PG-PLUS
REMOTE LINE UNIT

Model	List Number	Part Number	CLEI Code
PRL-770	1A	150-1670-11	S9MSAA0ARA

TELEPHONE
NETWORK
INTERFACE

CUSTOMER
ACCESS

PAIRGAIN
THE COPPEROPTICS COMPANY
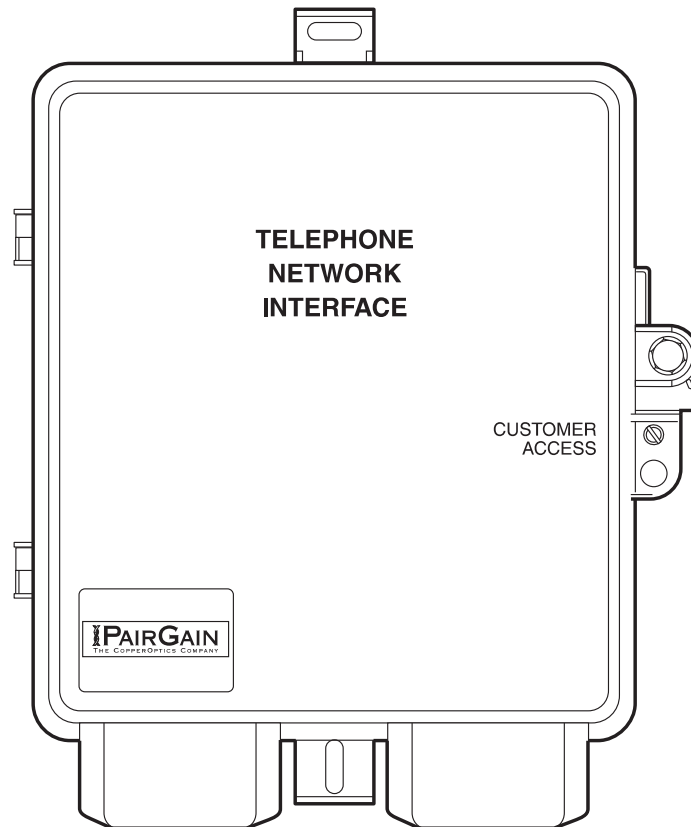
PAIRGAIN TECHNOLOGIES, INC.
ENGINEERING SERVICES TECHNICAL PRACTICE
SECTION 950-770-100

Revision History of this practice.
Revision 01—March 14, 1997
A) Initial Release

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USING THIS TECHNICAL PRACTICE

Three types of messages, identified by icons, appear in the text:

A note informs you of special circumstances.

A caution warns you of possible damage to equipment.

A warning indicates the possibility of personal injury.

A. PRODUCT OVERVIEW

1. Description and Features

1.1   This practice describes the PairGain® PG-Plus™ PRL-770 List 1A, a Remote Terminal (RT) enclosure that houses one Remote Line Unit (RLU) and provides interfaces for up to four Plain Old Telephone Service (POTS) subscribers.

1.2   **PG-Plus Systems.** A PairGain PG-Plus system provides bi-directional transport of multiple DS0s over a single, unconditioned wire pair using High-bit-rate Digital Subscriber Line (HDSL) technology. Using existing cable, PG-Plus provides for higher bandwidth needs of residential and business customers by providing multiple POTS interfaces on a single HDSL twisted-pair wire. Figure 1 shows a minimally configured PairGain PG-Plus system that consists of:

- •   One Central Office Terminal (COT) shelf

- •   One Central Office Line Unit (COLU)

- •   One RLU (housed in an RT)

PG-Plus COT shelf   **Remote Terminal**

Up to 4 POTS lines → **COLU** ═══ HDSL Pair ═══ **RLU** → Up to 4 POTS lines
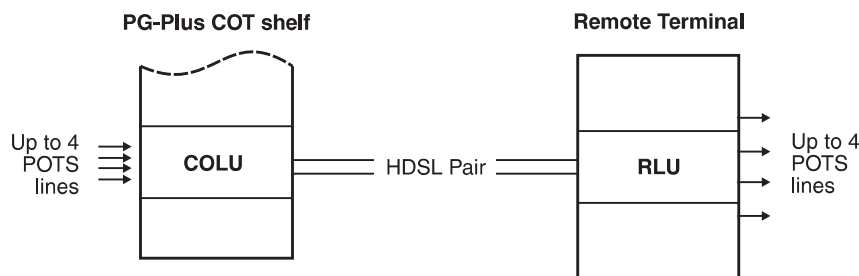
Figure 1. *Typical PG-Plus System*

Each COLU housed in a COT shelf interfaces with a corresponding RT. Using one pair of 24 gauge wire, the RT may be located up to 21.7 kft from the COT. POTS or digital lines from a Central Office (CO) switching system connect to the COT and are sent via the COLU and the HDSL wire pair to an RT. As an example, a 23" COT shelf can interface with 16 different PRL-770 RTs providing four POTS lines each, for a total of 64 subscriber lines. The COT operates on standard -48 V dc CO battery and supplies power to the RT, eliminating the need and expense of providing local power. A PG-Plus system with HDSL transmission and line powered RTs therefore results in fast, cost-effective solutions to POTS deployment over minimal copper facilities.

