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# USER'S MANUAL

## **Fiber Optic T1/E1 Transceiver** ***Series DL402/DL401***

*MARCH 2001*

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# FIBER OPTIC T1/E1 TRANSCIVER INSTALLATION MANUAL SERIES DL402/DL401

## OVERVIEW

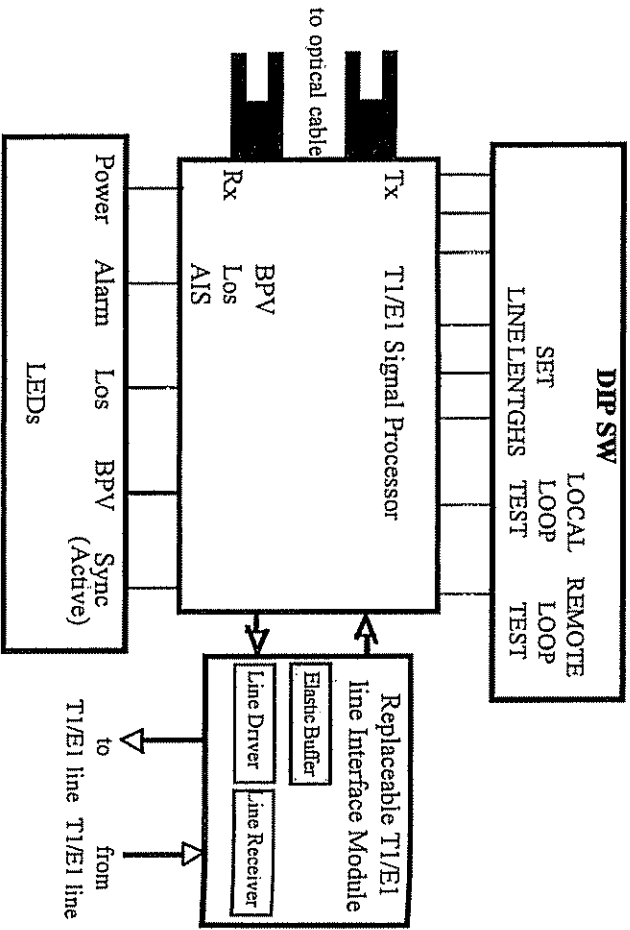
### Description

The *Series DL402/DL401* is a T1/E1 Fiber Optic Modem that offers advanced features such as Jitter Removal and a replaceable Line Interface Module. Because it is based on modern FPGA (field programmable gate array) technology, it offers extremely low current consumptions and higher reliability.

Transparent to the framing format, the *DL402/DL401* T1/E1 interface shapes the transmit pulse to support CCITT G.703, or for connecting to DSX-1 cross connects, line distances from 0 to 655 feet. The internal elastic buffer removes jitter from transmit data.

The *DL402/DL401* has five LED indicators to ease installation and troubleshooting--one each for Power, Alarm, T1/E1 Signal Loss, BPV violations and Sync Active. It provides 8 DIP switches, accessible from the panel, to control settings for line code, line length, local loopback or remote loopback setting such as when the line code does not match the line length setting. The intelligent line code setting switch will eliminate any confusion.

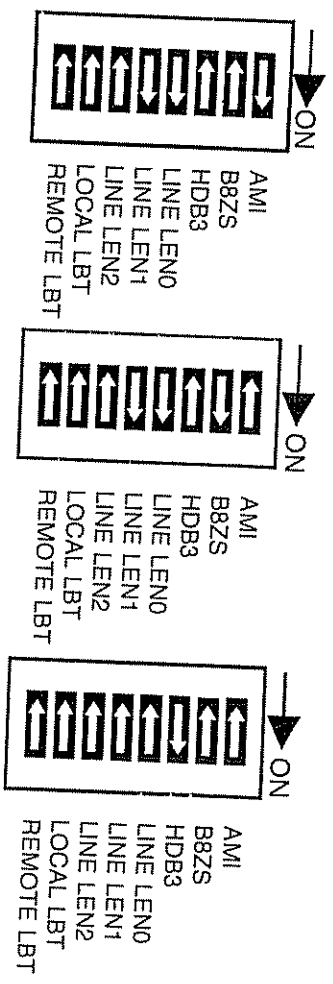
The *DL402/DL401* is compatible with all popular types and sizes of optical cable. Fiber optic connectors ST, FC or SMA are optional. Special four-position and two-position feed-through detachable terminals are provided for connecting the T1/E1 twisted pairs. Input power is 12V DC or 115/230V AC with an external power cube.



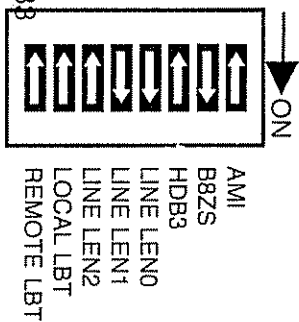
This unit has been pre-set by the factory as follows:

LINE CODE		LINE LENGTH	
AMI	B8ZS	HDB3	TI/E1 (ohm)
			1-133
			133-266
			266-399
			399-533
			533-655

only one should be marked



## Functions, LEDs & Switches



DIP switches S1-1, S1-2, S1-3 define:

line code selection: AMI, B8ZS, HDB3

DIP switches S1-4, S1-5, S1-6 define:

DSX-1 cross connect distance: 5 partitions to choose from.

