INSTRUCTION MANUAL

FOR

B & K-PRECISION

MODEL 1040
CB ServiceMaster

B+K PRECISION

DYNASCAN CORPORATION
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INTRODUCTION

The **B & K-Precision** Model 1040 CB ServiceMaster is a high-quality test instrument intended primarily for performance testing of class D Citizen's Band transceivers in the 27 MHz band. It will also test other types and bands of two-way radio transceivers, transmitters, receivers and audio equipment. Numerous measurements can be made directly from the Model 1040, but it also is designed for interconnection to an RF signal generator, frequency counter and oscilloscope, forming an entire Citizen's Band radio test center. The test center is capable of complete performance testing, including checks such as receiver sensitivity, receiver audio output power, audio distortion, transmitter frequency, transmitter modulation, transmitter RF power output, antenna standing wave ratio (SWR) and many more. The unit includes features for testing both AM and SSB operation.

The test center, including a Model 1040 CB ServiceMaster, helps the service technician realize his primary goal of quick and accurate trouble diagnosis. Time is the technician's most costly resource; he must spend as little time as possible servicing each piece of equipment. The Model 1040's simplicity of connections, easily used operating controls, and fast testing procedures significantly reduce servicing time. The instrument will quickly pay for itself. For example, only the antenna jack and external speaker jack of the radio are connected to the Model 1040 for testing. All standard tests can be made without changing test equipment or radio set connections.

Accurate trouble diagnosis the first time is crucial to the technician's reputation for competence and professionalism. The Model 1040 makes this possible. It offers every test necessary to isolate virtually any trouble in any CB radio. It tests all modes of operation and all channels of operation, and includes vital testing of accessories such as microphones and antennas. All test readings are the direct-reading type, which eliminates the need for any calculations or conversions. This further enhances the other speed and accuracy features of the instrument.

The versatile instrument operates from AC power for use on the service bench, or from 12-volts DC power for use in a vehicle.

FEATURES

FULLY SOLID STATE	Offers all the advantages of solid state construction, including: • Instant warm-up • Low power drain • Dependability, reliability • Ruggedness • Light weight
AC OR DC POWERED	Operates from 120-volt, 60 Hz AC power for bench servicing or from 12-volt DC power. Operation from 12-volt DC power is convenient for in-vehicle testing such as SWR checks of antennas.
VERSATILITY	In addition to testing Citizen's Band transceivers in the 27 MHz band, it will test many other communications transceivers, transmitters, receivers and audio equipment. Examples of testing several types of equipment are included in this instruction manual.
SIMPLIFIED OPERATING CONTROLS	Controls are so located and labeled as to eliminate error and speed servicing. Even distortion and SWR measurements are direct-reading for simplified and speedier operation.
SIMPLIFIED CONNECTIONS	Only one connection required from each instrument, RF generator, frequency counter, and oscilloscope, to the 1040. These connections need never be changed unless the instruments are to be used elsewhere. Only two connections to radio set for all standard tests, at the antenna jack and external speaker jack. Connections need not be changed from one test to another.
FAST SERVICING	Many troubles can be pinpointed directly from the test results. The housing does not even need to be removed from the radio set unless test results show the trouble is inside the radio.
RECEIVER AUDIO OUTPUT POWER MEASUREMENT	Accurately measures receiver audio output power from 1 milliwatt to 10 watts.
AUDIO LOAD	Terminates receiver audio output in 4-ohm, 8-ohm or 16-ohm load. Load dissipates up to 10 watts continuous.
RECEIVER SENSITIVITY MEASUREMENT	True signal-plus-noise to noise ratio (S + N)/N sensitivity measurement is made easily using dB scale.

dB SCALE	Receiver audio output meter has dB scale for convenience in making comparative type measurements, such as receiver sensitivity.
AUDIO MONITORING	Receiver audio output can be monitored, if desired, on variable volume speaker. High-impedance monitor signal source; turning on monitor speaker does not change the audio load.
DISTORTION MEASUREMENT	Distortion of standard 1000 Hz test signal can be read directly on 0-30% scale. Saves time and possible error from calculations and conversions. Tunable filter permits use of 900 to 1100 Hz test signal. Unit generates pure sinusoidal wave 1000 Hz test signal that can be used for distortion tests.
AUDIO DISPLAY ON OSCILLOSCOPE	Receiver audio output is displayed on oscilloscope when transceiver is in the receive mode.
RF GENERATOR PROTECTION	RF signal generator cannot be accidentally damaged by keying the transmitter. RF signal generator output is routed to antenna input of radio while receiving. When transmitter is keyed, the CB ServiceMaster detects the signal and automatically disconnects the RF generator, and at the same time connects the transceiver RF output to the RF power measuring circuits.
TRANSMITTER RF OUTPUT POWER MEASUREMENT	Accurately measures transmitter RF output power from 0.2 to 100 watts.
AVERAGE AND PEAK POWER MEASUREMENTS	Measures average power for transmitters operating in the AM mode and peak power for transmitters operating in the SSB mode.
INTERNAL RF LOAD	Internal 50-ohm dummy load dissipates up to 50 watts continuous and 100 watts intermittent.
EXTERNAL RF LOAD	External dummy load or antenna can be selected for RF load.
FORWARD AND REVERSE POWER MEASUREMENTS	Measures forward and reverse (reflected) power for testing antennas and antenna cables.
SWR MEASUREMENT	Direct reading of standing wave ratio on SWR scale... Saves time and possible error from calculations and conversions. Invaluable for testing antennas and antenna cables and obtaining maximum antenna efficiency.
TRANSMITTER FREQUENCY MEASUREMENTS	Samples appropriate level of transmitter RF output to drive frequency counter for direct reading of transmitter frequency. Most authorities agree that transmitter frequency should be checked with a frequency counter.
TRANSMITTER MODULATION TESTING	Generates 1 kHz test signal for modulating transmitters in AM mode. Generates 2-tone test signal for modulating transmitters in SSB mode. Modulation signal can be injected into transmitter.
SOUND GENERATOR	Modulation test signals can be applied to speaker to act as variable level sound generator. Microphone is placed over speaker to modulate transmitter; eliminates need to connect test cables.
MODULATION DISPLAY ON OSCILLOSCOPE	Displays 1 MHz representation of transmitter RF signal for observing modulation. Allows low-frequency oscilloscope to be used and eliminates need for expensive, high-frequency oscilloscope.
S METER/POWER METER CALIBRATION	Readings obtained from the CB ServiceMaster can be used to define the readings obtained on receiver signal strength meter (S meter) and transmitter power meter of radio sets so equipped.

SPECIFICATIONS

RF WATTMETER

Impedance	50 ohms.
Internal Load	50-ohm, 50-watt continuous, 100-watt intermittent.
External Load	Switch-selectable.
Ranges	0-10 watts, 0-50 watts, 0-100 watts.
Accuracy	±5%.
Metering Selection	Forward or reverse. Average or peak.
Frequency	27 MHz band.
SWR Scale	1:1 to 5:1 direct reading.
Insertion VSWR	Less than 1.1:1
Connector Type	
Input	Standard antenna type SO239 (UHF); mates with PL-259 antenna plug.
External Load	Standard antenna type SO239.

AUDIO WATTMETER

Load impedance	Switch-selectable. 4 ohms, 8 ohms or 16 ohms.
Load Rating	10 watts, continuous.
Ranges	0-100 milliwatts, 0-1 watt and 0-10 watts; auxiliary dB scale reads -20 dB to +3 dB.
Accuracy	±0.5 dB from 30 Hz to 15 kHz.
Connector Type	Banana plug receptacle.

DISTORTION MEASUREMENT

Type	Total harmonic distortion.
Scale	0-30% direct reading.
Accuracy	±5%.
Frequency	1 kHz, ±100 Hz.

AUDIO SECTION

Outputs	Receiver audio. 1 kHz test tone. Two-tone test signal.
Output Device	Speaker or output jack.
Level	Variable volume.
1 kHz Test Tone	
Accuracy	±10%.
Distortion	Less than 1%.
Two-tone Test Signal	500 and 2400 Hz two-tone
Speaker	Microphone modulation of transmitter.
Output Connector Type	Banana plug receptacle.

FREQUENCY COUNTER OUTPUT

Level	50 millivolts minimum at 1 watt RF input, for direct reading of transmitter carrier frequency.
Impedance	10 kΩ
Connector Type	BNC.

OSCILLOSCOPE OUTPUT

Transmit	1 MHz representation of 27 MHz carrier for visual examination of modulation envelope on any low-frequency oscilloscope.
Receive	Displays audio output of receiver.
Impedance	10 kΩ
Connector Type	BNC.

RF GENERATOR INPUT

Protection	RF generator coupled to transceiver in receive mode. In transmit mode, RF generator input automatically disconnected from transceiver antenna jack. Full protection when unit is off.
Impedance	50 ohms.
Connector Type	BNC.
Frequency	No limitation.

POWER REQUIREMENTS

120 VAC, 60 Hz	3 watts.
12 VDC	150 milliamperes. Reverse polarity protection provided.

WEIGHT:	2.55 Kg. (5 lbs. 10 oz.).
DIMENSIONS (HWD):	10.16 x 34.29 x 27.94 cm (4 x 13½ x 11").

OPERATOR'S CONTROLS, INDICATORS AND FACILITIES

(See Figures 1, 2 and 3)

1. **RECEIVER AUDIO OUTPUT Meter.**
   a. Measures receiver audio output power on 0-.1, 0-1 and 0-10 watt scales.
   b. Auxiliary dB scale reads from -20 to +3 dB for convenience in making comparative measurements.
   c. Measures percentage of distortion of 1000 Hz test signal on 0-30% scale.
2. **Meter Zero Adjust.** Adjusts RECEIVER AUDIO OUTPUT meter (1) to zero with no input applied.
3. **LOAD Switch.** Selects 4-ohms, 8-ohms or 16-ohm load impedance for receiver audio output signal.
4. **RECEIVER FUNCTION Switch.**
   a. WATTS positions:
      (1). **.1.** Selects 0-.1 watt scale (0-100 milliwatts) for meter (1).
      (2). **1.** Selects 0-1 watt scale for meter (1).
      (3). **10.** Selects 0-10 watt scale for meter (1).
   b. % DIST positions:
      (1). **SET FULL SCALE.** Used with control (5) and meter (1) to set and read reference for distortion measurement.
      (2). **ADJ FOR MIN.** Used with control (6) and meter (1) to set up and read percentage of distortion.
5. **% DIST, SET FULL SCALE Control.** Adjust meter (1) for full-scale reference in preparation for distortion measurement.
6. **% DIST, NULL Control.** Adjust meter (1) for null (minimum) before distortion measurement reading is taken.
7. **POWER Switch.** Turns unit ON and OFF.
8. **POWER Indicator.** Lights when unit is on.
9. **AUDIO SOURCE Switch.**
   a. **2-TONE.** Selects 500 Hz and 2400 Hz two-tone signal at speaker (12) and AUDIO OUTPUT jacks (21).
   b. **1 kHz.** Selects 1 kHz signal at speaker (12) and AUDIO OUTPUT jacks (21).
   c. **RECVR AUDIO.** Selects receiver audio output signal at speaker (12) and AUDIO OUTPUT jacks (21).
10. **AUDIO GAIN Control.** Adjusts level of signal at speaker (12) and AUDIO OUTPUT jacks (21).
11. **SPEAKER Switch.** Turns speaker (12) ON and OFF.
12. **Speaker.**
    a. Monitors receiver audio output.
    b. Drives microphone of transmitter with 1 kHz or 2-tone test signal when face of microphone is placed over speaker.
13. **TRANSMITTER RF OUTPUT Meter.**
    a. Measures transmitter RF output power, both forward and reverse, on 0-10, 0-50 and 0-100 watt scales.
    b. Measures standing wave ratio directly on SWR scale.
14. **Meter Zero Adjust.** Adjusts TRANSMITTER RF OUTPUT meter (13) to zero with no input applied (adjusted with unit turned on).
15. **RANGE Switch.**
    a. **10.** Selects 0-10 watt scale for meter (13).
    b. **50.** Selects 0-50 watt scale for meter (13).
    c. **100.** Selects 0-100 watt scale for meter (13).
16. **TRANSMITTER FUNCTION Switch.**
    a. **FWD.** Selects forward power for measurement on meter (13).
    b. **REV.** Selects reverse power for measurement on meter (13).
    c. **SET REF.** Selects control (17) to set reference for SWR reading. Reference is read on meter (13).
    d. **READ SWR.** Selects SWR for measurement on meter (13).
17. **SET REF Control.** Adjusts meter (13) to full scale reference in preparation for making SWR measurement.
18. **RF LOAD Switch.**
    a. **EXT.** Terminates transmitter RF output in external antenna or dummy load that is connected to EXT RF LOAD jack (22).
    b. **INT.** Terminates transmitter RF output signal in internal 50-ohm dummy load.
19. **RF POWER Switch.**
    a. **AVG.** Selects average power reading for meter (13); used for AM transmitter output measurements.
    b. **PEAK.** Selects peak power reading for meter (13); used for SSB transmitter output measurements.
20. **RECEIVER AUDIO Jacks.** Connects receiver audio output (typically external speaker output) of Citizen's Band transceiver to RECEIVER AUDIO OUTPUT meter (1).
21. **AUDIO OUTPUT Jacks.** Connects audio output of CB ServiceMaster to external equipment, such as the external modulation input of an RF signal generator. The type of signal (1 kHz, 2-tone or receiver audio) is selected by AUDIO SOURCE switch (9).

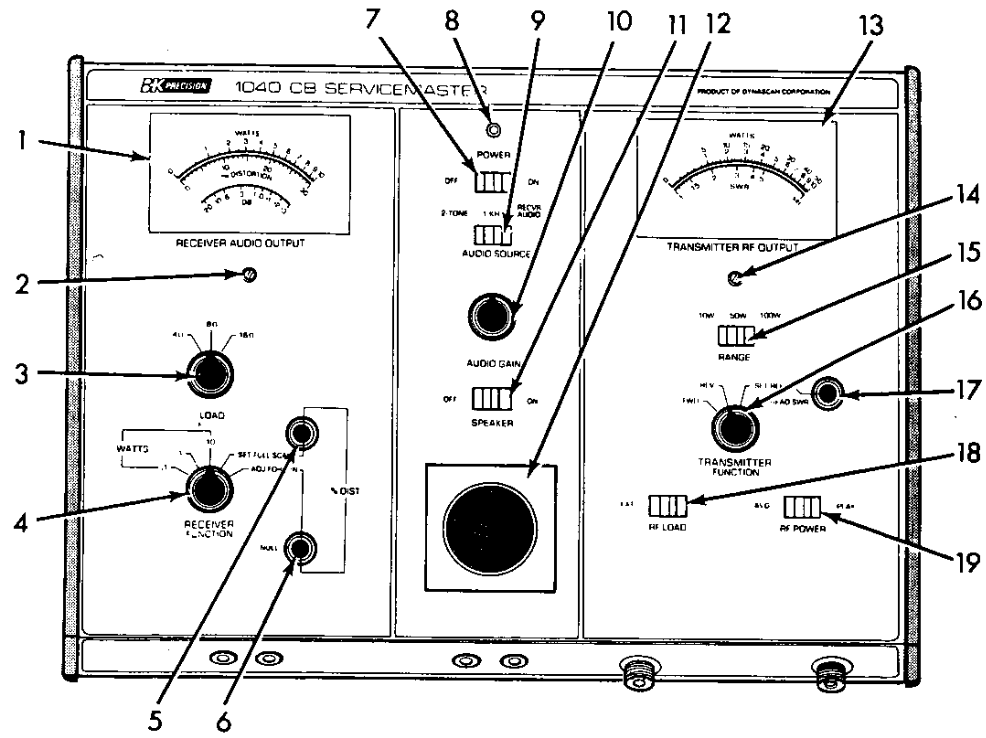


Fig. 1. Controls and Indicators and Operator's Facilities, Top View

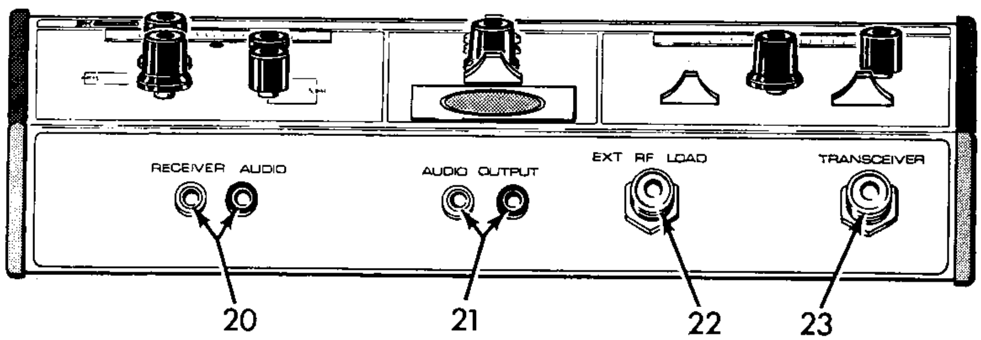


Fig. 2. Controls and Indicators and Operator's Facilities, Front View

22. **EXT RF LOAD Jack.** Connects external antenna or dummy load to CB ServiceMaster.

23. **TRANSCEIVER Jack.** Connects antenna jack of the Citizen's Band transceiver to the CB ServiceMaster. Signal from RF GENERATOR jack (26) is applied to the Citizen's Band receiver through the TRANSCEIVER jack during the receive mode. When the transmitter is keyed, the RF GENERATOR jack is automatically disconnected to protect the signal generator, and the transmitter output is monitored by the TRANSMITTER RF OUTPUT meter (13).

24. **OSCILLOSCOPE Jack.** Connects output signal to oscilloscope. When Citizen's Band radio is transmitting, the OSCILLOSCOPE jack output signal is a 1 MHz representation of 27 MHz carrier, which permits visual examination of the modulation envelope. When the Citizen's Band radio is receiving, the receiver audio output signal is applied to the OSCILLOSCOPE jack.

25. **FREQUENCY COUNTER Jack.** Connects low power sample of transmitter RF output to frequency counter.

26. **RF GENERATOR Jack.** Connects RF signal generator to CB ServiceMaster. When the Citizen's Band radio is in the receive mode, the RF signal generator carrier is applied to the transceiver's antenna input through the TRANSCEIVER jack (23). When the Citizen's Band radio is transmitting, the RF GENERATOR is automatically disconnected from the TRANSCEIVER jack to protect the signal generator and the power output of the transceiver is switched to the RF power-measuring circuits of the ServiceMaster.

27. **EXT 12V INPUT Terminals.** Connect CB ServiceMaster to external 12-volt power source; permit operation from 12-volt battery or DC power. (+) and (-) markings indicate proper polarity for connection.

28. **Fuse.** (Internal–not shown.)

29. **AC Power Cord.** Connects to 120-volt, 60-Hz AC power source.

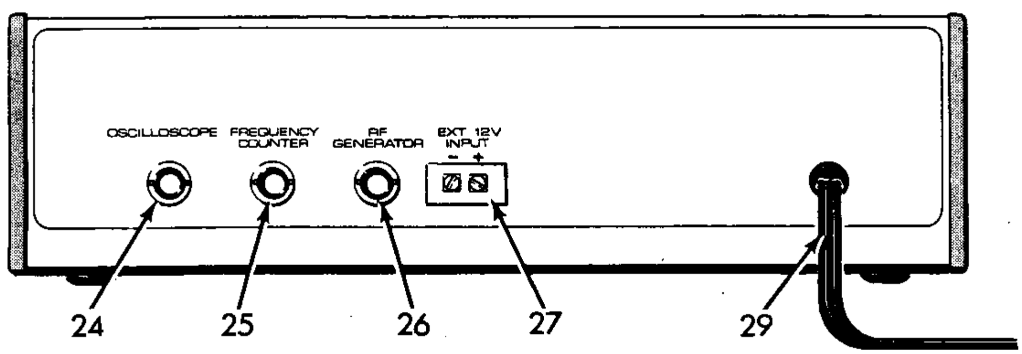


Fig. 3. Controls and Indicators and Operator's Facilities, Rear View

AUXILIARY TEST EQUIPMENT AND CABLE REQUIREMENTS

Auxiliary test equipment required to supplement the Model 1040 CB ServiceMaster and make up a complete test center: RF signal generator, frequency counter, and oscilloscope. If mobile radios are to be tested, a DC power supply is also required. This section of the manual outlines the minimum specifications for the auxiliary test equipment. Moderately priced, general purpose instruments will usually meet all the requirements. Naturally, instruments that exceed the minimum specifications may also be used. You may use your present test instruments if desired; merely check that they meet the specifications. If new test equipment is to be purchased, **B & K-Precision** offers the ideal companions for the Model 1040. Contact your **B & K-Precision** dealer for information on currently available models, or write to Dynascan for a free catalog.

This section of the manual also provides information on the variety of cables that may be required to interconnect the instruments that make up the test center, and cables that connect to the radio under test.

RF SIGNAL GENERATOR SPECIFICATIONS

FREQUENCY	Must cover the 27 MHz band CB channels.
OUTPUT IMPEDANCE	50 ohms.
OUTPUT LEVEL	Must provide at least 1000 microvolts output at highest setting and be adjustable down to 0.25 microvolt or less. Attenuator should accurately indicate output level in microvolts.
MODULATION	Must have AM modulation capability, external modulation capability, and modulation percentage meter.
DESIRABLE FEATURES	Covers commonly used CB IF frequencies (especially 455 kHz). Ultra-fine vernier control for easily setting exactly on frequency. High stability.

FREQUENCY COUNTER SPECIFICATIONS

FREQUENCY	Must display 27 MHz band CB frequencies. Should display 6 digits to show frequency to nearest hundred Hz.
SENSITIVITY	50 millivolts or less.
INPUT IMPEDANCE	Low-impedance (50-ohms), or high-impedance (typically 1 megohm).

OSCILLOSCOPE SPECIFICATIONS

FREQUENCY RESPONSE	20 Hz to 2 MHz or greater.
SENSITIVITY	50 millivolts/div or less.

POWER SUPPLY REQUIREMENTS

VOLTAGE	Adjustable from approximately 11.5 to 15 volts, nominal 13.8 volts transmit and receive.
CURRENT	2 amperes minimum.
DESIRABLE FEATURES	Adjustable current limiting. Maximum voltage output of approximately 15 volts to prevent accidental damage to radios. Low ripple and transient content. Good regulation as radio is switched from receive to transmit mode and vice versa.

CABLE REQUIREMENTS

The cables which connect from the Model 1040 CB ServiceMaster to the RF signal generator, frequency counter, and oscilloscope may terminate a wide variety of connectors, depending upon the specific test instruments used. The cables which connect from the Model 1040 to the radio under test may also require a variety of terminations depending upon the specific radio set. Fig. 4 shows several cables terminated in a variety of the most commonly encountered connectors. Each cable is identified by the corresponding **B & K-Precision** model number for convenience in ordering.

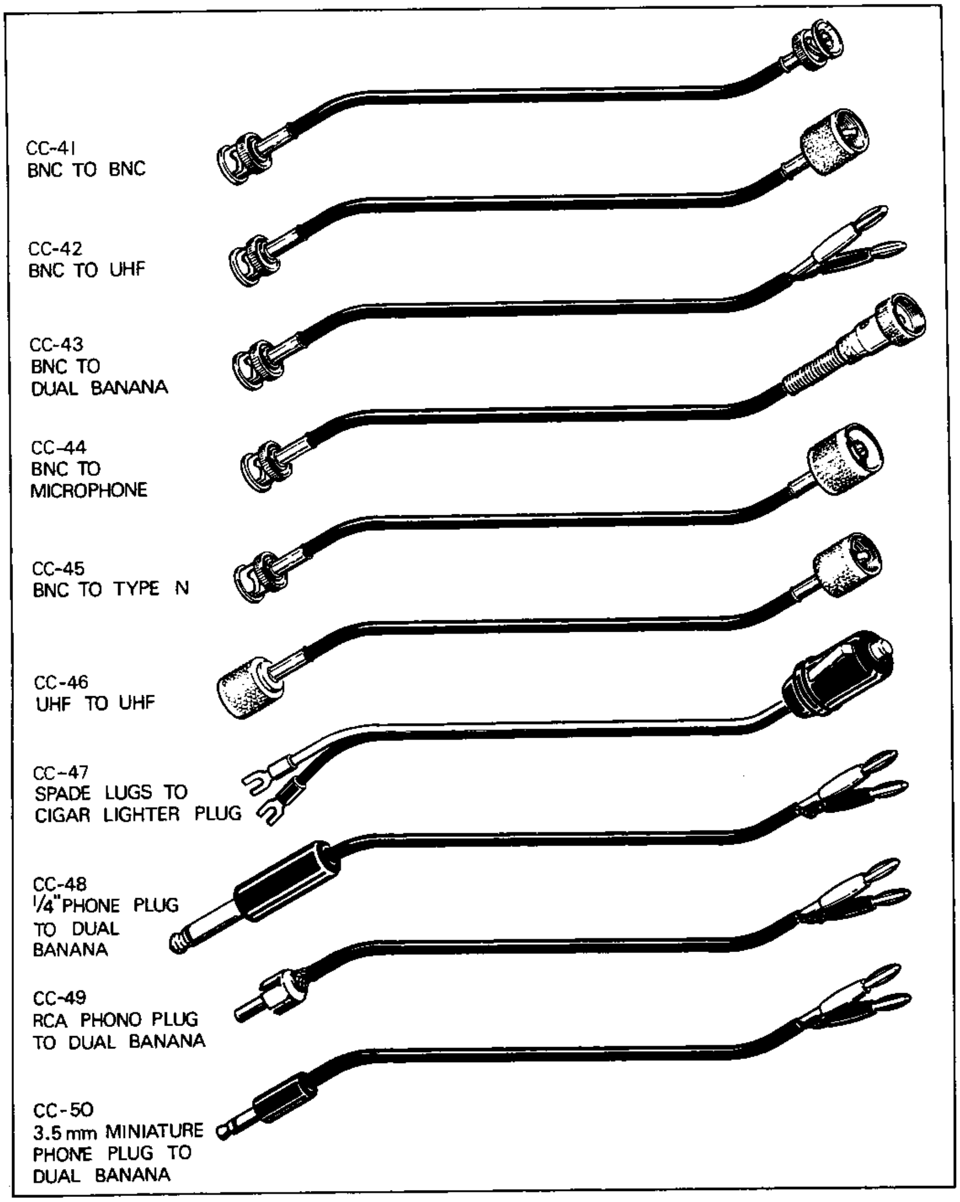


Fig. 4. Interconnect Cables

OPERATING INSTRUCTIONS

BASIC SET-UP AND INITIAL OPERATING PROCEDURE

In all of the operating instructions in this manual, the numbers in parentheses refer to controls and indicators and operator's facilities as identified in Fig. 1, 2 and 3. It is good practice to return operating controls to a standard configuration at the conclusion of each test. We recommend the settings listed in step 1, which are a combination of the most commonly used settings and those which provide maximum protection for equipment against accidental overload. All operating instructions in this manual assume that the controls have been placed in the standard configuration recommended in step 1 at the start of the test.

