REQUIRED TEST EQUIPMENT FOR MITREK RADIO SERVICING

GENERAL TYPE	APPLICATION	RECOMMENDED MODEL	MINIMUM SPECIFICATIONS
AC-DC VOM	DC voltage measurements, general	Motorola T1009A	Measurement range: 0-15 V dc Sensitivity: 20,000 ohms/volt
DC Multimeter	DC voltage readings requiring a high input resistance meter.	Motorola S1063B	Measurement range: 0-15 V dc Input resistance: 11 megohms
AC Voltmeter	Audio voltage measurements	Motorola S1053C	Measurement range: 0-10 V ac Input resistance: 10 megohms
RF Voltmeter	RF voltage measurements	Motorola S1339A	Measurement range: 100 uV-3 V from 1 MHz-512 MHz Inputs: 50 ohm and high impedance
Oscilloscope	Waveform observation	Motorola R1004A	Vertical sensitivity: 5 mV - 10 V/division Horizontal time base: 0.2 usec. 0.5 sec/division
RF Wattmeter	Transmitter output power measurement	Motorola S1350A with appropriate element and T1013A RF Dummy Load	Measurement range: 0-100 Watts
Frequency Meter	Transmitter frequency measurement	Model R1200A Service Monitor with high stability oscillator (X suffix) option. Frequency calibration recommended every 6 months or less.	Measurement range: 134-174 MHz Frequency resolution: 10 Hz
Deviation Meter	Transmitter modulation deviation measurement	Motorola R1200A Service Monitor	Measurement range: 0-10 kHz deviation Frequency range: 134-174 MHz
RF Signal Generator	Receiver Alignment and troubleshooting	Motorola R1200A Service Monitor with attenuator	Frequency range: 134-174 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 S1067B	Frequency range: 20 Hz-20 kHz Output Level: 50 mV-1 V
PL Tone Generator*	Tone-Coded "Private-Line" Decoder Troubleshooting	Motorola S1333B	Frequency range: 10 Hz-9999 Hz Output Level: 0-3 V rms
DPL Test Set**	"Digital Private-Line" Encoder-Decoder Troubleshooting	Motorola SLN6413A	
Radio Test Set w/appropriate metering cable SKN6012B	Meter readings at circuit metering points for alignment and troubleshooting	Motorola S1056B Portable Test Set, TEK5B-E Metering Panel with RPX4053A Conversion Kit, or TEK5F Metering Panel.	
Tuning Tool Kit	Receiver and transmitter alignment	Motorola HLN4023A	
DC Power Supply	DC power for shop service	Motorola R1011AA	1-20 V DC 0-40 A

*Required for tone-coded "Private-Line" models only
**Required for "Digital Private-Line" models only

NOTE
Versions B-E of TEK5 Metering Panel must be modified with RPX4053A Conversion Kit before use with MITREK radio.

FREQUENCY CALCULATIONS

FREQUENCY (MHz)	CALCULATION
136-174	$f_o = \frac{f_c - 10.7}{3}$

Where f_o = crystal frequency, f_c = carrier frequency

POSITIVE GROUND SYSTEMS — CAUTION:
In positive ground systems the case of the TEK5 Meter Panel and portions of the S1056B Portable Test Set are hot with respect to the vehicle chassis due to the nature of the positive ground installation. Take necessary precautions that the test equipment does not contact the vehicle chassis.

VHF MITREK RECEIVER ALIGNMENT PROCEDURE

1. The tuning procedure should be performed using the Motorola portable test set or the TEK5 set to position A. If using the TEK5-F or modified TEK5-B through TEK5-E meter panels, put the M1, 2 polarity switch in the reverse position and ignore the indicated polarity notes.

2. IMPORTANT: When using the Motorola portable test set for M4 place the FUNCTION SELECTOR SWITCH to the XMTR position. Switch polarity as necessary for proper M4 operation.

