CB42

AUTOMATIC CB ANALYZER

OPERATION, APPLICATION AND MAINTENANCE MANUAL

SENCORE

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the RF-IF OUTPUT, or set the DIGITAL READOUT SELECTOR to the RF-IF GEN position.

8. Set the IF High Freq. Adjust (L201) for a reading of 12.1 MHz.

9. Set the IF TUNING control fully counter-clockwise.

10. Check each IF band for proper operation throughout the tuning range of the IF TUNING control.

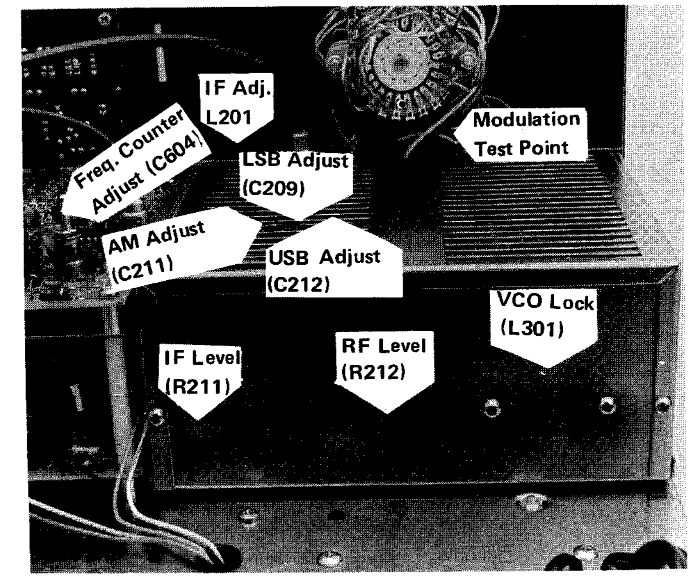


Fig. 64—Calibration points of RF-IF board.

RF-IF MODULATION

1. Connect AC Voltmeter to Audio Feed-through Capacitor on RF-IF shield.
2. Set AUDIO SELECTOR switch to 1000 Hz, and MODULATION switch to 100%.
3. Adjust 1000 Hz level control (R950) for 1.414 VRMS reading on AC Voltmeter.
4. Change AUDIO SELECTOR switch to 400 Hz, and adjust 400 Hz Cal (R944) for 1.414 VRMS.
5. Change MODULATION SWITCH to 30%. Set 30% Modulation Cal (R972) for .424 VRMS.

AUDIO TWO-TONE

1. Connect one channel of a dual-trace scope to pin 7 and the other channel to pin 8 of IC909.
2. Adjust the 500 Hz (R958) and 2400sHz (R964) controls for equal outputs.

FREQUENCY COUNTER

1. Feed in a signal of known frequency with an accuracy of .5 ppm or better to the 1 MEG FREQUENCY COUNTER INPUT.
2. Adjust Crystal Trimmer capacitor (C604) for a frequency reading the same as the reference frequency.

PERCENT OFF CHANNEL SENSITIVITY

1. Feed a CB transmitter set to channel 23 into the 50 Ohm input.
2. Set the CB RF TUNER to channel 1, and the DIGITAL READOUT SELECTOR TO THE % OFF CHANNEL position.
3. Adjust the % Off Channel Sensitivity Control (R671) until the DIGITAL READOUT gives a solid reading.

CB RF TUNER PLL

1. Select the RF-IF GEN position of the DIGITAL READOUT SELECTOR switch, and the AM position of the RF-IF CONTROL switch.
2. If the frequency is changing more than ± 2 counts (20 Hz), adjust the VCO Lock control (L301) until the VCO is stable. Check channels 1-40 to be sure the VCO locks on each channel and readjust L301 if necessary.

   Set the CB RF TUNER to channel 1. Set the RF-IF SELECTOR switch to the USB position, and set the USB trimmer (C212) for a reading of 26.966 MHz.
4. Set the RF-IF SELECTOR switch to the AM position, and set the AM trimmer (C211) for a reading of 26.965 MHz.
5. Set the RF-IF SELECTOR switch to the LSB position, and set the LSB trimmer (C209) for a reading of 26.964 MHz.

DVM

1. Switch DIGITAL READOUT SELECTOR to RF WATTS.
2. Connect frequency counter to pin 8 of IC5. Set DVM Clock Cal (R923) for frequency of 8000 Hz, ± 20 Hz.
3. Connect negative lead of external ungrounded adjustable DC power supply to DVM Reference (side of C904), and positive lead to DVM Input (side of C904).
4. Monitoring the adjustable supply with a .1% DVM such as the Sencore DVM38, set the output to approximately 1.4 VDC. Set DVM Cal (R913) for same reading on reference meter and CB42 Digital Readout (ignoring decimal).
5. Reset external supply for about 25 mV, and set DVM Lin (R916) for same reading on reference meter and CB42 Digital Readout.
6. Repeat steps 4 and 5 until both limits of the Digital Readout agree with the external meter.

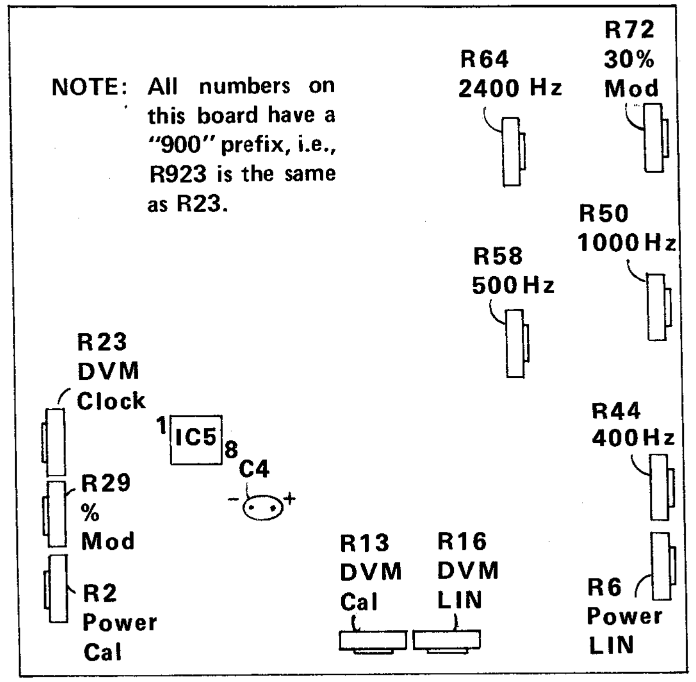


Fig. 63—Calibration points of function board.

AUDIO AND RF WATTS

1. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
2. Set SPEAKER LOAD switch to the SPEAKER position.
3. Feed 8 VRMS into the SPEAKER SUB jack. Adjust the Power Cal control (R902) for a reading of 1.00 Watts on the DIGITAL READOUT.
4. Feed 2.82 VRMS into the SPEAKER SUB jack. Adjust Power Lin control (R906) for a reading of 1.00 Watts on the DIGITAL READOUT.
5. Repeat Steps 3 and 4 until power function reads correctly at both calibration points.
6. Feed 2.82 VRMS into the SPEAKER SUB jack. Press S/N CHECK button. DIGITAL READOUT should read 10.00 Watts (± .5 Watts).

Feed 3.00 Watts RF into the 50 Ohm input. Select RF POWER on the DIGITAL READOUT SELECTOR. Adjust RF power Cal (R1002) through small hole in bottom of 50 Ohm Load shield for a power reading of 3.00 Watts.

PERCENT MODULATION

1. Feed .500 VRMS 1 KHz with a -1.414 VDC offset between the top and bottom feed-through capacitors on the 50 Ohm load shield. The top feed-through is -1.414 VDC and the bottom feed-through DVM reference.
2. Set DIGITAL READOUT SELECTOR to POSITIVE MODULATION position.
3. Adjust % MOD Cal (R929) for 50% readout.
4. Set DIGITAL READOUT SELECTOR to NEGATIVE MODULATION position. Reading should be 50% ± 2%.

RF-IF OUTPUT

1. Connect RF voltmeter terminated in 50 Ohms to RF-IF OUTPUT.
2. Set MICROVOLTS OUTPUT controls for 100K uV output.
3. With RF-IF FUNCTION Switch set to AM, adjust 27 MHz control (R212) for 100K uV on RF Voltmeter.
4. Set RF-IF FUNCTION switch to 6-12 MHz position, and adjust IF Level control (R211) for 100K uV on RF Voltmeter.
5. Repeat steps 3 and 4 until the same reading is obtained in both positions.
6. Set the IF TUNING control for maximum frequency on the 6-12 MHz position of the RF-IF FUNCTION switch.
7. Connect a 50 Ohm terminated frequency counter to

DESCRIPTION

INTRODUCTION

The great volume of sales of Class D (27 MHz) Citizen's Band (CB) radio transcievers has created a great demand for CB service. The CB42 CB Analyzer combines all functions necessary for alignment and trouble-shooting of any Class D transceiver including the 40 channel models.

Since all signals and measurements exceed FCC specifications, the technician using the CB42 can be sure the final proof of performance figures are correct when a service job is complete.

To get maximum effectiveness from your CB42, you should become thoroughly familiar with its operation and applications before putting the instrument to use. Play the Familiarization Tape supplied with the instrument. Then read through the step-by-step instructions in the Operations Section of this manual as well as the Applications Section.

FEATURES

The CB42 CB Analyzer includes all necessary functions for CB alignment and troubleshooting. The CB42 outputs include a 40 channel RF tuner, adjustable IF generator and audio generator. A special scope adapter output allows any 1 MHz scope to be used for carrier troubleshooting. The CB42 also includes a high accuracy auto-ranging digital frequency counter with 7 digits of readout. Special CB tests include digital readout of crystal activity, RF and audio power, and percent modulation. Sencore's exclusive Percent Off Channel and simplified EIA receiver sensitivity tests are included to speed transceiver troubleshooting.

SPECIFICATIONS

RF-IF GENERATOR

RF GENERATOR

METHOD: Crystal-controlled, digitally programmable phase-locked loop (PPLL).
CB AM: 40 standard FCC Class D channels, switch selected.
CRYSTAL ACCURACY: Setability ± .0001% (1 ppm) @ 25° C; temperature stability: 1 ppm/°C; aging: 5 ppm/mo, 10 ppm/year max.; warm-up time: 45 minutes for rated accuracy.
MODULATION: Internal AM modulation at 0, 30, or 100% using internal Audio Generator, or external input on rear panel. External input: 4 V P-P required for 100% modulation.

IF GENERATOR

Five continuously variable bands, from 375KHz-12MHz.
MODULATION: Same as RF Generator.

MONITORING

Either RF or IF frequency may be monitored with internal frequency counter.

OUTPUT ATTENUATOR

OUTPUT IMPEDANCE: 50 Ohms
RANGE: .1uV-.1V (100K uV) in 6 continuously variable steps.
PROTECTION: Diode protected against accidental transmit.

AUDIO GENERATOR

FREQUENCY: 400, 1000 Hz, or EIA SSB Two-tone (500+2400 Hz)
ACCURACY: ±10%
OUTPUT: 0-4 V P-P, AC coupled into 50 Ohms or greater load. Usable into 8 ohms.

FREQUENCY COUNTER:

DISPLAY: 7 digit, 7 segment, LED display -- auto ranging. LED "KHz, MHz" indicators controlled by auto range.
RANGE: 50Hz-50MHz (guaranteed), 55MHz (typical)
CRYSTAL ACCURACY: Setability ± .0001% (1 ppm) @ 25° C; temperature stability: 1 ppm/° C; aging: 5 ppm/mo, 10 ppm/year max.; Warm-up time: 45 minutes for rated accuracy.
INPUT IMPEDANCE: 1 Megohm or 50 Ohms.
RESOLUTION: 10 Hz.
SENSITIVITY: 300 mW (50 Ohm input, 25 Watts PEP max). 25 mV (1 Megohm input, 50 Hz-30 MHz).

CRYSTAL CHECK:

METHOD: Series resonant circuit for fundamental crystal frequency.
RANGE: 1-20 MHz
ACCURACY: Same as Frequency Counter

PERCENT OFF CHANNEL:

METHOD: Displays percent frequency deviation of transmitter compared to CB RF TUNER frequency.
RANGE: 0-1.0000% transmitter error.
ACCURACY: ±.0002% (25°C), ±.002% (15°-35° C)
DISPLAY: 6-digit. 0.0001% Resolution, LED "% OFF CHANNEL" indicator.

PERCENT MODULATION

METHOD: Indicates percent continuous tone AM modulation, positive or negative for sine wave modulation. Compares peak audio to average RF carrier.
RANGE: (Positive): 0-200%, (Negative): 0-95%.
ACCURACY: ±5% of reading (30-100%)
DISPLAY: 3 1/2 digit. 0.1% resolution. LED "% Mod" indicator.

RF POWER WATTMETER

RANGE: 0-20 watts Peak Envelope Power (PEP), 20-30 MHz.
ACCURACY: ± 5% of reading (2-20 WPEP).
INPUT IMPEDANCE: 50 Ohms
DISPLAY: 3 1/2 digit. 0.01 Watt resolution. LED "WATTS" indicator.

The Block Diagram of the CB42 is shown in Fig. 61 Each of the sections in the block diagram is isolated from the other sections with power supply filtering and electrical shielding. This results is very little interference between sections. This design approach also allows any circuit troubleshooting to quickly isolate a malfunction to a single circuit board by injecting signals or monitoring signals at the front panel input/output jacks.

COMPLETE CIRCUIT DESCRIPTION

The complete circuit description for the CB42, with simplified circuit diagrams, is available for $5.00 handling charge from the Sencore Field Engineering Department, 3200 Sencore Drive, Sioux Falls, S.D. 57107.

ACCESS/DISASSEMBLY

To gain access to the interior of the CB42 for maintenance or calibration, follow this procedure:

1. Remove AC power from the CB42 by disconnecting it from the AC line.
2. Remove the six screws in the bottom panel and slide the panel towards the rear of the unit to remove it.
3. Remove the two screws on either side of the case, and the two screws on the top of the case. Remove the case by sliding it towards the rear of the unit. As the case is removed, feed the AC cord through the hole in the case until the case is clear of the unit.
4. Complete access is available for calibrating the CB42 without further disassembly.
5. To reassemble, simply reverse the steps above.

CALIBRATION PROCEDURE

The calibration of the CB42 should be checked at regular intervals to make sure it is within original accuracy specifications. It is recommended that any unit requiring recalibration be returned to one of the Sencore Sales and Service Offices listed in the inside back cover of the manual. If field calibration is desired, follow the steps listed below:

EQUIPMENT REQUIREMENTS:

EQUIPMENT	SPECIFICATIONS
Frequency counter or Frequency standard	.0001% (1ppm)
RF Voltmeter	10%accuracy, 10uV-.1V RF at 30 MHz
DC Voltage Source	.1%, 25 mV-10 VDC
AC Voltmeter	1%, 0-2 VAC RMS at 1000 Hz.
AC Signal Source	.50Ω VRMS ± 1% at 1000 Hz.
RF Power Source	3.00 WRF ±5% at 27 MHz.

POWER SUPPLY

1. Measure ripple on 10 volt output of power supply PC board. Should indicate less than 30 mV.
2. Measure ripple on 5 volt output of power supply PC board. Should indicate less than 30 mV.
3. Monitor DC voltage of 10 volt output of power supply PC board. Set 10 Volt Adjust (R104) for 10.00 V ± 0.1 VDC.

SCOPE ADAPTER

1. Feed 26.965 MHz (CB channel 1) into 50 ohm input.
2. Connect scope to Scope Adapter output.
3. Set Scope Adapter Frequency Adjust for zero-beat on scope.
4. Readjust L701 for 40 KHz output on scope.
5. Switch RF input to 26.975 MHz (CB channel 2). Frequency on scope should increase. If Channel 2 frequency is lower than channel 1 frequency, repeat step 4 for 40 KHz signal on opposite side of zero-beat.

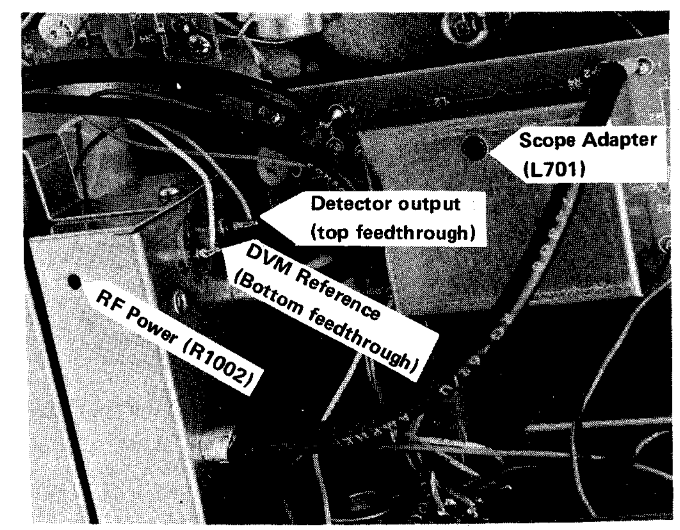


Fig. 62—Test-points and controls on bottom of chassis.

MAINTENANCE AND SERVICE

INTRODUCTION

This Maintenance and Service Section will help you maintain the CB42 within the published specifications and assure years of useful application.

This section covers general maintenance and complete recalibration instructions. The schematic and parts list as well as board legends are included on separate sheets. The schematics use Sencore's "Circuit Trace" color coding to aid in circuit tracing if service ever becomes necessary.

Complete warranty information is included in the Quality Assurance Tag attached to the CB42. The QA tag also includes general warnings applying to your CB42 and information on factory service. If you should find it necessary to return your CB42 for service, enclose the QA tag with the final tester's signature.

WARNING

These servicing instructions are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

FUNCTIONAL DESCRIPTION AND BLOCK DIAGRAM

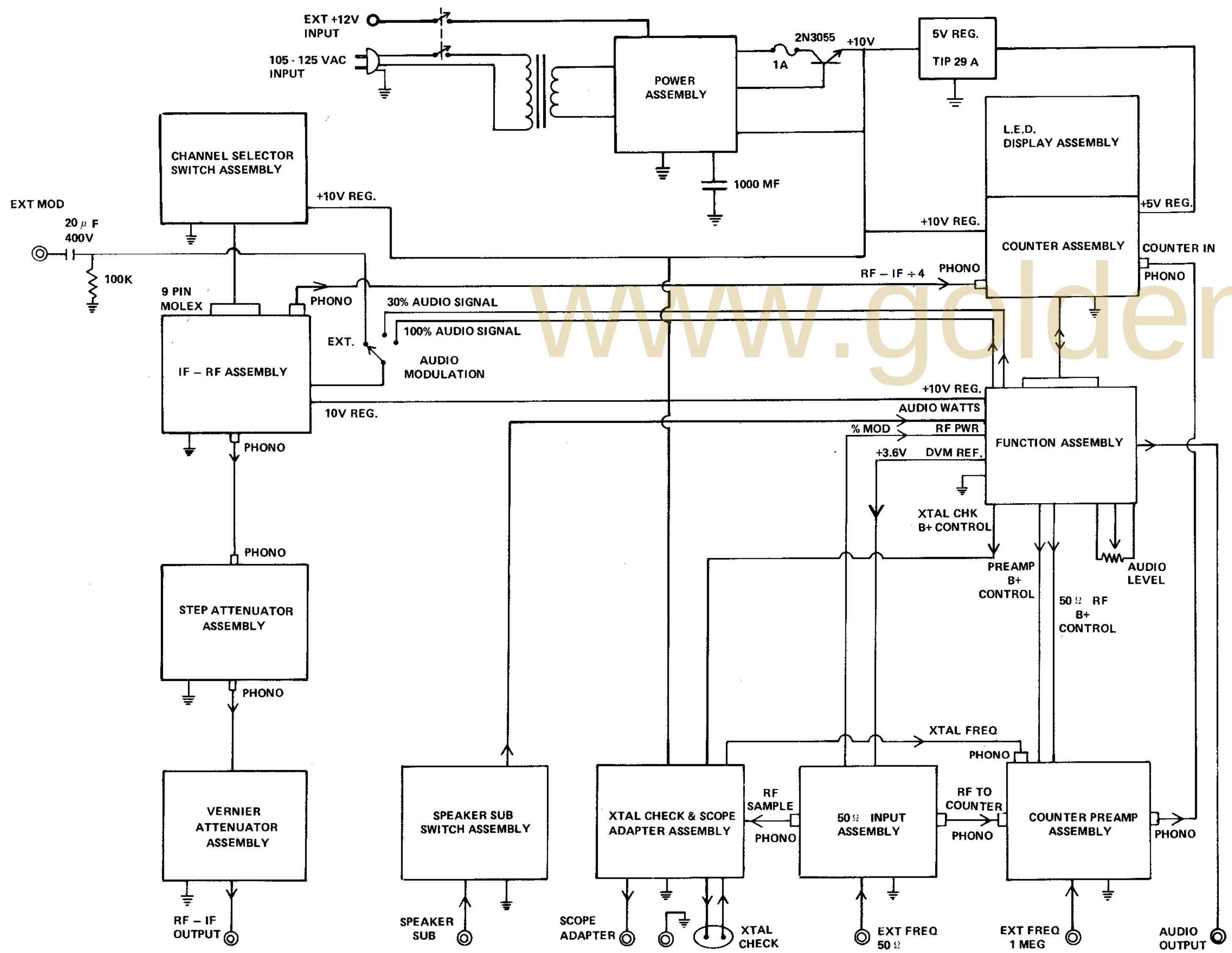


Fig. 61—Block diagram of CB42.

AUDIO POWER WATTMETER
METHOD: Peak-detecting, RMS-reading power of sine wave across internal load.
RANGE: 0-19.99 Watts RMS.
ACCURACY: ±5%
LOADS:
INTERNAL: 4, 8, or 16 Ohms.10 Watts continuous, 20 Watts for 30 seconds.
EXTERNAL: Calibrated for 8 Ohms.
DISPLAY: 3 1/2 digit, .01 Watts resolution, LED "WATTS" indicator.

SCOPE ADAPTER OUTPUT
METHOD: Heterodynes RF signal to under 1 MHz.
RF RANGE: 26.965-27.9400 MHz.
LOCAL OSCILLATOR: 26.925 MHz Approx.
OUTPUT VOLTAGE: .5V at 1 Watt RF.
OUTPUT FREQUENCY: 40 KHz-480 KHz (class D channels 1-40).
INPUT IMPEDANCE: 50 Ohms

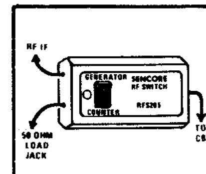
SIGNAL TO NOISE SENSITIVITY TEST
METHOD: Standard EIA 10 dB (S+N)/N test. Audio Power Wattmeter sensitivity is increased 10dB for Noise Reference.

GENERAL:
FUSE: 1A Fast-blow, type 3AG
ELECTRICAL: All solid state circuitry, including CMOS LSI.
MECHANICAL: Vinyl-clad steel with aluminum trim. Carrying handle. Lead storage compartment in back of case.
SIZE: 11" x 14" x 11" (HWD). (28cm x 35.5cm x 28cm).
WEIGHT: 24 lb. (10.9 Kg).
POWER: 105-130 VAC, 50/60 Hz, 15 W; or 12 VDC, 1A. 220 VAC modification available at extra cost.

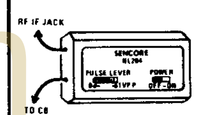
ACCESSORIES

Included:	39G102	Dynamic Mike Tester
	39G104	RF Cable Assembly (BNC/PL259)
	39G105	Counter Probe (isolated/direct)
	39G106	Audio Lead Assembly (phone/test clips)
	39G109	Audio Lead Assembly (phone/min. phone)
	39G110	RF Probe Assembly (50 Ohm Terminated)

OPTIONAL ACCESSORIES:



RFS205 RF Changeover Switch connects to both the CB42 RF-IF and 50-Ohm load jacks, and selects the proper cable with a switch. Just a single connection to the CB is all that is needed for simplified CB performance tests of receiver sensitivity and all transmitter outputs $25.00



NL204 EIA Noise Pulse Simulator simulates ignition noise for testing the Automatic Noise Limiter (ANL) and Noise Blanker (NB) circuits in some CBs . . . $25.00

Available through Sencore distributors or Service Parts Department, Sencore, Inc., 3200 Sencore Drive, Sioux Falls, SD 57107.

CONTROLS

1. DIGITAL READOUT provides all output readings including RF Power, Audio Power, Percent Modulation, Modulator Distortion, Percent Off Channel, Internal and External Frequencies. Includes LED indicators of range and function.
2. DIGITAL READOUT SELECTOR Selects all functions of DIGITAL READOUT.
   - 2A. RF-IF GEN monitors internal frequency of RF TUNER or IF GENERATOR.
   - 2B. EXT XTAL reads fundamental frequency of crystal plugged into front-panel jack.
   - 2C. 1 MEG LOAD reads external frequency applied to 1 MEG INPUT jack on front panel.
   - 2D. 50-OHM LOAD reads external frequency applied to 50-OHM INPUT jack on front panel.
   - 2E. % OFF CHAN reads percent of deviation from FCC specifications of transmitter feeding into front-panel 50-OHM INPUT by comparing incoming frequency to CB RF TUNER.
   - 2F. % POS MOD reads amount of positive modulation as a percentage by determining average RF power, and comparing peaks of modulation.
   - 2G. % NEG MOD reads amount of negative modulation as a percentage by determining average RF power, and comparing negative modulation swings.
   - 2H. RF WATTS reads Peak Envelope Power (PEP) of input at 50-OHM INPUT jack at front panel. Reads average or PEP power with same scale.
   - 2J. AUDIO WATTS reads audio output power of receiver applied to SPEAKER SUB input jack on front panel.
   - 2K. S/N CHECK pushbutton increases AUDIO WATTS function by 10 dB, and removes modulation from RF carrier provided by CB RF TUNER for performing EIA standard 10dB (S+N) N test.
3. SPEAKER SUB eliminates need of shop speakers during routine tests. Provides standard impedance loads of 4, 8, and 16 OHMS plus option of using external speaker.
4. SPEAKER SUB INPUT--convenient front-panel jack for connecting audio output of receiver to SPEAKER SUB for measuring audio output power.
5. HIGH SENSITIVITY FREQUENCY COUNTER INPUT loaded with 1 Megohm for measuring frequencies to 50 MHz with a sensitivity of 25 mV.
6. 50 OHM LOADED INPUT for measuring frequency output of transmitter plus all other transmitter output functions.
7. CRYSTAL CHECK SOCKET allows any type crystal to be inserted for a direct readout of crystal frequency.
8. AUDIO SELECTOR SWITCH chooses 400 or 1000 Hz or SSB two-tone (500 + 2400 Hz) for modulation of internal RF-IF generator or for output through front-panel jack.
9. AUDIO OUTPUT controls the amount of audio signal available at front panel AUDIO jack.
10. POWER SWITCH controls both AC power and 12 volt input power.
11. SCOPE ADAPTER JACK provides a 1 MHz max. output signal corresponding to carrier signal.
12. GROUND connection.
13. AUDIO OUTPUT jack. Provides audio from internal audio generator. Controlled by AUDIO OUTPUT control.
14. RF-IF OUTPUT jack provides single cable output from internal RF-IF GENERATOR.
15. MICROVOLTS OUTPUT CONTROLS provide adjustable RF-IF output from .1 uV to .1 V.
16. AUDIO MODULATION SWITCH provides 30 or 100% modulation from internal generator for RF-IF GENERATOR, or external modulation from rear panel connection.
17. IF TUNING CONTROL allows adjustment of any of 5 IF bands.
18. RF-IF GENERATOR CONTROL.
    - 18A. AM OUTPUT provides switch selectable CB channel output for standard 40 channel frequencies. Selected by CB TUNER.
    - 18B. SSB OUTPUT provides EIA standard USB or LSB signal 1000 Hz. above or below standard CB channel for Single Sideband receiver alignment and troubleshooting.
    - 18C. IF GENERATOR provides 5 overlapping IF bands from 375 KHz through 12 MHz. Tunable with IF TUNING CONTROL.
19. BAND SELECTOR SWITCH chooses channel 1-23 or 24-40 on RF TUNER SWITCH.
20. 40 CHANNEL CB RF TUNER provides 40 standard Class D CB frequencies.
21. LEAD STORAGE COMPARTMENT
22. AC LINE CORD
23. 12 VOLT DC INPUT
24. B+ FUSE
25. EXTERNAL AUDIO INPUT for external modulation of RF-IF GENERATOR.

