RX AMP Q101. The amplified signal is then fed to Q102 – the 1st RX MIXER – where it is mixed with an injected signal from the MASTER OSCILLATOR Q107 about 10 MHz above the receive channel frequency. L116 and C207 act as a trap for any FM broadcast band frequencies that might reach the base of Q102. The filter formed by T101 and T102 selects the 10 MHz converted signal which is then fed to Q103 – the 2nd RX MIXER – where it is mixed with an injection signal from the RX OSCILLATOR Q106 which is 455 KHz below the desired signal. The 455 KHz converted signal is selected by T103, T104, T105, and T106 and then fed to the 1st IF AMP Q104. The output of Q104 is then fed to Q105 which drives the AGC DETECTOR CR102, the S-METER DETECTOR CR109 and CR110, and the AUDIO DETECTOR CR107 and CR108. After passing through the AUTOMATIC NOISE LIMITER CR103, the detected audio signal is fed through C127 to the top of potentiometer R168 – the volume control. The audio signal developed at the wiper of R168 is then fed through CR106 – which is forward biased in receive mode – to the 1st AUDIO AMP Q114. The output of Q114 is direct coupled to Q115 which drives the audio output amplifier Q116.

AUTOMATIC GAIN CONTROL

The AGC circuit reduces the gain of the receiver in response to a strong signal by lowering the bias on the RF and IF amplifiers. The AGC voltage is developed at the R179, C128 junction. With a weak receiver input signal –less than 1μV – diode CR102 is forward biased by current through R109 and R179. About 4 volts of AGC appear on the capacitor C128. As the input signal increases, the signal at the top of C186 increases. When the signal at the top of C186 swings positive, increased current flows through R109, R179, and CR102 to C186. As the signal swings negative, C185 discharges through R119. The increase in current through R109 and R179 decreases the AGC voltage. The AGC voltage is then fed to the base of Q104 – the 1st IF AMP. Q104 functions as an emitter follower at low frequencies producing a low impedance AMPLIFIED AGC at the top of R111. This AMPLIFIED AGC is then fed to the base of Q101, to the base of Q102, and to the base of Q103.

THE AUDIO DETECTOR

The AUDIO DETECTOR demodulates the received signal. The output of the 2nd IF AMP Q105 is fed through C123 to AUDIO DETECTOR diodes CR107 and CR108. When the signal on the collector of Q105 swings negative, CR107 conducts current on to C123. As the signal swings positive, C123 discharges through CR108 and charges C124. The voltage on C124 thus tends to follow the peak-to-peak voltage of the received signal and is thus the demodulated audio signal.

AUTOMATIC NOISE LIMITER

The ANL circuit prevents impulse noise, such as ignition noise, from being amplified when the ANL switch S103 is in the ANL position. The audio output voltage level from the detector diodes CR107 and CR108 is reduced to about 1/3 by voltage divider R120 and R123 and then fed to the cathode of CR103 – the ANL diode. The audio output from the detector diodes is also fed through R121 to C126 where it is filtered and then fed through R122 to the anode of CR103. Since the audio signal is positive, the signal at the anode is normally more positive than the cathode and the diode is forward biased providing a low impedance path for the audio to the first audio stage Q114. When a noise pulse appears in the output of the detector, the time constant of R121 and C126 prevents the anode of CR103 from responding as fast as the cathode. The cathode of CR103 is thus driven more positive than the anode causing CR103 to become backed biased. CR103 thus becomes a high impedance that blocks the noise.

SQUELCH

The squelch circuit shuts the audio off when the received signal is less than the threshold level as determined by the SQUELCH CONTROL. If Q113 – the SQUELCH AMP – is off, R164, R163, and R167 form a voltage divider network that provides the proper forward bias to the base of Q114 – the first audio stage – permitting it to amplify the audio signal fed from the detector. Raising the wiper on R160 – the SQUELCH CONTROL – tends to forward bias the base of Q113 which turns Q113 on. When Q113 is on, the forward bias is removed from the base of Q114 thus preventing amplification of the audio signal. As the received signal becomes stronger, however, the AGC voltage lowers the bias on Q113 which turns it off and permits Q114 to amplify audio. Thus raising the wiper on R160 increases the threshold level a signal must overcome to "break squelch" – turn Q113 off and permit Q114 to amplify audio.

S METER CIRCUIT

In receive mode, meter M101 functions as an S METER, and indicates relative strength of the received signal. When the signal on the top of the T108 secondary swings negative, current flows through CR110 on to C189. As the signal swings positive, C189 discharges through CR109, R180 – S METER ADJUST – and CR114 to METER M1.

5.3 TRANSMITTER

GENERAL

In transmit mode, the output of the MASTER OSCILLATOR Q107 and the TX OSCILLATOR Q108 are mixed in the TX MIXER Q109. The output of Q109 is then fed through BAND PASS FILTER L104 and L105 (26.965 – 27.255 MHz) to the TX BUFFER Q110. The output of the TX BUFFER feeds the TX DRIVER Q111 which in turn drives the TX FINAL Q112. The output of the TX FINAL is fed through a filter and then through stripline printed circuit transmission line to the antenna. Modulation is accomplished by enabling the MIC AMP IC101 which feeds the audio amplifier Q114, Q115 and Q116. The output of Q116 then provides modulated B+ for the TX DRIVER Q111 and TX FINAL Q112.

