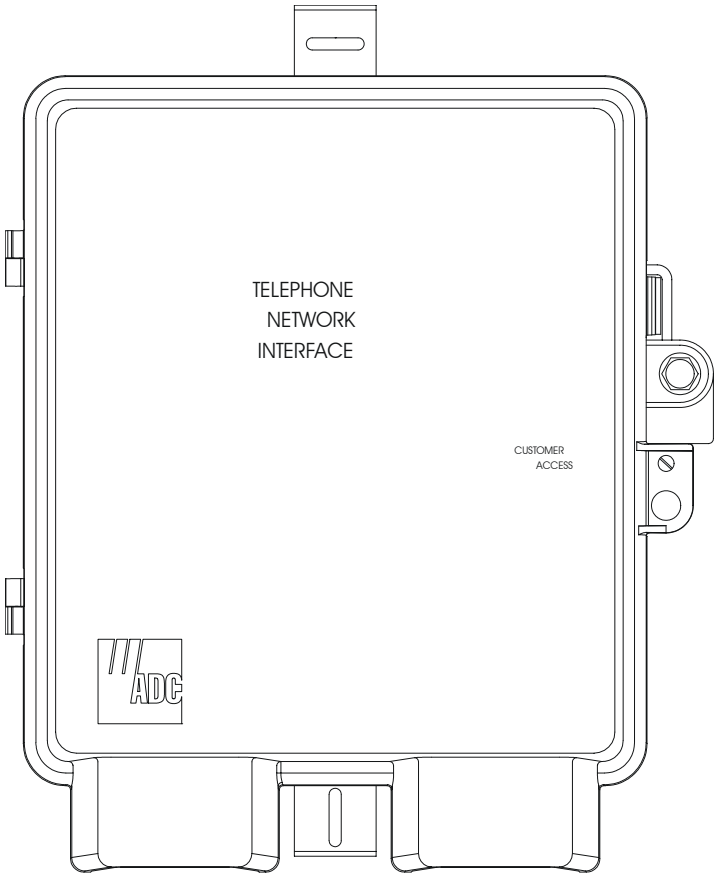
PG-PLUS

TECHNICAL PRACTICE



3 POTS/1 ISDN NID

Model	List	CLEI Code
PRL-772	1B	S9MSBD0A~~

SECTION SCP-PRL772-012-04H

Revision History of This Practice

Revision	Release Date	Revisions Made
01	September 19, 1997	Initial Release
02	February 19, 1999	Corrected specification table to reflect A2 compliance per GR-1089
03	January 29, 2002	Release to rebrand document to comply with ADC standards
04	January 6, 2003	Updated Product Support Information

USING THIS PRACTICE

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

Notes indicate information about special circumstances.

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

Electrostatic Discharge (ESD) susceptibility symbols indicate that a device or assembly is susceptible to damage from electrostatic discharge.You must wear an antistatic wrist strap connected to the appropriate ground connection prior to performing installation procedures. You must also observe normal ESD precautions when handling electronic equipment. Do not hold electronic plugs by their edges. Do not touch components or circuitry.

INSPECTING YOUR SHIPMENT

Upon receipt of the equipment:

- Unpack each container and visually inspect the contents for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC. 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 ADC as described in "Returns" on page 15. If you must store the equipment for a prolonged period, store the equipment in its original container.

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LIST OF FIGURES

OVERVIEW

This practice describes the ADC® PG-Plus® PRL-772 Remote Line Unit (RLU) that provides three Plain Old Telephone Service (POTS) interfaces and one Integrated Services Digital Network (ISDN) interface between a PG–Plus Remote Terminal (RT) and subscribers.

DESCRIPTION AND FEATURES

The PRL–772 RLU works in conjunction with the PLL–722 Central Office Line Unit (COLU) to interface the POTS and ISDN subscribers to the PG–Plus Central Office Terminal Shelf (COTS) over a single twisted-pair of wire. A ADC PG-Plus system (Figure 1) provides bidirectional 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 three POTS and an ISDN interface on a single HDSL twisted-pair wire. A minimally configured ADC PG-Plus system consists of:

- One Central Office Terminal shelf (COTS)
- One COLU
- One Remote Line Unit (RLU) housed in an RT enclosure.

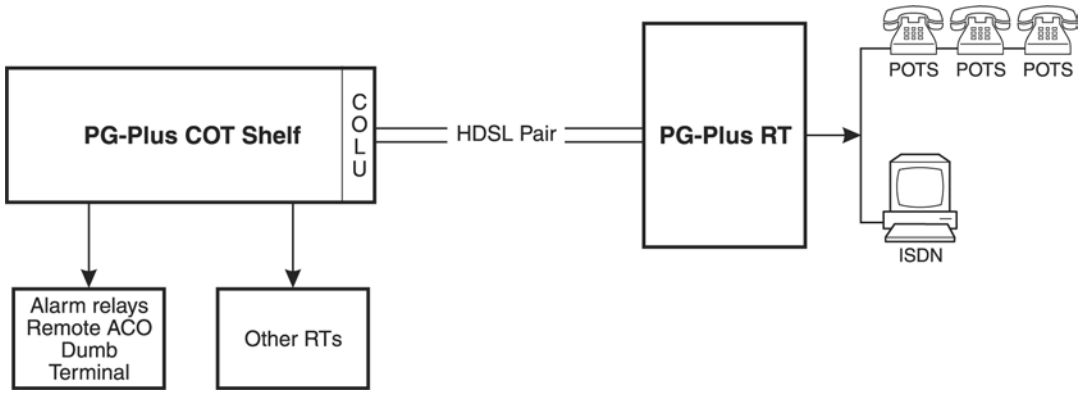

Figure 1. *Typical PG-Plus Application*

METALLIC FALLBACK

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

Relays in the COLU and RLU under control of the PG-Plus PAU provide a path for Subscriber Drop Testing (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 Supply