For T1 DSX-1 applications, line lengths from 0 to 655 feet (as measured from the transmitter to the DSX-1 cross connect) are selectable. The five partition arrangement meets CB-19 requirement when using ABAM cable.

DIP switches S1-7, S1-8 initiate:

Local loopback test and remote loopback test respectively.

### Data Rates

T1 data rate is 1.544 Mbps while E1 data rate is 2.048 Mbps.

## Fiber Optics

### Launch Power & Sensitivity

Transmitter: LED, typical launch power --

-24dBm\* (850nm MM, @62.5/125mm)

-24dBm\*\* (1300nm MM/SM, @62.5/9mm)

Receiver: PIN, typical sensitivity --

-40dBm\* (850nm MM, 62.5/125mm)

-40dBm\* (1300nm MM & SM)

\*Launch power & sensitivity listed are for reference only. These numbers may vary.  
 \*\*factory set launch power -24dBm to avoid overdrive optic receiver when short optic jumper is used for bench test. User can adjust the launch power to -20dBm by referring the diagram on next page.

### Connectors

Fiber optic connectors can be ST or FC.

### Loss Budgets

850nm multimode : 16dB @62.5/125mm

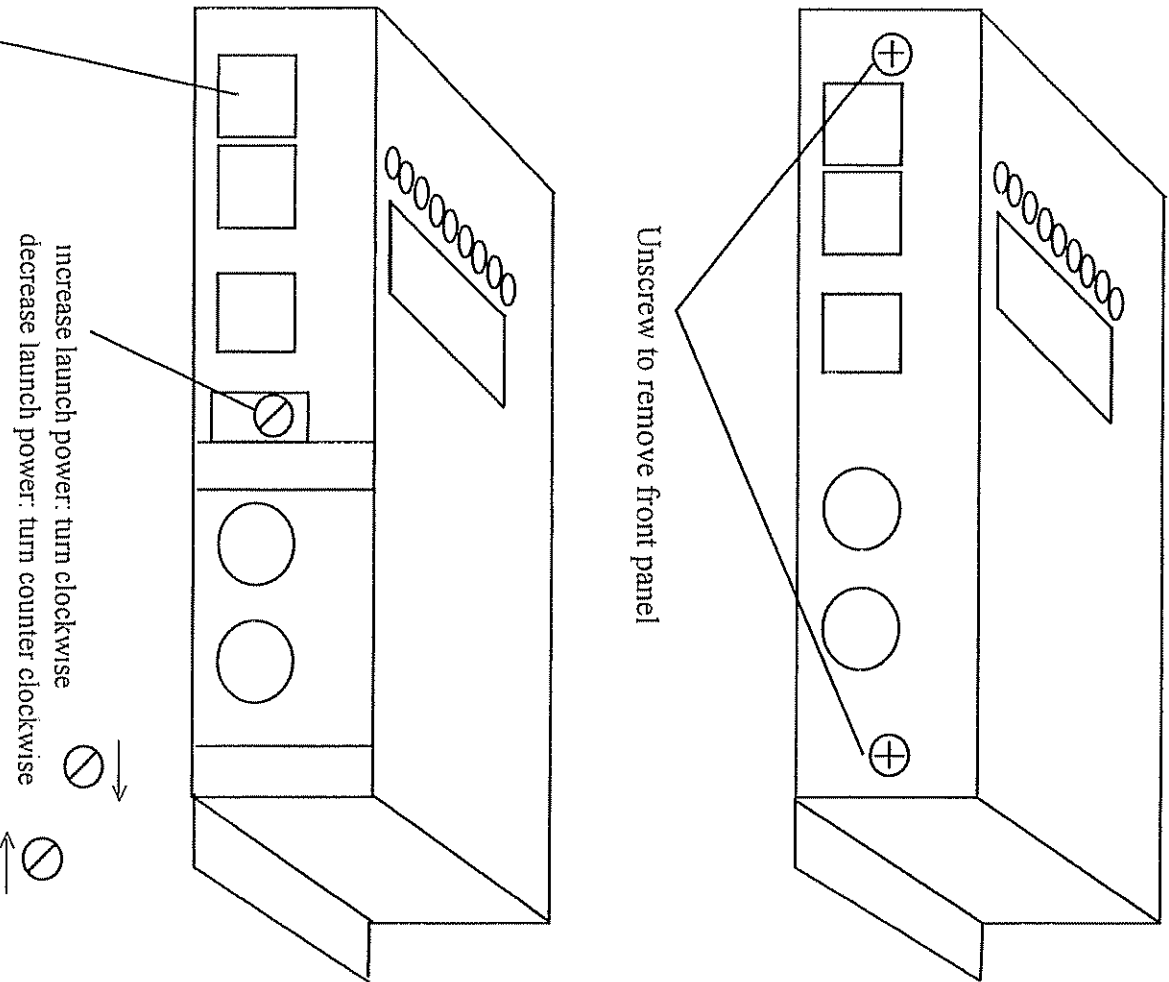
1300nm multitude : 16dB @62.5/125mm

1300nm singlemode : 16dB @9mm

### Transmission Distances (typical)

The DL402/DL401 will work with all popular sizes and types of fiber. Transmission distances up to 5km are typical over multimode fiber at 850nm and 8km at 1300nm. Distances of up to 40km are typical over singlemode fiber at 1300nm.

