


Single Channel T-1 Fiber Optic Link System

User Guide

 RLH Industries, Inc.

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Every effort has been made to ensure that the information in this manual is accurate. RLH is not responsible for printing or clerical errors. Because we are constantly seeking ways to improve our products, specifications and information contained in this document are subject to change without notice.

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Important information

Intended Audience

This manual is intended for use by field engineering, installation, operation and repair personnel. Every effort has been made to ensure the accuracy of the information in this manual is accurate. However, due to constant product improvement, specifications and information contained in this document are subject to change without notice.

Conventions

Symbols for notes, attention, and caution are used throughout this manual to provide readers with additional information, advice when special attention is needed, and caution to prevent injury or equipment damage.



Notes: Helpful information to assist in installation or operation.



Attention: information essential to installation or operation.



Caution: Important information that may result in equipment damage or injury if ignored.

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 T1 lines carry high DC voltages up to 56V. Use caution when handling T1 wiring.
- Active UHDSL lines carry high DC voltages up to 210V. Use caution when handling UHDSL wiring.

Standards compliance

The RLH T-1 Fiber Optic Link System is compliant with the following industry standards.

NEBS Level 3

IEEE-80

IEEE-1590

BR 876-310-100 BT (Telcordia)

GR-63

FCC PART-15

IEEE-367

IEEE-1615

Bellcore SR-3966

FCC PART-68B

IEEE-487

Motorola R56

GR-1089

Description and application

The Fiber Optic Link T-1 Model 2 (backwards compatible with the Model 1) System processes incoming bipolar signals (7.2 V P-P Max) within a bandwidth of 100 KHz to 10 MHz T-1 (1.544Mbps) or (CCITT 2.048Mbps), optically transmits these signals via fiber optic cable and converts the signal to the original electrical signal with minimal gain or loss.

Output to the copper line is automatically maintained at a nominal level. The Fiber Optic Link system is compatible with European E1. Transient voltages appearing on or between the 4-wire pairs and/or power supply input are limited by thermistors, gas tubes and MOVs.

Acronyms

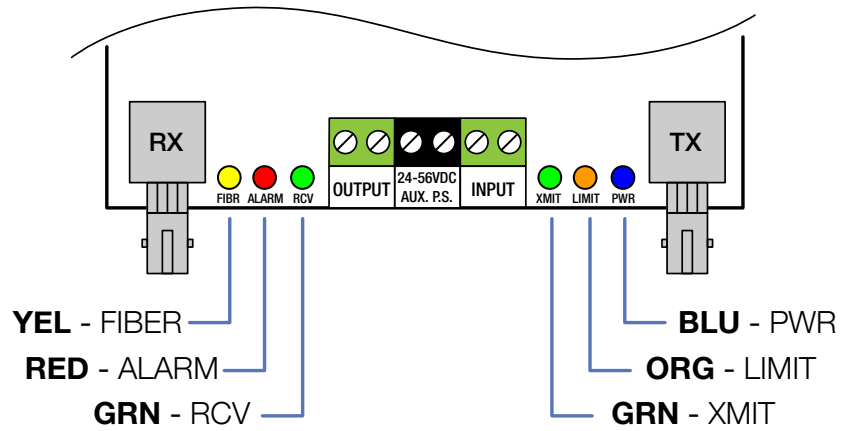
Commonly used acronyms and abbreviations

Acronym/Abbreviation	Description
B8ZS	Bipolar 8 Zero Substitution
AMI	Alternate Mark Inversion
CFJ	Copper Fiber Junction (also referred to as Demarc)
CO	Central Office
CPE	Customer Premises Equipment
Demarc	Location of RLH CO equipment and Telco connection
GPR	Ground Potential Rise
LED	Light Emitting Diode
Sub	Subscriber
NIU	Network Interface Unit
RX	Receive
TX	Transmit

Color abbreviations

Abbreviation	Color
BLU	Blue
GRN	Green
ORG	Orange
RED	Red
YEL	Yellow

LED status indicators

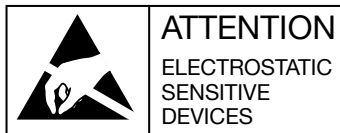


LED	Color	ON condition	OFF condition
FIBR (Fiber Test)	YEL	<ul style="list-style-type: none"> • “Fiber signal” switch SW2 is ON at the far end card. • Fiber test signal is being received. 	<ul style="list-style-type: none"> • Normal operation (“Fiber Signal” switch is OFF at the far end card) • If SW2 is ON on far end card, check fiber continuity
ALRM (Alarm)	RED	Signal is below minimum operating level	Normal operation
RCV (Receive)	GRN	Signal is received from fiber	Normal operation
XMIT (Transmit)	GRN	Signal is received at copper input	Normal operation
LIMIT	ORG	Copper input signal overload	Normal operation
PWR (Power)	BLU	DC power is connected	No DC power is connected

Before installing

1. Observe special handling requirements

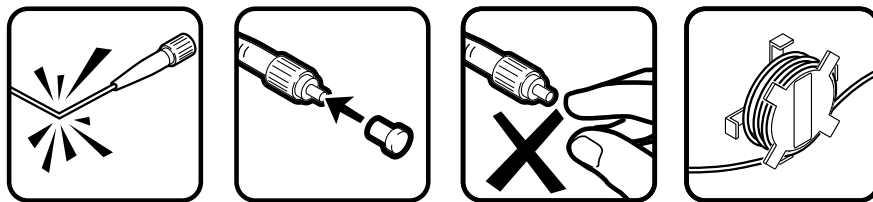
1.1 Be careful when handling electronic components



- 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.

1.2 Guidelines for handling terminated fiber cable



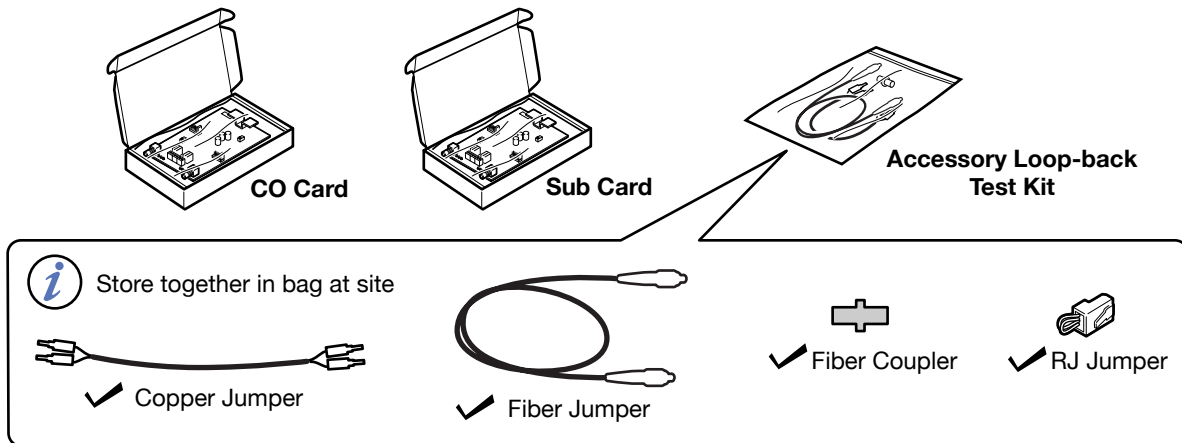
- Do not bend fiber cable sharply. Use gradual and smooth bends to avoid damaging glass fiber.
- Keep dust caps on fiber optic connectors at all times when disconnected.
- Do not remove dust caps from unused fiber.
- Keep fiber ends and fiber connectors clean and free from dust, dirt and debris. Contamination will cause signal loss.
- Do not touch fiber ends.
- Store excess fiber on housing spools or fiber spools at site

2. Set up for installation

2.1 Check for shipping damage.

Contact RLH immediately if any components are damaged or missing. Electronic components, fiber optic cable, and accessories have special handling requirements to prevent damage and enhance system reliability.

2.2 Verify T-1 System Contents.



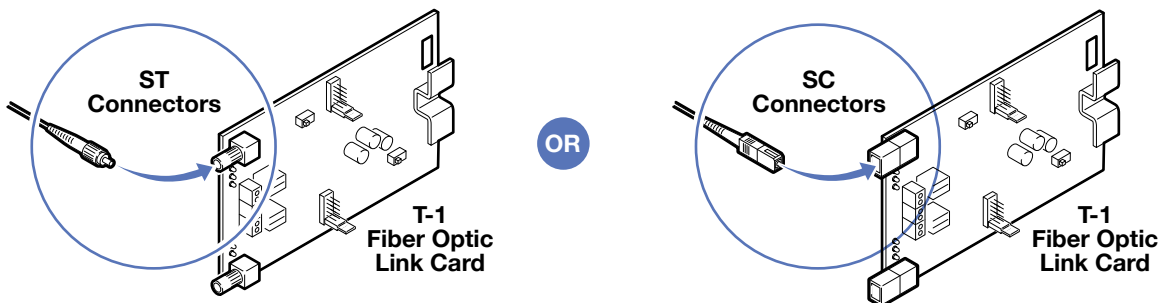
Fiber Type	Connector Style	4 Wire TI/EI CO Card	4 Wire TI/EI Sub Card
Multimode *	ST	8806-1315-02	8806-1325-02
Multimode *	SC	8805-1315-02	8805-1325-02
Single-mode	ST	8806-1300-02	8806-1310-02
Single-mode	SC	8805-1300-02	8805-1310-02
Single-mode (Long Haul)	ST	8806-1300-02LH	8806-1310-02LH
Single-mode (Long Haul)	SC	8805-1300-02LH	8805-1310-02LH

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

▶ Add **-RJ** to part number to include RJ adapter with the card

Part Number	Description
RLH-RJTI-CO	RJ-48C Adapter for CO 4Wire T1 Card
RLH-RJTI-SUB	RJ-48C Adapter for SUB 4Wire T1 Card

2.3 Verify matching connector types on fiber cable and T-1 cards.



2.4 Verify matching card and fiber modes.

Fiber mode and card mode must be the same.

Fiber Type	Color	Identifier
Single Mode	Yellow	9/125
Multimode	Orange	62.5/125

2.5 Set default T-1 card settings.

Settings are the same for both CO and Sub cards.

