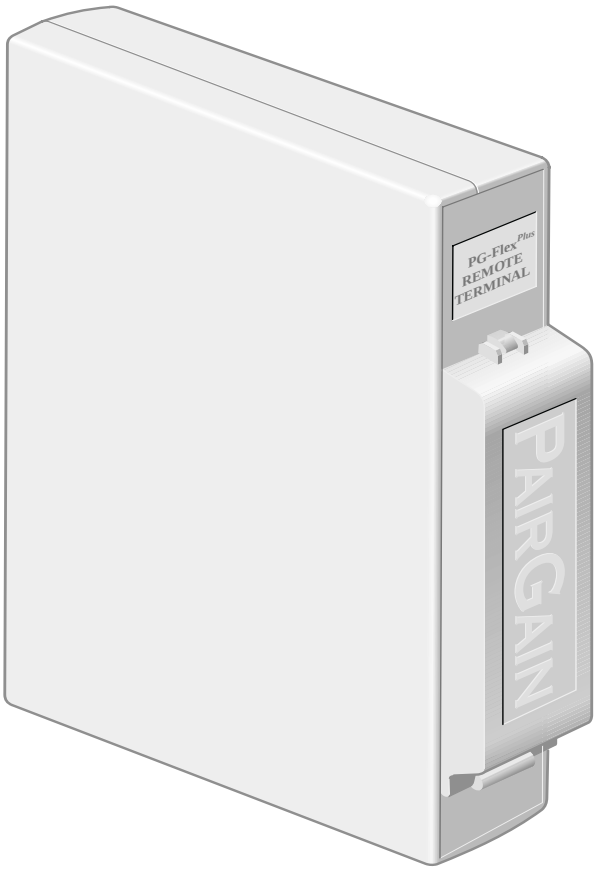
PG-FLEX*PLUS*



Indoor Remote Terminal Enclosure

PRL-770 List 2E
PRL-779 List 1E

Part Number:	150-1670-52
	150-1679-51
CLEI Code:	S9MSBA0A
	S9MSEH0A

PAIRGAIN TECHNOLOGIES, INC.
ENGINEERING SERVICES TECHNICAL PRACTICE

SECTION 950-779-115-02

pairgain
THE POWER BEHIND DSL ACCESS

Revision History of This Manual

Revision	Release Date	Revisions Made
01	December 13, 1999	Initial release.
02	March 17, 2000	Add 4 POTS support information and change reference label graphics.

USING THIS TECHNICAL PRACTICE

Three types of icons appear in the text.

Notes indicate information about special circumstances.

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

The ESD Susceptibility symbol indicates that a device or assembly is susceptible to damage from electrostatic discharge.

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 "Limited Warranty" on page 16. If you must store the equipment for a prolonged period, store the equipment in its original container.

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OVERVIEW

The PairGain® PG-Flex*Plus* ™ PRL-770 List 2 E and PRL-779 List 1 E, provides interfaces for LS/GS POTS subscribers. The PRL-779 supports Loop Start and Ground Start (LS/GS) POTS, allows Tip and Ring polarity reversal for support of Millennium pay phones, and implements TR-08 channel testing. The PRL-770 is a 4 LS Indoor Remote Terminal Enclosure, and the PRL-779 is a 6 LS/GS Indoor Remote Terminal Enclosure.

A PG-Flex*Plus* system 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 LS/GS interfaces on a single HDSL twisted-pair wire. Figure 1 shows a minimally configured PG-Plus application that consists of one COT shelf, one COLU, and one RT.

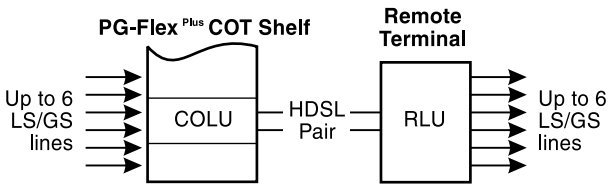

Figure 1. *Typical PG-Plus Application*

Each COLU housed in a COT shelf interfaces with a corresponding RT. LS/GS or digital lines from a CO switching system connect to the COT shelf and are sent by means of the COLU and the HDSL wire pair to an RT. As an example, a 23-inch COT shelf can interface with sixteen different RTs providing up to six LS/GS lines each, for as many as 96 subscriber lines. The COT shelf operates on standard -48 Vdc CO battery and supplies power to the RT, eliminating the need and expense of providing local power at the RT. A PG-Plus system with HDSL transmission and line-powered RTs results in fast, cost-effective solutions to LS/GS deployment over minimal copper facilities.

