SBE Trinidad Service Manual

Trinidad

MODEL SBE·11CB

SERVICE MANUAL

SBE®

TABLE OF CONTENTS

SECTION 1
GENERAL

1.1 CUSTOMER SERVICE

The SBE Technical Services Department functions as a source of information on the application, installation and use of SBE products. In addition, the Technical Services Department provides technical consultation on service problems and availability of local and factory repair facilities.

In any communications to the Technical Services Department, please include a complete description of your problems or needs, including model and serial numbers of the unit or units in question, accessories being used, any modifications or attachments in use, or any non-standard installation details.

For assistance on any of the above matters, please contact SBE, Incorporated, Technical Services Department, 220 Airport Boulevard, Watsonville, California 95076. Phone: 408/722-4177.

1.2 PARTS ORDERS

SBE original replacement parts are available from the Factory Parts Department at 1045 Main Street, Watsonville, California 95076.

When ordering parts, please supply the following information:

Model number of the unit.
Serial number of the unit.
Part number.
Description of the part.

1.3 FACTORY RETURNS

Repair services are available locally through SBE Certified Service Stations across the country. A list of these Service Stations is available upon request from the Technical Services Department. Do not return any merchandise to the Factory without authorization from the Factory.

SECTION 2

SPECIFICATIONS
SBE11-CB

2.1 GENERAL

Compliance	F.C.C. Type Accepted (Part 95, Class D)
Channels	23
Frequency Range	26.965 to 27.255 MHz
Frequency Control	Crystals, Synthesized
Frequency Tolerance	0.003%
Operating Temperature Range	0° C to +50° C
Humidity	95%
Input Voltage	117V AC – 50/60 Hz or 13.8V DC negative ground
Microphone	Dynamic
Size	5¾"H (146mm), including feet, 17¾"W (451mm), 8¾"D (222mm)
Weight	13 lbs.

2.2 RECEIVER

Sensitivity	Less than 1 microvolt for 10db S+N/N ratio
Selectivity	-6db at 5 KHz, -40db at 20 KHz and -60db at 40 KHz
IF Frequencies	10 MHz, 455 KHz
Automatic Gain Control	Less than 10db change in audio output for signal input from 10 – 100,000μV
Squelch	Threshold 1μV
Squelch Range	200μV (Minimum)
Delta Tune Range	±1.5 KHz
Audio Output Power	2.0 watts at 10% distortion at 1 KHz
Frequency Response	300 – 2500 Hz

2.3 TRANSMITTER

Power Output	4 watts (Maximum)
Modulation	100%
Modulator Response	300 – 2500 Hz
Output Impedance	50Ω unbalanced
Emission	6A3

SECTION 3
INSTALLATION

GENERAL

The first step in the installation of the SBE-11CB is to select a site which is convenient and permits accessibility to a good antenna location. The selection of an antenna system and its mounting location are the most critical factors in determining performance.

A vertical ground plane antenna will provide the most uniform horizontal coverage. This type of antenna is best suited for communications with a mobile unit. For point-to-point operation where both stations are fixed, a directional beam antenna will usually increase communication range since this type of antenna concentrates energy in one direction. Beam antennas also allow the receiver to "listen" in only one direction thus reducing interfering signals. F.C.C. regulations limit antenna height of directionals to 20 feet above ground or any formation and omnidirectionals and supporting structure to 60 feet above ground.

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 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.

EMERGENCY DC POWER

If it is anticipated that the unit may be used in the event of a power failure, a 12 volt storage battery may be connected to the terminal strip on the rear panel. Connect the negative and positive battery terminals to the corresponding points on the terminal strip using #14 or larger wire. In the event of AC power failure, the unit will automatically draw primary power from the battery source. When AC power is restored, the unit will automatically return to normal AC operation. It is not necessary to disconnect the emergency DC power source when the AC line is being used. It is recommended that a means to keep the storage battery fully charged be provided.

PUBLIC ADDRESS

An external 8Ω 4 watt speaker may be connected to the PA jack located on the rear panel of the unit when it is to be used as a public address system. The speaker should be directed away from the microphone to prevent accoustical feedback.

EXTERNAL SPEAKER

The external speaker jack on the rear panel is used for remote receiver monitoring. The external speaker may be 4 or 8Ω impedance and should be rated at 3 watts power dissipation. When the external speaker is plugged in, the internal speaker is disconnected. Suitable units are the model SBE-1SP Non-amplified speaker or SBE-1SP/AMP Amplified speaker.