HDSL Line Input Voltage	±135 V dc (Tip to Ring, maximum)
HDSL Line Start-up Voltage	±100 V dc (Tip to Ring, minimum)
RLU Input Power	7.5 Watts (Tip to Ring, maximum)

HDSL Line

HDSL Line Code	2B1Q
HDSL Line Rate	196 K symbols/sec; 392 Kb/sec
HDSL Reach	12.5 kft, 26 gauge; 18.0 kft, 24 gauge; 25.2 kft, 22 gauge

Environment

Operating Temperature	-40°F to +149°F ; -40°C to + 65°C
Operating Humidity	5% to 95% (noncondensing)
Altitude	-200 ft. MSL to 13,000 ft. MSL; -60 m MSL to 4,000 m MSL
Vibration	NEBS
ESD	Per GR-1089-CORE
Power and Lightning	Per GR-1089-CORE
Human Safety	Per UL 1459
Emissions Radiation and Immunity	Per FCC Part 15 for Class A digital devices

POTS Interface

Analog Impedance	600 Ω
RLU supervisory range	100 Ω plus 430 Ω for handset
Detection of Loop Open	≥10 kΩ
Idle State Voltage	-48 V 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 RLU)

ISDN U Interface

Interface/Line code	U Interface/2B1Q
Analog Impedance	135 Ω
Idle State Voltage	48 V minimum
Provisional Sealing Current	9 mA minimum
Bit Error Rate for ANSI 601 Loops	$< 10^{-7}$
Performance Monitoring	Interim Path
Provisional EOC	Multipoint EOC mp-eoc; transparent
Maximum Loop Length	18 kft, conforms to ANSI T1-601 Loops

Connectors

HDSL	3-terminal station protector, 3/8-inch hex nut
POTS	Screw Terminals on RJ-11 line interface

Dimensions

Height	10.25 in. (26.0 cm.)
Width	8.5 in. (21.6 cm.)
Depth	4.75 in. (12.1 cm.)
Weight	3.0 lb. (1.4 kg.)

INSTALLATION AND TEST

REQUIRED TOOLS AND TEST EQUIPMENT

The tools and test equipment required for the RLU are:

- One ISDN U-Interface Basic Rate test set
- One Telephone test set
- One 1/4-inch flat-head screwdriver
- One #1 Phillips screwdriver
- One insulated-handle 3/8-inch nut driver
- One 5/32-inch hex key, drilled for tamper-proof fasteners
- One insulated-handle wire stripper
- One insulated-handle needlenose pliers
- One insulated-handle wire cutter

INSTALLING THE RLU

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, use only power supplies listed with telephone equipment by a locally recognized organization.

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 RLU by applying ± 100 V dc 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 three seconds after removal of the short.

Security

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

- #8 pan-head pin and socket type, which requires a 5/32-inch drilled hex key. The #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.

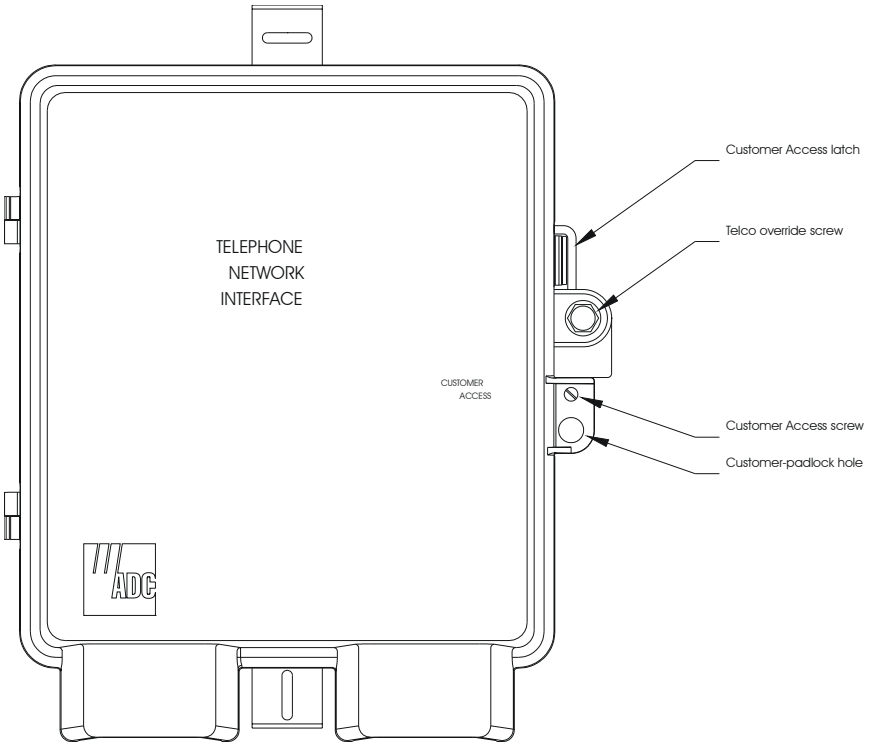

Figure 2. *Securing the Customer Access Door*

Subscribers can place a padlock through the customer-padlock hole drilled into the Customer Access door hasp (Figure 2) to secure the Customer Access door.

