MAINTENANCE and ALIGNMENT

1. GENERAL

This section describes overall maintenance and alignment of the *MSF 5000* stations, and includes a general station troubleshooting chart. Specific troubleshooting procedures are provided in the form of troubleshooting flowcharts, block diagrams, circuit board details, annotated schematics, and parts lists within each applicable instruction section of this manual. Refer to this instruction manual's contents pages for specific items and location.

2. TEST EQUIPMENT

Table 1 lists the test equipment recommended for *MSF 5000* servicing.

Table 1. Recommended Test Equipment

General Type	Application	Recommended Model	Minimum Specification
AC-DC VOM	DC voltage measurements, general	Motorola T1009	Measurement range: 0-15 V dc Sensitivity: 20,000 ohms/volt
DC Multimeter	DC voltage readings requiring a high input resistance meter	Motorola S1063	Measurement range: 0-15 V dc Input resistance: 11 megohms
AC Voltmeter	Audio voltage measurements	Motorola S1053	Measurement range: 0-1 mV ac Input resistance: 1 megohm
RF Voltmeter	RF voltage measurements and filter alignment	Motorola S1339	Measurement range: 100 uV-3 from 1 MHz-900 MHz Inputs: 50 ohms and high impedance
Oscilloscope, Dual-Trace	Waveform observation	Motorola R1004	Vertical sensitivity: 5 mV-10/division Horizontal time base: 0.2 usec.-0.5 sec/division
RF Wattmeter	Transmitter output power measurement	Motorola T1039 with appropriate element and T1013 RF Dummy Load	Measurement range: 0-100 and 0-250 watts
Frequency Meter	Transmitter Frequency measurement	Model R1200 Service Monitor with high stability oscillator (X suffix) option. Frequency calibration recommended every 6 months or less.	Measurement range: 390-512 MHz Frequency resolution: 10 Hz
Deviation Meter	Transmitter modulation deviation measurement	Motorola R1200 Service Monitor with SLN6350 Deviation Meter.	Measurement range: 0-10 kHz deviation Frequency range: 390-512 MHz
RF Signal Generator	Receiver alignment and troubleshooting	Motorola R1200 Service Monitor with attenuator	Frequency range: 390-512 MHz Output Level: 0.1 uV-100,000 uV Must be capable of at least ±3 kHz deviation when modulated by 1 kHz tone.
Audio Signal Generator	Audio circuit troubleshooting	Motorola S1067	Frequency range: 20 Hz-20 kHz Output level: 50 mV-1V
PL/DPL Generator	Tone coded *Private-Line*, and/or *Digital Private-Line* troubleshooting	Motorola R1100	—
■ Logic Probe	Check various digital devices	Motorola RTL4014	—
Radio Test Set	Meter readings at circuit metering points for alignment and troubleshooting	Motorola S1056 Portable Test Set with a TEK-37A Test Set Adapter or a Motorola TEK-5 Meter Panel with a 1-84253C65 Meter Panel Adapter. Either instrument uses Model RPX4221 Metering and Control Test Cabling kit.	

Table 1. Recommended Test Equipment (Cont'd.)

General Type	*Application*	*Recommended Model*	*Minimum Specification*
■ Tuning Tool Kit	Receiver and transmitter alignment	Motorola TRN5525A	
■ DC Power Supply	DC power for shop service	Motorola R1011	1-20 V dc 0-40A

NOTE: All the test equipment listed above, with the exception of those marked with (†6,) can be replaced with the Motorola R2001 Communications System Analyzer.

3. TYPICAL *MSF 5000* STATION EQUIPMENT

Figures 1-7 illustrate the major areas of the *MSF 5000* stations. The figures also show how the stations are disassembled for service access.

4. UNIQUE MAINTENANCE INFORMATION

4.1 BASE STATION ANTENNA SWITCH REMOVAL

4.1.1 The antenna switch can be removed by disconnecting:

- DC cable W900 from the antenna switch (disconnect P/J504)
- the transmit coaxial cable from the harmonic filter (unscrew P600C)
- the receive coaxial cable from the preselector (unscrew P11)

4.1.2 The antenna switch is secured, by means of a spanner nut, to the junction box panel. Removal of the nut requires the use of a spanner nut removal tool (Motorola Part No. RSX4028).

4.2 MICROSTRIP CERAMIC SUBSTRATE REPAIR

4.2.1 Repair of microstrip ceramic substrate modules is not recommended and should be avoided. Because of the critical nature of the circuits, the best repair procedure should consist of replacing a defective module rather than a faulty component on a given module.

4.2.2 However, should repair of a defective module be attempted, soldering on the microstrip ceramic substrates should be done with as little heat or pressure as is practical. The ceramic materials employed have properties that are similar to those of glass (they can be easily damaged by sharp blows or excessive heat).

4.3 "OMEGA" STRAP REPLACEMENT

The "Omega" straps (Motorola Part Nos. 42-84510M02 & 42-83680N01) absorb mechanical stresses caused during temperature excursions of the station and therefore must remain flexible after installation. When soldering these connections, do not allow solder to bridge over the top or to fill the underside of the "Omega" strap. Figure 8a shows how a correctly soldered "Omega" strap should look. Incorrect soldering is shown in Figure 8b. Furthermore, do not substitute any rigid material or attempt to replace an "Omega" strap by solder bridging. If proper soldering techniques are not observed during installation of "Omega" straps, premature failure of the associated hybrid module(s) can result.

4.4 TUNING CHANNEL

4.4.1 Tuning Channel Frequencies

Any adjustment made to the *MSF 5000* that could affect the transmit or receive frequency(ies) of the station should be made on the Tuning Channel of the station being adjusted. The Tuning Channel consists of a separate transmit and receive tuning frequency, TXt and RXt. Each of the tuning frequencies is predetermined and programmed into the station control code plug at the factory. The transmit and receive tuning frequencies are each calculated in the same manner.

For multichannel stations:

- TXt is equal to the sum of the highest and lowest customer transmit frequencies, divided by two.
- RXt is equal to the sum of the highest and lowest customer receive frequencies, divided by two.

For single channel stations:

- TXt is equal to the actual customer transmit frequency.
- RXt is equal to the actual receive frequency.

IMPORTANT

In multichannel stations, the tuning channel consists of derived frequencies, and the station is therefore NOT licensed by the FCC for operation on those frequencies. The serviceman is cautioned not to transmit (via Local PTT) while connected to the station's antenna system on TXt. The use of a non-radiating dummy load is required if transmission on TXt is desired.

