**Comm*Plete*** ™
COMMUNICATIONS SERVER

# PRI CARD
# MTPRI-HD23B &
# MTPRI-HD30B
# USER GUIDE

**Multi**Tech®
Systems

PRI Card  User Guide

P/N 82065901, Revision B

| Revision | Date | Description |
|---|---|---|
| A | 11/14/97 | Manual released. |
| B | 5/11/98 | Manual revised. |

# Federal Communications Commission 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.

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

# Exhibit J (Consumer Instructions)

This equipment complies part 68 of the Federal Communications Commission Rules. On the outside surface of this equipment is a label that contains, among other information, the FCC registration number. This information must be provided to the telephone company.

As indicated below, the suitable jack (Universal Service Order Code connecting arrangement) for this equipment is shown. If applicable, the facility interface codes (FIC) and service order codes (SOC) are shown.

A FCC-compliant telephone cord and modular plug is provided with this equipment. This equipment is designed to be connected to the telephone network or premises wiring using a compatible modular jack which is Part 68 compliant. See installation instructions for details.

If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice is not practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.

The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice in order for you to make necessary modifications in order to maintain uninterrupted service.

If trouble is experienced with this equipment (the model of which is indicated below) please contact MultiTech Systems, Inc. at the address shown below for details of how to have repairs made. If the equipment is causing harm to the network, the telephone company may request you to remove the equipment from the network until the problem is resolved.

No repairs are to be made by you. Repairs are to be made only by MultiTech Systems or its licensees. Unauthorized repairs void registration and warranty.

| | |
|---|---|
| Manufacturer: | MultiTech Systems, Inc. |
| Trade Name: | CommPlete |
| Model Number: | CC2400, CC9600 |
| FCC Registration Number: | AU7USA-31090-DE-E |
| Facility Interface Code: | 04DU9-ISN |
| Service Order Code: | 6.0N |
| Modular Jack (USOC): | RJ48C |
| Service Center in USA: | MultiTech Systems, Inc. |
| | 2205 Woodale Drive |
| | Mounds View, MN 55112 |
| | (612) 785-3500 Fax (612) 785-9874 |

# Canadian Limitations Notice

**Notice:** The ringer equivalence number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination of a interface may consist of any combination of devices subject only to the requirement that the sum of the ringer equivalence numbers of all the devices does not exceed 5.

**Notice:** The Industry Canada label identifies certificated equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

**Caution:** Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulation of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe B prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

# Ringer Equivalence Number

**Notice**: The ringer equivalence number (REN) asigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the ringer equivalence numbers of all the devices does not exceed 5.

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# 1   Introduction

# Introduction

The Multi-Tech PRI Card (MTPRI-HD23B for T1 or MTPRI-HD30B for E1) is a telecommunications interface card that provides CommPlete interconnectivity to Primary Rate ISDN (PRI) public switched telecommunications networks. The MTPRI-HD23 provides 23 B channels that provide 23 user sessions. The MTPRI-HD30 provides 30 B channels for 30 user sessions. The PRI card directly connects a CommPlete to a T1 or E1 circuit without the need for an external T1 channel bank or T1 channel service unit (CSU).

The PRI card operates as an ISDN PRI card, or as an E1 or T1 card for long-haul or short-haul applications, using 22 AWG (0.63 mm) twisted-pair wires at up to 6000 feet (0-2 km).

This manual provides information used to install, test and troubleshoot your Multi-Tech PRI card.

# Product Description

The PRI card has one RJ48C connector for a LEC line connection and 10 status LEDs. It provides intelligent support for the ISDN B and D circuits, performing all of the call setup, management, and tear-down functions on-board. The PRI card can establish and manage separate B channel connections at 64K bps, or it can aggregate two or more B channels for an Nx64K bps logical connection. The PRI card offers a variety of user-definable connection modes, allowing either static or dynamic bandwidth-on-demand operation. It performs all call management as well as full-duplex DMA processing on each channelized data stream. Logical channel protocols are configurable for PPP, or Multilink PPP link-level protocols, or raw (unframed) data mode.

