METRObility optical systems

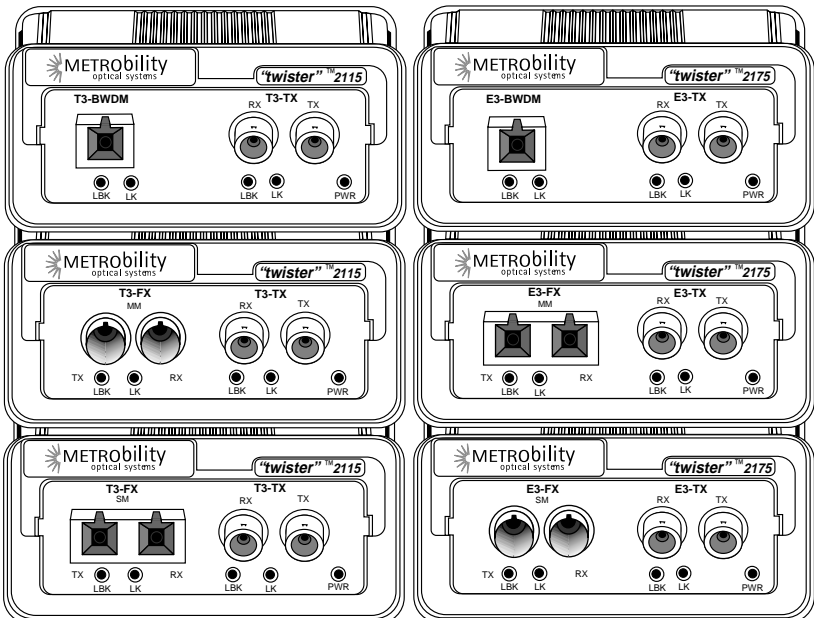# T3/E3 "twister"

Installation & User Guide

Models: 2115-23-01 / 2115-24-01 / 2115-25-01 / 2115-26-01 /
2115-27-01 / 2115-2J-01 / 2115-2X-01 / 2115-2Y-01 /
2175-23-01 / 2175-24-01 / 2175-25-01 / 2175-26-01 /
2175-27-01 / 2175-2J-01 / 2175-2X-01 / 2175-2Y-01

Metrobility T3/E3 Models

T3 Copper to T3 Fiber:
    2115-23-01 _____T3 BNC to T3 multimode SC
    2115-24-01 _____T3 BNC to T3 singlemode SC
    2115-25-01 _____T3 BNC to T3 multimode ST
    2115-26-01 _____T3 BNC to T3 singlemode ST
    2115-27-01 _____T3 BNC to T3 singlemode SC (40km)
    2115-2J-01 _____T3 BNC to T3 singlemode SC (100km)
    2115-2X-01 _____T3 BNC to T3 singlemode SC 1550/1310nm bidirectional wavelength
                             division multiplexed (BWDM)
    2115-2Y-01 _____T3 BNC to T3 singlemode SC 1310/1550nm BWDM

E3 Copper to E3 Fiber:
    2175-23-01 _____E3 BNC to E3 multimode SC
    2175-24-01 _____E3 BNC to E3 singlemode SC
    2175-25-01 _____E3 BNC to E3 multimode ST
    2175-26-01 _____E3 BNC to E3 singlemode ST
    2175-27-01 _____E3 BNC to E3 singlemode SC (40km)
    2175-2J-01 _____E3 BNC to E3 singlemode SC (100km)
    2175-2X-01 _____E3 BNC to E3 singlemode SC 1550/1310nm BWDM
    2175-2Y-01 _____E3 BNC to E3 singlemode SC 1310/1550nm BWDM

Table of Contents

Metrobility T3/E3 "twister" Installation & User Guide

Overview

Thank you for choosing the Metrobility T3/E3 media converter.
The T3/E3 media converter from Metrobility Optical Systems provides high-speed integration and conversion of T3 (44.736Mpbs) or E3 (34.368Mbps) coaxial telco communication lines to fiber transport environments. The copper data stream is converted to optical signals for greater noise immunity and longer transmission. The T3/E3 model supports remote fiber optic links up to 2km over multimode and up to 100km over singlemode cable.

To optimize your T3/E3 network, this plug-and-play media converter operates seamlessly with low jitter. All signal activity is completely converted ensuring accurate communication within connected segments. The Metrobility T3 model features a user-selectable line build out, and all T3 and E3 models include independent copper and fiber loopback modes to isolate problems within a specific segment of the network.

