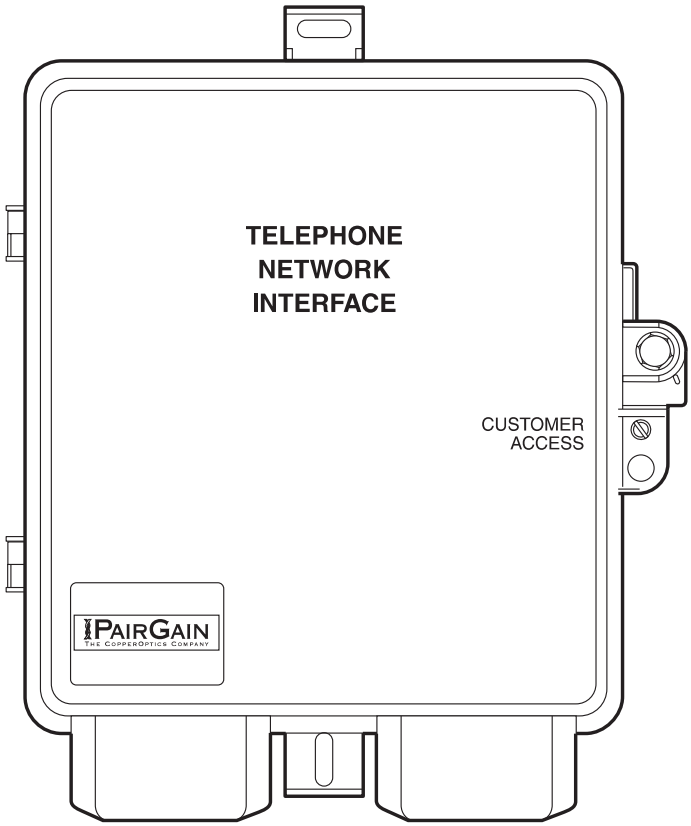
PG-PLUS

2 POTS REMOTE LINE UNIT

Model	List Number	Part Number	CLEI Code
PRL-784	1B	150-1684-21	S9MSCLAARA



PAIRGAIN TECHNOLOGIES, INC.
ENGINEERING SERVICES TECHNICAL PRACTICE

SECTION 950-784-112-01

Revision History of This Practice

Revision	Release Date	Revisions Made
01	December 18, 1998	Initial Release

USING THIS TECHNICAL PRACTICE

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

Notes contain information about special circumstances.

Cautions indicate the possibility of equipment damage or the possibility of personal injury.

INSPECTING YOUR SHIPMENT

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 packing list to ensure complete and accurate shipment of each listed item. If the shipment is short or irregular, contact PairGain as described in the Warranty. If you must store the equipment for a prolonged period, store the equipment in its original container.

ABBREVIATIONS

AWG	American Wire Gauge
BER	Bit Error Rate
CO	Central Office
COLU	Central Office Line Unit
COTS	Central Office Terminal Shelf
ESD	Electrostatic Discharge
HDSL	High-bit-rate Digital Subscriber Line
LED	Light-Emitting Diode
MLT	Mechanized Loop Test
PAU	PG-Plus Alarm Unit
PMU	PG-Plus Management Unit
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

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PRODUCT OVERVIEW

This practice describes the PairGain® PG-Plus™ PRL-784 List 1B, a Remote Terminal that provides interfaces to two 2 POTS RTs for four POTS subscribers.

DESCRIPTION AND FEATURES

A PG-Plus application (see Figure 1) provides bidirectional transport of multiple DS0s, over a single, unconditioned wire pair using HDSL technology. Using an 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. A typical configuration of PG-Plus application consists of:

- COTS
- COLU
- Two RTs

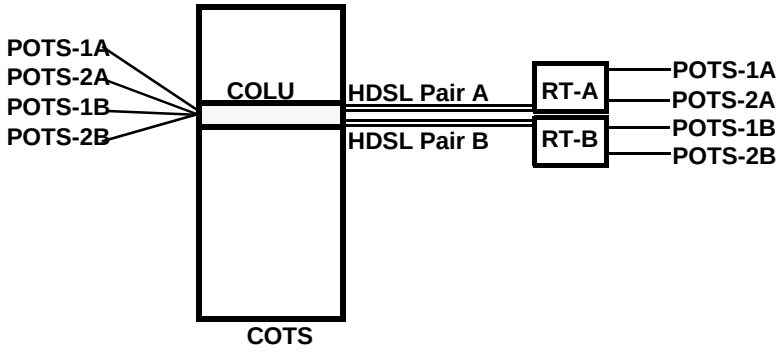

Figure 1. *Typical PG-Plus Application*

The COLU uses PairGain's HDSL technology to provide digital transmission without the need for repeaters, loop conditioning, or pair selection.

