![MRV Communications, Inc. logo]

MULTI VOICE 4
T1/ E1 Multiplexer
User Manual

Standards Compliance

UL 1950; CSA 22.2 No 950; FCC Part 15 Class A; CE-89/336/EEC, 73/23/EEC

Disclaimer

MRV reserves the right to modify the equipment at any time and in any way it sees fit in order to improve it.

MRV provides this document without any warranty of any kind, either expressed or implied, including, but not limited to, the implied warranties of merchantability or fitness for a particular purpose.

Even though much care has been taken in the preparation of this document, omissions and errors may still exist. The user, therefore, is advised to exercise due discretion in the use of the contents of this document since the user bears sole responsibility.

Trademarks

All trademarks are the property of their respective holders.

Copyright © 2002 by *MRV*

Document Number: ML46782 **Document Revision:** Rev. 02 **Release Date:** February 2003

Contact Information
For customer support, you can:

For customer support, you can:

- Contact your local MRV representative
- E-mail us at <u>InternationalSupport@mrv.com</u>
- Visit our MRV Web site at <u>http://www.mrv.com</u>

Contents

Figures

Tables

About this Manual

Audience

This manual is intended for the use of network administrators who wish to apply, install, setup, operate, and troubleshoot the MM 04[1] multiplexer. The network administrator is expected to have working knowledge of:

- E1/T1 and fiberoptic networking
- Multiplexers

Related Document

MRV maintains a policy of continual improvements to its products even after the User Manual is released for publication and distribution. Consequently, the User Manual may no longer accurately describe the product. In such event, an additional document, called Release Notes – which contains information about the product not found in the User Manual – is provided. The Release Notes document, therefore, serves as a supplement to the User Manual and overrides the User Manual in regard to issues on which discrepancies exist between the two.

Organization

This manual is organized into the following:

Safety Requirements – specifies the safety requirements that must be met at all times.

Overview – provides a general introduction to the MM 04 noting its key features, advantages, available configurations, layout, etc.

Applications – presents typical networks incorporating the MM 04.

Installation – shows how to mount, network connect, and operation mode configure the MM 04.

Startup and Operation – describes how to start, setup, and monitor operation of the MM 04.

Appendix A: Troubleshooting – is a guide for troubleshooting the MM 04 on the operative level.

Appendix B: Diagnostic Tests – is a shows how to perform the LLB and RLB tests for the MM 04.

Appendix C: Cleaning Optical Connectors – describes a recommended procedure for cleaning optical connectors.

Appendix D: Product Specification – gives the general specifications of the MM 04.

---

[1] From hereon, MM 04 is used to represent MULTI VOICE 4.

Typographical Conventions

The typographical conventions used in this document are as follows:

Convention	Explanation
`CourierBold`	This typeface represents information provided by/to the system.
Italics	This typeface is used for emphasis.
Enter	This format represents the key name on the keyboard or keypad.
ⓘ	This icon represents important information.
⚠	This icon represents risk of personal injury, system damage, or data loss.

Acronyms

BER	Bit-Error Rate
CTS	Clear To Send
dB	deciBel
DTE	Data Terminal Equipment
Gnd	Ground
LAN	Local Area Network
LLB	Local LoopBack
RLB	Remote LoopBack
TDM	Time-Division Multiplexer/Multiplexing
UPS	Uninterruptible Power Supply

Safety Requirements

<table>
<tr>
<td>⚠️</td>
<td>

Caution!

To reduce risk of electrical shock and fire and to maintain proper operation, ensure that the safety requirements stated hereunder are met!

</td>
</tr>
</table>

Before Installing

Power   Ensure that *all* power to the MM 04 is cut off. Specifically, disconnect all MM 04 power cords from the power line (mains).

Inspection   Ensure by inspection that no part is damaged.

Covers   Leave the protective covers (e.g., dust caps on optical connectors, etc.) on the MM 04 at all times except when the MM 04 is to be installed.

Before Powering On

Temperature Operate the MM 04 only at a location where the ambient temperature is in the range 0 to 50 ^{o}C (32 to 122 ^{o}F).

Humidity   Operate MM 04 only at a location where the ambient humidity is non-condensing and between 10 and 90 %.

Cooling Air Ensure that the air-flow around the MM 04 and through the air vents is not obstructed. In addition, ensure that there is a clearance of at least 25 mm (1 inch) between the air vents and nearby objects.

Line Power   Ensure that the line (mains) power is as specified on the label on the MM 04.

Power Cord   The ac power cord of MM 04 multiplexer must have the following specification:

In the USA and Canada

UL approved and CSA certified flexible 3-conductor power cord having individual conductor wire of gauge #18 AWG and length not exceeding 4.5 m (15 ft). The power cord terminations should be NEMA Type 5-15P (3-prong, one prong for earthing) at one end and an IEC appliance inlet coupler at the other end.