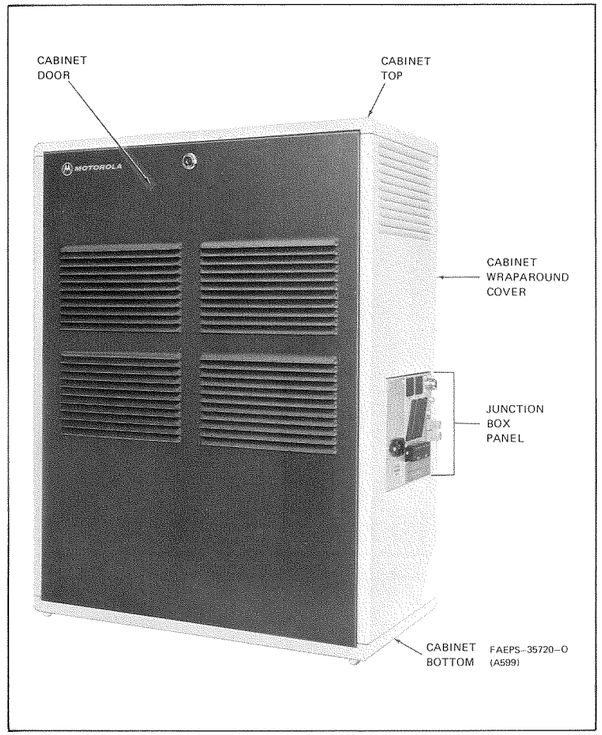

Figure 1. External View of Typical MSF 5000 Station

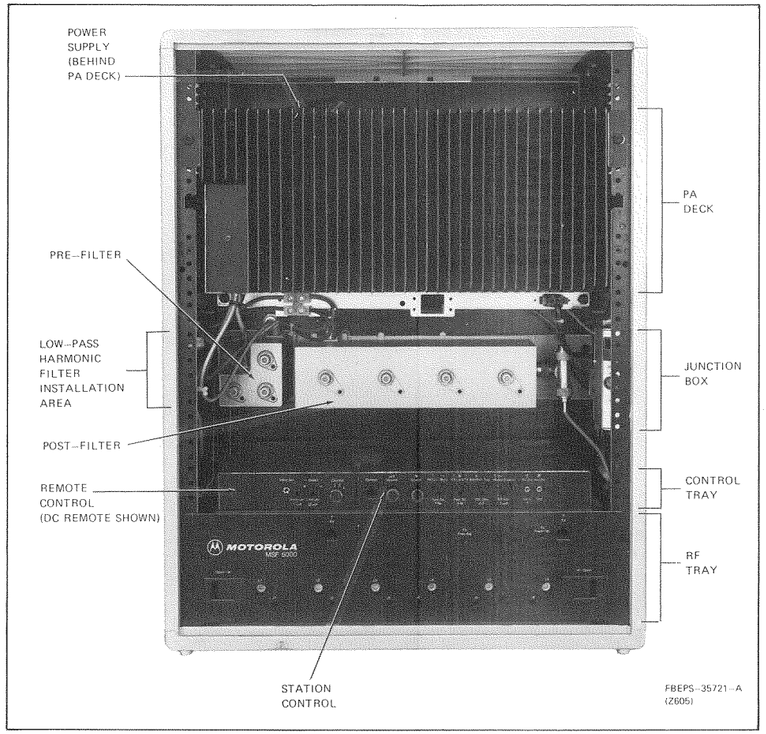

Figure 2. Internal View of Typical MSF 5000 Station

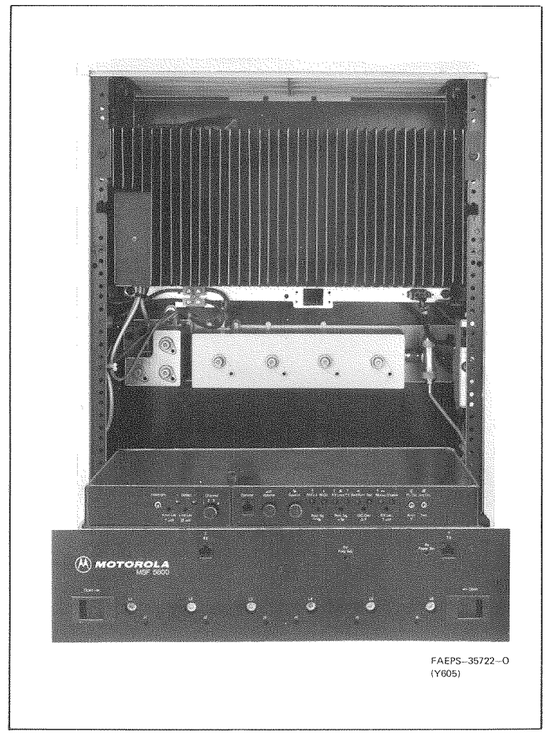

Figure 3. Internal View Showing RF Tray Drawer Slid Out

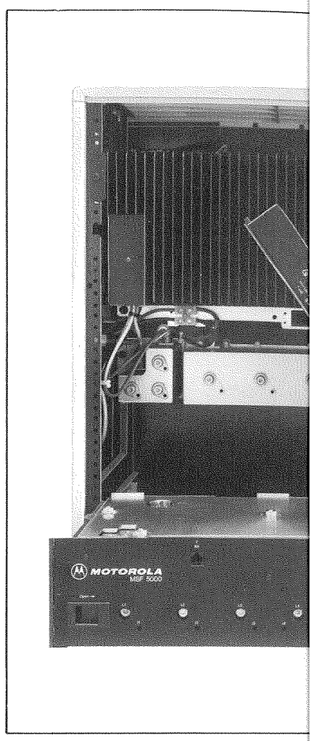

Figure 4. Internal View Showin Unfastened and Tilted U Station Control and Remo

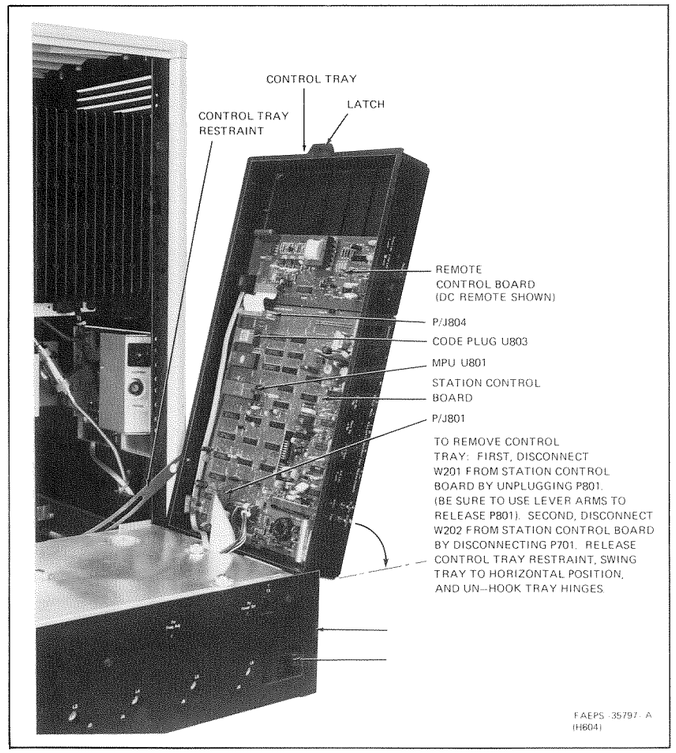

Figure 5. Internal View of Station Control Tray

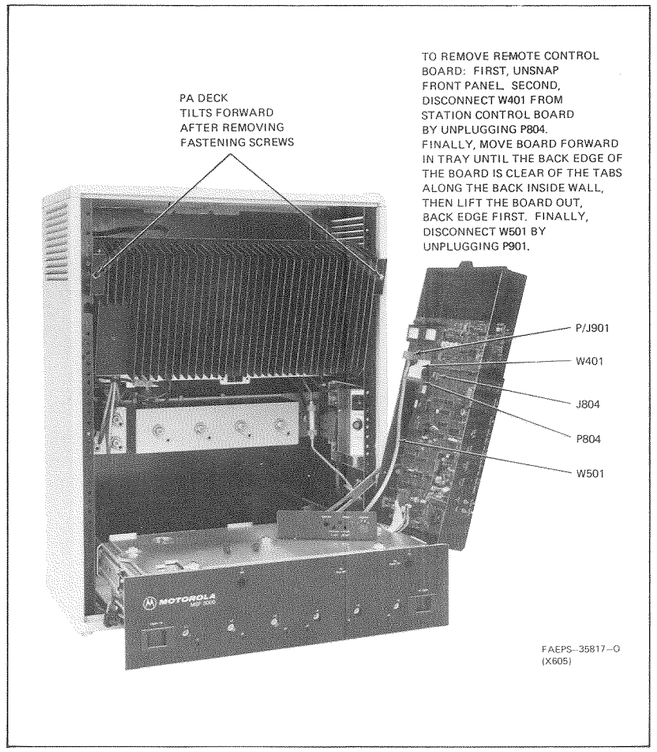

