RLH RLH Industries, Inc.

USER GUIDE

The leader in rugged fiber optic technology.

HDSL (Universal) Fiber Link Card System

SYSTEM INSTALLATION INFORMATION

HDSL Fiber Link Card

Introduction

The HDSL Fiber Link System interfaces directly with a standard HDSL 1, 2 or 4 copper telephone line. The HDSL CO card converts the electrical signal from the CO side HDSL copper line for transmission over fiber optic cable (multimode or single mode) to the HDSL Sub card, which then converts the fiber signal back to an electrical signal for transmission over copper lines.

This system provides a complete communications solution for HDSL over fiber. It has LED status and alarm output indicators for system monitoring, and is temperature hardened for use in extreme conditions.

Users can also perform complete end-to-end HDSL system loop back to the locally powered HDSL RT/NIU directly after the HDSL Sub card.

HDSL-2 service uses one copper pair. Up to Two separate HDSL-2 systems will run on one HDSL system.

HDSL-1 or HDSL-4 uses 4 copper wires (2 pairs). One HDSL-1 or HDSL-4 system can be used on the RLH HDSL system.

Refer to the Application Diagrams for additional information.

Note: The HDSL CO Fiber Link Card is powered only via the HDSL copper span, the HDSL SUB Fiber Link Card is powered by a local 44V-56V DC Power Source.

Our HDSL systems are made in the USA and are covered by our **Limited Lifetime Warranty**.

Contents

Compliance Information

The HDSL Fiber Link System is compliant with the following industry standards:

- **NEBS Level 3**
- **FCC PART-68B**
- **IEEE-487**
- **IEEE-1590**
- **Motorola R56**
- **BR 876-310-100 BT (Telcordia)**
- **Bellcore SR-3966**
- **GR-1089**
- **GR-63**

General Safety Practices

The equipment discussed in this manual may require tools designed for the purpose being described. RLH recommends that service personnel be familiar with the correct handling and use of any installation equipment used, and follow all safety precautions including the use of protective personal equipment as required.

Caution - Severe Shock Hazard

• Never install during a lightning storm or where unsafe high voltages are present.

• Active UHDSL lines carry high DC voltages up to 210V. Use caution when handling UHDSL wiring.

Special handling requirements

Be careful when handling electronic components


ATTENTION
ELECTROSTATIC
SENSITIVE
DEVICES
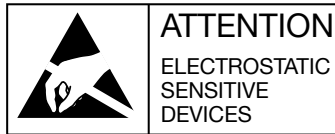
• This product contains static sensitive components.

• Handle the T1 cards at their edges only.

• **Follow proper electrostatic discharge procedures.**

This card utilizes circuitry that can be damaged by static electricity. When transporting the card, carry it in an ESD safe container such as the antistatic bag provided with the card. Before handling cards, discharge yourself of static electricity by physical bodily contact with earth ground. When handling cards, hold by outer edges and avoid touching circuitry. Failure to follow ESD precautions may cause serious damage to the card and prevent proper operation.

Warning

The intra-building port(s) of the equipment or subassembly is suitable for connection to intrabuilding or unexposed wiring or cabling only. The intra-building port(s) of the equipment MUST NOT be metallically connected to interfaces that connect to the OSP or its wiring. These interfaces are designed for use as intra-building interfaces only (Type 4 ports as described in GR-1089-CORE, Issue 4) and require isolation from the exposed OSP cabling. The addition of Primary Protectors is not sufficient protection in order to connect these interfaces metallically to OSP wiring.

Guidelines for handling terminated fiber cable
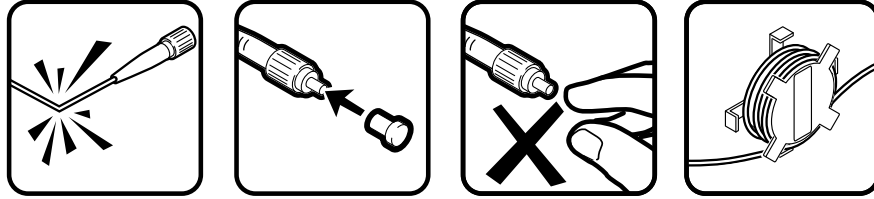
- Do not bend fiber cable sharply. Use gradual and smooth bends to avoid damaging glass fiber.

