

## section 2

### operation

#### 2.1 STARTING PROCEDURE

##### **Caution**

Set MIC GAIN control to OFF and EMISSION switch to LSB, USB, or CW to prevent accidental transmit condition before warmup or tuning.

To turn on the KWM-2/2A Transceiver, set the function switch (1) to ON. This turns on the power source being used with the KWM-2/2A. Allow a 1-minute warmup period.

#### 2.2 SELECTING THE KWM-2/2A OPERATING FREQUENCY

##### **Caution**

The KWM-2/2A must be operated into a 50-ohm load with an swr not to exceed 2.0:1. Random-length wire antennas or light-bulb dummy loads cannot be used. Conventional half-wave dipoles and beam antennas may be used only at, or very near, their resonant frequency. Exceeding an swr of 2.0:1 can destroy the components in the output stage of this transceiver.

- a. Set the EXCITER TUNING and P.A. TUNING controls to the desired operating frequency. Refer to the logging scale calibration curves in figure 2-2. If the operating frequency is outside an amateur band, ignore the amateur band markings on the dial scale and set the control according to figure 2-2.

##### **Caution**

If the transmitter drive is insufficient or receiver sensitivity is lacking, retune the trimmer capacitors according to paragraph 2.5.2.

- b. If the operating frequency is in an amateur band, refer to table 2-1. Set the band switch

to the proper position for the desired operating frequency. If the operating frequency is outside an amateur band, refer to paragraph 2.5. From this paragraph, determine the crystal frequency corresponding to the desired operating frequency. Insert the appropriate crystal in the crystal board and set the band switch to the proper position for the installed crystal.

##### **Note**

Be sure to insert the crystal in one of the sockets corresponding to the band in which the crystal belongs. A crystal in band C, for example, should be inserted in socket 1C, 2C, or 3C. Refer to table 2-3 for a list of crystal frequencies and operating bands.

- c. Set the vfo tuning dial so that the band-switch setting (crystal band frequency lower limit in MHz) and the vfo tuning dial setting in kHz add to give the desired operating frequency.