FREQUENCY MIXING SCHEME

Channel Selector switch S101 selects one of six crystals (X101 – X106) to set the MASTER OSCILLATOR Q107 frequency about 10 MHz above the selected channel frequency. (See Table 4-5.) The output of Q107 is fed to the 1st RX MIXER Q102 to produce the 1st IF. S101 also selects one of four crystals (X107 – X110) for the RX OSCILLATOR Q106. The output of Q106 is fed to the 2nd RX MIXER Q103 to produce the 455 KHz 2nd IF. One of four crystals (X111 – X114) is also selected by S101 for the TX OSCILLATOR Q108. The outputs of the TX and MASTER OSCILLATORS are mixed in TX MIXER Q109. The difference of the frequencies from these oscillators is selected to produce the transmitter frequency.

FIG. 5-1 TRANSCEIVER BLOCK DIAGRAM
A BOARD

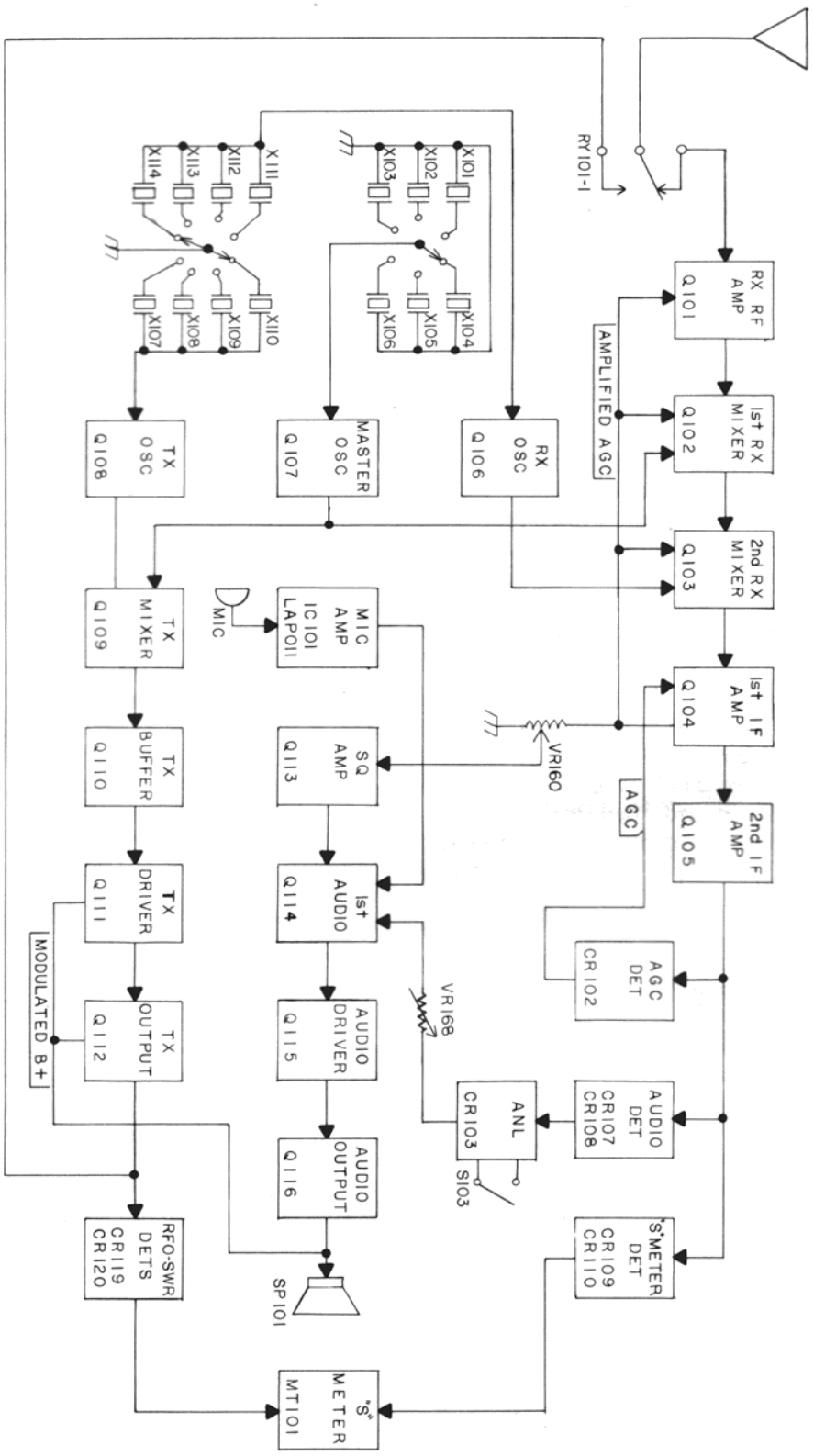


TABLE 5-2 SBE-11CB A BOARD

The following Troubleshooting Chart lists transceiver troubles and possible causes. This list is not meant to exhaust all possibilities, nor are they necessarily the most probable cause; they are the ones that stand out in repair people's minds often because they are not obvious. Also, check the back pocket of this manual for later Service Bulletins.

