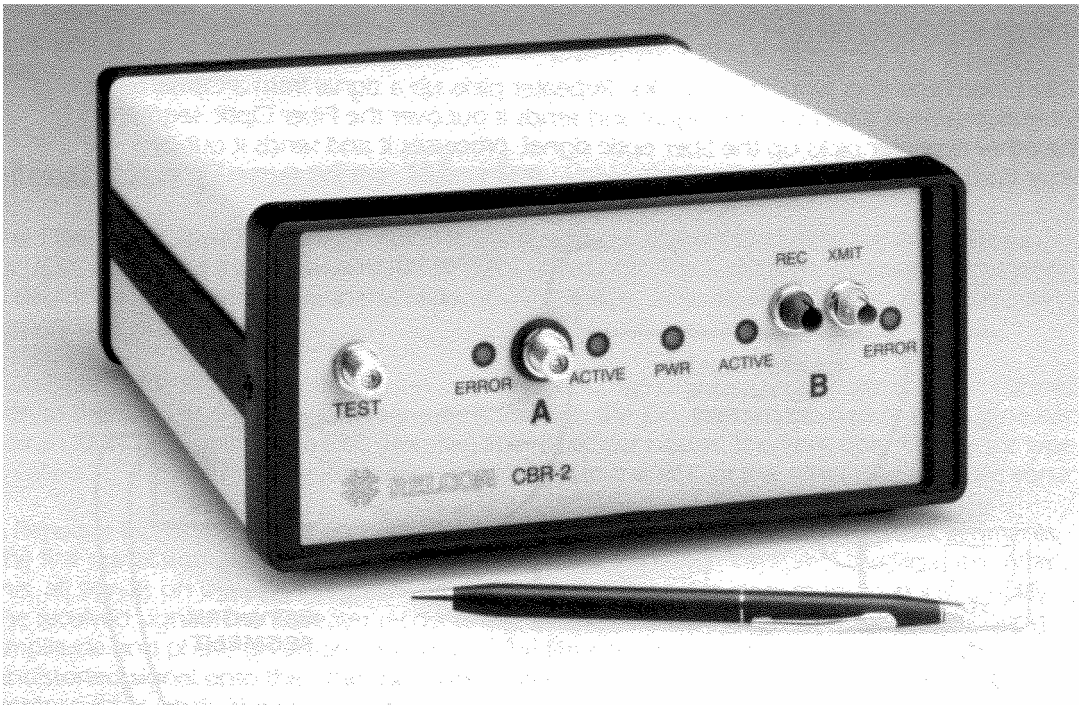
Installation and Testing

5 Mbit/s Repeater Carrier-band to Single-mode Fiber Optic

Models
CBR-7AC
CBR-7DC



This manual describes the procedures for installing and testing the CBR-7 Fiber-Optic Repeaters.

- For an explanation of how to install the coaxial cable part of the carrierband network, see Relcom's Carrier-band Network Handbook.
- For an explanation of how fiber optics works, see Relcom's Guide to Industrial Fiber Optics.
- For an explanation about how repeaters work, and CBR-7 system design information, see Relcom's CBR-7 System Design Application Note, document 501-276.
- For technical specifications, see the CBR-7 product specification, document PS-029.

Repeater Installation

The Repeater is connected to segments of the Carrier-band network like any other station through a drop cable and a tap. The following should be considered when installing a Repeater:

- Place the Repeater where its indicator lights can be seen. This will help identify and isolate network problems if they occur.
- While the Repeater is fully enclosed, it is not waterproof. Install the Repeater in a dry place.
- The Repeater operates at temperatures between -20 and +65 °C (-4 to 150 °F). However, do not install the Repeater in places where it will be heated by other equipment or where there is no airflow.
- A rack mounting kit for the Repeater is available.

Power

The Repeater is powered from an AC or DC power source depending on the option chosen.

CBR-7AC power input range is from 85 to 240 volts, 47 to 63 Hertz. The power cord connection to the Repeater is a standard IEC 320 plug. Different types of power cords can be used to adapt to various types of power sources.