The 16-bit interface ensures maximum performance for the most demanding data-intensive applications. In addition, 8-bit transfers are also supported. There are no restrictions imposed on alignment during data transfers. The on-board firmware resides in an 8 bit wide 512K byte Flash ROM.

# Features

The PRI card provides the following features:

- Extensive selection of Extended mode and Expanded mode memory addressing
- ISDN BRI
- supports PPP and Multilink PPP (MLPPP) Link Level Protocols
- extensive statistics reporting (link level and call management)
- extensive status LED monitoring of Faults, LEC circuit, and host interface activity
- support of PRI ISDN, Q.921, Q.931, and NI-2 compliant LEC circuits
- support of AT&T, MCI (and other) Multi-Rate Bearer services
- compatible with AT&T 4ESS and 5ESS, NT DMS-100 and DMS-250 switches
- multiple simultaneous remote connections at N x 64K bps bandwidth on demand

# Status LEDs

The PRI card contains 10 status LEDs on the front panel. The front panel is shown in Figure 1 and each LED is described in the following listing.

Figure 1. PRI Card Front Panel

| LED Indicator | Color | Indication |
|---|---|---|
| PHYSICAL LINK | Green | Lit - Indicates LEC circuit connection is active and signaling is correct. |
| | | Off - Indicates absence of valid LEC circuit signaling. |
| DATA LINK | Green | Lit - Indicates reception of a Link Up message from LEC. |
| | | Off - Indicates a reception of a Link Down message from LEC. |
| RED ALARM | Red | Lit - Indicates red alarm pattern is being received indicating an improper receive signal or no receive signal. This alarm can occur as a result of a high error rate or improper line configuration. When this alarm occurs a yellow alarm is sent to the other end of the network |
| | | Off - Indicates normal operation |
| YELLOW ALARM | Yellow | Lit - Indicates yellow alarm |
| | | Off - Indicates normal operation |
| DATA CHANNEL | Green | Changes state with each D-Channel message |
| CONTROL | Green | Not Currently used. |
| **LED Indicator** | **Color** | **Indication** |
| HOST FIFO | Green | Blinks - Indicates FIFO interrupt during normal operation. |
| HEART BEAT | Green | Lit - Indicates unrecoverable error |
| | | Blinking - Blinking at a one-second rate indicates normal operation. |
| SYSTEM ERROR | Red | Lit - Main processor failure (possibly FLASH is not programmed or destoryed). |
| CHANNEL CLOCK | Green | Momentarily lits when startup self test is completed. |

# Card Components

The 8-position DIP switch is located on the lower portion of the card and is used to set the operating modes of the card. The T1 line connector is a RJ48C connector located on lower back of the card and is used to connect to the T1 line facility. The PRI card components are descirbed in detail in the following sections.
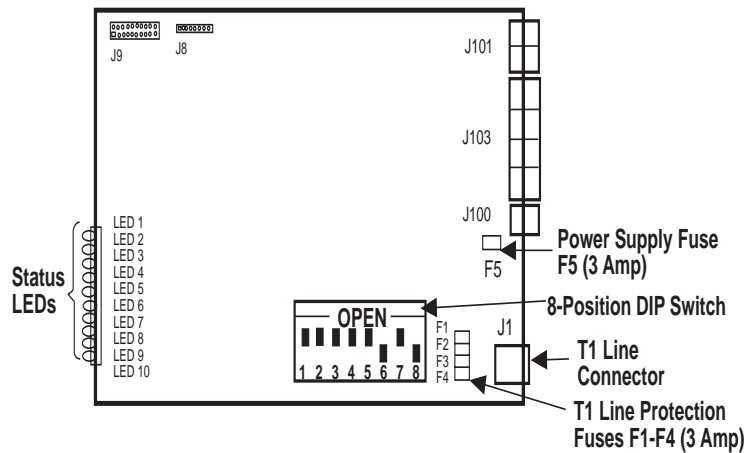


