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SENCORE

3200 SENCORE DRIVE, SIOUX FALLS, SOUTH DAKOTA 57107

FORM 1260

PRINTED IN U.S.A

CB41

AUTOMATIC CB PERFORMANCE TESTER

OPERATION, APPLICATION AND MAINTENANCE MANUAL

SENCORE

THE ALL AMERICAN LINE OF HIGH QUALITY TEST EQUIPMENT

SENCORE SAFETY REMINDERS

Every precaution has been taken in the design of your instrument to insure that it is as safe as possible. However, safe operation depends on you, the operator.

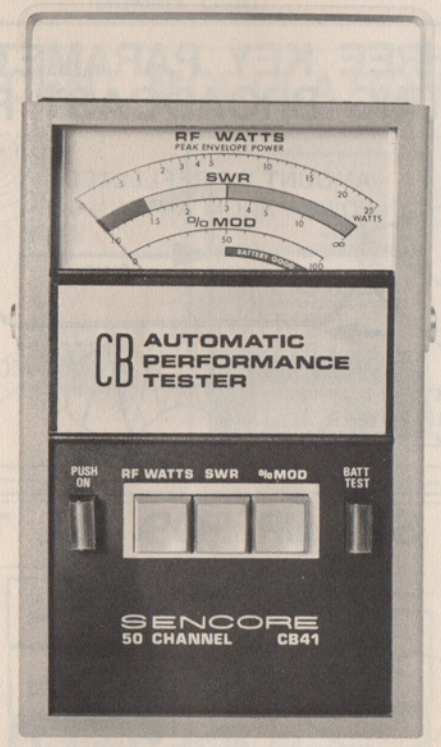
There is always a danger present when testing electronic equipment. Unexpected high voltages can be present at unusual locations in defective equipment. Become familiar with the equipment you're working with, and observe the following safety precautions.

1. Never exceed the limits of this instrument as given in the specifications section, and the additional special warnings in this manual.
2. A severe shock hazard can result if the chassis of the equipment being serviced is tied to the "hot" side of the AC line. An isolation transformer should always be used with this equipment. Also, be sure that the top of the workbench and the floor underneath it are dry and made of non-conductive material.
3. Remove the circuit power before making connections to high voltage points. If this cannot be done, be sure to avoid contact with other equipment or metal objects. Place one hand in your pocket and stand on an insulated floor mat to reduce the possibility of shock.
4. Discharge filter capacitors before connecting test leads to them.
5. Be sure your equipment is in good order. Broken or frayed test leads can be extremely dangerous and can expose you to dangerous voltages.
6. Remove the test leads immediately after the test has been completed to reduce the possibility of shock.
7. Do not work alone when working on hazardous circuits. Always have another person close by in case of an accident. Remember, even a minor shock can be the cause of a more serious accident, such as falling against the equipment, or coming in contact with high voltages.

WARNING: Maintenance and Calibration 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.

CB41
AUTOMATIC CB PERFORMANCE TESTER

OPERATION, APPLICATION AND MAINTENANCE MANUAL



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FAMILIARIZATION

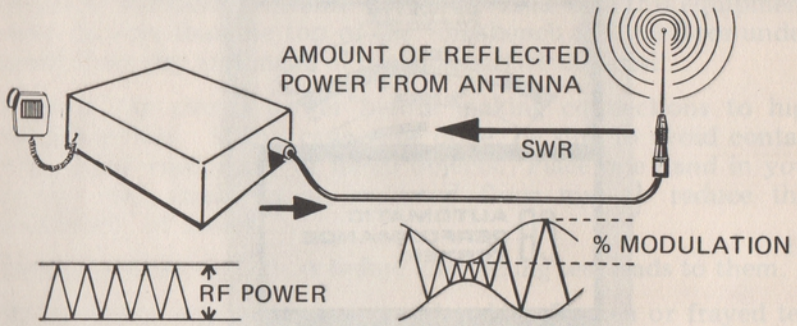
"HOW TO GET THE MOST FROM YOUR CB41."

PLAY THE CASSETTE TRAINING TAPE SUPPLIED WITH THE CB41, AND FOLLOW THE DIAGRAMS BELOW.

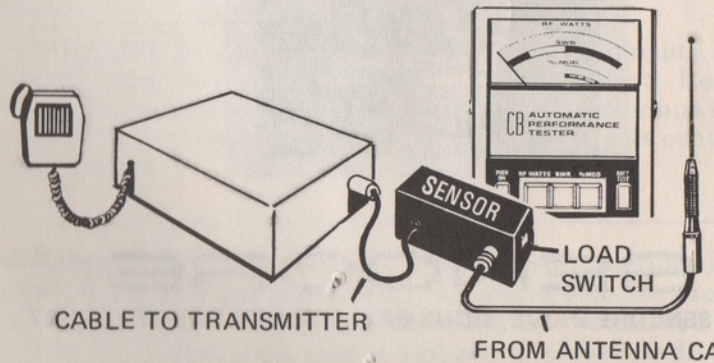
YOU WILL NEED:

- INSTALL TWO 9V RADIO BATTERIES IN THE CB41.
- REMOVE THE SENSOR FROM THE STORAGE COMPARTMENT.
- OPERATING CB TRANSCEIVER AND ANTENNA SYSTEM.

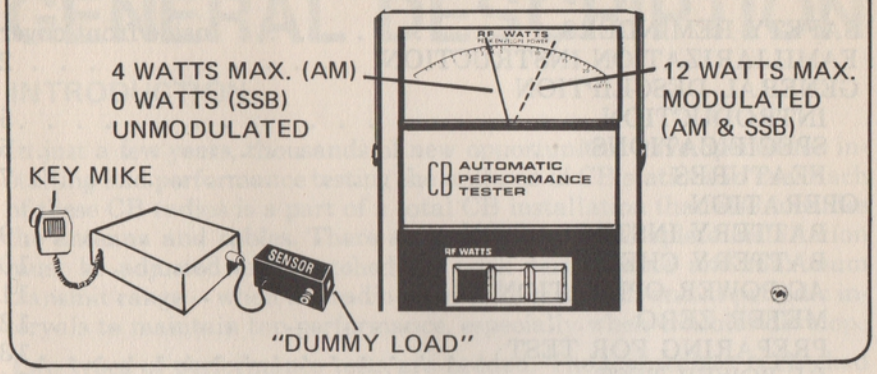
❶ THE THREE KEY PARAMETERS AFFECTING BROADCAST RANGE



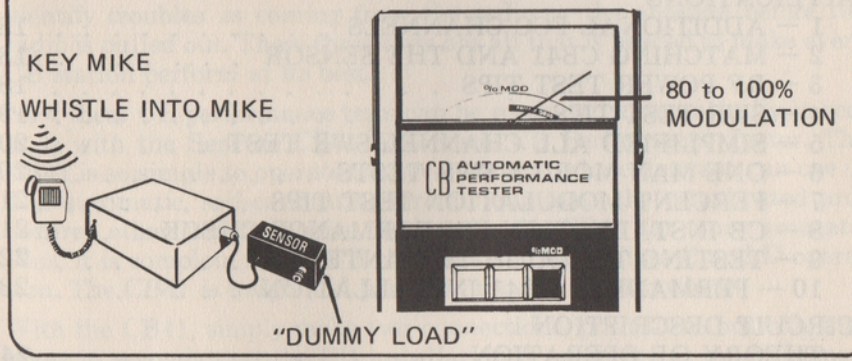
❷ INITIAL SET-UP FOR ALL TESTS



❸ RF POWER TEST



❹ PERCENT MODULATION TEST



❺ SWR TEST

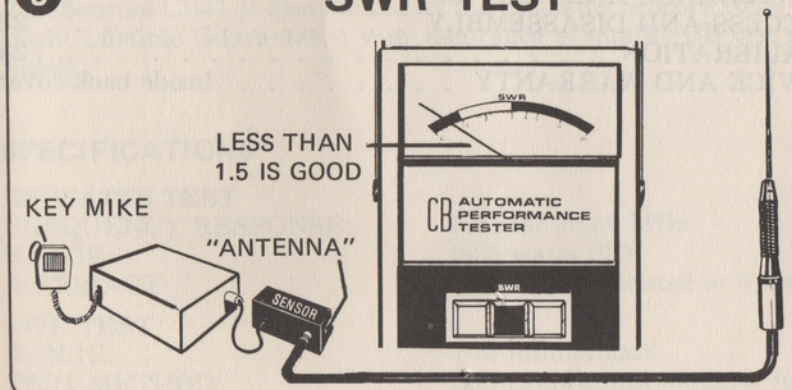


TABLE OF CONTENTS

INTRODUCTION AND GENERAL DESCRIPTION

INTRODUCTION

In just a few years, thousands of new opportunities have opened for installing and performance testing the millions of CB stations in use. Each of these CB radios is a part of a total CB installation that also includes the antenna and cables. There are two times the complete installation must be adjusted and matched for peak performance and maximum transmit range -- when the radio is initially installed, and at periodic intervals to maintain top performance, especially when troubles develop.

Two types of performance tests are needed. The transceiver is checked with RF Power and Percent Modulation tests. The entire system, including the antenna and cables, is checked by the SWR test. Performance testing can be used to tune a system for top performance, or to properly identify troubles as coming from the radio or the antenna before the radio is pulled out. These three tests are all that is needed to make every CB station perform at its best.