CBR-7DC power input range is from 18 to 36 Volts DC.

DC Version of the Carrier-band Repeater – Important Installation Note:

For the CBR-7DC Repeater it is important to note that this device is considered to have a PERMANENT CONNECTION TO THE POWER SUPPLY, in order to comply with CSA and UL regulations a readily accessible disconnect device is required between the power connections on the Repeater and its power source. This shall be provided during the installation of the unit in a manner to comply with local regulations.

Grounding

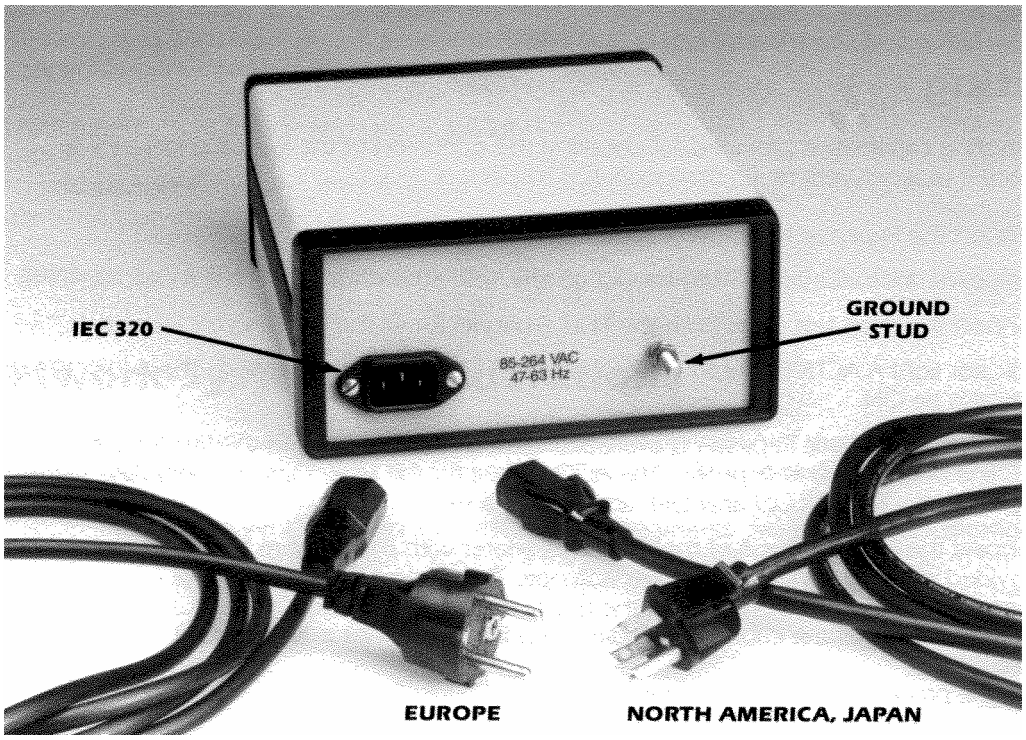
Both F-connectors are grounded to the Repeater's case for reducing RFI emissions.

The Repeater's case is connected to the front panel TEST F-connector, to the mains ground connection on the AC model, to the GND terminal on the DC model, and to the ¼-20 stud on the back panel.

Attach a ground wire from the ground stud to the grounding facilities provided in the building. Use a grounding wire that has a current carrying capacity equal or greater than that of the drop cable outer conductor.

Hazardous Area Warning

For both AC and DC Repeaters, users are warned not to disconnect power to the Repeater while the circuit is alive unless the location is known to be non-hazardous.



AC Power plugs

Testing

A self-testing capability is provided for checking the operation of the Repeater before it is connected to a network or if a malfunction is suspected.

1. Connect the Repeater to a power source.

The power indicator light, PWR, should be ON. The other indicator lights should be OFF

2. Connect the short test cable from the TEST F-connector to the F-connector labeled A.

3. If another Fiber Optic Repeater is available, connect the XMIT line of the first Repeater to the REC line on the second Repeater. The ACTIVE light for the Fiber Optic input on the second Repeater should be ON.