Any of the following types of power cords are acceptable: G, S, SE, SJ, SJE, SJO, SJOO, SJT, SJTOO, SO, SOO, SP-3, SPE-3, SPT-3, ST, STO, STOO, SV, SVE, SVO, SVT, SVTO, SVTOO, W.

In all other countries

Flexible 3-conductor power cord approved by the cognizant safety organization of the country. The power cord must be Type HAR (harmonized), with individual conductor wire having cross-sectional area 0.75 sq. mm. The power cord terminations should

be a suitably rated earthing-type plug at one end and an IEC appliance inlet coupler at the other end. Both of the power cord terminations must carry the certification label of the cognizant safety organization of the country.

During Operation

Do not connect or disconnect cables and/or power cords during lightning strikes and thunderstorms.

Servicing

All servicing must be carried out only by *qualified* service personnel.

Before servicing, ensure that *all* power to the MM 04 is cut off!

Overview

Function

The MM 04 is a standalone TDM used for multiplexing/demultiplexing up to 4 E1/T1 lines onto/from a single optical channel[2], which it creates.

Advantages

The MM 04's capability to create a multiplexed optical channel for the transfer of data has the following major advantages:

- Increases operating range
- Can be used to carry data at the same *time* as other channels on the fiberoptic cabling.
- Custom configurations
- Reduces cabling bulk by a factor of 4
- Uses existing fiberoptic infrastructures
- Provides greater reliability, increased security, and added safety
- Immediate, easy, and quick deployment
- No inherent lapse times

Features

- DC or universal wide range AC input power
- Standards compliant
- 4 independently operating E1/T1 ports, 1 multiplexed fiberoptic port
- E1/T1 ports independently configurable
- Redundancy power supply option
- Redundancy fiberoptic interface option
- Wide range of hardware configurations
- E1/T1 long-haul and short-haul trunk support
- Completely transparent transmission and reception
- Wire-speed operation
- Management-free operation
- Dry contact interface for relaying operation status to control station (option)
- Local indications of remote device status
- Small, compact, and robust
- Frame control algorithm
- Plug-installable
- Desk top or rack mountable.
- Protection against high power surges and lightning

---

[2] carrier wavelength

Application

MM 04 is applied in campus, access, and wide-area networks for high-speed transfer of voice coming over E1 or T1 carrier lines on fiberoptic cabling. For various application configurations, refer to the *chapter Applications*.

Configurations

The MM 04 can be ordered in any of a variety of configurations, using *Table 1*.

Table 1: Available MM 04 Configurations

Ordering Code	Configuration
E1 Multiplexers	
Ordering Code	Configuration
MM04E112/1M8SC	4xE1 Multiplexer, MM 850 nm (2 km)
MM04E112/1M3SC	4xE1 Multiplexer, MM 1310 nm (10 km)
MM04E112/1S1SC	4xE1 Multiplexer, SM 1310 nm (30 km)
MM04E112/1S2SC	4xE1 Multiplexer, SM 1310 nm (10-50 km)
MM04E112/1S3SC	4xE1 Multiplexer, SM 1550 nm (25-100 km)
MM04E112/1S4SC	4xE1 Multiplexer, SM 1550 nm (40-120 km)
MM04E112/113SC	4xE1 Multiplexer, single fiber SM 1310/1550 nm (30 km) (Sold in pairs with MM04E112/115SC)
MM04E112/115SC	4xE1 Multiplexer, single fiber SM 1310/1550nm (30 km) (Sold in pairs with MM04E112/113SC)
MM04E112/123SC	4xE1 Multiplexer, single fiber SM 1310/1550nm (20-50km) (Sold in pairs with MM04E112/115SC)
MM04E112/125SC	4xE1 Multiplexer, single fiber SM 1310/1550nm (20-50km) (Sold in pairs with MM04E112/113SC)
MM04E112/APAL1	4xE1 Multiplexer, with interface for PAL/A – FSO passive link
MM04E112/BPAL1	4xE1 Multiplexer, with interface for PAL/B – FSO passive link
MM04E112/2M8SC	4xE1 Multiplexer, MM 850nm (2 km) with redundant F/O
MM04E112/2M3SC	4xE1 Multiplexer, MM 1310nm (10 km) with redundant F/O
MM04E112/2S1SC	4xE1 Multiplexer, SM 1310nm (30 km) with redundant F/O
MM04E112/2S2SC	4xE1 Multiplexer, SM 1310nm (10-50 km) with redundant F/O
MM04E112/2S3SC	4xE1 Multiplexer, SM 1550nm (25-100 km) with redundant F/O
MM04E112/2S4SC	4xE1 Multiplexer, SM 1550nm (40-120 km) with redundant F/O
MM04E112/213SC	4xE1 Multiplexer, single fiber SM 1310/1550 nm (30 km) with redundant F/O (Sold in pairs with MM04E112/115SC)
MM04E112/215SC	4xE1 Multiplexer, single fiber SM 1310/1550 nm (30 km) with redundant F/O (Sold in pairs with MM04E112/113SC)
MM04E112/223SC	4xE1 Multiplexer, single fiber SM 1310/1550 nm (20-50 km) with redundant F/O (Sold in pairs with MM04E112/115SC)
MM04E112/225SC	4xE1 Multiplexer, single fiber SM 1310/1550 nm (20-50 km) with redundant F/O (Sold in pairs with MM04E112/113SC)
Options	
Ordering Code	Configuration
MM04T1xx/xxxxx	T1 version for all the above mentioned products
MM04E12x/xxxxx	Dual Power Supply version for all the above mentioned products
MM04E1x3/xxxxx	DC (35V-60V) power supply version for all the above mentioned products
MM04T1xx/xxxST	ST connector version for all the above mentioned products
MM04T1xx/xxxFC	FC connector version for all the above mentioned products
MM04T1xx/xxxxxD	For all the above mentioned products an option for 5 Dry Contacts