Figure 6. Internal View Showing Removal of Remote Control Board

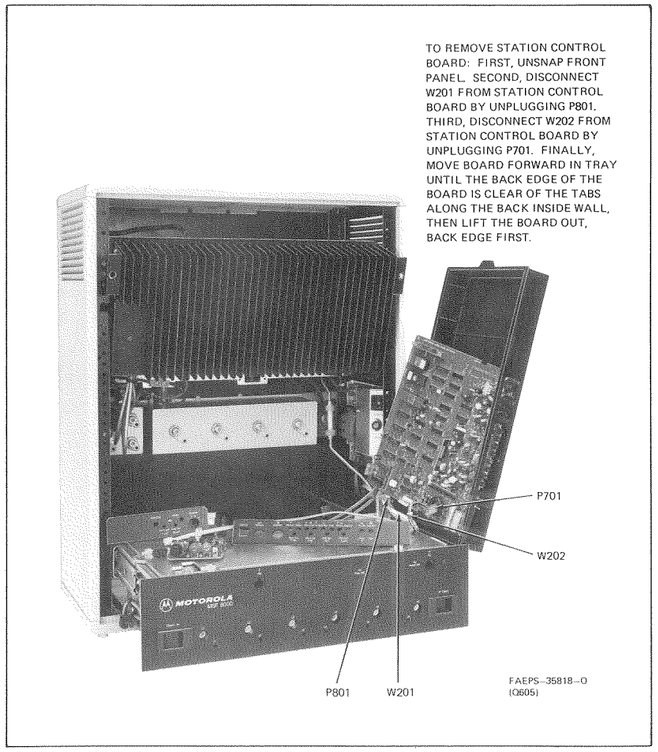

Figure 7. Internal View Showing Removal of Station Control Board

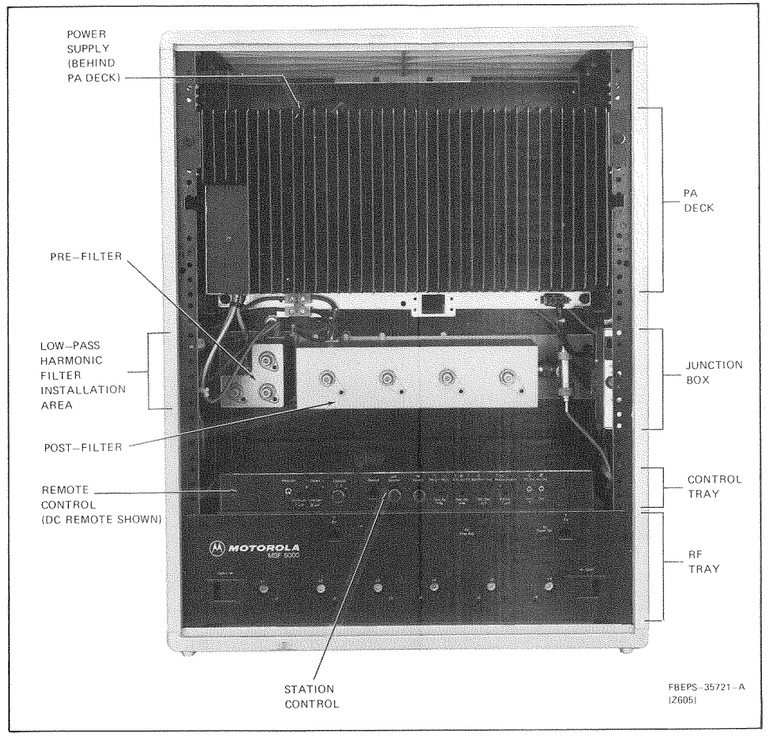

Figure 2. Internal View of Typical MSF 5000 Station

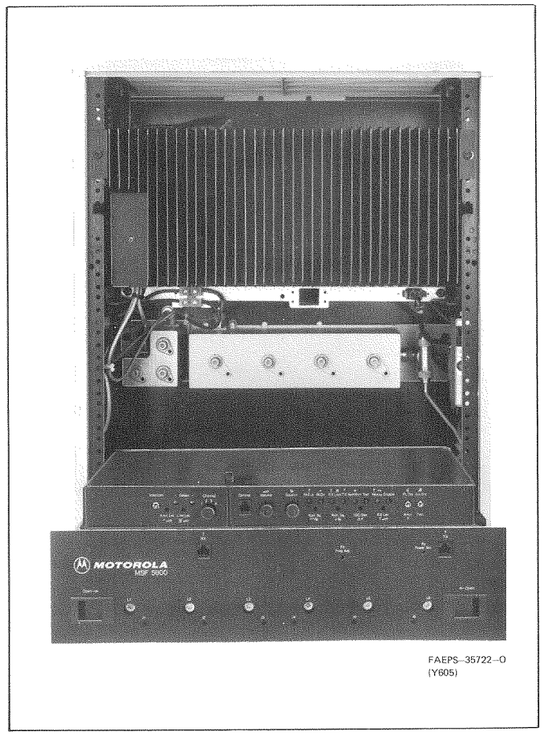

Figure 3. Internal View Showing RF Tray Drawer Slid Out

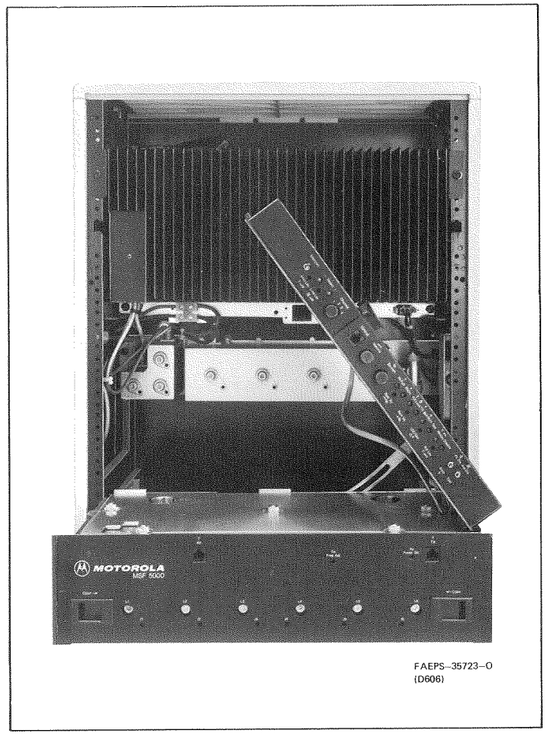

Figure 4. Internal View Showing Station Control Tray Unfastened and Tilted Up For Access to Station Control and Remote Control Boards

