RLH Industries, Inc.

Locating the Copper-Fiber Junction (CFJ) within the Zone of Influence (ZOI)

RLH Industries, Inc.
936 N. Main Street
Orange, CA 92867
USA

fiberopticlink.com

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RLH Industries, Inc.
936 North Main Street
Orange,CA 92867

Ph. 714 532-1672
email: info@fiberopticlink.com
www.fiberopticlink.com

Overview

RLH Industries, Inc. has been engineering and manufacturing fiber optic isolation solutions since 1988.

The Fiber Optic Link® is our industry tested copper-to-fiber transport system designed exclusively for High Voltage Isolation applications, and conforms to the following industry standards:

IEEE-487 Recommended Practice for the Protection of Wire-Line Communication Facilities Serving Electric Supply Locations

IEEE-1590 Recommended Practice for the Electrical Protection of Communication Facilities Serving Electric Supply Locations Using Optical Fiber Systems

IEEE-1615 Recommended Practice for Network Communication in Electric Power Substations

Motorola R56 Standards and Guidelines for Communication Sites

BR 876-310-100 BT (Telcordia) Electrical Protection of Communication Facilities Serving Power Stations

Fiber Optic Links are used to isolate power and lightning Ground Potential Rise (GPR) and the effects of noise.

Common applications are shown on the following pages and include:

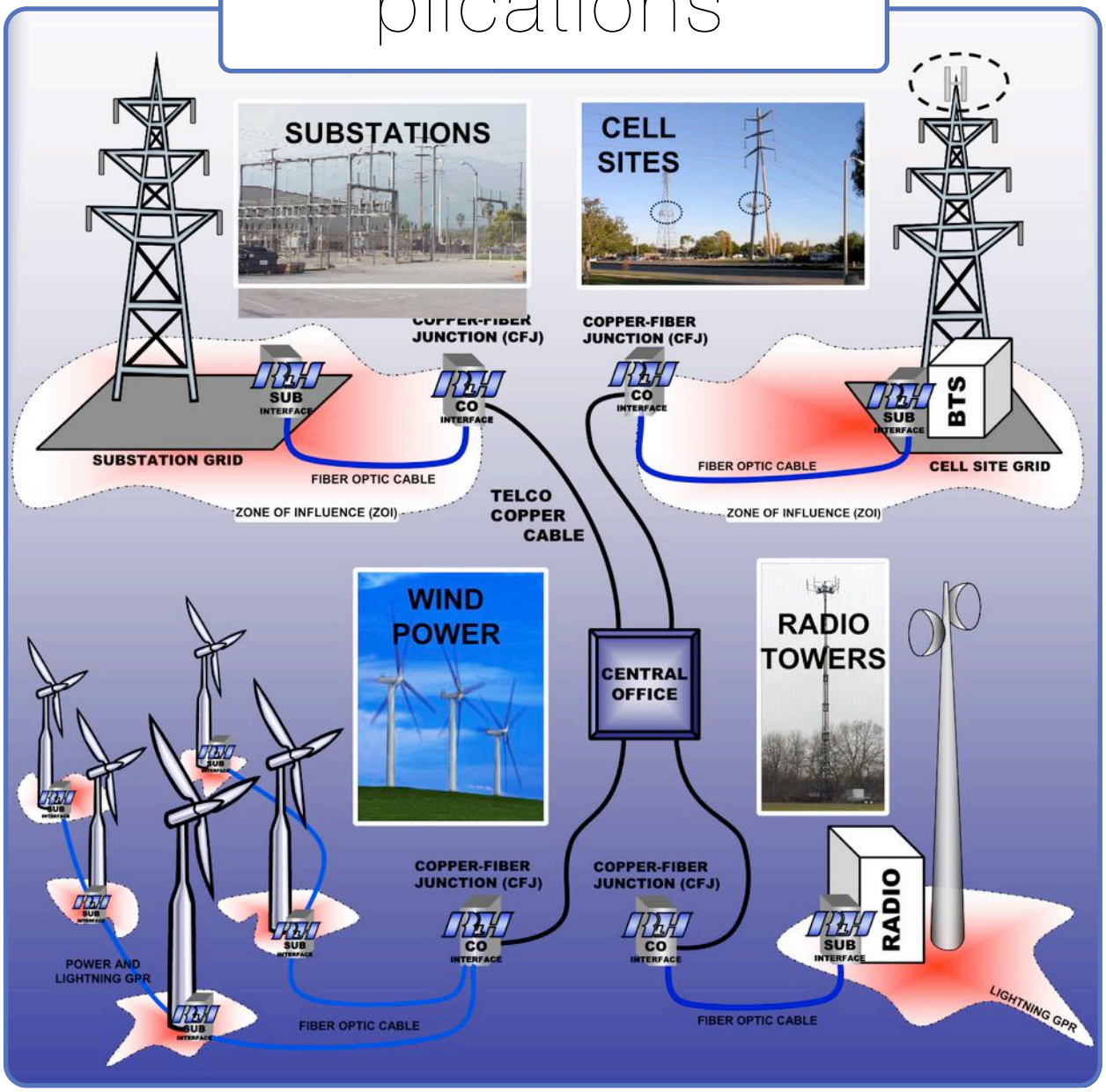
Power Generating Plants and or Substations

