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MDU9700C-10BT
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mDSL Access Rack Card

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Radio and TV Interference

The mDSL Access Rack Card generates and uses radio frequency energy, and if not installed and used properly—that is, in strict accordance with the manufacturer's instructions—may cause interference to radio and television reception. The mDSL Access Rack Card has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection from such interference in a commercial installation. However, there is no guarantee that interference will not occur in a particular installation. If the mDSL Access Rack Card does cause interference to radio or television reception, which can be determined by disconnecting the unit, the user is encouraged to try to correct the interference by one or more of the following measures: moving the computing equipment away from the receiver, re-orienting the receiving antenna and/or plugging the receiving equipment into a different AC outlet (such that the computing equipment and receiver are on different branches). In the event the user detects intermittent or continuous product malfunction due to nearby high power transmitting radio frequency equipment, the user is strongly advised to take the following steps: use only data cables with an external outer shield bonded to a metal or metalized connector; and, configure the rear card as shown on page 15 of this manual.

CE Notice

The CE symbol on your Black Box equipment indicates that it is in compliance with the Electromagnetic Compatibility (EMC) directive and the Low Voltage Directive (LVD) of the European Union. A Certificate of Compliance is available by contacting Black Box Technical Support.

General Information

Thank you for your purchase of this Black Box product. This product has been thoroughly inspected and tested and is warranted for One Year parts and labor. If any questions arise during installation or use of this product, please contact Black Box Technical Support.

Features

- DSL Distances on just two wires using mDSL technology
- DTE Speeds 64kbps to 2.3 Mbps
- 2-wire Operation
- Fits in Black Box's 2U Rackmount Chassis
- Plug-and-Play Master Capable
- SNMP Network Management with In-Band Management of Remote Units plus Advanced Diagnostics & Statistics using the Black Box Model RMU9700-SNMP
- Internal, external or receive recovered clocking options
- LED indicators for TD, RD, CTS, CD, DTR, TM, ER and NS

Description

The Black Box mDSL mDSL Access Rack Card provides high speed 2-wire connectivity to ISPs, PTTs, and corporations using mDSL (Multi-rate Digital Subscriber Line) technology. Multi-rate DSL offers the ability to deliver the maximum bit rate that a twisted pair line can accommodate. Supporting *multiple line* rates from 144kbps to 2.320Mbps, the mDSL Access Rack Card provides "megabit" speeds to leased line, LAN to LAN interconnection, and WAN access networks over 3.6 miles/5.8km (1.054Mbps on 24AWG/.5mm wire).

The mDSL Access Rack Card allows *DTE speeds* from 64kbps to 2.3Mbps in increments of 64kbps. Features include loopback diagnostics, out-of-band SNMP/HTTP remote management capabilities, using SNMP Management Module, and externally accessible configuration switches.

As a symmetric DSL NTU, the mDSL Access Rack Card offers the same data rates in both directions over a single pair of regular telephone lines using Carrierless Amplitude and Phase (CAP) modulation. The mDSL Access Rack Card is designed to fit into Black Box's 2U (3.5") high rack chassis. This chassis uses a mid-plane architecture allowing front cards to be plugged into different rear cards. Please see the Model RMU9700-16 manual for more information on the power supply options that are available.

The mDSL Access Rack Card Plug-and-Play feature allows the user to configure the DTE rate for the link from the rack card at the Central Office. The stand alone unit at the Customer Premise site will automatically configure itself to the DTE rate of the rack card. Other configuration parameters fall to the default state. This allows changes in the configuration to be handled from a single end of the link.

Configuration

This section describes the location and orientation of the mDSL Access Rack Card's configuration switches and jumpers, and provides detailed instructions for all possible settings.

Configuring the Hardware Switches

The mDSL Access Rack Card front card uses hardware switches for configuration. An interface driver board strap, and three eight-position DIP switches are positioned on the bottom side of the front card (see Figure 1, below).

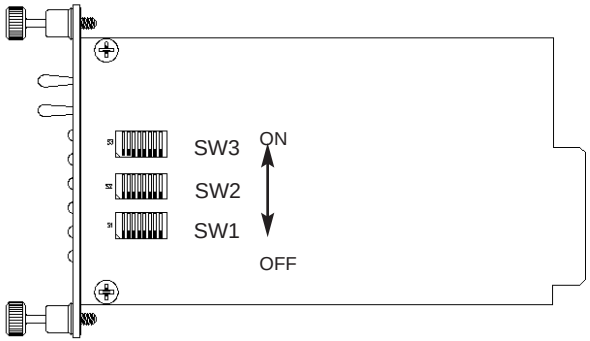

Figure 1. mDSL Access Rack Card, showing configuration switches and interface board

Figure 2 shows the orientation of the DIP switches with respect to the "ON" and "OFF" positions.

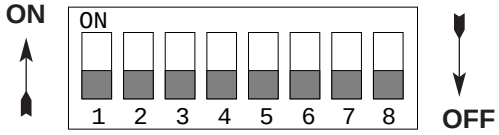

Figure 2. Close up of configuration switches (both sets are identical in appearance)

Reversible Interface Driver Board

The mDSL Access Rack Card features switchable interface driver boards that allow a wide range of DTE interface connections. Figure 3 shows the Interface Driver Board on the top of the mDSL Access Rack Card PC board.

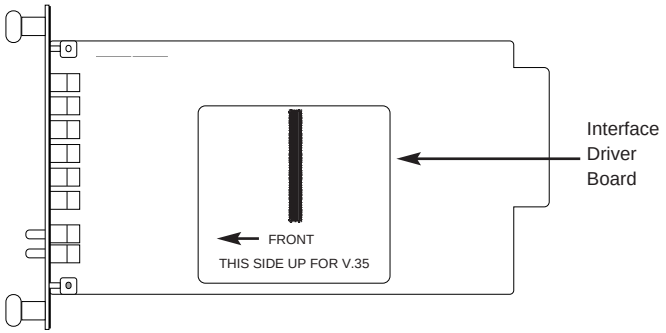

Figure 3. Close up of Top Side of mDSL Access Rack Card Interface Driver Board

Follow the instructions below to select the correct interface for your application:

1. With the mDSL Access front card pulled out of the rack or clusterbox chassis, locate the driver board on the top of the mDSL Access front card.

2. Lift the interface board gently off of the PC board.

3. Locate the correct interface on the bottom of the driver board. For example, the RS-232/V.35 interface board is marked "THIS SIDE UP FOR RS-232" on one side and "THIS SIDE UP FOR V.35" on the other side . Other "single" interface boards are marked with "FRONT" on one side of the board.