Now these CB performance tests can be measured automatically in seconds with the Sencore CB41 Automatic CB Performance Tester. The CB41 is so simple to operate that even a non-technical person can use it. The automatic, self-calibrating circuits eliminate the complicated procedures other testers require, and make the CB41 far more accurate. Plus, it is complete for all CB channels and both Class C and D operation. The CB41 is tough and portable, too, for use anywhere.

With the CB41, simply make two connections, push three buttons, and know in seconds that the CB installation is operating at top efficiency. Prove it to the customer, too.

The Sencore CB41 is also backed by the exclusive Sencore 100% Made Right Lifetime Guarantee -- your assurance of quality CB test instruments.

SPECIFICATIONS

RF WATTS TEST

FREQUENCY RESPONSE:	Flat for 20-30 MHz
RANGE:	0-25 watts PEP
ACCURACY:	±3° arc. Calibrated at 3 watts.

SWR TEST

RANGE:	1 to infinity (∞).
TEST METHOD:	Self-calibrating.Compares forward and reverse power ratio

ACCURACY:	±5° arc from SWR - 1.0-3.0. Nulled at SWR - 1.0 into 50 ohm load. Calibrated at SWR - 2.0
INPUT:	1-15 watts PEP for rated accuracy.

PERCENT MODULATION TEST

RANGE:	0 to 100% .
TEST METHOD:	(AM only) Self calibrating. Refers P-P detected audio to average RF power.
ACCURACY:	±5% FS with input of 1-12 watts PEP. Calibrated for continuous tone modulation.

39G101 SENSE HEAD

ANTENNA:	Internal non-inductive dummy load or loop-through to external antenna
IMPEDANCE:	50 ohm, unbalanced
POWER CAPABILITY:	25 watts PEP max.
CONNECTIONS:	PL259 Female output. PL259 Male input on 16'' coax stub. 4 conductor connector to unit.

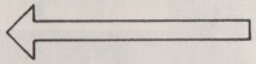
GENERAL

METER:	4 1/2'' moving coil, 100 uA, 1900 ohm, ±5% FS. Spring protected jeweled pivots.
POWER:	7.2-10 VDC, 8 mA. Batteries: Two 9V radio batteries (Eveready No. 216 or equivalent). Rechargeable: PA202 Power Adapter used with two 9V rechargeable cells. AC Line: 105-130 VAC, 50/60 Hz when used with PA202 Power Adapter and batteries installed for filtering. External: 9 VDC from Sencore PS43 Power Supply or external battery.
SIZE:	10'' x 5 1/2'' x 3 1/2'' HWD. (25.4 x 14 x 8.9 cm)
WEIGHT:	4 1/2 lb. (2 kg) (with 39G101 and batteries)
SUPPLIED ACCESSORIES:	39G101 Sensor Manual Schematic and Parts List Familiarization Training Tape
OPTIONAL ACCESSORIES:	EX203 Extension Cable PA202 Power Adapter

(Specifications subject to change without notice.)

FEATURES

(FOLD OUT)



FEATURES

CB41 AUTOMATIC CB PERFORMANCE TESTER

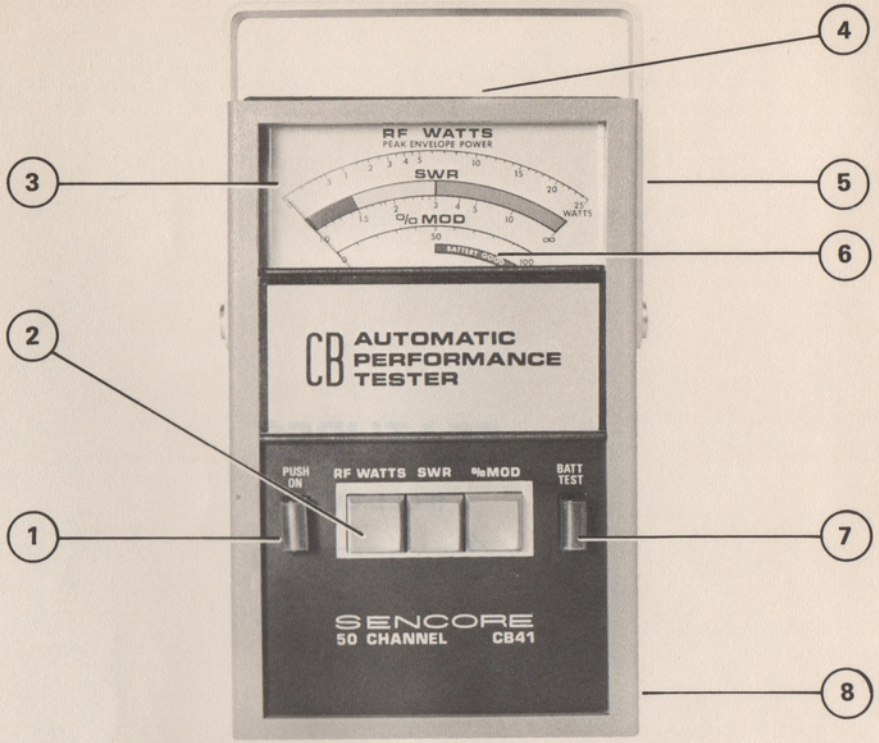
1. "PUSH ON" SWITCH: Applies power to the instrument when pressed. Indicator in button shows when power is on.
2. FUNCTION PUSHBUTTONS: Select measurement for RF Watts Power, SWR, or Percent Modulation.
3. METER: Contains calibrated and color-coded scales for all functions.
4. BATTERY COMPARTMENT: Under removeable cover holds two 9V batteries.
5. TILT STAND: Serves to tilt meter on bench or as portable carrying handle.
6. METER COVER: Slides over meter face for protection in portable use.
7. "BATTERY TEST" SWITCH: Indicates battery condition on meter scale when pressed.
8. CASE: Constructed of rugged plastic and vinyl-covered steel to withstand field use.
9. POWER ADAPTER JACK: Accepts PA202 Power Adapter for AC Line/rechargeable battery operation.
10. METER ZERO: Sets zero adjustment of meter.
11. STORAGE COMPARTMENT: Holds Sensor and cables when unit is not in use.

39G101 SENSOR

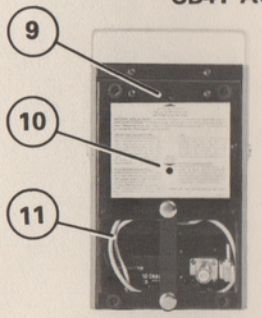
12. ANTENNA JACK: Connects to antenna cable of CB installation.
13. "ANTENNA/DUMMY LOAD" SWITCH: Selects antenna feed-through or internal 50 ohm dummy load.
14. CABLE PLUG: Connects to cable jack on CB41, or lengths of EX203 Extension Cables.
15. TRANSMITTER PLUG: Connects to output jack on CB radio.

ACCESSORIES

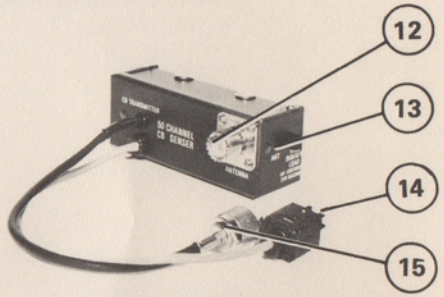
16. EX203 EXTENSION CABLE (Optional): Allows Sensor to be connected at radio and CB41 to be observed at antenna on mobile installations.
17. PA202 POWER ADAPTER (Optional): Plugs into Power Adapter Jack for AC Line/rechargeable battery operation.



CB41 AUTOMATIC PERFORMANCE TESTER

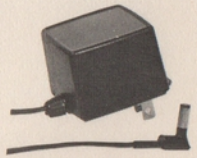


CB41 REAR VIEW



39G101 SENSOR

16 EX203 EXTENSION CABLE



17 PA202 POWER ADAPTER

OPERATION

INTRODUCTION

To get maximum effectiveness from your CB41, you should become thoroughly familiar with its operation and applications before putting the instrument to use. Play the Familiarization Instruction Tape supplied with the instrument, then read through the step-by-step instructions in this Operation Section, and the Applications Tips Section.

Observe all safety precautions listed inside the front cover and throughout the manual to insure continued usefulness with the CB41.

BATTERY INSTALLATION

The CB41 operates from two 9-Volt batteries (standard, alkaline, or rechargeable). To install or replace these batteries, use the following procedure:

1. Remove the two screws at the top of the battery compartment cover, and the two screws at the back of the cover. Remove the cover.
2. Clip the batteries into place and push them into the retaining clips inside the battery compartment, as shown in Fig. 1.
3. Replace the cover and re-install the four screws.