SUPPLIED CABLES/ACCESSORIES

26. 39G109 AUDIO CABLE for connecting speaker output to SPEAKER SUB input (Min. Phone/phone).
27. 39G106 AUDIO CABLE for direct audio connections (phono/test clips).
28. 39G102 DYNAMIC MIKE TESTER for injecting audio into microphone.
29. 39G105 COUNTER INPUT CABLE provides a direct or isolated input to the 1 Meg frequency counter input.
30. 39G104 RF CABLE for transceiver testing (BNC/PL259).
31. 39G110 TERMINATED RF CABLE provides matching from 50 Ohm output of RF-IF GENERATOR for injecting into various circuits.

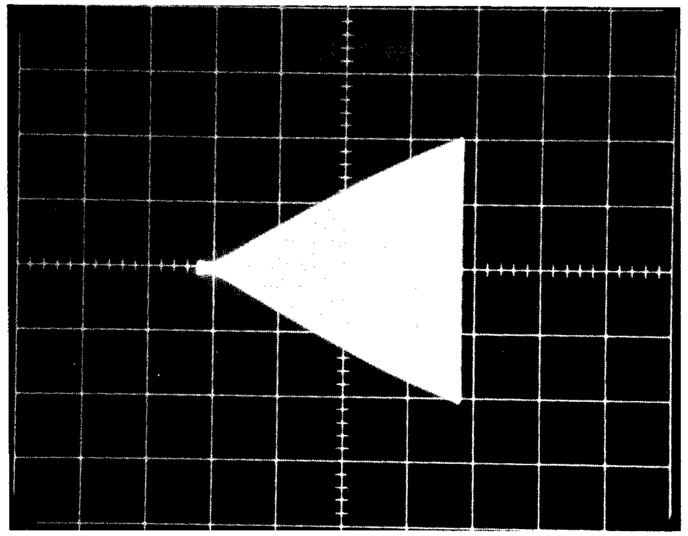


Fig. 56—Trapezoidal waveform showing negative modulation clipping.

SSB APPLICATIONS

The balanced modulator of an SSB transmitter should eliminate most of the carrier frequency allowing only one of the sidebands to be broadcast. The scope adapter output will show the presence of a carrier in one of two ways.

SSB ONE-TONE METHOD

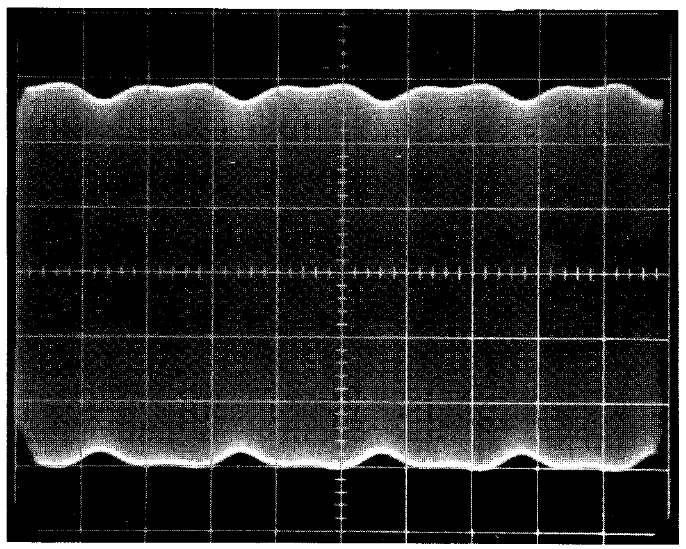


Fig. 57—Minimum AM modulation results from proper setting of balanced modulator in SSB transmitter.

If a single tone is used to modulate the SSB transmitter, the result should be a single frequency output. This output should be offset from the carrier frequency by the frequency of the modulating signal. Fig. 57 shows a properly adjusted balanced modulator output. Note that the single tone input produces a single unmodulated carrier.

Fig. 58 shows what happens when the balanced modulator is misadjusted slightly to allow some of the carrier to pass through. The waveform becomes modulated.

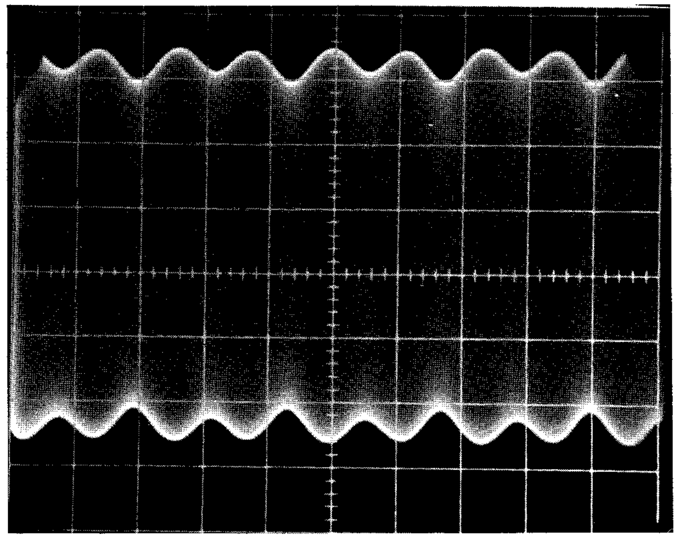


Fig. 58—Poorly adjusted balanced modulator increases AM modulation from SSB transmitter.

In adjusting the balanced modulator, simply set the balanced modulator for the least amount of modulation on the single tone output signal.

SSB TWO-TONE METHOD

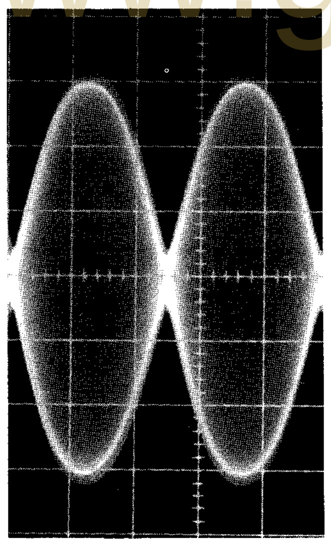


Fig. 59—Properly adjusted balanced modulator produces clean, cross-over.

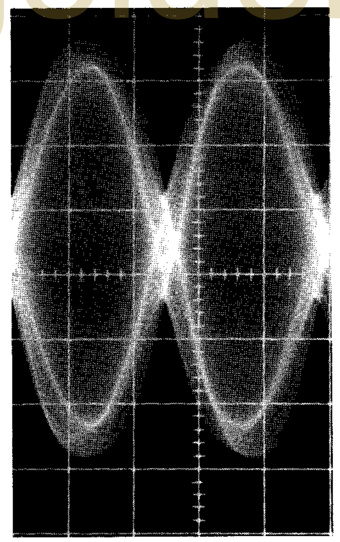
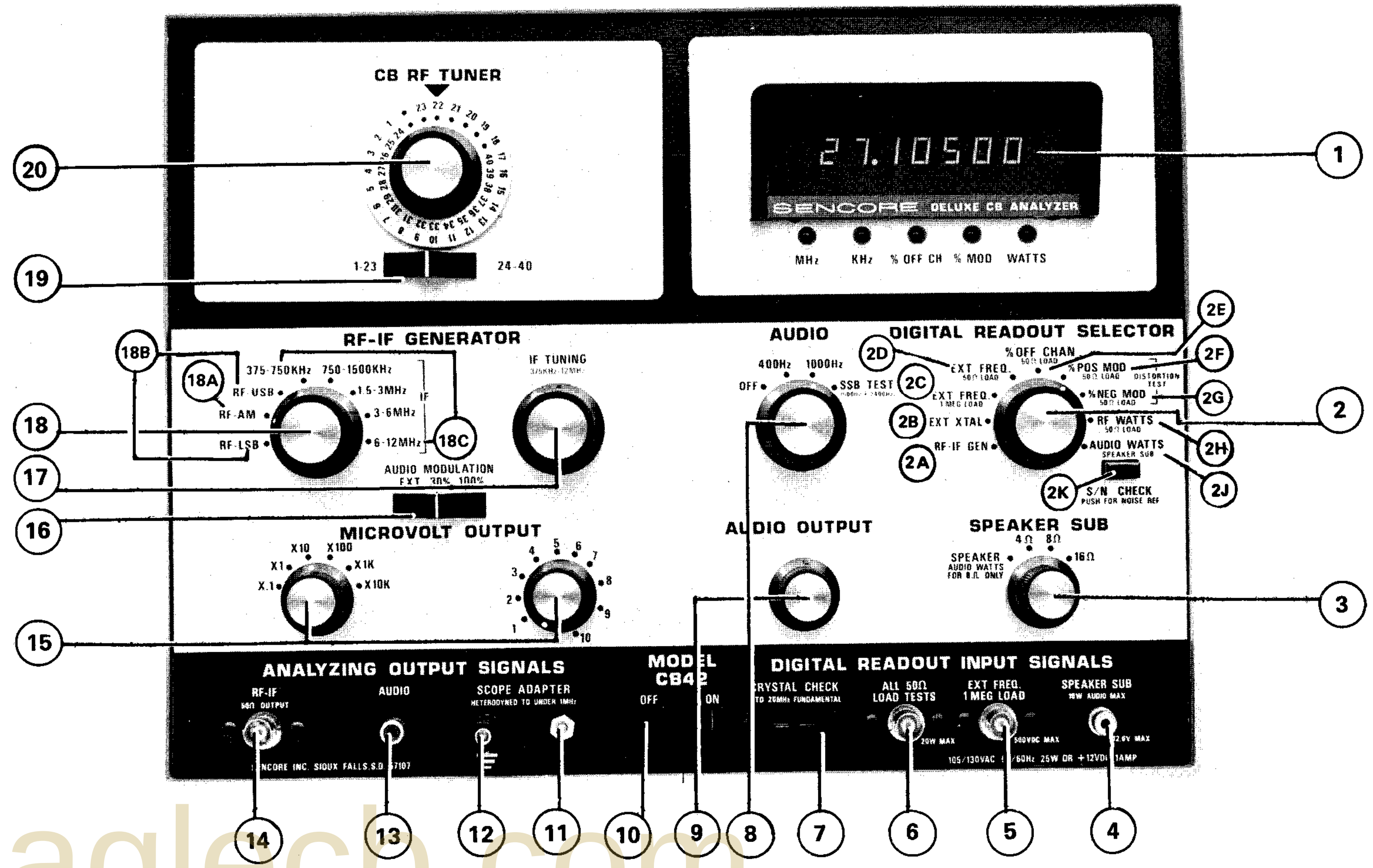
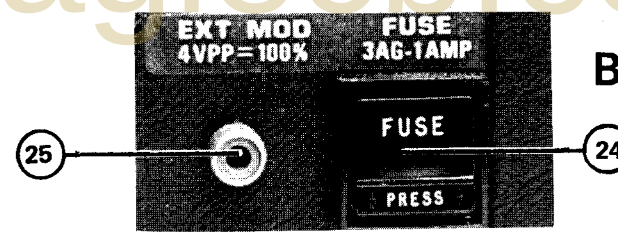


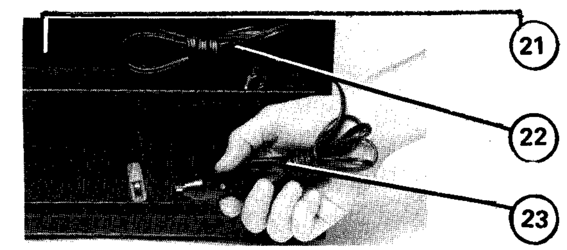
Fig. 60—Poorly adjusted balanced modulator distorts cross-over.

Using two balanced tones, the waveform in Fig. 59 should result. If there is any carrier information in the RF output, the waveform will not close at the baseline, but have the carrier present at these points. To adjust the balanced modulator using the two-tone input provided by the CB42, simply adjust the balanced modulator until the nulls of the waveform just close.

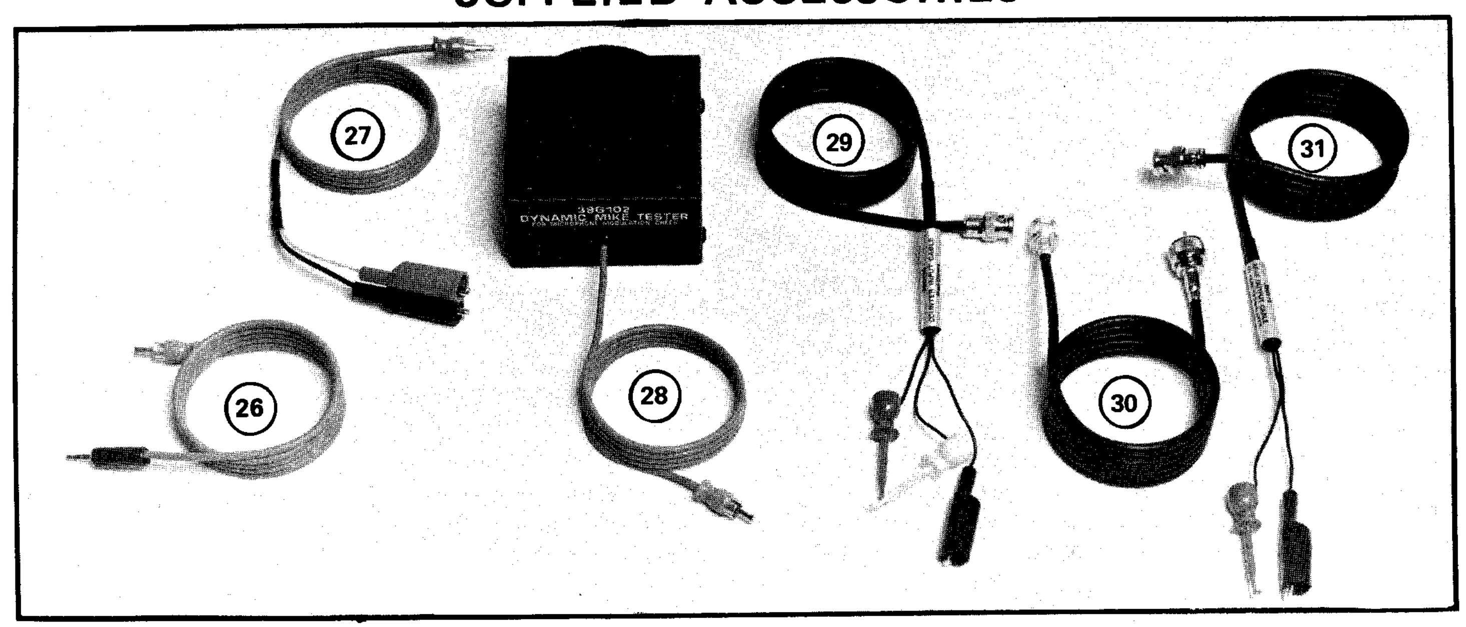


BACK PANEL





SUPPLIED ACCESSORIES



OPERATION

INTRODUCTION

The instructions for your CB42 are broken into two parts. This section describes general operations of each of the tests available on the CB42. The following Applications Section covers the basic theory of operations of a CB transceiver, followed by specific tests that the CB42 can perform. Each test in the Applications Section gives step-by-step instructions for the setup and applications of various tests recommended by the FCC and the Electronics Industries Association (EIA).

These same tests are listed in the CB42 Speed Test Setup Booklet also included with the CB42. Once you are familiar with the specific tests, the Test Setup Booklet should give the necessary information as to test setup and interpretation.

POWER CONNECTIONS

The CB42 may be used either on the shop bench or in the field for complete receiver and transmitter performance testing at the radio's location. Two power cables are provided for 105-130 VAC, 50/60 Hz operation or +12 VDC operation.

1. For AC power operation, pull the AC line cord from the storage compartment in the back of the CB42 and connect it to a source of AC power. If desired, the storage compartment door may be closed by passing the cable through the notch at either top corner of the door.

2. For 12 VDC operation, pull the lighter plug and cable from the storage compartment and connect to an automotive cigarette lighter socket supplying 12 Volts *negative* ground.

   NOTE: The CB42 will operate properly only from a 12 Volt *negative* ground system. Internal protection circuits prevent damage if connected to a positive ground system, but the CB42 will be inoperative.

3. Press the ON side of the OFF-ON switch to apply power to the CB42. The DIGITAL READOUT will light when power is applied.

4. Allow the CB42 to operate at least 45 minutes to allow the high accuracy crystal oscillators in the RF generator and digital frequency counter to stabilize.

   NOTE: Many CB transceivers are designed to operate with either a positive or negative grounded automotive electrical system. Many of these units have a red positive lead and black negative lead rather than a polarity reversal switch. In many cases, the negative lead is not connected to the chassis ground. For proper shielding, and transmitter operation, *BOTH* the negative supply lead and chassis should be connected to the negative supply terminal of the power supply as well as to the common jack on the CB42.

FUSE REPLACEMENT

The B+ fuse is located on the back panel. This fuse is in the DC voltage section to protect the CB42 when it is used with either AC or DC input voltages. If the fuse should need replacing, replace it only with a **1 Amp,** 3AG fast-blow type. Any other size fuse may result in serious damage to the CB42 and will void either the 90-day warranty or the 100% Made Right Lifetime Guarantee.

The primary of the transformer has internal protection against a shorted secondary, and requires no additional fuse.

CABLE SWITCH ACCESSORY

The separate RF-IF OUTPUT jack and 50 OHM INPUT jack offers the advantage of proper 50 Ohm termination for a receiver or transmitter while signals are being injected from the RF or IF generator.

The accessory RFS205 RF switch allows switching the CB's antenna connector between the signal output jack and the 50 Ohm load. In many cases, the RFS205 will simplify performance testing when CBs are being run through a test position (such as Quality Assurance tests).

The RFS205 provides a warning light which indicates that the transmitter is being broadcast into the protion circuits of the RF-IF OUTPUT jack.

The RFS205 may be purchased from the Sencore Factory Service Department, or any local Sencore FLPD Distributor.

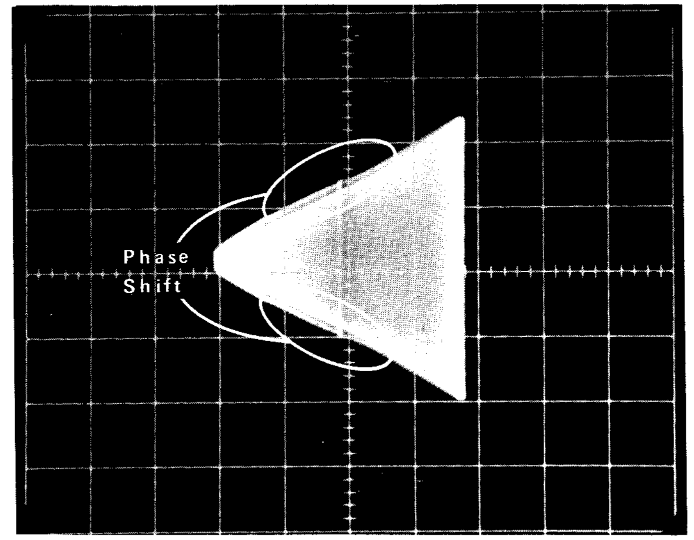


Fig. 52—Trapezoidal pattern showing signs of phase shift.

for these connections. When a signal is applied to the transmitter, the waveform shown in Fig. 51 results.If a phase shift like that shown in Fig. 52 is evident, the scope's horizontal input is not connected to the modulation line. Examine the transmitter schematic diagram to make sure there are no inductors or capacitors between the modulation line and scope connection that may cause such a phase-shift.

If the transmitter output is unmodulated, a vertical line should be present on the scope. Applying modulation forms the trapezoid. The formulas for determining modulation using the trapezoidal method of waveform analysis are the same as for standard modulation. The amplitude of the unmodulated carrier (the vertical line just mentioned) is used as the reference. The maximum and minimum points of the trapezoid are then used for determining positive and negative modulation.

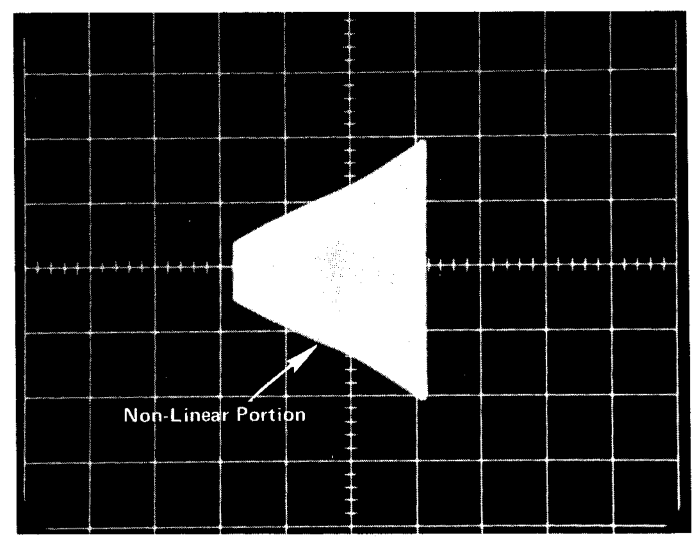


Fig. 53—Trapezoidal pattern showing slight amount of non-linear modulation.

Fig. 53 shows a non-symetrical signal due to a non-linear amplification stage in the modulation circuits of an AM transmitter. The curvature of the top and bottom portions of the trapezoid are due to the non-linear amplification. An extreme case of non-linear amplification is shown in Fig. 54 . The next waveforms in Fig. 55 show the three signals used to produce the waveform in Fig. 54 . Fig. A shows the modulation signal being applied to the collectors of the RF transistors. Fig. B shows the resulting RF output. The audio input signal is shown in Fig. C.

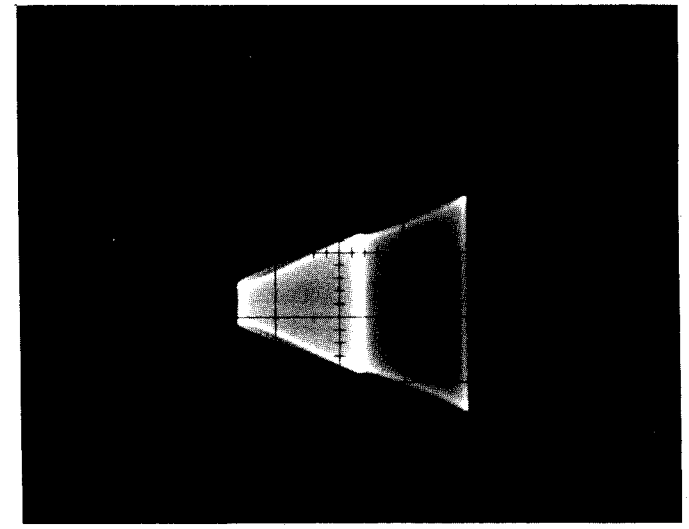


Fig. 54–Trapezoidal pattern showing severe case of non-linear modulation.

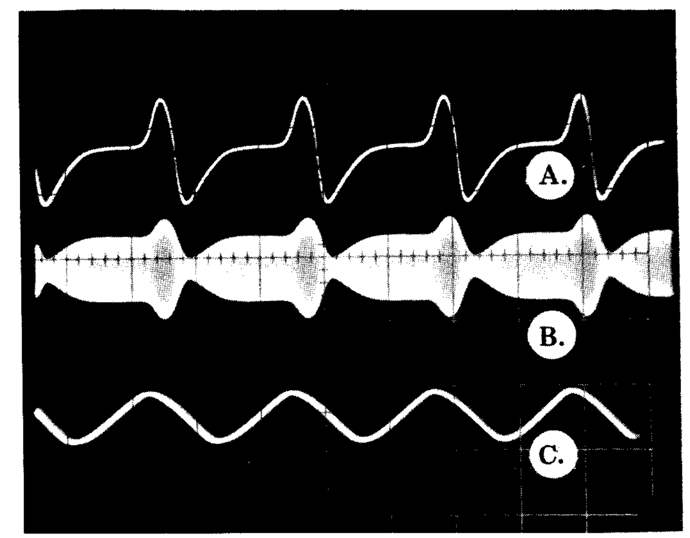


Fig. 55–Signals used to produce waveform in Figure 54.

If the transmitter is showing signs of negative overmodulation, the waveform shown in Fig. 56 results. The "tail" at the left of the waveform is a result of the clipped portion of the modulation envelope.

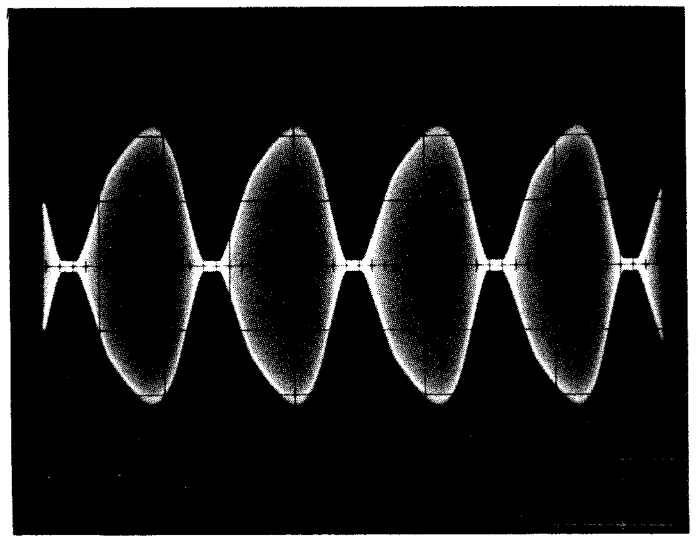


Fig. 48—Negative clipping due to over-modulation.

NOTE: When determining positive or negative modulation, the digital readout of percent modulation proves to be a more accurate method than scope interpretations. The reason is the circuitry of the percent modulation test determines the average carrier power to calculate positive and negative modulation. Any distortion of the waveform will show as a difference in positive and negative modulation when a symetrical wave is used to modulate the transmitter. Since the negative modulation detector will not show more than 100% modulation, however, the scope adapter should be used for checking negative over-modulation.

RESIDUAL CARRIER NOISE CHECK

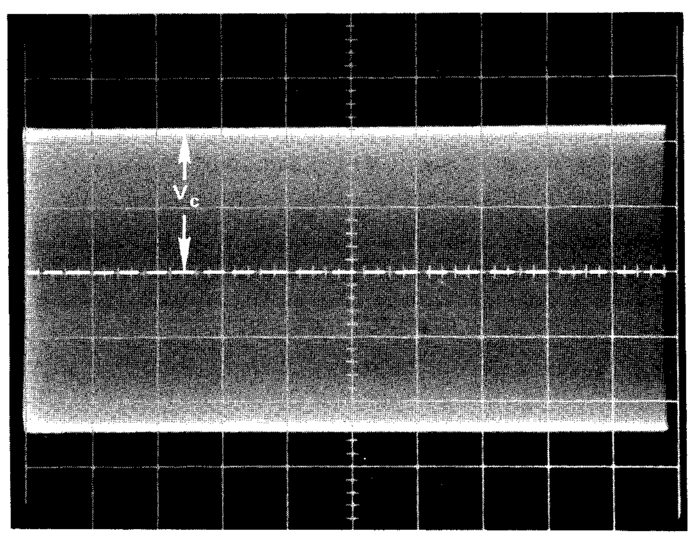


Fig. 49—Carrier with no residual noise.

With no modulation signal applied to the input of the transmitter, the result should be the clean carrier signal shown in Fig. 49 . If the modulation stages contain residual noise, the result is modulation of the carrier, with no signal applied to the microphone. To test for this condition, key the transmitter, and make sure that no audio signal reaches the microphone. Shielding the microphone from audio signals may be necessary for this test. If modulation appears on the waveform (which would also read as modulation using the modulation position of the DIGITAL READOUT SELECTOR) residual carrier noise is indicated.

TRAPEZOIDAL MODULATION

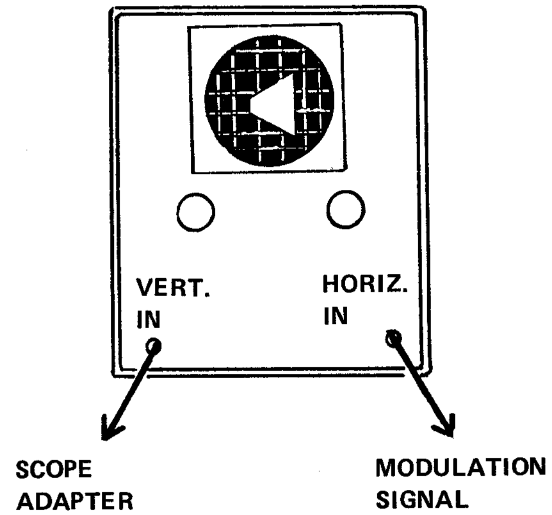


Fig. 50—Scope hookup for trapezoidal display.

