

Location of Adjustments  
 Figure 4-1

# section 4

---

## service instructions

### 4.1 GENERAL

Included in this section are signal tracing procedures, alignment and neutralization procedures, and voltage and resistance measurements. If any soldered parts are removed or replaced at terminals to which semiconductor diodes are connected, be sure to attach an alligator clip to the diode lead. This acts as a heat sink to protect the diode.

To remove the transceiver chassis from the cabinet, lift the lid and remove the two Phillips-head screws located between the lid fasteners. Remove the four feet and the screw located

midway between the rear feet. From the rear, push the chassis forward until the front panel protrudes from the cabinet about an inch. Grasp the front panel at the edges, and carefully slide the chassis out of the cabinet.

### 4.2 TRANSMITTER SIGNAL TRACING

Table 4-1 lists appropriate signal generator connection points and normal signal levels. Figure 4-1 shows location of adjustments. Before making measurements, set EMISSION switch to USB, disable the power amplifier by disconnecting the jumper between J5 and J6, and disconnect the +800-volt dc plate voltage

Table 4-1. Transmitter Signal Levels.

SIGNAL GENERATOR CONNECTION POINT	BAND-SWITCH POSITION	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR OUTPUT VOLTAGE
V8-2 (grid)	3.8 7.2 14.2 21.4 28A	3.9 MHz 7.3 MHz 14.3 MHz 21.5 MHz 28.6 MHz	0.5 volt 0.41 volt 0.5 volt 0.2 volt 0.75 volt
V7-1 (grid)	3.8 7.2 14.2 21.4 28A 28B, 28C	3.9 MHz 7.3 MHz 14.3 MHz 21.5 MHz 28.6 MHz According to crystal used	40,000 microvolts 22,000 microvolts 43,000 microvolts 30,000 microvolts 32,000 microvolts
V6-2 (grid)	14.2	3.055 MHz	32,000 microvolts
V5-2 (grid)	14.2	3.055 MHz	62,000 microvolts
V4A-6 (grid)	14.2	455 kHz	12,000 microvolts
For the following, disconnect signal generator, remove J16 short, set EMISSION switch to TUNE, and adjust MIC GAIN for grid current threshold. Measure with ac vtvm or calibrated oscilloscope.			
V3A-7 (cathode)	Any	*1750 Hz	0.014 volt
V3A-9 (grid)	Any	*1750 Hz	0.06 volt
V11B-9 (grid)	Any	*1750 Hz	2.8 volts
For the following, turn EMISSION switch to USB, and connect audio oscillator to J11 through a 40-dB pad. Set MIC GAIN fully clockwise, and adjust audio oscillator output for pa grid current threshold. Measure input at oscillator output with ac vtvm.			
V1A-9 (grid) or J11 PHONE PATCH	Any	1500 Hz	35 millivolts through a 40-dB pad

Table 4-1. Transmitter Signal Levels (Cont).

SIGNAL GENERATOR CONNECTION POINT	BAND-SWITCH POSITION	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR OUTPUT VOLTAGE
For the following, short J16 to ground, peak EXCITER TUNING for each band, and measure at test point with vtvm.			
V6-3	3.6 7.0 14.0 21.2 28.5		1.0 to 1.8 volts 1.0 to 1.4 volts 1.0 to 1.4 volts 1.0 to 1.4 volts 1.0 to 1.4 volts
V5-2 or 7 Wiper of R15	Vfo set at 100 Any		1.0 to 1.4 volts 1.0 to 1.4 volts 1.0 to 1.4 volts
*Frequency of internal tone oscillator.			

lead from the power supply. Set meter switch to GRID. Peak EXCITER TUNING, and turn VOX GAIN control full counterclockwise. Short PTT jack J16 to ground to key the KWM-2/2A to transmit. Connect signal generator output to points indicated in table 4-1, and adjust signal generator output attenuator until pa grid current just begins to show on the meter. Attenuator reading is signal voltage necessary at that point. Voltages given in the table are nominal and may vary  $\pm 20$  percent. Each time, be careful to set signal generator to frequency shown in the table. Oscillator output voltage may be measured with a vacuum-tube voltmeter.

### 4.3 RECEIVER SIGNAL TRACING

Table 4-2 lists significant test points and normal signal levels. Figure 4-1 shows location of test points and adjustments. All rf and if measurements were made by connecting a vacuum-tube voltmeter to the AVC bus and increasing signal generator output until the AVC threshold is reached. The AVC threshold voltage is the point at which the dc vtvm indication just changes with increased signal level. The receiver was tuned to 14.1 MHz for these measurements, and a test signal injected at indicated test points. Signal voltage values are taken from signal generator output attenua-

Table 4-2. Receiver Signal Levels.

TEST POINT	FREQUENCY	VOLTAGE	TEST POINT	FREQUENCY	VOLTAGE
V15B-8	455 kHz	1.1 volts	V13B-8	High-frequency oscillator injection signal (17.155 MHz)	*1.8 to 3.0 volts
V15B-9	455 kHz	*1.4 volts			
V3B-6	455 kHz	8000 microvolts			
V1B-6	455 kHz	220 microvolts	V13B-9	14.1 MHz	55 microvolts
V17B-9	2.5-2.7 MHz	*0.6 volt	V7-1	14.1 MHz	6.5 microvolts
V17B-8	3.055 MHz	180 microvolts	J2 (RCVR ANT) or J1 (RF OUT)	14.1 MHz	2.3 microvolts
*Oscillator injection voltage, measured with rf vacuum-tube voltmeter.					

tor. All values are nominal and may vary  $\pm 20$  percent without degrading performance.

#### 4.4 VOLTAGE AND RESISTANCE MEASUREMENTS

Table 4-3 lists voltage and resistance of all tube sockets of the KWM-2/2A except that of the vfo tube, V301. DO NOT OPEN the oscillator can. Refer to figure 7-2 for location of tube sockets. Measurements were made under the following conditions:

- a. All measurements made with a vtm and with all tubes in sockets. Unless otherwise noted in table, all measurements made with R. F. GAIN at maximum, A. F. GAIN at minimum, EMISSION switch in USB position, BAND switch in 14.2 position, vfo dial at 100, OFF-ON-NB-CAL switch in ON

- b. Resistances of less than 0.9 ohm listed as zero.
- c. Resistance measurements made with power supply plug removed from J13.
- d. All measurements made from tube socket pins to ground.
- e. When two voltages are given for same tube pin, the first is for receive condition and the second for transmit condition.

**Warning**

800 volts dc is present on rear power connector J13 (pin 2) and inside pa compartment.

Table 4-3. KWM-2A Transceiver, Voltage and Resistance Measurements.

