CORTEZ

MODEL SBE-21CB

SERVICE MANUAL

SBE®

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SECTION 2

SPECIFICATIONS

2.1 GENERAL

Compliance	F.C.C. Type Accepted (Part 95, Class D)
Channels	23
Frequency Range	(26.965 - 27.255) MHz
Frequency Control	Crystals, Synthesized
Frequency Tolerance	±0.003%
Operating Temperature Range	–30°C to +50°C
Humidity	95%
Input Voltage	(11.7 - 15.9) VDC positive or negative ground
Microphone	Dynamic
Size	Height: 2-1/8" (54mm) Width: 5-7/8" (150mm) Depth: 8-3/4" (223mm)
Weight	4 lbs., 1.82 Kg.
Power Consumption	13.8 VDC Receive (squelched) 400ma Receive (2 watts audio) 1.0A Transmit (3 watts out) 1.7A
Fuse	2A fast blow (Type 3AG or A.G.C.)

2.2 RECEIVER

Sensitivity	0.7μV for 10db S+N/N
Selectivity	6db @ 60 KHz, 50db @ 10 KHz
IF Frequency	10 MHz, 455 KHz
AGC Response	Less than 10db for 10-100,000μV
Squelch Threshold	Less than 1μV More than 200μV
Audio Power Output	2 watts

External Speaker	(Not Supplied) 4 or 8Ω. Disables internal speaker when connected.
Squelch Range	200μV (Minimum)

2.3 TRANSMITTER

Power Output	4 watts
Modulation	95-100%
Modulator Response	300-2500 Hz
Output Impedance	50Ω, unbalanced
Emission	6A3

SECTION 3
INSTALLATION

3.1 GENERAL

The first step in installation of the mobile transceiver is selection of antenna and transceiver mounting positions.

The selection of an antenna and its mounting position is the most critical factor in determining the end performance of an installation. Generally, the most satisfactory installation position for most vehicles is the center of the passenger compartment roof. As a second choice, the trunk can be a satisfactory antenna mounting point, especially on those cars where the trunk is large and flat. Due to increased susceptibility to ignition noise, mounting the antenna in the hood area is discouraged. Follow antenna manufacturer's recommendations carefully during installation.

The SBE-21CB is supplied with a universal mounting bracket and microphone holder. The transceiver may be mounted in any position and on any rigid surface, such as underneath an automobile dashboard, truck roof or vertically on a boat bulkhead.

The transceiver should be mounted with accessibility and operation convenience in mind.

CAUTION: Avoid mounting the transceiver in the direct air stream of the vehicle's heater. Temperatures in this area can exceed 150° and can result in serious damage to the unit.

It is recommended that the mounting bracket be installed on the transceiver and mounting clearances checked, with the unit held in the desired mounting position. It is especially important to leave sufficient space behind the unit for antenna and accessory cable connections.

When the most desirable mounting installation point has been decided upon, a pencil or other marking device should be used to outline the mounting bracket on the mounting surface. The transceiver should then be removed from the mounting bracket and the bracket held against the dash or other mounting surface, in the position marked, so that mounting holes may be marked and drilled.

CAUTION: Be sure to check behind the dash or other mounting surface to insure against damage of wiring and other devices before drilling any holes.

Install the microphone holder on the radio or other mounting surface as desired.

Install any accessories at this time, including external speaker, public address speaker, etc.

This unit is designed for either 12 volt positive or negative ground systems. In either system, the positive battery terminal always connects to the red supply wire, and the negative battery terminal always connects to the black supply wire. If the transceiver's power lead must be lengthened, use No. 14 or larger wire.

CAUTION: When using this radio in a positive ground system, it is important that none of the accessories are electrically connected to the vehicle's chassis (external speakers, P.A. speakers, etc.). Positive ground installations must utilize an additional 2 ampere fuse in the negative (black) supply lead to avoid possible damage to the transceiver. NOTE: The transceiver power lead may be connected to the accessory section of the ignition switch if desired. However, due to the possible presence of high-level noise from the ignition and accessories, this connection may not be desirable. In cases where excessive noise is present on the accessory line, a direct connection to the battery is recommended.

3.2 ANTENNA TUNING

The final step in installation is to trim the antenna for minimum S.W.R. The recommended method of antenna tuning is to use an in-line wattmeter or S.W.R. bridge to adjust the antenna for minimum reflected power on channel 11. A properly tuned antenna system will present a suitable load to the transceiver and will insure that maximum power is transfered from the radio to the antenna. If the antenna system in use presents a poor load, as indicated by a high S.W.R. reading, transmitter range will be substantially reduced and damage to the transmitter final amplifier transistor may occur. Poor S.W.R. can usually be corrected by altering the antenna's electrical length in accordance with the manufacturer's instruction. Extremely high S.W.R. readings may be indicative of a defective transmission line, antenna, or connections.

To determine whether the antenna should be lengthened or shortened, test the S.W.R. on channels 1 and 23. If the S.W.R. is the highest on channel 23, the antenna is too long and if highest on channel 1, the antenna is too short. When the antenna system has been tuned correctly, channel 11 should have the lowest S.W.R. and channels 1 and 23 will be slightly higher.

3.3 FINAL CHECK

Test drive the vehicle and make an operational check-out of the transceiver to insure proper operation of it and all the accessories installed. At this time, note any degradation of performance due to vehicle noise and take appropriate action to correct any deficiencies as outlined in the following section.

3.4 NOISE SUPPRESSION

The first step in assuring minimum ignition noise is to insure that the engine ignition system is in a good state of tune, and all factory original noise suppression devices are installed and operational. This includes an inspection of distributor points and condenser. Check to see that the spark plugs are clean and properly adjusted. The condition of the ignition wiring should be checked (radio resistor type ignition wire is standard on most late model vehicles and should be installed on vehicles not so equipped). The distributor cap should be checked for traces of carbon tracking or signs of arcing. Resistor type spark plugs are helpful in further reducing ignition noise and are standard as original equipment on many late model vehicles.

Alternator noise may be minimized by the installation of an alternator line filter, available from radio parts distributors.

Installation of bonding straps in the engine compartment will further reduce ignition noise. Short lengths of metal strap or heavy shield braid between the engine and frame, engine and fire wall, alternator and frame, exhaust pipe and frame, or hood to frame, will in many cases, greatly reduce ignition noise. Extremely high ignition noise levels or noise levels that become worse after a period of time are usually indicative of deterioration of the vehicle's electrical system. In some cases, interference may be caused by dash instruments including gasoline gauges, heater blowers and fans, etc. This interference may often be reduced by the installation of bypass capacitors from the terminals of the interfering instruments to ground. .01 microfarad capacitors of the ceramic disc variety rated at 500 working volts DC are recommended for this purpose.

For further information on the suppression of ignition noise in the automotive and marine environment, the Champion Spark Plug Company publication "Giving Two Way Radio Its Voice" is highly recommended. This publication is available from the automotive technical service department Champion Spark Plug Company, Post Office Box 910, Toledo, Ohio 43661. This publication is also available, at no charge, from the SBE Technical Services Department, upon request.

SECTION 4

CIRCUIT DESCRIPTION

4.1 INTRODUCTION

The SBE-21CB 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.

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

DISABLES:

RX RF AMP Q1,
1st RX MIXER Q2,
1st IF AMP Q3,
2nd IF AMP Q4,
RX OSCILLATOR Q9,
1st RX AUDIO Q15, by grounding the 9V RX BUS,
SPEAKER SP-1,

ENABLES:

TX OSCILLATOR Q10,
TX BUFFER Q12, by applying B+,
RX PROTECTION DIODE D1, by grounding the cathode.

When the push-to-talk switch is released the transceiver is in RECEIVE MODE and the above states are reversed.

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

disables the TX RF, by removing Q10, Q11 and Q12 B+,
disables the CB SPEAKER,
enables the PA speaker jack.

4.2 RECEIVER

In receive mode, an RF signal is fed from the antenna to the RF AMP Q1. The amplified RF signal is then fed to Q2 – the 1st mixer – where it is mixed with an injection signal from the MASTER OSCILLATOR Q8 about 10 MHz below the receive channel frequency. The resultant 10 MHz 1st IF is selected by T2 and fed to D4 – the 2nd mixer – where it is mixed with an injection signal from the RX OSCILLATOR Q9 455 KHz below the 10 MHz 1st IF. The ceramic filter FL-1 selects the 455 KHz signal and feeds it to the 1st IF AMP Q3 which then feeds it to the 2nd IF AMP Q4. The output of Q4 is fed through C28 to the AGC detection diodes D9 and D10, from T6 to the S METER detection diode D5, and through C26 to the audio detection diodes D6 and D7. After passing through the AUTOMATIC NOISE LIMITER, the detected audio signal is applied to the wiper of potentiometer VR3 – the volume control. The audio signal developed across VR3 is then fed to audio amplifier stage Q15 which then feeds Q16. The output of Q16 is transformer coupled to push-pull speaker driver amplifier Q17 and Q18.

AUTOMATIC GAIN CONTROL CIRCUIT

The AGC (Automatic Gain Control) on the SBE-21CB 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 R22, R23 junction and filtered by C34 and C35. With a weak receiver input signal – less than 1μV – diodes D9 and D10 are forward biased by current through R22 and R23. About 1.5 volts of AGC appear at the C34, R23 junction. As the input signal increases, the signal at the top of C28 increases. When the signal at the top of C28 swings negative, current flows through D9 on to C28. As the signal swings positive, C28 discharges through D10. The increase in current through R22 decreases the AGC voltage. The AGC voltage is then fed through R3 to the base of Q1, and through R11 to the base of Q3.