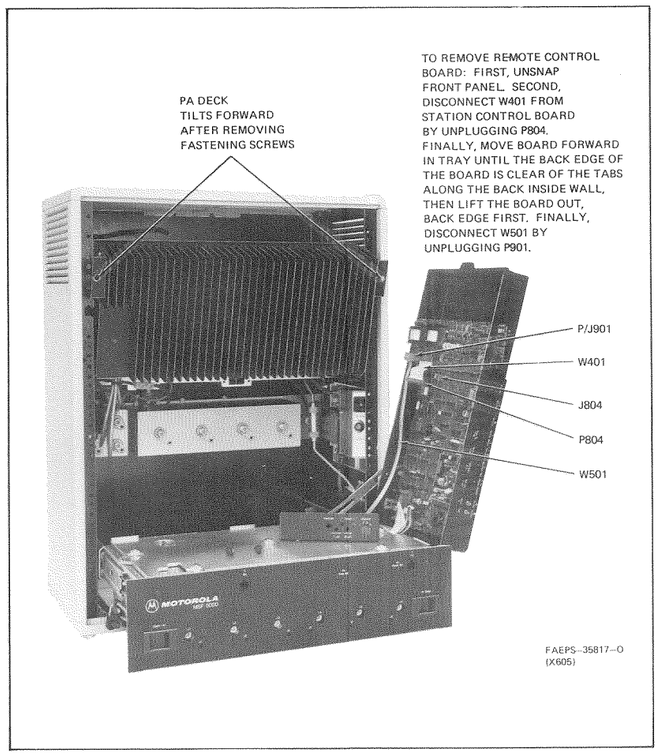

Figure 6. Internal View Showing Removal of Remote Control Board

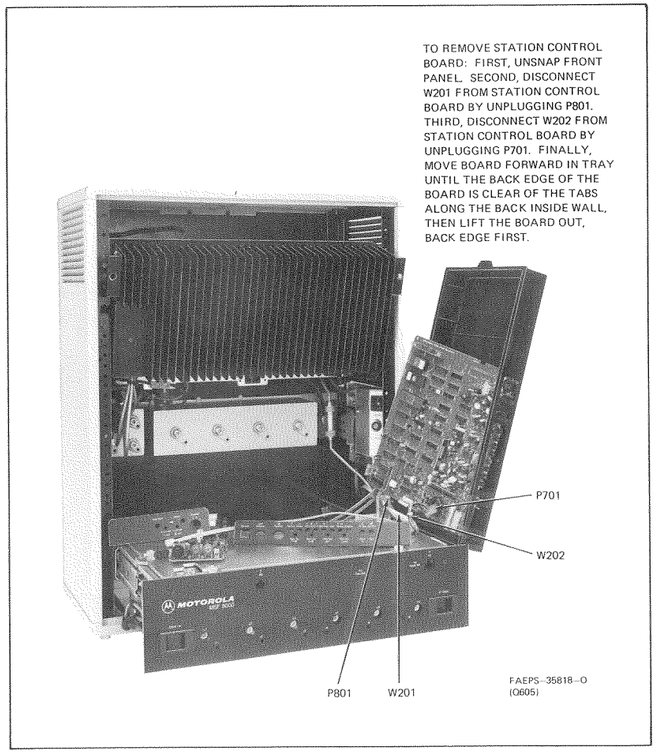

Figure 7. Internal View Showing Removal of Station Control Board

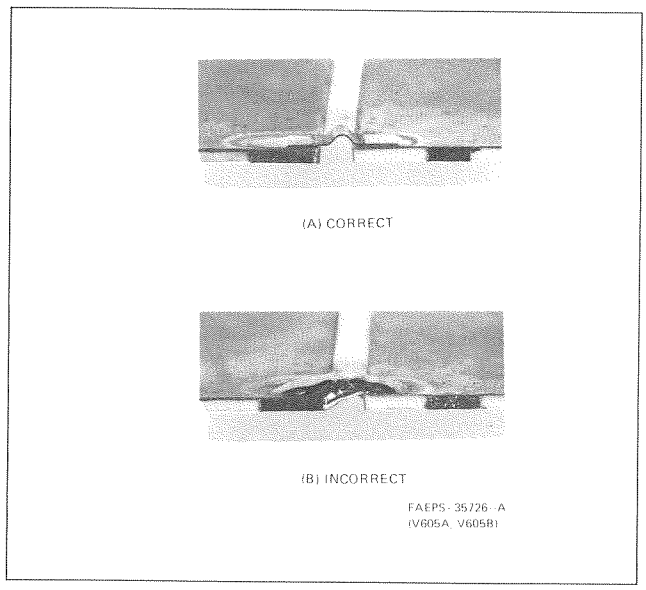

Figure 8. "Omega" Strap Replacement Soldering Techniques

4.4.2 Other Tuning Channel Characteristics

- The MUX bus bit labeled RX1 ACT is always active. This means that the local speaker is always unmuted and Receiver 1 audio is outbound on the line, unless local PTT is activated.
- The Automatic Station Identification function (if present in station) is disabled.
- The only valid push-to-talk signal recognized by the station is local PTT.
- The local TOT is disabled (local transmissions will never time-out).
- The station reverts to DPL operation, with DPL code 031 used for transmit encoding or receive decoding.

4.4.3 Tuning Channel Access

4.4.3.1 There are two methods available for access of the Tuning Channel.

- Front panel selection, via the CHANNEL select knob on the front panel of the remote control module.
- Direct selection, via the insertion of the tuning plug into the remote control receptacle J804, on the station control module.

4.4.3.2 Front panel selection of the Tuning Channel will only work if the total number of customer assigned channels is at least one less than the number of positions available via the CHANNEL select switch. For example, with dc control, the CHANNEL select switch has four positions. If the station has four customer assigned channels, then front panel selection of the Tuning Channel is not possible, and the direct selection methods must be employed. However, if only three of the four positions are customer assigned, then the Tuning Channel is position 4. Likewise, if two are assigned, then the Tuning Channel is position 3; and if one is assigned, then the Tuning Channel is position 2.

4.4.3.3 When the switch is set in a position higher than the tuning channel, the station reverts to the highest assigned channel. For example, if there are two assigned channels, then position 4 makes the station operate like channel 2.

4.4.3.4 Direct selection of the Tuning Channel shorts J804-11 to J804-26, and requires the following special procedure, employing the Tuning Plug (Motorola Part No. 1-80765D49), part of Model TRN5525 Tuning Tool Kit.

Step 1. Remove AC (or DC) power from the station.

Step 2. Unlatch and slide the RF Tray forward, out of the station (see Figure 3).

Step 3. Unlatch and tilt the station control tray up to the right (see Figure 4).

Step 4. Unplug P804 from J804 (see Figure 5).

Step 5. Insert the Tuning Plug into J804.

Step 6. Reapply AC (or DC) power to the station.

Step 7. Momentarily activate S801 to the TEST position. The station is now on the Tuning Channel.

Step 8. To return to normal operation, perform the procedure's Steps over, except remove the Tuning Plug and reattach P/J804.

4.5 *MSF 5000* STATION PARAMETER BOOKLET

4.5.1 The Station Parameter Booklet is a three page (minimum) document printed by the factory computer as it generates the programming information for the EPROM code plug. The programmed EPROM contains the customer's specific requirements, and is marked with a unique customer serial number. The Station Parameter Booklet provides a listing of those specific customer requirements. Figures 9, 10, and 11 illustrate typical examples of pages 1, 2, and 3 of the Station Parameter Booklet, respectively. After the booklet is printed, it is placed in the tuning tool pouch of the station in which its corresponding Code Plug is installed. Use the booklet to determine the specific station parameters describing the customer's equipment, e.g., transmit and receive frequency, PL and/or DPL codes, TOT

and DOD times, PTT priority, tuning channel (TXt and RXt frequencies), etc. Any field changes to the Code Plug's programming should be recorded in the booklet.

4.5.2 Figure 9 illustrates a typical page 1 of the *MSF 5000* System Parameter Booklet. The information presented on this page includes:

- The unique customer serial number.

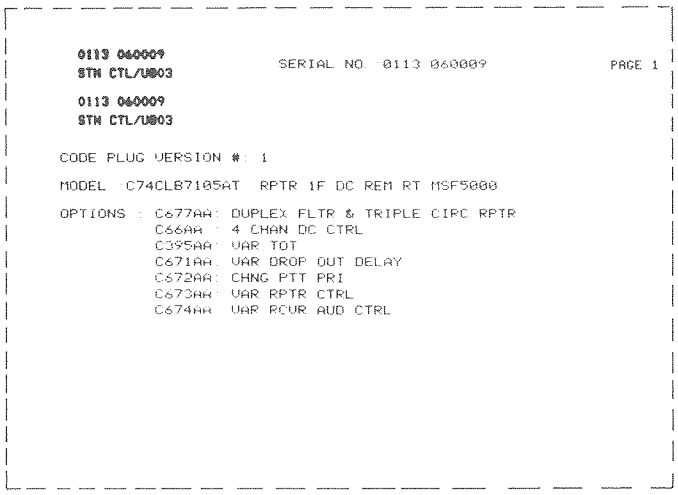

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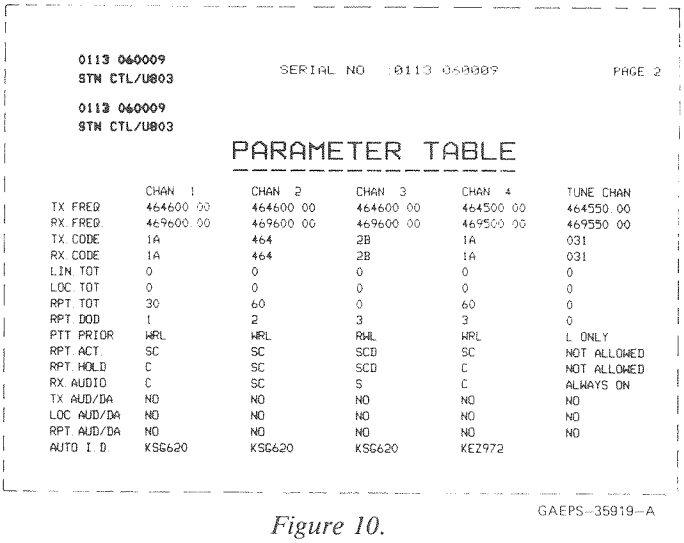
Figure 9.
Typical MSF 5000 System Parameter Booklet — Page 1



	CHAN 1	CHAN 2	CHAN 3	CHAN 4	TUNE CHAN
TX FREQ	464600.00	464600.00	464600.00	464500.00	464550.00
RX FREQ	469600.00	469600.00	469600.00	469500.00	469550.00
TX CODE	1A	464	2B	1A	031
RX CODE	1A	464	2B	1A	031
LIN TOT	0	0	0	0	0
LOC TOT	0	0	0	0	0
RPT TOT	30	60	0	60	0
RPT DOD	1	2	3	3	0
PTT PRIOR	WRL	WRL	RWL	WRL	L ONLY
RPT ACT	SC	SC	SCD	SC	NOT ALLOWED
RPT HOLD	C	SC	SCD	C	NOT ALLOWED
RX AUDIO	C	SC	S	C	ALWAYS ON
TX AUD/DA	NO	NO	NO	NO	NO
LOC AUD/DA	NO	NO	NO	NO	NO
RPT AUD/DA	NO	NO	NO	NO	NO
AUTO I.D.	KSG620	KSG620	KSG620	KEZ972	

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Figure 10.
Typical MSF 5000 System Parameter Booklet — Page 2

- Peel-off Code Plug stickers.
- Code Plug Software version number.
- Station model number and description.
- List of factory installed options.

4.5.3 Figure 10 illustrates a typical page 2 of the *MSF 5000* System Parameter Booklet. The information presented on this page includes:

- The unique customer serial number.
- Peel-off Code Plug stickers.
- The specific customer requirements, on a per channel basis.
- The station's tuning channel parameters.