Installation

The MM 04 is installed simply by *plugging* it into *existing* infrastructures.

Operation

Operation is autonomous once MM 04 multiplexer is powered on.

Layout

Front View

Figure 1: Front View

Ports

Fiberoptic Ports

One or two fiberoptic ports. If two ports are present, they operate in mutual redundancy mode[3]. The options for the connector and cable types are given in Table 1. The supported cable lengths are given in Appendix D: Product Specification.

E1/T1 Ports

Four E1 ports or four T1 ports. The connector type, pinout, and supported cable lengths are given in Appendix D: Product Specification.

DIP Switch

4-toggle DIP switches, one per E1/T1 port, for configuring the operation mode of each port individually. Table 2 specifies each DIP switch toggle, its two positions, and the function of each position.

Table 2: DIP Switch Functions for a E1/T1 Port

DIP Switch Toggle	Toggle Position	Function
1	UP	Encoding disabled (i.e., AMI mode per G.703, G.704).
	DOWN	E1 or T1 encoding enabled.
2	UP	Long-haul for E1/T1 ports.
	DOWN	Short-haul for E1/T1 ports.
3	UP	LLB operation mode
	DOWN	Normal
4	UP	RLB operation mode
	DOWN	Normal

---

[3] In the mutual redundancy mode, when one link (fiberoptic cable) fails, the other link immediately replaces it.

LEDs

Power LEDs

There are four power supply LEDs, two for the local MM 04 and two for the remote MM 04. The LEDs, their statuses, and the significance of each status are described in Table 3.

Table 3: Power Supply LEDs

LED	Status	Significance
POWER SUPPLY 1 LOCAL	ON	*Local* MM 04 Power Supply *1* receiving power.
	OFF	*Local* MM 04 Power Supply *1 not* receiving power.
POWER SUPPLY 1 REMOTE	ON	*Remote* MM 04 Power Supply *1* receiving power.
	OFF	*Remote* MM 04 Power Supply *1 not* receiving power.
POWER SUPPLY 2 LOCAL	ON	*Local* MM 04 Power Supply *2* receiving power.
	OFF	*Local* MM 04 Power Supply *2 not* receiving power.
POWER SUPPLY 2 REMOTE	ON	*Remote* MM 04 Power Supply *2* receiving power.
	OFF	*Remote* MM 04 Power Supply *2 not* receiving power.

E1/T1 Port LEDs

For a local MM 04 E1/T1 port and its co-port[4] on the remote MM 04, there are four LEDs, two for each port. The LEDs, their statuses, and the significance of each status are described in Table 4.

Table 4: E1/T1 Port LEDs

LED	Status	Significance
LINK LOCAL	ON	Port link of local MM 04 OK.
	OFF	Port link of local MM 04 faulty or absent.
LINK REMOTE	ON	Port link of remote MM 04 OK.
	OFF	Port link of remote MM 04 faulty or absent.
LOOP LOCAL	ON	Port set to operate in LLB mode (i.e., DIP switch toggles set as follows: 3 → UP and 4 → DOWN.) or remote loopback command is being received.
	OFF	Port *not* set to operate in LLB mode (normal operation mode).
LOOP REMOTE	ON	Port set to operate in RLB mode (i.e., DIP switch toggles set as follows: 3 → DOWN and 4 → UP.) or remote MM 04 is set to loopback mode.
	OFF	Port *not* set to operate in RLB mode (normal operation mode).

Fiberoptic Port LEDs

The two LINK LEDs apply to the local MM 04 fiberoptic port and its co-port on the remote MM 04. The two SYNC LEDs apply to the local MM 04 and the remote MM 04 as a whole. The LEDs, their statuses, and the significance of each status are described in Table 5.