The COLU can be installed in the PCS-718 or the PCS-719 COTS. The COLU operates in the standalone mode with no other COTS circuit cards required. Advanced features such as performance monitoring, alarm reporting, and testing require the addition of the PAU or the PMU. Line power is provided to the RT by the COLU.

Metallic fallback provides a direct connection from the CO to one subscriber under fault conditions. Service is provided to the first POTS subscriber on the affected system. At the RT, the system exits metallic fallback and attempts to synchronize if either the first POTS or the HDSL Tip to Ring pair is shorted for at least three seconds, and then released for at least three seconds. Otherwise, the COLU checks for the presence of an RT every five minutes. If an RT is present, the system begins HDSL synchronization acquisition.

Relays in the COLU and RT provide a path for SDT and metallic fallback operation. These relays are used to establish a circuit to POTS # 1 during fault conditions and to provide for drop testing of the selected subscriber line from the CO location.

SPECIFICATIONS

Power	
HDSL Line Input Voltage	±140 Vdc, maximum
HDSL Line Start-up Voltage	200 Vdc Tip to Ring, minimum
RT Input Power	7.7 Watts Tip to Ring, maximum
HDSL	
Line Code	2B1Q
Line Rate	65.3 K symbols/sec; 130.6 Kb/sec
Reach	18.0 kft, 26 AWG (.40 mm); 25.5 kft, 24 AWG (.51 mm); 36.5 kft, 22 AWG (.64 mm); 62.0 kft, 19 AWG (.91 mm)
Maximum Line Attenuation	46.4 dB at 33 kHz
Environment	
Temperature	-40°F to +149°F; -40°C to + 65°C
Humidity	5 percent to 95 percent noncondensing
Altitude	-200 ft. MSL to 13,000 ft.; -60 m to 4,000 m
Vibration	NEBS
Electrostatic Discharge	Per GR-1089-CORE
Power and Lightning	Per GR-1089-CORE
Human Safety	Per UL 1950
Emissions Radiation and Immunity	Per FCC Part 15 for Class B digital devices
POTS Interface	
Analog Impedance	600 Ω
Supported Subscriber Drop	100 Ω plus 430 Ω for handset
Open Circuit Voltage (no phone)	48 Vdc Typical
Minimum Phone Current	23 mA
Connectors	
HDSL	3-terminal station protector, 3/8-in. hex nut
POTS	Screw Terminals on RJ-11 line interface
Dimensions	
Height	10.25 in.; 260.35 mm
Width	8.5 in.; 215.9 mm
Depth	4.75 in.; 120.65
Weight	3 lbs. 10 oz.; 1.406 Kg

INSTALLATION

The installation of an RT involves two procedures, mounting and wiring. These procedures are described in the following sections.

To ensure the safety of personnel and equipment, 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.

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. Use caution when installing an HDSL pair that is already connected to a COLU, because dangerous voltages are present on the HDSL pair.

The COLU, unless previously disabled by means of Craft provisioning, periodically attempts to power up the RT by applying +130 Vdc with respect to ground 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 3 seconds after removal of the short.

REQUIRED TOOLS AND TEST EQUIPMENT

- POTS Telephone set
- 1/4-inch flat-head screwdriver
- No. 1 Phillips screwdriver
- insulated-handle 3/8-inch nut driver
- 5/32-inch hex key, drilled for tamper-proof fasteners
- insulated-handle wire stripper
- insulated-handle needlenose pliers
- insulated-handle wire cutter

PREPARING THE RT FOR WIRING

HDSL and subscriber wiring are threaded through rubber grommets at the bottom of the RT. Subscriber line connections are made through the right-hand side of the Line Modules. Use a No. 1 Phillips screwdriver to punch two small holes in the bottom of the rubber grommet on the left-hand bottom side and one small hole in the right-hand grommet of the RT.

Cutting the grommet with a utility knife or something similar is not recommended, because this can cause too large an opening thus allowing contaminants to enter.

MOUNTING THE RT

Use the two No. 10 x 1.5-inch wood screws and flat washers provided in the Mounting Kit to attach the RT to the side of the customer residence (see Figure 2). For mounting on stucco or other suitable surfaces, use the two No. 10 x 1-inch anchor nuts from the kit.

Mount the RT only as shown, with all access openings facing down. Otherwise, possibly damaging materials (such as fluids) can enter the RT.