TUBE		PIN NUMBER									PLATE CAP
		1	2	3	4	5	6	7	8	9	
V1	DC V	275/1.5	165/1.4	2.6	-	0	-1.6/-20	0.40	37/35	-0.31/-0.35	
	AC V	①	②	③	6.3	0					
	RES	10 k $\Omega$	36 k $\Omega$	10 $\Omega$ to 1 k $\Omega$	0	0	3.5 M $\Omega$	180 $\Omega$	80 k $\Omega$	1 M $\Omega$	
V2	DC V	270/245	0	**130	-	0	**140	**4.2	130/115	130/115	
	AC V		**6.5 ④		6.3	0					
	RES	10 k $\Omega$	600 k $\Omega$	120 k $\Omega$	0	0	60 k $\Omega$	$\infty$	7 k $\Omega$	58 k $\Omega$	
V3	DC V	220/1.5	145/1.4	0.5/0	-	0	-1.5/-17	5.7/7.5	0/180	0	
	AC V		⑤		6.3	0		⑥	⑦	⑧	
	RES	15 k $\Omega$	36 k $\Omega$	50 $\Omega$	0	0	3.2 M $\Omega$	1 k $\Omega$	20/29 k $\Omega$	0 to 250 k $\Omega$	
V4	DC V	0/250	0/135	0.1/1.7	-	0	-1.0/-1.0	18/0	275/72	0/-0.8	
	AC V		⑨	⑩	6.3	0	⑪	⑫	⑬		
	RES	11 k $\Omega$	18 k $\Omega$	92 to 101 $\Omega$	0	0	1.5 M $\Omega$ /750 k $\Omega$	2 k $\Omega$	36 k $\Omega$	$\infty$	
V5	DC V	275/215	-44/-0.05	0/2.1	0	0	275/215	-44/0.05	0/2.1	-	
	AC V	⑭	⑮	⑯	0	0	⑭	⑮	⑯	6.3	
	RES	12 k $\Omega$	300 k $\Omega$	250 $\Omega$	0	0	12 k $\Omega$	300 k $\Omega$	250 $\Omega$	0	
V6	DC V	0.3/220	-6.0/0	0/2.0	0	0	0.3/220	-2.9/0.5	0/2.0	0	
	AC V	⑰			6.3	6.3	⑰			0	
	RES	25/12 k $\Omega$	90 k $\Omega$	220 $\Omega$	0	0	25/12 k $\Omega$	100 k $\Omega$	220 $\Omega$	0	
V7	DC V	-1.5/-1.1	0	0	0	270/240	150/125	0			
	AC V			6.3	0						
	RES	2.5 M $\Omega$	0	0	0	12 k $\Omega$	30 k $\Omega$	0			
V8	DC V	0/4	-65/0	0.3/180	0	0	290/260	0	0.3/180	-65/0	
	AC V			⑱	0	6.3					
	RES	150 $\Omega$	28 k $\Omega$	23 k $\Omega$	0	0	10 k $\Omega$	0	23 k $\Omega$	28 k $\Omega$	

section 4  
service instructions

Table 4-3. KWM-2A Transceiver, Voltage and Resistance Measurements (Cont).

TUBE		PIN NUMBER									PLATE CAP
		1	2	3	4	5	6	7	8	9	
V9	DC V	0/0.1	0	0/240	0	-65	0/0.1	0	0		∞
	AC V			Ⓜ19				6.3			
	RES	2Ω	0	13/15 kΩ	2Ω	40 kΩ	2Ω	0	0		
V10	DC V	0/0.1	0	0/240	0	-65	0/0.1	0	0		∞
	AC V			Ⓜ19				6.3			
	RES	2Ω	0	13 k/15 kΩ	2Ω	40 kΩ	2Ω	0	0		
V11	DC V	85/75	-9/-8	81/75	0	0	180/165	0	2.2/2.0	0	
	AC V				6.3	0					
	RES	55 kΩ	1 MΩ	230 kΩ	0	0	18 kΩ	0	1 kΩ	450 kΩ	
V12	DC V	275/1.5	0/-0.1	280/1.5	0	0	280/1.5	15/0.1	100/0.4	120/-1.5	
	AC V				6.3	0		*0.6 Ⓜ20			
	RES	10 kΩ	1 MΩ	130 kΩ	0	0	250 kΩ	1 MΩ	6.8 kΩ	60 kΩ	
V13	DC V	155/1.5	2.8/2.5	195/180	0	0	290/260	0	1.8/0	0/-70	
	AC V			Ⓜ21	6.3	0					
	RES	20 kΩ	1 MΩ	42 kΩ	0	0	9 kΩ	0	150Ω	100 kΩ	
V14	DC V	-1.0	0	0.8/1.0	0	0	-0.1	90/82	0	0.7/0.6	
	AC V	Ⓜ22	Ⓜ23	Ⓜ24	6.3	0	Ⓜ25	Ⓜ26	Ⓜ27	Ⓜ28	
	RES	∞	0 to 500 kΩ	∞	0	0	270 kΩ	110 kΩ	220 to 485 kΩ	330Ω	
V15	DC V	-1.5/-20	2.8/2.5	2.8/2.5	0	0	-1.5/-20	130/180	0/-64	1.5/0	
	AC V				6.3	0					
	RES	2.2 MΩ	5.6 kΩ	5.6 kΩ	0	0	2.2 MΩ	45 kΩ	1 MΩ	850Ω	
V16	DC V	0/0	-0.8/-0.8	82/80	0	0	2.2/2.0	0	130/120	182/170	
	AC V	Ⓜ29	Ⓜ30		6.3	0					
	RES	0	2.3 MΩ	230 kΩ	0	0	68Ω	470 kΩ	25 kΩ	12 kΩ	
V17	DC V	0.5/0.3	1.7/1.5	0.5/0.3	0	0	-1.3	280/90	0/-64	3.8/0.2	
	AC V				0	6.3	Ⓜ31	Ⓜ32	Ⓜ33		
	RES	∞	1.5 kΩ	∞	0	0	2.3 MΩ/400 kΩ	8.5/300 kΩ	100 kΩ	1 kΩ	

\*OFF-ON-NB-CAL switch in the CAL position.

\*\*EMISSION switch in the TUNE position.

- ① Voltage at V1-1 may vary more than 20%. Voltage depends on RCVR GAIN ADJ (R132) setting.
- ② Voltage and resistance at V1-2 may vary more than 20%. Voltage depends on RCVR GAIN ADJ (R132) and S METER ZERO (R121) settings. Resistance depends on S METER ZERO (R121) setting.
- ③ Voltage at V2-3 may vary more than 20%. Voltage and resistance depend on RCVR GAIN ADJ (R132) setting.
- ④ Resistance at V2-2 is 640 kΩ (±20%) if R51 and R52 are 390 kΩ each. Refer to ① in illustrations section.
- ⑤ Voltage and resistance at V3-2 may vary more than 20%. Voltage and resistance depend on S METER ZERO (R121) setting.
- ⑥ Voltage at V3-7 may vary more than 20%. Voltage depends on MIC GAIN (R8) setting.
- ⑦ Voltage and resistance at V3-8 may vary more than 20%. Voltage depends on MIC GAIN (R8) setting. Resistance depends on polarity of ohmmeter and value of R18 used. Smaller resistance is with positive lead of ohmmeter connected to ground. Resistance is 22.5 kΩ, or 31.5 kΩ if R18 is 47 kΩ. Refer to ⑫ in illustrations section.
- ⑧ Voltage at V3-9 may vary more than 20%. Voltage and resistance depend on MIC GAIN (R8) setting.
- ⑨ Voltage at V4-2 is 0/95 Vdc (±20%) and resistance is 23 kΩ (±20%) if R18 is 47 kΩ. Refer to ⑫ in illustrations section.