1.3   **HDSL.** PairGain HDSL technology provides the equivalent of 256 kbps digital transmission rate without the need for repeaters, loop conditioning, or pair selection. The PRL-770 motherboard terminates the HDSL line with secondary surge protection, provides power converters and microprocessor circuitry, and synchronizes to the HDSL line rate from the COT. The PRL-770 maps the four DS0 channels from the HDSL line to the individual subscriber circuits, and can be located up to 31.2 kft (22 gauge wire) from the COT shelf. The PRL-770 operates at a nominal HDSL line rate of 261.3 kbps.

1.4   **Circuit boards.** The PRL-770 RLU comprises two circuit boards that are joined by a multi-conductor pin connector. The RLU circuit-board assembly is housed in a metal case that is secured inside the PRL-770 outdoor RT enclosure. This allows telephone company craftspersons the means to replace primary protectors and line modules without exposing the RLU circuit-board electronics.

1.5   **Housing.** The PRL-770 RT enclosure is a weather-resistant plastic case designed for installation on an outside wall of a business or residential building, and is hardened to withstand environmental impact, including temperature, humidity, salt fog, water spray, UV, and insect spray. A hinged, metal telco cover secured with two tamper-proof screws covers the wiring between the primary protection devices and the PRL-770 electronics.

1.6   **Wiring Harness.** A wiring harness consisting of a cable for the four POTS pairs, a cable for the HDSL pair, and a frame ground wire is held with a strain relief as it exits the inner metal case. The wiring harness is factory wired to the primary protection devices for the POTS and HDSL pairs and to the frame ground bus. An additional frame ground is attached to the metal case. The Protected Termination Modules on the POTS lines provide gas tube over-voltage protection and an RJ-11 test jack for isolating trouble to the network or subscriber.

1.7   **Wiring.** HDSL and subscriber wiring are threaded through rubber grommets at the bottom of the enclosure. The HDSL pair from the COT is terminated on an over-voltage-protected threaded binding post at the bottom of the enclosure and connected to the HDSL pair in the wiring harness. Subscriber line connections are made through the right-hand side of the Protected Termination Modules. A hinged RJ-11 jack allows the subscriber line to be disconnected from the network, or allows for a telephone to be plugged into the PRL-770 as an aide in diagnostic tests.

1.8   **Relays.** Relays in the PRL-770 provide a path for metallic fallback operation. These relays are also utilized for Subscriber Drop Testing (SDT), Mechanized Loop Testing (MLT), and 4TEL testing in conjunction with the COLU and PG-Plus Alarm Unit (PAU).

Metallic fallback provides a direct connection from the central office to one subscriber under fault conditions over the HDSL line. Service is provided to the subscriber assigned to the POTS #1 line in the PRL-770. Metallic fallback is activated under any of the following conditions:

- PRL-770 power failure

- PLL-720 power failure (COLU)

- System turn-up (COLU installed but not PRL-770)

- HDSL transceiver failure

1.9   **Security.** Subscribers can secure the Customer Access door by placing a padlock through the customer-padlock hole that is drilled into the Customer Access door hasp (Figure 2). For installations where more than one subscriber is serviced out of a single PRL-770 unit, you should plug the customer-padlock hole in the Customer Access door hasp with a 3/8" diameter hole plug.

When more than one subscriber is serviced out of a single PRL-770 unit, the subscriber can protect their phone line against unauthorized use by placing a padlock through the latch on the appropriate Protected Termination Module door (Figure 3).