ALTERNATE MICROPHONE INSTALLATION

A desk microphone may be installed with the unit. For best results, a low impedance dynamic type microphone or a transistorized preamplified microphone is recommended. The SBE 100X Preamplified Base Station Microphone or the SBE 200X Non-amplified Base Station Microphone may be ordered and are ready to plug into the unit. If another microphone is selected refer to the schematic diagram for the proper wiring connections to the microphone jack.

FINAL CHECKOUT

Make an operational checkout of the transceiver to insure operation of it and all the accessories installed. Contact other stations and inquire about their location and their reception of your signal. If an omni-directional antenna is used, the distance to other stations contacted should be about the same in all directions. A directional antenna should reach more distant stations in the direction in which it is beamed. Also inquire whether the stations contacted are omnidirectional or directional and if directional which way they are beamed.

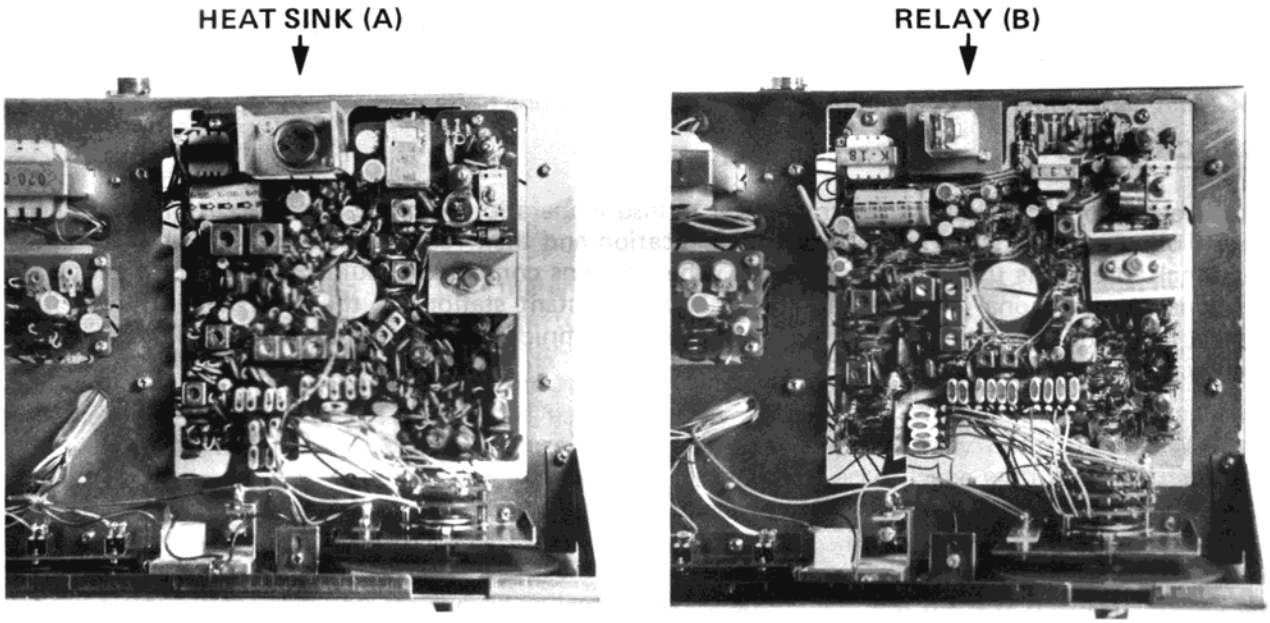
SECTION 4

SERVICING

4.1 INTRODUCTION

Read this section carefully before attempting any repair of the SBE-11CB.

IDENTIFY THE TYPE OF ELECTRONICS. There are basically two types of electronics used in SBE-11CB transceivers which are referred to as A BOARDs and B BOARDs. An A BOARD is readily distinguished from a B BOARD by its large heat sink on the AF POWER AMP Q116.