THE AUDIO DETECTOR

The AUDIO DETECTOR on the SBE-21CB demodulates the received signal. The output of the 2nd IF AMP is fed from the top of the primary T6 through C26 to the detector diodes D6 and D7. When the signal at the top of T5 swings negative, D7 conducts current on to C26. As the signal swings positive, C26 discharges through D6 and charges C30. The voltage on C30 thus tends to follow the peak-to-peak voltage of the received signal and is thus the demodulated audio signal which is then fed through the AUTOMATIC NOISE LIMITING circuit, through C32 to the wiper of VR3 – the volume control, and from the top of VR3 through C33 to Q15 – the first stage of audio.

AUTOMATIC NOISE LIMITER CIRCUIT

The ANL circuit prevents impulse noise, such as ignition noise, from being amplified. The audio output voltage from the detector diodes D6 and D7 is reduced about 1/2 by voltage divider R17 and R18 and then fed to the cathode of D8 – the ANL diode. The audio output from the detector diodes is also fed through R19 to C31 where it is filtered and then fed through R20 to the anode of D8. Since the audio signal is positive, the signal at the anode of D8 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, Q15. When a noise pulse appears in the output of the detector, the time constant of R19 and C31 prevents the anode of D8 from responding as fast as the cathode. The cathode of D8 is thus driven more positive than the anode causing D8 to become backed biased. D8 then becomes a high impedance that blocks the noise.

SQUELCH CIRCUIT

The squelch circuit shuts the audio off when the received signal is less than the threshold level as determined by the squelch control VR1. The 2nd IF signal is AC coupled from the secondary of T6 through C27 to the cathode of D11. A DC bias is applied to the signal from the wiper on the SQUELCH CONTROL VR1. An IF signal produces a negative voltage at the base of Q5 which tends to turn it off. When Q5 is turned off, Q6 is turned on turning Q7 off. With Q7 off, the 1st AUDIO AMP Q15 is properly biased to amplify audio. Moving the wiper on VR1 so as to make the DC component more positive, turns Q5 and Q7 on. Q7 then back biases Q15 and shuts the audio off. Thus moving the wiper on VR1 more positive increases the threshold level a signal must overcome to "break squelch" – turn Q7 off and permit Q15 to pass audio.

S METER CIRCUIT

In receive mode, meter M1 functions as an S METER, and indicates relative strength of the received signal. The IF signal from the secondary of T6 is rectified by D5, filtered by C29, and then fed to meter M1 through VR5 – the S METER ADJ.

4.3 TRANSMITTER

In transmit mode, the output of the MASTER OSCILLATOR Q8 and the TX OSCILLATOR Q10 are mixed in the TX MIXER D16. The output of D16 is then fed through BAND PASS FILTER T7 and T8 (26.965 – 27.255 MHz) to the TX BUFFER Q11. The output of the BUFFER feeds the TX AMP Q12 which in turn feeds the TX DRIVER Q13. The TX DRIVER then feeds the TX FINAL Q14. The output of the TX FINAL is then fed through a low pass filter, L8, C71, L9, C72, and a second harmonic trap CV1 and L10, to the antenna. Modulation is accomplished by driving the collector of the TX DRIVER and TX FINAL by modulated B+ derived from the lower secondary of T12 – the AUDIO OUTPUT transformer.

FREQUENCY MIXING SCHEME

Channel Selector switch S2 selects one of six crystals (X5 – X10) to set the MASTER OSCILLATOR Q8 frequency about 10 MHz below the selected channel frequency. (See Table 5-3.) The output of Q8 is fed to the 1st MIXER Q2 to produce the 1st IF. S2 also selects one of four crystals (X1 – X4) for the RX OSCILLATOR Q9. The output of Q9 is fed to the 2nd MIXER D4 to produce the 455 KHz 2nd IF. One of four crystals (X11 – X14) is also selected by S2 for the TX OSCILLATOR Q10. The outputs of the TX and MASTER OSCILLATORS are mixed in TX MIXER diode D16. The sum 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 T12 through the OML adjustment VR4 to D14 where it is rectified; it is then filtered by R68, C79 and C78 and then fed to the emitter of Q15 – the 1st AUDIO AMP. As the sound level into the MIC increases, the voltage at the emitter of Q15 will rise and thus lower the amplification of the sound input.

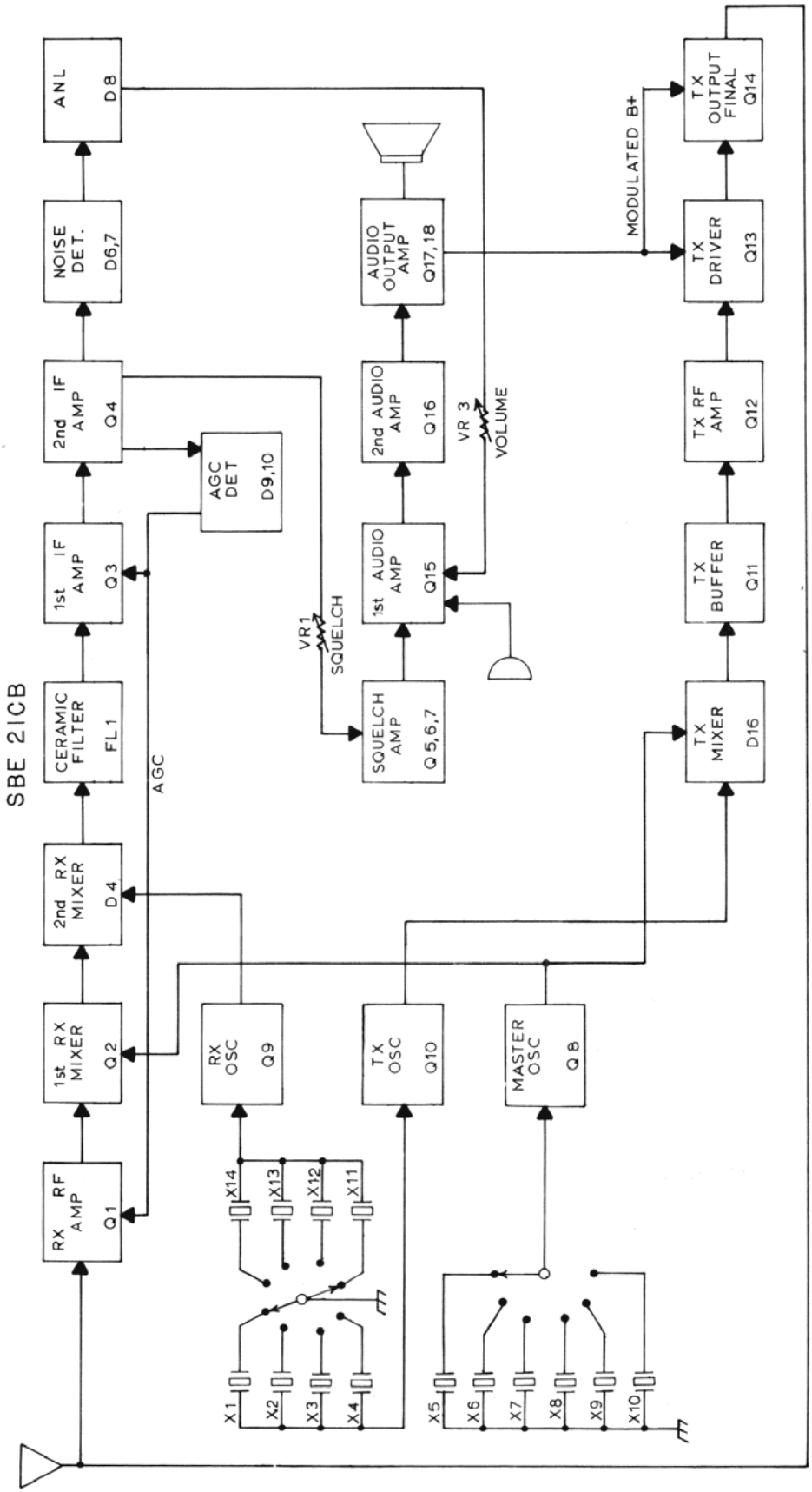
OSCILLATORS

Crystal oscillators Q8, Q9 and Q10 are common collector, colpitts circuits. Outputs are taken from the emitters. The collectors of Q8, Q9 and Q10 are at AC ground.

RF OUTPUT METER

In transmit mode, meter M1 functions as a transmitter power output indicator. A small sample of the transmitter's RF output signal is fed by C75 to network R71, D18 and C74 where it is rectified, filtered and then fed through VR6 – the RFO ADJ – to meter M1.