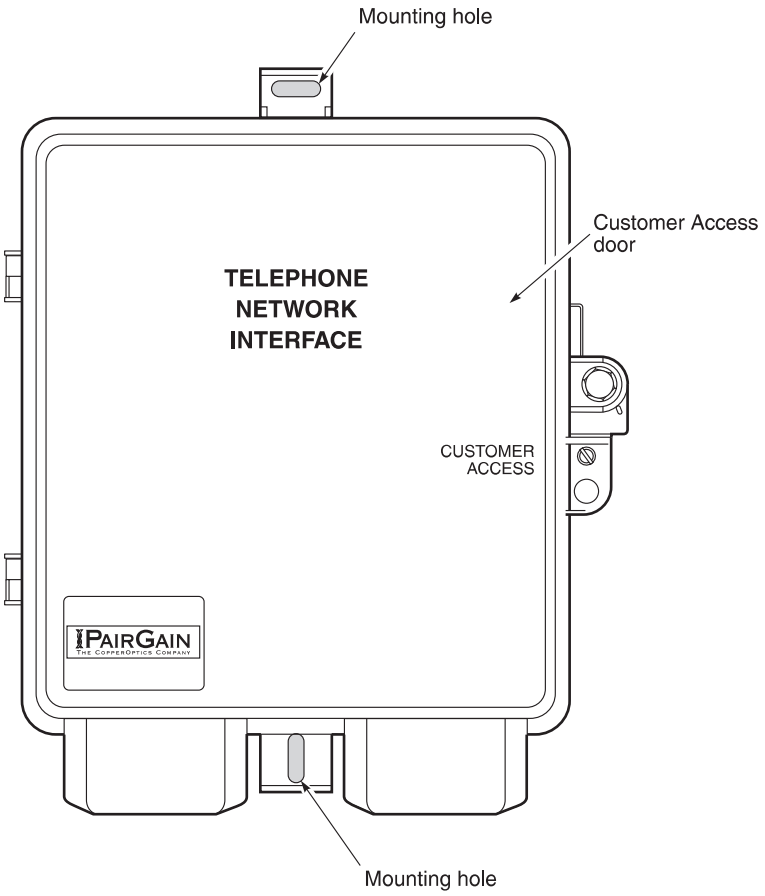

Figure 2. *Mounting the RT*

OPEN THE RT HOUSING

You have full access to the interior of the RT and to each Line Module inside the RT by loosening the Telco override screw from the Customer Access door, or by loosening the tamper-proof screw from the Telco Access door (see Figure 3). The tamper-proof screw can be either of the following:

- No. 8 pan-head pin and socket type, that requires a 5/32-inch drilled hex key. The No. 8 pan-head pin and socket type screw is preferred for improved security.
- 3/8-inch hex-head screw, which requires a 3/8-inch nut driver (216 tool or can wrench).

In either case, to gain access to the interior of the RT and to each Line Module, use a 5/32-inch drilled hex key to loosen and then remove the Telco override screw from the Customer Access or Telco Access door.

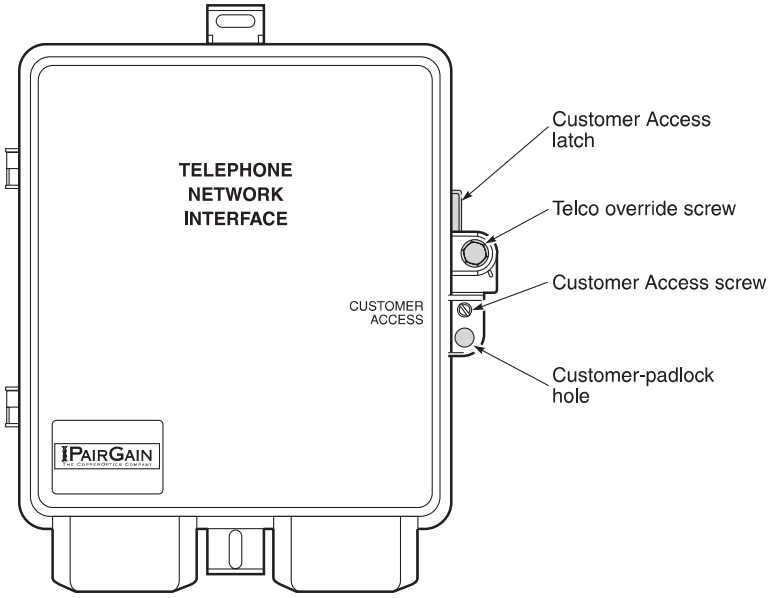

Figure 3. *Securing the Customer Access Door*

For installations that service more than one subscriber from a single RT, plug the customer-padlock hole in the Customer Access door hasp with a 3/8-inch diameter hole plug (see Figure 3).

Subscribers can place a padlock through the customer-padlock hole drilled into the Customer Access door hasp to secure the Customer Access door (see Figure 4).