4. Connect F-connector A of the second Repeater with a 75 ohm terminated cable to an oscilloscope. The second Repeater will put out signal bursts on its connector A. The peak-to-peak voltage of the bursts should be between 3.0 and 3.9 Volts. (Keep in mind that the cable gives a direct reading and is not a 10:1 probe.)

Repeat the procedure with the Repeaters reversed. Test only one direction at a time with a single fiber optic cable connecting the two repeaters.

There is no built-in provision for testing the Fiber Optic input or output other than to connect two Repeaters back-to-back and use the TEST signal to check the operation of the Fiber Optic ports as described above.

If these tests do not produce the specified results, the Repeater(s) may be defective and should be returned for repair.

THERE ARE NO USER ADJUSTMENTS OR REPAIRS TO BE MADE INSIDE THE REPEATER.

For guidance about installing the carrier-band segment of the network, see Relcom's Carrier-band Network Handbook.

Troubleshooting

During normal Repeater operation, the PWR light is ON, the two ACTIVE lights are ON and OFF intermittently and the ERROR lights may blink occasionally. If not, check the following list of symptoms and possible corrections:

1. The PWR light is OFF

Check the power cord and the power source.

2. An ACTIVE light is ON indicates that data is being received from that network segment. Normally the ACTIVE light shows differing levels of brightness indicating the relative amount of data received from the corresponding segment. If the light is solidly OFF, no data is being received. The causes may be:

The Repeater is disconnected from the network segment. Check the network wiring.

None of the stations on the network segment are transmitting.

The signal from the coaxial cable to the Repeater is too low. Check the signal level with the Carrier-band Tester.

The Repeater is defective. Check the Repeater with the test procedures above.

3. If the ERROR indicator light blinks ON the Repeater has received a frame with an error. The ERROR light should blink ON no more than once every 20 seconds. This corresponds to a bit error rate of about 10^{-8} or one bad bit received for one hundred million sent. If the ERROR light blinks ON more frequently:

There may be excessive noise on the network coaxial cable segment. Use the Carrier-band Tester to determine the noise level.

The Repeater may be receiving a signal from the coaxial cable that is too low. This may be a result of improper network design, failure in the cables or taps, or some station not transmitting at a sufficiently high signal level.

Note: Some systems are setup to switch between cables on a regular basis. These transitions may also cause the ERROR indicator to blink; these ERROR indications are part of the normal operation of the system and they can be ignored.

The Repeater detects two types of errors:

a. If the Repeater detects a start delimiter of a frame but no end delimiter before the received signal drops below threshold.

b. If the Repeater detects three consecutive "highs" or three consecutive "lows" within a bit cell. These are violations of the data encoding used in carrier-band.

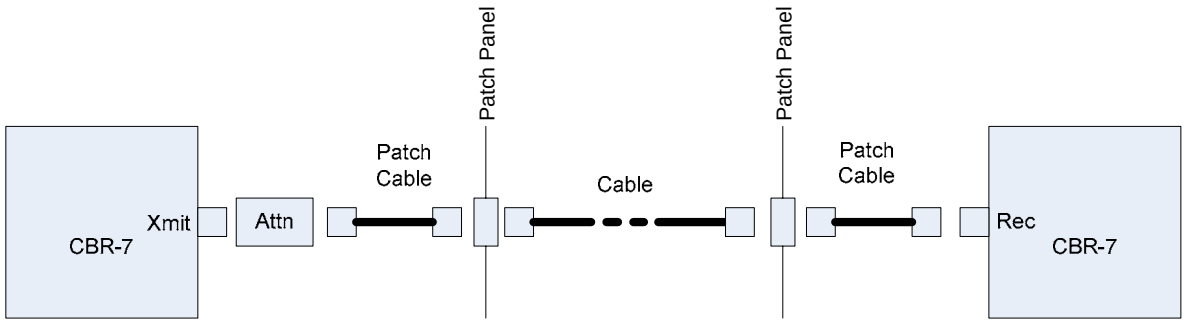
The Repeater does not check frame CRCs or other types of network errors. The ERROR indicator lights are only a diagnostic aid for pointing to a segment that may be generating more than the expected number of errors.