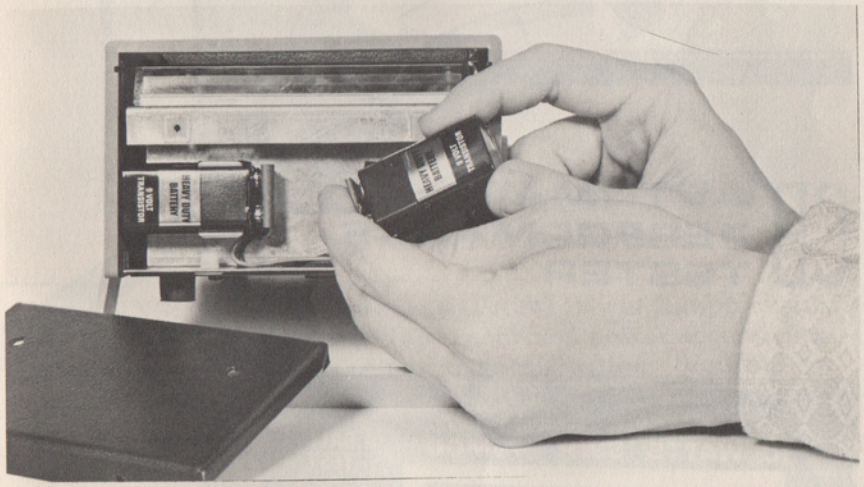


Fig. 1 — Battery installation

4. The following recommended battery types should be used.

RECOMMENDED BATTERY TYPES				
NEDA	MALLORY	EVEREADY	BURGESS	RCA
1604	M1604 MN1604	216 1222	2MN6	VS323

BATTERY CHECK

The batteries must supply sufficient voltage (7.2 Volts or more) for the CB41 to give reliable test results. To check battery condition, depress the "BATT TEST" switch just to the right of the three Function push-buttons. The meter should read in the green "BATTERY GOOD" area of the meter scale. If the meter reads below this area, the batteries should be replaced or recharged. The Battery Test may be made with the unit either OFF or ON.

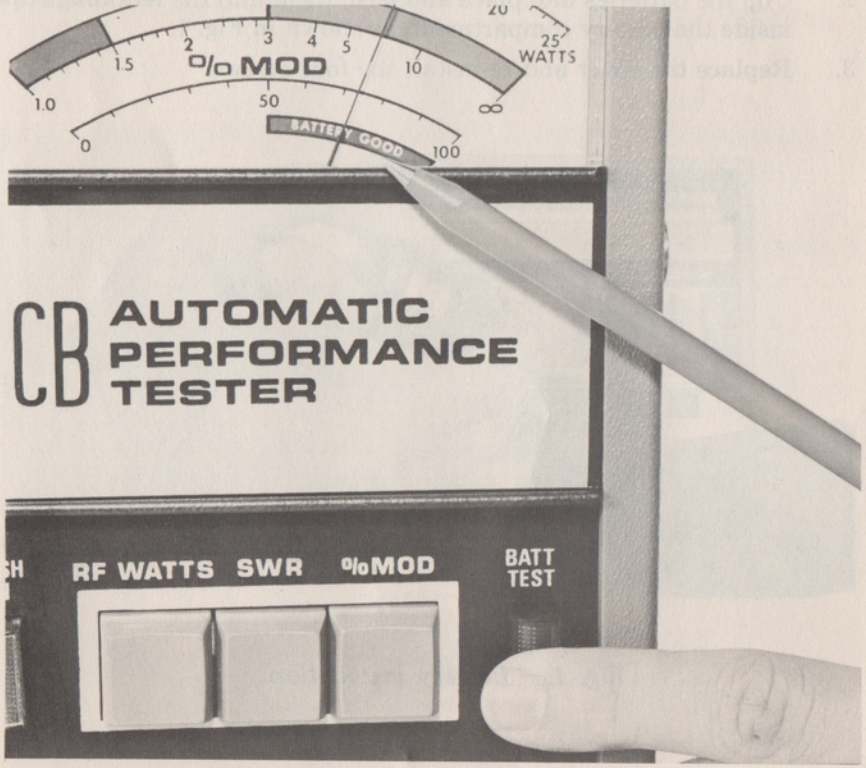


Fig. 2 — Battery check

AC POWER OPERATION (OPTIONAL)

The Sencore PA202 Power Adapter can be used to operate the CB41 from 105-130 VAC 50/60 Hz power, or used to recharge rechargeable batteries. The PA202 is an optional accessory that may be purchased at your Sencore Full Line Distributor, or from a Sencore Sales and Service Center listed in the back cover.

1. Plug the PA202 into a 105-130 VAC, 50/60 Hz outlet. Insert the small plug into the Power Adapter Jack on the back of the CB41.

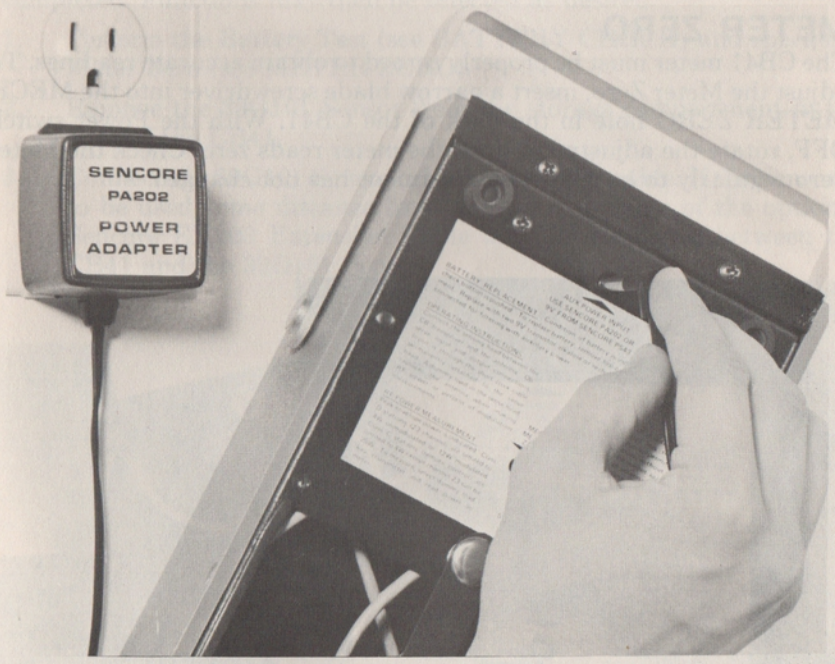


Fig. 3 — Installing the PA202 Power Adapter

WARNING: Use only the Sencore PA202 Power Adapter with the CB41. Similar-looking "tape recorder" power accessories are not designed with the power specifications required by the CB41. The PA202 is especially designed to be used with the CB41.

2. Batteries are required for filtering when operating the CB41 from AC power. See the BATTERY INSTALLATION section for installation instructions. The batteries must be charged for proper operation. If rechargeable batteries become discharged, connect the PA202 to the CB41 and recharge the batteries for several hours with the CB41 power OFF. Recheck the battery condition before using the CB41.

3. Standard carbon-zinc or alkaline batteries are not designed to be recharged. The PA202 will not recharge these types, but will extend their life by supplementing the battery power when operated from the AC Line.

4. The Power Adapter Jack is connected directly to the battery terminals and bypasses the POWER switch. Recharging may be done overnight with the POWER switch OFF. The PA202 will not be damaged if left in the AC outlet and not connected to the CB41.

METER ZERO

The CB41 meter must be properly zeroed to obtain accurate readings. To adjust the Meter Zero, insert a narrow blade screwdriver into the MECH METER ZERO hole in the back of the CB41. With the Power switch OFF, rotate the adjustment until the meter reads zero. Check the Meter Zero regularly to be sure the adjustment has not changed.

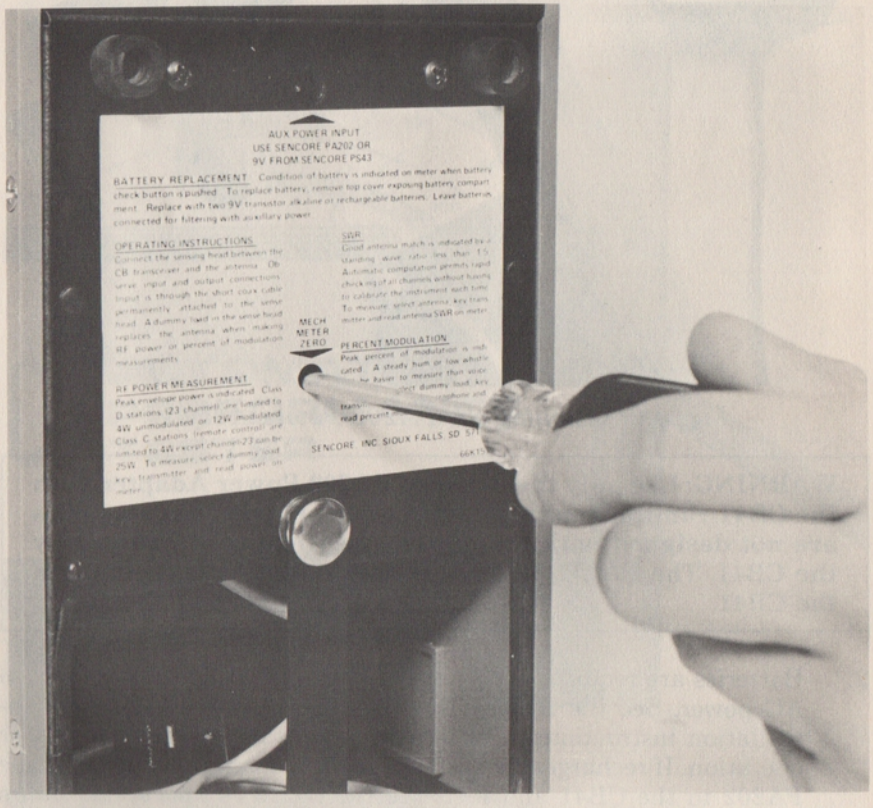


Fig. 4 — Adjusting Meter Zero

PREPARING FOR TEST

The CB41 has fully automatic and simplified operation for all CB performance tests. Cable hook-up is easy with only one connection required to the CB transmitter for RF Power and Percent Modulation checks. Only one additional connection to the antenna system is needed for automatic performance tests on any CB channel.