For installations where more than one subscriber is serviced out of a single RT unit, you should plug the customer-padlock hole in the Customer Access door hasp with a 3/8-inch diameter hole plug. When more than one subscriber is serviced out of a single RT, the subscriber can protect his line against unauthorized use by placing a padlock through the latch on the appropriate Line Module door (Figure 3.).

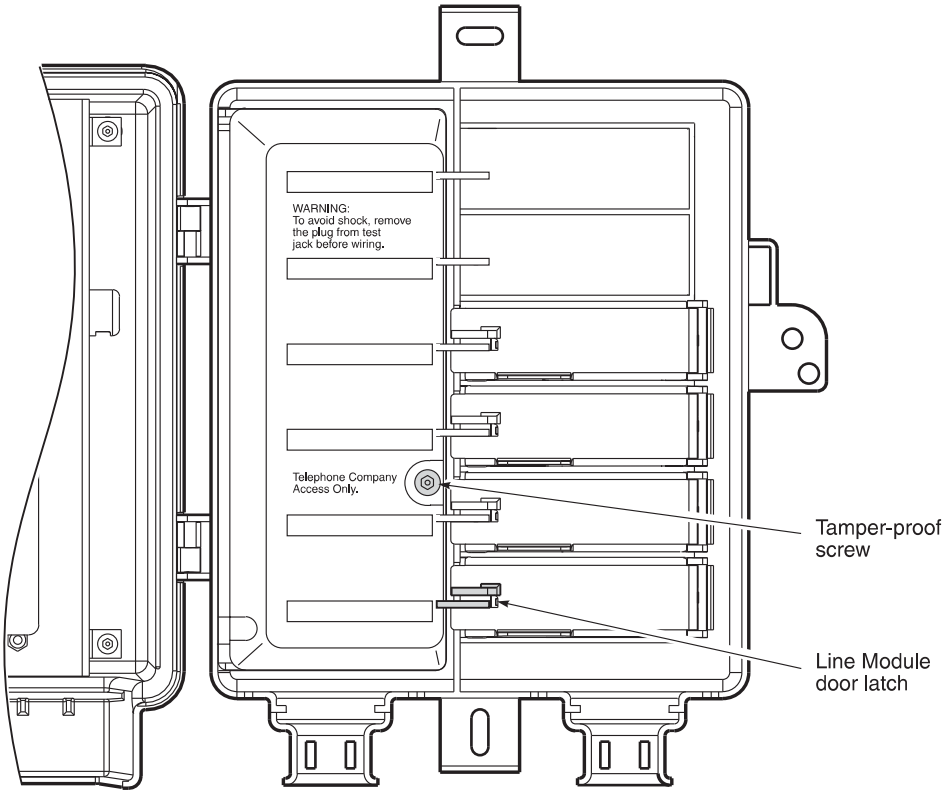

Figure 3. *Securing a Line Module*

RLU Reference Label

During installation, refer to the 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 three POTS and one ISDN lines.