FIG. 4-1 SBE-21CB TRANSCEIVER BLOCK DIAGRAM



SECTION 5

SERVICING

5.1 INTRODUCTION

Read this section carefully before attempting any repair of the SBE-21CB. Refer to the circuit description, block and schematic diagrams. The transistor case diagrams are shown on the schematic diagram. Refer to these diagrams before checking transistors. Component layout and location prints are provided to aid troubleshooting and alignment. Use only recommended replacement parts. Refer to the parts list in the back of this book. **Never replace blown fuses with higher rated ones or fast acting with slow blow.** To check operation of the unit, refer to Figure 5-1, PERFORMANCE VERIFICATION PROCEDURE. Figures 5-4, 5-5, TRANSMITTER TEST CONNECTION and RECEIVER TEST CONNECTION respectively, show the proper manner to connect the unit to test instruments for performance verification or alignment. Table 5-2 lists RECOMMENDED TEST INSTRUMENTS. Tables 5-10, 5-6 show the proper TRANSMITTER ALIGNMENT PROCEDURE and RECEIVER ALIGNMENT PROCEDURE respectively. Figure 5-8, ALIGNMENT LAYOUT is placed next to the alignment procedures to show alignment adjustments at a glance.

5.2 TEST SIGNALS

OSCILLOSCOPE WAVEFORMS are shown which were taken from various points in the SBE-21CB during normal operation into a dummy load. CHECK POINT numbers next to the waveform pictures correspond to numbers in boxes on both the schematic diagram and component layout drawing. Figure 5-11 shows RF amplification through a properly aligned transmitter. Figure 5-12 shows 50%, 100% and overmodulation respectively. Notice that the waveform at the ANODE of D16 – the TX MIXER – contains several frequency components. Also notice that the waveform at the collector of Q14 – the TX FINAL – is unsymmetrical (Figure 5-11e). This is proper since the TX FINAL operates class C for greater efficiency. Figure 5-11f shows how the output should look at the dummy load.

VOLTAGE MEASUREMENTS are shown on the schematic diagram for normal operation. All voltages were measured with an AC VTVM having 10MΩ input impedance. Voltage measurements on high impedance RF points should be taken through a choke. While any choke about 100μH is suitable, SBE part number 8000-00011-0018 (150μH) may be ordered from the factory. Mini-test clips are very useful for making voltage measurements in hard to reach places.

RECEIVER INJECTION VOLTAGES are given in Table 5-9 together with CHECK POINT numbers which correspond to numbers in boxes on both the schematic diagram and component layout drawing. This table specifies the voltage level, carrier frequency and particular points in the receiver string at which a 30% – 1 KHz modulated signal injected through a .01 MFD capacitor should produce 2 VAC of audio across the speaker or 8Ω load plugged into the speaker jack, EXT SP. While the value of this capacitor is not critical, capacitive coupling of the signal generator to the circuit is necessary to prevent grounding out the transistor biases.

Before setting up to measure RECEIVER INJECTION VOLTAGES, small hand-held "all-purpose signal generators" can be used to provide a quick check of the receiver string. Basically, these devices generate pulses rich in harmonics from AF to RF to test whether a stage is working.

AGC VOLTAGES versus RF INPUT LEVEL are shown in Table 5-7. This table should be consulted before any adjustments are made on the squelch circuit since squelch is a function of AGC.

5.3 TROUBLESHOOTING

Troubleshooting the SBE-21CB transceiver is not essentially different than troubleshooting any other electronic device. Be a detective; suspect everything and everyone. Carefully inspect the unit for evidence of overheated components, cold solder joints, or tampering. Understand thoroughly the circuit description and block diagram. Try to start big and isolate the problem. Devise tests that will divide the transceiver in two and isolate the trouble to a particular half. Continue to divide into two parts until the trouble is located. For example, it is determined that a problem exists in a particular transceiver. The unit is divided into:

TRANSMITTER – RECEIVER.

Suppose that the receiver functions properly but there is no carrier when the transmitter is keyed. Since the receiver audio works, it can be assumed that all of the audio amplifier is good. The MASTER OSCILLATOR can be assumed working since it is used by both the transmitter and receiver. After checking the TX/RX relay RL-1 and transmitter B+, the transmitter is then divided into:

BEFORE TX AMP – TX AMP and AFTER.

Figure 5-11, TRANSMIT ALIGNMENT WAVEFORMS, shows typical waveforms taken at various points in an SBE-21CB transmitter during normal operation. Place an oscilloscope probe on the collector of Q11. If a signal is present and doesn't differ significantly from the waveform picture then the problem exists after Q15. Keep dividing until the trouble is found.

This technique is sometimes called, "partitioning," "boxing-in-the-trouble," "divide and conquer," or "binary search"; it is mandatory for complex electronic systems, but can save time and energy on almost any electronic device.

A blown fuse should only be replaced by one of the proper rating and type. If the fuse blows again, replace it, but place an Ω meter at the power terminals in place of the supply. Make certain that the + side of the Ω meter is connected to the red power wire of the SBE-21CB. Some VOM's place the – side of the Ω meter out the red test jack. Observe that D19 protects the unit from a reversed supply.

A fuse may blow only when the unit is connected in a vehicle because the vehicle has a positive ground and there is a short from the PCB ground to the chassis, or a grounded speaker was plugged into EXT SP J2.

The second harmonic trap (L10 and CV1) is adjusted at the Factory; field adjustment should not be attempted without proper equipment. Failure of particular channels to work or be on frequency probably indicates a defective crystal. Refer to Table 5-3 SYNTHESIZER MIXING SCHEME. Notice that the same Transmit and Receive crystals are used every fourth channel while each Master crystal is used on four adjacent channels. Check channel selector switch, S2, by swapping crystals.

FIG. 5-1 PERFORMANCE VERIFICATION PROCEDURE

TRANSMITTER

INITIAL SET-UP

Connect the SBE-21CB to a 13.8 VDC supply. Connect a wattmeter, dummy load and oscilloscope to the antenna jack.

STEP 1

Key the transmitter and observe that the wattmeter indicates an output of at least 3 watts and that the RFO meter indicates about the same.

STEP 2

Whistle into microphone with transmitter keyed. Check for 90-100% modulation.

STEP 3

Connect counter to dummy load and check transmit frequencies on channels 1, 2, 3, 4, 8, 12, 16, and 20. (See Table 5-3.)

RECEIVER

INITIAL SET-UP

Connect SBE-21CB to 13.8 VDC supply. Connect RF signal generator to the antenna jack and set to 27.085 MHz 30% - 1 KHz modulation. Set the unit to channel 11. Turn the volume control full clockwise and the squelch control full counterclocksiwe. Connect 8Ω load to external speaker jack, EXT SP, and connect AC VTVM to 8Ω load. (See Figure 5-5.)

STEP 1

Adjust signal generator for 0.7μV output. Verify that at least 2 VAC appear across the 8Ω load.

STEP 2

Increase signal generator output to 200μV. Rotate squelch knob full clockwise. Receiver should squelch.

STEP 3

Adjust signal generator for 100μV. S-METER should read about 9.

FIG. 5-2 RECOMMENDED TEST INSTRUMENTS

TEST INSTRUMENT	REQUIRED SPECIFICATIONS	USE	RECOMMENDED INSTRUMENT TYPE
R.F. Signal Generator	Output frequency: 26.965 to 27.255 MHz. Output level calibrated from .1 microvolts to 500,000 microvolts. Internal modulation capability of 30% minimum at 1 KHz. (Calibrated)	Receiver service and alignment.	Hewlett-Packard Model 606A or B. Wavetek Model 3000.
Oscilloscope	Vertical bandwidth of 25 MHz or greater at 3db point. Triggered sweep capability.	Transmitter and receiver test and alignment.	Tektronics Model T932. Tektronics Model 465. Hewlett-Packard Model 180. Phillips Model PM3260E.
Frequency Counter	Frequency range DC to 30 MHz. Sensitivity: 10mv R.M.S. at 30 MHz. Overall timebase accuracy ±.002%, 6 digit resolution.	Transmitter frequency check and synthesizer troubleshooting.	Heath-Schlumburger Model SM128A
Wattmeter	5 watts full scale into 50 ohm load ±5% accuracy.	Measure power output and S.W.R.	Bird Model 43 with type 5A element. (May be terminated with antenna load
AC VTVM	-40 to +20db range.	Measure audio output.	Heath Model IM-21.
Audio Oscillator	400 Hz to 4000 Hz output: Adjustable level, 0-1 volt output impedence 600 ohm.	Audio and modulator tests.	Hewlett-Packard Model 204C. Heath Model SG18A.
DC Power Supply	13.8 volt DC ±10% at 2 amperes.	Primary supply voltage for servicing.	Heath Model SP2720 (SBE Model SBE-1AC may be used if available.)