4.2 TEST SIGNALS

OSCILLOSCOPE WAVEFORMS are shown which were taken from various points in the SBE-11CB during normal operation into a dummy load. TEST POINT numbers next to the waveform pictures correspond to numbers in boxes on both the schematic diagrams and component layout drawings. Figure 5-2, A BOARD, 5-12, B BOARD, shows RF amplification through a properly aligned transmitter. Figure 5-3, A BOARD, 5-13, B BOARD, shows 50%, 100% and overmodulation respectively. Notice that the waveform at the TX MIXER contains several frequency components. Also notice that the waveform at the TX FINAL is unsymmetrical (Figure 5-2d, A BOARD, 5-12d, B BOARD). This is proper since the TX FINAL operates class C for greater efficiency. Figure 5-2e, A BOARD, 5-12e, B BOARD, shows how the output should look at the dummy load.

VOLTAGE MEASUREMENTS are shown on the schematic diagrams 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 5-8, A BOARD, 5-16, B BOARD, together with TEST POINT numbers which correspond to numbers in boxes on both the schematic diagrams

and component layout drawings. These tables specify 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 are shown in Table 5-3, A BOARD, 5-18, B BOARD. These tables should be consulted before any adjustments are made on the squelch circuit since squelch is a function of AGC.

Separate TROUBLESHOOTING CHARTs are provided for both the A and B board. (See Figure 5-2, A BOARD, 5-15, B BOARD.)

4.3 TROUBLESHOOTING

Troubleshooting the SBE-11CB 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 descriptions and block diagrams. 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 transmitter puts out properly modulated carrier, but the receiver will not respond to a properly modulated RF signal at the channel frequency fed into the antenna jack. Since the transmitter modulates, it can be assumed that all of the audio amplifier is good. After checking the TX/RX relay and receiver B+, the receiver is then divided into:

BEFORE 1st IF – 1st IF and AFTER.

RECEIVER INJECTION VOLTAGES table shows the proper signal level to inject at the base of Q104 – the 1st IF AMP – to produce at least 2 VAC signal at the speaker. If the signal appears at the speaker, the problem is in the RF amplifier. Divide this and continue until the trouble is found.

This technique is variously 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-11CB. Some VOM's place the - side of the Ω meter out the red test jack. Observe that diodes protect the units from a reversed supply. The push-to-talk switch can be used to start isolating the short.

A fuse may blow only when a 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 the external speaker jack.

The second harmonic trap 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 4-5, 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 by swapping crystals.

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.)