FIBER LOSS
OFF <4dB> ON
← OFF ✓ (Red)

LOSS SELECT
6
5
4
3
2
1
✓ Position 1
(Blue Jumper)

FIBER SIGNAL → OFF SW2 ON
← OFF ✓ (Red)

GAIN
6
5
4
3
2
1
✓ Position 1
(Red Jumper)

2.6 For extended distance multimode systems.

Multimode Only

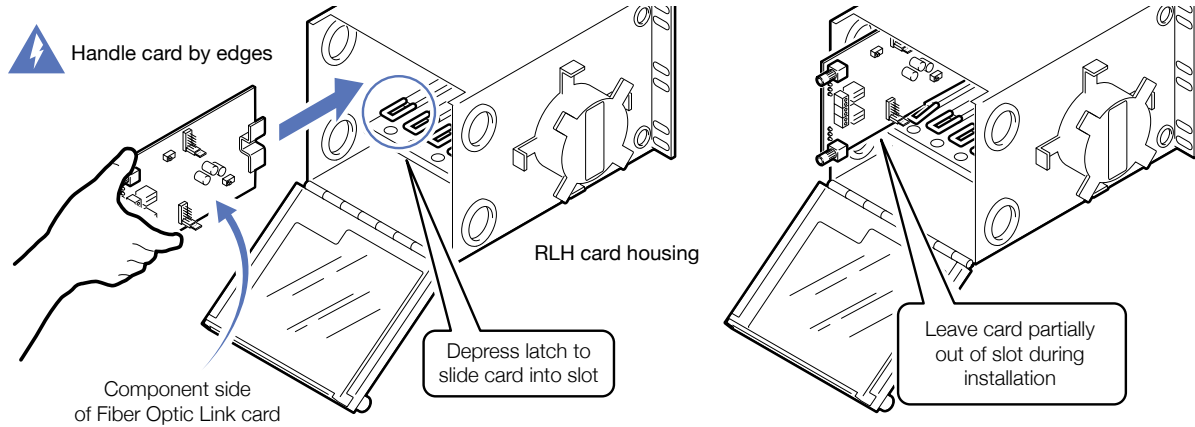
Set **FIBER LOSS** switch to **ON** for fiber **over 4,000 feet** (loss of 4dB)

FIBER LOSS
OFF <4dB> ON
ON →

3. Installing into card housing

3.1 Note card orientation in housing during installation.

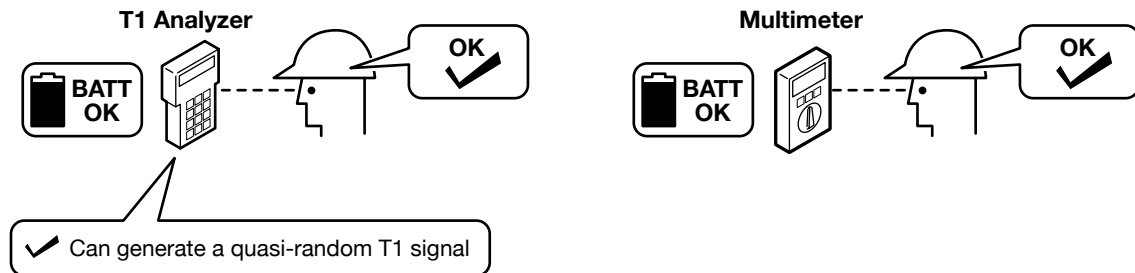
Handle card by edges. Install in slot 1 or next available card slot. Install card into housing before connecting.



4. Required test equipment

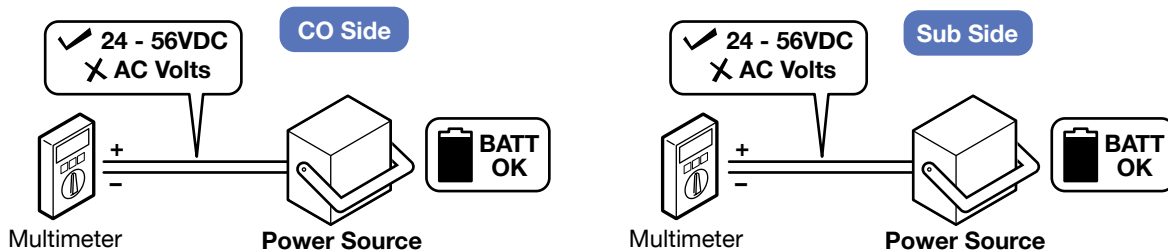
4.1 You will need a T1 analyzer such as a T-BERD and a multimeter.

Be familiar with the test settings. Some analyzers have line power and multimeter capability. For installation where no T-1 signal is available, the analyzer must be capable of generating a quasi-random T-1 signal.



4.2 Required power sources if installing before T-1 service is available at the site.

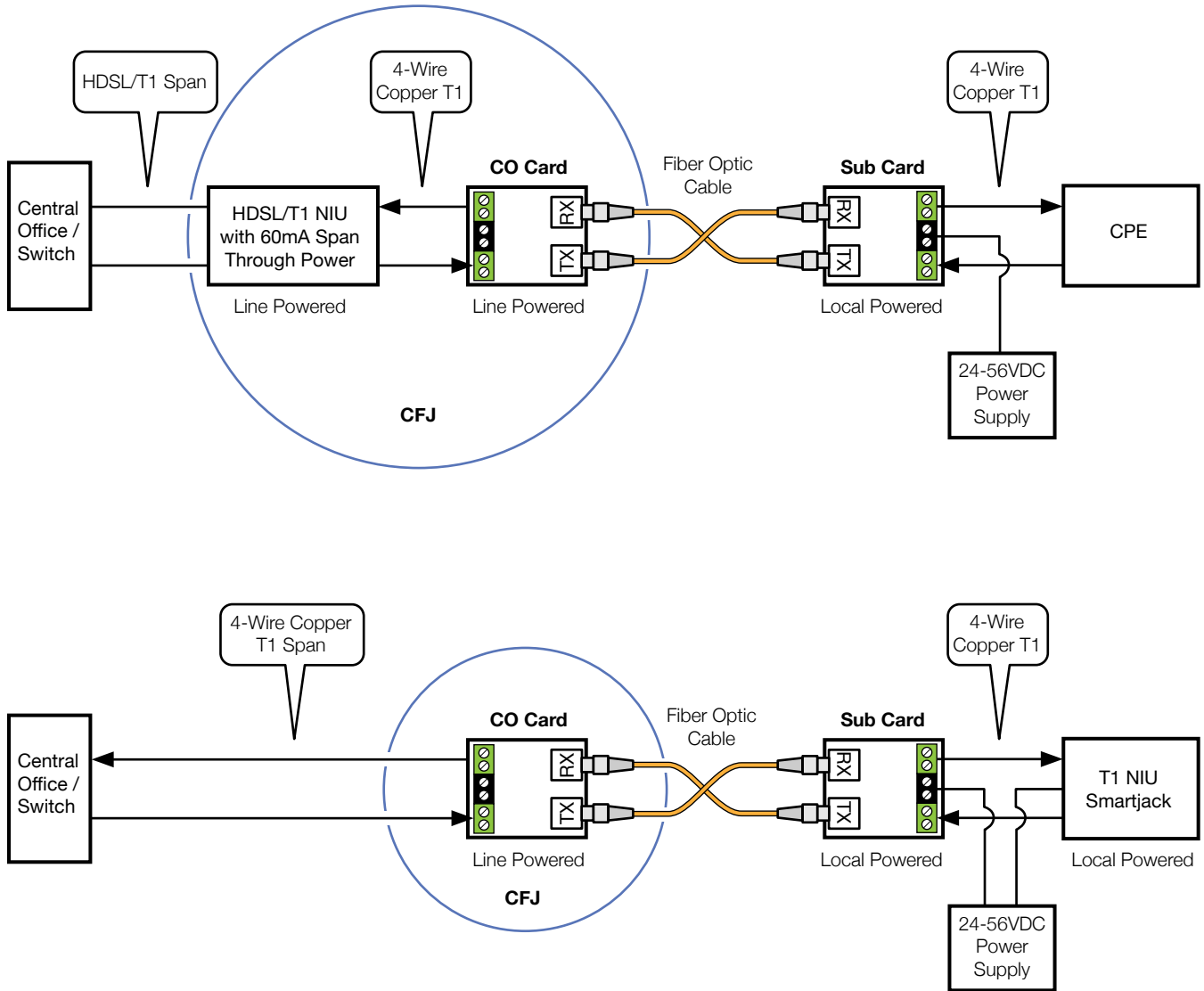
You will need to power the system to test it. Use a separate power source for powering the CO and Sub side card. A battery may be used.



5. Verify your installation environment

5.1 Typical T1 application environments.

Fiber optic cable needs to be installed prior to installing T-1 Fiber Optic Link system.



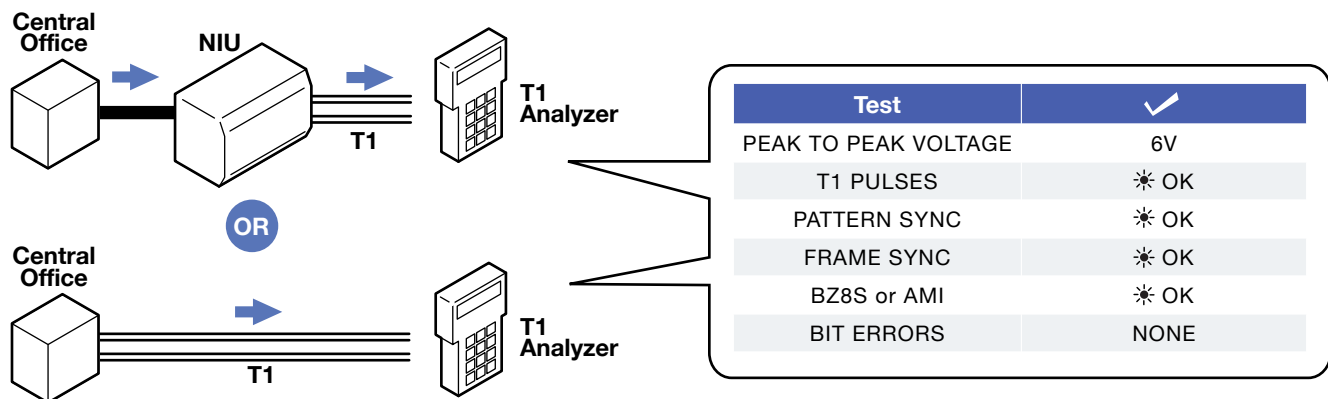
Installation when T-1 service is available

Also see **Installation prior to available T-1 service** on page 20

1 Connect CO card

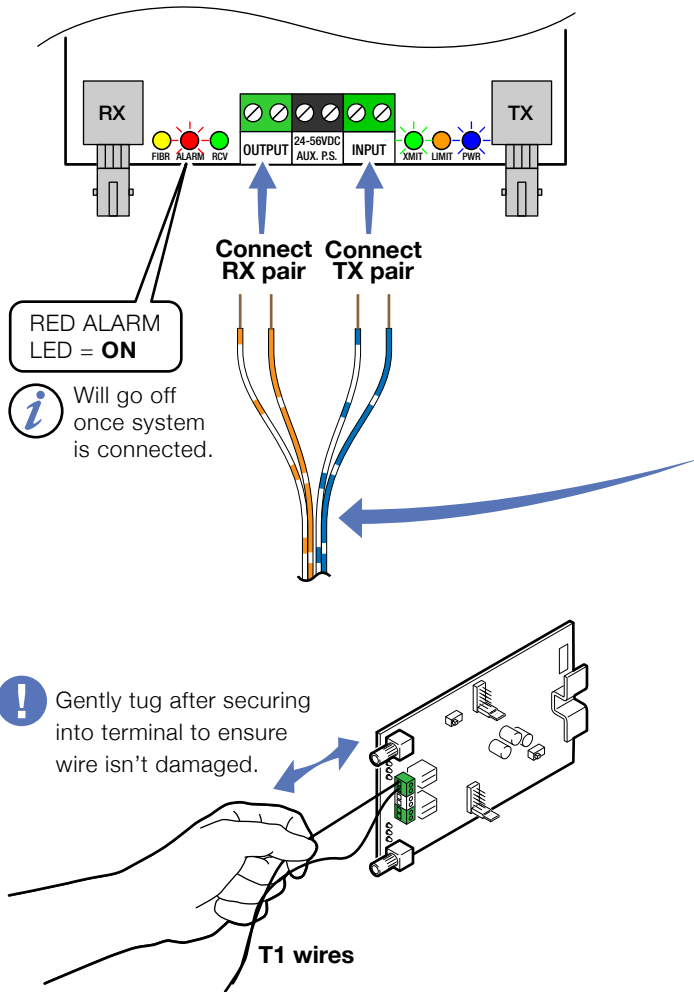
1.1 Verify acceptable T-1 signal

Repair the T-1 lines if service is not acceptable. Check for NIU compatibility in the troubleshooting section.



1.2 Connect T-1 pairs to card terminal

Install into housing for connecting and testing. Refer to **Installing into card housing** on page 9. All LEDs will be ON for approximately 5 seconds after span power is first applied.