Table 4-3. KWM-2A Transceiver, Voltage and Resistance Measurements (Cont).

10	Voltage and resistance of V4-3 may vary more than 20%. Voltage and resistance depend on ALC ZERO (R30) setting and R38 value. Resistance is 81 to 96Ω (±20%) if R38 is 68Ω. Resistance is 73 to 92Ω (±20%) if R38 is not installed. Refer to 12 in illustrations section.
11	Resistance at V4-6 depends on polarity of ohmmeter. Larger resistance is with positive lead of ohmmeter connected to ground.
12	Resistance at V4-7 is 3 kΩ (±20%) if R46 is 3300Ω. Refer to 9 in illustrations section.
13	Voltage at V4-8 is 275/170 Vdc (±20%) and resistance is 21 kΩ (±20%) if R202 is not in V4B plate circuit. Refer to 9 in illustrations section.
14	Voltage at V5-1 and V5-6 is 275/250 Vdc (±20%) and resistance is 9 kΩ (±20%) if L3 is in plate circuit instead of R197. Refer to 16 in illustrations section.
15	Voltage at V5-2 and V5-7 is -64/-0.05 Vdc (±20%) and resistance is 480 kΩ (±20%) if R212 has not been added. Refer to 14 in illustrations section.
16	Voltage and resistance at V5-3 and V5-8 may vary more than 20%. Voltage and resistance depend on 1st MIX BAL (R24) setting.
17	Resistance at V6-1 and V6-6 depends on polarity of ohmmeter and values of R143 and R18 used. Larger resistance is with positive lead of ohmmeter connected to ground. Resistance is 28 kΩ or 12 kΩ (±20%) if R18 is 47 kΩ. Resistance is 24 kΩ or 11 kΩ (±20%) if R143 is 1500Ω. Resistance is 27 or 11.5 kΩ (±20%) if R18 is 47 kΩ and R143 is 1500Ω. Refer to 22 and 12 in illustrations section.
18	Voltage at V8-3 is -0.4/145 Vdc (±20%) and resistance is 30 kΩ (±20%) if R105 is 22 kΩ. Refer to 31 in illustrations section.
19	Resistance at V9-3 and V10-3 depends on polarity of ohmmeter. Smaller resistance is with positive lead of ohmmeter connected to ground.
20	Resistance and voltage at V12-7 depend on position of OFF-ON-NB-CAL switch and the polarity of the ohmmeter. Dc voltage and resistance are normally checked with the OFF-ON-NB-CAL switch in the ON position. The smaller resistance is with the positive lead of ohmmeter connected to ground. (Because of very high resistance of R11, reversal of ohmmeter leads may not make a noticeable change in readings.) Ac voltage is measured with the OFF-ON-NB-CAL switch in the CAL position. Resistance to ground in the CAL position is 1000Ω (±20%).
21	Voltage at V13-3 is 195/180 Vdc (±20%) and resistance is 51 kΩ (±20%) if R125 is 47 kΩ. Refer to 27B in illustrations section.
22	Voltage at V14-1 may vary more than 20%. Voltage depends on VOX TIME CONSTANT (R43) setting, ANTI VOX GAIN (R45) setting, and whether or not R199 has been added. Refer to 8 in illustrations section.
23	Voltage and resistance at V14-2 may vary more than 20%. Voltage and resistance depend on ANTI VOX GAIN (R45) setting.
24	Voltage at V14-3 may vary more than 20%. Voltage depends on VOX TIME CONSTANT (R43) setting and whether or not R199 has been added. Refer to 8 in illustrations section.
25	Voltage at V14-6 may vary more than 20%. Voltage depends on VOX TIME CONSTANT (R43) setting and whether or not R199 has been added. Refer to 8 in illustrations section.
26	Voltage at V14-7 may vary more than 20%. Voltage depends on VOX GAIN (R39) setting and whether or not R201 has been added. Refer to 7 in illustrations section.
27	Voltage and resistance at V14-8 may vary more than 20%. Voltage and resistance depend on VOX GAIN (R39) setting and whether or not R201 has been added. If R201 has not been added, resistance is 0 to 250 kΩ (±20%); with no VOX input, voltage at V14-8 is 0 Vdc. Refer to 7 in illustrations section.
28	Voltage at V14-9 may vary more than 20%. Voltage depends on VOX GAIN (R39) setting and whether or not R201 has been added. Refer to 7 in illustrations section.
29	Voltage at V16-1 is 3.0/2.8 Vdc (±20%) and resistance is 5600Ω (±20%) if V16-1 is connected to V15-2. Refer to 26 in illustrations section.

Table 4-3. KWM-2A Transceiver, Voltage and Resistance Measurements (Cont).

30	Voltage at V16-2 is 1.8/1.5 Vdc ( $\pm 20\%$ ) if V16-1 is connected to V15-2. Refer to 26 in illustrations section.
31	Voltage at V17-6 is -1.5/-1.6 Vdc ( $\pm 20\%$ ) and resistance is 2.3 M $\Omega$ /2200 $\Omega$ ( $\pm 20\%$ ) if R190 is 2200 $\Omega$ and R211 is not installed. Resistance depends on polarity of ohmmeter. Larger resistance is with positive lead of ohmmeter connected to ground. Refer to 37 in illustrations section.
32	Voltage at V17-7 is 300/-4 Vdc ( $\pm 20\%$ ) and resistance is 8500 $\Omega$ /100 k $\Omega$ ( $\pm 20\%$ ) if R193 is 220 k $\Omega$ , R194 is 470 k $\Omega$ , and CR9 is installed. Resistance depends on polarity of ohmmeter. Smaller resistance is with positive lead of ohmmeter connected to ground. Voltage at V17-7 is 300/-4 Vdc ( $\pm 20\%$ ) and resistance is 8500 $\Omega$ ( $\pm 20\%$ ) if CR9 is not installed. Refer to 19 in illustrations section.
33	Voltage at V17-9 is 3.8/0.2 Vdc ( $\pm 20\%$ ) if R193 is 220 k $\Omega$ and R194 is 470 k $\Omega$ . Refer to 19 in illustrations section.

## 4.5 FIELD ALIGNMENT PROCEDURES

### 4.5.1 Field Alignment

Field alignment consists of a few simple adjustments and is intended as a means of restoring peak performance of a working KWM-2/2A. No alignment procedure should ever be performed just for the sake of alignment. Adjustments should be made only when there is reason to suspect that performance is not up to standard. All field alignment adjustment points can be reached by raising the cabinet lid, and the KWM-2/2A does not have to be removed from its cabinet. Refer to figure 4-1 for adjustment locations.

### 4.5.2 Test Equipment Required

Test equipment required for field alignment of the KWM-2/2A are a 50-ohm, 100-watt dummy load and a receiver with a 100-kHz crystal calibrator and an S-meter.