---

[4] Co-port is another port which receives from or forwards to an MM 04 port.

Table 5: Fiberoptic Port LEDs

LED	Status	Significance
LINK LOCAL	ON	*Local* MM 04 port receiving the carrier wavelength.
	OFF	*Local* MM 04 port *not* receiving the carrier wavelength.
LINK REMOTE	ON	*Remote* MM 04 port receiving the carrier wavelength.
	OFF	*Remote* MM 04 port *not* receiving the carrier wavelength.
SYNC LOCAL	ON	*Data* from remote MM 04 recognizable by *local* MM 04.
	OFF	*Data* from remote MM 04 *not* recognizable by *local* MM 04.
SYNC REMOTE	ON	*Data* from local MM 04 recognizable by *remote* MM 04.
	OFF	*Data* from local MM 04 *not* recognizable by *remote* MM 04.

Rear View

Power Supply

One or two power supply units. If two power supply units are present, they back up each other and operate in equal-load-sharing mode. This mode prolongs their service life.

Each power supply unit is internal, switched, universal, with *ac* or *dc* high or low voltage input. For specification details, refer to Appendix D: Product Specification.

Each power supply is fitted with one port for dc (high or low voltage) or ac (high voltage) input. The specifications for the power port are given in Appendix D: Product Specification.

Dry Contact

Pre-installed optional interface for relaying the MM 04 operation status to a remote control station. The Dry Contact is used for remote monitoring of TereScopes – see Figure 4 or Figure 5.

Figure 2: Rear View

Applications

General

This chapter presents typical networking applications with the MM 04. The network in an example can be adopted as is or can be modified to meet a specific set of requirements.
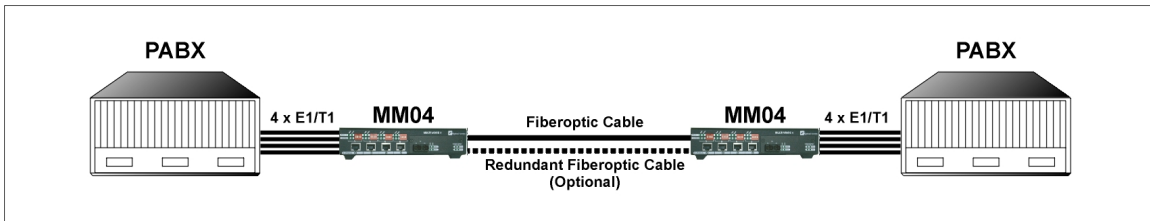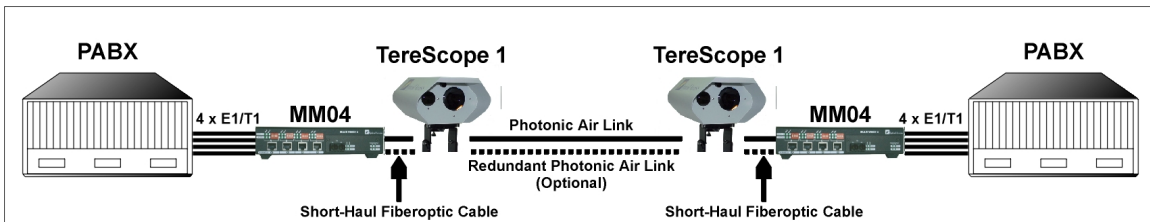

Figure 3: Modem

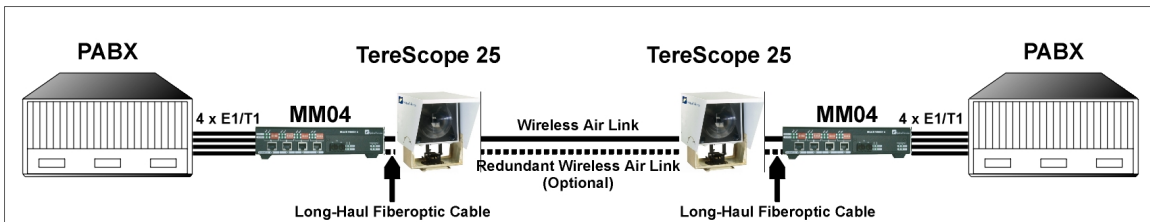**Figure 4: Short-Haul Photonic Air Link Extension**

Figure 5: Long-Haul Optical Wireless Link Extension

Installation

General

This chapter provides a detailed step-by-step procedure for installing the MM 04 multiplexer and its components (modules and chassis).

Safety

Before installing the MM 04, ensure that the safety requirements noted in the chapter Safety Requirements are met.