INITIAL OPERATING PROCEDURE

To familiarize yourself with the operating controls and testing techniques, it is recommended that all tests first be performed using a Citizen's Band transceiver known to be in good operating condition. Before power is applied to the unit the first time, start with the following procedure:

1. Set operating controls to the following standard configuration:

CONTROL	SETTING
RECEIVER FUNCTION Switch (4)	10 WATTS
AUDIO SOURCE Switch (9)	RECVR AUDIO
AUDIO GAIN Control (10)	Mid Position
SPEAKER Switch (11)	ON
RF Power Meter RANGE Switch (15)	100W
TRANSMITTER FUNCTION Switch (16)	FWD
RF LOAD Switch (18)	INT
RF POWER Switch	AVG
All Other Controls	Any Desired Position

2. Set POWER switch (7) to OFF.

3. Connect AC power cord (29) to 120-volt, 60-Hz AC outlet.

> **WARNING**
>
> Use only a 3-wire outlet. The 3rd wire connects the chassis of the 1040 to earth ground and eliminates all hazard from electrical shock. If a 2-wire to 3-wire adapter must be used, be sure the adapter wire is securely connected to a good earth ground.

4. Set POWER switch (7) to ON. POWER indicator (8) should light.

5. Check that both meters (1) and (13) are resting at exact zero. If necessary, adjust meter zero adjustments (2) and (14) for exact zero. Adjustment of (14) must be performed with unit turned on.

BASIC SET-UP (See Figure 5)

1. Connect a coaxial cable from the RF GENERATOR jack (26) to the RF output jack of the RF signal generator.

2. Connect a coaxial cable from the FREQUENCY COUNTER jack (25) to the input jack of the frequency counter.

3. Connect a coaxial cable from the OSCILLOSCOPE jack (24) to the vertical input jack of the oscilloscope.

4. Connect a coaxial cable from the TRANSCEIVER jack (23) to the antenna jack of the radio under test.

5. Connect a shielded audio cable from the RECEIVER AUDIO jacks (20) to the external speaker jack of the radio under test. Most CB transceivers are equipped with an external speaker jack, but if the radio under test is not so equipped, disconnect one side of the radio speaker and connect the transceiver speaker leads to the RECEIVER AUDIO jacks (20) using a shielded cable. If desired, an external speaker jack could be added to the transceiver to facilitate future testing and add operational convenience.

6. If the radio under test is a mobile unit, it must be connected to the DC power supply. Connect a cable from the power input plug of the radio under test to the (+) and (-) terminals of the power supply. Observe correct polarity. If the power cable is permanently wired to the radio set (no removable power plug), connect the power cable directly to the (+) and (-) terminals of the power supply. If the radio under test is a base station unit, connect it to a 120-volt, 60-Hz AC outlet; the power supply is not required.

7. Connect all test equipment to AC power outlets.

> **CAUTION**
>
> Before connecting the power supply to an AC outlet, make sure it is turned off or set to produce less than 15 volts output when power is applied.

8. Turn on all test equipment and the radio under test. If a mobile unit is under test and the power supply is used, adjust the power supply for 13.8 volts.

OPERATION FROM DC POWER

The Model 1040 CB ServiceMaster can be operated from any 12-volt DC power source such as an automotive vehicle, battery pack or DC power supply. If the power source is adjustable, it should be set for 13.8 volts. Make sure the power source voltage *never* exceeds 15 volts. Do *not* leave AC power connected when DC power is applied.

For convenient vehicular use, fabricate a 2-conductor power cable terminated in a cigar lighter plug. Then, whenever you wish to use the unit for vehicular antenna SWR checks, simply plug it into the vehicle's cigar lighter socket. A second DC power cable terminated in alligator clips should serve any vehicle without a cigar lighter and most other needs. Since the current requirement is low, cables up to 10 feet long can be made from 20 gauge insulated wire. Longer cables should use 18 gauge. Use two colors, such as red and black, so that polarity is easy to observe.

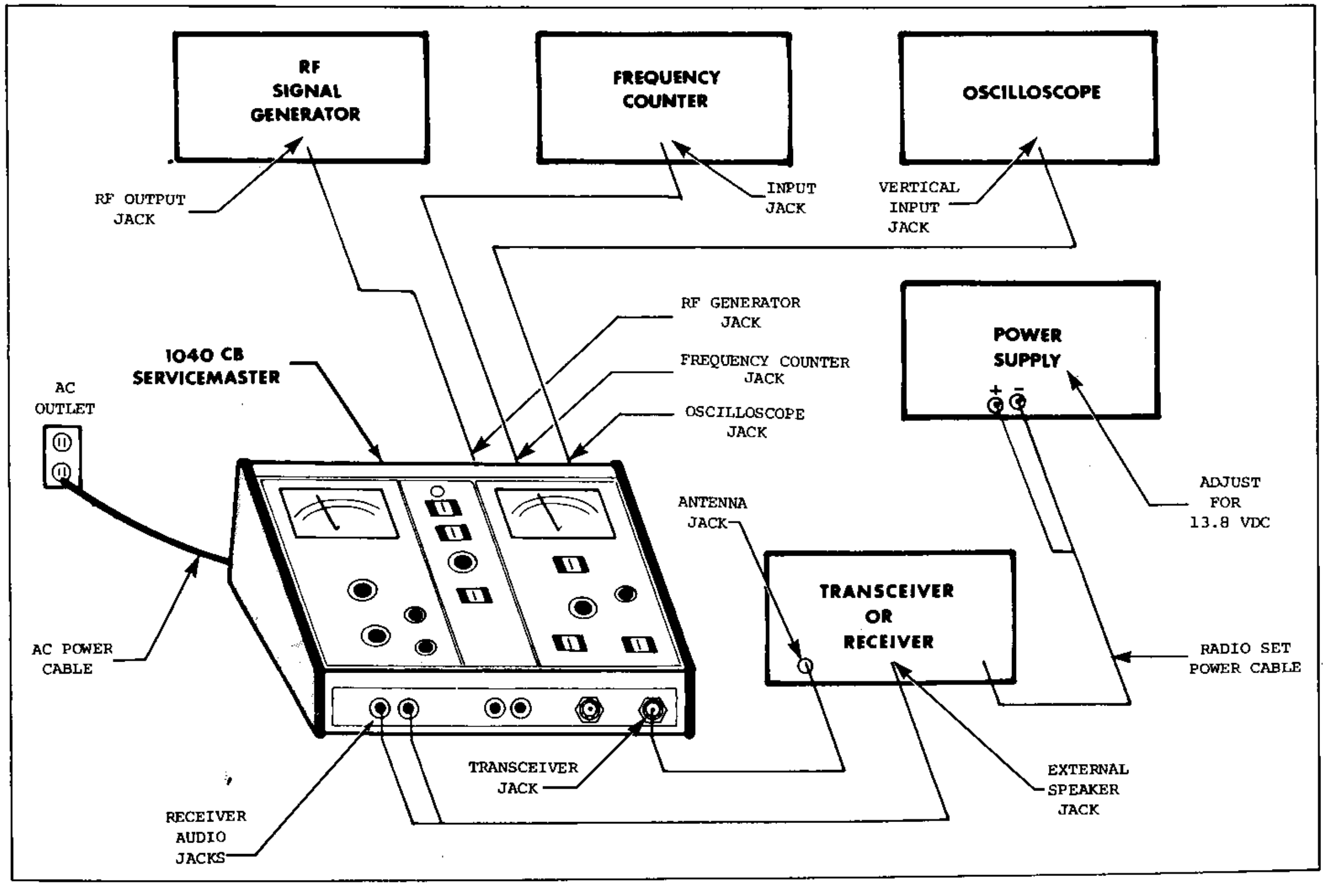


Fig. 5. Basic Set-Up

To operate the unit from DC power:

1. Connect a 2-conductor power cable to the EXT 12V INPUT (+) and (-) terminals (27) on the rear of the unit. If red and black conductors are used, connect the black wire to the (-) terminal and the red wire to the (+) terminal.
2. Connect the other end of the power cable to the power source. Observe correct polarity; the unit is protected against reverse polarity damage, but will not operate.
3. POWER indicator (8) will light when the DC power source is on. POWER switch (7) functions only for AC power and cannot be used to turn off the unit when operating from DC power.
4. If using an adjustable power source such as power supply, set it to 13.8 volts.

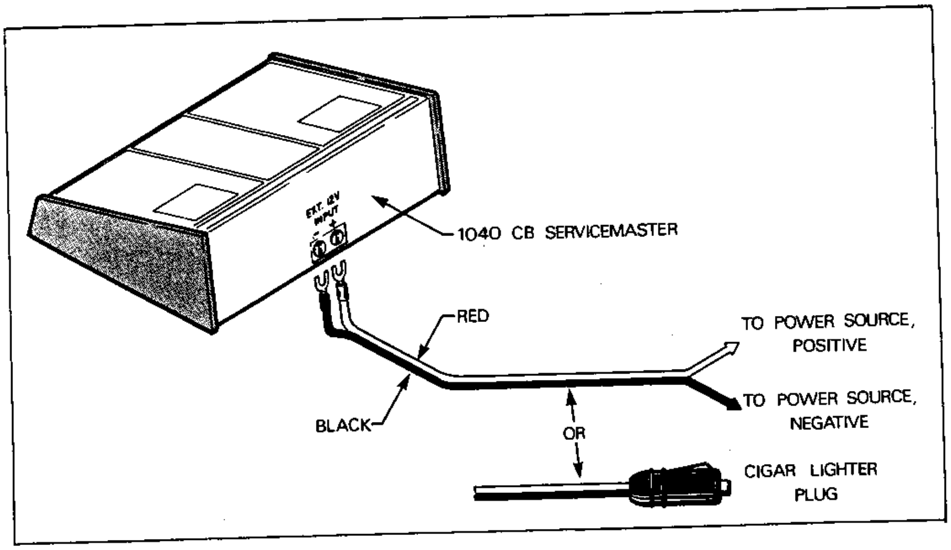


Fig. 6. Optional DC Power Connections

TRANSMITTER RF POWER CHECK
(Refer to Fig. 7)

This is normally the first transmitter check performed. It measures transmitter RF power to determine if it is normal. The check may be used for transceivers and transmitters operating in class D Citizen's Band service or any other AM or FM transceiver or transmitter in the approximate 27 MHz band with up to 100 watts RF output. For units with both AM and single sideband capability, this check should be performed in the AM mode before additional checks are performed in the SSB mode.

NOTICE

FCC regulations require that all checks, adjustments and repairs which affect transmitter power and frequency be performed only by or under the immediate supervision of persons holding a valid First or Second Class Radiotelephone License.

1. Hook up equipment in the basic test set-up shown in Fig. 5 and set all controls as instructed in INITIAL OPERATING PROCEDURE.
2. Set RANGE switch (15) to the 10W position for class D Citizen's Band transceivers or any other transmitters with a normal RF power of less than 10 watts. For transceivers and transmitters with normal RF power of 10 to 50 watts, select the 50W range. For transceivers and transmitters with normal RF power of 50 to 100 watts, select the 100W range.
3. Be sure the TRANSMITTER FUNCTION switch (16) is set to FWD (forward).
4. Be sure the RF LOAD switch (18) is set to INT (internal).
5. Be sure the RF POWER switch (19) is set to AVG (average).
6. For transceivers with both AM and SSB capability, select the AM mode. An FM transmitter may also be checked.
7. Set the transceiver to the first channel that is to be checked.

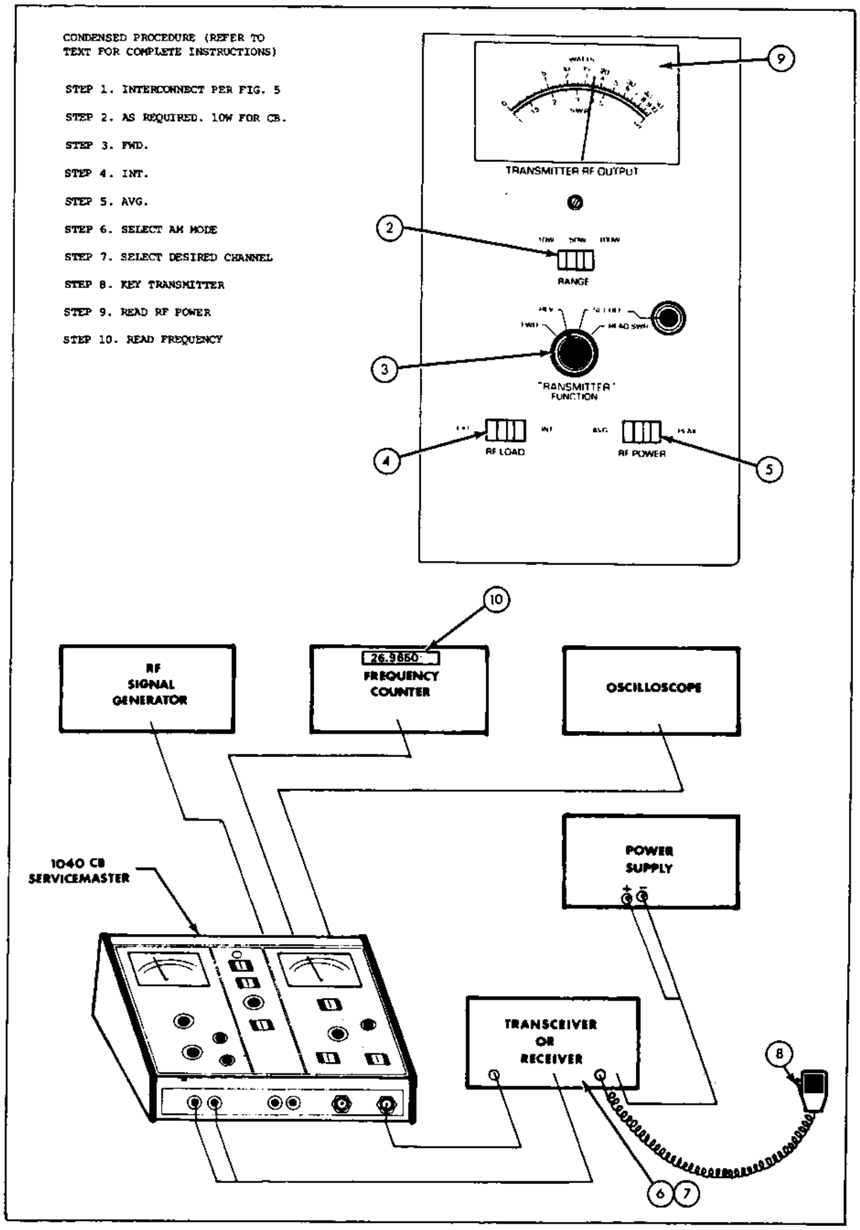


Fig. 7. Transmitter RF Power and Frequency Checks

8. Key the transmitter with the microphone push-to-talk switch.

9. Read transmitter RF power on the WATTS scale of the TRANSMITTER RF OUTPUT meter (13). Most CB transceivers operate at the maximum allowable 5 watts input power, which results in an RF output power of 2½ to 3½ watts. For other transmitters, refer to the manufacturer's specification for normal RF output power. *Latest FCC rules limit transmitter output power to 4 watts under any conditions of modulations.*

10. Repeat steps 8 and 9 for each channel. RF power should be equal on all channels.

TRANSMITTER FREQUENCY CHECK
(Refer to Fig. 7)

This check measures the accuracy of the transmitter operating frequency. It should be performed simultaneously with the TRANSMITTER RF POWER CHECK. Immediately after reading the RF power from the wattmeter, read the transmitter frequency from the frequency counter. The check is applicable to all types of transceivers and transmitters listed for the TRANSMITTER RF POWER CHECK.

NOTICE

FCC regulations require that all checks, adjustments and repairs which affect transmitter power and frequency be performed only by or under the immedate supervision of persons holding a valid First or Second Class Radiotelephone License.

1. Perform steps 1 through 7 of the TRANSMITTER RF POWER CHECK.

2. Set up the frequency counter for 27 MHz band reading.

3. Key the transmitter with the microphone push-to-talk switch. An unmodulated carrier is necessary; if necessary, cover the microphone to prevent audio modulation. If microphone gain is adjustable, set for lowest gain.

4. Read the transmitter frequency from the frequency counter. If the transmitter has no RF output, or an extremely low output, a frequency reading is not obtainable.

5. Repeat the check for each channel. Transmitter frequency must be within ±.005% or 1350 Hz of assigned CB channels, as follows:

NOTES

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	26.965	13	27.115
2	26.975	14	27.125
3	26.985	15	27.135
4	27.005	16	27.155
5	27.015	17	27.165
6	27.025	18	27.175
7	27.035	19	27.185
8	27.055	20	27.205
9	27.065	21	27.215
10	27.075	22	27.225
11	27.085	23	27.255
12	27.105		

MODULATION CHECK
(Refer to Figure 8)

This check shows whether or not transmitter modulation is normal by displaying the modulation envelope on the oscilloscope. The check is used for AM transceivers and transmitters and should be performed after the TRANSMITTER RF POWER CHECK and TRANSMITTER FREQUENCY CHECK. For AM/SSB units, this check is applicable to the AM mode only; additional modulation checks for the SSB mode are given later.

NOTICE

FCC regulations require that all checks, adjustments and repairs which affect transmitter power and frequency be performed only by or under the immediate supervision of persons holding a valid First or Second Class Radiotelephone License.

1. After performing the TRANSMITTER RF POWER CHECK and TRANSMITTER FREQUENCY CHECK, leave all connections and controls as specified at the conclusion of those checks.

2. Set AUDIO SOURCE switch (9) to 1 kHz.

3. Set AUDIO GAIN control (10) to mid-position.

4. Set SPEAKER switch (11) to ON.

5. If the radio is equipped with adjustable microphone gain, set it to mid-position.

6. Place microphone over the speaker of the Model 1040, face down, so that the speaker output drives the microphone with a constant tone.

7. Key the transmitter with the microphone push-to-talk switch.

8. Adjust the oscilloscope for a stable display of the modulation envelope.

9. Vary AUDIO GAIN control (10) from its minimum to maximum setting. The oscilloscope display should vary

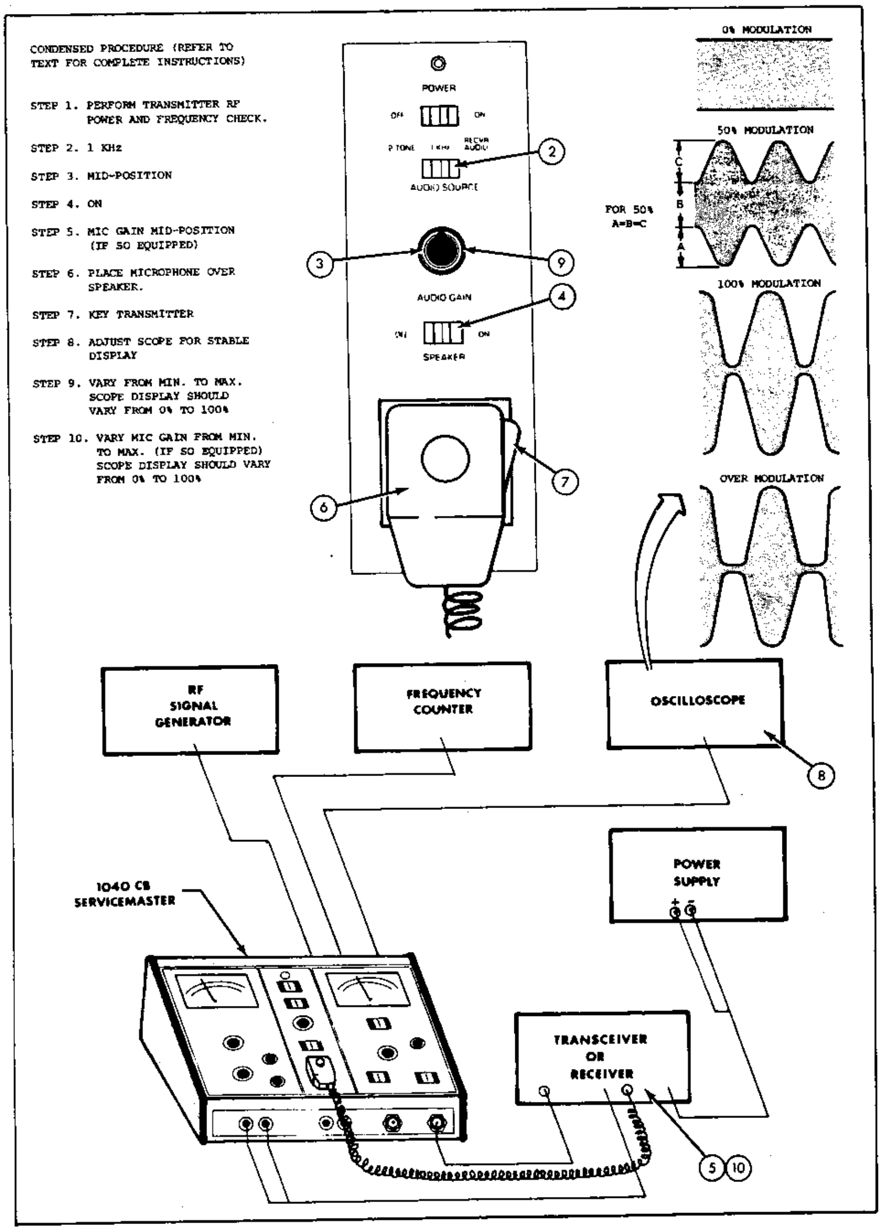


Fig. 8. Modulation Check

from 0% to 100% modulation. See Fig. 8 for interpretation of waveforms.

10. Return AUDIO GAIN control (10) to mid-position. If the radio is equipped with adjustable microphone gain, vary the control from its minimum to its maximum setting. The observed modulation percentage will vary as the microphone gain control is adjusted.

Normally, the MODULATION CHECK is necessary on only one channel. However, if a complete check is desired, merely leave the equipment set up as in step 9 and adjust for 50% modulation. Select each channel in turn and observe the oscilloscope display for any change. Unkey the transmitter while changing channels.

RECEIVER AUDIO POWER CHECK
(Refer to Fig. 9)

This is normally the first receiver check performed. It will quickly determine if the receiver is totally dead, and, if not, checks the receiver's ability to deliver adequate audio power to the speaker. It also accomplishes all the preliminary set-up steps necessary for a receiver sensitivity check which should be performed next if the results of this check are satisfactory. The check may be used for transceivers and receivers in class D Citizen's band service in the 27 MHz band, and any other AM or AM/SSB receiver with a 50-ohm antenna input and 4-ohm, 8-ohm or 16-ohm speaker output in virtually any frequency band. For receivers with both AM and SSB capability, this check should be performed in the AM mode before making subsequent SSB mode checks.

1. Hook up equipment in the basic test set-up shown in Fig. 5 and set all controls as instructed under INITIAL OPERATING INSTRUCTIONS.

2. Set LOAD switch (3) to match the normal speaker load of the receiver under test: 4 ohms, 8 ohms or 16 ohms.

3. Be sure the RECEIVER FUNCTION switch (4) is in the 10 WATTS position.

4. Leave the AUDIO SOURCE switch (9) in the RECVR AUDIO position.

5. Start with the AUDIO GAIN control (10) in mid-position. Readjust as required to maintain a comfortable listening level throughout the remaining steps of this procedure.

6. Leave SPEAKER switch (11) set to ON.

7. If the receiver is capable of operation in both AM and SSB modes, select the AM mode.

8. Select the desired channel on the transceiver or receiver being checked. The check can be performed on any channel, and normally needs checking on only one channel.

9. Set the receiver volume control to maximum and the receiver squelch control to the fully unsquelched position (fully counterclockwise).

10. If the receiver is equipped with adjustable RF gain, set it to maximum.

11. If the receiver is equipped with accessory circuits such as a noise limiter or ignition noise blanker, switch all such accessory circuits off. This precaution may exclude some circuits as a possible source of trouble. Accessory circuit operation should be tested after all basic checks are performed.

12. Receiver noise should be heard from speaker (12).

13. Set the RF generator to the approximate frequency of the receiver channel being checked, as close as the dial setting will quickly permit. A table of carrier frequencies for the CB channels is given in the previous TRANSMITTER FREQUENCY CHECK procedure.

14. Set the RF generator output level to 1000 microvolts.

15. Set the RF generator for internal modulation and adjust for 30% modulation. Some RF generators use 400 Hz internal modulation while others use 1000 Hz; either is satisfactory for this check. If both frequencies are available, the 1000 Hz is preferred.

16. Most RF generator dials are not calibrated to sufficient degree to permit adjustment to the exact desired frequency from the dial setting alone. Set the RF generator to the exact receiver frequency as follows:

    a. Slowly adjust the fine frequency control of the RF generator back and forth about the correct frequency point as indicated on the frequency dial.

    b. When the correct frequency is approached, an audio tone will be heard from the speaker (12) and a reading will be obtained on the receiver audio output meter (1). The receiver audio output will also be displayed on the oscilloscope. The tuning range over which the tone and meter reading occurs may be very narrow, and the frequency tuning control of the RF generator may need very careful adjustment.

    c. Carefully adjust the frequency control for peak meter reading and peak audio output on the speaker. This should coincide with minimum observed distortion on the oscilloscope display.

    If the receiver is completely "dead", no tone or meter reading will be obtainable. Repeat test on another channel, but with the RF generator output level set at maximum.

17. Adjust the oscilloscope for a stable display of a few cycles of audio.

18. Read the receiver audio output power level on the watts scale of meter (1). This reading should equal or exceed the receiver manufacturer's specification. All CB transceivers should provide at least 2 watts and some are rated substantially higher.

Receiver audio power specifications usually include a maximum distortion figure (for example, 2 watts at less than 10% distortion). This check does not include distortion measurement, but does provide a quick indication of audio power. Complete procedures for a distortion check are given later, but should be performed after sensitivity checks are completed.