The Metrobility T3/E3 media converter offers the following key features:
- B3ZS (T3) or HDB3 (E3) line code support on the coaxial interface.
- System and port LEDs on the front panel for easy visual diagnostics.
- Independent copper and fiber loopback modes.
- User-selectable line build out for short or long haul operation on the T3 models.
- Coaxial to multimode conversion up to 2km, coaxial to singlemode conversion up to 100km, or coaxial to bidirectional wavelength division multiplexed (BWDM) conversion up to 20km.
- Surge protection on the RX and TX ports of the coaxial interface.
- Low jitter for maximum transmission quality.
- Independent clocking on the RX and TX ports.
- High MTBF.

Installation Guide

Follow the simple steps outlined in this section to install and start using your Metrobility T3/E3 media converter.

1

Unpack the Media Converter and Accessories

Check that the following components have been included with your order:
- Metrobility T3/E3 media converter
- Power supply
- Power supply cord
- Four (4) rubber feet

Your order has been provided with the safest possible packaging, but shipping damage does occasionally occur. Inspect your order carefully. If you discover any shipping damage, notify your carrier and follow their instructions for damage and claims. Save the original shipping carton if return or storage of the unit is necessary.

2

Choose an Appropriate Location

The Metrobility media converter is intended for use in either office or industrial environments. The unit must be located within six (6) feet of the AC power source being used and placed as far away as possible from electrical noise generating equipment such as copiers, electrostatic printers and other motorized equipment. If exposed twisted-pair wiring is used nearby, the wiring should be routed as far away as possible from power cords and data cables to minimize interference.

The unit may be oriented in any manner which permits the user to make physical connection to the power supply and leaves a minimum of six (6) inches of space for proper ventilation.

TUV Compliance Note: For pluggable equipment, the socket outlet must be installed near the equipment and be easily accessible.
Bei Geräten mit Steckanschluß muß die Steckdose nahe dem Gerät angebracht und leicht zugänglich sein.

3 Set the Switches

A set of DIP switches is located on the back of the unit. On the T3 models, functional switches are clearly labeled and allow you to select from several modes of operation. On the E3 models, only the switches labeled CLP and FLP are functional. Unmarked switches are inoperative.

NOTE: *The switch is ON when it is in the DOWN position.*
The switch is OFF when it is in the UP position.

Switch Label	Position	Function
LBO (T3 only)	ON	Long haul Line Build Out (255-1200 ft).
	OFF *(default)*	Short haul Line Build Out (0-255 ft).
CLP	ON	Loopback is enabled on the copper port.
	OFF *(default)*	Copper loopback is disabled; normal operation.
FLP	ON	Loopback is enabled on the fiber optic port.
	OFF *(default)*	Fiber optic loopback is disabled; normal operation.

LBO Switch (functional only on T3 models)
Set the Line Build Out (LBO) switch down to support a long haul connection if the length of your coaxial cable is between 255 and 1200 feet. Set LBO up to support a short haul connection if the length of your coaxial cable is less than 255 feet. The default setting is short haul.

CLP Switch
The Copper Loopback (CLP) switch enables/disables loopback on the copper port. When copper loopback is enabled, the incoming data and clock are looped from the RX copper port to the TX copper port, thus returning the copper input back to the sending device. At the same time, the data is transmitted to the remote T3/E3 unit. However, data from the remote unit is ignored. Loopback is disabled by default. For more information, refer to "Loopback Modes" in the User Guide section of this manual.

FLP Switch
The Fiber Loopback (FLP) switch enables/disables loopback on the fiber optic port. When fiber loopback is enabled, the incoming data and clock are looped from the RX fiber port to the TX fiber port. The data is also transmitted to the copper port, however, data from the copper port is ignored. Loopback is disabled by default. For more information, refer to "Loopback Modes" in the User Guide section of this manual.

4 *Connect to the Network*

The Metrobility T3/E3 model offers the ease of plug-and-play installation. Once power is applied to the unit, correct connectivity can be verified via the link (LK) LED.

To connect to the network, insert the cables into the appropriate connectors as illustrated below.