A second method of modulation analysis is the use of the "trapezoidal method" of waveform analysis. The hookup for this test is shown in Fig. 50 . The horizontal input of an oscilloscope is connected to the modulation line running to the RF stage of the transmitter. The scope adapter output is run to the vertical input. A vector scope such as the Sencore PS29 or PS163 can be used

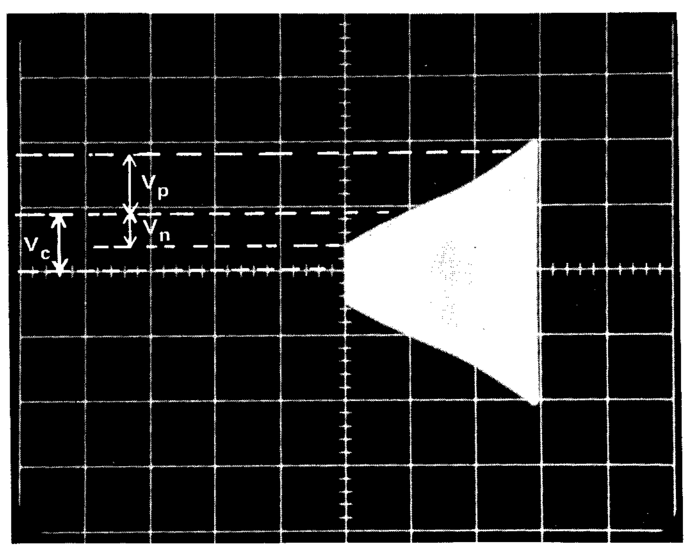


Fig. 51—Trapezoidal modulation envelope.

TRANSCEIVER SET-UP

1. Connect the transceiver under test to the proper voltage source, as specified by the equipment manufacturer. Most mobile units require a power source capable of supplying 13.8 VDC at 2A. EIA recommended tests also specify tests for varying the voltage ±15% from 13.8 VDC, (11.5-15.9 VDC). The Sencore PS43 Porta-Pak and UPS164 Universal Power Supply have been especially designed to provide these variable voltages.

2. The following are standard test conditions and performance limits as recommended by leading CB manufacturers. Set the transceiver controls to the positions listed to perform initial set-up for all basic tests.

VOLUME	2/3 of full rotation
TONE CONTROL	Center
SQUELCH	Max. unsquelch
NOISE LIMITER (ANL & ANB switch)	Off
RF GAIN	Full Gain
MIC GAIN	Full Gain
PA SWITCH	In "CB" position

All signal input terminations and transmitter and audio output loads, as specified by CB manufacturers, have been built into the CB42. No additional modifications are required for operation into these calibrated loads.

3. Refer to special note under "Power Connections."

POWER SUPPLY VARIATIONS

The EIA specifies that all receiver and transmitter tests be performed with an input of 13.8 VDC for 12 VDC units. The EIA code RS-382 further specifies tests to be performed with a raised or lowered supply voltage to be sure that the receiver will operate under different voltage supply conditions. An example of such variations is found in a 12 Volt automotive electrical system when the unit is operating just from the battery (12 Volts nominal) and when the alternator or generator circuits are providing maximum charging voltage (14-16 Volts).

The adjustable outputs of the Sencore UPS164 Universal Power Supply or PS43 Porta-Pak power supply allow these various tests to be performed.

The following are the specifications established by the EIA:

Varying ± 10%: (12.4-15.2 VDC):	Transmit Power	± 2 dB
	Audio Power	± 2 dB
	Sensitivity	± 2 dB
	Squelch	± 2 dB
± 15% (11.7-15.8)	Frequency stability of transmitter to be maintained.	
± 20% (11.0-16.6)	Unit shall operate	
	Transmit Power	± 3 dB
	Sensitivity	± 3 dB

RF GENERATOR

The RF GENERATOR provides a choice of a modulated or unmodulated signal at the standard CB channel frequencies for AM troubleshooting, or single sideband outputs. The SSB outputs are 1000 Hz above the standard AM channel for USB operation, or 1000 Hz below the standard AM channel for LSB operations. The SSB signals provide a 1000 Hz beat tone in a properly operating SSB receiver.

To use the RF GENERATOR:

1. Connect the CB42's RF-IF OUTPUT jack to the antenna input of the CB receiver using the supplied RF cable.
2. Select the modulation level desired, 0% (CW) using the EXT position of the AUDIO MODULATION switch with no external input, 30 or 100% from the internal audio generator, or an external modulation source through the rear panel jack (4V P - P = 100% modulation).
3. Select the proper internal modulation frequency if the internal audio generator is used. Use 1000 Hz for standard tests.

   NOTE: The setting of the AUDIO OUTPUT control does not effect the modulation level of the RF generator.

4. Set the RF-IF GENERATOR selector switch to the AM position for output on the standard AM channels. Set the switch to USB (Upper Sideband) or LSB (Lower Sideband) for SSB testing.

   NOTE: When in either SSB position, the modulation from the audio generator is automatically disconnected.

5. Rotate the CB RF TUNER to the desired CB channel.

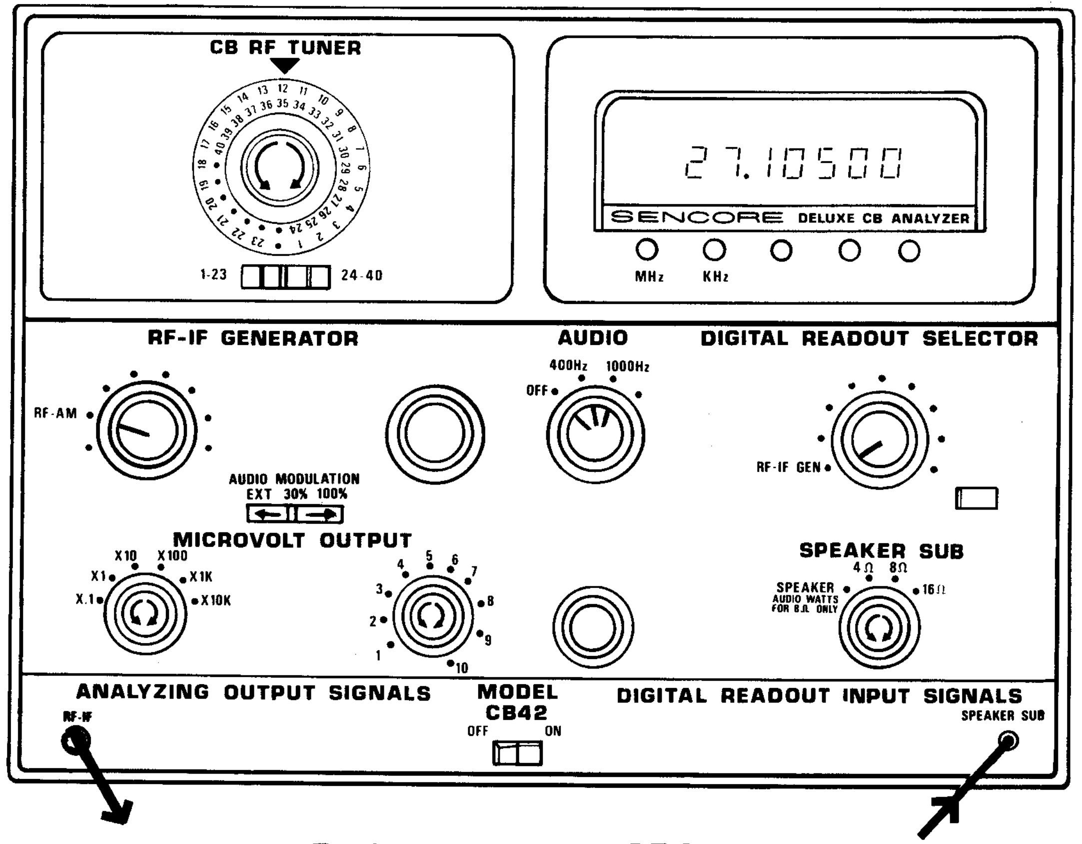


Fig. 2—Control setup for RF Output.

6. If it is desired to monitor the RF frequency, turn the DIGITAL READOUT SELECTOR to the RF-IF GEN position. The frequency will be read on the DIGITAL READOUT.

7. Adjust the signal level into the transceiver with the two MICROVOLTS OUTPUT controls. The controls are direct reading when feeding a 50 Ohm load. Simply read the setting of the vernier control, and multiply by the step attenuator setting for the actual RF output in microvolts.

NOTE: The output attenuator is diode-protected to prevent damage if the transmitter is keyed into the RF-IF OUTPUT jack.

IF GENERATOR

The IF GENERATOR provides a choice of a modulated or unmodulated signal at any frequency from 375 KHz to 12 MHz for injection into any single- or dual-conversion IF stage.

The adjustable IF generator is designed for troubleshooting any single- or dual-conversion IF system. Due to the wide tuning range of the IF generator (375 KHz-12 MHz), the IF frequency may change over a period of several minutes. It is recommended that the generator frequency be monitored using the RF-IF GENERATOR position of the DIGITAL READOUT SELECTOR. A slight touch-up of the IF TUNING control is all that is necessary to provide the desired IF frequency.

The CB42 IF generator is designed for troubleshooting defective IF stages and rough alignment of these stages. Most manufacturers recommend that the final IF alignment be made by injecting an RF signal at the antenna input on Channel 11 through 13 and tuning the IF stages for best sensitivity. If an IF stage is completely out of alignment, use the IF generator to set the IF stage close to the desired IF frequency. Then use the high-accuracy CB RF TUNER signals for final IF touch-up to compensate for receiver local oscillator or ceramic filter designs.

To use the IF GENERATOR:

1. Connect the supplied RF cable terminated in test clips to the RF-IF OUTPUT jack. This cable is terminated with a 50 Ohm load to prevent standing waves in the output cable and contains a series DC-blocking capacitor.

4. Read the percentage of difference from the DIGITAL DISPLAY.

NOTE: In many SSB transmitters, the "Clarifier" control changes the output frequency of the transmitter slightly. When checking the first channel's transmitter error, set this control for a minimum reading of error on the DIGITAL READOUT.

SSB TRANSMITTER CLARIFIER CONTROL TEST

The tuning range of the clarifier control should not cause the transmitted frequency to go beyond the .005% tolerance allowed by the FCC.

To test this function:

1. Set up the PERCENT OFF CHANNEL TEST described in the previous paragraph.
2. Rotate the clarifier through its tuning range.

The percent off channel indication should not read over .005% at any setting of the clarifier control.

SCOPE ADAPTER APPLICATIONS

The scope adapter output allows the modulation envelope of the transmitter output to be monitored using any general purpose oscilloscope with at least a 1 MHz bandwidth. The instructions for hookup for general waveform analysis are included in the General Operations section. The following figures show typical modulation envelopes. AM Modulation Fig. 46 shows an unmodulated carrier. By applying modulation, the modulation envelope can be seen.

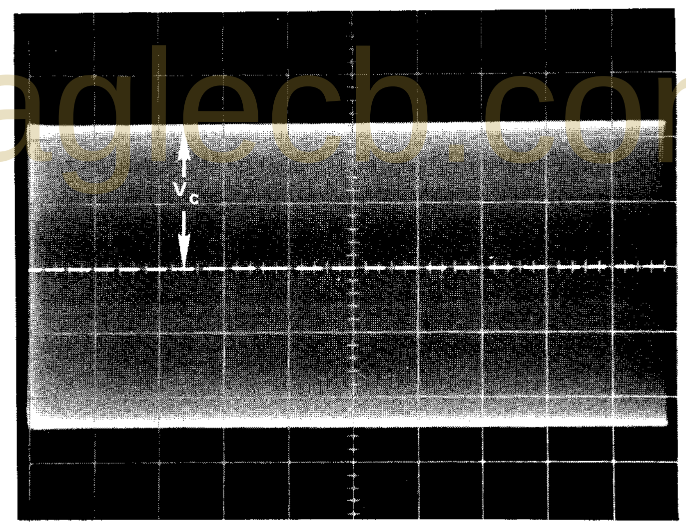


Fig. 46—Unmodulated carrier waveform.

Fig. 47 shows the definition of positive and negative modulation. Positive modulation is the amount of change from the unmodulated carrier level to the maximum peak. Fig. 47 shows a modulation envelope with the original carrier level shown as Vc. The percent modulation is simply the amount of change in the positive direction (Vp) divided by the carrier voltage. This ratio is then multiplied by 100.

$$\% \text{ Pos Modulation} = \frac{V_p}{V_c} \times 100.$$

The negative modulation is calculated the same way except the amount of voltage change in the negative direction is used. The formula for negative modulation is:

$$\% \text{ Neg Modulation} = \frac{V_n}{V_c} \times 100.$$

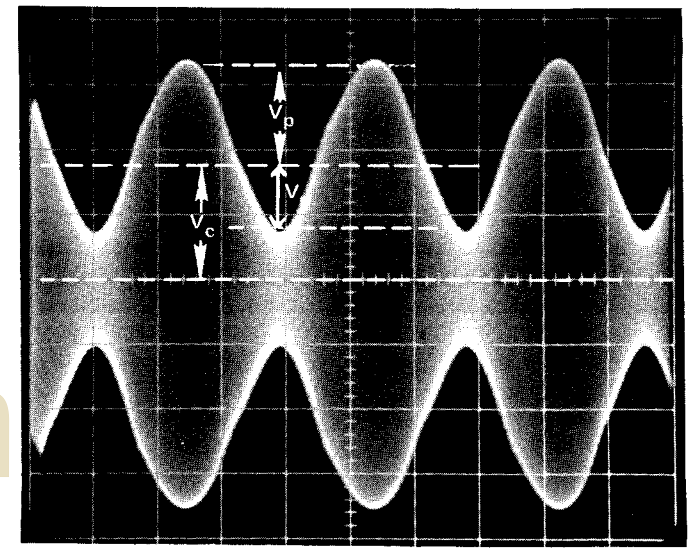


Fig. 47—Amplitude modulated Signal.

The FCC specifies that both the positive and negative modulation be limited to 100% maximum. It is possible to have over 100% positive modulation if we have a non-symetrical modulation waveform. Since this would increase our output power over 16 Watts PEP, the FCC prohibits this type of modulation.

Negative modulation over 100%, however, is not possible. Once the modulation envelope reaches 100%, the carrier is reduced to zero. Any further increase in modulation level results in a waveform like that shown in Fig. 48. The resulting clipping results in a distorted signal, and the generation of harmonics of the 27 MHz carrier. These harmonics result in signal splatter across several channels, or in severe cases into other communications bands.

The scope adapter allows checks for negative overmodulation peaks. Any amount of input signal should not result in the closing of the carrier and the resulting clipping. Transmitters are required to have peak limiting circuits to prevent this type of overmodulation.

Since a properly operating SSB transmitter has no output without modulation, a modulation signal must be applied to measure the output frequency.

To measure the output frequency:

1. Connect the antenna output to the 50 Ohm loaded input.
2. Connect the audio output of the CB42 to the microphone input using a direct connection (using the supplied audio cable) or by using the 39G102 Dynamic Mike Tester.
3. Set the transmitter function switch to the upper sideband position (USB).
4. Set the CB42's audio generator to 1000 Hz.
5. Set the CB42's audio output level to provide about 8 Watts PEP as monitored by the RF WATTS position of the DIGITAL READOUT SELECTOR.
6. Move the DIGITAL READOUT SELECTOR to the "50 OHM load" position of the EXTERNAL FREQ. function.

The output frequency of each channel may now be monitored. Remember that each channel will read 1000 Hz above the center frequency of the transmitter (since the signal being measured is actually the upper sideband which is the suppressed carrier frequency plus the modulation frequency). This difference may also be used to check the channel frequency by using the Percent Off Channel function.

SSB TRANSMITTER PERCENT OFF CHANNEL

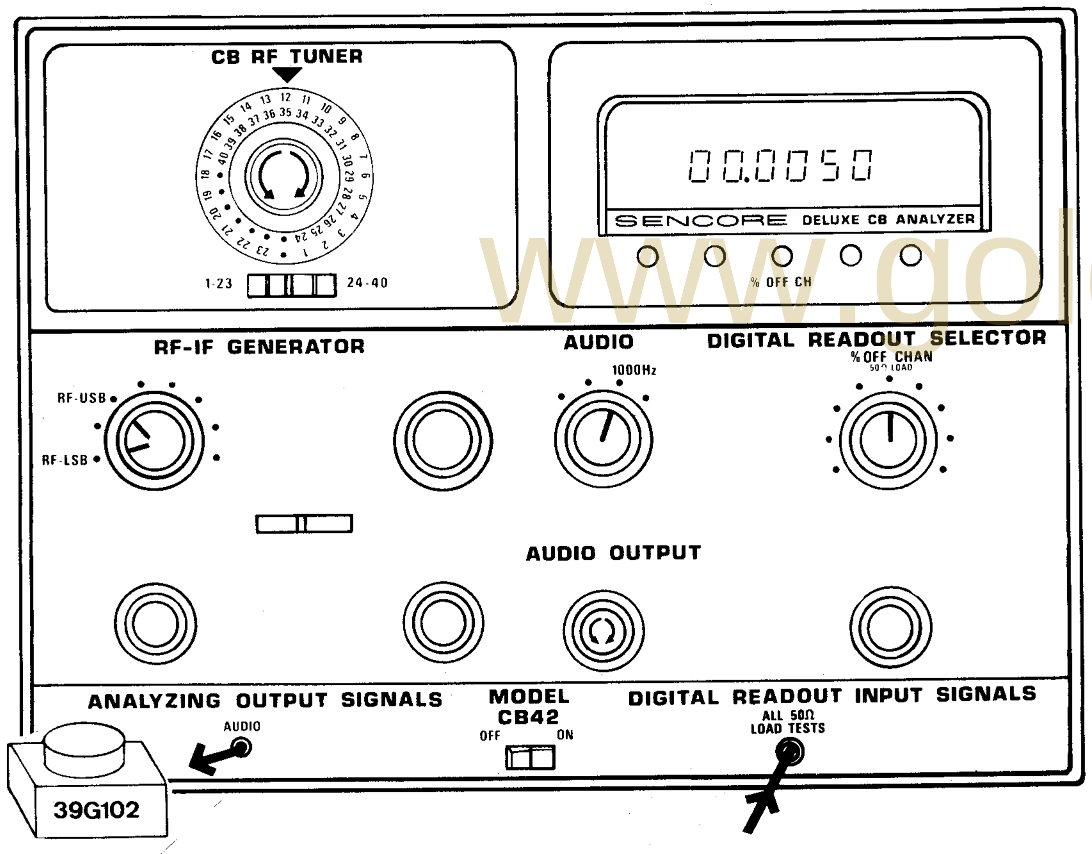


Fig. 45—Control setup for determining SSB transmitter percent off channel.

With the same cable connection used for the above test:

1. Set the DIGITAL READOUT SELECTOR to the PERCENT OFF CHANNEL position.
2. Set the RF-IF GENERATOR control to the USB position. This shifts the reference signal supplied to the % OFF CHANNEL circuits by the generator 1000 Hz above the normal carrier frequency.
3. Rotate the transmitter's channel selector knob through each of the CB channels while setting the CB RF TUNER knob to the same channel for each test.

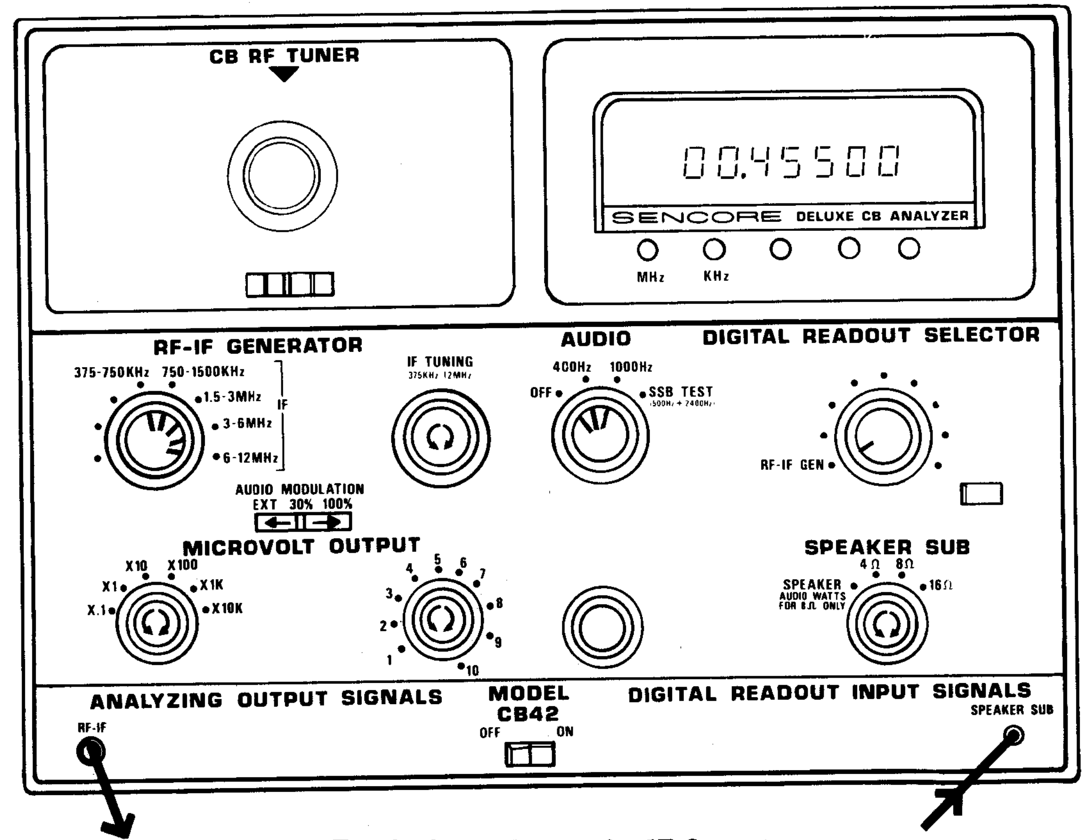


Fig. 3—Control setup for IF Output.

2. Select the modulation level desired: 0% (CW) using the EXT position of the AUDIO MODULATION switch with no external input, 30 or 100% from the internal audio generator, or an external modulation source applied through the rear-panel jack (4 V P - P = 100% modulation).
3. Select the proper internal modulation frequency if the internal audio generator is used. Use 1000 Hz for standard tests.

   NOTE: The setting of the AUDIO OUTPUT control does not affect the modulation level of the IF generator.

4. Select the frequency range of the generator by setting the RF-IF GENERATOR selector switch to the position that includes the desired IF frequency.
5. Set the DIGITAL READOUT SELECTOR to the RF-IF GEN position to read the exact IF frequency.
6. Adjust the IF TUNING control until the DIGITAL READOUT indicates the desired frequency.
7. Adjust the signal level with the two MICROVOLTS OUTPUT controls. These controls are direct reading when feeding into a 50 Ohm load. Simply read the setting of the vernier control and multiply by the step attenuator setting for the actual IF output in microvolts.

   NOTE: The output attenuator is diode-protected to prevent damage if the transmitter is keyed into the RF-IF OUTPUT jack.

AUDIO OUTPUT

The AUDIO GENERATOR provides a choice of two audio tones (400 or 1000 Hz) or a balanced two-tone SSB output. The output level is adjustable independently of the modulation of the internal RF-IF GENERATOR.

To use the AUDIO GENERATOR OUTPUT:

1. Plug either the audio cable (phono connector to alligator connectors) or the 39G102 Dynamic Mike Tester into the AUDIO OUTPUT jack on the CB42 front panel.

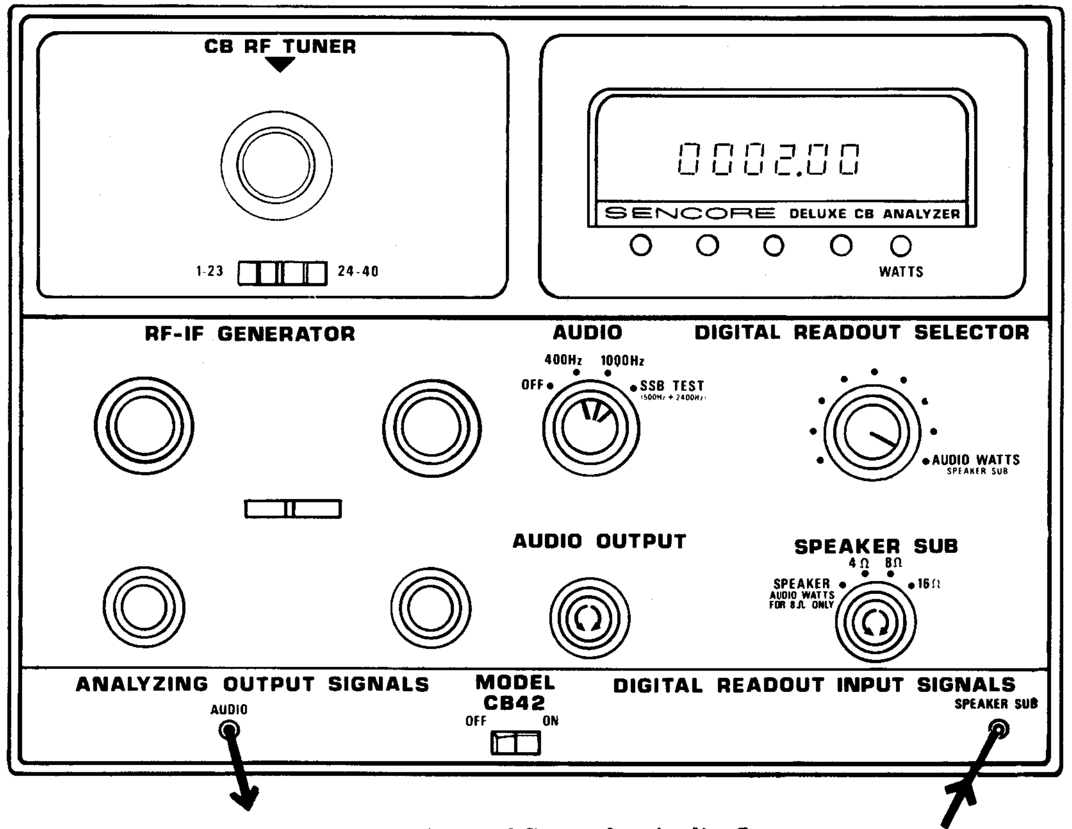


Fig. 4—Control Setup for Audio Output.

NOTE: When feeding the audio signal directly to the microphone input using the audio test lead, the level of audio signal may overdrive the mic pre-amp. Inserting a 100K Ohm resistor in series with the red test lead will usually match the output impedance of the generator to the input impedance of the pre-amp.

2. Select the audio frequency desired (400 Hz, 1000 Hz, or SSB two-tone) at the AUDIO selector switch.

3. Connect the audio cable to the desired test point or place the microphone on top of the rubber cushion on the Dynamic Mike Tester.

4. Adjust the AUDIO OUTPUT control for an adequate audio level.

NOTE: When the SSB two-tone is used for such tests as the alignment of the balanced modulator of an SSB transmitter, the audio should be fed directly into the audio circuitry of the transceiver rather than using the Dynamic Mike Tester. The reason for this is the frequency response of most CB microphones used with the Dynamic Mike Tester will cause the carefully balanced levels of the two audio signals to become unbalanced which may indicate symtoms in the transmitter that are not actually present.

FREQUENCY COUNTER

The FREQUENCY COUNTER inputs of the CB42 allow external frequencies of up to 50 MHz to be measured with the resulting frequency indicated on the DIGITAL READOUT. The counter offers both a 50 Ohm loaded input or high-sensitivity 1 Meg input.

To use the 50 OHM LOADED EXTERNAL FREQUENCY input:

1. Connect the output of the transmitter to be tested to the 50 OHM EXTERNAL FREQUENCY input jack using the supplied RF cable.

2. Select the EXTERNAL FREQ., 50 OHM LOAD position on the DIGITAL READOUT SELECTOR.

12. Switch the RF-IF CONTROL to AM.

13. With the receiver's ANL and ANB switches still turned off, turn on the NL204 and increase its output until the peak-to-peak level of the noise pulses displayed on the scope are the same as the reference in Step 11.

See yellow sheet for additional instructions

14. Turn the receiver's ANL and/or ANB switches on. Repeat the receiver sensitivity test.

NOTE: The amount of signal needed to reach the 10 dB sensitivity point should be greater than in Step 10.

15. Using the formula $dB = 20 \log_{10} \frac{E_1}{E_2}$, calculate the dB ratio of the two input voltages found in Steps 10 and 14. A dB conversion chart is found in the back of the CB42 Speed Test Setup Booklet.

The EIA specifications state that this ratio should be equal to or less than 3 dB ratio between the sensitivity figure found in Steps 10 and 14.

AM & SSB TRANSMITTER TESTS

The CB42 is equipped to perform all transmitter tests recommended by leading CB manufacturers. The following instructions, plus those tests discussed in the Operation section of this manual, give step-by-step instructions for performing these tests. If the manufacturer's instructions differ from these procedures, the manufacturer's literature should be followed.