4. Re-orient the interface board into the socket with the appropriate interface pointed UP and with the arrow pointing toward the front panel of the mDSL Access Rack Card PC board.

5. Push the interface driver board gently onto the socket and re-install into the rack or cluster system.

Connecting to a "DTE" Device

The serial port on most interface modules (all except the X.21 module) is hard-wired as a DCE. Therefore these modules "want" to plug into a DTE such as a terminal, PC or host. When making the connection to your DTE device, use a **straight through** cable of the shortest possible length—we recommend 6 feet or less. When purchasing or constructing an interface cable, please refer to the pin diagrams in **Appendix C** as a guide.

Connecting to a "DCE" Device

If the mDSL Access Rack Card interface module is hard-wired as a DCE (all except the X.21 module), you must use a *null modem* cable when connecting to a modem, multiplexer or other DCE device. This cable should be of the shortest possible length—we recommend 6 feet or less. When purchasing or constructing a null modem interface cable, use the pin diagrams in **Appendix C** as a guide.

Configuring the X.21 Interface Module

The serial port on the X.21 interface module is default wired as a DCE, but may be switched to a DTE. This is done by reversing the orientation of the DCE/DTE strap, as described below:

To reverse DCE/DTE orientation, remove the interface module according to the instructions on page 6. The DCE/DTE strap is located on the top side of the interface module's PC board. The arrows on the top of the strap indicate the configuration of the X.21 port (for example, if the DCE arrows are pointing toward the rear card connector, the X.21 port is wired as a DCE). Reverse the DCE/DTE orientation by pulling the strap out of its socket, rotating it 180º, then plugging the strap back into the socket. You will see that the DCE/DTE arrows now point in the opposite directions, showing the new configuration of the X.21 port. Reinstall the module.

Configuration DIP Switch Set "S1" - Management Address

Switch S1 is used to set the address of the card in the **SNMP Management Module**. When the mDSL Access Rack Card is installed with a SNMP Management Module, the cards and their remote units can be SNMP managed using a standard Network Management Station (NMS) or a standard web browser (Netscape, Internet Explorer). For more information about setting the address, refer to Appendix A of the SNMP Management Module Operations Manual.

NOTE: If you are not using your mDSL Access Rack Card in a Network Managed environment, please set all Switch Set S1 switches to the ON **position**

Configuration DIP Switch Set "S2"

The configuration switches on S2 allow you to specify the Line Rate, Clocking Mode and response to DTE Loop Enable. Default settings of S2 are shown in the table below.

S2 SUMMARY TABLE

Position	Function	Factory Default	
S2-1	Reserved	Off	
S2-2	Reserved	Off	
S2-3	Reserved	Off	
S2-4	Reserved	Off	
S2-5	Reserved	Off	
S2-6 S2-7	Clock Mode	On Off	Receive Recovered Clock
S2-8	Enable loop from DTE	Off	Disable

Switches S2-1, S2-2, S2-3, S2-4, S2-5: Reserved for Future Use and Should Remain in the Off Position.

Switches S2-6 and S2-7: Clock Mode

Use Switches S2-6 and S2-7 to configure the mDSL Access Rack Card for internal, external, or receive recover clock mode.

CC/CP Unit	S2-6	S2-7	Clock Mode	Description
CO	On	On	Internal	Transmit Clock generated internally
CO	Off	On	External	Transmit Clock derived from terminal interface
CP	On	Off	Receive Recover	Transmit Clock derived from the line interface
	Off	Off		Reserved

Switch S2-8: Enable/Disable Loop Tests from DTE

Use Switch S2-8 to allow the mDSL Access Rack Card to enter loopback tests when the DTE raises the appropriate loop request pin.

S2-8	Setting
On	Response to DTE Loopback Request Enabled
Off	Response to DTE Loopback Request Disabled

Configuration Switch Set "S3"

Use the eight DIP Switches in Switch S3 to enable the DTE connection rate. The following table summarizes default positions of DIP Switch S3. Detailed descriptions of each switch follow the table.

S3 SUMMARY TABLE			
Position	**Function**	**Factory**	
S3-1	DTE Rate	On	768 kbps
S3-2	DTE Rate	Off	
S3-3	DTE Rate	Off	
S3-4	DTE Rate	Off	
S3-5	DTE Rate	On	
S3-6	DTE Rate	On	
S3-7	Reset Software Defaults	On	Normal Operation
S3-8	Transmit Data Sample Point	On	Normal Operation

Switch S3-1: DTE Rate

Use Switch S3-1 through S3-6 to set the rate adaptive DTE bit rate.

S3-1	S3-2	S3-3	S3-4	S3-5	S3-6	DTE Rate (kbps)
Off	Off	On	On	On	On	64
On	On	Off	On	On	On	128
Off	On	Off	On	On	On	192
On	Off	Off	On	On	On	256
Off	Off	Off	On	On	On	320
On	On	On	Off	On	On	384
Off	On	On	Off	On	On	448
On	Off	On	Off	On	On	512
Off	Off	On	Off	On	On	576
On	On	Off	Off	On	On	640
Off	On	Off	Off	On	On	704
On	Off	Off	Off	On	On	768
Off	Off	Off	Off	On	On	832
On	On	On	On	Off	On	896
Off	On	On	On	Off	On	960
On	Off	On	On	Off	On	1024
Off	Off	On	On	Off	On	1088
Off	On	Off	On	Off	On	1216

On	Off	Off	On	Off	On	1280
Off	Off	Off	On	Off	On	1344
On	On	On	Off	Off	On	1408

NOTE: Based on the DTE rate chosen, the mDSL Access Rack Card will automatically select the optimum line rate for the distance. This selection is based on the lowest line rate that will support the DTE rate.

Switch S3-7: Reset Software Defaults

Switch S3-7 allows the user to reset the software configured factory defaults. This will only be needed when using the SNMP Management Module to SNMP manage your units. For more information, please refer to the SNMP Management Module Operations Manual.

S3-7	Setting
On	Normal Operation
Off	Reset

Switch S3-8: Transmit Data (TD) Sampling Point

Switch 3-8 controls the Transmit Data (TD) sampling point.

S3-8	Setting	Description
On	Normal	TD sampled on the falling edge of the mDSL Access Rack Card Transmit Clock (TC)
Off	Invert	TD sampled on the rising edge of the mDSL Access Rack Card Transmit Clock.

mDSL Access Rack Card Plug-and-Play

The mDSL Access Rack Card Plug-and-Play application allows ISPs and PTTs to quickly upgrade the link speed for a customer without re-configuring the Customer Premise (CP) mDSL Access Rack Card. It will also allow ISPs and PTTs to set up all of the configurations at the Central Office (on the rack cards) before installation of the stand alone units, thus saving time spent configuring and re-configuring DIP switch settings.