TABLE 5-3 SBE-21CB SYNTHESIZER MIXING SCHEME

CH.	CH. FREQ.	MASTER OSC. XTAL FREQ.	TX OSC. XTAL FREQ.	RX OSC. XTAL FREQ.
1	26.965		X11 = 10,000	X1 = 9.545
2	26.975	X5 = 16.965	X12 = 10,010	X2 = 9.555
3	26.985		X13 = 10,020	X3 = 9.565
4	27.005		X14 = 10,040	X4 = 9.585
5	27.015		X11	X1
6	27.025	X6 = 17.015	X12	X2
7	27.035		X13	X3
8	27.055		X14	X4
9	27.065		X11	X1
10	27.075	X7 = 17.065	X12	X2
11	27.085		X13	X3
12	27.105		X14	X4
13	27.115		X11	X1
14	27.125	X8 = 17.115	X12	X2
15	27.135		X13	X3
16	27.155		X14	X4
17	27.165		X11	X1
18	27.175	X9 = 17.165	X12	X2
19	27.185		X13	X3
20	27.205		X14	X4
21	27.215		X11	X1
22	27.225	X10 = 17.215	X12	X2
23	27.255		X14	X4

RECEIVE:

(CH FREQ) – (M.O. FREQ) – (RX OSC FREQ) = 455 KHz

FIG. 5-4 TRANSMITTER TEST CONNECTION

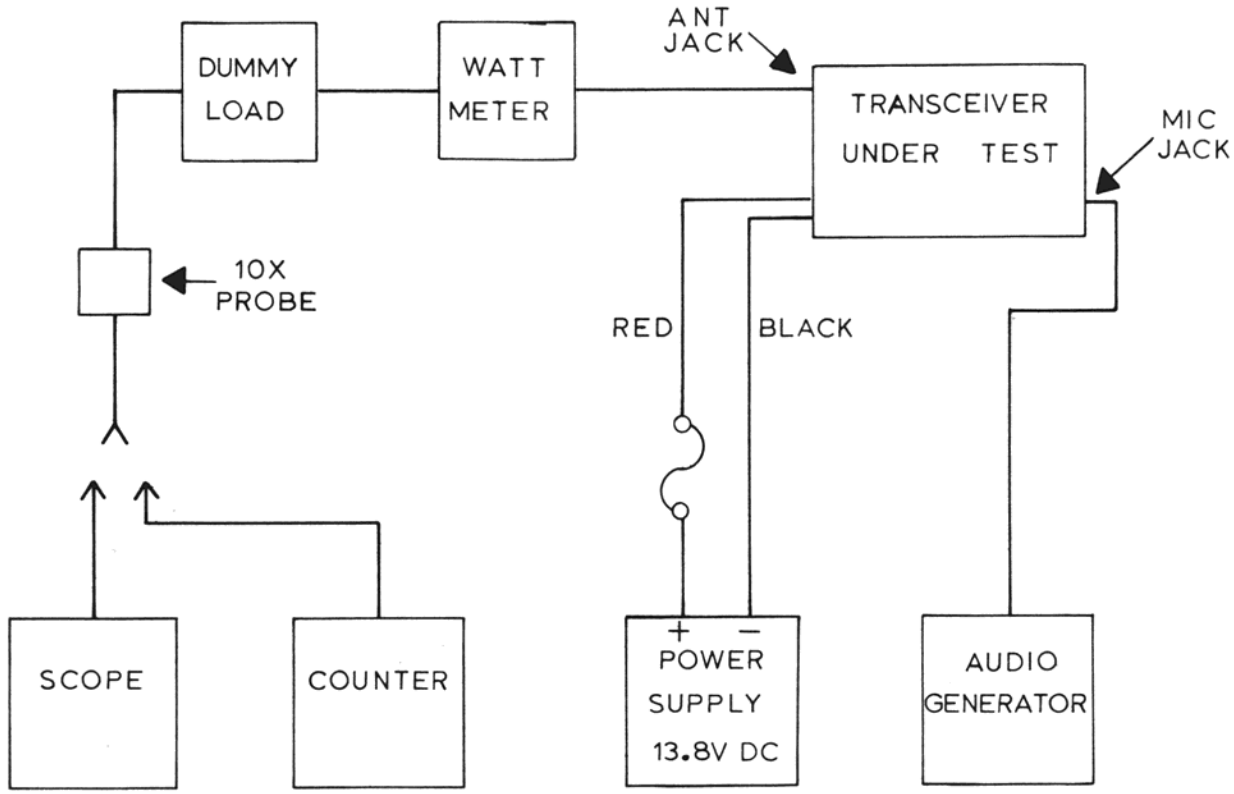


FIG. 5-5 RECEIVER TEST CONNECTION

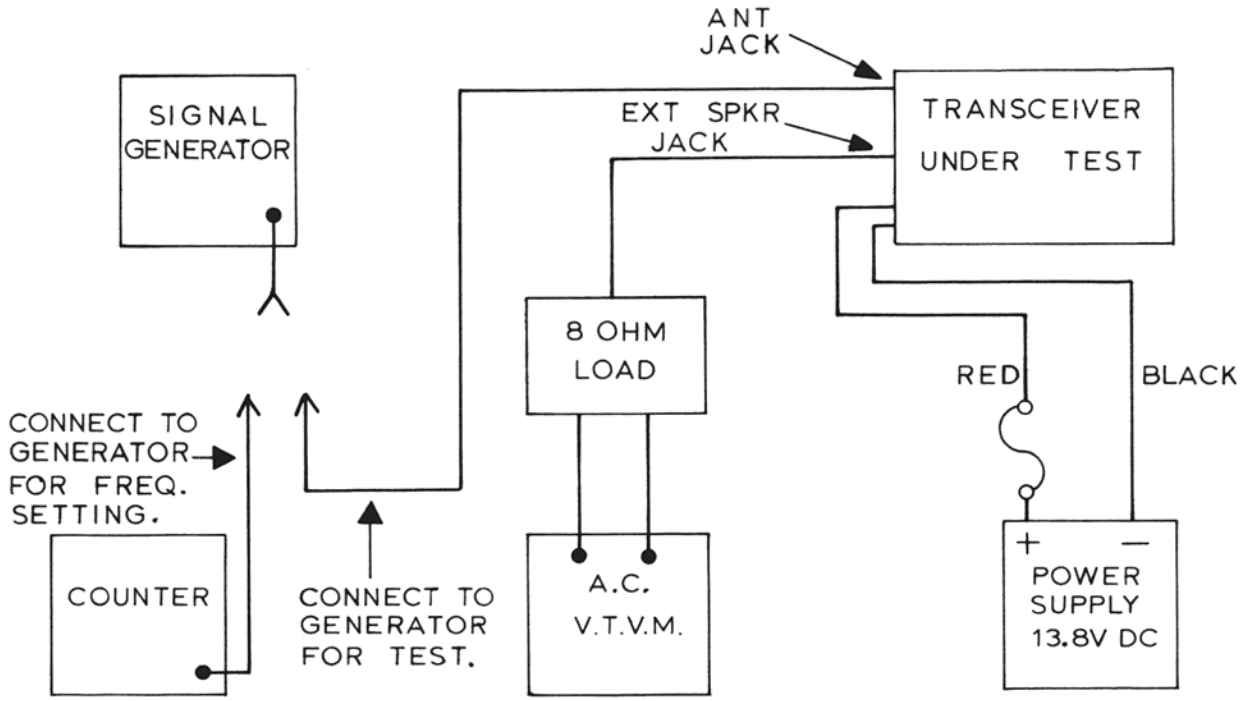


FIG. 5-6 RECEIVER ALIGNMENT PROCEDURE

INITIAL SET-UP

Connect an AC VTVM across the speaker or 8Ω load plugged into J3 EXT SP. Connect the RF signal generator to the antenna jack, set to 27.085 MHz 30% - 1 KHz modulation. Set the Channel Select SW to channel 11. Turn the squelch control full counterclockwise and the volume control full clockwise.

STEP 1

Adjust the RF output level of the signal generator to a level sufficient to produce about 2 VAC on the AC VTVM. Adjust T1, L2, L3, T2, T3, T4, T5 and T6 for maximum indications on the AC VTVM. If at any time during the alignment procedure the audio level increases to more than 4 VAC, reduce the generator output level. Repeat adjustment until 0.7 μV RF signal produces about 2 VAC on the AC VTVM.

STEP 2

Turn squelch control full clockwise. Increase the RF signal to 300μV. Squelch should break. If squelch fails to break, adjust VR2 to break squelch.

STEP 3

Turn squelch control full counterclockwise. Set RF signal generator to 10 MHz. Adjust 10 MHz trap L1 for minimum indication on the AC VTVM.

STEP 4

Set RF signal generator to 100 μV at 27.085 MHz. Adjust VR5 to make the S METER indicate 9.

TABLE 5-7 AGC VOLTAGES versus RF INPUT LEVEL

INPUT LEVEL (1)	AGC VOLTAGES (2)
1μV	+1.3
10μV	+0.86
100μV	+0.70
1000μV	+0.63
10,000μV	+0.58

(1) Channel Frequency at Antenna Jack.
(2) Measured with 10MΩ input at junction R23 and C34.