WARNING:
FCC Regulations require that any adjustments or repairs of any transmitter which may affect its operation must be made by, or under the immediate supervision of, a person holding a First- or Second-Class Commercial Radiotelephone License. (See FCC Rules and Regulations Part 95.97.)

AM TRANSMITTER FREQUENCY

The transmitter frequency may be monitored in either of two ways--direct frequency readout, or as a percent off channel. Both of these tests are described in the general operating instructions.

SSB TRANSMITTER FREQUENCY

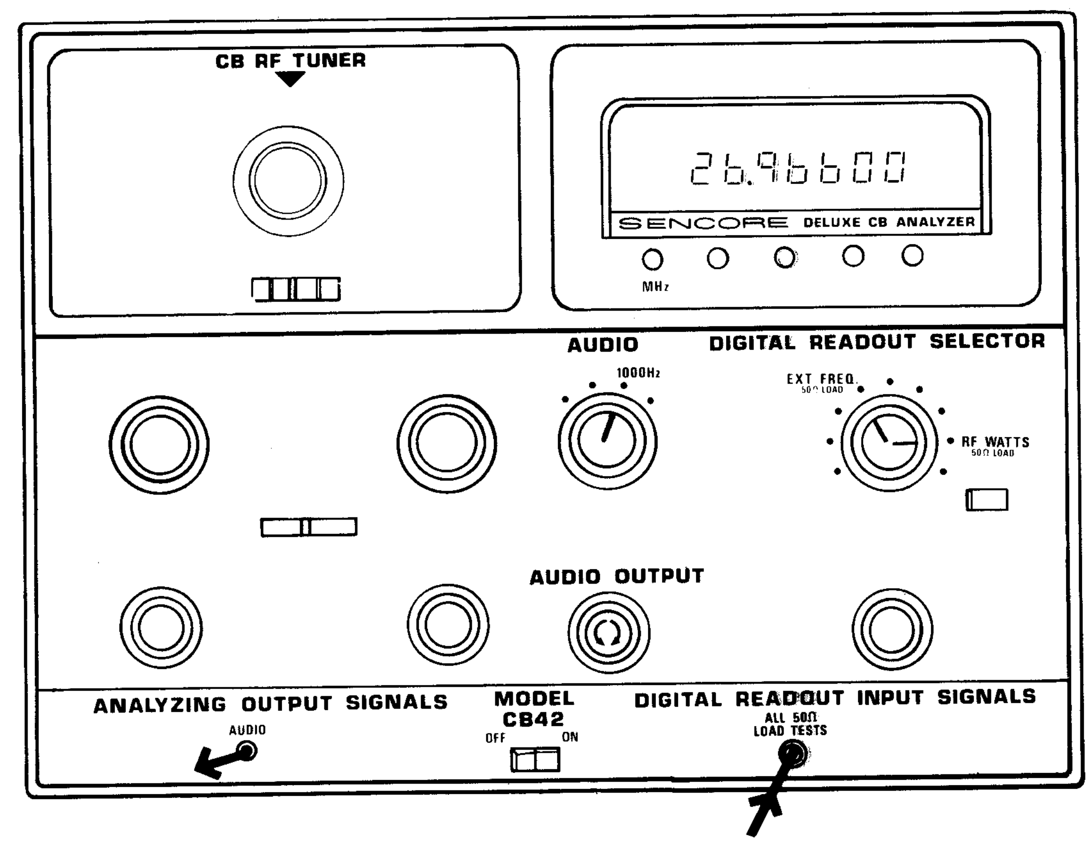


Fig. 44—Control setup for measuring SSB transmitter frequency.

SSB RECEIVER IMPULSE NOISE TEST

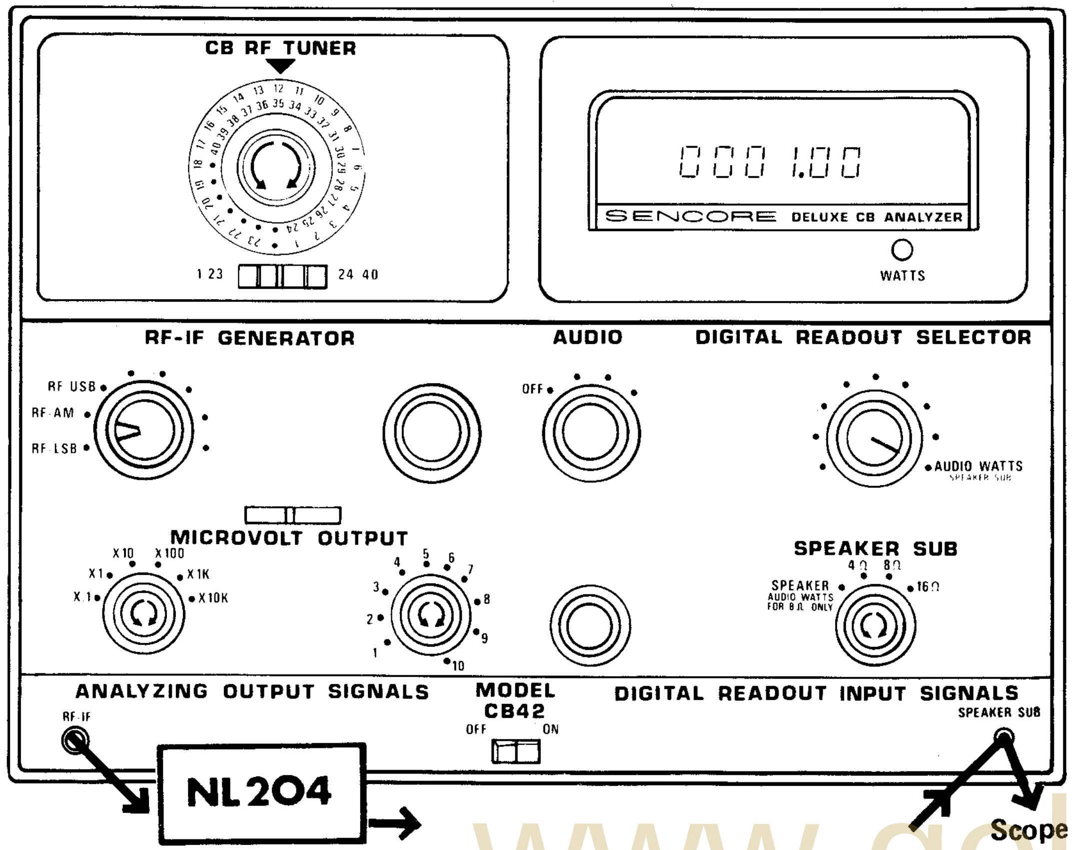


Fig. 43—Control setup for SSB AGC test.

The EIA impulse noise test indicates how well the Automatic Noise Limiter (ANL) and Automatic Noise Blanker (ANB) cancel noise pulses without drastically changing the receiver's sensitivity. The test is performed with the optional NL204 EIA Noise Pulse Simulator.

To perform the impulse noise test:

1. Supply the proper power to the CB receiver.
2. Connect the output of the CB42's RF-IF OUTPUT jack to the input of the NL204. Connect the output of the NL204 to the antenna input of the receiver using the supplied RF cable.
3. Connect the receiver's audio output to the SPEAKER SUB input jack using the supplied audio cable. Set the SPEAKER SUB control for the same impedance as the output of the receiver.
4. Set the CB RF TUNER and the SSB receiver's channel selector to the same channel with the squelch control at minimum.
5. Set clarifier by performing General SSB Receiver Test.
6. Set the MICROVOLTS OUTPUT controls to provide 1 uV of signal (x.1 and 10).
7. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
8. Connect an oscilloscope in parallel with the SPEAKER SUB connection. An audio "Y" cable may be used for this connection.
9. Set the RF-IF CONTROL switch to the LSB position.
10. With the NL204 turned off and receiver ANL and ANB switches turned off, perform the *SSB receiver sensitivity test* described previously.

    NOTE: The receiver's sensitivity should indicate about twice as many microvolts as a normal test due to the losses in the 6 dB mixing circuits of the NL204.

11. With the RF-IF CONTROL switch in the LSB position, adjust the receiver's volume control for a readout of 1.00 on the DIGITAL READOUT.

    NOTE: If a 1.00 readout cannot be obtained with the volume control at max, leave the control at max and note the readout at this point. Then use this figure as the reference point.

Note the peak-to-peak value of the audio output on the scope.

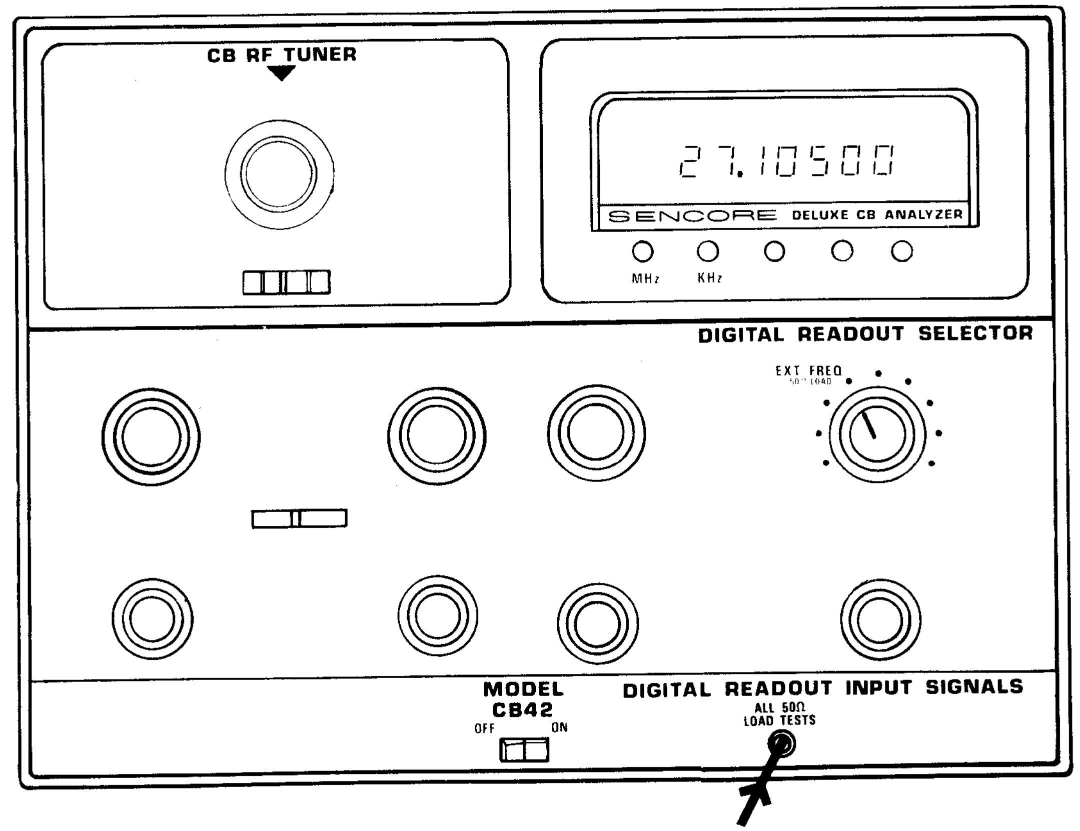


Fig. 5—Control Setup for 50 Ohm Frequency Counter.

3. Key the transmitter and read the frequency directly on the DIGITAL READOUT. If the frequency is less than 100 KHz, the FREQUENCY COUNTER will indicate KHz with the decimal point properly positioned, and the "KHz" L.E.D. lit. If the input frequency is between 100 KHz and 50 MHz, the FREQUENCY COUNTER will indicate MHz with the decimal point properly positioned, and the "MHz" L.E.D. lit.

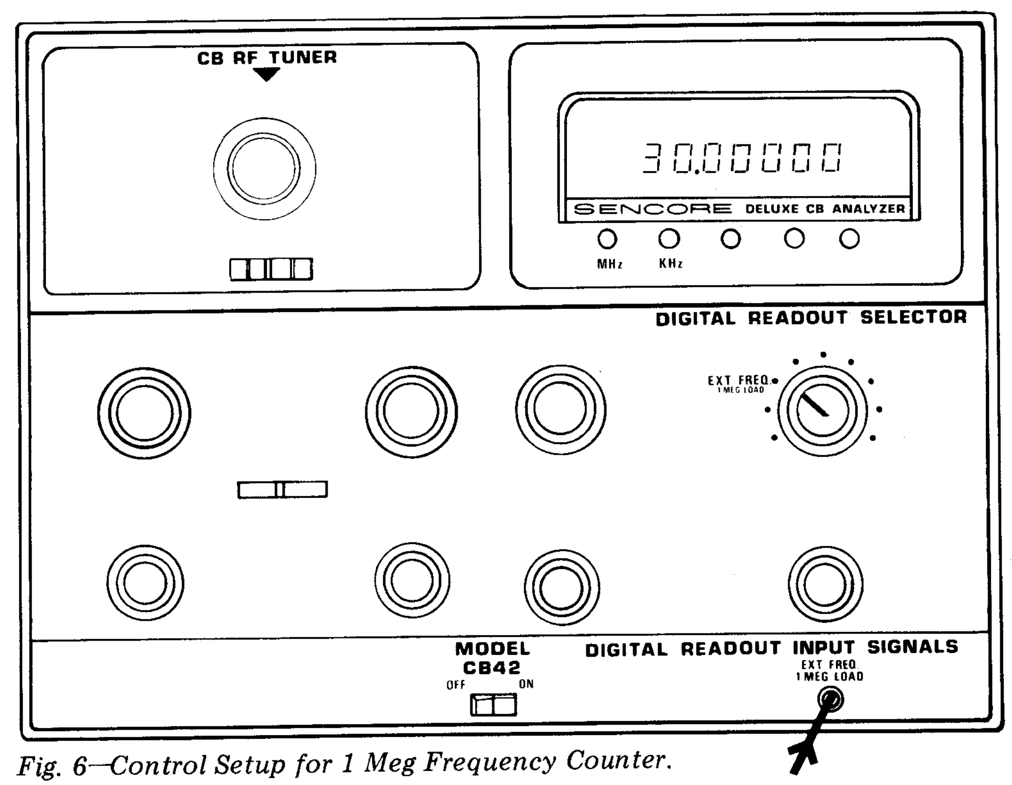


Fig. 6—Control Setup for 1 Meg Frequency Counter.

To use the 1 MEG LOADED EXTERNAL FREQUENCY input:

1. Connect the test point to be measured to the 1 MEG LOAD input using the special frequency counter test lead. This lead has a ground connection (black alligator clip) and two input leads. The red lead provides a direct connection to the counter, and the yellow lead is isolated with an internal 33 pF capacitor to minimize circuit loading.
2. Select the EXTERNAL FREQ., 1 MEG LOAD position on the DIGITAL READOUT SELECTOR.
3. Read the test point frequency on the DIGITAL READOUT. The MHz and KHz lights will display the range selected by the automatic ranging circuits of the FREQUENCY COUNTER, and the decimal point will be positioned appropriately.

PERCENT OFF CHANNEL TEST

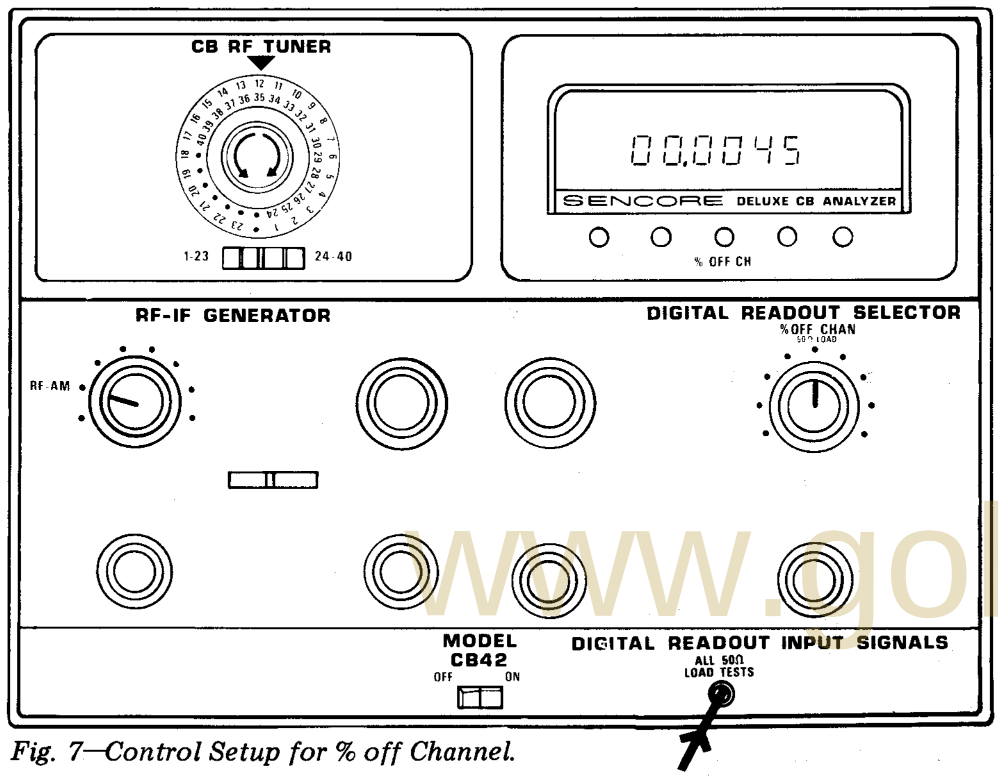


Fig. 7—Control Setup for % off Channel.

The PERCENT OFF CHANNEL test will indicate the percentage of deviation of the CB transmitter's frequency from the FCC specs on the DIGITAL READOUT.

To perform the PERCENT OFF CHANNEL test:

1. Connect the transceiver to the proper power source as described in the PREPARING FOR TEST section.
2. Connect the antenna output of the transceiver to the 50 OHM input of the CB42 using the supplied RF cable.
3. Set the DIGITAL READOUT SELECTOR to the % OFF CHAN position.
4. Set the RF-IF GENERATOR selector switch to the AM position.
5. Select the same channel on the CB RF TUNER and the transceiver under test. Key the transmitter.
6. The DIGITAL READOUT will indicate the amount of transmitter frequency error. The FCC allows a maximum error of .005%.
7. If a frequency error of more than .005% is indicated, the DIGITAL READOUT SELECTOR may be moved to the 50 OHM EXTERNAL FREQ. position to determine if the transmitted signal frequency is higher or lower than the proper frequency.

   NOTE: A reading of a transmitter frequency 0.0043-.0057% off channel would be considered questionable since the transmitted frequency is at the very limit of the FCC specs. The range given also includes the possibility of the CB RF TUNER operating slightly off channel but still within its frequency limits. The suspected bad transmitter may be retested using the EXTERNAL FREQUENCY function and referring to the upper and lower limits table found in the Test Setup Booklet.

8. Repeat the test on all transmitter channels by changing the transmitter's channel selector control at the same time as the CB RF TUNER switch.

11. Continue to decrease the MICROVOLTS OUTPUT controls until the DIGITAL READOUT indicates 0.25. This point is -16 dB from the original reading at 50,000 uV.

If the receiver meets or exceeds the EIA specifications, the settings of the MICROVOLTS OUTPUT controls should be less than or equal to the sensitivity point found with the SSB Receiver Sensitivity Test.

SSB RECEIVER SQUELCH

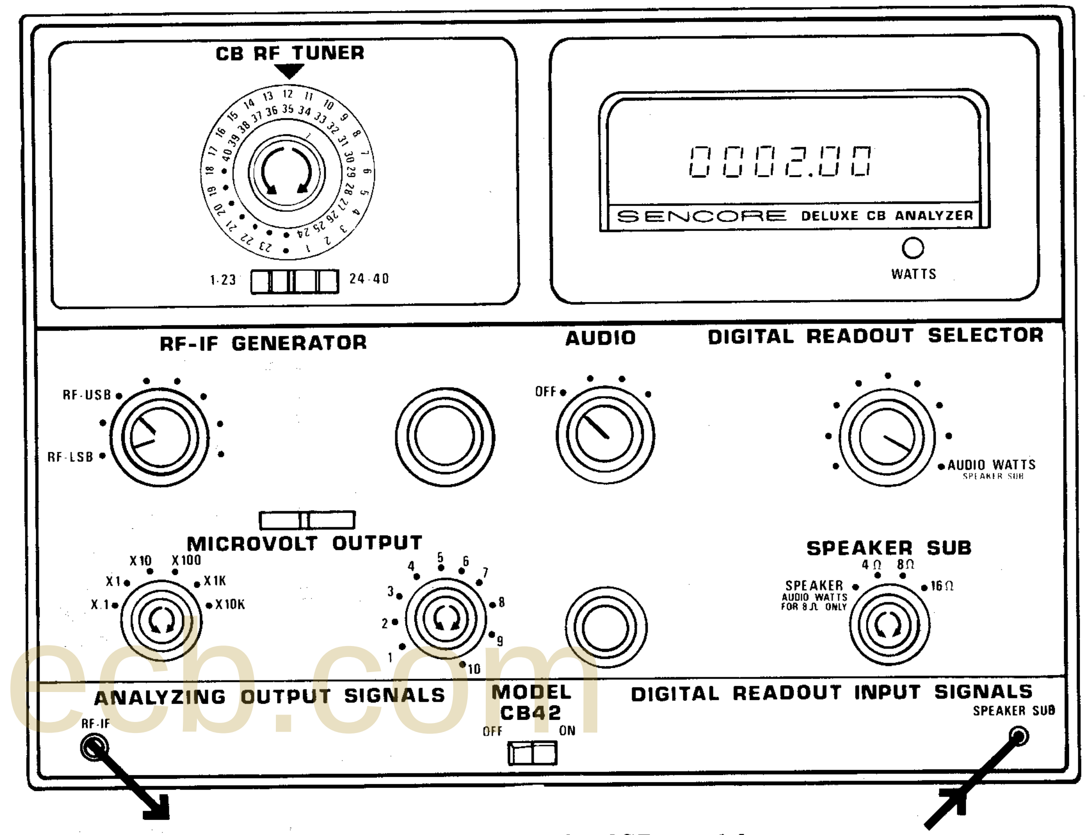


Fig. 42—Control setup for SSB squelch test.

This test indicates the point at which the squelch circuit opens when set to the maximum squelched position.

To test for squelch operation:

1. Supply the proper power to the CB receivers.
2. Connect the output of the CB42's RF-IF OUTPUT jack to the antenna input of the receiver using the supplied RF cable.
3. Connect the receiver's audio output to the SPEAKER SUB input jack using the supplied audio cable. Set the SPEAKER SUB control for the same impedance as the output of the receiver.
4. Set the CB RF TUNER and the SSB receiver's channel selector to the same channel.
5. Set clarifier by performing General SSB Receiver Test.
6. Set the receiver's squelch control to the minimum squelched (open) position.
7. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
8. Set the MICROVOLTS OUTPUT controls to provide 50 uV of signal (x10 and 5).
9. Set the RF-IF CONTROL switch to the LSB position.
10. Set the receiver's squelch control for the maximum squelch (tight) position.
11. Increase the settings of the MICROVOLTS OUTPUT controls until the reading on the DIGITAL READOUT reads more than zero.

Read the signal level from the MICROVOLTS OUTPUT controls. This is the amount of signal needed to break squelch. The EIA states that this should not be more than 500 uV.

Calculate the dB ratio of the final setting of the MICROVOLTS OUTPUT controls to the receiver's rated sensitivity using the formula $dB=20 \, Log_{10} \frac{E_1}{E_2}$.

A dB conversion chart is in the back of the CB42 Speed Test Setup Booklet. The EIA states that the minimum dB ratio is 40 dB for a properly operating receiver.

SSB RECEIVER AGC

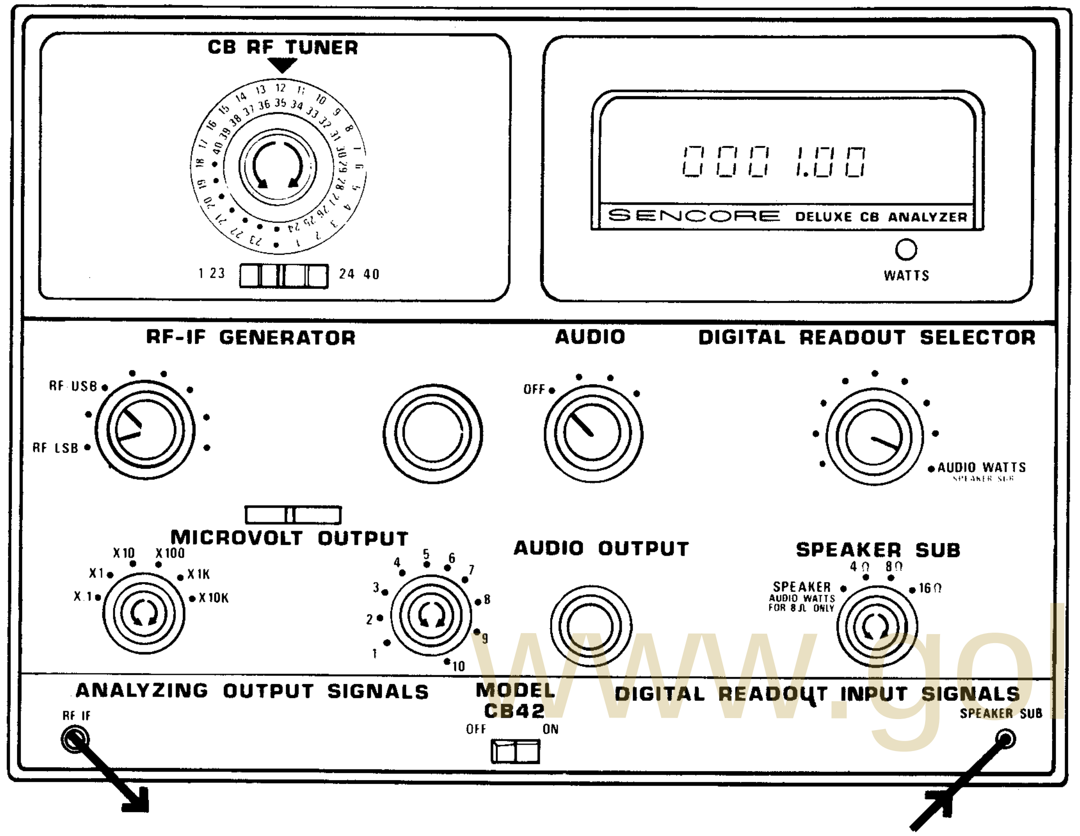


Fig. 41—Control setup for SSB AGC test.

The EIA specifies that the AGC circuits in a receiver should maintain the audio output within 16 dB with a signal input range of 50,000 uV down to the receiver's rated sensitivity.

To test the operations of the AGC circuits:

1. Supply the proper power to the CB receiver.
2. Connect the output of the CB42's RF-IF OUTPUT jack to the antenna input of the receiver using the supplied RF cable.
3. Connect the receiver's audio output to the SPEAKER SUB input jack using the supplied audio cable. Set the SPEAKER SUB control for the same impedance as the output of the receiver.
4. Set the CB RF TUNER and the SSB receiver's channel selector to the same channel.
5. Set clarifier by performing General SSB Receiver Test.
6. Set the MICROVOLTS OUTPUT controls to provide 50,000 uV of signal (x10K and 5).
7. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
8. Set the RF-IF CONTROL switch to the LSB position.
9. Set the receiver's volume control for a reading of 1.00 on the DIGITAL READOUT.
10. Decrease the MICROVOLTS OUTPUT controls until the reading of the DIGITAL READOUT drops to 0.10. Reset the receiver's volume control for a reading of 1.00 without disturbing the settings of the MICROVOLTS OUTPUT controls. At this point, the output is -10 dB from the 50,000 uV position.