## How to adjust Launch Power for 1300nm Multimode Application



## INSTALLATION

### Unpacking the Unit

Before unpacking any equipment, inspect all shipping containers for evidence of external damage caused during transportation. The equipment should also be inspected for damage after it is removed from the containers. Claims concerning shipping damage should be made directly to the pertinent shipping agencies. Any discrepancies should be reported immediately to Radiant Communications.

### Equipment Location

The DL402/DL401 should be located in an area that provides adequate lighting and working space. Avoid locating it next to any equipment that may produce electrical interference or strong magnetic fields such as elevator shafts, heavy duty power supplies, etc.

## Installation Procedure

The DL402/DL401 is designed for quick and easy installation. To install DL402/DL401, you must first configure the modem for the specific application by setting the line length. Once this is completed, you can connect the optical, T1 or E1 interface and power.

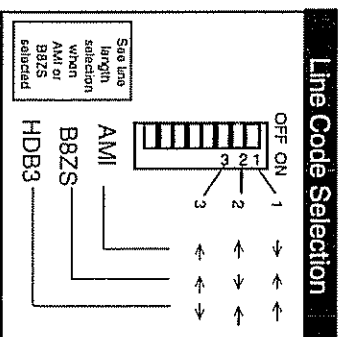
After installation is completed, it is a good idea to verify the optical cable loss. This reading will both verify the integrity of the circuit and provide a benchmark for future troubleshooting efforts. (See troubleshooting section for directions)

### Installation Procedure:

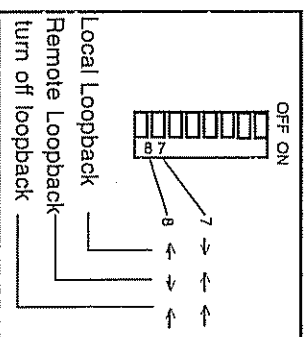
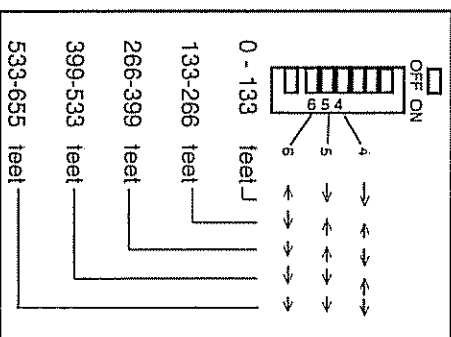
- A. Select your line code. (See LED & Switch diagram.)
- B. Select your line length. (See LED & Switch diagram.)
- C. Connect your T1 or E1 signal. (See installation diagram.)
- D. Connect your optical. Verify that local optic Tx is connected to optic Tx from remote unit. (See installation diagram.)
- E. Connect the power. When power is initially connected, the power light goes on. (See Installation Connection Diagram.)