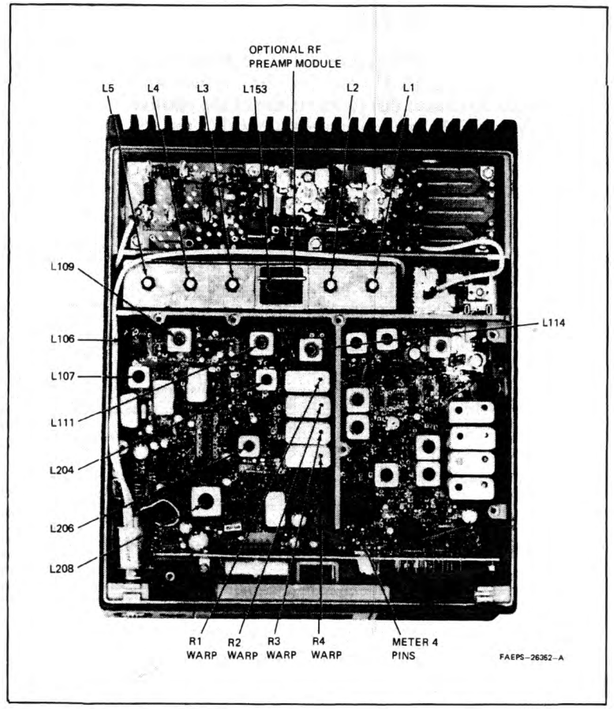
STEP	TEST SET METER POSITION	ADJUST	PROCEDURE
1		L1-L5	Preset the RF preselector tuning screws per the preset chart.
2		L109, L111, L114	Preset the injection string coil slugs per the preset chart.
3		L106	Preset the mixer gate coil per the preset chart. *This is the only tuning performed on this coil.* ***Preset carefully.***
4		L107	Preset mixer drain coil slug 10 turns from flush with top of coil form.
5		L204,L206	Preset the i-f matching network coil slugs 8 turns from flush with top of coil form.
6	2 (Reverse)	L208	Starting with the slug flush with top of coil form, adjust the detector coil for the *first* reading of 24 uA on meter 2. (No input signal is necessary). Perform Step 7A for radios with maximum receive frequency separation of 0.5 MHz or less; perform Step 7B for radios with maximum receive frequency separation greater than 0.5 MHz.
7A	6	L109,L111 L114	Adjust the injection string coils for peak reading on meter 6 with the *lowest* frequency selected. Repeat until no further improvement is obtained.
7B	6	L109,L111 L114	Adjust the injection string coils for peak reading on meter 6 with the *highest* frequency selected. Repeat until no further improvement is obtained. Tune L109 for peak meter 6 reading with the *lowest* frequency selected. Repeak L114 and L111 for peak on *highest* frequency and L109 on *lowest* frequency until no further improvement is obtained.
8	1 (Reverse), 4	Receiver Oscillator Warp	For each frequency, set rf generator to the carrier frequency (± 100 Hz) and adjust the output level for a meter 1 reading of 35 uA. Activate the meter 4 circuit by shorting the meter 4 enable pins. Adjust oscillator frequency for a zero reading on meter 4.
9	1 (Reverse)	L1-5 (and L153 with Preamp)	Adjust L1, L2, (L153), L3, L4, L5 in order for peak reading on meter 1 using the *highest* frequency and maintaining meter 1 between 30 and 40 uA by adjusting the signal generator output. Repeat until no further improvement is obtained. Perform Step 10 ***only*** for radios with maximum receive frequency separation greater than 0.5 MHz.
10	1 (Reverse)	L1-L5 (and L153 with preamp)	Adjust L1, L2, (L153), L3, L4, L5 *once* in that order for peak reading on meter 1 using the *lowest* frequency and maintaining meter 1 between 30 uA and 40 uA by adjusting the signal generator output.
11	1 (Reverse)	L107, L204 L206	Apply standard test modulation (1 kHz tone, ±3 kHz deviation) to the rf signal generator and adjust the output level for 35 uA on meter 1. Adjust i-f coils for a peak reading on meter 1 while maintaining meter 1 between 30 uA and 40 uA by adjusting the generator output. Repeat until no further improvement is obtained.
12	7 (AC Voltmeter across the speaker)	L208	With the same conditions as in Step 11, adjust L208 ***slowly*** for maximum audio voltage across the speaker.
13	1 (Reverse), 4	Receiver Oscillator Warp	Repeat Step 8. Perform Step 14A for radios with maximum receive frequency separation of 0.5 MHz or less; perform Step 14B for radios with maximum receive frequency separation greater than 0.5 MHz.
14A	AC Voltmeter across speaker	L5 (or L1 L2 with Preamp)	Adjust L5 (or L1 and L2 in Preamp Radios) for best quieting with the highest frequency selected. Receiver tuning is now complete.
14B	AC Voltmeter across Speaker	L1-L5 (Do not adjust L153 in preamp radios)	Check 20 dB quieting sensitivity on all frequencies. ***If necessary,*** retune L1 and L2 ***once*** on highest frequency for best quieting. Check sensitivities again and ***if necessary*** retune L3-5 ***once***, on the lowest frequency, for best quieting. Tuning is complete.