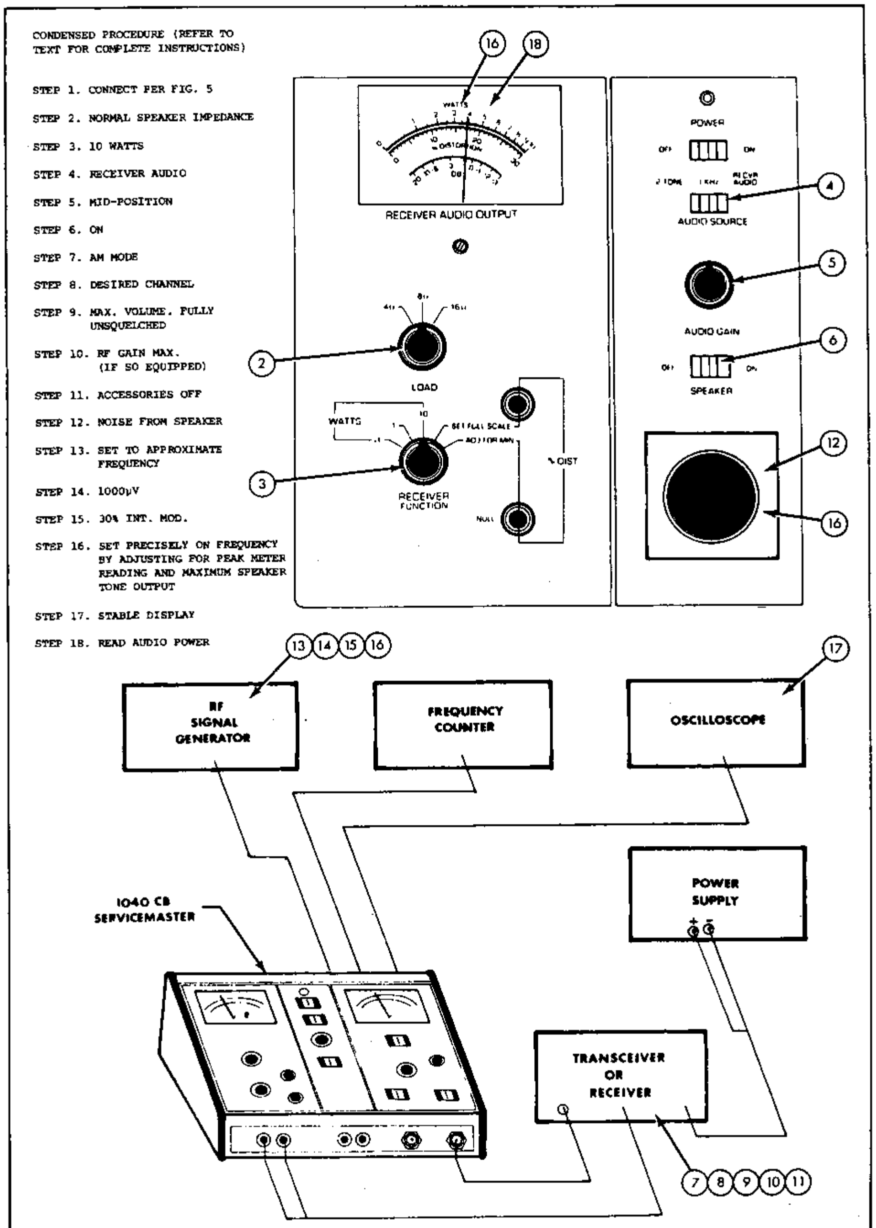


Fig. 9. Receiver Audio Power Check

RECEIVER SENSITIVITY CHECK
(Refer to Fig. 10)

This check measures the weakest usable signal level at which the receiver will operate. It is the best overall check of receiver performance that can be made. It should be performed immediately after the RECEIVER AUDIO POWER CHECK, as all the equipment is connected and set up as required for the sensitivity check. The sensitivity check is applicable to all types of receivers listed for the previous RECEIVER AUDIO POWER CHECK.

Receiver sensitivity is expressed as signal level required to produce a 10 dB signal-to-noise ratio (or to be more technically accurate, signal-plus-noise to noise ratio). For example, 1μV for 10 dB (S+N)/N. This means that a 1-microvolt modulated signal into the receiver antenna input should produce an audio output at least 10 dB above the receiver noise level obtained with a 1-microvolt input signal without modulation. Many radio specifications include the condition that the 10 dB (S+N)/N sensitivity be obtained at some minimum audio output power; for example, 1μV for 10 dB (S+N)/N at ½-watt audio. This is a good specification for overall receiver sensitivity.

1. After performing the RECEIVER AUDIO POWER CHECK leave all connections and control settings as at the conclusion of that check. The RF generator should already be set to the receiver frequency with 1000μV output and internal modulation of 30%.

2. Turn the receiver volume control to maximum and set the receiver squelch control fully unsquelched (fully counterclockwise).

3. Reduce the RF generator output level to a convenient low level such as 5 microvolts. If you think the receiver sensitivity may be normal, set it even lower, even as low as the receiver manufacturer's specification which is usually 1 microvolt or less. However, if the receiver sensitivity is poor, it may be necessary to start with a higher value such as 5 microvolts to obtain a reading in the following steps.

4. Reset the RF generator precisely on frequency. This is very important. If the RF generator is slightly off frequency it will cause serious error in the sensitivity measurement, appearing as very poor sensitivity. Rock the fine tuning dial of the RF generator back and forth very slowly as the output level is reduced and carefully adjust for peak reading on the receiver audio output meter (1). The oscilloscope display will also peak at maximum amplitude, and peak volume will be heard from speaker (12). For most RF generators, the frequency must be re-peaked after each change in the attenuator (level control) setting. The attenuator tends to have some pulling effect on the frequency.

   If no meter reading can be obtained with a 5-microvolt signal, receiver sensitivity is very poor and troubleshooting is required.

5. Set the RECEIVER FUNCTION switch (4) to the 10 WATTS or 1 WATT position, whichever gives the highest meter (1) reading without going off scale. Note the meter reading on the dB scale.

6. Switch the RF generator from internal modulation to unmodulated carrier (CW).

7. The meter (1) reading will drop. If the receiver has normal sensitivity and a 5-microvolt signal is used, the meter reading should drop more than 10 dB from the step 5 reading. (See NOTES ON USE OF dB SCALE at the end of this procedure.)

8. Return the RF generator to internal modulation operation. Repeat steps 3 thru 7 at progressively lower RF generator output levels until there is a 10 dB difference in meter readings between step 5 and step 7.

9. Note the setting of the attenuator on the RF generator. This setting, in microvolts, is the receiver sensitivity for 10 dB (S+N)/N. It should be equal to or lower than the receiver manufacturer's specification (for example, it should be 1μV or less for a specification of 1μV for 10 dB (S+N)/N at ½-watt audio).

10. Note the final step 5 reading in watts. It should equal or exceed the manufacturer's specification if provided (for example, the meter should read at least ½ watt for a specification of 1μV for 10 dB (S+N)/N at ½-watt audio).

11. The full receiver sensitivity check needs to be performed on only one channel. However, proper operation on all other channels can be checked rapidly as follows:

    a. Leave RF generator attenuator set at the 10 dB sensitivity level of step 9.

    b. With 30% internal modulation, note the meter (1) reading.

    c. Select each receiver channel, in turn.

    d. Tune the RF generator to each channel frequency and fine tune for peak meter (1) reading. The same reading should be obtained for all channels.

12. In most cases, it is only necessary to know if the receiver meets or exceeds the manufacturer's specification for sensitivity. To do this,

    a. Set the signal generator output at the specified sensitivity level with 30% modulation; for example: 1μV with 30% modulation.

    b. Set the receiver volume control to a convenient level as observed on the meter (1). A .5 watt reading is convenient as it corresponds to the zero dB point.

    c. Remove generator modulation and observe the meter reading. If it drops 10 dB, or more, the receiver sensitivity is equal to, or better than, the 1μV specification.

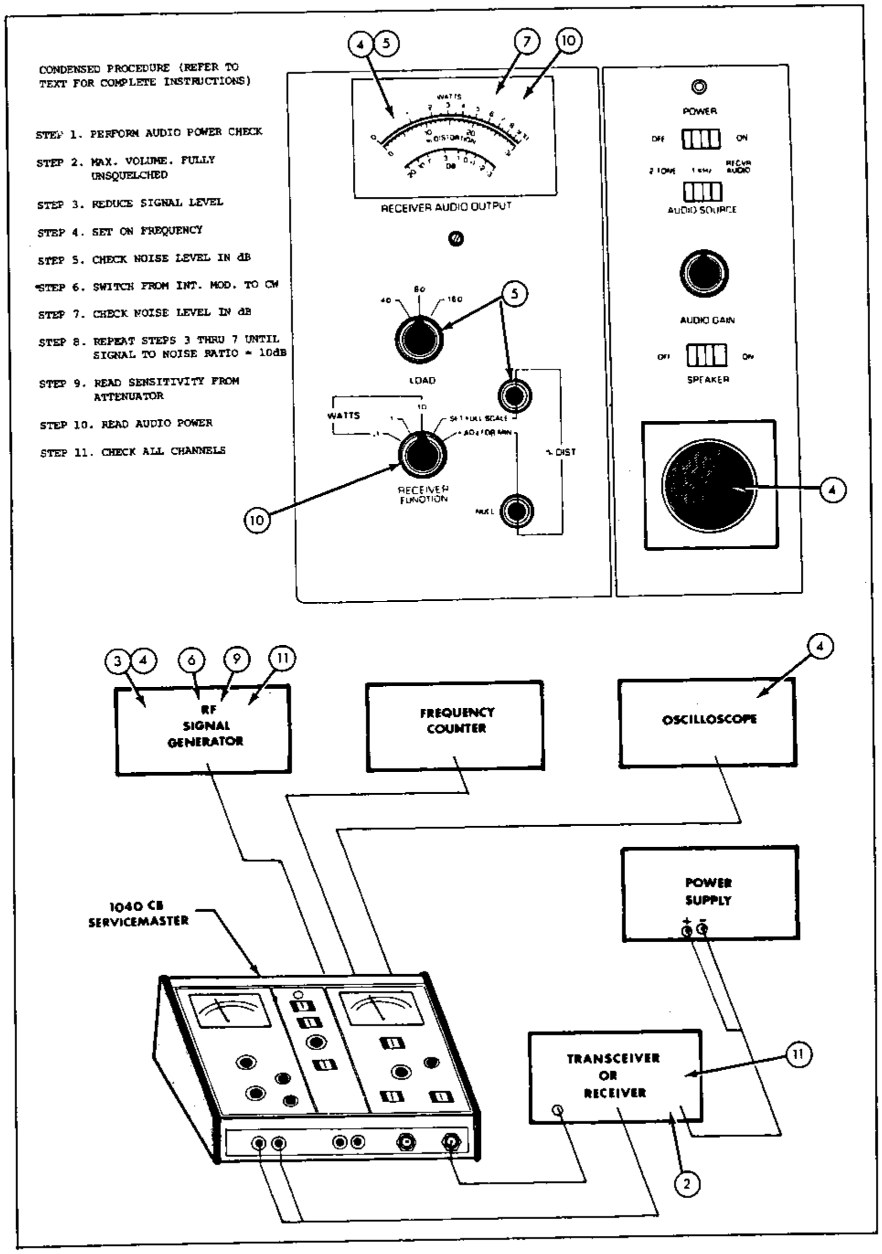


Fig. 10. Receiver Sensitivity Check

Notes on Use of dB Scale

The dB scale is used when comparing two readings, such as the 10 dB signal-to-noise ratio measurement in steps 5 and 7 of the receiver sensitivity check. If both readings are taken on the same meter range, readings are simply taken directly from the scale; for example, if the step 5 reading is +2 dB and the step 7 reading is -8 dB with both readings taken on the 1 WATT range, the difference is 10 dB.

However, for low meter readings (below about -7 dB on the dB scale) a more sensitive range should be selected to obtain more accurate readings. Each range represents a 10 dB change in meter sensitivity. A signal that measures -10 dB on the 10 WATTS range will read 0 dB on the 1 WATT range, a signal that measures -7 dB on the 1 WATT range will read +3 dB on the .1 WATT range, etc. If the step 5 reading is -3 dB on the 1 WATT range and the step 7 reading is -3 dB on the .1 WATT range, the difference is 10 dB.

One easy way to check for a 10 dB difference between steps 5 and 7 is to adjust the step 5 meter reading to 0 dB, regardless of its value in watts. The desired step 7 reading will then always be -10 dB. This is possible by placing the RECEIVER FUNCTION switch (4) in the ADJUST FULL SCALE position and setting the ADJUST FULL SCALE control (5) for 0 dB meter reading for step 5. This may not be possible if the step 5 audio output is low, below about ¾ watt. RECEIVER FUNCTION switch (4) must remain in the ADJUST FULL SCALE position for the step 7 reading.

ADJACENT-CHANNEL REJECTION CHECK

Rejection of adjacent-channel signals is very important to prevent strong signals on adjacent channels from causing interference. This check is comparable to a receiver selectivity measurement, it measures the ability of the receiver to reject adjacent channel signals.

This check can be performed on AM or AM/SSB transceivers or receivers. For AM/SSB units, the check is performed in the AM mode and need not be repeated for the SSB mode (However, the SSB ADJACENT SIDEBAND REJECTION CHECK should be performed).

Typically, adjacent-channel rejection is the same for all channels, and need be checked for only one channel. However, certain component failures can cause low adjacent channel rejection only on specific channels. The check should be repeated for each channel exhibiting adjacent channel interference. On CB transceivers and receivers, most channels are separated by 10 kHz, but some are separated by 20 kHz or more. The check should be performed on channels where both the upper and lower adjacent channels are only 10 kHz from the reference channel, specifically channels 2, 5, 6, 10, 13, 14, 17, 18 or 21.

1. Perform the RECEIVER SENSITIVITY CHECK and leave connections and controls as at the conclusion of that check.
2. Set the transceiver or receiver to channel 13 or the desired channel.
3. Leave the RF generator set for 30% internal modulation.
4. Tune the RF generator to the receiver frequency.
5. Set the RF generator output level to the 10 dB (S+N)/N level, which should be 1 microvolt or less. Use the lowest possible signal level. Note the level for reference.
6. Adjust receiver volume for a convenient reference level on the audio meter, such as ½ watt. Use a relatively low volume with respect to maximum rated audio.
7. Switch the transceiver or receiver to the adjacent higher channel, but leave the RF generator tuned to the reference channel selected in step 2. (If the transceiver was set to channel 13 in step 2, switch to channel 14).
8. Increase the RF generator output level until the audio meter reads the same as the reference level selected in step 6. To be sure that the RF generator remains precisely on the reference frequency, temporarily switch the transceiver or receiver back to the reference channel (step 2) after the attenuator is readjusted and retune the RF generator if necessary. After tuning the RF generator, switch back to the adjacent higher channel. Do not change the receiver volume or other controls.
9. Read the RF generator output level from the attenuator and compare the reading with step 5. The difference between the readings, in dB, is the adjacent-channel rejection figure. This figure should be at least 30 db for all transceivers and receivers. A high-quality receiver may measure 60 dB or more. This figure should exceed the manufacturer's selectivity specification which is usually stated for 20 kHz bandwidth. If the adjacent-channel rejection measures in the vicinity of 100 dB, receiver desensitization is probably the cause and the results are invalid. Using the lowest possible reference level in step 5 reduces the probability of receiver desensitization.
10. Switch the transceiver or receiver to the adjacent lower channel. (If the transceiver was set to channel 13 in step 2, switch to channel 12).
11. a. Normally, the audio meter should read the same as in step 8, which indicates that lower adjacent channel rejection equals higher adjacent channel rejection.

    b. If the audio meter reading is different from step 8, readjust the RF generator level until the audio meter reading does equal step 8. Read the RF generator level from the attenuator and compare it with step 5. The difference between the readings in dB is the lower adjacent channel rejection figure.

SQUELCH THRESHOLD SENSITIVITY CHECK
(Refer to Fig. 11)

NOTE: This test requires an extremely stable signal generator, preferably crystal-controlled.

CONDENSED PROCEDURE (REFER TO TEXT FOR COMPLETE INSTRUCTIONS)

PERFORM THIS CHECK IMMEDIATELY AFTER RECEIVER SENSITIVITY CHECK.

STEP 1. SQUELCH TO MINIMUM.

STEP 2. SET EXACTLY ON FREQUENCY WITH 30% MODULATION

STEP 3. SET TO MINIMUM RF OUTPUT

STEP 4. SWITCH TO ADJACENT CHANNEL IF REQUIRED (SO ONLY RECEIVER NOISE IS OBSERVED)

STEP 5. SET VOLUME TO REFERENCE LEVEL.

STEP 6. SET SQUELCH TO THRESHOLD

STEP 7. RETURN TO TEST CHANNEL

STEP 8. INCREASE OUTPUT AS REQUIRED. READ SQUELCH SENSITIVITY FROM ATTENUATOR.

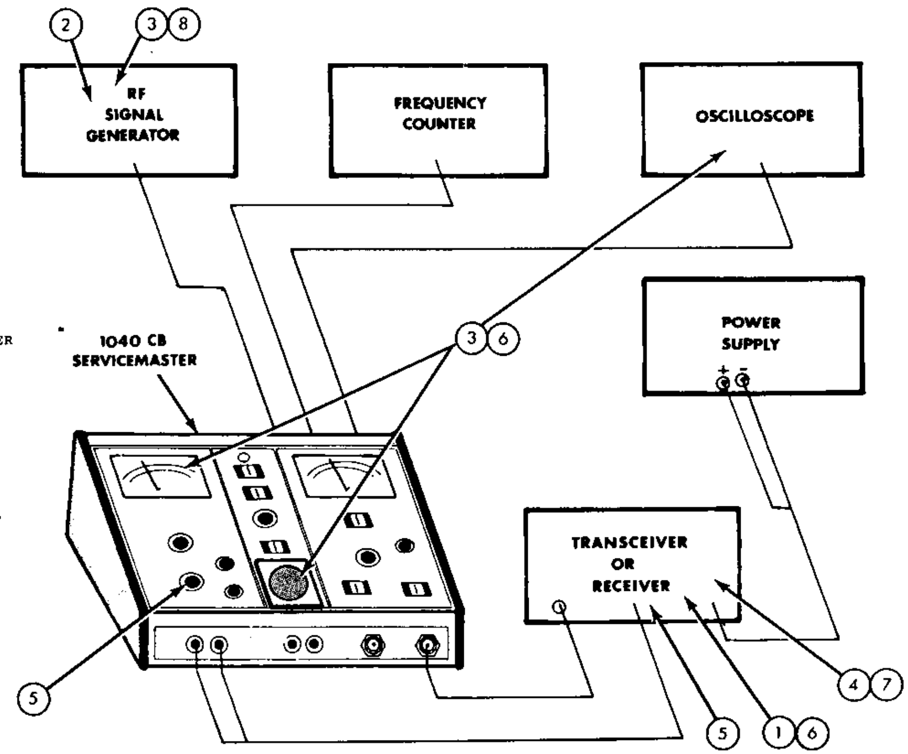


Fig. 11. Threshold Squelch Sensitivity Check

This check measures the weakest signal required to unsquelch the receiver when the squelch control is set at threshold. Perform this check immediately after the RECEIVER SENSITIVITY CHECK; the equipment is connected and set up as required to begin this check. This check is applicable to all types of receivers listed for the RECEIVER AUDIO POWER CHECK. It only needs to be performed on one channel; a mid-band channel such as 11 is satisfactory.

Squelch threshold sensitivity is measured in microvolts. The measured reading in microvolts should be equal to or less than the manufacturer's specification. Typically, squelch threshold sensitivity should be less than the specified 10 dB (S+N)/N sensitivity of the receiver which is usually 1 microvolt or less.

1. Set the transceiver squelch control to minimum.
2. Set the signal generator exactly on frequency with 30% modulation at 1000 Hz.
3. Set the generator output to minimum.
4. If audio output corresponding to the generator modulation is observed at minimum generator output, switch the transceiver channel selector to an adjacent channel so that only receiver noise is observed.
5. Set the transceiver volume control to a convenient output level as observed on the meter or at the speaker.
6. Adjust the receiver squelch control from minimum to threshold, that is, the point at which the receiver noise output just disappears. (Receiver noise should be reduced at least 20 db when the receiver squelches).
7. Switch the transceiver back to the test channel. If audio output corresponding to the signal generator modulation is observed, the threshold squelch level is less than the minimum generator output level.
8. If the receiver does not unsquelch, slowly increase the RF generator output level until it unsquelches and read the output level in microvolts from the attenuator of the RF generator. This is the squelch threshold sensitivity. Remember that any change in the RF generator output level may affect the frequency on most RF generators; be sure the RF generator is precisely on frequency. Repeat the check if there is any doubt that the most sensitive reading was obtained. This test is most efficiently performed with a crystal-controlled generator.

TIGHT SQUELCH SENSITIVITY CHECK
(Refer to Fig. 12)

NOTE: This test requires an extremely stable signal generator, preferably crystal-controlled.

When the receiver is adjusted for tight squelch (squelch control fully clockwise), it should block weak signals but accept strong, locally transmitted signals. This check measures the signal strength required to unsquelch the receiver when the squelch control is set at tight squelch. The sensitivity should not exceed 1000μV but may be as low as 30μV for some receivers. This check should be performed immediately after the SQUELCH THRESHOLD SENSITIVITY CHECK; the equipment is set up as required to start this check.

1. After performing the SQUELCH THRESHOLD SENSITIVITY CHECK, leave all controls as at the conclusion of that check. The RF generator should already be set for internal modulation at 30% and should be exactly on the test channel frequency.
2. Set the RF generator output level to minimum.
3. Set the receiver squelch control to tight squelch (fully clockwise). The observed receiver output will disappear.
4. Slowly increase the RF generator output level until the receiver unsquelches, at which time there will be audio output from the speaker, meter (1) or displayed on the oscilloscope. The signal generator level at this point is the tight squelch sensitivity of the receiver.

In step 4, the receiver may unsquelch at an unacceptably high signal level because the RF generator is pulled slightly off frequency during the measurement. To make sure that the most sensitive reading is obtained, use the following technique.

a. Reduce the RF generator output level until the receiver squelches.
b. Reduce the squelch control setting so the receiver unsquelches.
c. Set the RF generator precisely on frequency.
d. Return the squelch control to tight squelch and slowly increase the generator output until receiver audio output is observed.
e. Read the tight squelch sensitivity in microvolts from the attenuator on the RF generator.

AGC CHECK

This check verifies proper operation of the receiver AGC (automatic gain control) circuit. As the input signal level is changed from 50,000 microvolts to 1 microvolt, the audio output level should not change more than 30 dB. This check can be performed after the RECEIVER SENSITIVITY CHECK or SQUELCH SENSITIVITY CHECKS and needs to be performed only for one channel.

1. Leave equipment connected as for the RECEIVER SENSITIVITY CHECK.
2. The RF generator should be on frequency and adjusted for 30% internal modulation, 1000 Hz.
3. Set RF generator output level to 50,000 microvolts and retune to set precisely on frequency.
4. Set receiver RF gain to maximum (if so equipped).
5. Set receiver volume for a convenient reference reading on audio meter (1), such as 0 dB.

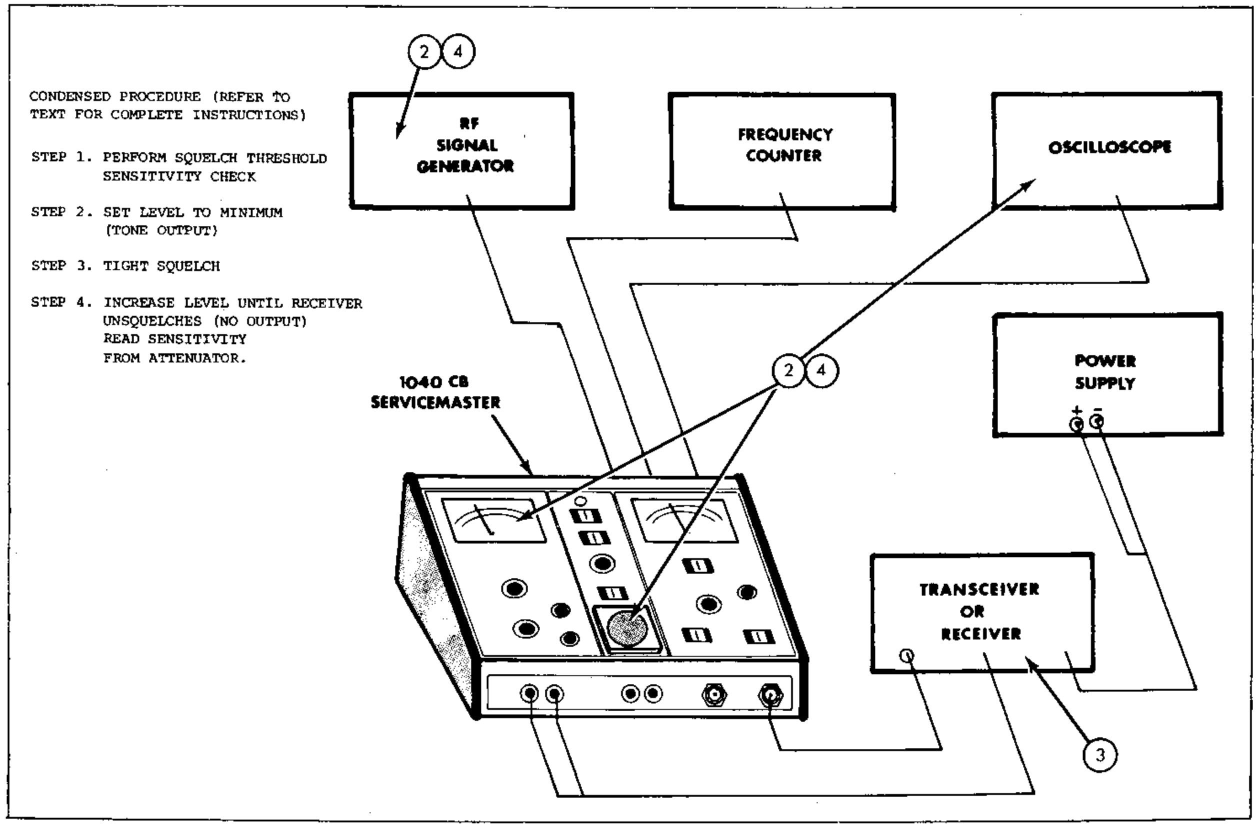


Fig. 12. Tight Squelch Sensitivity Check

6. Slowly reduce the RF generator output level to 1 microvolt, noting that the meter reading drops smoothly, without sharp dips or peaks. The meter reading at 1 microvolt should not be more than 30 dB below the reference reading at 50,000 microvolts. As the meter reading approaches -20 dB of the reference reading, retune the RF generator to keep it precisely on frequency.

DISTORTION CHECK
(Refer to Fig. 13)

This check measures the percentage of audio distortion of a 1000 Hz test signal. The distortion specification for most transceivers and receivers is rated in percentage at a given audio output level (for example, less than 10% at 2 watts). Distortion can be accurately measured only if the modulating signal is undistorted. The CB ServiceMaster supplies a 1000 Hz test signal with less than 1% distortion. This signal should be used to externally modulate the RF generator, if the internal modulation of the RF generator is excessively distorted.

This check can be performed after the RECEIVER SENSITIVITY CHECK, SQUELCH SENSITIVITY CHECK, or AGC CHECK. In each case the equipment is set up as required to begin this check. The check needs to be made on only one channel.