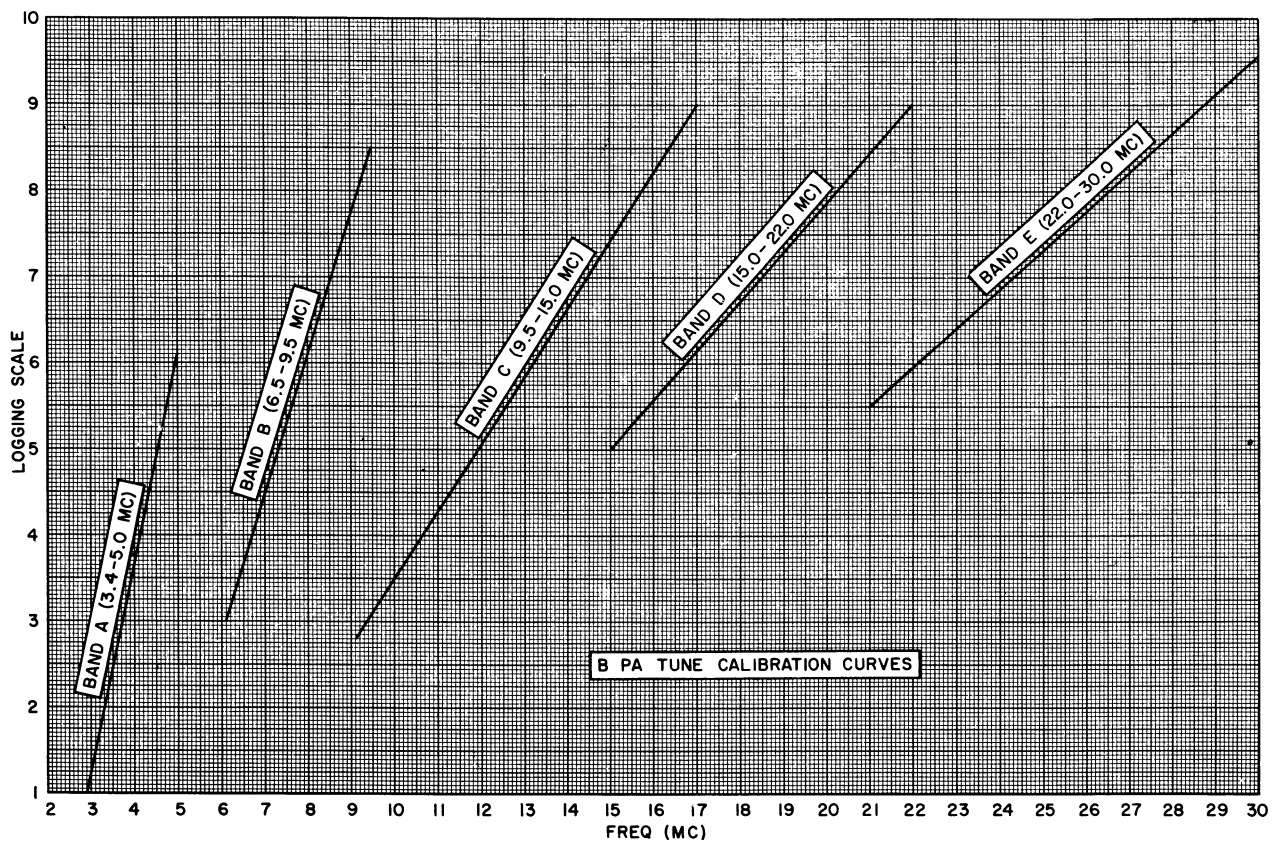
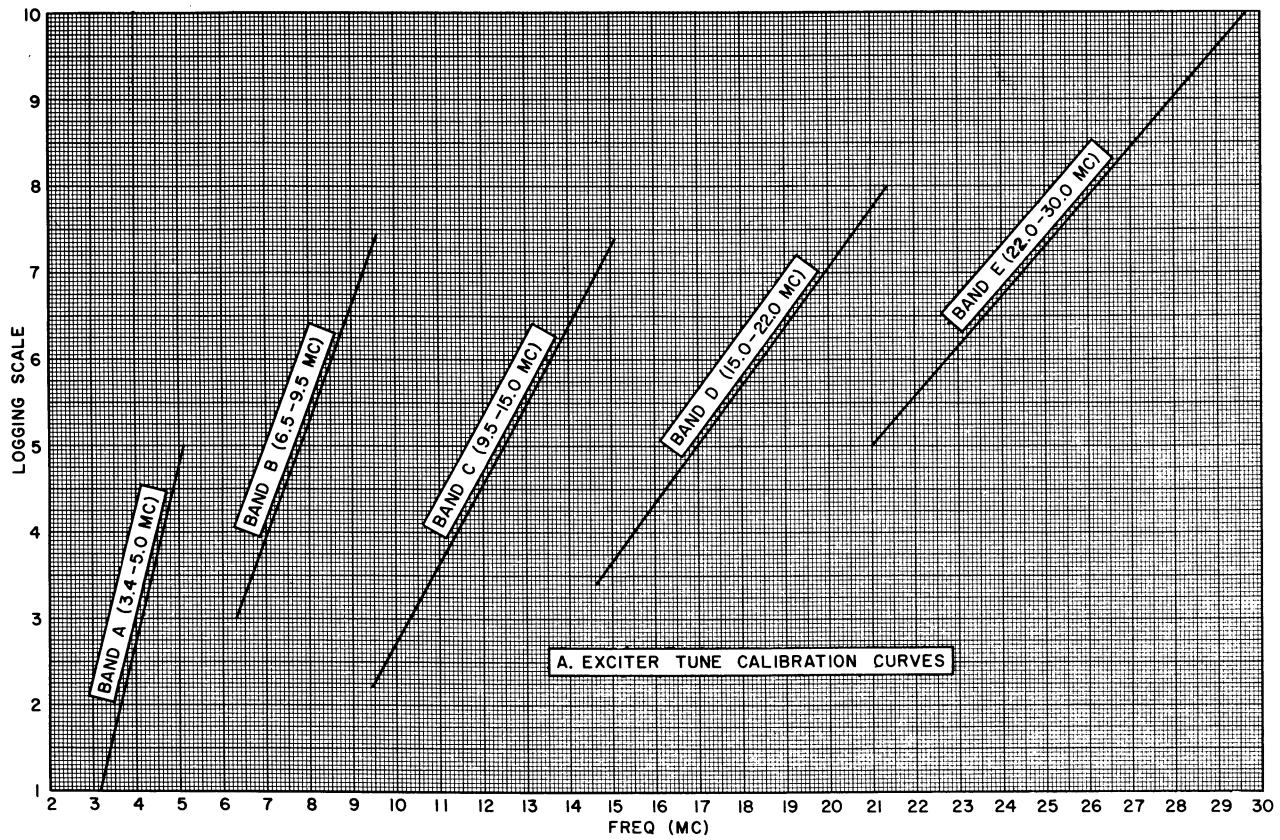
##### **Note**

