

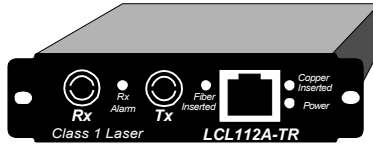


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The World's Source for Cabling and Network Connectivity™



OCTOBER 2000  
LCL112A-TR

# CampusLIGHT™ TOKEN RING FIBER EXTENDER



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14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
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  - B: Objetos han caído o líquido ha sido derramado dentro del aparato; o
  - C: El aparato ha sido expuesto a la lluvia; o
  - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
  - E: El aparato ha sido tirado o su cubierta ha sido dañada.

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The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications-network protective, operation, and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

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# 1. Specifications

Environment	Token Ring 802.5. Supports classic Token Ring NICs, MAUs, bridges, switches and hubs, and Dedicated Token Ring switch ports and NICs	
Data Rate	4 and 16Mbps	
Fault Recovery Time	5ms (milliseconds)	
Bit Error Rate	1 in 10 <sup>9</sup> maximum	
Drive Distance	Fiber	40km (24.9 miles) on 9/125 μm single-mode
	Copper	100m (CAT 5) total per link
Single-mode Optics	Transmit Power	-13dBm (typical)
	Receive Sensitivity	-32dBm (minimum)
	Power Budget	19dB (typical)
Switches	4 operating mode switches. (Only Switches 1, 2 and 3 are used)	
Environmental	Operating Temperature	0°C to 40°C
	Storage Temperature	-10°C to 70°C
	Storage Humidity	Maximum 95% non-condensing
Power Supply	12V DC, external 110V or 220V AC adapter with plug in jack	
Dimensions	Single Unit	100mm x 140mm x 25mm (W x L x H)
	Power Supply	100mm x 75mm x 60mm (W x L x H)
Gross Shipping Weight	1.5 kg	
Compliance	EMC	CE Directive 89/336/EEC
		FCC Part 15 Subpart J
Safety	CE Directive 73/23/EEC (LCL112A-TR operates in selv only), UL 1950, cUL 1950	



## 2. Introduction

### 2.1 Product Overview

The CampusLIGHT™ Token Ring Fiber Extender (LCL112A-TR) allows you to interconnect Token Ring stations, hubs and switches. On single-mode fiber, links of up to 40km (25 miles) are possible.

The LCL112A-TR copper port operates with most standard Token Ring products and protocols including:

- Classic Token Ring stations
- Classic Token Ring concentrators
- Dedicated Token Ring concentrator ports
- Dedicated Token Ring node ports
- Redundant links from classic stations to Ring In/Ring Out ports
- Links between lobe ports of hubs

Examples of common applications are shown in Section 4. The LCL112A-TR Fiber Extender also inter-operates with the LCL161A/LCL162A Token Ring repeaters to provide cost-effective SNMP manageable links.

### 2.2 Feature

#### 2.2.1 Drive Distances

##### 2.2.1.1 Single-mode

A fiber optic link of up to 40km is permitted between extenders. This figure assumes that the maximum link budget is not exceeded. The link budget is a maximum of 19dB.

The total copper link lengths can be up to 100m on CAT5 UTP. See Technical Specifications for details.

#### 2.2.2 Universal Copper Port

The copper interface automatically supports both 10 $\Omega$  UTP and 15 $\Omega$  STP cable types. The LCL112A-TR Fiber Extender is always supplied with a shielded RJ45 connector.

## 2.2.3 Station Count

The LCL112A-TR Fiber Extender does not affect station count. On STP networks up to 250 stations may be present on a single ring, and on UTP networks up to 72\* stations may be present.

\*NOTE: If jitterbeating products are used this may be up to 250 stations.