When using a 23-inch COT shelf to interface with sixteen PRL-770 4 LS RTs you can support as many as 64 subscriber lines.

INTEGRATED CHANNEL TESTING

The LS/GS RT supports channel testing as described in TR-TSY-000008 and TR-TSY-000465 when the PG-Plus system is configured to interface to a TR-08 compliant digital switch. During the channel test, a sequence of hand-shaking messages and tones are exchanged between the PG-Plus system and the switch, and the LS/GS RT responds by applying the appropriate absorptive (600 Ω) or reflective (0 Ω) test terminations to the remote channel under test, thus allowing for both transmission and signalling tests to be performed on that specific channel. The transmission tests verify the transmission parameters, such as channel loss, return loss, and idle channel noise are within the required limits. The signalling tests, that consist of off-hook detection and a ringing test, ensure that the channel can detect and produce the correct signalling states. In addition to the channel testing, the LS/GS RT works in conjunction with the switch to provide subscriber drop testing.

METALLIC FALLBACK

Metallic fallback provides a direct connection from the CO to subscriber number one under fault conditions. The metallic fallback feature is a provisionable item. You can disable this feature through the user screens.

Service is provided to the subscriber assigned to the LS/GS line in the affected COLU. At the RT, the system exits metallic fallback and attempts to synchronize if either LS/GS number one or the HDSL Tip to Ring pair is shorted for at least 3 seconds, and then released for at least 3 seconds. Otherwise, the COLU checks for the presence of an RT every 5 minutes. If an RT is present, the system begins HDSL synchronization acquisition.

Relays in the COLU and RT under control of the PG-Plus Alarm Unit (PAU) or PG-Plus Management Unit (PMU) provide a path for subscriber drop test and metallic fallback operation. These relays are used to establish a path to channel 1 of the LS/GS RT during fault conditions and to provide for drop testing of the selected subscriber line from the CO location.

SPECIFICATIONS

Power	
Voltage Safety	A2 compliant per GR-1089-CORE
HDSL Line Input Voltage	+/-135 Vdc Tip to Ring, maximum
HDSL Line Start-up Voltage	+/- 100 Vdc Tip to Ring, minimum
RT Input Power	10.2 Watts typical; 11.2 Watts Tip to Ring, maximum with 4 off-hook, 2 ringing 5 REN
HDSL	
Line Code	2B1Q
Line Rates	
PRL-770	130.6 K symbols/sec; 262 Kbps
PRL-779	196 K symbols/sec (392 K bps), 261.3 Kbps
Line Reach	
PRL-770	26 AWG (0.4 mm),15.0 kft (4.57 km) 24 AWG (0.5 mm), 21.7 kft (6.61 km) 22 AWG (0.6 mm), 31.2 kft (9.51 km) 19 AWG (0.9 mm), 49.7 kft (15.1 km)
PRL-779	26 AWG (0.4 mm), 12.5 kft (3.81 km) 24 AWG (0.5 mm), 18.0 kft (5.48 km) 22 AWG (0.6 mm), 25.2 kft (7.68 km) 19 AWG (0.9 mm), 37.8 kft (11.5 km)
Maximum Attenuation	
PRL-770	45.9 dB at 65 kHz
PRL-779	41.6 dB at 98 kHz
Environment	
Temperature	-40 °F to +131 °F (-40 °C to + 55 °C)
Humidity	5% to 95% noncondensing
Altitude	-200 ft. to 13,000 ft. (-60 m to 4,000 m)
Compliance	
Human Safety	UL 1950
Emissions Radiation and Immunity	GR-1089 Core Class B and FCC Part 15 for Class B compliant