## DIP Switch Diagram

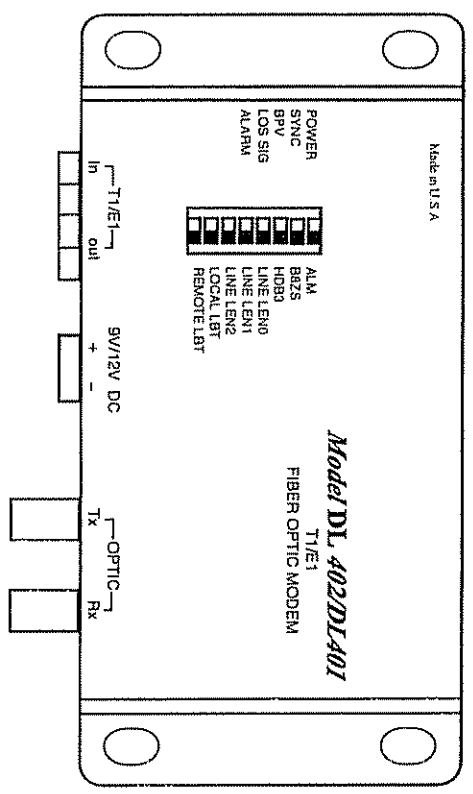
### DIP Switch S1 setting



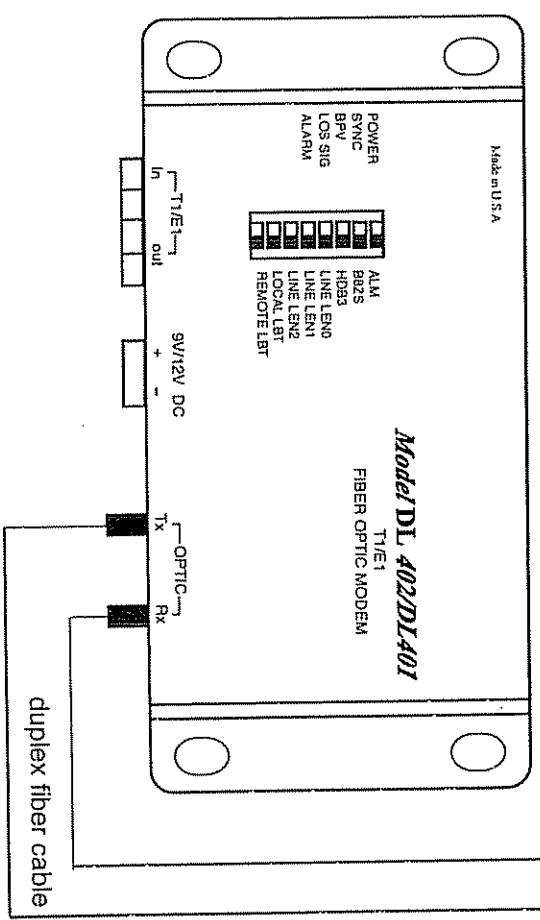
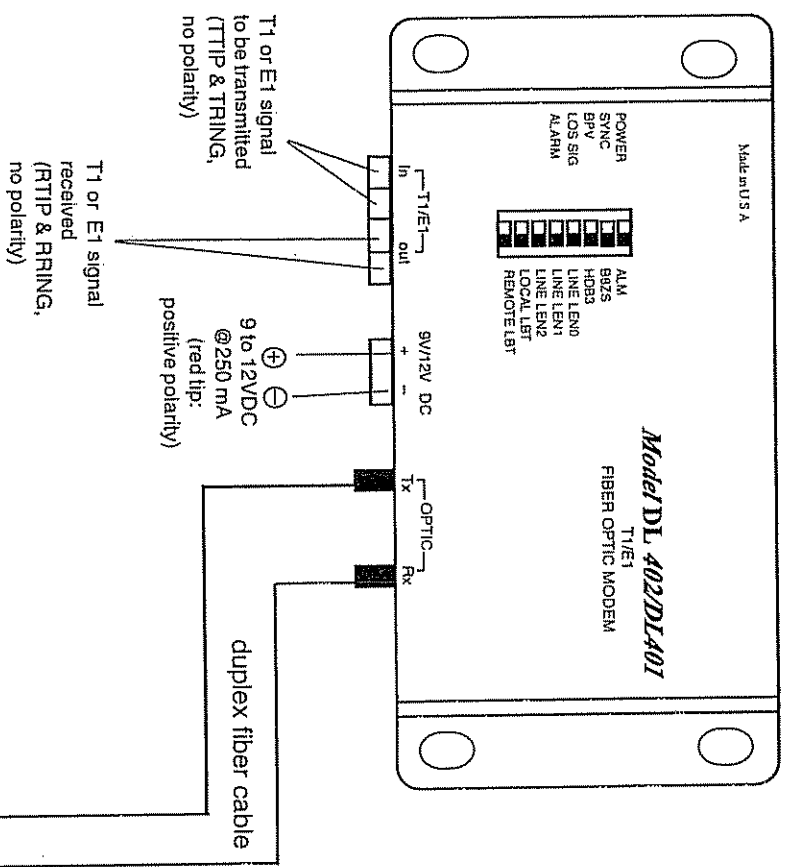
### T1 Line Length Selection



# LED Diagram



# Installation Diagram



## Configure Your Modem

- A. Select your line code: DIP switch #1, #2 or #3 ("on" or "1" : slide switch to right)
- AMI: set #1 to "on" position  
 B8ZS: set #2 to "on" position  
 HDB3: set #3 to "on" position

Only one of the above switches should be selected, any two switches at "on" position would cause alarm LED to flash.

- B. Select your line length: DIP switch #4, #5, #6 ("on" or "1" : slide switch to right). Depending on the distance between DL402/DL401 and T1 cross connect, you should set line length for T1 transmit line driver. When connecting to DSX-1 cross connects, for line lengths ranging from to 655 feet, see DIP switch setup page. There is no need to set the line length for E1 application:

	LINE CODE	LINE LENGTH			LOCAL/ REMOTE				
		#1	#2	#3	#4	#5	#6	#7	#8
AMI:									
DSX-1	0-133 feet 133-266 feet	1 1	0 0	0 0	1 0	1 0	0 1	0 0	0 0
ABAM	266-399 feet 399-533 feet 533-655 feet	1 1 1	0 0 0	0 0 0	1 0 1	1 1 1	1 1 1	0 0 0	0 0 0
CSU NETWORK INTERFACE	0-655 feet	1	0	0	0	1	0	0	0
B8ZS:									
DSX-1	0-133 feet 133-266 feet	0 0	1 1	0 0	1 0	1 0	0 1	0 0	0 0
ABAM	266-399 feet 399-533 feet 533-655 feet	0 0 0	1 1 1	0 0 0	1 0 1	1 1 1	1 1 1	0 0 0	0 0 0
CSU NETWORK INTERFACE	0-655 feet	0	1	0	0	1	0	0	0
HDB3: (PCM-30, G703)	0-655 feet	0	0	1	0	0	0	0	0