Package Contents

Essentials

1. MM 04s (as many as ordered by the customer)
2. Power Cord for high voltage ac option (1 per power supply)
   (The dc option has a Phoenix screw type connector for direct wires connection)
3. Angle brackets (1 long, 1 short) for mounting in a 19-inch rack
4. User Manual on CD (1)
5. Release Notes (1) – if provided

Options

1. Dry Contact relay system (pre-installed)
2. Redundant Fiberoptic Port (pre-installed)
3. Redundant Power Supply (pre-installed)

Requirements

Tools

- 6-inch Philips screwdriver
- 6-inch flat-tip screwdriver

Mounting

Rack or desk top.

Environmental

Temperature: 0 to 50 °C (32 to 122 °F).

Humidity: Non-condensing, between 10 and 90%.

Cooling air: Must be allowed to flow around the MM 04 and through the air vents unobstructed. In addition, ensure that there is a clearance of at least 25 mm (1 inch) between the air vents and nearby objects.

Power

The input to the power supply must have the ratings specified in the label on the MM 04.

	Note
	It is recommended to connect the MM 04 through a UPS to ensure continued operation even when the line (mains) power gets cut off.

Networking

Fiberoptic Interface

One fiberoptic cable as specified in Appendix D: Product Specification.

E1/T1Interface

One E1 or T1 line per E1/T1 port.

Procedure

	Note
	This procedure must be performed for all MM 04s.

Configuration

Configure the E1/T1 ports as follows:

1. Identify Port **A** and its DIP switch (shown in Figure 1).
2. With the aid of *Table 2, s*et the DIP switch toggles.
3. Repeat Steps 1 and 2 for the remaining ports (**B**, **C**, etc.)

Mounting

Place the MM 04 on a flat stable surface, such as a desktop, or mount it in a 19-inch rack by first fastening the two supplied angle brackets as shown in Figure 6.

Figure 6: Attaching Brackets to the MM 04 for Rack Mounting

Cabling

E1/T1

The E1/T1 cable must be wired so that the signals on the RJ48 conector pins are as shown in Figure 7. Connect the E1/T1 cables to the MM 04 as shown in Figure 8.