The following steps should be performed for initial set-up of any test. Refer to the instructions of the test to be performed once these steps are completed. Functions may then be selected as desired.

1. Perform the Battery Test (see BATTERY CHECK) and check the Meter Zero (see METER ZERO).

2. Remove the 39G101 Sensor from the storage compartment in the back of the CB41.

3. Connect the 39G101 Sensor cable to the CB41 cable. If the Sensor is to be used some distance from the tester, lengths of the optional Sencore EX203 Extension Cable may be connected between the CB41 and the 39G101 Sensor.

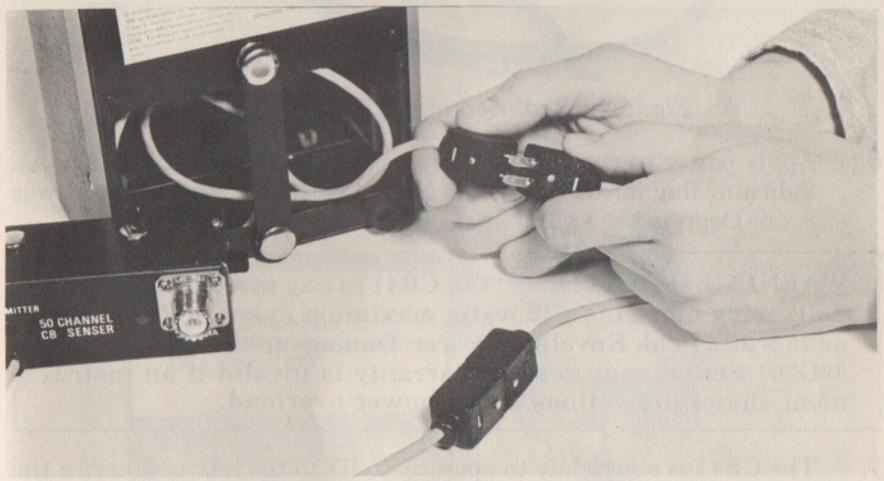


Fig. 5 — Connecting EX203 Extension Cables

4. Disconnect the antenna cable from the antenna jack on the CB radio. Connect the CB TRANSMITTER lead from the 39G101 Sensor to this jack. RF Power and Percent Modulation may be read by making this connection and by using the internal dummy load in the 39G101.

5. Connect the antenna cable to the "ANTENNA" jack on the Sensor, in addition to the CB TRANSMITTER connection explained in step 4, for testing SWR performance of the CB installation.

Fig. 6 — Radio connections to CB41

6. Apply power to the CB41 by depressing the PUSH ON switch. An indicator flag inside the switch button will appear when the power is on. Depress the switch again to turn the power off.

WARNING: Do not connect the CB41 to any system capable of delivering more than 12 watts maximum average RF power, or 25 watts Peak Envelope Power. Damage to the CB41 and/or 39G101 Sensor may result. Warranty is invalid if an instrument shows indications of RF power overload.

7. The CB41 is now ready to operate. Refer to the instructions for the test to be performed.

RF POWER TEST

NOTE: ANY INTERNAL ADJUSTMENTS OF A CB TRANSMITTER THAT MAY AFFECT THE FREQUENCY OR OUTPUT POWER MUST BE PERFORMED BY, OR UNDER THE SUPERVISION OF, A PERSON HOLDING A VALID FIRST OR SECOND CLASS FCC RADIO-TELEPHONE LICENSE.

The RF Power Test reads the Peak Envelope Power (PEP) of the transmitter RF output. The CB41 can be used for testing standard CB AM transmitters, or Single Sideband (SSB) transmitters: First, perform these initial RF Power Test steps:

1. Perform the steps explained in PREPARING FOR TEST.
2. Place the ANT/LOAD switch on the 39G101 Sensor to the "50 OHM DUMMY LOAD" position.
3. Depress the RF WATTS function button.

To test AM power output:

1. Perform the initial RF Power Test steps as explained above.
2. Turn the transmitter on and key the Push-to-Talk switch. With no modulation, the meter shows the unmodulated carrier power on the RF WATTS scale. FCC rules specify that this power should be 4 watts or less. (Refer to FCC Citizens Radio Service Rules and Regulations, Part 95).

See Applications Tip 3 if the power appears to be low.

Fig. 7 — RF Power Test

3. Modulating the carrier by whistling or humming into the mike should increase the power reading. The maximum legal modulated power is 12 watts.
4. Some common types of RF power meters provide average RF power readings. These meters show no change between unmodulated and modulated carrier power. The peak envelope power readings of the CB41, however, will be higher for a modulated carrier than an unmodulated carrier. The PEP power thus serves as an indication of both carrier power and modulation.
5. Remote control Class C transmitters are allowed to transmit an unmodulated power of 25 watts on channel 23 only. Measure Class C RF power using a 30-second ON, 30-second OFF duty cycle to prevent damage to the internal dummy load, if operating into the dummy load.

To test for SSB power output:

1. Perform the initial RF Power Test steps as explained above.
2. Turn the SSB transmitter on, select either Upper (USB) or Lower (LSB) sideband operation, and key the Push-to-Talk switch.
3. With no modulation, the CB41 should read zero RF watts. If a power reading is present with no modulation, the CB transmitter may need adjustment.
4. Modulate the transmitter by whistling or humming into the microphone with a loud, steady tone. The maximum PEP should not be more than 12 watts. Perform this test with a duty cycle of 30-seconds ON, 30-seconds OFF, to prevent damage to the dummy load in the Sensor, if operating into the dummy load.

See Applications Tip 3 for details on transmitter defects which may cause improper RF power readings.

SWR TEST

The SWR test reads the Standing Wave Ratio of the transmitted (forward) power to the power reflected back from the antenna (reverse power). Minimum reflected power produces lowest SWR, greatest transmit range, and maximum efficiency. The CB41 SWR test does not need nulling or calibration, as required by other SWR testers. It is fully automatic for all CB channels. For ease of operation, the SWR test should be performed in the AM transmit mode only.

To measure SWR:

1. Perform the steps explained in PREPARING FOR TEST.
2. Place the ANT/LOAD switch on the 39G101 Sensor to the "ANT" position.
3. Depress the SWR function button.

4. Key the transmitter. The meter will read SWR directly on the "SWR" scale. For most efficient broadcast, the SWR should be 1.5 or less (green area). SWR between 1.5 to 3 (yellow area) shows questionable system performance. SWR greater than 3 (red area) means the system requires adjustment or repair.

NOTE: Accurate SWR measurements cannot be made while holding the antenna, since the body becomes part of the antenna system. Be sure to release the antenna before each SWR reading.

See Applications Tip 4 if the reading is more than 1.5.

PERCENT MODULATION TEST

The Percent Modulation test compares the peak-to-peak audio modulation to the average RF power of the transmitted signal. The test is fully automatic and self-adjusting for typical power levels.

To test for Percent Modulation:

1. Perform the steps explained in PREPARING FOR TEST.
2. Place the ANT/LOAD switch on the Sensor to the "50 OHM DUMMY LOAD" position.
3. Depress the % MOD Function button.
4. Modulate the RF signal with a steady whistle or hum into the microphone held at normal speaking distance. The meter should read 80-100% on the "% MOD" scale.

See Applications Tip 7 if the reading cannot be made to read at least 80%.

APPLICATIONS

TIP 1 - UPDATING FOR ADDITIONAL FCC CHANNEL ALLOCATIONS

The CB41 has flat response on all functions for any RF carrier frequency between 20 and 30 MHz. It is not frequency selective around 27 MHz and will not become obsolete with new channel allocations. Any additional frequencies that may be assigned by the FCC in this range may be tested using the normal procedures without any modification of the CB41.

TIP 2 - MATCHING THE CB41 AND 39G101 SENSOR

Each CB41 is supplied with a 39G101 Sensor that is factory matched and calibrated for use with the particular unit. If several CB41s are in use in the same shop or business, it is suggested that each matched set be individually marked to prevent interchanging units and Sensors. If a replacement 39G101 Sensor is obtained, the CB41 must be recalibrated (see CALIBRATION section).

TIP 3 - RF POWER TEST TIPS

The CB41 measures Peak Envelope Power (PEP). This allows the same power test to be used for AM or SSB transmitters. The maximum legal output power for a transmitter is 4 watts unmodulated or 12 watts at 100% modulation. An exception is a Class C remote control transmitter operating on channel 23, which is allowed 25 watts unmodulated power.

The following is a list of some of the more common causes of improper RF Power readings on the CB41:

1. Most mobile transmitters are designed to operate on a 13.8 VDC power supply input. A vehicle battery supplies a nominal voltage of 12 volts, but the charging system increases the supply voltage to 13-15 Volts. This change in the supply voltage can result in as much as a 25% change in the output power of an properly operating transmitter. To obtain an accurate power reading when testing a mobile transceiver, the test should be made with the engine running, or the CB powered by a portable adjustable power supply such as the Sencore PS43.
2. SSB transmitters should give a zero power output with no modulation. The balanced modulator in the transmitter should remove all of the carrier. If the balanced modulator is out of adjustment, there may be a power reading when the transmitter is keyed. This indicates the need for bench service of the unit. To measure the transmitter output power, a modulation signal should be applied to the input of the transmitter in the form of a low whistle or hum. The output power should read 12 watts or less.
3. Low transmitter output may be caused by a defective transmitter, or by a poor ground or power supply connection, resulting in an insufficient supply voltage when the transmitter is keyed.

