a metering panel to the Rx metering jack on the front left-hand side of the RF Tray using the metering cable.
Refer to Figure 4-3 for the location of the RF Tray metering jacks.
8. On the metering panel, verify Meter 5 is selected and the reversing switch (\pm) is set to + (positive).
Meter 5 should read $38 \pm 2 \mu\text{A}$. If the meter indicates this value, proceed to step 11.
9. Adjust the RX VCO tuning screw until the Rx Lock indicator on the control tray illuminates.
Access the RX VCO tuning screw from the upper hole on the left-hand side of the RF Tray. Turning the RX VCO clockwise (CW) increases the level; turning it counter-clockwise (CCW) decreases the level. Refer to Figure 4-5.

Alignment Procedures



NOTE: External Reference Connector is included only on External Reference Base Stations.

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Figure 4-4 TX VCO Tuning Screw

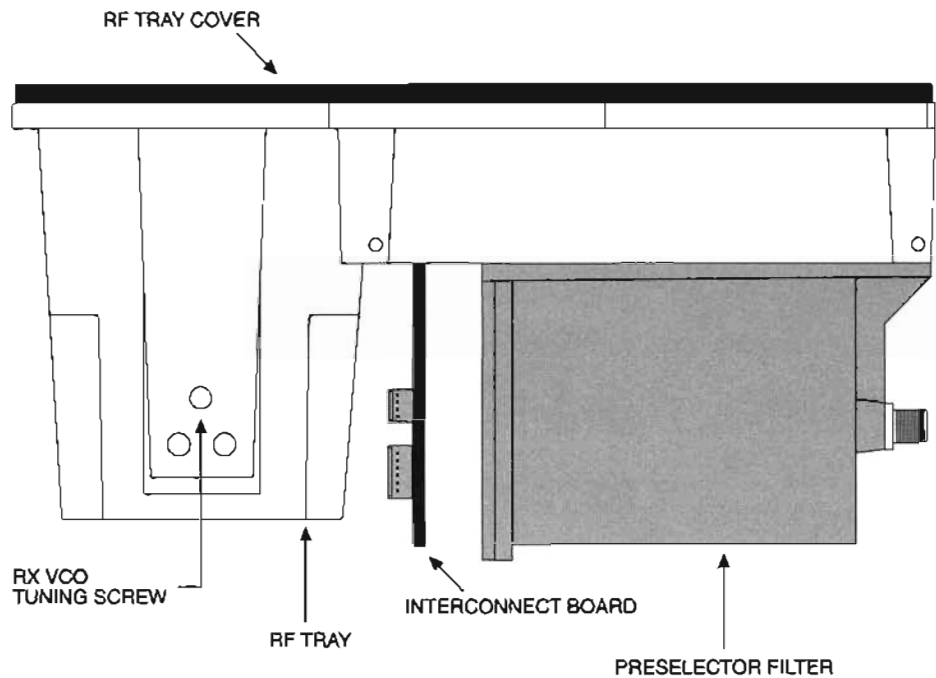
10. Adjust the RX VCO tuning screw until Meter 5 on the metering panel indicates $38 \pm 2 \mu\text{A}$.
11. Rotate both VCO locking cams to **Operate**.

Injection Filter Adjustment

The following procedure aligns the Injection Filter for the tuning channel frequency (channel 0/mode 0). By adjusting the Injection Filter to the tuning channel, the station is tuned for all programmed frequencies.

The Injection Filter tuning screws are accessed through the RF Tray cover. The tuning screws are adjusted until a maximum reading is obtained on the metering panel.

1. Connect a metering panel to the Rx metering jack on the front left-hand side of the RF Tray using the metering cable.
2. On the metering panel, set the Meter switch to 3 and verify the reversing switch (\pm) is set to the + (positive).

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02/25/94Figure 4-5 ***RX VCO Tuning Screw***

3. On the control tray, set the Acc Dis/Reset switch to Acc Dis.
4. Using the Select/Set switch, set the station to tuning channel.
5. Using a tuning screwdriver, adjust L7 until Meter 3 on the metering panel indicates a maximum level.
Refer to Figure 4-6 for the location of the Injection Filter tuning screws.
6. Using a tuning screwdriver, adjust L8 until Meter 3 on the metering panel indicates a maximum level.
7. Using a tuning screwdriver, adjust L9 until Meter 3 on the metering panel indicates a maximum level.
8. Repeat steps 5 through 7 until a maximum level is obtained.

Preselector / Image Filter Adjustment

The following procedure aligns the Preselector and Image Filters for the tuning channel frequency (channel 0/mode 0). By adjusting the Preselector and Image Filters to the tuning channel, the station is tuned for all programmed frequencies.

Alignment Procedures

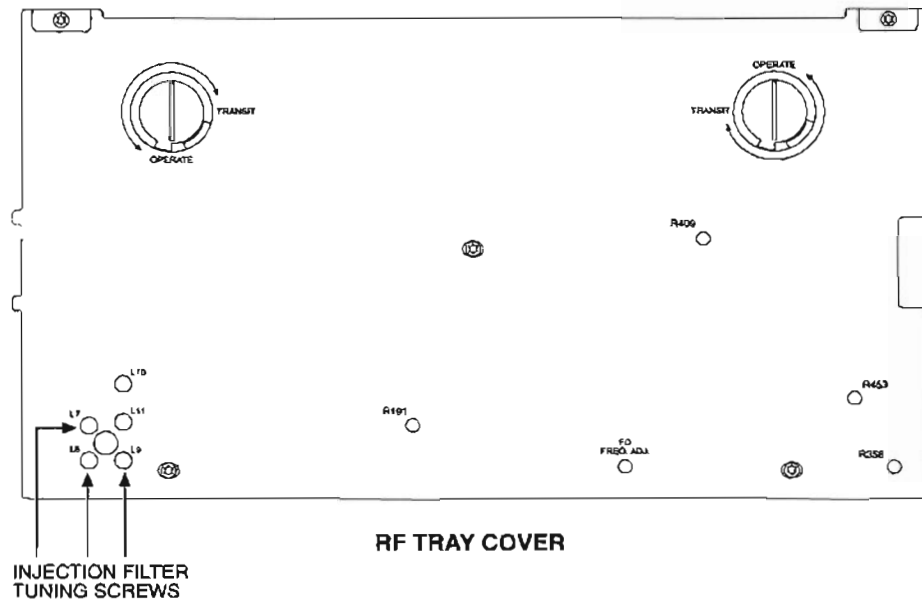
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Figure 4-6 Injection Filter Tuning Screws (RF Tray Cover)

The Preselector Filter tuning screws are accessed through the RF Tray front panel. There are a total of six Preselector tuning screws, except for VHF stations which contain only five tuning screws. For VHF stations, the RF Tray front panel must be removed. The Preselector Filter tuning screws are adjusted until the proper reading is obtained on the metering panel.

The Image Filter tuning screws are accessed from the top of the RF Tray cover. The Image Filter tuning screws are adjusted until the proper reading is obtained on the metering panel.

Typically, the Preselector and Image Filter require only a fine adjustment. However, if the station requires a major tuning adjustment, the coarse adjustment must be performed initially. Coarse adjustments are usually required after frequency changes, filter replacements, and servicing.

Coarse Adjustment

1. If adjusting a *VHF station*, remove the RF Tray front panel. Otherwise, proceed to step 2.
2. Using the **Select/Set** switch, set the station to the tuning channel.
3. Terminate the Preselector by connecting a 50 Ω load to the Preselector input. For non-duplex repeaters and base stations, connect the load to the receive antenna connection on the Junction Box.

NOTE

When tuning for a minimum or maximum reading on the meter, adjust the tuning screws an additional half-turn. This ensures that the true minimum or maximum level.

4. On the front of the RF Tray, adjust all the Preselector tuning screws CCW as indicated below. Refer to Figure 4-7.

On 800 MHz stations, adjust the tuning screws until they extend approximately 1/8" from the front panel.

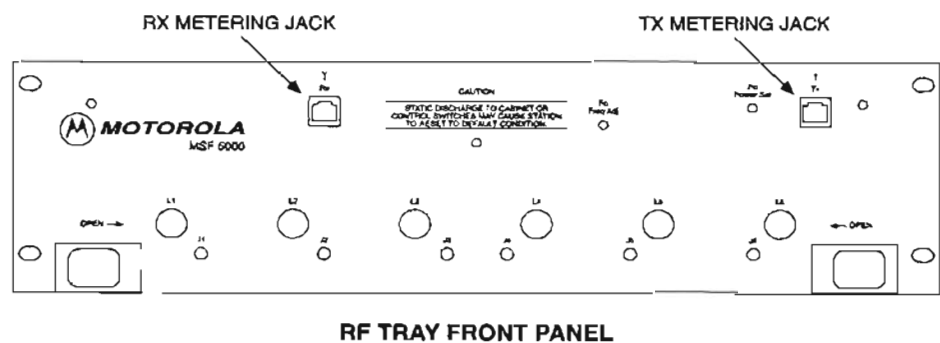
On UHF and 900 MHz Analog Plus stations, adjust the tuning screws until they extend approximately 1/4" from the front panel.

On VHF stations using VHF Range 1 Option (C367), adjust the tuning screws until they extend approximately 3/4" from the tension nut.

On VHF stations using VHF Range 2, adjust the tuning screws until they extend approximately 1/8" from the tension nut.

NOTE

On VHF stations at frequencies near 158 MHz (Range 1) or near 174 MHz (Range 2), the meter indication may not decrease after tuning for a maximum level. If this happens, stop adjusting the tuning screw.



RF TRAY FRONT PANEL

NOTE: L1 - L6, J1 - J6 and Fo Freq Adj are not found on VHF models.
Access requires the removal of the front panel.

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Figure 4-7 Preselector Filter Tuning Screws

5. Connect the Preselector probe from the output of a signal generator to J1 of the Preselector located on the front panel of the RF Tray.

Alignment Procedures

6. Set the signal generator to output a 1 mV on-channel signal.
7. On the metering panel, set the Meter switch to 2 and verify the reversing switch (\pm) is set to the + (positive).
Verify a level between 25 and 35 μ A on the metering panel. Adjust the signal generator output, as necessary, to meet the required level.
8. On the top of the RF Tray, adjust the Image Filter (L10 and L11) until Meter 2 indicates a maximum level.
Refer to Figure 4-8 for the location of the Image Filter tuning screws.