When making network connections, make sure that the receive (RX) port on the unit connects to the transmit (TX) port of the connected device, and make sure that the receive port of the connected device connects to the transmit port of the Metrobility model.
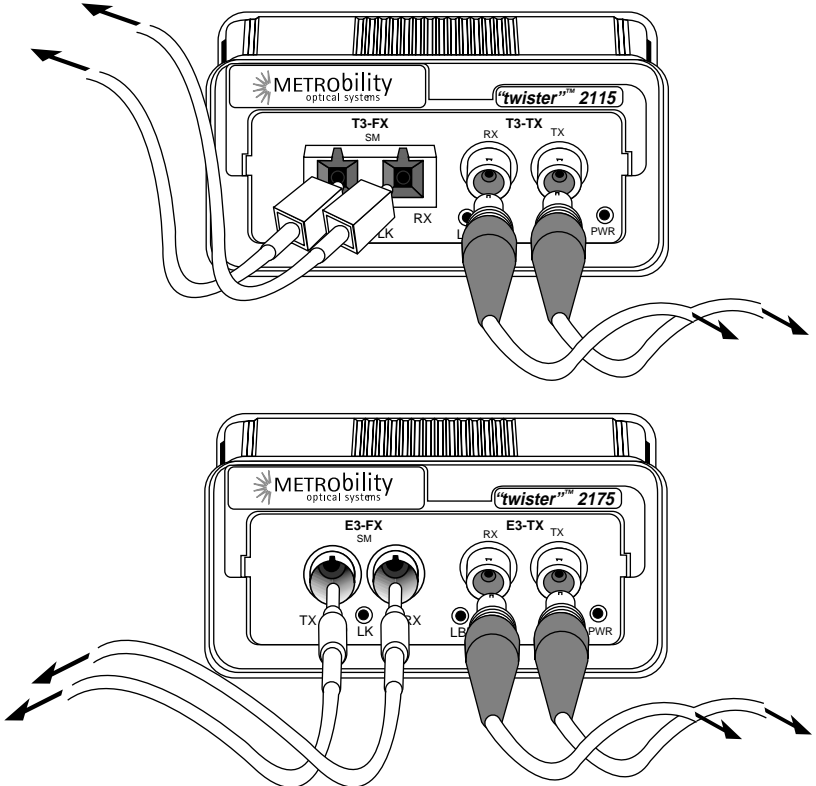
Coaxial Interface

The coaxial interface provides two BNC connectors. The receive port is labeled RX and the transmit port is labeled TX. Each connector supports a maximum segment length of 1200 feet. Use only RG-59 cables.

Fiber Optic Interface

2115-23-01, 2115-25-01, 2175-23-01 and 2175-25-01: The fiber optic multimode (MM) interface supports a maximum segment length of 2km for remote links.

2115-24-01, 2115-26-01, 2175-24-01 and 2175-26-01: The singlemode (SM) connector supports a maximum segment length of 15km.

2115-27-01 and 2175-27-01: The singlemode long haul interface supports a maximum segment of 40km.

2115-2J-01 and 2175-2J-01: The singlemode extended long haul interface supports a maximum segment length of 100km.

BWDM Interface

The 2115-2X-01, 2115-2Y-01, 2175-2X-01 and 2175-2Y-01 provide one bidirectional wavelength division multiplexed (BWDM) SC connector which supports a maximum segment length of up to 20km for remote links. BWDM units must always be used in complementary pairs. That is, a-2X model must be connected to a -2Y. The -2X unit is designed to transmit data at a wavelength of 1550nm and receive at 1310nm. Correspondingly, the -2Y unit transmits data at 1310nm and receives at 1550nm.


up to 20km

**Metrobility
-2X Model**

**Metrobility
-2Y Model**
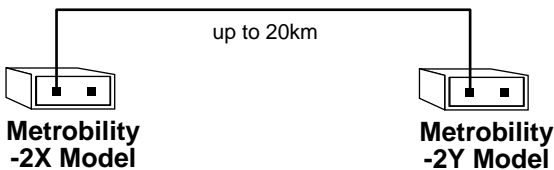
5 *Apply Power*

Power is provided through the desktop power supply module. This power module is equipped with an S760 hollow-type plug for insertion into the DC jack located on the back of the unit and a standard IEC 320-type AC power receptacle.

When making power connections, it is recommended that the DC power cord be connected to the DC input jack located on the back of the media converter **_before_** making the AC connection to the outlet. Seat the power cord into the strain relief clip to ensure against accidental disconnection.

Upon receiving power, the media converter goes into normal operation mode and automatically provides the appropriate signal translation between the connected network segments.

Verify correct segment connectivity via the LK LEDs on the front panel.
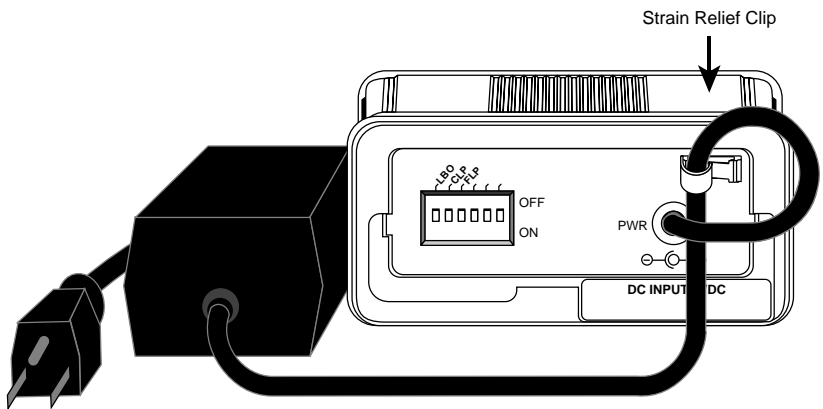
If an additional extension cord is used to connect the power module to the power source, the following guidelines must be followed.

