MDU9705A-V35
MDU9705A-X21
August 2000

Compact mDSL Modem

464 Basingstoke Road, Reading, Berkshire RG2 0QN

TECHNICAL: (0118) 965 6000
SALES: (0118) 965 5100
FAX: (0118) 931 5001
ADDRESS: *464 Basingstoke Road, Reading, Berkshire RG2 0QN*
WEB: www.blackbox.co.uk

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Radio and TV Interference

The Compact mDSL Modem 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 Compact mDSL Modem 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 Compact mDSL Modem 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).

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 (EU). A Certificate of Compliance is available by contacting 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.

Features

- Multi-Rate Symmetric DSL
- CAP (Carrierless Amplitude and Phase) Modulation
- Data Rates up to 2.304Mbps
- V.35 and X.21 Interfaces
- Interoperable with the MDU9700
- SNMP Manageable via SNMP Management Module
- NetLink Plug 'n' Play for Easy Installations
- Universal Power Options, 120VAC, 230VAC and -48VDC Available
- Front Panel Status Indicators
- Small, Convienent Desktop Unit
- CE Marked

Description

The Black Box Compact *mDSL Modem* provides high speed 2-wire connectivity to ISPs, PTTs, and corporations using mDSL (Multi-rate Symmetric 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 modem provides "megabyte" 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 MDU9705A-V35 provides a V.35 interface on an M/34 female connector. MDU9705A-X21 provides an X.21 interface on a DB-15 female connector. Features include loopback diagnostics, SNMP/HTTP remote management capabilities using NetLink Plug-and-Play and inband externally accessible configuration switches. All versions of the Compact mDSL Modem are compatible with Black Box's mDSL standalone and mDSL Access rack card.

As a symmetric DSL NTU, ***mDSL*** offers the same data rates in both directions over a single pair of regular telephone lines using Carrierless Amplitude and Phase (CAP) modulation. Line connection is made by an RJ-45 jack. Standard versions of the Compact mDSL Modem are powered by a 100/230VAC(Universal) supply. The DC power supply option supports any DC input between 36-72VDC.

Configuration

The Compact mDSL Modem is equipped with two sets of eight DIP switches, which allow configuration of the unit for a wide variety of applications. This section describes switch locations and explains all possible configurations.

Configuring the Hardware DIP Switches

The 16 external switches are grouped into two eight-switch sets, and are externally accessible from the underside of the Compact mDSL Modem (See Figure 1).

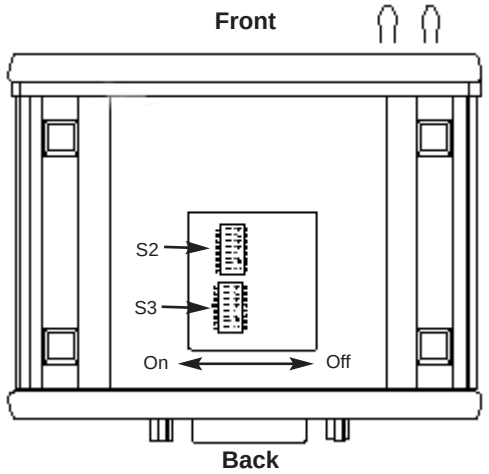

Figure 1. Underside of Compact mDSL Modem, Showing Location of DIP Switches

The two sets of DIP switches on the underside of the Compact mDSL Modem will be referred to as S2 and S3. As Figure 2 shows, the orientation of all DIP switches is the same with respect to "ON" and "OFF" positions.

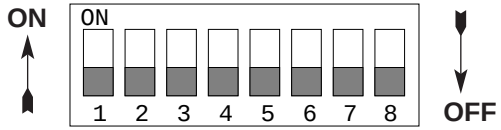

Figure 2. Close Up of Configuration Switches (all sets are identical in appearance)

Configuration DIP Switch Set "S2"

The configuration switches on S2 allow you to specify the Clocking Mode and to enable/disable Local and Remote Loop requests from the V.35 DTE. 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	Clock Mode	On	Receive
S2-7	Clock Mode	Off	Recover
S2-8	Enable Loop from DTE	Off	Disabled

Switch S2-1, S2-2, S2-3, S2-4, and S-5:

Reserved for factory use and **must remain in the OFF Position.**

Switches S2-6 and S2-7: Clock Mode

Use Switches S2-6 and S2-7 to configure the 1088 for internal, external, or receive recover clock mode.