## 2.2.4 Ergonomics

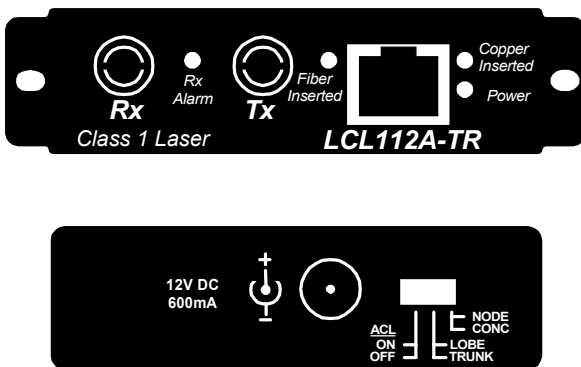
The LCL112A-TR Fiber Extender is packaged in a small free-standing case (140mm x 100mm x 25mm, L x W x H). This can be rackmounted in a 19" rack using the fiber mounting metalwork. There are two variants: the LCL100-RACK supporting up to 4 LCL112A-TR units in a 1U high 19" frame, and the RM510 supporting up to 16 LCL112A-TR units in a 3U high 19" frame. For wallmounting a bracket that holds the LCL112A-TR and its power supply is available, order code LCL100-WALL.

## 2.2.5 Power Supply

The LCL112A-TR Fiber Extender can either be powered from a small external power supply or from a 3U high rackmounting power supply capable of supplying 14 devices. Two variants are available: 90-264V AC (PS500) and 48V DC (LCL100-PS48).

NOTE: Units ordered for use with the rackmounting power supply will not contain a separate power supply; this must be ordered separately.

Figure 1: LCL112A-TR Front and Rear Panels



### 3. Overview Of Operating Modes

To successfully install the LCL112A-TR extenders an understanding of the basic interoperability issues is important. This section describes those aspects of Token Ring important to LCL112A-TR interoperability.

#### 3.1 Variants of Token Ring

Token Ring products have come a long way since the early 4Mbps systems based on IBM cabling of the mid-eighties. Today there is a mix of devices supporting 4 and 16Mbps data transfer on passive and active MAUs, bridges, switches and routers with cable choices of STP, UTP and fiber optics.

Many manufacturers have added to the complexity by introducing proprietary smart mechanisms that increase ring integrity at the expense of interoperability.

The major issues when using a fiber extender in a network are:

- Phantom current mechanisms
- Frequency lockout on active MAUs
- Switch to switch auto-negotiation

##### 3.1.1 Phantom Current Mechanisms

Phantom Current mechanisms are defined by IEEE 802.5 for station to concentrator links. Phantom Current is a DC (Direct Current) signal sent with the data down the lobe cable to the MAU to open the port at the MAU. This was the principle that allowed early MAUs to be unpowered devices as the controlling power came from the station. The station measures the amount of current flowing to detect wire faults in both open and short-circuit conditions.

All lobe links, including those between the station and concentrator ports of switches, make use of phantom current in a standard way.

Whenever fiber is used in a link it is not possible to send the phantom current from one end of the link directly to the far end device. The transceiver local to the station has to mimic a MAU port and conversely the transceiver next to the MAU has to mimic a station. Special 802.5J keying sequences are used as messages between the transceivers on the fiber link to indicate when phantom should be generated.

Whilst the mode of phantom current operation is explicitly defined for the lobe there is no standard for phantom current use in trunk applications. However some form of phantom mechanism has been widely adopted by many manufacturers who are keen to increase main path integrity. As most of these have different mechanisms of phantom generation/detect, interoperability between different vendors' smart Ring In and Ring Out ports is usually only possible with the smart mode (phantom current mode) disabled.

The rule of thumb is "Lobe Connections are standard": always use phantom current (referred to as ACL on the LCL112A-TR). Trunk Connections do not use phantom current in a standard way and do not use phantom current on the Ring In /Ring Out path.

### 3.1.2 Frequency Lockout

Frequency lockout mechanisms are designed to stop devices at 4Mbps crashing 16Mbps rings and vice versa. The lobe port of the MAU detects whether the data received on its port is running at the correct speed. If the data is not at the correct speed, or is not present, then the port is disabled.