Receive 1
Receive 2
Transmit 4
Transmit 5

**Male RJ-48
(Front View)**
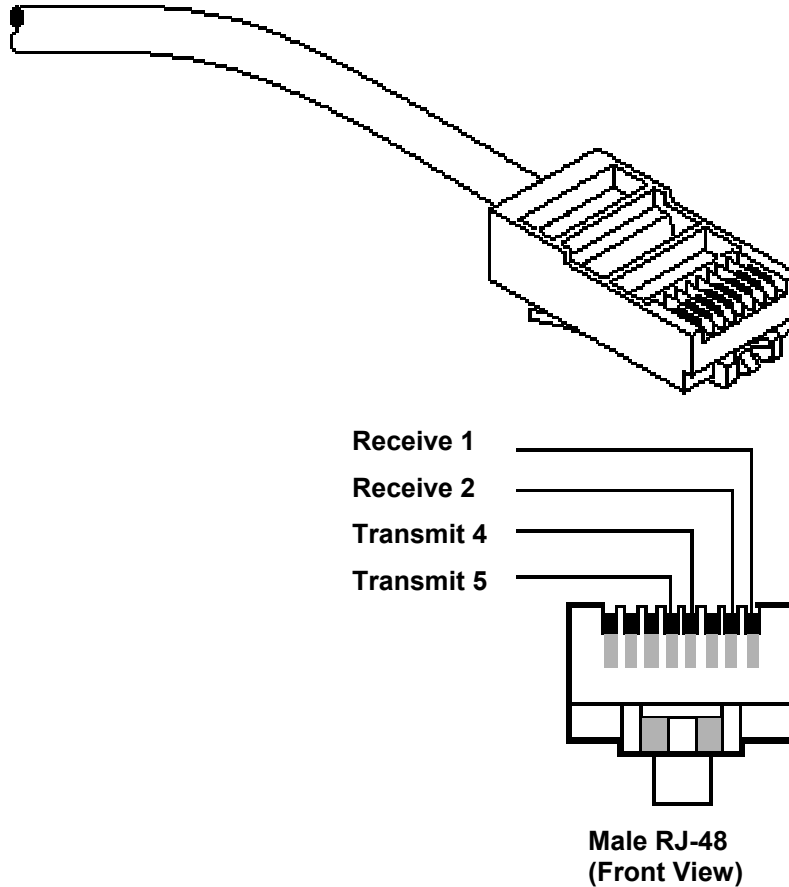
Figure 7: RJ48 Connector

Fiberoptic

Connect the fiberoptic cables to the MM 04 as shown in Figure 8.
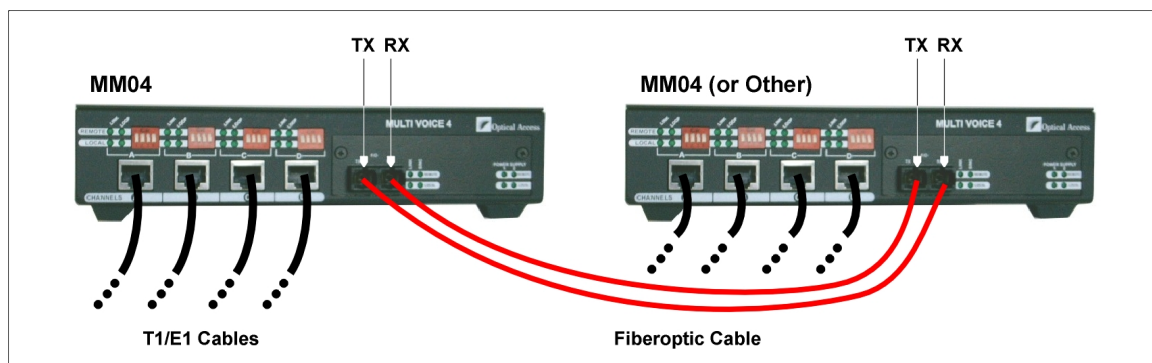
Figure 8: Connecting a Fiberoptic Cable

Startup and Operation

Startup

To start up the MM 04:

1. Connect one (both) power cord(s) to the MM 04.

2. Connect the end(s) of the power cord(s) to the power line (mains).

This causes the MM 04 to undergo initialization.

Operation

MM 04 becomes fully operational within a few seconds after being powered on. Its operation can be monitored by interpreting the status of its LEDs, described in Layout. If there is a problem, use *Appendix A: Troubleshooting* to resolve it.

Appendix A: Troubleshooting

The troubleshooting procedure is given in *Table 6*. Read the entries in the column **Problem** until you reach the problem that applies to the MM 04. Then perform the corrective action(s) appearing in the same row. If the problem persists, note the status of the LEDs and consult your *MRV* representative.

Table 6: Startup and Operation Troubleshooting

No.	Problem	Probable Cause	Corrective Actions
1	**POWER SUPPLY** LED off.	No line (mains) power.	1. Verify that the MM 04 is supplied with power according to the ratings specified in the label. 2. Check power cord connection. 3. Check source of power. 4. Check power cord.
2	**LINK** LED off.	No link to port.	1. Check cable connections. 2. Check device at other end of cable. 3. Check whether the cable is damaged 4. If the cable is fiberoptic, clean its connectors as described in Appendix C: Cleaning Optical Connectors.
3	**SYNC** LED off.	Data cannot be identified.	1. With the aid of Table 2, ensure that the DIP switch toggles are correctly set. 2. Check the DTE attached to the MM 04 port. 3. Check that device connected to the MM 04 works with same data type and rate.
4	Data present at local MM 04 port but not received at the remote device.	Local MM 04 port's electrical interface not transmitting or fiberoptic cable faulty.	1. Run LLB test, as described in LLB Test on page 21, for the local MM 04 port. 2. Run RLB test, as described in RLB Test on page 21, for the local MM 04 port. 3. Perform the corrective actions described in row 2 of this table.
5	Data present at remote MM 04 port but not received at the local device.	Remote MM 04 port's electrical interface not transmitting or fiberoptic cable faulty.	1. Run LLB test, as described in LLB Test on page 21, for the remote MM 04 port. 2. Run RLB test, as described in RLB Test on page 21, for the remote MM 04 port. 3. Perform the corrective actions described in row 2 of this table.

Appendix B: Diagnostic Tests

The following diagnostics tests can be run for the MM 04:

- LLB Test
- RLB Test

LLB Test

This test is run to check whether the electrical interface of the port of the *local* MM 04 faithfully transfers the data it receives. Referring to Figure 9, during the test, the *local* MM 04 ignores all optical signals, and data entering the port's electrical interface is looped back out of the same port. Data transmitted to the local MM 04 from the remote MM 04 via the fiberoptic cable is also returned back.

To run the LLB test for the port, do the following:

1. Locate the DIP switch above the port.
2. Set DIP switch toggle **3** in the UP position. (DIP switch toggle **4** should be in the DOWN position.)
3. Check that **LOOP LOCAL** LED turns ON.
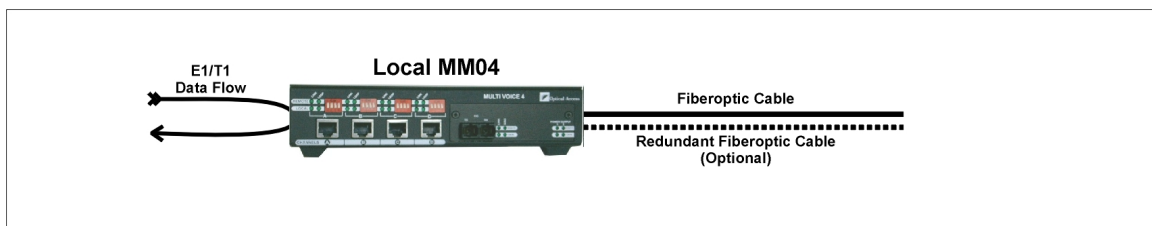
Figure 9: LLB Mode