TROUBLESHOOTING CHART (A)

TROUBLES	REMEDY	
	CHECK	REPLACE
No B+ regulation	Q117, Q118	
No audio output	R175 (over heat)	R175, Z102, and C175
No RX after TX	Q111 for oscillation	
Low TX power		Q111, and Q112

TABLE 5-3 AGC versus RF INPUT LEVEL A BOARD

INPUT LEVEL (1)	AGC VOLTAGES (2)
OPEN ANT JACK	+4.1V
1μV	+3.3V
10μV	+2.1V
100μV	+1.6V
1000μV	+1.3V
10,000μV	+1.2V

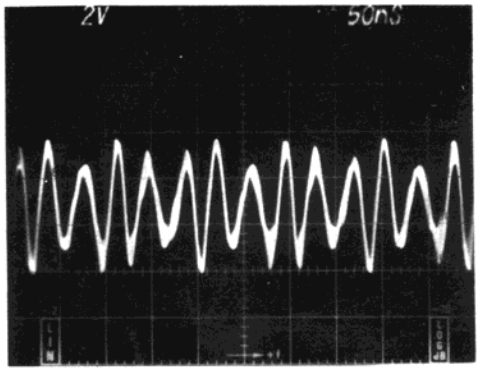
(1) Channel Frequency at Antenna Jack.

(2) Measured with 10MΩ input.

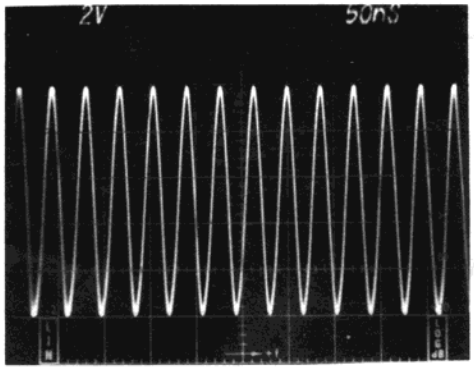
FIG. 5-4 TRANSMITTER ALIGNMENT PROCEDURE
SBE-11CB A BOARD

INITIAL SET-UP
Connect the transceiver to 110 VAC. Connect an audio oscillator to the MIC input, a wattmeter and dummy load to the antenna jack, an oscilloscope to the dummy load, set the CB/PA switch to CB, the RFO-S/SWR switch to RFO-S, the CAL/REV switch to CAL and the channel selector to channel 11. (See Figure 4-2.)
STEP 1 With no modulation, key the transmitter and adjust L104, L105, L106, L107, and C154 for maximum wattmeter indication.
STEP 2 Alternately, switch channel selector to channel 1 and 23. Adjust L104 and L105 for least change in wattmeter indication.
STEP 3 Set to channel 11. Adjust L110 and C154 for maximum wattmeter indication not to exceed 4 watts.
STEP 4 Set the audio oscillator to 1 KHz. While observing scope, adjust L110 and C154 for best modulation symmetry. (See Figure 5-6.)
STEP 5 Adjust the audio oscillator's level for 50% modulation. Read level on AC VTVM and increase level until the AC VTVM reads 8 times as great (about 18db). Adjust VR152 for 90-100% modulation.
STEP 6 Remove audio oscillator. Adjust VR182 until RFO METER reads the same as wattmeter.
STEP 7 Connect the frequency counter to the output of the dummy load. Check channels 1, 2, 3, 4, 8, 16, 20, and 23. (See Table 4-5.)

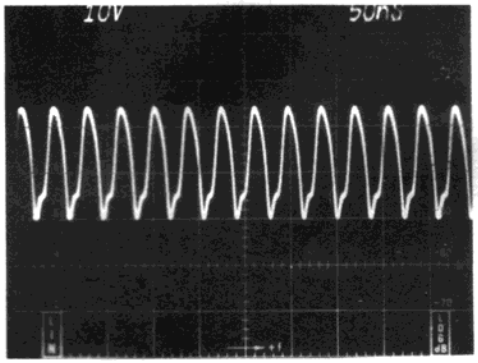
FIG. 5-5 TRANSMITTER ALIGNMENT WAVEFORMS
A BOARD