Figure 2. Card Components

## 8-Position DIP Switch

The 8-position DIP switch shown in Figure 4 is used to select various PRI card operating modes. The default settings of the DIP switch module are also shown in Figure 3.
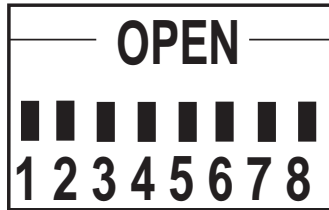


Figure 3. 8-position DIP Switch

The DIP-switch selections are described in the following listings.

| Switch Number | Function | Open | Closed |
|---|---|---|---|
| 1 | Selects Jitter Attentuation path | Activate Jitter Attentuation in receive path | Activate Jitter Attentuation in transmit path |
| 2 | Selects TOS | Transmit data inputs ignored, instead transmits a stream of ones | Normal |
| 3 | Selects local loopback | Local loopback test enabled | Normal |
| 4 | Selects remote loopback | Remote loopback test | Normal |

| | | enabled | |
|---|---|---|---|
| 5 | Equalization Control 4. See Note 1 | Refer to the following listing | Refer to the following listing |
| 6 | Equalization Control 3. See Note 2 | Refer to the following listing | Refer to the following listing |
| 7 | Equalization Control 2. See Note 2 | Refer to the following listing | Refer to the following listing |
| 8 | Equalization Control 1. See Note 2 | Refer to the following listing | Refer to the following listing |

Note 1:  Used with DIP-Switches 6 thru 8 for pulse equalization, line build-out (LBO), and equalizer gain limit settings.

Note 2:  Used with DIP-Switches 5,7,8 for pulse equalization, line build-out (LBO), and equalizer gain limit settings.

## T1 DIP Switch 5 thru 8 Configuration

| DIP#5 | DIP#6 | DIP#7 | DIP#8[1] | Function | Tx Level | Cable | RcvLevel |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | T1 Long Haul | 0.0 dB | 100Ω TP | 36 dB |
| 0 | 0 | 1 | 0 | T1 Long Haul | -7.5 dB | 100Ω TP | 36 dB |
| 0 | 1 | 0 | 0 | T1 Long Haul | -15 dB | 100Ω TP | 36 dB |
| 0 | 1 | 1 | 0 | T1 Long Haul | -22.5 dB | 100Ω TP | 36 dB |
| 0 | 0 | 0 | 1 | T1 Long Haul | 0.0 dB | 100Ω TP | 26 dB |
| 0 | 0 | 1 | 1 | T1 Long Haul | -7.5 dB | 100Ω TP | 26 dB |
| 0 | 1 | 0 | 1 | T1 Long Haul | -15 dB | 100Ω TP | 26 dB |
| 0 | 1 | 1 | 1 | T1 Long Haul | -22.5 dB | 100Ω TP | 36 dB |
| 1 | 1 | 1 | 1 | T1 Short Haul | 533-655ft/ 2.4dB | 100Ω TP | 36 dB |

Note 1:  DIP Switch #8 sets the receive equalizer gain (EGL) during T1 long haul operations.

Note 2:  applicable when enabled.

## E1 DIP Switch 5 thru 8 Configuration

| DIP#5 | DIP#6 | DIP#7 | DIP#8 | Function | Tx Level | Cable | RcvLevel |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | E1 Short Haul | ITU Rec G.703 | 120Ω TP/ 75Ω Coax | 12 dB |
| 1 | 0 | 0 | 1 | E1 Long Haul | 0.0 dB | 100Ω TP | 43 dB |
| 1 | 0 | 1 | 0 | E1 Long Haul | 0.0 dB | 100Ω TP/ 75Ω Coax | 43 dB |

# Technical Specifications

The PRI card operating characteristics and specifications are provided below.