FIG. 4-2 TRANSMITTER TEST CONNECTION

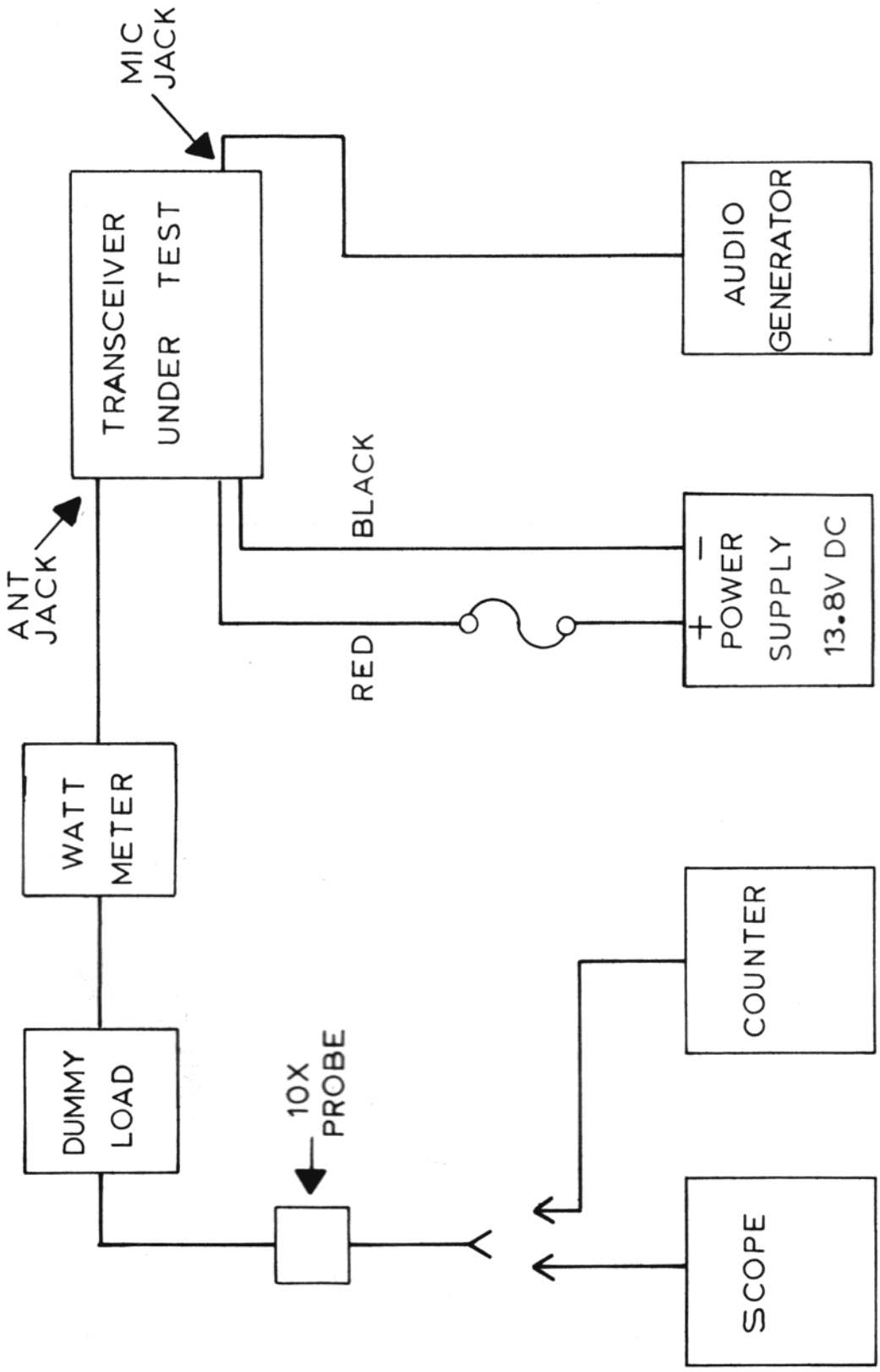


FIG. 4-3 RECEIVER TEST CONNECTION

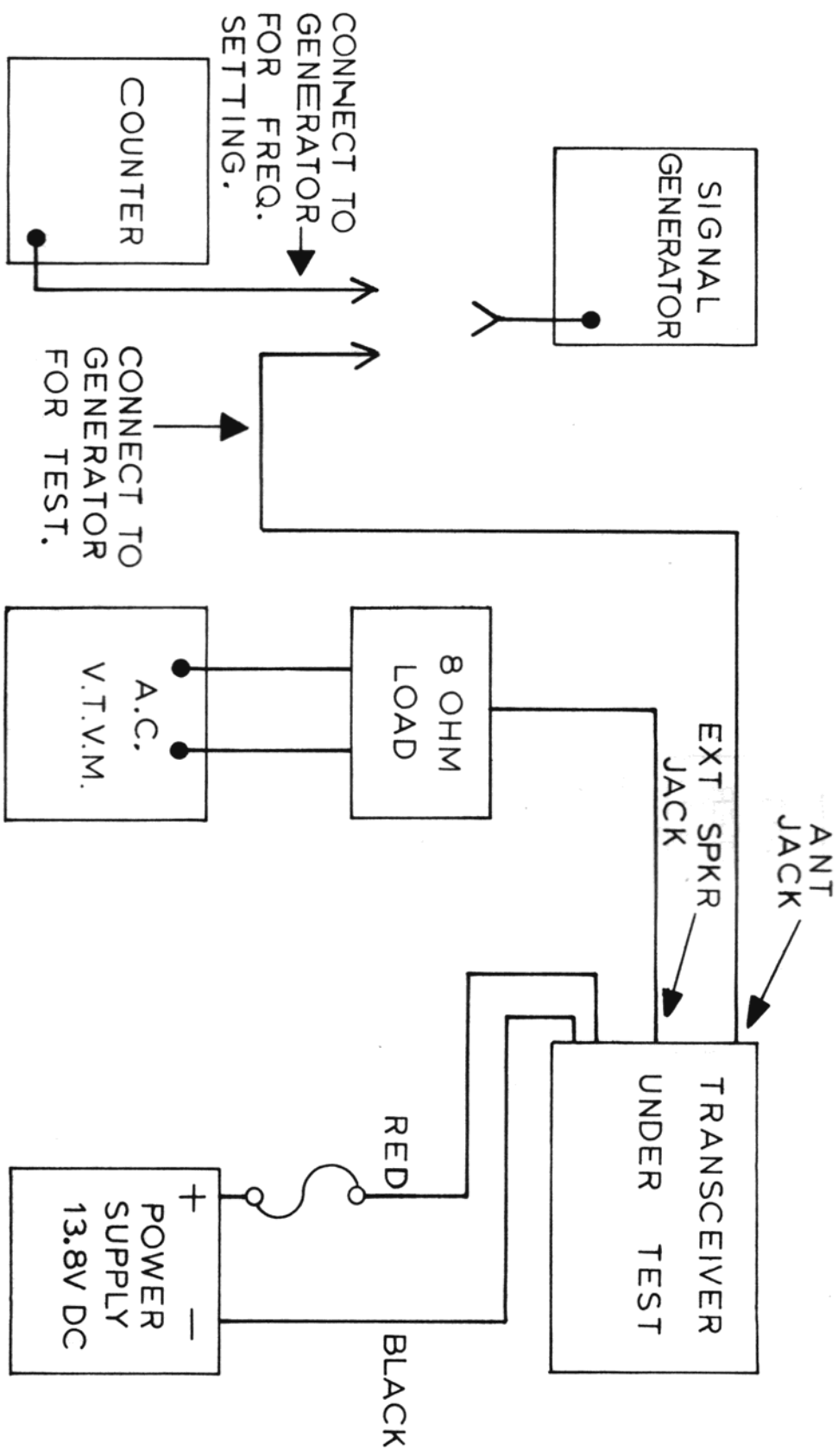


FIG. 4-4 PERFORMANCE VERIFICATION PROCEDURE

TRANSMITTER

INITIAL SET-UP
Connect the SBE-11CB to 110 VAC. 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 3.2 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 4-5.)

RECEIVER

INITIAL SET-UP
Connect SBE-11CB to 110 VAC. 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 counterclockwise. Connect 8Ω load to external speaker jack, EXT SP, and connect AC VTVM to 8Ω load. (See Figure 4-3.)
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.

TABLE 4-5 SYNTHESIZER MIXING SCHEME
SBE-11CB

CH.	CH. FREQ.	MASTER OSC. XTAL FREQ.	TX OSC. XTAL FREQ.	RX OSC. XTAL FREQ.
1	26.965		X114 = 10.635	X110 = 10.180
2	26.975	X101 = 37.600	X113 = 10.625	X109 = 10.170
3	26.985		X112 = 10.615	X108 = 10.160
4	27.005		X111 = 10.595	X107 = 10.140
5	27.015		X114	X110
6	27.025	X102 = 37.650	X113	X109
7	27.035		X112	X108
8	27.055		X111	X107
9	27.065		X114	X110
10	27.075	X103 = 37.700	X113	X109
11	27.085		X112	X108
12	27.105		X111	X107
13	27.115		X114	X110