FIG. 5-8 ALIGNMENT LAYOUT

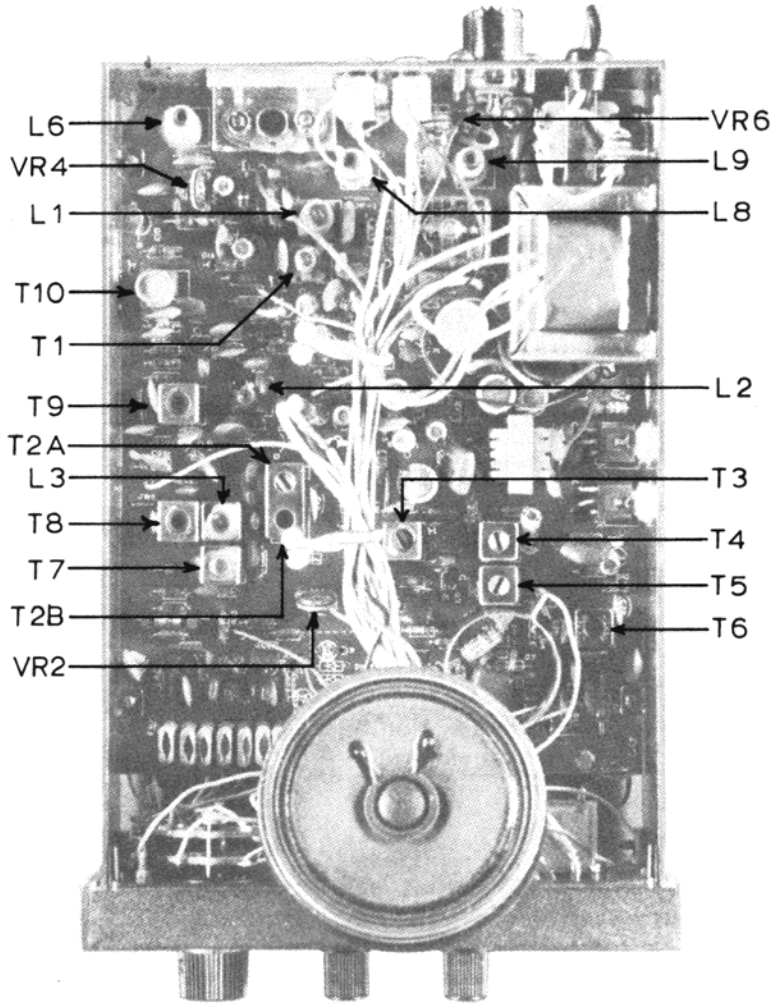


TABLE 5-9 RECEIVER INJECTION VOLTAGES

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 XP J2. Volume control is turned full clockwise, squelch control full counter-clockwise, and ANL switch off. Typical audio output voltages are given.

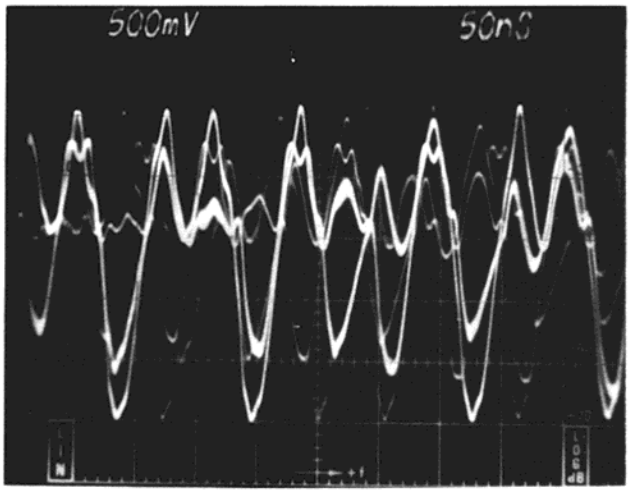
INJECTION POINT	AC VOLTAGE AT SPKR	INJECTION LEVEL	FREQUENCY
Antenna	6.2V	1μV	27.085 MHz
Q1 Emitter-CP1*	6.0V	1μV	27.085 MHz
Q2 Gate-CP2	3.6V	10μV	10.02 MHz
TP-2 – CP3	3.4V	10μV	455 KHz
Q3 Base-CP4	2.6V	10μV	455 KHz
Q4 Base-CP5	5.4V	1000μV	455 KHz

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

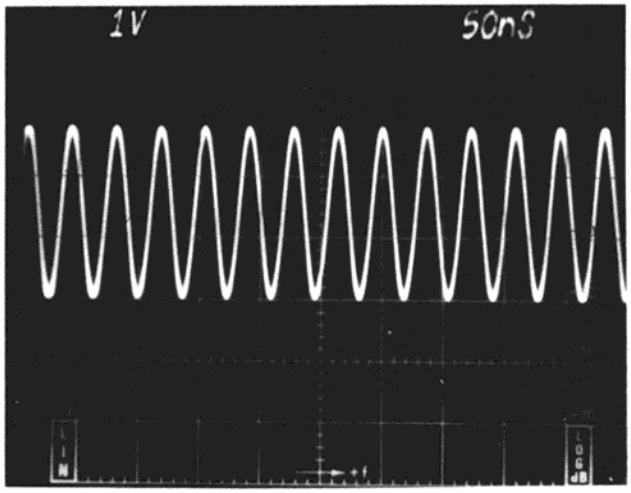
FIG. 5-10 TRANSMITTER ALIGNMENT PROCEDURE

INITIAL SET-UP
Connect the transceiver to a 13.8 VDC supply. Connect an audio oscillator to the MIC input, a wattmeter and dummy load to the antenna jack, an oscilloscope to the dummy load, and set the channel selector to channel 11. (See Figure 5-4)
STEP 1 With no modulation, key the transmitter and adjust T7, T8, T9, T10 and L6 for maximum wattmeter indication.
STEP 2 Alternately, switch channel selector to channel 1 and 23. Adjust T7 and T28 for least change in wattmeter indication.
STEP 3 Adjust L8 and L9 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 L8 and L9 for best modulation symmetry.
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 VR4 for 100% modulation.
STEP 6 Remove audio oscillator. Adjust VR6 until RFO METER reads the same as wattmeter.

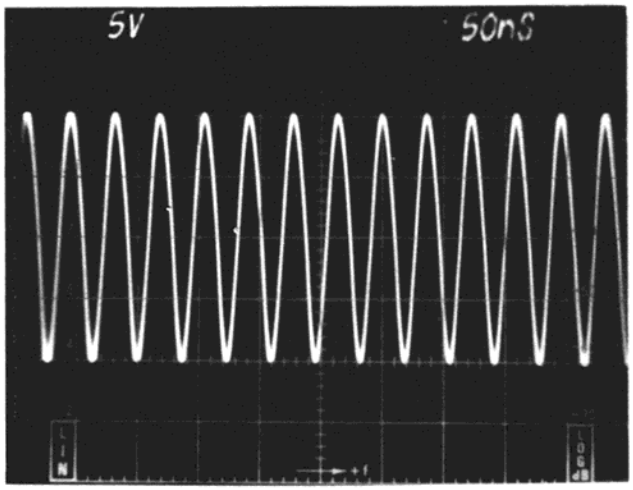
FIG. 5-11 TRANSMITTER ALIGNMENT WAVEFORMS