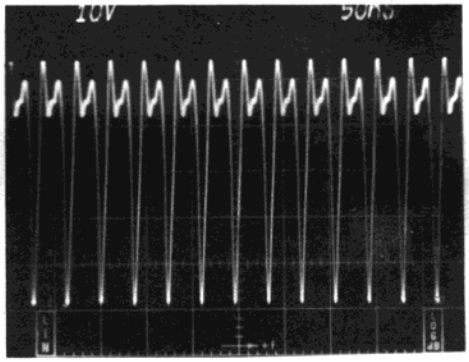
(a) TP5



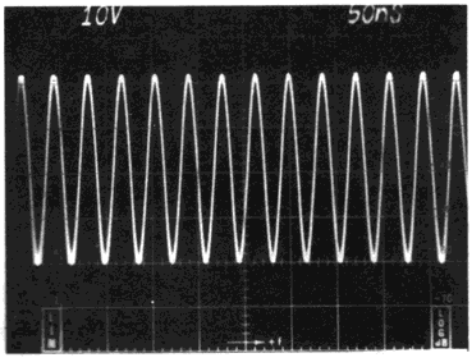
(b) TP6



(c) TP7

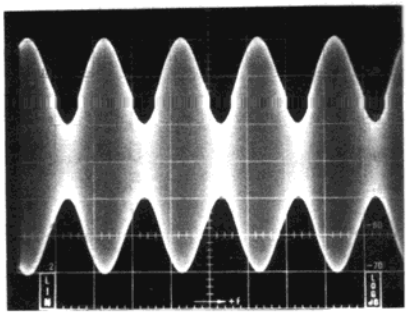


(d) TP8

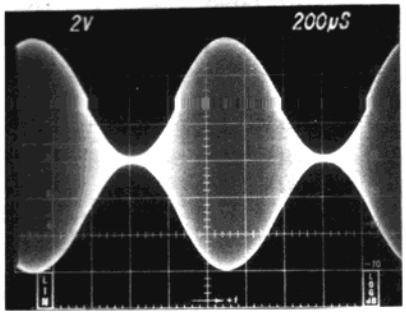


(e) TP9

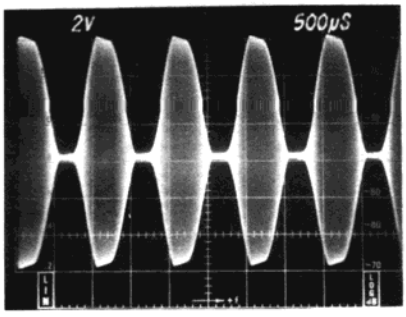
FIG. 5-6 MODULATION WAVEFORMS
A BOARD



50% MODULATION



100% MODULATION



OVERMODULATION

FIG. 5-7 RECEIVER ALIGNMENT PROCEDURE SBE-11CB A BOARD

INITIAL SET-UP
Connect the transceiver to 110 VAC. Connect an AC VTVM across the speaker or 8Ω load plugged into the EXT SP J102. Connect an RF signal generator to the antenna jack, set channel selector to channel 11, PA/CB switch to CB, RFO-S/SWR switch to RFO-S, CAL/REV switch to CAL, ANL switch OFF, DELTA TUNE control to 0, squelch control full counterclockwise, and the volume control full clockwise. (See Figure 4-3.)
STEP 1 Adjust the RF signal generator to a level sufficient to produce a slight indication on the S METER. Adjust L101, L102, T101, T102, T103, T104, T105, T106, T107 and T108 for maximum indication on S METER. Repeat adjustment until 0.7μV RF signal produces about 2 VAC on the AC VTVM.
STEP 2 Adjust T103 until DELTA TUNE + and - gives the same S METER indication.
STEP 3 Set output level of RF signal generator to 100μV. Adjust VR180 for an S-9 indication.
STEP 4 Set RF signal generator output to 300μV. Turn squelch control full clockwise. Adjust VR160 until squelch just breaks.

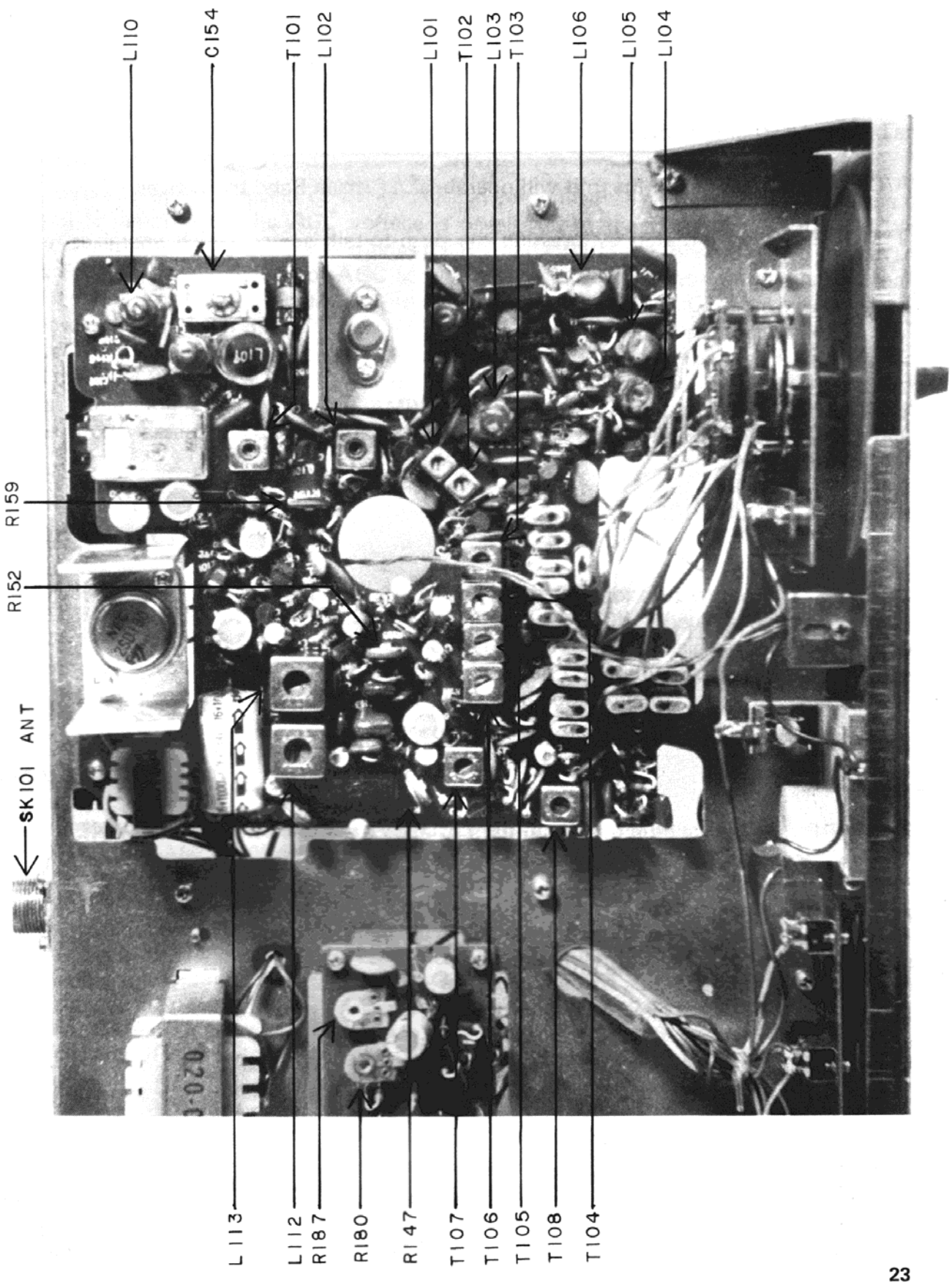
TABLE 5-8 RECEIVER INJECTION VOLTAGES A BOARD

