Operating Manual

# CBTester





**Relcom Inc.**
INDUSTRIAL LAN | WIRING COMPONENTS AND TESTERS

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500-346 Rev. 0

## PURPOSE OF THE CBTester

The purpose of the CBTester is to make measurements on the Carrier-band Network so that:

- The cable-system components, such as taps and cable, can be tested before installation.
- The network cable-system can be properly installed.
- The network cable-system can periodically be verified to be good.
- The stations to be connected to the network cable can be tested for proper signal output.

The Carrier-band Network is defined in the IEEE 802.4 standard and the ISO equivalent standard 8802/4. The types of measurements to be made and the values expected are taken from these documents.

THE CBTester IS NOT A SCIENTIFIC INSTRUMENT AND IS NOT INTENDED FOR HIGH PRECISION OR ENGINEERING DESIGN MEASUREMENT PURPOSES.

## FRONT PANEL DESCRIPTION

**CBTester** is a portable, battery powered field test instrument. The parts of its front panel are shown in Figure 1:

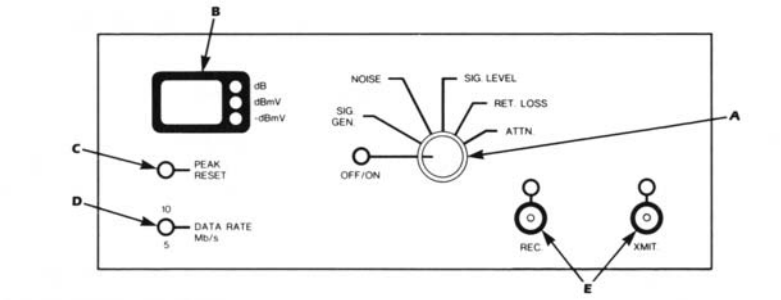


**Figure 1. Front Panel**

A. The **FUNCTION KNOB** turns the CBTester on and selects the type of measurement to be made.

B. The **DISPLAY** shows the measured value. The lights to the right of the DISPLAY indicate the units of measurement: dB, dBmV or —dBmV.

C. The **PEAK/RESET** switch selects if the peak value measured is to be displayed or if the currently measured value is to be displayed.

D. The **DATA RATE** switch configures the CBTester for either a 5 Mbit/second network or a 10 Mbit/second network.

E. Two BNC connectors are used to connect the CBTester through the Probe Cable to the device or the cable being measured. These are labeled the **XMIT.** and the **REC.** connectors. A light by each connector indicates which connector is active.


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## ACCESSORIES

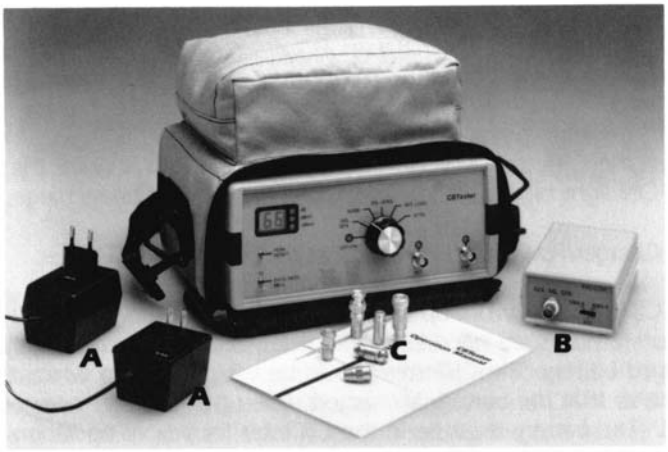


**Figure 2. Accessories**

A. The **Charger/Power-plug** is used to either power the CBTester or to charge the CBTester's internal battery. The Charger/Power-plug connects to the back of the CBTester. It is also used to power the Auxiliary Signal Generator. One type of Charger/Power-plug is used with 90/120 VAC; the other with 220/240 VAC power.

B. **Auxiliary Signal Generator**. ASG. is used to provide signals for testing the installed cable system attenuation. The switch on the ASG selects a 10 MHz signal for a 5 MBit/sec. network or a 20 MHz signal for a 10 Mbit/sec. network.