In either case, you have full access to the interior of the PRL-770 and to each Protected Termination Module by removing the Telco override screw from the Customer Access door, or by removing the two tamper-proof screws from the Telco Access door.
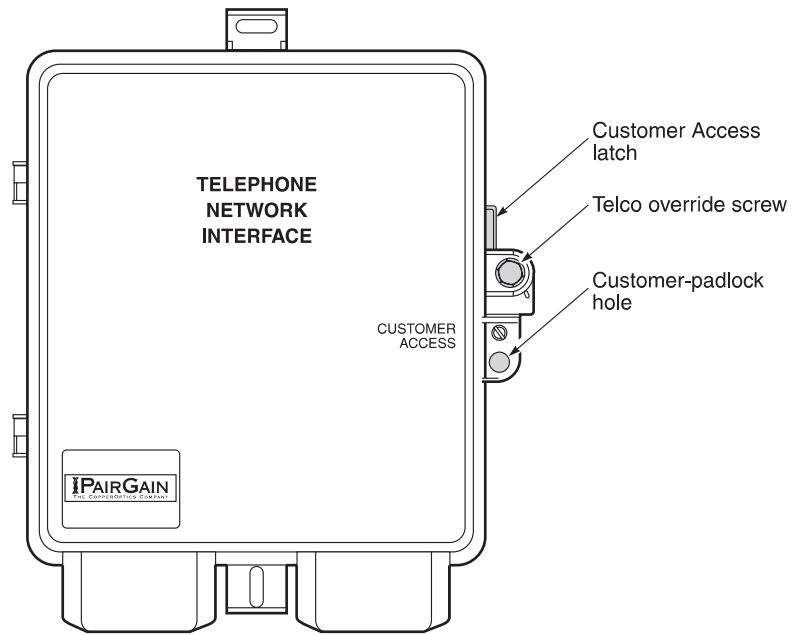
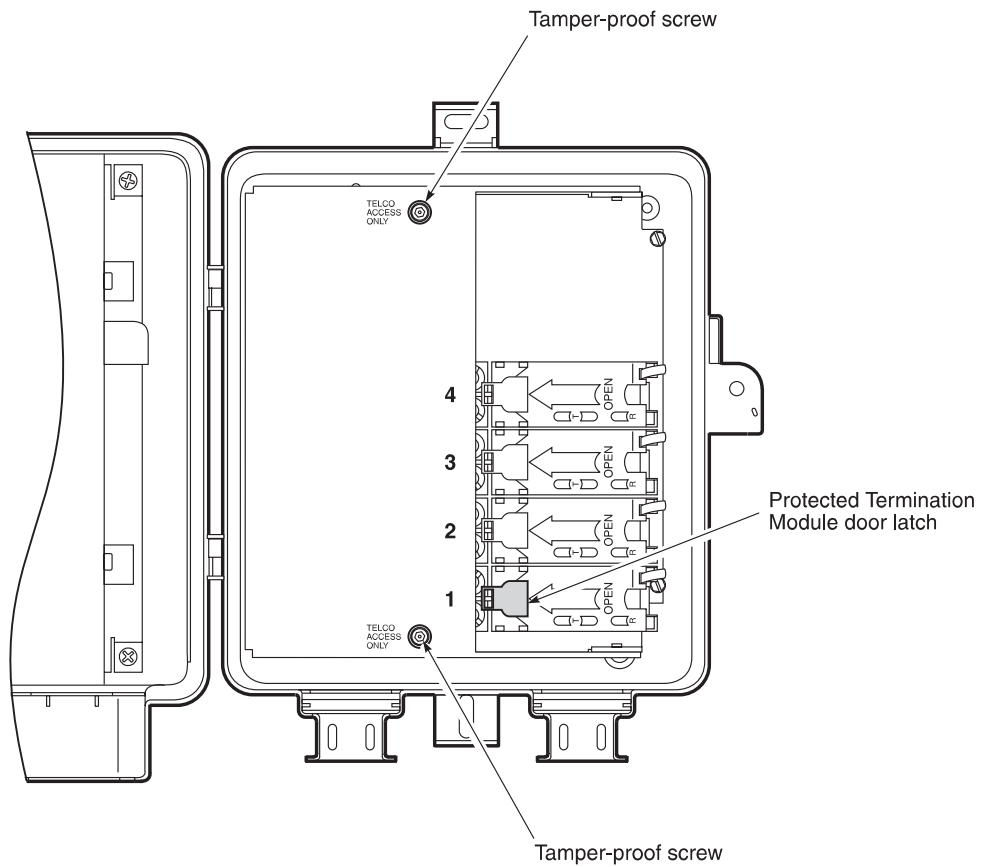**Figure 2.** *Securing the Customer Access Door*

Figure 3. *Securing a Protected Termination Module*

2. Specifications

Dimensions

Height..	10.25"
Width	8.5"
Depth..	4.75"
Weight..	4 lbs. 10 oz.

Power

HDSL Line Operating Input Voltage: .... 135 V dc (Tip to Ring, minimum)

HDSL Line Start up Voltage:...................... 200 V dc (Tip to Ring, minimum)

PRL-770 Input Power: .... 10.9 Watts (Tip to Ring, maximum)

HDSL

HDSL Line Code:...................................... 2B1Q

HDSL Line Rate:...................................... 130.6 K symbols/sec (261.3 K b/sec)

HDSL Reach.. 15.0 kft, 26 gauge
21.7 kft, 24 gauge
31.2 kft, 22 gauge

Environment

Temperature .... -40ºC to +65ºC
-40ºF to +149ºF

Humidity .... 5% to 95% (non-condensing)

Altitude .... -60m to 4,000m
-200' to 13,000'

Vibration .... NEBS

Electro-Static Discharge (DSD) .... Per GR-1089-CORE

Power and Lightning.................................. Per GR-1089-CORE

Human Safety .... UL 1459

Emissions Radiation and Immunity............. Per FCC part 15 for class B equipment

Connectors

HDSL .... 3-terminal station protector, 3/8 inch hex nut

POTS... Screw Terminals on RJ-11 line interface

POTS Interface

Analog Impedance...................................... 600 Ω

PRL-770 remote unit Supervisory Range .... 100 Ω plus 430 Ω for handset

Detection of Loop Open.............................. ≥ 10 kΩ

Idle State Voltage .... -48V (minimum)

Loop Current .... 23 mA (minimum)

Ring Generation... Balanced, Trapezoidal 40 Vrms (minimum) @ 20 ± 3 Hz in up to
5 REN per line (10 REN total at PRL-770 remote unit)

Ring Trip.. Removed in 200 ms after Loop Closure

B. INSTALLATION AND TEST

3. Required Tools and Test Equipment

3.1   To install or test a PRL-770 List 1A, the following tools are required:

- One Telephone test set

- One #2 Flat-head screwdriver

- One 3/8 inch nut driver

- One 5/32 inch hex key, drilled for tamper-proof fasteners

4. Inspecting Your Shipment

4.1   Upon receipt of the equipment:

- Unpack each container and visually inspect it for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to PairGain. Order replacement equipment if necessary.

- Check the contents versus the packing list to ensure complete and accurate shipment. If the shipment is short or irregular, contact PairGain as described in the section entitled "Warranty." If you must store the equipment for a prolonged period, store the equipment in its original container inside a building or under cover.

5. Installation

5.1   **Safety Precautions.** To ensure the safety of personnel and equipment, carefully observe the following safety rules:

Be careful when installing or modifying telephone lines. Dangerous voltages can be present. It is unsafe to install telephone wiring during a lightning storm.

Always disconnect all telephone lines and power connections before servicing or disassembling this equipment.