Cell Sites on Power Towers

Wind Power Generation

Stand alone Cell Sites and Radio Towers

Typical Ap-plications



Power System Faults and GPR

Power system faults can occur at any time or location within a power network. A portion of the resulting fault current will return to its generating source(s) by way of an earth return path and enter the substation grounding grid. With two components of Ohm's law in effect, fault current and ground grid impedance, the result is a voltage called Ground Potential Rise (GPR).

GPR values can be as high as 50kV under unusual circumstances; however, GPR values are usually less than 10kV. In addition to the GPR there might also be longitudinally induced voltages (noise) impressed on copper cable facilities serving a power substation. The two voltages will, in all probability, add together to form a high voltage difference between the substation reference and a remote earth reference, where a serving telephone central office is located.

Lightning strikes may also occur at any time or location within a power network. In addition, due to their raised elevation, lightning also strikes wind power generators and radio towers. The major difference between power faults and lightning is frequency. They both produce GPR! Lightning has a frequency range from dc to 100 MHz and produces current flows from 2 to 250kA with an average around 30kA. Lightning also produces high levels of induced voltages in copper cable facilities.

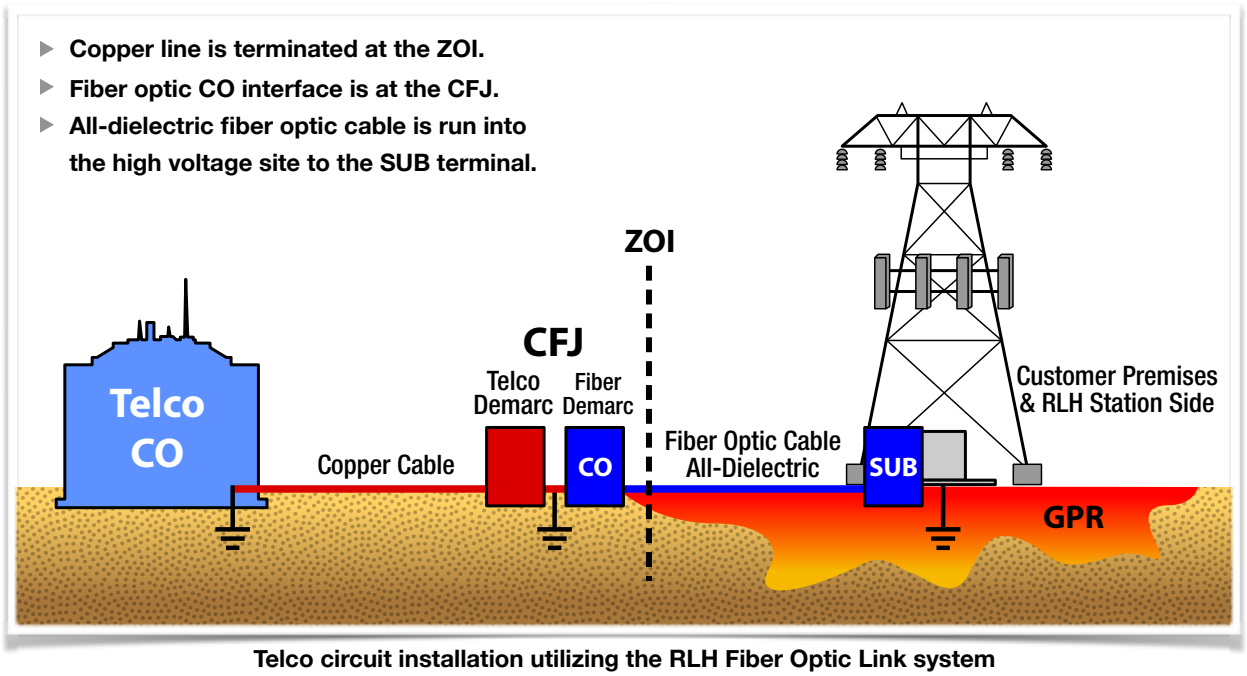
Lightning GPR is another good reason for not running copper telephone service directly into lightning prone structures, such as tall metallic mono-poles or roof top PCS cell sites. Again, the only difference between power GPR and lightning GPR is frequency and high current magnitudes.