Before setting the vfo tuning, calibrate the vfo by setting the function switch (1) to the CAL position and zero-beating the calibration signal at the 0, 100, or 200 dial marking, whichever is closest to the desired operating frequency. Adjust the dial hairline so that it is directly over the dial 0, 100, 200 marking at zero beat. Set the function switch to ON.

#### 2.3 RECEIVER TUNING

- a. Refer to figure 2-1. Set function switch (1) to ON. This is the switch labeled OFF-ON-NB-CAL. Refer to table 2-2.
- b. Set EMISSION switch (2) to desired sideband (USB or LSB position). Set BAND switch

section 2  
operation



Logging Scale Calibration Curves  
Figure 2-2

Table 2-1. Crystals Supplied in the KWM-2/2A Transceiver.

KWM-2/2A BAND-SWITCH SETTING		KWM-2/2A OPERATING FREQUENCY (MHz)	CRYSTAL FREQUENCY (kHz)
1A	3.4	3.4 to 3.6	6555.000
2A	3.6	3.6 to 3.8	6755.000
3A	3.8	3.8 to 4.0	6955.000
1B	7.0	7.0 to 7.2	10155.000
2B	7.2	7.2 to 7.4	10355.000
1C	14.0	14.0 to 14.2	8577.500
2C	14.2	14.2 to 14.4	8677.500
3C	14.8	14.8 to 15.0 (WWV)	8977.500
1D	21.0	21.0 to 21.2	12077.500
2D	21.2	21.2 to 21.4	12177.500
3D	21.4	21.4 to 21.6	12277.500
1E	28A	28.5 to 28.7	15827.500
*2E	28B		
3E	28C		

\*Crystals may be inserted in these sockets to cover remaining part of 10-meter band.

- (3) to desired band. If KWM-2A, set crystal board selector (12) so desired set of bands appears in window.
- Set the MIC GAIN control (4) full counterclockwise. Set R.F. GAIN control (10) full clockwise.
  - Set VOX GAIN control (figure 4-1, R39) full counterclockwise.
  - Set ANTI-VOX GAIN control (figure 4-1, R45) full counterclockwise.
  - Adjust the A.F. GAIN control (5) until some receiver noise is heard in speaker.
  - Adjust the EXCITER TUNING control (6) to white portion of scale indicating the desired band. Adjust this control slightly to peak the receiver noise output. The transceiver is now ready to receive and the selected 200-kHz band may be tuned with the tuning control. The operating frequency can be determined by adding the dial reading to the BAND switch setting.
  - Turn function switch (1) to CAL position. Tune dial to nearest 100-kHz point (0, 100, or 200), and decrease A.F. GAIN control as necessary for comfortable listening level. Adjust tuning until the calibrate signal is zero beat. When the calibrate signal is zero beat in the receiver, set the hairline on the 100-kHz point with the zero set knob (11). Set function switch to ON and tune dial to the desired portion of the 200-kHz band selected. If checking calibrate circuit against WWV is desired, refer to paragraph 4.5.9.

**Note**

The crystal calibrator also will be heard at dial settings 55 and 155 when function switch is in CAL position. Ignore these responses.

Table 2-2. KWM-2/2A Operating Control Functions.