For performance and safety reasons, only power supplies listed for use with telephone equipment by a locally recognized organization should be used with PairGain equipment.

All wiring external to the product should follow the local wiring codes.

Always treat the HDSL pair as if it were live with high voltage present. When installing an HDSL pair which is already connected to a COLU, caution must be used as dangerous voltages are present on the HDSL pair. The COLU, unless previously disabled via craft provisioning, periodically attempts to power up the PRL-770 by applying $\pm$ 100 V dc to the HDSL pair. The COLU also initiates a start-up after a momentary short has been applied to the HDSL pair. The COLU responds with start-up voltage immediately upon removal of the short.

5.2 **Disable the line power.** To disable the line power, use a test lead with two clips to short the HDSL Tip and Ring conductors:

1 Attach one test-lead clip to the Tip conductor.

2 Attach the second test-lead clip to the Ring conductor.

This ensures that the potential difference between Tip and Ring is zero. The PRL-770 and the PLL-721 COLU go to the metallic fallback to POTS state, and remain in metallic fallback until the short is removed. Once the PLL-721 COLU senses the short (or off hook) condition has been removed, it initiates a power up sequence to start the PRL-770.

5.3 **Install the PRL-770 RT Enclosure.** Use the two #10 x 1.5" wood screws and flat washers provided in the PRL-770 Mounting Kit to attach the PRL-770 RT enclosure to the side of the customer residence (see Figure 4). For installation on stucco or other suitable surface, use the two PairGain provided #10 x 1" anchor nuts.

> **Install the PRL-770 RT enclosure only as shown in Figure 4, with all access openings facing down. Otherwise, possibly damaging materials (such as fluids) can enter the PRL-770 RT enclosure.**
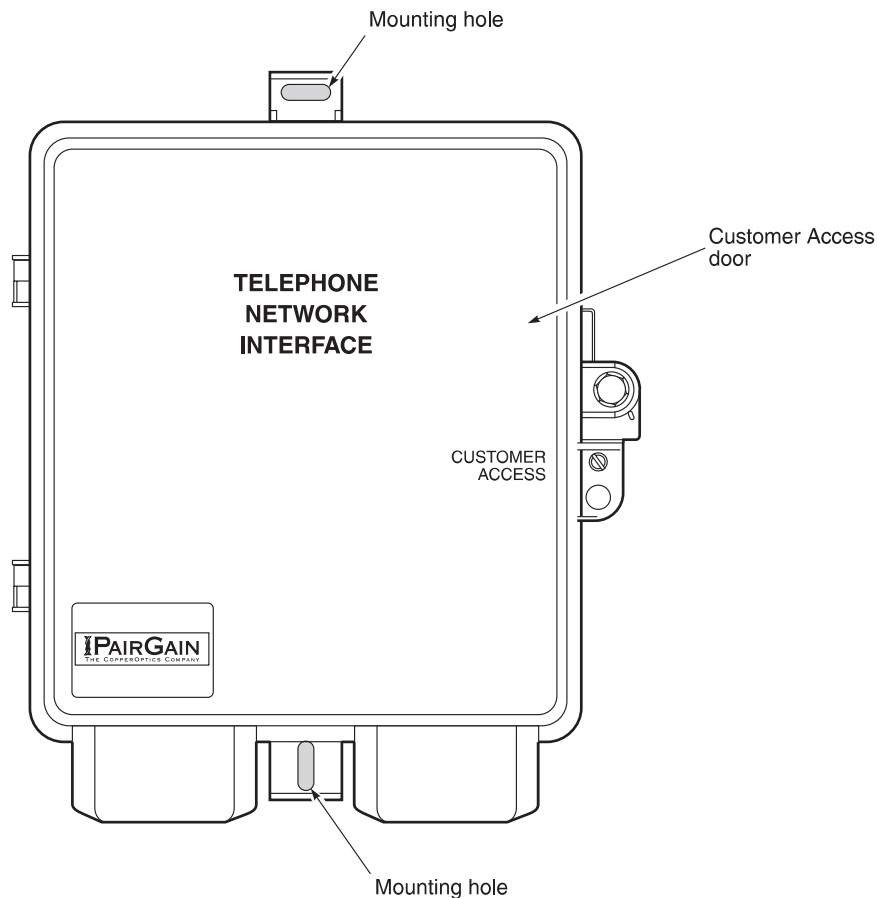