Fiber optic cable has an infinite dielectric tolerance capability and is also immune to the effects of induction.

GPR and the CFJ

Locating the Zone of Influence (ZOI) of power and lightning GPR very accurately is not crucial, since inhomogenuities in the earth and presence of metallic infrastructures will distort the ZOI. The important point is to locate the Copper-Fiber Junction (CFJ) so that the GPR is not high enough to cause dielectric breakdown in the general-use cable. Of primary concern is Ground Potential Difference (GPD) within rural, urban, or urbanized environments that would create unsafe touch potentials, or cause dielectric breakdown in general-use (copper based) cables, while also considering the equalizing effects and safety record of existing metallic utility grounding grids that have been placed using NEC and NESC standards.

In urban and urbanized areas, with extensive metallic infrastructures, the Ground Potential Difference (GPD) between bonded metallic objects can be assumed to be low for all practical purposes. In those cases, telco cable sheath isolation becomes useless to prevent GPR from transferring into the telecommunication network. The net result is very large areas within a community rising and falling in potential at the same time resulting in smaller current flows between individual bonded and grounded structures.



Telco circuit installation utilizing the RLH Fiber Optic Link system

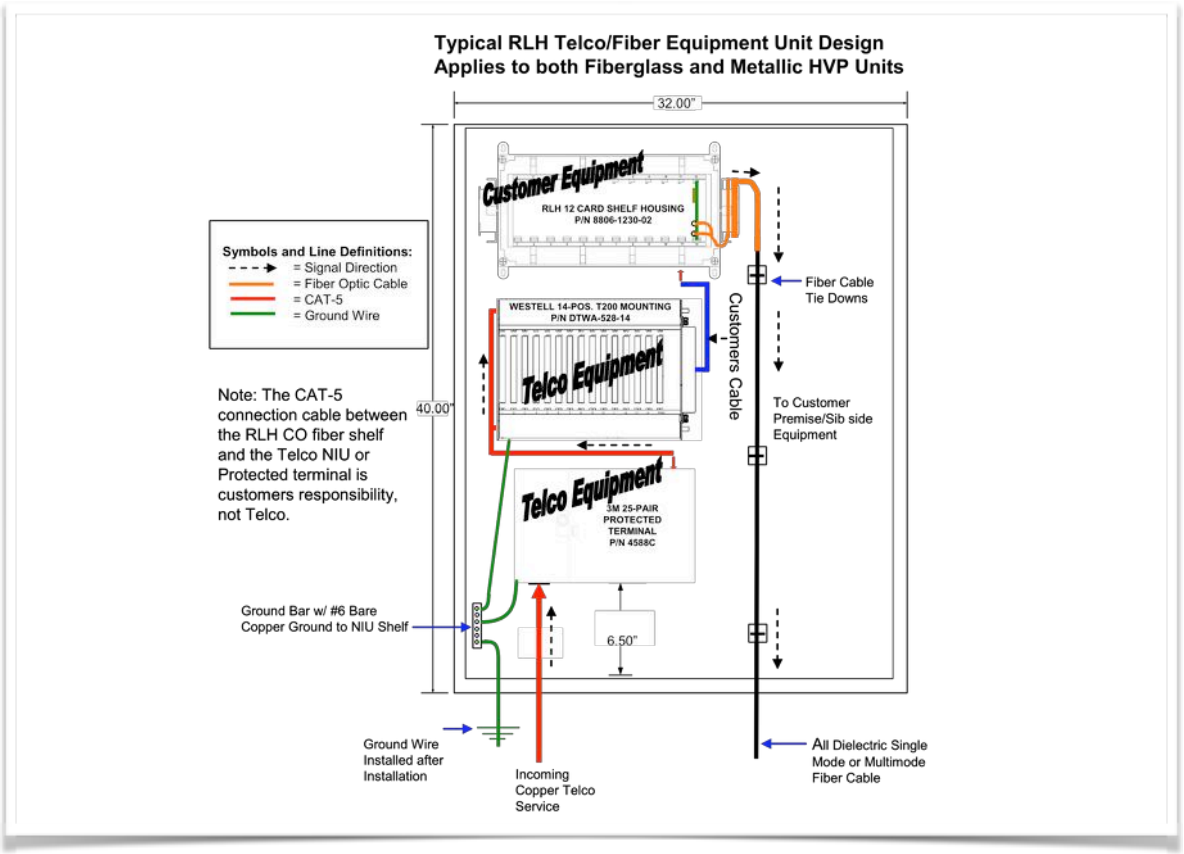
From a practical point of view, when installing a fiber optic cable, the ZOI limit can be fixed as the first connection point to a structure connected to a multi-grounded neutral network.