The mDSL Access Rack Card Plug-and-Play feature allows the user to configure the DTE rate for the link from the rack card at the Central Office (CO). The stand alone unit at the Customer Premise (CP) site will automatically configure itself to the DTE rate of the rack card. Other configuration parameters fall to the default state. This allows changes in the configuration to be handled from a single end of the link.

When installing a CO/CP style application, the local end of the link is comprised of a CO unit (mDSL Access Rack Card) set to either Internal or External clocking mode and a CP unit (mDSL Access Rack Card) set as a mDSL Access Rack Card Plug-and-Play CP. ***The mDSL Access Rack Card Plug-and-Play CP stand alone will have all of its DIP switches set to the ON position*** (as indicated below in Figure 4).

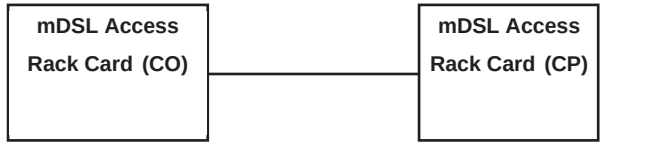

Figure 4. Typical mDSL Access Rack Card Plug-and-Play Application

When the units are connected, the CP will come up with a predefined default configuration (Receive Recovered Clocking). During the handshaking process between the units, the CO unit will set the DTE rate/line rate of the CP unit to match its DIP switch configuration settings. If the DTE rate for the link requires a change, the change is needed only at the CO side of the link.

The mDSL Access Rack Card Plug and Play application will also work in the managed system using the SNMP Management Module and mDSL Access Rack Cards installed in Black Box's 2U rack system. In this application, the system administrator can configure the entire rack through the Network Management Station (NMS) before the stand alone (CP) units are installed. For more information on the SNMP management of your rack, please refer to the SNMP Management Module Operations Manual.

Configuring the Rear Interface Cards

The mDSL Access Rack Card has six interface card options: DB-25/RJ-45, M/34/RJ-45, DB25/TB, M/34/TB, DB-15/RJ45, and D15/TB. Each of these options supports one DTE interface connection and one 2-wire line connection. Figure 5 below illustrates the six different interface options for the mDSL Access Rack Card.

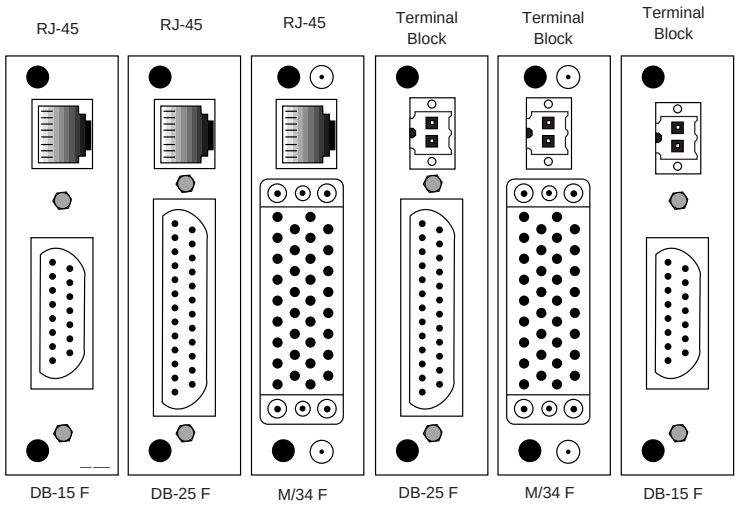

Figure 5. mDSL Access Rack Card interface card options

NOTE: The mDSL Access Rack Card rear cards are specifically designed to operate with the mDSL Access function card and will not operate if swapped with other Black Box function cards.

Prior to installation, examine the rear card you have selected to be sure it is properly configured for your application. Each rear card is configured by setting straps located on the PC board. To configure the rear cards, set the configuration straps. Figure 6 below shows the orientation of these straps. Each strap can either be on pegs 1 and 2, or on pegs 2 and 3.

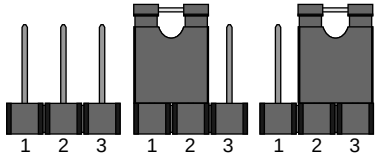

Figure 6. Orientation of Interface Card Straps

Pages 14 through 18 describe the strap locations and possible settings for each rear card.

DB-25 Rear Card Strap Settings

Figure 7 shows strap locations for the DB-25 rear cards. These straps determine various grounding characteristics for the terminal interface and twisted pair lines. JB3 and JB4 are user configurable.

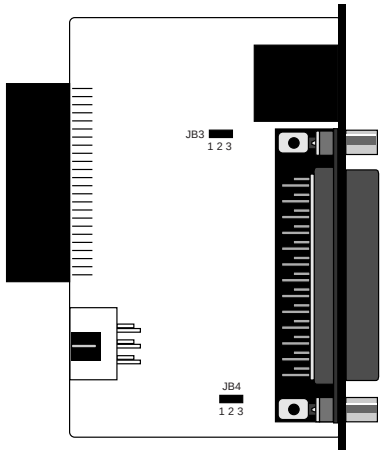

Figure 7. DB-25 rear card strap locations

The table below provides an overview of interface strap functions for the rear interface cards. Following the table overview are detailed descriptions of each strap's function.

INTERFACE CARD STRAP SUMMARY TABLE #1			
Strap	**Function**	**Position 1&2**	**Position 2&3**
JB3	DTE Shield (Pin1) & FRGND	Connected	Open*
JB4	FRGND & SGND	Connected	Open*

* Indicates default setting

DTE Shield (DB-25 Pin 1) & FRGND (JB3)

In the connected position, this strap links DB-25 pin 1 & frame ground. In the open position, pin 1 is disconnected from frame ground.

JB3

Position 1&2 = DTE Shield (Pin 1) and FRGND Connected
Position 2&3 = DTE Shield (Pin 1) and FRGND Not Connected

SGND & FRGND (JB4)

In the connected position, this strap links DB-25 pin 7 (Signal Ground) and frame ground through a 100 ohm resistor. In the open position, pin 7 is connected directly to frame ground.

JB4

Position 1&2 = SGND (Pin 7) and FRGND Connected through a 100 ohm resistor
Position 2&3 = SGND (Pin 7) and FRGND Directly Connected

M/34 Rear Card Strap Settings

Figure 8 shows the strap location for the M/34 rear card. This strap determines whether Signal Ground and Frame Ground will be connected.