RLB Test

This test is run to check whether the electrical and optical interface of the port of the *local* MM 04 and the optical interface of the co-port of the *remote* MM 04 faithfully transfer the data they receive. Referring to Figure 10, during the test, the *remote* MM 04 ignores all electrical signals, data entering the local MM 04 port's electrical interface is transmitted through the fiberoptic cable. When the data reaches the optical interface of the remote MM 04, it is looped back. Data received by the local MM 04 port via the electrical cable is also looped back.

To run the RLB test for the port, do the following:

1. Locate the DIP switch above the port.
2. Set DIP switch toggle **4** in the UP position. (DIP switch toggle **3** should be in the DOWN position.)
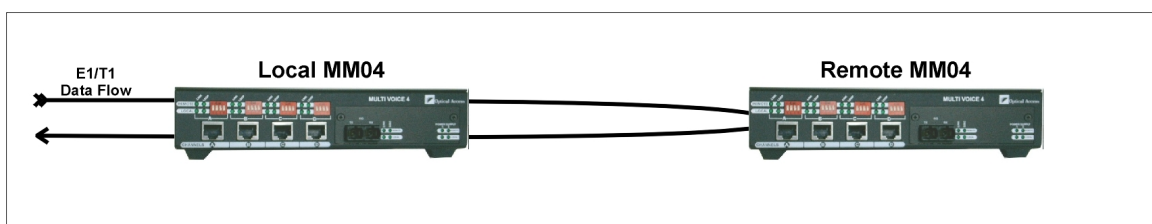3. Check that **LOOP REMOTE** LED turns ON.

Figure 10: RLB Mode

Appendix C: Cleaning Optical Connectors

General

Intrusions (e.g., dust, grease, etc.) at the interface of two optical fibers, such as at a pair of coupled connectors, attenuate the signal through the fiber. Consequently, optical connectors must be cleaned before they are coupled with other connectors.

Tools and Equipment

Following are tools and equipment required for cleaning connectors.

- **Dust caps**
  Caps for protecting the connector from intrusions. A cap is usually made from flexible plastic. When placing a cap over a connector, avoid pressing it against the fiber ferula surface in the connector so as to prevent contamination.
- **Isopropyl alcohol**
  Solvent for contaminants.
- **Tissues**
  Soft multi-layered fabric made from non-recycled cellulose.

Procedure

The procedure for cleaning connectors is as follows:

1. If no stains are present, using a new clean dry tissue, gently rub, in small circular motions, the exposed fiber surface and surrounding area in the connector to remove dust.
2. If stains are present, moisten a new clean dry tissue with isopropyl alcohol and gently rub, in small circular motions, the exposed fiber surface and surrounding area in the connector to remove the stains.
3. Using a new clean *dry* tissue, gently rub, in small circular motions, the exposed fiber surface and surrounding area in the connector to remove the dissolved stains and excess isopropyl alcohol.
4. If a connector is not to be coupled with another immediately, cover it with a dust cap.

Appendix D: Product Specification

Application	
Function	TDM
Protocol	E1 or T1
Network Topology	1 to 4 E1/T1 electrical lines ←→ 1 fiberoptic muxed line.
Operation	

Number of Channels
    E1 or T1
    Multiplexed
	
	4
	1

Data Rate Per Channel
    E1
    T1
	
	2.048 Mbps ± 50 ppm
	1.544 Mbps ± 50 ppm

Aggregate Throughput Rate
    4 x E1
    4 x T1
	
	E2 standard 8.448 Mbps Manchester encoded
	6.369 Mbps Manchester encoded

Operating Distance (electrical cable length + fiberoptic cable length)	Per the power loss for electrical and optical cable – see cabling under **Electrical** and **Optical**.
Link Protection switching time	Full redundancy operation
Attenuation	OUT: 1.5 dB, IN: 1.5 dB
BER	10^{-12}
Electrical	

Power
    High Voltage (± 10 %)
        Input:
        Consumption:
        Isolation:
        Ports:
    Low Voltage
        Input:
        Consumption:
        Isolation:
        Ports:
	
	AC: 100 to 240 Vac, 0.2 to 0.1 A, 60/50 Hz
	12 to 20 W
	1500 V rms
	AC/DC: 1 (or 2 optional) with 3-prong receptacle.
	