> While one end of the AC power cord can be fitted with whatever plug is standard for the country of operation, the end that connects to the power supply module must have a female plug that fits this type of AC receptacle.

- AC 115V (North American): use a UL-listed and CSA-certified cord set consisting of a minimum 18 AWG, type SVT or SJT three-conductor cord, a maximum of 15 feet in length and a parallel blade, grounding-type attachment plug rated 15A, 125V.

- AC 230V (USA): use a UL-listed cord set consisting of a minimum No. 18 AWG, type SVT three-conductor cord, a maximum of 15 feet in length and a Tandem blade grounding-type attachment plug rated 15A, 250V.

- 240V (outside USA): use a cord set consisting of a minimum No. 18 AWG cord and grounding-type attachment plug rated 15A, 250V. The cord set should have the appropriate safety approvals for the country in which the unit is being installed and marked HAR.

User Guide

This section contains more detailed information regarding the operating features of the Metrobility T3/E3 media converter.

LED Indicators

The Metrobility T3/E3 media converter provides several LEDs on the front panel for the visible verification of unit status and proper functionality. These LEDs can aid in troubleshooting and overall network diagnosis and management.

System LED

LED Label	Color/ Status	Indication
PWR	Green	Unit is receiving power.
	OFF	Unit is not receiving power or has failed.

Copper Port LEDs

LED Label	Color/ Status	Indication
LK	Green	A signal is present on the copper receive port.
	OFF	No signal is detected at the port.
LBK	Yellow	Copper port is in loopback mode. Incoming frames on the copper port are sent back on the coaxial transmit line. Data is also sent through the fiber optic transmit line.
	OFF	Loopback is disabled on the copper port; normal operation.

Fiber Optic Port LEDs

LED Label	Color/ Status	Indication
LK	Green	An optical signal is present on the fiber optic receive port.
	OFF	No signal is detected at the fiber port.
LBK	Yellow	Fiber port is in loopback mode. Incoming data and clock are sent back on the transmit fiber line. Data is also transmitted out the coaxial transmit line.
	OFF	Loopback is disabled on the fiber port; normal operation.

Theory of Operation

Functional Block Diagram
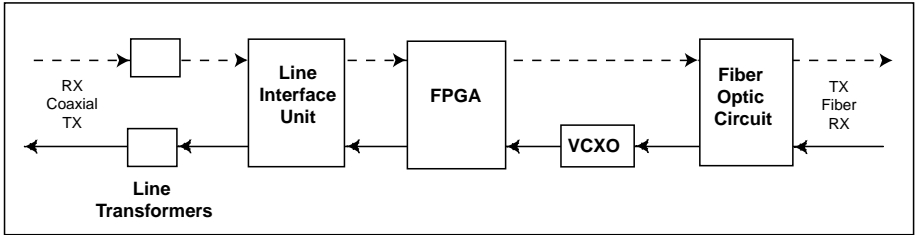
Coaxial to Fiber Data Path

The receive (RX) port on the coaxial interface accepts an electrical signal. This signal is coupled to the line interface unit (LIU) through a line transformer. The LIU performs clock and data recovery and converts the signal into non-return to zero (NRZ) data and clock. The NRZ data and clock then pass through the field-programmable gate array (FPGA), which encodes the data for fiber optic transmission. The encoding ensures adequate transition density for reliable clock recovery at the remote T3/E3 fiber optic interface.

Fiber to Coaxial Data Path

The RX port on the fiber interface accepts an optical signal from the remote T3/E3 unit and converts it back to an electrical signal. The optical signal first enters the voltage-controlled crystal oscillator (VCXO), which extracts the line rate clock and data. The recovered clock and data are then sent to the FPGA for decoding. The decoded data stream goes to the LIU for encoding into T3 or E3 signals. The transmitted signal is coupled to the BNC coaxial connector through a line transformer.

On both the RX and TX ports of the coaxial interface, surge protection is provided.

Timing Paths

The transmit (TX) and receive (RX) paths are clocked independently and during normal operation, the Metrobility T3/E3 units are never timing masters of the network system. In the coaxial to fiber path, timing is recovered by the unit's LIU and transmitted over the fiber line to the remote T3/E3 unit. In the fiber to coaxial path, timing is derived from the incoming optical signal and sent over the coaxial TX line.
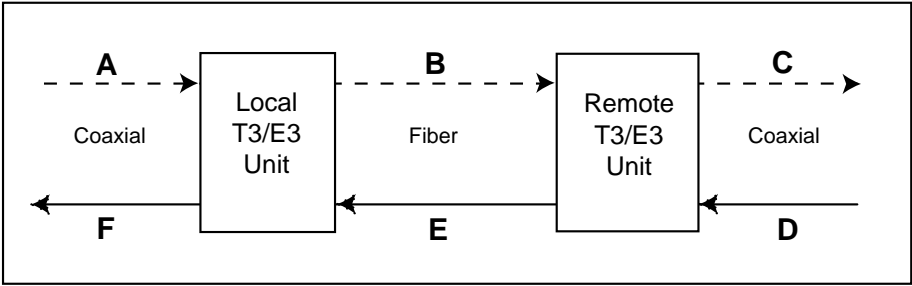
The following table describes how timing is affected if a failure occurs at various points in the network.