This is important when establishing a link using LCL112A-TRs between say 2 lobe ports as no data can be present on the link until AFTER THE LINK IS ESTABLISHED. This can result in a "Catch 22" when the link will not insert until data is present, but no data is present until the link is inserted.

The user should be aware that this does not apply to standard lobe style links between a station and a concentrator.

### 3.1.3 LCL112A-TR Trunk Operation

When the LCL112A-TR is set to trunk mode it creates a fiber backbone between the two LCL112A-TRs that the other devices can connect to. When the backbone between the LCL112A-TRs is first started it has no data present. This will stop the LCL112A-TRs inserting into the lobe ports of active MAUs until an active station is present on the ring.

Note: Whenever the LCL112A-TRs are set to trunk mode, links to active concentrator ports will only insert if the far end device connects to a main ring or a station port and that device is carrying valid data.

Trunk links between the active ports of two active MAUs may never insert as both ports wait for the far end to send valid data. The application shown in Figure 4, Concentrator Port to Concentrator Port, should be limited to passive MAUs or other MAUs without frequency lockout.

### Full Duplex Operation

As stated above in trunk mode the LCL112A-TRs form a fiber backbone between the two ends. This backbone does not carry any data until a device has inserted into the ring. When switch ports connect to this ring it appears as the lobe port of a passive MAU. No communication is possible between switch ports at either end of the link until after insertion has taken place. This stops the auto-negotiation used to trade-up to full duplex used by most switches.

To avoid this problem always connect switch ports together in lobe mode which carries the data before the link is inserted using phantom current.

#### 3.1.4 LCL112A-TR Lobe Operation

Lobe applications are the most common application for the LCL112A-TR. Here connection is always made from a station port to a lobe or concentrator port.

Examples of station ports are:

- 1) Switch ports permanently configured as "NODE", "STATION" or "ADAPTER".
- 2) Standard Token Ring NICs
- 3) Bridge or Router ports.

Examples of concentrator ports are:

- 1) Switch ports configured as "Concentrator", "Lobe" or "Port".
- 2) Standard Hub lobe ports

In lobe mode the communication path between the station and the concentrator operates as if the station and concentrator were connected using a copper cable. This allows the auto-negotiation (trade-up) mechanisms used by Token Ring switches and frequency lockout mechanisms to operate correctly as the whole link can carry data end to end before the device is inserted by phantom current into the ring.

#### 3.1.5 Pair Swapping during Auto-negotiation

Some NICs and switch ports that have full duplex capability not only negotiate speed and mode of operation but local pair configuration too.

One device opts to be the station, the other the concentrator. This can involve the switch swapping the transmit and receive pairs round after negotiation. As the LCL112A-TR does not take part in the negotiation process it cannot perform pair swapping in this way.

Consequently the ports of a switch must be fixed. One as a station and the other as a concentrator and the local LCL112A-TRs configured to suit that fixed configuration.

### 3.1.6 Main Ring(RI/RO) Operati

The IEEE standard for Token Ring does not define a phantom (intelligent) method of operation for automatic loopback. As an intelligent mode is desirable in the main ring between Ring In and Ring Out, many manufacturers developed their own proprietary methods of operation.

The LCL112A-TR uses a system that is compatible with the standard lobe mechanism defined in the standard; this is enabled/disabled using the ACL (Automatic Copper Loopback) switch. With ACL set to ON the NODE/CONC switch determines whether the LCL112A-TR mimics a concentrator or node. With the switch set to NODE the LCL112A-TR is configured to connect to a node i.e. uses phantom current like a MAU lobe port. With the switch set to CONC the LCL112A-TR is configured to connect to a concentrator i.e. uses phantom current like a PC/station/router device.

Providing the Ring In or Ring Out port that you are connecting to uses phantom current in this way, i.e. a Ring In port mimics the station and the Ring Out mimics a MAU then the LCL112A-TR smart (ACL) mode can be selected.

For maximum compatibility the LCL112A-TR should be set to have ACL off. In this mode the LCL112A-TR operates in accordance with the IEEE specification and interoperability is assured.