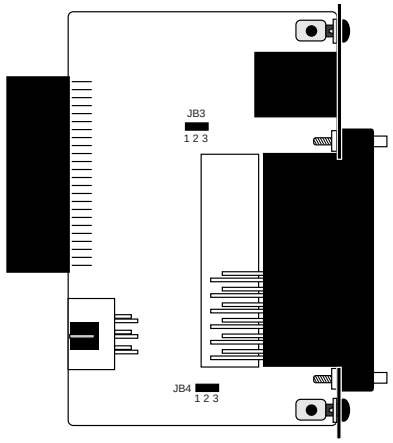

Figure 8. M/34 rear card strap locations

The table below provides an overview of interface strap functions for the rear interface cards. Following the table overview are detailed descriptions of each strap's function.

INTERFACE CARD STRAP SUMMARY TABLE #2			
Strap	**Function**	**Position 1&2**	**Position 2&3**
JB3	DTE Shield (Pin A) & FRGND	Connected	Open*
JB4	FRGND & SGND (Pin B)	Connected	Open*

* Indicates default setting

DTE Shield (M/34 Pin A) & FRGND (JB3)

In the connected position, this strap links M/34 pin A & frame ground. In the open position, pin A is disconnected from frame ground.

JB3

Position 1&2 = DTE Shield (Pin A) and FRGND Connected
Position 2&3 = DTE Shield (Pin A) and FRGND Not Connected

SGND & FRGND (JB4)

In the connected position, this strap links Signal Ground and frame ground through a 100 ohm resistor. In the open position, signal ground is disconnected from frame ground.

JB4
Position 1&2 = SGND and FRGND Connected
Position 2&3 = SGND and FRGND Not Connected

DB-15 Rear Card Strap Settings

Figure 9 shows strap locations for the DB-15 rear cards. These straps determine various grounding characteristics for the terminal interface and twisted pair lines. JB3 and JB4 are user configurable.

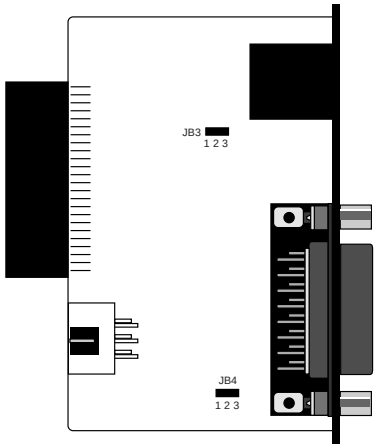

Figure 9. DB-15 strap locations

The table below provides an overview of interface strap functions for the rear interface cards. Following the table overview are detailed descriptions of each strap's function.

INTERFACE CARD STRAP SUMMARY TABLE #3

Strap	Function	Position 1&2	Position 2&3
JB3	DTE Shield (Pin1) & FRGND	Connected	Open*
JB4	FRGND & SGND (Pin 8)	Connected	Open*

* Indicates default setting

DTE Shield (DB-15 Pin 1) & FRGND (JB3)

In the connected position, this strap links DB-15 pin 1 & frame ground. In the open position, pin 1 is disconnected from frame ground.

JB3
Position 1&2 = DTE Shield (Pin 1) and FRGND Connected
Position 2&3 = DTE Shield (Pin 1) and FRGND Not Connected

SGND & FRGND (JB4)

In the connected position, this strap links DB-15 pin 8 (Signal Ground) and frame ground through a 100 ohm resistor. In the open position, pin 8 is connected directly to frame ground.

JB4
Position 1&2 = SGND (Pin 8) and FRGND Connected through a 100 ohm resistor
Position 2&3 = SGND (Pin 8) and FRGND Directly Connected

Installation

This section describes the functions of the rack chassis, explains installation of front and rear mDSL Access Rack Cards into the chassis, and how to connect to the twisted pair interface and the serial interface.

The Rack Chassis

The rack chassis (Figure 10, below) has fourteen short range modem card slots, plus its own power supply. Measuring only 3.5" high, the rack is designed to occupy only 2U in a 19" rack. Sturdy front handles allow the rack chassis to be extracted and transported conveniently.

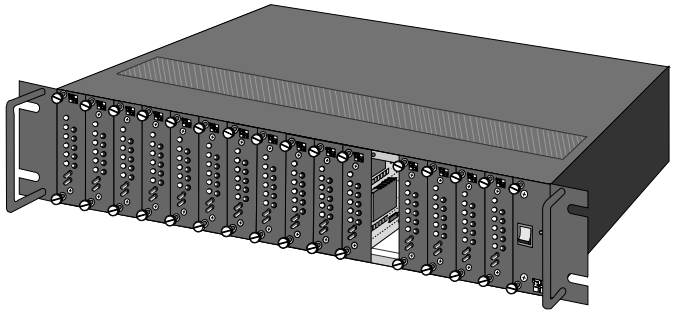

Figure 10: SNMP Management Module Rack Chassis with power supply

The Rack Power Supply

The power supply included in the rack uses the same mid-plane architecture as the modem cards. The front card of the power supply slides in from the front, and the rear card slides in from the rear. They plug into one another in the middle of the rack. The front card is then secured by thumb screws and the rear card by conventional metal screws.

WARNING! There are no user-serviceable parts in the power supply section of the mDSL Access Rack Card. Voltage setting changes and fuse replacement should only be performed by qualified service personnel.

Powering Up Your Rack

The power supplies that come with your rack system are equipped with a power entry connector on the rear card. The power supplies are *Hot-Swappable*, so you are not required to remove the cards from the rack while applying power to the system.

The power switch is located on the front panel. When plugged in and switched on, a red front panel LED will glow. Since the rack chassis is a "hot swappable" rack, *it is not necessary for any cards to be installed before switching on the power supply*. The power supply may be switched off at any time without harming the installed cards.

NOTE: Please refer to the RMU9700-16 User Manual *AC & DC Rack Mount Power Supplies* for fuse and power card replacement information.

Installing the mDSL Access Rack Card into the Chassis

The mDSL Access Rack Card is comprised of a front card and a rear card. The two cards meet inside the rack chassis and plug into each other by way of mating 50 pin card edge connectors. Use the following steps as a guideline for installing each mDSL Access Rack Card into the rack chassis:

1. Slide the rear card into the back of the chassis along the metal rails provided.

2. Secure the rear card using the metal screws provided.

3. Slide the front card into the front of the chassis. It should meet the rear card when it's almost all the way into the chassis.