THERE ARE NO USER ADJUSTMENTS OR REPAIRS THAT CAN BE PERFORMED ON THE REPEATER. IF THE REPEATER DOES NOT WORK PROPERLY, RETURN IT TO RELCOM FOR REPAIR OR REPLACEMENT.

Fiber-Optic Testing

When the CBR-7 repeaters and the optical components are installed, they must be tested to verify that they work properly.

The fiber optic components between two CBR-7 repeaters must be able to carry light signals from the transmitter of one repeater to the receiver of the other. The components include the main cable between the two repeaters, the patch panel at each end, the patch cables and an attenuator. Some installations may have more optical interconnection components.



The total attenuation (insertion loss) of optical components must be at least 20 dB but not more than 28 dB. If necessary, an attenuator must be used on the transmit side of the main fiber-optic cable.

For example: Assume that each optical connection has an attenuation of 0.5 dB and there are two connections at the transmitter side and two at the receiver side. The main cable is 4 km long and has an attenuation of 0.4 dB/km for a total attenuation of 1.6 dB. The total fiber-optic attenuation is

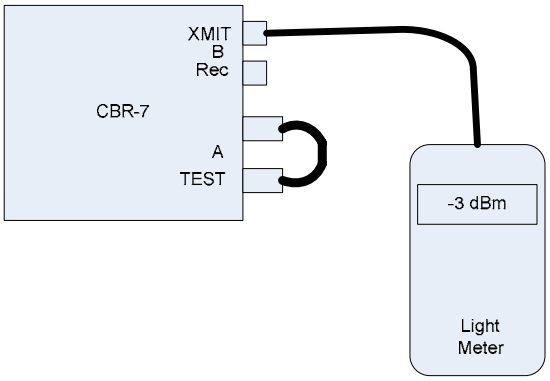
$$2 \text{ X } 0.5 + 1.6 + 2 \text{ X } 0.5 = 3.6 \text{ dB}$$

To get into the needed attenuation range, a 20 dB attenuator needs to be put at the transmitter side between the main cable and the patch panel. The **calculated** attenuation of all the fiber optic components is:

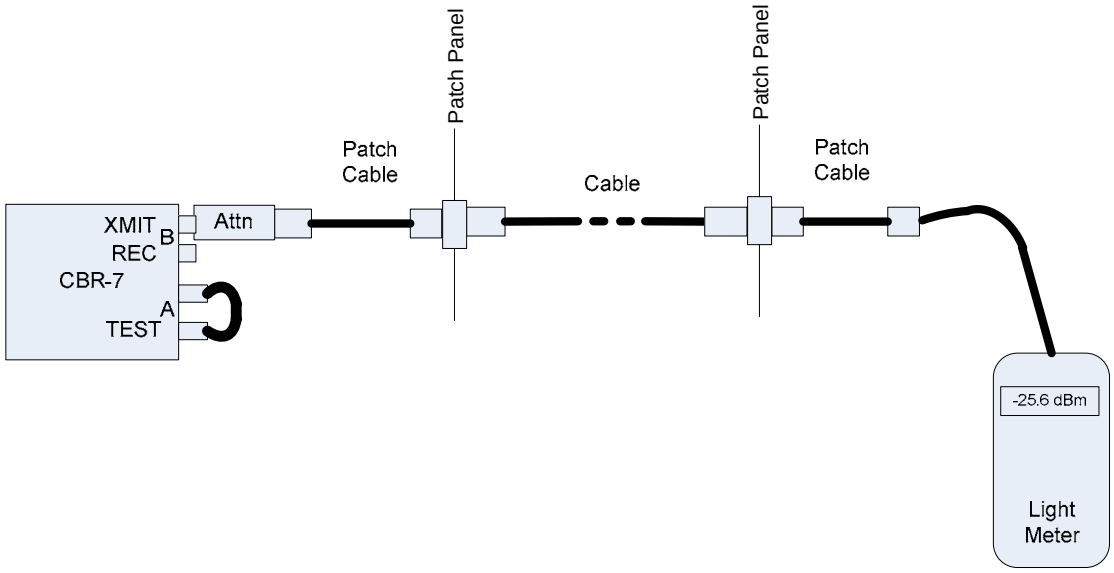
$$20 + 3.6 = 23.6 \text{ dB}.$$

Attenuation Measurement

Determine the light output level of the CBR-7 transmitter. Disconnect all patch cables from the transmitter. Connect a coaxial cable between the Test and the A connectors of the CBR-7. Connect a light meter to the transmit connector. Power the CBR-7 and measure the transmitter light level. This should be approximately -3 dBm.



Disconnect the light meter from the transmitter. Connect the patch cable to the transmitter and all the other optical components. Measure the light level at the receiver of the corresponding CBR-7 repeater. This should be close to the level measured at the transmitter minus the calculated attenuation determined at design.



From the example above, if the light measured at the receiver is 25.6 dBm then the **Measured Attenuation** of the optical components is:

25.6 – 3 (the measured transmitter output) = 22.6 dB

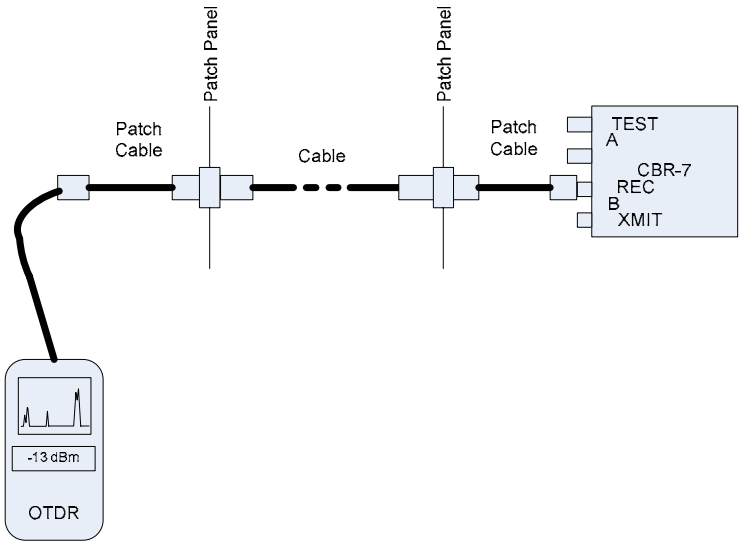
This is 1 dB less than the calculated attenuation value. A variation of 1 dB is not critical. A larger deviation would indicate a problem with the attenuation estimate or that optical components are out of specification.

Return Loss

CBR-7 performance depends on low return losses (reflections) of the optical components. This must be measured to be sure all the optical components are within their specifications.