**Note:** This requires that the attached MAUs also have their smart RI/RO operation disabled. This does not apply to 802.5c stations which do not use the phantom current mechanisms. Examples of 802.5c devices are IBM 8230 CAUs, Madge 8260 CAUs, RI/RO ports etc.

#### Summary

For Trunk Operation

For maximum compatibility set ACL OFF, Trunk Mode and disable any proprietary phantom band smart RI/RO operation on the MAUs.

If the MAUs use phantom current that is compatible with Black Box's LT4000A phantom mechanism:

For Ring In connections set

ACL ON  
Trunk Mode  
Node Mode

For Ring Out connections set

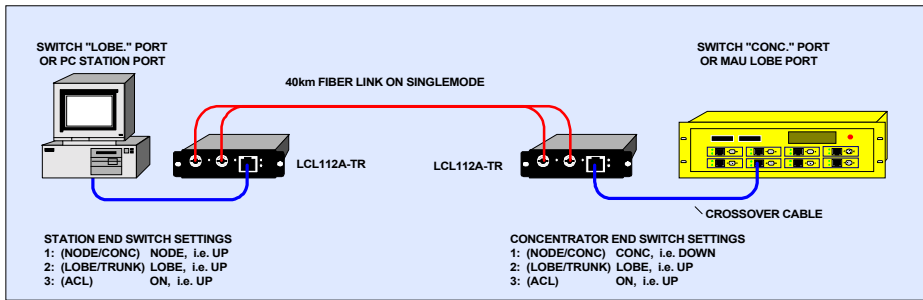
ACL ON  
Trunk Mode  
Concentrator Mode

## 4. Typical Applications

### 4.1 Fiber Lobe Link Station to Concentrator

A site has a remote station which is to be connected to a MAU via fiber. This is the main application for LCL112A-TRs. In this mode auto-negotiation between switches and frequency lockout mechanisms all work as intended.

Figure 2: Station to Concentrator Link



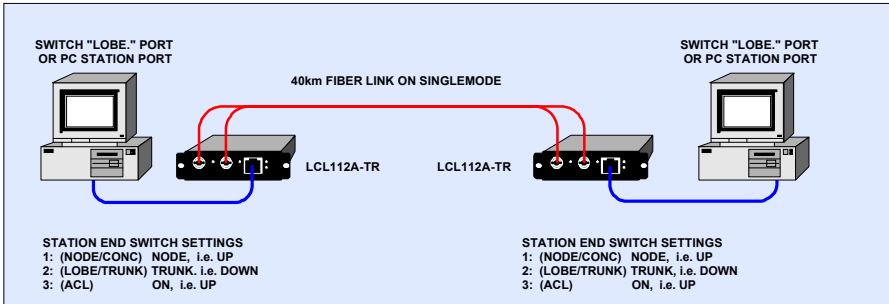
The total copper link length can be up to 100m; the fiber link can be up to 40km on single-mode. This configuration is also applicable to remote server to switch architecture.

**NOTE:** In Dedicated Token Ring Switches automatic switch configuration must not be used. The switch at one end must be defined as station and the other as concentrator (as shown above).

### 4.2 Fiber Trunk Link Between Stations

For links between servers or switches, the LCL112A-TR can be used to provide a point to point link as shown in Figure 3. In this mode the fiber link operates as a fiber backbone with lobe ports attached at the LCL112A-TRs. Devices inserting into the ring cannot see the far end device until after insertion has completed. In this mode auto-negotiation will not operate as the two ends do not communicate until after insertion. This application works well for fixed data rate station to station half duplex links.