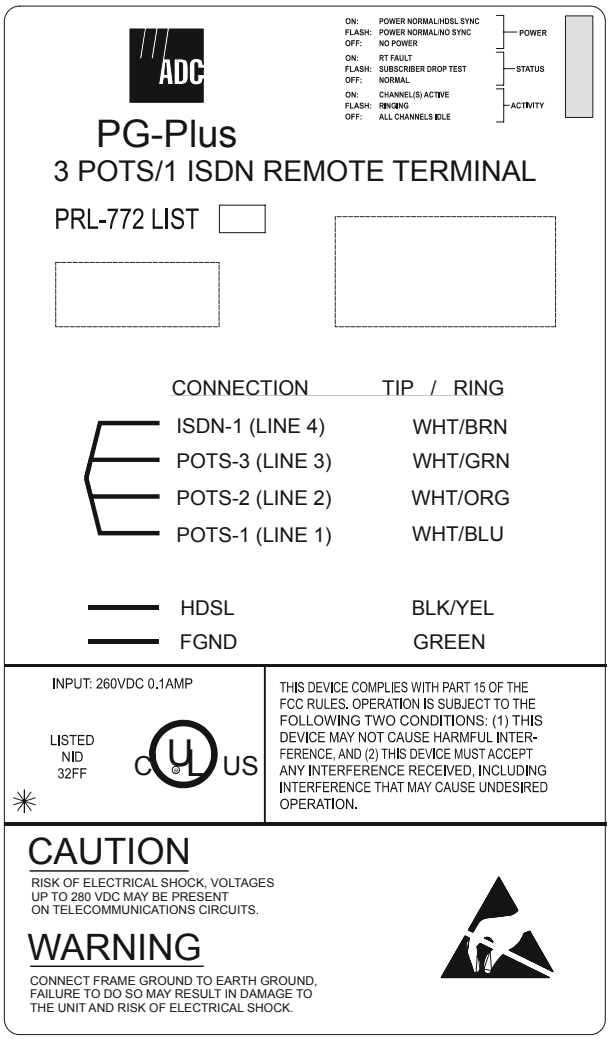

Figure 4. *RLU Reference Label*

Install the RT Enclosure

Install the RT enclosure only as shown in Figure 5, with all access openings facing down. Otherwise, possibly damaging materials, such as fluids, can enter the RLU enclosure.

Use the two #10 x 1.5-inch wood screws and flat washers provided in the RLU Mounting Kit to attach the RT enclosure to the side of the customer residence (see Figure 5). For installation on stucco or other suitable surface, use the two ADC provided #10 x 1-inch anchor nuts.

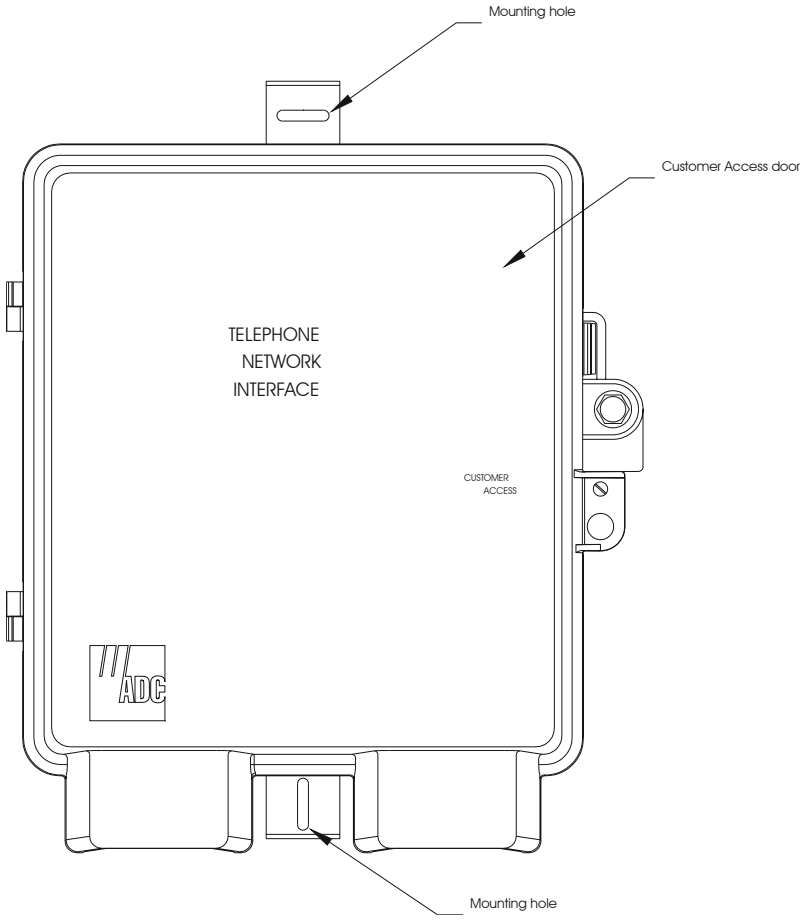

Figure 5. *Installing the RLU Enclosure*

Wiring

A wiring harness, consisting of a cable for the three POTS and one ISDN 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 ISDN and HDSL pairs and to the frame ground bus. An additional frame ground is attached to the metal case. The Line Modules on the ISDN and POTS lines provide an RJ-11 test jack for isolating trouble to the network or subscriber. Each ISDN and POTS line is protected by a gas tube over-voltage protection device under the Telco cover.

HDSL and subscriber wiring are threaded through rubber grommets at the bottom of the enclosure. 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 an ISDN test set to be plugged in as an aide to diagnostic tests.

Attach the Frame-Ground Wire

To attach the ground wire:

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

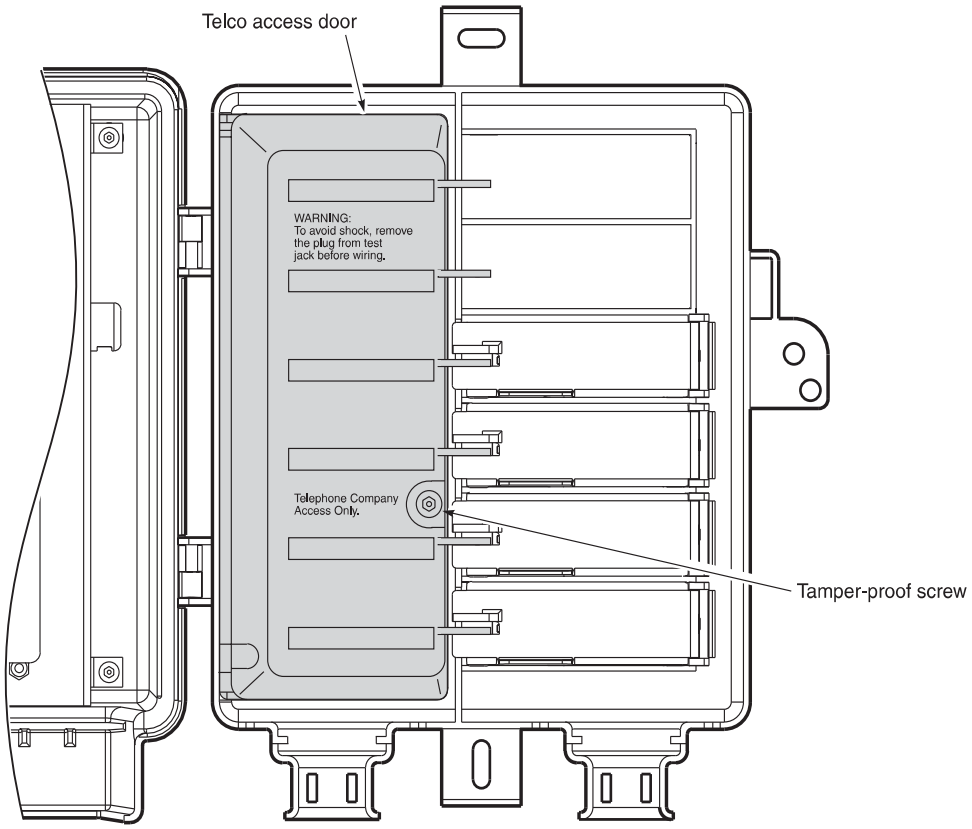

Figure 6. *Opening the Telco Access Door*

2 Use a #1 Phillips screwdriver to punch a small hole in the bottom of the rubber grommet on the left-hand bottom side of the RT enclosure (see Figure 7).

Cutting the grommet with a utility knife or something similar is not recommended, because this may cause a large opening in the grommet, allowing insects or other contaminants to enter the enclosure.

3 Insert the frame-ground wire into the RT enclosure through the 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.

6 Replace in reverse order and tighten the hardware removed in step 4.

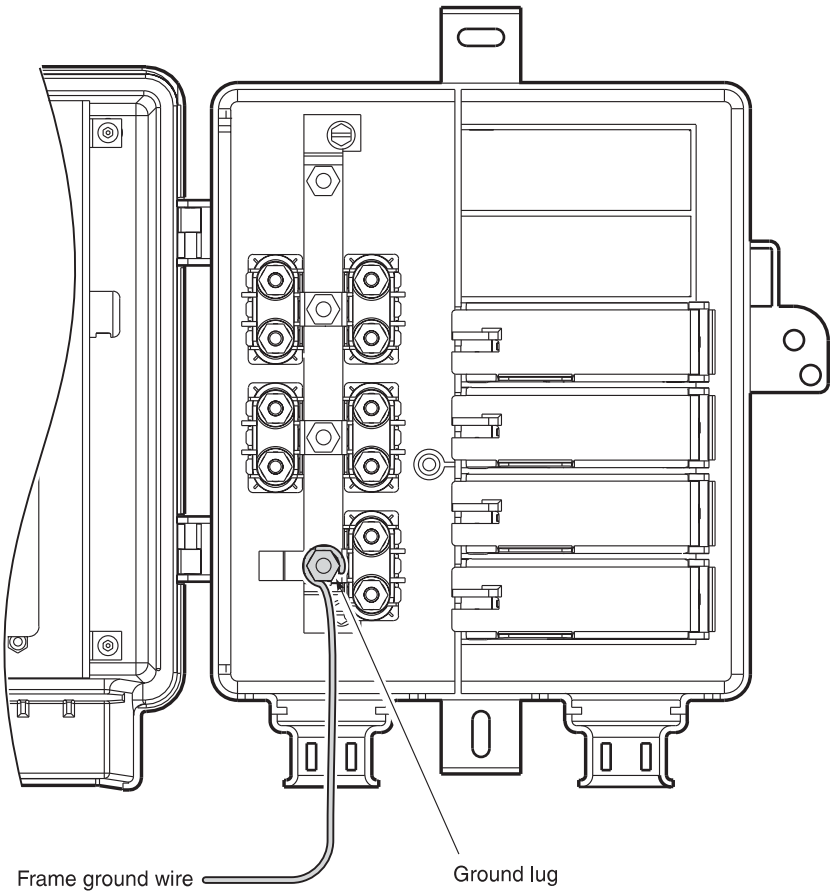

Figure 7. *Attaching the Frame-Ground Wire*

Attach the HDSL Tip and Ring Wire

To attach the 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 Use a #1 Phillips screwdriver to punch a second small hole in the bottom of the rubber grommet on the left-hand bottom side of the RT enclosure (see Figure 8).

Cutting the grommet with a utility knife or something similar is not recommended, because this may cause a large opening in the grommet, allowing insects or other contaminants to enter the enclosure.