1. After performing the RECEIVER SENSITIVITY CHECK, leave all connections and controls as at the conclusion of that check.
2. Set RECEIVE FUNCTION switch (4) to the 10 WATTS position.
3. Set SPEAKER switch (11) to OFF.
4. Set AUDIO SOURCE switch (9) to 1 kHz.
5. Connect a shielded audio test cable from the AUDIO OUTPUT jacks (21) of the CB ServiceMaster to the external modulation jack of the RF generator.
6. Set the RF generator to operate with external modulation.
7. Adjust the AUDIO GAIN control (10) and the modulation control on the RF generator for 30% modulation.
8. Set the RF generator output level to 1000 microvolts and tune to the receiver frequency.
9. Adjust receiver volume for the rated audio power in the distortion specification (in watts), as read on audio meter (1).
10. Set RECEIVER FUNCTION switch (4) to the SET FULL SCALE position.
11. Adjust the SET FULL SCALE control (5) for a full scale meter reading on audio meter (1).
12. Set RECEIVER FUNCTION switch (4) to the ADJ FOR MIN position.
13. Adjust NULL control (6) for minimum meter reading on audio meter (1).
14. Read the percentage of distortion on the % DISTORTION scale of audio meter (1).

Notes on Distortion Measurement

Be sure to use only 1000±100 Hz test signal for distortion measurement.

The audio waveform for which distortion is being measured is displayed on the oscilloscope. Distortion can be observed on the oscilloscope display as any characteristic which tends to make the waveform non-sinusoidal. Note any change in the distortion characteristics as adjustments are varied, such as receiver volume control, receiver RF gain (if so equipped), input signal level or fine tuning of the RF generator frequency. Perhaps distortion can be reduced by the proper combination of control settings.

If distortion is greater than 30%, it will not be possible to get an on-scale reading in step 13. However, it is always possible that an error in procedure or hasty setting of controls caused the off-scale reading. It may be helpful to repeat steps 10 and 11, but adjust for less than full-scale reference. Choose an alternate reference point such as the 20% distortion mark. Now, when steps 12 and 13 are repeated, it should be possible to set the NULL control for minimum meter reading. If this reading is higher than the reference point, distortion is indeed more than 30%. If the reading is lower than the reference point, it should now be possible to repeat the standard procedure beginning at step 10 and obtain the distortion measurement.

SSB TRANSMITTER RF POWER CHECK
(Refer to Fig. 14)

This check measures peak envelope power (PEP) of single sideband (SSB) transceivers and transmitters in the 27 MHz band. It may be used to check the SSB modes of operation for class D Citizen's Band transceivers or any other SSB transmitters in the approximate 27 MHz band with PEP ratings up to 100 watts. This is normally the first transmitter check made in the SSB modes, which is usually performed after all transmitter checks have been performed in the AM mode of operation.

In SSB operation, the carrier signal and one sideband are suppressed and all RF power is carried on one sideband. Therefore, there is no RF output when the transmitter is unmodulated. The CB ServiceMaster provides a two-tone test signal for modulating SSB transmitters. This two-tone test signal conforms to the industry standard for SSB transmitter checks.

NOTICE

FCC regulations require that all checks, adjustments and repairs which affect transmitter power and frequency be performed by or under the immediate supervision of persons holding a valid First or Second Class Radiotelephone License.

1. Perform transmitter checks for the AM mode of operation and leave equipment connected as at the conclusion of those checks, or hook up equipment in the basic test set-up shown in Fig. 5.

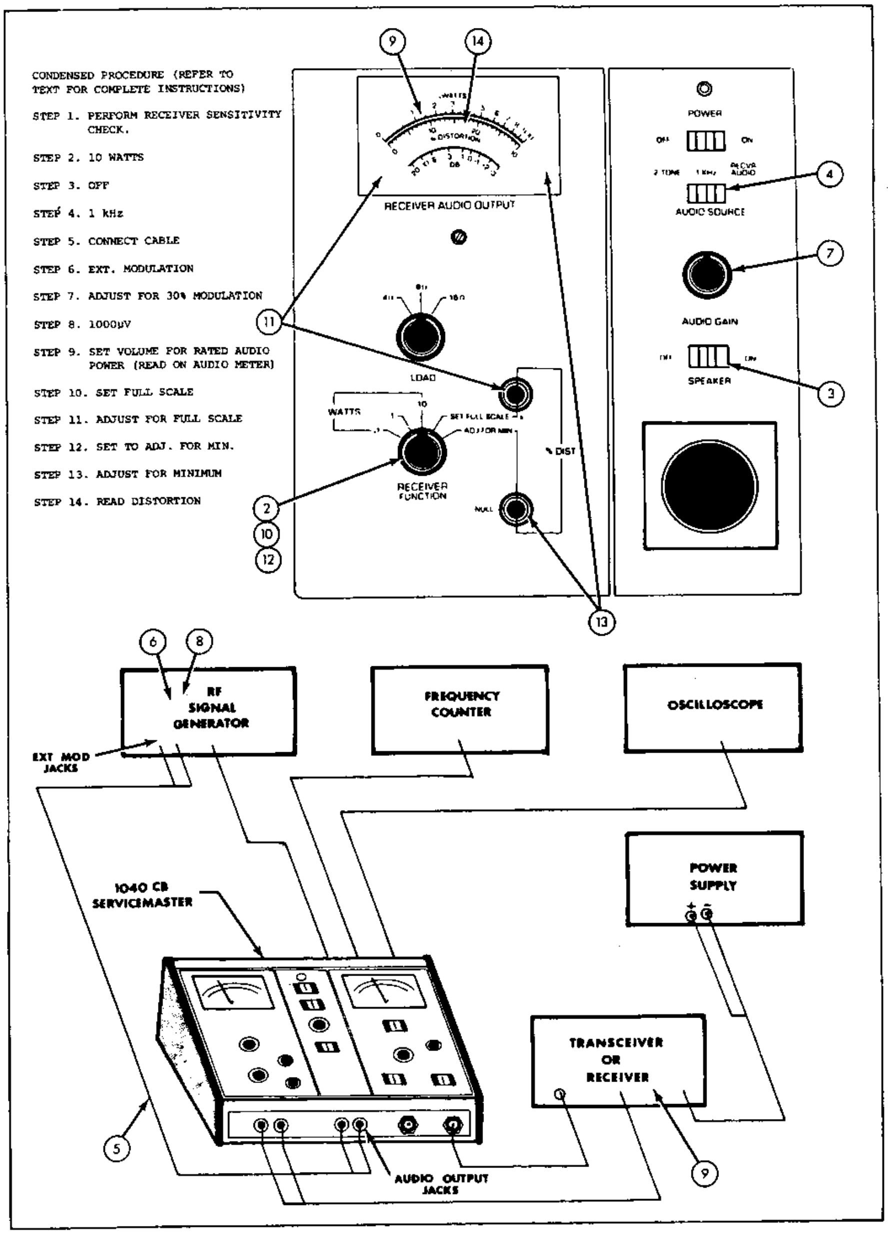


Fig. 13. Distortion Check

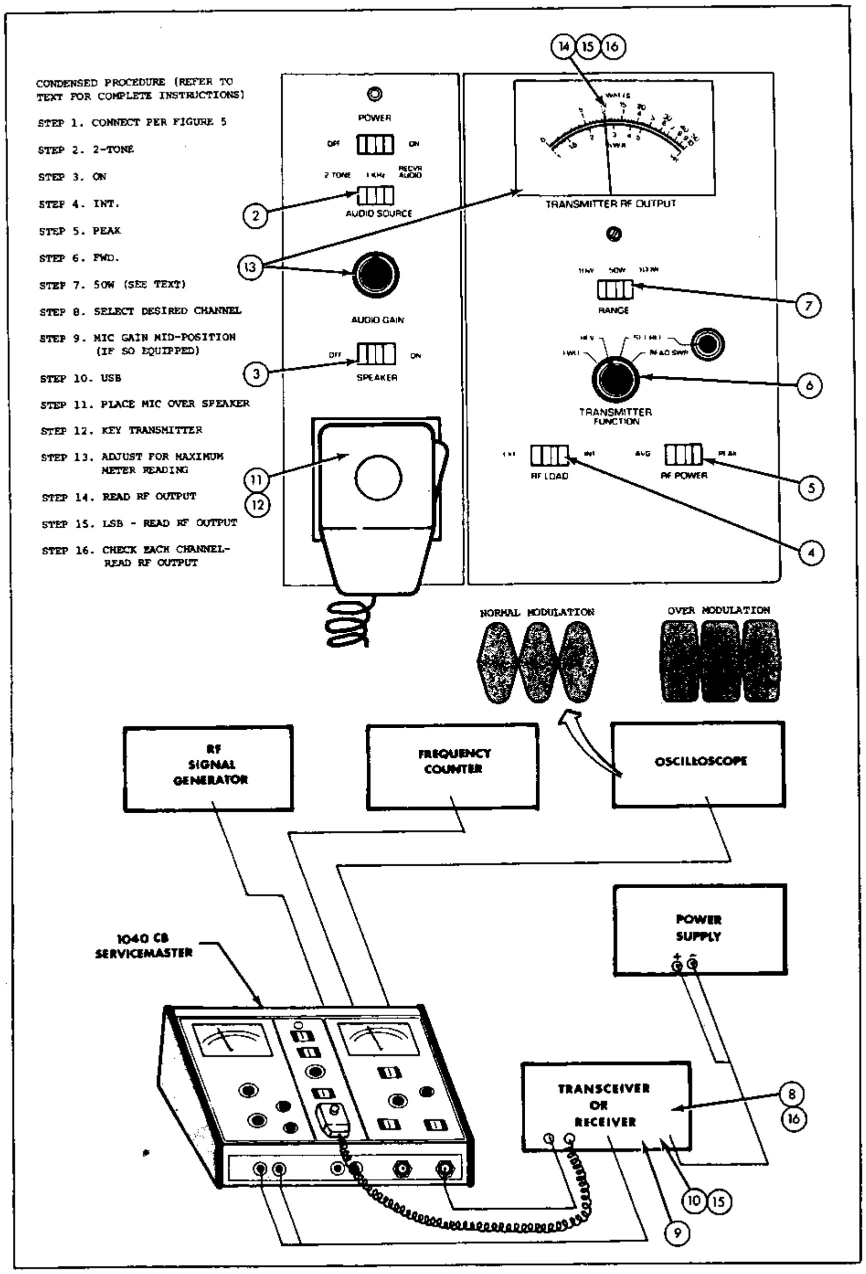


Fig. 14. SSB Transmitter RF Power Check

2. Set AUDIO SOURCE switch (9) to the 2-TONE position.

3. Set SPEAKER switch (11) to ON.

4. Set RF LOAD switch (18) to INT (internal).

5. Set RF POWER switch (19) to PEAK.

6. Set TRANSMITTER FUNCTION switch (16) to the FWD (forward) position.

7. Set RANGE switch (15) to the 50W position for class D Citizen's Band transceivers. For other transceivers and transmitters that have a rated peak power of 10 watts or less, select the 10W range. For transceivers and transmitters that have a rated peak power of over 50 watts, select the 100W range.

8. Select the desired channel on the transceiver or transmitter being checked. Any channel is satisfactory.

9. If the transceiver has adjustable microphone gain, adjust it to mid position

10. Select USB (upper sideband) mode.

11. Place microphone of transceiver or transmitter being checked over the speaker of the CB ServiceMaster, face down, so it can be driven by the two-tone test signal.

12. Key the transmitter with the push-to-talk switch on the microphone.

13. Adjust the AUDIO GAIN control (10) for maximum reading on the RF meter (13). Starting at a low gain setting, increase gain until the meter reading no longer increases. The control should not be at its limit.

14. Read the transmitter RF power, in watts, from the selected watts scale on the RF meter (13). This is the transmitter peak envelope power (PEP). Power output should meet the transceiver or transmitter manufacturer's specification, and must not exceed any applicable FCC limit for the unit being checked. The peak RF output for class D Citizen's Band transceivers in SSB modes should not exceed 12 watts.

15. Select the LSB (lower sideband) mode. Transmitter RF power output should be the same as for the upper sideband.

16. Measure USB and LSB RF power for each channel. All channels should have approximately the same power output.

SSB TRANSMITTER MODULATION CHECK
(Refer to Fig. 14)

This check of modulation quality displays the SSB transmitter modulation envelope for examination. This check applies to all types of transceivers and transmitters listed for the SSB TRANSMITTER RF POWER CHECK. It needs to be performed on only one channel.

For ease of understanding, this check is described as a separate test. However, in actual practice, the steps of the modulation check are often performed as part of the RF power check. Since the transmitter must be modulated to generate RF output, both can be checked simultaneously.

1. Perform steps 1 thru 12 of the SSB TRANSMITTER RF POWER CHECK.

2. With the AUDIO GAIN control (10) fully counterclockwise, RF meter (13) should indicate zero output from the transmitter.

3. Place transceiver microphone over ServiceMaster speaker and slowly increase AUDIO GAIN (10).

4. As AUDIO GAIN is increased, the RF meter reading should increase and the modulation envelope should be displayed on the oscilloscope.

5. Adjust the oscilloscope for a stable display which should resemble that shown in Fig. 14 (normal modulation).

6. Continue increasing the AUDIO GAIN setting. When maximum power is approached, the amplitude of the waveform ceases to increase and the peaks flatten out. This is the Overmodulation condition of Fig. 14, which is called flat-topping.

7. There should be a smooth transition from no output to full output.

8. If the transceiver is equipped with adjustable microphone gain, return the AUDIO GAIN control to a position that produces ½ of the maximum measured RF power. Vary the microphone gain control from minimum to maximum and again note that there is a smooth transition from minimum power to full power output.

NOTE

The preceding tests are a convenient method for quickly verifying that the single-sideband performance is acceptable. If a detailed evaluation of sideband performance is required, such as that performed with a spectrum analyzer, the two-tone signal should be obtained at the AUDIO OUTPUT terminals (14) and connected directly to the audio pins of the transceiver microphone jack using a shielded cable. The push-to-talk leads of the microphone jack are then connected to a switch for keying the transmitter. All above instructions then apply, except that the modulation signal is not applied through the transceiver microphone from the ServiceMaster speaker.

SSB TRANSMITTER FREQUENCY CHECK
(Refer to Fig. 15)

This check measures the transmitter operating frequency in the SSB modes. It should be performed immediately after the SSB TRANSMITTER RF POWER CHECK. It is applicable to all types of transmitters listed for that check.

Since the RF carrier is suppressed in SSB operation, the frequency of the sideband signal is measured. If a 1000 Hz modulating signal is applied the frequency of the upper sideband signal should equal the assigned carrier signal plus 1000 Hz. The lower sideband signal should equal the assigned carrier signal minus 1000 Hz. A stable single frequency tone should be used for modulation during this check, such as that furnished by the CB ServiceMaster.

Most SSB transceivers are equipped with a speech clarifier adjustment which is a fine frequency adjustment of the oscillator for clearest reception of SSB signals. Operation of the speech clarifier (sometimes called voice lock) circuit is checked during this test. Although the circuit is typically used only while receiving, it also adjusts the transmitter frequency, and its operation is most readily checked while measuring transmitter frequency.

NOTICE

FCC regulations require that all checks, adjustments and repairs which affect transmitter power and frequency be performed by or under the immediate supervision of persons holding a valid First or Second Class Radiotelephone License.

1. Perform the SSB TRANSMITTER RF POWER CHECK and leave equipment connected and controls set as at the conclusion of that check.
2. Select the desired channel on the transceiver or transmitter being checked.
3. If the transceiver is equipped with a speech clarifier (or voice lock) adjustment, it should be preset to the center of its adjustment range.
4. Select the upper sideband (USB) mode of operation on the transceiver or transmitter being checked.
5. Set AUDIO SOURCE switch (9) to the 1 kHz position.
6. This step need not be performed each time the check is performed. It can be performed one time and recorded for use in the future.
   a. Temporarily disconnect the frequency counter from the FREQUENCY COUNTER jack (25).
   b. Temporarily connect a shielded audio cable from the AUDIO OUTPUT jacks (21) to the frequency counter input.
   c. Set SPEAKER switch (11) to OFF.
   d. Set AUDIO GAIN control (10) to maximum.
   e. Measure the frequency of the 1 kHz test signal, which should be 1000±100 Hz. Accuracy to the nearest 100 Hz is satisfactory.
   f. Remove the temporary connections from the AUDIO OUTPUT jack (21) and reconnect the frequency counter to the FREQUENCY COUNTER jack (25).
7. Set SPEAKER switch (11) to ON.
8. Hold the microphone of the transceiver or transmitter being checked face down over the speaker (12) of the CB ServiceMaster.
9. Key the transmitter with the push-to-talk switch on the microphone.
10. Adjust AUDIO GAIN control (10) for one half of maximum RF power as measured on RF meter (13), except that RF power output should be at least 1 watt.
11. Read the frequency directly from the frequency counter. It should display the assigned channel frequency plus the modulating frequency (approximately 1 kHz). Refer to the TABLE OF CB FREQUENCIES at the end of this procedure.
12. Select the lower sideband (LSB) mode of operation on the transceiver or transmitter being checked.
13. Key the transmitter and read the frequency from the display on the frequency counter. It should display the assigned channel frequency minus the modulating frequency (approximately 1 kHz). Refer to the TABLE OF CB FREQUENCIES at the end of this procedure.
14. Check the USB and LSB frequencies for each channel.
15. If the transceiver is equipped with a speech clarifier (or voice lock) adjustment, it should adjust the frequency displayed on the frequency counter. The range of adjustment should not exceed about ±1000 Hz from the assigned channel frequency.

    To determine the adjustment range of the speech clarifier,

    a. Obtain the upper sideband frequency reading as outlined in steps 1 through 11 above.
    b. Set the speech clarifier adjustment at the maximum counterclockwise position and note the frequency reading observed on the frequency counter.
    c. Set the speech clarifier adjustment at the maximum clockwise position and again note the frequency counter reading.
    d. The difference in readings obtained in steps b and c is the total adjustment range of the speech clarifier. If the adjustment range is properly centered, the frequency change above and below the USB frequency listed in the TABLE OF CB FREQUENCIES should be approximately equal.

NOTES

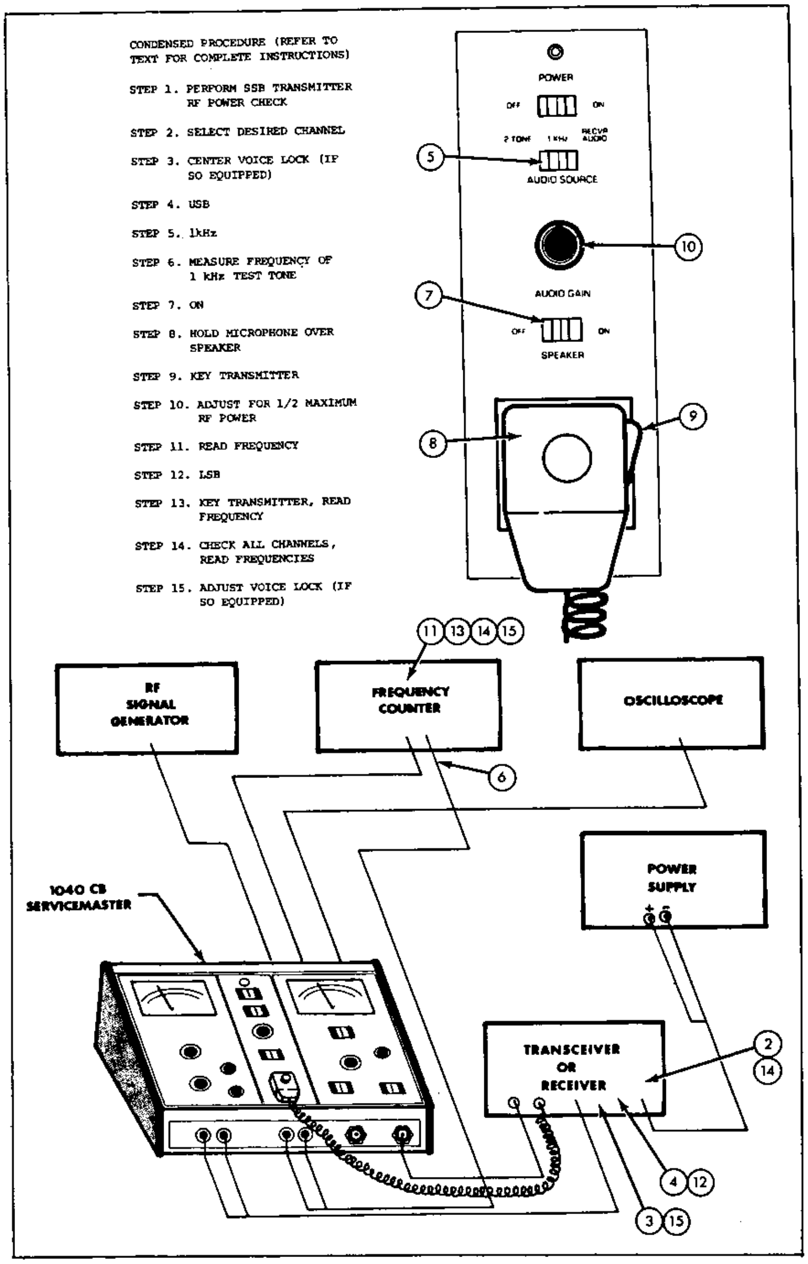


Fig. 15. SSB Transmitter Frequency Check

TABLE OF CB FREQUENCIES

Transmitter frequency must be within ±.005% of assigned channels. If modulating frequency is other than 1000 Hz, make necessary correction factor (USB = assigned carrier frequency + modulating frequency; LSB = assigned carrier frequency − modulating frequency).

CHANNEL	ASSIGNED CARRIER FREQUENCY (in MHz)	USB FREQUENCY WITH 1000 Hz MODULATION (in MHz)	LSB FREQUENCY WITH 1000 Hz MODULATION (in MHz)
1	26.965	26.966	26.964
2	26.975	26.976	26.974
3	26.985	26.986	26.984
4	27.005	27.006	27.004
5	27.015	27.016	27.014
6	27.025	27.026	27.024
7	27.035	27.036	27.034
8	27.055	27.056	27.054
9	27.065	27.066	27.064
10	27.075	27.076	27.074
11	27.085	27.086	27.084
12	27.105	27.106	27.104
13	27.115	27.116	27.114
14	27.125	27.126	27.124
15	27.135	27.136	27.134
16	27.155	27.156	27.154
17	27.165	27.166	27.164
18	27.175	27.176	27.174
19	27.185	27.186	27.184
20	27.205	27.206	27.204
21	27.215	27.216	27.214
22	27.225	27.226	27.224
23	27.235	27.236	27.234

NOTES

SSB RECEIVER SENSITIVITY CHECK
(Refer to Fig. 16)

This check measures the weakest usable signal level at which the receiver will receive SSB signals. This check may be used for AM/SSB transceivers and receivers in class D Citizen's Band service in the 27 MHz band, or for any other AM/SSB receiver with a 50-ohm antenna input and 4-ohm, 8-ohm or 16-ohm speaker output in virtually any frequency band. This check should be performed *after* the AM mode checks.

Receiver sensitivity is expressed in microvolts for 10 dB signal-plus-noise to noise ratio at a minimum audio level (for example, 0.5 microvolt for 10 dB (S+N)/N at ½ watt audio). this means that a 0.5 microvolt signal into the receiver antenna input should produce an audio output at least 10 dB above the noise level with an audio output of at least ½ watt. For SSB receiver checks, an unmodulated carrier (CW) signal is injected from the RF generator at the sideband frequency (slightly above the assigned channel carrier frequency for upper sideband operation and slightly below the assigned channel carrier frequency for lower sideband operation). When the CW signal from the RF generator beats with the re-injected carrier in the receiver, an audio tone is produced in the receiver output.

1. Perform the AM mode receiver checks and leave equipment connected as at the conclusion of the AM mode RECEIVER SENSITIVITY CHECK.
2. Set RECEIVER FUNCTION switch (4) to the 10 WATTS position.
3. Set AUDIO SOURCE switch (9) to the RECVR AUDIO position.
4. Set SPEAKER switch (11) to ON.
5. Set the transceiver or receiver being checked to the desired channel.
6. Select the upper sideband (USB) mode on the receiver being checked.
7. Adjust the receiver volume to maximum.
8. If the receiver is equipped with adjustable RF gain, adjust for maximum gain.
9. Adjust receiver squelch fully unsquelched (fully counterclockwise).
10. If the receiver is equipped with accessory modes such as an automatic noise limiter or ignition noise blanker, turn them all off.
11. Adjust AUDIO GAIN control (10) so noise is audible from speaker (12).
12. Set the RF generator to the unmodulated carrier (CW) mode.
13. Adjust the RF generator output level to the 10 dB (S+N)/N level. Start with the receiver manufacturer's sensitivity specification for the SSB modes (typically 0.5 microvolt or less).