FIG 2-1 INDEX	CONTROL	FUNCTION
1	Function (S11)  OFF  ON  NB  CAL	Removes ac power from power supply.  Connects ac power to power supply.  Turns on accessory noise blanker when used.  Turns on 100-kHz crystal calibrator.
4	MIC GAIN (R8, S10)	Controls audio amplifier gain for SSB operation, and controls tone level for CW operation.
6	EXCITER TUNING	Controls all ganged slug-tuned circuits in receiver and exciter portions of transceiver.
12	Crystal board selector (S15) (in KWM-2A only)	Selects second bank of crystals for additional coverage, and changes scale on BAND switch.
3	BAND (S2 through S8, S13)	Selects capacitors and crystals needed to tune transceiver to desired 200-kHz band. S13 grounds a different pin on J25 for each band for remote antenna selection.
7	P.A. TUNING (C150)	Resonates pa plate circuit to operating frequency.
5	A.F. GAIN (R92)	Controls receiving audio amplifier gain.
10	R.F. GAIN R84)	Controls gain of receiver-transmitter rf amplifier and receiving if amplifiers during receiving.
8	Meter switch (S12)  PLATE  GRID  ALC	Measures pa plate current by measuring pa cathode voltage changes.  Measures pa grid current.  Shows ALC action by measuring cathode voltage changes at transmitter if amplifier V4A.
2	EMISSION (S9)  LOCK  TUNE  LSB  USB  CW	Grounds key line for continuous output in CW mode at full power. Used for tuning.  Reduces pa screen voltage with series resistor, and produces CW carrier for tuneup.  Selects LSB bfo crystal, and raises vfo frequency for LSB operation.  Selects USB bfo crystal, and lowers vfo frequency for USB operation.  Selects USB bfo crystal, raises vfo frequency, and turns on tone oscillator. Keyed tone is applied to balanced modulator instead of voice signal.
*	ANTI-VOX GAIN (R45)	Controls level of antiVOX signal fed to VOX circuit.

Table 2-2. KWM-2/2A Operating Control Functions (Cont).

FIG 2-1 INDEX	CONTROL	FUNCTION
*	VOX GAIN (R39)	Controls gain of VOX amplifier for voice-controlled operation.
*	VOX TIME CONSTANT (R43)	Controls held-in time of VOX circuit.
9	INCR LOAD	Adjusts power amplifier output impedance level to match transmission line impedance for maximum power transfer.
11	Zero set knob	Permits calibration of frequency dial.
13	Vfo tuning dial	Selects the frequency to be added to the band frequency to establish the transceiver operating frequency.
*These operating controls are inside the cabinet.		

**Warning**

During amateur operation, DO NOT operate transmit circuits while the transceiver is tuned to receive outside the amateur band in use. The transmit frequency is always locked to the receive frequency. Return tuning to within the band before transmitting.

**Caution**

TO PREVENT DESTROYING THE FINAL AMPLIFIER, THE FOLLOWING STEPS MUST BE MADE QUICKLY.

## 2.4 TRANSMITTER TUNING

### 2.4.1 General

- Set up the KWM-2/2A for the receive function as in paragraph 2.3.
- Turn EMISSION switch (2) to TUNE position.
- Set meter switch (8) to GRID.
- Adjust MIC GAIN control (4) for a 1/2 to 2/3-scale meter indication.
- Adjust EXCITER TUNING control (6) for a peak on the meter. Reduce the MIC GAIN as necessary to maintain the 1/2- to 2/3-scale meter reading.
- Set meter switch (8) to PLATE.
- Dip the plate current with PA TUNING control (7).
- Adjust the load (under PA TUNING control) for an increase in plate current: redip with PA TUNING control (7). Reduce MIC GAIN control (4) as necessary to keep the plate current below 200 mA.

- Turn EMISSION switch (2) to the LOCK position (leave meter switch (8) at PLATE).
- Reduce MIC GAIN control (4) to keep plate current below 230 mA.
- Adjust EXCITER TUNING control (6) for a peak plate current reading.
- Readjust PA TUNING control (7) for a plate current dip.
- Turn EMISSION switch (2) to either LSB, USB, or CW and meter switch (8) to ALC.

**Caution**

If the operating frequency is changed more than 50 kHz, recheck tuning and loading adjustments. Readjust if necessary.

### 2.4.2 Single-Sideband Operation

- Set up receiver operation and transmitter operation according to paragraphs 2.3 and 2.4.1.