CO/CP Unit	S2-6	S2-7	Clock Mode	Description
CO	On	On	Internal	Transmit clock generated internally
CO	Off	On	External (DTE)	Transmit clock derived from terminal interface
CP	On	Off	Receive Recover	Transmit clock derived from the received line
	Off	Off		*Reserved*

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

Switch S2-8 may be used to allow the MDU9705A-V35 to enter loopback diagnostic tests (Local or Remote) when the V.35 DTE raises the appropriate loop request pin (LLB: Pin L or RDL: Pin N). When Switch S2-8 is in the On position, the MDU9705A-V35 will enter Local Loopback or Remote Loopback at the request of the DTE. When Switch S2-8 is in the Off position, the MDU9705A-V35 ignores DTE loop requests. In the Off position, loop requests may still be initiated by the front panel switch.

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

Configuration Switch Set "S3"

Use the six DIP Switches in Switch S3 to enable the DTE bit 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 Default**
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 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
On	On	Off	On	Off	On	1152
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
Off	On	On	Off	Off	On	1472

On	Off	On	Off	Off	On	1536
On	On	Off	Off	Off	On	1600
Off	On	Off	Off	Off	On	1664
On	Off	Off	Off	Off	On	1728
Off	Off	Off	Off	Off	On	1792
On	On	On	On	On	Off	1856
Off	On	On	On	On	Off	1920
On	Off	On	On	On	Off	1984
Off	Off	On	On	On	Off	2048
On	On	Off	On	On	Off	2112
Off	On	Off	On	On	Off	2176
On	Off	Off	On	On	Off	2240
Off	Off	Off	On	On	Off	2304

NOTE: Based on the DTE rate chosen, the Compact mDSL Modem will automatically select the optimum line rate depending on distance and line conditionsfor the distance. The line selection will be 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 Compact mDSL Modem Transmit Clock (TC)
Off	Invert	TD sampled on the rising edge of the Compact mDSL Modem Transmit Clock.

Plug-and-Play

The Plug-and-Play feature allows ISPs, carriers and PTTs to quickly upgrade the link speed for a customer without requiring the customer to re-configure the Customer Premise (CP) Compact mDSL Modem. This feature also allows service providers to set up all of the configurations at the Central Office (on the rack cards) before installing the stand alone units, saving time spent configuring or re-configuring DIP switches.

NOTE: Plug-and-Play is only available when using a rack-mounted mDSL Rack Card as the CO unit.

The Plug-and-Play feature allows the user to configure the DTE rate (bandwidth allocation, see Switches S3-1 through S3-6) of the CP unit 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 (Bandwidth Allocation) of the rack card. Other configuration parameters remain in the default setting.

Follow the instructions below to activate Plug-and-Play between CO (mDSL Rack Card and CP Compact mDSL Modem) units:

1. Set the mDSL Rack Card (CO) to either Internal or External clocking mode as defined by the application.

2. Set the Compact mDSL Modem (CP) to “Plug-and-Play CP” by setting all S2 and S3 DIP switches in the OFF position as described in Figure 3, below.

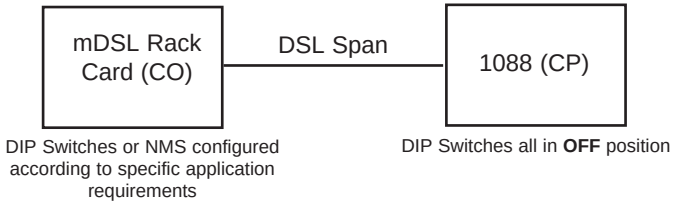

Figure 3. Typical Plug-and-Play Application

When the CO and CP units connect over DSL, the CP will enter a predefined default configuration (Receive Recovered Clocking). During the negotiation process between the units, the CO unit will configure the DTE rate/line rate on the CP unit as defined by the settings of the CO unit. When additional bandwidth is required, only the configuration of the CO unit should be changed. This feature gives ISPs, LECs and PTTs the ability to provision bandwidth on an as needed basis to customers.