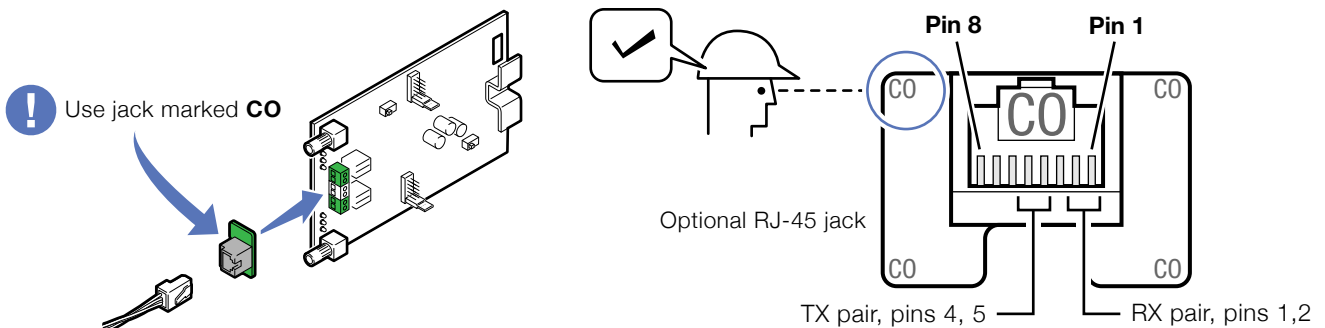


Standard 25-Pair Color Code

Pair #	First wire	Second wire
1		Blue
2		Orange
3	White	Green
4		Brown
5		Gray
6		Blue
7		Orange
8	Red	Green
9		Brown
10		Gray
11		Blue
12		Orange
13	Black	Green
14		Brown
15		Gray
16		Blue
17		Orange
18	Yellow	Green
19		Brown
20		Slate
21		Blue
22		Orange
23	Violet	Green
24		Brown
25		Gray

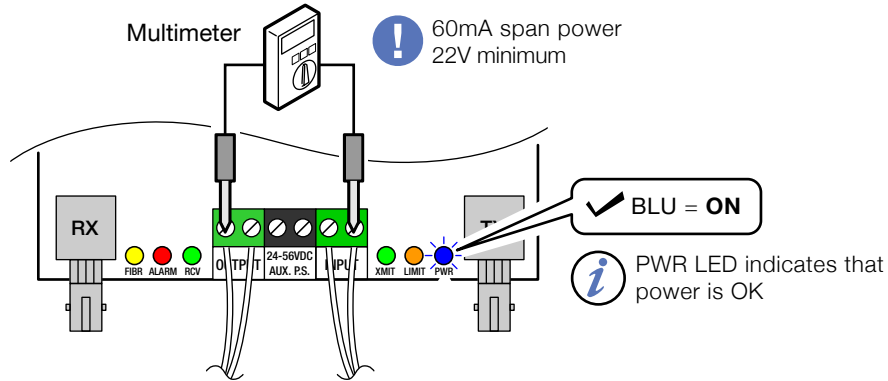
1.3 Connection using optional RJ connector

RJ connector may be pre-installed or obtained separately.



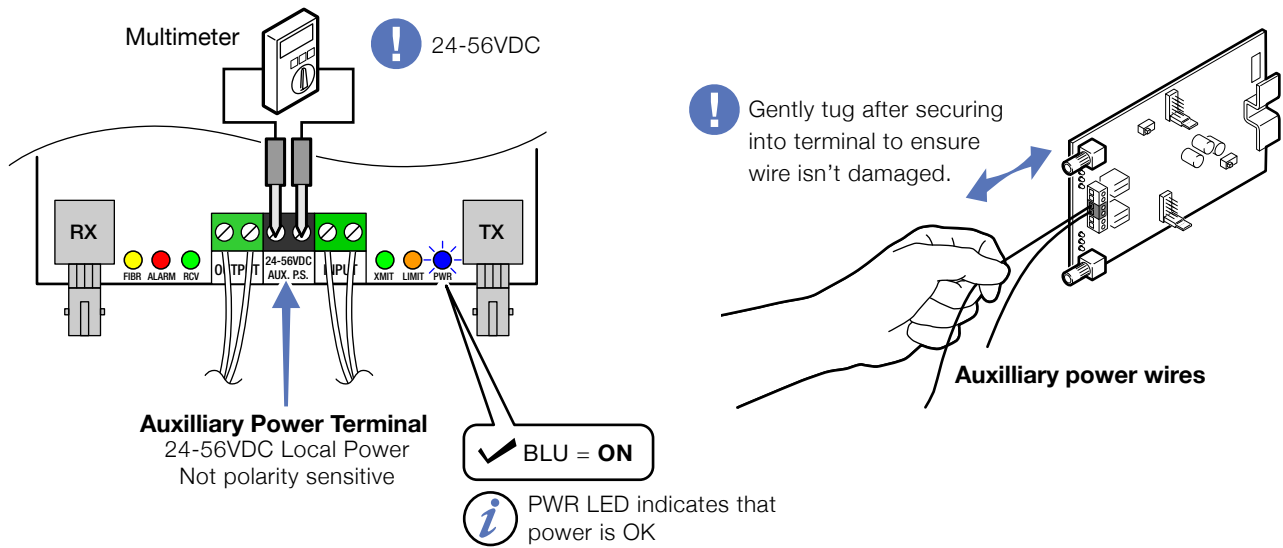
1.4 Verify power at the T1 card

Test for Span power.



1.5 Connect local power if Span power is not present.

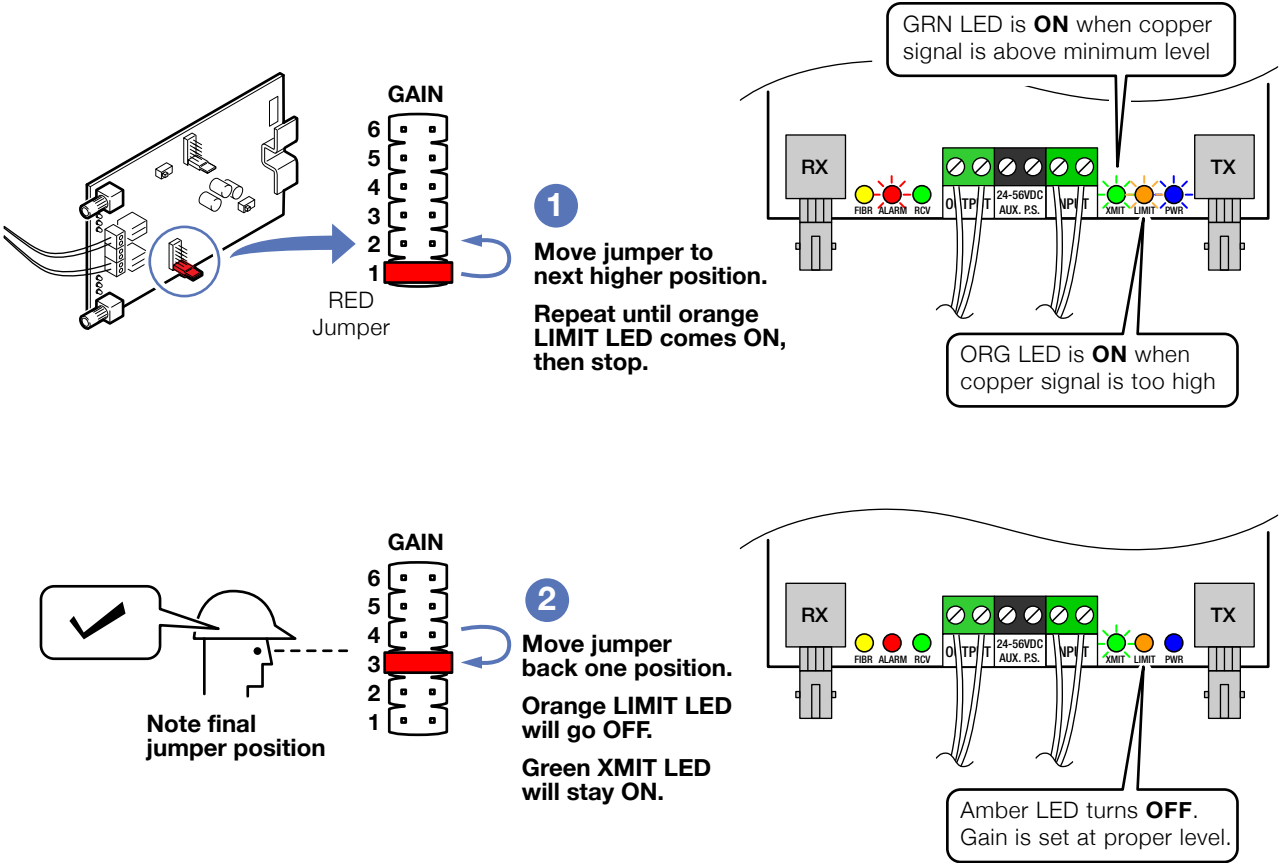
All LEDs will be ON for approximately 5 seconds after power is first applied.



2 Set CO card gain

2.1 Set gain using red gain GAIN jumper

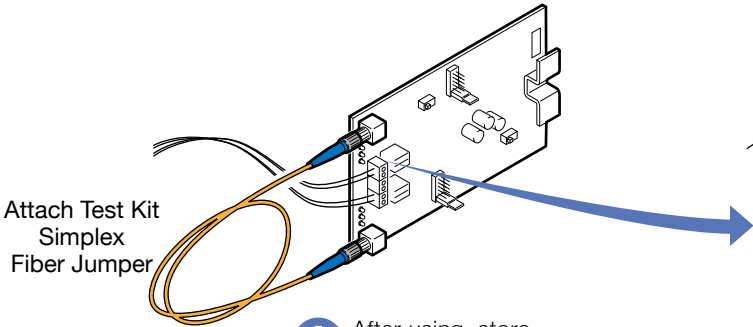
Set gain while T-1 signal is present.



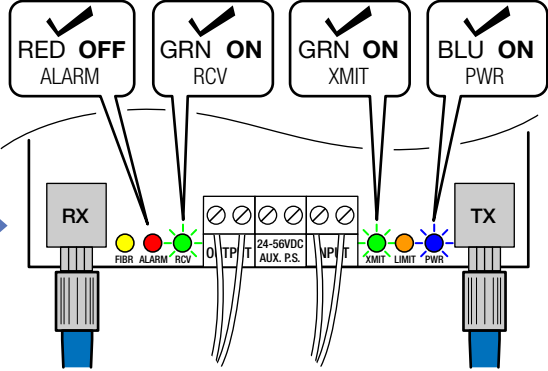
3 Verify CO card operation

3.1 Check CO card operation

Perform loopback test using fiber jumper



- ! After using, store fiber jumper with test kit at convient site location.
 - Do not discard fiber caps.
 - Replace caps after use.