C. Connect your T1/E1 signal: (refer to the Installation diagram)

**T1 signal connection:**

**100 ohm line:** Connect incoming T1 signal (from your equipment) to #1 & #2 terminal blocks, they are not polarity sensitive. Valid T1 signal will cause "LOS" LED to turn off.

Connect outgoing T1 signal (received from optical cable) to terminal blocks #3 & #4.

**E1 signal connection:**

**75 ohm line:** Connect incoming signal (from your equipment) to "in" BNC connector, connect outgoing signal (received from optical cable) to "out" BNC connector terminal blocks.

**120 ohm line:** If twisted cable, connect the wires in the same way as T1's wire. If dual coaxial (each cable has two cores & shield), connect the cores to terminal blocks #1 & #2 for incoming signal, #3 & #4 for outgoing signal.

D. Verify optical connection:

Make sure local DL402/DL401's optic Tx is connected to remote DL402/DL401's optic Rx and local DL402/DL401's optic Rx is connected to remote DL402/DL401's optic Tx.

**Power Supplies**

The DL402/DL401 is powered by an external DC power adapter rated 9V DC to 12V DC @ 250mA.

**Fiber Optic Cable & Connectors**

The optic connectors are located on the rear panel, one for transmit and one for receive. Connector type can be ST, SMA or FC. Two pairs of terminal blocks are provided to connect T1/E1 signals. When facing the front panel, the left pair is for T1/E1 signal going into (transmit) the DL402/DL401 while the right pair is for received signal.

**System Start Up**

Connect the power:

When power is initially connected, the following conditions should be observed.

- a. The "POWER" LED is on.
- b. The "LOS" LED is off to indicate valid T1 or E1 signal input.
- c. The "ALARM" LED should be shut off.

Start T1/E1 signal transmission:

- a. The "POWER" LED stays on.
- b. The "SYNC" LED should be light to indicate received optic signal.

If the modem is not functioning properly please refer to the Troubleshooting section.

# TROUBLESHOOTING

## General

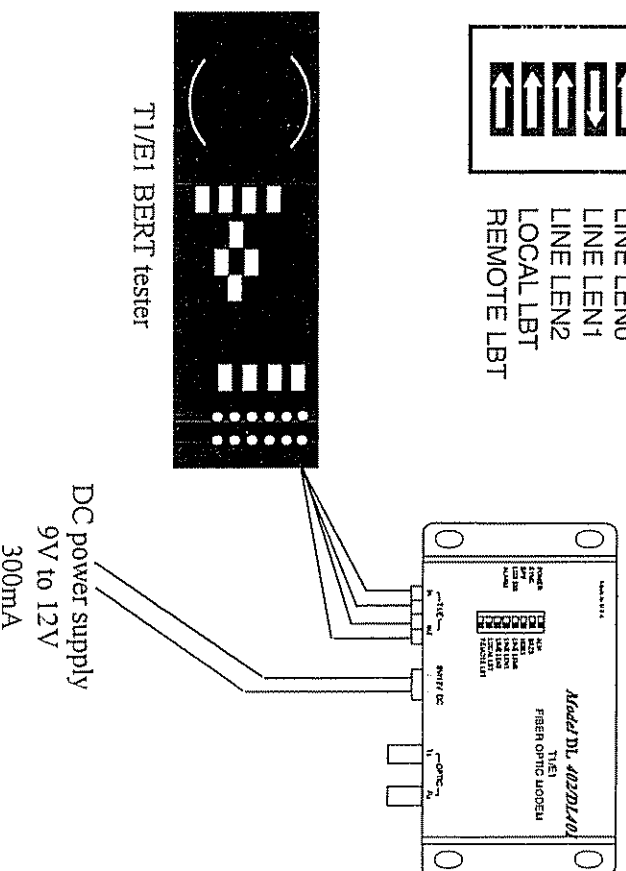
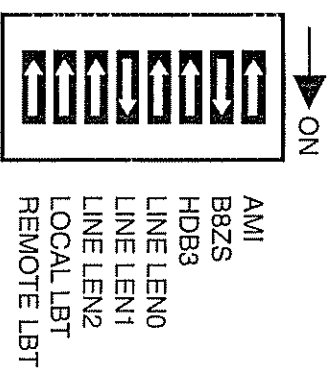
The fiber optic link and/or the connectors are frequently the source of various problems. Check out the connectors and the integrity of the link first. Ideally, the link should be calibrated for total loss after the installation has been completed. This will accomplish two things. One, it will verify that the total loss of the system is within the loss budget of the device. Two, it will provide a benchmark for future testing. For example, a system that has been tested as having 6dBm total loss when installed, and suddenly tests out having a loss of 10dBm, obviously has a connector or link problem.