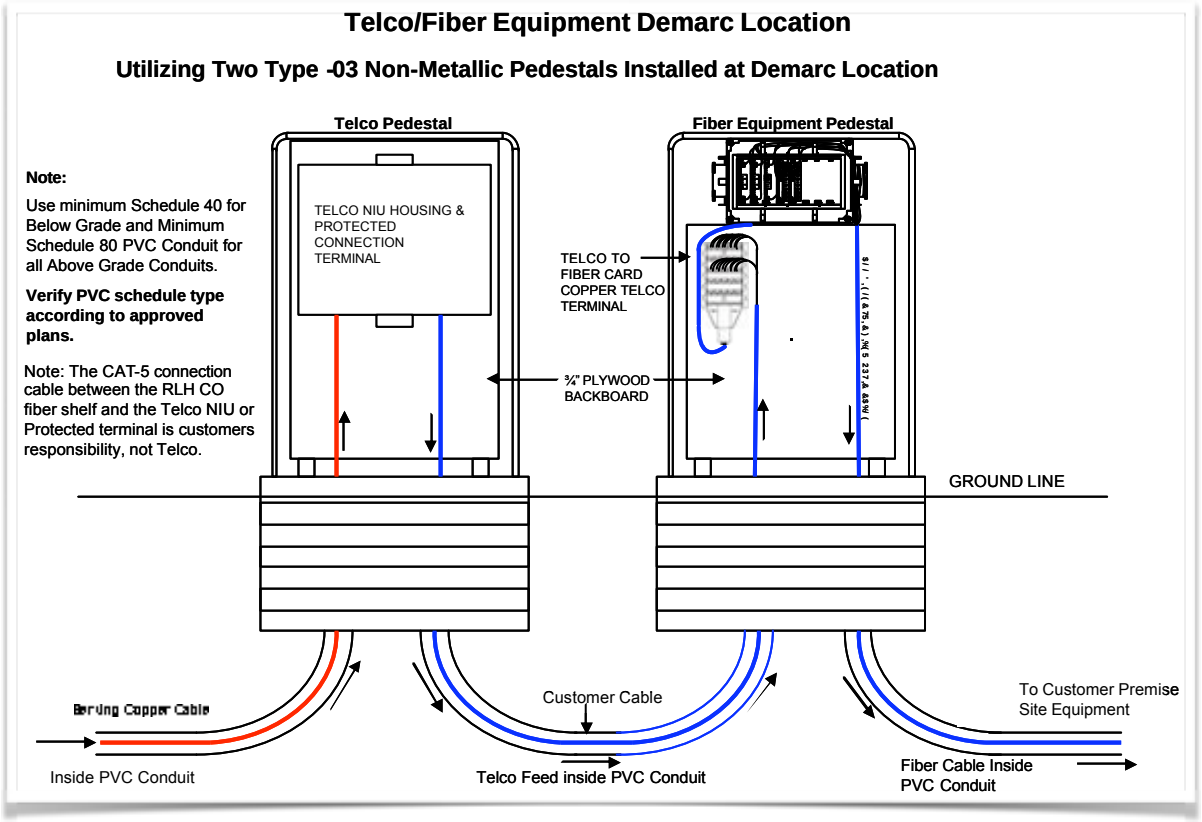
For additional engineering details, refer to the engineering white paper titled Recommended Practice for Establishing Ground Potential Rise and Zone of Influence (ZOI), available as a free download from www.fiberopticlink.com.