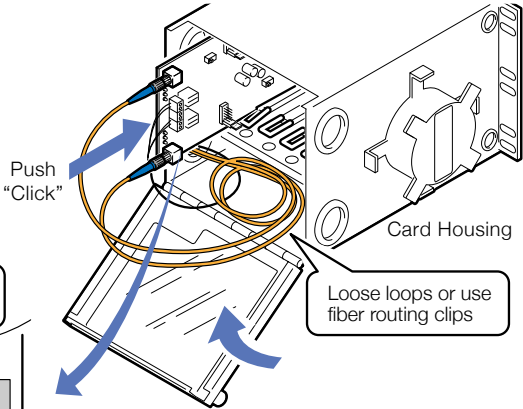
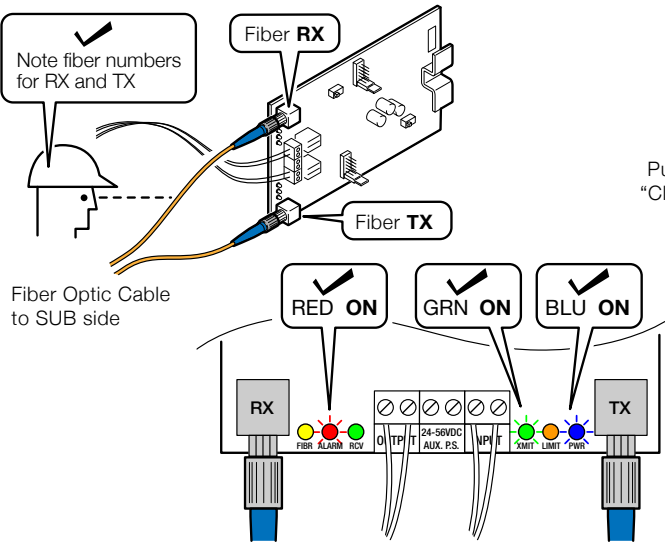


- i If both GREEN LEDs are not ON, verify T1 signal, power and connections

4 Connect CO fiber cables

4.1 Connect fiber optic cable

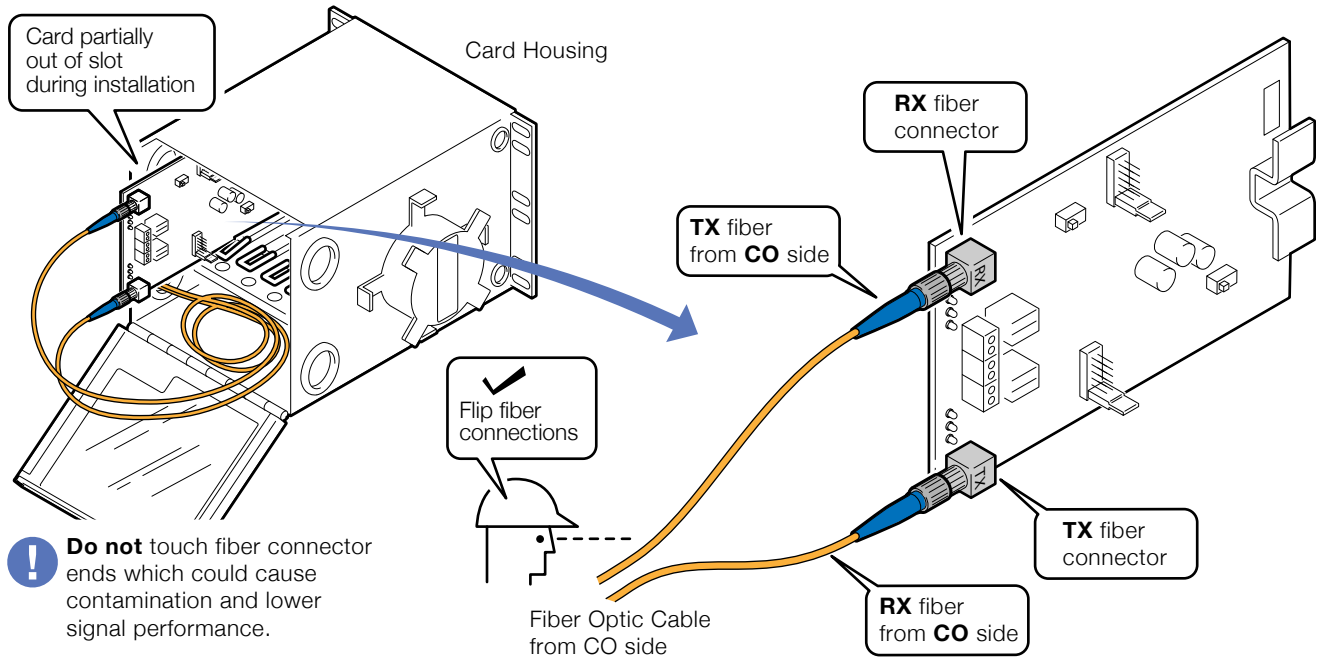
Move on to Sub side after verifying LEDs.



5 Connect Sub card

5.1 Connect fiber cables

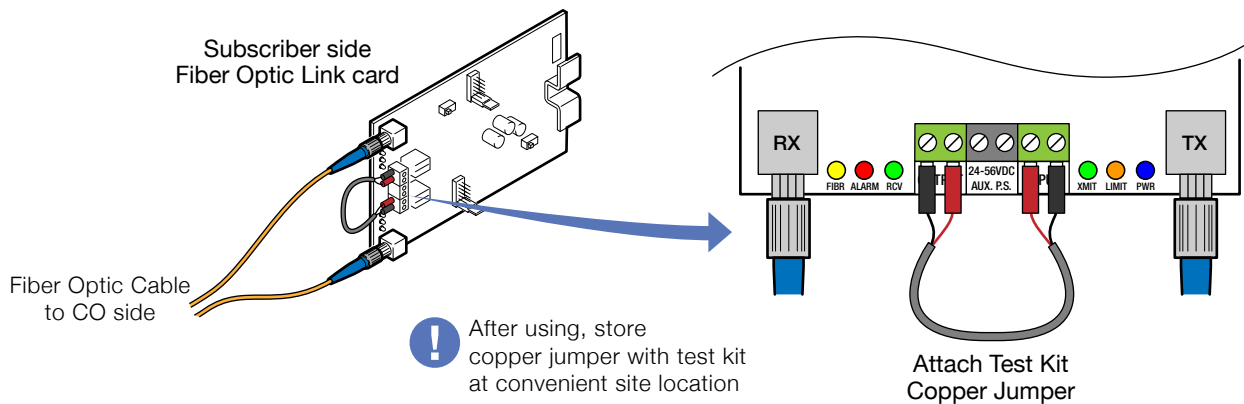
Flip or roll the fiber cables



6 Connect loopback jumpers and power

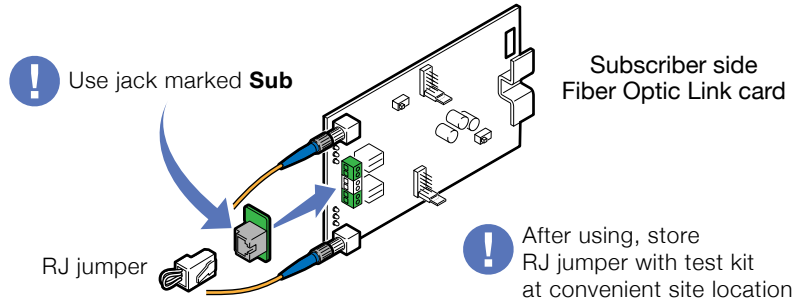
6.1 Connect copper loopback jumpers

When using wire terminals.



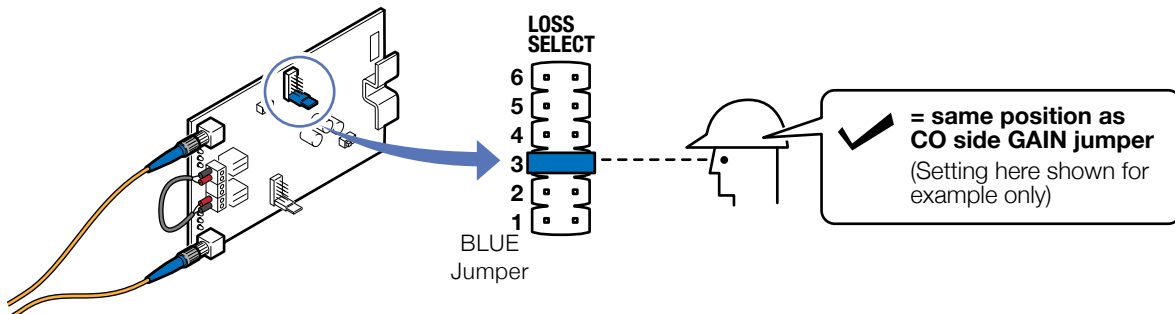
6.2 Connect optional RJ loopback jumper

When using RJ connections.



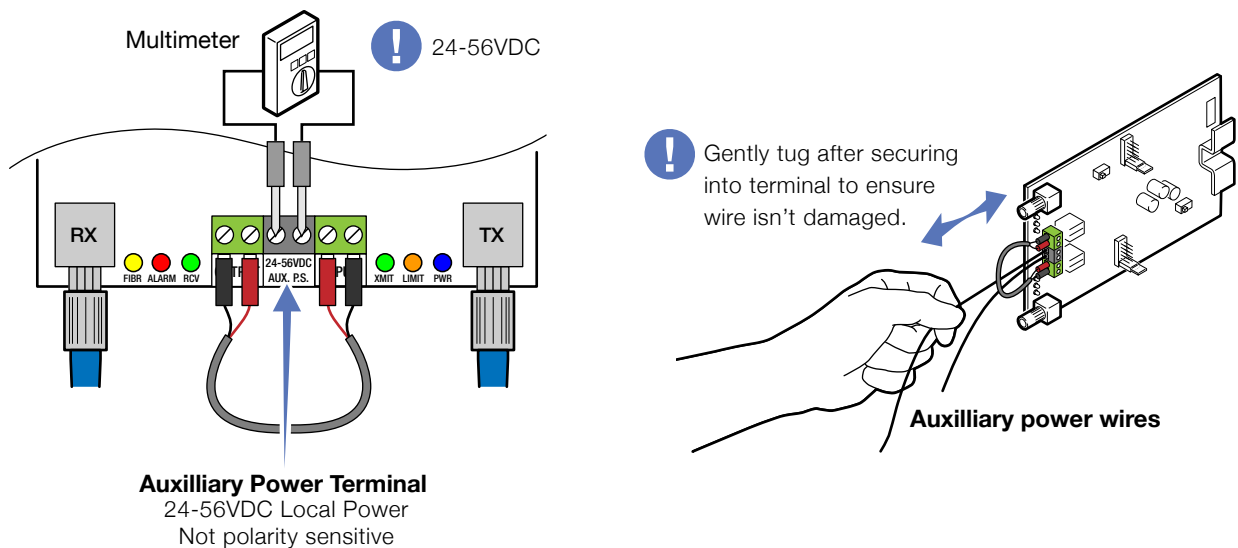
6.3 Set loss select jumper

Set to same number as GAIN jumper on CO side card.



6.3 Connect local power source

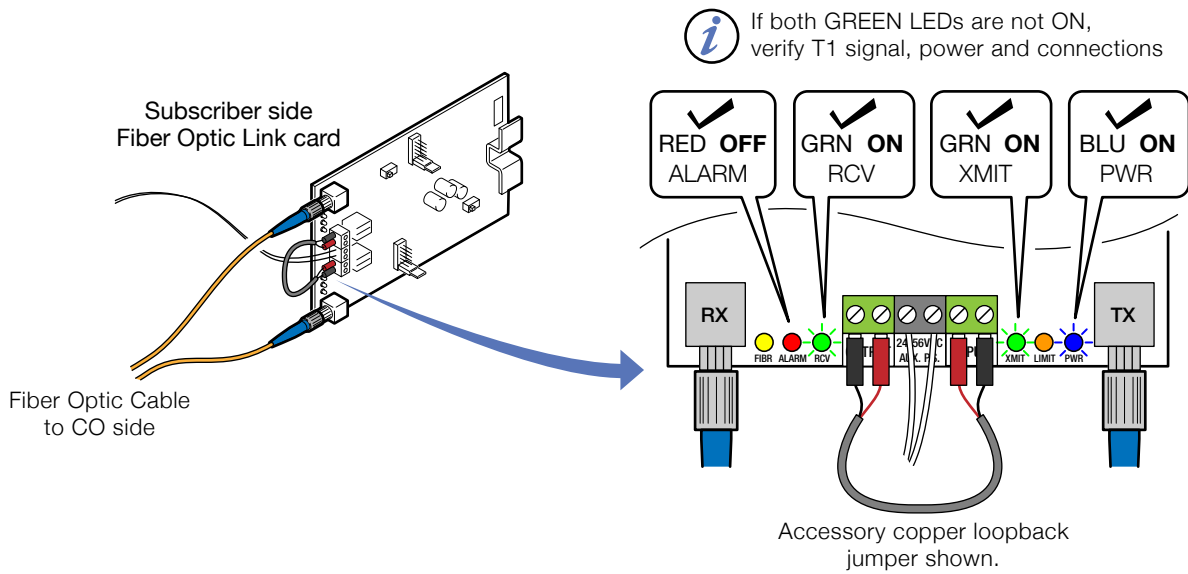
All LEDs will be ON for approximately 5 seconds after power is first applied. Copper loopback jumpers shown.