Figure 4. Installing the PRL-770 List 1A RT Enclosure

5.4   **PRL-770 Reference Label.** During installation, refer to the PRL-770 reference label (Figure 5) affixed inside the Customer Access door. The middle section of the PRL-770 reference label identifies the Frame Ground and HDSL Tip and Ring wires as well as the wire color code for the four POTS lines.
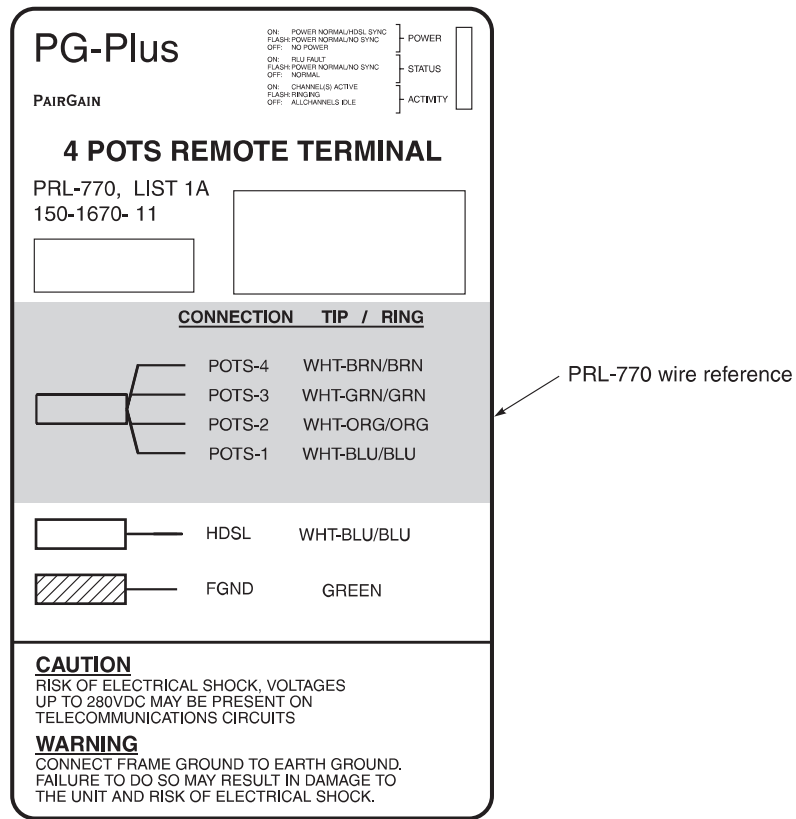

Figure 5. PRL-770 Reference Label

5.5   Attach the Frame-Ground Wire:

1   Use a 5/32" tamper-proof hex key to loosen the two tamper-proof screws on the Telco Access door, then open the Telco Access door (Figure 6).
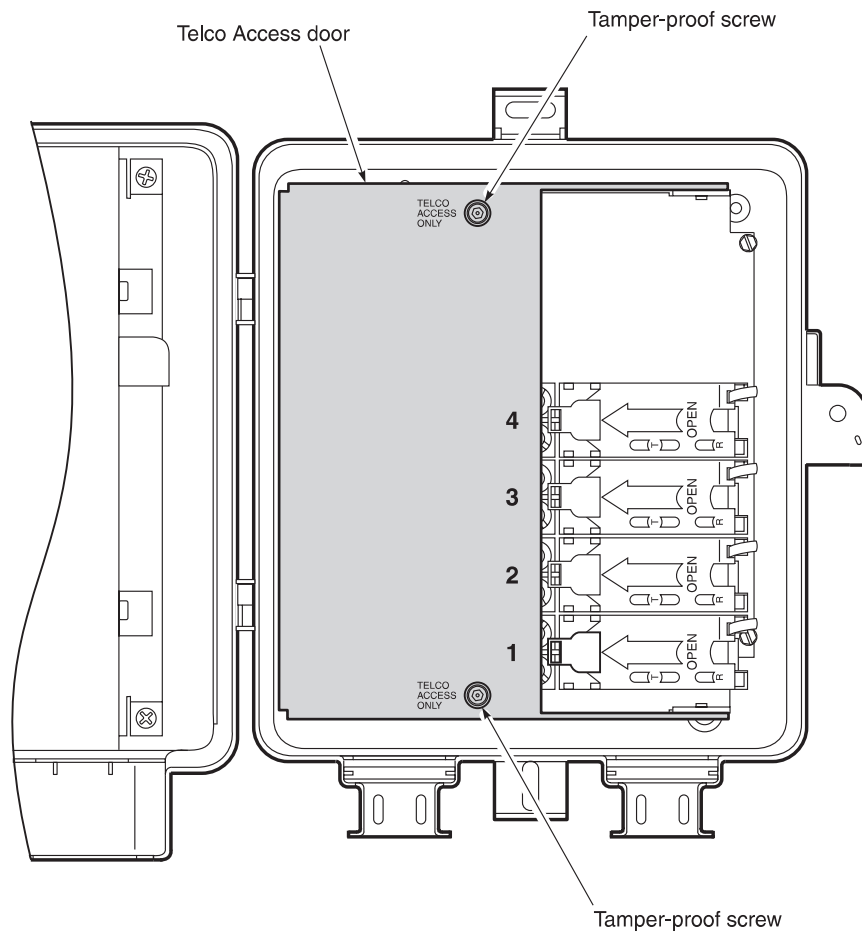