Refer to Table 2 for definitions of the entries on this page.

Table 2. Parameter Table Definitions

Entry	Definition
1A	PL code
464	DPL code
TOT Times	Time in seconds, except 0 = disabled
DOD Times	Time in seconds, except 0 = immediate off
PTT Priority	WRL = Wire line-remote-local
Rpt. Act.	S = Carrier; C = Coded; D = PL Disable
Rpt. Hold	(RPTR Keying Only). May be
Rx Audio	AND'ed in any arrangement.

4.5.4 Figure 11 illustrates a typical page 3 of the *MSF 5000* System Parameter Booklet. The information presented on this page includes:

- Remote control functions assigned to each current (DC control) or tone (tone control).
- Station power up initialization or reset functions.

Refer to Table 3 for definitions of the mnemonics used on this page.

5. ROUTINE MAINTENANCE

The following routine maintenance procedures should be performed six months after installation, and every twelve months thereafter.

- System Operation Check
- Receiver Operation Check
- Transmitter Operation Check
- Power Supply Operation Check (Battery Charger Supply Models Only)

NOTE
When making measurements, record measured values for comparison with future measurements.

Table 3.
Command Mnemonics List For Use With Option C683

Available On		Command	Action
Tone	DC		
✓	✓	NULL.....	Signifies that this tone will be disabled.
✓	✓	DEF (or blank).....	Keep default assignments (from standard options).
✓	✓	MON	MONitor channel. Disables receiver PL until next KEY.
✓		KEY	KEY transmitter until low-level guard tone is removed.
✓	✓	KEY (ON/OFF)	Manually KEY or DeKEY station. Used for timed operations.
✓	✓	CHNxx.....	Select Channel xx (xx = 15 max.).
✓		CHN.....	Select Channel using tones that follow.
✓	✓	AUX xx	Select Aux. channel xx (xx = 15 max.).
✓		AUX.....	Select Aux. channel using tones that follow.
✓		LLT.....	Perform phone line loop test sequence.
✓	✓	TPL (ON/OFF)	Enable/Disable transmitter PL.
✓	✓	RPL (ON/OFF)	Enable/Disable receiver PL.
✓	✓	SPT (ON/OFF)	Enable/Disable special PTT operation.
✓	✓	SQ1 (ON/OFF).....	Enable/Disable receiver #1 remote squelch.
✓	✓	SQ2 (ON/OFF).....	Enable/Disable receiver #2 remote squelch.
✓		TXM (ON/OFF)	Transmitter audio mute On/Off.
✓	✓	RPT (ON/OFF)	Setup/Knockdown repeater operation.
✓	✓	R2M (ON/OFF).....	Auxiliary receiver audio mute On/Off.
✓	✓	ALM (ON/OFF)	Enable/Disable station alarms.
✓	✓	SAL (ON/OFF)	Turn On/Off Selective Alarm feature.
✓	✓	SCAN (ON/OFF)....	Enable/Disable channel scan feature.
✓		*DVP*S (0/1).....	Select *DVP* code 0 or 1.
✓		*DVP* (ON/OFF).....	Enable/Disable *DVP* operation.
✓	✓	STBY (ON/OFF)....	Enable/Disable Hot Standby operation.
✓	✓	WCx (ON/OFF).....	Turn On/Off Wild Card function #x (x = 1 to 8).
✓		MORE	Reset function tone buffer and look for MORE tones.
✓		RESx	RESET & perform power-up self-test for: x = 1 Reset TRC module x = 2 Reset Station x = 3 Reset System (default)
✓		WAITxxxx	WAIT for xxxx milliseconds. xxxx range is 5 to 6800.
✓		SELxxxxxxxx.....	Set station SELect word to xxxxxxxx. Each x can be a 0 or 1. Default = 10000000 (see Station Addressing).
✓		SEL.....	Set station SELect word using tones that follow.
✓		STATxx.....	STATus Request. Send back value of MUXBUS address xx. Default xx is 8 (channel #). Range is 0 to 15.
✓		STAT.....	STATus Request. Send back value of MUXBUS for address, defined by tones that follow.
✓		ACK	Send acknowledge handshake for this function.
✓		CONTxx	CONTinue executing commands at tone #xx. Range 0 to 15.
✓		TRAKxx.....	TRAcK but ignore tones until tone #xx is received. Range is 1 to 15.
✓	✓	FNCON x, y	Active a FuNCtion bit on MUX bus address x, bit y. Range x: 0 to 15, Range y: 0 to 3.
✓	✓	FNCOFF x, y	Deactive a FuNCtion bit (see above).
✓		FNC	Modify a MUXBUS FuNCtion bit using tones that follow.
✓	✓	NIB x, y.....	Set data NIBble on MUX bus address x to value y. Range x and y: 0 to 15.
✓		NIB.....	Modify a MUXBUS NIBble using tones that follow.

0113 060009
STN CTL/U803

SERIAL NO 0113 060009 PAGE 3

0113 060009
STN CTL/U803

DC REMOTE TABLE

		COMMAND # 1	COMMAND # 2	COMMAND # 3	COMMAND # 4
+12 5 ma	DET	CHN 2	KEY ON		
	UND	KEY OFF			
+5 5 ma	DET	CHN 1	KEY ON		
	UND	KEY OFF			
+2 5 ma	DET				
	UND				
-2 5 ma	DET	MON			
	UND				
-5 5 ma	DET	CHN 3	KEY ON		
	UND	KEY OFF			
-12 5 ma	DET	CHN 4	KEY ON		
	UND	KEY OFF			
RESET		CHN 1			

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TN REM/U1011

SERIAL NO 474CHL0007 PAGE 3

TONE REMOTE TABLE

	COMMAND # 1	COMMAND # 2	COMMAND # 3	COMMAND # 4
F0(GUARD TONE)	MORE			
F1 (2050 Hz)	MON			
F2 (1950 Hz)	CHN 1	KEY		
F3 (1850 Hz)	TPL OFF	KEY	TPL ON	
F4 (1750 Hz)	NULL			
F5 (1650 Hz)	NULL			
F6 (1550 Hz)	SQ1 OFF			
F7 (1450 Hz)	SQ1 ON			
F8 (1350 Hz)	NULL			
F9 (1250 Hz)	NULL			
F10 (1150 Hz)	NULL			
F11 (1050 Hz)	NULL			
F12 (950 Hz)	NULL			
F13 (850 Hz)	LLT			
F14 (750 Hz)	NULL			
F15 (650 Hz)	NULL			
RESET	WAIT 500	CHN 1	SQ1 ON	

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Figure 11.
Typical MSF 5000 DC or Tone Remote Control System Parameter Booklet — Page 3

5.1 SYSTEM OPERATION CHECK

- On DC remote control stations, adjust the XMIT LEV control on the control tray front panel for proper transmit level, as described in the Installation section of this manual.

- Measure line levels and check control functions for proper operation, as described in the Installation section of this manual. On tone remote control stations, an internal routine called "Tone Test" generates its own test tones, then indicates whether these tones are properly detected. See "Tone Remote Control" portion of "Control" section of manual.

- On repeater models, check for proper repeater operation.

- On coded squelch channels, check for proper encode and decode code(s). Does receiver 1 squelch open when the proper squelch code is detected?

5.2 RECEIVER OPERATION CHECK

- Measure, record, and compare all RCVR MTR readings with minimum values and previous readings.

- Measure the signal level required to obtain 20 dBq. If necessary, realign the preselector, image, and injection filters as described in the Receiver section of this manual.

CAUTION

The preselector will be mistuned unless the correct procedure is followed. Tuning the filter for optimum quieting alone can result in increased radio interference problems.

- Measure RCVR MTR 3 to ensure an injection level within acceptable limits, as described in the Installation section of this manual.

- Measure RCVR MTR 5 to ensure a receiver VCO steering line level within acceptable limits. If necessary, retune the receive VCO by performing the synthesizer alignment and adjustment procedures in this section of this manual.

5.3 TRANSMITTER OPERATION CHECK

- Measure, record, and compare all XMTR MTR readings with minimum values and previous values.

- Measure station output power. If power is low DO NOT adjust level without first referring to the transmitter troubleshooting procedure.

- If station has battery back up or optional power cutback control, also check power output under these conditions, and adjust if necessary.

- Verify that each transmit channel is programmed correctly. Adjust reference oscillator frequency if necessary, by performing the synthesizer alignment and adjustment procedures in this section of this manual.