**Figure 3: Station to Station / Switch to Switch**

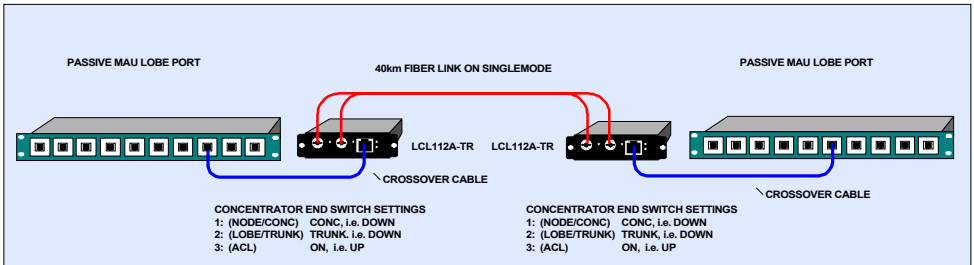


### 4.3 Fiber Trunk Link Between Concentrator

For links between switch concentrator ports or to interconnect two Token Ring networks via the TCU port, the LCL112A-TRs should be configured as shown in Figure 4.

Note: In this mode the LCL112A-TRs attempt to insert into the copper port immediately. If the copper port of the MAU needs to see valid data before insertion is permitted this method of operation will not work if both ends connect to such MAUs. This configuration is only recommended for links between passive MAUs.

**Figure 4: Concentrator Port to Concentrator Port**

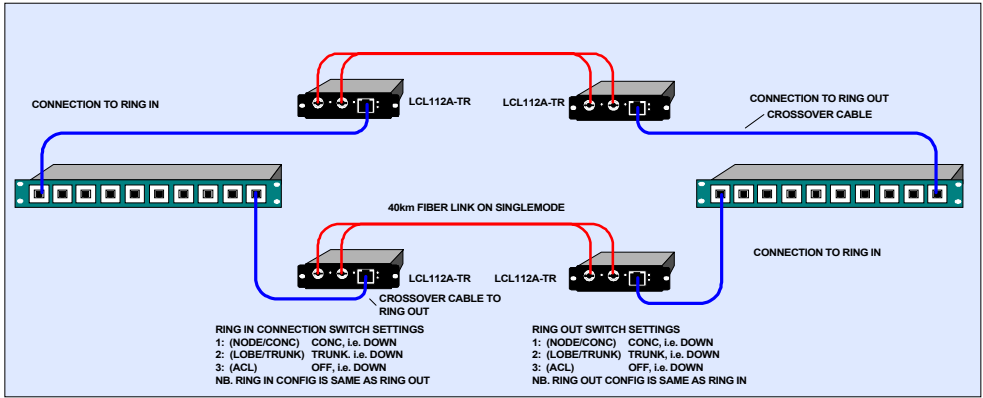


### 4.4 Ring In to Ring Out

For links in the main ring path the LCL112A-TRs can be used in trunk mode. For maximum compatibility the ACL (phantom current) should be switched off on both LCL112A-TRs and the attached ports of the MAU. Phantom current can only be used in this mode for devices operating with phantom current in exactly the same manner.



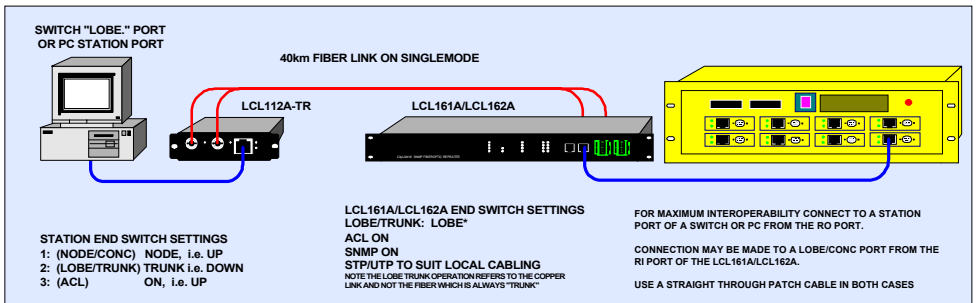
Figure 5: Ring In to Ring Out between Passive MAUs



### 4.5 Single-mode LCL112A-TR to LCL161A/LCL162A

To provide cost-effective manageable links between a router and a remote Token Ringsite, the LCL112A-TR may be used in conjunction with the LCL161A/LCL162A fiber interface to permit one SNMP entity on the link as shown below.