Installation

Once the Compact mDSL Modem is properly configured, it is ready to connect to the twisted pair interface, to the serial port, and to the power source. This section tells you how to make these connections.

Connecting the Twisted Pair Interface

The Compact mDSL Modem supports communication between two DTE devices at distances to 5 miles (8 km) over 24 AWG (.5mm) twisted pair wire. Two things are essential:

1. These units work in **pairs**. Both units at the end of the twisted pair DSL span must be set for the same DTE rate.

2. To function properly, the Compact mDSL Modem 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 will limit distance). Standard dial-up telephone circuits, or leased circuits that run through signal equalization equipment, or standard, flat modular telephone type cable, are *not acceptable*.

The RJ-45 connector on the Compact mDSL Modem’s twisted pair interface is polarity insensitive and is wired for a two-wire interface. The signal/pin relationships are shown in Figure 5 below.

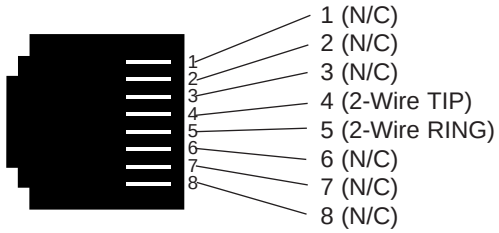

Figure 4. Compact mDSL Modem RJ-45 twisted pair line interface.

Connecting the Compact mDSL Modem (V.35) Serial Interface

The MDU9705A-V35 supports V.35 serial port connections. This section describes how to connect the serial ports to your V.35 equipment.

Connecting the Compact mDSL Modem (V.35) to a "DTE" Device

The MDU9705A-V35 provides a V.35 DCE (Data Circuit Terminating Equipment) interface on an M/34 female connector. As a DCE, this interface is designed to connect to DTE equipment, such as a router. When connecting the V.35 interface of the Compact mDSL Modem to your DTE device, use a V.35 **straight through** cable (See Figure 4, below). **Appendix C** describes pin assignments and signal sources for the Compact mDSL Modem V35 interface. When purchasing or constructing an interface cable, please refer to the pin diagrams in **Appendix C** as a guide.

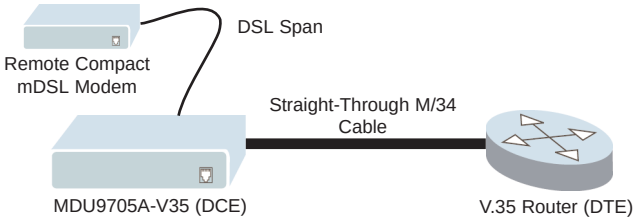

Figure 4. Connecting the MDU9705A-V35 to V.35 Serial DTE

Connecting the Compact mDSL Modem (V.35) to a "DCE" Device

The MDU9705A-V35 provides a V.35 DCE (Data Circuit Terminating Equipment) interface on an M/34 female connector. As a DCE, this interface is designed to connect to DTE equipment, such as a router. However, tail-circuit applications require connection to another DCE equipment, such as a multiplexer. When connecting the V.35 interface of the Compact mDSL Modem to your DCE device, use a V.35 **null modem** cable. Some applications may also require the installation of a V.35 **tail-circuit buffer** to account for small differences in clock frequency between the MDU9705A-V35 and the V.35 DCE (Multiplexer).

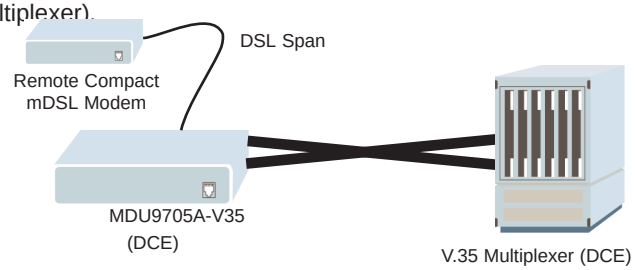

Figure 5. Connecting the MDU9705A-V35 to V.35 Serial DCE

Connecting the Compact mDSL Modem (X.21) Serial Interface

The MDU9705A-X21 supports X.21 serial port connections. This section describes how to connect the serial ports to your X.21 equipment.