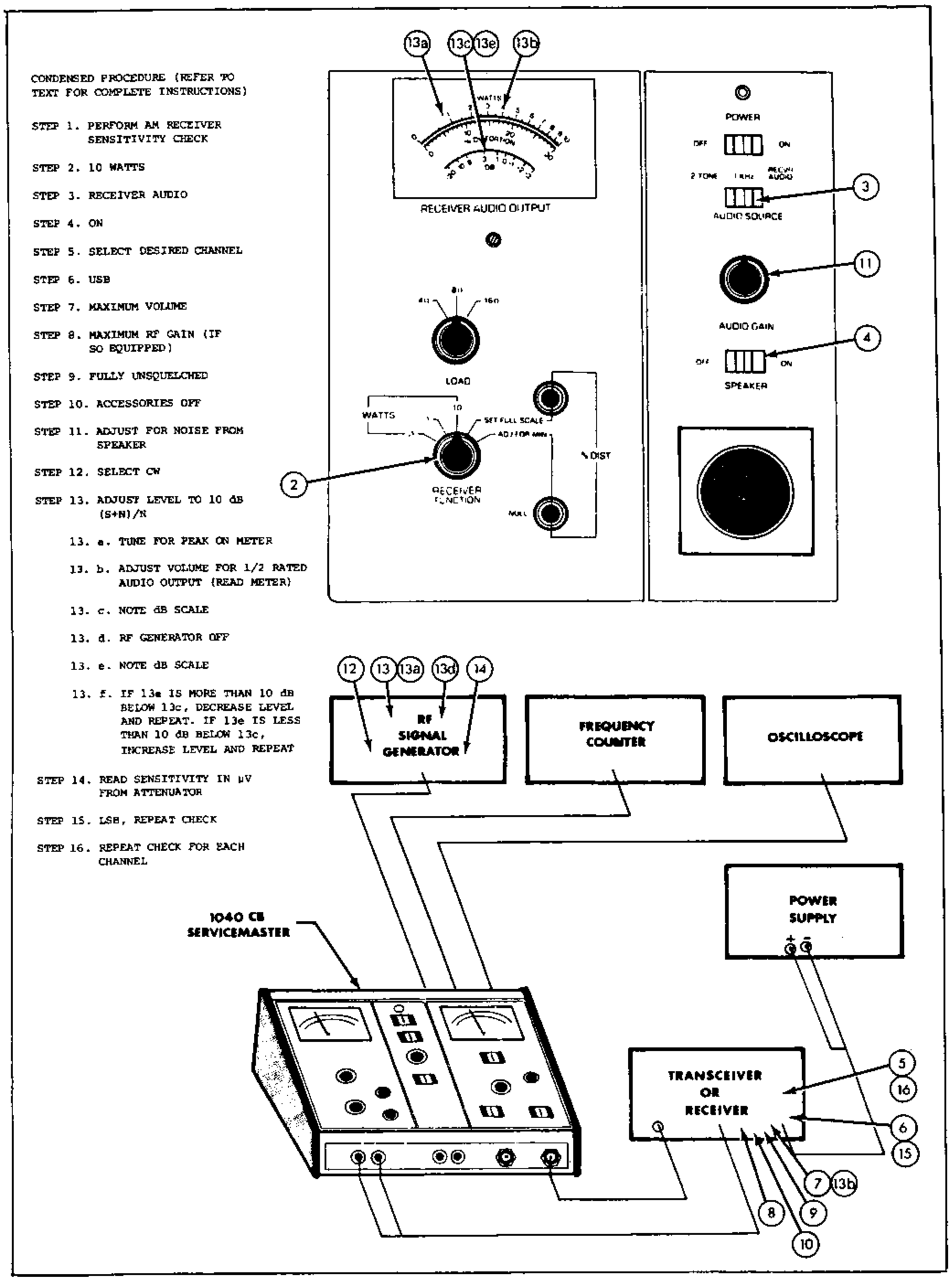


Fig. 16. SSB Receiver Sensitivity Check

a. Tune RF generator for peak reading on audio meter (1) and peak volume from the speaker (12). The frequency of the audio output will vary as the signal generator frequency is changed. If no tone output can be obtained on the meter and speaker, receiver sensitivity is poor and a much higher RF generator level may be required.

b. Read the audio output level in watts from audio meter (1). Adjust the receiver volume control for ½ of the receiver's rated maximum audio power (if the receiver is rated at 2 watts of audio, adjust for 1 watt). If audio output is less than ½ of the receiver's rated maximum audio output, leave the volume control set at maximum.

c. Note the audio meter (1) reading on the dB scale.

d. Turn off the RF generator.

e. Again note the audio meter (1) reading on the dB scale.

f. If step 13e is more than 10 dB below step 13c, decrease the level of the RF generator output and repeat steps 13a thru 13e. If step 13e is less than 10 dB below step 13c, increase the level of the RF generator output and repeat steps 13a thru 13e.

14. Read sensitivity in microvolts from the attenuator of the RF generator.

NOTE

It is not always necessary to measure the sensitivity in microvolts, but merely to note whether or not the receiver meets the manufacturer's specification. In this case, merely set the RF generator to the specification level and note the meter reading. Next, turn off the RF generator and again note the meter reading. If there is 10 dB or greater difference between the meter readings, the receiver meets specification; if less than 10 dB, it does not meet specification. Also note that the audio output level equals or exceeds the specification value. (For a specification of 0.5μV or 10 dB (S+N)/N at ½ watt audio, set the RF generator level at 0.5μV and note at least ½ watt of audio and at least 10 dB difference between the signal and no-signal conditions).

15. Select the lower sideband mode (LSB) on the receiver being checked and repeat the check. Sensitivity should be the same as for the upper sideband mode

16. Check USB and LSB mode sensitivity for each channel of operation. Sensitivity should be approximately the same for all channels.

SSB RECEIVER ADJACENT SIDEBAND REJECTION CHECK
(Refer to Fig. 17)

This check measures the ability of a single sideband receiver to suppress signals received on the opposite sideband. When the receiver is set for USB reception, any LSB input signals should be suppressed at least 40 dB, and when the receiver is set for LSB reception, any USB input signals should be suppressed at least 40 dB.

This check should be performed after the SSB RECEIVER SENSITIVITY CHECK and is applicable to all types of receivers listed for that check. If desired, the steps of this procedure may be incorporated into the procedure for the sensitivity check. This check needs to be performed on only one channel. Any channel is satisfactory.

1. After performing the SSB RECEIVER SENSITIVITY CHECK, leave connections and controls as at the conclusion of that check.
2. Select the USB mode on the receiver being checked.
3. Set the RF generator to the CW mode.
4. Adjust the RF generator to the 10 dB (S+N)/N sensitivity level.
5. Tune the RF generator frequency for maximum receiver output on audio meter (1).
6. Note the meter reading for reference.
7. Switch the receiver to the LSB mode.
8. Increase the output level of the RF generator until the audio meter (1) equals the reading in step 6, if possible.
9. Read the level from the attenuator of the RF generator. It should require at least a 40 dB increase in signal level to produce this condition. If less than 40 dB suppression of the opposite sideband is measured, be sure the RF generator frequency is not shifted toward the opposite sideband by the level adjustment. Recheck RF generator tuning on the desired sideband.
10. Repeat procedure, except set RF generator to LSB frequency and measure USB suppression.

SSB RECEIVER SQUELCH SENSITIVITY CHECK
(Refer to Fig. 18)

This check measures the minimum amount of on-frequency RF carrier required to unsquelch the receiver when adjusted at squelch threshold (the point which barely suppresses receiver noise), and at tight squelch. The receiver should meet the receiver manufacturer's specifications for squelch threshold sensitivity, which is typically 0.5 microvolt or less. It should also meet the receiver manufacturer's specification for tight squelch which may vary from 30 microvolts to 500 microvolts. The receiver should not block strong signals, even when set at tight squelch.

This check should be performed after the SSB RECEIVER SENSITIVITY CHECK and is applicable to all types of receivers listed for that check. The check is very similar to the squelch sensitivity checks for the AM mode except that the receiver is operated in the USB or LSB mode and a CW signal is injected from the RF generator. This check needs to be performed on only one channel. Any channel is satisfactory.

CONDENSED PROCEDURE (REFER TO TEXT FOR COMPLETE INSTRUCTIONS)

STEP 1. PERFORM SSB RECEIVER SENSITIVITY CHECK

STEP 2. USB

STEP 3. SELECT CW

STEP 4. ADJUST LEVEL TO 10 dB (S+N)/N

STEP 5. TUNE FOR MAXIMUM OUTPUT

STEP 6. NOTE METER READING

STEP 7. SELECT LSB

STEP 8. INCREASE LEVEL UNTIL READING EQUALS STEP 6

STEP 9. READ LEVEL FROM ATTENUATOR. SHOULD BE AT LEAST 40 dB ABOVE STEP 4

STEP 10. REPEAT PROCEDURE EXCEPT SELECT LSB AND MEASURE USB SURPRESSION

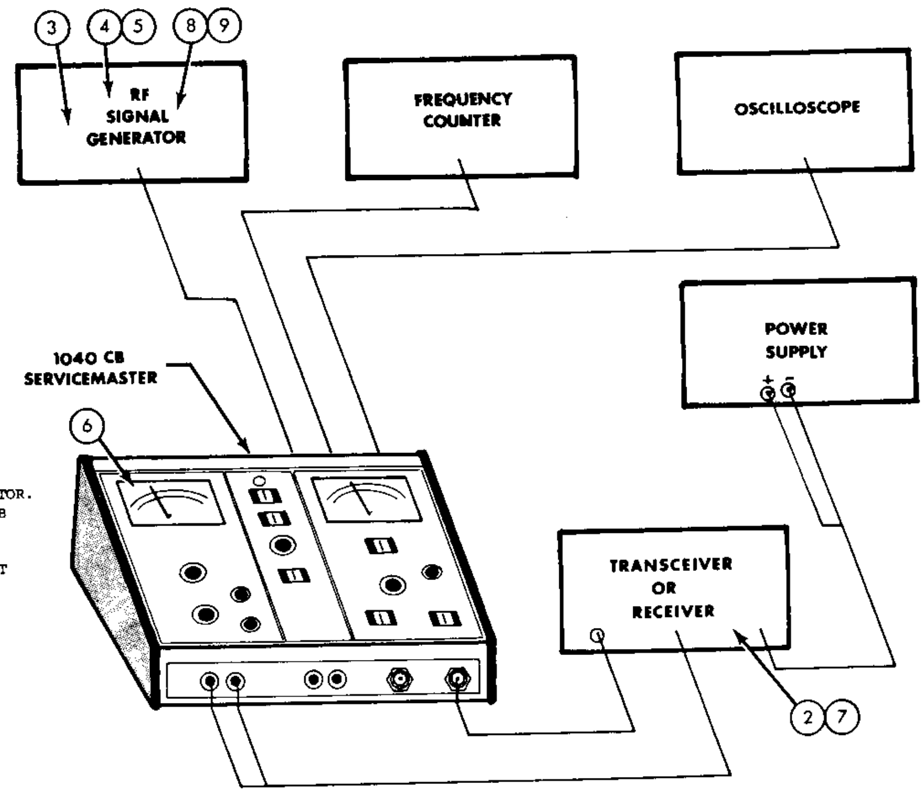


Fig. 17. SSB Receiver Adjacent Sideband Rejection Check

CONDENSED PROCEDURE (REFER TO TEXT FOR COMPLETE INSTRUCTIONS)

STEP 1. PERFORM SSB RECEIVER SENSITIVITY CHECK

STEP 2. SELECT USB

STEP 3. SELECT CW

STEP 4. ADJUST LEVEL FOR 10 dB (S+N)/N

STEP 5. TUNE FOR MAXIMUM OUTPUT

STEP 6. RF GEN. OFF

STEP 7. ADJUST FOR NOISE

STEP 8. SQUELCH THRESHOLD

STEP 9. ADJUST TO MINIMUM OUTPUT

STEP 10. RETURN TO CW.

STEP 11. INCREASE LEVEL UNTIL RECEIVER UNSQUELCHES

STEP 12. READ LEVEL FROM ATTENUATOR

STEP 13. TIGHT SQUELCH

STEP 14. INCREASE LEVEL UNTIL RECEIVER UNSQUELCHES

STEP 15. READ LEVEL FROM ATTENUATOR

STEP 16. SELECT LSB, REPEAT STEPS 3 THRU 15

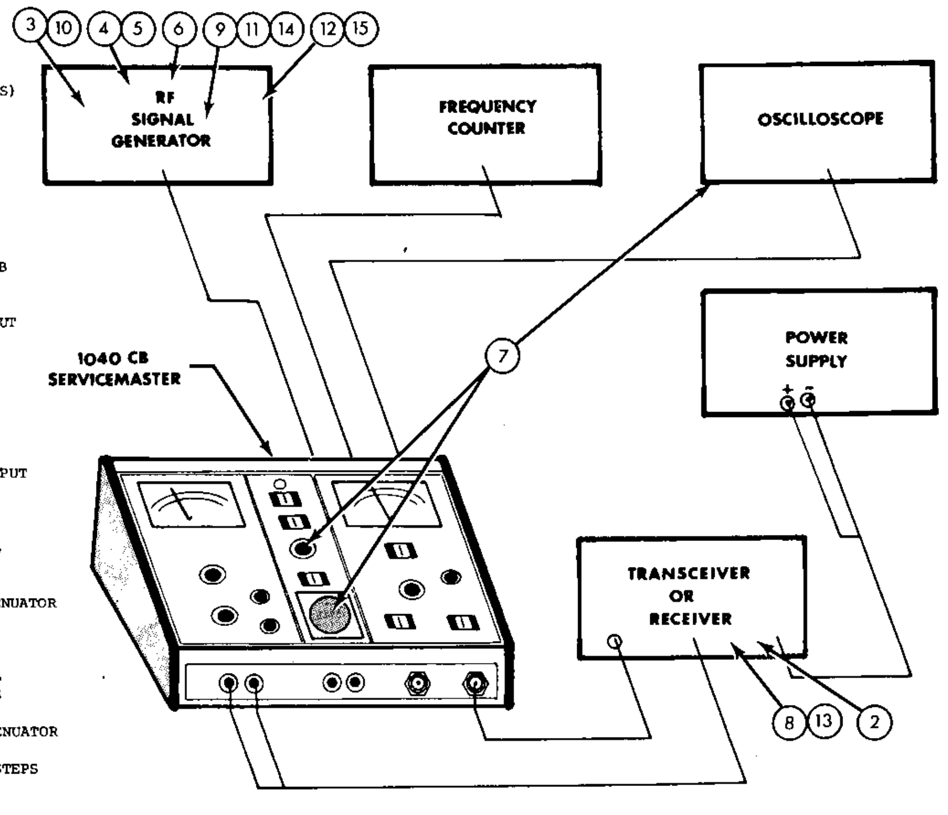


Fig. 18. SSB Receiver Squelch Sensitivity Check

1. After performing the SSB RECEIVER SENSITIVITY CHECK, leave connections and controls as at the conclusion of that check.

2. Select the USB mode of operation on the receiver being checked.

3. Set the RF generator to the CW mode.

4. Set the RF generator to the 10 dB (S+N)/N sensitivity level for the receiver being checked.

5. Tune the RF generator frequency for maximum meter reading on audio meter (1).

6. Turn off the RF generator.

7. Adjust AUDIO GAIN control (10) so noise is heard from speaker (12). Noise will also be displayed on the oscilloscope.

8. Adjust receiver squelch control to squelch threshold, that is, to the point where the noise is just squelched.

9. Set the RF generator output level to minimum.

10. Return RF generator to CW mode.

11. Increase RF generator output level until receiver unsquelches. There should be at least a 20 dB difference in the audio meter (1) reading between the squelched and unsquelched condition. In the unsquelched condition, audio output should be at least 1/10 of the receiver's rated maximum audio output.

12. Read the RF generator output level in microvolts from the attenuator of the RF generator. This is the SSB squelch threshold sensitivity of the receiver. The reading in microvolts should be equal to or less than the receiver manufacturer's specification for SSB squelch threshold. Typically, this value is 0.5 microvolt or less.

13. Adjust the receiver squelch control for tight squelch (fully clockwise).

14. Increase the output level of the RF generator until the receiver unsquelches. To make sure that the RF generator remains on frequency when the output level is increased, temporarily reduce the squelch setting and retune the RF generator for peak meter reading, then return the squelch control to tight squelch.

15. Read the RF generator output level in microvolts from the attenuator of the RF generator. This is the tight squelch sensitivity. The reading should be equal to or lower than the manufacturer's specification, which is typically in the range of 30 microvolts to 500 microvolts.

16. Switch the receiver to the LSB mode and repeat steps 3 thru 15.

ANTENNA CHECK AND SWR MEASUREMENT
(Refer to Fig. 19)

The antenna check is one of the most important performance checks that can be made. A low SWR (standing wave ratio) measurement is essential for good radio performance. A low SWR allows the transmitter to operate at maximum effectiveness, and also gives optimum receiver performance. A low SWR results when the antenna is properly tuned to the operating frequency and there is a close match of impedance between the transmitter output, antenna cable, and antenna (all are 50 ohms). In this condition, all of the transmitter energy is radiated by the antenna. If the transmitter output and antenna or antenna cable impedances are mismatched, part of the energy is reflected back to the transmitter instead of being radiated. This reflected or reverse power can be measured on the RF meter of the CB ServiceMaster. The CB ServiceMaster also compares forward power to reverse power for a direct SWR measurement. A greater degree of impedance mismatch causes a higher reverse power and higher SWR. The ideal condition would be zero reverse current and an SWR reading of 1 (standing wave ratio of 1:1). Satisfactory performance can be expected if the SWR reading is 2 or less (standing wave ratio of 2:1) on all channels. The antenna is normally tuned for minimum SWR on its center frequency. SWR will be somewhat higher at lower and higher operating frequencies. A damaged antenna, a damaged antenna cable, corroded connectors, etc. can cause a very high SWR. A high SWR often causes premature failure of final RF amplifier transistors of solid state transceivers.

The SWR measurement must be made using the antenna and antenna cable that are normally used with the radio. For a mobile installation, the check must be performed in the vehicle with the CB ServiceMaster connected between the radio set and the antenna. The CB ServiceMaster can be operated from 12 volts DC for convenience in making such vehicular checks. For a base station installation, the check must be performed at the base station site with the CB ServiceMaster connected between the base station and its antenna. Be sure the test includes all the antenna cable and connectors that are normally used.

An SWR measurement is essential at the time of installation and should always be performed after repairs to the radio are completed. The check also is needed if damage to the antenna or antenna cable is suspected. A periodic SWR measurement will detect any gradual deterioration and assure continued high performance.

The antenna check can be made for any transmitter or transceiver in the approximate 27 MHz band with RF power output of up to 100 watts. For units with both AM and SSB capabilities, the check is made in the AM mode and need not be repeated in the SSB mode. The check is also applicable to SSB only and FM transmitters.

1. a. For checking a vehicle antenna, connect a DC power cord from the EXT 12V INPUT terminals (27) of the CB ServiceMaster to a source of 12 volts DC in the vehicle. Refer to the OPERATION FROM DC POWER procedure for more details.

   b. For checking a base station antenna, connect the AC power cord (29) of the CB ServiceMaster to a 120 volt AC outlet.

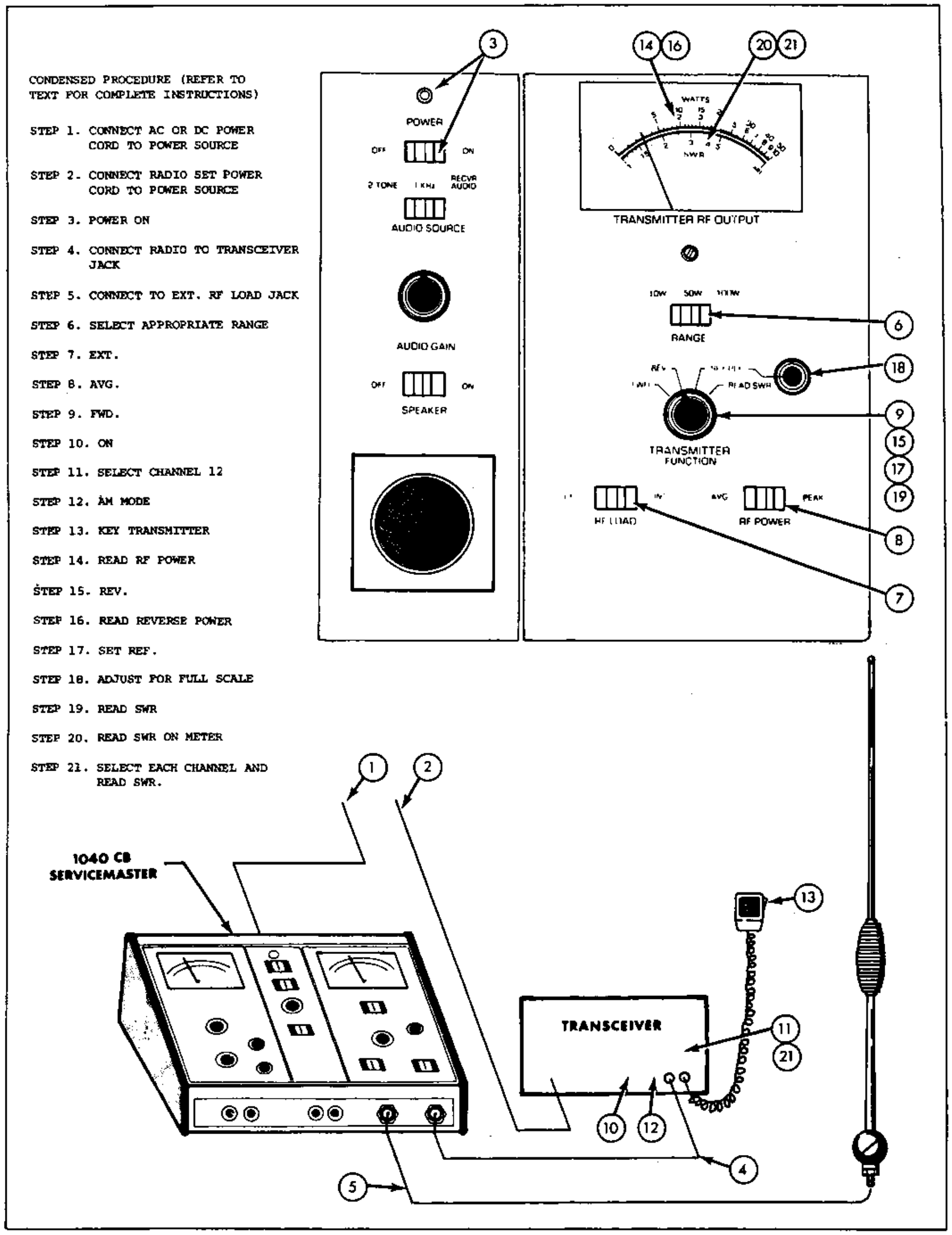


Fig. 19. Antenna Check and SWR Measurement

2. a. For checking a vehicle antenna, mount the radio in the vehicle and connect the radio set power cord to a source of 12 volts DC in the vehicle.

   b. For checking a base station antenna, connect the power cord of the base station to its normal power source (usually 120 volts AC outlet).

3. If the CB ServiceMaster is operating from AC power, turn POWER switch (7) to ON. If operating from DC power, the CB ServiceMaster is on as soon as it is connected to the DC power source. In either case, POWER indicator (8) should light.

4. Connect a coaxial cable from the radio set antenna jack to the TRANSCEIVER jack (23).

5. Connect the cable of the antenna being checked to the EXT RF LOAD jack (22).

6. Set RANGE switch (15) to 10W for transmitters rated at 10 watts or less, 50W for transmitters rated at 10 to 50 watts, and 100W for transmitters rated at 50 to 100 watts. For AM/SSB units, use the AM mode power rating as reference.

7. Set RF LOAD switch (18) to EXT.

8. Set RF POWER switch (19) to AVG. (For SSB only transmitters, select the PEAK position).

9. Set TRANSMITTER FUNCTION switch (16) to FWD.

10. Turn on the radio set.

11. Select a mid-frequency channel. For 23 channel CB transceivers, select channel 12.

12. For AM/SSB transceivers, select the AM mode.

13. Key the transmitter. (For SSB only transmitters, modulate the carrier with a two-tone signal as instructed in the SSB TRANSMITTER POWER CHECK procedure.)

14. Read the transmitter RF power output on RF meter (13). It should approximate the rated RF output of the transmitter being checked.

15. Set the TRANSMITTER FUNCTION switch (16) to the REV position and key the transmitter.

16. Read the reverse (reflected) power on RF meter (13). It is desired that this reading be as low as possible. Adjust the antenna loading coil for minimum meter reading if adjustment is being performed.

17. Set the TRANSMITTER FUNCTION switch (16) to the SET REF position and key the transmitter.

18. Adjust the SET REF control (17) for full scale meter reference on RF meter (13).

19. Set the TRANSMITTER FUNCTION switch (16) to the READ SWR position.

20. With the transmitter still keyed, read the indication on the SWR scale of the RF meter (13). For good performance, reading should be 2 or less. The lowest possible reading is desired.

21. Select each operating channel on the radio and key the transmitter. SWR should be 2 or less on all channels.

NOTE

Compact mobile antennas and high-gain beam type base station antennas are frequency sensitive and will display variations in SWR as the transmitter is keyed on all 23 CB channels. Optimum antenna adjustment is obtained when the SWR is minimum at mid-band (Channel 11 or 12) and remains flat or increases only slightly at the band ends (Channels 1 and 23).

RECEIVER FREQUENCY RESPONSE CHECK
(Refer to Fig. 20)

This check measures receiver audio frequency response. An audio frequency response specification of 300 to 3000 Hz usually means that all audio frequencies from 300 to 3000 Hz at a given input level should produce audio outputs that are within 3 dB. Audio frequencies below 300 Hz and above 3000 Hz are attenuated more than 3 dB. A 1000 Hz reference is often used, although the point of reference can be the frequency within the response band at which the maximum output level is developed.

The check can be performed for all transceivers and receivers with a 50-ohm antenna input and a 4-ohm, 8-ohm or 16-ohm speaker. In fact, it can be performed on broadcast band receivers or other transceivers or receivers without 50-ohm antenna input if the RF generator output is coupled directly to the receiver antenna input (rather than through the CB ServiceMaster) through a suitable impedance matching network.

The check is performed by applying a constant amplitude modulated test signal to the receiver input. The modulation percentage is maintained at a constant value and the receiver audio output level is observed as the modulation frequency is varied.

1. a. Connect equipment as shown in the basic set-up of Fig. 5. The frequency counter and oscilloscope are not essential to this check and may be omitted if desired. If the transceiver or receiver being checked is not equipped with an external speaker jack, disconnect the speaker and connect the transceiver speaker leads to the RECEIVER AUDIO jacks (20) using a shielded cable.

   b. Connect a shielded audio cable from the output of an audio signal generator to the external modulation jack of the RF generator.

2. Set LOAD switch (3) to match the normal speaker load of the transceiver or receiver being checked: 4 ohms, 8 ohms or 16 ohms.