All injection voltages are at 30% — 1 KHz modulation at the specified frequency fed through a .01 MFD capacitor, and should produce at least 2 VAC audio output measured across the speaker or across an 8Ω load connected at EXT SP J2. Typical audio output voltages are given.

INJECTION POINT	INJECTION LEVEL	FREQUENCY	AUDIO OUTPUT
ANT JACK J1	1μV	Channel Freq.	5.8V
Base of Q102 — TP1 *	3μV	Channel Freq.	5.4V
Base of Q103 — TP2	30μV	455 KHz	5.6V
Base of Q104 — TP3	30μV	455 KHz	3.5V
Base of Q105 — TP4	3000μV	455 KHz	5.2V

* TP numbers correspond to numbers in boxes on schematic diagram and component location drawing.

FIG. 5-9 ALIGNMENT LAYOUT
A BOARD



CIRCUIT DESCRIPTION
B BOARD

5.4 INTRODUCTION

The SBE-11CB with B electronics is an AM transceiver with a dual-conversion receiver using intermediate frequencies of 10 MHz and 455 KHz.

Refer to the block and schematic diagrams while following the circuit description.

With the PA/CB switch S202 in CB, the unit will operate as a Citizen Band transceiver.

TRANSMIT MODE is then initiated by pressing the push-to-talk switch which energizes relay RL-1 which:

DISABLES:

SPEAKER SP-1,
RX RF AMP Q101,
1st RX MIXER Q102,
2nd RX MIXER Q103,
1st IF AMP Q104,
2nd IF AMP Q105,
RX OSCILLATOR Q106,

ENABLES:

MIC AMP Q107,
TX OSCILLATOR Q114,
TX MIXER Q115,
TX BUFFER Q116.

PA MODE is initiated by placing PA/CB switch S202 in PA which:

DISABLES:

transmitter RF by disabling the B+ on the TX DRIVER and FINAL, CB SPEAKER,

ENABLES:

PA speaker jack J3.

The push-to-talk switch then enables the MIC AMP.

5.5 RECEIVER

GENERAL

In the receive mode, the RF signal is fed from the antenna to the 1st RX AMP Q101. The amplified signal is then fed to Q102 – the 1st RX MIXER – where it is mixed with an injected signal from the MASTER OSCILLATOR Q113 about 10 MHz above the receive channel frequency. The filter formed by T101 and T102 selects the 10 MHz converted signal which is then fed to Q103 – the 2nd RX MIXER – where it is mixed with an injection signal from the RX OSCILLATOR Q106 which is 455

KHz below the desired signal. The 455 KHz converted signal is selected by T103, T104, T105, and T106 and then fed to the 1st IF AMP Q104. The output of Q104 is then fed to Q105 which drives the AGC DETECTOR CR102 and CR103, the S-METER DETECTOR CR205 and CR206, and the AUDIO DETECTOR CR104 and CR105. After passing through the AUTOMATIC NOISE LIMITER CR106, the detected audio signal is fed to the wiper of potentiometer VR205 – the volume control. The audio signal developed across VR205 is then fed to the 1st AUDIO AMP Q109. The output of Q109 is transformer coupled to push-pull speaker driver amplifier Q111 and Q112.

AUTOMATIC GAIN CONTROL

The AGC circuit reduces the gain of the receiver in response to a strong signal by lowering the bias on the RF and IF amplifiers. The AGC voltage is developed at the R121, C128 junction. With a weak receiver input signal – less than 1μV – diodes CR102 and CR103 are forward biased by current through R112 and R121. About 2.5 volts of AGC appear on the C128 capacitor. As the input signal increases, the signal at the top of C125 increases. When the signal at the top of C125 swings negative, increased current flows through CR103, R121 and R112 to C125. As the signal swings positive, C125 discharges through CR102. The increase in current through R121 and R112 decreases the AGC voltage. The AGC voltage is then fed to the base of Q104,– the 1st IF AMP. Q104 functions as an emitter follower at low frequencies producing a low impedance AMPLIFIED AGC at the top of R113. This AMPLIFIED AGC is then fed to the base of Q101, through R105 to the base of Q102, and through R109 to the base of Q103.

THE AUDIO DETECTOR

The AUDIO DETECTOR demodulates the received signal. The output of the 2nd IF AMP Q105 is fed through C126 to AUDIO DETECTOR diodes CR104 and CR105. When the signal on the collector of Q105 swings negative, CR104 conducts current on to C126. As the signal swings positive, C126 discharges through CR105 and charges C129. The voltage on C129 thus tends to follow the peak-to-peak voltage of the received signal and is thus the demodulated audio signal.