Connecting the MDU9705A-X21 to a "DCE" or "DTE" Device

The MDU9705A-X21 provides an X.21 interface on a DB-15 female connector. The X.21 interface default configuration is DCE (Data Circuit Terminating Equipment) for connection to DTE (Data Terminal Equipment) such as a router. However, the X.21 interface on the Compact mDSL Modem may be configured as DTE (Data Terminal Equipment) for connection to DCE such as a modem or multiplexer. When connecting the X.21 interface of the MDU9705A-X21 to your DTE device, use a X.21 **straight through** cable (See Figure 6, below).

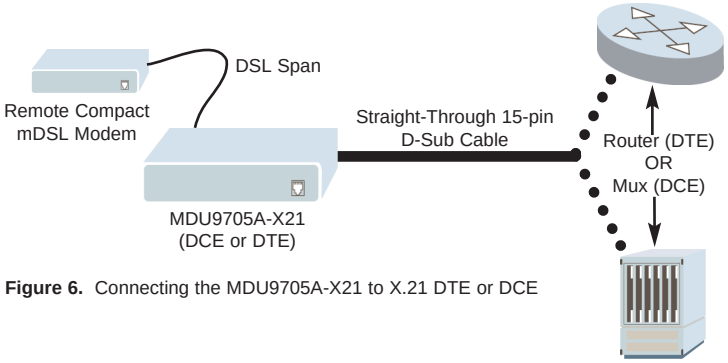

Figure 6. Connecting the MDU9705A-X21 to X.21 DTE or DCE

To change the DCE/DTE orientation from the default position (DCE), you must open the case Compact mDSL Modem case.

Opening the Case

To open the Compact mDSL Modem case, insert a flat head screw driver into an open slot on both sides of the case, as in Figure 7. Twist the screw driver head slightly and the top half of the case will separate from the lower half, as in Figure 7, below. Take caution not to

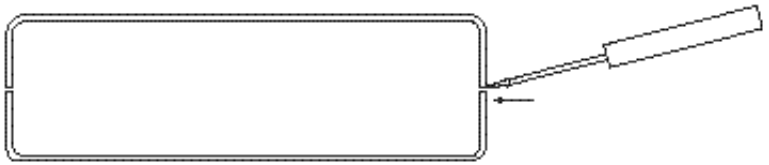

Figure 7. Opening the case with a small screwdriver

damage the pc-board mounted components.

The DCE/DTE strap is located on the top side of the MDU9705A-X21 pc board (See Figure 8, below). 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 DB-15 connector, the X.21 port is wired as a DCE). Change 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. To close the case, fit the 2 halves together snugly and snap them back in place.

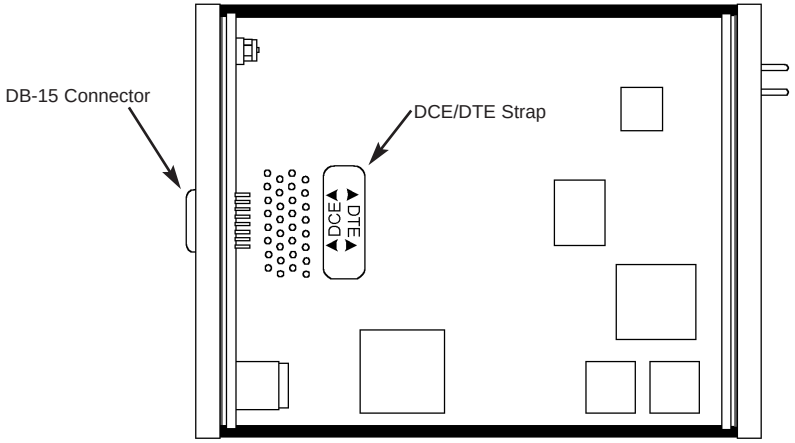

Figure 8. Setting the DCE/DTE Strap

Connecting Power

The Compact mDSL Modem (all versions) are available with Universal AC (100-240VAC), 120VAC, 230VAC or -48VDC power options. This section describes these options.