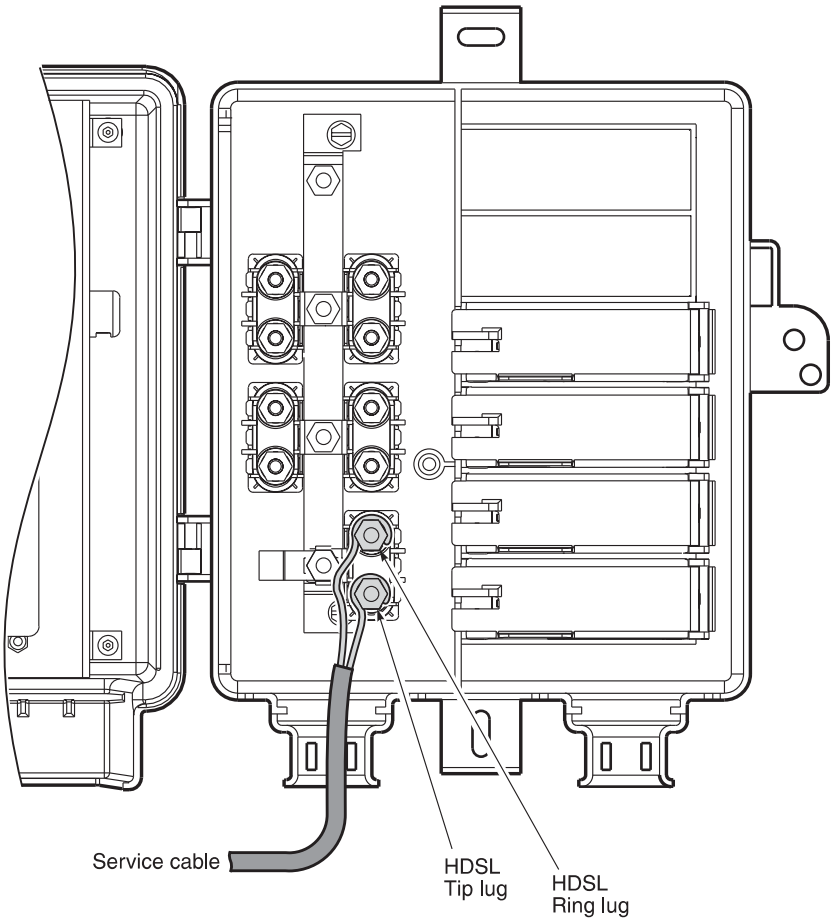

Figure 8. *Attaching the HDSL Tip and Ring Wires*

2 Insert the service cable containing the HDSL Tip and Ring wires into the hole made in step 1.

3 Loosen only the top nut on the Ring gas tube protection binding post (see Figure 8).

If this unit is to be pole mounted, ADC recommends that the subscriber drop wires be connected directly to the appropriate gas tube protection binding posts.

4 Remove the service cable outer jacket from the cable inside the RT enclosure.

5 Strip the insulation from the end of the HDSL Ring wire using an insulated handle wire stripper.

6 Carefully insert and loop in a clockwise direction the HDSL Ring wire between the top two washers on the HDSL binding post. To avoid electrical shock, handle the stripped HDSL wire by it's insulation with insulated-handle needlenose pliers.

7 Tighten the HDSL binding post nut with an insulated-handle nut driver.

8 Trim any excess uninsulated wire with an insulated-handle wire cutter.

9 Repeat steps 5, 6, 7, and 8 for connecting the HDSL Tip wire to its gas tube protection binding post.

Attach the POTS and ISDN Drops

To attach the POTS and ISDN drops:

1 Use a #1 Phillips screwdriver to punch a second small hole in the bottom of the rubber grommet on the right-hand bottom side of the RT enclosure (see Figure 9).

Cutting the grommet with a utility knife or something similar is not recommended, because this may cause a large opening in the grommet that would allow insects or other contaminants to enter the enclosure.