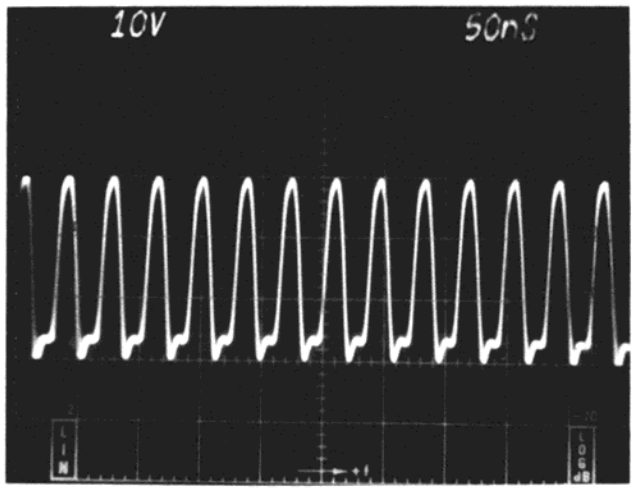
(a) D16 ANODE–TX MIXER 6*



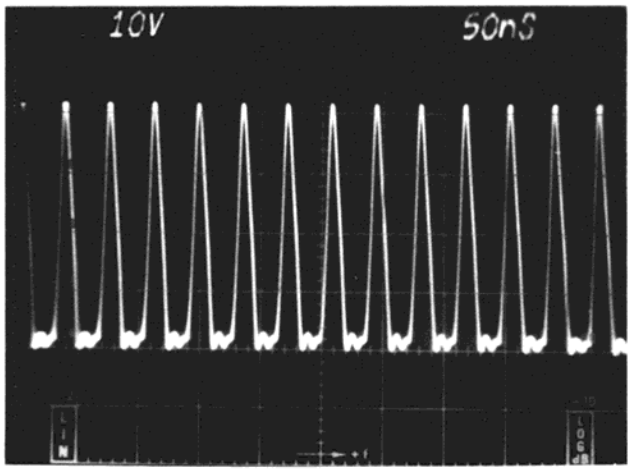
(b) Q11 COLLECTOR–TX BUFFER 7



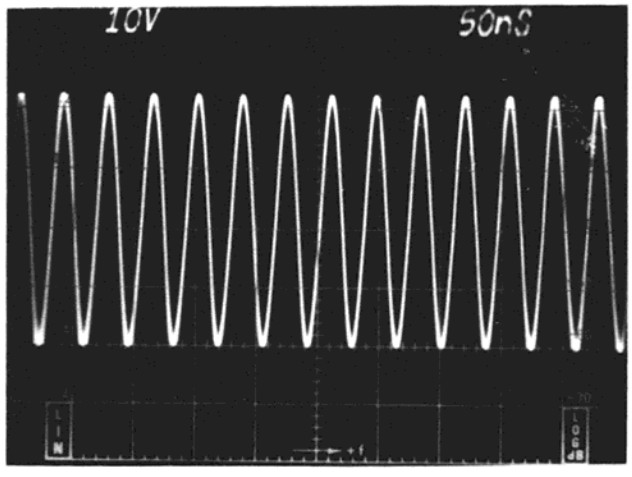
(c) Q12 COLLECTOR–TX AMP 8



(d) Q13 COLLECTOR–TX DRIVER 9



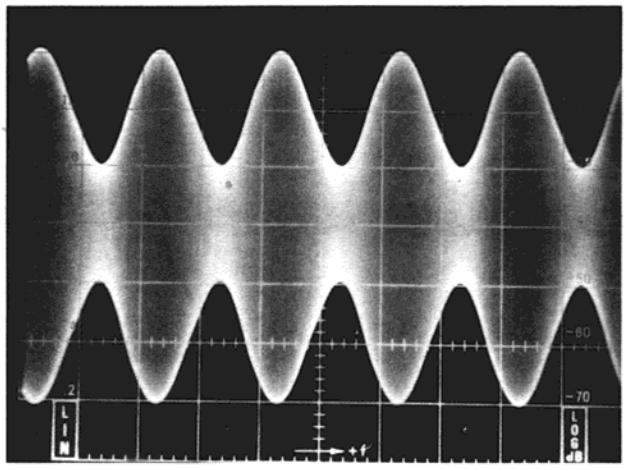
(e) Q14 COLLECTOR–TX FINAL 10



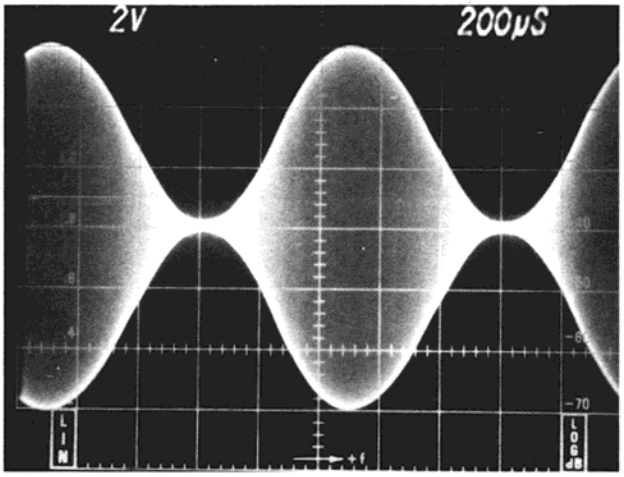
(f) ANTENNA JACK

* Numbers in corner of pictures correspond to numbers in boxes on schematic diagram and component location drawing.

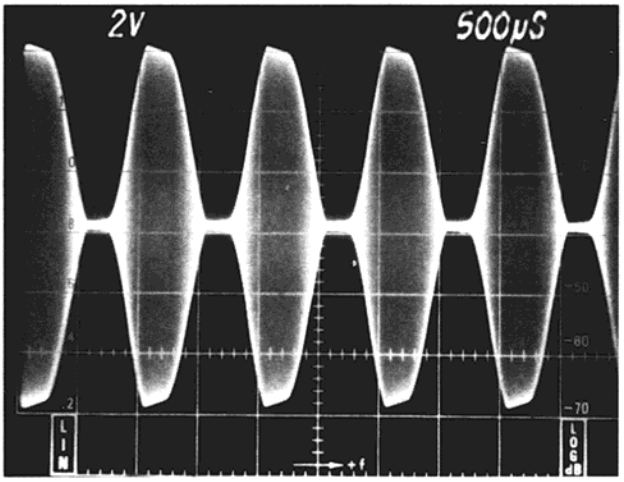
FIG. 5-12 MODULATION WAVEFORMS



50% MODULATION

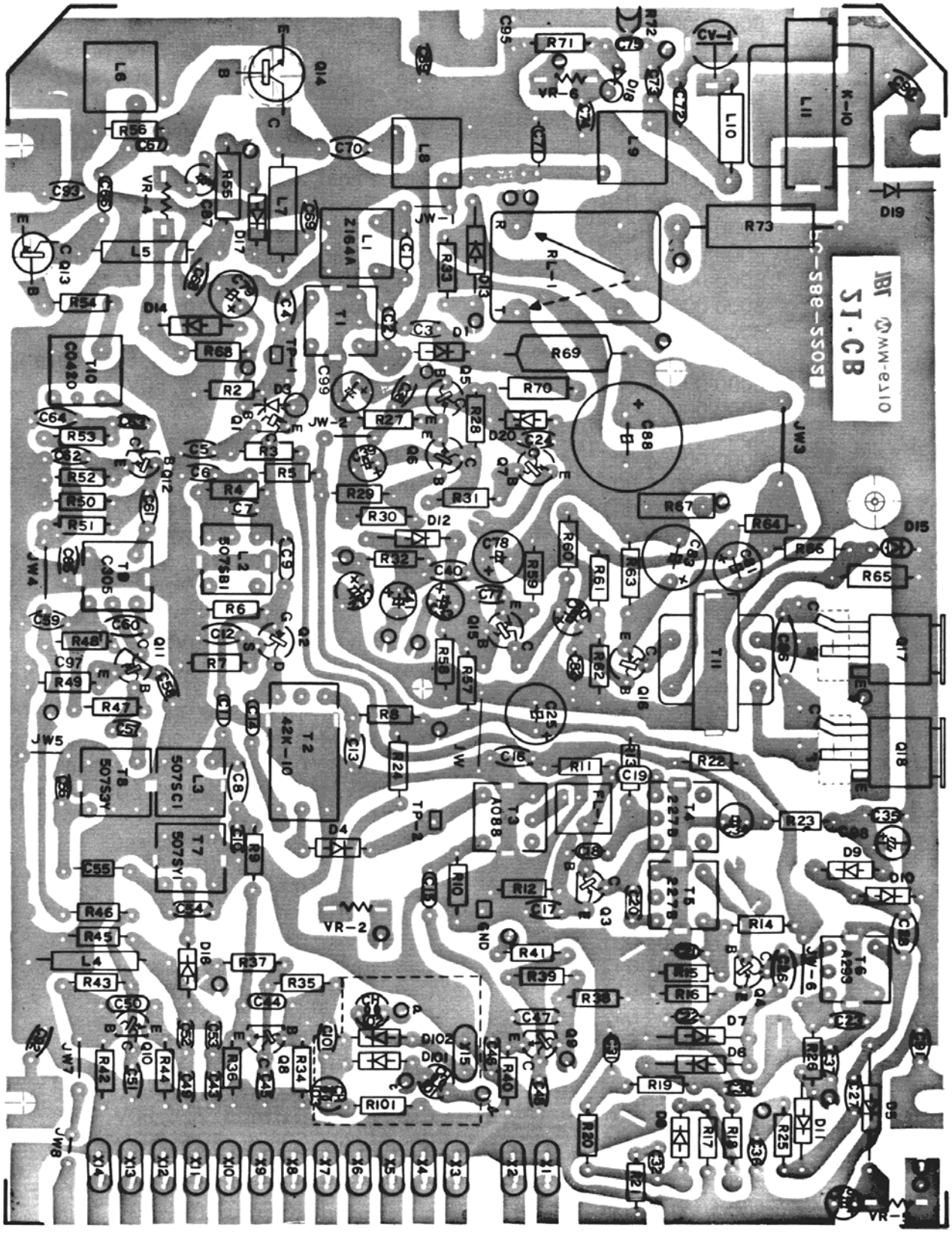


100% MODULATION



OVERMODULATION

FIG. 5-13 COMPONENT LAYOUT



SBE-21CB CORTEZ PARTS LIST

SYMBOL #	PART #	DESCRIPTION
C1	8000-00011-011	Cap., Fixed, 300pfd, ±10%, 50V, Mica
C2	8000-00004-024	Cap., Fixed, 30pfd, ±10%, 50V, Mica
C3	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C4	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C5	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C6	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C7	8000-00012-011	Cap., Fixed, 30pfd, N330, 50V, Cer.
C8	8000-00004-016	Cap., Fixed, 20pfd, ±10%, 50V, Mica
C9	8000-00004-021	Cap., Fixed, 47pfd, ±10%, 50V, Mica
C10	8000-00004-020	Cap., Fixed, 100pfd, ±10%, 50V, Mica
C11	8000-00030-006	Cap., Fixed, 20pfd, N750, 50V, Cer.
C12	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C13	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C14	8000-00012-002	Cap., Fixed, 1.5pfd, ±0.5pfd, 50V, Mica
C15	8000-00011-009	Cap., Fixed, 56pfd, ±10%, 50V, Mica
C16	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C17	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C18	8000-00004-003	Cap., Fixed, 0.04mfd ±10%, 50V, Mylar
C19	8000-00012-002	Cap., Fixed, 1.5pfd, ±0.5pfd, 50V, Mica
C20	8000-00004-007	Cap., Fixed, 10pfd, ±10%, 50V, Mica
C21	8000-00004-003	Cap., Fixed, 0.04mfd, ±10%, 50V, Mylar
C22	8000-00004-018	Cap., Fixed, 0.1mfd, 10%, 50V, Mylar
C23	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C24	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C25	8000-00004-044	Cap., Fixed, 220mfd, 16V, Elect.
C26	8000-00004-011	Cap., Fixed, 0.001mfd, 20%, 50V, Cer.
C28	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C29	8000-00004-042	Cap., Fixed, 1mfd, 16V, Elect.
C30	8000-00004-011	Cap., Fixed, 0.0001mfd, 20%, 50V, Cer.
C31	8000-00004-018	Cap., Fixed, 0.1mfd, 10%, 50V, Mica
C32	8000-00030-005	Cap., Fixed, 0.01mfd, ±10%, 50V, Mylar
C33	8000-00004-042	Cap., Fixed, 1mfd, 16V, Elect.
C34	8000-00004-030	Cap., Fixed, 4.7mfd, 16V, Elect.
C35	8000-00004-018	Cap., Fixed, 0.1mfd, 10%, 50V, Mylar
C36	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C37	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C38	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C39	8000-00004-042	Cap., Fixed, 1mfd, 16V, Elect.
C40	8000-00004-011	Cap., Fixed, 0.001mfd, 20%, 50V, Cer.
C41	8000-00004-042	Cap., Fixed, 1mfd, 16V, Elect.
C42	8000-00004-047	Cap., Fixed, 10mfd, 16V, Elect.
C43	8000-00030-004	Cap., Fixed, 50pfd, ±10%, 50V, Mica
C44	8000-00004-020	Cap., Fixed, 100pfd, ±10%, 50V, Mica
C45	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C46	8000-00030-004	Cap., Fixed, 50pfd, ±10%, 50V, Mica
C47	8000-00004-027	Cap., Fixed, 220pfd, ±10%, 50V, Mica
C48	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C49	8000-00004-020	Cap., Fixed, 100pfd, ±10%, 50V, Mica
C50	8000-00004-027	Cap., Fixed, 220pfd, ±10%, 50V, Mica
C51	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.