4. Push the front card *gently* into the card-edge receptacle of the rear card. It should "click" into place.

5. Secure the front card using the thumb screws.

Wiring the mDSL Access Rack Card

Each of the rear interface cards compatible with the mDSL Access Rack Card has one terminal interface port and one 2-wire (twisted pair) port. For specific interface pin-outs, refer to the diagrams in **Appendix C and E** of this manual.

Connection to the Twisted Pair Interface

The mDSL Access Rack Card supports communication between two DTE devices at distances to 5 miles (8 km) over 24AWG (.5mm) twisted pair wire. There are two essential requirements for installing the mDSL Access Rack Card:

1. These units work in ***pairs***. Therefore, you must have one mDSL Access Rack Card (or a compatible model) at each end of a single twisted pair interface.

2. To function properly, the mDSL Access Rack Card needs one **twisted** pair of metallic wire. This twisted pair must be ***unconditioned***, dry, metallic wire, between 19 (.9mm) and 26 AWG (.4mm) (the higher number gauges may limit distance some what). Standard dial-up telephone circuits, or leased circuits that run through signal equalization equipment, or standard, flat modular telephone type cable, are *not acceptable*.

Two-Wire Cable Connection Via RJ-45

1. The RJ-45 connector on the mDSL Access Rack Card's twisted pair interface is polarity insensitive and is wired for a two-wire interface.The signal/pin relationships are shown in Figure 11 below.

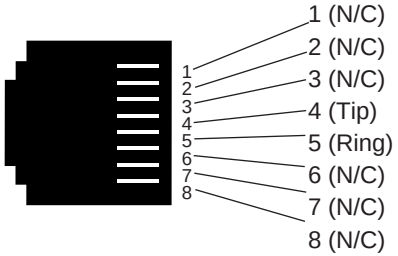

Figure 11. mDSL Access Rack Card twisted pair line interface.

Two-Wire Cable Connection Via Terminal Block

The two pin terminal block connector on the mDSL Access Rack Card's twisted pair interface (TB rear card option) is polarity sensitive. Connection to the terminal block is made by connecting your two-wire cable to the connector supplied with your unit. For replacement parts please see **Appendix B.**

Notice! Any modular twisted pair cable connected to the mDSL Access Rack Card must be shielded cable, and the outer shield must be properly terminated to a shielded modular plug on both ends of the cable.

Operation

Once the mDSL Access Rack Card is properly configured and installed, it should operate transparently. These sections describes functions of the LED status indicators, and the use of the built-in loopback test modes.

LED Status Indicators

The mDSL Access Rack Card features twelve front panel LEDs that monitor power, the DTE signals, network connection and test modes. Figure 12 (below) shows the front panel location of each LED. Following Figure 12 is a description of each LEDs function.

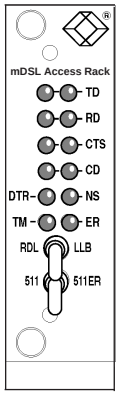

Figure 12. The mDSL Access Rack Card front panel LEDs

TD & RD Glows yellow to indicate an idle condition of Binary "1" data on the respective terminal interface signals. Green indicates Binary "0" data.

CTS Consists of 2 LEDs, 1 yellow, 1 green. CTS glows green to indicate that the Clear to Send signal from the modem is active. Yellow indicates inactive CTS.

CD Consists of 2 LEDs, 1 yellow, 1 green. CD glows yellow if no carrier signal is being received from the remote modem. Green indicates that the remote modem's carrier is being received.

DTR Glows green to indicate that the Data Terminal Ready signal from the terminal is active.

ER Blinks ON/OFF after a 511/511E test has timed out. See Section 5.2.3 (Test Pattern Generator) for more information.

Flashes once to indicate that a CRC error has occurred (during normal operation) or bit errors have occurred (during 511/511E test).

Only at power up, blinks once every 200 ms if the DTE Rate is set to an unsupported setting.

TM Glows yellow to indicate that the mDSL Access Rack Card has been placed in Test Mode. The unit can be placed in test mode by the local user or by the remote user. The TM LED will flash for 400msec when a valid packet is received from the SNMP Management Module.

NS (No Signal) glows red to indicate that the local mDSL Access Rack Card is not connected with the remote mDSL Access Rack Card. The TM LED will flash for 400msec when a valid packet is received from the SNMP Management Module

Test Modes

The mDSL Access Rack Card offers two proprietary loopback test modes, plus a built-in V.52 BER test pattern generator to evaluate the condition of the modems and the communication link. These tests can be activated physically from the front panel or via the interface.

Overview

Figure 13 below shows the major elements used in the loop-back and pattern tests available in the mDSL Access Rack Card. Each block has several functions. Following Figure 13 are descriptions that show how the elements are used during Test Modes.

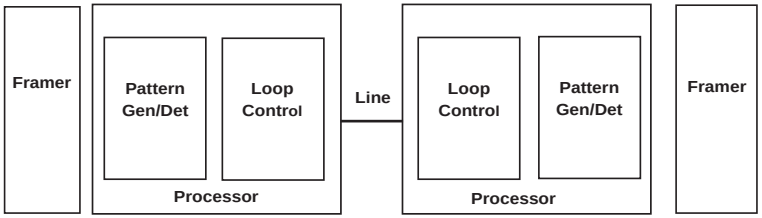

Figure 13: Block Diagram mDSL Access Rack Card

Framer

The framer is used to determine the status of the line. In normal operation the framer transmits and expects to receive framed packets from the far end. If the framer receives framed packets from the far end, CTS and CD will be active. If framed packets are not received, CTS and CD will be inactive. The restart procedure uses this information to determine if a valid connection is made (cable disconnect, poor cable quality, etc). In normal Data Mode, if the box receives 4 seconds of unframed packets it will restart the box and begin trying to re-establish a connection with the far end. The distinction between framed packets and unframed packets becomes important when we discuss the Pattern Generator.

Pattern Gen/Det

This part of the Processor generates and detects the 511/511E patterns. When transmitting 511 patterns, the information is unframed (because it originates after the framer) and is intended to be evaluated only by another Processor. If the units are in Data Mode and the pattern generator is enabled on one end of the link, the far end will begin receiving unframed packets and assume that the line has gone down. During test modes, we force the pattern generator to time out before it can cause the link to be killed.