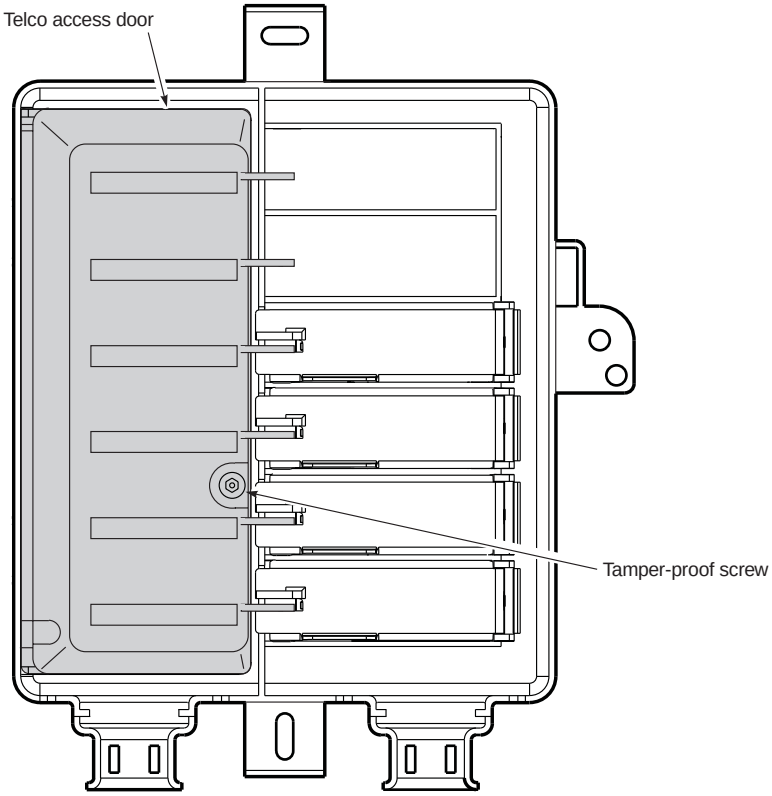

Figure 4. *Securing a Line Module*

WIRING THE RT

A wiring harness, consisting of a cable for the two 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 frame. The wiring harness is factory-wired to the primary protection devices for the POTS and HDSL pairs and to the FGND bus. An additional frame ground is attached to the inner metal frame. The Line Modules on the POTS lines provide an RJ-11 test jack for isolating trouble to the network or subscriber. Each POTS line is protected by a over-voltage-protected threaded binding post under the Telco cover.

HDSL and subscriber wiring are threaded through rubber grommets at the bottom of the RT. The HDSL pair from the COTS 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 Line Modules. An RJ-11 jack allows the subscriber line to be disconnected from the network, or allows for a POTS test set to be plugged in as an aid to diagnostic tests.

Reference Label

During installation, refer to the RT Reference label (see Figure 5) affixed inside the Customer Access door. The middle section of the Reference label identifies the Frame Ground and HDSL Tip and Ring wires, and the wire color code for the two POTS lines.

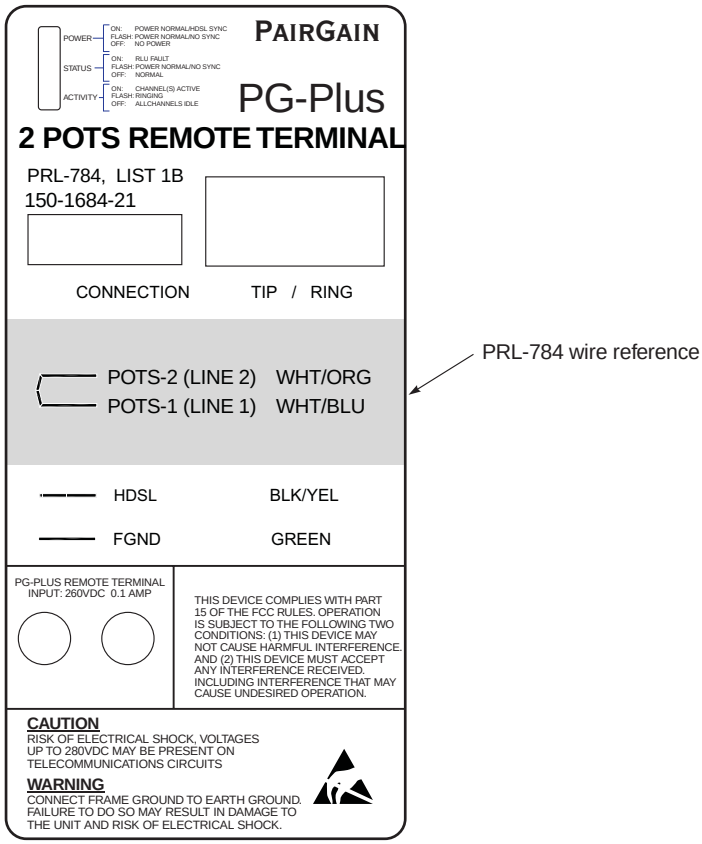

Figure 5. *Reference Label*

Attach the Frame-Ground Wire

1 Open the Telco Access door.

2 Insert the FGND wire through one of the holes in the left-hand rubber grommet. A 10 AWG (25.8 mm) solid copper ground wire is recommended.