Typical RLH Fiber Optic Link Installation Details

Enclosure features and installation notes:

- Enclosure (metal or fiberglass) is NEMA-4X rated.
- Enclosure includes four mounting feet for wall or H-Frame mounting.
- For pole mounting add -PMK to the end of the RLH unit part number.
- 8 position Ground buss bar is included that accepts #2-#14 Wire. NIU shelf and Gas tube protected block comes pre-wired from RLH factory.
- NEMA-4X upper and lower ventilation.
- ¾-4" knockouts included on aluminum enclosures. Fiberglass enclosures may be modified at job site.
- 3ft pigtail connecting the 25 pair protected block to the Westell 14 position NIU shelf has the 25 pair protected terminal end of the cable is left un-terminated to accommodate either 2 or 4 wire circuit type connections.
- 3ft pigtail that connects the Westell 14 position NIU shelf to the RLH 12 card housing has the 12 card shelf end of the cable left un-terminated to accommodate either 2 or 4 wire circuit connections.
- 25 Pair 5 element gas tube protection block, 300Vdc 5 element gas tubes included.
- NIU card shelf is pre-wired for Telco provided NIU's.
- Fiber Optic Link card shelf is pre-wired or may be shipped separately from factory.




Telco/Fiber Equipment Demarc Location
Utilizing Two Type -03 Non-Metallic Pedestals Installed at Demarc Location
Telco Pedestal
Fiber Equipment Pedestal
Note:
Use minimum Schedule 40 for Below Grade and Minimum Schedule 80 PVC Conduit for all Above Grade Conduits.
Verify PVC schedule type according to approved plans.
Note: The CAT-5 connection cable between the RLH CO fiber shelf and the Telco NIU or Protected terminal is customers responsibility, not Telco.
TELCO NIU HOUSING & PROTECTED CONNECTION TERMINAL
TELCO TO FIBER CARD COPPER TELCO TERMINAL
¾" PLYWOOD BACKBOARD
GROUND LINE
Customer Cable
To Customer Premise Site Equipment
Inside PVC Conduit
Telco Feed inside PVC Conduit
Fiber Cable Inside PVC Conduit

Worker Safety at the CFJ

The CFJ must be placed adjacent to and bonded (per NEC and NESC) to the local MGN grounding system. Place an RLH D-Pad platform in front of all access doors. The D-Pad is made from outdoor rated fiberglass material, 4" thick, and has a slip resistant surface to enhance traction. It should be placed on a minimum 6" layer of crystalline (high dielectric) gravel as shown in these examples.

RLH also recommends that a ring of bare #6 copper wire be placed at a depth of 12" in the soil encircling the CFJ D-Pads and bonded to the CFJ ground to reduce touch and step potentials.

Working on the D-Pad insulated surface and or an insulation blanket at these locations reduces the effects of touch potential, as well as power line capacitive coupling, on the incoming copper pairs and cable sheath.

RLH SUB at the Customer Premises

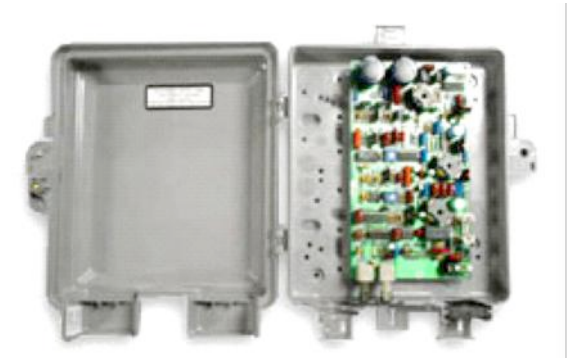
RLH Card shelves consist of an all-dielectric housing with insert designed for inserting Fiber Optic Link cards of any combination. The housings come complete with mounting hardware for cabinet or wall mounting. The shelves can also be mounted on our 19" or 23" mounting brackets.