- Keep dust caps on fiber optic connectors at all times when disconnected.

- Do not remove dust caps from unused fiber.

- Keep fiber ends and fiber connectors clean and free from dust, dirt and debris. Contamination will cause signal loss.

- Do not touch fiber ends.

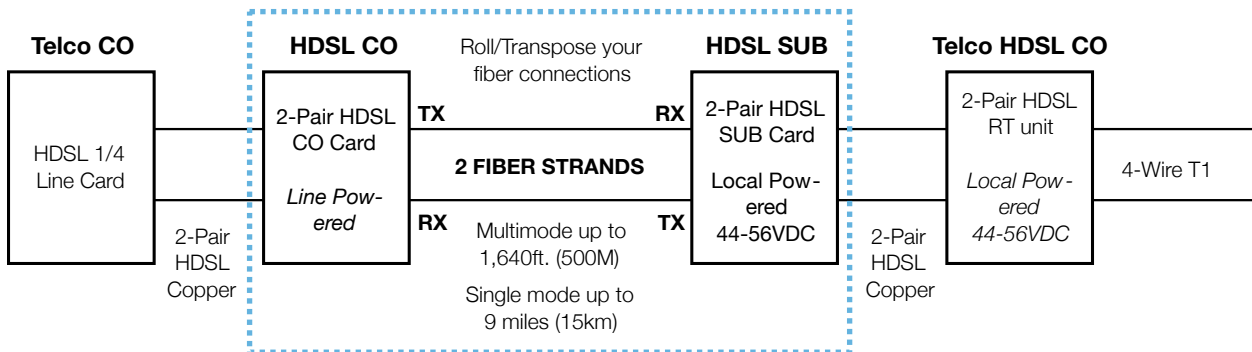- Store excess fiber on housing spools or fiber spools at site

Application

Using non-conductive fiber cable in place of serving copper telephone cable

Telecommunication equipment in high voltage areas can be at risk due to Ground Potential Rise (GPR). A copper telephone line referenced to a remote ground can become a path for high voltages during a ground fault. Placement of an all-dielectric fiber optic cable and locating the CO HDSL fiber card at either the 300 Volt Point as determined by a GPR Engineering study or at the nearest/safest telco service drop completely eliminates the presence of a copper telephone cable into a high voltage environment. This design will dramatically increase the overall safety of personnel and equipment involved.
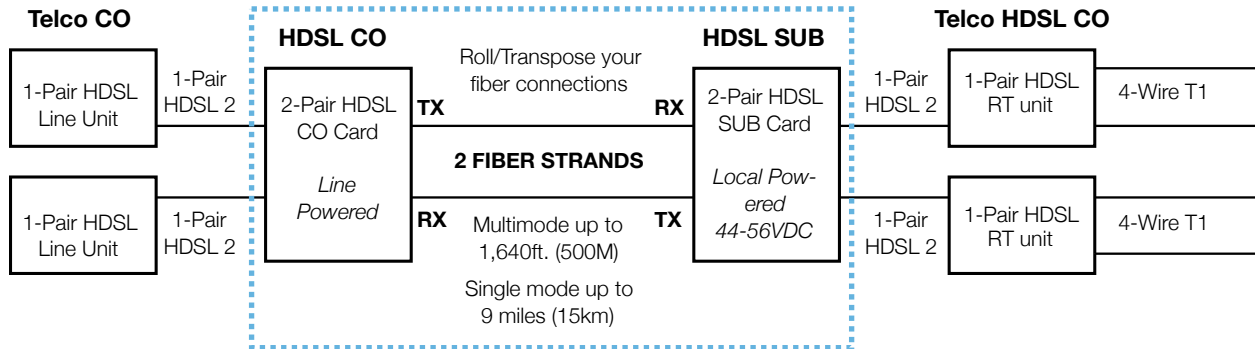
Application Diagram A