RECEIVER METERING TABLES

1. Meter readings reflect no signal applied after proper alignment.

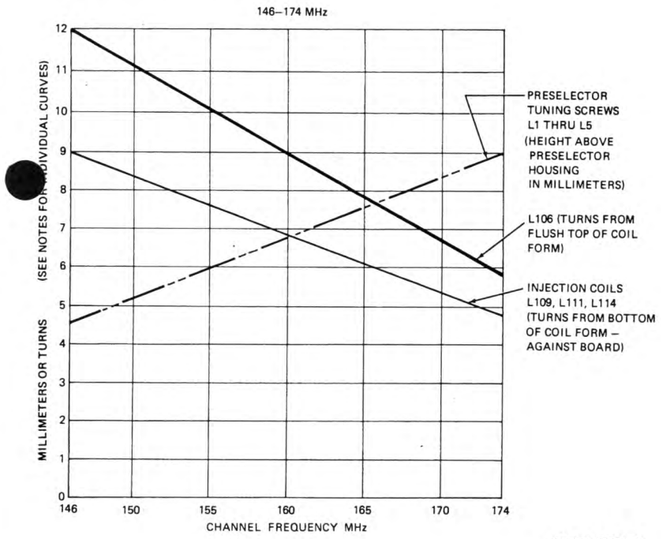
2. When dial readings are shown the reading before the / is without preamplifier and the reading after the / is with preamplifier.

PORTABLE TEST SET SWITCH POSITION	1	2	4	6
METER READING (uA)	12/14 (min) 30/32 (max)	20 (min) 28 (max)	0 (nom)	10 (min)
FUNCTION METERED	Signal Strength	Detector D.C. Output	Carrier Offset	Injection Level

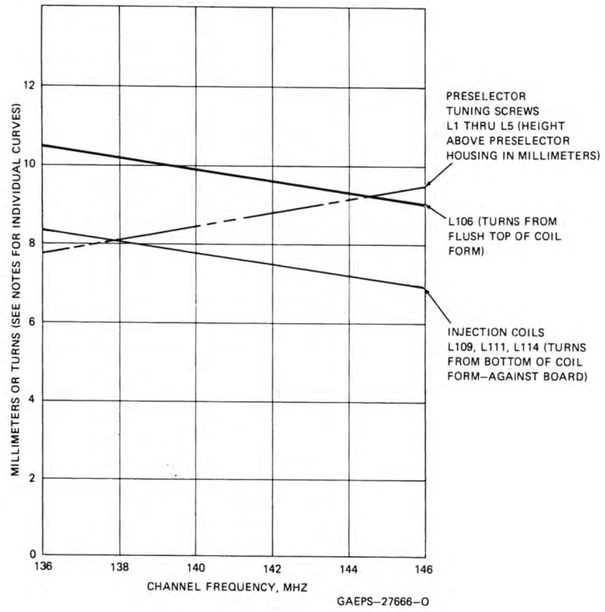


High Band MITREK Receiver Alignment Locations

146-174 MHz



136-146 MHz



Receiver Preset Charts

HIGH BAND MITREK
TRANSMITTER ALIGNMENT

CAUTION

In positive ground systems the case of the TEK5 Meter Panel and portions of the S1056B Portble Test Set are hot with respect to the vehicle chassis due to the nature of the positive ground installation. Take necessary precautions that the test equipment does not contact the vehicle chassis.