C. **Adapter Connectors** are used to connect the CBTester to cables or to devices being tested. These include:

1. F-female to F-female
2. F-male to F-male
3. BNC-male to F-female
4. BNC-female to F-male
5. Quick connect F-male
6. Precision 75 ohm terminator

D. **Probe Cable** (not shown) is used to connect the CBTester to the devices being tested.

## POWER

The CBTester can operate from its own internal battery or from the Charger/Power-plug. The CBTester is turned on by switching the FUNCTION KNOB from the OFF/ON position to any of the CBTester functions.

When the CBTester power is on, the OFF-ON light is on. If the OFF-ON light blinks, the battery is low and should be recharged.


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The Charger/Power-plug connects at the rear of the CBTester.

The CBTester will work up to 6 hours on a completely charged battery. About 12 hours are needed to completely recharge a completely discharged battery. The CBTester should be left plugged in when it is not in use so that the battery is charged when the CBTester needs to be used. (The battery must be in the CBTester for proper operation and should not be removed.)

For CBTesters with serial number 500 and above, improvements have been made In the battery operation of the Tester. The measurement capability of the Tester, as described in this Operations Manual, has not changed.

When the ON-OFF light starts blinking, the battery can be used to operate the Tester for at least 1/2 hour more. During this time, the measurement readings of the Tester will be accurate.

When the battery Is discharged to where the measurement readings are no longer accurate, the Tester will shut itself off.

The purpose of this change is to insure accurate measurements and to prevent the battery from being completely discharged.

## MEASUREMENT TYPES

The CBTester is designed to work with two types of carrier-band networks:

5 Mbit/second and 10 Mbit/second. Before making measurements on any particular network component or network cable system, set the DATA RATE switch to the appropriate setting.

On any of the measurement functions, if the DISPLAY blinks, the measurement is above or below the range of the CBTester.

### Attenuation

The attenuation, ATTN., function of the CBTester measures the amount of signal loss through the network cable, a tap or some other network component. The test frequency at the 5 Mbit/second DATA RATE setting is 10 MHz; at the 10 Mbit/second setting the test frequency is 20 MHz.

The ATTN. measurement range of the CBTester is 0 to 35 dB. If the measured attenuation is greater than 35 dB, the display blinks “35”. In the 0 to 9.9 dB range, the resolution is 0.1 dB; for the rest of the range, the resolution is 1 dB.

### Attenuation Measurement

Set the DATA RATE switch to either 5 Mbits/second or to 10 Mbits/second depending on the network. Turn the FUNCTION KNOB to the ATTN. function.

The lights above the XMIT. and the REC. Connectors should be on. With nothing connected to the CBTester, the DISPLAY should blink “35” dB.

Connect one end to the cable or device to be measured to the XMIT. Connector; connect the other end of the device to the REC. Connector. The DISPLAY will show the measured attenuation.



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### Attenuation Measurement Example

Suppose a reel of cable is to be measured before installation. This cable is for a 5 Mbit/second network. Assume the cable has a manufacturer's attenuation specification of 1.5 dB per 100 meters at 10 MHz and the reel has 300 meters of cable.

Put an F-connector on each end of the cable and connect the CBTester with the Probe Cables. Set the data rate switch to 5Mb/s and turn the FUNCTION KNOB to ATTN. The display should show 1.5 x 3 = 4.5 dB.

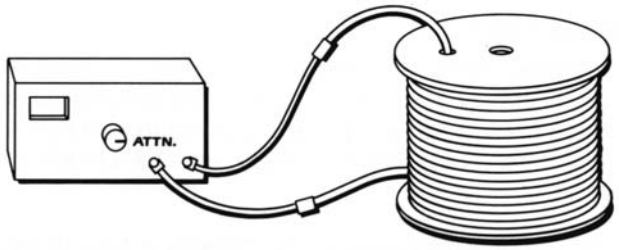


**Figure 3. Cable Attenuation Measurement Example**

## Return Loss

The Return Loss, RET. LOSS, function of the CBTester measures the amount of signal reflected by components in the network's cable-system or by damaged portions of the cable. The CBTester transmits a signal and measures any signal reflected back.