- b. Close-talk into the microphone, increasing VOX GAIN control setting until VOX relay just operates. For VOX operation, it is desirable to close-talk the microphone to prevent background noises from tripping the KWM-2/2A into transmit function.
- c. Set meter switch to ALC position. Increase setting of MIC GAIN control to obtain S6 average reading on voice.
- d. Leave MIC GAIN control as set in step c above. Leave microphone in normal operating position. Set function switch to CAL position, tune in calibrate signal, and adjust A.F. GAIN control for comfortable listening level.
- e. Adjust the tuning control for approximately 1000-Hz beat note. If the VOX relay trips, increase ANTIVOX GAIN (figure 4-1, R45) setting to minimum point necessary to prevent speaker output from tripping VOX. It may be necessary to increase VOX GAIN setting slightly after this antiVOX gain adjustment in order to compensate for the antiVOX gain.

**Note**

Do not use more VOX gain or more antiVOX gain than necessary to control VOX operation. If VOX circuits transfer between words, increase the release time constant by turning VOX TIME CONSTANT control (figure 4-1, R43) clockwise. If less release time is desired, turn the control counter-clockwise.

- f. Set function switch to ON position. The KWM-2/2A is now ready for transmit operation in SSB service. Speaking into the microphone transfers from receive function to transmit function through the VOX circuit action. If the receiver is tuned to a different frequency, the transmitter is also tuned to this new receiver frequency.
- g. After changing frequency more than 50 kHz, perform steps i through m, paragraph 2.4.1.

### 2.4.3 CW Operation

**Note**

The CW output signal frequency is 1750 Hz higher than the dial reading. To set the CW output signal frequency, subtract 1750 Hz from the desired output signal frequency. Set the crystal and vfo dial for the resultant output in CW operation.

- a. Set up receiver and transmitter operation according to paragraphs 2.3 and 2.4.1 with EMISSION switch set to CW.
- b. Press key and adjust A.F. GAIN control for comfortable monitoring level.
- c. Hold key down, and increase VOX GAIN control setting until the VOX relay operates. If it is desired to change the release time constant, adjust the VOX TIME CONSTANT potentiometer, R43. Clockwise rotation of this control increases the release time. This control is located on a bracket under the top cover, behind the meter.
- d. Set meter switch to ALC position. While sending a series of dots, adjust MIC GAIN control for S3 meter indication of ALC.

**Note**

Component heating during operation may cause the ALC reading to decrease. Maintain the ALC reading at S3 by adjusting the MIC GAIN control as required.

- e. When receiving, leave the A.F. GAIN control set for comfortable monitoring level, and adjust the receive level with the R.F. GAIN control. When the KWM-2/2A is receiving, the received signal is indicated in S-units. The S-meter will read correctly with the R.F. GAIN at less than maximum setting, provided the received signal level is high enough to actuate the S-meter. For example, if the R.F. GAIN control is set for no-signal reading of S8 and reads S9 with signal, the received signal is S9.

example, if the R.F. GAIN control is set for no-signal reading of S8 and reads S9 with signal, the received signal is S9.

#### 2.4.4 FSK Operation

**Note**

The KWM-2/2A Transceiver has an audio response of 300- to 2400-Hz nominal, therefore any FSK audio input must be between 300 and 2400 Hz.

Usually in RTTY, the FSK signal is an 850-Hz total shift between mark and space signals. This shift is most often obtained by providing a 425-Hz shift to either side of a reference frequency. The reference frequency is the RTTY center frequency. To obtain the 850-Hz shift and reference frequency using the KWM-2A, follow the procedures listed below.

**Caution**

During RTTY operation of the KWM-2/2A, a small blower must be directed on the power amplifier cage to permit continuous operation.

- a. Set the function switch to ON.
- b. Connect a 1275- and 2125-Hz 2-tone keyer (850 Hz difference -- both frequencies in the 300- to 2400-Hz audio response of the KWM-2/2A) to the teletypewriter.
- c. Connect the keyer audio output to the KWM-2/2A audio input and the KWM-2/2A audio output to the converter audio input. Adjust the keyer audio output level to provide an audio input level between 25 and 100 millivolts to the KWM-2/2A.
- d. Set up receiver and transmitter operation at 1700 Hz above the desired RTTY center frequency operation. Refer to paragraphs 2.3 and 2.4.1. Set EMISSION switch to LSB.
- e. Normally the 2-tone keyer provides a ptt key. If a ptt key is not provided, key the teletypewriter and increase the VOX GAIN control setting until the VOX relay just operates.
- f. Using a phono plug, solder a connection from the inner conductor to the outer conductor.