Universal AC Power (100-240VAC)

The Compact mDSL Modem uses a 5VDC, 2A universal input 100-240VAC, power supply (center pin is +5V). The universal input power supply has a male IEC-320 power entry connector. This power supply connects to the Compact mDSL Modem by means of a barrel jack on the rear panel. Many international power cords are available for the universal power supply (Please refer to Appendix B for country-specific power cords.

The Compact mDSL Modem powers up as soon as it is plugged into an AC outlet--there is no power switch.

120 VAC Power (US)

The 100-132 VAC adapter supplied with the U.S. version of the Compact mDSL Modem is a wall mount type and may be plugged into any approved 120 VAC wall jack.

230 VAC Power (International)

The 230 VAC adapter supplied with the International version of the Compact mDSL Modem is a wall mount type and may be plugged into any approved 230 VAC wall jack.

DC Power

The 36-60 VDC DC to DC adapter supplied with the DC version of the Compact mDSL Modem plugs in a DC source (nominal 48VDC) and plugs into the barrel power supply jack on the rear of the Compact mDSL Modem. Please refer to Figure 9, below, to make the proper connection.

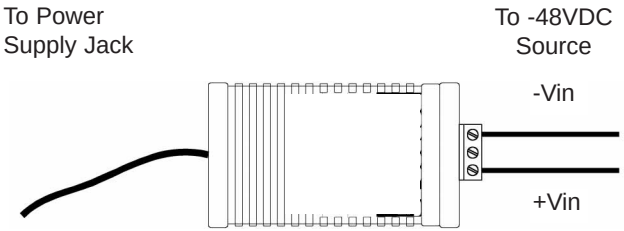

Figure 9. Connecting DC Power to the 48VDC Power Supply.

WARNING! There are no user-serviceable parts in the power supply section of the Compact mDSL Modem. Fuse replacement should only be performed by qualified service personnel.

Operation

Once the Compact mDSL Modem is properly configured and installed, it should operate transparently. This sections describes power-up, reading the LED status monitors, and using the built-in loop-back test modes.

Power Up

To apply power to the Compact mDSL Modem, first be sure that you have read **Section 4.4**, and that the unit is connected to the appropriate power source. Then power-up the unit.

LED Status Monitors

The Compact mDSL Modem features six front panel LEDs that monitor power, the DTE signals, network connection and test modes. Figure 10 (below) shows the front panel location of each LED. Following Figure 10 is a description of each LEDs function. See also, LED description chart on page 17.

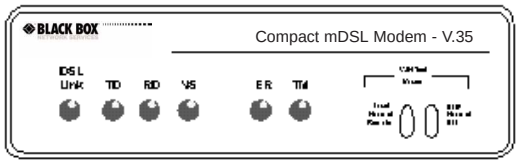

Figure 10. Compact mDSL Modem Front Panel

DSL Link (Active Green) Solid green (On) indicates that the end to end DSL Framer Link is up, signifying that the link across the DSL span is active. The DSL Link LED is Off when the link is down.

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

NS (No Signal) glows red to indicate that the local Compact mDSL Modem is not connected with the remote Compact mDSL Modem.

ER - blinks ON/OFF after a 511/511E test has timed out. See Section 5.3.3 (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 tests).

-only at power up, blinks once every 200 ms if the DTE Rate is set to an unsupported settings

TM glows yellow to indicate that the Compact mDSL Modem 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.

5.2.1 Compact mDSL Modem LED Descriptions Chart

Clock (CO) Internal 768Kb No DTE							Clock (CP) R/R No DTE						
	TD	RD	DSL	NS	ER	TM		TD	RD	DSL	NS	ER	TM
Power ON	G	O	off	ON	off	off		O	O	off	ON	off	off
DSL Link	G	O	G	off	off	off		O	G	G	off	off	off
Link Brk	G	O	off	off	off	off		O	O	off	off	off	off
Brk+ 10s	G	G	off	ON	off	off		O	O	off	ON	off	off
RDL	G	G	G	off	off	ON		O	G	G	off	off	ON
RDL+511	G	G	off	off	off	ON		O	G	off	off	off	ON
With DTE Connected							With DTE Connected						
Mark	O	O	G	off	off	off		O	O	G	off	off	off
Space	G	G	G	off	off	off		G	G	G	off	off	off
Data	GO	GO	G	off	off	off		GO	GO	G	off	off	off

Link Brk = DSL Link Broken
Brk+10s = 10 Seconds following Link Break
G=GREEN
O=ORANGE
ON= ON
off= OFF
Y=yellow

Test Modes

The Compact mDSL Modem 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 DTE interface.