### Return Loss Measurement

Set the DATA RATE switch to either 5 Mbits/second or to 10 Mbits/second depending on the network. Set the FUNCTION KNOB to RET. LOSS.

The light above the REC. Connector should be on and the DISPLAY's dB light should be on.

When nothing is connected to the CBTester, the DISPLAY will show "0" or 1" dB. (All the signal is reflected back from an open circuit.)

When the REC. Connector is terminated by the Precision 75-ohms terminator, the DISPLAY should blink "35" dB. (No signal is reflected back.) This is a way to check if the CBTester is working properly.

Connect the CBTester's REC. Connector to the device being tested or to the cable system. Be sure that the device or the cable system is properly terminated with 75-ohm terminations.

The DISPLAY will show the amount of reflected signal.

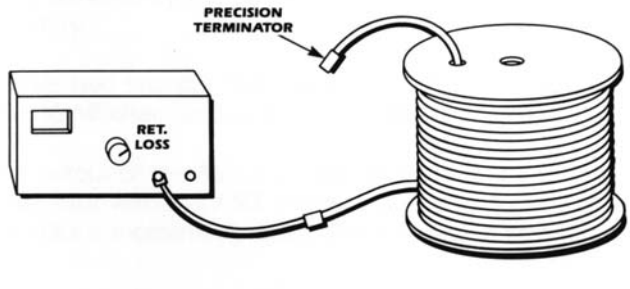


**Figure 4. Cable Return Loss Measurement**


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The acceptable amount of return loss for various network cable-system components and the cable system is shown below The number in the DISPLAY should be equal or greater.

| COMPONENT | RETURN LOSS |
|---|---|
| Cable on a reel | 26 dB |
| Installed trunk cable without taps | 24 dB |
| Tap trunk cable port | 33 dB |
| Tap drop cable port | 14 dB |
| Installed trunk cable with taps | 21 dB |
| Drop cable connected to a tap | 14 dB |

**Table 1. Return Loss Values**

**Note:** When making return loss measurements with expected readings above 28 dB, connect the device tested directly to the CBTester. The precision 75-ohm probe cables provided with the CBTester have a return loss of about 30 dB so that measurements made with them cannot be any better than that.

## Signal Level

The CBTester can measure signal levels. This capability can be used to measure the cable-system attenuation when the cable system is not being used by the stations. Also, a station's signal output can be measured before the station is attached to the network cable-system. Each of these measurement types is explained below

### Signal Level Measurement

Turn the FUNCTION KNOB to SIG. LEVEL. The light above the REC. Connector should be on. Without anything connected to the REC. Connector, the DISPLAY should blink "5" dBmV.

If the HOLD/RESET switch is on HOLD, the CBTester will hold the highest value measured within the last 20 seconds. If the switch is on RESET, the CBTester will display the current value measured.

The signal to be measured is connected to the REC. Connector.

## Network Cable-System Signal Measurement

When the installed network cable system is tested for signal attenuation, the CBTester is used to measure the signal level along the cable. The **Auxiliary Signal Generator, ASG**, is used as a signal source at one end of the cable as shown in Figure 5.

The ASG is powered by the power plug of the CBTester. It has no internal battery.

The ASG has two settings. The 5 MBit/sec. setting provides a 10 MHz signal; the 10 Mbit/sec. setting provides a 20 MHz signal.

The signal output of the ASG is pulsed. This allows the CBTester to synchronize itself with the ASG and to make return loss measurements while the ASG is momentarily silent.

The MG output is 64 to 67 dBmV of signal power. Measure the ASG output power with the CBTester and note. Since the ASG is attached to a drop port at the end of the cable system, the level of the signal getting onto the trunk cable is 20 dB less. The trunk cable and the taps on the trunk cable can attenuate the signal by as much as 13 dB.