3. Set RECEIVER FUNCTION switch (4) to 10 WATTS.

4. Select the desired channel on the transceiver or receiver. The check can be performed on any channel.

5. Unsquelch the receiver.

CONDENSED PROCEDURE (REFER TO TEXT FOR COMPLETE INSTRUCTIONS)

STEP 1. INTERCONNECT AS SHOWN

STEP 2. NORMAL LOAD

STEP 3. 10 WATTS

STEP 4. SELECT DESIRED CHANNEL

STEP 5. UNSQUELCHED

STEP 6. VOLUME AND RF GAIN (IF SO EQUIPPED) TO MID-POSITION

STEP 7. AM MODE

STEP 8. ACCESSORIES OFF

STEP 9. 1000 Hz

STEP 10. EXT. MODULATION

STEP 11. 30% MODULATION

STEP 12. 1000µV

STEP 13. TUNE TO RECEIVER FREQUENCY

STEP 14. a. ADJUST VOLUME FOR 0 dB

14. b. SET TO 1 WATT IF DESIRED

STEP 15. TUNE ACROSS FREQUENCY RESPONSE BAND

STEP 16. KEEP MODULATION AT 30%

STEP 17. METER SHOULD CHANGE 3 dB OR LESS

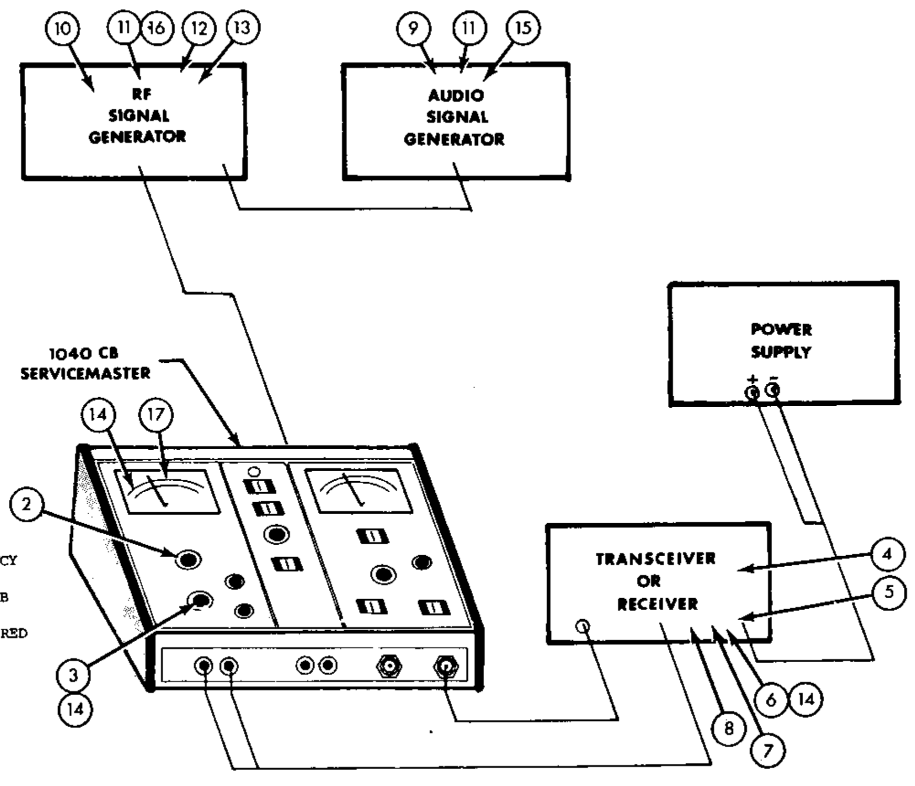


Fig. 20. Receiver Frequency Response Check

6. Adjust receiver volume and RF gain (if adjustable) to mid-position.

7. On AM/SSB transceivers or receivers, select the AM mode.

8. Turn off all accessory mode switches on the transceiver or receiver.

9. Set the audio signal generator to 1000 Hz.

10. Set the RF generator for external modulation.

11. Adjust the audio signal generator level and the modulation adjustment of the RF generator for 30% modulation.

12. Adjust the RF generator for 1000 microvolts output level.

13. Tune the RF generator to the receiver frequency.

14. Adjust receiver volume for a convenient reference level on audio meter (1), such as 0 dB. Choose a volume well below the maximum capability of the receiver to minimize distortion. Change the RECEIVER FUNCTION switch (4) to the 1 WATT range if desired.

15. Tune the audio signal generator across the specified band of audio frequencies; that is, the transceiver or receiver manufacturer's frequency response specification. For example, if the manufacturer lists a 300 to 3000 Hz frequency response, tune from 300 to 3000 Hz.

16. Readjust modulation as required to maintain 30% modulation as the frequency of the audio signal generator is changed.

17. Read audio meter (1) as the frequency of the audio signal generator is changed. The meter reading should not change more than 3 dB over the entire range of the specified frequency response (unless the specification states a variation greater than 3 dB).

PA MODE CHECK
(Refer to Fig. 21)

Many CB transceivers are equipped with a PA (public address) mode. In this mode, the microphone audio is amplified and applied to a separate PA speaker. This check confirms proper operation of the PA mode.

If desired, equipment may be left connected as for the basic set-up shown in Fig. 5. However, the RF generator, frequency counter and oscilloscope are not essential for the check.

1. Connect a shielded audio cable from the PA speaker jack of the transceiver to the RECEIVER AUDIO jacks (20).

2. Set LOAD switch (3) to match the normal speaker load of the PA speaker, 4 ohms, 8 ohms or 16 ohms.

3. Set RECEIVER FUNCTION switch (4) to 10 WATTS.

4. Set AUDIO SOURCE switch (9) to 1 kHz.

5. Set SPEAKER switch (11) to ON.

6. Set AUDIO GAIN control (10) for a clearly audible 1 kHz tone from speaker (12).

7. Select the PA mode on the transceiver.

8. Place the microphone of the transceiver over the speaker of the CB ServiceMaster, face down.

9. Close the push-to-talk switch on the microphone.

10. a. If microphone gain is adjustable, vary gain and note that audio power reading on audio meter (1) varies.

    b. If microphone gain is not adjustable, vary AUDIO GAIN control (10) and note that audio power on audio meter (1) varies.

11. Read audio power on meter (1) and adjust per step 10a or 10b for the manufacturer's rated audio output.

12. If desired, a distortion check can be made:

    a. Set RECEIVER FUNCTION switch (4) to SET FULL SCALE.

    b. Adjust SET FULL SCALE control (5) for full scale reference on audio meter (1).

    c. Set RECEIVER FUNCTION switch (4) to ADJ FOR MIN.

    d. Adjust NULL control (6) for minimum meter reading.

    e. Read distortion on % DISTORTION scale of audio meter.

S METER/POWER METER CHECK

Many Citizen's Band transceivers are equipped with an S meter that indicates received carrier signal strength and a power meter that indicates transmitter RF output power. Most transceivers that are equipped with meters include a dual-purpose unit that operates as an S meter while receiving and as a power meter while transmitting. Normally, these meters give relative indications rather than specific values in microvolts and watts. The CB ServiceMaster can be used to check proper operation of S meters and power meters. It can also serve as a standard against which the meters can be calibrated, thus converting the relative indications to specific values in microvolts and watts.

The receiver S meter can be checked while performing the RECEIVER AGC CHECK. The S meter reading should vary as the RF generator output level is changed. However, the RF generator output signal need not be modulated, since the S meter responds to the carrier signal. If desired, note the RF signal level required (in microvolts) for each increment on the S meter scale. This information can be recorded or plotted on a graph and presented to the owner of the radio.

The transmitter power meter can be checked while performing the TRANSMITTER RF POWER CHECK. The power meter of the transceiver should indicate normal transmitter output power when the transmitter is keyed

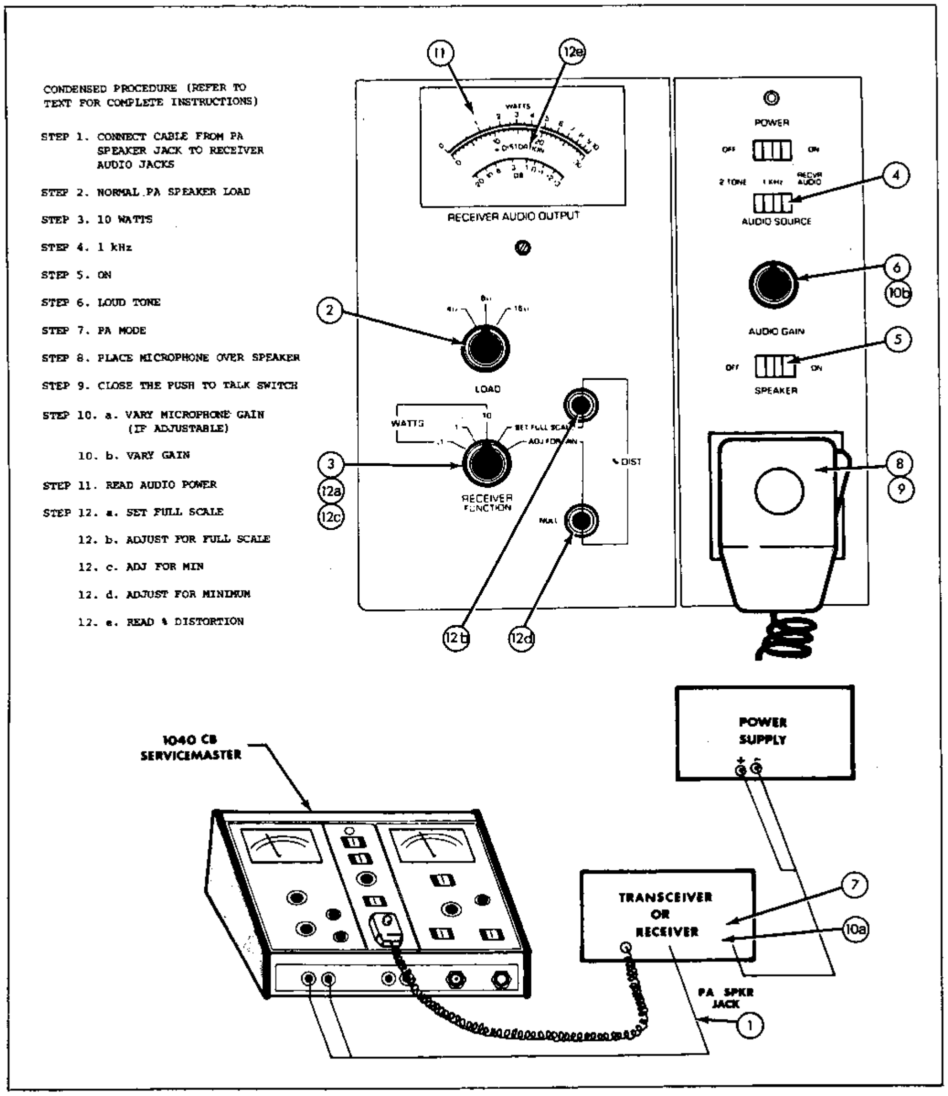


Fig. 21. PA Mode Check

and a normal reading is obtained on the CB ServiceMaster. If the transceiver is being powered by a bench power supply, adjust the power supply voltage over the range of 11 to 15 volts and note that the transmitter power output varies on both the CB ServiceMaster and the power meter of the transceiver. If desired, note the power level in watts from the CB ServiceMaster for each increment on the power meter scale. This information can be recorded or plotted on a graph and presented to the owner of the radio.

If the transceiver is equipped to operate on both AM and SSB modes, the power meter will undoubtedly have a different range for each mode. Check operation of the AM mode as described in the previous paragraph. Check operation of the power meter in the SSB mode while performing the SSB TRANSMITTER RF POWER CHECK and SSB TRANSMITTER MODULATION CHECK. Note that the power meter indication and the RF wattmeter indication of the CB ServiceMaster both vary as the modulation varies. Note the power (in watts) for each increment of the power meter.

EFFECTS OF VOLTAGE CHECK

All previous checks in this instruction manual prescribed a 13.8 volt DC input to mobile transceivers being checked. In all checks it is good practice to note the effects of low voltage. Vary the power supply output over the range of 11 to 15 volts and note the results. Never increase voltage above 15 volts, as it may burn.out the equipment being checked.

Voltage changes should have very little affect on transmitter frequency. Transmitter power, receiver sensitivity, and audio power may be affected to a significant degree. Testing at low and high voltages can occasionally reveal a fault that is undetected at normal voltage levels.

CHECKING AUDIO EQUIPMENT

In addition to checking Citizen's Band transceivers and other communications equipment, the CB ServiceMaster can be used to check and service audio equipment. It can check any audio equipment with 4-ohm, 8-ohm, or 16-ohm speaker output at output levels up to 10 watts. On stereo equipment, only one channel can be checked at a time, or two CB ServiceMasters can be used simultaneously.

Connect the speaker output of the audio equipment to the RECEIVER AUDIO jacks on the CB ServiceMaster. The AUDIO OUTPUT jacks can be used to inject 1 kHz or two-tone test signals from the CB ServiceMaster into the equipment being checked. The audio meter can be used for checking audio output power and distortion. The dB scale can be used for frequency response checks.

The output of the audio equipment can be monitored on the speaker of the CB ServiceMaster if desired. The audio signal is also displayed on the oscilloscope.

NOTES

TROUBLESHOOTING WITH THE "CB SERVICEMASTER"

INTRODUCTION

This section of the manual gives some practical tips on using the CB ServiceMaster and its associated test equipment to isolate troubles in Citizen's Band transceivers. Of course, the most valuable troubleshooting tool is a strong knowledge of circuit fundamentals and functional operation. The CB ServiceMaster can convert that knowledge into faster servicing for technicians of all experience levels. The troubleshooting technique presented in this section of the manual demonstrates the guideline for developing a logical, systematic approach to troubleshooting. The checks are presented in a logical sequence based upon an analysis of the transceiver's operation.

Although each manufacturer, and in fact each model, incorporates its own design variations, there is a basic similarity between most CB transceivers. Fig. 22 depicts a block diagram of a typical AM only transceiver and Fig. 23 depicts a block diagram of a typical AM/SSB transceiver. These transceivers use a dual conversion receiver with 7.8 MHz and 455 kHz IF frequencies, synthesizer type transmit/receive oscillator, and an audio circuit that is common to transmit, receive and PA modes of operation. The SSB receiver IF circuits and transmitter RF circuits are independent of the AM circuits, but several SSB circuits are common to transmit and receive operation. These are the most common basic designs found in today's CB transceivers. The troubleshooting procedure in this manual is tailored to the circuit designs of Figs. 22 and 23 in order to more clearly demonstrate the analyzing technique. However, using the technique which is demonstrated, the procedure can then be modified to troubleshoot transceivers with design variations. As technicians become more experienced and proficient, they are encouraged to develop their own technique and shortcuts which could further reduce servicing time and improve profitability. By carefully observing the symptoms, it is often possible to go directly to a specific checkout procedure and bypass unrelated checks.

Virtually all CB transceivers built in recent years have been fully solid state units that operate directly from a 12-volt vehicle battery (120-volt AC for most base stations). Therefore, no effort was made to include specific troubleshooting data for vacuum tube circuits or DC-to-DC power supplies. However, many of the checkout procedures are applicable to vacuum tube equipment as well as solid state circuits, if you should happen to service such equipment.

The troubleshooting procedures isolate the defect to a small area consisting of only a few parts. Conventional voltage and resistance measurements should then be made within the suspected circuit to locate the defective part. Refer to the service manual for the transceiver being serviced for data such as a schematic diagram, normal RF and DC voltages, and test specifications. A detailed block diagram of the transceiver is a valuable tool for rapid trouble isolation.

MOBILE TRANSCEIVER INITIAL CHECKS

When troubleshooting mobile transceivers, it is advisable to perform a few checks to eliminate all items external to the radio set before removing it from the vehicle for bench servicing. External items such as the power cable, antenna, antenna cable, microphone and external speaker are often more subject to physical damage than the radio set and must always be considered as a likely source of trouble. The following checks will quickly verify if external items are good or bad.

If the transceiver was already removed from the vehicle and brought to the service shop for checkout, proceed with the bench check of the radio. However, if the transceiver checkout indicates normal operation, these in-vehicle checks may be necessary when the radio is returned to the vehicle.

For AM/SSB transceivers, perform all these checks in the AM mode of operation.

Power Cable Check

1. Turn on the transceiver. Be sure the ignition switch is also on if required for radio operation.
2. On most transceivers there is some type of lighted indicator when power is applied, such as channel selector illumination or meter illumination. Note whether or not the illumination is lit.
   a. If the indicator is lit, the power cable is probably okay.
   b. If the indicator does not light, check the fuse.
      (1) If the fuse is good, power apparently is not getting through the power cable to the radio set. Make voltage and continuity checks on the power cable and its connectors to isolate the cause of the malfunction. If power is available to the radio set power connector, the problem is within the radio set.
      (2) If the fuse is open, replace it with a new fuse of the proper rating. If the new fuse blows, there is an apparent overload or short circuit in the receiver.
      (3) If the new fuse does not blow, key the transmitter. If this causes the fuse to blow, there is an apparent overload or short circuit in the transmitter.
      (4) If the new fuse does not blow when the transmitter is keyed, normal operation is restored, at least temporarily. Operate the transceiver in both the receive and transmit condition while driving over a rough street. If the fuse does not blow, the likelihood of future fuse failure is greatly reduced. If the new fuse blows during the test drive, there is an apparent intermittent short within the radio.

External Speaker Check

If the installation does not include an external speaker, skip to the "Antenna Check."

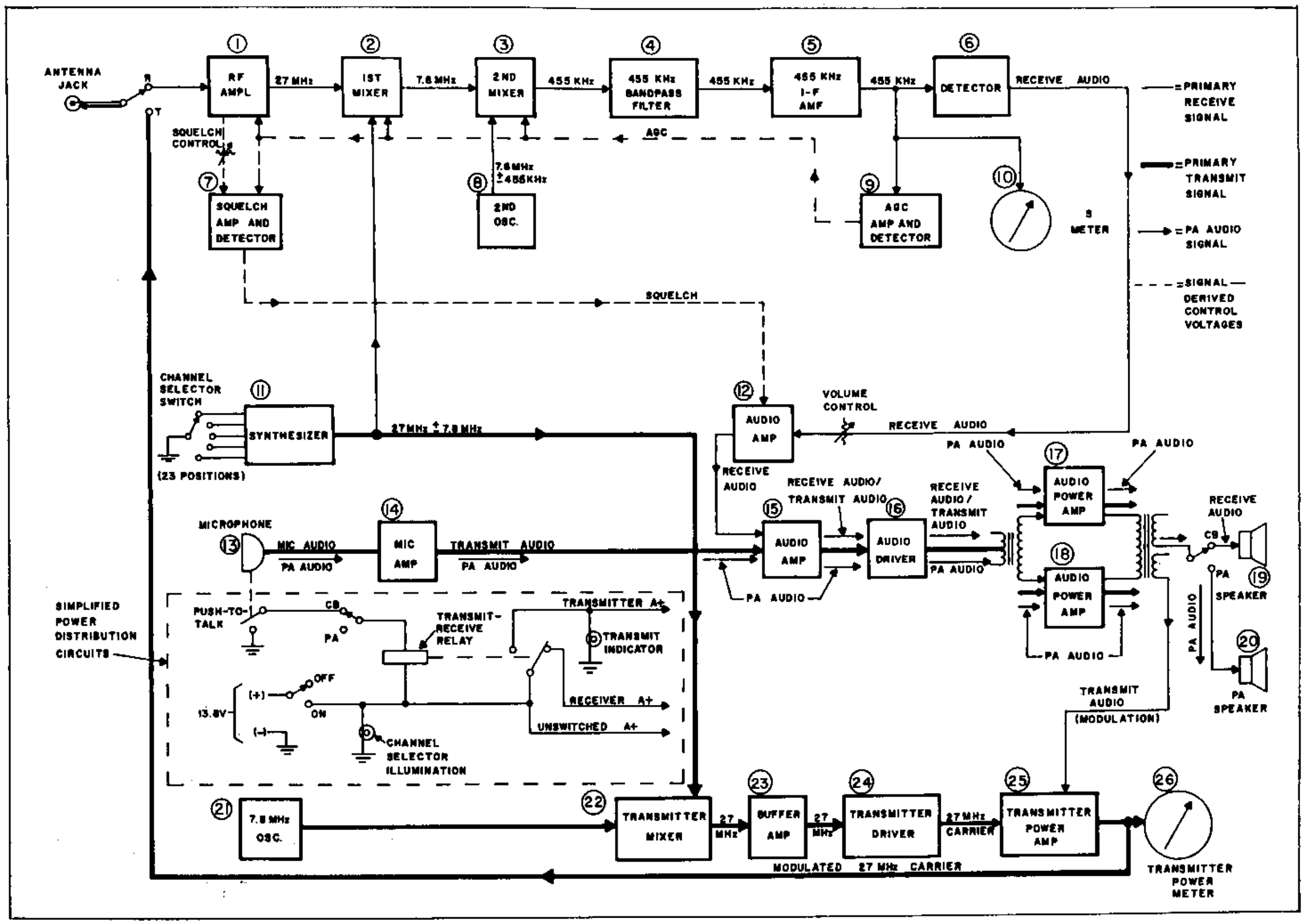


Fig. 22. Block Diagram of Typical AM CB Transceiver

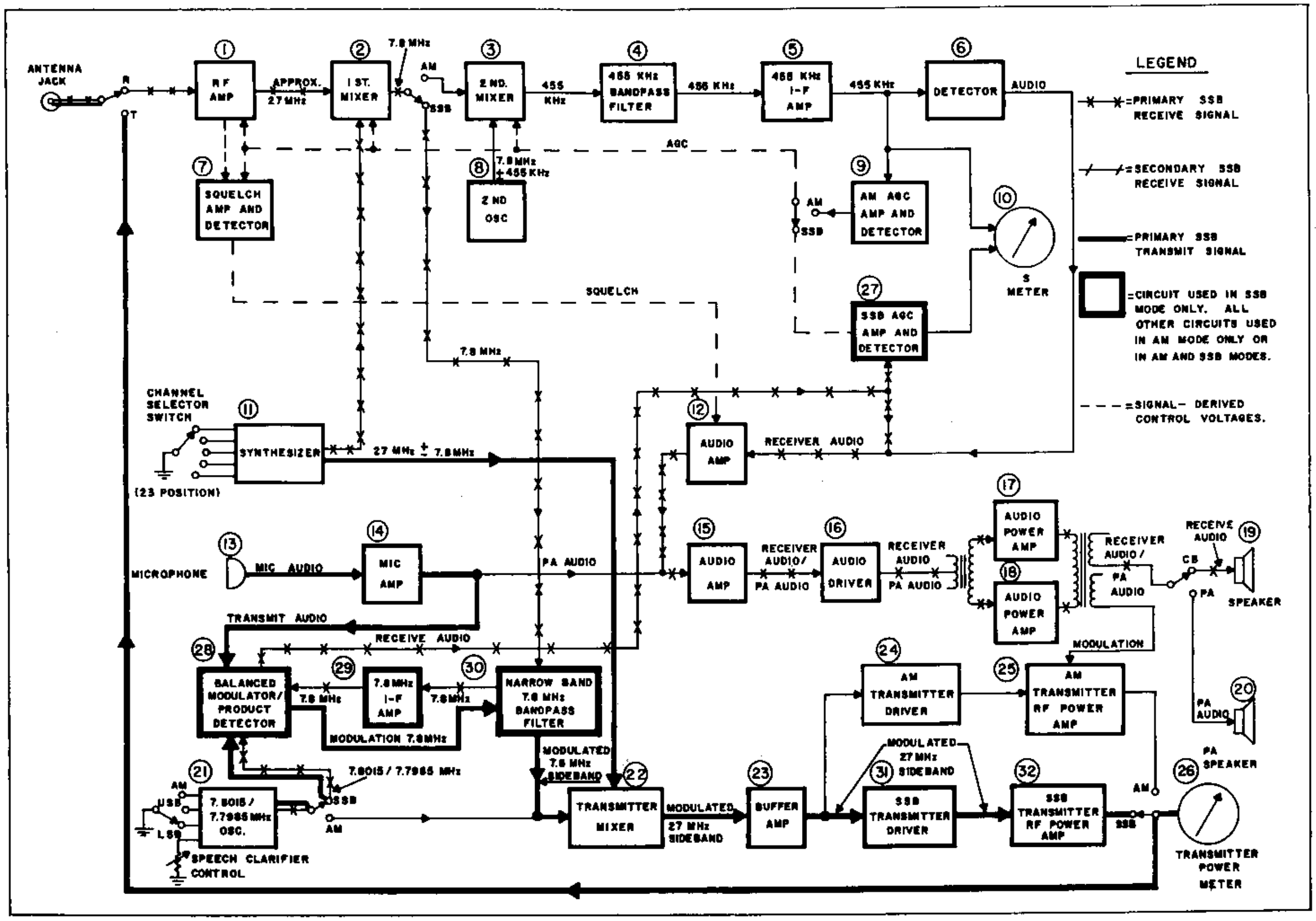


Fig. 23. Block Diagram of Typical AM/SSB CB Transceiver

1. Unsquelch the receiver and turn up the volume. If receiver noise or received signals are heard on the external speaker, it is operating.

2. If received signals are heard on the external speaker, but severe audio distortion is noted, as could be produced by a speaker with a torn cone, disconnect the external speaker and listen to the internal speaker (or connect a substitute external speaker). If no distortion is noted on the internal or substitute speaker, the external speaker is in fact the cause. If distortion is noted in both speakers, the trouble lies within the radio.

3. If nothing is heard from the external speaker, either the radio or the speaker could be the cause. Disconnect the external speaker and listen for receiver noise or received signals on the internal speaker. (If nothing is heard and you do not know whether or not the radio is equipped with an internal speaker, connect substitute speaker to the external speaker jack. Use the PA speaker if the vehicle is so equipped.) If noise or received signals are heard on the internal or substitute speaker, the trouble lies with the external speaker or its cable or connector. If nothing is heard on the internal or substitute speaker, it is unlikely that both speakers are defective. Assume that the trouble is within the radio set.

Antenna Check

This check cannot be completed unless there is transmitter power output. If any step reveals the need for troubleshooting the radio set, the antenna check should be delayed until the radio is returned to the vehicle.

1. If the transceiver is equipped with a transmitter power meter, key the transmitter and observe the meter indication. (If the transmitter cannot be keyed, skip to the "Microphone Check.") If abnormal power output is indicated, you can omit the "Antenna Check," because there is trouble within the radio.

2. If the transmitter power output reading is normal, or the transceiver is not equipped with a transmitter power output meter, connect the CB ServiceMaster as for an antenna SWR check.

3. Key the transmitter and check forward power. (If the transmitter cannot be keyed, skip to the "Microphone Check".) If abnormal power output is indicated, the trouble is within the radio.

4. Perform the Antenna SWR measurement.

   a. If SWR is 2:1 or less, the antenna and antenna cable are okay.

   b. A higher reading indicates a mismatched condition which may be due to a damaged antenna, corroded or improperly fitted connectors, or crushed antenna cable.

   c. An extremely high reading indicates an open circuit or short circuit condition such as antenna cable cut in two or disconnected.

Microphone Check

A microphone check needs to be made only if one or more of the following symptoms is indicated:

- Transmitter cannot be keyed.
- No transmitter modulation.
- No output in PA mode.

1. Disconnect the microphone and connect a known-good substitute microphone in its place.

   a. If no change in symptoms is noted, the trouble is within the radio set.

   b. If the symptom is corrected when using the substitute microphone, the original microphone is defective.

   c. If no substitute microphone is available, or the microphone is the wired-in type, remove both the radio and microphone from the vehicle for bench servicing.

PA Speaker Check

This check is applicable only if the installation includes a PA speaker and the transceiver includes a PA mode.

1. Operate the transceiver in the PA mode. If the PA announcement is heard on the PA speaker (without excessive distortion), the PA speaker is okay.

2. If there is excessive distortion in the PA speaker, such as could be produced by a torn cone, disconnect the PA speaker and connect a substitute speaker in its place. If there is no distortion in the substitute speaker, the PA speaker is defective. If there is distortion in both speakers, the trouble is within the radio.

3. If nothing is heard on the PA speaker, disconnect the PA speaker and connect a substitute speaker in its place. If PA announcements can be heard on the substitute speaker, the PA speaker is defective. If PA announcements cannot be heard on either speaker, the trouble is within the radio.

Conclusion of Test

a. If all items external to the radio set are good, the fault is within the radio set; remove it from the vehicle for bench servicing.

b. Whenever repairs have been completed and the transceiver is reinstalled in the vehicle, always perform an antenna SWR check. SWR must be below 2:1 by tuning the transmitter to match the antenna (or vice versa), or by finding and correcting the cause of the mismatch. A high SWR can cause burnout of the transmitter final RF amplifier.

c. If bench checking indicates normal performance, yet the radio performs poorly in the vehicle, try checking the following items:

   (1) Poor ground connection.