SYMBOL #	PART #	DESCRIPTION
C52	8000-00011-008	Cap., Fixed, 5pfd, ±10%, 50V, Mica
C53	8000-00004-007	Cap., Fixed, 10pfd, ±10%, 50V, Mica
C54	8000-00011-008	Cap., Fixed, 5pfd, ±10%, 50V, Mica
C55	8000-00011-012	Cap., Fixed, 1pfd, 10%, 500V, Gimic
C56	8000-00012-010	Cap., Fixed, 25pfd, N150, 50V, Cer.
C57	8000-00004-011	Cap., Fixed, 0.001mfd, 20%, 50V, Cer.
C58	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C59	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C60	8000-00012-010	Cap., Fixed, 25pfd, N150, 50V, Cer.
C61	8000-00004-011	Cap., Fixed, 0.001mfd, 20%, 50V, Cer.
C62	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C63	8000-00004-020	Cap., Fixed, 100pfd, ±10%, 50V, Mica
C64	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C65	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C66	8000-00004-002	Cap., Fixed, 15pfd, ±10%, 50V, Mica
C67	8000-00004-020	Cap., Fixed, 100pfd, ±10%, 50V, Mica
C68	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C69	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C70	8000-00004-011	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C71	8000-00004-027	Cap., Fixed, 220pfd, ±10%, 50V, Mica
C72	8000-00011-010	Cap., Fixed, 170pfd, ±10%, 50V, Mica
C73	8000-00004-011	Cap., Fixed, 0.001mfd, 20%, 50V, Cer.
C74	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C75	8000-00011-008	Cap., Fixed, 5pfd, ±10%, 50V, Mica
C76	8000-00004-011	Cap., Fixed, 0.001mfd, 20%, 50V, Cer.
C77	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C78	8000-00004-009	Cap., Fixed, 47mfd, 16V, Elect.
C79	8000-00004-009	Cap., Fixed, 47mfd, 16V, Elect.
C80	8000-00004-042	Cap., Fixed, 1mfd, 16V, Elect.
C81	8000-00004-009	Cap., Fixed, 47mfd, 18V, Elect.
C82	8000-00004-003	Cap., Fixed, 0.04mfd, ±10%, 50V, Mylar
C83	8000-00004-044	Cap., Fixed, 220mfd, 16V, Elect.
C86	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C87	8000-00004-042	Cap., Fixed, 1mfd, 16V, Elect.
C88	8000-00004-049	Cap., Fixed, 1000mfd, 16V, Elect.
C89	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C90	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C91	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C92	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C93	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C94	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C95	8000-00004-001	Cap., Fixed, 0.01mfd, 20%, 50V, Cer.
C96	8000-00004-011	Cap., Fixed, 0.001mfd, 20%, 50V, Cer.
C97	8000-00004-048	Cap., Fixed, 1000pfd, Feed Through
CV-1	8000-00004-204	Cap., Var., 10pfd, Max., Trimmer
D1	8000-00006-008	Diode, WG1012
D2	8000-00011-046	Diode, 1S1007
D3	8000-00011-046	Diode, 1S1007
D4	8000-00011-042	Diode, 1S2472
D5	8000-00004-060	Diode, 1N34A

SYMBOL #	PART #	DESCRIPTION
D6	8000-00004-060	Diode, 1N34A
D7	8000-00004-060	Diode, 1N34A
D8	8000-00004-064	Diode, 1S84
D9	8000-00006-008	Diode, WG1012
D10	8000-00006-008	Diode, WG1012
D11	8000-00004-060	Diode, 1N34A
D12	8000-00004-060	Diode, 1N34A
D13	8000-00006-008	Diode, WG1012
D14	8000-00004-060	Diode, 1N34A
D15	8000-00011-045	Diode, 1S1211
D16	8000-00011-042	Diode, 1S2472
D17	8000-00030-010	Diode, 1N4002
D18	8000-00004-060	Diode, 1N34A
D19	8000-00030-010	Diode, 1N4002
D20	8000-00011-043	Diode, BZ090, Zener
F1	8000-00004-152	Fuse, 2A
FH	8000-00004-151	In-line Fuse Holder,
FL-1	8000-00004-139	Filter, LF-B6, Ceramic
J1	8000-00004-070	Microphone Connector
J2	8000-00030-021	Jack, Ext. Speaker
J3	8000-00030-021	Jack, PA
J4	8000-00004-069	Coaxial Connector, SO-239
L1	8000-00030-015	Coil, HF, Z164A
L2	8000-00030-014	Coil, HF, 507SB1
L3	8000-00012-022	Coil, HF, 507SC1
L4	8000-00011-019	Choke Coil, 22μh
L5	8000-00030-011	Choke Coil, 2.5μh
L6	8000-00030-017	Coil, HF, S-18
L7	8000-00004-055	Choke Coil, 0.65μh
L8	8000-00030-017	Coil, HF, S-18
L9	8000-00030-017	Coil, HF, S-18
L10	8000-00004-059	Choke Coil, 0.85μh
L11	8000-00030-012	Choke Coil, K-10
M1	8000-00030-029	Meter
PL-1	8000-00004-142	Lamp, 16V, 40ma
PL-2	8000-00004-142	Lamp, 16V, 40ma
PL-3	8000-00011-056	Lamp, 14V, 75ma
Q1	8000-00011-004	Transistor, 2SC710B
Q2	8000-00004-081	Transistor, 2SK19Y
Q3	8000-00011-047	Transistor, 2SC710C
Q4	8000-00011-047	Transistor, 2SC710C
Q5	8000-00030-007	Transistor, 2SC403C
Q6	8000-00030-007	Transistor, 2SC403C
Q7	8000-00030-007	Transistor, 2SC403C

SYMBOL #	PART #	DESCRIPTION
Q8	8000-00011-047	Transistor, 2SC710C
Q9	8000-00011-047	Transistor, 1SC710C
Q10	8000-00011-047	Transistor, 2SC710C
Q11	8000-00011-047	Transistor, 2SC710C
Q12	8000-00011-047	Transistor, 2SC710C
Q13	8000-00030-008	Transistor, 2SC1475
Q14	8000-00006-230	Transistor, 2SC756
Q15	8000-00030-009	Transistor, 2SD187
Q16	8000-00030-007	Transistor, 2SC403C
Q17	8000-00004-087	Transistor, 2SC1014
Q18	8000-00004-087	Transistor, 2SC1014
R67	8000-00004-091	Res., Fixed, 1 Ω, 10%, 1W, Oxide Film
RL-1	8000-00030-022	Relay
S2	8000-00030-020	Rotary Switch 24T
S3	8000-00030-037	Slide Switch 2P2T
S4	8000-00030-036	Slide Switch 1P2T
SP-1	8000-00011-057	Speaker, 8 Ω, 3W
T1	8000-00030-013	Coil, HF, C234D
T2	8000-00012-032	Transformer IF, 42K-10
T3	8000-00030-018	Transformer IF, A088
T4	8000-00012-034	Transformer IF, EIA 227B
T5	8000-00012-034	Transformer IF, EIA 227B
T6	8000-00012-035	Transformer IF, EIA 146D
T7	8000-00012-023	Coil, HF, 507SY1
T8	8000-00012-024	Coil, HF, 507S3Y
T9	8000-00030-045	Coil, HF, 507SZ
T10	8000-00030-016	Coil, HF, C042D
T11	8000-00030-019	Transformer, Input, A31
T12	8000-00012-037	Transformer, Output, E03
VR-1	8000-00030-002	Res., Var., 10KΩ, B type, Trimmer
VR-2	8000-00030-001	Res., Var., 50KΩ, 2T, Trimmer
VR-3	8000-00030-003	Res., Var., 50KΩ, D type w/switch, Trimmer
VR-4	8000-00011-082	Res., Var., 1KΩ, 2T Trimmer
VR-5	8000-00004-096	Res., Var., 10KΩ, 2T, Trimmer
VR-6	8000-00004-094	Res., Var., 100KΩ, 2T, Trimmer
X1	8000-00012-043	Crystal, 9.545 MHz, HC25/U
X2	8000-00012-044	Crystal, 9.555 MHz, HC25/U
X3	8000-00012-045	Crystal, 9.565 MHz, HC25/U
X4	8000-00012-046	Crystal, 9.585 MHz, HC25/U
X5	8000-00012-047	Crystal, 16.965 MHz, HC25/U
X6	8000-00012-048	Crystal, 17.015 MHz, HC25/U
X7	8000-00012-049	Crystal, 17.065 MHz, HC25/U
X8	8000-00012-050	Crystal, 17.115 MHz, HC25/U
X9	8000-00012-051	Crystal, 17.165 MHz, HC25/U
X10	8000-00012-052	Crystal, 17.215 MHz, HC25/U