Connect this plug to the ALC phono jack (J4) to provide a short to ground for the ALC line.

- g. Set meter switch to GRID position. Adjust setting of MIC GAIN control for S3 meter indication of grid current.
- h. Adjust the R.F. GAIN control full clockwise. Adjust the A.F. GAIN control for the amount of receive power required by the converter. If audio is monitored, this should provide a comfortable monitoring level.

**Note**

These procedures are for high mark and low space RTTY operation. For additional information on FSK operation, refer to RTTY Operation of KWM-2/2A and S-Line Equipment Instruction Sheet 523-0182000.

#### 2.4.5 Mobile Operation

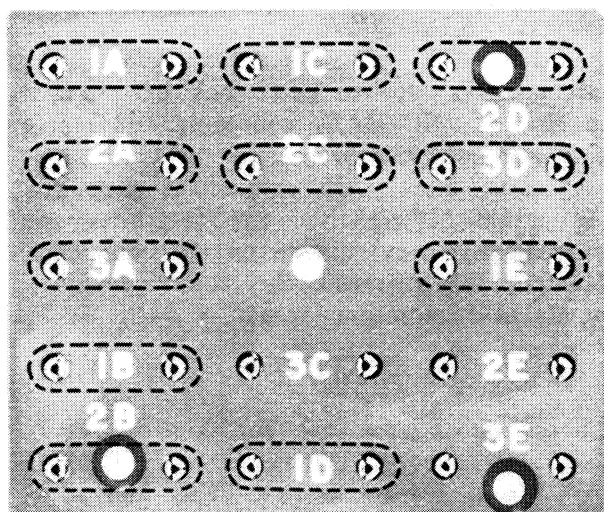
VOX and antiVOX circuits will operate in mobile operation, but push-to-talk operation is recommended, since high-level background noises will produce undesirable VOX switch-over. Set VOX GAIN and ANTIVOX GAIN controls full counterclockwise before installation. If VOX operation is desired, leave clearance in installation so top cover can be opened. For mobile operation, load the power amplifier to 210-mA plate current. (In some installations, power amplifier plate current readings less than 210 mA will be obtained due to cable length, cable size, and battery condition.)

### 2.5 OPERATION OUTSIDE AMATEUR BANDS

#### 2.5.1 Selection of Crystals

The crystals supplied provide for complete coverage of all amateur bands except the 10-meter band for which only one crystal is furnished (for 28.5 to 28.7 MHz). Two extra sockets are provided for additional crystals in the 10-meter band. Figure 2-3 shows crystal socket locations. Select these crystals as follows:

- a. If the lower edge of the desired 200-kHz band is 11.8 MHz or less, the required frequency is equal to the lower edge of the desired band plus 3.155 MHz. As an example,



*Crystal Socket Locations*  
Figure 2-3

if the desired band is 4.0 to 4.2 MHz, 4.0 MHz plus 3.115 MHz equals 7.155 MHz.

- b. If lower edge of desired 200-kHz band is 12.00 MHz or higher, the required crystal frequency is half the sum of the lower edge of desired band plus 3.155 MHz. As an example, if the desired band is 14.4 to 14.6 MHz:

$$\frac{14.4 + 3.155}{2} = 8.7775 \text{ MHz.}$$

The plate circuit of the oscillator is tuned to twice the crystal frequency when required injection frequencies are this high.

**Caution**

Avoid transmitter operation between 5.0 and 6.5 MHz. In this range, the second harmonic of the vfo and the variable if frequency is nearly the same as the desired frequency. In transmit function, some of this energy will pass through the tuned circuits and become spurious emission.

- c. Plug substitute or extra crystals into the appropriate socket on the mounting board according to band-switch position and crystal frequency columns in table 2-3. The

example cited in step b above calls for placement of the crystal in one of the sockets marked C. If two additional 10-meter crystals are used, they must be plugged into the sockets marked E. Table 2-3 lists crystal socket designations, switch positions (BAND), and crystal frequencies furnished.