TIP 4 - SWR TEST TIPS

SWR is very important in CB performance testing because it has a direct effect on broadcast range. While RF Power and Percent Modulation are functions of the transmitter's operation, SWR depends on the entire antenna and coax installation. SWR can usually be improved for better performance and range.

The following are the most common SWR problems and solutions.

1. Almost every CB antenna has a method of matching the "electrical length" to the particular installation. The installer should be familiar with each type of antenna adjustment.

   Many antennas are adjusted by changing the actual length of the antenna, often by means of a set screw at the antenna base. Other antennas have a variable capacitor in the base which changes the performance of the antenna system without actually changing the antenna's mechanical length. With either type of adjustment, the important thing is to set the antenna for the lowest SWR reading throughout the entire CB band.
2. When adjusting SWR, first check the reading on channel 1, and then on channel 23. If the SWR is higher on channel 1 than 23, the antenna is too short. If the SWR is higher on channel 23, the antenna is too long for best overall performance.

   To check complete SWR performance on all channels, simply rotate the channel selector on the CB through all 23 channels and observe the meter. The lowest SWR should be obtained on channels 10 through 13 for best overall performance of the system.
3. Never adjust SWR with the vehicle inside a building or close to large metal objects. The building will reflect the transmitted power back to the transmitter, giving a high SWR reading. Even reflective surfaces such as trees or wet pavement can increase the SWR reading. To avoid these reflected conditions, SWR should be set with the vehicle in an open area, such as a parking lot, with as few reflective surfaces as possible within 20 feet of the antenna.
4. High SWR readings can be caused by pinched or damaged coax cable between the transmitter and the antenna. If such damage is suspected, measure the SWR at both ends of the coax, if possible. There should be little difference between the two readings. If the reading at the transmitter end of the cable is higher than at the antenna, the cable should be inspected for damage and repaired or replaced.
5. A high SWR reading may result from an improperly grounded antenna, or if the antenna is installed on a non-metallic surface that does not offer an adequate ground plane. It is suggested that the antenna manufacturer's instructions be consulted for specific installations.

6. A high SWR reading may be caused by a poor connection at the coax input of the antenna itself. Make sure that all RF connections have been made properly.

TIP 5 - SIMPLIFIED ALL CHANNEL SWR TESTING

When checking SWR on an installation, first check the reading on all CB channels to see if there is a dip in the SWR reading. This is easily done with the automatic calculating circuits of the CB41. If the dip shows in the high channel region of the band, the antenna is too short or resonates at too high a frequency. The dip may occur in the lower channels or below the first channel. In this case, the antenna is too long and resonates at too low a frequency. The antenna should be adjusted for a SWR dip in the center of the CB band for maximum range on all channels.

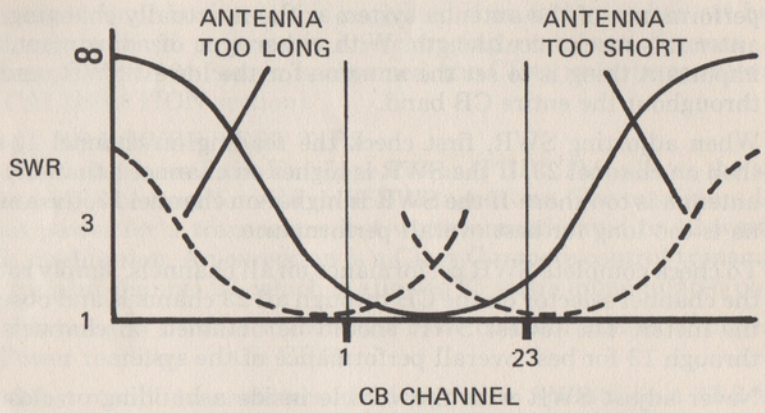


Fig. 8 — All channel SWR Test

TIP 6 - ONE MAN MOBILE SWR TESTS

A common difficulty is encountered when installing or adjusting a mobile CB system since two technicians are often required for adjusting antenna SWR. A person at the radio reads the SWR on the CB41 and tells the other technician at the antenna how to improve the antenna length. This "double teaming'' can be eliminated by using the optional EX203 Extension Cable with the CB41 for one-man SWR monitoring and adjustment at the antenna, doubling CB installation and servicing efficiency.

The Sensor may be connected to the radio and the CB41 carried to the antenna location with lengths of EX203 cables plugged into the Sensor. Place the CB41 in view near the antenna, whether at the roof, trunk, mirror-mount, or rear bumper. Select the "ANT'' position on the Sensor and key the mike with a rubber band around the PTT switch, or by placing it between the seats.

Check the SWR on a middle channel (10 to 13) and adjust for minimum SWR according to the antenna manufacturer's instructions. As a final check, rotate the CB's channel selector through all channels to be sure the SWR dips in the middle channels.

WARNING: Do not touch the antenna during the SWR reading, or anytime while transmitting, since the body will act as part of the antenna system, upsetting the SWR reading. In addition, a possible "tickle" could result if adequate insulation is not used between the body and antenna. Use a pair of insulated pliers for grasping the antenna when adjusting its length. Also use an insulated handle screwdriver when adjusting the loading coil. DO NOT ATTEMPT TO PERFORM "HANDS-ON" ANTENNA ADJUSTMENTS IN TRANSMIT MODE WITH A CB DELIVERING MORE THAN 4 WATTS AVERAGE RF POWER.

TIP 7 - PERCENT MODULATION TEST TIPS

Since the CB41 shows average modulation, it is important to provide a relatively steady modulating signal during the Percent Modulation test. A low-pitched whistle or hum is best for this modulation tone. Normal speaking tones (such as "testing one, two, three'') will not show the best modulation capability of the transmitter. When modulated with normal speaking, most transmitters will read an average of 30-50% modulation.

Some causes of low modulation are:

1. A bad microphone or poor connection.
2. A weak battery in a microphone using a built-in pre-amplifier.
3. A defect in the audio amplifier of the transceiver. Since most CB radios use the same amplifier for transmit modulation and receive amplification, this may also be indicated by poor audio quality during receive.
4. Using a modulation tone higher in frequency than the frequency response of the modulation circuit. Normally, the modulation signal should be 1000 Hz or less.

TIP 8 - CB INSTALLATION PERFORMANCE CHECK

The CB41 is the ideal instrument to totally check a complete CB installation -- in the car, truck, home or business. By monitoring adjustments with the CB41, peak performance and maximum range can be obtained quickly, easily, and accurately. The CB41's automatic tests help to identify any area that may limit performance by determining whether the problem is in the transmitter itself or in the antenna and cables.

A simple performance check takes only four steps and a few minutes. (1) Connect the CB41 and Sensor between the transmitter and the antenna

cable. (2) Check the RF Power into the 50 ohm load. (3) Whistle into the mike for the Percent Modulation test. (4) Switch through all channels while monitoring SWR. The meter should read in the good SWR area on all channels.

Refer to this chart for common CB system curses and cures.

SYMPTOM	PROBLEM AREA
RF PWR ok % MOD low	-Defective mike -Not speaking close enough to mike -Low gain in audio circuits -XMIT/RCV relay not activating -Defective modulation coupling circuits
RF PWR ok % MOD ok SWR high	-Antenna or coax cable problem -Broken wire or shield (check full cable length with ohmmeter) -Shorted coax cable (check between conductor and shield with ohmmeter) -Pinched coax cable (inspect for kinks and sharp bends) -Open loading coil -Cold solder connection on jacks or antenna -Corrosion at antenna terminal connections -Corroded or aged coax cable -Improper antenna length -Improper antenna type -Moisture in loading coil
RF PWR low % MOD ok	-Low supply voltage to radio -Bad supply connection to radio -Defective RF output stage -Defective voltage regulator in auto
No RF PWR on one or a few channels	-Defective crystal or selector switch

TIP 9 - TESTING THROUGH THE ANTENNA

The antenna loop-through built into the 39G101 Sensor has no insertion loss. Therefore, it will not alter the SWR or transmit power of an antenna system.

RF Power test may be monitored either with the Sensor connected to a good external antenna and the ANT/LOAD switch in the "ANT" position, or with the switch in the "LOAD" position. You can key the transmitter in either switch position and know that the proper load is connected. The internal 50 ohm dummy load provides an accurate reference for RF power and percent modulation tests, plus prevents broadcast and possible interference on a CB channel during the tests.

To test the actual RF Power being transmitted through the antenna, however, the SWR must be less than 1.5 (green area on SWR meter scale). Power readings obtained with an SWR greater than 1.5 may be higher or lower than the true power output, and are unreliable. This is because a high SWR indicates that a large portion of the transmitted signal is being reflected back to the radio and is not being broadcast. This reflected power is not detected by the CB41 in the RF Power mode. High SWR is also indicated when the RF Power readings vary considerably when the ANT/LOAD switch is switched between the antenna and the 50 ohm dummy load. Any high SWR condition should be corrected before attempting to measure true power output through the antenna.