Line Failure Point	Result
A	The local T3/E3 unit detects loss of signal. The fiber receiver's VCXO becomes the timing source for transmission over fiber link B.
B	The remote T3/E3 unit's VCXO reverts to its reference clock input. The remote T3/E3 unit becomes the system timing master.
C	If the equipment connected to the remote T3/E3 unit supports looped timing, the equipment should revert to its internal clock when it detects loss of signal. Alternatively, the equipment could fail to provide a valid signal or clock, and the system will behave as if the failure occurred at point D.
D	The remote T3/E3 unit's LIU detects loss of signal. The fiber receiver's VCXO becomes the timing source for transmission over fiber link E.
E	The local T3/E3 unit's VCXO reverts to its reference clock input. The local T3/E3 unit becomes the system timing master.
F	No system timing disruption occurs. The device connected to the local T3/E3 unit detects loss of signal.

Data Transparency
The Metrobility T3/E3 media converter offers full data transparency. Any codes or commands contained within the data stream are passed through to the remote device. The only commands executed by the Metrobility converter are those set through the DIP switches.

Link Loss Indications

The following examples show the status of the LK LED under various link conditions and describe when unframed all ones are generated. (Loopback is disabled in these examples.)

Note: An all-ones pattern indicates an alarm indication signal (AIS) for the E3 units only. For T3 models, the all-ones pattern is simply transmitted to the remote device; it does NOT indicate AIS.

Normal
The diagram below shows a typical configuration with good link status.
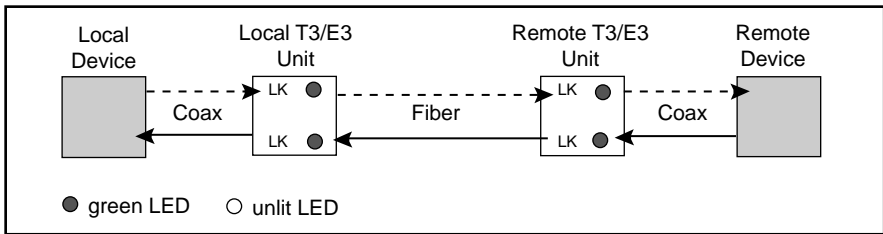
Input Coaxial Link Loss
Loss of the copper input disables the BNC port's LK LED. It also forces the T3/E3 unit to generate unframed all ones (AIS for E3 only), which are transmitted out its fiber port. For example, if the local unit's inbound coaxial cable breaks, it will transmit all ones to the remote T3/E3 unit via the fiber cable. The remote unit then carries the pattern forward via its coaxial cable to the remote device.
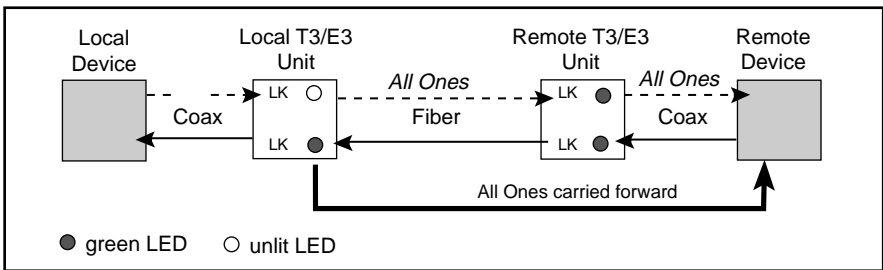

Input Fiber Link Loss
Loss of the fiber input is indicated by the fiber port's unlit LK LED. When the fiber input is lost, an unframed all-ones pattern is transmitted from the coaxial port, as shown in the following illustration.
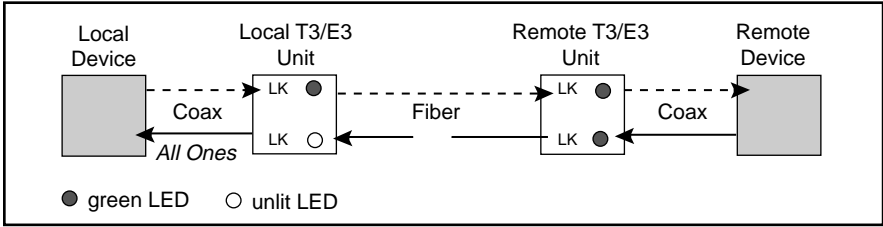
Remote Coaxial Link Loss