- CPU                                      Intel 960 (16 MHz RISC processor)

- Dynamic RAM                              4 Mb

- Program Memory               512K bytes Flash

- Serial I/O channels supported      23B + D on MTPRI-HD23B and
  30B + D on MTPRI-HD30B

- Serial I/O operation          Simultaneous full duplex DMA (all
  channels)

- Diagnostic/status indicators      10 LEDs

- Line Coding                          T1 - B8ZS or AMI (programmable), E1 HDB3

- Framing                      T1 - ESF or D4 (programmable), E1 ESF

- Capture Frequency              T1 - 1.544 Mbps/E1 2.048 M  +/- 200 bps

- Input/Output Impedence          T1 - 100 ohms/E1 120 ohms  +/- 5%

- Received Signal Level Range      T1 - DSX-1 level to -27.5 db, E1 ITU G.703 to -43

- Line Buildout                          T-1 7 levels (programmable) 0-320 meters, E1
  short haul

- Transitted Signal Level Range      T-1 DSX-1 into 100 ohms, E1 G.703 into 120
  ohms

- Pulse Density and Zeroes Enforcement  T-1 Per AT&T Pub 62411, E1 G.703/G.823

- Line Loopback Set Inband Code (1000)  repeating binary pattern

- Line Loopback Reset Inband Code      (100) repeating binary pattern

- Interface Connector              ISDN RJ-48C

- Operating Temperature                  0-55 degrees C (32-131 degrees F)

- Relative Humidity              to 90% without condensation

- Dimensions:                          9.2" H x 0.9" W x11.5 D "  (23.3 x 2.3 x 29.2 cm)

- Power Requirements:                  +5V (+/-10%)   1.25 A

- ISDN Signaling (PRI) Standards      Q.921 and Q.931

- Standards Supported                  National ISDN-2, AT&T 4ESS and 5ESS,
  Northern Telecom DMS-250

# 2  Installation

# Introduction

This chapter describes how to install the PRI card into a CommPlete Communication system. This equipment should be installed only by a qualified service person.

# Safety Warnings

- Never install telephone wiring during a lightning storm.

- Never install telephone jacks in wet locations unless the jacks are specifically designed for wet locations.

- Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface.

- Use caution when installing or modifying telephone lines.

- Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electrical shock from lightning.

- Do not use the telephone to report a gas leak in the vicinity of the leak

- Ports that are connected to other apparatus are defined as SELV. To ensure conformity to EN 41003, ensure that these ports are only connected to the same type on the other apparatus.

# Pre-Installation Notes

**Warning:** Interconnection directly, or by way of other apparatus, of ports marked "SAFETY WARNING see instructions for use" with ports marked or not so marked may produce hazardous conditions on the network. Advice should be obtained from a competent engineer before such a connection is made.

- All installation must be done by a qualified service person.

- To reduce emissions, be sure to use blanking plates to cover empty slots in the CC9600 or CC2400 chassis.

- When transporting the MTPRI-HD23B, wrap it in an anti-static bag (such as the original shipping packaging). When handling the board, observe anti-static procedures, such as the DOD-STD-1686 or equivalent.

# Installation Procedure

Typically the PRI card will be set up with the 8-position DIP switches all in the DOWN (Closed) position. This setting is for a T1 long haul configuration.  If your configuration is different, set the 8-position DIP switches according to the T1 or E1 DIP Switch 5 thru 8 Configuration listing in Chapter 1 of this User Guide.

**Warning:**

Power the CommPlete system off before installing the PRI card.  Under no circumstances should the PRI card be installed in an energized system.

Perform the following steps to install the PRI card in the CommPlete chassis:

1. Unpack the PRI card from its packaging and save the packaging for possible future use.  Perform a visual inspection of the card. If you are concerned about its condition, call Technical Support for instructions.

2. Determine the operating mode of the PRI card, refer to the T1/E1 DIP Switch 5 thru 8 Configuration listings in Chapter 1 of this User Guide.