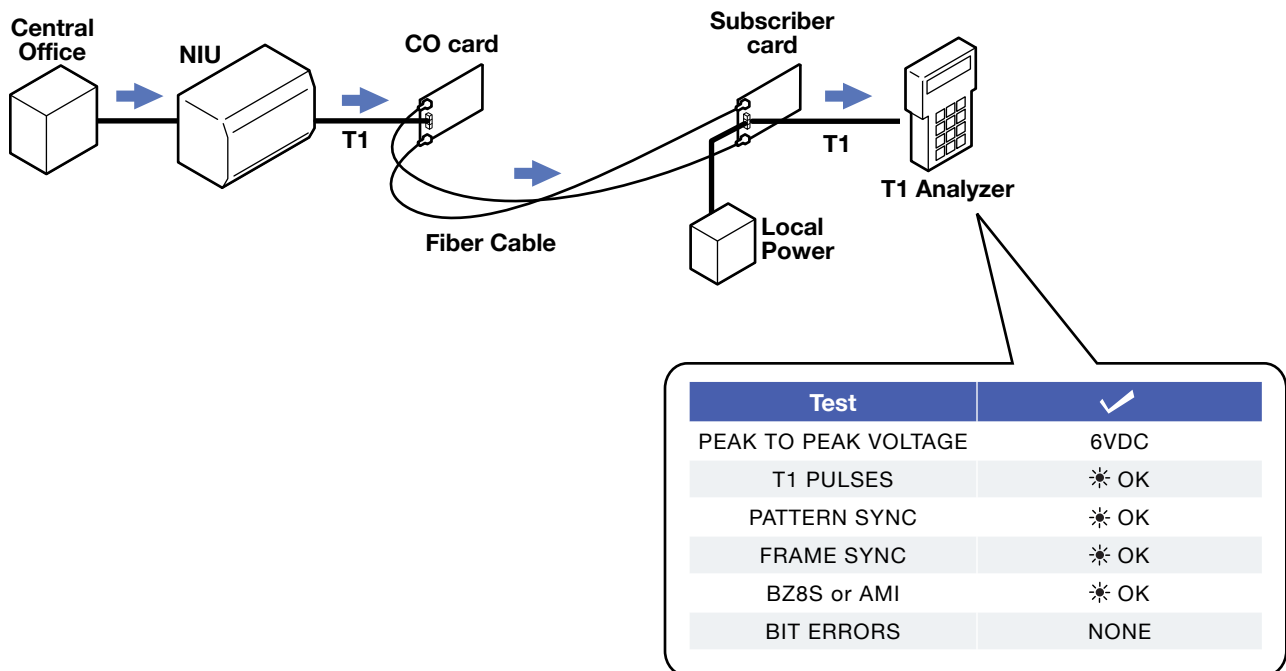
7 Verify Sub card operation

7.1 Verify subscriber card operation

Status LEDs are the same when using either copper loopback jumpers or optional RJ jumper.



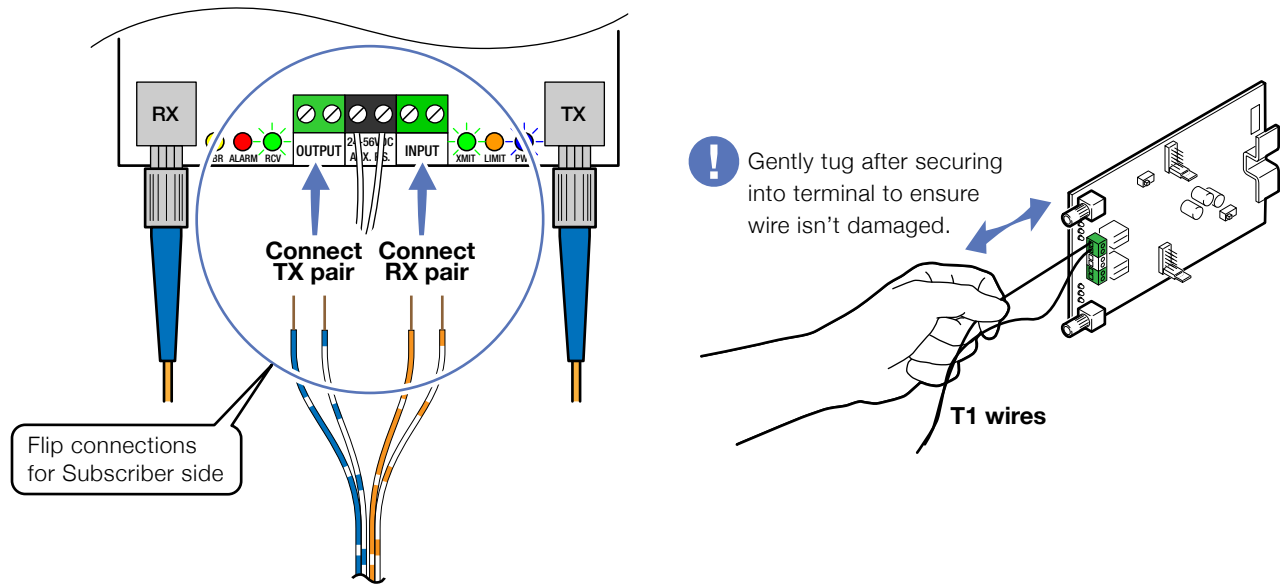
7.2 Test Sub side T1 signal



8 Connect customer premises equipment

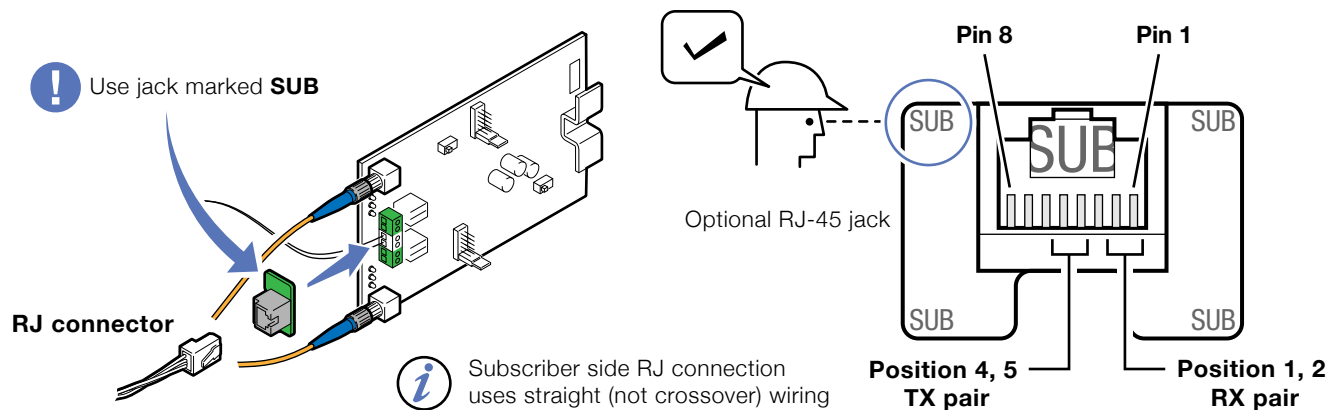
8.1 Connect Customer Premises Equipment

Connect CPE to Fiber Optic Link Card.



8.2 Optional RJ connection

Connect CPE to Fiber Optic Link Card using RJ connector. Note RJ jack identifiers when installing.



8.3 Close Sub side housing

Store excess fiber cable. Installation is complete.

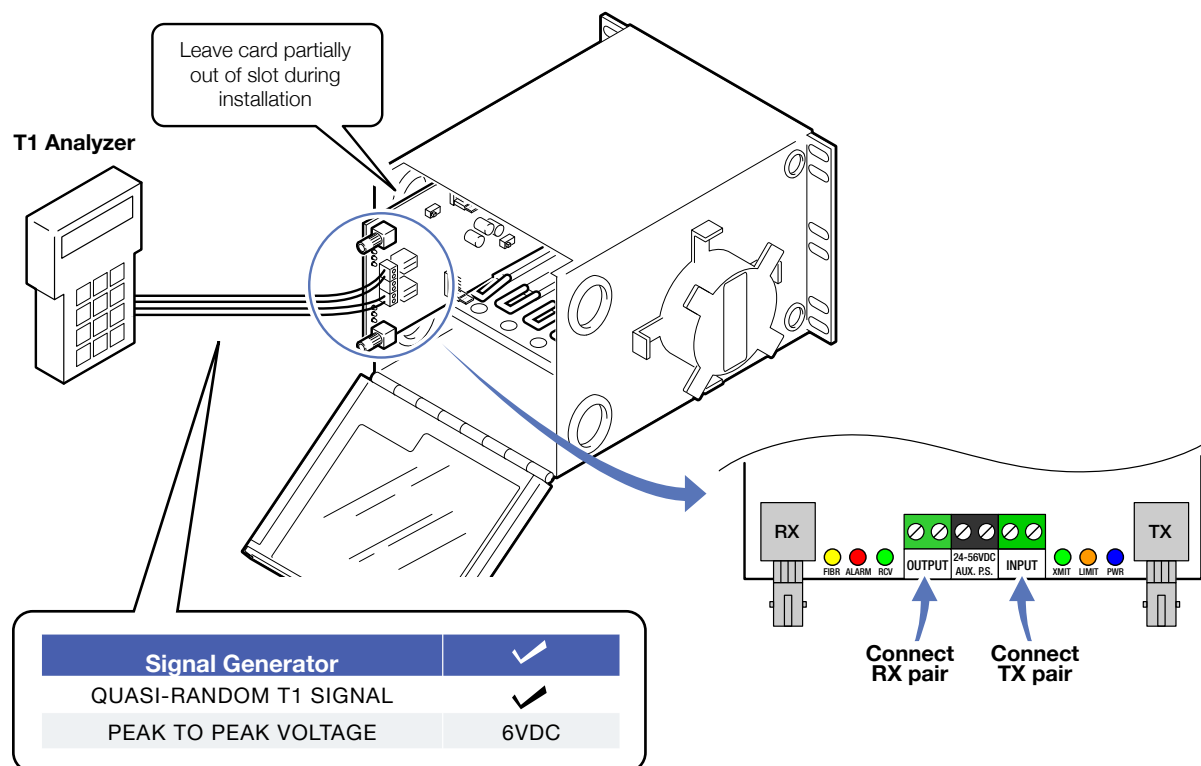
Installation prior to available T-1 service

Also see **Installation when T-1 service is available** on page 11

1 Set up CO card

1.1 Connect T1 signal to CO card

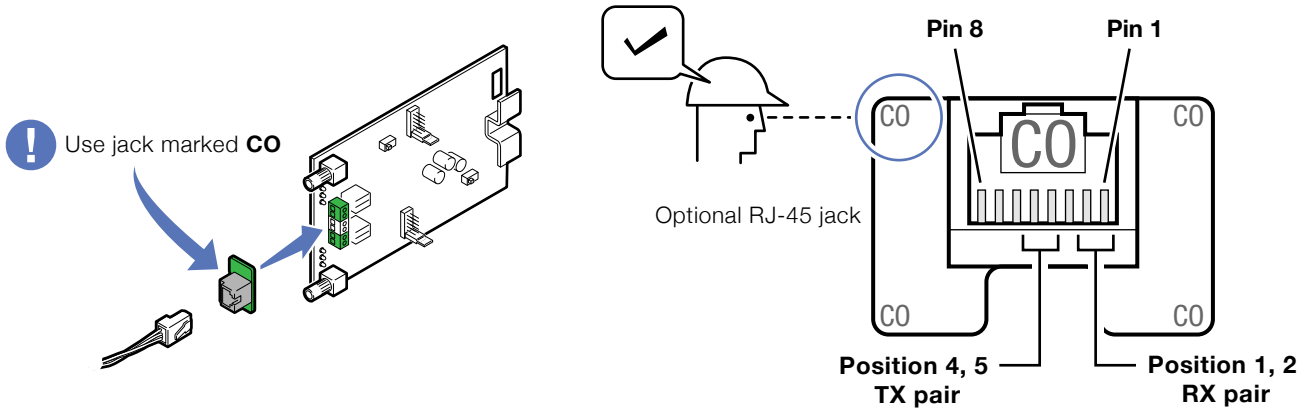
If Span power is provided by the analyzer, all LEDs will be ON for approximately 5 seconds after signal and power are first applied.