AUTOMATIC NOISE LIMITER

The ANL circuit prevents impulse noise, such as ignition noise, from being amplified when the ANL switch S205 is in the ANL position. The audio output voltage level from the detector diodes CR104 and CR105 is reduced to about 1/3 by voltage divider R122 and R123 and then fed to the cathode of CR106 – the ANL diode. The audio output from the detector diodes is also fed through R124 to C131 where it is filtered and then fed through R125 to the anode of CR106. Since the audio signal is positive, the signal at the anode is normally more positive than the cathode and the diode is forward biased providing a low impedance path for the audio to the first audio stage Q109. When a noise pulse appears in the output of the detector, the time constant of R124 and C131 prevents the anode of CR106 from responding as fast as the cathode. The cathode of CR106 is thus driven more positive than the anode causing CR106 to become backed biased. CR106 then becomes a high impedance that blocks the noise.

SQUELCH

The squelch circuit shuts the audio off when the received signal is less than the threshold level as determined by the SQUELCH CONTROL. If Q108 – the SQUELCH AMP – is off, R159, R160 and R161 form a voltage divider network that provides the proper forward bias to the base of Q109 – the first audio stage – permitting it to amplify the audio signal fed from the detector. Raising the wiper of

R202 – the SQUELCH CONTROL – tends to forward bias the base of Q108 which turns Q108 on. When Q108 is on, the forward bias is removed from the base of Q109 thus preventing amplification of the audio signal. As the received signal becomes stronger, however, the AGC voltage lowers the bias on Q108 which turns it off and permits Q109 to amplify audio. Thus raising the wiper on R202 increases the threshold level a signal must overcome to "break squelch" – turn Q108 off and permit Q109 to amplify audio.

S METER CIRCUIT

In receive mode, meter M1 functions as an S METER, and indicates relative strength of the received signal. When the signal on the collector of Q105 – the 2nd IF AMP – swings negative, current flows through CR206 on to C206. As the signal swings positive, C206 discharges through CR205, VR202 – S METER ADJUST – and CR207 to METER M1.

5.6 TRANSMITTER

GENERAL

In transmit mode, the output of the MASTER OSCILLATOR Q113 and the TX OSCILLATOR Q114 are mixed in the TX MIXER Q115. The output of Q115 is then fed through BAND PASS FILTER L104 and L105 (26.965 – 27.255 MHz) to the TX AMP Q116. The output of the TX AMP feeds the TX DRIVER Q117 which in turn drives the TX FINAL Q118. The output of the TX FINAL is fed through a filter and then through stripline printed circuit transmission line to the antenna. Modulation is accomplished by enabling the MIC AMP Q107 which feeds the AUDIO DRIVER AMP Q110 which feeds the AUDIO OUTPUT AMP Q111, and Q112. The output of Q111 and Q112 then provides modulated B+ for the TX DRIVER Q117 and TX FINAL Q118.

FREQUENCY MIXING SCHEME

Channel Selector switch S201 selects one of six crystals (X101 – X106) to set the MASTER OSCILLATOR Q113 frequency about 10 MHz above the selected channel frequency. (See Table 4-5.) The output of Q113 is fed to the 1st RX MIXER Q102 to produce the 10 MHz 1st IF. S201 also selects one of four crystals (X107 – X110) for the RX OSCILLATOR Q106. The output of Q106 is fed to the 2nd RX MIXER Q103 to produce the 455 KHz 2nd IF. One of four crystals (X111 – X114) is also selected by S201 for the TX OSCILLATOR Q114. The outputs of the TX and MASTER OSCILLATORS are mixed in TX MIXER Q115. The difference of the frequencies from these oscillators is selected to produce the transmitter frequency.

OVERMODULATION LIMITER

The OML regulates the gain of the audio amplifier so as to accommodate a wide range of voice levels without overmodulating the carrier. The audio signal is fed from the secondary of the audio output transformer T110 through C155 to CR107 where it is rectified; it is then filtered by R143 and C167 and fed to the emitter of Q107 – the MIC AMP – through the OML adjustment R125. As the sound level into the MIC increases, the voltage at the emitter of Q107 will rise and lower the amplification of the sound input.

OSCILLATORS

Crystal oscillators Q106 and Q114 are common collector, colpitts circuits. Outputs are taken from the emitters; collectors are at AC ground. Crystal oscillator Q113 is a common emitter colpitts circuit. Output is taken from the collector; emitter is at AC ground.