5-CARD SHELF INSTALLED IN MOUNTING BRACKET

12-CARD SHELF

8-CARD SHELF

5-CARD SHELF



INDOOR SINGLE CARD UNIT

RLH Fiber Optic Link Cards

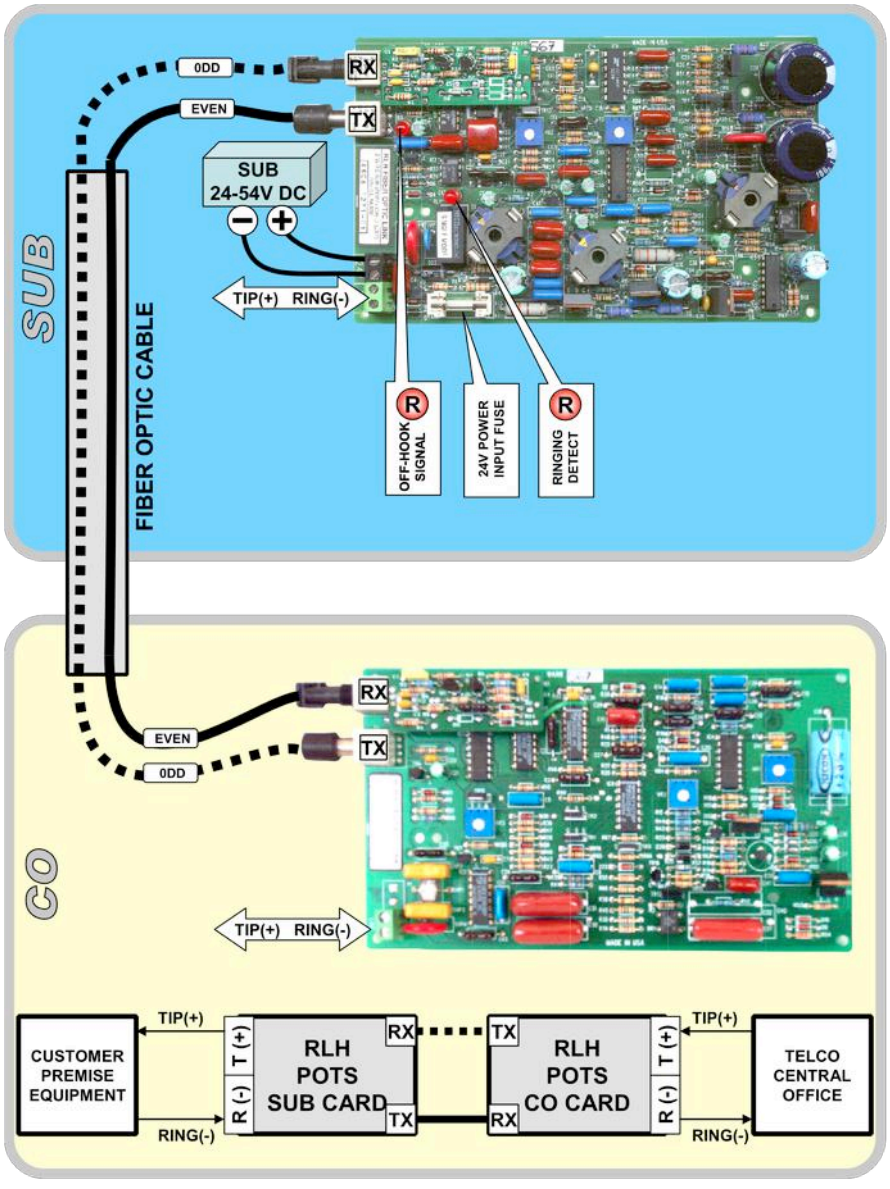
RLH Fiber Optic Link cards are industrial hardened copper-to-fiber media converters, designed for outside plant and power station environments. Fiber Optic Link Cards can be installed into RLH card housings, and may be configured for single line or multiple line applications.

Most Fiber Optic Link CO (Central Office) cards have the unique ability to operate from telephone line power (simplex current) eliminating the need for a local power source.

From the CO side location a copper derived signal is transmitted over an all-dielectric fiber optic cable (single-mode or multimode). The Sub (Subscriber) side of the Fiber Optic Link system recreates the copper signal.

FIBER OPTIC LINK CARDS:

- 2 Wire (POTS)
- 2 Wire Data (SCADA)
- 2 Wire DID
- 2 Wire ISDN
- 4 Wire Data (SCADA)
- 4 Wire Data with E&M
- 9.6K DDS
- T1 / E1
- 4x1 T1 Mux
- UHDSL
- 2 Wire Digital Phone
- RS-232
- Ethernet
- HDSL1 Adtran®
- DS3
- ADSL
- 4 Ch. Alarm Closure
- 8 Ch. Alarm Closure



Technical Support

Email:	support@fiberopticlink.com
24/7 technical support:	Toll Free 1-855-RLH-24X7 Toll Free 1-855-754-2497

Contact Information

Corporate Headquarters:	RLH Industries, Inc. 936 N. Main Street Orange, CA 92867 USA
Phone:	(714) 532-1672 Toll Free 1-800-877-1672 Toll Free 1-866-DO-FIBER
Fax:	(714) 532-1885
Email:	info@fiberopticlink.com
Web site:	www.fiberopticlink.com

RLH Industries, Inc.
936 N. Main Street, Orange, CA 92867 USA
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F: (714) 532-1885

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