(2) Too much resistance in power cable. Voltage into radio substantially below 13.8 volts.

(3) Vehicle battery voltage low or poor voltage regulation from the vehicle electrical system.

(4) Too much ignition interference and electrical disturbance due to inadequate noise suppression on the vehicle.

(5) Antenna poorly located for good propagation characteristics.

BASE STATION INITIAL CHECKS

Citizen's Band base stations are very similar to mobile transceivers except that they usually have more meters for monitoring radio performance and they usually operate from 120-volt AC power. The power supply usually converts 120-volt AC to 13.8 volt DC, which is the same as the vehicle battery voltage for a mobile radio.

As with mobile transceivers, eliminate all external items as possible troubles before starting a bench check on a base station.

1. Connect the base station to 120-volt AC power. If the station is DC-powered, connect it to its usual power source.

2. Turn on the station. If the channel selector and meter illumination is lit, assume that the power supply voltages are correct.

3. If the channel selector and meter illumination is not lit in step 2, check the fuse and replace if necessary.

   a. If a new fuse restores operation, proceed to step 4.

   b. If a new fuse does not restore operation, remove the base station, including its power supply, for bench servicing.

4. a. If the transmitter RF output power is normal, check antenna SWR. Many base stations have a built-in SWR meter for performing this check, but the CB ServiceMaster can be used if the base station is not so equipped. Normally, the SWR for a base station installation is far below 2:1.

   b. If transmitter RF output power is abnormal, postpone the SWR check until the base station is serviced and returned to the base station site.

5. Check base station microphones by substitution, or include them in the bench check.

CURRENT DRAIN CHECKS

When a mobile transceiver is set up on the service bench for checkout, it is connected to a power supply. Most power supplies include output voltage and current meters. Voltage should be adjusted to 13.8 volts and current limiting (a feature of many power supplies) should be set at about 2 amperes. If the radio set has been blowing fuses or indicates a high current drain, it will be necessary to find the short circuit or overload and repair it before continuing with other checks. It is advisable to note the current drain for each radio set when it is initially connected to the power supply. Refer to the transceiver manufacturer's specifications for maximum current drain for a specific radio. Generally, maximum current drains are in the vicinity of:

Standby (receiver squelched)	500 mA
Receive (full rated audio)	1.5 A
Transmit	2.2 A

DEFINING THE SYMPTOMS

Although the CB ServiceMaster can be used to perform a complete diagnosis of an ailing CB transceiver without a description of its symptoms, a good description of the symptoms can often lead a technician directly to the problem. Servicing time is reduced by eliminating the time required for a complete checkout of all possible symptoms.

When a service order for a CB transceiver is taken, obtain a full description of the symptoms. This description should be defined as precisely as possible. Ask the owner additional questions, if necessary, to refine the description. For example, a symptom of "poor reception" could include the entire range of symptoms from "weak audio" to "short range (poor receiver sensitivity)", "adjacent channel interference (poor receiver selectivity)" or "garbled voice (distortion)". One of the latter terms much more precisely defines the malfunction, and, more importantly, further isolates the probable area in which the trouble is located.

Unless the servicing job is to be started immediately, jot down the description of the symptoms in correct technical terms. Keep the note with the equipment for reference when the troubleshooting job begins.

The troubleshooting procedures in this manual are grouped by symptoms. The symptoms alone localize the trouble within a portion of the radio set. The troubleshooting technique that will isolate the malfunction in the shortest time does not include checks in circuits that are not related to the symptom.

On AM/SSB transceivers, the usual practice is to fully check the AM mode of operation and correct any malfunction before checking the SSB modes.

SERVICE BENCH DIAGNOSTIC CHECK

The following procedure may be used to determine what is wrong with the transceiver if no description of symptoms is available, or if the technician wishes to verify the symptoms and check for additional symptoms. The procedure may also be used if the technician wishes to perform a complete performance check of the transceiver and correct any subnormal performance.

1. Connect the transceiver to the CB ServiceMaster and associated test equipment in the basic test set-up configuration (Fig. 5).

2. Set up the test equipment to monitor receiver audio on the speaker of the CB ServiceMaster.

3. Set transceiver controls as follows:

a. Select any channel.

b. Set squelch control to fully unsquelched position.

c. Set CB-PA switch to CB.

d. Set RF gain control to maximum position (if so equipped).

e. Set any accessory mode switches such as noise blanker or automatic noise limiter to off.

f. Select the AM mode on AM/SSB units.

4. Turn on the transceiver.

5. Turn up volume until strong receiver noise is heard in the speaker. If no receiver noise is present, adjust the volume control to about ¾ of its maximum setting.

6. Perform as many steps of Fig. 24 as is required to be directed to a troubleshooting procedure. Use the referenced troubleshooting procedure to isolate and correct any malfunction.

7. If troubleshooting and repair are required, recheck transceiver operation by repeating the steps of Fig. 24, starting at the beginning. Repeat the steps as many times as required until the test results end with "Check SSB mode of operation for AM/SSB transceivers".

8. If an AM/SSB transceiver is being checked, perform as many steps of Fig. 25 as is required to be directed to a troubleshooting procedure. Use the referenced troubleshooting procedure to isolate and correct any malfunction. If an AM only transceiver is being checked, skip this step and proceed to step 10.

9. If troubleshooting and repair are required, recheck SSB operation by repeating the steps of Fig. 25, starting at the beginning. Repeat the steps as many times as required to successfully complete the SSB checks.

10. Perform as many steps of Fig. 26 as is required to be directed to a troubleshooting procedure. Use the referenced troubleshooting procedure to isolate and correct any malfunction.

11. If any troubleshooting and repair are required in step 10, recheck transceiver performance by repeating the steps of Fig. 26, starting at the beginning. Repeat the steps as many times as required to successfully complete the checks.

12. The transceiver completely meets all performance specifications.

TROUBLESHOOTING BY SYMPTOM

TROUBLESHOOTING PROCEDURE FOR "RADIO DOES NOT RECEIVE" SYMPTOM

Use this troubleshooting procedure when there is no received audio and transmitter RF power is normal. More specifically, use this procedure if there is no receiver noise, or if an audio output cannot be obtained when a strong modulated carrier is applied to the receiver.

This symptom can be caused by failure in almost any portion of the receiver (circuits No. 1 thru 9, 12, and 15 thru 19 in Figs. 22 and 23).

NOTE

If there is no receiver noise, it is probable that the fault is in the 455 kHz IF or audio section of the receiver. If some receiver noise is present, the problem is more likely in the RF or 1st IF section of the receiver. An open circuit in the RF portion often does not cause complete failure to receive; high strength RF test signals are often coupled through the open circuit with sufficient strength to produce an audio output. Receiver sensitivity, of course, is extremely poor. A short in the RF circuits will often give a symptom of no receiver audio.

The following steps will isolate the problem to a much smaller area.

1. Perform the PA mode check.

   a. If the PA mode operates, the audio section is proven good (circuits 15 thru 18). Proceed to step 2 if the transceiver is not equipped with an S meter, or to step 3 if the radio is equipped with an S meter.

   b. If the PA mode does not operate, the audio section is defined as the problem area (circuits 15 thru 18).

      (1) Operate the transceiver in the PA mode.

      (2) Generate a 1 kHz test tone on the speaker of the CB ServiceMaster.

      (3) Drive the microphone with the 1 kHz test tone.

      (4) Measure audio signal on the oscilloscope at circuit 15, then 16, then 17 and 18 until the loss of signal is noted.

      (5) The circuit at which loss of signal is noted is defective.

2. If the transceiver is not equipped with an S meter, inject a modulated 455 kHz signal into the detector (circuit No. 6).

   a. If audio output is obtained, the detector (circuit No. 6) and first audio amplifier (circuit No. 12) are proven good. Proceed to step 4.

   b. If no audio output is obtained, measure the audio signal on the oscilloscope at each accessible measurement point in the signal path from the detector (circuit No. 6) through the first audio amplifier (circuit No. 12), and note the point of signal loss. If the input to circuit No. 12 is normal, but no output is measured, check the DC voltages of the associated squelch switch circuit. Certain component failures can cause the circuit to remain in the fully squelched condition at all times.

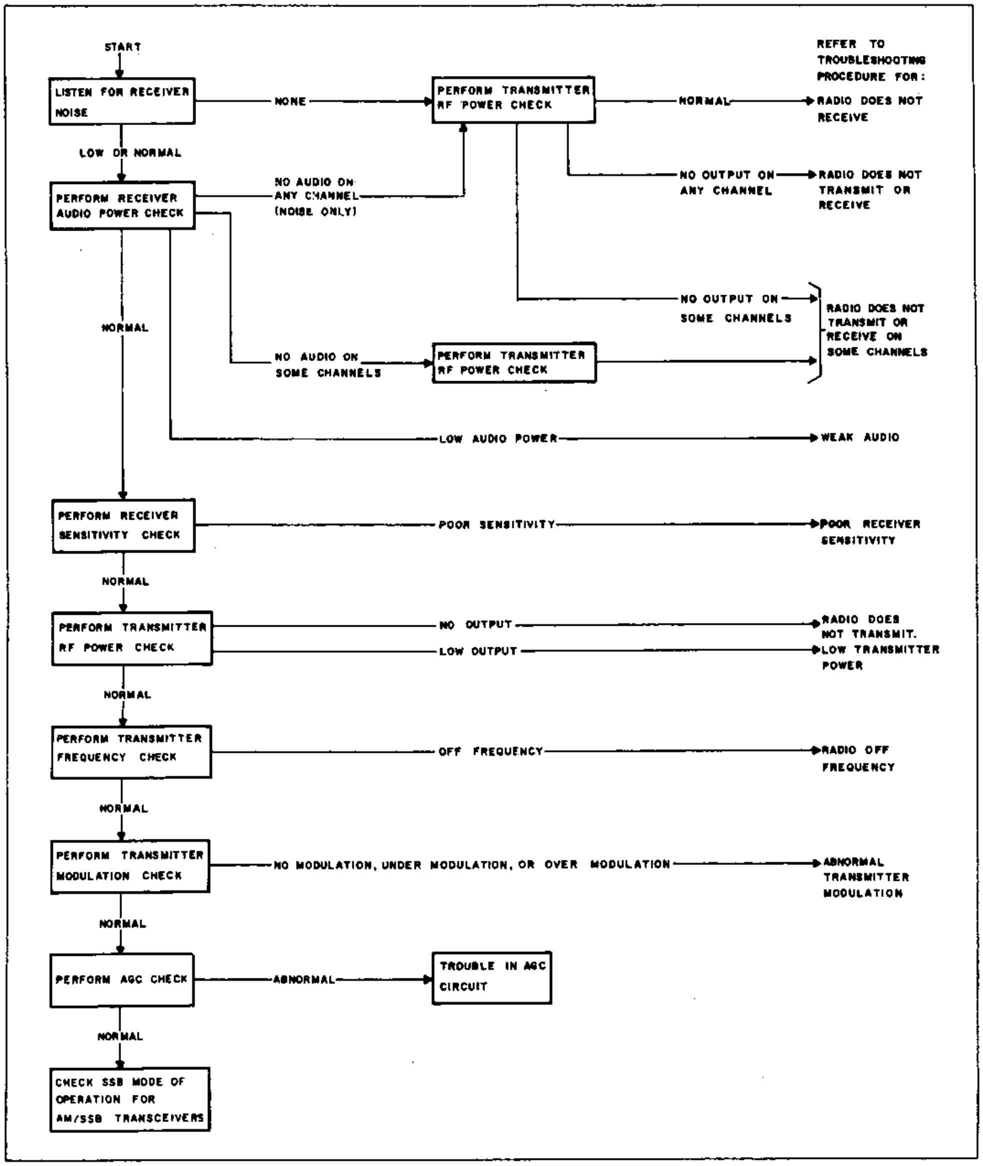


Fig. 24. Service Bench Diagnostic Check, AM Mode

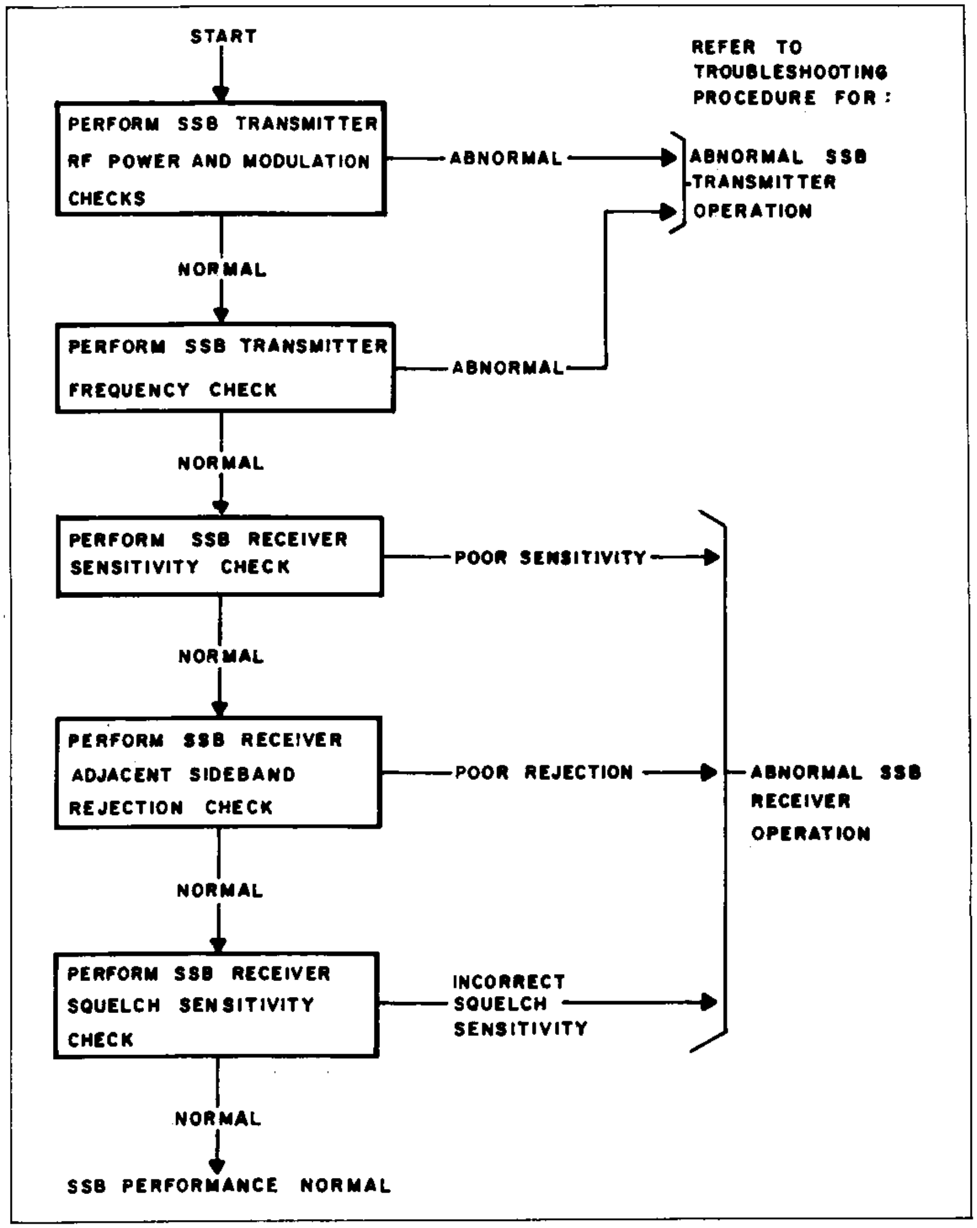


Fig. 25. Service Bench Diagnostic Check, SSB Modes

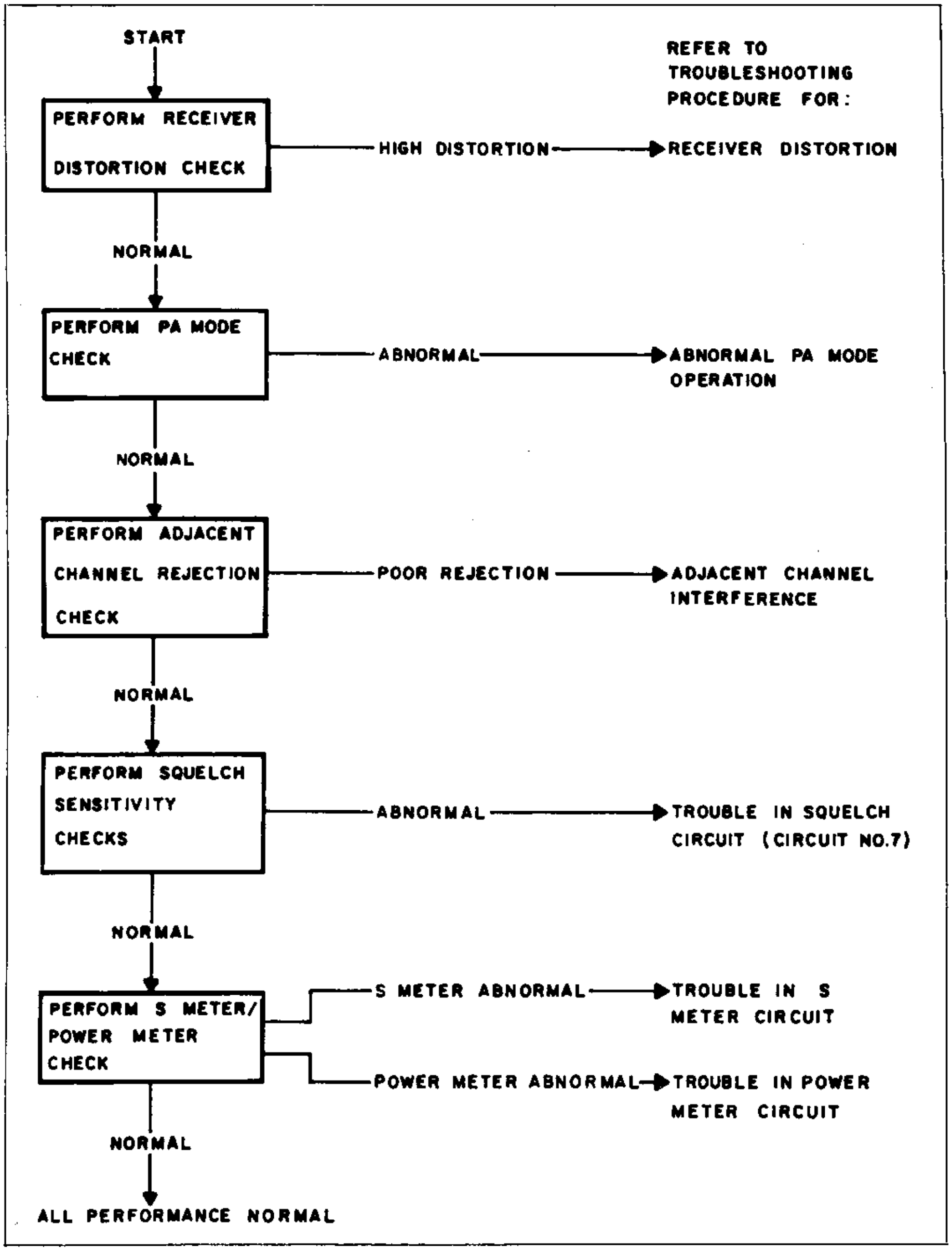


Fig. 26. Final Diagnostic Check, AM and AM/SSB Transceivers

3. If the transceiver is equipped with an S meter, apply a 1000μV on-frequency carrier signal from the RF signal generator and note the S meter reading.

   a. If a strong S meter reading is obtained, the RF and IF sections are operating (circuits No. 1 thru 5). The trouble is isolated to the detector (circuit No. 6) or first audio amplifier (circuit No. 12). Inject a modulated 455 kHz signal into the detector and troubleshoot as instructed in step 2b.

   b. If no S meter reading is obtained, the signal is not passing through the RF and IF sections. Proceed to step 4.

4. Inject a modulated 455 kHz signal at the output of the 2nd mixer (circuit No. 3). [In a single-conversion receiver, the point of injection is the output of the first mixer, and the frequency may not be 455 kHz.]

   a. If audio output is obtained, the 455 kHz IF section is operating. Proceed to step 5.

   b. If no audio output is obtained, the signal is not being passed through the 455 kHz IF section (circuit No. 4 or 5). Starting at the point of signal injection and working toward the detector, measure 455 kHz signal on the oscilloscope until loss of signal is noted. This is the defective area.

5. Inject a modulated 7.8 MHz signal at the output of the first mixer (not all transceivers use 7.8 MHz first IF frequency, use appropriate first IF frequency).

   a. If audio output is obtained, the 2nd oscillator (circuit No. 8) and 2nd mixer (circuit No. 3) are good. Proceed to step 6.

   b. If no audio output is obtained, either the 2nd oscillator (circuit No. 8) or the 2nd mixer (circuit No. 3) are defective. Measure output of the 2nd oscillator on an RF voltmeter. If no RF is measured, this is the defective stage. If RF is present, the 2nd mixer is the defective stage. A defective AGC circuit (circuit No. 9) could bias the 2nd mixer to cutoff. Measure AGC voltage with no RF signal applied.

6. Inject a modulated carrier frequency directly into the first mixer (bypass the RF amplifier).

   a. If normal audio output is obtained, the trouble is in the RF amplifier circuit (circuit No. 1) or AGC circuit (circuit No. 9).

   b. If no audio output is obtained, the first mixer (circuit No. 2) or AGC circuit (circuit No. 9) is indicated as defective.

TROUBLESHOOTING PROCEDURE FOR "RADIO DOES NOT TRANSMIT OR RECEIVE" SYMPTOM

This procedure is used when there is no transmitter RF output and no receiver audio on any channel. The symptom can be verified by making transmitter RF power checks on several channels and receiver audio power checks on several channels. No output will be measured in any check.

The only circuit that is common to the receiver and the RF portion of the transmitter is the synthesizer (circuit No. 11 in Figs. 22 and 23). If the synthesizer fails, there is usually low receiver noise present. About the only other trouble possibility is the loss of power on a main power distribution bus. A remote trouble possibility that should not be entirely overlooked is two separate, simultaneous failures, one in the receiver and one in the transmitter. The following steps will help isolate the trouble.

1. Is there any receiver noise? If so, the trouble is probably in the synthesizer; go to step 2. If no noise is heard, go to step 5.

2. Check the output of the synthesizer with an RF voltmeter or high frequency oscilloscope. If no RF is measured, or it is of the wrong frequency, the synthesizer is defective. Remember that the RF voltmeter is not frequency sensitive. If one of the mixer inputs is missing, there will still be an RF output, but of the wrong frequency. However, if a mixer input is missing, the RF level will probably be low. See step 4 for an alternate checkout method.

3. A synthesizer typically contains at least two oscillators and a mixer. If any of these stages is defective, the correct output will not be generated. Measure RF output voltages at each stage until the defective stage is located, then make DC voltage and resistance measurements to isolate the bad part.

4. An alternate to steps 2 and 3 is to use an RF signal generator and inject the correct frequency signals into the synthesizer. If the injected signal restores operation, the normal signal is missing from that point. Move the point of injection from the output of the synthesizer toward the input, one stage at a time. Each point may require a different frequency; refer to the manufacturer's literature. When the point of injection is moved beyond the defect, signal injection will no longer restore normal operation and the defective area has been isolated. A high impedance injection probe is required to prevent circuit loading, which could detune or disable the circuit and render the check useless.

5. If no receiver noise was heard in step 1, check the channel selector illumination and meter illumination. If they are lit, input power is getting into the radio set. Check some of the major power distribution voltages. If the indicators are not lit, check input power.

6. If no problem was found in step 5, perform steps 2, 3 and 4.

7. If no other problem can be found, treat the "Radio does not transmit" and "Radio does not receive" symptoms as separate symptoms. Refer to the associated troubleshooting procedure for each of these symptoms.

TROUBLESHOOTING PROCEDURE FOR "RADIO DOES NOT TRANSMIT OR RECEIVE ON SOME CHANNELS" SYMPTOM

This procedure is used to isolate a trouble when there is no transmitter RF power output on certain channels and normal RF output on the other channels, and no received audio on certain channels and normal reception on the other channels.

The trouble can result from only one circuit, the synthesizer. More specifically, it can only result from a defective crystal or a faulty channel selector switch. These are the only parts involved in switching from one channel to another.

Many manufacturers of CB radios use the frequency generation scheme shown in Table 1, or a similar scheme, which permits 10 crystals to generate all 23 channel frequencies. The crystals are connected in a 4 x 6 matrix to permit 24 possible frequency combinations. The channel selector switch is wired to select 23 of the 24 possible combinations. A crystal failure in such a synthesizer usually disables 4 or 6 channels.

A defective crystal is easy to identify from the manufacturer's synthesizer crystal frequency scheme. For a radio that uses the scheme in Table 1, if channels 13, 14, 15 and 16 don't operate, crystal 'H' is defective. If the problem is noted on channels 2, 6, 10, 14, 18 and 22, crystal 'B' is the cause. The frequencies of the crystals are different with nearly every manufacturer. To convert the crystal 'H' or crystal 'B' identification to a specific crystal in a specific radio set requires the manufacturer's synthesizer frequency scheme. This information should be included in the service manual for the CB set.

TABLE 1
TYPICAL CRYSTAL SCHEME FOR CB SYNTHESIZER

Channel	OSC #1 Crystal	OSC #2 Crystal	Channel	OSC #1 Crystal	OSC #2 Crystal
1	A	E	13	A	H
2	B	E	14	B	H
3	C	E	15	C	H
4	D	E	16	D	H
5	A	F	17	A	I
6	B	F	18	B	I
7	C	F	19	C	I
8	D	F	20	D	I
9	A	G	21	A	J
10	B	G	22	B	J
11	C	G	–	C	J
12	D	G	23	D	J

NOTES

TROUBLESHOOTING PROCEDURE FOR "WEAK AUDIO" SYMPTOM

Use this troubleshooting procedure when the receiver audio is below rated power with a strong modulated carrier applied to the receiver. The symptom also may be accompanied by high distortion.

Perform the PA Mode Check.

1. If normal audio power output is possible in the PA mode, the trouble is in the first audio amplifier stage (circuit No. 12). Inject a modulated 455 kHZ signal into the detector (circuit No. 6) and measure audio signal levels in circuit No. 12. Use an oscilloscope for the measurement and look for evidence of signal amplitude clipping or below normal levels.

2. If audio power output is also below rated power in the PA mode, the trouble is in the audio amplifier circuits (circuits No. 15 thru 18). Generate a 1 kHz test tone on the speaker of the CB ServiceMaster and use it to drive the microphone in the PA mode. Make audio level checks on an oscilloscope in circuits 15 thru 18. Look for evidence of signal amplitude clipping or below normal levels.