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Each tap also attenuates the signal from the trunk cable to the drop cable by 20 dB. If the ASG output is (for example) 66 dBmV, then the minimum signal level at any drop cable on the network should be at least:

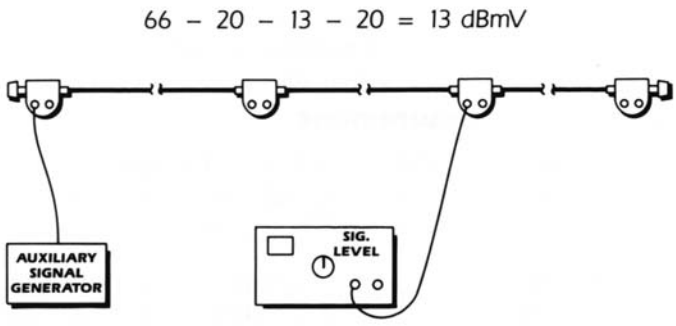


**Figure 5. Cable System With Auxiliary Signal Generator**

## Signal Generator

The CBTester can be used as a signal generator. It will generate either 10 MHz signal In the 5 Mbit/second setting or 20 MHz signal In the 10 Mbit/second setting.

To have the CBTester generate signals, turn the FUNCTION KNOB to SIG. GEN. The light by the REC. Connector should be on. The signal will be on the REC. Connector The DISPLAY will show “66” dBmV.

**Note:** The Signal Generator in the CBTester, like the ASG, puts out a pulsed signal rather than a continuous one.

## Noise

The network’s cable system may be subject to noise that destroys signals on the cable. The CBTester can be used to determine the extent if any, of the noise. To make this measurement, the stations on the network have to be silent or be disconnected from the network.

### Noise Measurement

Turn the FUNCTION KNOB to NOISE. Since noise is not generally constant, the PEAK/RESET switch should be set to PEAK. This will make the DISPLAY show the highest value of noise measured within the last 20 seconds.

The DISPLAY’s -dBmV light should be on and the light by the REC. Connector should be on.

The CBTester measures noise in the -25 to 0 dBmV range. The maximum allowable noise on a carrier-band network is -10 dBmV.

If the noise measurement is below -25 dBmV, the DISPLAY will blink "25”. If the noise is above 0 dBmV, the DISPLAY will blink "0”.

**Note:** Noise from the AC power line can add to the noise being measured. When making noise measurements, disconnect the power plug so that the CBTester operates from its internal battery.


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# NETWORK INSTALLATION MEASUREMENTS

## Pre-Installation Testing

The trunk cable installation is the most difficult and expensive part of the cable-system installation. For this reason, it is necessary to know that the cable on a reel is good. If bad cable is installed, it will have to be removed, and a new one put in. This time consuming, frustrating and expensive problem can be avoided if the cable is tested before it is installed.

Some cable vendors test their cable before it is shipped. However, the cable can be damaged in shipping or by just being stored in a warehouse that is too hot or has rodents. For this reason, it is a good idea to retest the cable before installation.

Measure the return loss from both ends of the cable. (See 'Return Loss'; p. 7] The return loss should be less then 26 dB (The DISPLAY should show a number equal to or greater than 26.) If the Return Loss number in the DISPLAY is less than that, the cable should not be used.

Measure the cable attenuation. (See Attenuation" p. 5.) It should be as indicated by the manufacturer's specification for the length of cable on the reel. For a 5 Mbit/sec. network, the attenuation is measured at 10 MHz; for a 10 Mbit/sec. network, the attenuation is measured at 20 MHz.

Pre-testing the taps is less critical than cable testing. The taps are checked during the cable-system installation as part of the installation procedure. If a bad tap is found, it can be replaced at that time.

## Installed Trunk Cable Testing

Once the trunk cable has been installed, test it for return loss from each end of the cable before the taps are installed. This testing will identify any trunk cable problems that may have been caused by improper cable installation. For the return loss of the installed trunk cable, the DISPLAY should be equal to or greater than 24 dB.

## Tap Installation and Testing

In order to install a tap, the trunk cable has to be cut and connectors attached to both ends of the cut cable. This step presents a good opportunity to test the trunk cable and any other taps that have already been attached to it.

Install a tap at each end of the trunk cable. Terminate the trunk cable ports at each end with a precision 75-ohm terminator. Terminate the unused drop cable ports with regular 75-ohm terminators.