Overview

Figure 11 shows the major elements used in the loop-back and pattern tests available in the Compact mDSL Modem. Each block has several functions. Following Figure 11 are descriptions that show how the elements are used during Test Modes.

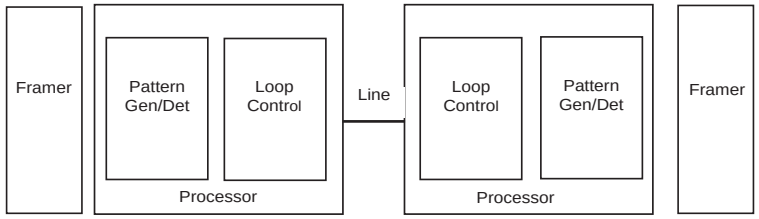

Figure 11: Block Diagram Compact mDSL Modem

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 Compact mDSL Modem receives 4 seconds of unframed packets it will restart 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.

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 Model 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 Compact mDSL Modem. 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 in 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 12. When the Local Loop is initiated, either by the front panel switch or the DTE interface, the loop will be activated within the local Processor. 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 on, CTS LED yellow, and CD LED yellow, until the local unit is taken out of the Local Loop 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 13. 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 and 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.

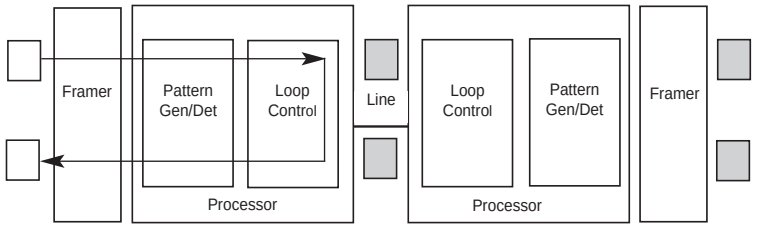

Figure 12. Block Diagram Local Loop Mode 1

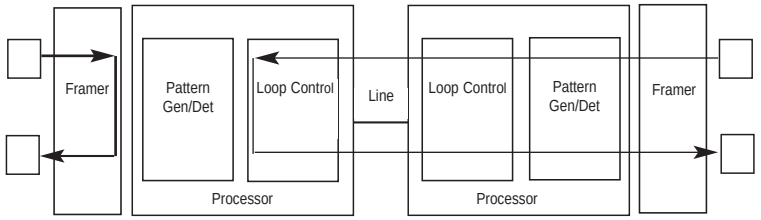

Figure 13. Block Diagram Local Loop Mode 2

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 time out after 45 seconds, allowing the framer to begin seeing framed packets (and not restart the box).

Local Loop with 511/511E (continued)

After the 511/511E pattern times out, the ER led will begin flashing. 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 11, 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.

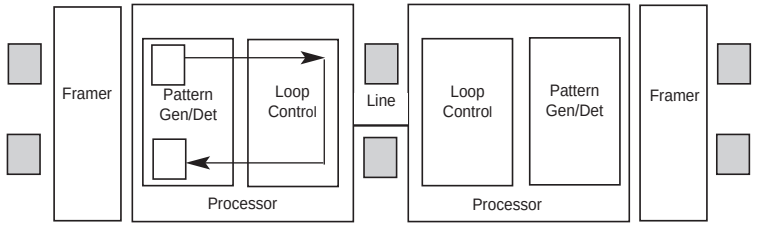

Figure 14. Block Diagram Local Loop Mode 1 with 511/511E

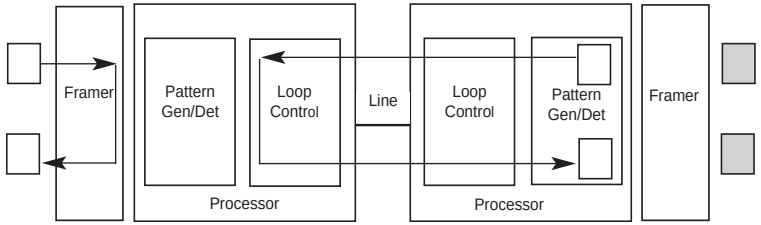

Figure 15. Block Diagram Local Loop Mode 2 with 511/511E

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 PROCESSOR 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 explain 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.