### 4.5.3 RF Circuits Peaking

- Connect dummy load to KWM-2/2A output jack J1. Set KWM-2/2A controls as follows: OFF-ON-NB-CAL to ON, BAND to 28A, EMISSION to LSB, MIC GAIN to OFF, INCREASE LOADING to 50 $\Omega$ , and tuning dial to 100.
- After 5-minute warmup period, set EMISSION switch to TUNE and meter switch to GRID. Adjust MIC GAIN and EXCITER

TUNING to produce midscale indication on meter. Set meter switch to PLATE, and dip plate current with P. A. TUNING. Reset meter switch to GRID. Peak the four (E)28 trimmer capacitors for maximum grid current. Refer to figure 4-1 for trimmer locations.

- Set BAND switch to 21.2 and tuning dial to 100. Adjust MIC GAIN and EXCITER TUNING for midscale grid current. Set meter switch to PLATE, and dip plate current. Reset meter switch to GRID. Peak the four (D)21 trimmer capacitors for maximum grid current.
- Set BAND switch to 14.0 and tuning dial to 150. Adjust MIC GAIN and EXCITER TUNING for midscale grid current. Set meter switch to PLATE and dip plate current. Reset meter switch to GRID. Peak the four (C)14 trimmer capacitors for maximum grid current.
- Set BAND switch to 7.0 and tuning dial to 150. Adjust MIC GAIN and EXCITER TUNING for midscale grid current. Set meter switch to PLATE, and dip plate current. Reset meter switch to GRID. Peak the four (B)7.0 trimmer capacitors for maximum grid current.
- Set BAND switch to 3.6 and tuning dial to 100. Adjust MIC GAIN and EXCITER TUNING for midscale grid current. Set meter switch to PLATE, and dip plate current. Reset meter switch to GRID. Peak the four (A)3.5 trimmer capacitors for maximum grid current.
- Set EMISSION switch to LSB.

#### 4.5.4 VFO Sideband Frequency Shift Adjustment

**Caution**

Do not make this adjustment unless switching from one sideband to the other makes readjustment of tuning dial necessary to keep output signal from shifting.

Set the EMISSION switch to LSB and the OFF-ON-NB-CAL switch to CAL, and turn the main tuning dial to zero beat with the calibrate signal at 3.7 MHz. Without further movement of the main tuning dial, switch the EMISSION switch to USB and adjust the vfo capacitor (C308) to obtain zero beat.

#### 4.5.5. Carrier Balance (Null) Adjustment

- a. Set BAND switch to 3.6 and tuning dial to 100.
- b. Set EMISSION switch to LSB, and turn MIC GAIN full counterclockwise until it clicks. Key KWM-2/2A by turning VOX GAIN counterclockwise until it clicks or by grounding push-to-talk (ptt) line at jack J16.
- c. Loosely couple receiver antenna lead to dummy load, and peak EXCITER TUNING and P. A. TUNING to obtain a midscale reading on receiver S-meter.
- d. Adjust CARRIER BAL potentiometer R15 and trimmer capacitor C9 for minimum indication on receiver S-meter. These adjustments interact, so adjust first one and then the other until neither produces any further decrease in S-meter indication.
- e. Switch EMISSION switch back and forth between USB and LSB to see that the carrier suppression is about the same for either sideband. If it is not, repeat step d until carrier suppression is about equal for both sidebands.
- f. Remove receiver antenna lead from near dummy load, and remove short from PTT line.

#### 4.5.6 ALC Zero Adjustment

- a. Set EMISSION switch to TUNE position. Tune and load transmitter to 14.1 MHz. Set EMISSION switch to USB.

- b. Set MIC GAIN control to minimum, and set meter switch to ALC position. Short ptt jack J16 to ground.
- c. Adjust ALC ZERO potentiometer (inside cabinet) until meter indicates zero. Remove ptt short.

#### 4.5.7 First Mixer Balance Adjustment

- a. Set BAND switch to 21.0 and tuning dial to 0. Tune and load KWM-2/2A into dummy load, then set EMISSION switch to LSB and MIC GAIN to counterclockwise limit until switch clicks.
- b. Loosely couple receiver antenna lead to dummy load. Tune receiver across 21.455 MHz until signal is heard.
- c. Adjust mixer balance potentiometer R24 and trimmer capacitor C21 for minimum signal. These adjustments interact, so adjust first one and then the other until neither produces any further decrease in output.

#### 4.5.8 S-Meter Zero Adjustment

- a. Set BAND switch to 14.2 and tuning dial to 100. Connect output of 100-kHz crystal calibrator in test receiver to 50-ohm dummy load. Peak KWM-2/2A EXCITER TUNING for maximum KWM-2/2A S-meter indication. Set R. F. GAIN to clockwise limit, and turn off 100-kHz crystal calibrator.
- b. Short RCVR ANT. jack J2 to ground. Adjust S METER ZERO potentiometer R121 for zero indication on S-meter.

#### 4.5.9 Crystal Calibrator Adjustment

- a. Tune KWM-2/2A to zero beat with carrier of station WWV at 15.0 MHz at a time when station WWV is not transmitting a tone.
- b. Set OFF-ON-NB-CAL switch to CAL. Adjust CAL ADJUST trimmer C76 (inside cabinet on chassis) for zero beat of calibration signal.

#### 4.5.10 VFO End-Point Adjustment

With the BAND switch set to 3.6, the KWM-2/2A should be in zero beat with the calibrator signal at 3600 kHz (0 on the KWM-2/2A dial)



and 3800 kHz (200 on the KWM-2/2A dial). The hairline indicator should be vertical and in the dial window. If there is no end-point spread, but the hairline is slanted to left or right, loosen the setscrews on the dial hub, and slip the dial mechanism on the oscillator shaft until zero beat occurs with the hairline vertical.

If there is end-point spread, correct it as follows before correcting a slanting hairline.

- a. Zero beat the KWM-2/2A with the 100-kHz calibrator signal at 3800 kHz and set KWM-2/2A hairline right on 200.
- b. Zero beat the KWM-2/2A with the 100-kHz calibrator signal at 3600 kHz. Note difference in kHz between hairline and 0 on KWM-2/2A dial (for example, -1.5 kHz).
- c. Without moving hairline, move dial to opposite side of 0 by an amount equal to frequency difference noted above (for example, +1.5 kHz).
- d. Adjust L302 for zero beat. It is located on top of vfo can.
- e. Set KWM-2/2A hairline over 0.
- f. Check zero beat at 200 oh dial (3800 kHz). If zero beat does not occur at exactly 200, repeat steps a through e.
- g. If, after adjustment of end points, hairline is not vertical in dial window, loosen setscrews on dial hub, and move dial with respect to the oscillator shaft so that zero beat occurs with end points (0 and 200) set at center.
- h. After these adjustments of vfo calibration, recheck vfo sideband frequency shift adjustment according to paragraph 4.5.4.

#### **4.5.11 VFO Dial Centering**

- a. Tune the KWM-2/2A to 14.3 MHz LSB, and set function switch to CAL.
- b. Tune the KWM-2/2A to zero beat.
- c. With the hairline vertical, 100 should be exactly under the hairline. If not, loosen the two setscrews on the dial hub (accessible from the bottom of the chassis with the cabinet removed), and set 100 exactly under the hairline.
- d. Retighten the setscrews.