- Measure transmitter frequency deviation for both voice and PL/DPL modulation. Adjust the IDC control if necessary.

- Measure automatic identification deviation.

- Measure XMTR MTR 5 to ensure a transmitter VCO steering line level within acceptable limits. If necessary, retune the transmit VCO by performing the syn-

thesizer alignment and adjustment procedures in this section of this manual.

5.4 POWER SUPPLY OPERATION CHECK (Battery Charger Supply Models Only)

- Measure and adjust battery charger supply voltage recommended by manufacturer. If no batteries are installed, adjust voltage to 14.25 ±0.1 V (in standby).
- Perform periodic battery maintenance as required by battery manufacturer.

6. SYNTHESIZER ALIGNMENT AND ADJUSTMENTS

6.1 INTRODUCTION

The following adjustments can be made to the *MSF 5000* Synthesizer:

- Reference oscillator frequency
- Deviation
- Modulation compensation

NOTE

Refer to the list of recommended test equipment provided in this section of the manual.

6.2 REFERENCE OSCILLATOR FREQUENCY ADJUSTMENT PROCEDURE

IMPORTANT

The reference oscillator frequency adjustment should be performed before setting or checking the deviation adjustment.

Step 1. Set front switch S801 to ACC-DIS (Access-Disable) position.

Step 2. Key transmitter with the front panel XMIT switch S802.

NOTE

Keying the transmitter in this manner will prevent a PL/DPL station from transmitting the PL/DPL code (transmit PL stripping).

Step 3. Adjust RF tray front panel FREQ. ADJ. warp control to set the proper frequency.

6.3 VCO ADJUSTMENT PROCEDURE

Normally, the VCO will require only slight adjustment over time. However, a major adjustment may be required if the radio frequencies are moved outside the 6.1 MHz transmit or 2 MHz receive operating bandwidth. If the synthesizer lock LED is off when the station is adjusted to the new frequencies, then the VCO's require coarse adjustment.

Step 1. Turn the VCO locking cam (located on RF tray over) to the transmit position.

Step 2. Set the station to the highest frequency assignments, by setting the channel select rotary switch to the highest TX and RX frequency assignments (for single frequency radios, there is no need to change frequency to tune the VCO's).

Step 3. Observe MTR 5 on the transmitter or receiver metering jack.

Step 4. Adjust the VCO tuning screw in the direction given in Table 4 until the synthesizer lock LED turns on.

Table 4. VCO Tuning Screw Direction of Rotation

If MTR 5 is	Tuning Screw Direction	Comment
greater than 40 uA	CCW	Increasing the VCO frequency
less than 15 uA	CW	Decreasing the VCO frequency

Step 5. Adjust the VCO tuning screws for the MTR 5 readings given in Table 5, with the transmitter keyed.

Table 5. VCO Fine Adjustment

	TX	RX
MTR 5	38 uA	37 uA

IMPORTANT

Always perform the following VCO fine adjustment after performing the previous VCO coarse adjustment.

Step 6. Key the transmitter and adjust the VCO tuning screws for the MTR 5 readings given in Table 5.

Step 7. Return the VCO locking cam to the OPERATE position.

6.4 DEVIATION ADJUSTMENT PROCEDURE

NOTE

When setting deviation, it is important to check deviation on all transmit channels.

Step 1. Set the station to the highest transmit frequency.

Step 2. Apply a 1 kHz, 1 V rms tone to the microphone input of the test set. Key the transmitter with the test set's XMIT switch.

Step 3. Set the deviation with the front panel IDC/DEV control to ±4.6 kHz.

Step 4. Set the frequency to the lowest transmit frequency. Reset deviation if the deviation is greater than ±4.6 kHz.

Step 5. Check deviation on all transmit frequencies and readjust if the deviation is greater than ±4.6 kHz.

6.5 MODULATION COMPENSATION ADJUSTMENT PROCEDURE

This procedure sets the ratio of the transmit audio signal between the transmit VCO and the transmit phase detector (U323), thus ensuring good DPL waveform fidelity and flat modulation response.

NOTE

The modulation compensation adjustment control (R358), located on the Uniboard, is set at the factory and normally does not require readjustment. However, the modulation compensation adjustment procedure should be used whenever any of the following conditions occur in a station:

- If transmit DPL (encode) performance is poor.
- If the VCO or Uniboard is replaced.
- If R358 is replaced or inadvertently adjusted.
- If the station frequency is changed beyond the 6.1 MHz transmit operational bandwidth.

Step 1. Connect the center lead of a shielded cable from an ac voltmeter to the MOD compensation test point (refer to the RF Tray section in this manual). Connect the shielded lead to the chassis.

Step 2. Access the tuning channel.

Step 3. Key the transmitter with the test set XMIT switch.

NOTE

This will allow the tuning DPL code 031 to be transmitted (no transmit PL stripping).

Step 4. Adjust modulation compensation control R358 in a small-step-like fashion for a null reading on the ac voltmeter. The small-step adjustments are necessary to allow the ac voltmeter to settle between adjustments.

Step 5. De-access the tuning channel.

Step 6. Perform the deviation adjustment procedure, as described in this section of this manual.

7. SETTING TRANSMITTER RF OUTPUT POWER

IMPORTANT

The power output of any *MSF 5000* station is dependent not only upon the PA Deck installed in the station, but also upon any optional equipment attached to the output of the PA Deck. Tables 6 through 10 provide cross reference that shows station rated power output versus the installation of optional equipment on any of the 403-435 MHz station sales models.

Step 1. Dekey station and connect a calibrated wattmeter and 50-ohm load to the transmit antenna connector on the station junction box.

Step 2. Rotate front panel POWER SET potentiometer (R426) fully counterclockwise (minimum power setting).

NOTE

Refer to Tables 6 through 10 for the proper Power Set Level, since rated power output from a station is a function of some of the options incorporated into a station.

Step 3. Rekey station by activating transmitter XMIT switch located on the station control module front panel. Verify that both transmitter status LED's (PA FULL and PA ON) turn on before proceeding. Otherwise, refer to transmitter troubleshooting guide.

Step 4. Adjust POWER SET potentiometer (R426) clockwise until rated power level is indicated by the wattmeter. Power output must not exceed maximum allowed level specified on the current station authorization.

NOTE

If the power set level is increased above rated output, the power of the station will, at some point, drop to approximately half of rated power output, and a PA Fail alarm signal will be sent out of the station by the station control board. This cutback in power is the result of the power control overdrive protection circuitry being activated. Should this situation occur, dekey the station and repeat the transmitter power output adjustment.

Table 6. C74CLB-71xx 110 W Sales Models & Options Vs. Power Output*

OPTION DESCRIPTION							
Option Number	Single Circulator	Triple Circulator	Low Pass Filter	Duplex Site Filters	Antenna Switch	Duplex Tee	Rated Power Output
Base	●		●		●		110 W
**C597AA	●			●		●	60 W
**C598AA		●		●		●	45 W
**C597AB	●			●		●	60 W
**C598AB		●		●		●	45 W
C675AB	●			●		●	85 W
C676AA		●	●		●		70 W
C677AB		●		●		●	55 W
C682AA	●		●				110 W
C676AA & C682AA		●	●				75 W
Repeater	●		●				110 W
C675AA	●			●		●	85 W
C676AA		●	●				75 W
C677AA		●		●		●	55 W

NOTES:
1. xx* may be 05, 05__T, 06, 06__T, 75, or 76.
2. **C597 and **C598 not available for 435-475 MHz.

Table 7. C74CLB-71xx 75 W Sales Models & Options Vs. Power Output*

OPTION DESCRIPTION							
Option Number	Single Circulator	Triple Circulator	Low Pass Filter	Duplex Site Filters	Antenna Switch	Duplex Tee	Rated Power Output
Base	●		●		●		75 W
C675AB	●			●		●	55 W
C676AC		●	●		●		45 W
C677AD		●		●		●	40 W
C682AA	●		●				75 W
C676AC & C682AA		●	●				50 W
Repeater	●		●				75 W
C675AA	●			●		●	55 W
C676AC		●	●				50 W
C677AE		●		●		●	75 W

NOTE xx* may be 05, 05__T, 06, 06__T, 75, or 76.

8. SYSTEM LEVEL MEASUREMENT

The System Level stamped on the rear inside wall of the station control tray is determined by the voltage at which the deviation limiter output (U838B on station control board) goes into limit. This measurement, which determines whether the system level has changed, need not be made unless U838 on the station control board (or the entire board) is replaced, or the intermediate power amplifier/9.6 V regulator is replaced or the 9.6 V regulator is serviced. This measurement should only be made after the deviation adjustment has been checked (section 6.4). The System Level is twice the rms audio voltage appearing on TP1 of station control that produces 3 kHz peak transmit deviation with a 1000 Hz sinusoidal input.