TIP 10 - PERMANENT CB41 INSTALLATION

Strong, clear transmission is essential to good personal communications. Weak, garbled, or clipped levels cause distortion and overmodulation, preventing intelligible reception of the transmitted signal. The CB41 may be used as a permanent part of a CB installation in the home, business, or shop for continuous monitoring of Percent Modulation on every broadcast for clear communications. In this application, the Percent Modulation function must be used with the Sensor ANT/LOAD switch in the "ANT" position.

Normal voice transmission will indicate an average of 30-50% modulation. Peak voice modulation is not indicated on the meter, but 100% peak corresponds to approximately 50% average voice modulation.

The CB41 may also be used occassionally for RF Power and SWR tests to insure the installation is operating properly, although these characteristics generally do not change during normal operation.

CIRCUIT DESCRIPTION

INTRODUCTION

This section describes the theory of operation and the circuits of the CB41. These will be helpful in learning how your CB41 operates and will serve as a guide to the calibration and maintenance of the instrument.

THEORY OF OPERATION

There are two key operating sections in the CB41.

First, the 39G101 Sensor elements pick up and detect the appropriate portions of the loop-through signal to produce three reference signals -- Forward Power, Reverse Power, and Modulation. Each sensing element is sensitive to a "traveling wave" in only one direction on the loop-through line.

Then, these reference signals are processed to DC voltages according to the selected function and applied to the two main inputs of the Integrator-Comparator circuit. This circuit controls the meter reading by switching the meter on and off at a 60Hz duty cycle. The meter is turned on at t_0 when the Integrator begins to develop a ramp signal. The reference voltage to the Integrator DC Input controls this ramp slope. The Comparator compares this ramp voltage with the Comparator DC input, setting the output to the HI state t_1 when both inputs are equal, causing the meter to be shut off.

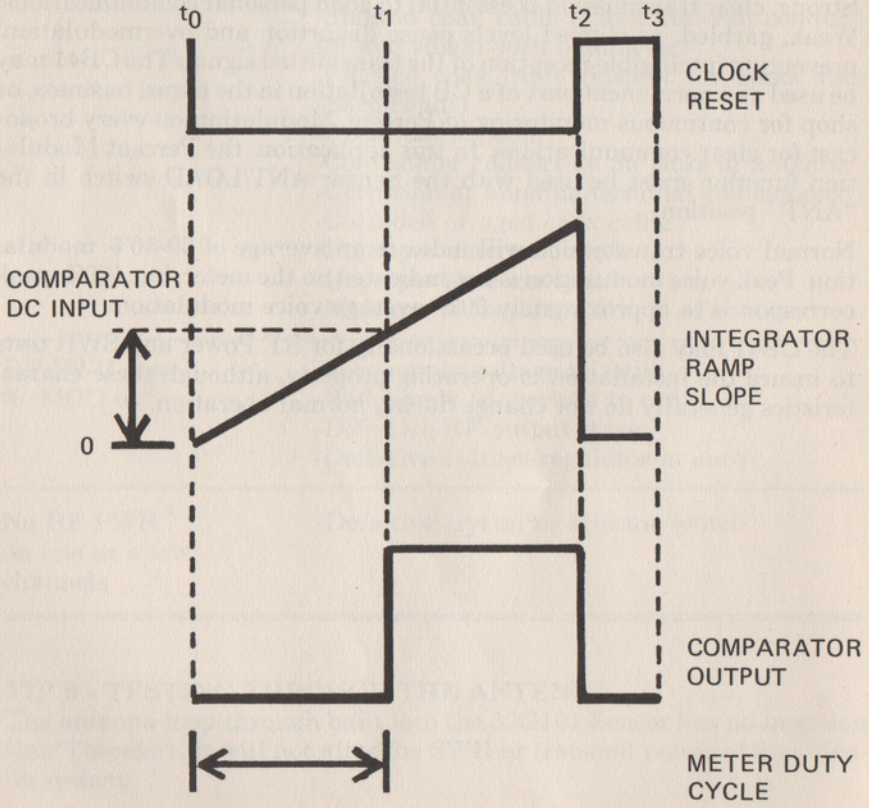


Fig. 9 — CB41 test measurement relationships

The meter reading is thus proportional to the duty cycle t_0 to t_1, as determined by one reference voltage controlling the Integrator ramp slope and another reference voltage controlling the Comparator DC Input. As these reference voltages increase, the duty cycle becomes longer, increasing the meter reading.

The clock resets the circuits at a 60 Hz rate between t_2 and t_3 to prepare for the next measurement cycle, and begins the ramp again at t_3.

The following diagram illustrates which of the processed reference signals control the Integrator Slope and the Comparator DC Input for each function.

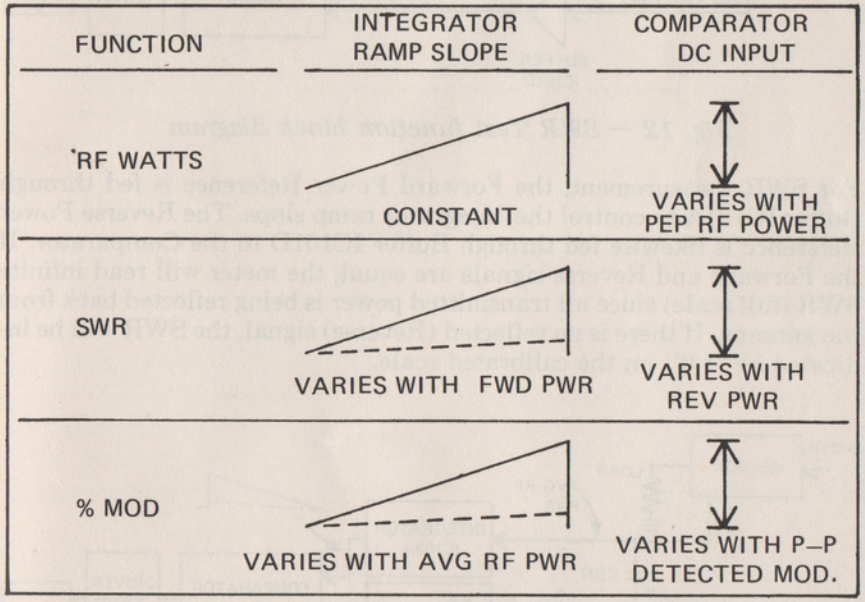


Fig. 10 — Integrator and Comparator inputs

In the RF Power function, the slope of the Integrator ramp is constant since it is tied to the +5 regulated source through the Buffer IC101A. The DC level of the Forward Power Reference signal thus controls the

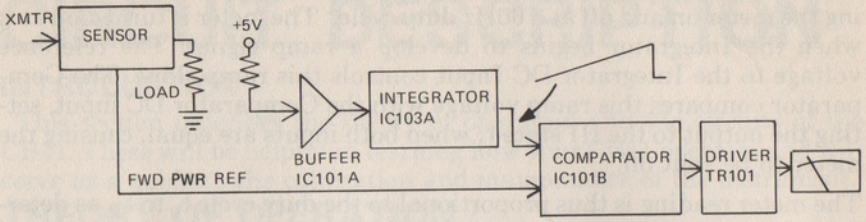


Fig. 11 — RF Power function block diagram

ON duty cycle to the Comparator output. The greater the RF power, the higher the meter will read, with the scale calibrated in RF watts.

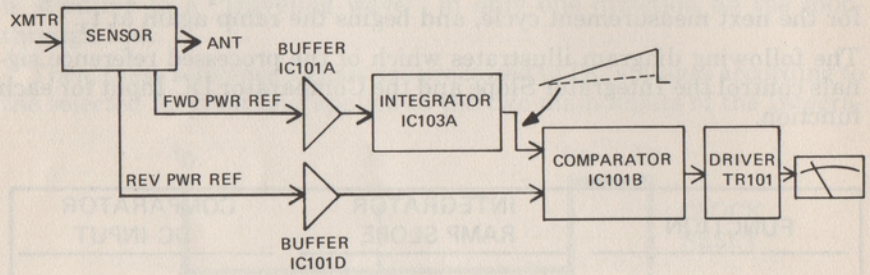


Fig. 12 — SWR Test function block diagram

For SWR measurement, the Forward Power Reference is fed through Buffer IC101A to control the Integrator ramp slope. The Reverse Power Reference is likewise fed through Buffer IC101D to the Comparator. If the Forward and Reverse signals are equal, the meter will read infinite SWR (full scale) since all transmitted power is being reflected back from the antenna. If there is no reflected (Reverse) signal, the SWR will be indicated as "1.0" on the calibrated scale.

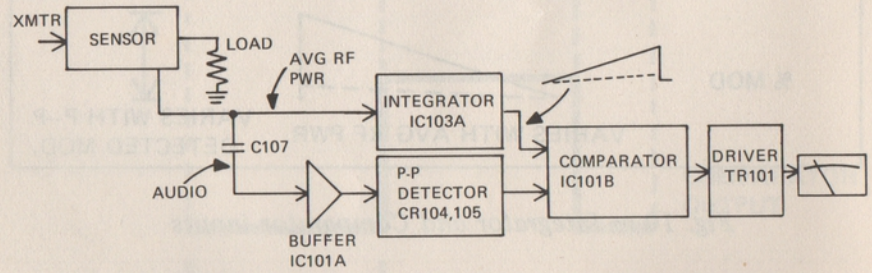


Fig. 13 — Percent Modulation function block diagram

The Modulation Reference signal from the Sensor is separated into AC and DC components by C107 during the Percent Modulation Test. The

DC component, containing the average RF power level, controls the Integrator ramp slope. The AC component is the audio modulation level. This signal is fed through the Buffer IC101A, peak detected by CR104, 105, and applied to the Comparator. If both AC and DC component levels are equal, 100% modulation is shown on the meter.