Figure 6: Single-mode LCL112A-TR to LCL161A/LCL162A SNMP Fiber LAN Extender



Links to devices other than a router are possible at the LCL112A-TR end. The only constraint is that the (LOBE/TRUNK Switch 2) operating switch is always set to TRUNK.

For details of the LCL161A/LCL162A connection possibilities please refer to the LCL161A/LCL162A SNMP Fiber LAN Extender Installation Manual.

## 5. Switch Settings

The switches on the LCL112A-TR are located on the rear panel. These provide the following functionality.

Switch Number	Name	Function
1	NODE/ CONC	<p>When ACL is set to ON the NODE/CONC switch defines whether the LCL112A-TR sources phantom current (i.e. looks like the NIC in a PC) or provides the valid phantom load (i.e. looks like the lobe port of a MAU).</p> <p>To connect to a node (PC or other station/router etc.) set switch 1 to "NODE" i.e. UP.</p> <p>To connect to a concentrator (lobe port of a MAU etc.) set Switch 1 to "CONC" i.e. DOWN.</p> <p><b>Note:</b> This switch has no effect when ACL is disabled.</p>
2	LOBE/ TRUNK	<p>When set to "LOBE" the LCL112A-TR uses 802.5J keying sequences to establish the link. This means that the fiber link will not insert until the PC on the lobe is inserted on to the LAN.</p> <p>When set to "TRUNK" the fiber link is established immediately. No devices need to be inserted using phantom before the fiber link comes up.</p> <p>Lobe mode is selected when the links are established by switches, stations and routers connected to the LCL112A-TR in a lobe extension mode to a concentrator port of a switch or MAU. Lobe mode is the best mode of operation for inter-switch links and links to the lobe ports of MAUs.</p> <p>Trunk mode is selected when the fiber link must always be inserted, e.g. in the Ring In/Ring Out path. Trunk mode has some limited use in creating a Fiber backbone between two sites with devices connecting as stations to that backbone. Trunk mode connections to active MAU lobe ports are not recommended.</p>

Switch Number	Name	Function
3	ACL	<p>With ACL on, the Automatic Copper Loopback is enabled. This is the phantom current based insertion mechanism that operates in the standard way that a PC adapter card inserts into a MAU. This is used in conjunction with the NODE/CONC (Node/Concentrator) switch to provide controlled insertion at either end of the link.</p> <p>NODE with ACL ON when connected to a NODE or station.</p> <p>CONC with ACL ON when connected to a MAU lobe port.</p> <p>When connecting to the trunk of a Token Ring it is usual to have ACL set to OFF, unless the MAUs are smart MAUs that have a phantom current mechanism that operates in the same manner.</p> <p><b>Summary</b>            ACL= ON for all lobe connections and trunk connections that support the same phantom mechanism.            ACL= OFF for trunk (RI/RO) connections and 802.5c (8230/CAURI/RO) connections.</p> <p><b>Note:</b> When ACL is OFF the NODE/CONC switch has no effect.</p>

## 6. Installation

Installation of LCL112A-TR units requires the following tools and accessories:

### Tools

- 1300nm loss set (source and power meter)
- Screwdriver

### Accessories

- Rackmounting kit (optional)
- Rackmounting screws/cage nuts

### STEP BY STEP GUIDE

1. Decide on the operating mode suitable for your application. See Sections 3 and 4. Set the switch settings on the LCL112A-TRs noting that they may be different at either end of the link.
2. Using a fiber optic loss set, measure the loss of the fiber link. Check that it is less than 19dB for single-mode LCL112A-TRs.
3. If the LCL112A-TR is to be rackmounted, fasten the support bracket (Order Code LCL100-RACK, not supplied) into the rack. Otherwise place the LCL112A-TR on a suitable desk or shelf ensuring adequate space is left around the LCL112A-TR for convection cooling.
4. With appropriate patch cords connect Tx to Rx for each LCL112A-TR.
5. Connect the remote site in the same manner.
6. Connect the power connector and power up the LCL112A-TR.