NOTE

The tuning procedure should be performed using the Motorola portable test set or the TEK5 set to position A.

CAUTION

Do not key the transmitter for more than a few seconds at a time until it is properly tuned. Turn on the transmitter for brief periods while reading the meter and making the adjustments.

FREQUENCY CALCULATIONS

FREQUENCY (MHz)	CALCULATION
136-174 MHz	$f_O = \frac{f_c}{12}$

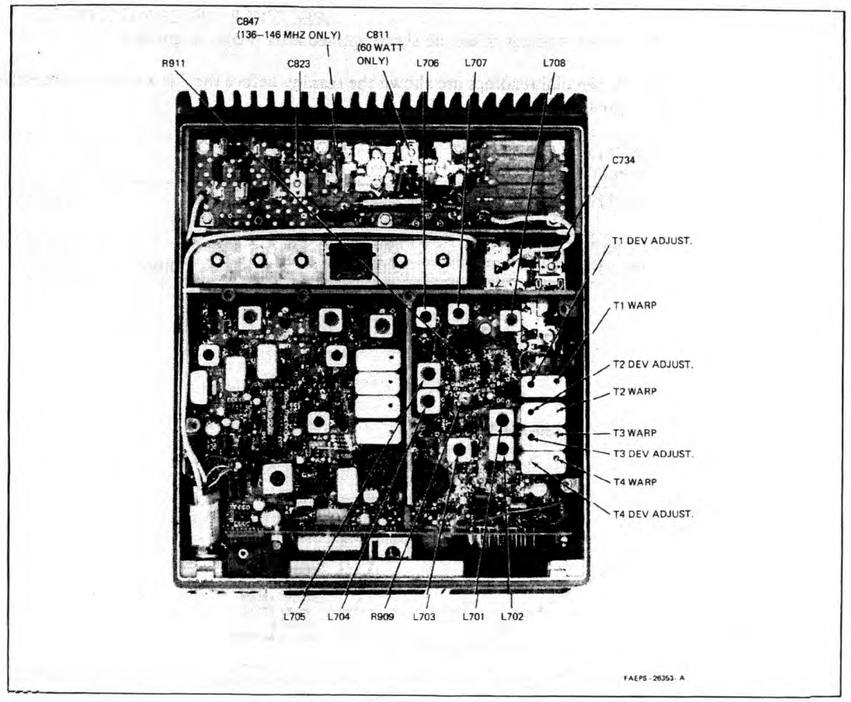
Where f_O = crystal frequency, f_c = carrier frequency

Preset Table for L707 and L708

136-146 MHz Models		146-174 MHz Models	
#Of Turns From Top of Coil Can	Frequency of F min	#Of Turns From Top of Coil Can	Frequency of F min
6 Turns	136-146 MHz	8 Turns	146-155 MHz
		7 Turns	From Above 155 to 165 MHz
		6 Turns	From Above 165 to 174 MHz

High Band Transmitter Alignment Procedure (40 W or 60 W Models Only)