CRYSTAL CHECK

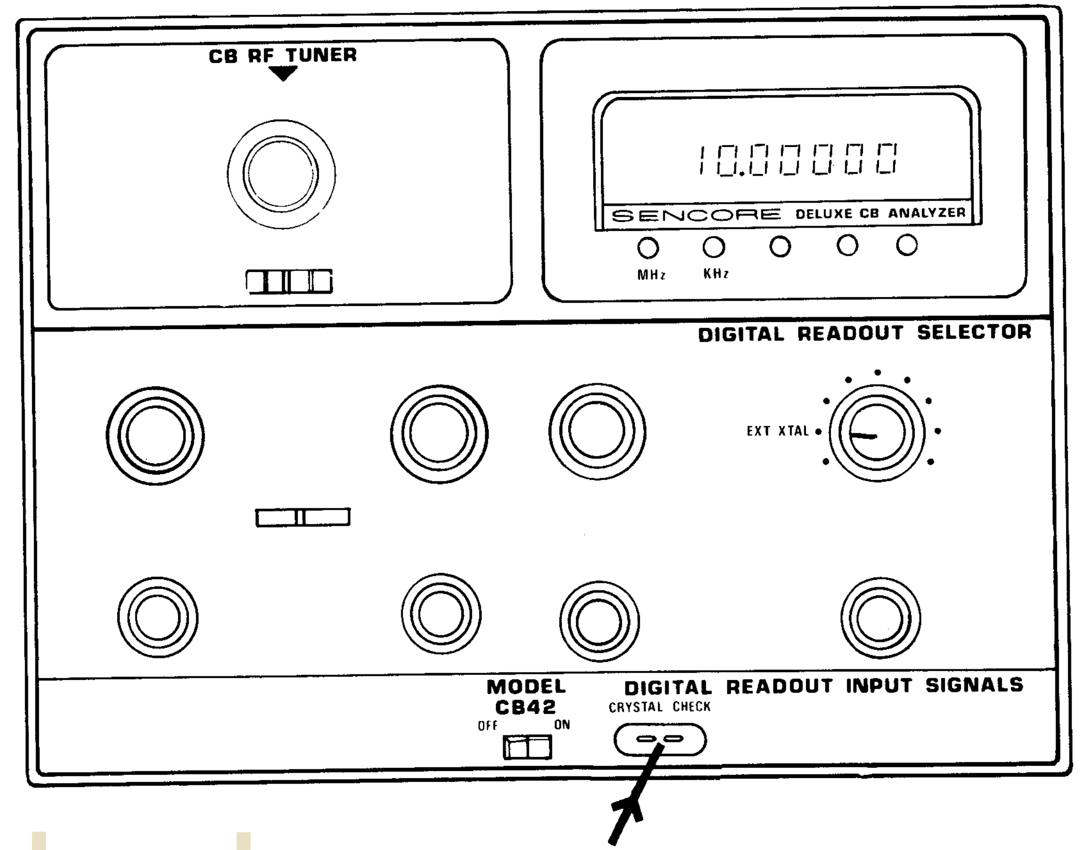


Fig. 8—Control Setup for Crystal Check.

The CRYSTAL CHECK function allows any crystal with a fundamental frequency of 1-20 MHz to be inserted into the front panel universal crystal socket to check for crystal activity. The crystal will be made to resonate at its fundamental operating frequency.

To perform the external CRYSTAL CHECK:

1. Insert the crystal to be tested into the front-panel socket marked CRYSTAL CHECK.
2. Select the EXT XTAL position of the DIGITAL READOUT SELECTOR.
3. Read the fundamental crystal frequency on the DIGITAL READOUT. Defective or inoperative crystals will be indicated by an intermittent or a zero frequency readout.

NOTE: Many crystals used in CB transceivers are designed to operate on an overtone, rather than their fundamental frequency. For example, an oscillator operating at 27.000 MHz will use a third overtone crystal with a fundamental frequency of 9.000 MHz. This fundamental frequency is the one that the CB42 will indicate. The exact operating frequency of the crystal depends on the circuit it is part of. For an exact reading of a crystal's operations, it should be measured in-circuit with the 1 Meg frequency counter input.

RF WATTMETER

WARNING: The RF power output should be checked before making any modulation or frequency tests on a CB transmitter. If the last three digits of the digital readout show a flashing "888", the transmitter is providing more than 20 Watts output. If this overrange condition is present, immediately stop testing until the power output is reduced to prevent damage to the 50 Ohm load, and possible damage to the transmitter's output stages.

The RF WATTMETER of the CB42 is designed to read the Peak-Envelope-Power (PEP) of the RF signal. This allows the same meter to read SSB PEP, or average AM carrier power.

To use the RF WATTMETER:

1. Connect the transceiver to the proper power source as described in the PREPARING FOR TEST section.
2. Connect the antenna output of the transceiver to the 50 OHM input of the CB42 using the sup-

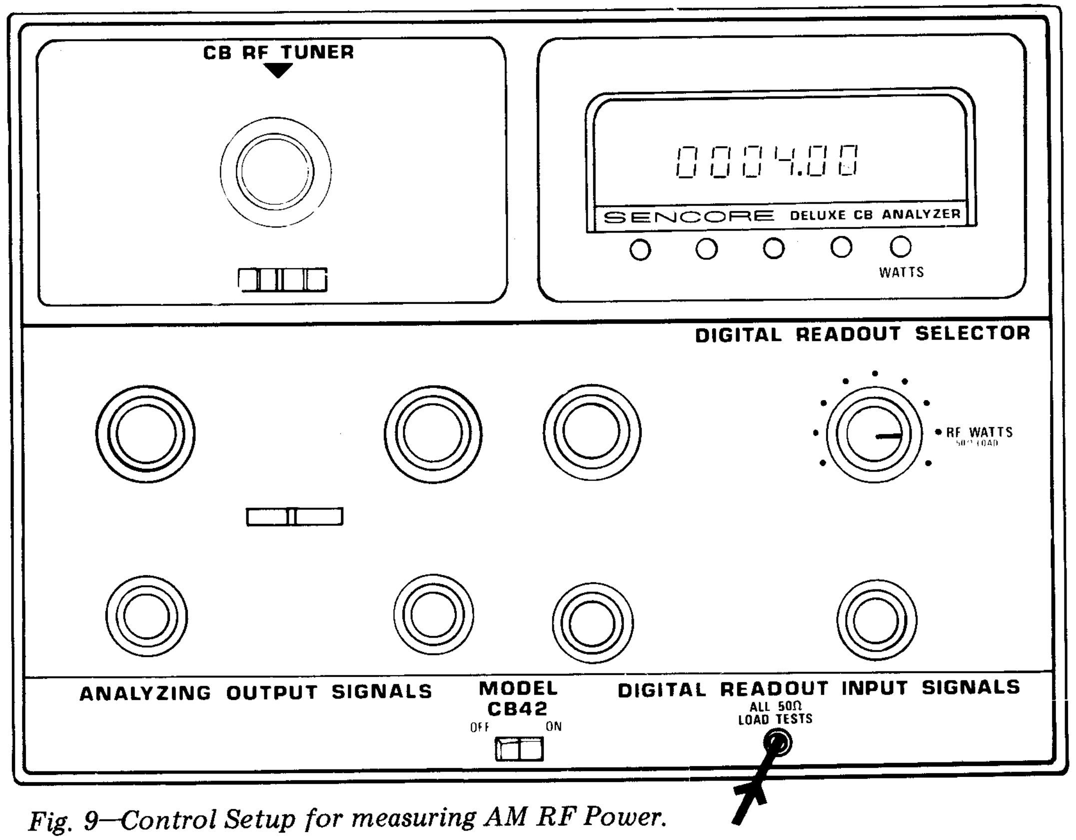


Fig. 9—Control Setup for measuring AM RF Power.

plied RF cable.

3. Select the RF WATTS function of the DIGITAL READOUT SELECTOR.

4. For AM power, key the transmitter and read the RF Watts output on the DIGITAL READOUT with no modulation applied to the microphone. The legal maximum reading is 4 Watts. With modulation, the PEP reading meter will indicate the carrier plus the sideband power of the signal. The maximum legal power for a fully modulated AM signal is 16 Watts PEP.

   NOTE: When measuring average AM carrier power, shield the mike from modulation sources as modulation will cause an increase in the RF power reading.

5. For SSB power:

   a. Plug the 39G102 Dynamic Mike Tester into the AUDIO OUTPUT jack.

   b. Select the SSB TEST position on the audio selector switch.

   c. Place the CB mike over the cushion on the Dynamic Mike Tester. Press the mike against the cushion to insure good acoustical coupling.

   d. Key the SSB transmitter with either the USB or LSB function on the transmitter selected.

   e. Gradually turn the AUDIO OUTPUT control to maximum. Most transmitters will be able to provide at least 8 Watts PEP. The legal maximum output power is 12 Watts PEP.

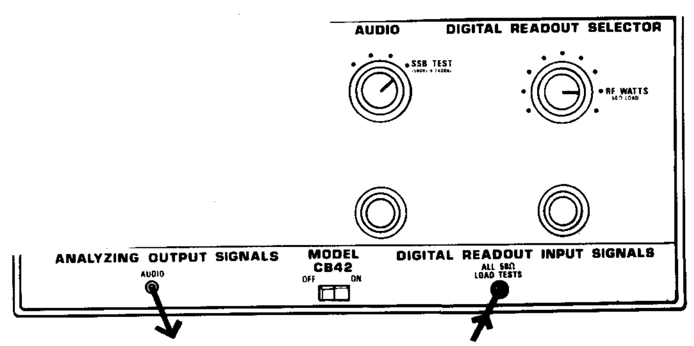


Fig. 10—Control Setup for measuring SSB RF Power.

8. Set the RF-IF CONTROL to AM.

9. Depress the S/N CHECK button and note the reading of the DIGITAL READOUT.

   With the S/N CHECK button in the "out" position, set the RF-IF CONTROL switch to the LSB position and re-adjust the MICROVOLTS OUTPUT control for the same reading on the DIGITAL READOUT as was noted in Step 9.

Note the setting of the MICROVOLTS OUTPUT controls. This setting is the 10 dB (S+N)/N sensitivity point. The test should be repeated on the USB. The sideband giving the *highest* reading is the rated receiver sensitivity.

SSB ADJACENT SIDEBAND REJECTION

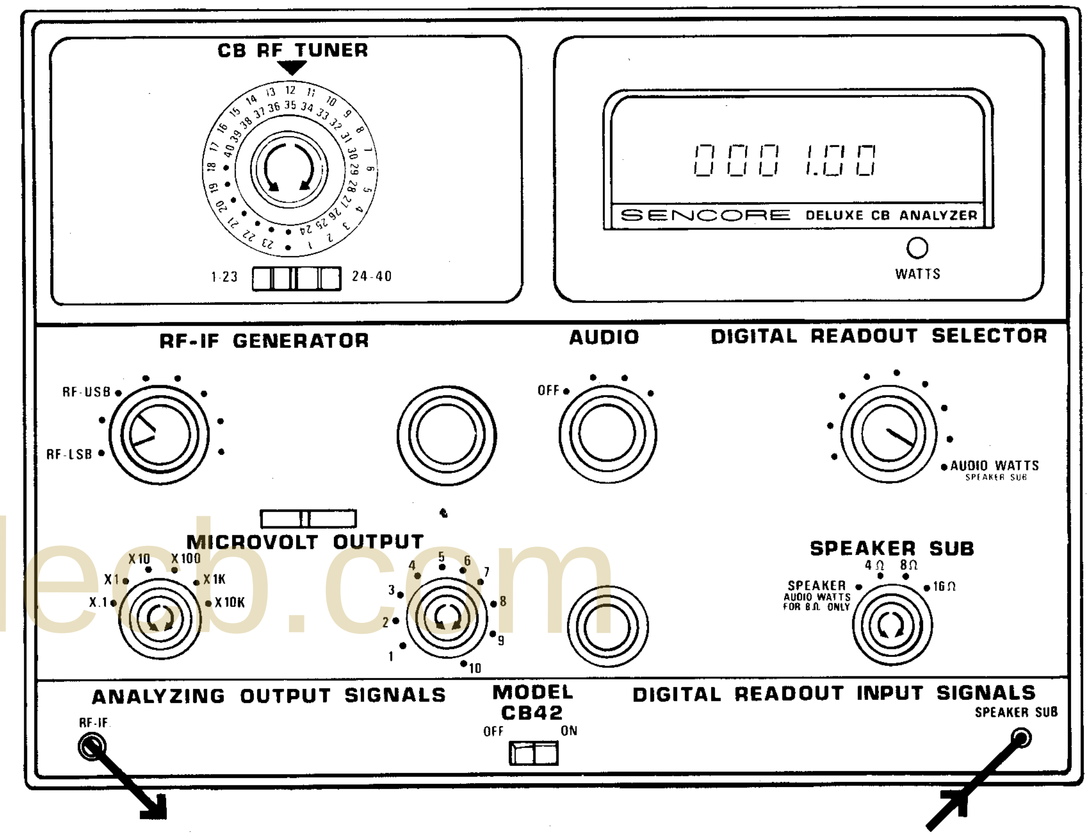


Fig. 40—Control setup for SSB adjacent sideband rejection test.

The adjacent sideband rejection of a receiver indicates how well the receiver's IF stages will reject a signal on the sideband opposite the one desired. For example: If the receiver is set for USB on channel 4, the figure indicates how well the receiver will reject a LSB signal on channel 4.

To test for adjacent sideband rejection:

1. Supply the proper power to the CB receiver.
2. Connect the output of the CB42's RF-IF OUTPUT jack to the antenna input of the receiver using the supplied RF cable.
3. Connect the receiver audio output to the SPEAKER SUB input jack using the supplied audio cable. Set the SPEAKER SUB control for the same impedance as the output of the receiver.
4. Set clarifier by performing General SSB Receiver Test.
5. Set the MICROVOLTS OUTPUT controls to the receiver's rated 10 dB sensitivity point.
6. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
7. Set the RF-IF CONTROL switch to the LSB position.
8. Set the receiver's volume control for a reading of 1.00 on the DIGITAL READOUT.
9. Set the receiver's function switch to USB.
10. Increase the setting of the MICROVOLTS OUTPUT controls for a reading of 1.00 on the DIGITAL READOUT.

7. Set the MICROVOLTS OUTPUT controls to provide 50 uV of signal (x 10 and 5).

8. Adjust the receiver volume control to maximum.

9. Set the DIGITAL READOUT SELECTOR to EXT FREQ (1 Meg load) position.

10. Adjust the receiver clarifier for a reading on the DIGITAL READOUT of 1.00 KHz.

11. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS positon.

12. Read the audio output power on the DIGITAL READOUT. A properly operating receiver should provide 2-4 Watts.

This test may be performed on each of the channels by rotating the channel selector switch of the receiver at the same time as the CB RF TUNER. It should not be necessary to reset the clarifier control for each channel. Changes in the output frequency of more than 1 KHz indicates an off-frequency crystal in the receiver local oscillator. This test may also be made on the USB function by repeating Steps 9-12. If the clarifier must be shifted more than 15° for a 1 KHz readout, the alignment of the receiver should be considered.

SSB RECEIVER SENSITIVITY

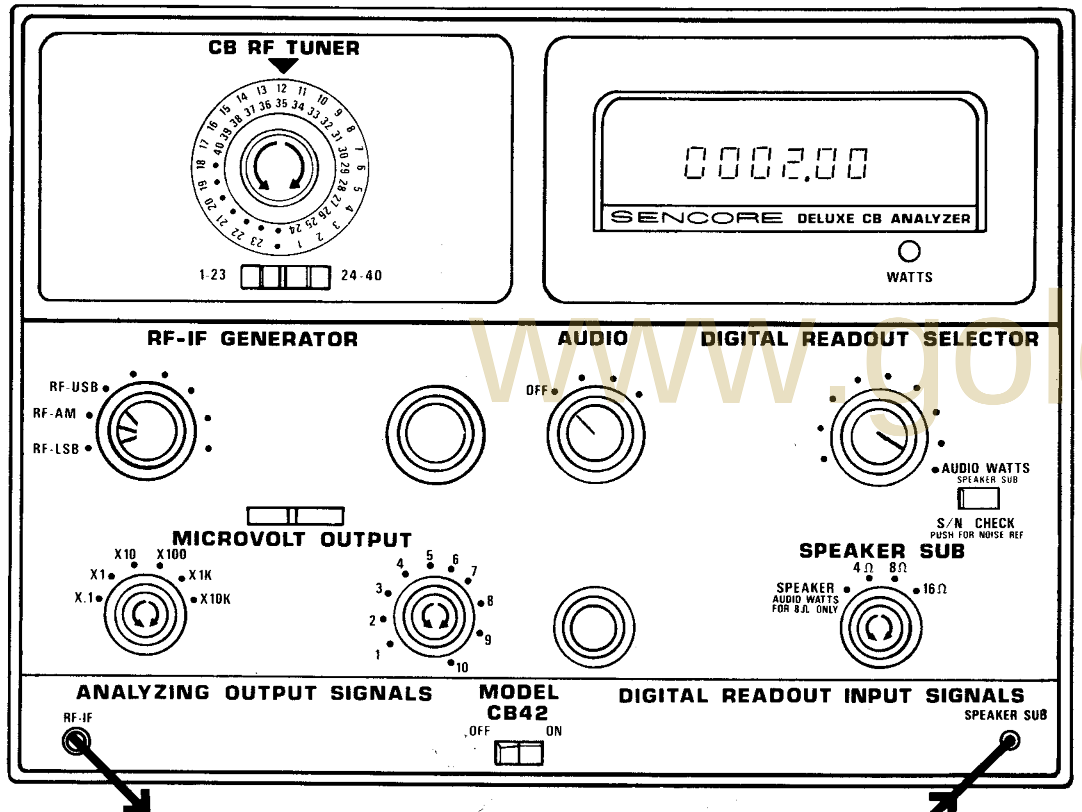


Fig. 39—Control setup for determining SSB receiver sensitivity.

The EIA defines receiver sensitivity as the point where the signal plus noise (S+N) is 10 dB greater than the noise (N) of the receiver. The formula for sensitivity is $10\ \text{dB}: \frac{(S+N)}{(N)}$.

To test for receiver sensitivity:

1. Supply the proper power to the SSB receiver.
2. Connect the output of the CB42's RF-IF OUTPUT jack to the antenna input of the receiver using the supplied RF cable.
3. Connect the receiver audio output to the SPEAKER SUB input jack using the supplied audio cable. Set the SPEAKER SUB control for the same impedance as the output of the receiver.
4. Set clarifier by performing General SSB Receiver Test.
5. Set the receiver's function switch to LSB.
6. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
7. Set the MICROVOLTS OUTPUT controls to provide 1 uV of signal (x.1 and 10).

PERCENT MODULATION & DISTORTION

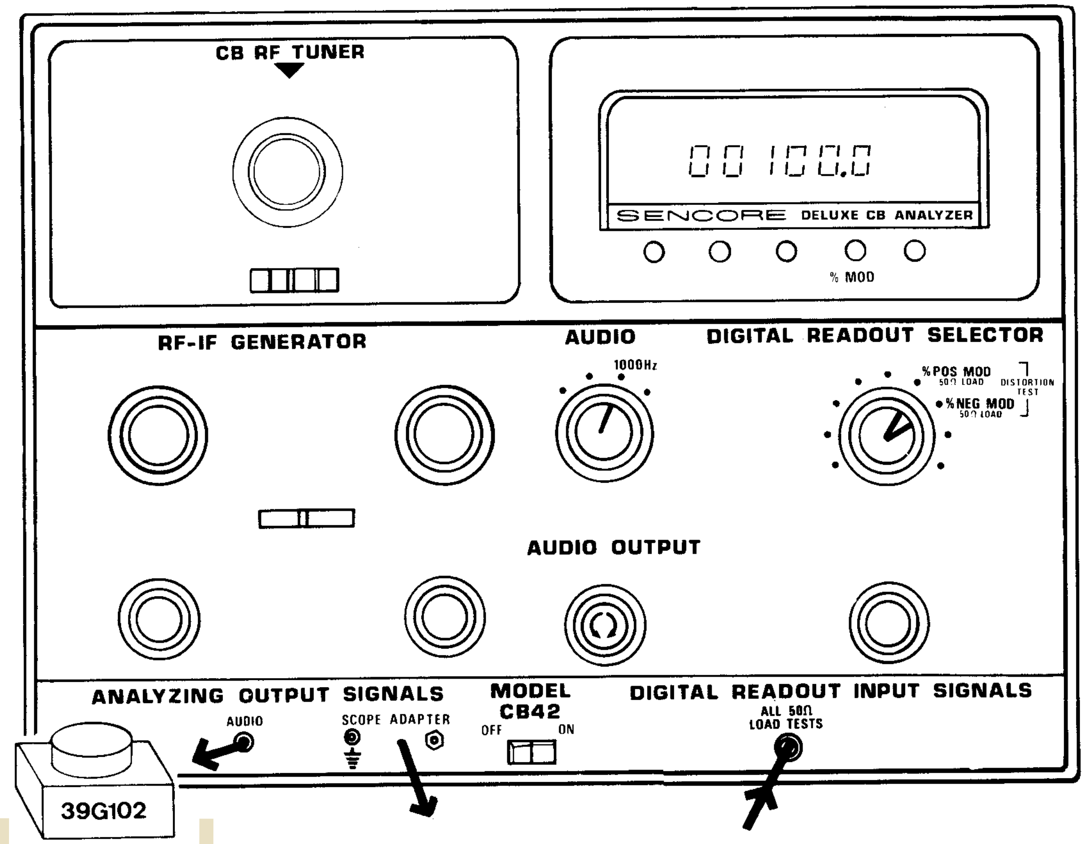


Fig. 11—Control Setup for measuring AM modulation.

The PERCENT MODULATION function of the CB42 will read either positive or negative modulation of an AM transmitter. The positive modulation test indicates as much as 200% modulation, and the negative modulation will indicate as much as 95% modulation. By comparing the positive and negative modulation, an indication of modulator distortion is realized.

To test for modulation:

1. Connect the transceiver to the proper power source as described in the PREPARING FOR TEST section.

2. Connect the antenna output of the transceiver to the 50 OHM input of the CB42 using the supplied RF cable.

3. Plug the 39G102 Dynamic Mike Tester into the AUDIO OUTPUT jack.

4. Place the AUDIO selector switch into the 1000 Hz position.

5. Select the % NEG MOD function on the DIGITAL READOUT SELECTOR.

6. Place the CB mike over the cushion on the Dynamic Mike Tester. Press the mike against the cushion to insure good acoustic coupling and to eliminate extraneous noises from affecting the test.

7. Key the transmitter and increase the AUDIO OUTPUT control until a reading of 80% negative modulation is obtained.

8. Switch the DIGITAL READOUT SELECTOR to the % POS MOD position. The modulation should indicate between 70 and 90%. If the reading is outside this range, the modulator and audio driver circuits may be defective and causing modulation distortion.

9. Increase the AUDIO OUTPUT control to full output. The transmitter's peak limiter should prevent modulation of over 100% if functioning properly. Most transmitters will limit modulation to 90-95%.

NOTE: Modulation may also be monitored using the scope adapter output. See applications section beginning on Page 43 for details.

AUDIO WATTS AND SPEAKER SUB

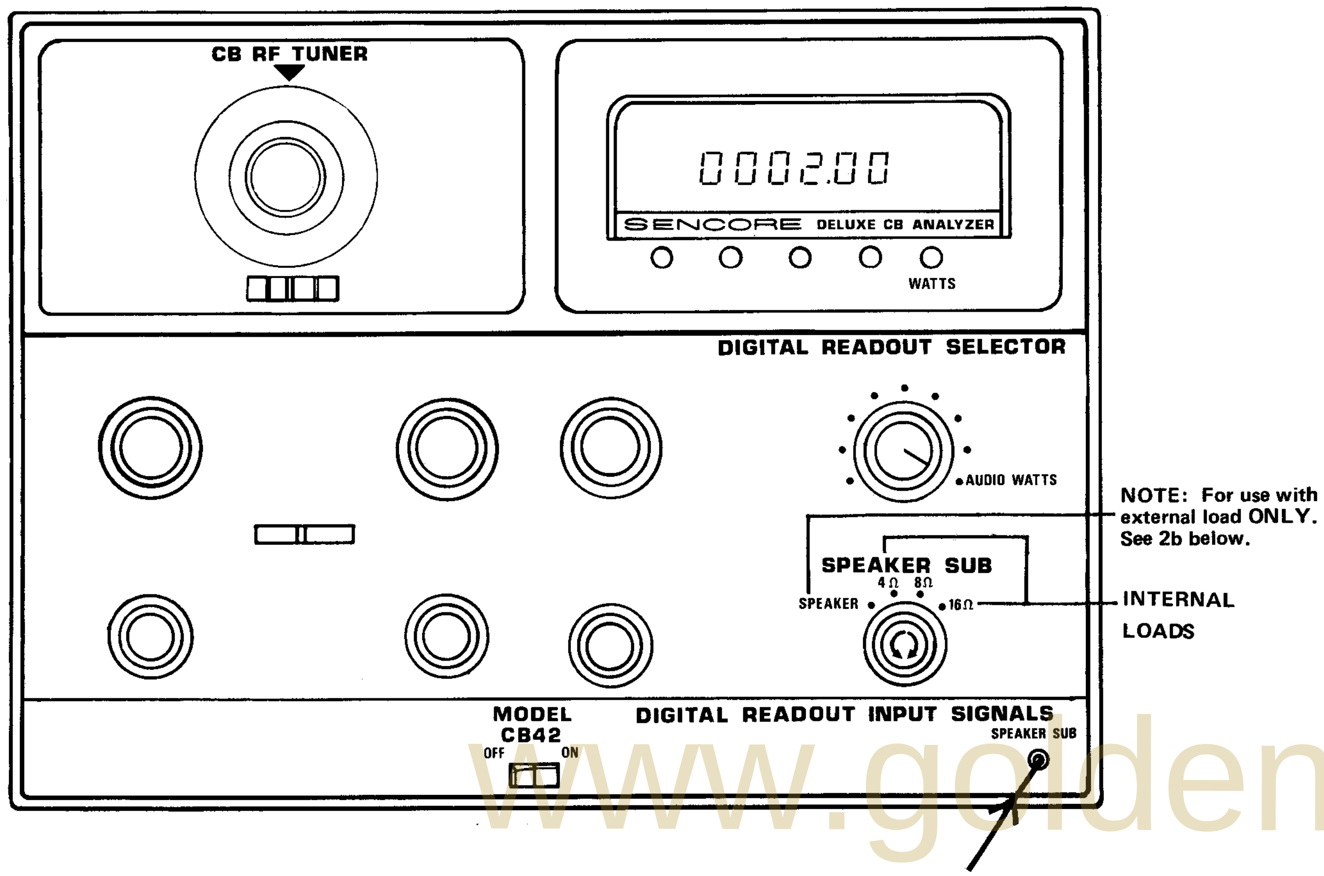


Fig. 12—Control Setup for measuring Audio Power.

The internal SPEAKER SUB provides a matched and calibrated load for audio power measurements and eliminates unwanted audio noise during routine testing. The SPEAKER SUB used in conjunction with the AUDIO WATTS function of the DIGITAL READOUT provides a convenient method of determining receiver output power and receiver sensitivity.

To use the AUDIO WATTS and SPEAKER SUB:

1. Connect the speaker output to the SPEAKER SUB input jack using one of the supplied audio cables. Since most receivers have a miniature phone jack for the external speaker output, one of the audio cables is supplied with a miniature phone plug. The other cable provides alligator connectors for direct connection to a speaker or internal connection.

2. Select a rated speaker load using the SPEAKER SUB switch.
   a. The internal 10 Watt load is used to provide 4, 8, or 16 Ohm termination. When the internal SPEAKER SUB is used, the AUDIO WATTS function reads the output power directly.
   b. If an *external speaker or load is used*, select the SPEAKER position on the SPEAKER SUB switch. In this position, the AUDIO WATTS function will read directly if an 8 Ohm load is used. If a 4 Ohm load is used, the reading of the AUDIO WATTS function must be doubled. If a 16 Ohm load is used, the reading must be halved for the actual audio power.

3. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position. The DIGITAL READOUT will now read the audio output power of the amplifier section in RMS Watts.

NOTE: For specific applications of the AUDIO WATTS function, see the Applications Section.

SPECIAL APPLICATIONS OF DYNAMIC MIKE TESTER

In addition to using the Dynamic Mike Tester for injecting signals to the transmitter, it may also be used as a substitute speaker for a receiver with a suspected bad speaker. Simply use the proper audio adapter (available from most electronics distributors) to connect the standard RCA phono plug to whatever type of connector is used for the output of the receiver for external speaker use. The Dynamic Mike Tester will now function as the unit's speaker.