#### **4.5.12 VFO Overtravel**

- a. With the hairline vertical, turn the main tuning dial to the end stop past 0.
- b. Note the overtravel between the hairline and 0.
- c. Turn the main tuning dial to the end stop past 200, and note the overtravel.
- d. If the overtravel is not equal, loosen the two setscrews in the vfo end-stop collar (accessible from the bottom of the chassis with the cabinet removed).
- e. Set the main tuning dial for half the total difference, and tighten the setscrews.
- f. This completes the field alignment of the KWM-2/2A.

### **4.6 LABORATORY ALIGNMENT PROCEDURES**

#### **4.6.1 Laboratory Alignment**

Laboratory alignment of the KWM-2/2A is performed only when extensive component replacement has taken place or when the KWM-2/2A is being placed in service after a long period of storage. These adjustments should be performed by a skilled technician. Laboratory alignment requires the KWM-2/2A to be removed from its cabinet. Refer to paragraph 4.1 for removal instructions.

#### **4.6.2 Test Equipment Required**

Test equipment required for laboratory alignment of the KWM-2/2A are a 50-ohm, 100-watt dummy load; a receiver with a 100-kHz crystal calibrator and an S-meter; an rf signal generator with a calibrated output attenuator; and a vtvm with an rf probe.

#### **4.6.3 Transmitting 455-kHz IF Alignment**

- a. Disable the screen circuit of the pa tubes by unsoldering one end of the jumper between PA DISABLE jacks J5 and J6. Remove V301 from its socket.
- b. Connect an rf vtvm from pin 2 of V5 to ground.
- c. Set OFF-ON-NB-CAL switch to ON. Set EMISSION switch to TUNE. Turn MIC GAIN off.
- d. Any voltage reading on the vtvm is due to carrier. Roughly adjust carrier balance

- potentiometer R15 and capacitor C9 for minimum vtmv indication.
- e. Set MIC GAIN to full on.
- f. Adjust the slug of T1 for peak vtmv reading. Adjust filter input trimmer C54 for peak vtmv reading.
- g. Disconnect vtmv, replace V301, and reconnect the jumper between the PA DISABLE jacks.
- h. After performing the above procedure, adjust the carrier balance according to paragraph 4.5.5.

#### 4.6.4 Bandpass IF Alignment

- a. Set OFF-ON-NB-CAL switch to ON. Set EMISSION switch to TUNE. Tune and load KWM-2/2A into a dummy load at 14.3 MHz. Switch meter to GRID position.
  - b. Make a swamping tool by connecting a 1000-ohm resistor and a 0.01- $\mu$ F capacitor in series and connecting clips to their free pigtailed. Connect the swamping tool across terminal 3 (secondary winding) of T2 to ground. This terminal is connected to the T2 end of coupling capacitor C25.
  - c. Keep grid current to approximately mid-scale or lower by adjusting MIC GAIN control, and peak the primary of T2. The primary slug for T2 is at the bottom of the can. Use grid current as peak indication.
  - d. Remove the swamping tool from the secondary of T2, and connect it across terminals 1 and 2 (primary winding) of T2 (between pins 1 and 6 of first mixer V5). Peak the secondary of T2 (slug at top of shield can). Remove the swamping tool.
- e. Retune and reload at 14.255 MHz. Without swamping any of the tuned circuits, peak L4 for grid current indication.

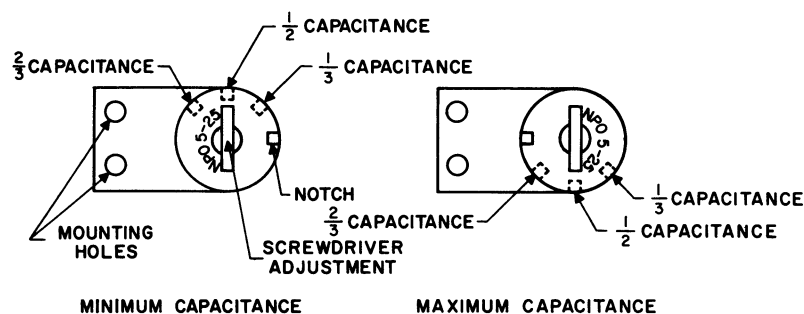
#### 4.6.5 RF Circuits Alignment

- a. Adjust all ceramic trimmer capacitors, including the three below the chassis, to one-half maximum capacitance, except as follows: DO NOT change the setting of CARRIER BAL capacitor, and set 3.8-MHz trimmers C70, C37, C109, and C130 to two-thirds maximum capacitance. Maximum capacitance of these trimmers occurs when the large square notch is set midway between the two mounting screws. One-half capacitance occurs with the notch pointed directly at the front or rear of the unit. Two-thirds capacitance occurs with the notch turned off the half-point toward the mounting screws. Refer to figure 4-2.
- b. Connect the KWM-2/2A output to a 50-ohm dummy load. Set the dial to 100, BAND switch to 3.6, and EXCITER TUNING control to 2.1 on the logging (lower) scale. Set meter switch to GRID and EMISSION switch to LOCK.

**Caution**

Keep MIC GAIN setting low to protect pa. Check frequently to be sure the pa is resonated.

- c. Adjust MIC GAIN control for approximately 1/4-scale grid current. Tune and load the pa into the dummy load.



Ceramic Trimmer Capacitor  
Figure 4-2

- d. Adjust all slugs except the rear one for maximum grid current. Reduce MIC GAIN setting as necessary to keep the grid current indication below 1/4 scale. Make no adjustment to rear slug L14 at this time. Return MIC GAIN control to minimum setting.

**Note**

If slugs must be turned more than two turns in either direction, the unit has a defect other than alignment. Troubleshoot the unit.

- e. Set dial to 150, BAND switch to 7.0, and EXCITER TUNING to 3.6 on the logging (lower) scale.
- f. Adjust MIC GAIN for 1/4-scale grid current. Tune and load the pa into the dummy load. Adjust the 7-MHz trimmers for peak grid current, keeping grid current below 1/4 scale with MIC GAIN control. Return MIC GAIN to minimum position.
- g. Set BAND switch to 14.0, dial to 150, and EXCITER TUNING to 6.1 on logging (lower) scale. Adjust MIC GAIN for 1/4-scale grid current. Tune and load pa into dummy load.
- h. Tune rear slug L14 for maximum grid current, keeping the current at 1/4 scale or less with the MIC GAIN control.
- i. Adjust all 14-MHz trimmers for peak grid current, keeping current below 1/4 scale with MIC GAIN control. Return MIC GAIN control to minimum setting.
- j. Set BAND switch to 21.2, dial to 100, and EXCITER TUNING to 7.6 on logging (lower) scale. Set grid current to 1/4 scale, and tune and load the pa into the dummy load.
- k. Adjust all 21-MHz trimmers for peak grid current, keeping grid current at 1/4 scale or less with the MIC GAIN control. Return the MIC GAIN control to minimum setting.
- l. Set BAND switch to 28A, dial to 100, and EXCITER TUNING to 9.0 on the logging (lower) scale. Set grid current to 1/4 scale with MIC GAIN control, and tune and load the pa into dummy load.
- m. Adjust all 28-MHz trimmers for maximum grid current, keeping grid current at 1/4 scale with the MIC GAIN control. Return MIC GAIN to minimum position.