1.2 When using optional RJ connector

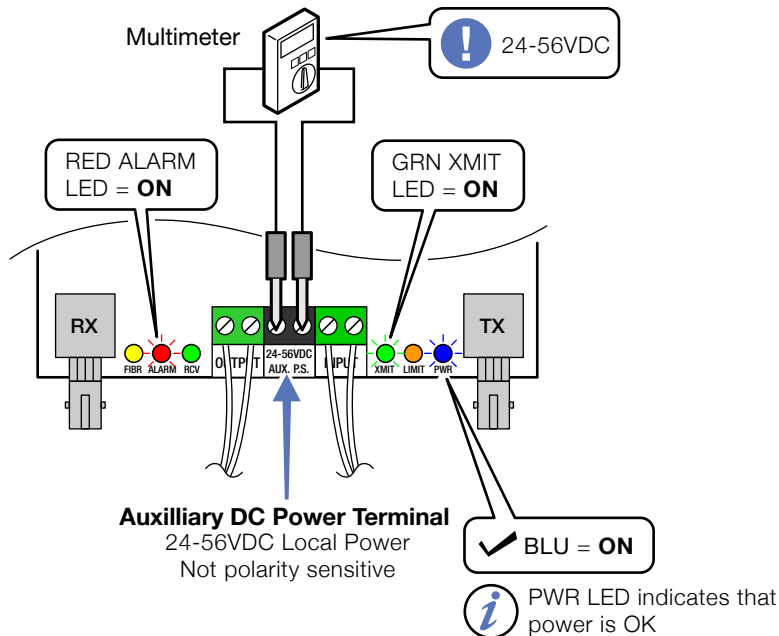
Connect T-1 signal from analyzer using RJ connector. Note RJ jack identifiers when installing.

If Span power is provided the analyzer, all LEDs will be ON for approximately 5 seconds after signal and power are first applied.



1.3 Connect Power to CO card

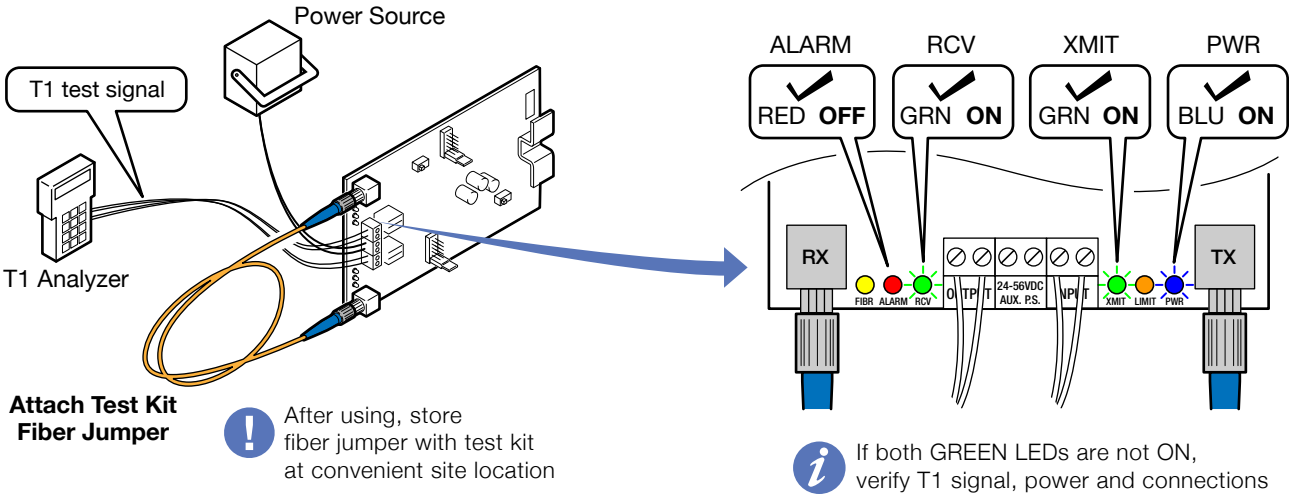
With the T-1 signal applied, attach the 24-56VDC portable power source. All LEDs will be ON for approximately 5 seconds after power is first applied.



2 Verify CO card operation

2.1 Check CO card operation

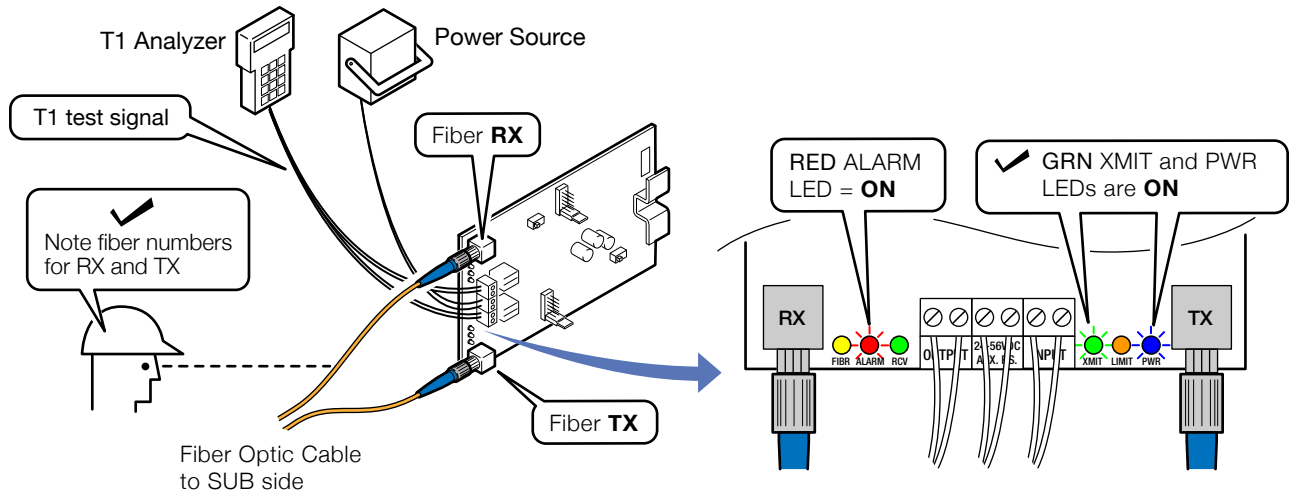
Perform loopback test. Attaching fiber jumper to TX and RX fiber connectors while T-1 signal and power are present.



3 Connect CO fiber cables

3.1 Connect CO side fiber optic cable

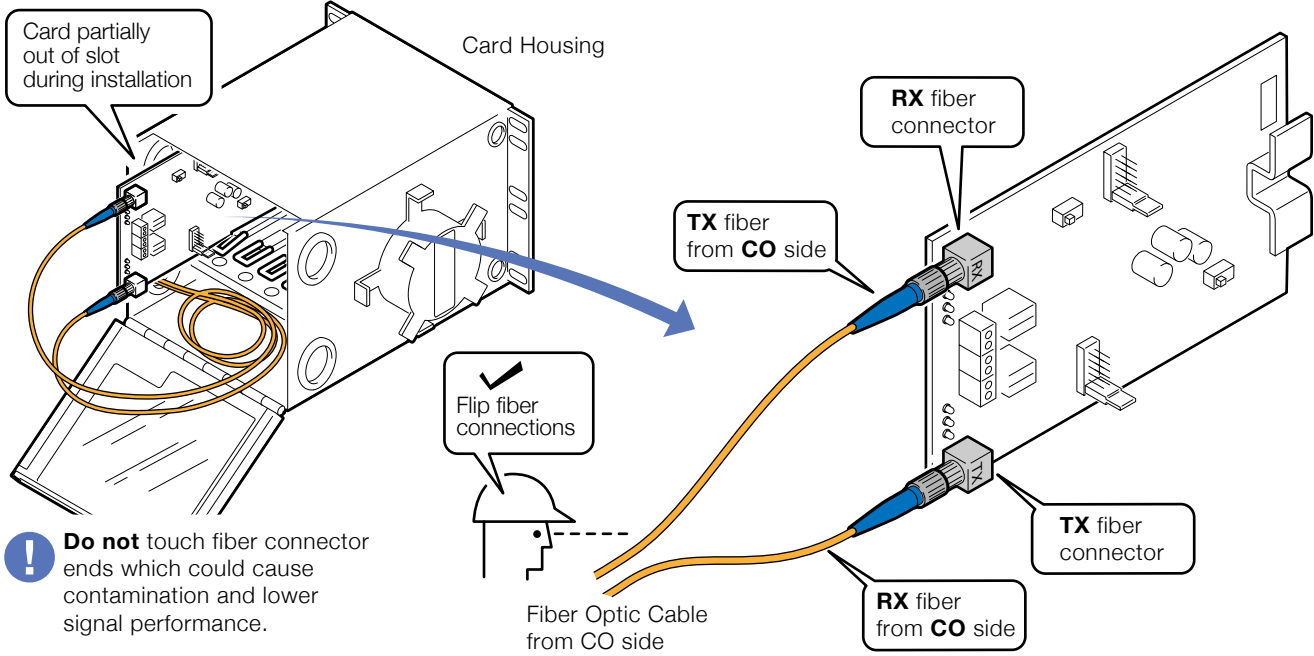
Remove test kit fiber jumper from CO card and connect fiber cable. T1 analyzer and power source remain connected. Proceed to Sub side.