SSB RECEIVER TESTS

GENERAL SSB RECEIVER TEST/CLARIFIER ADJUSTMENT

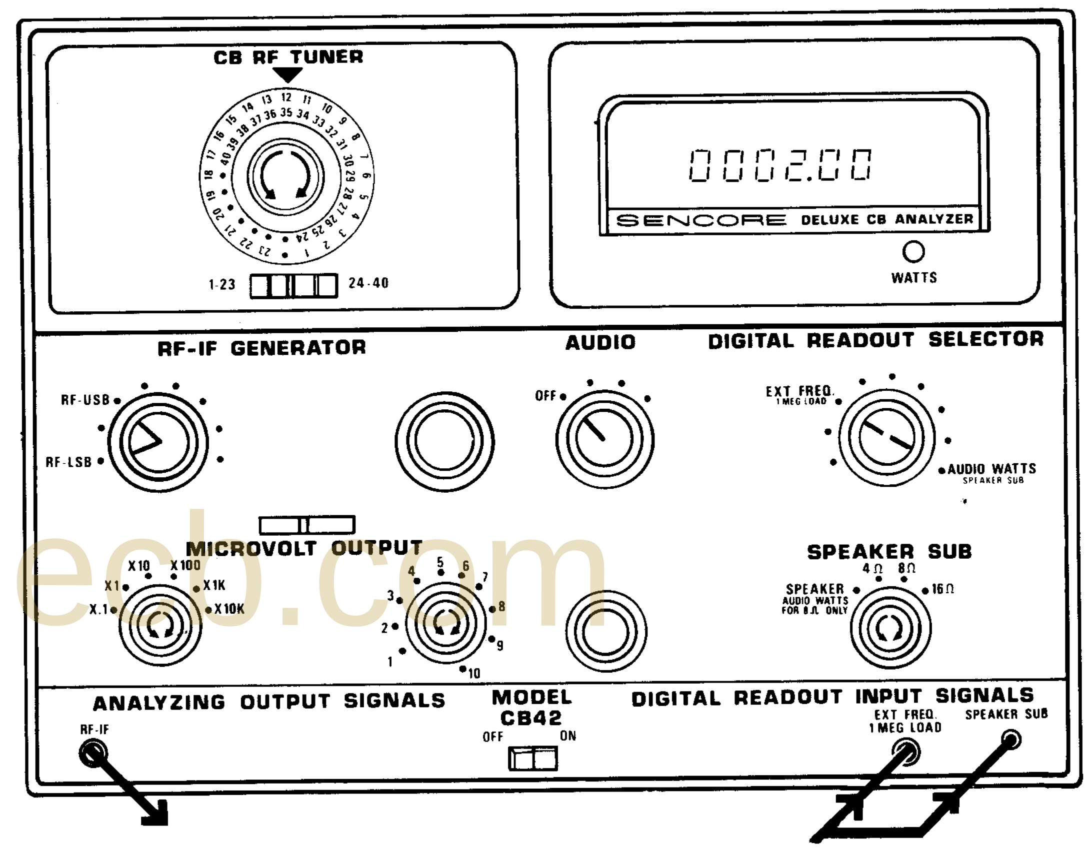


Fig. 38—Control setup for general SSB receiver test.

This test determines if the SSB receiver is operating properly before being tested for complete specifications. Checking all channels will indicate any defective synthesizer crystals or defective PPL programming switch contacts.

The setting of the clarifier (voice lock) control is necessary before any other receiver tests are made. **Once the clarifier is set as indicated in this general test, it should be left at the final setting for all other tests.** If the clarifier is not mechanically centered at the conclusion of the test, the manufacturer's instructions for centering should be consulted.

To test the general operation of the SSB receiver:

1. Supply the proper power to the SSB receiver.
2. Connect the output of the CB42's RF-IF OUTPUT jack to the antenna input of the receiver using the supplied RF cable.
3. Connect the receiver's audio output to the SPEAKER SUB input jack using the supplied audio cable. Set the SPEAKER SUB switch for the same impedance as the output of the receiver.
4. Make an audio connection from the SPEAKER SUB input to the 1 MEG COUNTER input. The use of an audio "Y" adapter available through most electronics parts distributors will assist in making this connection.
5. Set the CB RF TUNER and the SSB receiver's channel selector to the same channel with the squelch control at minimum.
6. Set the RF-IF CONTROL switch and the SSB receiver's function switch to LSB.

The impulse noise limiter test determines the effectiveness of the Automatic Noise Limiter (ANL) or Automatic Noise Blanker (ANB) circuits in the receiver. These circuits are designed to reduce interference from such sources as automotive ignition systems and high power AC lines. The test requires the use of the optional NL204 Noise Pulse Simulator. The NL204 consists of a noise spike generator which feeds a 1 Volt Peak-to-Peak signal into a 6 dB "T" mixing pad. In operation, the output of the spike generator is mixed with the signal output of the CB42 and a signal-to-noise test performed.

To test the operations of the ANL and ANB circuits:

1. Supply the proper power to the CB receiver.
2. Connect the output of the CB42's RF-IF OUTPUT jack of the INPUT JACK of the NL204.
3. Connect the OUTPUT JACK of the NL204 to the antenna input jack of the receiver.
4. Set the receiver ANL switch on, and squelch to minimum.
5. Set the CB RF TUNER to the same channel as the receiver.
6. With the NL204 turned off, perform the EIA Sensitivity Test as described previously.

   NOTE: Since the output of the CB42 is dropped 6 dB by the mixing circuits of the NL204, the receiver should require twice as much output from the CB42 for this test as compared to the standard sensitivity test.

7. Note the setting of the MICROVOLTS OUTPUT controls for the 10 dB (S+N)/N point.
8. Adjust the NL204 to the calibrated 1 V P-P position, and repeat the EIA Sensitivity Test. More output from the CB42 should be required to reach the second 10 dB point.

The EIA specifies that the two points should be less than 10 dB apart. Calculate the dB ratio of the two signals using the formula $dB = 20\ Log_{10}\frac{E_1}{E_2}$, or refer to the table in Fig. 37 to determine if the two microvolt readings are less than 10 dB apart. If the ratio is more than 10 dB, improper operation of the ANL or ANB circuits should be considered.

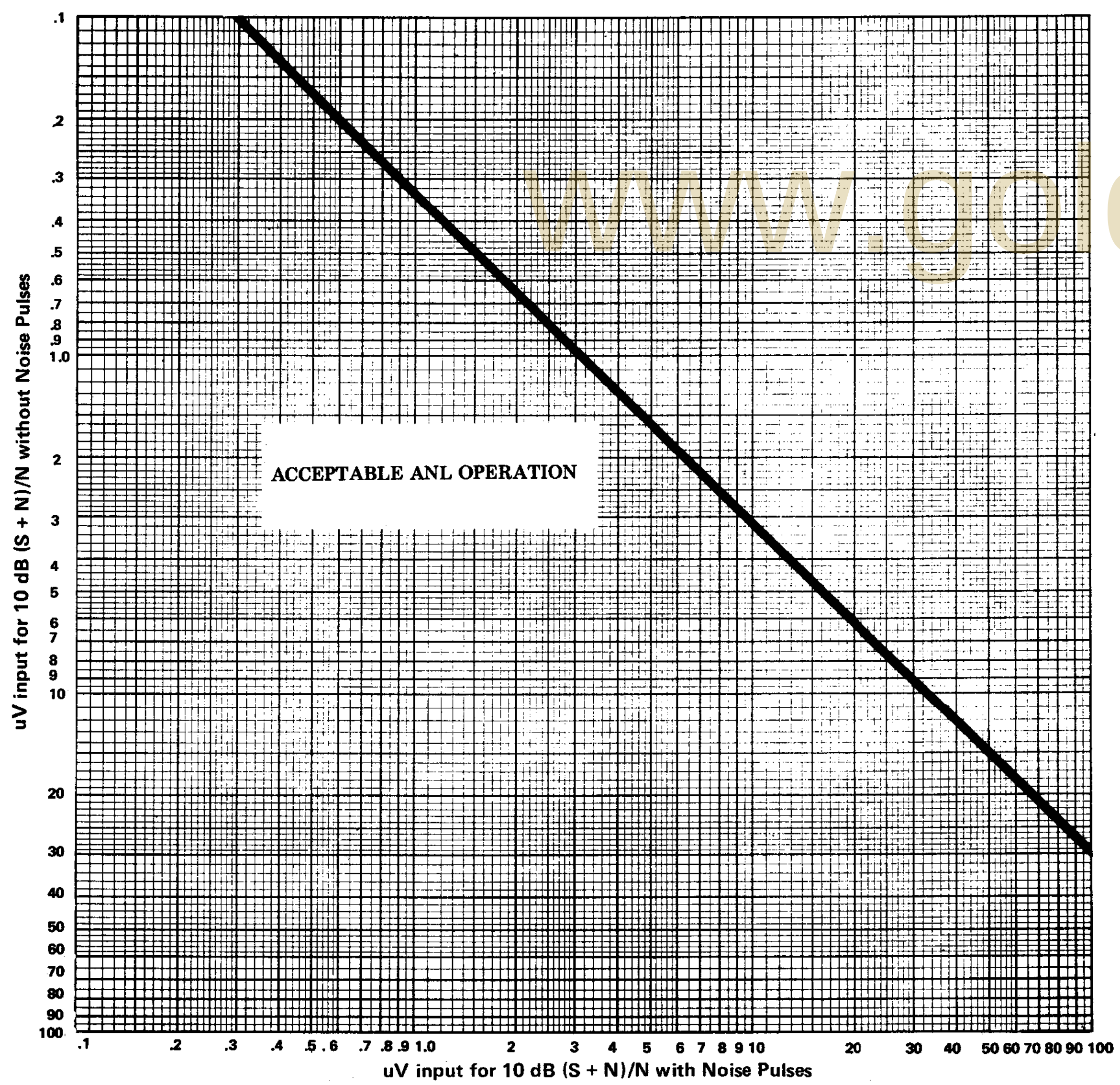


Fig. 37—Chart for determining acceptable ANL operation.

SCOPE ADAPTER

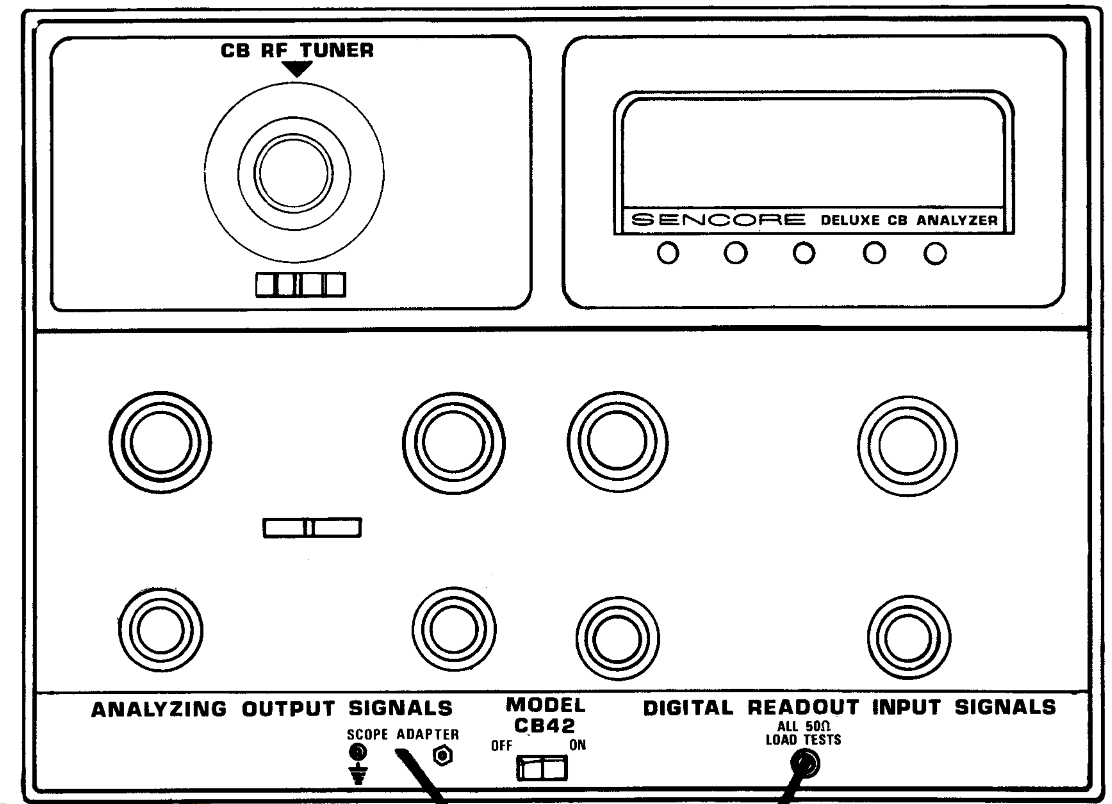


Fig. 13—Control Setup for using scope adapter.

The SCOPE ADAPTER output provides a converted output of the modulation envelope present at the 50 OHM input at a frequency under 1 MHz. This allows any general purpose scope (with a bandwidth of at least 1 MHz) to be used for analysis of the modulation envelope. Specific applications of this output are listed in the Applications Section.

To use the SCOPE ADAPTER:

1. Connect the oscilloscope vertical input probe to the SCOPE ADAPTER output jack on the CB42. Connect the scope ground lead to the black binding post. Set the scope vertical amplifier to 1 Volt per division.
2. Connect the RF output of the CB radio to the 50 OHM LOAD input jack of the CB42 using the supplied RF cable.
3. Key the transmitter. The scope display will show the carrier information (.5 V P-P indicates about 1 Watt RF).
4. Modulate the carrier of the transmitter. The use of the AUDIO OUTPUT and the 39G102 Dynamic Mike Tester provides a convenient method of modulating the carrier. The scope will now show the modulation envelope. Adjust the scope for proper sync on this composite waveform.

   NOTE: The scope adapter will provide an output with a signal applied to the 50 OHM LOAD input jack, regardless of the position of the DIGITAL READOUT SELECTOR.

See pages 43 through 46 of the applications section for special scope adapter applications.

APPLICATIONS

TRANSCEIVER THEORY & TROUBLESHOOTING

INTRODUCTION

CB Transceivers differ greatly from model to model. Some may use tubes, transistors, or ICs while others are hybrids made up of more than one type of active components.

Most transceivers, however, follow standard block diagrams. By studying the block diagrams for various types of transmitter and receiver sections, it is easier to interpret the manufacturer's schematic diagrams.

The following block diagrams cover the most common types of CB transceivers. Each diagram also contains notes as to the type of troubleshooting techniques--signal injection or signal tracing--that may be used with the CB42 CB Analyzer.

The CB42 is equipped to inject signals into any stage--from the antenna input to the speaker of a receiver, or from the microphone to the antenna output of a transmitter. When used for signal tracing, the frequency counter becomes a valuable tool. A second tracing aid is a high-sensitivity volt meter such as the Sencore DVM38 used with a RF probe such as the Sencore 39G3.

The block diagrams cover AM transmitters and receivers, and then SSB transmitters and receivers.

AM TRANSMITTER

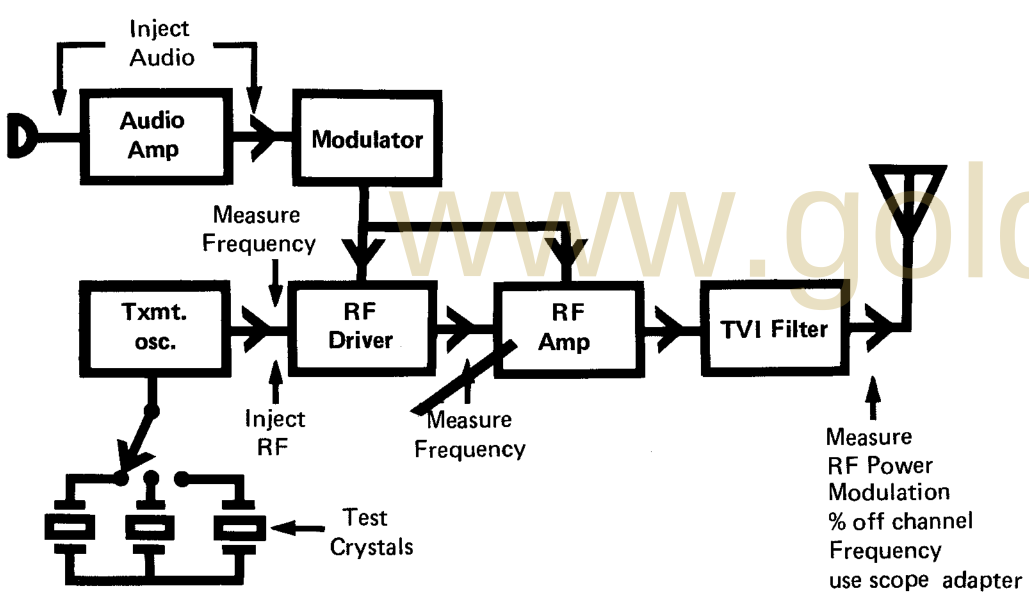


Fig. 14—Typical AM transmitter.

An AM transmitter requires two signals to provide the amplitude modulated output that is fed to the antenna. The first is an RF signal operating at the CB channel frequency. FCC rules require that this signal must be supplied by a crystal controlled oscillator. The RF carrier must be within .005% of the specified channel frequency.

This RF signal is amplified and fed to a stage or set of stages that can be modulated. One common method of providing this modulation is to take the output of the audio amplifier and feed it to the collectors of the RF amplifier transistors. The bias on the collectors now changes in step with the audio signal while the RF signal is applied to the base of the driver transistor. The result is amplitude modulation of the RF carrier.

Filtering stages (TVI filters) are added at the output of the RF amplifier to eliminate any harmonic content which would cause interference in other communications bands.

AM RECEIVER

There are two basic types of AM receivers in general use. Lower priced receivers use *single conversion* superhetrodyne receivers. In this receiver, the incoming RF signal is mixed with the signal of a local oscil-

The gain of a receiver is the ratio of the output power to the amount of antenna input power. The use of the CB42's audio wattmeter simplifies this test, since the output signal is read as a power rather than a voltage. This means that the output impedance and voltages do not need to be calculated for the power ratio. The accompanying graph shows the amount of receiver gain in dB using a 1.00 Watt output as a reference.

To determine receiver gain:

1. Supply the proper power to the CB receiver.
2. Connect the output of the RF-IF OUTPUT jack to the receiver's antenna jack using the supplied RF cable.
3. Connect the audio output of the receiver to the SPEAKER SUB input of the CB42 using the supplied audio cable. Set the SPEAKER SUB switch to the proper impedance to match the output of the receiver.
4. Set the CB CHANNEL TUNER to the same channel as the CB receiver.
5. Set the internal audio generator to 1000 Hz and the AUDIO MODULATION switch to 100%.
6. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
7. Set the receiver's volume control to maximum gain, and squelch to minimum.
8. Adjust the MICROVOLTS OUTPUT controls for a reading of 1.00 Watts on the DIGITAL READOUT.
9. Read the setting of the MICROVOLTS OUTPUT controls to determine the amount of input necessary for a 1.00 Watts readout.
10. The receiver gain is the point on the graph indicated by the setting of the MICROVOLTS OUTPUT controls. EXAMPLE: A reading of 1 uV indicates a gain of 137 dB.

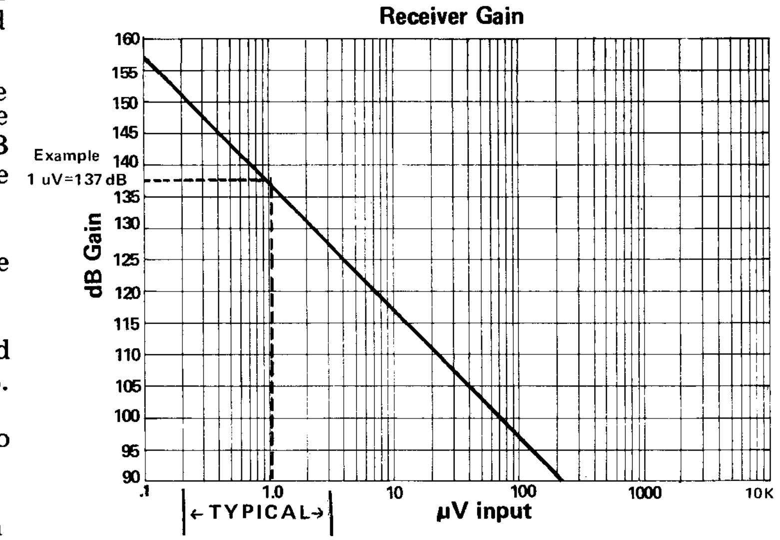


Fig. 35—Chart for determining dB of receiver gain.

EIA IMPULSE NOISE LIMITER TEST

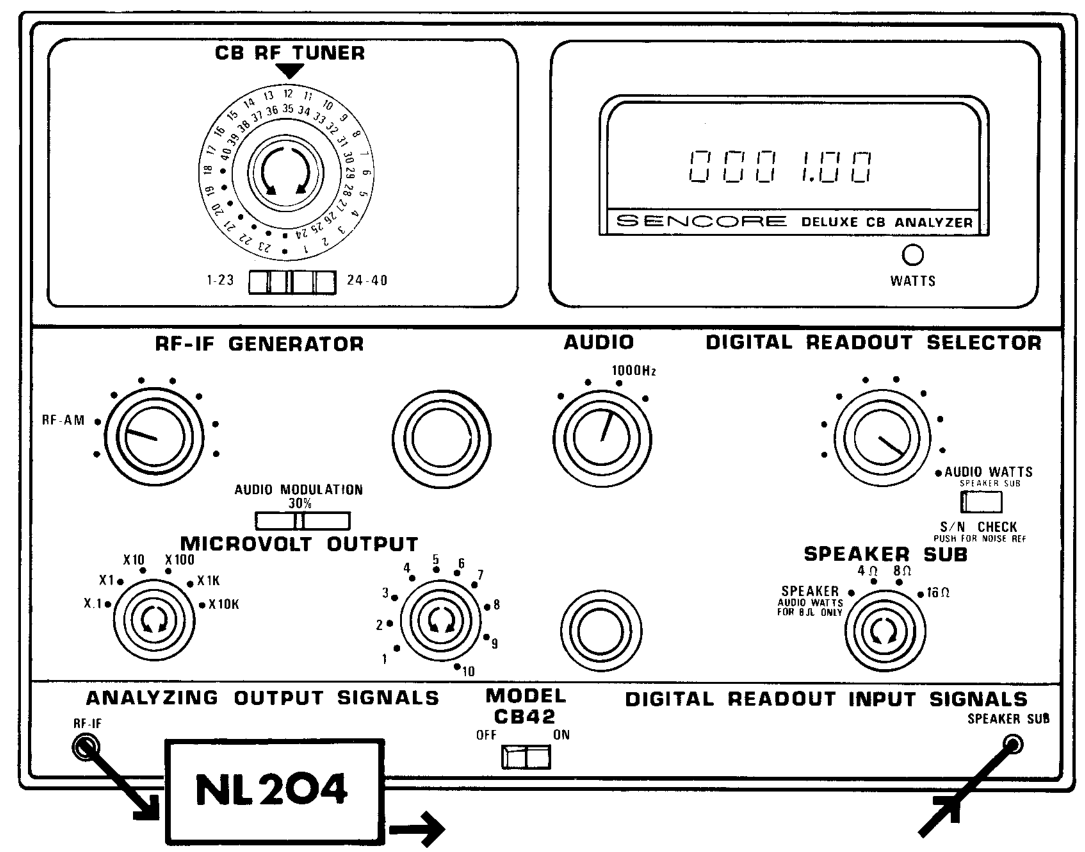


Fig. 36—Control setup for testing ANL questions.

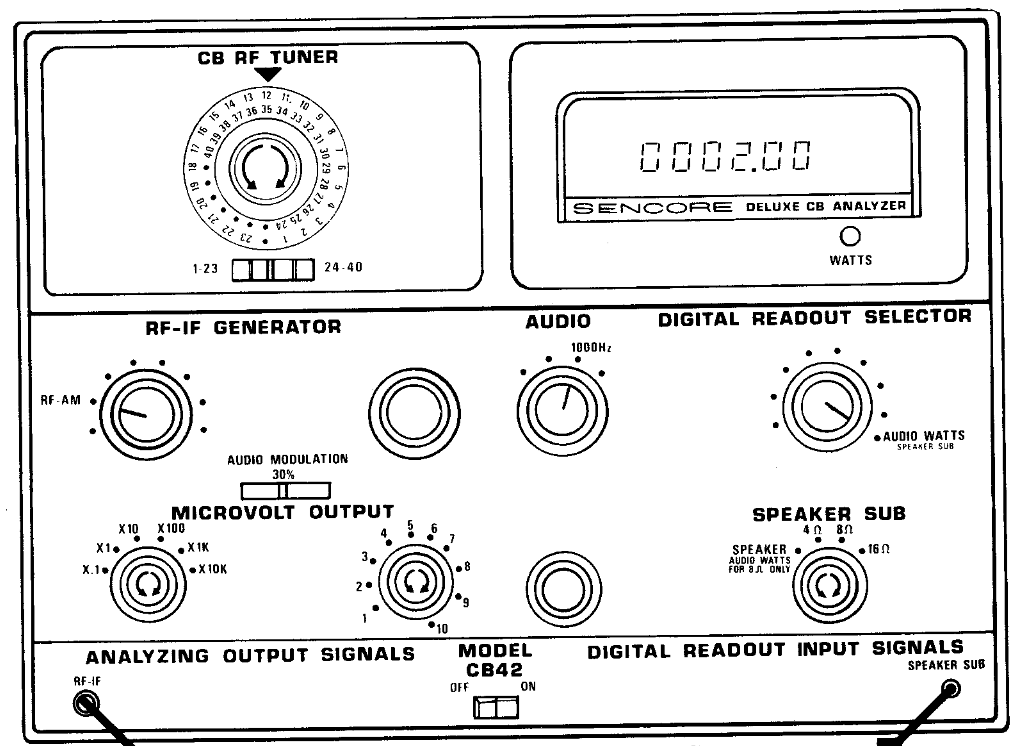


Fig. 33—Control setup for AGC test.

12. Repeat step 9 once more. At this point the output is -30 dB from the starting point.

A properly operating receiver should require less than 1 uV of input signal to reach the -30 dB point.

NOTE: Some receivers greatly exceed the 30 dB range specified by the EIA. This is indicated by the RF level reaching 1 uV before resetting the receiver volume control three times. If the receiver has less than a 30 dB change from 50,000 uV to 1 uV input, it meets the EIA specifications for AGC operation.

RECEIVER GAIN

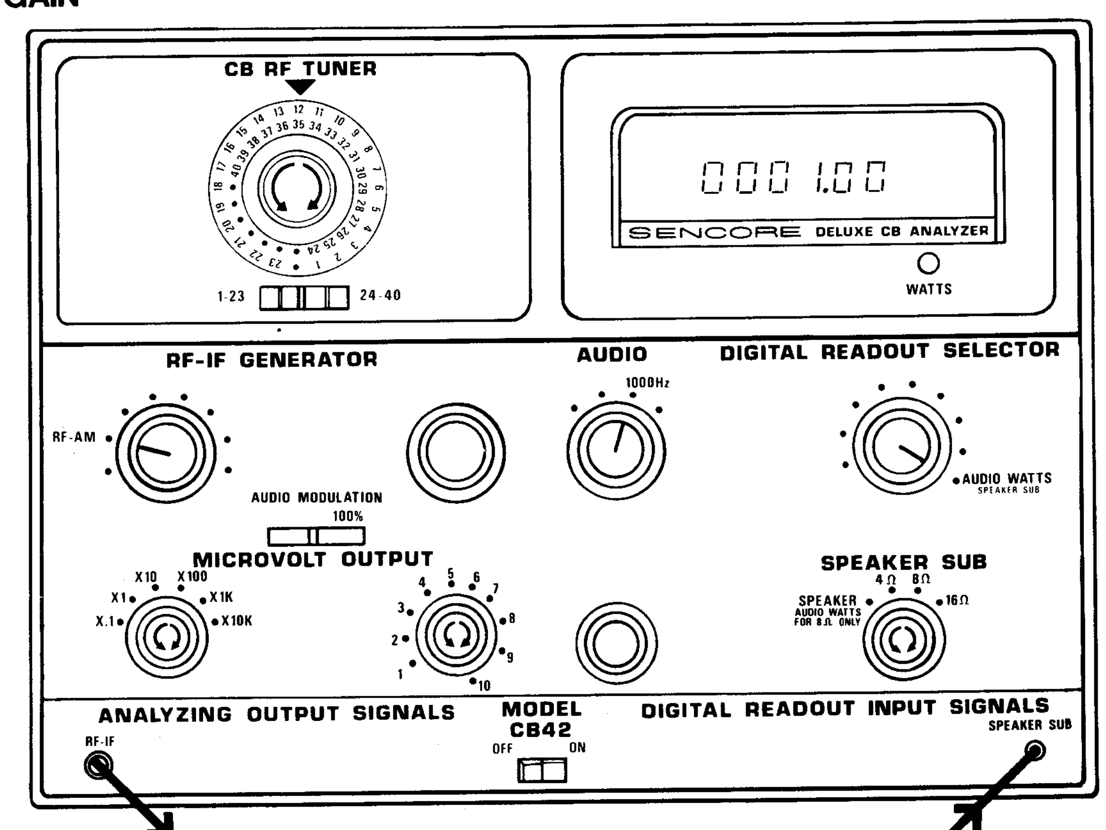


Fig. 34—Control setup for measuring receiver gain.

lator to produce a single IF frequency. A second type of receiver uses *dual conversion*. In this receiver, the incoming RF signal is converted to one IF frequency, and then mixed with a second local oscillator to produce a second (lower) IF frequency.