CAUTION

Do not allow the transmitter to key into the rf signal generator when performing the following steps. The transmitter may be disabled by disconnecting the rf cable from the power amplifier to the duplexer (if present) or activating the ACC DIS switch which disables repeater push-to-talk.

Table 8. C44CLB-71xx 40 W Sales Models & Options Vs. Power Output*

OPTION DESCRIPTION							
Option Number	**Single Circulator**	**Triple Circulator**	**Low Pass Filter**	**Duplex Site Filters**	**Antenna Switch**	**Duplex Tee**	**Rated Power Output**
Base	●		●		●		40 W
C675AB	●			●		●	30 W
C676AD		●	●		●		25 W
C677AF		●		●		●	20 W
C682AA	●		●				40 W
C676AD & C682AA		●	●				30 W
Repeater	●		●				40 W
C675AA	●			●		●	30 W
C676AD		●	●				30 W
C677AG		●		●		●	20 W

NOTE: xx* may be 05, 05__T, 06, 06__T, 75, or 76.

Table 9. C34CLB-71xx 15 W Sales Models & Options Vs. Power Output*

OPTION DESCRIPTION							
Option Number	**Single Circulator**	**Triple Circulator**	**Low Pass Filter**	**Duplex Site Filters**	**Antenna Switch**	**Duplex Tee**	**Rated Power Output**
Base	●		●		●		15 W
C675AB	●			●		●	10 W
C676AE		●	●		●		9 W
C677AH		●		●		●	8 W
C682AA	●		●				15 W
C676AE & C682AA		●	●				11 W
Repeater	●		●				15 W
C675AA	●			●		●	10 W
C676AE		●	●				11 W
C677AJ		●		●		●	8 W

NOTE: xx* may be 05, 05__T, 06, 06__T, 75, or 76.

Table 10. C24CLB-71xx 6 W Sales Models & Options Vs. Power Output*

OPTION DESCRIPTION							
Option Number	**Single Circulator**	**Triple Circulator**	**Low Pass Filter**	**Duplex Site Filters**	**Antenna Switch**	**Duplex Tee**	**Rated Power Output**
Base	●		●		●		6 W
C675AB	●			●		●	4 W
C676AF		●	●		●		3 W
C677AK		●		●		●	3 W
C682AA	●		●				4 W
C676AF & C682AA		●	●				4 W
Repeater	●		●				6 W
C675AA	●			●		●	4 W
C676AF		●	●				4 W
C677AL		●		●		●	3 W

NOTE: xx* may be 05, 05__T, 06, 06__T, 75, or 76.

Step 1. Repeater Stations: Feed an rf signal (approximately 1000 uV) into receiver on frequency (any channel). Modulate with 1000 Hz tone at 5 kHz peak deviation. Lift PL DIS switch on front panel to allow reception without a PL (*Private-Line*) tone.

Non-Repeater Stations: Connect an audio signal generator to Motorola test set local audio input, or to TP8 (connect generator ground lead to AG test pin) on station control board. Set frequency of sine wave to 1000 Hz. Also, actuate local push-to-talk switch on test set (or ground TP9 to AG test pin on station control board).

Step 2. While monitoring transmit deviation, adjust 1000 Hz tone level (by adjusting generator deviation on repeater stations, or audio generator level on non-repeater stations) to produce 3 kHz peak transmit deviation.

Step 3. Repeater Stations: Measure the AC rms voltage level (using an AC-coupled voltmeter) of the 1000 Hz tone between TP1 and the AG (ground) test pin on station control. Double this voltage to obtain System Level voltage.

Non-repeater Stations: Measure the AC rms voltage level (using an AC-coupled voltmeter) of the 1000 Hz tone between U834 pin 14 and the AG (ground) test pin on station control. Multiply this voltage times 4 to obtain System Level voltage.

Step 4. If the System Level voltage, as determined in Step 3 above, differs from that marked on the label on the rear inside wall of the control tray, write in the new level and perform the transmit level, receive level, and line level adjustments.

9. AUDIO LEVEL ADJUSTMENTS

9.1 TRANSMIT LEVEL (XMIT LEV) ADJUSTMENT

9.1.1 On tone remote control stations this control is factory adjusted and should not require adjustment unless the tone remote board is replaced or the system level changes (see SYSTEM LEVEL MEASUREMENT above). Tone remote control stations automatically compensate for variations in phone line loss, so adjustment of the XMIT LEV control is not normally required. On DC remote control stations, this adjustment should periodically be performed according to instructions in INSTALLATION section of this manual to compensate for possible variations in phone line loss.

9.1.2 If adjustment becomes necessary on tone remote control stations, the following procedure should be used.

Step 1. Turn INTERCOM switch on. ACCESS DISABLE switch should *not* be activated (leave in center position).

Step 2. Feed a 1 kHz tone into L1 phone line terminals at any convenient level between —5 and +11 dBm (0.44 mV to 2.75 V rms). The internally generated Tone Test routine 1050 Hz tone may be used for this purpose (in 4-wire station, connect L1 to L2 if this is used). See TONE REMOTE CONTROL portion of CONTROL section of this manual for a description of the Tone Test diagnostic tone generator feature. If Tone Test is used, the anode (+) side of CR1007 must be grounded to TP3 on tone remote control board during this procedure.

Step 3. Connect an AC-coupled voltmeter capable of reading 500 mV rms between TP5 and ground (TP14) on tone remote control board.

Step 4. Adjust XMIT LEV control on front panel to produce an AC level on voltmeter which is half the value marked on the System Level label located on the back inside wall of the control tray.

9.2 RECEIVER LEVEL (RX LEV) ADJUSTMENT

This control is factory set and should not require adjustment unless the System Level changes (see SYSTEM LEVEL MEASUREMENT above). After this adjustment is made, the LIE LEV adjustment should be checked (see Receiver Line Level Setting in INSTALLATION section of this manual). The RX LEV control determines the deviation of re-transmitted audio in repeater stations, and also affects wireline level.

Step 1. Inject an on-frequency carrier signal into the receiver antenna port at a high quieting level (approximately 1 mV rms). Modulate the generator output with a 1 kHz tone at ±5 kHz deviation. Activate PL DIS switch on front panel.

Step 2. Adjust the RX LEV control on the control tray front panel to produce a audio level at test point TP1 on station control board equal to the value stamped on the system level label located on the back inside wall of the control tray.

9.3 AGC ADJUSTMENT (TONE REMOTE CONTROL STATIONS ONLY)

9.3.1 For normal operation the AGC front panel control is fully clockwise. Since Tone Remote Control incorporates Auto-level Control within its AGC in order to maintain high audio quality, "pumping" of the audio level should not occur (except possibly in Intercom) if the unit is functioning properly, and AGC adjustment should not be necessary for this reason. However, there are circumstances under which adjustment of the AGC control may be desirable: 1) to disable AGC action or 2) to reduce excess dynamic range. This may be desired if

the phone line produces a high level of noise or crosstalk that may cause false high-level guard tone detection. The effect of a guard tone false can be seen as a flash of Tone Detect LED and as a momentary muting of receiver line audio when no tones are being sent by the remote console. If this problem is experienced, adjustment in Section 9.3.2 should be performed to reduce the excess gain above what is required to overcome phone line loss.

9.3.2 To Remote Excess Dynamic Range While Maintaining AGC Action

Step 1. Feed a 1 kHz tone through remote console according to instructions for setting line level at console output. If multiple consoles are used, feed tone into the console which produces the lowest signal level on phone line at base station. Be sure AGC control is initially fully clockwise on station front panel. Clip Q1010 gate (center lead) to 9.6 V (TP4).

Step 2. Measure the voltage level at the station across L1 phone line terminals.

Step 3. Temporarily reduce the 1 kHz level being sent from the console by 12 dB (factor of four), or remove the remote console tone and apply a 1 kHz tone from a local generator to the station L1 terminals to produce 1/4 the voltage measured in Step 2.

Step 4. Measure the signal voltage level on TP5 of Tone Remote Control. Reduce AGC front panel control (counterclockwise) until TP5 level drops by factor of two (6 dB).

Step 5. Readjust console to normal output level, if changed in Step 3. The *maximum* AGC gain is now only 6 dB above (twice) the level required to achieve full deviation on this phone line, so that full deviation could still be obtained if phone line loss increased by 6 dB.