HDSL1 or HDSL4 (2 pair copper wires)

(Application diagram continued on next page)

Application Diagram B

HDSL (1 pair copper wires)

Telco CO		HDSL CO			HDSL SUB		Telco HDSL CO		

Telco CO

1-Pair HDSL Line Unit — 1-Pair HDSL 2

1-Pair HDSL Line Unit — 1-Pair HDSL 2

HDSL CO

2-Pair HDSL CO Card

Line Powered

TX — Roll/Transpose your fiber connections — **RX**

2 FIBER STRANDS

RX — Multimode up to 1,640ft. (500M) — **TX**

Single mode up to 9 miles (15km)

HDSL SUB

2-Pair HDSL SUB Card

Local Powered 44-56VDC

Telco HDSL CO

1-Pair HDSL 2 — 1-Pair HDSL RT unit — 4-Wire T1

1-Pair HDSL 2 — 1-Pair HDSL RT unit — 4-Wire T1

Note:

- HDSL-2 Telco services utilize only one copper pair. Up to two, HDSL-2 copper circuits can be applied thru one RLH HDSL Fiber Link System. Turn OFF unused Loop when using only one HDSL-2(one pair) circuit.

- The RLH HDSL Sub Card does not provide DC output/span power to operate an RT/NIU. Use an RT/NIU that will accept a local 48VDC power source. as per manufactures spec.

Installation

Prior to installation:

- Check for shipping damage

- Check the contents to ensure correct model and fiber type

- Have a clean, dry installation environment ready

- Ensure that the fiber type at the site matches the system type

If damage is discovered file a claim immediately with the carrier, then contact RLH customer service.

Required for installation:

- 44-56VDC (60mA@24VDC maximum) local power source at Sub side of the system.

- Suitable RLH Fiber Link Card housing

- Active HDSL line

- Multimeter

Housings

RLH CO and SUB Fiber Link Cards are are designed to be mounted into a RLH card housing. The HDSL cards are compatible with a wide range of RLH card housings. For additional information please contact RLH Customer Service or go to www.fiberopticlink.com .
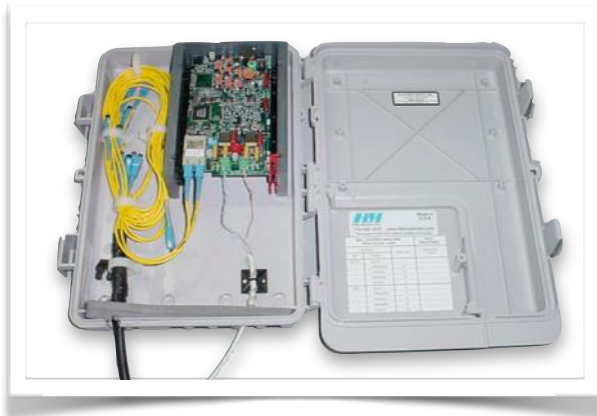
Copper Connections:

- Each copper pair LOOP 1/LOOP 2 is connected into the green screw-down terminal located at the front of the HDSL board marked LOOP 1 and LOOP 2. See Fig. 4.2

- Use standard CAT-5E or better 22-26 ga. solid cable for both your LOOP 1/LOOP 2 connections
Use 22 to 26 ga. CAT5 for your DC power connection to the HDSL Sub card. See Fig. 4.3 and 4.4, Powering. Strip back enough copper to insure a good connection to the HDSL card.

- Note that the HDSL CO card is Span/line powered only and lacks an AUX. P.S. terminal.
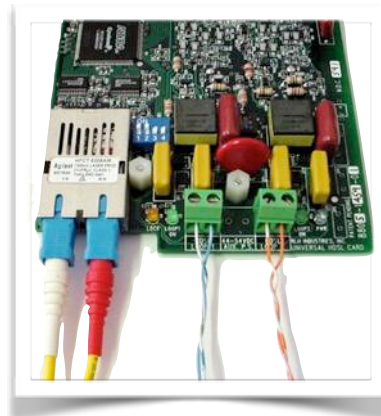
Fiber Connections:

- The HDSL Card is equipped with one ST or SC female duplex fiber optic connector.