Loop Control

This part of the Processor is used to control loop-backs. In a Local Loop, the data is looped back towards the local DTE. In a Remote Loop, the data is looped back to the line, but it is also allowed to pass through to the framer and to the remote DTE.

mDSL Access Rack Card

Restart Procedure and Time Outs

The restart procedure is in place to allow the units to re-establish a connection after the framer begins seeing unframed packets. The Test Mode Timing Chart below shows the amount of time the framer must see consecutive unframed packets before the unit will restart and try to establish a new line connection. The reason that there are different Restart Times will become apparent after reading the rest of the document. The 511/511E Time Out shown refers to the amount of time the 511/511E pattern will be valid. At the end of this time the pattern will automatically turn itself off and the normal data path will be re-established. The ER led will flash indicating to the user that the test has timed out. The ER led will stop flashing once the 511/511E switch is placed into the normal position.

Test Mode Timing	
Item	**Elapsed Time (seconds)**
Start Up	50
Data Mode	4
511/511E Generator Enabled	60 (The generator will stop after 45 seconds.)
Remote End of an RDL	60
511/511E Time Out	45 (The pattern generator will automatically turn off after 45 seconds. The ER LED will flash until the user turns off the 511/511E switch.)

Symbol Indicators

This symbol designates the origination or the termination of a data path. The direction of the arrow connected distinguish the two data paths.

This symbol designates an invalid data path. If there is data present it should be ignored.

Loops and Patterns

The following section describes the Test Modes used in the mDSL Access Rack Card. At the bottom of each Test Mode, a figure is included to show the data path.

Local Loop

There are two different modes of operation for a Local Loop depending on the status of the units at the time that the Local Loop is initiated. If the units are not linked (NS LED on) and the Local Loop is initiated, either by the front panel switch or the DTE interface, the unit will enter mode 1. If the units are linked, NS LED off, then the unit will enter a mode 2 Local Loop.

A Mode 1 Local Loop is shown in Figure 13. When the Local Loop is initiated, either by the front panel switch or the DTE interface, the loop will be activated within the local DSP. The data present at the local DTE interface will be looped back to the local DTE by the Loop Control block within the Processor. Any data present on the line or at the far end DTE interface is invalid. The remote unit will remain in the StartUP mode, NS LED off, CTS LED yellow, and CD LED yellow, until the local unit is taken out of the LocalLoop mode. After the Local Loop is deselected, the units will both be in StartUP mode and the link will be established.

A mode 2 Local Loop is shown in Figure 14. When the Local Loop is initiated, either by the front panel switch or the DTE interface, two separate loop paths will be started. In the first path, data presented to the local DTE interface will be looped back to the local DTE within the framer. In the second path data presented at the far end DTE will be transmitted to the local DTE then looped back within the local DTE Loop Control block with the Processor. After the Local Loop is deselected, the units will be placed back into DataMode and the normal data paths will be re-established.

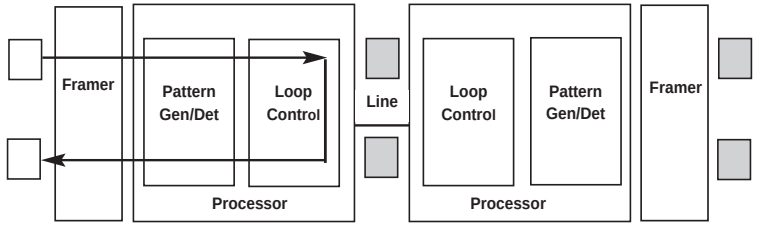

Figure 13. Block Diagram Local Loop Mode 1

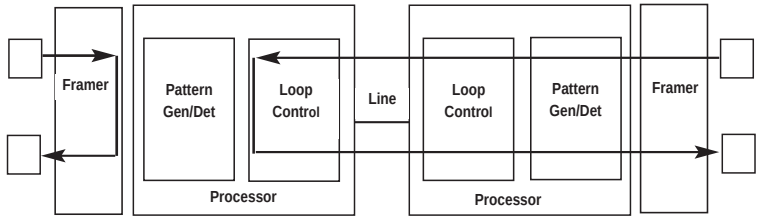

Figure 14. Block Diagram Local Loop Mode 2

Local Loop with 511/511E

When the unit is placed into a Mode 1 Local Loop and the 511/511E pattern generator is activated, the local pattern generator begins sending out a 511/511E pattern to the Loop Control block. The Loop Control block will loop this data back to the 511/511E pattern detector block, which will evaluate the data for errors. Because the 511/511E pattern generator is contained within the Processor the data is unframed so the framer will begin seeing unframed packets. The framer receives this unframed data and can not distinguish this information from a line disconnection (this would cause the units' Restart procedure to start). What we have done to allow this mode to work is to add time outs for the pattern generators. When the 511/511E is initiated the line restart procedure is changed to one minute. The 511/511E pattern will timeout after 45 seconds. So if the 511/511E is turned on during a local loop, the restart procedure is set to one minute, but the 511/511E pattern will timeout after 45 seconds, allowing the framer to begin seeing framed packets (and not restart the box). After the 511/511E pattern times out, the ER led will begin flashing.

Local Loop with 511/511E

It will remain this way until the pattern generator switch is turned off. Note that the data at the local DTE and the remote DTE are not valid. Because the data is unframed there is no way for the framer to send this data out to the DTE. This is an important distinction because other Black Box units will send out the 511 pattern.

When the unit is placed into a Mode 2 Local Loop, the 511/511E pattern generator on the local unit is unavailable for transmission. As can be seen from Figure 15, the 511/511E pattern generator has no data path connections available. The 511/511E pattern generator is still available on the remote unit. For more information on the proper operation of this pattern generator please refer to the "Remote Digital Loop with 511/511E" section.