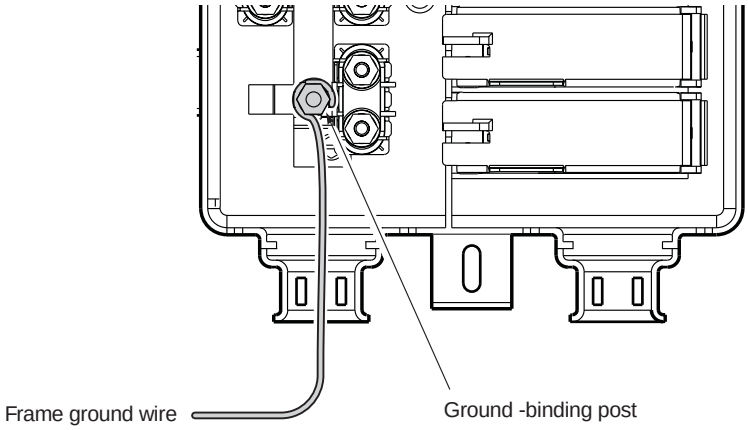

Figure 6. *Attaching the Frame-Ground Wire*

3 Loosen and remove the top nut and three flat washers from the ground-binding post. Loop the FGND wire around the ground-binding post. Then replace and tighten in reverse order the hardware removed earlier.

Attach the HDSL Tip and Ring Wires

Always treat the HDSL pair as if it were live with high voltage present. Review the safety precautions at the beginning of this section before proceeding.

1 Insert the service cable containing the HDSL Tip and Ring wires into the second hole in the bottom of the left-hand rubber grommet.

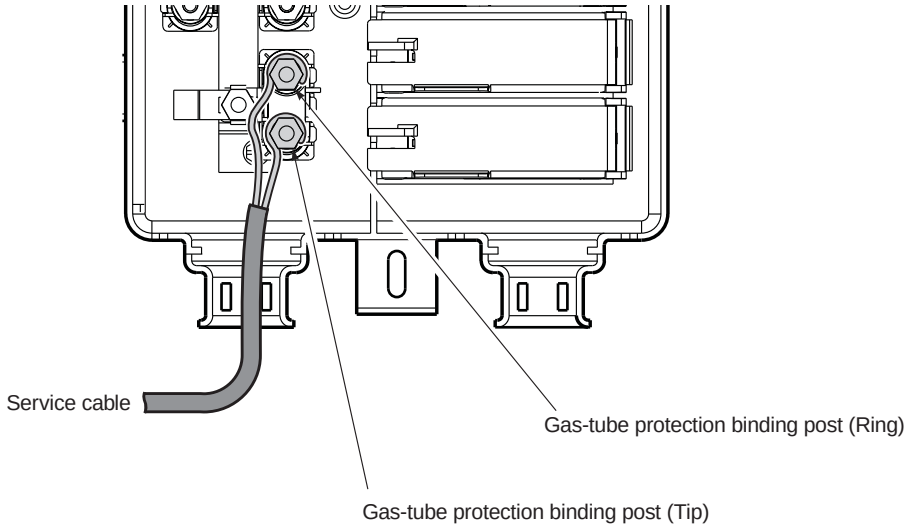

Figure 7. *Attaching the HDSL Tip and Ring Wires*

2 Loosen the top nuts on the Tip and Ring gas-tube protection binding posts (see Figure 7).

3 Remove the service cable outer jacket from the cable inside the RT, strip the insulation from the end of the HDSL Ring wire using an insulated-handle wire stripper, then carefully insert and loop the HDSL Ring wire in a clockwise direction between the top two washers on the HDSL Ring binding post.

To avoid electrical shock, handle the stripped HDSL wire by it's insulation with insulated-handled needlenose pliers

4 Tighten the HDSL Ring binding post nut with an insulated-handle nut driver, then trim any excess uninsulated wire with an insulated-handle wire cutter.

5 Connect the Tip conductor as done with the Ring conductor.

Attach the POTS Drop Wires

If this unit has been pole mounted, PairGain recommends that the subscriber drop wires be connected directly to the appropriate gas-tube protection binding posts.