**NOTE:** Following power on, the LEDs displayed on the LCL112A-TRs will vary with application. See Section 7.

## 7. Troubleshooting

Power LED	Copper LED	Fiber LED	Rx Alarm	Mode	Condition
Off	D/C	D/C	D/C	ANY	The LCL112A-TR is not receiving power. Check that external PSU is powered up and correctly connected to the LCL112A-TR. If swapping the PSU does not correct the fault check that local AC supply is working. If LCL112A-TR power LED is still extinguished, return the LCL112A-TR to your supplier.
On	Off	Off	On	ANY	The LCL112A-TR cannot see unit at the far end of the link. Either remote LCL112A-TR is unpowered (see above) or receive path is faulty. Check receive power at this LCL112A-TR is greater than -32dBm. Note that the Single-mode LCL112A-TR is a 1300nm device and an appropriate power meter must be used.
On	Off	Off	Off	LOBE ACL ON NODE	The LCL112A-TR can see the far end LCL112A-TR device. The copper link to the station is not inserted. Check that cables are correctly attached, and a straight through cable is used. <b>NOTE:</b> This condition will exist each time the local station is powered off.

## TOKEN RING FIBER EXTENDERS

Power LED	Copper LED	Fiber LED	Rx Alarm	Mode	Condition
On	Off	Off	Off	LOBE ACL ON CONC	LCL112A-TR can see far end device, however LCL112A-TR is not inserted on either interface. Check that the remote end station is powered up, its drivers have loaded correctly crossover cable is used.
On	D/C	Off	Off	TRUNK MODE ACL ON CONC OR STATION	Fiber link not operating correctly. 1) Check Tx connection to remote LCL112A-TR is powered up. 2) Check switch settings for required operating mode.
On	Off	On	Off	TRUNK ACL ON CONC (connector to MAU lobe port)	Fiber link is inserted, however fault exists on local copper link to MAU. Check cabling and MAU operation, and that a crossover cable has been used between the LCL112A-TR and the MAU.
On	Off	On	Off	TRUNK ACL ON NODE (connected to a station)	Fiber link is inserted, however copper link is not inserted. There are two possible causes: 1) The PC is powered off. 2) The link between the PC and LCL112A-TR is faulty: Check that a straight through patch cable is being used.

**TOKEN RING FIBER EXTENDERS**

<b>Power LED</b>	<b>Copper LED</b>	<b>Fiber LED</b>	<b>Rx Alarm</b>	<b>Mode</b>	<b>Condition</b>
On	On	On	Off	TRUNK ACLOFF RI/RO CONNECT- ION	The fiber is inserted, the links appear on, but the ring does not work properly. Inspect the copper cabling to the LCL112A-TRs. A crossover cable must be used to connect to the RO port. A straight through cable must be used to connect to RI.
On	On	On	Off	ANY	Both the fiber and copper links are inserted. All connections appear good and link should carry data.

## 8. Diagnostic LEDs

LED	Color	Meaning
Power	Green	Power is correctly supplied to the LCL112A-TR. If this LED is extinguished, check that the power supply is connected to the LCL112A-TR and that it is powered up.
Copper Inserted	Green	The LCL112A-TR copper port is inserted into the network. There are three reasons: 1) ACL is disabled and the fiber link is inserted. If the fiber link is not inserted, the LED will be extinguished. 2) ACL is enabled and the operating mode (Switch 1) is set for a concentrator. A valid load is present at the far end of the copper link. 3) ACL is enabled and the operating mode (Switch 1) is set for a station. A valid phantom source is present at the far end of the copper link.
Fiber Inserted	Green	The fiber link is inserted. If the Inserted LED is extinguished check the transmit fiber link.