Loss of link to the remote device produces a red alarm condition at the remote site and should force the device to revert to its internal clock. If the remote device is configured to send back a yellow alarm under this condition, the two T3/E3 units will carry the alarm forward to the local device, as shown below.
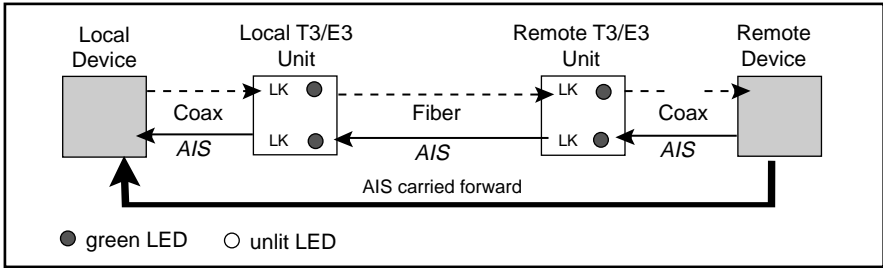
Loopback Modes

The Metrobility T3/E3 media converter features two loopback modes to help verify correct installation and to diagnose system problems.

Normal

During normal operation, without loopback, data from a local device (CSU, PBX, etc.) enters the local T3/E3 unit's coaxial receiver, passes through the fiber line between the two converters, then exits the remote unit's coaxial transmitter to enter the remote equipment, and vice versa.
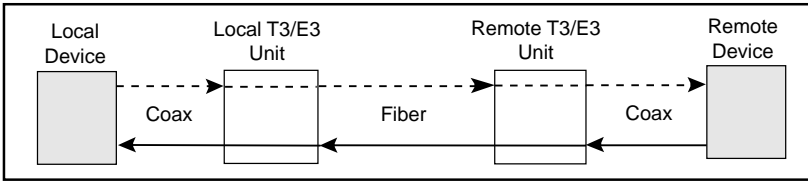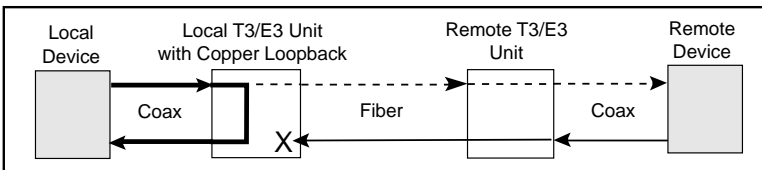

Loopback

Loopback helps to isolate and identify traffic problems within a specific segment. During loopback, the yellow LBK LED is lit. Loopback is enabled/disabled by setting DIP switch 2 or 3. Once loopback is enabled, the unit will remain in this mode until the DIP switch is turned off.

Copper and fiber loopback cannot be enabled at the same time. If both DIP switches are enabled, only the first one set will be in effect until it is disabled.

Copper Loopback

During copper loopback, timing and data received on the coaxial line are looped back to the sending device. The loop occurs in the FPGA. The data is also transmitted to the remote T3/E3 converter, but the data from the remote unit is ignored by the converter in loopback mode.

In the example shown below, the local T3/E3 unit has copper loopback enabled. Data received at the BNC port is simultaneously returned to the local device <u>and</u> sent to the remote T3/E3 unit and on to the remote device. Data from the remote device is transmitted by the remote unit, however, it is ignored by the local unit at its fiber optic interface.

Fiber Loopback

In this mode, the incoming data and clock on the fiber line are looped back. The loop occurs in the FPGA. The data is still sent out the coaxial transmitter. However, the data received at the BNC interface is ignored.

In the example below, the remote T3/E3 unit has fiber loopback enabled. Data received at the fiber optic input is simultaneously returned to the local device <u>and</u> sent to the remote device. However, data from the remote device is ignored by the remote T3/E3 unit at its coaxial interface.
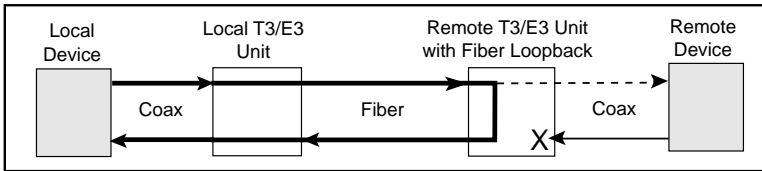
Topology Solutions

The Metrobility T3/E3 model is a point-to-point media converter designed to extend the reach of copper T3/E3 links and to provide protection from power surges and electromagnetic interference. Each model supports a single remote T3/E3 unit.