COMPLETE CIRCUIT DESCRIPTION

The complete circuit description for the CB41, with simplified circuit diagrams, is available for a $3.00 handling charge from the Sencore Field Engineering Department, 3200 Sencore Drive, Sioux Falls, S.D. 57107.

MAINTENANCE AND SERVICE

INTRODUCTION

This Maintenance and Service section will help you to maintain the CB41 within published specifications and assure years of useful application.

The schematic, parts location diagrams, and parts list are included as a separate sheet to this manual. The exclusive color-coded "Signal Tracer" schematic has the key signal paths marked for fast identification and recognition of supply voltages, function paths, and circuit waveforms. The color coding simplifies and speeds understanding of the circuit functions and pinpoints signal locations that otherwise would be "lost in the woods."

Warranty information is printed on the back of the Quality Assurance tag attached to the instrument. Factory Service information is located inside the back cover of this manual.

BATTERY REPLACEMENT

See page 9 for battery replacement instructions.

CLEANING

The front panel and case may be cleaned with a mild solution of detergent and water. Use a soft cloth when cleaning the meter face to prevent scratching.

ACCESS/DISASSEMBLY

To gain access to the interior of the CB41 for calibration, proceed as follows:

1. Remove the four screws on the sides of the CB41 which hold the front panel to the case back.
2. Pull the front panel away from the unit. All calibration controls and test points are now exposed.
3. To make adjustments to the 39G101 Sensor, remove the snap-on caps to expose the calibration controls inside the Sensor.
4. For access to the battery compartment, remove the four screws holding the battery compartment cover at the top of the case. See the BATTERY INSTALLATION section for instructions.

CALIBRATION

The calibration procedure should be performed at regular intervals (twelve months recommended), or when accuracy is in doubt, to restore CB41 performance to the original factory specifications.

The test standards for calibration and performance tests are listed in the following chart.

CALIBRATION EQUIPMENT REQUIRED

EQUIPMENT	SPECIFICATIONS
CB RADIO	
1½ VOLT BATTERY (3 Required)	ALL MUST HAVE SAME VOLTAGE OUTPUT ± .01V
WATTMETER	BIRD MODEL 43 THRULINE OR EQUIVALENT
SINE WAVE GENERATOR	1000 Hz , 0–5 VP–P
MULTIMETER	SENCORE DVM36 OR EQUIVALENT (.5% ACCURACY, 1 mV RESOLUTION)
DUMMY LOAD*	25 OHM, 2%, 6W MIN.

**Note: Dummy load may be constructed from four-100 ohm 2% 2W resistors connected in parallel. Attaching to Sensor is more convenient if resistors are soldered to a UHF (PL259) plug.*

Proceed as follows for calibration of the CB41.

1. With the power OFF, perform the Battery Test (See BATTERY CHECK for instructions). Replace or recharge batteries if meter does not read in "Battery Good" area on the meter scale.
2. Check the Meter Zero. (See METER ZERO for instructions.)
3. Depress the PUSH ON button and select the SWR Function Pushbutton.
4. With the multimeter, measure the voltage at test point TP301 on the Function Switch P.C. Board (See Fig. 14). Adjust V_r Bias R103 for -5 mV at this test point. Likewise, adjust V_f Bias R110 for -5 mV at Test Point TP302.

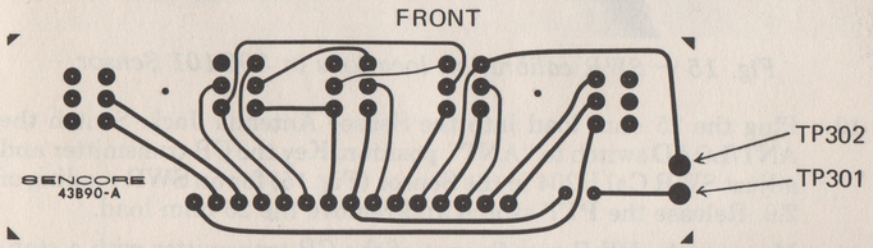


Fig. 14 — Voltage test point locations on foil side of Function Switch P.C. Board

5. Disconnect the 39G101 Sensor from the CB41.
6. Apply -1.5 Volt between ground and pin 3 of Jack J1. A 1 1/2 Volt battery may be used with the positive terminal connected to ground. The green lead from the Sensor cable may also be used for this connection. Adjust Full Scale Cal R126 for a full scale meter reading.
7. Apply +3.0 Volts between ground and pin 2 of Jack J1, leaving the voltage source of Step 6 connected. Two 1 1/2 Volt batteries having the same potential (±.01 V) as the battery in Step 6 may be connected in series with the most negative terminal to ground. The red lead from the Sensor cable may also be used for this connection. Adjust Integrator Slope Cal R115 for a meter reading of SWR=3.
8. Remove the voltage sources and plug in the Sensor to the cable. Select the LOAD position of the ANT/LOAD switch.
9. Connect the CB41 to an operating CB transceiver as explained in PREPARING FOR TEST. Key the Push-to-Talk switch on the CB. (A rubber band may be used to hold the CB in transmit mode while making the following adjustments). Adjust SWR Null R203 in the Sensor for an SWR reading of 1.0 on the meter. Release the PTT switch.

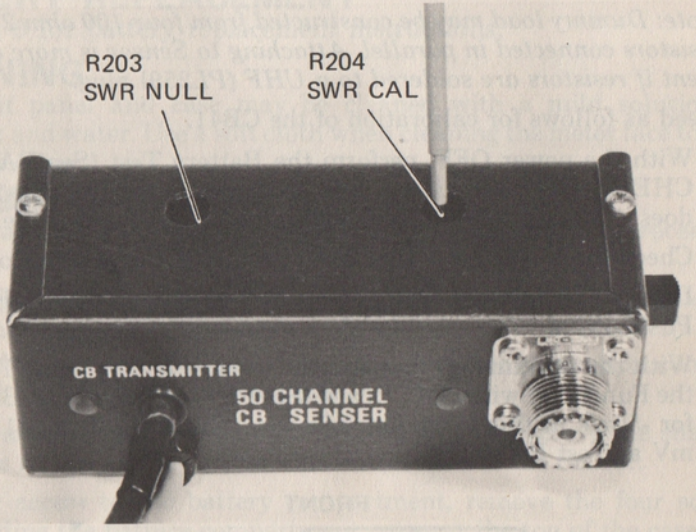


Fig. 15 — SWR calibration locations in 39G101 Sensor

10. Plug the 25 ohm load into the Sensor Antenna Jack. Switch the ANT/LOAD switch to "ANT" position. Key the CB transmitter and adjust SWR Cal R204 in the Sensor (Fig. 15) for an SWR reading of 2.0. Release the PTT switch and remove the 25 ohm load.
11. Measure the RF Power Output of the CB transmitter with a standard wattmeter, such as specified in the "Calibration Equipment Required" chart. Select the "LOAD" position of the ANT/LOAD switch. Connect the CB radio to the CB41, select the RF Watts Function pushbutton, and key the transmitter. Adjust RF Power Cal R123 for the same output power reading as given by the wattmeter. Release the PTT switch and disconnect the CB.
12. Select the Percent Modulation Function pushbutton. Apply -3.0 Volts from the battery to the white wire from the Sensor in series with 1.060 V RMS (3.0 VP-P) sine wave output from a signal generator. Be sure to connect a matching load across the generator output (typically 600 ohms). See Fig. 16. Note: The peak-to-peak AC signal voltage must be the same as the battery voltage for this calibration. If the battery voltage is other than -3.00 V, multiply the actual battery voltage by .353. This value is then the correct generator signal level, as measured with an RMS-reading meter.

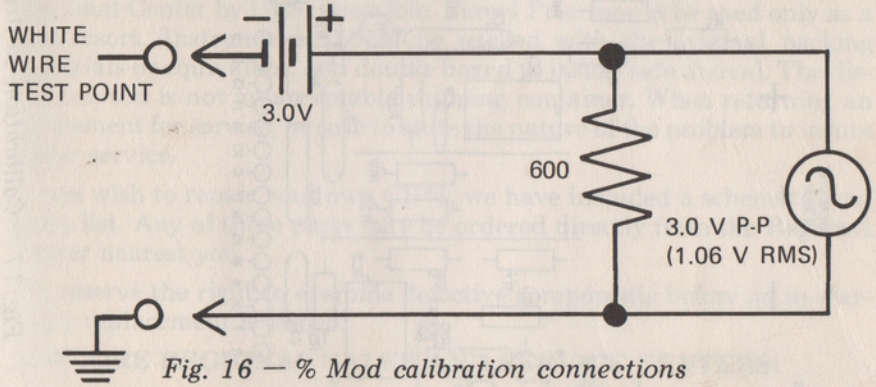


Fig. 16 — % Mod calibration connections

13. Adjust % Mod Cal R109 for 50% modulation on the meter. Disconnect all calibration inputs. The CB41 calibration is now complete.