If one of the push-pull audio power amplifiers (circuits No. 17 or 18) is disabled, audio power is about 25% of normal and highly distorted.

TROUBLESHOOTING PROCEDURE FOR "POOR RECEIVER SENSITIVITY" SYMPTOM

Use this troubleshooting procedure when the receiver provides rated audio output, but does not meet the receiver sensitivity specification. This symptom is produced by a malfunction in the RF or IF amplifier section of the receiver (circuits No. 1 thru 5 in Figs. 22 and 23).

1. Set up test equipment as for the Receiver Sensitivity Check, but increase the RF generator output until the 10 dB (S+N)/N level is reached.

2. Check AGC voltage for normal DC values. If convenient, disable AGC and re-check sensitivity. AGC can usually be disabled by shorting the AGC bus to chassis ground, or connecting a bias type power supply to the AGC line and setting it for the normal no-signal AGC DC level. If normal sensitivity is restored when AGC is disabled, troubleshoot the AGC circuit.

3. Measure the RF voltage levels of the synthesizer (circuit No. 11) and 2nd oscillator (circuit No. 8) outputs. Low injection levels can cause this symptom.

4. If the manufacturer's literature includes typical stage gains, make gain measurements and compare them to the specified figures.

   a. Inject 30% modulated 455 kHz at the detector (circuit No. 6) and adjust the RF generator level for a convenient audio level such as ½ watt.

   b. Note the RF generator output level.

   c. Move the point of injection toward the antenna, one stage at a time, and readjust the RF generator level for the same audio reference level.

d. Again note the RF generator output level.

e. The difference in the RF generator output levels between step "b" and "e" (in dB) is the gain (or loss) between injection points.

f. Troubleshoot any stage with low gain, or any passive device with high attenuation.

g. Change from 455 kHz to 7.8 MHz to the RF carrier frequency as the point of injection moves from the 455 kHz IF section to the 7.8 MHz IF section to the RF section.

This is a good troubleshooting technique even when the manufacturer's literature does not give typical stage gains. Sometimes the defective stage is obvious. Also, with experience, the typical stage gains will become memorized and a low stage gain will be easy to spot.

5. Realign the receiver.

TROUBLESHOOTING PROCEDURE FOR "RADIO DOES NOT TRANSMIT" SYMPTOM

Use this troubleshooting procedure when there is no transmitter RF power output, but receive operation is normal. It includes the symptom in which the transmitter cannot be keyed.

Does the red transmit indicator light up when the push-to-talk switch is closed?

1. If it does not light up, jumper across the push-to-talk pins of the microphone jack, or equivalent point in the radio set.

   a. If the transmit indicator light goes on, the problem is in the microphone or microphone cord.

   b. If the transmit indicator light does not turn on, the transmit-receive relay is probably the cause. In radios without a transmit-receive relay, look for the trouble in the solid-state switching circuit that replaces the relay.

2. If it does light up, the problem could lie in almost any of the transmitter RF circuits (circuits No. 21 thru 25 in Figs. 22 and 23). Use an RF voltmeter or high frequency oscilloscope to measure RF voltages. Starting with circuit No. 21 and working toward No. 25, measure each accessible point in the signal path until absence of RF voltage is noted. This is the defective area.

In some transceivers, circuits No. 21 and 22 may be part of the synthesizer, and the synthesizer output in the transmit mode is a low level RF carrier frequency. If the transceiver uses this design, check RF voltage at. the synthesizer output and, if present, check circuits No. 23 thru 25.

In some other transceivers, circuit No. 21 may operate at a different frequency. The transmit oscillator usually operates at the same frequency as the receiver IF, and 7.8 MHz is used only if the receiver IF is 7.8 MHz.

TROUBLESHOOTING PROCEDURE FOR "LOW TRANSMITTER POWER" SYMPTOM

Use this troubleshooting procedure if the transmitter RF output power is below normal, and receiver operation is normal. The symptom is caused by low gain or low voltage in the transmitter RF amplifiers (circuits No. 23 thru 25). Measure RF voltages and DC voltages at each of these amplifiers. Troubleshoot the stage with low readings. Touching up transmitter alignment adjustments may also restore maximum power.

TROUBLESHOOTING PROCEDURE FOR "RADIO OFF-FREQUENCY" SYMPTOM

Use this troubleshooting procedure if the transmitter frequency is not within specification on any channel(s). The receiver may also operate off-frequency but detection of the symptom is more difficult. An off-frequency receiver displays symptoms of poor sensitivity and, possibly, distortion during operation. Normal results may be obtained during testing because the RF generator is usually tuned for maximum receiver output, not necessarily to the channel frequency.

If the radio is off-frequency, the problem is usually one of the crystal oscillators. If the trouble appears on all channels, the transmit oscillator (circuit No. 21) is operating off-frequency. If the trouble appears on only certain channels, refer to Troubleshooting Procedure for "Radio Does Not Transmit or Receive on Some Channels" Symptom for method of isolating the defective crystal; but instead of certain channels being inoperative, there will be certain channels that are off-frequency. Replace the crystal or reactive components (capacitors/coils) that may detune the crystal operating frequency. Slight off-frequency conditions may be improved by realignment.

TROUBLESHOOTING PROCEDURE FOR "ABNORMAL TRANSMITTER MODULATION" SYMPTOM

Use this troubleshooting procedure if there is no transmitter modulation and receiver audio power is normal. Also use it if the transmitter appears undermodulated, or if the transmitter is easily overmodulated.

If there is no modulation, the microphone, microphone amplifier (circuit No. 14) or modulation input to the transmitter RF power amplifier (circuit No. 25) is defective.

1. Perform the PA Mode Check.

2. If PA mode operation is normal, troubleshoot the audio output transformer and audio input to circuit No. 25.

3. If PA mode does not produce audio output, inject a 1 kHz test signal into the audio pins of the microphone jack or equivalent points in the radio and key the transmitter.

4. If modulation is achieved, the microphone or microphone cord is faulty.

5. If no modulation is produced, troubleshoot microphone amplifier (circuit No. 14).

If an unusually high audio level is required for 100% modulation (or 100% modulation cannot be attained), perform the PA mode check. If rated audio power is possible in the PA mode, troubleshoot the audio input portion of circuit No. 25. If low audio power is measured on the PA mode check, troubleshoot the microphone amplifier (circuit No. 14) for low gain, and the microphone for low output.

If overmodulation is prevalent, troubleshoot the modulation limiting circuitry which is usually part of circuit No. 25.

TROUBLESHOOTING PROCEDURE FOR "ABNORMAL SSB TRANSMITTER OPERATION" SYMPTOM

Use this troubleshooting procedure for any abnormal SSB transmit condition; no output, low power, improper modulation, or incorrect frequency. The AM mode is normal. It includes symptoms in which the SSB transmitter and receiver both show abnormal operation.

1. If there is no SSB transmitter RF power output, check SSB receiver audio power.
2. If both modes are inoperative, the trouble could be in the ring modulator/product detector (circuit No. 28) or narrow band 7.8 MHz bandpass filter (circuit No. 30).
   a. Apply a two-tone test signal to the microphone and measure the RF output of the ring modulator (circuit No. 28).
   b. If no output is measured, troubleshoot the ring modulator circuit.
   c. If output is measured, troubleshoot the 7.8 MHz bandpass filter.
3. If receiver operation is normal, the SSB transmitter RF amplifiers are the suspected stages (circuits No. 31 and 32). Apply a two-tone test signal to the microphone and measure RF voltages in circuits 31 and 32. Troubleshoot the area where RF voltage is first missing.
4. If there is no transmitter and receiver operation on one sideband only, the problem is probably in the 7.8015/7.7985 MHz oscillator (circuit No. 21). It uses one crystal in the AM and one sideband mode and another crystal in the opposite sideband mode. Troubleshoot the crystal and mode selector switch.
5. If transmitter RF power is low, troubleshoot the transmitter RF amplifiers for low gain (circuits No. 31 and 32).

TROUBLESHOOTING PROCEDURE FOR "ABNORMAL SSB RECEIVER OPERATION" SYMPTOM

Use this troubleshooting procedure for any abnormal SSB receive condition; no output, poor sensitivity, or poor adjacent sideband rejection. The AM mode and SSB transmit modes are normal.

1. If there is no receiver audio or poor sensitivity, set up test equipment for an SSB receiver sensitivity check.
2. Disable the SSB AGC circuit (circuit No. 27). If normal operation is restored, troubleshoot the AGC circuit.
3. Troubleshoot the 7.8 MHz IF amplifier (circuit No. 29).
4. If adjacent sideband rejection does not meet specification, troubleshoot the narrow band 7.8 MHz bandpass filter (circuit No. 30).

TROUBLESHOOTING PROCEDURE FOR "RECEIVER DISTORTION" SYMPTOM

Use this procedure when receiver audio will not meet the distortion specification or there is a symptom of distorted audio in the AM mode.

Measure distortion in the PA mode.

1. If distortion is measured in the same degree in the PA mode, measure audio signals in circuits 15 thru 18 (see Figs. 22 and 23) on the oscilloscope. Starting at circuit No. 15 and working toward the speaker, observe waveforms for a point where change in the waveform occurs.
2. If distortion meets specification in the PA mode, check distortion with 1 kHz test signal injected at the detector.
   a. If the same degree of distortion is measured, measure audio waveforms in circuit No. 12 and look for the point where the waveform changes.
   b. If distortion meets specification, check receiver for off-frequency condition, lack of AGC action, and IF amplifier distortion.

TROUBLESHOOTING PROCEDURE FOR "ABNORMAL PA MODE OPERATION" SYMPTOM

Use this troubleshooting procedure only when the PA mode is inoperative but all other modes are normal. With the transceiver shown in Figs. 22 and 23, this symptom could be caused only by faulty PA jack wiring or the PA mode select switch.

TROUBLESHOOTING PROCEDURE FOR "ADJACENT CHANNEL INTERFERENCE" SYMPTOM

Use this troubleshooting procedure when the receiver will not meet the adjacent channel rejection specification in the AM mode, but all other performance specifications are normal.

1. Recheck receiver alignment.
2. Check the bandpass filter and all tuned circuits in the RF and IF stages as follows:

a. Inject a modulated 455 kHz signal at the output of the second mixer. Tune the RF generator 10 kHz above and below the 455 kHz center frequency. Measure the output of the 455 kHz bandpass filter (circuit No. 4) as the RF generator is tuned across the band. The bandpass should be symmetrical. A defective part usually causes a non-symmetrical condition.

b. Measure the bandpass at each accessible point in the signal path through the 455 kHz IF amplifier (circuit No. 5).

c. If the 455 kHz circuits show symmetrical bandpass, check the bandpass of the 7.8 MHz IF circuits (circuits No. 1 and 3).

If the receiver meets specificatons, little can be done to further improve adjacent channel rejection.

THEORY OF OPERATION

The Model 1040 CB ServiceMaster can be divided into three separate sections. RF SECTION, AUDIO SECTION, and AUDIO TONE SECTION. Refer to block Diagram, Fig. 27.

RF SECTION

The RF sensing circuit consists of a printed circuit strip-line with a characteristic impedance of 50 ohms. Transmitter RF output flows thru the line to the load. LOAD switch S1 selects either the internal 50-ohm, 50-watt load or an external load. A voltage is induced in each of two pickup lines located opposite the strip-line on the PCB. On one line the induced voltage is proportional to forward power while the voltage on the other line is proportional to reflected power. The voltages are rectified by diodes D1 and D2 and filtered by capacitors C2 and C3. The detected voltages are routed thru RF FUNCTION switch S7 to the input to meter amplifier IC2a.

The detected voltage passes thru a divider consisting of resistors R17-R20. RANGE switch S3 selects the range to be displayed. Meter amplifier IC2a drives RF WATT-METER M2 in proportion to the input voltage from S3. Trimpot R12 sets the calibration for the meter circuit. Average power is indicated on the meter unless RF Power switch S2 is placed in the PEAK POSITION. In the PEAK position additional filtering is added to capture and hold modulation peaks for PEAK power indication.

When reading SWR, RF FUNCTION switch S7 is placed in the SET REF position. In this position forward power is applied to IC2a and pot R11 adjusts amplifier gain for full scale indication. Reverse power is applied to IC2a and the meter deflection is read as a percentage of forward power. SWR is read directly for the SWR scale on the meter.

RF generator input protection is accomplished by RLY 1 which automatically disconnects the RF generator when the transceiver is keyed. One set of contacts of RLY 1 controls what is connected to the transceiver RF output jack. Normally RLY 1 is pulled in which connects the RF GENERATOR jack to the transceiver RF jack. This enables receiver checkout by RF GENERATOR signal injection. As soon as the transceiver transmit button is keyed IC2b senses the RF signal and turns RLY 1 off through transistor Q2. In the off state, RLY 1 conneots the internal 50-ohm load to the transceiver RF jack for RF output measurements.

When in the transmit mode IC2B also applies power to the 26 MHz internal oscillator consisting of Q1 and associated components. The 26 MHz oscillator and a portion of the RF carrier are mixed by D6. The resulting 1 MHZ signal is routed through another set of contacts of RLY 1 for display on a scope. A low frequency representation of the RF carrier can then be seen on any low-frequency oscilloscope when in the transmit mode. When in the receive mode, a portion of the transceiver audio output (from the EXT SPEAKER) is displayed on the scope.

AUDIO SECTION

LOAD switch S8 connects either a 4Ω, 8Ω, or 16Ω internal load resistor to the transceiver EXT speaker jack. The audio output signal is also connected to a divider network consisting of resistors R69 thru R72. AUDIO FUNCTION switch S9 selects the signal level for .1W, 1W, or 10W full scale indication. The audio signal is then applied to buffer/notch filter IC1a. When S9 is in the WATTS position, IC1a acts as a unity gain amplifier. The output of IC1a goes to peak detector D10, C40. This DC level is then applied to meter amplifier IC1b and displayed on AUDIO WATTMETER M1. Three trimpots, R73, 74, and 75, set the calibration for the 4Ω, 8Ω, and 16Ω positions, while R76 adjusts meter zero.

The SET FULL SCALE control R68 adjusts the input to the amplifier for full scale, while resistors R66 and R67 set the scale factor for 30% distortion full scale. In the distortion position, IC1a is connected as a tunable notch filter at approximately 1 kHz. NULL control R79 adjusts the frequency of the notch ±100 Hz around 1 kHz.

The 1000 Hz signal is eliminated from the audio output and all remaining harmonics are then passed on to the peak detector for display on the meter.

AUDIO TONE SECTION

Three internal audio oscillators are contained in ServiceMaster. Q3 and Q4 comprise a 1000 Hz oscillator; Q5 and Q6 a 500 Hz, and Q7 and Q8 a 2400 Hz oscillator.

MAINTENANCE

The 1040 has been precisely calibrated at the factory for optimum performance and should not require readjustment. If the unit malfunctions, use conventional troubleshooting techniques, such as voltage and resistance checks, to isolate the defective component.

CALIBRATION

To gain access to the calibration adjustments, remove two screws on back panel and one screw on bottom to remove bottom cover. Refer to Fig. 28 for location of calibration adjustments.

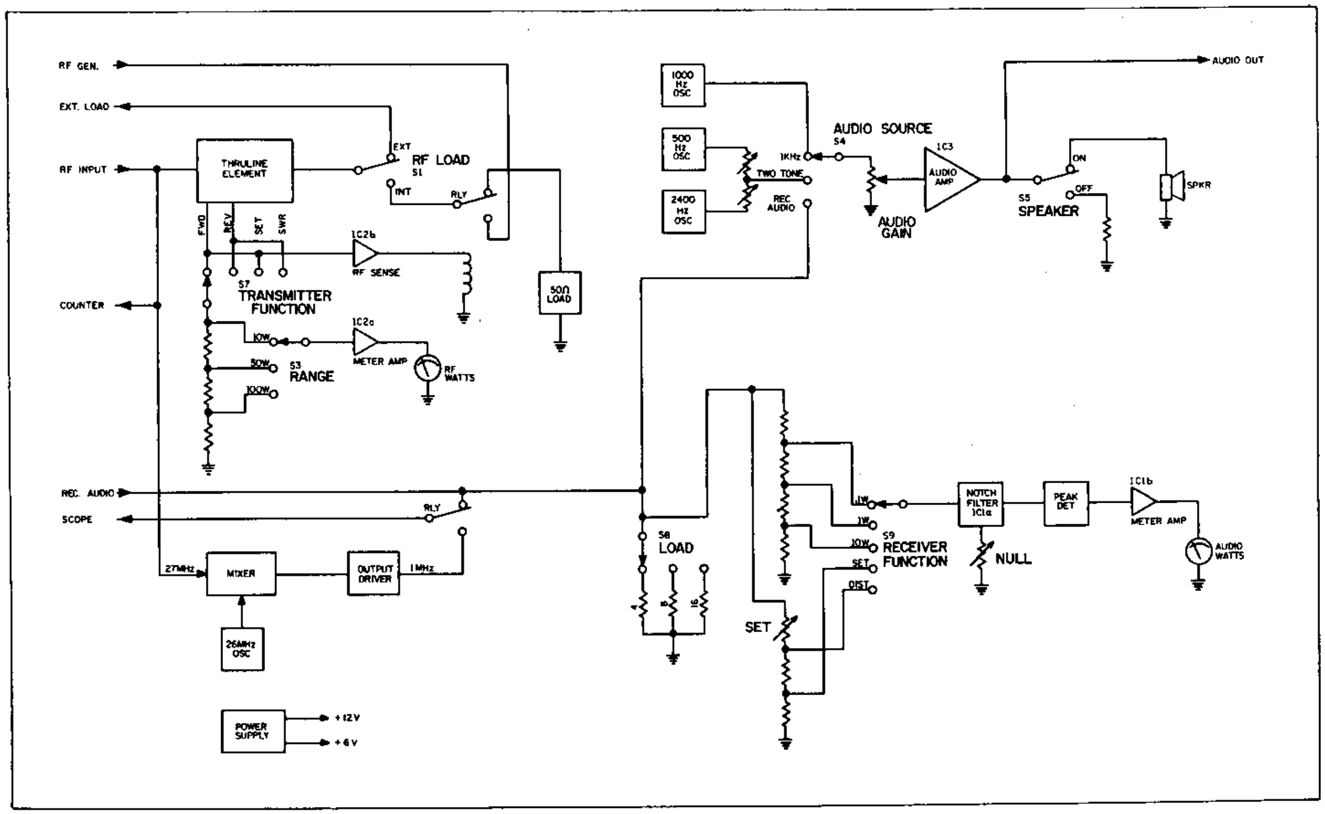


Fig. 27. Block Diagram of Model 1040

RF WATTMETER CALIBRATION

1. Connect the output from a transceiver to the TRANSMITTER jack on 1040.
2. Connect an accurate, calibrated RF WATTMETER to the EXT RF load jack on the 1040. If the RF WATTMETER is a thruline, terminate the wattmeter into a 50Ω resistive load.
3. Rotate the 1040 RF FUNCTION switch to FWD and the RANGE switch to 10W. RF LOAD switch should be in to EXT position.
4. Turn 1040 power switch to ON and zero RF WATTMETER.
5. Key the transmitter with no modulation.
6. Adjust R12 until 1040 RF WATTMETER and external wattmeter agree.

26 MHz OSCILLATOR ADJUSTMENT

1. Temporarily connect a jumper wire from emitter to collector Q1.
2. Connect an accurate, calibrated frequency counter to the collector of Q11.
3. Adjust C15 with a nonmetallic screwdriver for a reading of 26.255 MHz.
4. Disconnect jumper wire.

TWO-TONE AMPLITUDE ADJUSTMENT

1. Connect an oscilloscope to the 1040 AUDIO OUTPUT jacks.
2. Move the AUDIO SOURCE switch to the TWO-TONE position, and the SPEAKER switch to OFF.
3. Rotate AUDIO GAIN control to full CW.
4. Temporarily connect a .1 mfd capacitor from the collector of Q6 to ground and adjust R92 for 1.5 V P-P signal on scope.
5. Remove capacitor from Q6 and connect to the collector of Q7. Adjust R50 for 1.5 V P-P signal on scope.
6. Remove capacitor from Q7.

AUDIO WATTMETER CALIBRATION

1. Rotate the 1040 AUDIO FUNCTION switch to the .1 WATT range.
2. Rotate the 1040 LOAD switch to the 4Ω position.
3. Adjust R76 for zero on AUDIO WATTMETER.
4. Connect a 1000 Hz oscillator to the input of an audio amplifier and the amplifier output to the 1040 EXT SPKR jacks.
5. Connect an accurate, calibrated AC voltmeter to the 1040 EXT SPKR jacks and adjust the amplifier output for .632 V RMS (100 mW at 4Ω).
6. Adjust R73 for full scale.
7. Rotate the LOAD switch to the 8Ω position and adjust the amplifier output for .894 V RMS (100 mW at 8Ω).
8. Adjust R74 for full scale.
9. Rotate the LOAD switch to 16Ω and adjust amplifier output for 1.265 V RMS. (100 mW at 16Ω).
10. Adjust R75 for full scale.

The 500 Hz and 2400 Hz oscillators are combined by R49, 50, 51 and R92 to form the two-tone signal.

The two signals are selected by AUDIO SOURCE switch S4 to be applied to audio amplifier IC3. Switch S4 also selects a portion of the transceiver output for monitoring. The output of audio amplifier IC3 is also available at the 1040 front panel AUDIO OUTPUT jacks.

NOTES

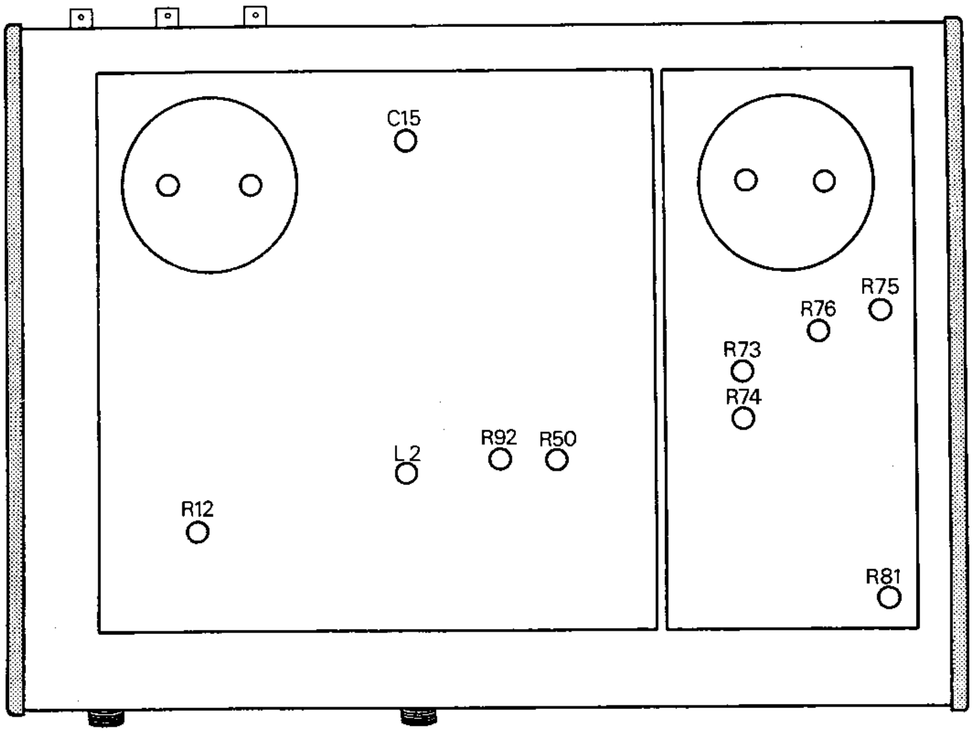


Fig. 28. Location of Internal Adjustments

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the MAINTENANCE section of your B & K-Precision instruction manual for adjustments that may be applicable.

2. Defective parts removed from units which are within the One Year Limited Warranty period should be sent PREPAID to the Service Department listed below. Be sure to state the model and serial number of the unit from which the parts were removed and date the unit was purchased. These parts will be exchanged at no charge, under the terms of the Warranty.

3. If the above-mentioned procedures do not correct the problem you are experiencing with your unit, pack it securely (preferably in the original carton or double-packed). Enclose a letter describing the problem and include your name and address. Deliver to, or ship PREPAID (UPS preferred) to the nearest B & K-Precision authorized service agency (see list enclosed with unit).

If your list of authorized B & K-Precision service agencies has been misplaced, contact your local distributor for the name of your nearest service agency, or write to:

Service Department

B & K-Precision Product Group
DYNASCAN CORPORATION
2815 West Irving Park Road
Chicago, Illinois 60618

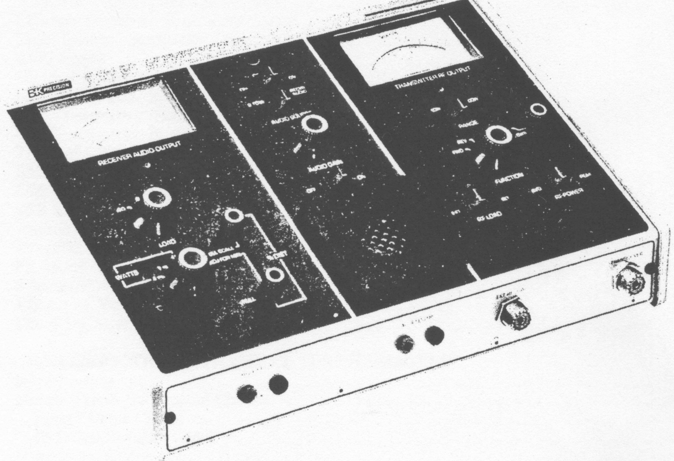
ONE YEAR LIMITED WARRANTY

DYNASCAN warrants that each product manufactured by it will be free from defects in material and workmanship under conditions of normal use and service for a period of one (1) year from the date of purchase from an authorized DYNASCAN distributor. DYNASCAN will, at its option, repair or replace any product or component not conforming with the foregoing warranty and which is returned, transportation prepaid, to our factory or our authorized service contractor. *DYNASCAN shall not otherwise be liable for any damages, consequential or otherwise.* DYNASCAN makes no other express warranties. *Any implied warranties (including any warranty of merchantability) are limited in duration to (1) one year from the date of purchase.* This warranty does not apply to (i) damage resulting from unauthorized alterations and repairs, misuse, negligency or accident; or (ii) damage resulting from improper installation, connection or adjustment otherwise than in accordance with DYNASCAN's authorized Instruction Manual. This warranty is void if the serial number has been altered, defaced or removed. DYNASCAN reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. To register this warranty, the enclosed DYNASCAN warranty registration card should be completed and mailed to DYNASCAN CORP., 6460 W. Cortland Street, Chicago, Illinois 60635, within ten (10) days after date of purchase.

INSTRUCTION MANUAL

B+K PRECISION **1040**

CB ServiceMaster



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