LS/GS Interface

Analog Impedance	600 Ω
RT supervisory range	300 Ω plus 430 Ω for handset; or 3.5 kft on 26 AWG; 5.7 kft on 24 AWG; 9.2 kft on 22 AWG
Detection of Loop Open	≥10 kΩ
Idle State Voltage	-48 V minimum
Loop Current	23 mA minimum
Ring Generation	
PRL-770	Balanced Trapezoidal 40 Vrms minimum @ 20 ± 3 Hz up to 5 REN per line (10 REN total at RT)
PRL-779	Unbalanced Trapezoidal 40 Vrms minimum @ 20 ± 3 Hz up to 5 REN per line (10 REN total at RT)
Ring Trip	Removed in 200 ms after Loop Closure

Connectors

HDSL	Insulation Displacement Contact (IDC) Connector
LS/GS	IDC Connector

Dimensions

Height	9 in. (228.6 mm)
Width	6 in. (152.4 mm)
Depth	1.8 in. (45.7 mm)
Weight	
PRL-770	1 lbs. 11 oz. (.76 Kg)
PRL-779	2 lbs. 3 oz. (1 Kg)

INSTALLATION AND TURN-UP

The PRL-770 List 2 E and PRL-779 List 1 E are a listed accessory to be used only with PairGain Model PLL-729 or PLL-735 List 1 or equivalent.

Installation and maintenance to be performed by qualified service personnel only. This RT is to be installed in a restricted access location.

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 to the HDSL pair. The COLU also initiates a start-up after a short of at least 3 seconds has been applied to the HDSL pair. The COLU responds with start-up voltage 3 seconds after removal of the short.

The installation of an RT, described in the following sections, involves the following procedures:

- Preparing the RT for wiring
- Mounting the RT
- Wiring the RT
- Turn-up and testing

REQUIRED TOOLS AND TEST EQUIPMENT

- LS/GS telephone set
- $^{1}/_{4}$-inch flat-head screwdriver
- No. 1 Phillips screwdriver
- Insulated-handle $^{3}/_{8}$-inch nut driver
- Insulated-handle needlenose pliers
- Insulated-handle wire cutter

PREPARING THE RT

HDSL and subscriber wiring are threaded through the Insulation Displacement Contact (IDC) connector located on the right-hand side of the RT. Use either the wall mounting or the line-up template provided in the Mounting Kit for the RT wall positioning.

The RT is now prepared for mounting.

MOUNTING THE RT

The PRL-770 and PRL-779 are suitable for mounting on a wall or line-up. Wall mounting is preferable.

Before setting up the equipment, select a location that will allow sufficient access to wiring connections from the telco access door.

Wall Mounting

Use the back panel of the enclosure, or the enclosed hole pattern drawing as a template for marking the locations of mounting holes as shown in Figure 2.

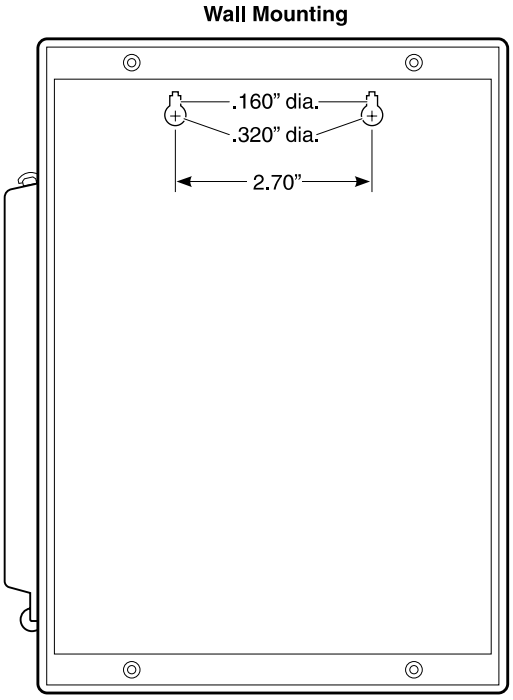

Figure 2. *Wall Mounting Dimensions*

Use the two No. 6 x 1-inch wood screws provided in the Mounting Kit to attach the RT to the wall of the restricted access area (see Figure 3).