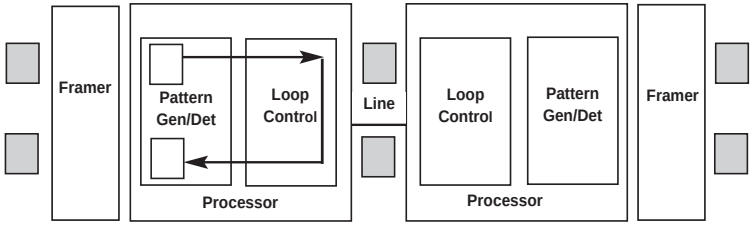

Figure 15. Block Diagram Local Loop Mode 1 with 511/511E

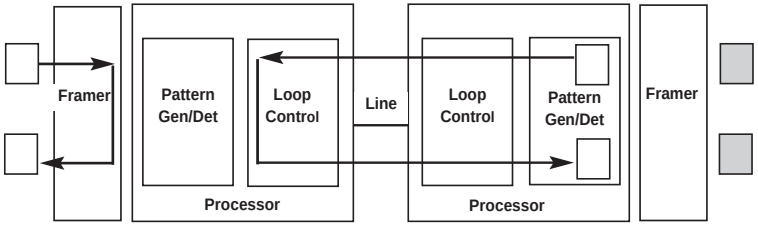

Figure 16. Block Diagram Local Loop Mode 2 with 511/511E

Remote Digital Loop

The Remote Loop uses the EOC channel (an out-of-band signaling channel) to establish the remote link. Upon the RDL switch being thrown or DTE initiation, a RDL_ON Request signal is sent to the remote unit. The Remote unit then responds with an RDL Acknowledge command and the link is established. Data originates at the local DTE and is looped at the Remote DSP back to the Local DTE. Note that the data is also passed through to the Remote DTE and is not squelched. When a Remote unit enters RDL, it changes its' Restart timeout to one minute (the reason will be explained in the RDL with 511/511E section). If the line is disconnected, the local unit will Restart (NS led activated) after 4 - 6 seconds, but the Remote unit will wait for one minute before it Restarts. Note that the transmit data at the Remote DTE is ignored. When the switch is thrown or the DTE removes the RDL request, the local unit will transmit an RDL_OFF Request to the Remote unit. The local unit will keep its' TM led active until this request has been completely sent out. If the switch is thrown again before the completion of the termination phase the switch will be ignored until it is placed back into the normal position.

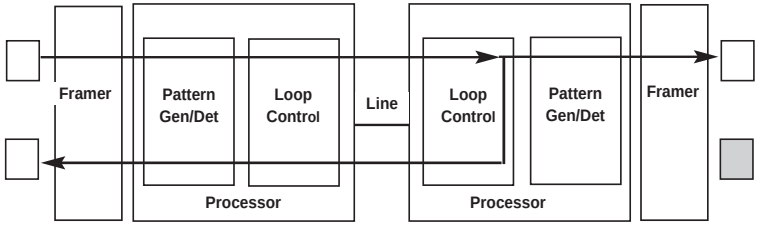

Figure 17. Block Diagram Remote Loop

Remote Digital Loop with 511/511E

The Remote Digital Loop with 511/511E is shown below. After RDL is established the Remote units' Restart Timer is set to one minute. This has been done because when the 511/511E generator is started on the local unit, the Remote framer begins seeing unframed packets. The Remote unit can not distinguish the 511/511E pattern from the line being disconnected so the Restart Timer has been lengthened to allow the pattern generator to function. Once the 511/511E test is started, the Local unit changes its' Restart Timer to one minute. The pattern originates within the DSP and is sent to the Remote unit. It is then looped back to the Local unit where it is evaluated for errors. After 45 seconds, the Pattern Generator will timeout and stops sending the pattern. The ER led will begin blinking until the user turns off the 511/511E switch.

Data Mode with 511/511E Pattern Generators

When the units enter DataMode it is possible to turn on the 511/511E pattern generators on both ends of the link. Once a 511/511E pattern is selected on one end of the link, the pattern generator will begin transmitting unframed 511/511E through the line to the Remote end. A possible problem with this test can occur due to the Restart procedure. Once the Local 511/511E is turned on, the Remote unit begins receiving an unframed 511 pattern. If the Remote unit does not turn on the 511/511E-pattern generator within 4 seconds, the Remote unit will Restart and enter the StartUp mode. Note that once the 511/511E-pattern generator is started the Restart timer is changed to one minute (only on the unit which has the pattern enabled). If both units enable the 511/511E pattern within 4 seconds of each other, both units will be transmitting and receiving the 511/511E pattern. Both framers are now receiving unframed data and will restart after one minute. The 511/511E pattern generators will TimeOut after 45 seconds re-enabling the normal data path. The ER led will begin flashing until the user terminates the test.

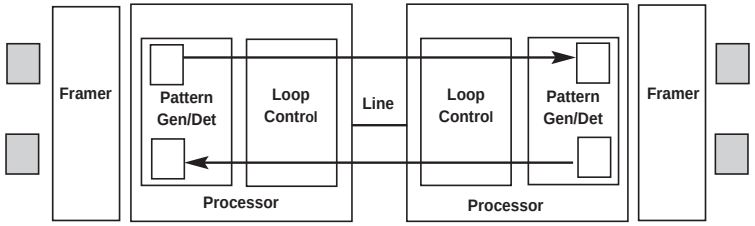

Figure 19. Block Diagram DataMode with 511/511E

Using the V.52 (BER) Test Pattern Generator

To use the V.52 BER tests in conjunction with the Remote Digital Loopback tests* (or with Local Line Loopback tests), follow these instructions:

1. Locate the “511/511E” toggle switch on the front panel of the mDSL Access Rack Card and move it to the left. This activates the V.52 BER test mode and transmits a “511” test pattern into the loop. If any errors are present, the local modem’s red “ER” LED will blink sporadically.

2. If the above test indicates no errors are present, move the V.52 toggle switch to the right, activating the “511/E” test with errors present. If the test is working properly, the local modem's red “ER” LED will glow. A successful “511/E” test will confirm that the link is in place, and that the mDSL Access Rack Card’s built-in “511” generator and detector are working properly.

***NOTE: The above V.52 BER tests can be used independently of the Remote Digital Loopback tests. This requires two operators: (1) to initiate and monitor the tests at the local mDSL Access Rack Card, and (2) to do the same at the remote mDSL Access Rack Card. In this case, the test pattern sent by each mDSL Access Rack Card will not be looped back, but will be transmitted down the line to the other mDSL Access Rack Card.**

APPENDIX A-Black Box mDSL Access Rack Card Specifications

Transmission Format:	Synchronous
Transmission Line:	Two-Wire unconditioned twisted pair
Clocking:	Internal, external or receive recovered clock
Interface Modules:	EIA RS-232/ITU/T V.24, RS-232/530, ITU/T V.35 and ITU/T X.21
Line Rates:	144, 272, 400, 528, 784, 1040, 1552, 2064, and 2320 kbps
DTE Rates:	64, 128, 192, 256, 320, 384, 448, 512, 576, 640, 704, 768, 832, 896, 960, 1024, 1088, 1152, 1216, 1280, 1344, 1408, 1472, 1536, 1600, 1664, 1728, 1792, 1856, 1920, 1984, 2048, 2112, 2176, 2240, and 2304 kbps
Diagnostics:	V.52 compliant bit error rate pattern (511/511E pattern) generator and detector with error injection mode; Local Line Loopback and Remote Digital Loopback, activated by front panel switch or via serial interface
LED Status Indicators:	TD, RD, CTS, CD, DTR, NS(no signal), ER (error) and TM (test mode)
Connectors:	RJ-45 or Terminal Block on line side; DB-25 female, M/34 female or DB-15 female on serial interface side, depending upon which interface module is installed.
Power:	100-253 VAC, 50-60 Hz (universal input); 48 VDC (option). 10 watts.
Temperature Range:	32-122°F (0° -50°C)
Altitude:	0-15,000 feet
Humidity:	5 to 95% non-condensing
Dimensions:	Front Card: 4.81” x 3.10” x 0.95” (12.2 x 7.8 x 2.4cm) Rear Card: 3.33” x 2.8” x 0.95” (8.4 x 7.1 x 2.4cm)
Weight:	Front Card: 0.22 lbs (.10Kg) Rear Card (M/34 with V.35 interface): 0.16 lbs (.07Kg) Rear Card (DB-25/RS-232 interface): 0.12 lbs. (.05Kg)