#### **4.6.6 Crystal Oscillator Alignment**

- a. This procedure is a refinement that peaks the oscillator plate circuits in the center of the 200-kHz tuning range. Turn the tuning dial to 100.
- b. Set BAND switch to 28A. Set EMISSION switch to TUNE. Increase MIC GAIN setting, if necessary, to obtain grid current indication. Adjust EXCITER TUNING control for a peak on the pa grid current meter.
- c. Repeak the (E)28 trimmer in the crystal oscillator plate circuit.
- d. Set the BAND switch to 21.2, and adjust EXCITER TUNING control for peak in grid current.
- e. Repeak the (D)21 trimmer in the oscillator plate circuit.
- f. Repeat this procedure with BAND switch settings of 14.0, 7.0, and 3.6, adjusting crystal oscillator plate circuit trimmers (C)14, (B)7.0, and (A)3.8 respectively.

#### **4.6.7 VFO Sideband Frequency Shift Adjustment**

Refer to paragraph 4.5.4 for vfo sideband frequency shift adjustment procedure.

#### **4.6.8 Carrier Balance (Null) Adjustment**

Refer to paragraph 4.5.5 for carrier balance (null) adjustment procedure.

#### **4.6.9 ALC Zero Adjustment**

Refer to paragraph 4.5.6 for ALC zero adjustment procedure.

#### **4.6.10 First Mixer Balance Adjustment**

Refer to paragraph 4.5.7 for first mixer balance adjustment procedure.

#### **4.6.11 VFO Dial Calibration**

Refer to paragraphs 4.5.9 through 4.5.12 for vfo dial calibration and adjustment procedures.

#### **4.6.12 PA Neutralizing**

- a. Disconnect the high voltage (800 volts) from the transmitter by removing the lead at the power supply.

- b. Disable the screen circuit of the pa tubes by unsoldering one end of the jumper between PA DISABLE jacks J5 and J6.
- c. Connect a 50-ohm, noninductive, 100-watt dummy load to RF OUT jack J1.
- d. Connect a vtm rf probe across the 50-ohm dummy load.
- e. Set the OFF-ON-NB-CAL switch to ON; set the BAND switch to 28A; and set the EMISSION switch to LOCK and the tuning dial to 100. Set the meter switch to GRID.
- f. Advance the MIC GAIN control as necessary and adjust the EXCITER TUNING control for maximum grid current.
- g. Adjust the P. A. TUNING control for a maximum rf voltage indication on the vtm. Adjust the MIC GAIN control to keep this indication below 0.5 volt.
- h. From the bottom of the chassis, adjust pa neutralizing capacitor C184 (figure 6-3) for a minimum rf indication on the vtm. This voltage is the pa plate circuit feed-through and is minimized by neutralization.
- i. Remove the vtm rf probe from the dummy load, reconnect the jumper between the PA DISABLE jacks, and reconnect the high-voltage lead to the power supply.

#### **4.6.13 Driver Neutralizing**

- a. Set the OFF-ON-NB-CAL switch to OFF. Remove heater voltage from driver tube V8 by unsoldering L29 from C241 (figure 6-3), or, if an old 6CL6 tube with no short circuits is available, clip off its filament pins and substitute it for V8.
- b. Connect rf probe to dummy load. Set OFF-ON-NB-CAL switch to ON, BAND switch to 28A, and tuning dial to 100. Set EMISSION switch to LOCK and meter switch to PLATE.
- c. Increase MIC GAIN setting, and adjust EXCITER TUNING AND P. A. TUNING controls for maximum voltage across dummy load. This level should be less than 0.3 volt.
- d. Adjust driver neutralizing capacitor C117 for a voltage dip. This capacitor is located on the shield partition closest to the shield can. Refer to figure 6-3.
- e. Set the OFF-ON-NB-CAL switch to OFF, and replace V8 in its socket.

#### **4.6.14 Feedback Neutralizing**

- a. Set BAND switch to 28A position and tuning dial to 100, EMISSION switch to TUNE, and meter switch to PLATE position.
- b. Adjust EXCITER TUNING control for a peak in pa plate current.
- c. Dip the pa plate current with the P. A. TUNING control.
- d. Switch to LOCK, and repeat steps b and c.
- e. Adjust feedback neutralizing capacitor C120 (on driver-pa shield below chassis and farthest from shield cans, figure 6-3) until pa plate current dip and grid current dip coincide. Readjust the MIC GAIN as necessary to hold pa grid current at about half-scale during this adjustment.
- f. Set BAND switch to 21.2, peak EXCITER TUNING control, and dip pa plate current with P. A. TUNING control.
- g. Check that pa plate current dip and grid current dip occur at same setting of P. A. TUNING control.
- h. Repeat this check on bands 14.2, 7.0, and 3.6.

#### **4.6.15 PA Loading Trimmer Adjustment**

These trimmer capacitors are adjusted to provide the required total output capacity for matching 50-ohm antenna loads on the amateur bands with the INCR LOAD control set at the 50 $\Omega$  mark. Normally, they will not need readjustment since, when the pa is properly loaded, the tuning is relatively broad. If it is determined that adjustment is necessary, proceed as follows:

- a. Refer to figure 7-2 for location of the loading trimmers.
- b. Connect a 50-ohm nonreactive dummy load to the transceiver RF OUT jack.
- c. Set INCR LOAD control to 50 $\Omega$  mark.
- d. Tune to 21.3 MHz, and set EMISSION switch to lock.
- e. Set MIC GAIN to the point that begins to produce pa grid current. This is grid current threshold.
- f. Adjust C155 until pa draws 230-mA plate current at the dip.
- g. Tune to 28.6 MHz, and check plate current. If not 230 mA, readjust C155 for best compromise between 21.3 and 28.6 MHz.

- h. Tune to 14.150 MHz, and set MIC GAIN as in step e.
- i. Adjust C152 as in step f.
- j. Tune 7.150 MHz, and set MIC GAIN as in step e.
- k. Adjust C153 as in step f.
- l. Tune to 3.700 MHz, and set MIC GAIN as in step e.
- m. Adjust C154 as in step f.
- n. Set OFF-ON-NB-CAL switch to OFF.

#### 4.6.16 Receiving 455-kHz IF Alignment

- a. Remove vfo tube V301 from socket, and set OFF-ON-NB-CAL switch to ON.
- b. Set EMISSION switch to USB.
- c. Connect signal generator to pin 8 of V17B, and set to 455 kHz. Increase signal generator output until S-meter shows slight indication (S3). Rock the signal generator frequency to center the signal at the approximate center of the filter passband.

**Note**

If a vtm is available, it may be connected to AVC bus and used as alignment peak indicator.