Figure 6. *Opening the Telco Access Door*

2   Use a pencil to punch a small hole in the bottom of the rubber grommet on the left-hand bottom side of the PRL-770 RT enclosure (Figure 7).
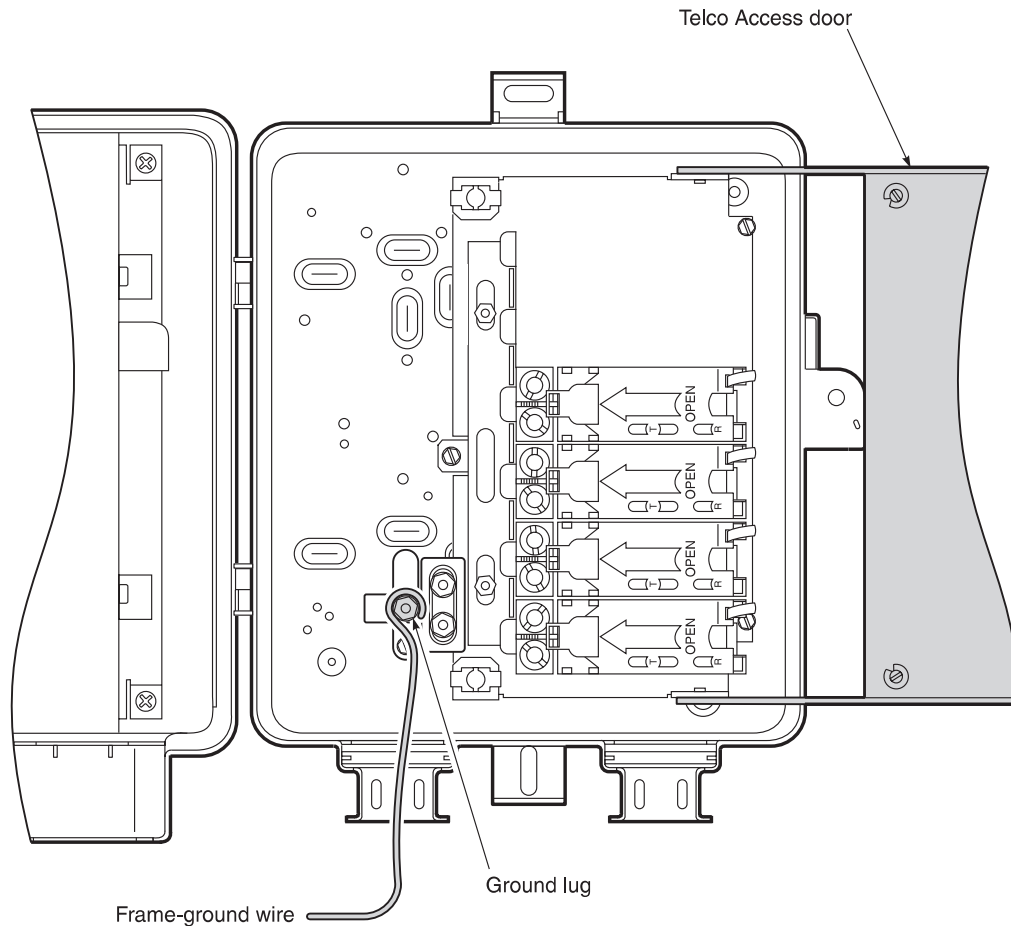
Telco Access door

Ground lug

Frame-ground wire

Figure 7. *Attaching the Frame-Ground Wire*

3   Insert the frame-ground wire into the PRL-770 RT enclosure through the pencil hole made in step 1. A 10 AWG copper frame ground wire is recommended.

4   Loosen and remove from the ground-binding post the top nut and three flat washers.

5   Loop the frame-ground wire around the ground-binding post, then replace and tighten the hardware removed in step 4, in reverse order.

5.6 Attach the HDSL Tip and Ring Wires:

Always treat the HDSL pair as if it were live with high voltage present. If you have not shorted the HDSL Tip and Ring conductors as described in section 5.2, do not connect the HDSL Tip and Ring wires. Otherwise you may receive a severe electrical shock.

1 Use a pencil to punch a second small hole in the bottom of the rubber grommet on the left-hand bottom side of the PRL-770 RT enclosure.

2 Insert the HDSL Tip and Ring wires into the pencil hole made in step 1.

3 Loosen only the top nut on the Tip and Ring gas tube protection binding posts (Figure 8).

4 Insert and then loop in a clockwise direction the HDSL Tip and Ring wires between the top two washers on the appropriate binding post, then tighten the nut you loosened in step 3.
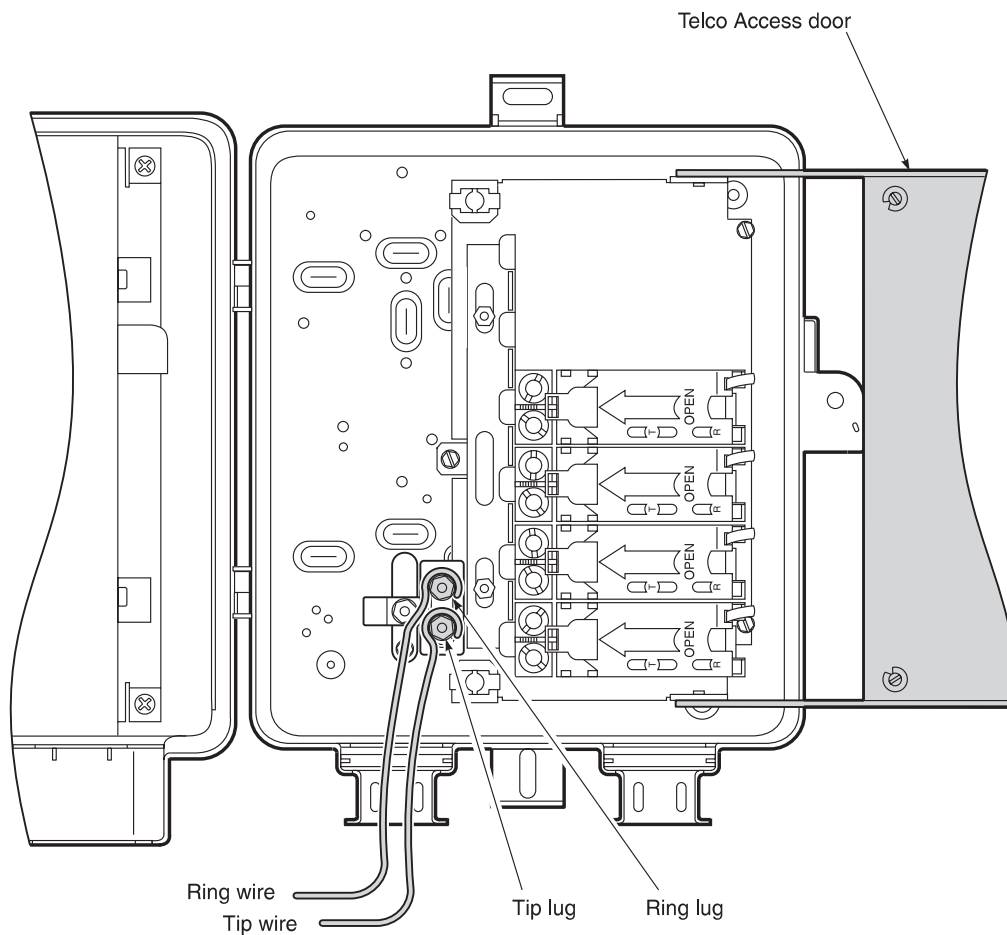