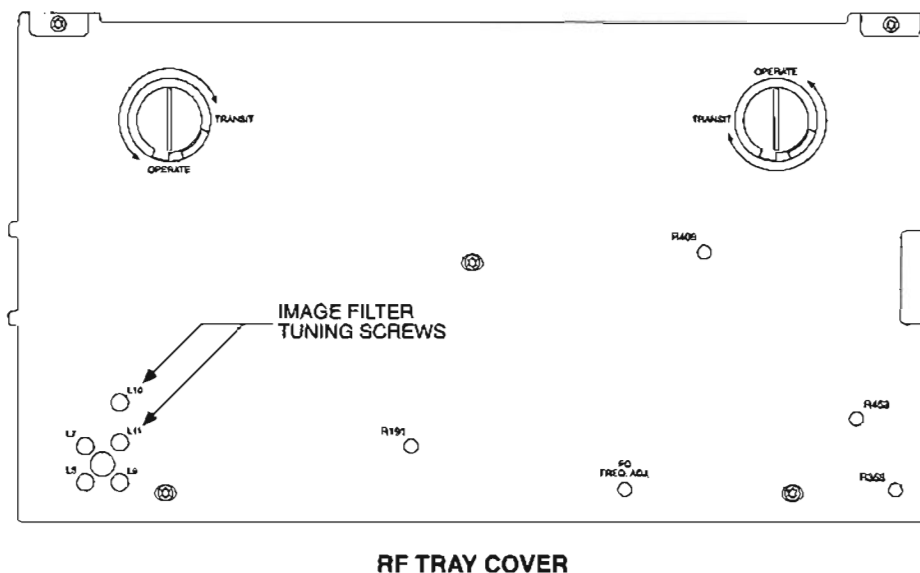
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Figure 4-8 Image Filter Tuning Screws (top View of RF Tray)

9. On the front of the RF Tray, adjust L1 on the Preselector until Meter 2 indicates a maximum level.
10. Adjust L2 on the Preselector until Meter 2 indicates a minimum level.
11. Move the probe to J2 and adjust L3 on the Preselector until Meter 2 indicates a minimum level.
12. Move the probe to J3 and adjust L4 on the Preselector until Meter 2 indicates a minimum level.
13. Move the probe to J4 and adjust L5 on the Preselector until Meter 2 indicates a minimum level.

NOTE

Perform step 14 only if aligning *UHF, 800 MHz, and 900 MHz Analog Plus stations*. Otherwise, proceed to Fine Adjustment.

14. For *UHF, 800 MHz, and 900 MHz Analog Plus stations*, move the probe to J5 and adjust L6 on the Preselector until Meter 2 indicates a minimum level.

Fine Adjustment

15. Using the **Select/Set** switch, set the station to the tuning channel.
16. Use a signal generator to inject a 1 mV on-channel signal into the receiver antenna connector on the Junction Box.
17. Alternately adjust L10 and L11 on the Image Filter until Meter 2 indicates a maximum level.
18. Alternately adjust L1 on the Preselector and L11 on the Image Filter until Meter 2 indicates a maximum level.
19. Adjust L6 on the Preselector (L5 for *VHF stations*) until Meter 2 indicates a maximum level.

NOTE

Perform step 20 only if aligning a *VHF station*. Otherwise, proceed to Adjusting the Transmit Filter (Duplexer).

20. On *VHF stations* only, reinstall the RF Tray front panel.

Adjusting the Transmit Filter (Duplexer)

The following procedure is only performed for *UHF stations* equipped with the *Duplex Filter Option (C597, C675, or C677)*. This procedure aligns the prefilter and postfilter of the Duplex Filter.

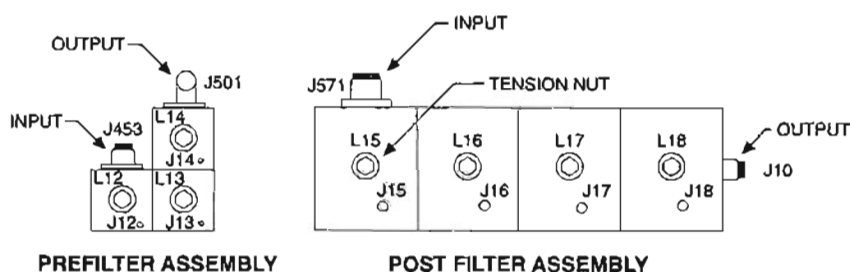
The prefilter and postfilter are aligned for the tuning channel frequency (channel 0/mode 0). By adjusting the prefilter and postfilter to the tuning channel, the station is tuned for all programmed frequencies.

The prefilter and postfilter tuning screws are easily accessed within the station cabinet. The tuning screws are adjusted until the proper reading is obtained on the metering panel.

CAUTION

Never attempt to adjust the Prefilter or Postfilter for the purpose of obtaining maximum station output power.

1. On the control tray, set the Acc Dis/Reset switch to Acc Dis.
2. Disconnect the PA input cable from the output of the Prefilter (J501). Refer to Figure 4-9 for the location of J501.



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Figure 4-9 Duplexer Tuning Screws

3. Connect a 50 Ω load to J501.
4. Set the signal generator to the transmitter tuning channel frequency.
5. Adjust the signal generator output to 0 dBm (225 mV).
If the Preselector is properly aligned, connect the signal generator to the transmit antenna connector on the Junction Box. Otherwise, connect the signal generator to the Postfilter output (J10).
6. Detune the Postfilter by turning L15 through L17 CCW until they extend approximately 1/2" from the tension nut.
7. Connect the tuning probe to J18 on the Postfilter.
8. Adjust L18 for maximum indication on the millivoltmeter.
9. Adjust L17 for minimum indication on the millivoltmeter.
10. Move the tuning probe to J17 on the Postfilter.
11. Adjust L16 for minimum indication on the millivoltmeter.
12. Move the tuning probe to J16 on the Postfilter.
13. Adjust L15 for minimum indication on the millivoltmeter.

14. Remove the IPA output cable from the Prefilter input (J453).
15. Connect a signal generator to the Prefilter input (J453).
16. Detune the Prefilter by turning L13 and L14 CCW until they extend approximately 1/2" from the tension nut.
17. Move the tuning probe to J12 on the Prefilter.
18. Adjust L12 for maximum indication on the millivoltmeter.
19. Adjust L13 for minimum indication on the millivoltmeter.
20. Move the tuning probe to J13 on the Prefilter.
21. Adjust L14 for minimum indication on the millivoltmeter.
22. Disconnect all test equipment.
23. Connect the PA input cable to the Prefilter (J501).
24. Connect the IPA cable to the IPA (J453).
25. Set the Acc Dis/Reset switch to the center (normal) position.

Forward/Reflected Power Trip Point Set

The following procedure is only performed for *trunked stations* or *data stations*. This procedure adjusts the forward and reflected power trip points to a user specified level.

This procedure requires adjustment of the station output power level, setting the trip point, and then readjusting the station for the appropriate output power level. The trip point value appearing in the **Status** display is a relative value. This value cannot be converted to the actual power level adjustment.

CAUTION

Do not attempt to enter or adjust the forward and reflected power trip set mode if a wattmeter is not present in the station (i.e., it is a conventional station). The codeplug may be corrupted which causes constant alarms.

1. Connect the station transmit antenna connector on the Junction Box to a wattmeter terminated with a 50 Ω load.
Use a wattmeter capable of handling the full-rated station power.
2. Key the station by setting the LOC PTT MUXbus bit (A1/D1).
This may also be accomplished by grounding TP9 (or J812-4) on the SSCB.

Alignment Procedures

3. Set and hold the **Select/Set** switch to **Set**.
Be sure to hold this switch during step 4 and step 8.
4. Set the **PL Dis/Xmit** switch to **PL Dis**.
5. Set the **Acc Dis/Reset** switch to **Acc Dis**.
The **Status** display indicates "trP".
6. Release the **Select/Set** switch.
7. Set the **PL Dis/Xmit** and **Acc Dis/Reset** switches to the center (normal) position.
The first character of the **Status** display toggles between "F" (forward power) and "r" (reflected power), as shown in Figure 4-10.

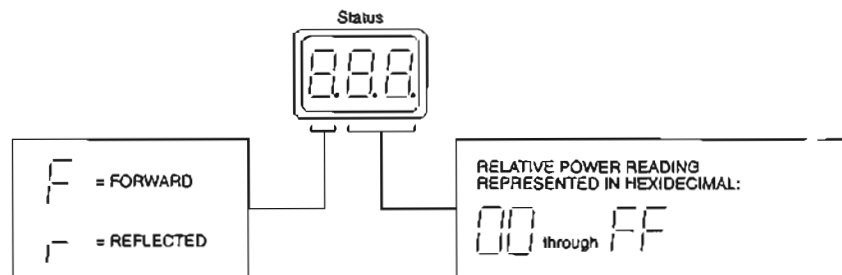
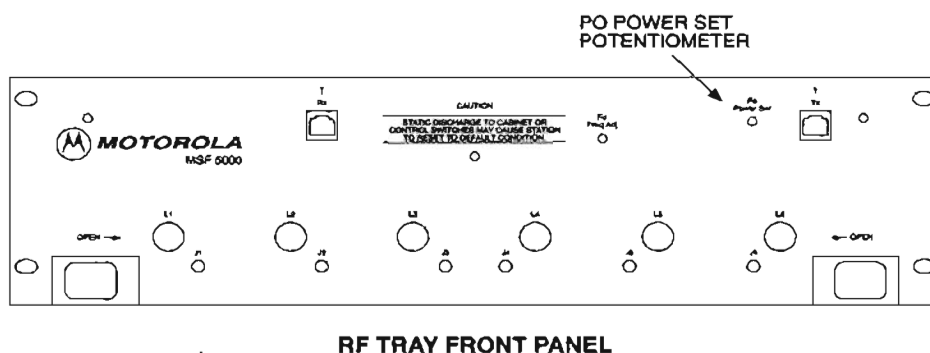
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Figure 4-10 Forward/Reflected Power Status Display Definitions

Forward Power Level Adjustment

8. Use the tuning tool to set the power output to the desired forward power level trip point by adjusting **Po Power Set** potentiometer (R426).
This is typically set to 35% of the rated station power level. Refer to Table 4-4 through Table 4-6.
The **Po Power Set** potentiometer is part of the Uniboard and is accessed through the opening in the RF Tray front panel, refer to Figure 4-11. Turn the **Po Power Set** potentiometer CW to increase power out; turn it CCW to decrease power out.
9. With the transmitter keyed, set the **Select/Set** switch to **Select** when the first character of the **Status** display shows "F".
The second and third digits indicate the forward power level trip point. This value is represented in hexadecimal.



NOTE: L1 - L6, J1 - J6 and Fo Freq Adj are not found on VHF models.
Access to these requires the removal of the front panel.

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Figure 4-11 *Po Power Adjustment*

Reflected Power Level Adjustment

10. Use the tuning tool to set the power output to the desired reflected power level trip point by adjusting the **Po Power Set** potentiometer.
The reflected power level trip point is typically set to 20% of the rated station power level. Refer to Table 4-4 through Table 4-7.
11. Toggle the **Select/Set** switch to **Select** when the first character of the **Status** display shows "r".
The second and third digits indicate the reflected power level trip point. This value is represented in hexadecimal.
12. Set the **Select/Set** switch to **Set** to exit the power trip point mode.
13. Deactivate all activated MUXbus bits.

RF Power Output Adjustment

The following procedure is divided into three parts:

- ☐ Overdrive Control
- ☐ Power Set Control
- ☐ Battery Cutback Control

The Overdrive Control is only performed on high power stations (i.e., containing two Power Amplifiers). This procedure adjusts the power cut-back if the output power level exceeds a predetermined level set by the user. The Overdrive Control (R453) adjustment is located on the Uniboard, and is accessed from the top of the RF Tray cover.

Alignment Procedures

Table 4-4 VHF Station Rated RF Power Levels

| Model | with Duplexer (C182) | with Single Circulator (C265) | with Duplexer & Single Circulator (C182/C265) | Standard |
|---------------------------|----------------------|-------------------------------|---|-----------|
| C23CXB | 3.5 | 4.5 | 3.0 | 6 |
| C43CXB | 15 | 20 | 12 | 25 |
| C63CXB | 45 | 60 | 35 | 75 |
| C73CXB | 75 | 100 | 60 | 125 |
| C93CXB | n/a | 300 (360) | n/a | 350 (390) |
| C93CXB with 220 Vac 50 Hz | n/a | 260 (340) | n/a | 300 (380) |

- Notes:
1. All RF power levels are listed in Watts.
 2. All power levels are for 110 Vac/60 Hz stations, except where noted.
 3. RF power levels in parenthesis are Overdrive Power Levels.