- d. Adjust the slugs of L9 and T5 for peak indication on the S-meter. Reduce signal generator output as necessary to keep S-meter indication low. Repeak L9 and T5 as in any standard alignment procedure.
- e. Replace vfo tube.

#### 4.6.17 Receiver RF Gain and S-Meter Zero Adjustment

- a. Set receiver to 14.3 MHz, and peak EXCITER TUNING control for maximum output.

Set R. F. GAIN control (front panel) to maximum clockwise position. Tune calibrated signal generator to same frequency as receiver.

- b. Short RCVR ANT. jack J2 to ground; adjust S METER ZERO potentiometer R121 so S-meter reads zero.
- c. Remove short from J2. Using a 50-ohm calibrated signal generator, apply 25  $\mu$ V to the circuit shown in figure 4-3. Adjust RCVR GAIN ADJUST R132 until S-meter just moves off zero (1/2 S-unit or less).
- d. Repeat step b.
- e. This completes the laboratory alignment of the KWM-2/2A. Replace it in its cabinet.

### 4.7 TEST SELECT COMPONENTS

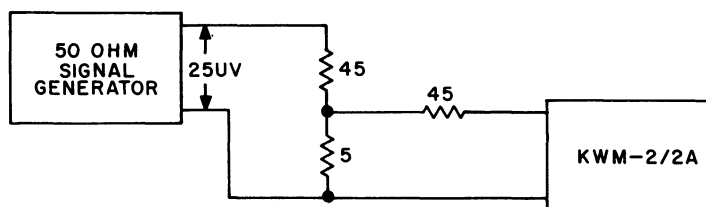
#### 4.7.1 Capacitor C10

- a. Connect equipment as required to perform carrier balance (null) adjustment, paragraph 4.5.5.
- b. Perform carrier balance adjustment.

**Note**

In some units C10 may have to be added in parallel with C9 to produce the desired results.

- c. If carrier balance adjustment does not produce an rf output of less than 0.2 Vrms, select and replace C10 with a value capacitor that provides less than 0.2 Vrms output.
- d. Repeat carrier balance adjustment, paragraph 4.5.5.



Receiver Gain Adjustment Setup  
 Figure 4-3

#### 4.7.2 Resistor R140

- a. Connect equipment as required to perform ALC zero adjustment, paragraph 4.5.6.
  - b. Perform ALC zero adjustment.
  - c. Connect a precision multimeter to the PHONE PATCH terminals and measure the 2-tone generator input.
  - d. Set the MIC GAIN control fully clockwise, and increase the 2-tone input level until ALC threshold is indicated on the KWM-2/2A meter (set at ALC position).
  - e. If the multimeter indicates more than 5-mV input to the PHONE PATCH terminals, recheck the KWM-2/2A alignment.
- c. Set EMISSION switch to LSB and MIC GAIN control to OFF. Set meter switch to GRID.
  - d. Set EMISSION switch to LOCK, and adjust the MIC GAIN control for grid current threshold, then set meter switch to PLATE.
  - e. Connect an ammeter in series with J13-2 and +800-Vdc power source. Check that ammeter reads 220 mA. The KWM-2/2A meter should read 230 mA. (KWM-2/2A meter reads cathode current; approximately 10 mA of cathode current is screen current.)
  - f. If KWM-2/2A meter does not read 230 mA, select and replace R161 with a value resistor that provides 230-mA current.

**Note**

If alignment appears normal and more than 5 mVac is indicated, select and replace R140 with a value to give an ALC threshold between 2- and 5-mV 2-tone input.

- f. If the multimeter indicates less than 2 mV, select and replace R140 with a value to give an ALC threshold between 2- and 5-mV 2-tone input.

#### 4.7.3 Resistor R162

- a. Turn on the KWM-2/2A and set to receive LSB.
- b. Select a value of R162 to provide 1.25 Vac at V2A-9.

#### 4.7.4 Resistor R158

- a. Connect equipment as required to perform receiver 455-kHz if alignment procedures, paragraph 4.6.16.
- b. Set the rf signal generator to 100  $\mu$ V. Select and replace R158 with a value resistor that provides a KWM-2/2A meter reading of S8 to S9 +10.

#### 4.7.5 Resistor R161

- a. Connect equipment as required to perform rf circuit peaking procedures, paragraph 4.5.3.
- b. Set EMISSION switch to TUNE (any frequency) and PA LOAD control to 50 $\Omega$ , and tune the KWM-2/2A.

#### 4.8 DIAL CORD REPLACEMENT (Refer to figure 4-4.)

**Note**

Be careful not to damage the band-switch cord or loading capacitor cord. Frayed dial cords should be replaced. Frayed cords can provide rf loops that might affect transceiver operation.

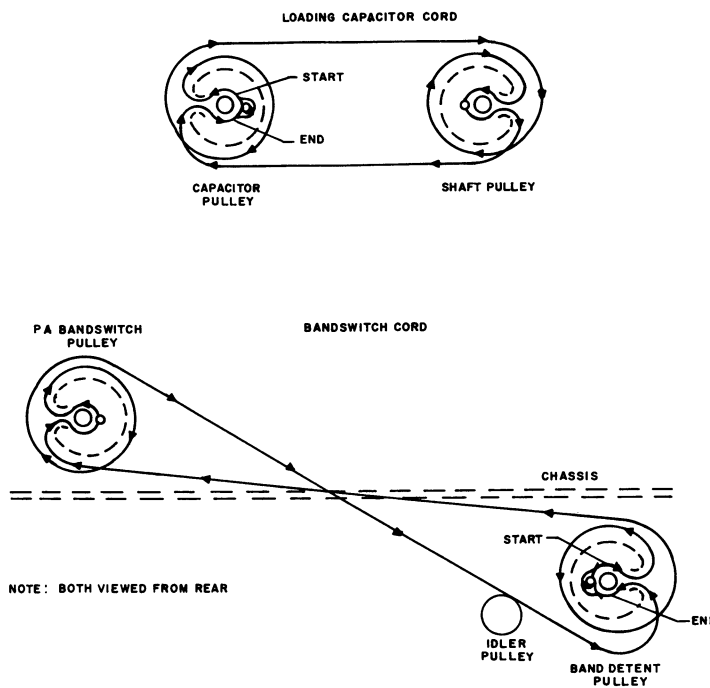
##### 4.8.1 Band-Switch Cord

- a. Remove the power cable from the KWM-2/2A.
- b. Using a knife blade or small screwdriver, pry open the tabs, and remove the broken or defective cord from the two band-switch pulleys. The band-switch pulleys are located near the front panel, one above and the other below the chassis. Loosen the idler pulley so it will not be in the way during restringing.
- c. Place the BAND switch in position 1A, and rotate the pa band-switch pulley to the approximate position shown in figure 4-4.

**Note**

The band detent pulley may not be in the exact same position shown in figure 4-4. Do not reposition this pulley, but assume it to be in the correct position during restringing.

- d. Replace the old cord with three feet (9.144 dm) of new cord, Collins part number 432-1009-00. When ordering dial cord, be sure



*Dial Cord Stringing Diagram*  
 Figure 4-4

to state the desired length in feet. String the cord according to the band-switch cord illustration in figure 4-4. Make sure cords do not overlap on the pulleys. Pull cord tight, and tie to the tab. Mash the tab down to clamp the cord securely. Tighten the idler gear to bring the cord to tension.