Figure 8. *Attaching the HDSL Tip and Ring Wires*

5.7   Attach the subscriber analog POTS drop:

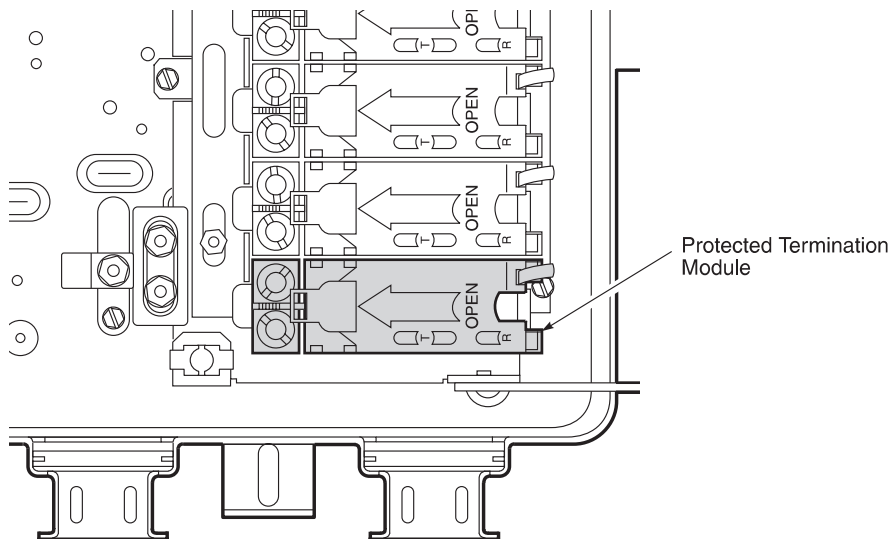**1**   Lift the appropriate Protected Termination Module door (Figure 9).

Figure 9. *Inserting the POTS Wires*

2   Insert the POTS wire pair through the cutout on the right side of the Protected Termination Module door (Figure 10).

3   Connect the Tip conductor to the green terminal lug on the Protected Termination Module.

4   Connect the Ring conductor to the red terminal lug on the Protected Termination Module.
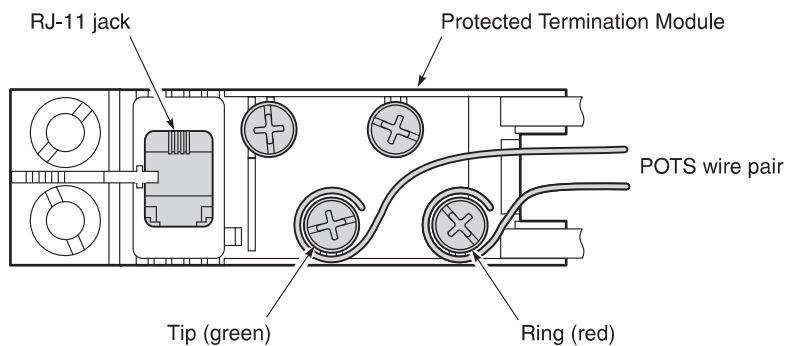

Figure 10. *Attaching the POTS Wire Pair*

6. Turn up and Testing

6.1   To turn up and test the PG-Plus system:

1   Open all the Protected Termination Module doors to ensure there are no off-hook conditions present from the subscriber lines.

2   Remove the short from the HDSL Tip and Ring conductors.

The following start-up sequence should occur:

The COLU responds with start-up voltage immediately.

- The PRL-770 detects HDSL line voltage, drops the metallic fallback to POTS, then initiates the HDSL start-up sequence.

- The POWER LED flashes green and the ACTIVITY LED is solid green.

Start-up is complete once the POWER LED is on solid green and the ACTIVITY and STATUS LEDs are both off.

3   Close all the Protected Termination Module doors.

4   Follow standard POTS procedures to check the overall performance of the POTS channel coming in and out, including ringing, dialing, and transmission. Use the customer's telephone if possible.

7. Close the Housing

7.1   To close the housing:

1   Close the Telco Access door and secure its two tamper-proof screws.

2   Verify that the screws on the Telco Access door are completely seated to avoid interference with the PRL-770 RT enclosure cover.

3   Close the housing cover and secure its tamper-proof screw.

Failure to close the PRL-770 Telco Access door or housing cover leaves the PRL-770 interior exposed to the environment. This shortens the life span of the PRL-770.