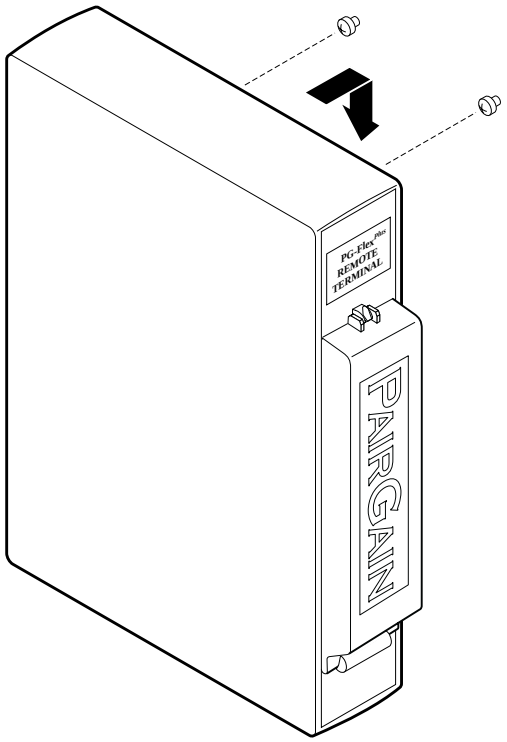

Figure 3. *Wall Mounting the RT*

Line-up Mounting

Use the back panel of the enclosure, or the enclosed hole pattern drawing as a template for marking the locations of mounting holes as shown in Figure 4.

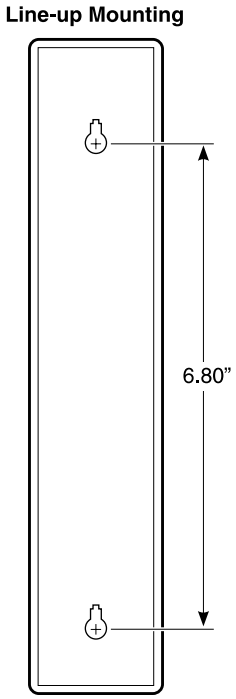

Figure 4. *Line-up Mounting Dimensions*

Use the two No. 6 x 1-inch wood screws provided in the Mounting Kit to attach the RT to the side of the restricted access area (see Figure 5).

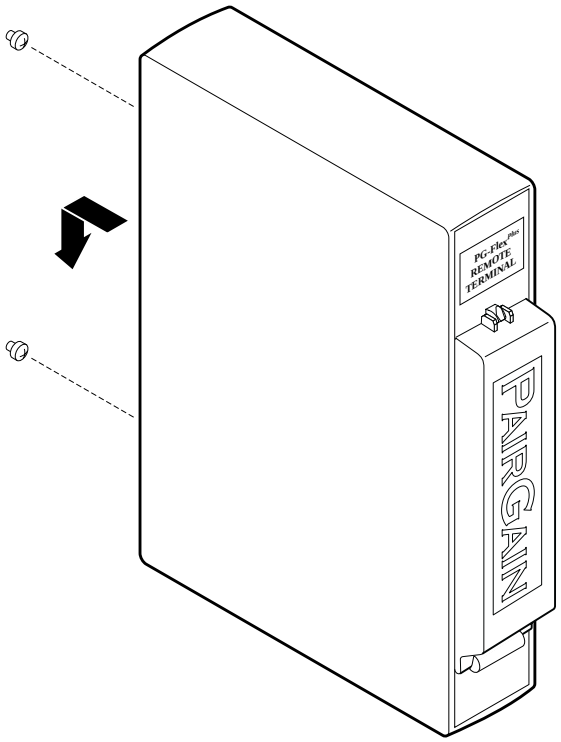

Figure 5. *Line-up Mounting the RT*

WIRING THE RT

Wiring the RT consists of three major steps:

- attaching the frame ground wire
- attaching the HDSL Tip and Ring wires
- attaching the subscriber line wires

Before setting up the equipment, select a location that will allow sufficient access to wiring connections from the telco access door.