1 Thread the subscriber wire pairs through the hole made earlier in the right-hand rubber grommet (see Figure 8).

2 Lift the Line Module door, and insert the subscriber wire pair through the cutout on the right side of the Line Module door. The HDSL Tip and Ring wires, which you installed in the previous section, are not shown in this graphic.

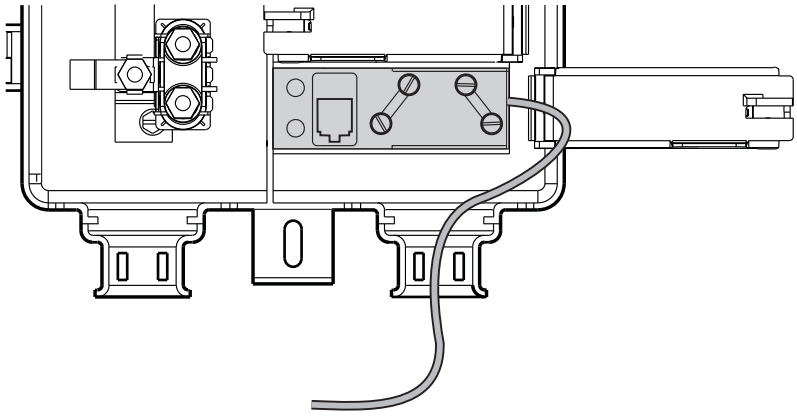

Figure 8. *Inserting the POTS Wires*

3 Connect the Tip conductor to the Line Module green terminal gas-tube protection binding post, connect the Ring conductor to the red terminal gas-tube protection binding post, then close the Line Module door.

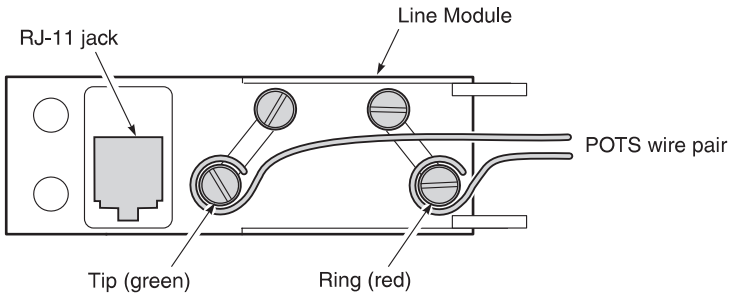

Figure 9. *Attaching the POTS Wire Pair*

4 Repeat the steps for each additional subscriber line being installed.

5 Close the Line Module door.

TURN UP AND TESTING

1 Open all the Line Module doors and unplug each RJ-11 jack to ensure there are no wiring errors from the subscriber lines (see Figure 10).

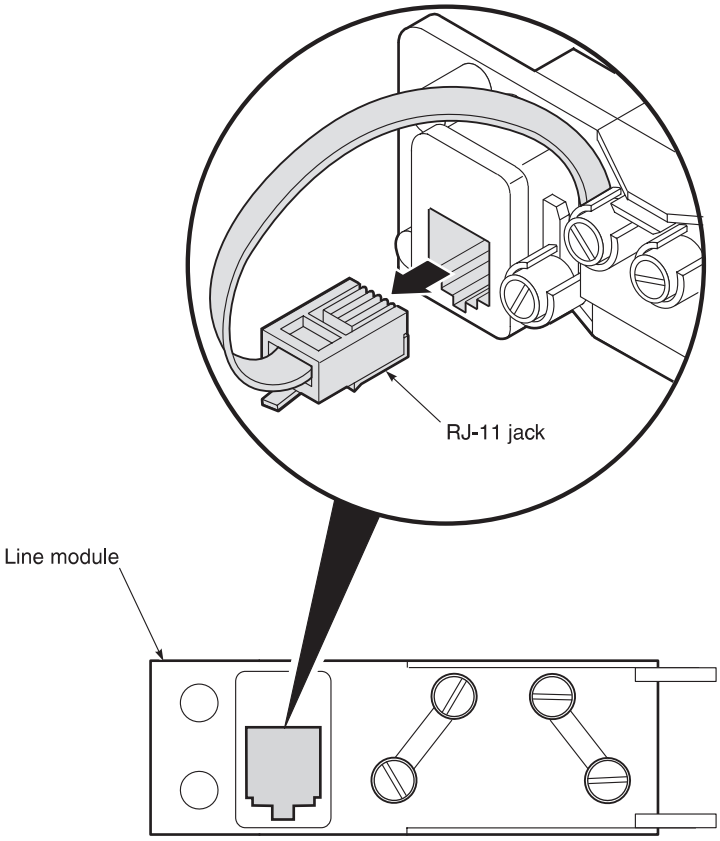

Figure 10. *Unplugging the RJ-11 Jack*

2 Open the Telco Access door and, at the Tip and Ring posts, apply a short between the HDSL Tip and Ring conductors for at least for 3 seconds. The following start-up sequence occurs after a 3-second delay:

- COLU responds with start-up voltage immediately
- RT detects HDSL line voltage, then initiates the HDSL start-up sequence
- PWR LED Flashes green

Start-up is complete when the PWR LED is On green and the ACTIVITY and STATUS LEDs are Off.