- Remove rubber plug from connector and save for later use if card is removed from service.

- When inserting the fiber connections into the duplex HDSL connector, be sure to not touch fiber connector ends to avoid contamination that may affect optical signal performance.

- Seat each fiber connector firmly but carefully into the HDSL fiber connector.

- The excess Fiber cable should be routed & stored loosely without tight bends to avoid excessive optical signal loss.
See connection examples below.

- Make sure the CO and Sub HDSL cards fiber connections are rolled or transposed. Example if you use the #1 fiber on the CO cards TX, then insert #1 fiber into the RX on the Sub HDSL card.

Connection Examples

*RLH HDSL CO Card installed inside RLH wall mount card housing.*

Close up view of CO Cards copper and fiber connections. LOOP 1 left connection, LOOP 2 right connection.   RJ-45 input copper input option is available instead of screwdown terminals.

NOTE: When using just one HDSL-2 one pair line, utilize the LOOP 1 Terminal only and & turn LP2 DIP Switch OFF to conserve power and reduce noise and crosstalk.

Powering

- The HDSL CO card is line powered via the HDSL Telco span power (90-210V DC) and lacks an AUX. P.S. DC Input.

- The HDSL SUB card requires a local DC source of 44-56 Volts and draws 5 Watts. Power is connected to the black screw down terminal labeled: (44-56VDC AUX. P.S.). The AUX. P.S. input is not polarity sensitive.

- For HDSL DC power connections standard 24-26 AWG CAT-5 or equiv. Cable is sufficient. Strip back enough insulation to insure a good DC power connection to UHDSL Sub card.

- RLH manufactures reliable AC/DC or DC/DC power supplies designed for this application if one is not available to you. Contact RLH for power solution appropriate for this product.
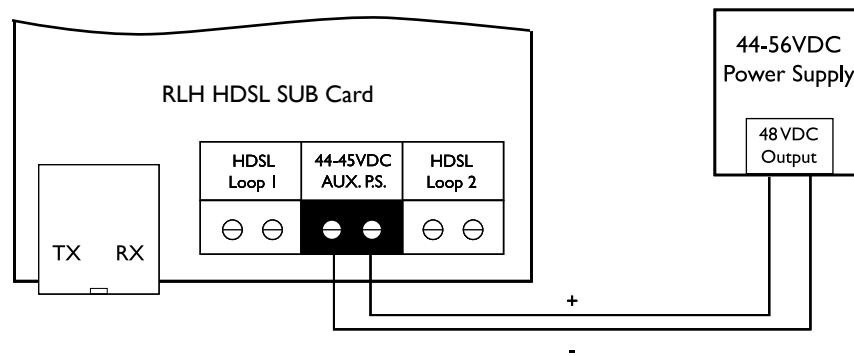
SUB side local DC power connection diagram
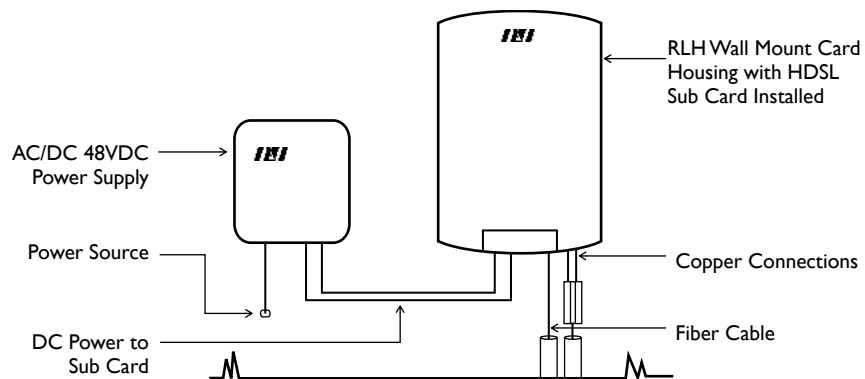
Visual example of SUB/CPE side setup with AC/DC power supply

LED Indicators

There are four (4) Light Emitting Diodes (LEDs) that indicate operational status of the RLH HDSL Card.
On the topside of the card near the Optical Transceiver are the LOCK and Channel 1 LEDs. Below the connectors are the Channel 2 and Power LEDS.