During installation, refer to the RT Reference label (see Figure 6) affixed inside the Telco Access door. The Reference label identifies the Frame Ground and HDSL Tip and Ring, and the Subscriber Line wires.

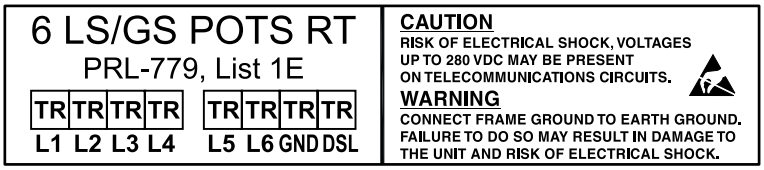

Figure 6. *Reference Label*

Attaching the Frame Ground, HDSL and Subscriber Line Wires

To install the RT wires, do the following:

This RT does not provide primary protectors on the HDSL or subscriber pairs. The primary protection for HDSL pairs must be an integral part of the premises wiring. If the subscriber wiring is routed outside of the premises for any reason, then primary protection for subscriber pairs must also be an integral part of the premise wiring.

1 Open the Telco Access door as shown in Figure 7.

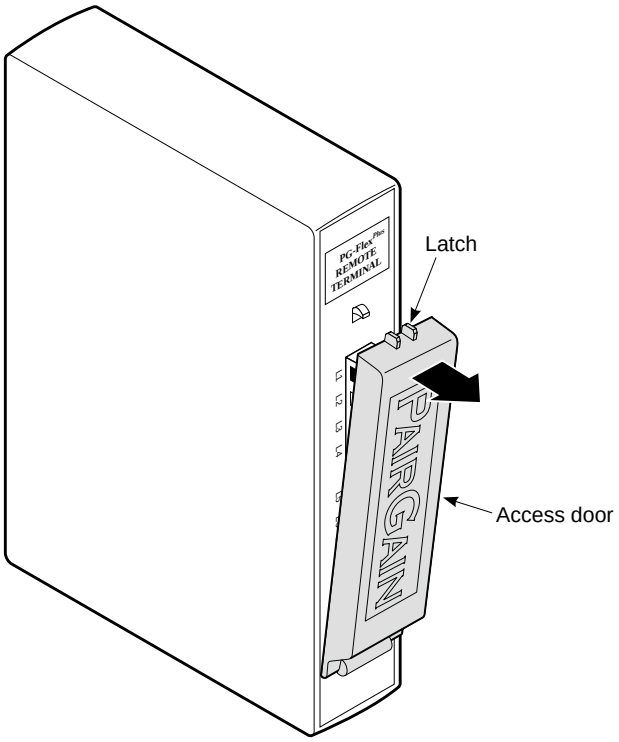

Figure 7. *Opening the Telco Access Door*

2 Insert the Tip and Ring wires through the hole below the Telco Access door.

3 For the FGND and Subscriber Line wires, pivot the IDC connector upward, then insert the wire pair through the tip and ring holes (see Figure 8). Each wire entry hole accepts one unstripped solid copper wire 22-24 American Wire Gauge (AWG) with a maximum insulation diameter of 1.52 mm.