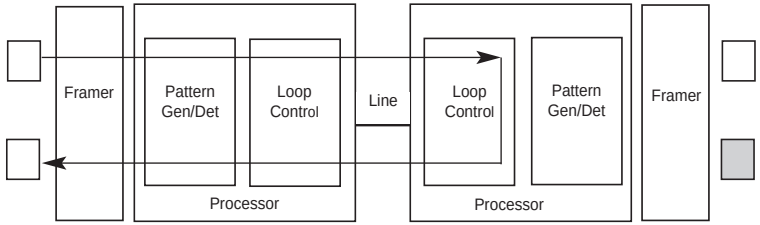

Figure 16. Block Diagram Remote Loop

Remote Digital Loop with 511/511E

The Remote Digital Loop with 511/511E is shown above. 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 Processor 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.

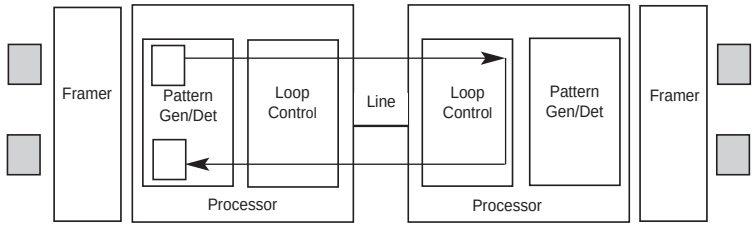

Figure 17. Block Remote Loop with 511/511E

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.

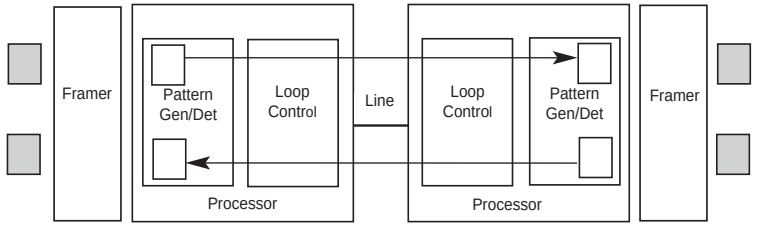

Figure 18. Block Diagram DataMode with 511/511E

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 Compact mDSL Modem and move it UP. 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 DOWN, 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 Compact mDSL Modem built-in “511” generator and detector are work ing 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 Compact mDSL Modem, and (2) to do the same at the remote Compact mDSL Modem. In this case, the test pattern sent by each Compact mDSL Modem will not be looped back, but will be transmitted down the line to the other Compact mDSL Modem. While one operator initiates test, the other monitors for errors.