Table 4-5 UHF Station Rated RF Power Levels

| Model | with Option C675 or C182 | with Option C597 | with Option C676 | with Option C677 | Standard |
|---------------------------|--------------------------|------------------|------------------|------------------|-----------|
| C24CXB | 4 | 3 | 3 | 3 | 6 |
| C34CXB | 10 | 8 | 9 | 8 | 15 |
| C44CXB | 30 | 22 | 25 | 20 | 40 |
| C64CXB | 55 | 40 | 45 | 40 | 75 |
| C74CXB | 85 | 60 | 70 | 55 | 110 |
| C84CXB | 140 | n/a | n/a | n/a | 225(285) |
| C84CXB with 220 Vac 50 Hz | 125 (160) | n/a | n/a | n/a | 200 (260) |

- Notes:
1. All RF power levels are listed in Watts.
 2. All power levels are for 110 Vac/60 Hz stations, except where noted.
 3. RF power levels in parenthesis are Overdrive Power Levels.

The Power Set Control (R426) adjusts the RF output power level of the station to the site specified level. The Power Set Control adjustment is located on the Uniboard, and is accessed from the RF Tray front panel.

The Battery Cutback Control (R409) adjusts the RF output power level of the station to 50% of the rated station output power level. This adjustment reduces the station output power level when the station reverts to battery back-up. The Battery Cutback Control adjustment is located on the Uniboard, and is accessed from the top of the RF Tray cover.

Table 4-6 800 MHz Station Rated RF Power Levels

| Model | with Duplexer (TDF9680A) | with Triple Circulator (C676) | with Duplexer & Triple Circulator (C676/TDF9680A) | Standard |
|--|--------------------------|-------------------------------|---|-----------|
| C45CXB | 23 | 30 | 21 | 35 |
| C65CXB | 50 | 60 | 45 | 75 |
| C85CXB | 100 (150) | 125 (180) | 90 (130) | 150 (220) |
| C85CXB with 220 Vac 50 Hz | 85 (125) | 110 (160) | 75 (120) | 125 (180) |
| Notes: 1. All RF power levels are listed in Watts. 2. All power levels are for 110 Vac/60 Hz, stations except where noted. 3. RF power levels in parenthesis are Overdrive Power Levels. | | | | |

Table 4-7 900 MHz Analog Plus Station Rated RF Power Levels

| Model | with Duplexer (TDF6542A) | with Triple Circulator (C676) | with Duplexer & Triple Circulator (C676/TDF6542A) | Standard |
|--|--------------------------|-------------------------------|---|-----------|
| C65GFB | 50 | 60 | 45 | 75 |
| C85GFB | 100 (150) | 125 (180) | 90 (130) | 150 (220) |
| C85GFB with 220 Vac 50 Hz | 80 (125) | 110 (160) | 75 (120) | 125 (180) |
| Notes: 1. All RF power levels are listed in Watts. 2. All power levels are for 110 Vac/60 Hz, stations except where noted. 3. RF power levels in parenthesis are Overdrive Power Levels. | | | | |

1. Connect the station transmit antenna connector on the Junction Box to a wattmeter terminated with a 50 Ω load.
Use a load capable of handling two times the rated station power.
2. Using tuning tool, rotate the **Po Power Set** potentiometer (R426) fully CCW, then CW 1/8 turn.
The **Po Power Set** potentiometer is accessed through the opening in the RF Tray front panel.

Alignment Procedures

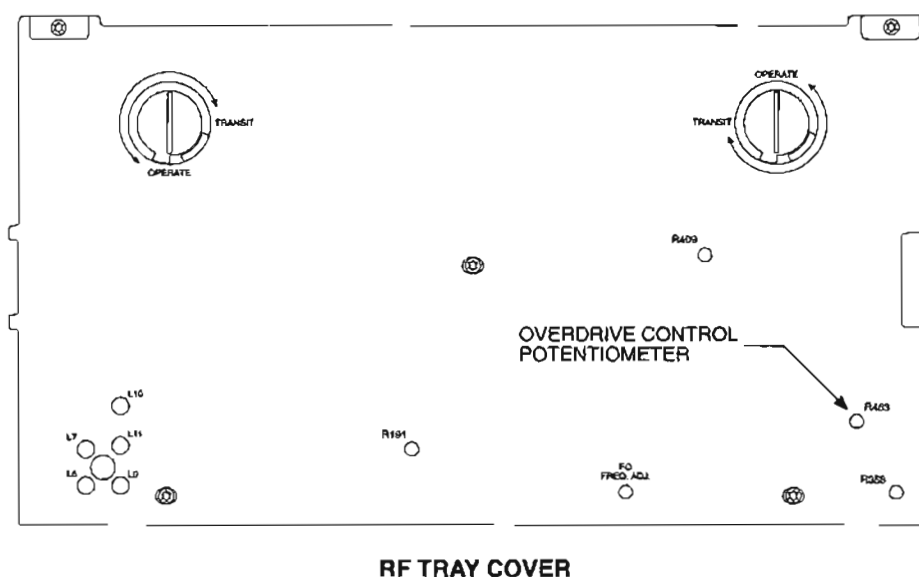
Overdrive Control

NOTE

Step 3 through step 8 only apply to *high power stations*, which contain two Power Amplifiers. Otherwise, proceed to Power Set Control.

3. Using the tuning tool, rotate the **Overdrive Control** potentiometer (R453) fully CW.

R453 is part of the Uniboard. Refer to Figure 4-12 for the location of the Overdrive control.



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Figure 4-12 **Overdrive Control Adjustment**

4. Key the station by setting the LOC PTT MUXbus bit (A1/D1) or by setting the PL Dis/Xmit switch to Xmit.
5. Using the tuning tool, adjust the **Po Power Set** control to obtain the overdrive power level.
The overdrive power level is shown in Table 4-4 through Table 4-7.
6. Using the tuning tool, adjust the **Overdrive Control** slowly CCW until the **PA Full LED** just turns off.
7. Dekey the station by clearing the LOC PTT MUXbus bit (A1/D1).
8. Using the tuning tool, adjust the **Po Power Set** potentiometer fully CCW, then CW 1/8 turn.

Power Set Control

9. Key the station by setting the LOC PTT MUXbus bit (A1/D1) or by setting the PL Dis/Xmit switch to Xmit.
10. Using the tuning tool, adjust the **Po Power Set** control to obtain the lowest of either the rated RF Station Power Level, the maximum level allowed by the FCC license, or the site specific power level. Refer to Figure 4-12.

NOTE

The rated RF station power level may not be the recommended site output power level.

11. Dekey the station by clearing the LOC PTT MUXbus bit.

Battery Cutback Control

NOTE

If the station is not equipped with a *Battery Revert Option (C28)*, proceed to step 19. Also, cutback must be programmed to happen while in battery revert mode. Refer to the RSS manual for additional information.

12. Disconnect the AC power cord from the Junction Box.
The station should continue to operate on battery backup.
13. Key the station by setting the LOC PTT MUXbus bit (A1/D1) or by setting the PL Dis/Xmit switch to Xmit.
14. Using the tuning tool, adjust the **CUTBACK** control to obtain 50% of the rated station power level.
The **CUTBACK** control (R409) is part of the Uniboard. Refer to Figure 4-13 for the location of the cutback control. Table 4-4 through Table 4-7 lists the rated station power level for each band.
15. Deactivate all activated MUXbus bits and disconnect all test equipment.
16. Apply AC power by connecting the AC power cord to the Junction Box.

Transmit Frequency Adjustment

The following procedure adjusts the Fo Freq Adj to fine tune the transmit frequency. It is assumed the station is programmed with the correct frequencies and hardware. Allow sufficient time for the external reference to warm-up prior to performing this procedure.

Alignment Procedures

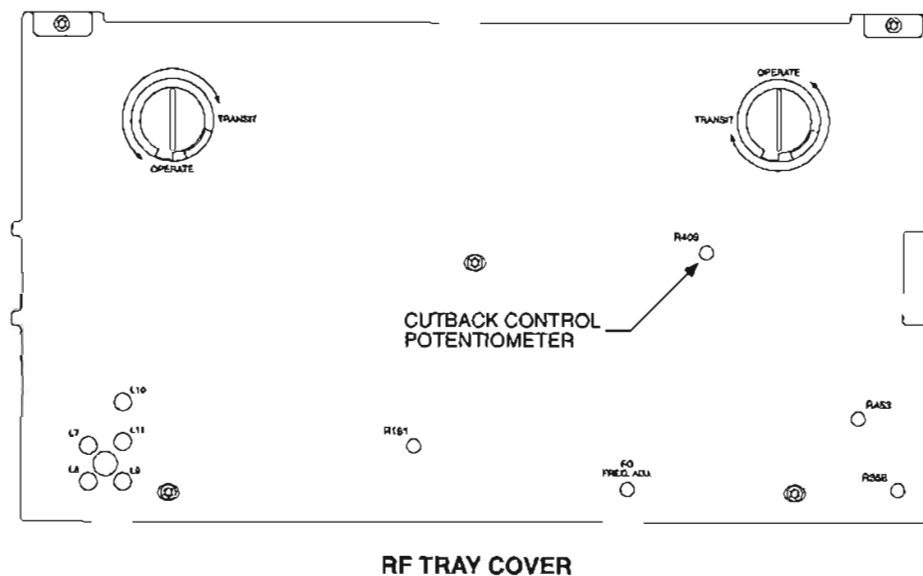
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02189A/JNM

Figure 4-13 Cutback Control Adjustment

For 900 MHz Analog Plus stations, an High Stability Oscillator (HSO) or an external reference is required. For all other bands, an HSO or an external reference is not required, but optional.

The Fo Freq Adj potentiometer is located on the Uniboard. For VHF stations, the Fo Freq Adj is accessed from the top of the RF Tray cover. For all other bands, the Fo Freq Adj is accessed from the RF Tray front panel.

NOTE

A minimum warmup time of 60 minutes is required if the station is a 900 MHz Analog Plus station or if it is equipped with a High Stability Oscillator Option (C573). Otherwise, ensure that the frequency reference device is fully warmed up.

1. On 900 MHz Trunking stations or stations equipped with the External Reference Option (C574), apply the site high stability 5 MHz reference signal to the external reference connector on the Junction Box.
2. Adjust U1 on the reference synthesizer board for 1.5 +/- 0.1 Volts at TP1.
3. Set the Acc Dis/Reset switch to Acc Dis.
4. If necessary, attenuate the transmitted RF signal from the station to the frequency measuring device.

5. Key the station by setting the LOC PTT MUXbus bit (A1/D1) or by setting the **PL Dis/Xmit** switch to **Xmit**.
6. Measure the transmitter carrier frequency.

NOTE

If the station contains an *External Reference Option* (C574) or a *High Stability Oscillator Option* (C573), and the frequency is out of alignment, refer to the appropriate alignment procedure. Otherwise proceed to step 8.