Measure the output of the Auxiliary Signal Generator, ASG, with the CBTester and note. For this example, assume the output is 66 dBmV. Attach the ASG to one of the tap drop ports. Call this direction on the trunk cable "A"; call the other direction "B".

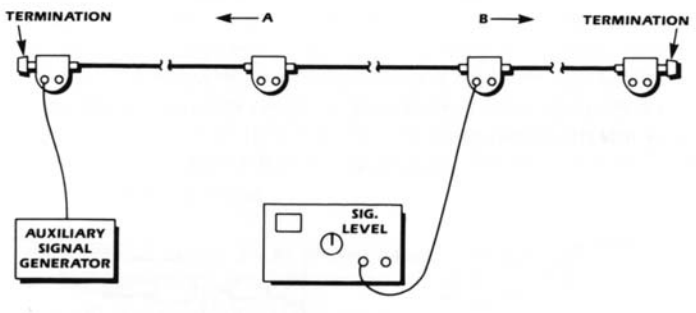


**Figure 6. CBTester and the Trunk Cable**

Cut the trunk cable at the place a tap is to be installed and attach the connectors. Measure the return loss of the trunk cable in both direction A and B. For the return loss, the DISPLAY should 24 dB or greater as the first taps are installed. The DISPLAY should show 22 dB or more as the last tap is installed.

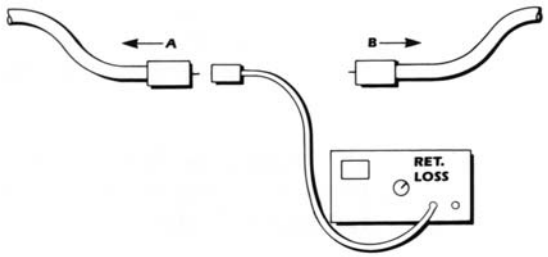


**Figure 7. Trunk Return Loss Measurement**

Attach the tap to trunk cable segment A. Measure the return loss and the signal level at the unconnected tap trunk cable port. For the return loss, the DISPLAY should show 22 dB or greater. On the trunk cable port of the tap, the signal level should be between 32 and 47 dBmV. Be sure that the drop cable connectors on the tap are terminated during the measurement.

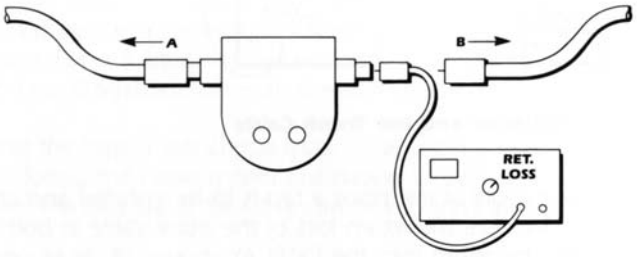


**Figure 8. Tap and Trunk Return Loss**

Attach trunk segment B to the tap. Measure the signal levels at each of the drop cable ports. The signal level should be between 12 and 27 dBmV. Be sure that the unused drop cable connectors are terminated during the measurement.

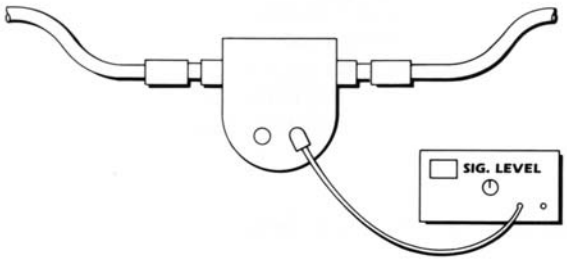


**Figure 9. Signal Levels at Drop Ports**



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At this point, all the necessary measurements have been made on the tap being installed and on the cable-system.

Once a tap has been installed successfully, attach the drop cables. Be sure to terminate the drop cable ends. Measure the signal level and the return loss at each of the drop cables. The signal level should be between 12 and 27 dBmV. For the drop cable return loss, the DISPLAY should show 14 dB or more.

It is a good idea to keep a log of the values measured at each tap. This can become important information at a later date if the network is not operating properly and has to be verified. Knowing previous measurement values can help pinpoint the problems.