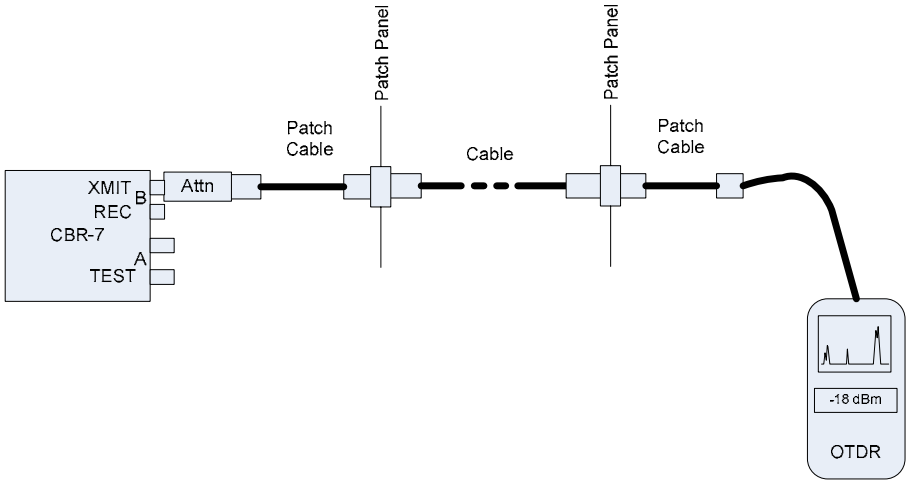
Transmit side

With all the optical components connected together, disconnect the patch cable at the CBR-7 transmitter and measure the return loss of the optical components without the attenuator with an Optical Time Domain Reflectometer, OTDR, as shown below. Neglect any near-end readings. The return loss of interest is that at the end of the cable as seen from the transmitter end. Note the value as Transmit Return Loss.



Receiver side

With all the optical components connected, disconnect the CBR-7 at the receiver. (Be sure that the CBR-7 on the transmit side is not powered). Measure the return loss of the optical components as shown below. Neglect any near-end readings. The return loss of interest is that at the end of the cable as seen from the receiver end. Note this as Receive Return Loss.



For proper operation of the CBR-7 repeaters over the fiber optic cable

The value of the attenuator + Transmitter Return Loss + Receiver Return Loss must be at least 48 dB.

If this is not the case, there is something wrong with the attenuator or the patch cable assemblies that produces extraordinary reflections.

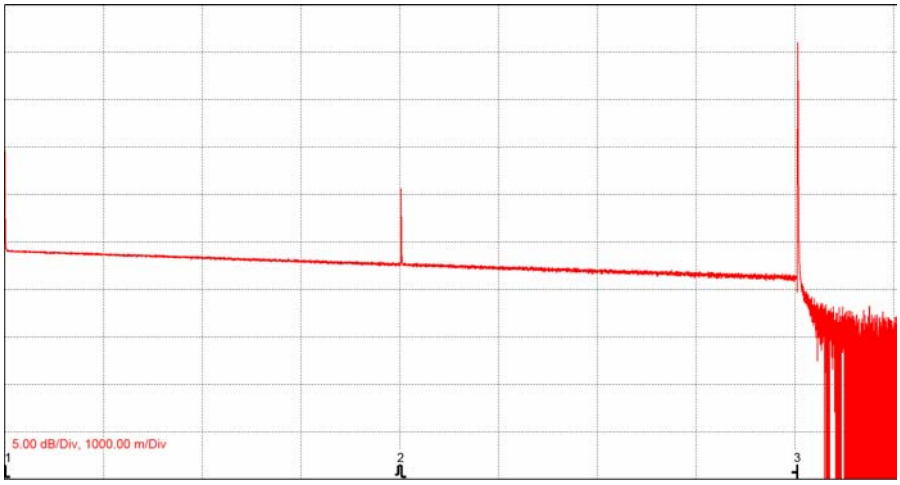
In the example above, the attenuator's value is 20 dB. Assume the measured Transmitter Return Loss was 15 dB and the Receiver Return Loss was measured to be 20 dB. Then

20	Attenuator value
13	Transmit Return Loss
18	Receive Return Loss
51	Total

In this example, the total of 51 is over the required 48.

For both the Transmitter and Receiver return loss measurements, neglect any near-end readings. The measurement of interest is at the end of the cable. If there are other reflections that are not at the cable's length mark and these are closer to the measurement of interest than 10 dB, then there is something wrong with the optical components at that location.

Here is an example:



The top of the screen is at -10 dB. There are two reflections. One is at 4 km and the other at 8 km, at the end of the cable. The one at 4 km is 15 dB below the one at the end and it can be neglected since it is more than 10 dB below the reflection of interest at the end of the cable. The reflection at the end of the cable is at -14 dB. The return loss at the end of the cable due to this reflection is 14 dB, as seen from the other end of the cable where the measurement is made.