7. If necessary, adjust the **Fo Freq Adj** warp control to set the measured transmit frequency to the nominal station transmit frequency.
For UHF, 800 MHz, and 900 MHz Analog Plus stations, the Fo Freq Adj warp control is located on the RF Tray front panel. For VHF stations, the Fo Freq Adj warp control is accessed through the top cover of the RF Tray. Refer to Figure 4-14 for the location of the Fo Freq Adj.
8. Dekey the station by clearing the LOC PTT MUXbus bit (A1/D1).
9. Set the **Acc Dis/Reset** switch to the center (normal) position.

I-F AGC Threshold Adjustment

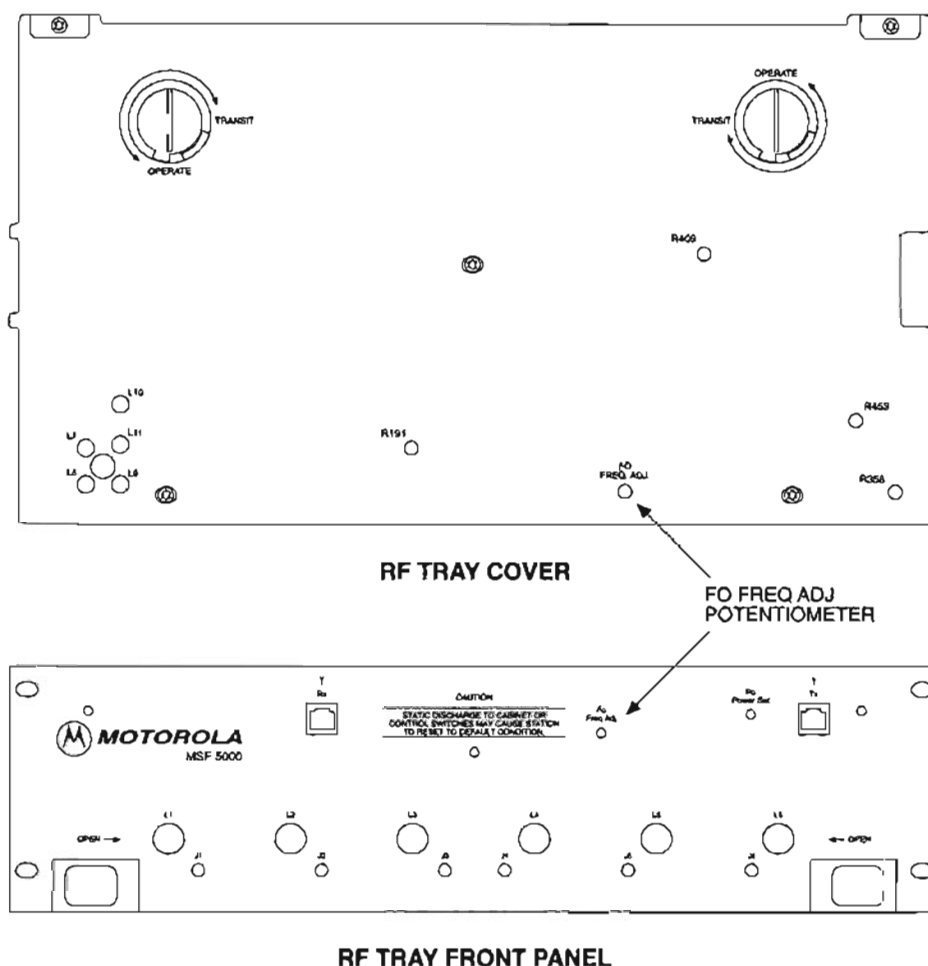
The following procedure is only performed on *800 MHz and 900 MHz Analog Plus stations*. This procedure adjusts the I-F AGC Threshold.

This adjustment is performed by the tuning channel frequency (channel 0/ mode 0). This allows the station to be tuned for all programmed frequencies.

The I-F AGC Threshold adjustment (R191) is located on the Uniboard, and is accessed from the top of the RF Tray cover.

1. Set the **Acc Dis/Reset** switch to **Acc Dis**.
2. Using the **Select/Set** switch, set the station to the tuning channel.

Alignment Procedures



NOTE: L1 - L6, J1 - J6 and Fo Freq Adj are not found on VHF models. Access to these requires the removal of the front panel.

NOTE: For UHF, 800 MHz and 900 MHz models, the Fo Freq Adj is accessed at the RF Tray Front Panel. For VHF models, the Fo Freq Adj is accessed at the RF Tray Cover.

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Figure 4-14 Fo Freq Adj Control

3. Inject an on-channel 1000 μ V signal, modulated with a 1 kHz tone at 60% of full station deviation into the receiver connector on the Junction Box.

Station deviation settings are listed in Table 4-8.

Table 4-8 Deviation Settings

| Deviation Adjustment | Frequency Range | | |
|---|----------------------------|-------------------|---------------------------|
| | VHF,UHF, and 800 MHz (kHz) | 886-869 MHz (kHz) | 800 MHz Analog Plus (kHz) |
| 100% Full Station Deviation | 5 | 4 | 2.5 |
| Maximum Station Deviation | 4.6 | 3.7 | 2.3 |
| 60% Full Station Deviation | 3 | 2.4 | 1.5 |
| 40% Full Station Deviation | 2 | 1.6 | 1.0 |
| Simulcast Data Deviation | 0.85 | 0.7 | 0.5 |
| Trunked Data Deviation | 0.85 | 0.7 | 0.5 |
| Failsoft Data Deviation | 1 | 0.8 | 0.7 |
| Coded Deviation (+/-) 200 Hz, using a 1 kHz square wave | 3.9 | 2.3 | N/A |
| Note: All deviation measurements and settings must be within +/- 100 Hz except where noted. | | | |

4. Using a digital voltmeter, adjust R191 for 0.60 Vdc between NORM ENV (TP13 or HY804-13 on the SSCB) and AGC REF (TP12 or HY804-10 on the SSCB).
Refer to Figure 4-15 for the location of R191 on the Uniboard and Figure 4-16 for the location of NORM ENV and AGC REF on the SSCB.
5. Remove the injected signal from the receiver connector on the Junction Box.
6. Set the Acc Dis/Reset switch to the center (normal) position.

Modulation Compensation Adjustment

The following procedure adjusts the modulation compensation circuit on the Uniboard. This adjustment is performed by using the tuning channel frequency (channel 0/mode 0). This allows the station to be tuned for all programmed frequencies.

While in the tuning channel, a 10 Hz waveform should appear whenever the station is keyed via a local push-to-talk (LOC PTT). This gives the technician a

Alignment Procedures

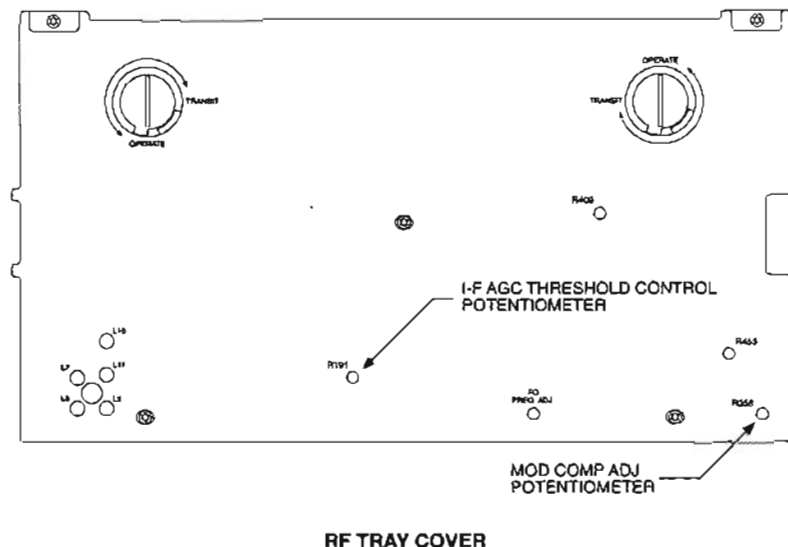
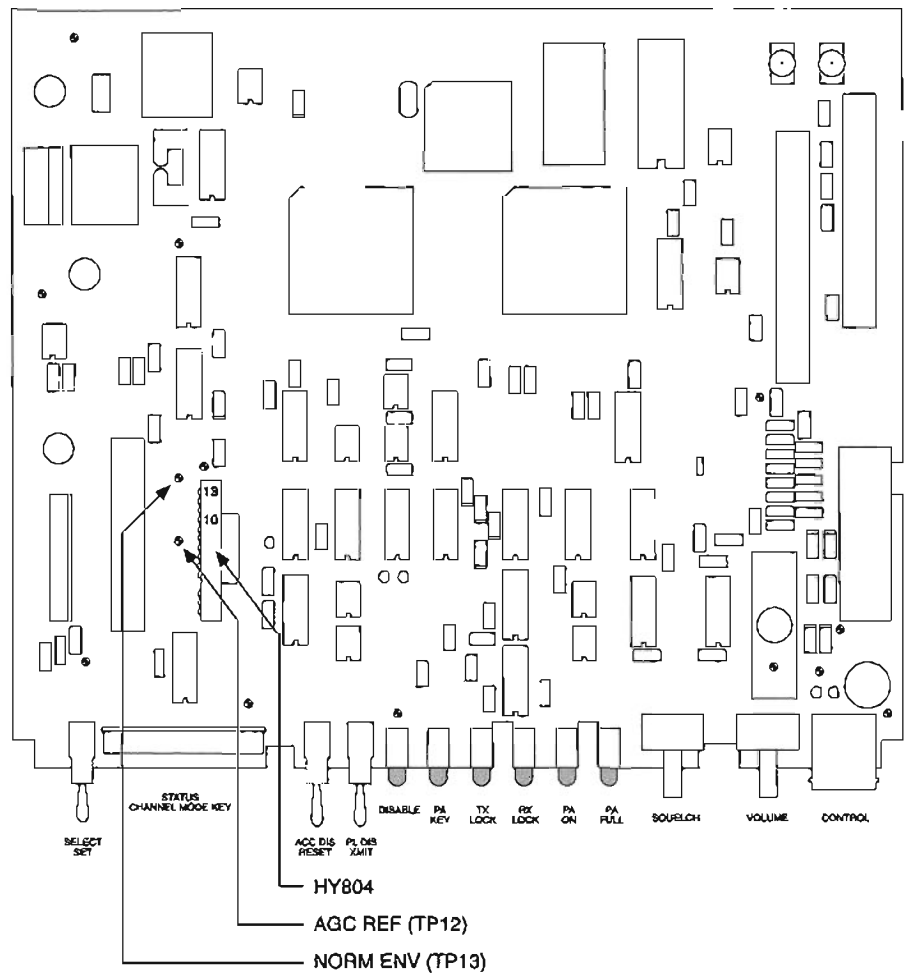


Figure 4-15 I-F AGC Threshold Control

good reference waveform to use to tune and verify proper modulation compensation operation.

The modulation compensation adjustment (R358) is located on the Uniboard, and is accessed from the top of the RF Tray cover.

1. Set the Acc Dis/Reset switch to Acc Dis.
2. Using the Select/Set switch, set the station to the tuning channel.
3. Key the station by setting the LOC PTT MUXbus bit (A1/D1).
4. Monitor the transmitter waveform. The waveform should consist of a 10 Hz square wave, as shown in Figure 4-17.
5. Examine the waveform for straight long transitions, however, a slight slant is acceptable.
If adjustment is required continue with step 6, otherwise, proceed to step 8.
6. Adjust R358 for the best 10 Hz square wave.
R358 is part of the Uniboard and is accessed through the RF Tray cover, as shown in Figure 4-15.
7. Dekey the station by clearing the LOC PTT MUXbus bit (A1/D1).
8. Set the Acc Dis/Xmit switch to the center (normal) position.