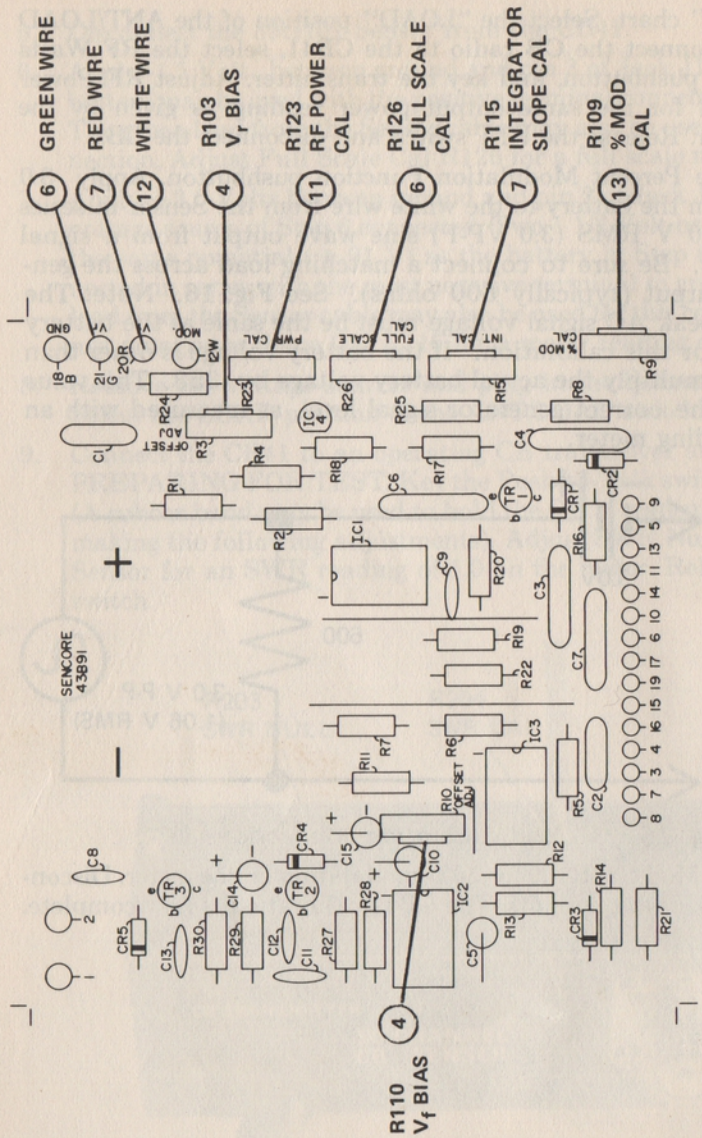


Fig. 17 — Calibration control location diagram

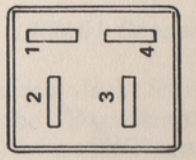


Fig. 18— Pin numbering of CB41 cable connector

SERVICE AND WARRANTY

You have just purchased one of the finest CB Performance Testers on the market today. The Sencore CB41 has been inspected and tested twice at the factory and has passed a rugged use test by our Quality Assurance Department to insure the best quality instrument to you. If something should happen, the CB41 is covered by the exclusive 100% Made Right Lifetime Guarantee as explained on the warranty policy enclosed with your instrument.

Sencore has six factory-owned Regional Sales and Service Centers to serve you. Instruments to be serviced should be returned to the nearest Regional Center by UPS if possible. Parcel Post should be used only as a last resort. Instruments should be packed with the original packing materials or equivalent, and double boxed to insure safe arrival. The display carton is not an acceptable shipping container. When returning an instrument for service, be sure to state the nature of the problem to insure faster service.

If you wish to repair your own CB41, we have included a schematic and parts list. Any of these parts may be ordered directly from the Regional Center nearest you.

We reserve the right to examine defective components before an in-warranty replacement is issued.

SENCORE REGIONAL SALES AND SERVICE CENTERS:

Sencore East Central
4105 Duke Street
Alexandria, VA 22304
(703) 751-3556

Sencore Central
2711 B Curtiss Street
Downers Grove, IL 60515
(312) 852-6800

Sencore Western Coast
833 Mahler Road
Burlingame, CA 94010
(415) 697-5854

Sencore West
3200 Sencore Drive
Sioux Falls, SD 57107
(605) 339-0100

Sencore Southeastern
2459 Roosevelt Hwy. Suite B-3
College Park, GA 30337
(404) 768-0606

Sencore Northeastern
1237 Central Avenue
Albany, NY 12205
(518) 459-6040

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3200 SENCORE DRIVE, SIOUX FALLS, SOUTH DAKOTA 57107

PRINTED IN U.S.A.

Form 1261

CB41

AUTOMATIC CB PERFORMANCE TESTER

SCHEMATIC AND PARTS LIST WITH "SIGNAL-TRACER" CODING

SENCORE

THE ALL AMERICAN LINE OF HIGH QUALITY TEST EQUIPMENT

CB41 PARTS LIST

SCHEMATIC REFERENCE	PART NUMBER	DESCRIPTION	PRICE
MAIN P.C. BOARD			
IC101	69G13	IC, LM324	3.25
IC102	69G7	IC, 4001	.50
IC103	69G11	IC, 4016	1.25
IC104	69G29	IC, 5V Regulator, LM78L05A	1.50
TR101, 102	19A34	Transistor, 2N3906	.50
TR103	19A33	Transistor, 2N3904	.50
CR101, 102, 104,	50C3-2	Diode, IN695	.25
CR103	50C5-2	Diode, IN4148	.25
R103, 110	15C7-8	Control, 1.2M, Bias Cal	.75
R109	15C7-28	Control, 50K, % Mod	.75
R115	15C7-12	Control, 25K, Int. Cal	.75
R123	15C7-25	Control 250K, PWR Cal	.75
R126	15C7-12	Control, 25K, Meter Cal	.75
R101, 102, 106	14C30-1005A	Resistor, 100K, 2%, 1/2W	.75
R116	14C30-2405A	Resistor, 24K, 2%, 1/2W	.75
R131	14C30-2005	Resistor, 200K, 2%, 1/2W	.75
C101, 102	24G303	Capacitor, .01mF, Mylar	.25
C103, 104, 107	24G222	Capacitor, .47mF, Mylar	.75
C105	24G212	Capacitor, .047mF	.25
C106	24G330	Capacitor, .33mF, Film	1.00
C108	24G125	Capacitor, .005mF, Disc	.25
C109	24G90	Capacitor, 68pF, Disc	.25
C110, 114, 115	24G196	Capacitor, 2mF, Lytic	.25
C111	24G208	Capacitor, 150pF, Disc	.25
C112, 113	24G299	Capacitor, 100pF, Disc	.25
MI	23C62	Meter, 100uA, 1900 ohm	22.50
SENSOR ASSEMBLY			
CR201-203	50C3-2	Diode, 1N695	.50
R203	15C7-21	Control, 500 ohm, SWR Null	.75
R204	15C7-21	Control, 500 ohm, SWR Cal	.75
R205-207	14A23-151	Resistor, 150 ohm, 10%, 2W	.25
C201, 203	24A254-2	Capacitor, .001mF, Feed thru	.25
C202	24A254-1	Capacitor, 100pF, Feed thru	.25
	25G238	Switch, Slide, ANT-LOAD	.50
	13G42	Cable, 4-conductor	
	13G43A	Cable, 50 ohm Coax, RG58C	
	26G206	Connector, UHF, Female	1.50
	26G207	Connector, UHF, Male	1.25
	26G208	Connector, 4-pin, Male	1.25
	26G209	Connector, 4-pin, Female	1.25

SCHEMATIC REFERENCE	PART NUMBER	DESCRIPTION	PRICE
SWITCH P.C. BOARD			
SW301	25A237	Switch, Push, BATT TEST	1.25
SW302	25A234	Switch, Push, FUNCTION	2.75
SW303	25A236	Switch, Push, PUSH-ON	1.25
ASSEMBLIES			
	143B91	Main P.C. Board Assy.	43.75
	39G101	Sensor Assy.	25.00
	143B90	Switch P.C. Board Assy.	12.50
	108K154-41	Case Front Assy.	2.25
	110K293-41	Case Back Assy.	5.75
	10K343	Battery Door Assy.	.75
MISCELLANEOUS			
J1	26G203	Jack, AC Adapter	.75
	26G152	Connector, 9V battery	.75
	111K46	Strap, Lead Compartment	.75
	21A44B	Glamor Cap, Black	.25
	21G71	Button, Indicator	1.00
	21A58	Button, Grey	.25
	37G26	Rubber Foot	.25
	1262T	Familiarization Tape	3.00

Components not listed are standard replacement parts and may be purchased locally. When ordering parts, please specify instrument model number, schematic reference, part number, and description. Please include remittance (check or money order) with your order, otherwise invoices will be shipped C.O.D. Minimum billing is $3.00. Prices and specifications in effect at date of printing and subject to change without notice.

CB41 SCHEMATIC ADDENDUM

Please note these changes to the CB41 Automatic Performance Tester Schematic and Parts List (Form 1261). Mark these changes on the schematic for future reference.

1. The illustrations for the SWR and Percent Modulation Block Diagrams are reversed.
2. Pin connections 3 and 4 (inside the diamonds) of the 39G101 Sensor schematic are reversed. The front view drawings of J1 and P1 are shown correctly.
3. The location of R105 has been changed. It is now connected between C102 and pin connection 20 of P.C. Board 43B91. A jumper wire is used where R105 is presently shown on the schematic.

SENCORE

Form 1308