APPENDIX B-Black Box mDSL Access Rack Card Factory Replacement Parts and Accessories

Black Box	**Description**
RMU9700-16	Access Rack
PSU9700-AC	AC Power Supply for Access Rack
PSU9700-DC	DC Power Supply for Access Rack
RMU9700-SNMP	SNMP Management Module for Access Rack
RMU9700-CAS	Casscade Module for Access Rack

APPENDIX C-Black Box mDSL Access Rack Card V.35 Interface Pin Assignment (M/34F Female Connector) (DCE Configuration)

Pin #	Signal
B	SGND (Signal Ground)
C	RTS (Request to Send)
D	CTS (Clear to Send)
E	DSR (Data Set Ready)
F	CD (Carrier Detect)
H	DTR (Data Terminal Ready)
L	LLB (Local Line Loop)
M	TM (Test Mode)
N	RDL (Remote Digital Loop)
P	TD(Transmit Data-A)
R	RD (Receive Data-A)
S	TD/ (Transmit Data-B)
T	RD/ (Receive Data-B)
U	XTC (External Transmit Clock-A)
V	RC(Receive Timing-A)
W	XTC/ (External Transmit Clock-B)
X	RC/ (Receive Timing-B)
Y	TC(Transmit Clock-A)
AA	TC/ (Transmit Clock-B)

APPENDIX C (Continued)-Black Box mDSL Access Rack Card RS-232, RS-530 Interface Pin Description (DB-25 Female Connector) (DCE Configuration)

Pin #	Signal
1	FG (Frame Ground)
2	TD (Transmit Data-A)
3	RD (Receive Data-A)
4	RTS (Request to Send-A)
5	CTS (Clear to Send-A)
6	DSR (Data Set Ready-A)
7	SGND (Signal Ground)
8	CD (Carrier Detect-A)
9	RC/ (Receive Timing-B)
10	CD/ (Carrier Detect-B)
11	XTC/ (External Transmit Clock-B)
12	TC/ (Test Control-B)
13	CTS/ (Clear to Send-B)
14	TD/ (Transmit Data-B)
15	TC (Test Control)
16	RD (Receive Data-A)
17	RC (Receive Timing-A)
18	LLB (Local Line Loop)
19	RTS/ (Request to Send-B)
20	DTR (Data Transfer Rate-A)
21	DL (Remote Digital Loop)
22	DSR/ (Data Set Ready-B)
23	DTR/ (Data Transfer Rate-B)
24	XTC (External Transmit Clock-A)
25	TM (Test Mode)

APPENDIX C (Continued)-Black Box mDSL Access Rack Card X.21 Interface Pin Assignments (DB-15 Female Connector) (DTE /DCE Configuration)

Pin # **Signal**

1 . . . . . Frame Ground
2 . . . . . T (Transmit Data-A)
3 . . . . . C (Control-A)
4 . . . . . R (Receive Data-A)
5 . . . . . I (Indication-A)
6 . . . . . S (Signal Element timing-A)
7 . . . . . BT (Byte Timing-A, Not Used)
8 . . . . . SGND (Signal Ground)
9 . . . . . T/ (Transmit Data-B)
10 . . . . . C/ (Control-B)
11 . . . . . R/ (Receive Data-B)
12 . . . . . I/ (Indication-B)
13.....S/ (Signal Element Timing-B)
14 .....BT/ (Byte Timing-B, Not Used)

Distance Table MDU9700C/MDU9705A mDSL Modem Standalone and Rack Access Card

		NO NOISE																											
		26g (0.4mm)			24g (0.5mm)			22g (0.6mm)			20g (0.8mm)			19g (0.9mm)			18g (1.0mm)			16g (1.2mm)		
Line Rate	DTE Rates	feet	miles	km	feet	miles	km	feet	miles	km	feet	miles	km	feet	miles	km	feet	miles	km	feet	miles	km
kbps	kbps																					
144	64, 128	21400	4.0	6.6	30700	5.8	9.4	42980	8.1	13.2	55260	10.4	17.0	64470	12.2	19.8	70610	13.4	21.7	90784	17.2	27.9
272	192, 256	20300	3.8	6.2	30600	5.8	9.4	42840	8.1	13.2	55080	10.4	16.9	61200	11.6	18.8	70380	13.3	21.7	90488	17.1	27.8
400	320, 384	18600	3.5	5.7	29100	5.5	9.0	40740	7.7	12.5	52380	9.9	16.1	55290	10.5	17.0	66930	12.7	20.6	86053	16.3	26.5
528	448, 512	17400	3.3	5.4	26100	4.9	8.0	36540	6.9	11.2	46980	8.9	14.5	49590	9.4	15.3	60030	11.3	18.5	77181	14.6	23.7
784	576-768	15800	3.0	4.9	22600	4.3	7.0	29380	5.6	9.0	38420	7.3	11.8	42940	8.1	13.2	51980	9.8	16.0	67974	12.9	20.9
1040	832-1024	15500	2.9	4.8	22100	4.2	6.8	28730	5.4	8.8	37570	7.1	11.6	41990	7.9	12.9	50830	9.6	15.6	66470	12.6	20.5
1552	1088 - 1536	13600	2.6	4.2	19200	3.6	5.9	24960	4.7	7.7	32640	6.2	10.0	34560	6.5	10.6	44160	8.3	13.6	57748	10.9	17.8
2064	1600 - 2048	12200	2.3	3.8	17200	3.3	5.3	22360	4.2	6.9	29240	5.5	9.0	30960	5.9	9.5	39560	7.5	12.2	51732	9.8	15.9
2320	2112 - 2304	11500	2.2	3.5	15800	3.0	4.9	20540	3.9	6.3	26860	5.1	8.3	28440	5.4	8.8	36340	6.9	11.2	47522	9.0	14.6