9.3.3 To Completely Disable AGC

Step 1. Feed a 1 kHz tone through remote control according to instructions for setting line level at console output.

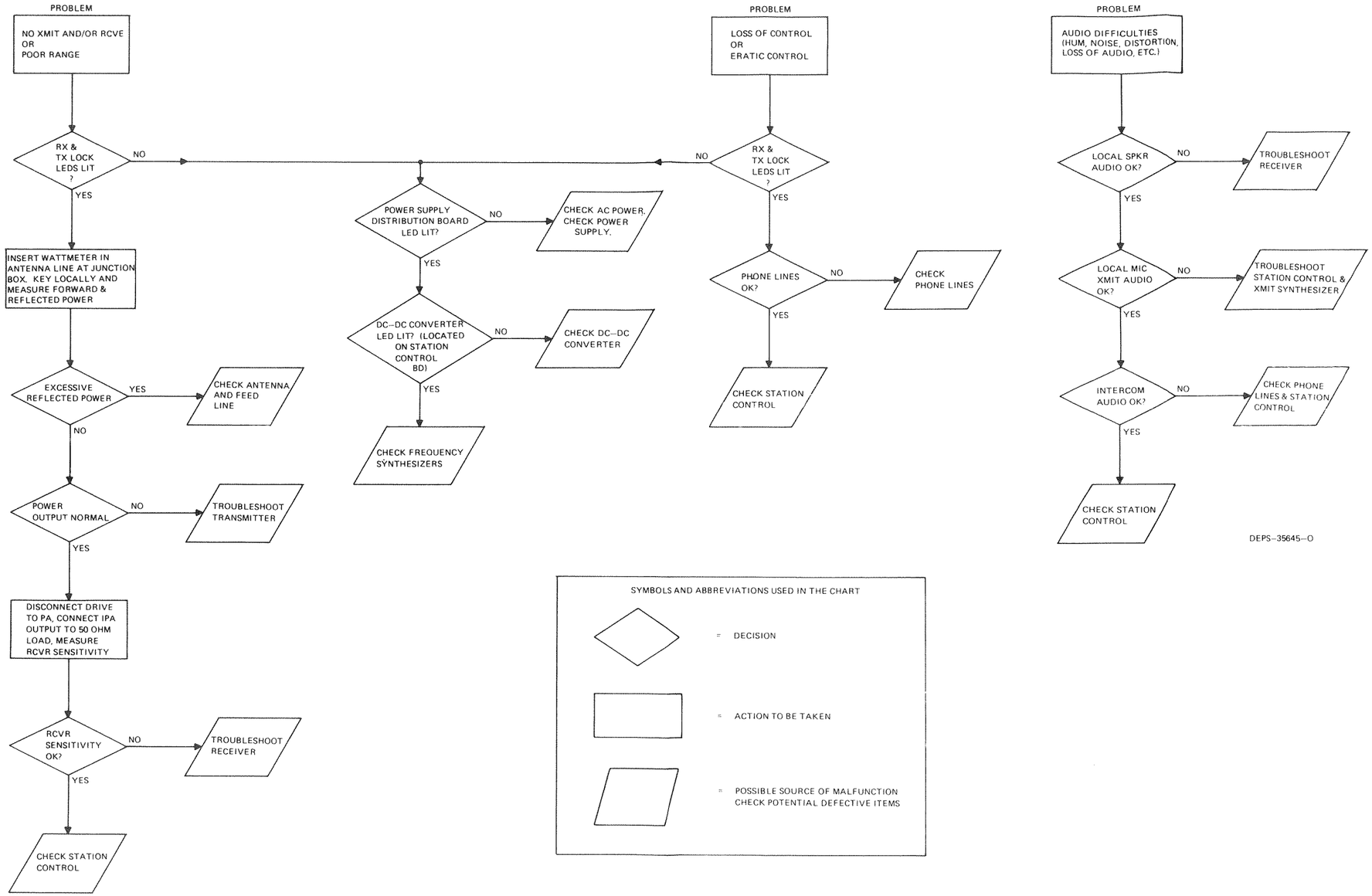
Step 2. At station, clip Q1010 gate (center lead) to 9.6 V (TP4). Record voltage on TP5 of Tone Remote Control board.

Step 3. Reduce AGC control on front panel until voltage on TP5 reduces by 2 dB (20%) from reading in Step 2.

Step 4. Increase XMIT LEV control on front panel (clockwise) by 2 dB to obtain the same voltage on TP5 as was originally measured in Step 2.

Step 5. Remove clip from Q1010 gate lead.

STATION TROUBLESHOOTING CHART



DEPS–35645–O

SYMBOLS AND ABBREVIATIONS USED IN THE CHART

= DECISION

= ACTION TO BE TAKEN

= POSSIBLE SOURCE OF MALFUNCTION CHECK POTENTIAL DEFECTIVE ITEMS

MSF 5000 STATION HARDWARE, CABINET, AND CABLING KITS
PARTS LISTS

parts list

TRN5525A Tuning Tool Kit — PL-8243-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1-80763D22	ASSEMBLY, filter probe clip, includes:
	28-84476G01	CONNECTOR, plug; male, single contact
	30-83794C01	CABLE, coaxial (WHT) 24" used
	51-80765D49	ASSEMBLY, tuning channel plug
	42-84010N01	CLIP, probe
	56-84824N01	POUCH, tuning tools
	66-84089N01	TOOL, tuning
	66-82977K03	TOOL, universal
	66-84974L01	TOOL, tuning

TKN8314A Standard Base or Repeater (RT) RF Cabling Kit — PL-8282-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J7, 8	9-83213K01	female; single contact (N type)
		connector, plug:
P11	28-87317C03	male; single contact
P600C	28-84476G01	male; single contact
		cable, assembly:
W800	1-80752D53	transmitter output; duplexer; includes: J7 and P600C
	30-84173E01	CABLE, coaxial double shield; 6" used
W801	1-80752D50	receiver input includes: J8 and P11
	30-84173E01	CABLE, coaxial double shield; 20" used

TKN8315A Base Station Cable Kit — PL-8278-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, plug:
P500	15-83142M10	housing, 3 position
P504	15-84860K02	housing
		cable:
W900	1-80752D92	assembly cable, antenna switch; includes: P500 and P504
	29-84706E06	TERMINAL, crimp; 2 used
	39-82717M01	CONTACT, receptacle; 2 used
	42-102117A02	STRAP, tie, 0.091 x 3.62 nylon; 2 used
	30-844810	CABLE, 2-conductor; 17-1/2" used

TFE6502A Low Pass Filter — PL-8232-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		filter, harmonic:
FL501	91-84224N01	low pass; fc = 525 MHz; includes: J571, 600c
		mechanical parts
	3-83498N02	SCREW, tapping: M3 x 0.5 x 5; 3 used
	42-801125	CLIP, cap mounting; 3 used
	42-10217A06	TIE, strap; 2 used
	64-83963N01	PLATE, mounting LP filter

TKN8281A Cable Interconnect Auxiliary EIA Rack — PL-8234-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptacle:
J1	9-84538E03	female; 25 contact
		connector, plug:
P1	28-84506E08	male, 25-contact
		mechanical parts
	2-84586C01	NUT, square; 2 used
	3-129674	SCREW, machine; 4-40 x 3/16"; 2 used
	15-82486M01	HOUSING, cable
	29-812979	LUG, crimp terminal; 10 used
	30-86970A03	CABLE, 10 conductor; 46" used
	42-10217A02	STRAP, tie; .091 x 3.62 nylon; 12 used
	43-10646A09	STANDOFF; 4-40 x .188; 2 used
	64-83159N02	PANEL, front

TRN5158A Cover Skin and Door Kit — PL-8235-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-10943J41	SCREW, tapping: TT8 x 1.25 x 16; 4 used
	3-10943J45	SCREW, tapping: TT8 x 1.25 x 40; 2 used
	3-83498N02	SCREW, tapping: star
	14-82935N01	INSULATOR, terminal block
	15-82821N02	HOUSING, top
	15-82832N01	COVER, cabinet
	15-82833N01	DOOR, cabinet
	55-83616B01	LOCK

THN6483A Cabinet Frame Kit — PL-8236-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	3-10943J41	SCREW, tapping: TT8 x 1.25 x 16; 4 used
	7-82831N01	FRAME, cabinet
	7-82831N02	FRAME, cabinet
	15-82821N01	HOUSING, bottom

TRN5427A Power Cord 110 V — PL-8043-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	30-82933N01	LINE CORD; with plug and receptacle