14	27.125	X104 = 37.750	X113	X109
15	27.135		X112	X108
16	27.155		X111	X107
17	27.165		X114	X110
18	27.175	X105 = 37.800	X113	X109
19	27.185		X112	X108
20	27.205		X111	X107
21	27.215		X114	X110
22	27.225	X106 = 37.850	X113	X109
23	27.255		X111	X107

RECEIVE:

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

TRANSMIT:

(M.O.) - (TX OSC) = CH FREQ

SECTION 5

CIRCUIT DESCRIPTION
A BOARD

5.1 INTRODUCTION

The SBE-11CB with A 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 S104 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 RY-101 which:

DISABLES:

SPEAKER SP101,
RX RF AMP Q101,
1st RX MIXER Q102,
2nd RX MIXER Q103,
1st IF AMP Q104,
2nd IF AMP Q105,
RX OSCILLATOR Q106,
DIODE CR106,

ENABLES:

MIC AMP IC101,
TX OSCILLATOR Q108,
TX MIXER Q109,
TX BUFFER Q110,
MODULATION LIGHT DS103.

PA MODE is initiated by placing PA/CB switch S104 in PA which:

DISABLES:

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

ENABLES:

PA speaker jack J103.

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

5.2 RECEIVER

GENERAL

In the receive mode, the RF signal is fed from the antenna through the RY101-1 contacts to the 1st