Normal operation

When both cards are powered and connected through fiber, the orange LOCK LED is ON, blue PWR LED is ON, and (optionally) the green channel LEDs are ON if selected.

Parameters indicated by LEDs

LOCK (Orange LED):   **ON** (STEADY) --- CO and SUB HDSL Cards are in sync.
   FLASHING --- CO and SUB HDSL Cards are not in sync (check that fiber connector is fully inserted into optical connectors. Fibers may be reversed).

LOOP 1 & LOOP 2 (Green LED's):   **ON** --- Green LED's are lit if corresponding Dip Switch is in the ON position.
   OFF--- Dip Switch Position is OFF.

POWER (Blue LED):   **ON** --- Power is operational.

   OFF --- Power not applied to card or power supply is not working.
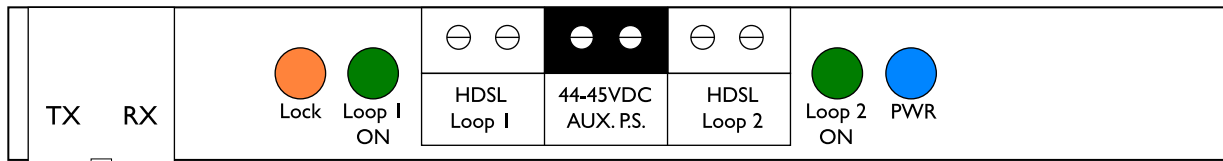
Front edge of SUB side card

DIP Switch Settings

The card has a DIP switch with 4 positions for switching loop terminals off or on, and for setting the optical gain.

Switch	Setting	Description
LP1	ON	Turns LOOP 1 ON
	OFF	Turns LOOP 1 OFF
LP2	ON	Turns LOOP 2 ON
	OFF	Turns LOOP 2 OFF
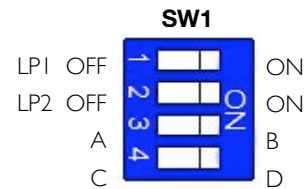
Positions 1 and 2 turn the LOOP1 and LOOP2 wire connection terminals ON and OFF. Dip switches 3 and 4 are used for setting the gain depending on the type of circuit the HDSL system is connected to. Refer to the following section for use of the gain switches.

Setting the Optical Gain

Dip switches 3 and 4 are used for various gain settings when the signal needs attenuation or gain.

The factory default setting is OFF for positions 3 and 4, corresponding to 0dB gain, and will function normally in many installations. The switch settings will not require adjustment unless the the SUB side fails to communicate properly with the signal from the fiber link card.

Before adjusting the gain, verify all copper and fiber connections. Refer to the LED status section to verify correct fiber, power and HDSL operation.

To adjust the gain:

1. Estimate the effective maximum copper cable length from the CO or nearest repeater to the HDSL CO card using the worksheet formula.
2. Find the recommended CO and SUB gain settings using the gain charts.
3. Set switch positions 3 and 4 accordingly, using the switch settings table.

Check the HDSL system for communication status after setting the switches. More than one setting may be tried before finding the optimum gain setting. Using an incorrect gain setting will not harm the system, but may prevent the HDSL equipment from communicating properly with the fiber card.

Estimating Effective Maximum Copper Cable Length

Use the following worksheet to determine the maximum length of copper cable in kilofeet, between the Central Office and HDSL CO Line, or last repeater, and the CO HDSL Fiber Link Card.

For HDSL1 and HDSL2

Description	Value	Name	What to Enter
Bridge Taps	*	**BT**	Total length in feet of bridge taps (max 2500 ft)
Length of Non-24G	*	**L**	Total length in feet of non-24 gauge cable (max 6000 ft)
Gauge changes	*	**J**	Number of gauge changes that exceed 100 ft.