3 Reconnect the RJ-11 jacks and close all the Line Module doors and the Telco Access door.

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.

CLOSE THE HOUSING

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

1. Close the Line Module door.
2. Close the Telco Access door.
3. Tighten the screw on the Telco Access door until it is completely seated. This is to avoid interference with the RT enclosure cover.
4. Close the RT housing cover and secure both the Telco override screw and the slotted-head Customer Access screw.

FAULT ISOLATION

The following sections detail the fault isolation procedures. For sections that indicate a condition such as “distance limitation exceeded”, refer to “Specifications” on page 2 for the correct values.

RT STATUS INDICATORS

You can view the LEDs status through the window of the RT case. These LEDs indicate system states and subscriber line activity. The top portion of the label is a guide to the meaning of the Status LEDs (see Figure 11).

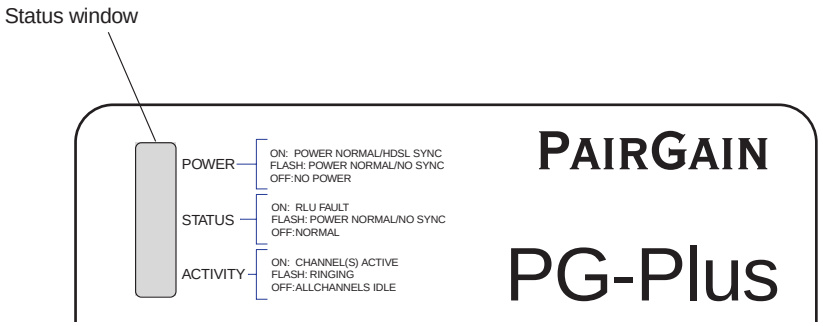

Figure 11. *Status Window*

If the PWR LED is Off, perform the following operations:

1 Verify that the RT and its corresponding COLU are installed on the same pair.

2 Verify the COLU is installed and turned up, and the HDSL Periodical Power Up option is Enabled.

3 Verify that the signal loss on the pair is no more than 46.4 dB at 33 kHz.

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

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

6 Verify that the line length does not exceed the values supported (see “Specifications” on page 2). The distances provide 10^{-7} BER with 6 dB of margin. The distances supported over single-gauge cable, without the use of bridge taps, for the 2 POTS RT are: 26 AWG (.40 mm) 5.49 km (18.0 kft); 19 AWG (.91 mm) 21.58 km (62.0 kft); 24 AWG (.51 mm) 7.77 km (25.5 kft); and 22 AWG (.64 mm) 11.2 km (36.5 kft).

7 Replace the RT and if necessary, replace the corresponding COLU.

COLU FAULT INDICATORS

At the CO, you can use the VT-100 terminal to initiate a SDT to determine the cause of any of the following problems. The following sections provide procedures for isolating faults indicated by the COLU LEDs.

No LEDs On

- processor in the COLU stopped

  1 Remove and re-insert the COLU.

  2 At the VT-100 interface, go to the COLU Main Screen to view the Performance report to verify that no alarms exist. If you cannot view the COLU Main Screen, a communication error exists indicating a faulty COLU.

  3 If the LEDs do not illuminate, replace the COLU.

Fault LED On

- indicates an existing alarm condition on the COLU
  1. At the VT-100 interface, go to the COLU Main Screen to view the Performance report to determine the cause of the alarm. Correct the condition, if possible. If you cannot view the COLU Main Screen, a communication error exists.
  2. Remove and re-insert the COLU.
  3. If the communication error still exists, replace the COLU.

Margin LED On

- distance limitation exceeded
- fault in HDSL line.
- faulty COLU
  1. At the VT-100 interface, go to the COLU Main Screen to view the Performance report to verify that no alarms exist.
  2. Initial installation, check engineering records for distance between COTS and RT.
  3. If existing installation, measure loss of HDSL line to ensure that the maximum attenuation value has not been exceeded.
  4. Replace COLU and/or the RT.

Margin LED Flashing

- distance limitation exceeded
- fault in HDSL line
- faulty RT
  1. Initial installation, check engineering records for distance between COTS and RT.
  2. If existing installation, measure loss of HDSL line to ensure that the maximum attenuation value has not been exceeded.
  3. Replace COLU and/or the RT.