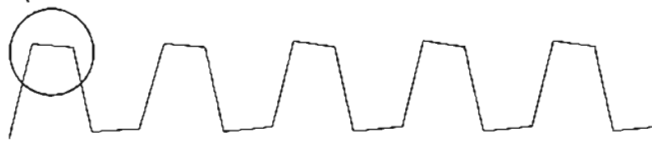
MSF023
021564JNMFigure 4-16 **NORM ENV and AGC REF Measurement Points**

Trunked Data Deviation Adjustment

The following procedure is only performed for *trunked stations*. For optimum performance, perform this procedure with the Central Controller to allow the adjustment to be made with the disconnect word. The disconnect word is equal in deviation to TDATA. The station should not enter failsoft mode during this adjustment.

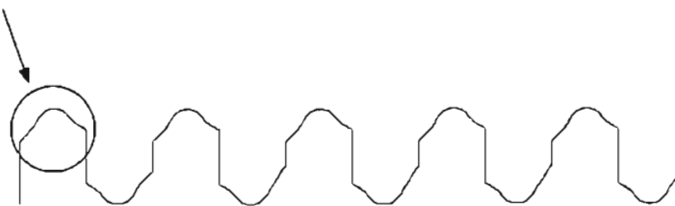
Alignment Procedures

NOTE SHARPNESS
OF EDGES OF LONG
TRANSITIONS



CORRECT WAVEFORM

NOTE ROUNDED
EDGES OF LONG
TRANSITIONS



INCORRECT WAVEFORM

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Figure 4-17 **Modulation Compensation Waveform**

NOTE

Proceed to Transmitter Maximum Deviation Adjustment if this is not a *trunked station*.

1. If a Trunked Radio Central Controller is available proceed to step 3.

NOTE

Perform step 2 only when a Central Controller is not available (i.e., lab or depot). Once the station is installed back into the system, perform the entire procedure again for optimum performance.

2. Inject a 150 Hz tone at 0.9 Vrms (closed circuit level) with 600 Ω termination across pins 4 (-) and 12 (+) of the trunking connector J2901 on the TTRC board. Proceed to step 5.

This simulates a trunking data (TDATA) signal to perform this alignment procedure. Refer to Figure 4-18 for the location of the trunking connector J2901.

The **Fail Soft** LED should not be illuminated.

3. Connect an operational Trunked Radio Central Controller to the station.

This allows the station that is being aligned to receive trunked data (TDATA) from the Trunked Radio Central Controller.

The **Fail Soft** LED should not be illuminated.

4. Verify the station being aligned is disabled from the Trunked Radio Central Controller.

This is accomplished by pressing the Transmit Interface Board (TIB) disable switch on the Trunked Radio Central Controller for the channel being adjusted.

5. Key the station by setting the LOC PTT MUXbus bit (A1/D1).

6. Monitor the transmitted deviation level.

7. Measure the Trunked Data Deviation level and compare it to the requirements of Table 4-8.

If the level is out of adjustment, set it by adjusting EEPOT b. Refer to Chapter 2 - Operation for additional information on adjusting EEPOTs.

If the station contains the *Simulcast Operation Option (C777)*, measure the simulcast data deviation. EEPOT b is used to adjust the simulcast deviation. Refer to Appendix H - Simulcast Alignment for additional information.

8. Dekey the station by clearing the LOC PTT MUXbus bit (A1/D1).

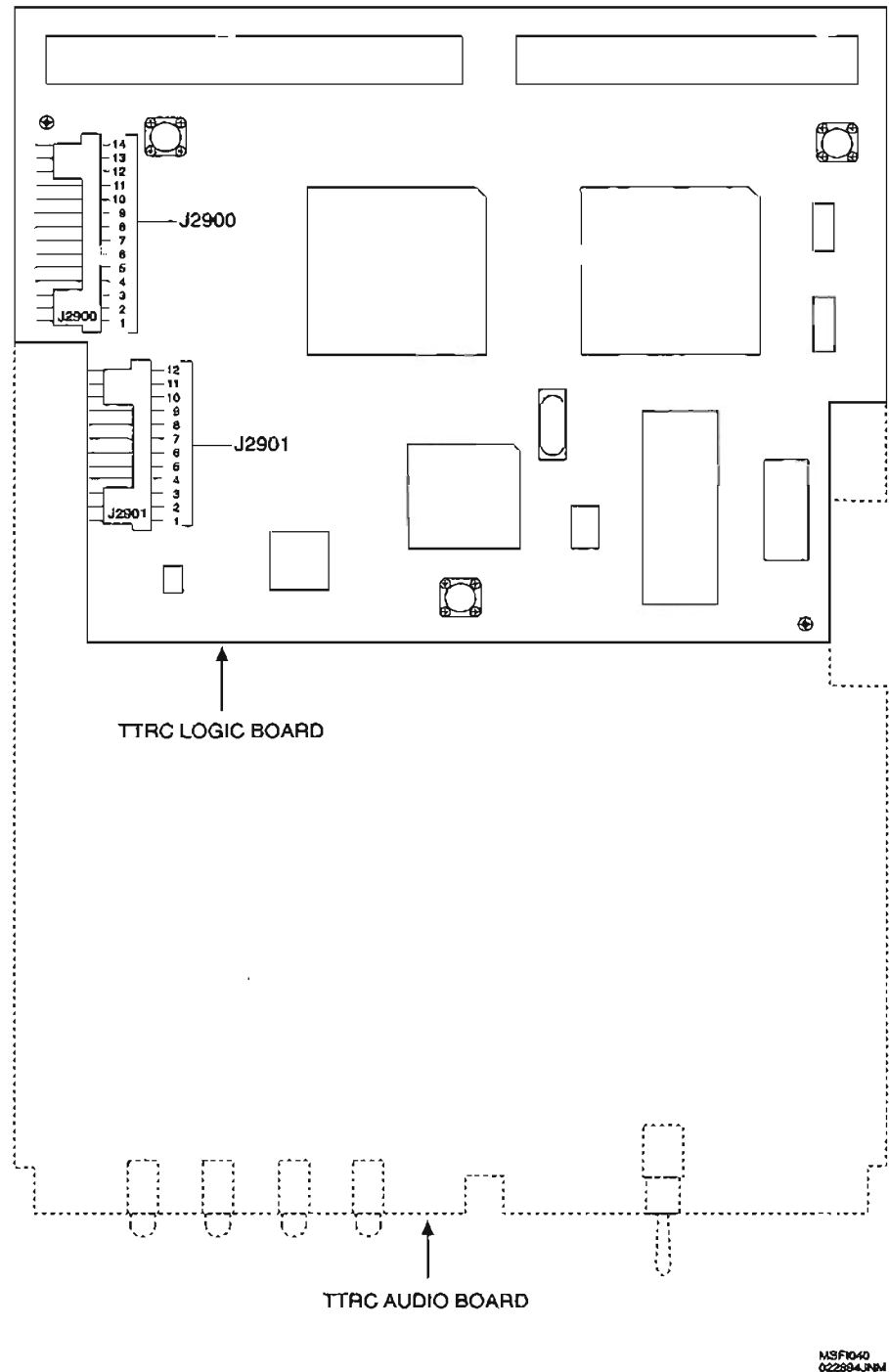


Figure 4-18 TTRC Logic Board Showing J2901

NOTE

If the adjustments cannot be made within ± 100 Hz, refer to Chapter 5 - Troubleshooting.

Transmitter Maximum Deviation Adjustment

The following procedure adjusts the maximum deviation for the transmitter. This adjustment is required to keep the station within local regulatory agency standards by preventing interference with adjacent channels.

To accurately perform this procedure, make sure all transmitted data is present (e.g., PL, DPL, Connect Tone, TDATA, etc.). Do not use the Xmit switch because it strips the PL and other transmitted data from the transmitted signal.

NOTE

Each channel must have the Maximum Deviation measured and set individually, since this level is channel slaved. It is not necessary to check the tuning channel deviation levels.

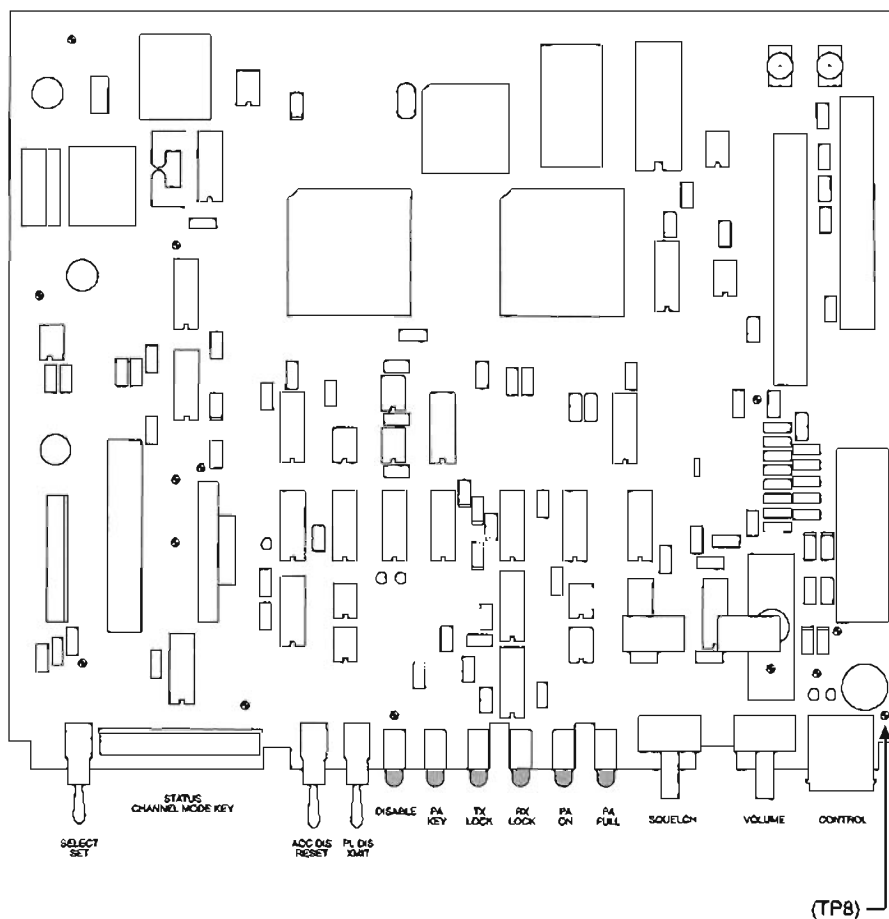
1. Inject a 1 kHz tone, at 1 Vrms closed circuit level, into the **MIC AUDIO** connector on the front panel or into TP8 on the SSCB. This is a 600 Ω input. Refer to Figure 4-19 for the location of TP8.
2. Set the **Acc Dis/Xmit** switch in **Acc Dis** to prevent the station from keying during this procedure.
3. Set the station to channel 1 if the station has multiple channels.
4. Key the station by setting the **LOC PTT MUXbus** bit (A1/D1).

NOTE

If this is a *trunked station* or if the station is equipped with PL or DPL coded squelch, the transmit signal consists of Mic Audio summed in with TDATA or the coded squelch signal. **DO NOT** use the **PL Dis/Xmit** switch to key the station; doing so strips the TDATA and coded squelch signals from the transmitted signal and gives a false deviation reading.