2 Lift the appropriate Line Module door (see Figure 9).

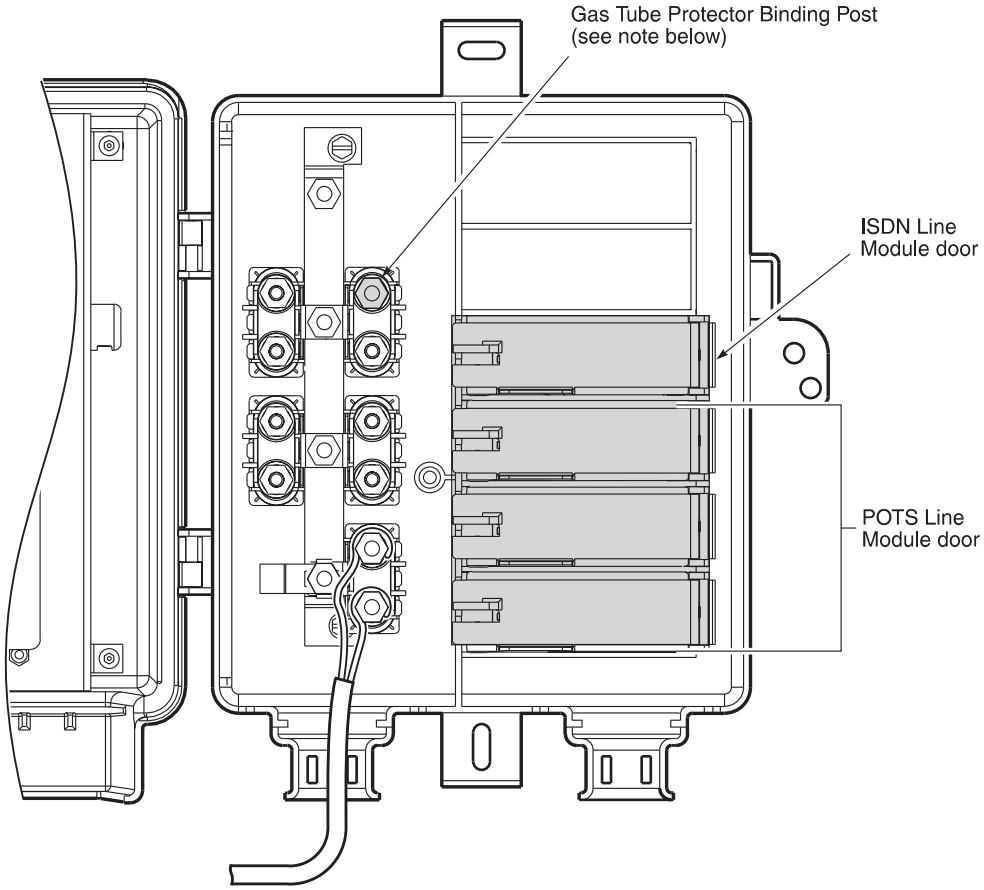

Figure 9. *Inserting the ISDN and POTS Wires*

3 Insert the POTS wire pair through the cutout on the right side of the Line Module door (see Figure 10)

4 Connect the Tip conductor to the green terminal lug on the Line Module.

5 Connect the Ring conductor to the red terminal lug on the Line Module.

6 Repeat steps 2 through 5 for connecting the second and third POTS wires and the ISDN wires.

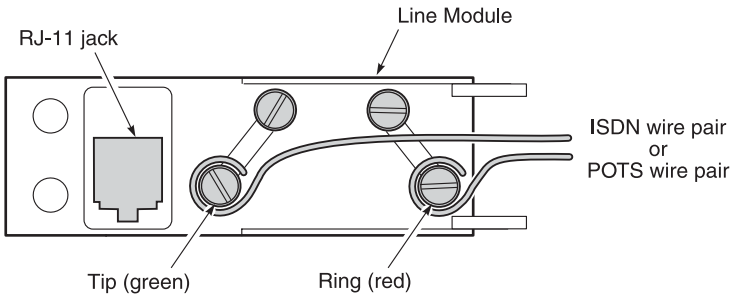

Figure 10. *Attaching the ISDN and POTS Wire Pair*

TURN-UP AND TESTING

HDSL Connections

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

1 Open all the Line Module doors and unplug each RJ-11 jack to ensure there are no off-hook conditions present from the subscriber lines (Figure 11).

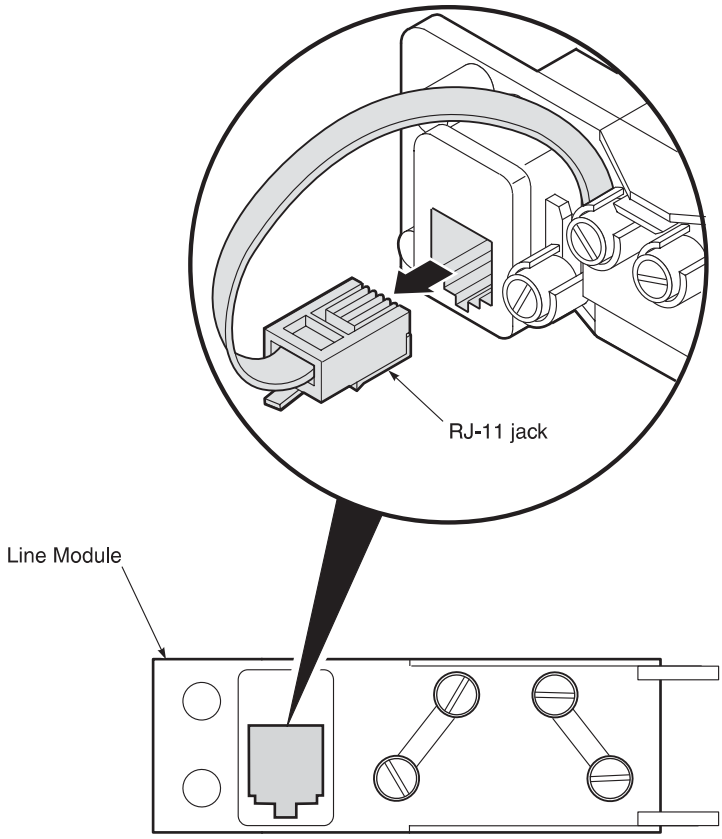

Figure 11. *Unplugging the RJ-11 Jack*

2. Apply a short between the HDSL Tip and Ring conductors for at least for ten seconds. The following start-up sequence should occur after a ten second delay:
   - COLU responds with start-up voltage immediately.
   - RLU detects HDSL line voltage, drops the metallic fallback to POTS, then initiates the HDSL start-up sequence.
   - PWR LED flashes green and the Activity LED is solid green.