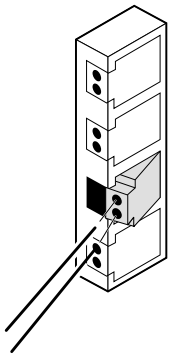

Figure 8. *Attaching the RT Wires*

4 Press the IDC connector downward to secure the FGND and Subscriber Line wires (see Figure 9).

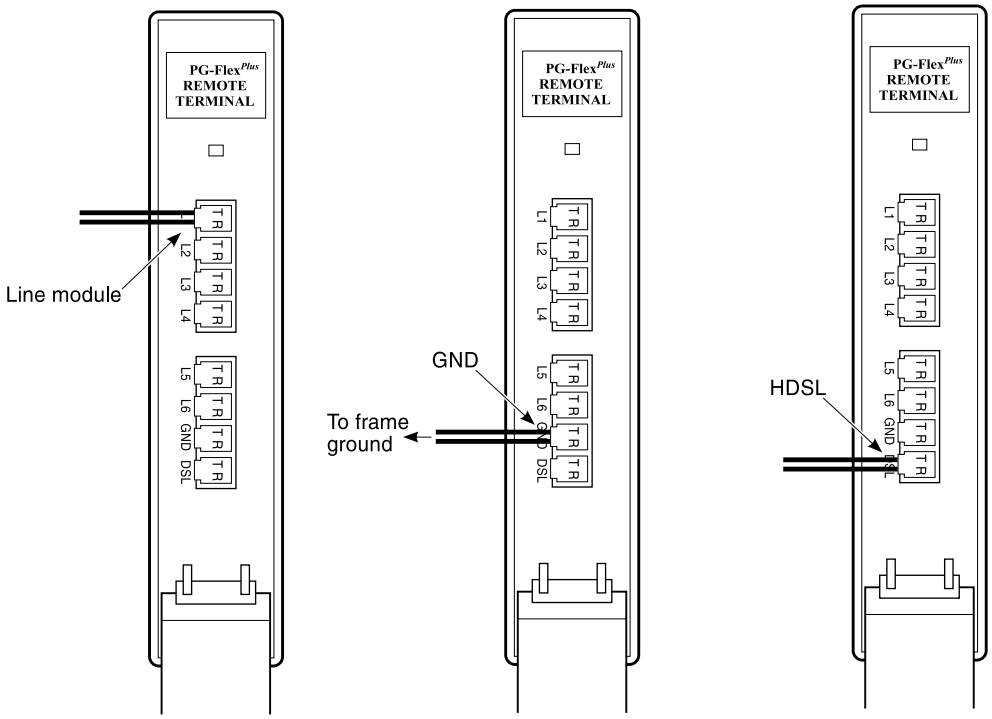

Figure 9. *Attaching the FGND, HDSL and Subscriber Line wires*

5 Repeat steps 2 through 4 to attach the HDSL wires.

6 Close the Telco Access door.

TURN UP AND TESTING

To continue the installation of your PRL-770 and PRL-779 for readiness:

1 Ensure that at least one COLU is installed into the PG-Flex*Plus* COT shelf. Refer to the appropriate COLU Technical Practice for verifying the COLU installation.

2 Locate the HDSL Tip and Ring on the protector block or punchdown, apply a short between the HDSL Tip and Ring conductors for at least 3 seconds. Start-up begins in 3 seconds after removal of the short. Within 2 minutes the system should provide dial tone and battery voltage on the subscriber pairs.

3 Listen for a dial tone using the customer phone line.

4 If dial tone is not heard, then refer to the appropriate COLU Technical Practice for COLU Fault Indicators.

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.

COLU FAULT INDICATORS

At the CO, you can use the VT-100 terminal to initiate a subscriber drop test to determine the cause of any of the following problems. Table 1 provides procedures for isolating faults indicated by the COLU LEDs.

Table 1. *COLU LED Fault Isolating*

LED	Mode	Condition	Procedure
None	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 the COLU Main screen cannot be viewed, a communication error exists, indicating a faulty COLU. **3** If the LEDs do not illuminate, replace the COLU.
Fault	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 the COLU Main screen cannot be viewed, a communication error exists. **2** Remove and re-insert the COLU. **3** If the communication error still exists, replace the COLU.
Margin	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 COT shelf and RT. **3** If existing installation, measure loss of HDSL line to ensure that the maximum attenuation value has not been exceeded. **4** Replace the COLU or the RT.