While 455 KHz is a common IF frequency found in both single- and dual-conversion receivers, there are many other IF frequencies used. In general, the IF frequency can be anything from 455 KHz to 12 MHz and just about any frequency in between. For this reason, the CB42 provides a fully adjustable IF generator providing 375 KHz - 12 MHz.

SINGLE CONVERSION IF

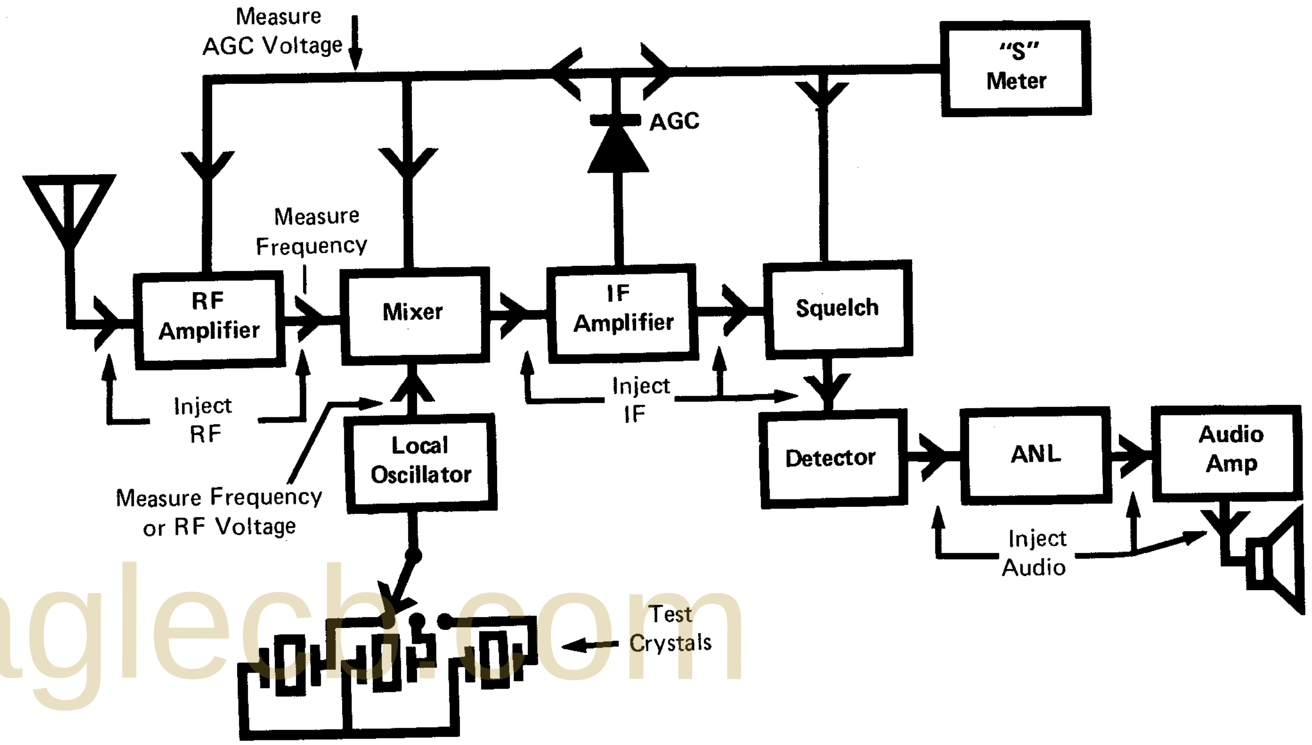


Fig. 15—Typical Single-Conversion AM receiver.

A typical single conversion receiver is shown in the block diagram in Fig. 15. The incoming RF signal is amplified in the RF amplifier. This amplifier usually consists of a single tuned amplifier stage. The resulting amplified signal is fed to the mixer stage where a local oscillator signal is present whose frequency is offset from the incoming signal's frequency by an amount equal to the IF frequency.

The local oscillator may be operated at a higher or lower frequency than the incoming signal's frequency. The result is an output signal containing both the sum and difference frequency of the two input signals. This signal is fed into additional stages that are tuned to the difference frequency or the IF frequency.

The local oscillator is usually crystal controlled (although FCC rules do not require crystal controlled receiver operation). The local oscillator may use a single crystal for each channel (46 crystals--23 for transmit and 23 for receive), frequency synthesis (requiring fewer crystals, such as 14 for both transmit and receive), or phase-locked loop operation (one crystal for both transmit and receive). These types of oscillators will be described later.

The IF signal is then passed through several stages of tuned amplification, and then fed to a diode detector, and finally to the audio amplifier.

A portion of the IF signal is passed through the AGC detector diode and converted to a DC reference voltage. This AGC voltage is fed to the RF and IF stages to control their gain so different signal levels have approximately the same output level. This same AGC signal may be fed to a meter circuit ("S" Meter) to indicate relative signal strength. It may also be used to control the squelch circuit.

The squelch circuit is an adjustable sensitivity control. It is set to allow an audio output only if the input signal exceeds a certain level. The squelch circuit may be controlled by the AGC voltage (which is proportional to the input signal) or the output of the audio detector. A certain level of input signal causes the squelch circuit to pass the audio signal, and a lower level of signal causes the audio to be cut off.

DUAL- CONVERSION IF

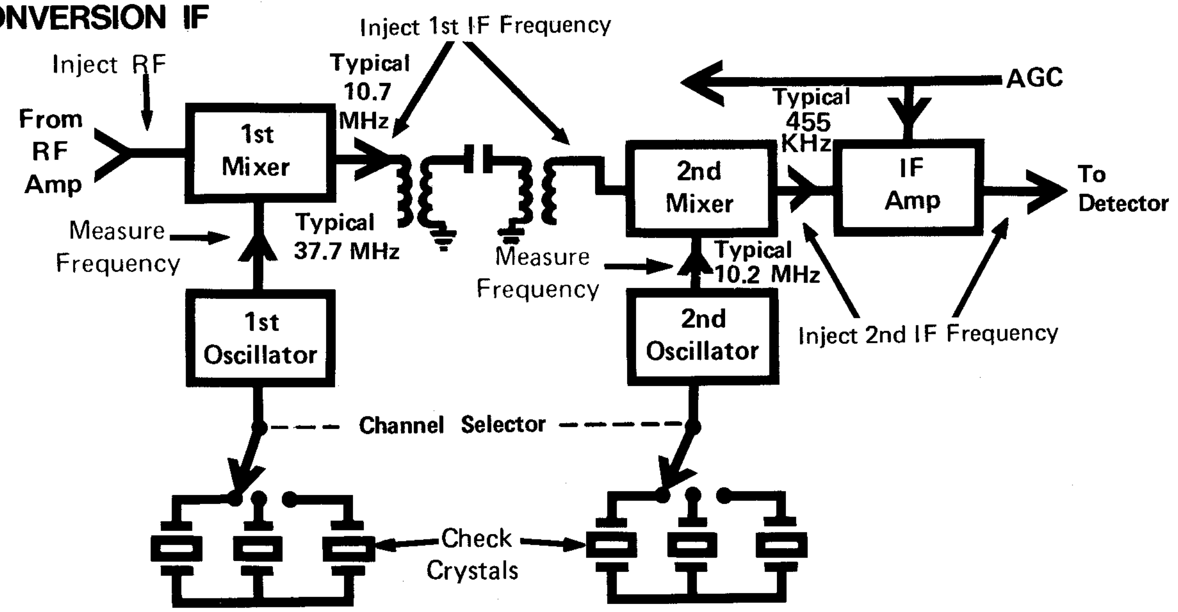


Fig. 16—Dual-Conversion IF stage with un-amplified 1st IF frequency.

The operation of a dual-conversion receiver is similar to that of the single-conversion receiver with the exception of an additional mixer and local oscillator. Most dual-conversion receivers follow the block diagram shown in Fig. 16. In this type of receiver, there is no amplification for the first (high) IF frequency other than that gain the mixer stage provides. In this example, the first local oscillator operates at about 37.7 MHz, or 10.7 MHz above the incoming signal's frequency. The exact frequency of the local oscillator is selected by the channel selector switch.

The output of the first mixer is fed to a link circuit made up of two tuned transformers with the secondary winding of the first transformer connected to the primary of the second transformer. This circuit is tuned to 10.7 MHz. This eliminates the other frequencies produced by the mixer.

The output of the second link transformer is fed to the input of the second mixer, where a frequency of approximately 10.2 MHz is used to convert the signal to 455 KHz. In this example, the second oscillator is also crystal controlled and adjusted by the channel selector switch. In many dual-conversion receivers, however, this second oscillator operates on a fixed frequency, with the channel selection being made by varying the frequency of the first oscillator.

The output of the second mixer is amplified in several tuned amplifier stages and detected the same as in a single-conversion receiver.

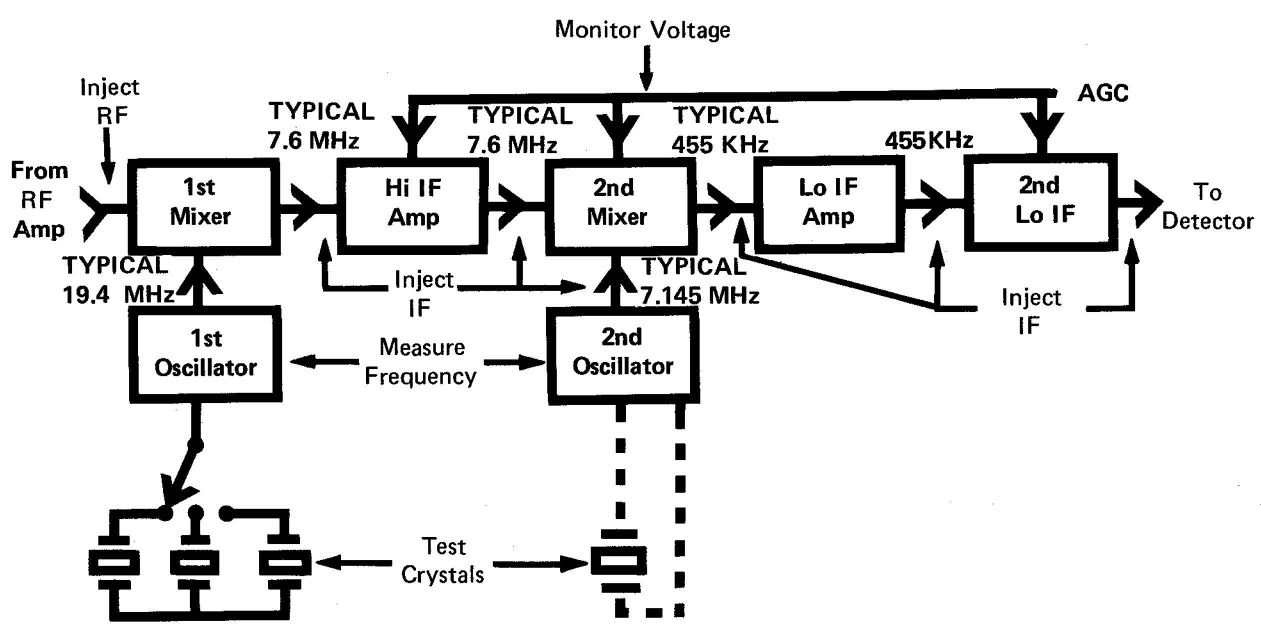


Fig. 17—Dual-Conversion IF stage with amplified 1st IF frequency.

2. Connect the output of the RF-IF OUTPUT jack to the receiver's antenna jack using the supplied RF cable.

3. Connect the audio output of the receiver to the SPEAKER SUB input of the CB42 using the supplied audio cable. Set the SPEAKER SUB switch to the proper impedance to match the output of the receiver.

4. Set the CB CHANNEL TUNER to the same channel as the CB receiver.

   NOTE: Only use Channels 2, 5, 6, 9, 10, 13, 14, 17, 18, 21, or 27-40 for adjacent channel rejection tests since other channels have more than the normal 10 KHz spacing between channels.

5. Set the internal audio generator to 1000 Hz and the AUDIO MODULATION switch to 30%.

6. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.

7. Set the receiver's volume control to maximum gain, and squelch to minimum.

8. Set the MICROVOLTS OUTPUT controls for an output of 1 uV (x.1 and 10)

9. Set the receiver's volume control for a reading of 1.00 on the DIGITAL READOUT.

   NOTE: If 1.00 cannot be obtained, leave the volume control at maximum and use this reading as the reference for Step 11.

10. Switch the RF TUNER to the next adjacent channel above the one being tested.

11. Increase the MICROVOLTS OUTPUT control for a reading of 1.00 on the DIGITAL READOUT.

12. Using an electronic calculator, slide rule, or the dB table found in the back of the CB42 Speed Test Setup Booklet, calculate the dB ratio of the adjacent channel setting of the MICROVOLTS OUTPUT control to the 1 uV reference.

13. Repeat steps 10-12 for the lower adjacent channel. The adjacent channel rejection is the dB ratio of signals that gave the *lowest* dB ratio.

AGC

The EIA specifies that the AGC circuits should maintain the output of a receiver within 30 dB with a signal input range of 1 uV through 50K uV. A typical AGC receiver curve is shown in Fig. 32. The AUDIO WATTS function of the CB42 will quickly show that a receiver is within EIA specs with a test of the dynamic range of the receiver.

To test the operation of the AGC circuit:

1. Supply the proper power to the CB receiver.

2. Connect the output of the RF-IF OUTPUT jack to the receiver's antenna jack using the supplied RF cable.

3. Connect the audio output of the receiver to the SPEAKER SUB input of the CB42 using the supplied audio cable. Set the SPEAKER SUB switch to the proper impedance to match the output of the receiver.

4. Set the CB CHANNEL TUNER to the same channel as the CB receiver.

5. Set the internal audio generator to 1000 Hz and the AUDIO MODULATION switch to 30%.

6. Set the MICROVOLT OUTPUT controls to provide 50K uV of signal (x10K and 5).

7. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.

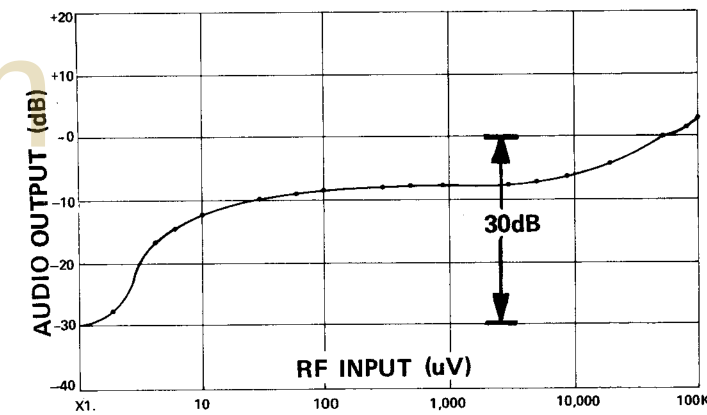


Fig. 32—Typical receiver AGC curve.

8. Adjust the receiver volume control for a reading of 2.00 Watts with squelch at minimum.

9. Reduce the output of the RF GENERATOR using the MICROVOLTS OUTPUT controls until the DIGITAL READOUT indicates 0.20 Watts.

10. Without changing the MICROVOLTS OUTPUT controls, re-adjust the receiver's volume control for a second reading of 2.00 (at this point you have found the point at which the sensitivity curve is at -10 dB).

11. Repeat steps 9 and 10, which gives the -20 dB point.

To perform the receiver sensitivity test:

1. Supply the proper power to the CB receiver.
2. Connect the output of the RF-IF OUTPUT jack to the receiver's antenna jack using the supplied RF cable.
3. Connect the audio output of the receiver to the SPEAKER SUB input of the CB42 using the supplied audio cable. Set the SPEAKER SUB switch to the proper impedance to match the output of the receiver.
4. Set the CB CHANNEL TUNER to the same channel as the CB receiver.
5. Set the internal audio generator to 1000 Hz and the AUDIO MODULATION switch to 30%.
6. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
7. Set the receiver's volume control to maximum gain, and squelch to minimum.
8. Set the MICROVOLTS OUTPUT controls for 1 uV output (x.1 and 10).
9. Read the audio output power on the DIGITAL READOUT.
10. Depress the S/N CHECK pushbutton and read the DIGITAL READOUT with the button depressed.
11. If the reading is *higher* with the button depressed, the noise figure is greater than the signal plus noise, so the signal must be *increased* by increasing the output of the MICROVOLTS OUTPUT controls.

    If the reading is *lower* with the button depressed, the signal figure is greater than the noise, so the signal must be *reduced* by decreasing the output of the MICROVOLTS OUTPUT controls.

The point where the same readout is obtained with the button in or out is the 10 dB (S+N)/N point. The receiver sensitivity is simply read from the two MICROVOLTS OUTPUT controls.

ADJACENT CHANNEL REJECTION

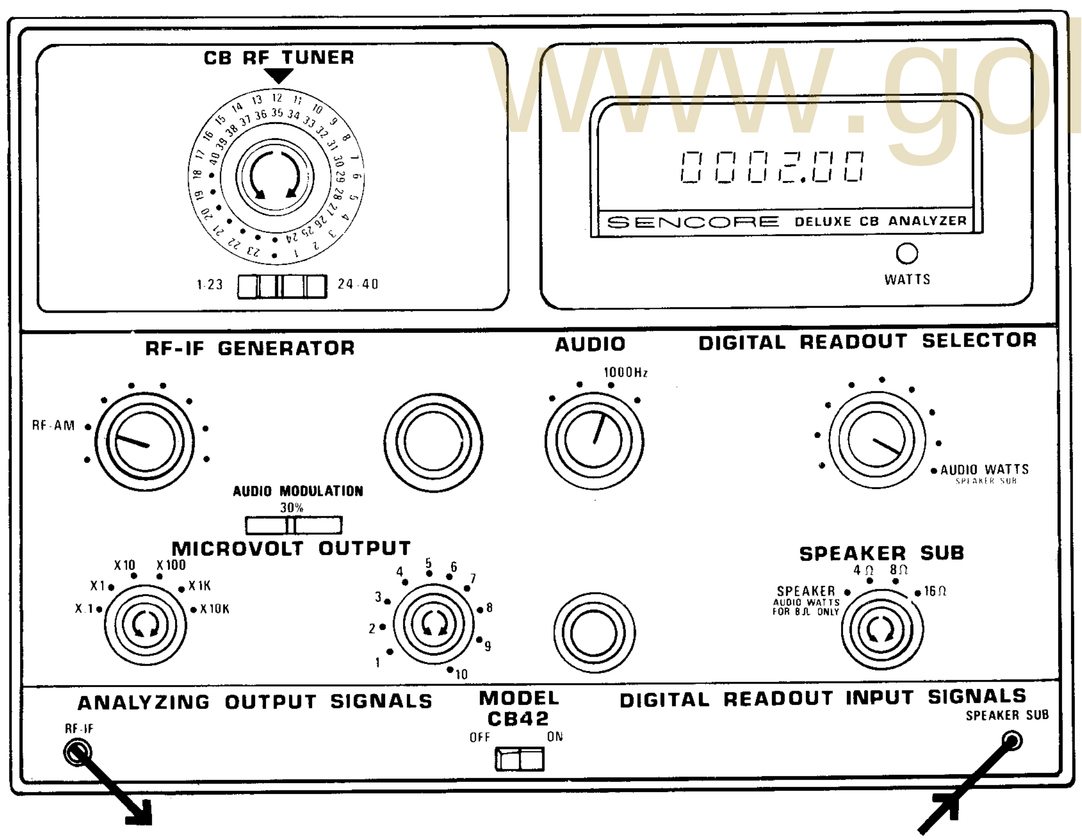


Fig. 31—Control Setup for adjacent channel rejection test.

Adjacent channel rejection indicates the selectivity of the receiver by showing how much signal on an adjacent channel is required to interfere with a signal on the selected channel.

To test for adjacent channel rejection:

1. Supply the proper power to the CB receiver.

Fig. 17 shows a variation on the dual-conversion receiver just explained. In this receiver, an additional stage of amplification is present between the first and second mixer stages. Also note that the first IF frequency is 7.6 MHz, due to a different first local oscillator frequency than used in the first example.

AUTOMATIC NOISE LIMITER

Most receivers contain some type of noise suppression circuits. The most common type is an Automatic Noise Limiter (ANL). This stage usually consists of a diode in series with the detector. The diode is slightly forward biased which allows the audio signal to pass through during normal operation. If a noise spike is applied to the cathode of the diode, the spike reverse-biases the diode causing it to stop conduction for the time the noise spike is present. This causes a momentary interruption of the audio being fed to the audio amplifier.

AUTOMATIC NOISE BLANKER

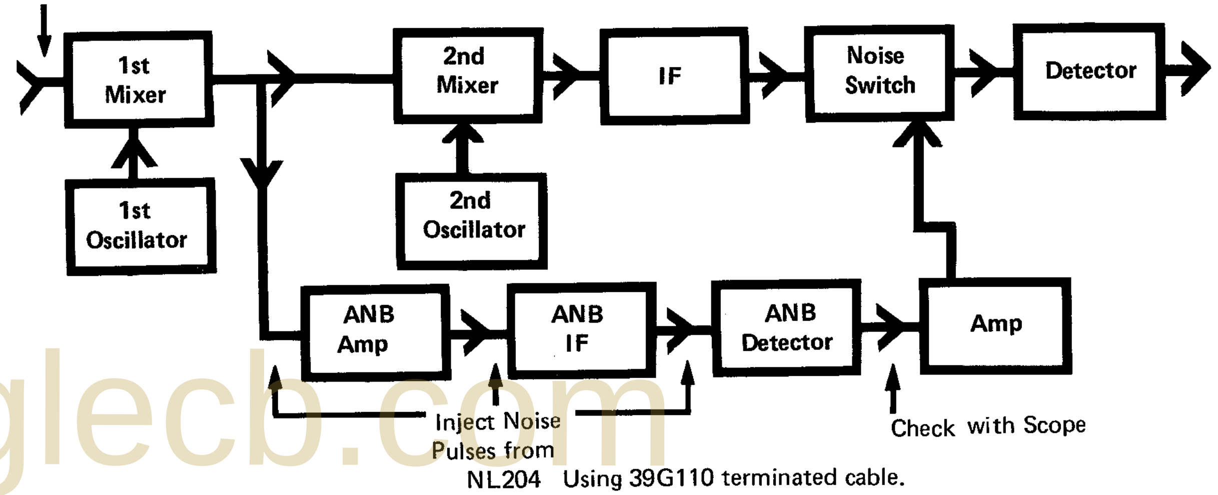


Fig. 18—Extra circuitry used for Automatic Noise Blanker.

Fig. 18 shows a more effective type of noise suppression is provided with an Automatic Noise Blanker (ANB). Rather than sampling the detected audio output, the noise information is taken from the output of the RF amplifier or the first mixer. This signal is fed through a separate IF system tuned to frequencies less than 300 Hz, which noise pulses usually occupy (ignition noise, AC power line noise, etc.).

The output of this amplification stage is detected, and fed to a "Noise Switch". This noise switch may be between any of the IF stages or between the IF stages and detector. Any time there is an output at the ANB detector, the noise switch is turned off, eliminating the noise spikes from being passed to the detector circuit.

SINGLE SIDEBAND OPERATION

Many transceivers are equipped for Single Sideband (SSB) operation. In this mode of operation, the carrier of the transmitted signal is removed (suppressed) with only one of the sidebands being broadcast. SSB transmissions have two main advantages. First, since only one sideband is necessary for transmission, twice as many conversations can be present on the 40 CB channels at one time. Half of the conversations are on the upper sidebands (USB) and half are on the lower sideband (LSB) of each channel. Secondly, SSB transmissions are less susceptible to interference.

In operation, the transmitter must produce the necessary sideband, and remove most of the carrier signal. The receiver, on the other hand, must re-insert this missing carrier before being detected as a normal AM signal.

SSB TRANSMITTER

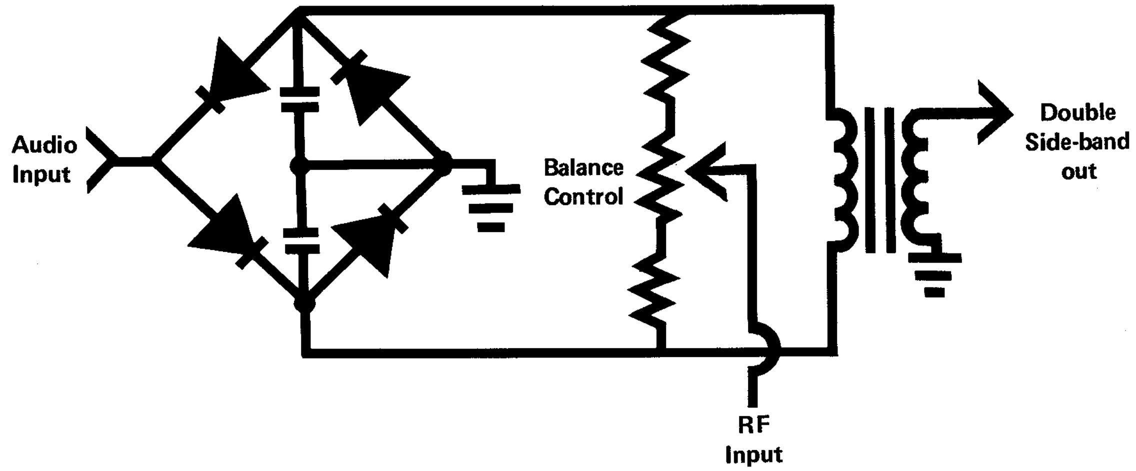


Fig. 19—Simplified SSB balanced modulator.

The heart of an SSB transmitter is a "Balanced Modulator". The balanced modulator is a bridge circuit with an audio input and an RF input. A simplified balanced modulator is shown in Fig. 19. The function of the balanced modulator is to produce both the upper and lower sidebands when the audio modulating signal and RF signal are injected at their respective inputs. The balance control is adjusted until the RF carrier is completely canceled in the bridge. Fig. 20 shows how the balanced modulator is used in a typical SSB transmitter. This example typifies most SSB transmitters which use a frequency lower than the carrier frequency to operate the balanced modulator. This simplifies the design of the balanced modulator since it operates at a lower frequency.

The output of the balanced modulator has both the upper and lower sidebands present. To select the proper sideband, the output of the balanced modulator is fed to a filter that removes the unwanted sideband.

At this point, we have an SSB signal with a suppressed carrier of 7.8 MHz. This signal is applied to the input of the transmit mixer which operates the same as a receiver mixer except we are raising the frequency instead of lowering it. The output of this mixer is the desired RF frequency.

The output of the transmit mixer is fed to several stages of linear amplification, and finally to a low-pass filter to eliminate any harmonic content that has been created in the mixing processes. The output of the filter is fed to the antenna for transmission.

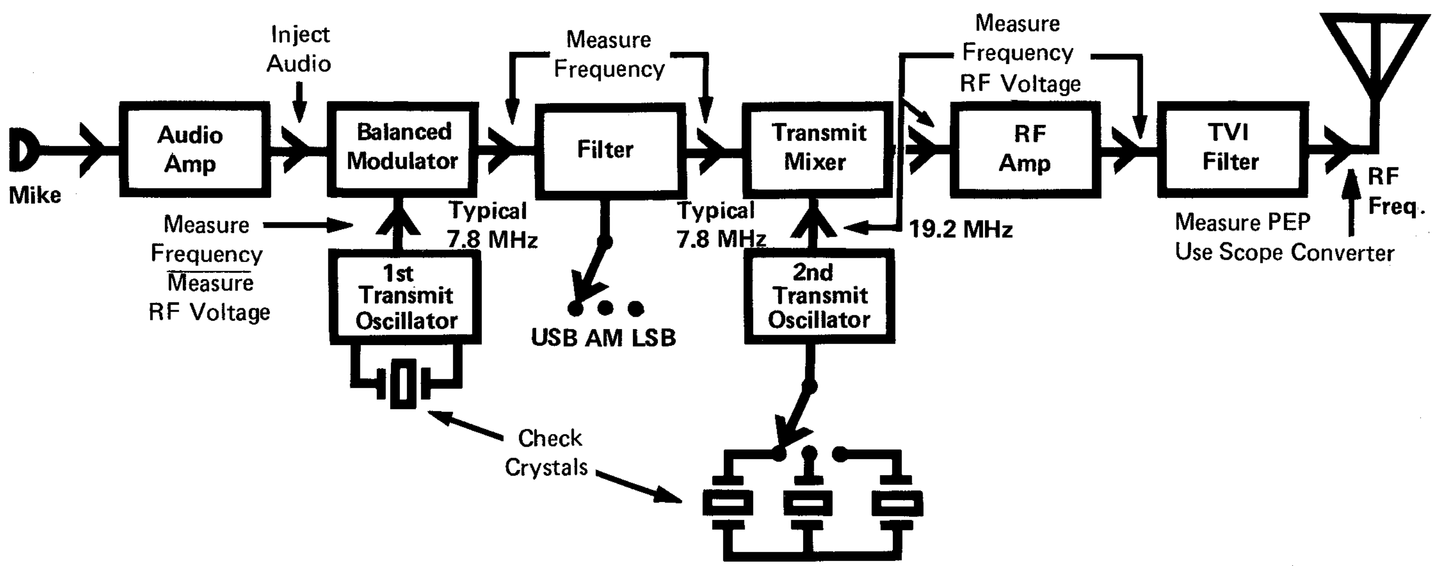


Fig. 20—Typical SSB transmitter.