If, after going through the troubleshooting section, you fail to resolve your problem and require more help, please contact Black Box Technical Support at 724-746-5500 with the following information:

1. Unit type.
2. Unit serial number.
3. Environment lay-out. Include hubs, bridges and routers (with model numbers), estimated cable lengths (between equipment) and type of cable used.
4. A description of the problem you are experiencing.
5. List of tests performed.



## 9. Accessories

**Figure7 RackmountMetalwork**

LCL100-RACK Rackmount Frame



RM510 Rackmount Frame



### Ordering Information

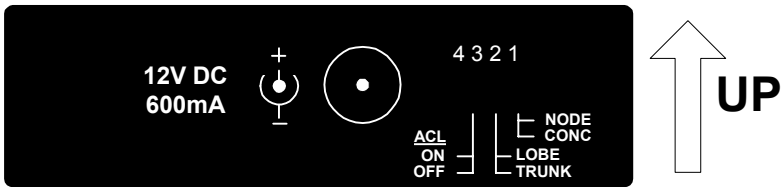
Product Number	Description
LCL112A-TR	RJ45- Single-mode ST, w/PSU and Lead
LCL100-RACK	Rackmount Frame, 1U/19", holds 4 units
RM510	Rackmount Frame, 3U/19", holds 16 units
PS500	Power Supply for RM510 Rackmount Frame, 110/220V
LCL100-PS48	Power Supply for RM510 Rackmount Frame, 48V

## 10. Glossary

802.5J	IEEE fiber optic station attach standard
ACL	Automatic Copper Loopback (Phantom controlled insertion mechanism)
Conc/Concentrator Port	A port of a Multistation Access Unit for a switch that a station/PC can connect to
LCL112A-TR	Token Ring Single-mode Fiber Extender
MAU	Multistation Access Unit
Node	A station on the ring or a port of a switch in station emulation mode
RI	Ring In port of a MAU
RO	Ring Out port of a MAU
TCU	Trunk Coupling Unit - the port of a MAU or switch that a station can connect to

## 11. APPENDIX A: Switch Convention

Figure 8: Switch Convention



### Switch Settings

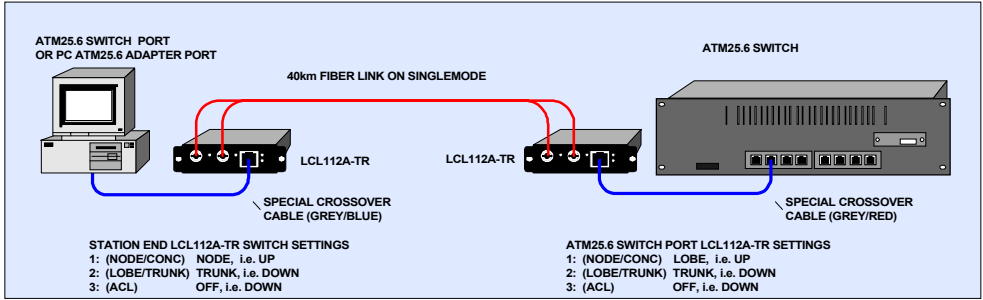
The use of UP and DOWN for switch positions refers to the orientation of the whole LCL112A-TR and not the switch block contained within.

'UP' in the manual is the same as 'ON' as indicated on the switch block.

## 12. APPENDIX B: Use with ATM25.6 Links

The LCL112A-TR can be used with ATM25.6 switches and devices as shown below.

**Figure 9: Use with ATM25.6 Links**



This requires special crossover cables which can be ordered separately.

### 13. APPENDIX C: Pinouts

The LCL112A-TR copper port is wired in the same way as a MAU lobe port. This is:

Function	Pin
TxA(+)	4
TxB(-)	5
RxA(+)	3
RxB(-)	6

To connect to a station a straight through cable is always used.

To connect to a MAU a crossover cable is required. This is supplied with the unit and has the following pinout:

RJ45	RJ45
3	4
4	3
5	6
6	5

Pins 1, 2, 7 and 8 are not used.



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1000 Park Drive · Lawrence, PA 15055-1018 · 724-746-5500 Fax 724-746-0746