SYMBOL #	PART #	DESCRIPTION
X11	8000-00012-053	Crystal, 10.000 MHz, HC25/U
X12	8000-00012-054	Crystal, 10.010 MHz, HC25/U
X13	8000-00012-055	Crystal, 10.020 MHz, HC25/U
X14	8000-00012-056	Crystal, 10.040 MHz, HC25/U
	8000-00030-023	Feed-through Capacitor Bracket
	8000-00030-024	Front Die Cast
	8000-00030-025	Front Plate
	8000-00030-026	Volume Knob
	8000-00030-027	Squelch Knob
	8000-00030-028	Channel Selector
	8000-00030-030	Heat Sink for 2SC756
	8000-00030-031	Cable Clamp
	8000-00030-032	Meter Mounting Plate
	8000-00030-033	Sponge Rubber
	8000-00030-034	Rubber Sheet for Meter
	8000-00030-035	Rubber Lamp Bracket
	8000-00030-038	Speaker Mounting Bracket
	8000-00004-159	Lamp Assembly, Red
	8000-00030-039	Cabinet
	8000-00030-040	Mounting Bracket
	8000-00030-041	Felt Speaker Insulator
	8000-00004-153	Microphone Complete
	8000-00030-042	F.C.C. Name Plate
	8000-00030-043	Display Box
	8000-00030-044	Styrofoam Box
	8000-00004-164	Microphone Connector, female

TRANSISTOR VOLTAGES

13.8V DC input, Volume at minimum, Squelch at minimum, NB off.

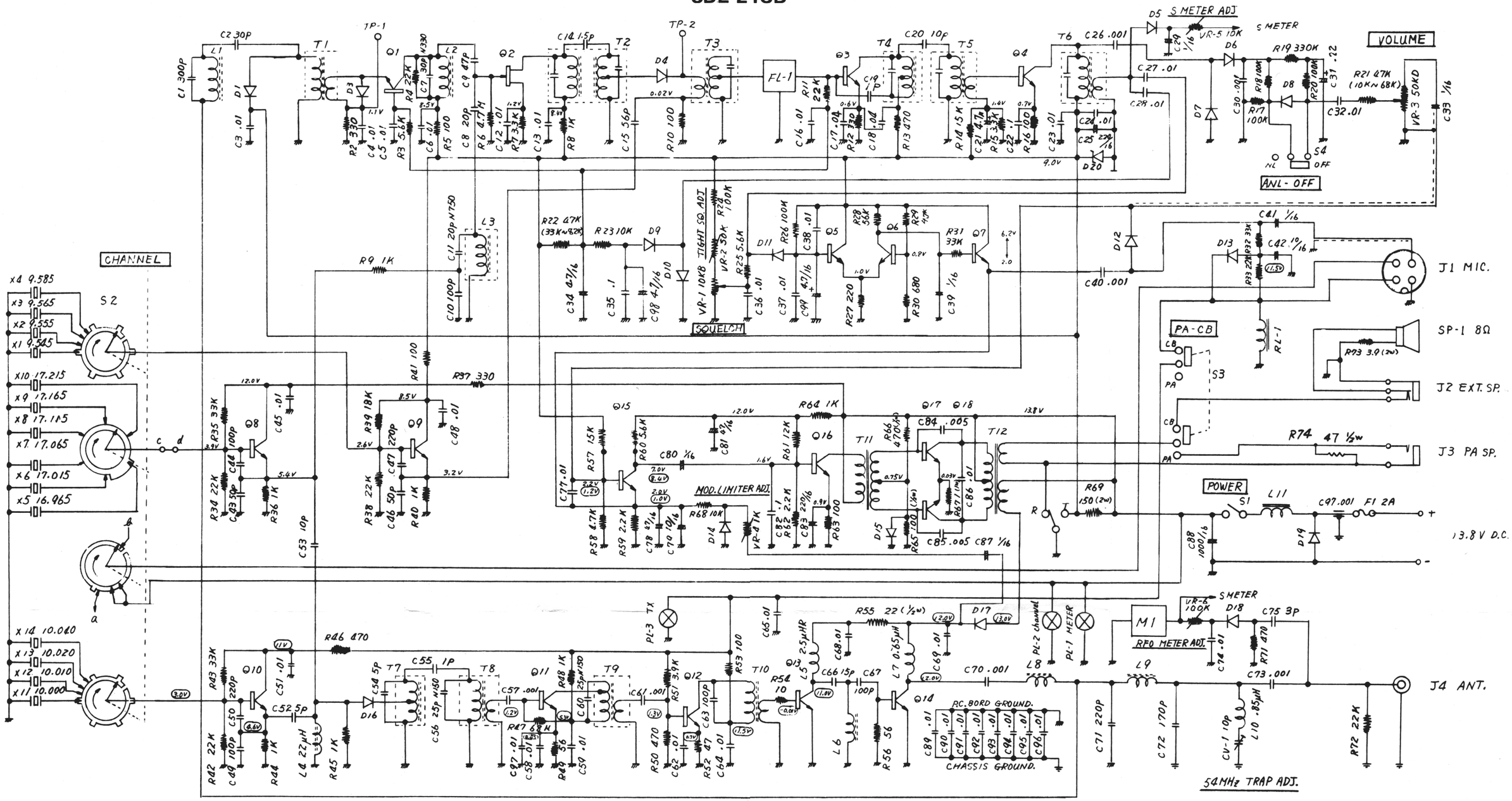
DEVICE	EMITTER	BASE	COLLECTOR	DEVICE	EMITTER	BASE	COLLECTOR
Q1	0.6	1.3	9.0	Q10	4.5 TX	3.3 TX	11.0 TX
Q2	Source 1.6	Gate 0.0	Drain 8.7	Q11	0.0 0.4 TX	0.0 1.1 TX	0.0 6.8 TX
Q3	0.4	1.1	8.6	Q12	0.0 0.9 TX	0.0 1.3 TX	0.0 11.2 TX
Q4	0.7	1.4	9.1	Q13	0.0 0.0 TX	0.0 0.0 TX	13.7 10.8 TX
Q5	0.2 1.0 SQ	0.7 1.7 SQ	9.2 9.1 SQ	Q14	0.0 0.0 TX	0.0 –0.4 TX	13.4 12.3 TX
Q6	0.2 1.0 SQ	0.9 1.2 SQ	0.2 7.2 SQ	Q15	2.2 1.2 SQ	2.0 1.0 SQ	7.0 8.4 SQ
Q7	2.0 5.5 SQ	0.2 6.1 SQ	9.2 9.2 SQ	Q16	0.9	1.6	13.2
Q8	4.4	3.9	12.3	Q17	0.0	0.7	13.6
Q9	4.0 0.0 TX	4.6 0.0 TX	8.7 0.0 TX	Q18	0.0	0.7	13.6

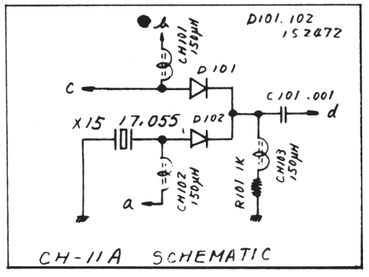
SQ: Voltages with set fully squelched

TX: Voltages with set in transmit mode

DC voltages taken with 150μh choke in series with probe when RF is present.

SBE-21CB





SEMICONDUCTORS

Q1	2SC710B	Q9	2SC710C	Q17	2SC1014	D1	WG713	D9	IN34A	D17	IN4002
Q2	2SK19Y	Q10	2SC710C	Q18	2SC1014	D2	1S1007	D10	WG1012	D18	IN34A
Q3	2SC710C	Q11	2SC710C			D3	1S1007	D11	IN34A	D19	IN4002
Q4	2SC710C	Q12	2SC710C			D4	1S2472	D12	IN34A	D20	BZ090
Q5	2SC403C	Q13	2SC1425			D5	IN34A	D13	WG713		
Q6	2SC403C	Q14	2SC756			D6	IN34A	D14	IN34A		
Q7	2SC403C	Q15	2SD187			D7	IN34A	D15	1S1211		
Q8	2SC710C	Q16	2SC403C			D8	1S84	D16	1S2472		

1 Voltage values shown are measured with voltmeter (20KΩ/V) through 150μH coil.

2 Voltage values with ⬭ are values during Transmitting, without ⬭ are values during receive.

3 All Resistors and Capacitors are rated in Ω and μF. unless otherwise specified.

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