Effective Length = 120 - (**BT** x .01) - (**L** x .005) - (**J** x 3) x 75

For HDSL4

Description	Value	Name	What to Enter
Bridge Taps	*	**BT**	Total length in feet of bridge taps (max 2500 ft)
Length of Non-24G	*	**L**	Total length in feet of non-24 gauge cable (max 8000 ft)
Gauge changes	*	**J**	Number of gauge changes that exceed 100 ft.

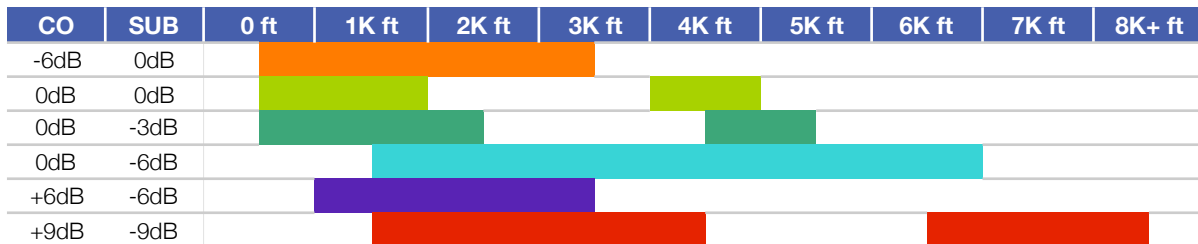**Effective Length** = 120 - (**BT** x .01) - (**L** x .005) - (**J** x 3) x 100

Next, using the graphs below, chose the switch where the color bar is closest to the middle of the effective length.

For 24 AWG

CO	SUB	0 ft	1K ft	2K ft	3K ft	4K ft	5K ft	6K ft	7K ft	8K ft	9K+ ft
-6dB	0dB										
0dB	0dB										
0dB	-3dB										
0dB	-6dB										
+6dB	-6dB										
+9dB	-9dB										

For 26 AWG

CO	SUB	0 ft	1K ft	2K ft	3K ft	4K ft	5K ft	6K ft	7K ft	8K+ ft
-6dB	0dB									
0dB	0dB									
0dB	-3dB									
0dB	-6dB									
+6dB	-6dB									
+9dB	-9dB									
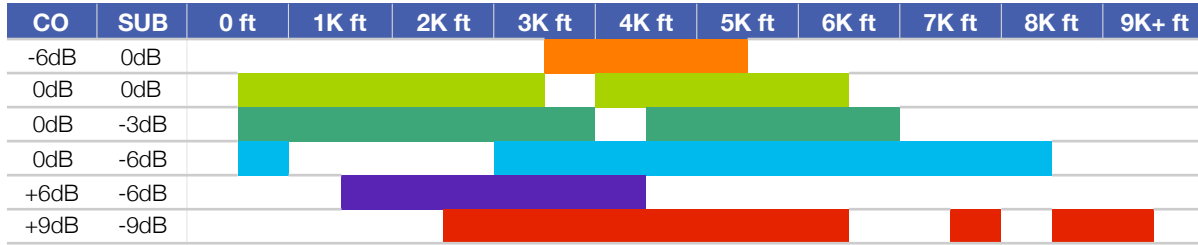
After determining the effective length, set the gain on the DIP switch (SW1) for the corresponding gain values.

For CO Card			For SUB Card		
Switch 3	Switch 4	Gain/Attenuation	Switch 3	Switch 4	Gain/Attenuation
A - OFF	**C** - OFF	0dB	**A** - OFF	**C** - OFF	0dB
A - OFF	**D** - ON	+6dB	**A** - OFF	**D** - ON	-6dB
B - ON	**C** - OFF	-6dB	**B** - ON	**C** - OFF	-3dB
B - ON	**D** - ON	+9dB	**B** - ON	**D** - ON	-9dB

Troubleshooting

If trouble is encountered, verify all copper and fiber connections and settings.