5. Measure the Maximum Station Deviation level and compare it to the requirements in Table 4-8.

Alignment Procedures



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Figure 4-19 **SSCB Showing TP8**

6. If the level is out of adjustment, set it by adjusting EEPOT 4.
Refer to Chapter 2 - Operation for additional information on adjusting EEPOTs.
7. If the station has multiple channels (excluding channel 0) perform steps 4 through 6 for each one.
8. Dekey the station by clearing the LOC PTT MUXbus bit (A1/D1).
9. Set the Acc Dis/Xmit switch to the center (normal) position.

Transmitter Wireline Audio Adjustment

This procedure adjusts the transmitter wireline audio level. When performing this procedure for Tone Remote Control, there are two different paths the transmit audio can take via Line 1 (ALC path) or Line 3 (non-ALC path). For conventional stations, the default is Line 1. For *trunked stations*, the default is Line 3. The only path the audio can take via Line 3 is the non-ALC path. Refer to Figure 4-20 for a block diagram of the ALC circuitry.

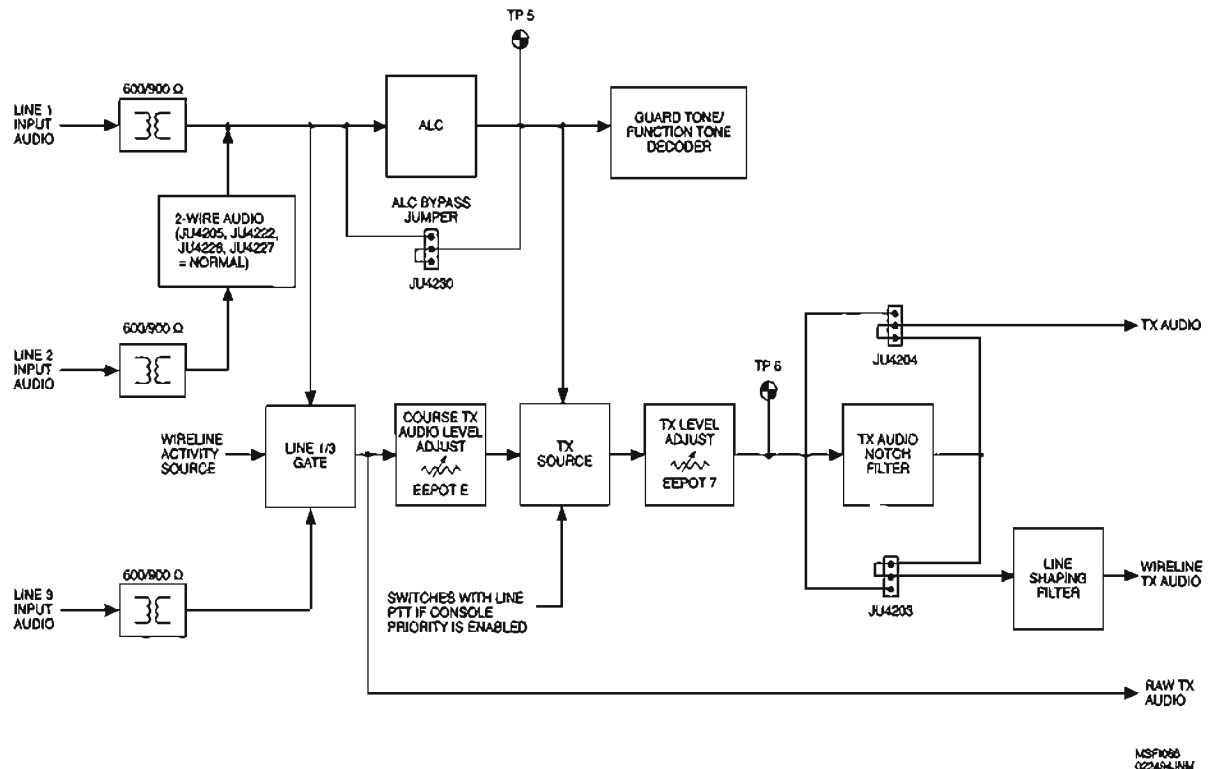


Figure 4-20 ALC Circuitry Block Diagram

For adjusting transmit audio via the ALC path, the standard HLGT/FT/LLGT sequence should be followed for the ALC circuitry to adjust accordingly.

For adjusting transmit audio via the non-ALC path, a 1 kHz tone should be used. There is also a course level adjustment via EEPOT E which compensates for a higher or lower levels of audio. There are four different settings for this EEPOT. EEPOT E should only be used if the level for EEPOT 7 could not be met for audio through the non-ALC path.

For Console Priority Option (C115), the console is connected to Line 1 or Line 2 depending on the wireline setting. The trunking phone interconnect audio is connected to Line 3 and Line 4. The value of EEPOT 7 has two values, one for interconnect audio and one for console audio. EEPOT 7 must be aligned twice in this configuration.

Alignment Procedures

For DC remote control, the audio is always routed through the non-ALC path.

When the TTRC Audio board is jumpered for a four-wire system, the transmit wireline interface is across Line 1 (+) and Line 1 (-) on the Junction Box screw terminal strip. The receive wireline interface is across Line2 (+) and Line2 (-).

When the TTRC Audio board is jumpered for a two-wire system, the transmit/receive wireline interface is across Line 2 (+) and Line 2 (-) on the Junction Box screw terminal strip.

For two and four-wire systems, these connections are 600 Ω balanced inputs, unless otherwise jumpered for 900 Ω balanced inputs.

NOTE

If the station is a *trunked station without the Console Priority Option (C115)* or is configured for DC remote control, proceed to the DC Remote Control/Trunking Adjustment.

If this is a *trunked station with the Console Priority Option (C115)*, proceed to the Trunking/Console Priority Adjustment.

Tone Remote Control Adjustment

1. Using RSS, determine if the transmit audio is being routed to the modulator via the ALC circuit.
 - **Transmit source = ALC** - Key the station using a High Level Guard Tone (HLGT)/Function Tone (FT) sequence. This allows the ALC circuit to be properly set. Proceed to step 2.
 - **Transmit source = non-ALC** - Key the station via a LIN PTT (A1/D2). Proceed to step 4.
2. Set HLGT, FT, LLGT, and the 1 kHz tone to the levels expected from the console, in the following relative relationship:
 - HLGT to 0 dBm
 - FT to -10 dBm
 - LLGT to -30 dBm
 - Average audio (1 kHz tone @ -6 dBm)

NOTE

These recommended levels are intended for co-located consoles which do not have phone line loss. If other levels are required due to phone line loss, the same relative relationship of signal levels should be maintained.

CAUTION

Do not key the station via RSS or by setting the LIN PTT MUXbus bit since these methods do not set ALC correctly.

3. Inject an HLGT/FT sequence followed by a 1 kHz tone with LLGT across the appropriate transmit wireline terminals, using a console or service monitor.
Line 1 +/- for four-wire systems or Line 2 +/- for two-wire systems.
The station should be keyed. Proceed to step 6.
4. Inject a 1 kHz tone across the appropriate transmit wireline terminals at a level matching average audio (-6 dBm), or other levels relative to peak input level.

NOTE

The recommended level is intended for co-located consoles which do not have phone line loss. If other levels are required due to phone line loss, the same relative relationship of signal levels should be maintained.

5. Key the station by setting the LIN PTT MUXbus bit (A1/D2).
6. Set and hold the PL Dis/Xmit switch to Xmit during step 7.
This strips any data from being summed with the transmit audio.
7. Adjust transmit audio level via EEPOT 7 until the transmitted deviation level reaches 60% full station deviation, as indicated in Table 4-8.
8. Adjust EEPOT E if the level cannot be set via EEPOT 7 alone.
9. Exit the EEPOT adjust mode.
Refer to Chapter 2 - Operation for additional information relating to the EEPOT adjust mode.

Alignment Procedures

10. Remove the test tones.

DC Remote Control/Trunking Adjustment**NOTE**

The following procedure applies only if the station is configured for *DC remote control* or is configured as a *trunked station*. Otherwise, proceed to the Receiver Level Adjustment.

1. Inject a 1 kHz tone at the average audio (6 dB below peak audio) phone line level into the transmit wireline interface on the Junction Box.
Line 1 +/- for four-wire systems or Line 2 +/- for 2-wire systems.
2. If this is *not a trunked station*, gate the wireline audio to the transmitter by setting the LIN PTT MUXbus bit (A1/D2).
For trunked stations, key the transmitter with a trunked PTT by disconnecting the trunking cable from connector J3 on the Junction Box.
Key the transmitter by connecting a jumper wire jumper from J2901-8 (TKG PTT) to J2901-1 (LOGIC GND) on the TTRC logic board.
3. Enter the EEPOT adjust mode.
Refer to Chapter 2 - Operation for additional information relating to the EEPOT adjust mode.
4. Set and hold the **PL Dis/Xmit** switch to **Xmit** for step 5.
This strips any data from being summed with the transmit audio.
5. Adjust the TX Audio Level (EEPOT 7) until the transmitted deviation level reaches 60% full station deviation as indicated in Table 4-8.
6. Release the **PL Dis/Xmit** switch and remove all tones from the wireline.
7. Clear the LIN PTT MUXbus bit (A1/D2) or the trunked PTT jumper.

Trunking/Console Priority Adjustment**NOTE**

The following procedure applies only to a *trunked station with the Console Priority Option (C115)*. Otherwise, proceed to the Receiver Level Adjustment.

1. Set HLGT, FT, LLGT, and the 1 kHz tone to the expected input levels:
 - HLGT to 0 dBm.
 - FT to -10 dBm

- LLGT to -30 dBm
- 1 kHz tone to -6 dBm (average audio)

NOTE

These recommended levels are intended for co-located consoles which do not have phone line loss. If other levels are required due to phone line loss, the same relative relationship of signal levels should be maintained.

CAUTION

Do not key the station via RSS or by setting the PTT MUXbus bit since these methods do not set ALC correctly.

2. Inject an HLGT/FT sequence followed by a 1 kHz tone with LLGT across the appropriate transmit wireline terminals, using a console or service monitor.
Line 1 +/- for four-wire systems or Line 2 +/- for two-wire systems.
3. Set and hold the PL Dis/Xmit switch to Xmit during step 4.
This strips any data from being summed with the transmit audio.
4. Adjust transmit audio level via EEPOT 7 until the transmitted deviation level reaches 60% full system deviation, as indicated in Table 4-8.
Refer to Chapter 2 - Operation for additional information relating to the EEPOT adjust mode.
5. Remove the LLGT and 1 kHz test tone.
6. Inject a 1 kHz tone at the average audio phone line level (i.e., 6 dB below peak audio) through the wireline into the Line 3 input on the system connector of the Junction Box.
7. If this is a *trunked station*, disconnect the trunking cable from Junction Box connector (J3).
8. Key the transmitter by connecting a jumper wire jumper from J2901-8 (TKG PTT) to J2901-1 (LOGIC GND) on the TTRC logic board.
9. Set and hold the PL Dis/Xmit switch to Xmit during step 11.
This strips any data from being summed with the transmit audio.
10. Scroll completely through the EEPOT numbers once, and then back to EEPOT 7.