FIG. 5-10 TRANSCEIVER BLOCK DIAGRAM
B BOARD

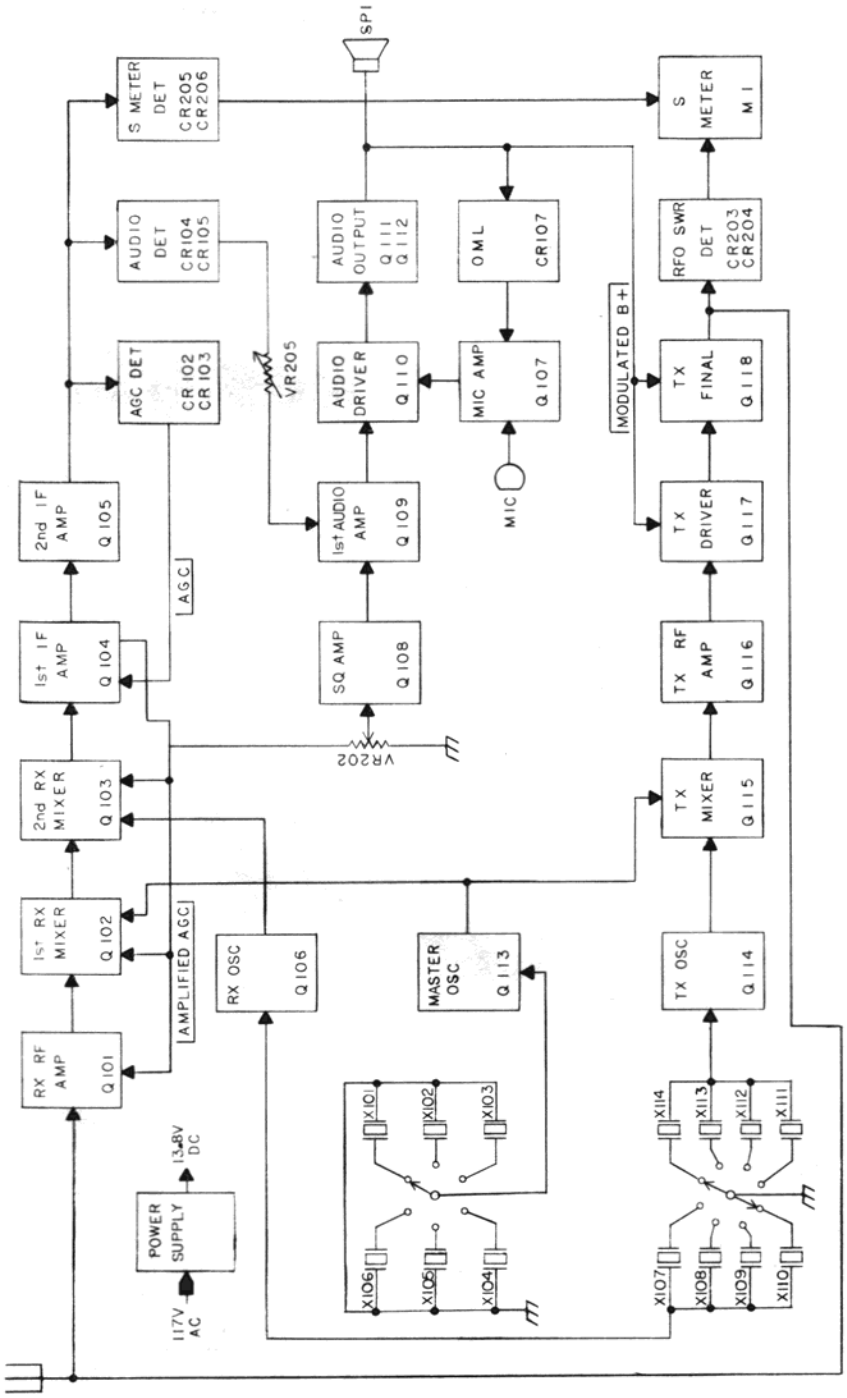
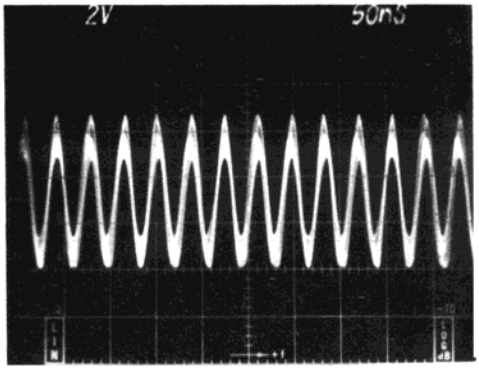


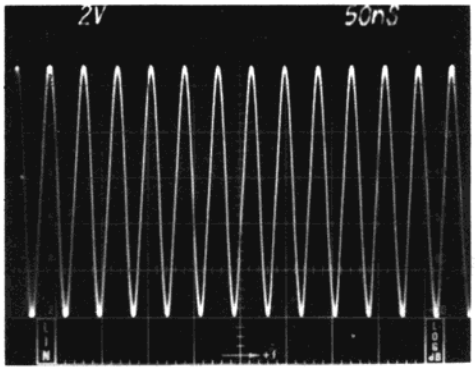
FIG. 5-11 TRANSMITTER ALIGNMENT PROCEDURE SBE-11CB B BOARD

INITIAL SET-UP
Connect the transceiver to 110 VAC. Connect an audio oscillator to the MIC input, a wattmeter and dummy load to the antenna jack, an oscilloscope to the dummy load, set the CB/PA switch to CB, the RFO-S/SWR switch to RFO-S, the CAL/REV switch to CAL and the channel selector to channel 11. (See Figure 4-2.)
STEP 1 With no modulation, key the transmitter and adjust L104, L105, L106, L107, and C162 for maximum wattmeter indication.
STEP 2 Alternately, switch channel selector to channel 1 and 23. Adjust L104 and L105 for least change in wattmeter indication.
STEP 3 Set to channel 11. Adjust L111 and C162 for maximum wattmeter indication not to exceed 4 watts.
STEP 4 Set the audio oscillator to 1 KHz. Adjust output level for about 80% modulation. While observing scope, adjust L111 and C162 for best modulation symmetry. (See Figure 5-13.)
STEP 5 Adjust the audio oscillator's level for 50% modulation. Read level on AC VTVM and increase level until the AC VTVM reads 8 times as great (about 18db). Adjust VR152 for 100% modulation.
STEP 6 Remove audio oscillator. Adjust VR201 until RFO METER reads the same as wattmeter.
STEP 7 Connect the frequency counter to the output of the dummy load. Check channels 1, 2, 3, 4, 8, 16, 20, and 23. (See Table 4-5.)