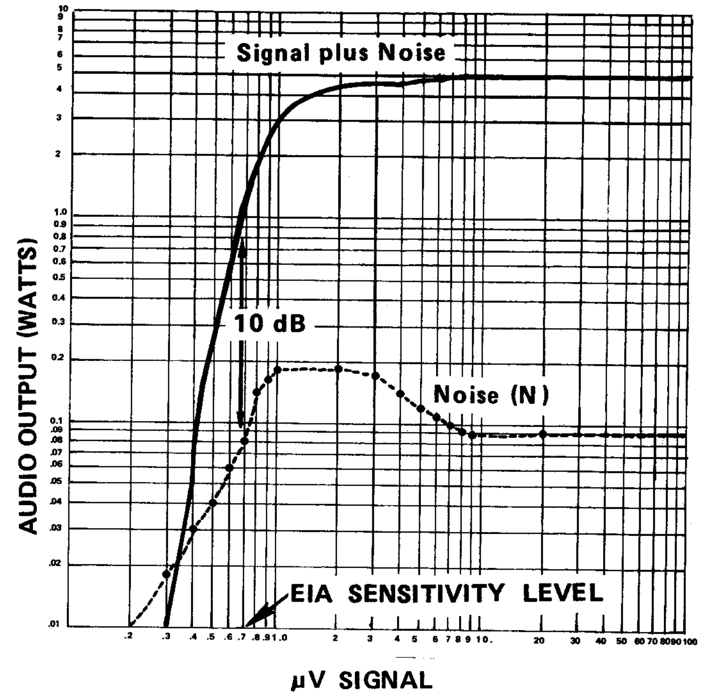


Fig. 28—Typical receiver sensitivity curves showing EIA definition of sensitivity.

A typical sensitivity curve is shown in Fig. 28. As the graph shows, the noise figure (dashed line) increases with the input signal until the AGC circuit begins to reduce the receiver's gain, at which point it begins to level off. The Signal Plus Noise (S+N) curve builds more quickly with an increasing input signal, and also levels off due to the limits of the receiver's audio detector circuit. The EIA Sensitivity is the point where these two lines are 10 dB apart, or the (S+N) figure is 10 times the (N) figure.

The CB42 simplifies the EIA sensitivity test in two ways. When the S/N button is pressed, the sensitivity of the AUDIO WATTS function is increased by 10 dB. This eliminates the need of a Decibel reading meter. The button also removes modulation from the RF signal so only the noise figure is being generated.

SENSITIVITY TEST IN CB42

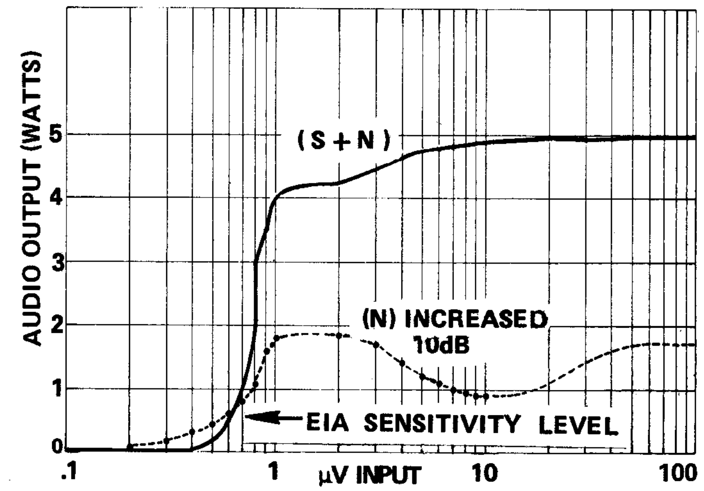


Fig. 29—Receiver sensitivity curves with "noise" curve increased by 10 dB.

The graph in Fig. 29 shows what happens if the noise curve shown in Fig. 28 is increased by 10 dB. The graph shows that the point where the two lines cross is the same point that gave the sensitivity figure in the preceding graph. This is exactly what the CB42 does. The noise output is increased by 10 dB, so all that is necessary is to find the point where the S+N and N figure read the same on the DIGITAL READOUT.

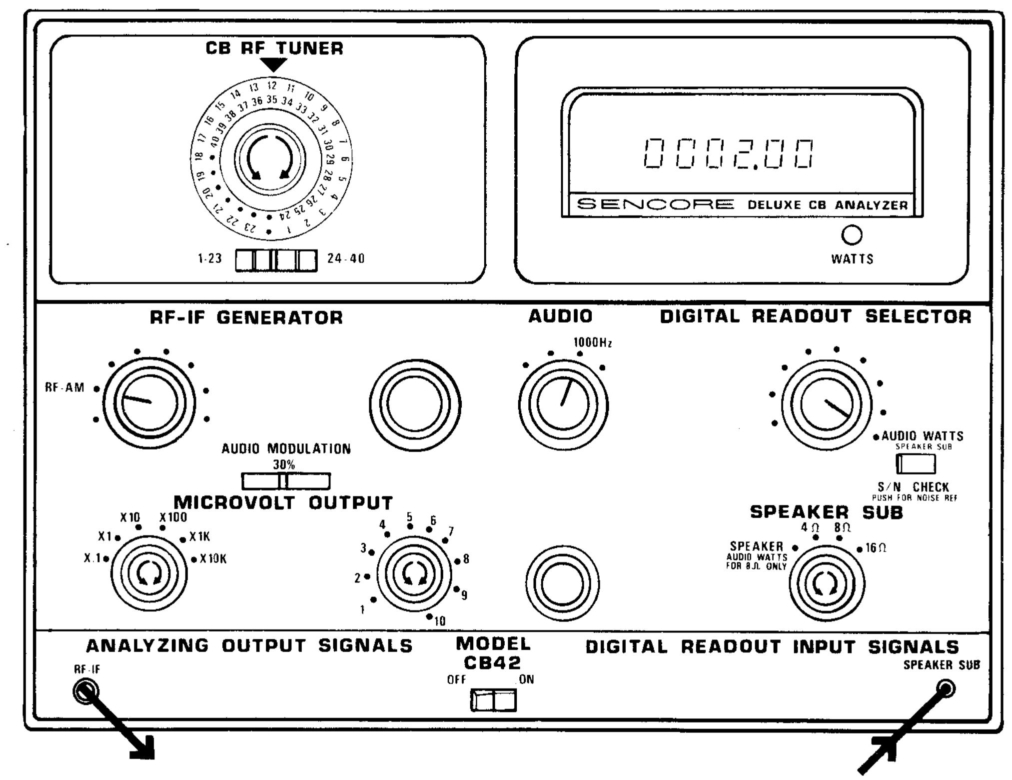


Fig. 30—Control setup for determining receiver sensitivity.

SQUELCH TEST

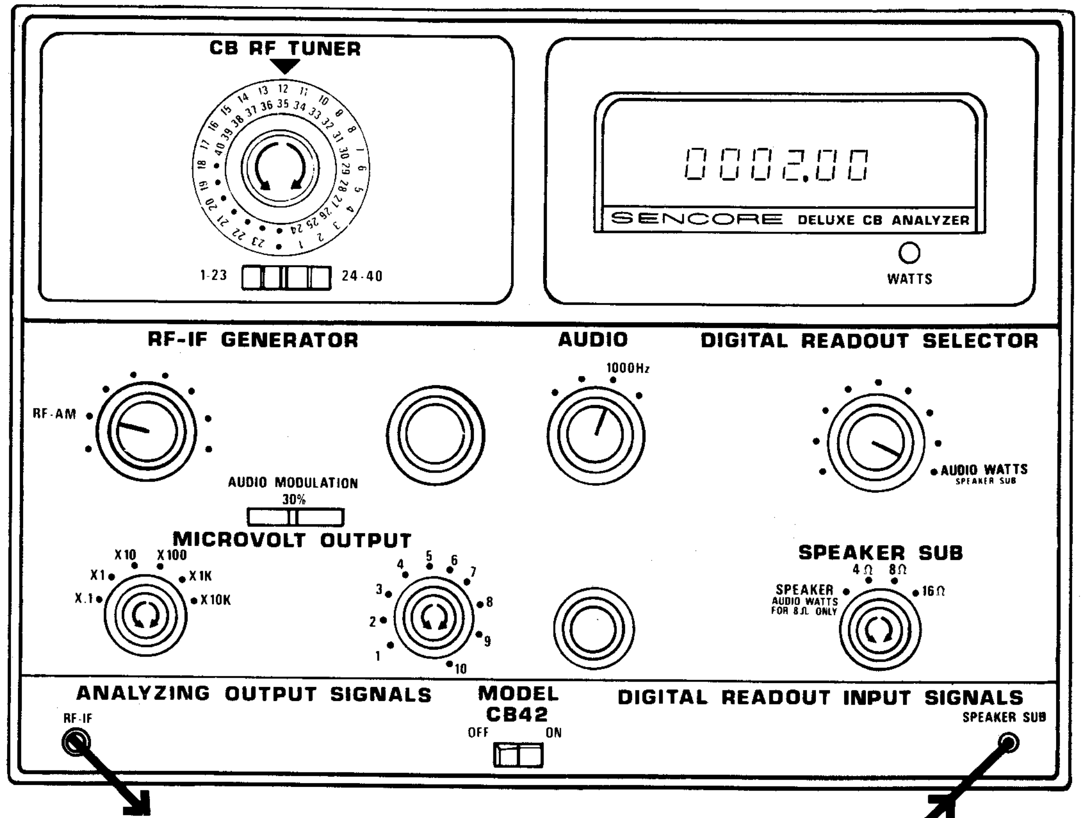


Fig. 27—Control Setup for test of squelch operation.

Proper operation of the squelch circuits allow the CB user to eliminate background noise by raising the sensitivity rating of the receiver. The EIA specifies that the receiver should unsquelch itself with the squelch control set to its "tight" (maximum squelched) position somewhere between 30 and 1000 microvolts of incoming signal. Most manufacturer's instructions are more specific as to the point at which the receiver unsquelches itself. For this reason, the specific manufacturer's instructions should be consulted for the proper squelch sensitivity.

To test for squelch operation:

1. Supply the proper power to the CB receiver.
2. Connect the output of the RF-IF OUTPUT jack to the receiver's antenna jack using the supplied RF cable.
3. Connect the audio output of the receiver to the SPEAKER SUB input of the CB42 using the supplied audio cable. Set the SPEAKER SUB switch to the proper impedance to match the output of the receiver.
4. Set the CB CHANNEL TUNER to the same channel as the CB receiver.
5. Set the internal audio generator to 1000 Hz and the AUDIO MODULATOR switch to 30%.
6. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
7. Set the receiver's volume control to maximum gain.
8. Set the receiver's squelch control for tight squelch (maximum squelch).
9. Increase the MICROVOLTS OUTPUT controls until the receiver just breaks squelch. This will be the point that the DIGITAL READOUT just begins to show an audio output.
10. Read the amount of input signal directly from the calibrations on the MICROVOLTS OUTPUT controls.

EIA SENSITIVITY TEST

Receiver sensitivity is defined by the EIA as the amount of signal that gives a 10 dB ratio between the Signal Plus Noise (S+N) and the Noise (N). The formula for sensitivity is:

$$10\text{dB}: \frac{(S+N)}{(N)}.$$

SSB RECEIVER

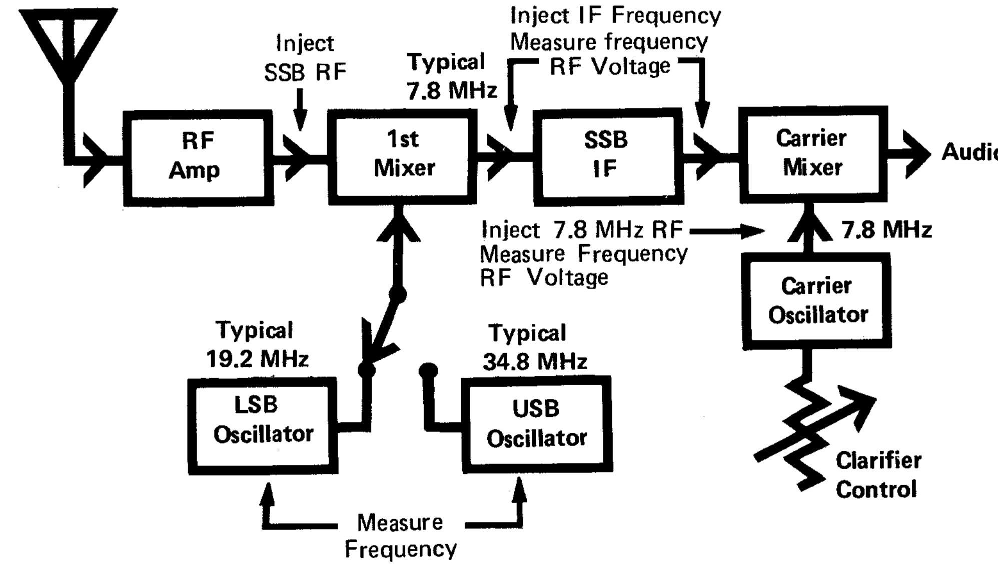


Fig. 21—Simplified SSB receiver.

There are only minor differences between the operation of an SSB receiver and a standard AM receiver. First, the frequency of the local oscillator selects the upper or lower sideband. The block diagram in Fig. 21 shows a typical local oscillator arrangement. The LSB oscillator will produce a different frequency of 7.8 MHz when combined with a *lower* sideband signal. This is done by mixing the incoming single sideband signal with a frequency of about 19.2 MHz. The USB oscillator will also produce a 7.8 MHz IF frequency when mixed with an *upper* sideband signal. In this case, the injected frequency is 34.8 MHz, or 7.8 MHz above the selected sideband frequency.

The IF stages pass the signal as an SSB signal. It is necessary to re-insert the missing carrier frequency before final detection. This is done in a "Product Mixer" which inserts the missing 7.8 MHz carrier on the SSB IF signal. The result is an audio output that is the same as the original modulation information present in the transmitter. In order for the carrier mixer to operate properly, the inserted signal must be EXACTLY the same frequency as the missing carrier.

The "clarifier control" allows the frequency of the 7.8 MHz oscillator to be shifted slightly. This compensates for a transmitter that may be slightly off frequency (but still within FCC specs).

FREQUENCY SYNTHESIZER

Some transceivers require one crystal for each transmitter channel and one for each receiver channel. This means a 23 channel transceiver requires 46 crystals. Frequency synthesizer stages reduce the number of crystals to 14 or less for all 23 transmit and receive stages.

A synthesizer takes advantage of heterodyning--which produces the sum and difference of two oscillator frequencies. By selecting the frequencies of two oscillators properly, the required 46 frequencies can be obtained with fewer than 46 crystals.

Most synthesizers use two oscillators which are fed to a mixer stage. The output of the mixer is then filtered to produce the sum or difference frequency.

In other types of synthesizers, a third oscillator is also used. With this setup, the output of the first set of oscillators produces an intermediate frequency which is then mixed with the third oscillator to produce the final desired frequency.

CRYSTAL SYNTHESIZER SCHEME

NOTE: All frequencies are in MHz.

CHANNEL	HF CRYSTAL	RECEIVE LF CRYSTAL	RECEIVE OUTPUT	TRANSMIT LF CRYSTAL	TRANSMIT OUTPUT
1	32.700	6.1904	26.5096	5.735	26.965
2	32.700	6.1804	26.5196	5.725	26.975
3	32.700	6.1704	26.5296	5.715	26.985
4	32.700	6.1504	26.5496	5.695	27.005
5	32.750	6.1904	26.5596	5.735	27.015
6	32.750	6.1804	26.5696	5.725	27.025
7	32.750	6.1704	26.5796	5.715	27.035
8	32.750	6.1504	26.5996	5.695	27.055
9	32.800	6.1904	26.6096	5.735	27.065
10	32.800	6.1804	26.6196	5.725	27.075
11	32.800	6.1704	26.6296	5.715	27.085
12	32.800	6.1504	26.6496	5.695	27.105
13	32.850	6.1904	26.6596	5.735	27.115
14	32.850	6.1804	26.6696	5.725	27.125
15	32.850	6.1704	26.6796	5.715	27.135
16	32.850	6.1504	26.6996	5.695	27.155
17	32.900	6.1904	26.7096	5.735	27.165
18	32.900	6.1804	26.7196	5.725	27.175
19	32.900	6.1704	26.7296	5.715	27.185
20	32.900	6.1504	26.7496	5.695	27.205
21	32.950	6.1904	26.7596	5.735	27.215
22	32.950	6.1804	26.7696	5.725	27.225
23	32.950	6.1504	26.7996	5.695	27.255

Fig. 22—Oscillator frequencies of 14 crystal synthesizer.

Fig. 23 shows a typical synthesizer setup using three oscillators. Two of the oscillators produce the on-channel frequency needed by the transmitter. The same high frequency oscillator used with a different low frequency oscillator produces a frequency 455 KHz below the carrier frequency for use as the receiver's local oscillator.

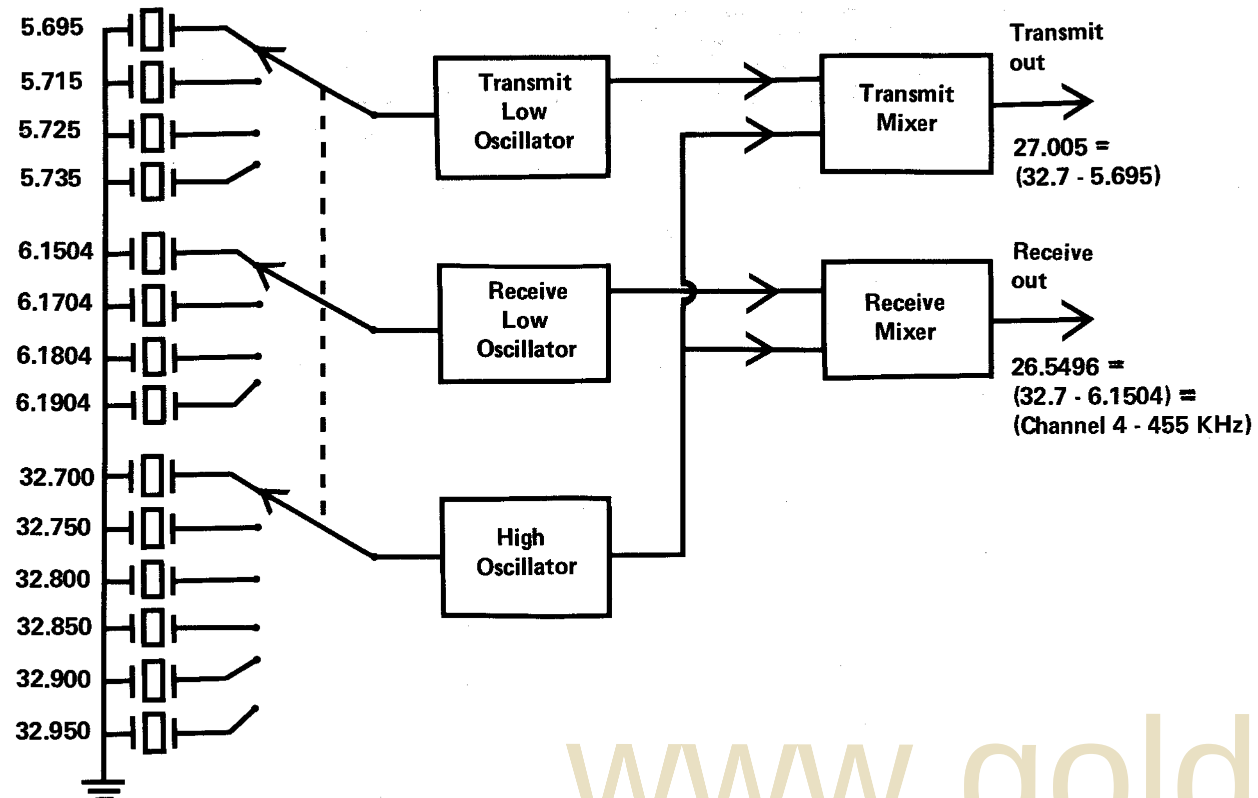


Fig. 23—Oscillator setup for 14 crystal synthesizer.

PHASE - LOCKED LOOP

Some 23 channel transceivers and many 40 channel transceivers use Programmable Phase-Locked Loop (PPLL) circuits to produce the necessary internal frequencies. This system usually requires only one or two crystals for transmit and receive frequencies.

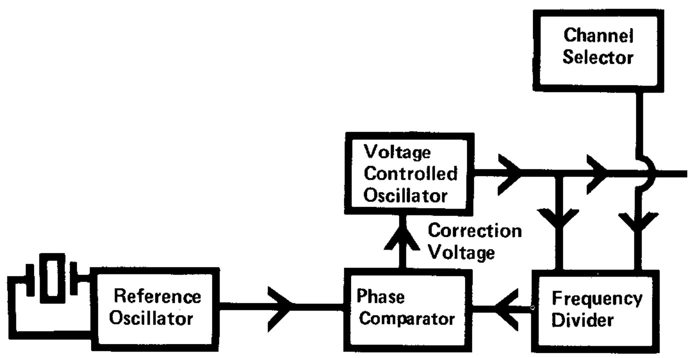


Fig. 24—Programmable Phase-Locked Loop block diagram.

A typical PPLL is shown in Fig. 24. It consists of a crystal controlled master oscillator and a voltage controlled oscillator (VCO). The VCO is designed to operate at the desired output frequency. Its exact output frequency is controlled by an input voltage.

In addition to the two oscillators, the PPLL consists of several digital countdown stages, and a phase comparator. The amount of countdown is controlled by external programming lines connected to the channel selector switch. The phase comparator generates a correction voltage output if the phase of the two input signals is not the same.

In operation, a DC voltage is applied to the VCO which causes it to operate at a frequency close to the desired output frequency. The digital countdown circuits are set so that the output of the countdown is the same as the frequency of the master oscillator when the VCO is exactly on frequency.

If the two inputs to the phase comparator are out of phase, an error in the VCO frequency is indicated. This phase error results in a correction voltage output from the phase comparator which is applied to the VCO. This correction voltage causes the VCO to shift frequencies until VCO is operating at the desired frequency.

AM RECEIVER TESTS

AUDIO OUTPUT POWER

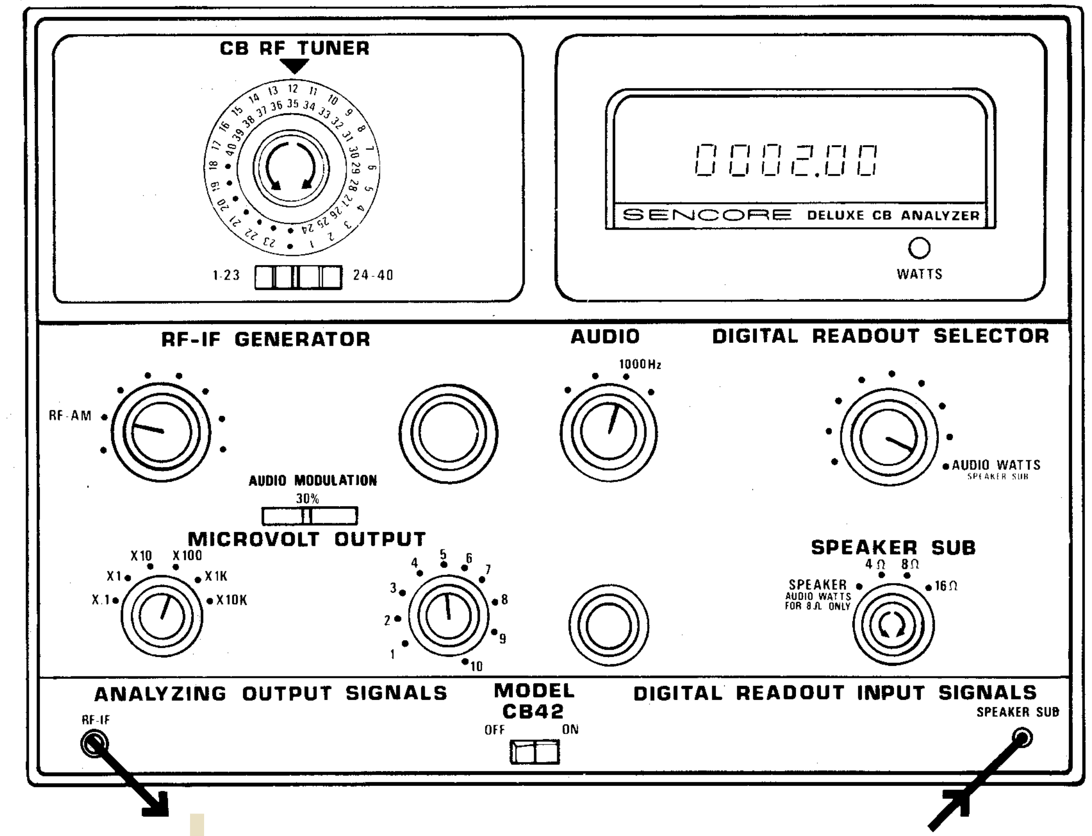


Fig. 25—Control Setup for measuring Audio Output Power.

The audio amplifier of a transceiver usually performs two functions. First, it drives the loudspeaker during receiver operation. Secondly, the same amplifier is usually used to drive the modulator stage of the AM transmitter. In order for the transmitter to be fully modulated, the audio amplifier must be able to provide an undistorted output of 2-4 Watts (depending on the modulator circuitry used). By testing the audio output power in the receive mode of operation of the transceiver, we can be sure that sufficient power is available during the transmit mode.

To test for audio output power:

1. Supply the proper power to the CB transceiver.
2. Connect the output of the RF-IF OUTPUT jack to the receiver's antenna jack using the supplied RF cable.
3. Connect the audio output of the receiver to the SPEAKER SUB input of the CB42 using the supplied audio cable. Set the SPEAKER SUB switch to the proper impedance to match the output of the receiver.
4. Set the CB CHANNEL TUNER to the same channel as the CB receiver.
5. Set the internal audio generator to 1000 Hz and the AUDIO MODULATION switch to 30%.
6. Set the receiver's volume control for maximum gain, and squelch to minimum.
7. Adjust the MICROVOLTS OUTPUT controls for a reading of 500 uV (x100 and 5).
8. Set the DIGITAL READOUT SELECTOR to the AUDIO WATTS position.
9. Read the output power on the DIGITAL READOUT.

The EIA specifies that the audio output power is the point at which 15% clipping is present. To determine this power point, connect an oscilloscope across the SPEAKER SUB connection and increase the volume control until about 15% clipping is shown. Fig. 26 shows a sine wave with 15% clipping.

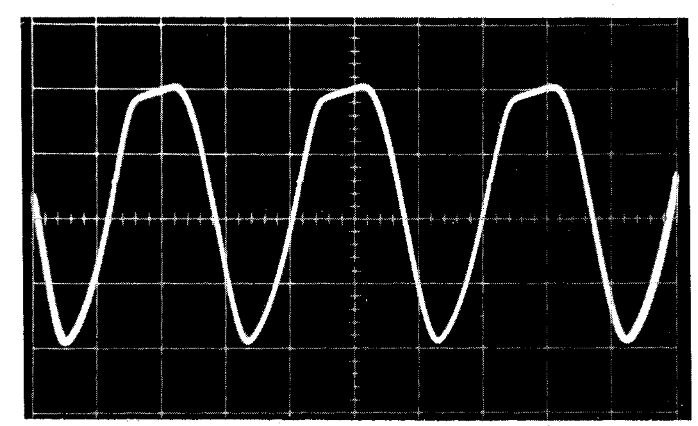


Fig. 26—Sine wave signal with 15% clipping.