SYNC LED Off

- HDSL line has lost synchronization
- distance limitation may have been exceeded
- COLU is faulty
  1. Initial installation, check engineering records for distance between COTS and RT.
  2. If existing installation, measure loss of HDSL line to ensure that the maximum attenuation value has not been exceeded.
  3. Replace COLU and/or the RT.

PWR LED Off

- no input power
- on-board fuse is blown on COLU
  1. Ground fault condition exists.
  2. Check input power at COTS backplane with COLU removed.
  3. If power is present at COTS backplane, replace the COLU.

PWR LED Flashing

- HDSL line open
- an overload exists
  1. Check line continuity and resistance.
  2. COLU power supply or RT may be faulty.

SUBSCRIBER REPORTED FAULTS

At the CO, you can use the Craft interface to initiate a SDT to determine the cause of any of the following problems. The SDT test performs Hazardous Potential, Foreign Voltage, Resistive Faults, Receiver Off-Hook, and Ringers Tests. At the customer site, the following sections provide procedures for isolating faults, based on subscriber reports.

No dialtone, can not dial

- Short-circuit or open-circuit
- faulty COLU or RT

1 At the CO using the Craft screen, select TEST option, and view the test results. The tests run are for Hazardous Potential, Foreign Voltage, Resistive Fault, and CPE Termination.

2 At the RT, lift the subscriber pair at the RT by opening the RJ-11 connector on the Integrated Protector Module. If dialtone is present at the RT and calls can be placed, the fault is in the subscriber side. Check for shorts or opens towards the subscriber or on the customer premise.

3 If dialtone is not present with the RJ-11 test connector lifted, lift the jumper in the CO between the CO switch and the COTS. If dialtone is present at the switch, replace the COLU.

4 If after replacing the COLU the dialtone is still not present, the fault is in the RT. Replace the RT.

Phone does not ring

- high-resistance short on subscriber drop (REN load exceeded, see Specification table)
- faulty RT or COLU

1 At the CO, using the Craft interface, go to the COLU Main Screen to verify the correct operation of the COLU. If you cannot view the COLU Main Screen, a communication error exists indicating a faulty COLU. Remove and re-insert the COLU.

2 Go to the Test option, and select the desired circuit to test.

3 View the SDT results. Refer to the Test Submenu section for specific results.

4 At the RT, check for ringing at the RT with the RJ-11 test jack open. If ringing is not present, check for ringing on another line terminated on the same RT. If ringing is present on other lines, check for high-resistance shorts on the subscriber drop. If no high resistance shorts, replace the RT.

5 If ringing is not present on another circuit terminated on the RT, lift the jumper between the CO switch and the COTS. If ringing is present, replace the COLU. If ringing is not present, the fault is in the switch.

Phone does not stop ringing

- faulty subscriber station instrument
- loop length too long
- faulty RT

1 If phone stops ringing when using a butt-in set at the subscriber location, the subscriber's station internal resistance is too high. Replace phone.

2 If phone does not stop ringing when using a butt-in set at the subscriber location, one or both of these conditions exist:

- loop length is too long (refer to Specification table)
- or the RT is faulty.

Can not hear, can not be heard

- subscriber problem
- faulty COLU or RT

1. Open the RJ-11 test jack at the RT. If audible level is acceptable, the problem is with subscriber equipment.
2. If audible level is too low at the RT with the RJ-11 test jack lifted, lift the jumper in the CO between the CO switch and the COTS.
   - If audible level is acceptable, replace the COLU or RT
   - otherwise, the problem is in the CO switch.

PRODUCT SUPPORT

TECHNICAL SUPPORT

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

During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday through 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.

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) 730-2800. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1.

WARRANTY

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 correct 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 incorrect use or installation.

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.

If a unit needs repair, call PairGain for a Return Material Authorization (RMA) number and return the defective unit, freight prepaid, along with a brief description of the problem, to:

PairGain Technologies, Inc.
14352 Franklin Avenue
Tustin, CA 92780
ATTN: Repair and Return Dept.
(800) 638-0031

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

FCC COMPLIANCE

This unit is designed to comply with the limits for Class B digital devices pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, can cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Refer to the installation section of the appropriate instruction manual for the unit you are installing to get information on:

- Cabling
- Correct connections
- Grounding

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.

All wiring external to the products should follow the provisions of the current edition of the National Electrical Code.

Corporate Office

14402 Franklin Avenue
Tustin, CA 92780

Tel: (714) 832-9922
Fax: (714) 832-9924

For Technical Assistance:

(800) 638-0031

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