APPENDIX A

BLACK BOX COMPACT MDU9705A-V35 AND MDU9705A-X21 SPECIFICATIONS

Clocking Modes:	Internal, External, or Receive Recovered
DTE Rate:	All 64k steps from 64 to 2304 kbps
DTE Interface:	V.35 (Compact mDSL Modem), DCE Orientation; X.21 (Compact mDSL Modem), DCE or DTE Orientation depending upon orientation of pc-board mounted daughter board
DTE Connector:	M/34 Female (Compact mDSL Modem) D-Sub-15 Female (Compact mDSL Modem)
Diagnostics:	V52 compliant (511/511E) pattern generator and detector with error injection mode controlled by front panel switch, Local and Remote Loopback control by either a front panel switch or from the DTE interface
LED Status:	The following LEDs are displayed on the front panel: **DSL Link (Green Active) -** DSL Link Active **TD, RD (Yellow/Green) -** Idle Yellow **NS (Red Active) -** No signal DSL Link **ER (Flashing Red) -** CRC error during normal operation, bit error during pattern generation test **TM (Active Yellow) -** Test Mode Enabled
Configuration:	Externally accessible dip switches or SNMP managed through mDSL Rack Card
Power:	+5 VDC external desk top power supply, 90-260VAC, 50-60 Hz (Universal Input), 10W or -48 VDC
Compliance:	FCC Part 15, CE, CTR1
Transmission Line:	Single Twisted Pair
Line Coding:	CAP (Carrierless Amplitude and Phase Modulation
Line Rates (DSL line):	144, 272, 400, 528, 784, 1040, 1552, 2064, 2320 kpbs
Line Interface:	Transformer coupled, 1500 VAC isolation
mDSL Physical Connection:	RJ-45, 2 wire, polarity insensitive pins 4 and 5
Environment:	Operating temperature 0-50°C; humidity 5-95% non-condensing; altitude, 0-15, 000 feet (0-4600 m)

APPENDIX B

BLACK BOX MDU9705A-V35 INTERFACE PIN ASSIGNMENTS

V.35 INTERFACE
(M/34 Female Connector)
(DCE Orientation)

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

Compact mDSL Modem

APPENDIX C

BLACK BOX MDU9705A-X21 INTERFACE PIN ASSIGNMENTS

X.21 INTERFACE
(D-Sub-15 Female Connector)
(DTE /DCE Orientation)

Pin #	Signal
1	Frame Ground
2	T (Transmit Data-A) (DTE Source)
3	C (Control-A) (DTE Source)
4	R (Receive Data-A) (DCE Source)
5	I (Indication-A) (DCE Source)
6	S (Signal Element Timing-A) (DCE Source)
7	BT (Byte Timing-A) (DCE Source)
8	SGND (Signal Ground)
9	T/ (Transmit Data-B) (DTE Source)
10	C/ (Control-B) (DTE Source)
11	R/ (Receive Data-B) (DCE Source)
12	I/ (Indication-B) (DCE Source)
13	S/ (Signal Element Timing-B) (DCE Source)
14	BT/ (Byte Timing-B) (DCE Source)

APPENDIX E

BLACK BOX COMPACT MDU9705A-V35 AND MDU9705A-X21 TRANSMISSION DISTANCE CHART

Transmission Distance - Black Box Compact mDSL Modem

		No Cross Talk					
Line Rate	DTE Rates	26 AWG (0.4mm)			24 AWG (0.5mm)		
kbps		feet	miles	km	feet	miles	km
144	64, 128	21400	4.0	6.6	30700	5.8	9.4
272	192, 256	20300	3.8	6.2	30600	5.8	9.4
400	320, 384	18600	3.5	5.7	29100	5.5	9
528	448, 512	17400	3.3	5.4	26100	4.9	8.0
784	576, 640, 704, 768	15800	3.0	4.9	22600	4.3	7.0
1040	832, 896, 960, 1024	15500	2.9	4.8	22100	4.2	6.8
1552	1088 - 1536	13600	2.6	4.2	19200	3.6	5.9
2064	1600 - 2048	12200	2.3	3.8	17200	3.3	5.3
2320	2112 - 2304	11500	2.2	3.5	15800	3.0	4.9
		Cross Talk (49 adjacent CAP pairs)					
Line Rate	DTE Rates	26 AWG (0.4mm)			24 AWG (0.5mm)		
kbps		feet	miles	km	feet	miles	km
144	64, 128	16992	3.2	5.2	25000	4.7	7.7
272	192, 256	15088	2.9	4.6	22000	4.2	6.8
400	320, 384	13264	2.6	4.2	20000	3.8	6.2
528	448, 512	12300	2.3	3.8	18000	3.4	5.5
784	576, 640, 704, 768	10216	1.9	3.1	14000	2.6	4.3
1040	832, 896, 960, 1024	8417	1.6	2.6	12000	2.3	3.7
1552	1088 - 1536	7107	1.3	2.2	10000	1.9	3.1
2064	1600 - 2048	5920	1.1	1.8	8000	1.5	2.5
2320	2112 - 2304	5416	1.0	1.7	73000	1.4	2.2

Compact mDSL Modem