Alignment Procedures

11. Adjust EEPOT 7 until the transmitted deviation level reaches 60% full system deviation as indicated in Table 4-8.
If the deviation level could not be set, adjust EEPOT E to select the appropriate range (0 through 3) of EEPOT 7. Repeat step 11.
12. Remove the test tone.
13. Release the **PL Dis/Xmit** switch.

Receiver Level Adjustment

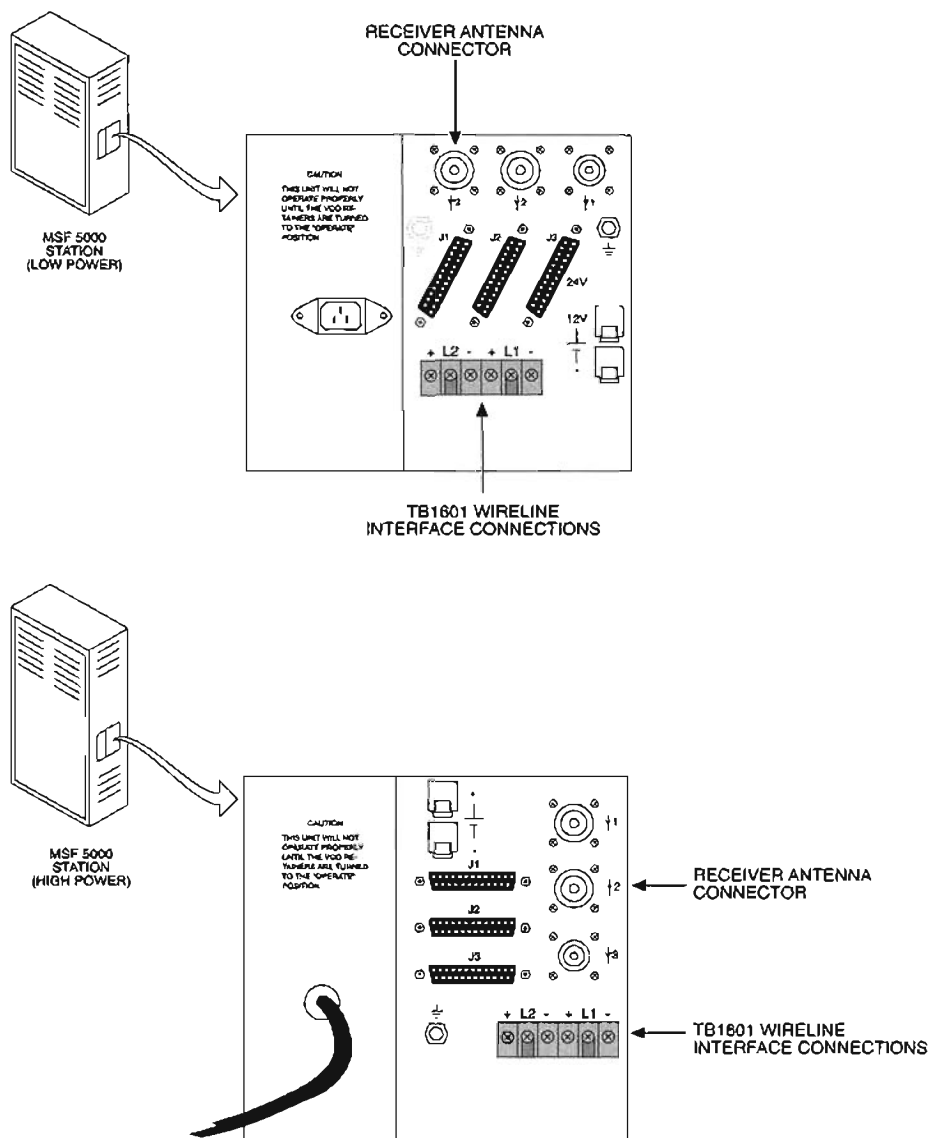
The following procedure adjusts the receiver level deviation for the repeater mode of operation. For stations configured as base stations, a relative level can be measured on the SSCB which is equivalent to the repeater deviation level. For stations containing the *Spectra-TAC/DIGITAC Encoder Option (C269)*, the receiver level should be adjusted during in-cabinet repeat operation.

1. Inject a 1mV RF receive signal, modulated with a 1 kHz tone at 40% full station deviation, as indicated in Table 4-8, into the receiver antenna connector on the Junction Box.
Refer to Figure 4-21 for the antenna connector locations.
2. Set the R1 PL DT MUXbus bit (A3/D2).

NOTE

Steps 3 through step 9 apply only to stations configured as repeaters. If the station is configured as a base station (half-duplex with antenna relay or full-duplex base station) or is a *trunked station* with a *Spectra-TAC/DIGITAC Encoder Option (C269)*, proceed to step 10.

3. If this is a *trunked station*, disconnect the trunking cable from Junction Box connector (J3).
4. Key the transmitter by connecting a jumper wire jumper from J2901-8 (TKG PTT) to J2901-1 (LOGIC GND) on the TTRC logic board.
Refer to Figure 4-22 for the connection locations.
5. Set and hold the **PL Dis/Xmit** switch to **Xmit** to strip off any TDATA or PL/DPL.
6. Verify the transmitted deviation level is at 60% full station deviation as indicated in Table 4-5.
This setting provides +3.5 dB of repeater gain. If this level is out of adjustment, set it by adjusting EEPOT 5.
If unity gain is desired, set for 40% full system deviation.



NOTE: Dashed components (24V connection and ground) are used on VHF models only.

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Figure 4-21 Junction Box Antenna Connections

NOTE

Step 7 through step 9 only apply to 900 MHz Analog Plus stations.

7. Select EEPOT 1 to enable *Flutter Fighter*.
8. Set and hold the PL Dis/Xmit switch to Xmit.

Alignment Procedures

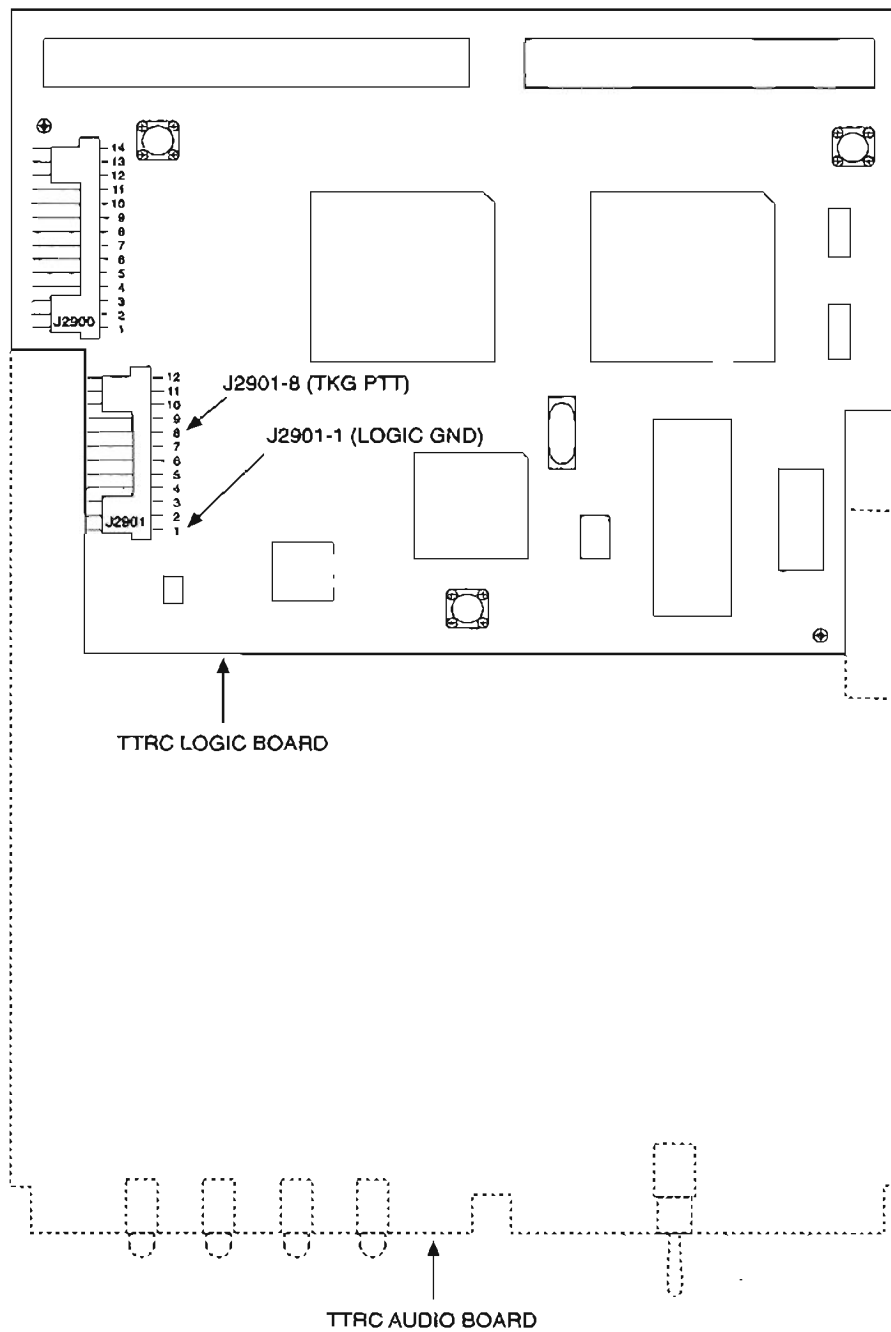
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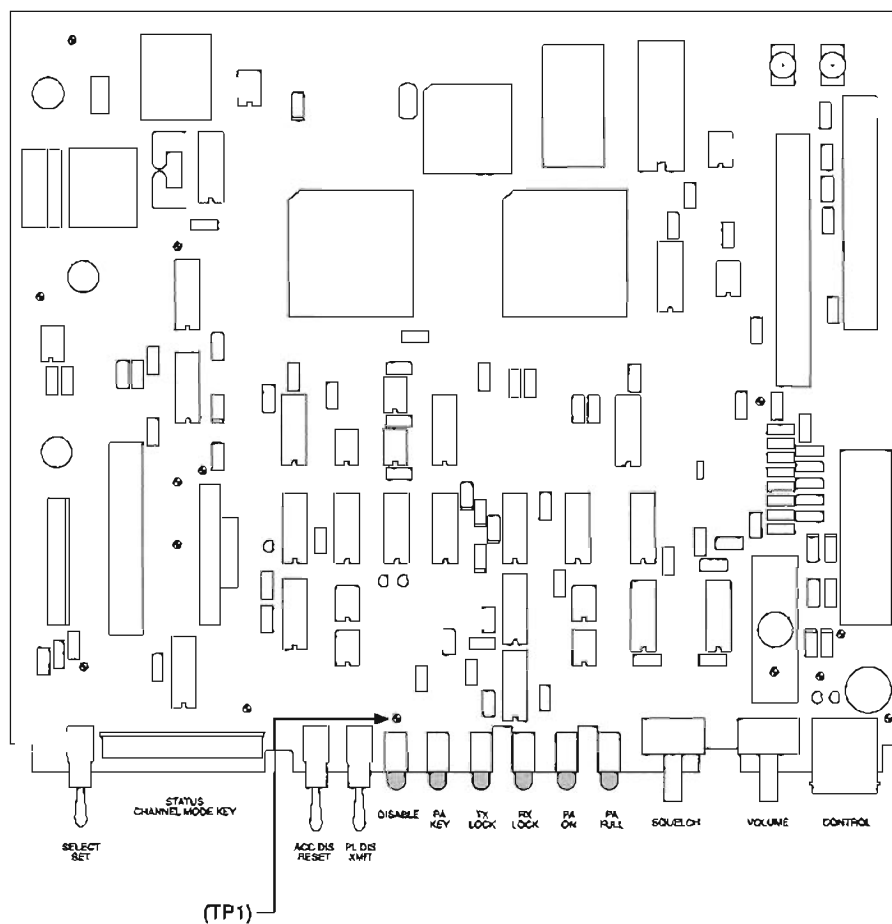
Figure 4-22 TTRC Logic Board

9. Verify the transmit deviation level is at 60% full system deviation as indicated in Table 4-8. If not, adjust EEPOT 1.