## LED Indicators

There are five LEDs on the cover. Under normal operating condition, only "PWR" and "SYNC" should be on. When alarm flashes, one of the following possible problems may exist:

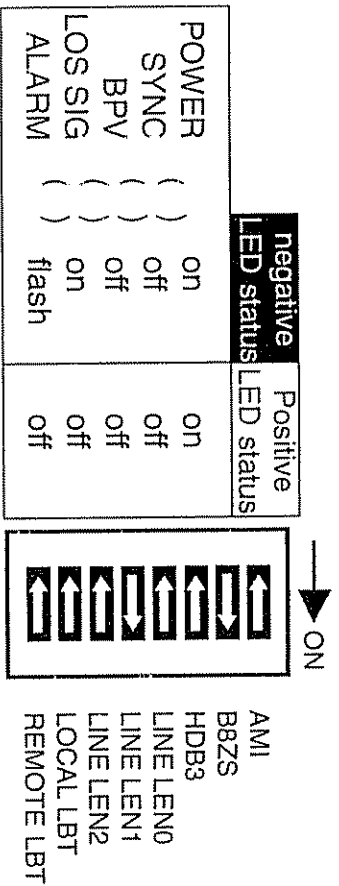
- a. The line code selection: only one line code (AMI, B8ZS or HDB3) should be selected. Alarm flashes when more than one line code switches are activated.
- b. All ones received from customer T1 or E1 device: If customer's device generates all ones signal, the alarm LED will flash but at less bright level.
- c. If optic Rx is not receiving signal, the "SYNC" will be off and alarm LED flashes.
- d. If no valid T1 or E1 signal present at terminal blocks ("INPUT") then "LOS SIG" LED will be lit.
- e. If bi-polar violation occurs during T1 or E1 signal's reception, the "BPV" LED will flash according to bi-polar violation's frequency.

	negative LED status	Positive LED status
POWER	( ) on	on
SYNC	( ) off	off
BPV	( ) off	off
LOS SIG	( ) on	off
ALARM	( ) flash	off

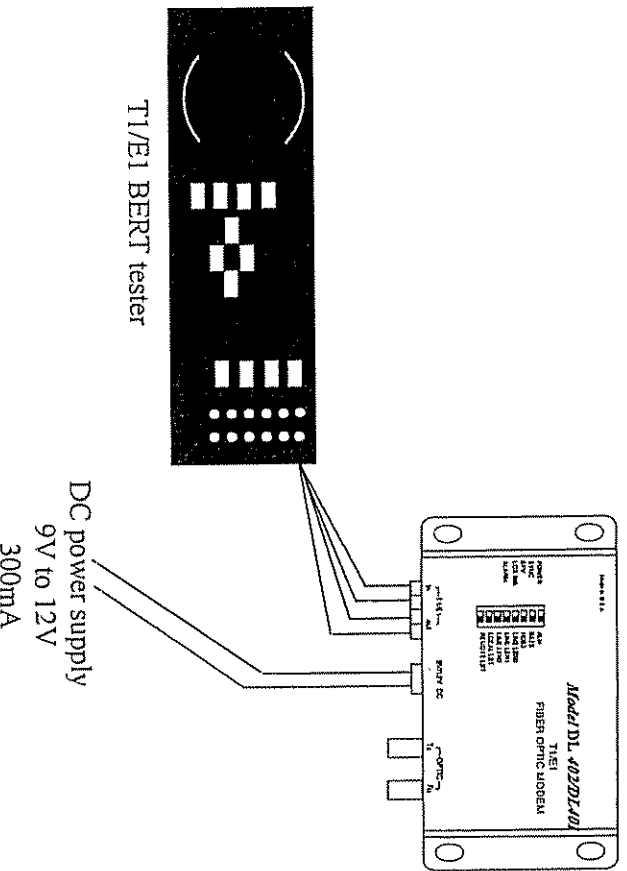


### Optical Loopback Test

At anytime you may use a short cable to loopback from Optic Tx to Rx. The "SYNC" LED on the cover should light when a good optic signal is received. This test is to verify optic transmitter's function. Before you start the test, make sure you have selected line code and switch off the local loopback test.