8. Fault Isolation

8.1 The circuit board metal enclosure has a System Status window through which Status LEDs may be viewed. The Status LEDs indicate different system states such as status of power, and subscriber line activity including on-hook, off-hook, ringing, and subscriber drop test activity. The top portion of the PRL-770 reference label provides a guide to what the Status LEDs indicate (Figure 11).
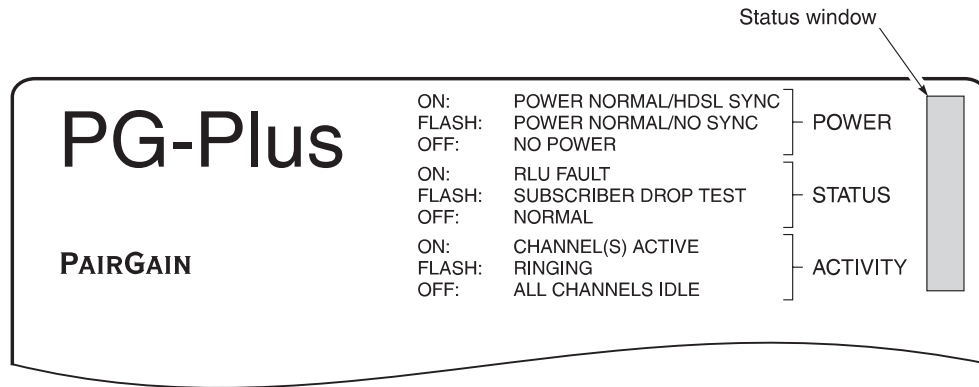
Status window

PG-Plus

ON:	POWER NORMAL/HDSL SYNC
FLASH:	POWER NORMAL/NO SYNC	POWER
OFF:	NO POWER

ON:	RLU FAULT
FLASH:	SUBSCRIBER DROP TEST	STATUS
OFF:	NORMAL

ON:	CHANNEL(S) ACTIVE
FLASH:	RINGING	ACTIVITY
OFF:	ALL CHANNELS IDLE

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Figure 11. *PRL-770 Status Window*

If the PRL-771 fails to indicate power on (as evidenced by the Power LED being off), perform the following diagnostic and repair operations:

1 Verify that the PRL-771 and its corresponding COLU are installed on the same pair.

2 Verify that the corresponding COLU is installed and turned up, and that the *HDSL Periodical Power Up* option is enabled.

3 Verify that the signal loss on the pair is no more than 41 dB at 130 kHz.

4 Replace the PRL-771.

5 Replace the corresponding COLU.

6 Check for a short placed on the HDSL Tip and Ring conductors, and remove if necessary.

7 Check for HDSL cable fault, and replace if necessary.

9. Technical Support

9.1   PairGain Technical Assistance is available 24-hours-a-day, 7-days-a-week by contacting PairGain Customer Service Engineering group at:

Telephone: (800) 638-0031 or (714) 832-9922

Fax: (714) 832-9924

9.2   During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday-Friday, excluding holidays), technical assistance calls are normally answered directly by a Customer Service Engineer. At other times, a request for technical assistance is handled by an on-duty Customer Service Engineer through a callback process. This process normally results in a callback within 30 minutes of initiating the request.

9.3   In addition, PairGain maintains a computer bulletin board system for obtaining current information on PairGain products, product troubleshooting tips and aids, accessing helpful utilities, and for posting requests or questions. This system is available 24-hours-a-day by calling (714) 730-3299. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1.

10. Certification

10.1   **FCC Compliance**. The PG-Plus PRL-770 Remote Line unit complies with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the situation by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and the receiver.

- Consult the dealer or an experienced radio or television technician for help.

10.2   **Modifications.** The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by PairGain Technologies, Inc. may void the user's authority to operate the equipment.

10.3   All wiring external to the product(s) should follow the provisions of the current edition of the National Electrical Code.

11. Warranty

11.1   PairGain Technologies warrants this product to be free of defects and to be fully functional for a period of 60 months from the date of original shipment, given proper customer installation and regular maintenance. PairGain will repair or replace any unit without cost during this period if the unit is found to be defective for any reason other than abuse or improper use or installation.

11.2   Do not try to repair the unit. If it fails, replace it with another unit and return the faulty unit to PairGain for repair. Any modifications of the unit by anyone other than an authorized PairGain representative voids the warranty.

11.3   If a unit needs repair:

     1   Call PairGain for a Return Material Authorization (RMA) number at (800) 638-0031.

     2   Return the defective unit, freight prepaid, along with a brief description of the problem, to:

> PairGain Technologies, Inc.
> 2120 Ritchey Street
> Santa Ana, CA 92705-5101
> ATTN: Repair and Return Dept.

11.4   PairGain continues to repair faulty modules beyond the warranty program at a nominal charge. Contact your PairGain sales representative for details and pricing.

C. ABBREVIATIONS

12. Abbreviations

CO	Central Office
COLU	Central Office Line Unit
COT	Central Office Terminal
ESD	Electro-Static Discharge
HDSL	High-bit-rate Digital Subscriber Line
LED	Light-Emitting Diode
MLT	Mechanized Loop Test
PAU	PG-Plus Alarm Unit
POTS	Plain Old Telephone Service
PRL	PG-Plus Remote Line unit
RLU	Remote Line Unit (circuitry only)
RMA	Return Materials Authorization
RT	Remote Terminal (enclosure and RLU inclusive)
SDT	Subscriber Drop Test

ISO 9001

DNV

DNV Certification, Inc.
Certificated Firm

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