NOTE

Perform step 10 only if the station is configured as a base station.

10. For base stations, verify 350 ± 50 mVac is measured at TP1 on the SSCB, as shown in Figure 4-23. If not, adjust EEPOT 5.



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Figure 4-23 SSCB Showing TP1

NOTE

Step 11 and step 12 only apply to 900 MHz *Analog Plus* stations with the *Spectra-TAC/DIGITAC Encoder Option (C269)* or an antenna relay.

11. For *Analog Plus* stations equipped with a *Spectra-TAC/DIGITAC Encoder Option (C269)* or an antenna relay, select EEPOT 1 to enable the *Flutter Fighter*.
12. Verify the AC voltage at TP1, on the SSCB is 350 ± 50 mVac as shown in Figure 4-23. If not, adjust EEPOT 1.
13. Dekey the station, deactivate any activated MUXbus bits, connect any disconnected cables, and remove any jumper wires that were installed.

Receiver Wireline Audio Adjustment

The following procedure adjusts the receiver wireline audio level for Line 2 and Line 4. The desired audio level is dependent upon the system configuration. If the station is configured for *Spectra-TAC/DIGITAC Encoder Option (C269)*, proceed directly to the High/Low End Adjustment to compensate for line loss.

NOTE

Perform this procedure only if the station is NOT equipped with a *Spectra-TAC/DIGITAC Encoder Option (C269)* to be used in a voting system. If voting will be used, proceed to the High/Low End Adjustment.

1. Inject a 1mV RF receive signal, modulated with a 1 kHz tone at 60% full station deviation into the receiver antenna connector on the Junction Box. Refer to Table 4-8.
2. Set the PL Dis/Xmit switch to PL Dis.
3. Verify the receive audio between Line 2 (+) and Line 2 (-) on the Junction Box screw terminal strip is at the desired phone line level.
The typical phone line level is from 0 dBm to -10 dBm.
If not, set it by adjusting EEPOT C.

NOTE

If the station is a *trunked station* with a *Console Priority Option (C115)* installed, continue with step 4. Otherwise, proceed to step 5.

4. Verify the receive audio at Line 4 on the system connector is at the desired phone line level.
The typical phone line level is from 0 dBm to -10 dBm.
If not, set the desired level by adjusting EEPOT d.
5. Deactivate all activated MUXbus bits.
6. Set the PL Dis/Xmit switch to the center (normal) position.

Decoded Receive Audio Adjustment

The following procedure adjusts the decoded receive audio level for stations containing the *Secure Encryption Option (C331, C388, C794, C795, or C797)*. Before performing this procedure, make sure the level of Line 2 is adjusted to the same relative level (0 dB) as the clear receive audio level.

NOTE

The Line 2 level must be adjusted before performing this procedure.

1. Inject a 1mV RF receive signal, modulated with a secure (digitally encrypted) 1 kHz tone at 3.9 kHz deviation into the receiver antenna connector on the Junction Box.

NOTE

The encryption source must be programmed with the same encryption key as the station. Refer to Chapter 2 - Operation for additional information.

2. Verify the outbound receiver audio between Line 2 (+) and Line 2 (-) is 0 dB relative to the clear wireline audio level.
The clear wireline audio level setting was set up in the Receive Wireline Audio Adjustment procedure or the maximum allowable phone line level, whichever is less. If not, adjust EEPOT 0.
3. Remove the RF signal from the antenna connector on the Junction Box.

Squelch Adjustment

The following procedure adjusts the repeater and receiver squelch levels. If the station is configured for *Spectra-TAC/DIGITAC Option (269)* or to generate status tone, proceed directly to the High/Low End Adjustment.

The repeater squelch level is typically set for an RF level corresponding to 15 dB SINAD. The receiver squelch level is typically set for an RF level corresponding to 12 dB SINAD (15 dB SINAD for *trunked stations*). The RF level is measured at the SPEAKER AUDIO on the front panel connector. Both squelch levels can be set to the levels corresponding to system requirements.

For *trunked stations*, the repeater squelch potentiometer (EEPOT 2) is set to 00.

NOTE

If the station is configured to generate status tone and is not used for voting purposes, proceed to Status Tone Adjustment.

If the station is used for voting purposes, proceed to High/Low End Adjustment.

1. Set the PL Dis/Xmit switch to PL Dis.

NOTE

EEPOT 2 and EEPOT 3 are set at the factory to the maximum level (99). This fully closes the squelch.

2. Set EEPOT 2 and EEPOT 3 to the minimum level (00) to fully open the squelch.
3. Inject an on channel RF signal, without modulation at the desired repeater squelch threshold level, into the receiver antenna connector on the Junction Box.

NOTE

If this is a *trunked station*, proceed to step 5.

4. Adjust the Repeater Squelch Level (EEPOT 2) to the desired level.
5. Adjust the Receive Squelch Level (EEPOT 3) to the desired level.
6. Set the PL Dis/Xmit switch to the center (normal) position.

High/Low End Adjustment

The following procedure is only performed when a station is configured voting purposes. This adjustment provides an increase in level at the high and low end frequency response of the receiver audio to compensate for phone line loss. All voting receivers must be equalized to provide proper voting.

This procedure requires a technician at the comparator end of the phone line and the station being aligned.

NOTE

Perform this procedure only if the station is equipped with a *Spectra-TAC/DIGITAC Encoder Option (C269)* and will be used for voting. Otherwise, proceed to the Status Tone Adjustment.

1. Adjust the STAC Encoder Level (EEPOT 8) to the minimum level (00) to cause a minimum wireline status tone output.
2. With an audio generator, inject a 1 kHz tone at 1 mV into the MIC AUDIO input (J812-4) on the control connector or into TP8 on the SSCB.

NOTE

The generator must remain at a constant output level from 400 Hz to 4 kHz.

3. Set the **Intercom** switch to **On**.
4. Monitor across Line 2 (+) and Line 2 (-) and adjust the Line 2 Output Level (EEPOT C) for -10 dB.
5. Measure and record the level at the input to the comparator (DIGITAC input).
The difference between the -10 dBm input and measurement at the comparator is the phone line loss at 1 kHz.
6. Set the audio generator frequency to 3 kHz.
7. Adjust the STAC High End Equalization Level (EEPOT 9) so that the level measured at the comparator is the same level recorded in step 5.
8. Repeat steps 5 through 7 until the level difference between 1 kHz and 3 kHz is within +/- 1 dB. The 1 kHz reference level must remain at -10 dB.
9. Set the generator frequency to 400 Hz.

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10. Adjust the STAC Low End Equalization Level (EEPOT A) so that the level measured at the comparator is the same level recorded in step 5. Do not readjust EEPOTS C or 9.
11. Adjust the STAC Low End Equalization Level (EEPOT A) to the same level recorded in step 5.
12. Deactivate all activated MUXbus bits.
13. Set the Intercom switch to Off.
14. Disconnect the audio generator from the MIC AUDIO input.

Status Tone Adjustment

The following procedure is performed when a station is configured to have status tone sent from the station. This adjustment also sets the receiver and repeater squelch EEPOTs.

When completed, the status tone EEPOT is set to provide the required status tone level to be sent down the wireline Line 2. If the station is configured to operate with *Spectra-TAC/DIGITAC Encoder Option (C269)*, the receiver and repeater squelch levels are also adjusted to provide the proper unsquelching level.

NOTE

Only perform this procedure if the station being aligned is configured to generate status tone.

1. Inject an on channel 1mV RF signal, modulated with a 1 kHz tone at 100% full station deviation (60% full station deviation for *trunked stations*), into the receiver antenna connector on the Junction Box.
Refer to Table 4-8 for values of full station deviation.
2. Set the PL Dis/Xmit to PL Dis.
3. Monitor the receive audio across Line 2 (+) and Line 2 (-) and adjust the Line 2 Output Level (EEPOT C) for the maximum desired phone line level. This is typically in the range of 0 dBm through -10 dBm.
4. Measure and record the level at the input to the comparator or other equipment expecting status tone from the station.
5. Set the PL Dis/Xmit to the center (normal) position.
6. Remove the RF signal generator from the receiver and verify the receiver is squelched.
7. Monitor the TAC comparator input and adjust the status tone Level (EEPOT 8) for a 2175 Hz status tone level 13 dB (9 dB for *trunked stations*) below the level recorded in step 4.

NOTE

Perform this procedure only if the station is equipped with a *Spectra-TAC/DIGITAC Encoder Option (C269)*. Otherwise, proceed to the Coded Transmit Deviation Adjustment procedure.

8. Set EEPOT 2 and EEPOT 3 to the minimum level (00) to fully open the squelch.
9. Set the PL Dis/Xmit switch to PL Dis.
10. Measure and record the rms noise voltage level at the Line 2 output.
11. Inject an on channel 0.1 μ V RF signal, without modulation into the receiver antenna connector on the Junction Box.
12. Increase the RF level until the Line 2 output level decreases 20 dB from the level recorded in step 10.

NOTE

The 20 dBQ level correlates to a 17 dB SINAD measurement.

13. Adjust the Receiver Squelch Level (EEPOT 3) until the R1 UN SQ MUXbus bit (A5/D0) is disabled.
14. Adjust the Repeater Squelch Level (EEPOT 2) until the RPT USQ MUXbus bit (A3/D0) is disabled.
15. Disconnect all test equipment and set the PL Dis/Xmit switch to the center (normal) position.

Coded Transmit Deviation Adjustment

The following procedure is only performed when a station is configured for the *Transparent Operation Option (C514)*. This procedure does not apply to any 900 MHz Analog Plus stations, due to its incompatibility with secure operation.

When performing this procedure, the EEPOT mode (EEPOT 6) is entered to generate a 1 kHz tone. The station is then keyed via the Xmit switch and the deviation is adjusted.

Alignment Procedures

NOTE

Perform this procedure only if the station is equipped with a *Transparent Operation Option (C514)* for secure operation. This option is not available on *900 MHz Analog Plus stations*.

1. Select EEPOT 6 on the **Status** display.
After 5 seconds, an internal 1 kHz square wave generator is enabled in the station.
2. Key the station by holding the **PL Dis/Xmit** switch to **Xmit**.
3. With a modulation analyzer, measure the transmitter deviation level and compare it to the settings shown in Table 4-8.
Adjust EEPOT 6 if required to reach the desired level.
4. Set the **PL Dis/Xmit** switch to the center (normal) position.
5. Reset the station by toggling the **Acc Dis/Reset** switch to **Reset**.

NOTE:

If aligning a station that contains the *Simulcast Option (C777)*, perform the procedures in Appendix H - *Simulcast*.

6. This concludes the *MSF 5000* Alignment procedure.