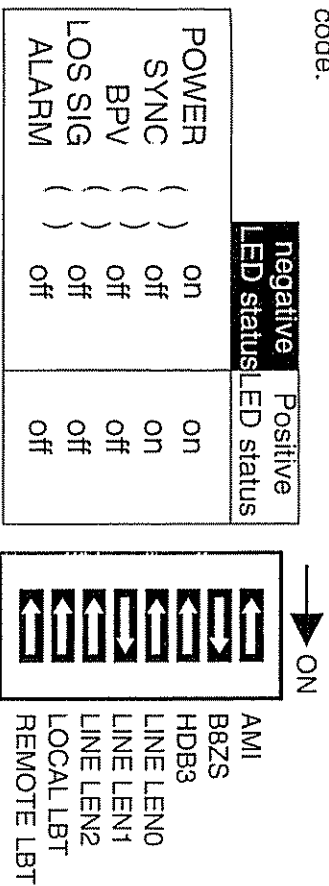


Optical Loopback Test Diagram

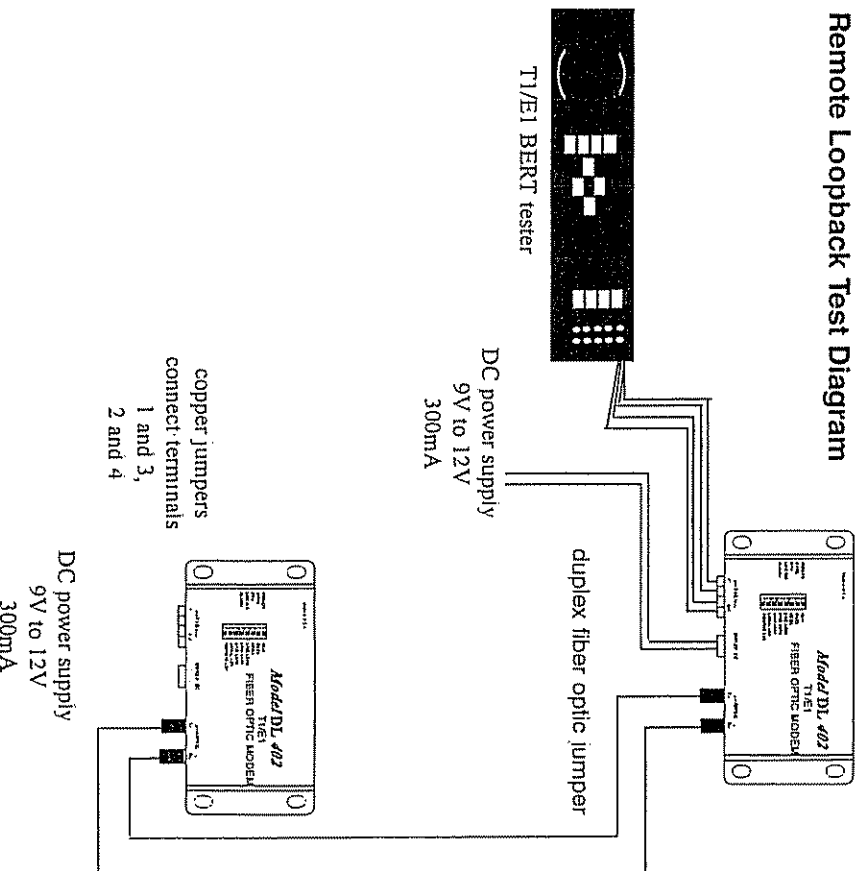


### Remote Loopback Testing

You may connect two DL402/DL401 units as following to conduct a remote loopback test. Make sure the line codes are selected on both local unit and remote unit. Set both units the same line code.



Remote Loopback Test Diagram

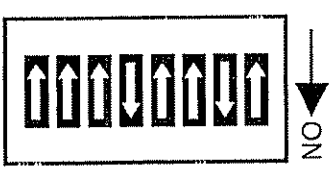


a. Remote unit: loopback through internal path



	negative LED status	Positive LED status
POWER ( )	on	on
SYNC ( )	off	on
BPV ( )	off	off
LOSS SIG ( )	on	on
ALARM ( )	flash	flash

b. Remote unit: loopback through external path



	negative LED status	Positive LED status
POWER ( )	on	on
SYNC ( )	off	on
BPV ( )	off	off
LOSS SIG ( )	on	off
ALARM ( )	flash	off

## SPECIFICATIONS

### Data Rates

T1/E1 (per channel).....up to 2,048 Mbps  
 Line Code.....AMI, B8ZS, HDB3

### Optical

transmitter.....LED/ELED  
 wavelength.....850nm/1300nm multimode  
 .....\*ST (FC or SMA optional)  
 connector.....  
 Loss Budget.....16dB multimode 850nm/1300nm @62.5 mm  
 .....16dB singlemode @ 9 mm  
 .....\*contact factory for requirement higher than 16 dB

### Electrical

interface.....T1/E1  
 connector for T1.....terminal block  
 connector for E1 120 ohm.....terminal block  
 connector for E1 75 ohm.....BNC

*\*ST is a trademark of AT&T*

### System

bit error rate.....1 in 10<sup>10</sup> or better

### Indicator

LEDs.....POWER, SYNC, BPV, LOSS SIG, ALARM

### Power

source.....9V to 12V DC @ 120 mA typical  
 .....48V DC optional

### Temperature

operating.....-10°C to 50°C  
 storage.....-40°C to 90°C  
 humidity.....95% non-condensing

### Physical

height.....(2.80 cm) 1.125"  
 width.....(12.75 cm) 5.0"  
 depth.....(7.50 cm) 2.5"  
 weight.....(275 g) 10 oz