The KWM-2A is equipped with an extra crystal mounting board and a front-panel switch to allow selection of either board. The crystal mounting board for extra-band operation is located on the top of the chassis. If amateur band operation is not needed, extra-band crystals may be substituted in the crystal mounting board under the chassis. Be sure the crystals are plugged into appropriate sockets according to information of table 2-3 and figure 2-3. The transmitter can be operated at other frequencies outside the specified amateur bands or at other 10-meter frequencies by plugging the proper crystals into the mounting boards.

Mark the desired lower band edge information on the white card in the band-switch windows. Make sure this information is marked in the appropriate switch positions.

### 2.5.2 Adjustment of Tuned Circuits

For operation outside amateur bands, disregard amateur band markings on EXCITER TUNING and P.A. TUNING scales, and use logging scales. Figure 2-2 shows logging scale calibration curves. Operation at frequencies outside the amateur bands will result in slightly decreased receiver sensitivity and transmitter pa grid drive unless the tuned circuits of the transceiver are retuned to peak their responses in the desired portions of the high-frequency spectrum. For moderate excursions from the amateur bands, the decrease in performance is minor, and realignment of the rf circuits is usually not necessary unless optimum performance is desired. Adjustment of the trimmer capacitors only will normally be sufficient to peak the response outside the amateur bands. Figure 4-1 shows the location of these adjustments. The letter portions of the capacitor designations correspond to the frequency



ranges listed in the band-switch position column of table 2-3. For example, the E trimmers are normally peaked on 10 meters but may be reset to favor another portion of band E, which covers 22.0 to 30.0 MHz.

**Warning**

Be sure that all power is disconnected before working in the pa compartment. Dangerous voltages are present with power on.

At the extremities of some bands the pa loading may be either too heavy or too light. This condition can be corrected by the following procedure:

- a. If the plate current is too high, add a capacitor to the output to increase the output capacity and reduce the output current.

- b. If plate current is too low, reduce the output capacity and increase the output current as follows: Remove the KWM-2/2A cover. Adjust trimmers C152, C153, C154, and C155 as necessary to increase output current. Refer to paragraph 4.6.15 for pa loading trimmer adjustment. Adjust the trimmers for a compromise that best suits your operating frequency.

Table 2-3. Crystal Frequencies and Operating Bands.

KWM-2/2A OPERATING FREQUENCY (MHz)	CRYSTAL FREQUENCY (kHz)	KWM-2/2A OPERATING FREQUENCY (MHz)	CRYSTAL FREQUENCY (kHz)
Band-switch setting 1A, 2A, or 3A		8.2 to 8.4	11355.0
3.4 to 3.6	* 6555.0	8.4 to 8.6	11555.0
3.6 to 3.8	* 6755.0	8.6 to 8.8	11755.0
3.8 to 4.0	* 6955.0	8.8 to 9.0	11955.0
4.0 to 4.2	7155.0	9.0 to 9.2	12155.0
4.2 to 4.4	7355.0	9.2 to 9.4	12355.0
4.4 to 4.6	7555.0	9.4 to 9.6	12555.0
4.6 to 4.8	7755.0	Band-switch setting 1C, 2C, or 3C	
4.8 to 5.0	7955.0	9.4 to 9.6	12555.0
Band-switch setting 1B or 2B		9.6 to 9.8	12755.0
6.6 to 6.8	9755.0	9.8 to 10.0	12955.0
6.8 to 7.0	9955.0	10.0 to 10.2	13155.0
7.0 to 7.2	*10155.0	10.2 to 10.4	13355.0
7.2 to 7.4	*10355.0	10.4 to 10.6	13555.0
7.4 to 7.6	10555.0	10.6 to 10.8	13755.0
7.6 to 7.8	10755.0	10.8 to 11.0	13955.0
7.8 to 8.0	10955.0	11.0 to 11.2	14155.0
8.0 to 8.2	11155.0	11.2 to 11.4	14355.0

Table 2-3. Crystal Frequencies and Operating Bands (Cont).