Step	Test Switch Position	Adjustment	Procedure
1	None	Freq. Select	Adjust to lowest frequency channel, F min, for multiple freq. models.
		L701 — L708	Turn all coil slugs to flush with top of can. Then, preset L701 and J703 to 7 turns in from top of coil can.
		L707, L708	Preset L707 and L708 per the preset table.
		R909, R911	Adjust fully clockwise.
		C734, C811, C823, C847	Preset to 2 turns from tight for C734, 1 turn from tight for C811, C823 or C847.
2	M3	L701, L702, L703	Peak L702, then peak L701, L702, L703 until no further improvement.
3	M3	L704, L705	Dip L704, peak L705.
4	M5	L706, L707, L708, L704, L705	Peak L706, L707, L708, L704, and L705, in that order. If necessary, adjust R911 to prevent M5 saturation.
5	Wattmeter	C734, C811, C823, C847	Peak power out with C734. Also peak C811 and C823 on 146-174 MHz 60 W models or C847 on all 136-146 MHz models.
6	Wattmeter	R911	Adjust R911 to 70 W for 60 W models, 47 W for 40 W Models, 40 W for 30 W models. Set R911 to the appropriate extreme position if this power level cannot be achieved.
7	M5	L707, L708	Peak L707, L708.
8	Wattmeter	C734	Peak C734.
	Steps 9-11 apply to wide-spaced radios only. If transmitter is to be tuned for a single frequency, or a separation of less than 500 kHz, skip to Step 16 (136-146 MHz models) or to Step 18 (146-174 MHz models).		
9	M3	L702	Select the highest frequency channel Fmax. Peak L702.
10	M5	L704, L706	Peak L704 and L706.
11	M3	L701, L703	Select the lowest frequency channel, Fmin. Peak L701 and L703.
12	M5	L705, L707	Peak L705 and L707.
13	M5	L708, frequency select.	Adjust L708 such that the reading on M5 is the same on Fmin and Fmax. If this is not possible, peak L708 on the channel with the lowest M5 reading.
	Steps 14-15 apply to 60-watt wide-spaced radios only. For 30/40 Watt (136-146 MHz models) skip to Step 16. For 40 Watt (146-174 MHz models) skip to Step 18.		
14	Wattmeter	R911, R909	Adjust R911 fully clockwise. For 136-146 MHz models select channel with lowest power. For 146-174 MHz models select channel with highest power. Adjust R909 for 68 watts out.
15	Wattmeter	C823, C847, R909	Adjust C823 or C847 so that output power of Fmin and Fmax are within 3 watts of each other. For 136-146 MHz models adjust C847 in direction of increasing power. After adjusting C823 or C847, turn R909 fully clockwise.
	Steps 16-17 apply to 136-146 MHz radios only. If transmitter frequency is between 146-174 MHz skip to Step 18.		
16	Wattmeter	R911	Select channel with the lowest power out (multiple frequency models only). Adjust R911 for 68, 50 or 40 watts out for 60, 40 or 30 watt models, respectively. Recheck all channels and if necessary, readjust R911 until lowest power channel yields the power level stated above.
17	Wattmeter	R909	Adjust R909 for 64, 44 or 34 watts out for 60, 40 or 30 watt models, respectively. Select channel with lowest power out (multiple frequency models only). If power is less than 62, 43 or 33 watts for 60, 40 or 30 watt models, respectively, then readjust R909 for that minimum power.
	This completes the alignment of 136-146 MHz transmitter models.		
18	Wattmeter	R911	Select the channel with the highest power output *(multiple frequency models only).* Adjust R911 to 70 W (60 W models) or 47 W (40 W models). If power output cannot be reduced to 70 W or 47 W, adjust R911 to fully counterclockwise.
19	Wattmeter	R909	Adjust R909 to 65 W (60 W models) or 44 W (40 W models).
	This completes the alignment of 146-174 MHz transmitter models.		



High Band MITREK Transmitter Ajustment Locations (40 and 60 Watt Models)

FINAL METER READINGS

1. Each time a transmitter is aligned or tested, final meter readings should be made and entered in a logbook.

2. All readings given in the following table are minimum (based on a nominal dc supply voltage of 13.6 volts) except M7 (PA current) which is a nominal reading.