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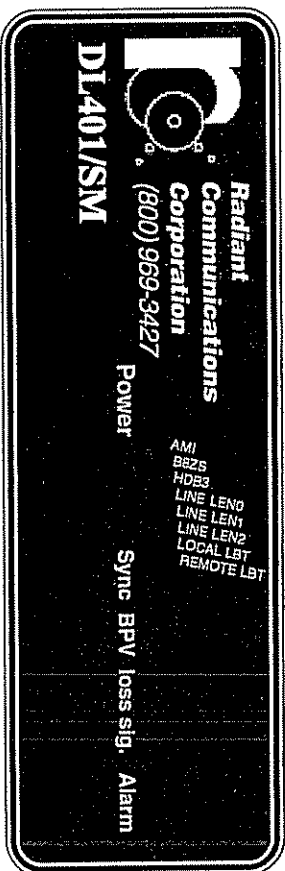
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## S/DL401/SM-R

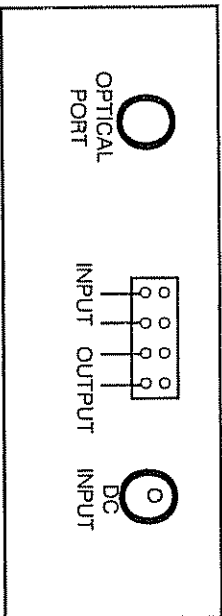
These units are the same as the DL402 modular units. The difference in these units are as follows:

1. These units use a single fiber and they must be used in pairs. They are tested this way: use wavelength 1310nm with wavelength 1550 nm.
2. The "dip switches" that are in the manual are now toggle switches numbers 1 through 8 on the front panel.
3. The LEDs are now on the front panel also.
4. The DC power in, the T1 input and output connector and the single optical port are on the rear of the chassis.

### Front Panel



### Rear Panel



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## IMPORTANT NOTE

Many of our Fiber Optic Electronic Systems are manufactured to transmit signals over the maximum distance possible. This is true for both singlemode and multimode versions. However, it is especially true for singlemode fiber systems, many of which are manufactured to transmit up to 50Km (30 miles).

For short lengths of fiber optic cable, the receiver may saturate -- the amount of light intensity may be too high for the receiver to handle. When this occurs, the system will not operate properly. This frequently occurs when singlemode video systems are tested on a bench using a short jumper. But it can also happen when a 50Km singlemode system is used over a 5Km length of cable. For multimode system, a 3Km system may saturate when used over a 1500 foot length of cable.

There is a simple solution to the problem of saturation. If you suspect this is happening, contact the factory at 1-800-WOW-FIBR. We will be happy to provide you with a fixed attenuator to increase the losses in your fiber optic cable. This extra loss will decrease the light intensity to allow the system to operate properly.

## OLD STYLE CONFIGURATIONS

These units are the same as the DL402 modular units. The difference in these units are as follows:

1. These units use a single fiber and they must be used in pairs. They are tested this way: use serial numbers T1-XXX-A with T1-XXX-B.
2. The "dip switches" that are in the manual are now toggle switches numbers 1 through 8 on the front panel.
3. The LEDs are now on the front panel also.
4. The DC power in, the T1 input and output connector and the single optical port are on the rear of the chassis.

### Front Panel

S1	<input type="radio"/>	AMI
S2	<input type="radio"/>	B8ZS
S3	<input type="radio"/>	HDB3
S4	<input type="radio"/>	LINE LENGTH 0
S5	<input type="radio"/>	LINE LENGTH 1
S6	<input type="radio"/>	LINE LENGTH 2
S7	<input type="radio"/>	LOCAL LBT
S8	<input type="radio"/>	REMOTE LBT

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## WARRANTY

Radiant Communications Corporation warrants that at the time of shipment, the products manufactured by Radiant Communications Corporation will be free from defects in material and workmanship, and will conform to the specifications furnished and approved by Radiant Communications Corporation.

Should any defects appear within one year from date of shipment, Radiant Communications Corporation shall, at its sole discretion, repair or replace the defective unit. Defected units shall not be accepted for return or repair without prior authorization from Radiant Communications Corporation.

Return shipments to Radiant Communications Corporation shall be at the buyer's expense. Radiant Communications Corporation will return repaired or replacement equipment prepaid via best way.

This warranty excludes all other expressed or implied warranties of merchantability, fitness, or otherwise. Items manufactured by suppliers other than Radiant Communications Corporation used with the equipment covered by this document are not eligible under the terms of this warranty. Radiant Communications Corporation assumes no responsibility for the performance or reliability of third-party products.

Radiant Communications Corporation will not be liable for any special or consequential damages, nor for loss, damages, or expenses directly or indirectly arising from the improper use of the products, either as standalone devices or used in conjunction with other equipment and material.

This warranty does not extend to any products manufactured by Radiant Communications Corporation that have been subjected to misuse, neglect, accident, improper installation, an act of God, or in violation of the instructions furnished by Radiant Communications.