LED	Color	Condition	Meaning	Items to Check
LOCK	**ORG**	Blinking or OFF	Fiber port communication is poor or missing	Fiber connectors are clean and seated properly
				The TX fiber from each card is attached to the RX connector of the other card
				Test the fiber cable for damage
				Make sure both cards have power
LOOP1	**GRN**	OFF	Loop 1 terminal disabled	Turn DIP switch 1 ON to enable LOOP1
LOOP2	**GRN**	OFF	Loop 2 terminal disabled	Turn DIP switch 2 ON (If used) to enable LOOP2
POWER	**BLU**	OFF	Power not present at power terminal	Ensure power source is functioning
				Inspect copper wiring from power source to ADSL card
				Test the power for 44~56VDC, 5W

If trouble persists, replace the unit and retest. If technical assistance is required, contact our technical support department. Refer to the Technical Support information of this guide.

Compatibility

The RLH HDSL Fiber Link Card System is compatible with HDSL 1,2 & 4 systems but may not be compatible with some early version HDSL copper telco equipment such as the PairGain HI-Gain HDSL-1, 4 wire system. Verify compatibility with RLH prior to ordering.

Please contact the following Telco Central Office/NIU OEM's for part numbers & technical support.

- Adtran (800) 726-8663
- ADC/PairGain (800) 638-0031

General Specifications

Transmission method	Serial Bit Stream via two optical fibers	
	Multimode	1310nm
	Single-mode	1310nm
Maximum Fiber Loss / Distance*	Multimode	12dB / 1640 feet (500m
	Single-mode	17dB / 8 miles (13km)
Fiber Type	Multimode	62.5/125µm, 50/125µm
	Single-mode	9/125µm
Fiber Connector Types	ST or SC	
Maximum Copper Length	8kft of 26AWG, 12kft of 24AWG Cable	
	(Between HDSL-1, 2 or 4 CO Line or Repeater card and RLH CO HDSL Card)	
HDSL Signal Format	Full duplex 2B1Q or TC-PAM w/Spectral Shaping	
End-to-End Sync	Typically 30 seconds additional for HDSL system to train.	
Maximum Data Rate	3.152 Mbps	
BER	<10-8	
Transmit Level	Equal to opposite end receive level +/- 1.5dB (Dip switch SW1 position 4A)	
Surge Protection	PTC thermistors, Surgectors™ and varistors	
Power Methods	**CO Card**	Typical HDSL line powering 85-210VDC.
	Sub Card	44-56VDC, local power over 8kft of 26AWG or 12kft of 24AWG Cable
Powering Requirements	5.5 Watts Maximum	
Operating Temperature	-40° to +160° F (-40° to +70° C)	
Humidity	5-95% non-condensing	
Warranty	Limited Lifetime *Visit* www.fiberopticlink.com *for warranty details*	

Ordering Information

HDSL part numbers are located at the lower front area of HDSL card.

Optics	Distance	Fiber	Description	Part Number	CLEI
Multimode ST	2km / 1.2 mi.	62.5µm	CO Card	**8806-1439-01**	NPP1RM0CAA
			SUB Card	**8806-1449-01**	NPP1SM0CAA
Multimode SC	2km / 1.2 mi.	62.5µm	CO Card	**8805-1439-01**	NPIFHJ01AA
			SUB Card	**8805-1449-01**	NPIFJJ01AA
Single-mode ST	15km / 9 mi.	8~9µm	CO Card	**8806-1459-01**	NPP1RK0CAA
			SUB Card	**8806-1469-01**	NPP1SK0CAA
Single-mode SC	15km / 9 mi.	8~9µm	CO Card	**8805-1459-01**	NPIFHD01AA
			SUB Card	**8805-1469-01**	NPIFJD01AA

▶ 62.5µm multimode fiber compatibility is standard, add **-50** to part number for 50µm fiber compatibility

▶ To add RJ-45 copper input instead of screw-down input, add **-RJ** at the end of the UHDSL card part number.

▶ Example part number: **8806-1439-01-RJ** = HDSL CO Multimode w/ ST fiber connectors and RJ-45

Contact Information

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Please contact your RLH sales representative for pricing and delivery information.