	DC: 35 to 60 Vdc
	12 to 20 W
	2000 V dc
	1 (or 2 optional) with Phoenix contact 5 mm pitch detachable screw terminal.

Data Ports
    Number
    Connector
    Pinout:
        E1
 	
        T1
	
	4
	RJ48 female 8-pin shielded connector
	
	1 → R-Tip; 2 → R-Ring; 3 → Not used; 4 → T-Tip
	5 → T-Ring; 6 → Not used; 7 → Not used; 8 → Not used
	
	1 → R-Tip; 2 → R-Ring; 3 → Not used; 4 → T-Tip
	5 → T-Ring; 6 → Not used; 7 → Not used; 8 → Not used

Cabling
    Line (Mains) Power
    E1
        Cable Type:
        Cable Attenuation (max)
            For long haul:
	
	Cord as specified in **Power Cord**.
	
	Category 5, STP
	
	12 dB

For short haul:	42 dB
Cable Impedance:	120 Ω
Wire gage:	22 AWG
Length for short haul (max):	200 m
Length for long haul (max):	2500 m
Connector Type:	RJ48 female 8-pin shielded connector
T1	
Cable Type:	Category 5, STP
Cable Attenuation (max)	
For long haul:	12 dB
For short haul:	36 dB
Cable Impedance:	100 Ω
Wire gage:	22 AWG
Length for short haul (max):	633 ft
Length for long haul (max):	6000 ft
Connector Type:	RJ48 female 8-pin shielded connector

Line Code	
E1:	HDB3/AMI
T1:	B8ZS/AMI

Dry Contact Relay System:	
Type	5 PhotoMOS solid-state telecommunications relays 1 SPST contact connected to 20-pin terminal block
I/O Isolation Level	3000 Vac rms between contacts and the rest
Isolation between Channels	500 Vac rms
Contacts Rating (max)	350 Vac rms or 350 Vdc or 0.1 A (up to 0.5 W)
Peak load current	0.4A, 0.1 sec.
Typical "ON" Resistance	25 Ω, 35 Ω (max)
"Snabber Protector	200 Ω, 1 nF/1500Vdc capacitor
Standards Compliance	UL, CSA, TUV, and BSI
Pinout	Top Row – Not used
	Bottom Row – 1, 2 → Data synchronization status in fiber channel
	3, 4 → Primary link status
	5, 6 → Secondary link status
	7, 8 → Power Supply 1 status
	9, 10 → Power Supply 2 status
Weight	50 g (2 oz)

Optical

Transmitter Output Power	-8 to -2 dBm (per the MM 04 configuration)
Receiver Dynamic Range	
E1 (at 8.448 Mbps) or T1 (at 6.369 Mbps):	–40 up to -20 dBm (per the MM 04 configuration)

Data Ports	1 (or 2 set to operate in mutual redundancy mode)

Cabling	
Connectors	SC (ST optional)
Core/Cladding Diameters	
Multimode:	62.5/125 μm
Singlemode:	9/125 μm
TereScope 1 (PAL)	Custom Multimode
Length (max)	
Multimode 850 nm	5 km
Multimode 1310 nm	15 km
Singlemode 1310 nm	30 km
Singlemode 1550 nm	45 km
Multimode 850 nm for	380 m (1250 ft) at 17 dB/km
TereScope 1 (PAL) to MM04	50 m

Environmental	

Temperature
    Operating:
    Storage:
	0 to 45 °C (32 to 113 °F)
	-10 to 70 °C (14 to 158 °F)

Humidity (non-condensing)	10 to 90%
Physical	
Dimensions (W x H x D)	217 x 1U[5] x 312mm ^{3} (8$^1/_2$ x 1$^3/_4$ x 12$^9/_{32}$ in ^{3})
Weight (with full load)	Up to 1.5 kg (3 lb, 5 oz). Exact weight depends on the MM 04 configuration.
Mounting	Desktop or 19-inch (483 mm) rack
Compliance	
Safety	EN50081-1: 1991; EN50082-1: 1998; EN55022: 1997; EN61000-4-2: 1995; EN61000-4-3: 1995; EN61000-4-4: 1995; EN61000-4-5: 1995/ ENV50142; EN61000-4-6: 1996/ENV50141; EN61000-4-8: 1993; EN61000-4-11: 1994; EN61000-3-2: 1995 IEC 950, 1991, A1, A2, A3, A4 EN 60950, 1992, A1, A2, A3, A4, A11 UL1950, 3rd Edition (1995) CSA 22.2, No. 950 (1995)

Protocol:
    T1 (1.544 Mbps)
    E1 (2.048 Mbps)
	ITU G.703, G.704, G.706, G.736, G.737, G.738, G.739, G.742, G.775, G.823

---

[5] 1U = 1¾ inch or 44.45 mm