3. The PRI card must be installed next to the RASCard in the chassis. Remove a blank panel or previous PRI card from that slot.

4. Supporting the PRI card by the front panel and the bottom edge of the card, place it into the open slot. Make sure the edges of the PRI card mate properly with the metal guides in the chassis.

5. Slide the PRI card into the chassis until you feel the card's connectors mate with the chassis bus connectors.

6. Tighten the PRI card retaining screws.

7. Connect the PRI card to the T1/E1 line.

8. Turn on system power.

# 3 Solving Problems

# Introduction

This chapter provides the processes and procedures to help solve PRI card problems.  The steps are generally presented in the recommended chronological order.

# General Troubleshooting Process

At the first indication of a problem, perform the steps below.  The recovery options are listed in the recommended chronological order (from simplest and most likely to most complex and least likely cause).

1.  Verify that your site meets the specifications (Environmental Requirements, Physical Characteristics, Power Requirements, On-Board Hardware Resources, Host Interface, CSU/T1 LEC Interface Standards, and Primary Rate ISDN Standards) earlier in this manual.

2.  Verify proper hardware installation procedure (earlier in this manual).

3.  Check the LEC cabling  (earlier in this manual).

4.  Check the Startup Self Test, refer to the Startup Self Test LED Patterns in the following section.

5.  Check the Run Time Test, refer to the Run Time LED Status Indicators in the following section .

6.  Re-try the failed operation.

7.  Call your LEC representative and/or your ISDN service provider.  Have the information that you recorded during hardware installation available.

8.  Call Multi-Tech's Tech Support department.

# Startup Self Test LED Patterns

Each time the PRI card is reset (i.e., the CommPlete is powered on or the system reset is asserted) the PRI card firmware executes a series of startup self-test routines.  The routines perform 8 basic tests which require a total of approximately 10-15 seconds to complete, and during which the yellow LEDs report the progress of the tests.  The yellow LEDs display a test status pattern (the applicable LED is lit) as each test executes.

As each test passes, its pattern is displayed by the yellow LEDs.  The subsequent test then begins execution and its pattern is likewise displayed.  This process continues until the final test executes successfully, after which only the Frame Sync LED is lit for a short time, indicating successful completion of the startup self-test phase.

If any test fails, its LED pattern is flashed continuously at a 1/2 second rate and the PRI card will suspend further operations until the problem is fixed.

# Run Time LED Status Indicators

On successful completion of the startup self-tests, the yellow LEDs display the real-time operating status of the PRI card hardware and software.  In this mode, the LED meanings are defined by a COMM Engine

Process.  The LEDs can be used for low-level troubleshooting of the ISDN connection. Some of the most common reasons for an ISDN connection failure are:

## Problems involving HEART BEAT

- If the HEART BEAT LED is lit, it indicates the firmware has encountered an unrecoverable error. Verify that the firmware has had time to load properly and that processes are successfully completed.  Call Tech Support if the problem persists.

## Problems involving PHY LINK LINK

- The ISDN circuit is not connected to the PRI card.  If the PHY LINK LED is Off it indicates the absence of valid LEC circuit signaling. The ISDN circuit is not connected to the PRI card properly.  Look for missing or broken wiring from the LEC distribution facility, malfunctioning interconnect cabling (broken wires, bad connectors, incorrect connector installation, etc.).

Recommended action: contact your LEC representative.

## Problems involving RED ALARM LED

The PRI card is experiencing a high error rate or is not configured properly.  If the RED ALARM LED is lit, it indicates an improper receive signal or no receive signal.  Check the configuration of the PRI card with the PRISTATUS command at the controller.  Contact your LEC representative or Multi-Tech's Technical Support Department if you continue to experience this alarm.

## Problems involving YELLOW ALARM LED

The device at the other end of the network is in red alarm.  It may not be receiving the signal from the PRI card.  Contact your LEC representative.