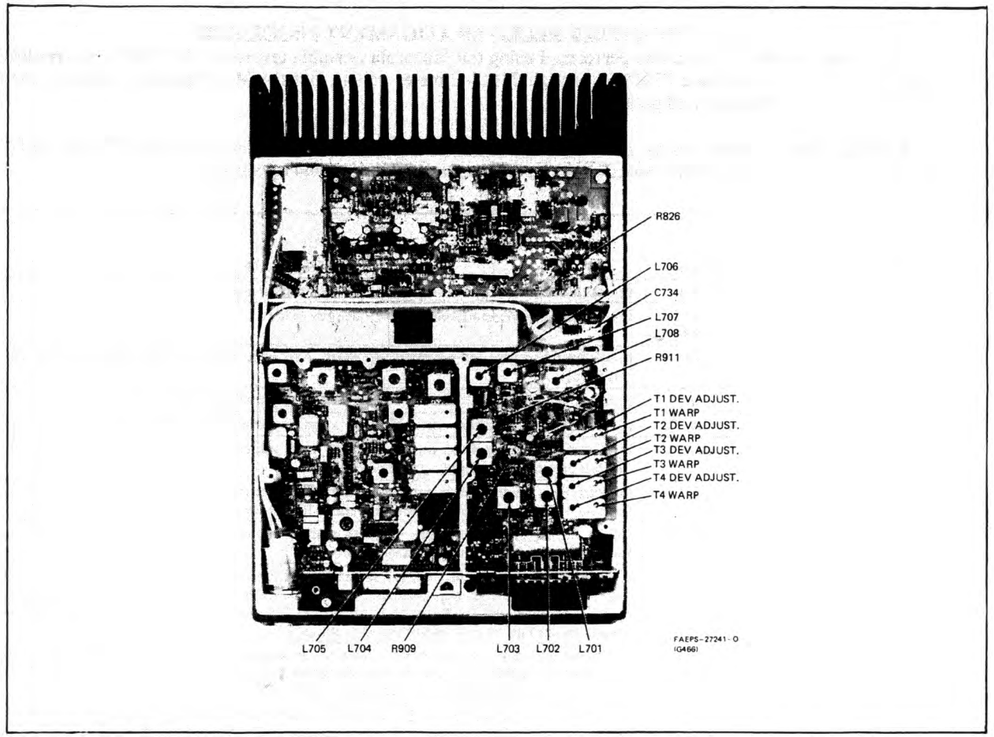
3. The readings at M3 and M5 are purely relative and do not give actual current or voltage measurements.

4. Multiple the microampere scale reading obtained at M7 by 0.6 (40 W), 0.8 (60 W), or 1.3 (75 and 110 W) to determine the actual final amplifier current in amperes.

Transmitter Metering Tables

S1056B-9B Series Switch Position	3	5	7
Meter Reading	15 uA (min)	10 uA (min)	9-13 uA (40 watt models) 9-15 uA (60 watt models) 9-15 uA (75 watt models) 11-19 uA (110 watt models)
Circuit Metered	Oscillator Output	First Amplifier Output	Final Amplifier Current

Transmitter Alignment Procedure
Motorola No. ***PEPS-26662-F***
5-1-84



Transmitter Adjustment Locations (75 and 110 watt models)

OSCILLATOR FREQUENCY ADJUSTMENT

Setting the oscillator "on frequency" should be done *after* the transmitter has been aligned, but *before* transmitter deviation is checked and set. In addition, it is essential that the bottom shield is in place when this adjustment is made. Set the oscillator on frequency and perform the following steps:

Step 1. Set the frequency selector switch to the F1 position (multi-frequency units only).

Step 2. Key the transmitter with no modulation using the portable test set. On "Private-Line" and "Digital Private-Line" radios, disable the encoder output by shorting the code disable points.

Step 3. Adjust T1 warp control for proper readings on the frequency meter. If the frequency, as indicated on the frequency meter, is too low; then turn the warp control counterclockwise; if too high, turn clockwise. Set frequency within ± 75 Hz.

NOTE
Omit Steps 4 & 5 for single frequency units.

Step 4. Set the frequency selector switch to the F2 position and repeat Step 3 using T2 warp control.