4 Connect Sub card

4.1 Connect fiber cables

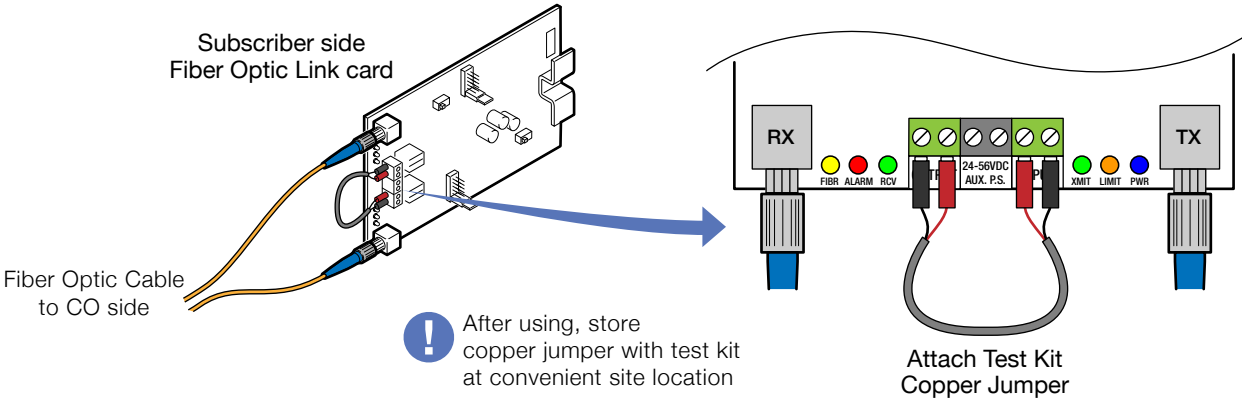
Flip or roll the fiber cables



5 Connect loopback jumpers and power

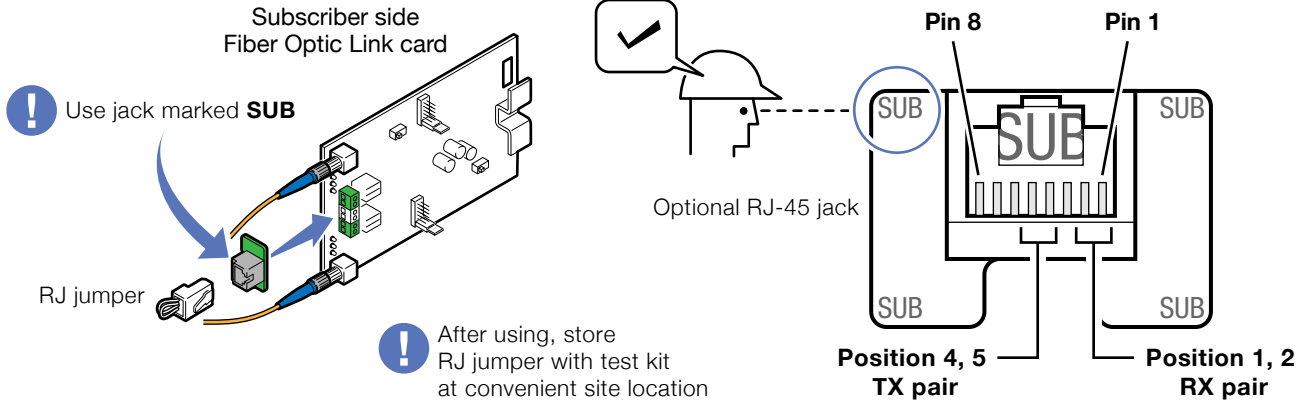
5.1 Connect copper loopback jumpers

When using wire terminals.



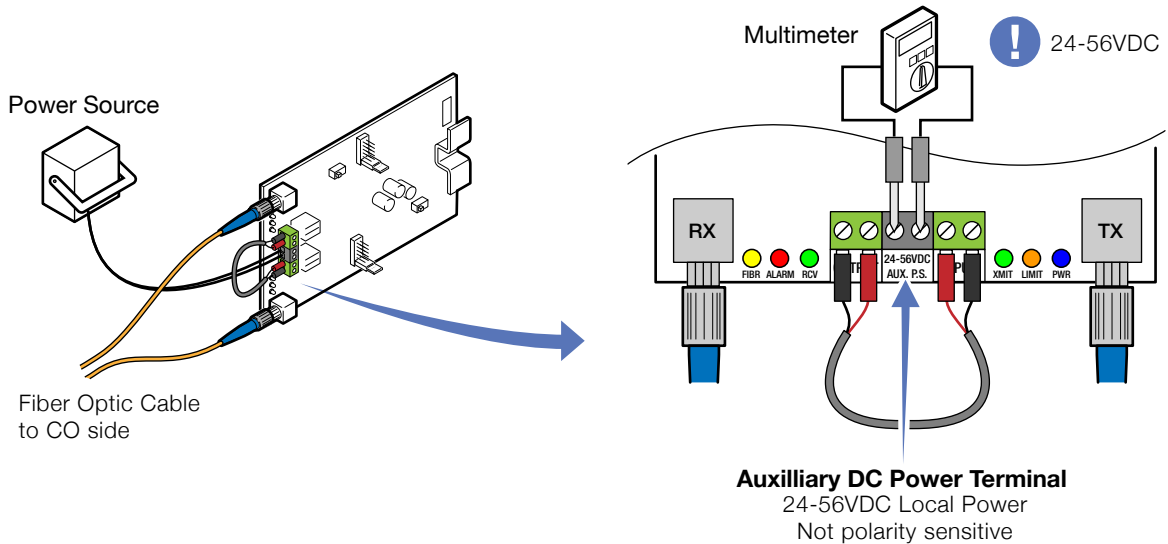
5.2 Connect optional RJ loopback jumper

When using RJ connections.



5.3 Connect local power source

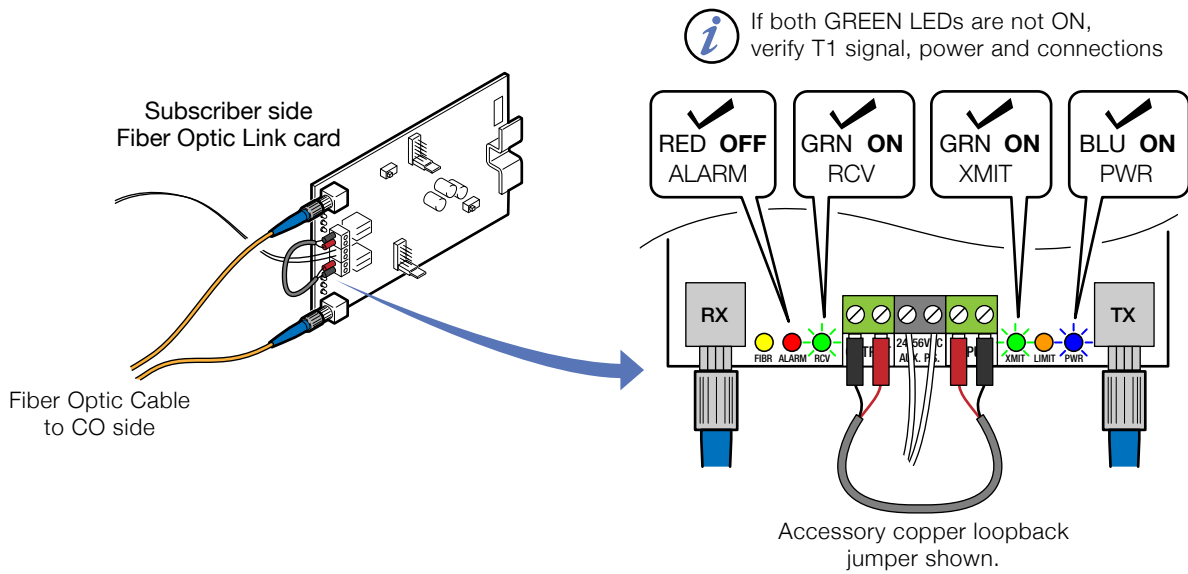
All LEDs will be ON for approximately 5 seconds after power is first applied. Copper loopback jumpers shown.



6 Verify Sub card operation

6.1 Verify subscriber card operation

Status LEDs are the same when using either copper loopback jumpers or optional RJ jumper.



6.2 Complete installation

Disconnect jumper, power, and T-1 analyzer. Push cards into housings and close cover at both CO and Sub side. Leave fiber cables connected and properly store excess fiber.

Troubleshooting

First Step: Isolate the problem

Following the the installation procedure will greatly speed any troubleshooting. It is designed to isolate different parts of the system during installation.

Isolating the source of trouble is essential to determining the steps needed to fix the problem. Most installation problems can be easily fixed in the field once the problem is properly identified.

Common Issues

Most problems encountered during installation and testing can be attributed to these 4 issues:

- **Problems with the incoming T-1 signal** (where T-1 signal is present)
- **Problems providing correct power to the cards**
- **Problems with the copper connection wiring due to nicking, scoring or poor terminating**
- **Problems with the fiber optic cable**

RLH T-1 cards are built to the highest standards and fully tested before leaving the factory.

Isolating and ruling out common issues with the installation will help determine if there is a problem with the card itself.

Power supply issues

Blue PWR LED remains off

The T-1 card isn't receiving proper power.

- Check power by using a multimeter on the top of the screw-down terminals.

If using Span power

- Check across the INPUT and OUTPUT terminals. Power must be 22VDC minimum.
- Check the NIU compatibility chart for NIU systems providing span power.
- If Span power is too low or not provided, repair the T-1 line or use an auxiliary power source.
- Check wiring for nicking, scoring or poor termination.

If using auxiliary power

- Check the AUX P.S. terminals for 24-56VDC, 55-75mA.
- No AC power can be detectable on the DC power line.
- Check wiring for nicking, scoring or poor termination.

CO side troubleshooting

Fiber loopback doesn't turn on green RCV LED.

A signal isn't being received at the fiber connection.

- Check the incoming power to the card with the BLU LED.
- Verify that the GRN XMIT LED is ON, indicating that a T-1 signal is present.
- Check that the fiber jumper isn't damaged or contaminated.

Sub Side troubleshooting

The green XMIT LED remains OFF with copper loop-back jumper

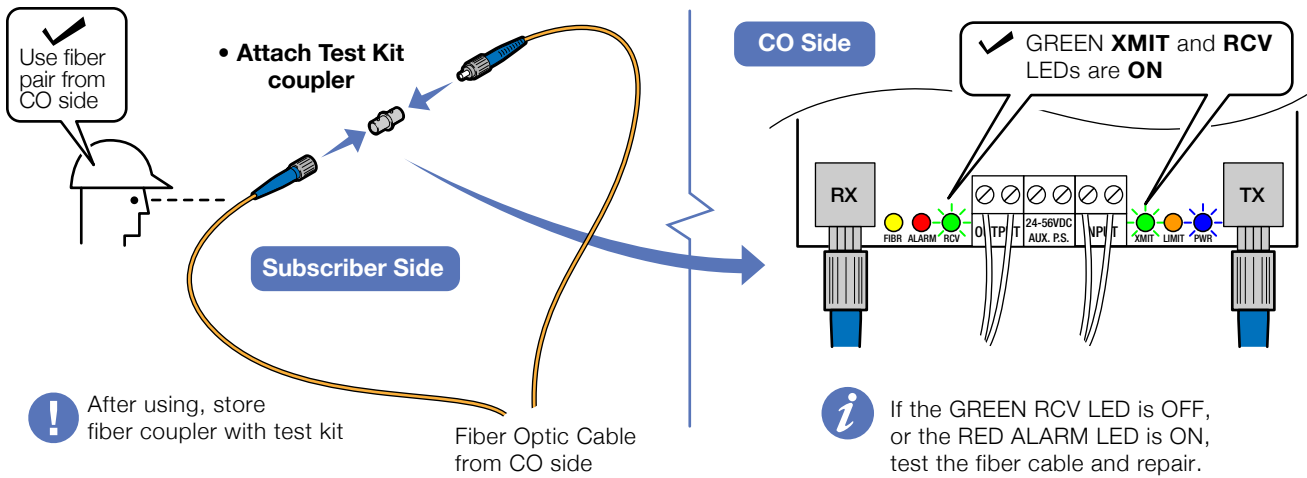
- Indicating that no T-1 signal is being transmitted back to the CO card
- Check the correct connection of the fiber cable. The fiber connections must be flipped for correct operation.
- Verify that the fiber cable is good. Check that the GRN RCV LED is ON, indicating a fiber signal is being received from the CO card. See the section on testing the fiber.
- If using multimode system over 4,000 ft., verify that the CO and Sub multimode switches (SW1) are ON.