Private Branch Exchange (PBX)

PBX

up to 100km
singlemode

Metrobility T3/E3 Model

Metrobility T3/E3 Model

copper T3/E3
fiber T3/E3

Data Service Unit (DSU)

Channel Service Unit (CSU)

up to 100km
singlemode

Metrobility T3/E3 Model

Metrobility T3/E3 Model

PBX

CSU

up to 2km
multimode

**Intelligent 7500 Chassis
with T3/E3 Modules**

Metrobility T3/E3 Model
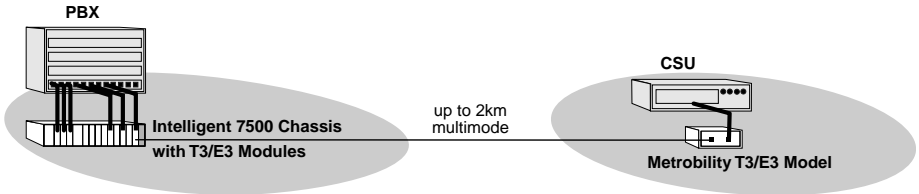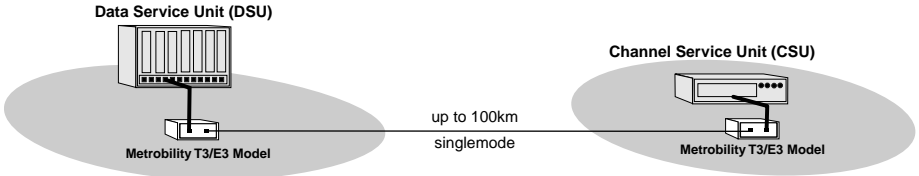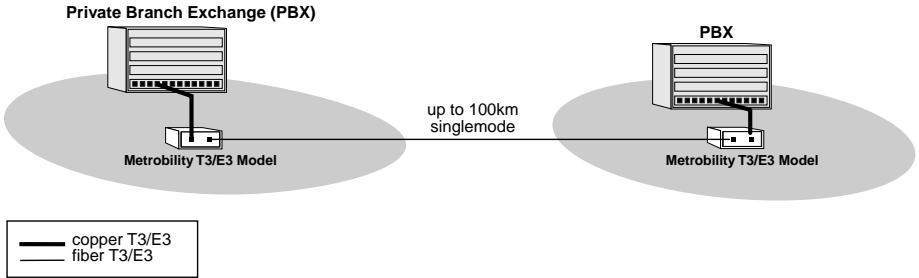
Technical Specifications

Network Connections

Coaxial Interface

Connector	BNC receptacle
Impedance	75 ohms
Signal Structure	ANSI T1.404, T1404a (T3)
	ITU G.703 (E3)
Supported Link Length	up to 1200 ft
Cable Type	RG-59 coaxial cable

Multimode Fiber Optic Interface

Connector	ST or SC
Wavelength	1310 nm
RX Input Sensitivity	-31 dBm peak minimum
Output Power	-20 dBm to -14 dBm (62.5/125 µm)
Supported Link Length	up to 2km full duplex
Cable Type	50/125, 62.5/125 µm F/O

Singlemode Fiber Optic Interface

Connector	ST or SC
Wavelength	1310 nm
RX Input Sensitivity	-31 dBm peak minimum
Output Power	-15 dBm to -8 dBm (9/125 µm)
Supported Link Length	up to 15km full duplex
Cable Type	8.3/125, 8.7/125, 9/125, 10/125 µm F/O

Singlemode Fiber Optic Interface — long haul distance support

Connector	SC
Wavelength	1310 nm
RX Input Sensitivity	-35 dBm minimum
Output Power	-5 dBm to 0 dBm (9/125 µm)
Supported Link Length	up to 40km full duplex
Cable Type	8.3/125, 8.7/125, 9/125, 10/125 µm F/O

Singlemode Fiber Optic Interface — extended long haul distance support

Connector _____ SC
Wavelength _____ 1550 nm
RX Input Sensitivity _____ -37 dBm minimum
Output Power _____ -3.0 dBm to 0 dBm (9/125 μm)
Supported Link Length _____ up to 100km full duplex
Cable Type _____ 8.3/125, 8.7/125, 9/125, 10/125 μm F/O

Singlemode BWDM Fiber Optic Interface

Connector _____ SC
Supported Link Length _____ up to 20km full duplex
Cable Type _____ 9/125 μm F/O
(2115-2X-01, 2175-2X-01)
  TX Wavelength _____ 1550nm
  RX Wavelength _____ 1310nm
  RX Input Sensitivity _____ -32 dBm minimum
  Output Power _____ -8 dBm to -15 dBm (9/125 μm)
(2115-2Y-01, 2175-2Y-01)
  TX Wavelength _____ 1310nm
  RX Wavelength _____ 1550nm
  RX Input Sensitivity _____ -32 dBm minimum
  Output Power _____ -8 dBm to -15 dBm (9/125 μm)