KWM-2/2A OPERATING FREQUENCY (MHz)	CRYSTAL FREQUENCY (kHz)	KWM-2/2A OPERATING FREQUENCY (MHz)	CRYSTAL FREQUENCY (kHz)
11.4 to 11.6	14555.0	17.2 to 17.4	10177.5
11.6 to 11.8	14755.0	17.4 to 17.6	10277.5
11.8 to 12.0	14955.0	17.6 to 17.8	10377.5
12.0 to 12.2	7577.5	17.8 to 18.0	10477.5
12.2 to 12.4	7677.5	18.0 to 18.2	10577.5
12.4 to 12.6	7777.5	18.2 to 18.4	10677.5
12.6 to 12.8	7877.5	18.4 to 18.6	10777.5
12.8 to 13.0	7977.5	18.6 to 18.8	10877.5
13.0 to 13.2	8077.5	18.8 to 19.0	10977.5
13.2 to 13.4	8177.5	19.0 to 19.2	11077.5
13.4 to 13.6	8277.5	19.2 to 19.4	11177.5
13.6 to 13.8	8377.5	19.4 to 19.6	11277.5
13.8 to 14.0	8477.5	19.6 to 19.8	11377.5
14.0 to 14.2	* 8577.5	19.8 to 20.0	11477.5
14.1 to 14.3	8627.5	20.0 to 20.2	11577.5
14.2 to 14.4	* 8677.5	20.2 to 20.4	11677.5
14.4 to 14.6	8777.5	20.4 to 20.6	11777.5
14.6 to 14.8	8877.5	20.6 to 20.8	11877.5
14.8 to 15.0	* 8977.5	20.8 to 21.0	11977.5
Band-switch setting 1D, 2D, or 3D		21.0 to 21.2	*12077.5
15.0 to 15.2	9077.5	21.2 to 21.4	*12177.5
15.2 to 15.4	9177.5	21.4 to 21.6	*12277.5
15.4 to 15.6	9277.5	21.6 to 21.8	12377.5
15.6 to 15.8	9377.5	21.8 to 22.0	12477.5
15.8 to 16.0	9477.5	Band-switch setting 1E, 2E, or 3E	
16.0 to 16.2	9577.5	22.0 to 22.2	12577.5
16.2 to 16.4	9677.5	22.2 to 22.4	12677.5
16.4 to 16.6	9777.5	22.4 to 22.6	12777.5
16.6 to 16.8	9877.5	22.6 to 22.8	12877.5
16.8 to 17.0	9977.5		
17.0 to 17.2	10077.5		

Table 2-3. Crystal Frequencies and Operating Bands (Cont).

KWM-2/2A OPERATING FREQUENCY (MHz)	CRYSTAL FREQUENCY (kHz)	KWM-2/2A OPERATING FREQUENCY (MHz)	CRYSTAL FREQUENCY (MHz)
22.8 to 23.0	12977.5	27.4 to 27.6	15277.5
23.0 to 23.2	13077.5	27.6 to 27.8	15377.5
23.2 to 23.4	13177.5	27.8 to 28.0	15477.5
23.4 to 23.6	13277.5	27.9 to 28.1	15527.5
23.6 to 23.8	13377.5	28.0 to 28.2	15577.5
23.8 to 24.0	13477.5	28.1 to 28.3	15627.5
24.0 to 24.2	13577.5	28.2 to 28.4	15677.5
24.2 to 24.4	13677.5	28.3 to 28.5	15727.5
24.4 to 24.6	13777.5	28.4 to 28.6	15777.5
24.6 to 24.8	13877.5	28.5 to 28.7	*15827.5
24.8 to 25.0	13977.5	28.6 to 28.8	15877.5
25.0 to 25.2	14077.5	28.7 to 28.9	15927.5
25.2 to 25.4	14177.5	28.8 to 29.0	15977.5
25.4 to 25.6	14277.5	28.9 to 29.1	16027.5
25.6 to 25.8	14377.5	29.0 to 29.2	16077.5
25.8 to 26.0	14477.5	29.1 to 29.5	16127.5
26.0 to 26.2	14577.5	29.2 to 29.4	16177.5
26.2 to 26.4	14677.5	29.3 to 29.5	16227.5
26.4 to 26.6	14777.5	29.4 to 29.6	16277.5
26.6 to 26.8	14877.5	29.5 to 29.7	16327.5
26.8 to 27.0	14977.5	29.6 to 29.8	16377.5
27.0 to 27.2	15077.5	29.8 to 30.0	16477.5
27.2 to 27.4	15177.5		
*Crystals supplied with the KWM-2/2A.			