Table 1. *COLU LED Fault Isolating (Cont.)*

LED	Mode	Condition	Procedure
Margin	Flashing	• distance limitation exceeded	**1** Initial installation, check engineering records for distance between COT shelf and RT.
		• fault in HDSL line	**2** If existing installation, measure loss of HDSL line to ensure that the maximum attenuation value has not been exceeded.
		• faulty RT	**3** Replace the COLU or the RT or both.
SYNC	Off	• HDSL line has lost synchronization	**1** Initial installation, check engineering records for distance between COT shelf and RT.
		• distance limitation may have been exceeded	**2** If existing installation, measure loss of HDSL line to ensure that the maximum attenuation value has not been exceeded.
		• COLU is faulty	**3** Replace the COLU or the RT or both.
PWR	Off	• no input power	**1** Ground fault condition exists.
		• on-board fuse is blown on COLU	**2** Check input COT power at COT shelf backplane with COLU removed.
			3 If power is present at COT shelf backplane, replace the COLU.
PWR	Flashing	• HDSL line open	**1** Check line continuity and resistance.
		• an overload exists	**2** COLU power supply or RT may be faulty.

SUBSCRIBER REPORTED FAULTS

Use the craft interface to initiate a subscriber drop test to determine the cause of any of the following problems. The subscriber drop test performs Hazardous Potential, Foreign Voltage, Resistive Faults, Receiver Off-Hook, and Ringers Tests. Table 2 provides procedures for isolating faults, based on subscriber reports.

Table 2. *Subscriber Fault Isolating*

Conditions	Causes	Procedures
no dial tone, cannot dial	• Short-circuit or open-circuit	**1** At the CO using the craft interface, select Test menu option, and view the test results. The tests run are for Hazardous Potential, Foreign Voltage, Resistive Fault, and CPE Termination.
	• faulty COLU or RT	**2** Check for shorts or opens towards the subscriber or on the customer premise.
		3 Lift the jumper in the CO between the CO switch and the COT shelf. If dial tone is present at the switch, replace the COLU.
		4 If after replacing the COLU the dial tone 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 Specifications)	**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.
	• faulty RT or COLU	**2** Go to the Test menu option, and select the desired circuit to test.
		3 View the subscriber drop test results. Refer to the Test Submenu section for specific results.
		4 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 COT shelf. If ringing is present, replace the COLU. If ringing is not present, the fault is in the switch.

Table 2. *Subscriber Fault Isolating (Cont.)*

Conditions	Causes	Procedures
Phone does not stop ringing	• faulty subscriber station instrument • loop length too long • faulty RT	**1** If phone stops ringing when using a butt 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 set at the subscriber location, one or both of these conditions exist: • loop length is too long (refer to Specifications) • or the RT is faulty
Cannot hear, cannot be heard	• faulty COLU or RT	Lift the jumper in the CO between the CO switch and the COT shelf. • If audible level is acceptable, replace the COLU or RT • otherwise, the problem is in the CO switch

ABBREVIATIONS

AWG	American Wire Gauge
CO	Central Office
COLU	Central Office Line Unit
COT	Central Office Terminal
ESD	Electrostatic Discharge
HDSL	High-bit-rate Digital Subscriber Line
IDC	Insulation Displacement Contact
LED	Light-emitting Diode
LS/GS	Loop Start and Ground Start
MLT	Mechanized Loop Test
PAU	PG-Plus Alarm Unit
PMU	PG-Plus Management Unit
POTS	Plain Old Telephone Service
REN	Ringer Equivalence Number
RMA	Return Materials Authorization
RT	Remote Terminal

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 714.730-3222

Fax: 714.832.9924

Email: support@pairgain.com

During normal business hours (7:30 AM to 5:30 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.

LIMITED WARRANTY

PairGain Technologies, Inc. ("PairGain") warrants that, for a period of twelve (12) months from the date of shipment, the hardware portion of its products will be free of material defects and faulty workmanship, under normal use. PairGain's obligation, under this warranty, is limited to replacing or repairing, at PairGain's option, any such hardware product which is returned during the 12-month warranty period per PairGain's instructions and which product is confirmed by PairGain not to comply with the foregoing warranty.