Data Rate

Data Rate _____ 44.736Mbps (T3); 34.368Mbps (E3)

Power

Input _____ +5.0VDC @ 0.4A, 2W average

Environmental

Operating Temperature _____ 0° to 55° C
Storage Temperature _____ -30° to 70° C
Relative Humidity _____ 5% to 95% non-condensing
Physical Case _____ Fully enclosed metal construction
Dimensions _____ 4.38"L x 3.26"W x 1.71"H
_____ 12.3 cm x 8.3 cm x 4.3 cm
Weight (including power supply) _____ 3 lb, 1.36 kg

Acronyms and Abbreviations

This list defines the acronyms and abbreviations used in this guide.

AIS	Alarm Indication Signal
ANSI	American National Standards Institute
AWG	American Wire Gauge
B3ZS	Bipolar Three Zeroes Substitution T3 line coding
BNC	Bayonet-Neill-Concelman connector
BWDM	Bidirectional Wavelength Division Multiplexed
CLP	Copper Loopback
CSA	Canadian Standards Association
CSU	Channel Service Unit
DSU	Data Service Unit
E3	34.368 Mbps communications standard
F/O	Fiber Optic
FLP	Fiber Loopback
FPGA	Field-Programmable Gate Array
HDB3	High Density Bipolar Three Zeroes Substitution E3 line coding
IEC	International Electrotechnical Commission
ITU	International Telecommunications Union
LBK	Loopback
LBO	Line Build Out
LIU	Line Interface Unit
LK	Link
Mbps	Megabits per second
MM	Multimode
MTBF	Mean Time Between Failures
NRZ	Non-Return to Zero line coding
PBX	Private Branch Exchange
PWR	Power
RX	Receive
SM	Singlemode
T3	44.736 Mbps communications standard
TX	Transmit
UL	Underwriters Laboratories
VCXO	Voltage-controlled crystal oscillator

Product Safety, EMC and Compliance Statements

This equipment complies with the following requirements:

- UL
- CSA
- EN60950 (safety)
- FCC Part 15, Class A
- EN55022 Class A (emissions)
- EN55024: 1998 (immunity)
- IEC 825-1 Classification
- ITU-G.703
- G.704
- G.706
- ANSI T1.403-1999
- ANSI T1.408
- Class 1 Laser Product
- DOC Class A (emissions)

This product shall be handled, stored and disposed of in accordance with all governing and applicable safety and environmental regulatory agency requirements.

The following *FCC* and *Industry Canada* compliance information is applicable to North American customers only.

USA FCC Radio Frequency Interference Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy, and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Caution: Changes or modifications to this equipment not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Canadian Radio Frequency Interference Statement

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Réglement sur le matériel brouilleur du Canada.

Warranty and Servicing

Three-Year Warranty for the Metrobility T3/E3 Model

Metrobility Optical Systems, Inc. warrants that every Metrobility T3/E3 model will be free from defects in material and workmanship for a period of THREE YEARS. This warranty covers the original user only and is not transferable. Should the unit fail at any time during this warranty period, Metrobility will, at its sole discretion, replace, repair, or refund the purchase price of the product. This warranty is limited to defects in workmanship and materials and does not cover damage from accident, acts of God, neglect, contamination, misuse or abnormal conditions of operation or handling, including overvoltage failures caused by use outside of the product's specified rating, or normal wear and tear of mechanical components.

To establish original ownership and provide date of purchase, complete and return the registration card or register the product online at **www.metrobility.com**. If product was not purchased directly from Metrobility, please provide source, invoice number and date of purchase.

To return a defective product for warranty coverage, contact Metrobility Customer Service for a return materials authorization (RMA) number. Send the defective product postage and insurance prepaid to the address provided to you by the Metrobility Technical Support Representative. Failure to properly protect the product during shipping may void this warranty. The Metrobility RMA number must be clearly on the outside of the carton to ensure its acceptance.

Metrobility will pay return transportation for product repaired or replaced in-warranty. Before making any repair not covered by the warranty, Metrobility will estimate cost and obtain authorization, then invoice for repair and return transportation. Metrobility reserves the right to charge for all testing and shipping costs incurred, if test results determine that the unit is without defect.

This warranty constitutes the buyer's sole remedy. No other warranties, such as fitness for a particular purpose, are expressed or implied. Under no circumstances will Metrobility be liable for any damages incurred by the use of this product including, but not limited to, lost profits, lost savings, and incidental or consequential damages arising from the use of, or inability to use, this product. Authorized resellers are not authorized to extend any other warranty on Metrobility's behalf.
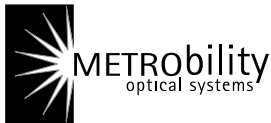
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