Step 5. Repeat Step 4 for F3 and F4 using T3 and T4 warp controls, respectively.

DEVIATION ADJUSTMENT

The oscillator frequency adjustment must be made *before* this adjustment.

Step 1: Connect the output leads of the tone oscillator through a 0.33-μF capacitor to the transmitter audio input (microphone receptacle).

Step 2: Connect the ac voltmeter across the audio oscillator and adjust the tone generator output to 1 volt at 1000 Hz. On Private-Line radios disable the encoder by turning R23 on the PL board fully counterclockwise. On Digital Private-Line radios short the code disable points.

Step 3: Switch the frequency selector switch to F1 and key the transmitter. Adjust F1 DEV ADJ for:

Carrier Squelch Radio 4.8 kHz
PL/DPL Radio 4.0 kHz

For multiple-frequency models, adjust the F2, F3, and F4 deviation with the frequency selector switch in the corresponding position. This completes the deviation adjustment for carrier squelch radios.

Step 4: For Private-Line or Digital Private-Line radios, disconnect the audio oscillator. On Private-Line radios adjust R23 on the PL board to set PL DEV to 700 Hz. No deviation adjustment is required for DPL radios. Private-Line or Digital Private-Line deviation should read 750 Hz ±250 Hz. Reconnect the audio oscillator. Readjust DEV ADJ for 4.8 kHz on all transmit channels.

High Band Transmitter Alignment Procedure (75 W or 110 W Models Only)

Step	Test Switch Position	Adjustment	Procedure
1	None	Freq. Select	Adjust to lowest frequency channel, F min, for multiple frequency model.
		L701 — L708	Turn all coil slugs to flush with top of can. Then, preset L701 and L703 to 7 turns in from top of can.
		L707, L708	Preset L707 and L708 per the preset table.
		R909, R911, R826	Adjust fully clockwise.
		C734	Preset to 2 turns from tight.
2	M3	L701, L702, L703	Peak L702, then peak L701, L702, L703 until no further improvement is obtained.
3	M3	L704, L705	Dip L704, then peak L705.
4	M5	L706, L707, L708, L704, L705.	Peak L706, L707, L708, L704, and L705, in that order. If necessary, adjust R911 to prevent M5 saturation.
5	Wattmeter	C734, R911	Peak power output with C734. Adjust R911 to 125 W (75 W models) or 130 W (110 W models).
6	M5	L707, L708	Peak L707 and L708.
7	Wattmeter	R911, C734	Adjust R911 to 125 W (75 W models) or 130 W (110 W models). Peak power output with C734.
If transmitter is tuned for a single frequency, or a maximum separation of less than 500 kHz, skip to Step 14.			
8	M3	L702	Select the *highest* frequency channel, F max and peak L702.
9	M5	L704, L706	Peak L704 and L706.
10	M3	L701, L703	Select the *lowest* frequency channel, F min. Peak L701 and L703.
11	M5	L705, L707	Peak L705 and L707.
12	Wattmeter	R911	While monitoring output power on all channels, adjust R911 so that the minimum output power among all channels is 92 W (75 W models) or 130 W (110 W models).
13	Wattmeter, M5	R911, L708	Adjust L708 for equal M5 reading on F min and F max. While adjusting L708, reset R911, if necessary, to maintain the minimum power levels stated, in Step 12. If balancing of M5 is not possible, peak L708 on the channel with the lowest M5 reading.
14	Wattmeter, M5	R911	Select the channel with the *lowest* power output (multiple frequency models only). Adjust R911 for output of 125 W for 75 W models or 130 W for 110 W models. Note M5. Readjust R911 to *increase* M5 by 2 microamperes.
15	Wattmeter	R826	While monitoring output power on all channels, adjust R826 so that the minimum output power among all channels is 125 W (75 W models) or 130 W (110 W models).
16	Wattmeter	R909	While monitoring output power on all channels, adjust R909 so that the minimum output power among all channels is 82 W (75 W models) or 120 W (110 W models).