   Start-up is complete when the PWR LED is on solid green and the Activity and Status LEDs are both off. After power-up is complete and there is no connection at the ISDN interface jack, then the Activity LED will be OFF.
3. Reconnect the RJ-11 jacks and close all the Line 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.

ISDN Connections

To turn-up and test the ISDN connections:

1. Open the line module door and disconnect all the ISDN RJ-11 jacks. The Activity LED goes OFF.
2. Configure the ISDN U-Interface Basic Rate test set appropriately
3. Connect the ISDN test set to the ISDN RJ-11 jack.
4. The ISDN test set should acquire synchronization in approximately 30 to 60 seconds.
5. Verify that the Activity LED is solid green. This happens only if, on the CO end, the ISDN is connected to the ISDN switch.
6. Perform the necessary ISDN turn-up tests through the ISDN test set.
7. Disconnect the ISDN test set from the ISDN RJ-11 jack.
8. Reconnect the ISDN RJ-11 jacks and close all the Line Module doors.

CLOSE THE HOUSING

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

To close the housing:

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 circuit board metal enclosure has a System Status window through which Status LEDs can 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 RLU reference label provides a guide to what the Status LEDs indicate (see Figure 12).

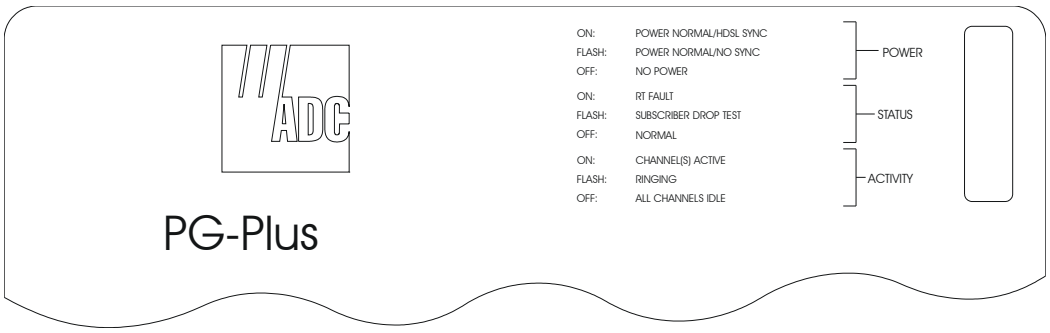

Figure 12. *Status Window of the RLU*

If the RLU fails to indicate power on (as evidenced by the PWR LED being off), perform the following diagnostic and repair operations:

1. Verify that the RLU 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 RLU.
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.

PRODUCT SUPPORT

TECHNICAL SUPPORT

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

Telephone:	800.366.3891 The 800 telephone support line is toll-free in the U.S. and Canada.
Email:	wsd_support@adc.com
Knowledge Base:	http://adc.com/Knowledge_Base/index.jsp
Web:	www.adc.com

LIMITED WARRANTY

Product warranty is determined by your service agreement. Refer to the ADC Warranty/Software Handbook for additional information, or contact your sales representative or Customer Service for details.

RETURNS

To return equipment to ADC:

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 ADC's Return Material Authorization (RMA) Department.
2. Call or write ADC'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: 800.366.3891
   - Email Address: rma@ADC.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 ADC 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 ADC's address and the RMA Number you received from the RMA Department clearly on the outside of the carton and return to:

ADC DSL Systems, Inc.
14352 Franklin Ave.
Tustin, CA 92780-7013

Attention: **RMA (Number)**

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

FCC CLASS B COMPLIANCE

This equipment has been tested and found to comply 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 interference by one or more of the following measures:

* Reorient or relocate the receiving antenna.
* Increase the separation between the equipment and receiver.
* Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
* Consult the dealer or an experienced radio/TV technician for help.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by ADC 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.

ACRONYMS

ACO	Alarm Cut-Off. Reset and test switch for Alarm Unit of PG–Plus.
CO	Central Office
COLU	Central Office Line Unit
COTS	Central Office Terminal Shelf. PG–Plus Central Office Shelf including line units and common equipment.
DS0	Digital Signal Zero. A single 64 kbs channel of a DS1 signal.
DS1	Digital Signal One. A 1.544 Mbps digital carrier signal.
ESD	Electrostatic Discharge
HDSL	High-bit-rate Digital Subscriber Line
ISDN	Integrated Services Digital Network
LED	Light Emitting Diode
MLT	Mechanized loop Testing. Per TA297, description of subscriber loop method.
MSL	Mean Sea Level
NEBS	Network Equipment-Building System. Bellcore Generic Requirements GR-63-CORE
PAU	PG–Plus Alarm Unit. PG–Plus Alarm and Systems Interface Unit.
POTS	Plain Old Telephone Service
REN	Ringer Equivalence. A number.
RLU	Remote Line Unit. PG–Plus HDSL Interface Unit.
RMA	Return Materials Authorization
RT	Remote Terminal (enclosure and RLU inclusive)
SDT	Subscriber Drop Test

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ISO 9001
DNV
DNV Certification, Inc.
Certificated Firm

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