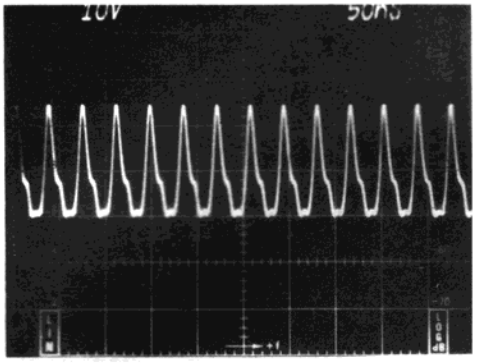
FIG. 5-12 TRANSMITTER ALIGNMENT WAVEFORMS
B BOARD



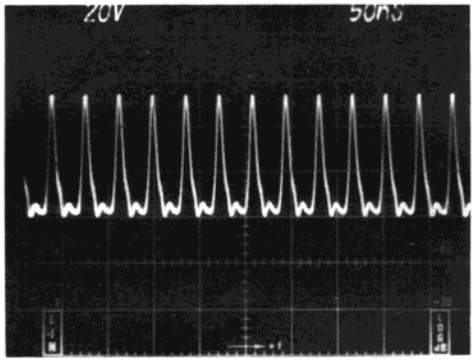
(a) TP5



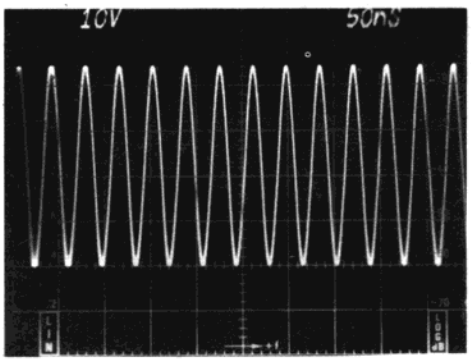
(b) TP6



(c) TP7

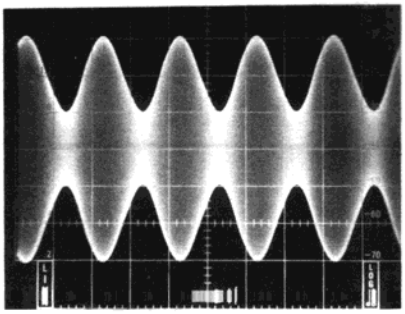


(d) TP8

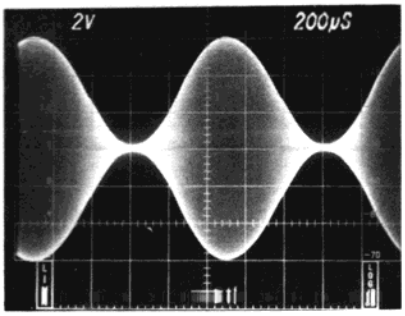


(e) TP9

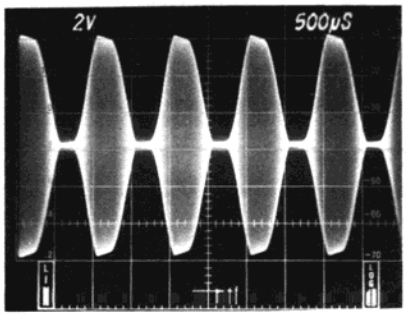
FIG. 5-13 MODULATION WAVEFORMS
B BOARD



50% MODULATION



100% MODULATION



OVERMODULATION

FIG. 5-14 RECEIVER ALIGNMENT PROCEDURE
SBE-11CB B BOARD

INITIAL SET-UP

Connect the transceiver to 110 VAC. Connect an AC VTVM across the speaker or 8Ω load plugged into the EXT SP J2. Connect an RF signal generator to the antenna jack, set channel selector to channel 11, PA/CB switch to CB, RFO-S/SWR switch to RFO-S, CAL/REV switch to CAL, ANL switch OFF, DELTA TUNE control to 0, squelch control full counterclockwise, and the volume control full clockwise. (See Figure 4-3.)

STEP 1

Set AGC adjust for maximum background noise.

STEP 2

Connect RF signal generator to the antenna jack, set to 27.085 MHz 30% – 1 KHz modulation. Adjust the RF output level of the signal generator to a level sufficient to produce a slight indication on the S METER. Adjust L101, L102, T101, T102, T103, T104, T105, and T106 for maximum indication on the S METER. Repeat adjustment until 0.7μV RF signal produces about 2 VAC on the AC VTVM.

STEP 3

Adjust T103 until DELTA TUNE + and - gives the same S METER INDICATION.

STEP 4

Disconnect RF signal generator, adjust AGC potentiometer on bottom of board for 2.6 VDC of AGC measured at junction of R121 and C128.

STEP 5

Connect RF signal generator and set output to 100μV. Adjust VR–202 for an S–9 indication.

STEP 6

Set RF signal generator output to 300μV. Turn squelch control full clockwise. Adjust VR–155 until squelch just breaks.