PairGain warrants that, for a period of 90 days from the date of purchase, the software furnished with its products will operate substantially in accordance with the PairGain published specifications and documentation for such software. PairGain's entire liability for software that does not comply with the foregoing warranty and is reported to PairGain during the 90-day warranty period is, at PairGain's option, either (a) return of the price paid or (b) repair or replace of the software. [PairGain also warrants that, for a period of thirty (30) days from the date of purchase, the media on which software is stored will be free from material defects under normal use. PairGain will replace defective media at no charge if it is returned to PairGain during the 30-day warranty period along with proof of the date of shipment.]

The transportation charges for shipment of returned products to PairGain will be prepaid by the Buyer. PairGain will pay transportation charges for shipment of replacement products to Buyer, unless no trouble is found (NTF), in which case the Buyer will pay transportation charges.

PairGain may use reconditioned parts for such repair or replacement. This warranty does not apply to any product which has been repaired, worked upon, or altered by persons not authorized by PairGain or in PairGain's sole judgment has subjected to misuse, accident, fire or other casualty, or operation beyond its design range.

Repaired products have a 90-day warranty, or until the end of the original warranty period-whichever period is greater.

PAIRGAIN DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WITH RESPECT TO ITS PRODUCTS AND ANY ACCOMPANYING WRITTEN MATERIALS. FURTHER, PAIRGAIN DOES NOT WARRANT THAT SOFTWARE WILL BE FREE FROM BUGS OR THAT ITS USE WILL BE UNINTERRUPTED OR REGARDING THE USE, OR THE RESULTS OF THE USE, OF THE SOFTWARE IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY OR OTHERWISE.

ADVANCE REPLACEMENT

Any product determined by PairGain not to comply with the applicable warranty within 30 calendar days from the date of shipment to the Buyer, or as otherwise authorized, are eligible for advance replacement free of charge. A replacement product will be shipped to the Buyer within 24 hours of PairGain's receipt of notification from the Buyer.

If products returned to PairGain for advance replacement are not received by PairGain within 30 calendar days of shipment of the replacement product or if no trouble is found (NTF) as determined by PairGain, the Buyer will be responsible for payment of the cost of the replacement product.

BILLING

PairGain's repair of products returned for repair, replacement, or credit, whether in warranty or out of warranty, which are found to be damaged due to customer negligence or which have had parts removed will be billed at prevailing time and material rates.

In the event that the returned equipment is not covered by warranty, PairGain will contact the customer with estimated repair or replacement charges and obtain customer disposition of the product if a purchase order has not been provided.

Equipment returned for repair or replacement is subject to a $250 per unit no trouble found (NTF) charge in the event that diagnostic evaluation reveals no evidence of functional failure or physical defects.

RETURNING A PRODUCT

To return equipment to PairGain:

1 Locate the number of the purchase order under which the equipment was purchased. To obtain a return authorization number, you need to provide the original purchase order number to PairGain’s Return Material Authorization (RMA) Department.

2 Call or write PairGain’s RMA Department to ask for an RMA number and any additional instructions. Use the telephone number, fax number or email address listed below:

- Telephone: 800.370.9670
- Fax: 714.832.9923
- Email Address: rma@pairgain.com

3 Include the following information, in writing, along with the equipment you are returning:

- Company name and address.
- Contact name and telephone number.
- The shipping address to which PairGain should return the repaired equipment.
- The original purchase order number.
- A description of the equipment that includes the model and part number of each unit being returned, as well as the number of units that you are returning.
- The reason for the return. For example:
  - The equipment needs an ECO/ECN upgrade.
  - The equipment is defective.

If the equipment is defective, please tell us what you observed just before the equipment malfunctioned. Be as detailed in your description as possible.

If there is another reason for returning the equipment, please let us know so we can determine how best to help you.

4 Pack the equipment in a shipping carton.

5 Write PairGain's address and the RMA Number you received from the RMA Department clearly on the outside of the carton and return to:

PairGain Technologies, Inc.
14352 Franklin Ave.
Tustin, CA 92780-7013

Attention: **RMA (Number)**

All shipments are to be returned prepaid. PairGain will not accept any collect shipments.

FCC COMPLIANCE

This unit complies 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. voids the user's warranty.

All wiring external to the product(s) 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
714.730.3222

ISO 9001
DNV
DNV Certification, Inc.
Certificated Firm