Performing the testing during installation saves a lot of work later. If the cable system is completely installed, tested, and then found to be outside the specifications, then a determination has to be made of where the fault or faults might be. This determination may require that the cable system be taken apart at several places. Taking the cable system apart may introduce other faults.

### Verification

After a network has been operating for a while or if the network starts to experience many errors, the cable-system should be verified to be sure that it is within specifications.

Cable-system verification requires the stations on the network to be shut down so that they do not put signals on the trunk cable while the measurements are being made. If new taps have not been put on the trunk cable or trunk cable segments added, the verification is simply the measurement of the return loss at each end to the trunk cable. If taps or cable segments have been added, the signal levels should also be measured.

### Station Signal Output Test

A station attached to the network's cable system should generate between 63 and 66 dBmV of signal when it transmits. Before a station is attached to the network, its output signal level should be verified.

Connect the station to the REC. Connector. Set the HOLD/RESET switch to HOLD. This makes the CBTester hold the largest measured value in the DISPLAY for 20 seconds. The HOLD is needed because the station puts out a signal only periodically In this mode, the CBTester will make measurements in the 45 to 70 dBmV range.

Turn the station on and make it generate a signal. Consult the station's operations manual to see how this is to be done.

The DISPLAY should read between 62 and 67 dBmV of signal from the station.


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# SPECIFICATIONS

The CBTester is not a scientific instrument and is not intended for high precision or engineering design measurement purposes. The primary purpose of the CBTester is to be able to make measurements on the Carrier-band network that determine if the cable-system is able to carry the network's signals properly. Consequently, the measurement capabilities of the CBTester are designed to give only a reasonable indication of the quality of the network's cable-system, not precise values.

## Signal Power Measurements

The CBTester measures signal power by measuring the peak voltages of incoming signals. The CBTester assumes that the waveform of the signal is sinusoidal and displays the equivalent rms power value. If the measured signal is trapezoidal or square, the CBTester does not indicate true signal power.

The output signal of a station is in many cases trapezoidal. The station's signal power measured by the CBTester will be lower then the actual power. The amount of difference depends on the exact shape of the signal. For this reason, the limits suggested in "Station Signal Output Test" of acceptable station output power are wider than those stated in the IEEE 802.4 standard specification.

## Function Specifications

**Signal Generator** output level: 66 ± 2 dBmV

**Signal Level** measurement:

Range: 5 to 70 dBmV in the RESET mode
45 to 70 dBmV in the HOLD mode

Accuracy: ± 2 dB

**Attenuation** measurement accuracy:

± 0.2 dB in the 0 to 3 dB range
± 0.5 dB in the 3 to 9.9 dB range
± 2 dB in the 10 to 35 dB range

**Return Loss:**

Range: 0 to -35 dB
Accuracy: ± 2 dB

**Noise:**

Range: -25 to 0 dBmV
Accuracy: ± 3 dB



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## SERVICE

The CBTester does not contain any user serviceable parts. All adjustments and/or repairs have to be performed at the factory If the CBTester needs to be serviced, return it to Relcom, Inc. If the CBTester is covered by the limited warranty, the repairs or replacement will be made free of charge. For service outside the warranty please call or write to determine the charges for the service before sending the instrument.

## WARRANTY

Relcom, Inc. warrants the CBTester to perform as described in this manual under normal use for a period of one year after delivery to the original purchaser. This warranty does not apply if the CBTester has been disassembled, modified or used for purposes other than those described in this manual.

Upon verification of any defect. Relcom, Inc. shall, at its option. repair or replace the defective unit.

In no event does Relcom, Inc. assume liability for incidental or consequential damages. This warranty is the extent of the obligation or liability assumed by Relcom, Inc., and no other warranty or guarantee is either expressed or implied.

Relcom, Inc. reserves the right to make design changes to the CBTester without notice and with no obligation to make the same or similar changes to units previously manufactured.

Relcom, Inc. has made every effort to assure the accuracy of the information contained in this manual. Relcom is not, however, responsible for any errors or omissions. If you have any questions or suggestions, please contact:

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