Verifying fiber cable

When T-1 signal is present

Verify the fiber cable when the CO card fiber loopback test is good, but the Sub side GRN RCV LED will not go on, indicating that a fiber signal is not being received. Refer to **Installing into working environment step 5.5**, or **Installing prior to T-1 service step 5.4** for information on the CO fiber loopback test.

Use the accessory test kit coupler to verify fiber cable continuity. The CO card must be powered and connected to a T-1 signal.



To test the fiber cable, use a fiber optic cable test set with light source and meter.

T-1 System Fiber Test Specifications

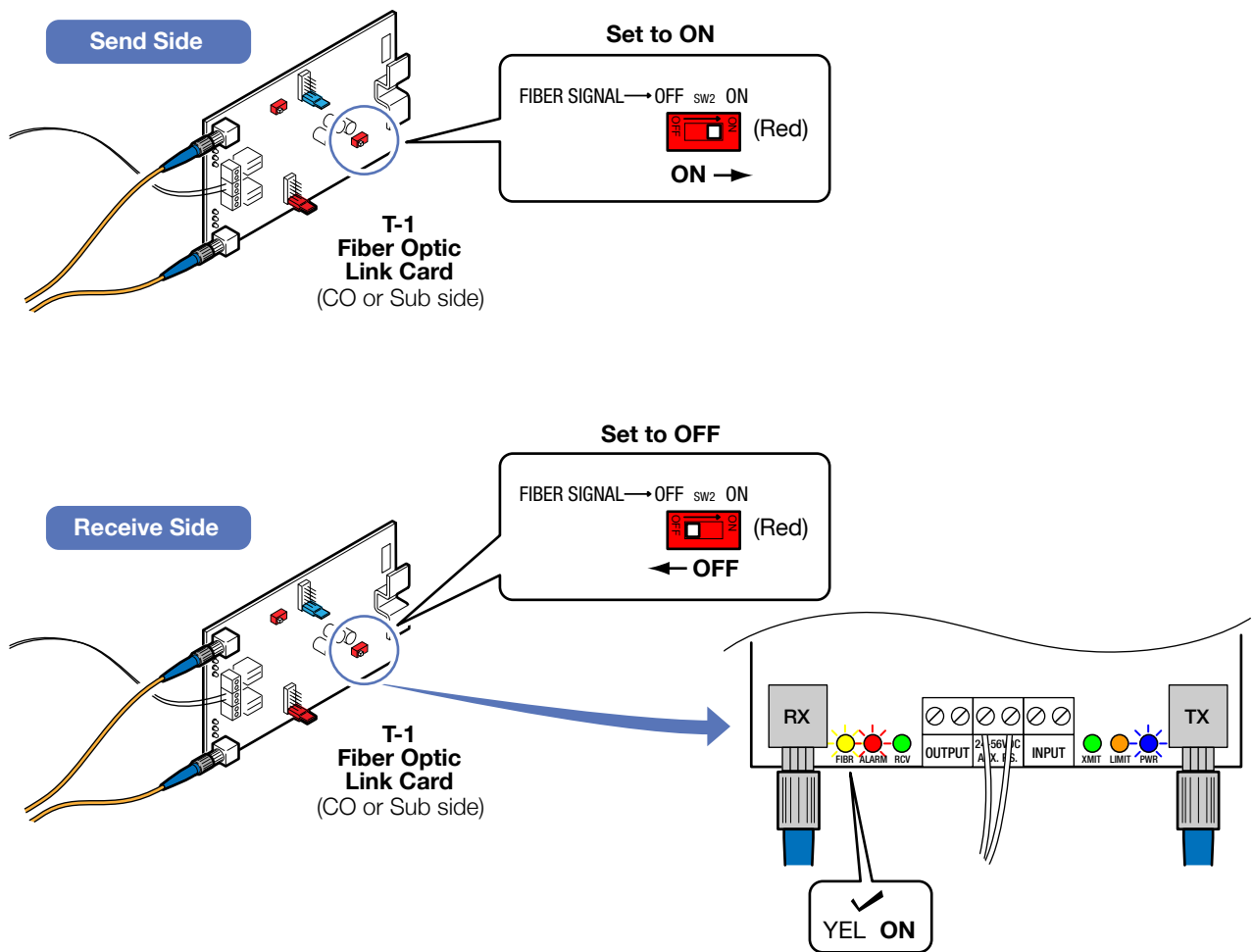
Fiber Type	Wavelength	Loss Budget	Maximum Distance
Multimode	850nm	10dB	1.5 miles (2.5km)
Single-mode	1310nm	8dB	9 miles (15km)
Single-mode Long Haul	1310nm	26dB, 8dB required min. loss	37 miles (60km)

Note: Distances equated using industry standard fiber and connector attenuation of 3dB/Km. Fiber condition, splices and connectors may affect actual range. When reconnecting fiber cables, check the correct connection of the fiber cable.

When T-1 signal is not present

The T-1 cards have a fiber signal test system built-in. You can verify the fiber cable when there is no T-1 signal present. Both the CO and Sub cards need to be powered (a battery may be used) and the fiber cables need to be connected correctly to the cards. Refer to the installation sections for power and fiber connection information.

You may use either the CO or Sub card to send the test signal. On the send side, set the **SW2 FIBER SIGNAL** switch to ON. At the receive side, the yellow FIBR LED will go ON, indicating that the fiber cable is OK. You may repeat this test from the opposite side.



Set the **SW2 FIBER SIGNAL** switch to **OFF** once the test is completed.

If the receive side LED does not turn on, test the fiber cable using a fiber optic test set with light source and meter. See the T-1 System Fiber Test Specifications chart on the previous page for test specifications.

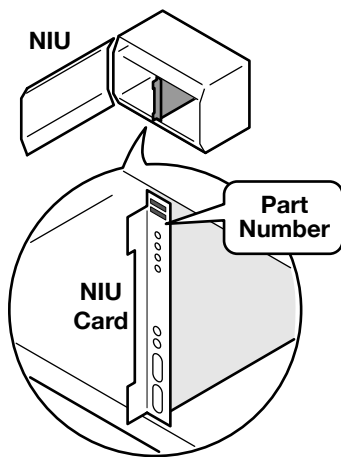
Connecting T-1 service after installation

When connecting T-1 Service AFTER the Fiber Optic Link has been pre-installed, make sure to check the following.

- Verify span or auxiliary power to the CO card at the card terminals (page XX)
- Set the gain using the GAIN jumper on the CO card (page XX)
- Verify auxiliary power to the Sub card at the card terminals (page XX)
- Set the LOSS SELECT jumper on the Sub card to the same setting as the GAIN jumper on the CO card (page XX)

NIU Compatibility

Check for compatible NIU systems that supply Span Through-Power to the T-1 Fiber Optic Link cards. Contact RLH for T-1 compatibility with systems not listed.



HDSL/T1 Span Through Power NIU Compatibility Chart			
Manufacturer	Part Number	Description and Material ID	CLEI Code
HDSL1			
Adtran	1246026L4	T200 HTU-R (VZ# 594993)	T1L2C8J8AA
Adtran	1246026L5	T200 HTU-R (BST# 98001580)	T1L3KD5AAA
Adtran	1245024L1	T400 HTU-R	T1L2C8J8AA
Adtran	1247026L1	T200 HTU-R,	
ADC	SPX-HLXRD11	T400 HLXR	SND1FJRAAA
HDSL2			
Adtran	1223024L1	H2TU-R (VZ# 11018736)	T1L6VR8B_ _
HDSL4			
Adtran	1223424L1	H4TU-R (VZ# 11018731)	T1L6EYHB_ _
Repeated T1			
Adtran	1181315L1-5B	T1 NIU, Total Access	T1L3PU0A
Hyperedge	520-10-SW13	T200 T1 NIU (BST# 300058336)	
Westell	DNI5760LNI3	T1 NIU (VZ# NCIUV9A)	NCIUV9A4AA
Westell	A90-3128-70	T1 NIU (VZ# T1L3P96)	T1L3P96CAA
Westell	A90-3115-31	T1 NIU (VZ# T1S1AEF)	T1S1AEFAAA

Specifications

Transmission method	Amplitude modulated light via two optical fibers
	Multimode: 850nm (Tx level: -16dB +/- 1dB)
	Single-mode: 1310nm (Tx level: -23dB +/- 1dB)
	Single-mode Long Haul: 1310nm (Tx level: -8dB +/- 2dB)
Maximum Fiber Attenuation / Distance	Multimode: 10dB / 1.5 miles (2.5 km)
	Single-mode: 8dB / 9 miles (15 km)
	Single-mode Long Haul: 26dB / 37 mi. (60 km), Required min. loss 8dB
	*Note: Distances equated using industry standard fiber and connector attenuation of 3dB/Km. Fiber condition, splices and connectors may affect actual range.
Fiber Type	(ST or SC connectors) Multimode: 62.5/125µm, 50/125µm
	Single-mode: 8-9/125µm
Temperature Limits	-40°F to +158°F (-40°C to +70°C)
Humidity	95% non-condensing
Bandwidth	100 kHz to 10 MHz
Signal to Noise	>45 dB for line attenuation up to 30 dB at 772 kHz
Digital Data Type	Bipolar digital data stream with no DC reference
Maximum Data Rate	3.152 Mbps
BER	<10 ⁻⁹
Transmit Level (Loss Select at position 1)	6V P-P Nominal at 20°C (68°F) 4.8V P-P to 6.5V P-P from -40°C to 70°C (-40°F to +158°F)
Surge Protection	Fuses, thyristors, PTC thermistors, zeners, and MOVs
Power Requirements	CO/ Sub Cards: 24-56 VDC, 57-66mA
Powering Method	Line power simplex on Send and Receive pairs, or an isolated DC power source connected to AUX. P.S. input.
RJ-45 Adapter	Rx Pair Pins 1,2
	Tx Pair Pins 4,5

Support

Warranty

RLH is recognized throughout the U.S. and offers the only **UNCONDITIONAL LIFETIME WARRANTY** in the telecommunications industry. We are very proud of our warranty which simply states that our Fiber Optic Link Assemblies are warranted to be free of defects in material and workmanship for the **LIFE OF THE PRODUCT**.

We can offer this warranty because:

- We believe our customers shouldn't have to incur additional costs due to failure or damage
- We engineer and manufacture our Fiber Optic Links in the USA, with total confidence in our quality
- We understand how safety and reliability impact the total cost of ownership
- We know that customer support extends beyond the initial sale, so **we stand behind our products**

RLH will replace any product, or part thereof, that fails **FOR ANY REASON**, provided the defective part is returned to RLH Freight prepaid. This warranty is **UNCONDITIONAL** and valid even when RLH Fiber Optic Link Assemblies have been abused or mishandled, where unauthorized repairs have been attempted or performed, or product has been damaged as a result of a natural disaster. Compare this warranty to our competitors and see how our warranty will reduce your costs and simplify your maintenance activities.

To make a warranty claim, or schedule repair or replacement of your RLH product, please contact us for an RMA number. You will be promptly assisted by one of our warranty specialists. All returns must have an RMA number before we can receive any items.

Technical Support

Normal technical support: (Mon - Fri 6am - 6pm PST)	Local (714) 532-1672 Toll Free (800) 877-1672 Toll Free (866) DO-FIBER
24/7 Technical support:	(714) 396-8982 (714) 457-5740

Contact Information

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