- e. Turn the band switch to position 3E, and check to see that the movable contact (rotor blade) of both S7 and S8 (refer to figure 6-1 for location of S7 and S8) are at positions 1 and 2. This may be determined by counting clockwise on the wafer from the X-mark. The X-mark, identified by a blue mark, is located immediately clockwise from the left-hand securing screw on wafer S7. The holes with no terminal lugs should be counted as positions. If the movable contacts are incorrectly positioned, loosen the pa band-switch pulley, and turn the switch to its proper position. Tighten the pa band-switch pulley.
- f. Apply a little airplane cement on the dial cord knots to keep them tight. After the cement is dry, trim the loose end back NO CLOSER than one-quarter inch from the knot.

#### 4.8.2 Loading Capacitor Cord

- a. Remove the power cable from the KWM-2/2A.
- b. Remove the pa cage by unscrewing the five self-trapping Phillips-head screws (located on the bottom side of the chassis) that secure the cage to the chassis.
- c. Using a knife or small screwdriver, pry open the tabs, and remove the broken or defective cord from the two loading capacitor pulleys.
- d. Manually position the loading capacitor to its fully meshed position and the INCR LOAD control to position 10 on the P.A. TUNING logging scale.
- e. String the cord according to the loading capacitor cord illustration in figure 4-4. Make sure cords do not overlap on the pulleys. Pull cord tight, and tie to the tab. Mash the tab down to clamp the cord securely. Tighten the idler gear to bring the cord to tension. Check to make sure that the loading capacitor and INCR LOAD control are still in the positions set up in

step d above. If not, loosen the shaft pulley, mesh capacitor plates manually, and re-tighten the pulley.

- f. Apply a little airplane cement on the knots in the dial cords to help hold them tight. After the cement is dry, trim the loose ends back NO CLOSER than one-quarter inch from the knot.

#### 4.9 RELAY MAINTENANCE

Gradual accumulations of dust, lint, or oxidation may cause the contacts of relays to become high-resistance connections and degrade switching functions. Relays K2 and K4 are plug-in types and can be removed for cleaning. Relay K3 is wired in place and cannot be removed except by disconnecting all leads to it.

If cleaning of the relay contacts is necessary, use a relay contact burnishing tool. If such a tool is not available, use a piece of rough paper soaked in carbon tetrachloride. Be careful not to bend any of the contact springs. DO NOT use files, emery paper, or abrasives, as the silvered surfaces of the contacts are very

thin. Observe the contacts in a dental mirror, and press the armature down with thumb or finger. Check that all normally closed contacts have opened before any of the normally open contacts close. If this is not the case, the relay may have to be replaced.

#### 4.10 DIAL LAMP REPLACEMENT

To replace the dial lamp, refer to figure 4-5 for the lamp location. When replacing the lamp, orient the reflector to direct the light forward to illuminate the tuning dial properly.

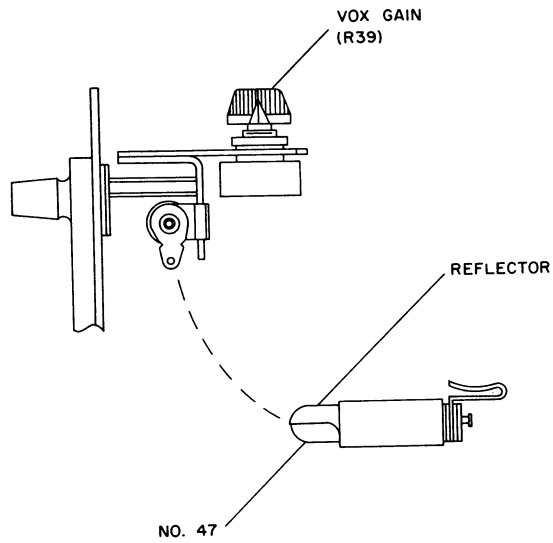
#### 4.11 METER LAMP REPLACEMENT

To replace the meter lamp, refer to figure 4-6.

**Caution**

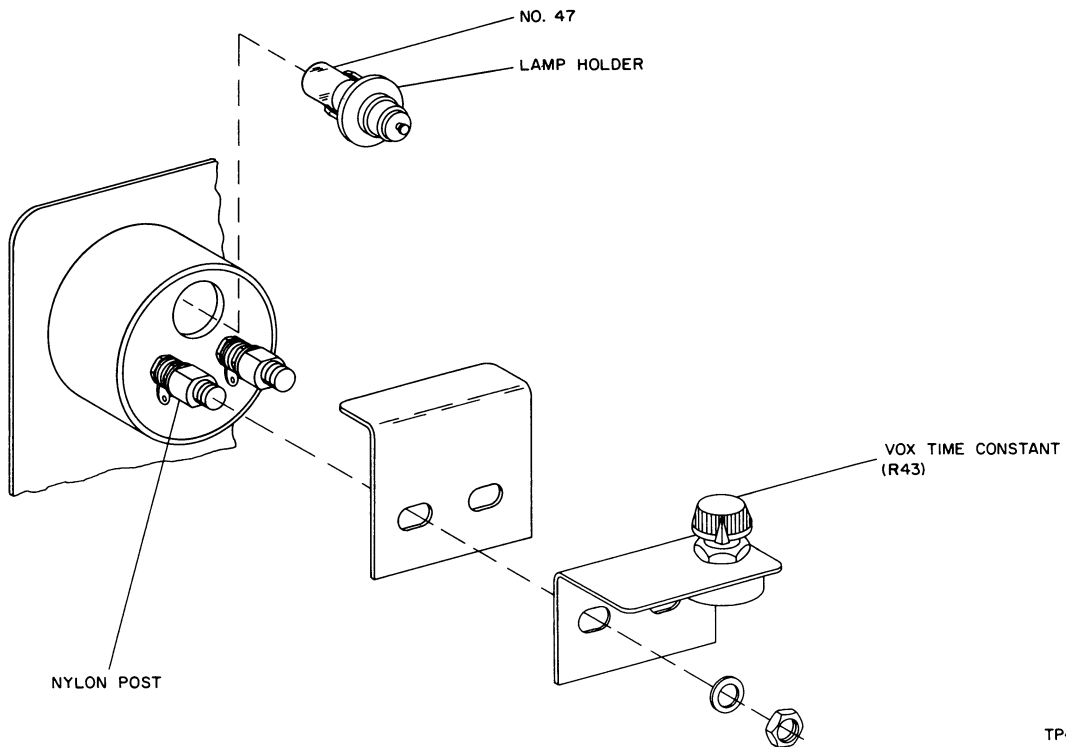
When removing the mounting hardware from the nylon posts, extreme care is necessary to prevent breaking the post. To remove the lampholder from the meter use a small, flatblade screwdriver between the holder and the meter case.





TP4-3064-013

*Dial Lamp Replacement  
Figure 4-5*



TP4-3063-013

*Meter Lamp Replacement  
Figure 4-6*